BENEFITS FROM INFRASTRUCTURE INVESTMENT: A CASE STUDY IN NUCLEAR ENERGY

AN IPPR TRADING LTD REPORT FOR EDF ENERGY

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EDF ENERGY

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EXECUTIVE SUMMARY

> - **Building new nuclear energy capacity could boost UK GDP by up to 0.34 per cent a year (equivalent to £5.1 billion in 2011) for 15 years and if capacity reached 18GW, nuclear power would account for 0.4 per cent of GDP in the operational phase.**
> - **Delivering additional nuclear energy capacity could result in up to an additional 32,500 jobs annually: 11,250 direct and indirect jobs together with a further 5,000 to 10,000 induced jobs.**
> - **Annual exports from the nuclear industry could increase from £700 million a year to £1.1 to £1.6 billion.**

The double-dip recession has highlighted a number of longstanding problems in the British economy. The Government's plan to restore growth in the economy largely through stronger growth in exports and investment spending by the private sector is intended to tackle these problems. Historically, the UK has invested less relative to GDP (in aggregate – and in infrastructure in particular) than other similar economies. This paper takes as its starting point the assumption that there is now an urgency to invest in major infrastructure projects, including upgrading energy infrastructure.

However, this will have to be done in a way that allows the UK to meet its target of cutting emissions by 80 per cent of 1990 levels by 2050. Achieving these targets will require a number of measures, including closing down carbon-intensive electricity generators, such as coal-fired stations, over the next decade. Other generators are also reaching the end of their lifecycle. As well as replacing this existing capacity, the UK will need substantial investment in electricity generating capacity over the next 20 years to meet a likely rise in demand. The Government aims to encourage investment in new low-carbon power generation – including wind, nuclear and carbon capture and storage – through wide-ranging reforms to the electricity market. The Department of Energy and Climate Change (DECC) estimates that £110 billion of investment in power generation will be needed over the next decade to ensure that capacity meets demand. The Government has stated that new nuclear power should be free to contribute as much as possible towards meeting the need for around 18GW of new non-renewable capacity by 2025.

Investment in nuclear energy will have benefits in contributing to both economic growth and job creation and has the potential to give Britain a greater share in the export market. Given the relatively high multipliers associated with the nuclear industry, investment could boost GDP by between 0.04 and 0.34 per cent per year, depending on the cost and timescale.[1] At full capacity of 18GW, nuclear power could account for 0.4 per cent of GDP.

Particularly at the local level, investment in nuclear energy can boost jobs. Estimates suggest that delivery of up to 18GW in new nuclear power could deliver, on average, 11,250 direct and indirect jobs per year. It is possible that between 5,000 and 10,000 induced jobs per year could also be generated if the investment materialised.[2] These jobs tend to be higher-paid than the average and outside London and the South-East.

If the Government makes a clear and credible commitment to nuclear energy in the form of a long-term nuclear energy strategy, and if it has all-party support in doing so, then UK industry can be reasonably confident that there will be a steady stream of work and contracts in the future. This level of certainty should enable it to make the investments needed to develop a UK-based supply chain for the nuclear industry.

By making this investment, the UK can equip itself to compete in the international market in nuclear energy. Current UK nuclear sector exports total £700 million. If growth projections prove accurate and Britain retains its market share, it could expect to expand its exports to between £1.1 billion and £1.6 billion per year by 2030, in current prices.

1 For more on economic multipliers, see boxed text, p27.

2 An induced job occurs elsewhere in the economy due to the increased economic activity of people and businesses affected by the initial investment.

1. INTRODUCTION

In 2008 and 2009, the UK economy experienced its deepest recession since the 1930s. Now, the Office for National Statistics[3] says that the economy was back in recession at the end of 2011 and the beginning of 2012. This double-dip recession has highlighted the unsustainable and unbalanced nature of economic developments in the UK during the preceding decades. It has also left substantial negative legacies in the form of a large fiscal deficit and a high level of joblessness.

The Coalition Government has put in place a plan to deal with the first of these legacies, the budget deficit. It is now seeking to identify a range of policies that will actively promote growth in output and employment, while ensuring that growth in the future is better balanced than it was in the past. It has put in place measures to improve access to finance and is implementing cuts to regulations and corporate tax rates. As a result of these policies, the Government's hope is that future growth will be led by exports and by investment spending by the private sector, rather than by debt-fuelled consumer and government spending.

This is a tough challenge. Historically, the UK has invested less, relative to the overall size of its economy, than other similar countries. Investment-led growth is likely to require a change in the mindset of private industry in the UK alongside the emergence of new sources of investment. The construction of new nuclear energy production plants could help lift investment and growth.

At the same time, the Government is reviewing how it can best achieve its commitments to reduce carbon emissions as set out in the Climate Change Act 2008 – cuts of 34 per cent between 1990 and 2020 and 80 per cent by 2050 – while simultaneously ensuring that the UK has an adequate supply of electricity to meet likely increases in demand over coming decades. It has made it clear that it believes these twin objectives can only be met through a wide range of different sources of energy, including renewables and nuclear.

This approach will require a major programme of investment in new nuclear production capacity. DECC believes that 59GW of new-build capacity is needed by 2025. They have set out that 'new nuclear power should be free to contribute as much as possible towards meeting the need for around 18GW of new non-renewable capacity by 2025' (DECC 2011a). Other estimates suggest that as much as 30GW may be needed (Bloomberg 2012). Such an investment programme would represent a significant boost to construction activity in the UK, bringing additional growth and extra jobs as well

3 http://www.ons.gov.uk/ons/rel/naa2/second-estimate-of-gdp/q1-2012/stb---second-estimate-of-gdp-q1-2012.html

as wider economic benefits, and it would help to shift the balance of growth towards investment, as desired by the Government. The purpose of this paper is to analyse the potential scale of the effects of the nuclear investment programme on the UK economy.

Chapter 2 provides the UK's historical record on investment, and spending on infrastructure in particular. It highlights how investment spending in the UK has fallen short of spending in other similar countries. Chapter 3 analyses the energy sector environment and highlights government policy, focusing on the UK's low-carbon commitments and the need to ensure adequate electricity supply in the future. Finally, chapter 4 assesses the potential benefits to the UK economy of investment in nuclear energy infrastructure, looking in turn at growth, jobs and wider benefits. EDF Energy's planned development of new nuclear capacity at Hinkley Point is used as a case study in this section.

2.
THE UK'S NEED FOR A HIGHER LEVEL OF INFRASTRUCTURE INVESTMENT

> **The UK has historically spent less on investment, including on infrastructure, than other similar economies.**
>
> **Additional infrastructure spending boosts demand in the short term and adds to the economy's productive potential in the long term.**
>
> **Investment in new electricity generation capacity in coming years will help to improve the UK's track record on investment spending.**

Investment is crucial for the growth of productivity in the economy. Investment in physical capital – buildings, machines and equipment – can increase productivity in two ways. First, it increases the level of capital per worker in the economy, which should increase output per worker (economists call this 'capital deepening'). Second, it means that the latest, most efficient technology is brought into the production process.

Investment in infrastructure is part of the capital deepening process. Building a high-speed rail link between London and the north of England, for example, will make it easier for people to travel about the country and exploit economic opportunities. Investing in energy generation performs the same function by ensuring that the UK has a secure supply of electricity in the future. Failure to invest in infrastructure is likely to have a significant negative effect on productivity over time (for example, if people cannot commute to work or firms face intermittent power black-outs).

Investment in infrastructure is carried out by the private sector, by the government and by private companies on the government's behalf. The vast majority of the road network, for example, was built and is maintained by the government (although there are private roads in the UK as well as hybrids like the M6 toll road, which was built by a private company that will hold the lease on the road for 50 years before ownership reverts to the government). Public and private sectors can also work in partnership, for example through the private finance initiative (PFI), which funds public sector infrastructure projects – such as new hospitals – with private capital.

In some areas, the government relies largely on the private sector to provide essential infrastructure, although it retains some degree of control over the total level of infrastructure through strict regulatory control. Recognising, for example, the need for clean water and a fully functioning sewage system, the government has placed private sector water companies under a heavy obligation to invest in maintaining the country's water and sewage infrastructure. Similarly, the government is concerned to ensure that the country has an adequate supply of energy in the future. But its direct involvement is concerned more with encouraging certain types of energy infrastructure that will help it to achieve carbon reduction targets – such as wind farms – rather than with the overall level of production capacity.

The UK's historical record on investment

Investment spending in the UK has been perceived as being too low for at least 60 years: in the 1950s and 1960s, low levels of investment were blamed for the UK's poor economic performance. One of the central aims of economic planning in the 1960s – and of the short-lived Department for Economic Affairs – was to boost investment levels to increase the UK's trend rate of economic growth. More recently, a low rate of investment spending has been associated variously with the unbalanced sectoral mix of growth in the economy, wide differences in growth between London and the south east and the rest of the UK, and the UK's persistent trade deficit.

It is, however, difficult to say exactly what the correct level of investment should be in an economy at any point in time. For this reason, international comparisons between similar economies are widely used to judge whether a country has a high, low or average level of investment.

Historically, the UK has a poor record on investment spending, compared to other large advanced economies. Data from the International Monetary Fund (IMF) show that, over the last 30 years, the UK has been at or close to the bottom of the league table among G7 countries in terms of total gross fixed capital formation (that is business, government and household investment) as a share of GDP (see figure 2.2). Throughout the period from 1980 to 2010, total investment in the UK averaged 17.5 per cent of GDP, compared to 19.3 per cent in the United States and 20 per cent or more in the other five major economies. In the UK, it is now below 15 per cent, the lowest in the G7.

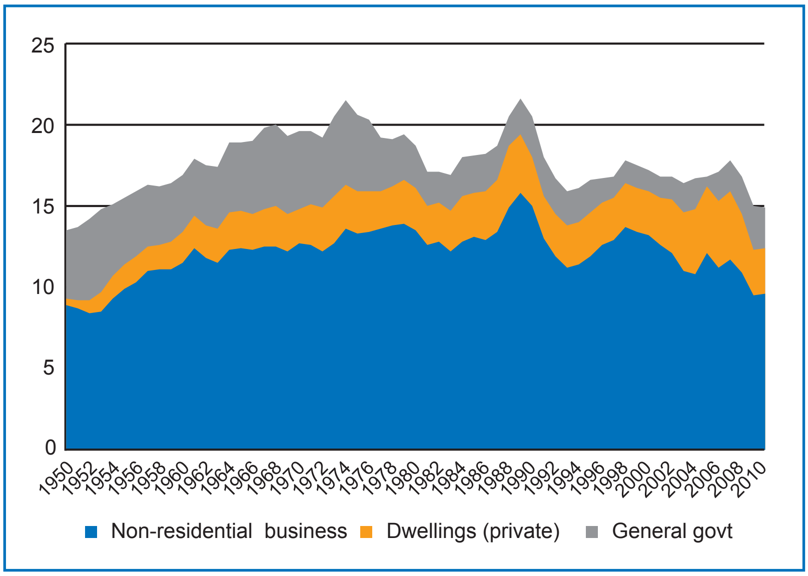

Figure 2.1: UK gross fixed capital formation by broad type (% of GDP)
Source: ONS 2011

The UK's relatively poor record on total investment reflects, in part, a relatively low level of business investment. Analysis in 2008 by the Department for Business, Enterprise and Regulatory Reform (now the Department for Business, Innovation and Skills), using OECD data, showed that in the years immediately prior to the financial crisis and recession, business investment in the UK – as a share of GDP – was lower than in the US, Germany and France (BERR 2009: 34). In 2007, business investment was around 10 per cent of GDP in the UK, 11 per cent in the US and 12 per cent in Germany and France. BERR argued that the UK's relatively low business investment ratio was 'a key contributing factor to the [UK's] productivity gap with international competitors'.

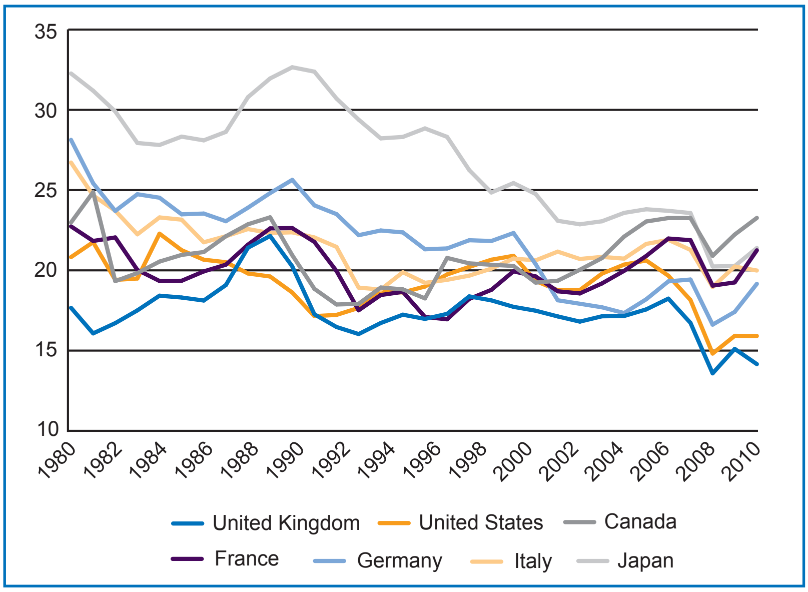

Figure 2.2: Gross fixed capital formation (% of GDP)
Source: International Monetary Fund, World Economic Outlook database, September 2011[4]

The same paper also shows that from 1992 to 2007 government investment in the UK lagged behind investment in the US and France (it was also lower than in Germany from 1992 to 2002). Data for earlier periods suggests this is a longstanding problem (see for example Bond 2001, who presents data for the period from 1960 to 1997). Given the crucial role of government spending for the provision of infrastructure, this strongly suggests UK governments were spending less on infrastructure than these other countries throughout the whole period 1960 to 2007.

UK investment in infrastructure

Certainly, there is a perception that infrastructure in the UK is worse than in many of our competitor countries. A recent survey of British businesses (CBI/KPMG 2011) found that half of those surveyed felt that the UK's transport network had deteriorated over the preceding five years and two-fifths felt that the energy infrastructure had gotten worse. More than half of the firms surveyed said that the UK's infrastructure compared unfavourably with that of other EU countries. The UK also scores badly on infrastructure in the World Economic Forum's global competitiveness index, ranking just 28th on quality of overall infrastructure in the 2011–12 index (WEF 2011: 361).

This failing is acknowledged by the Government in its National Infrastructure Plan (HM Treasury 2011a). It argues that although the UK compares favourably to other OECD countries in some areas,

4 http://www.imf.org/external/pubs/ft/weo/2011/02/weodata/index.aspx

there are serious concerns: ‘many power stations are ageing, road congestion is a growing concern, train punctuality in the UK is worse than in other parts of Europe and in the longer term there will be an airport capacity challenge in the South East of England’ (ibid: 6).

The low historical level of investment in infrastructure in the UK has been, in part, the result of a series of political decisions by successive governments, which have favoured lower taxes or higher current spending over capital spending. But a clear break occurred in the early 1980s, when capital spending as a share of GDP fell sharply as a result of cuts meant to reduce government borrowing; it has never since returned to the levels seen in the 1950s, 1960s and 1970s. Subsequently, in the early 1990s and again following the recent economic crash, when governments have been faced with the problem of reducing their deficits they have opted for the ‘easy’ option of large capital spending cuts (the effects of which will only become apparent over an extended period of time) rather than bigger cuts in current spending or bigger increases in taxes.[5]

The low level of government investment in infrastructure is likely to be one reason behind the low level of business investment in the UK, if it led to lower expected returns on investment (because inadequate infrastructure was expected to hold back output). Over 80 per cent of firms in the CBI/KPMG survey said that the quality of energy and transport infrastructure has a significant impact on investment decisions (CBI/KPMG 2011: 6). Perceived deficiencies in education and training could have had the same effect. It could also be that firms held back from investing because of macroeconomic volatility. Alternatively, it may be that firms wanted to invest more but were prevented from doing so because of the nature of UK capital markets (a concern that dates back at least to the 1931 Macmillan Committee on Finance and Industry). Most likely it was some combination of all these factors, with each being more or less important at different times and for different sectors. Macroeconomic volatility, for example, was a huge problem in the 1970s but less so in the period 1997 to 2007; financing problems are a bigger factor for small businesses than for large ones.

As the share of manufacturing in the UK economy has shrunk, and the share of services has increased, physical investment – in the form of buildings or new productions lines – has become less important. At the same time, investment in ‘intangibles’ – such as intellectual property, brand names, software and business processes – has become more important. These investments are much harder

5 This is true of the Coalition Government’s deficit reduction plan. The last Labour Government was also planning cuts in capital spending almost identical to those being implemented by the Coalition.

to measure, and failure to do so leads to an underestimation of the total amount of investment in the UK economy.

Haskell et al argue that UK investment in intangible assets has been greater than in tangible assets for the last decade and that in 2008 it was £137 billion, as opposed to £104 billion in tangible investment (2011: 16).

It is often argued that the UK does not need to invest as much in physical capital as Germany, because manufacturing is less important in the UK economy than it is there. This is true, but the argument does not extend to all the G7 economies. Manufacturing has also declined significantly in the US and France, and the structure of these economies (in terms of the mix between manufacturing and services) is very similar to the structure of the UK economy.

The sectoral composition of the UK economy cannot explain why investment is lower in the UK than in all the other G7 economies. It also cannot explain why the UK's investment ratio has been persistently lower, even when manufacturing was a far bigger proportion of economic activity.

	Services sector as % of GVA
France	77.4
US	76.9
UK	76.3
Italy	70.4
Japan	70.1
Germany	68.7
Canada	66.1

Table 2.1: Services sector as share of gross value added, 2007 (%)
Source: OECD 2009

Investment and the economy

Increased investment spending – on infrastructure or more generally - would add to the UK economy's capacity for growth in the medium term by improving conditions on the supply-side of the economy. In current circumstances, it would also boost short-term growth by adding to demand in the economy. Since the UK Government wants to increase the share of manufacturing in the economy, there is also a case for increasing investment in order to encourage this rebalancing.

Increased capital spending, such as on infrastructure, is one of the best ways to boost the economy in the short term. This is because almost the entire initial boost goes directly into the UK economy in the form of wages and purchasing of British raw materials, while only a small amount is lost to overseas economies in the form of imports. When comparing different forms of fiscal stimulus, capital spending compares favourably with tax cuts. This is because some of the extra disposable income that results from a tax cut might be saved, and a significant portion of it will be spent on goods and services that are imported or have a high import content. According to the Office for Budget Responsibility (OBR) (2010), money spent on capital spending generates roughly three times more output in the UK than tax cuts and two-thirds more than spending on current goods and services.

Measure	Estimated multiplier
Capital expenditure	1.0
Welfare measures	0.6
Current expenditure by government departments	0.6
Change in VAT rate	0.35
Change in personal tax allowance and national insurance contributions	0.3

Table 2.2: Estimates of fiscal multipliers
Source: OBR 2010: 95

Although estimates vary, there is little doubt that currently there is plenty of spare capacity in the UK economy. In the first quarter of 2012, real GDP was still over 4 per cent lower than at its peak level four years earlier; unemployment stood at 8.3 per cent, up from 5.2 per cent just before the economy went into recession in 2008. The latest forecasts from the OBR suggest that GDP will not return to its previous peak until 2014 at the earliest (OBR 2012).

More specifically, there is certainly spare capacity in the construction industry. Construction output was down 7.5 per cent between Q1 2008 and Q4 2011. And the number of jobs in construction at the end of 2011 was 2,055,000 – almost 300,000 fewer than the average number in 2007 and 2008. This means there is very little danger of increased spending on infrastructure leading to the crowding-out of other economic activity as a result of competition for scarce labour resources.

An increase in investment spending is acknowledged by the Government as an essential element in the rebalancing of the UK economy (see for example the Chancellor's Mansion House speech of June 2011[6]). This will be necessary in an arithmetical sense. If the government is cutting its spending and the economy is to be less reliant on debt-fuelled consumer spending, then investment and exports will have to grow more rapidly than in the past. This has been a feature of all the five forecasts made by the OBR. In its June 2010 budget forecast, it expected business fixed investment to grow in real terms by 8.1 per cent in 2011, followed by average annual growth of 9.5 per cent in the next four years (OBR 2010). Although by the time of the March 2012 budget it was clear that business investment had significantly underperformed expectations in the short term (it increased by just 1.2 per cent in 2011 and was forecast to increase by 0.7 per cent in 2012), the OBR was still looking for average annual growth of close to 9 per cent from 2013 to 2016 (OBR 2012).

An increase in investment will also be necessary to facilitate the sustained increase in exports that is needed to rebalance the UK economy (and break a long-running tendency for the UK to run a current account deficit). The UK has a comparative advantage in the export of many services (particularly financial and insurance services) so sustained strong growth in that area is essential. But large increases in exports of goods will also be needed. Right now, it is doubtful whether the UK has the right sort of capacity to generate an increase on the necessary scale, so greater investment in industrial capacity will be needed if the UK is to experience a multi-year export-led recovery.

6 Available at http://www.hm-treasury.gov.uk/press_58_11.htm

This is not just about individual firms building extra plant and spending more on capital equipment. The UK will also need to invest across a range of different types of infrastructure, including transport, broadband and energy supply. Without this essential investment in infrastructure, firms will not be able to maximise their productive potential. Indeed, recognising the lack of investment in infrastructure, firms may not even try to increase capacity. As a result, business investment will fall short of what is needed to produce the sustained and better-balanced growth that could return unemployment to the levels seen prior to the financial crisis and recession.

The aim of the Government's National Infrastructure Plan (HM Treasury 2011a) is to give the private sector some degree of certainty about the future state of infrastructure in the UK. It sets out 40 priority infrastructure projects and programmes covering road and rail improvements (including major, multi-year projects like 'High Speed 2', the rail link planned initially to connect London and Birmingham, with later extensions to the north west and north east), airport and dock upgrades, increased energy generation capacity and improved broadband connectivity. In addition, there is a broader pipeline of over 500 projects and programmes worth over £250 billion. It is clear from this document that a series of major construction programmes of different types is likely to take place in the UK over the next decade.

The Government is also seeking innovative sources of funding to pay for some of these projects. It hopes that private pension funds and insurance funds will invest an additional £20 billion in infrastructure at the construction stage (with an initial £2 billion investment expected in 2013); it is considering allowing local authorities to support major infrastructure projects by borrowing against future growth in tax receipts (tax increment financing); and hopes also to attract money from foreign sovereign wealth funds.

The Government is also setting up (subject to a state aid ruling from the European Commission) the Green Investment Bank (GIB) to provide a new source of funding for 'green infrastructure'. The GIB will be provided with £3 billion in initial capital and will be able to raise additional funds from April 2015, if public sector net debt as a percentage of GDP is falling by then. It will invest, initially at least, in energy efficiency projects, including building retrofit, urban infrastructure and industrial energy efficiency. Its remit will not extend to large infrastructure projects, such as energy supply and the smart grid, because its capitalisation is too modest.

However, the GIB and plans to increase private sector pension funds' investment in infrastructure have to be seen in the context of the Government's decision in the 2010 spending review to cut departmental capital budgets by 29 per cent, in real terms, between 2010/11 and 2014/15. Departmental capital spending will fall, in nominal terms, from £51.6 billion to £40.2 billion. During the next few years, therefore, it is very likely that government-led investment in infrastructure in the UK will be lower than in the recent past.

So, if the UK's poor historical record on investment spending on infrastructure is to improve, the private sector will have to fill the gap. One area in which this will have to happen is in the creation of new electricity generation capacity because otherwise the UK faces a potential supply shortfall, and it is probable that nuclear power capacity will be an important element of this programme.

This sort of investment will provide a range of potential benefits to the UK economy, over and above the obvious one of ensuring that future demand for electricity can be met. It adds to demand and growth in the economy and, by doing so, creates jobs, directly in the construction and running of nuclear power plants and indirectly in supply industries and in the local economies where construction takes place (though there might be some offsets if, for example, the investment is funded by higher energy bills).

Furthermore, if the UK is entering a period that will be characterised by a number of large-scale construction projects, in the transport sector as well as in energy, it offers the potential for 'learning by doing': the development of skills and techniques in one project that will benefit others. If other countries follow the UK in investing in new nuclear electricity generation capacity, it may even be possible to sell these skills and techniques overseas.

Chapter 4 of this report provides some estimates of the possible scale of these effects, but before that chapter 3 discusses in more detail the specific need for more investment in the UK's electricity infrastructure.

3.
THE NEED FOR INVESTMENT IN THE UK'S ELECTRICITY INFRASTRUCTURE

> **The Government has identified a need in the UK for affordable, secure and low-carbon electricity.**
>
> **The last Labour Government and the Coalition Government believe nuclear energy should play a prominent role in future electricity supply.**
>
> **A major capital investment programme is needed to expand the UK's nuclear energy production.**

The current economic climate – cuts in public spending and cautious consumers – creates a need for strong growth in investment, including investment in infrastructure. An opportunity for this investment lies in addressing Britain's future energy needs. The UK is committed to cutting its carbon emissions by 80 per cent of 1990 levels by 2050. This will require a range of measures, such as closing down carbon-intensive electricity generators, including coal-fired stations, over the next decade. This chapter investigates some of the concerns that come with the transition to a low-carbon economy. It demonstrates that, while supply may not be an issue within the next decade, it is possible that electricity demand will reach new peaks as transport and other sectors become more dependent on electricity in the long term. This could potentially affect Britain's security of energy supply. To overcome this, new and old low-carbon technologies will need to be considered to make up capacity needs.

The UK's commitment to tackling climate change

In the 2008 Climate Change Act, the UK introduced the world's first domestic long-term legally binding framework designed to tackle climate change. The Act institutionalised better carbon management in a bid to help ease the UK into a low-carbon economy. The Committee on Climate Change (CCC) was established as an independent advisory body to help inform the government on cost-effective methods of low-carbon generation. Additionally, the Act set out ambitious emissions reduction targets, including an 80 per cent cut to greenhouse gas emissions by 2050 and 34 per cent by 2020 against a 1990 baseline.

In 2011, DECC (2011b) estimated that the UK had reduced emissions by 24.3 per cent between 1990 and 2010. Figure 3.1 shows reduction level calculations provided by Eurostat for 2009 compared to 1990 levels. According to these figures, the UK has reduced all greenhouse gas emissions by nearly 27 per cent, a higher rate than any other original member of the EU-15.

Although the UK appears to be on track to meet its 2020 emissions reduction targets, the power sector will need to be almost completely decarbonised by 2030 if the 2050 target is to be achieved (CCC 2010, DECC 2011c). DECC estimates that £110 billion of investment in power generation will be needed over the next decade to achieve this outcome (DECC 2011c).

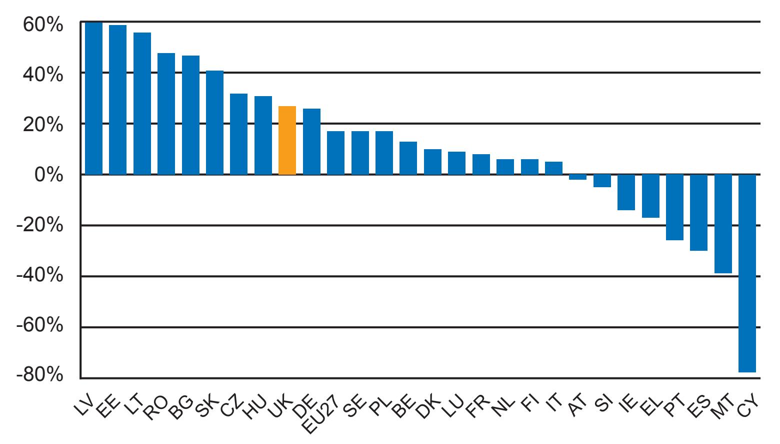

Figure 3.1: Greenhouse gas emissions, reduction in 2009 from 1990 levels, EU-27 (%)

Source: Eurostat/EEA (env_air_gge)

The Coalition Government is committed to tackling climate change. The Coalition agreement said: 'The Government believes that climate change is one of the gravest threats we face … we will implement a full programme of measures to fulfil our joint ambitions for a low carbon and eco-friendly economy' (HM Government 2010). As part of its efforts to tackle climate change, the Government aims to bring forward investment in new low-carbon power generation – including renewables, nuclear and carbon capture and storage – through wide-ranging reforms to the electricity market.

In July 2011, the Government published its electricity market reform (EMR) white paper (DECC 2011c). A range of radical reforms were proposed that, if implemented, will have a transformative impact on electricity generation in the UK. The Government believes these reforms are necessary to ensure the UK has a secure, affordable low-carbon electricity supply.

At the heart of the EMR are long-term contracts that it is hoped will provide clear, stable and predictable revenue streams for investors in low-carbon electricity generation. The Government predicts that the stability provided by these contracts could reduce the cost of capital for investments, saving a potential £2.5 billion over the period to 2030. Contracts will take the form of feed-in tariffs with contracts for difference, stipulating a fixed level (that is, an agreed tariff) under which variable payments are made to top up the revenue a generator makes from selling electricity in the market or, alternatively, above which the generator is required to pay back the difference when the market price rises.

There are two other measures that complement the contracts for difference. The Government believes that the price of traded carbon within the EU emissions trading scheme (ETS) is too low to bring forward investment in new low-carbon generation and that a higher carbon price is required. A carbon price floor (CPF) will involve the UK setting its own carbon price and topping up the difference between this and the price within the EU ETS (HM Treasury 2011b). The intention of the CPF is to reduce uncertainty, put a fair price on carbon and provide a stronger incentive to invest in low-carbon generation now (DECC 2011c). An emissions performance standard (EPS) for power generation will also be introduced, intended to provide a clear regulatory signal on the amount of carbon new fossil-fuel powered stations can emit. The standard will be set at an annual limit equivalent to 450g CO_2/kWh at baseload, which will have the effect of preventing the construction of any new coal plant that does not have carbon capture and storage in place (ibid).

The final major aspect of the EMR is a mechanism to reward generators for the provision of capacity. This is intended to bring forward investment in new flexible generation, which is likely to be fossil-fuelled, to help balance the grid alongside intermittent renewable generation. Fossil-fuelled generation will, however, decline significantly in overall importance.

The Queen’s Speech in 2012 announced an Energy Bill, which will begin the parliamentary process for implementing the EMR (although the carbon price floor has already been enacted through the Finance Act 2011). The draft Bill is currently undergoing pre-legislative scrutiny by the Energy and Climate Change Select Committee, and is expected to be introduced in the House of Commons later in 2012. However, there are reasons to expect it will be hotly debated.

First, the contracts for difference mechanism has been criticised as potentially providing a subsidy for nuclear power, including by the Energy and Climate Change Committee (ECCC 2011). This would contravene both the Government’s commitment in the Coalition agreement and EU state aid legislation. The contracts for difference mechanism has also been criticised as too complex, and so could undermine investment in new renewable generation.

The carbon price floor has also faced criticism. Although the intention of the price floor is to strengthen the EU ETS, critics suggest that this would be best delivered at the EU level (Sandbag 2012). A report by IPPR (Maxwell 2011) outlined how the implementation of a unilateral increase in the carbon price in the UK would not necessarily reduce overall carbon emissions, since anything avoided in the UK might simply be emitted elsewhere in Europe. Although supporting the carbon price floor in principle, the CBI claimed it would have a significant impact on the UK’s energy intensive industries, which employ 225,000 people and account for 1 per cent, or roughly £15 billion, of the country’s annual GDP. To mitigate this risk, it called for a rebate-based exemption linked to the energy intensive industries’ work on energy efficiency (CBI 2011). Similar concerns about cost have been expressed by the Energy and Climate Change Committee (ECCC 2012). The Government has moved to assuage these concerns from energy-intensive industries by giving them £250 million worth of tax relief (HM Treasury 2011c).

Some also criticise the EMR proposals for committing the UK to a certain quantum of low-carbon technology, regardless of world energy prices (Platchkov et al 2011). While consumers may gain insurance against high gas prices through the EMR, they do not benefit if gas prices are low. However, successive governments have committed the UK to a diverse energy mix in order to reduce risks to security of supply and to avoid the affordability issues that might result from reliance on too-narrow a range of energy supply. It is incredibly difficult to predict future gas prices with any degree of certainty. For illustration, instability in the Middle East and growth in the use of shale gas could both have a big impact on prices, the first sending them higher, the latter lower. While DECC recognises in the draft Energy Bill that gas will continue to play an important role in the electricity sector in the short term, it also notes the contribution of the EMR to tackling our increasing dependence on gas.

The EMR represents a clear statement of the Government's low-carbon ambitions, the principles of which are broadly supported by the Opposition. It is reasonable to assume, therefore, that the replacement of ageing electricity generating capacity over the next two decades or so will be done in a way that allows the UK to make significant strides towards its carbon emissions targets. This will likely require substantial investment in renewables, carbon capture and nuclear production capacity.

Supply of electricity in a low-carbon economy

Policies established to tackle climate change by both the present Coalition and previous Labour governments have set out ambitious targets requiring a dramatic shift in the UK's electricity supply. As outlined above, meeting these targets will require the closure of a number of carbon-intensive generators and their replacement with low-carbon sources.

The UK power sector currently has a generating capacity of approximately 90GW (DECC 2011d). The UK, however, is expected to see significant decreases in its energy generating capacity as older oil, coal and nuclear power plants reach the end of their plant cycles. This includes the loss of 12GW of coal- and oil-fired generation and 7.1GW of existing nuclear generation by the end of 2020 (DECC 2011e). Further closures are possible as a result of a number of factors, primarily ageing plant and the need for investment to meet tighter environmental standards (NOx emissions) from 2016 onwards to meet the Industrial Emissions Directive. However, EDF Energy has announced it expects to extend the life of its nuclear plants by an average of seven years across its AGR fleet and 20 years for Sizewell B.[7]

There is a significant difference of opinion about the urgency of additional measures to ensure new capacity is built to safeguard security of supply. The Smith School of Enterprise and the Environment at Oxford University argues that the loss of almost 20GW of power means that the electricity capacity margin could fall below 5 per cent towards the end of this decade, which would be likely to increase the chance of supply shortages (SSEE 2012). Conversely, Bloomberg New Energy Finance has stated that weak demand, high levels of new-build and life extensions for nuclear plants mean that the UK is unlikely to see power blackouts in the near future (Bloomberg 2012). DECC estimates that around 21.5GW of energy could be generated from additional renewable, nuclear and gas-powered electricity generation by the end of this decade (DECC 2011e). Bloomberg (2012) believes this new capacity will be even greater, estimating that plant retirements will be offset by 30GW of new capacity due to come online by 2016 – including two-thirds said to be from renewable sources. Moreover, electricity consumption has fallen by 9 per cent, relative to peaks in 2005 – a result of the recession – and is unlikely to rise above pre-recession levels until after 2020.

All that said, in the longer term, DECC (2011e) believes that UK electricity supply may need to increase by 30 to 60 per cent in order to meet demand in 2050. Achieving this will require significant investment in and expansion of electricity generating plants, and some new investment will be needed in the near future.

In addition to the loss of energy capacity, there are also concerns about the UK's security of supply (DECC 2011e). Figure 3.2 shows the dynamic shift in the percentage of net imported energy for all EU-27 member states between 2000 and 2009. The UK stands out as a unique case: in 1990, Britain had a net export surplus of 17 per cent, but by 2009 it was dependent on imported energy to the tune of nearly 27 per cent net – the greatest reversal of any country in the EU-27. This dramatic change was due to the decline in the extraction of oil from the North Sea. DECC (2011d) estimates that by 2020 the UK could be importing as much as 50 per cent of its oil and 55 per cent or more of its gas supply from foreign sources.

7 EDF Energy evidence to the Energy and Climate Change Select Committee inquiry into new nuclear build, May 2012, http://www.publications.parliament.uk/pa/cm201213/cmselect/cmenergy/writev/nuclear/nuc01.htm

In 2010, the EU spent $297 billion on crude oil imports alone. If the same level of consumption continues into the future at an oil price of $115 per barrel[8], the EU's import bill for oil would rise to $433 billion per year or 2.6 per cent of EU GDP. Citing figures from the International Energy Agency, the European Commission (EC 2011) expressed its concern over the EU's energy security and its vulnerability to fossil fuel energy prices. Oil prices are about twice as high as they were in 2005 and EU import costs rose by $70 billion from 2009 to 2010.

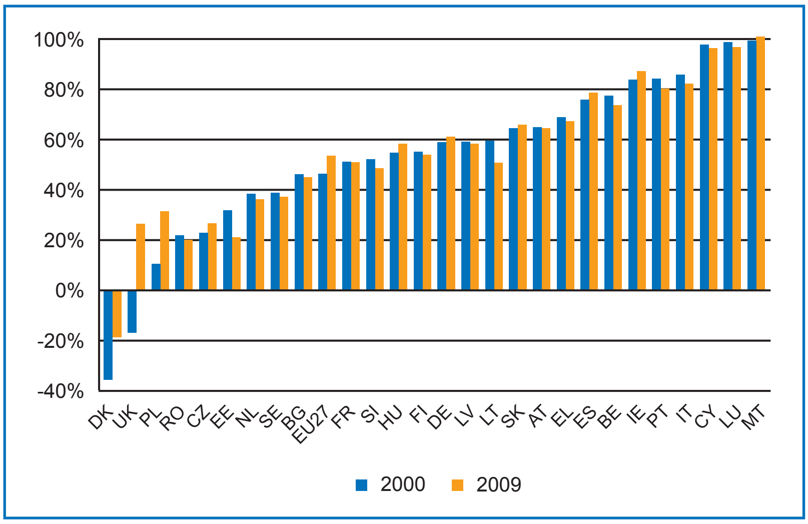

Figure 3.2: Energy dependency, EU-27 (% of energy imported)
Source: Eurostat (tgigs360)
Note: Chart shows percentage of net imports in gross inland consumption.

Demand for electricity in a low-carbon economy

As well as affecting supply, the shift to a low-carbon economy will affect demand for energy in the UK. Figure 3.3 shows changes in electricity consumption for the residential, industrial, and services sectors between 1990 and 2010. Electricity consumption rose significantly in all three sectors from 1990, reached its peak in 2005, and has since plateaued and slightly declined.

Electricity consumption is, however, likely to increase significantly beyond the next decade as carbon-intensive sectors, including transport, increase electricity consumption – for example, as more electric vehicles are placed on the roads and rail becomes more electrified (DECC 2011d). According to Eurostat, in 2010, transport in the UK consumed 3,899GWh, comprising roughly 1.2 per cent of all electricity consumption. This percentage is likely to increase as new investments in transport infrastructure roll out.

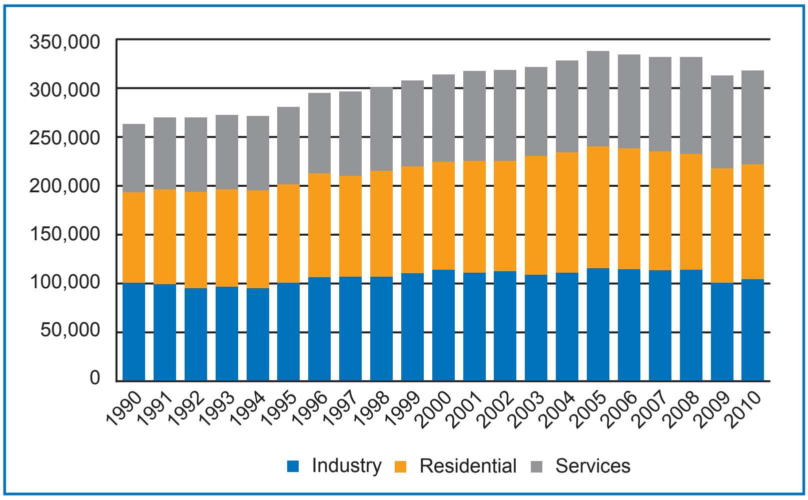

Figure 3.3: Electricity consumption by sector, UK (GWh)
Source: Eurostat (nrg_105a)

Some of these increases in demand are likely to be offset by improvements in energy efficiency. DECC (2011d) is targeting significant energy efficiency gains in the consumption of electricity, estimating that energy efficiency will reduce demand by 30 to 50 per cent per head of population by 2050.

8 The average price for Brent crude in the first five months of 2012 (though its price in June fell well below this level).

An Energy Efficiency Deployment Office[9] has been established to oversee DECC's efforts. Estimates from Ofgem (2011) indicate that demand-side energy-saving measures could lead to £11.9 billion in savings over the next decade, including £1.5 billion–£6.2 billion in avoided wholesale electricity costs, £1.3 billion–£5.4 billion in avoided capital costs for new generation, and £140 million–£280 million in avoided capital costs for networks. E3G (2011) suggests that demand-side measures to reduce consumption can deliver vital flexibility at peak times when dealing with intermittent technologies which could otherwise result in using costly backup generation.

The overall picture, however, is that in the short term there is sufficient spare capacity to ensure that demand is met and supply shortages do not occur, as new power generation comes online sufficiently quickly to replace the older carbon intensive generation that is going offline. In the longer term, however, the risks of a supply shortage will increase if the UK does not invest rapidly in additional capacity. Demand is expected to increase as transport and other sectors start to rely more heavily on electricity, causing demand to outweigh supply. Unless new domestic sources are found, Britain will become increasingly reliant on foreign, expensive and volatile sources of energy.

Energy prices

Although there have been big increases in the cost of energy in the UK in the past – following massive hikes in the oil price in 1973 and 1979, for example – the last seven or eight years have been characterised by unusual volatility in energy prices and by a large overall increase. The retail price measure of the cost of fuel and light has doubled in the last seven years, having increased by only 15 per cent over the previous decade. This has added to the country's economic problems, by squeezing the amount of money that households have available to spend on other goods and services and by adding significantly to the cost base of some companies. It has also created enormous problems for the Bank of England's Monetary Policy Committee, which has found it a great deal harder to keep inflation within 1 percentage point of its target level (of 2 per cent) because the volatility of energy prices has caused large swings in the overall inflation rate. Figure 3.4 shows UK inflation in the costs of fuel and light from 1988 to 2012.

A combination of rising global demand for fuel, historically inadequate investment in oil production and continued instability in some oil exporting regions increases the risks of high and volatile fuel prices.

9 See http://www.decc.gov.uk/en/content/cms/tackling/saving_energy/what_doing/eedo/eedo.aspx

Based on government estimates of how wholesale energy prices may change, the CCC has investigated the costs of household energy in 2020. They project that the combined gas and electricity bill for the average household could increase in real terms from £1,060 in 2010 to £1,250 by 2020, if there is limited success in introducing energy efficiency measures. They estimate that policies driving the low-carbon transition will be responsible for adding £110 to bills in 2020, primarily to increase fiscal support for low-carbon power generation and energy efficiency investments (CCC 2011a). The cost of the carbon price floor specifically is expected to increase the price of electricity by 0.7p/kWH in 2020 and add around £34 to the average bill. The projections do not include the costs of the contracts for difference mechanism, the rates for which are yet to be determined. However, the Government has stated that as a result of the proposed Electricity Market Reform, 'electricity bills are estimated to be, on average, 4 per cent lower over the next two decades than they would otherwise have been. Average bills for businesses and energy intensive industries will also be lower than without reform'.[10]

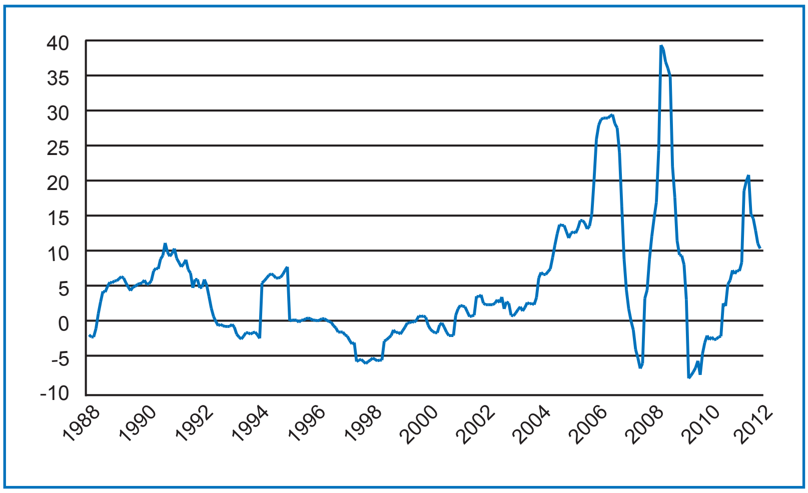

Figure 3.4: UK inflation rate for the costs of fuel and light (%)
Source: Office for National Statistics

Increasing the stability of long-term prices for fuel would bring significant macroeconomic benefits to the UK economy. Sharp increases in oil and gas prices, leading to higher energy costs, were one of the main factors behind the slowdown in economic activity in the UK in 2011: because they were paying more for gas and electricity, and at the petrol pumps, households had less to spend on other goods and services, and this reduction in demand led to cuts in production that eventually saw the economy slide back into recession. Some businesses, particular the more energy-intensive, may also be more reluctant to recruit or to invest at times of high and uncertain energy costs.

The British Government's position on nuclear energy

The Government is committed to reducing the UK's carbon emissions through a range of energy sources, including nuclear power. Both Labour's nuclear energy white paper (BERR 2008) and the Coalition's electricity market reform white paper (DECC 2011c) stated that nuclear energy should have a prominent role in future

10 http://www.decc.gov.uk/en/content/cms/news/pn12_062/pn12_062.aspx

energy supply. This was reiterated by the then Energy and Climate Change Secretary, Chris Huhne, who said: 'I could not make it clearer if I tried that we want to see nuclear play a part in our energy' (SCST 2011: 32). Both previous and current governments have signalled their approval for nuclear development in the UK, through setting up the Office for Nuclear Development (OND)[11] in 2009, the national policy statement on nuclear generation,[12] and most recently the drafting of the Energy Bill.

Nuclear is a viable low-carbon energy source, capable of supplying significant amounts of energy from a single plant. DECC estimates that current UK nuclear generation reduces carbon emissions by between 7 per cent and 14 per cent.[13] The 2008 Nuclear Power White Paper estimated that CO_2 emissions produced throughout a nuclear plant's lifecycle were in the range 7 to 12g/kWh of electricity produced. These figures are significantly lower than the amount of emissions produced by gas (385g/kWh) and coal (755g/kWh) (BERR 2008). George Monbiot, a leading environmental campaigner, has stated that it would be impossible to meet emissions reduction targets without the use of nuclear power. He warns that 'if nuclear power does not make up the remainder, the gap will be filled by fossil fuel' (Monbiot 2012).

The CCC has demonstrated that, by 2030, renewable energy sources could make up 30 per cent of the necessary 460TWh in their central scenario and up to 45 per cent of 680TWh in a higher-level scenario (CCC 2011b: 156). The remaining proportion (70 and 55 per cent respectively) would therefore have to come from alternative low-carbon sources if the UK is to stay on course to meet its 2050 emissions target level.

Increasing nuclear power is also expected to contribute to the UK's energy security. In 2008, the Labour Government concluded that nuclear energy could help to diversify Britain's energy mix and help to assure Britain's electricity supply (BERR 2008).

Of course, nuclear energy has its critics and some groups argue that nuclear energy is not necessary for the decarbonisation of the British economy. The World Wildlife Fund, for example, believes the UK can achieve at least 60 per cent of its energy supply from renewable sources by 2030, particularly if there is a greater focus

11 This body is tasked with removing potential barriers to investment and signalling to industry the UK's openness to new development: see http://www.decc.gov.uk/en/content/cms/meeting_energy/nuclear/new/office/office.aspx

12 Available at http://www.decc.gov.uk/en/content/cms/meeting_energy/consents_planning/nps_en_infra/nps_en_infra.aspx

13 'About nuclear' at http://www.decc.gov.uk/en/content/cms/meeting_energy/nuclear/nuclear.aspx

on reducing demand. It also thinks connection with the electricity grids of other European countries can help to diversify Britain's energy mix, thereby improving energy security while reducing reliance on fossil fuels (WWF 2011). It appears to be the case, though, that this would leave the UK heavily dependent on imported gas and vulnerable to intermittent wind patterns.

Others suggest that nuclear power is no longer feasible in the liberalised energy markets of Europe and North America because it is simply not competitive (Economist 2012). Citigroup Global Markets has identified that the size and variability of three of the risks faced by developers – construction, power price and operational – could each be enough to overwhelm an individual utility firm without government support (Atherton et al 2009). The report claims that nowhere in the world has nuclear power been built where the private sector takes on all these three risks.

A third group is concerned about the level of government support any nuclear investment might require. The EMR is believed by some to provide a subsidy for new nuclear plant, in breach of the Coalition Government's commitment. However, the proposals for EMR contained in the draft Energy Bill will apply to all low-carbon technologies.

Another area of perceived concern is nuclear waste management. The Government has proposed a waste transfer price methodology that will determine how a fixed price paid by new nuclear operators to the government will be set in exchange for the disposal of waste and spent fuel. This price is expected to be capped at around three times the current best estimate of waste disposal costs and five times the current Variable Costs estimate which includes a contribution to the fixed costs of the 'geological disposal facility'. This will minimise the risk of costs being passed back to the taxpayer (DECC 2011f). However, a report commissioned by Greenpeace suggests that if the cost of waste disposal increases by 4.2 to 4.5 per cent above inflation,[14] there could be a hidden government subsidy of up to £1.572 billion for every 60-year 1.35 gigawatt-electric (GWe) pressurised water reactor (PWR) (Jackson 2011). However, the Nuclear Decommissioning Authority (2011) believes that, while the costs of dealing with the nuclear legacy will increase as new detailed plans are developed, the costs will start to reduce over time as 'efficiencies and innovation kick in'. This view is inconsistent with the assumption that costs will continue to increase at a rate of 4.5 per cent above inflation.

14 This is the rate at which Nuclear Decommission Authority liabilities have increased in recent years.

Another set of costs that have attracted concern are liabilities in the event of nuclear disaster or radiation leakage, even though these are judged to be unlikely. The Government has proposed a sevenfold increase in the liabilities cap for nuclear installations from £140 million to £1.2 billion (DECC 2012). The new cap comes on top of industry implementation of all the recommendations made by Dr Mike Weightman, the UK's chief inspector of nuclear installations, in his report into events at Fukushima, Japan. This report found that the UK practice of periodic safety reviews of licensed sites 'provides a robust means of ensuring continuous improvement in line with advances in technology and standards'.[15] In addition to changes to ensure, as far as possible, that an event of that kind does not happen in the UK, the liabilities cap will cover the majority of likely foreseeable circumstances, even though the new maximum is below potential clean-up costs for the most extreme events.

One final potential hidden cost comes from measures in the EMR to reduce risk for new investors, which will transfer costs to the public sector (Platchkov et al 2011). However, until the specific details of the EMR are clarified it is unclear what these costs may be.

Notwithstanding these concerns, the Government has reiterated on more than one occasion its commitment not to provide subsidies – overt or hidden – for nuclear power generation. Not only would this be counter to the Government's own philosophy, it is extremely likely that they would run into trouble with the EU's state aid rules if they tried to do so.

Conclusion

The UK needs substantial investment in electricity generating capacity in the next two decades, first to replace existing capacity that will have to be retired and later to meet a likely rise in demand (notwithstanding efforts to increase efficiency of use). At the same time, the Government – and the Opposition – are firmly committed to reducing the UK's carbon emissions by 80 per cent between 1990 and 2050. This affects the type of new capacity that the UK will have to build, necessitating a focus on renewables, carbon capture and storage, and nuclear generation. The Government would also like to increase the UK's energy security by reducing the need for imports of energy.

The Government – and the Opposition – appear to believe very strongly that these diverse aims cannot all be met without some expansion in the UK's nuclear energy production. This will require a major capital investment programme –the next chapter looks at the potential benefits this kind of programme could bring to the UK economy.

15 http://www.decc.gov.uk/en/content/cms/news/pn11_79/pn11_79.aspx

4.
THE ECONOMIC IMPACT OF INVESTMENT IN NUCLEAR ENERGY INFRASTRUCTURE

> **Building new nuclear energy capacity could boost UK GDP by up to 0.34 per cent a year (equivalent to £5.1 billion in 2011) and at full capacity of 18GW nuclear power would account for 0.4 per cent of GDP.**
> **Delivering additional nuclear energy capacity could result in up to 32,500 jobs annually: 11,250 direct and indirect jobs, together with a further 5,000 to 10,000 induced jobs.**
> **Investing in nuclear energy now will mean the UK is well placed to sell its expertise to other countries, as well as providing learning that could be useful to other industries.**

The UK Government is committed to reducing carbon emissions by 80 per cent from 1990 levels by the year 2050. To help meet these commitments, a number of carbon-intensive industries and electricity generators will be closed down over the next decade and beyond. A number of new low-carbon electricity generation sources are scheduled to begin supplying the grid in order to replace the lost capacity. As noted in chapter 3, a shortage of supply is unlikely in the short term but increased demand for electricity over the long term could place pressure on the grid if the UK does not invest now. According to the CCC's illustrative scenario, nuclear power might deliver around 40 per cent of the UK generation mix in 2030.

Without forming a conclusion on the merits of nuclear power compared to other low-carbon technologies, this section examines the economic impact of investment in nuclear power. DECC (2011a) has called on the nuclear industry to provide up to 18GW of capacity by 2025; others have suggested that between 20GW and 30GW of nuclear power is needed (SCST 2011: 5). To fulfil even the lower estimate would require a significant level of infrastructure investment in nuclear production. Assuming that this investment is forthcoming, it will have direct and indirect benefits for economic growth and job creation in the UK over the lifecycle of the plant, as well as additional benefits that should accrue in relation to the supply chain and export potential.

Benefits of nuclear investment

As noted, the Coalition Government is encouraging the private sector to deliver up to 18GW of new nuclear power in the UK by 2025. The Coalition agreement set out that the replacement of existing nuclear power stations would go ahead so long as energy providers 'receive no public subsidy'. All investment must therefore be undertaken by the private sector. Current plans include a proposal by EDF Energy to build four European pressurised reactors (EPRs) at Hinkley Point and Sizewell amounting to 6.4GW in generation capacity.

The boxed text below summarises the economic impact that EDF Energy believes will be leveraged from its investment at Hinkley Point. The remainder of this section examines the wider impact on the economy of nuclear investment. This includes a summary of the expected impact on economic output, the effect on job creation in the construction, generation and decommissioning phases, and the wider economic benefits from exporting technology and expertise. Each of these can be broken down into the direct effect on the industry itself, the indirect effect on economic activity in the supply chain and the induced effect from goods, facilities or services engaged by those employed in the industry.

EDF Energy's infrastructure spending plans

EDF Energy has produced estimates for what it believes its investment in the Hinkley Point C plan will provide to both the British and local economies. EDF Energy has indicated a scale of investment of around £10 billion in the UK's economy through the Hinkley site through the project's 60-year lifecycle. It expects this to add £144 million each year to the UK's GDP, including £100 million each year in the regional economy during the peak construction phase and £40 million annually during the 60 years that the plant will be operational (EDF Energy 2011a). The construction and manufacturing of the nuclear reactors require a significant proportion of the total investment. Rolls-Royce and AREVA have formalised an agreement that Rolls-Royce will manufacture complex components and provide engineering and technical services for the first EPR reactor at Hinkley Point C. If Rolls-Royce was successful in its bid for all four planned EPRs, this work is valued at £400 million (Rolls-Royce 2012). Recently released figures from EDF Energy report that existing contracts with over 300 UK companies are worth in excess of £650 million.[16]

16 http://www.edfenergy.com/media-centre/press-news/news-documents/Statement_at_NDF_15_May_2012.pdf

EDF Energy has also planned other investments in the local community to mitigate any disruption. For example, at Hinkley Point it is planning to build new accommodation campuses, park-and-ride areas, road and safety improvements and highway upgrades. In addition, EDF Energy has committed £6 million of planned investment in local colleges, £5 million to invest in local housing and public services, £1.75 million for improved leisure facilities, and a £20 million community fund in acknowledgment of the 'intangible effects from the development' (EDF Energy 2011b).

When investigating the nuclear project at Hinkley Point C, EDF Energy predicted the creation of 20,000 to 25,000 jobs over the eight-year construction phase, 5,000 of which are expected to be filled by Somerset residents. Its analysis shows that after the construction phase is completed the plant would create 900 operational jobs, which would persist for at least 60 years (700 full-time directly employed staff and 200 contract staff) with a temporary workforce of 1,000 during the periodic one-month outage periods (every 18 months). EDF Energy expects a 'major increase in local employment opportunities' through the use of local suppler firms and local services jobs (ibid). An example of this type of job would be in the construction of new accommodation, especially to house the temporary staff required during outage periods. While EDF Energy is building campus accommodation for 1,510 people, at peak 3,700 construction workers will require local accommodation (ibid). Its estimate is that, at peak, 600 workers will use tourist accommodation while 750 will rent privately.

Impact on economic growth

Nuclear energy is currently a small part of the UK economy. DECC estimates that the UK nuclear industries currently account for around 0.1 per cent to GDP. This is roughly equivalent to the coal industry but less than the 2 per cent contributed by the oil and gas industry. Overall, it is a small fraction of the 3.6 per cent of GDP contributed by the energy industries in total (DECC 2010). But according to the National Metals Technology Centre the UK civil nuclear sector contributes more: approximately £3.3 billion to UK GDP, equivalent to 0.2 per cent of GDP (NAMTEC 2009: 14). According to other sources, planned expenditure on decommissioning was valued at £2.8 billion for 2010/11, with a predicted 57 per cent of that sum going to private business in the UK (Peck 2010: 8).

These figures contrast with the 1.9 per cent contribution to GDP made by the French nuclear industry. There, the nuclear industry produces over 75 per cent of the country's electricity and roughly €33.5 billion to GDP. This figure includes €12.3 billion in direct contributions, €8.8 billion indirectly and a further €12.3 billion from induced economic output (PWC 2011).

EDF Energy has provided estimates on the socioeconomic impact from their Torness nuclear facility near Dunbar, Scotland. It believes the site contributes £56 million to GDP: £35 million direct, £18 million indirect, and £3 million induced. The site contributes nearly £33 million in income into the local economy, representing nearly 4 per cent of all economic output in the East Lothian region. The Torness study indicated a multiplier effect of 60p for every £1 of spending during the operations and maintenance phase (EDF Energy 2011c).

The contribution of the nuclear sector to the UK economy will be greatly increased over the next decade or so if the necessary investment takes place to create the additional capacity the Government hopes to secure. According to DECC (2010), net investment by the nuclear industries has been on the decline since 1999, standing at £11 million in 2009 compared with £151 million in 2008. (This figure is net after counting the disposal of assets as negative expenditure – gross investment would have been a lot higher.) The boxed text below shows how additional investment could affect GDP – in short, this trend would reverse.

Economic multipliers

In economics, the multiplier is the ratio by which one variable (often output) changes in response to a change in another variable (often government spending or taxation). Thus, if a £1 billion increase in the government's road building programme leads to a £1.5 billion increase in GDP, the multiplier is calculated to be 1.5.

The multiplier captures not just the 'first-round' effect of any change – such as wages paid to construction workers building the road – but also subsequent effects, such as the boost to retailing when those workers spend their incomes. It also subtracts an estimate of the stimulus to be lost to the UK economy, if some raw materials used to build the road are imported or if construction workers spend some of their incomes on imported goods and services.

The size of multiplier effects are the subject of much controversy within the economics profession. Some economists argue that the multiplier is zero, essentially because they believe the economy will always tend to equilibrium at full employment. This is an extreme view (but note that the Coalition's argument that reducing the fiscal deficit faster would boost growth in the economy actually implied a negative multiplier). Most economists would accept that extra spending has some positive impact on the aggregate economy, while also believing that additional spending in one area has the potential to 'crowd out' some spending in other areas. This may be because there is a finite amount of capital available to invest, or a finite number of workers to employ. If this is the case, the multiplier will lie between 0 and 1. In other circumstances – where there is lots of slack in the economy – the multiplier might be above 1, at least in the short to medium term.

The OBR's estimates of multipliers for the UK (see table 2.2) are consistent with the mainstream view that additional government spending (including tax cuts) will have some positive impact on GDP but that there will be some crowding out.

The OBR's estimates are fiscal multipliers: that is, they relate only to changes in government spending and taxation. But they are broadly consistent with estimates of the effect of spending in the nuclear industry on the economy. They suggest the multiplier for capital spending (construction) is around 1 and suggest the multiplier for current spending (operation) is around 0.6.

In the US, a study investigating the potential impact of investment in 52 new reactors over the next 20 to 25 years estimated that nuclear investment would contribute $34 billion towards GDP during the investment and construction phase[17] and $12 billion during the operational phase[18] (Oxford Economics 2008). Recent modelling in the US suggests that 'every dollar spent by the average nuclear plant results in the creation of economic value of $1.07 in the local community' (NEI 2010: 7), a multiplier of 1.07.

Estimates of the amount of investment needed to deliver the Government's nuclear ambitions vary. One study suggests that £40 billion in investment would be needed to produce up to 16GW

17 $10.4 billion direct, $10.6 billion indirect and $12.6 billion induced.

18 $8.3 billion direct, $1.0 billion indirect and $2.5 billion induced.

of nuclear capacity over 20 to 30 years (Dalton 2011), equivalent to £2,500 per kW of generating capacity. Another study puts the current cost at £3,500 per kW, falling to £2,608 by 2020 and £2,259 by 2040 (Mott MacDonald 2011); this current cost is equivalent to £63 billion for 18GW. A third study puts the total capital cost in the range £2,966 to £4,166 per kW (Parsons Brinckerhoff 2011). Table 4.1 outlines what this investment could mean in terms of GDP per year, given multipliers for construction of 1 to 1.07, costs per kW of £2,500 to £4,000, and different timetables.[19]

Investment over...	6.4GW	16GW	18GW
15 years	0.07–0.12%	0.18–0.30%	0.20–0.34%
30 years	0.04–0.06%	0.09–0.15%	0.10–0.17%

Table 4.1: Potential effect on GDP of investment in nuclear capacity (% growth)

There is such a range of estimates because nuclear developments are subject to the risk of cost escalation. Recent examples of rising costs have come from Olkiluoto in Finland and Flamanville 3 in France. These cases are relevant to the UK since both installed EPR reactors. Olkiluoto was due to be completed in 2009 with a budget of €3 billion; the completion date has now been rescheduled to 2016 with a revised budget of €5.7 billion. Flamanville, originally planned for completion in 2012 with a budget of €3.3 billion, is now scheduled to be completed in 2016 with a budget almost doubled to €6 billion (NAO 2012). However, the plans for new nuclear build in the UK that are at the most advanced stage would be the fifth and sixth EPRs to be built. They will benefit from scale economies, improvements and lessons in delivery.

The risk of cost and time overruns belong to the project developer. Lessons have been learned from previous construction experiences: for example, 'replica' stations are cheaper than first-of-its-kind stations. Indeed, a secure electricity supply will be cheaper to build with less financial risk and uncertainty about completion dates if a firm commitment is made to a fleet of identical stations rather than to one at a time (RAE 2010).

Depending, in part, on how these risks develop in practice, investment in nuclear capacity could provide a significant boost to growth of up to 0.34 per cent.

Following construction, it can be estimated that the operational phase will contribute up to £330 million to GDP for every 1GW of power.[20] This would be the equivalent of 0.4 per cent of GDP in current prices if 18GW was operational. This figure would not be considered a boost to GDP since the power would be replacing

19 Assuming nominal GDP in 2011/12 of £1,521 billion.

20 Based on current estimates that 10GW of generating capacity provides £3.3 billion to GDP (NAMTEC 2009).

other sources of energy: it would just mean that nuclear energy as a subsector was making a greater overall contribution to GDP.

Potential for job creation

DECC estimates that there are 44,000 people currently employed in the British nuclear industry. This includes 24,000 who are employed directly (with 12,000 in decommissioning, 7,500 in electricity generation and 4,500 in fuel processing) and 20,000 with contracted indirect jobs in the wider supply chain.[21] Other estimates have been higher.[22] Over 200 companies are currently contracted through the nuclear industry (NIA 2011).

Without further investment or development in nuclear infrastructure, the number of jobs will decline. In the absence of new-build, Cogent (the sector skills council for science-based industries) anticipates a decline in workforce demand to 58 per cent of its current size and a reduction by 88 per cent of the workforce directly employed by the nuclear industry by 2025 (Cogent 2009).

In France, a PwC study for AREVA calculated that the nuclear industry constituted 410,000 jobs in total (with an associated boost of €33.5 billion in added value to the economy). The estimated totals for direct, indirect and induced jobs can be seen in figure 4.1, suggesting that there is at least one induced job to every direct job.

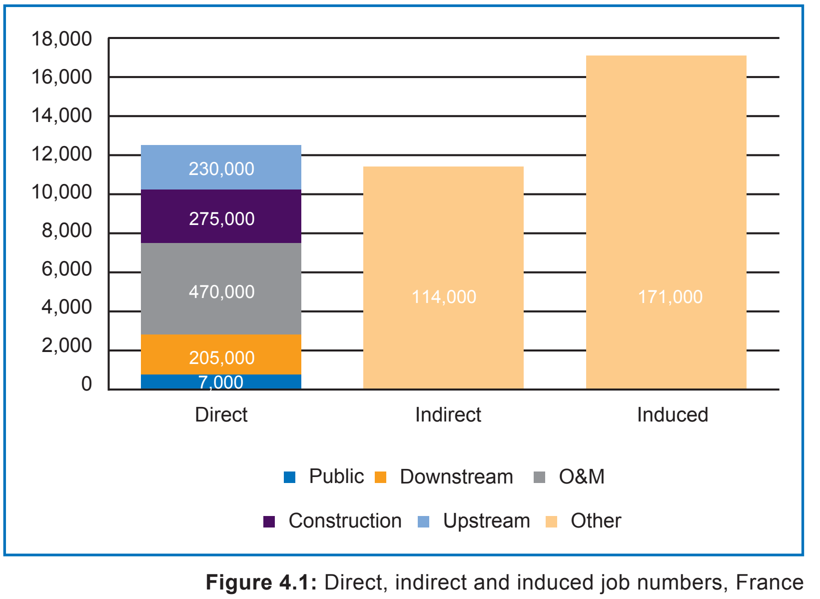

Figure 4.1: Direct, indirect and induced job numbers, France

Source: PwC 2011

In the US and France, there may be as many as two induced jobs for every one direct job. One report prepared for the US Department of Energy suggested that for each direct construction, manufacturing or operations job in a new nuclear power plant, there were two new jobs provided for indirect goods and services to that plant and two new induced non-nuclear jobs in the economy. The study estimated the number of jobs across 44 plants expected to be operating in 2024 and the 25 plants under construction in 2024, which hire and train workers three years prior to beginning operations. It found a total of 117,000 direct jobs, 250,000 indirect jobs, and 242,000 induced jobs over a 15-year timeframe (INEEL 2004). If these figures were replicated in the UK it would suggest that there would be an additional 5,000

21 http://www.decc.gov.uk/en/content/cms/meeting_energy/nuclear/nuclear.aspx

22 See for example NAMTEC 2009.

to 10,000 induced jobs per year in delivering up to 18GW of new nuclear capacity.

Initially at least, these figures may not be replicable in the UK, because Britain has a less developed supply chain and lower levels of government support for, and ownership of, the industry. However, if the Government makes a clear and credible long-term commitment to nuclear energy, and if it has all-party support in doing so, then UK industry can be reasonably confident that there will be a steady stream of work and contracts in the future. This level of certainty should enable it to enhance the UK-based nuclear industry supply chain.

Nonetheless, as well as boosting growth, investment in Britain's energy infrastructure will have a significant effect on job creation. Job creation rates for different energy technologies vary in each of the planning and development, construction, operation, and decommissioning phases, depending on the labour intensity of the task at hand. In the nuclear industry, job creation is particularly high during the construction phase before declining and then levelling out during the operational phase, as figure 4.2 illustrates.

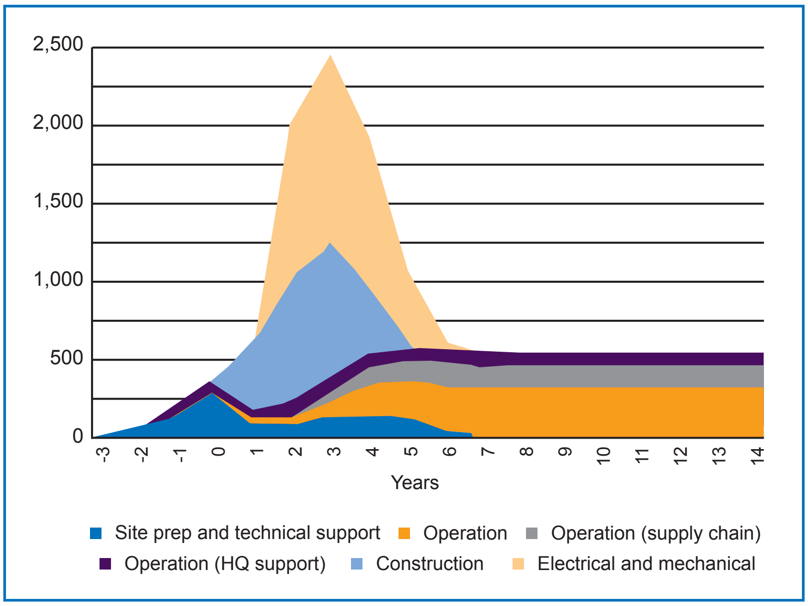

Figure 4.2: Employment numbers through construction and operational phases, single pressurised water reactor (PWR)
Source: Cogent 2010a

DECC believes that 30,000 jobs can be created through the planned construction of up to 16GW of nuclear capacity by 2025.[23] Indeed, it was recently announced that the arrangement between AREVA and Rolls-Royce on nuclear new-build will create more than 1,500 new UK jobs in the nuclear supply chain. Cogent estimates that 10,000 direct and indirect jobs per year will be created, on the basis that 110,000–140,000 person years will be needed to deliver up to 16GW of new nuclear capacity over the lifecycle of a plant (Cogent 2010b). Scaling up for 18GW of capacity, this suggests 11,250 direct and indirect jobs.

In their analysis for AREVA, PwC estimates that the design and construction phase of a single EPR would support up to 8,350 jobs (2,700 direct) while the operation and decommissioning phase would support 1,650 (500 direct) jobs. The operation and

23 http://www.decc.gov.uk/en/content/cms/meeting_energy/nuclear/new/supply_skills/supply_skills.aspx

maintenance of a twin plant would require 5,000 person years, plateauing at 800 full-time jobs (PwC 2011). Given expected levels of investment of £40 billion to £50 billion, this implies costs per person year of between £290,000 and £450,000.

These figures are within the range of other major infrastructure projects. For example, the 2012 Olympic and Paralympic Games are expected to generate around 17,900 permanent jobs and around 100,000 induced jobs over an eight- to nine-week period (Visa Europe 2011). At around 35,000 person years in total and a cost of £9.2 billion, this is equivalent to around £260,000 per person year. The HS2 rail development is expected to generate 40,000 direct jobs at a total cost of £32 billion (DfT 2011): this is equivalent to £800,000 per direct job, a somewhat different measure since one direct job could take place over many years.

While job creation is an obvious benefit of infrastructure investment, the scale of its effect on the UK economy will depend crucially on the proportion of jobs that go to UK workers, as opposed to leaking overseas. The proportion of jobs that go to domestic workers will depend on two elements: the capacity and capability of the UK workforce to do the work and the ability of UK firms to win the contracts.

It has been suggested that the total proportion of these jobs going to the British workforce will be 70 per cent, with the possibility that this could rise to 80 per cent with 'investment in facilities and the training of new personnel' (NIA 2006). This, however, is a qualitative assessment, based on a judgment about the capability of the UK workforce rather than a robust quantitative prediction about the proportion of future work staying in the UK, which would depend on capacity, competitiveness and a business case for the necessary investment. No such quantitative estimate can be made confidently given that circumstances vary from case to case: the Finnish Olkiluoto 3 EPR built by AREVA relied on 2,000 suppliers from 28 countries, with only 40 per cent of suppliers coming from Finland (NAMTEC 2009: 35), but this might not be typical. EDF Energy and AREVA have stated their desire to provide jobs for UK companies when building new nuclear capacity in the UK (though both have extensive existing supply chains in France).

There is little doubt that the UK has the potential to be competitive in most elements of nuclear build, but skills assessments suggest that, for this to be realised, the UK needs to invest in the skills of its workers (ibid: 28). While much of the UK industry is capable of gaining extensive experience from the building, operation, maintenance and upgrading of nuclear plant facilities in the UK and abroad, some elements of the supply chain and equipment have been eroded considerably over the past 15 years. This is a consequence of the UK's nuclear fleet being 20 to 50 years old: the newest British nuclear plant is Sizewell B, where construction was completed in 1995 (ibid: 16). The nuclear industry will, therefore, need to work with local further education colleges and other training providers if the necessary skills are to be developed. It will also have to undertake a good deal of training on its own behalf.

During the construction phase, many of the jobs are local and cannot be outsourced. These jobs tend to be long-term due to the lengthy construction schedules. Although the total number of jobs falls during the operation phase, the need for support staff and security personnel creates local employment opportunities in addition to operational staffing (Harker and Hirschboeck 2010). See the annex to this paper for two alternative takes on the number of jobs associated with different types of electricity generation.

Where jobs are created in the nuclear industry, they tend to provide relatively high average annual salaries. EDF Energy's Torness report finds that in 2008 the average annual salary at the site was £39,560, significantly higher than the contemporary British average of £25,532. EDF Energy finds that these wages are comparable to wages in similar industrial activities: by more recent estimates, workers average £47,300 in renewables, £61,900 in oil refining and £52,900 in chemicals and allied products (EDF Energy 2011c). In the US, jobs created in the nuclear industry paid roughly 35 per cent more than average salaries in the local area (NEI 2010: 7).

Wider economic benefits

The UK's nuclear industry is already a major exporter of technology and skills, with UK companies actively engaged in collaborative projects with overseas bodies. The combined civil and defence nuclear sectors export around £700 million a year in overseas business (NAMTEC 2009: 14). This represents around 0.25 per cent of UK exports.

The potential to grow these exports rapidly is obvious: new-build alone is valued globally at £600 billion over the next 20 years (TSB 2009). The World Nuclear Association expects to see an expansion from 367 power stations worldwide today to between 602 and 1350 by 2030, including in over 30 countries that do not yet have a nuclear programme.[24]

The International Atomic Energy Agency (IAEA) predicts that global growth in nuclear power will be in the range of 2.0 to 4.1 per cent from 2010 to 2030. Figure 4.3 breaks down this estimate by region

24 http://www.world-nuclear.org/outlook/nuclear_century_outlook.html

and shows how the Middle East and South Asia market is expected to see the fastest growth. If the UK can become one of the global 'early movers' in new-build, then UK companies have considerable global market potential, which will help to secure highly skilled jobs in the UK. (Cogent 2009: 22). If the IAEA's growth projections prove true then Britain could expect to expand its exports from £700 million a year at present to between £1.1 billion and £1.6 billion by 2030.

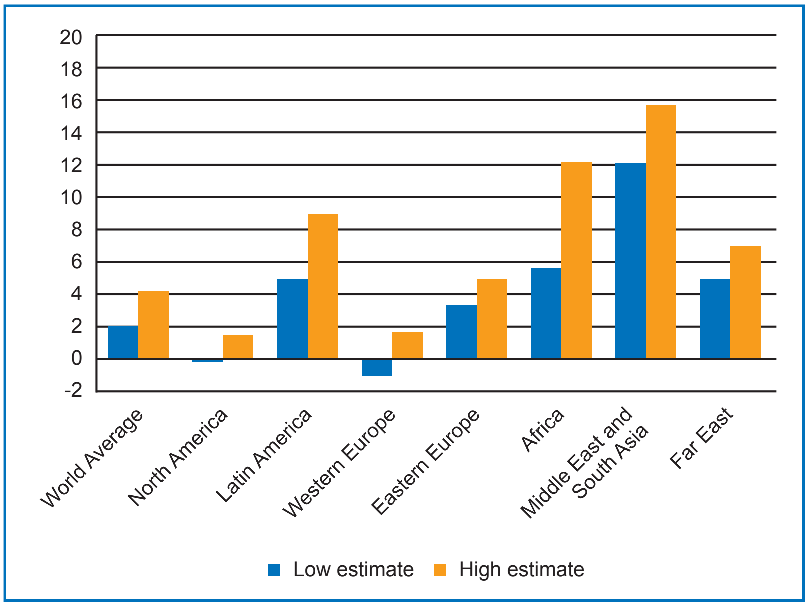

Figure 4.3: Estimates of average annual growth rates in nuclear energy, 2010–2030 (%)
Source: IAEA 2011

As well as new-build, decommissioning presents opportunities for UK exports. This global market is expected to be worth £250 billion over the next 20 years (TSB 2009), with countries such as France, Japan, Russia, the US, Canada, Germany and, of course, the UK having the greatest long-term needs. Forecasts indicate that over 50 per cent of the world's civil nuclear reactors will be due for shutdown and decommissioning by 2016 (Bambrough and Buckley 2005).

There are concerns about whether the UK is equipping itself to exploit this opportunity. In the recent House of Lords Science and Technology Committee report on nuclear research and development capabilities, both EDF Energy and the Nuclear Industry Association agreed that the Government was clear and positive about its commitment to nuclear energy in the short term but now needed to demonstrate a greater level of commitment after 2025. The risk is of the UK 'simply becoming' reliant on skills and technology from elsewhere (SCST 2011: 30). Hergen Haye, the head of nuclear new-build at DECC, suggested recently that without investment British companies would miss out: '[T]here will need to be a lot of work to put UK companies into the position of being credible partners for new nuclear. If that doesn't happen, new-build will go ahead but without a share of involvement by British Companies'.[25]

Summary: investment impact

Investment in the nuclear industry would clearly boost GDP and create jobs in the UK, with the added potential for Britain to claim a greater share of export markets.

25 http://profeng.com/features/how-to-be-a-nuclear-winner

Given the relatively high multipliers associated with the nuclear industry, investment could boost GDP by between 0.04 and 0.34 per cent per year, depending on cost and timescale. At full capacity of 18GW, nuclear power could contribute 0.4 per cent to GDP.

The impact on jobs in a local community can be significant. There are currently 24,000 direct jobs in the UK nuclear industry and about 20,000 indirect jobs in the supply chain.

Nuclear has among the highest employment rates of direct jobs per megawatt of induced energy (although this falls when examined on a GWh basis). Estimates suggest that delivery of up to 18GW in new nuclear power could deliver, on average, 11,250 direct and indirect jobs per year. If evidence from France and the US is correct, there are likely to be between 5,000 and 10,000 induced jobs per year on top of that if the investment materialises.

By making this investment, the UK can equip itself for the expanding global nuclear market. Currently, British exports are worth just £700 million. If growth projections prove accurate and Britain retains its market share, it could expect to expand its exports to between £1.1 billion and £1.6 billion per year by 2030, in current prices.

5.
CONCLUSION

> **Investment by energy companies in extra capacity in the nuclear industry could boost demand, jobs and exports in the UK, and government can help facilitate this outcome.**
> **The Government should do more to ensure that the UK workforce has the skills, particularly in engineering, that will be needed to support a higher level of investment spending.**
> **The Government should support the strengthening of the supply chain in the UK for the construction industry.**

Britain's double-dip recession highlights the urgent need for growth. The Government has called for a rebalancing of the economy away from debt-fuelled consumption and government spending and towards exports and investment. But the UK has had chronically low levels of investment for decades and therefore needs to take concerted action to address this problem. Investment in infrastructure is a particularly cost-effective means of supporting the economy. Jobs tend to be domestic and boost growth in the short run more effectively than other measures while providing a longer-term boost for growth by raising productivity.

Although government must be careful not to 'pick winners', it has an important strategic role in picking the right races. Investment in low-carbon electricity infrastructure is clearly one of those races, given Britain's need to ensure affordable, secure and low-carbon electricity. Given rising global demand for low-carbon energy there are also significant export opportunities for Britain in markets where it can establish a comparative advantage.

Encouraging investment means ensuring that potential investors have access to finance, an adequately skilled workforce, and that there is a fully functioning innovation ecosystem carrying out research, development, demonstration and deployment of new technologies.

With banks having to rebuild their capital bases at present and historically low interest rates, there is an unprecedented case for the creation of a National Investment Bank. Supporting investment in the UK's infrastructure, including energy supply, should be one of its remits. It should have the power to begin borrowing immediately (the Green Investment Bank will not be able to borrow until 2015/16) so that it can make a significant difference to the level of investment in the UK.

The Government should help to ensure that increased investment spending creates jobs that stay inside the UK and thus helps to alleviate Britain's unemployment crisis. To this end, it should take steps to ensure that the workforce has adequate skills, particularly in engineering.

The Government should facilitate the development of a strong supply chain inside the UK to support the construction industry. Much of the benefit from additional infrastructure spending will accrue to companies that provide resources to the construction industry. These companies need support in areas such as finance and in ensuring they can recruit the skilled workers they need.

In relation to the nuclear sector, this report has shown that there is a clear direct macroeconomic benefit from additional investment in production capacity, as well as indirect benefits through the supply chain and to the local economy where new plants are built. The potential for international growth in demand for investment in nuclear capacity also means the sector could become a point of comparative advantage and source of future export earnings for the UK.

Further work is needed within government to estimate the potential supply chain benefits from investment in nuclear power in terms of domestic jobs and growth. On the basis of these estimates, ministers should become more active in the procurement process to help ensure British companies prepare themselves as well as possible to win competitive tenders.

Supporting infrastructure investment across all sectors is critical to driving growth in the current economic climate. The UK needs to apply its talent and ingenuity, as it has in the past, to rebalance the economy, provide good jobs, and capture the potential benefits of new global markets.

ANNEX
ELECTRICITY GENERATION AND EMPLOYMENT

Research from the US shows that nuclear is second only to solar PV in terms of permanent direct local jobs per megawatt of installed electric capacity, as shown in table A1. Solar PV tends to be labour-intensive but creates lower-skilled jobs, such as on-site staff to clean the solar panels and provide plant security.

An alternative perspective is given by looking at average employment over the life of a nuclear facility. As table A2 shows, solar PV leads the field on this basis, providing 0.87 job years per GWh, with nuclear further down the list on 0.14GWh. This is primarily because nuclear power's high capacity factor makes it a more efficient and productive form of energy than solar: the capacity factor for nuclear is 90 per cent, compared to just 20 per cent for solar PV. However, this says nothing about the quality of the jobs, or about other possible benefits, including impact on exports. Nor does it reflect the limited potential output of solar PV, and some other technologies, in the UK. The employment potential of nuclear on this basis is more comparable with that of other potential major sources of electricity supply.

Energy technology	Jobs per MWe
Solar PV	1.06
Nuclear	0.50
Concentrated solar power (CSP)	0.47
Micro hydro (<20MW)	0.45
Hydro (> 20MW)	0.19
Coal	0.19
Hydro (>500MW)	0.11
Hydro pumped storage	0.10
Combined cycle	0.05
Wind	0.05

Table A1: Comparison of permanent direct local jobs per megawatt of installed electric capacity
Source: Harker and Hirschboeck 2010

Energy technology	Job years / GWh	Capacity factor	Lifetime (years)
Solar PV	0.87	20%	25
Landfill gas	0.72	85%	40
Small hydro	0.27	55%	40
Geothermal	0.25	90%	40
Biomass	0.24	85%	40
Solar thermal	0.23	40%	25
Carbon capture and storage	0.18	80%	40
Wind	0.17	35%	25
Nuclear	0.14	90%	40
Coal	0.11	80%	40
Natural gas	0.11	85%	40

Table A2: Comparison of average job years, various energy technologies
Source: Wei et al 2010

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BENEFITS FROM INFRASTRUCTURE INVESTMENT: A CASE STUDY IN NUCLEAR ENERGY

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