Introduction

Balfour Beatty is a leading international infrastructure group. With 16,000 employees across the UK, Balfour Beatty finances, develops, delivers and maintains the increasingly complex infrastructure that underpins the UK’s daily life. Delivering projects across transportation, power and utility systems, social and commercial buildings: from Crossrail and the Channel Tunnel Rail link, Heathrow T2B to the M25, M60, M3 and M4/M5; Sellafield and soon Hinkley C nuclear facilities; to the Olympics Aquatic Centre and Olympic Stadium Transformation.

We also have significant experience and understanding of the links between infrastructure investment and regeneration and economic growth.

The scale of the challenge

The National Infrastructure Plan, first published in 2010 and updated annually, began the process of providing clarity and visibility on the investment needed in the country’s infrastructure. It articulated the Government’s infrastructure investment priorities to 2015 and beyond. Its successor, the National Infrastructure Delivery Plan (NIDP)1 builds on the progress made, providing a clearer timetable for the delivery of vital infrastructure projects and improving visibility for the supply chain and investor community.

To complement this, we hope that the publication of the National Infrastructure Assessment every five years will help establish a planned and visible pipeline of prioritised projects over a 30 year period to enable the infrastructure industry to plan its investments in skills and equipment. Of course, this is a huge challenge: Global Infrastructure Basel estimates that 75% of the infrastructure that will be in place by 2050 does not exist yet.

The challenge is increased by the recent vote to leave the EU, which is likely to have a significant impact on the UK economy, for at least the next decade. Indeed, there is little doubt that a prolonged period of uncertainty will impact infrastructure investment and delivery in the medium to long term in a number of ways, for example:

- There is a skills shortage in the infrastructure industry. The free movement of labour has allowed us to find the skilled staff we cannot currently source in the UK. Given the number of major infrastructure projects in the pipeline, uncertainty around the free movement of labour could cause the industry recruitment and staffing difficulties and may increase costs where demand for labour outstrips supply, with the subsequent risk of project delays. This will be particularly relevant for mega projects such as HS2 and the nuclear new build programme. In our view, this requires an early and integrated policy response to both retain the skills of those who have migrated here and to ensure that the UK remains an attractive place for talented people to move to. The country must maintain its skills base.

In the same vein, it is vital that the UK looks beyond the current economic cycle and maintains its investment in home-grown skills. However, funding for skills and apprenticeships in particular depends on a strong economy and profitable businesses and is therefore likely to be

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impacted by any economic turbulence. Furthermore, as an unprotected department, Department for Business, Energy and Industrial Strategy and Skills Funding Agency budgets may be at risk of being used to backfill gaps left by the withdrawal of EU funding elsewhere. In our view, it must remain a government priority to invest in skills for the long term prosperity of the UK, by maintaining and reaffirming its commitments on promised infrastructure spend and by mitigating, as much as possible, doubts caused by the current short term uncertainty.

In terms of infrastructure investment, at the very least while our exit from the EU is negotiated, private investment may slow. Longer term, the impact on private investment in infrastructure projects is unclear, but some investors are likely to postpone decisions to make investments until the UK-EU relationship is renegotiated. Given the long lead times for major infrastructure projects, this risks delaying some of the key planned projects.

The impact on private investment in infrastructure is significant since, according to the National Infrastructure Pipeline, private finance dominates the UK’s planned infrastructure investment: 69% of financing is from the private sector (worth £260 billion), whilst 19% is from the public sector (£73 billion) and 12% is from mixed financing (£46 billion). In order to attract private investment, the political and policy landscape have to be attractive and stable enough to maintain and even improve the UK’s position as a place for infrastructure investment.

The 2016 Arcadis Global Infrastructure Investment Index has seen the UK move up the global rankings from 13th in 2012 and 10th in 2014, to ninth in 2016. The compilers of the Index point to government commitment to infrastructure projects such as HS2, Crossrail 2, HS3 and the Northern Powerhouse initiative in a mature, stable and relatively low risk environment as motivators behind investors’ positive attitude towards UK infrastructure. The creation of the National Infrastructure Commission, with its remit for establishing a long-term needs assessment, also motivates investors. However, they also cite slow political decision making as the key reason behind the country’s inability to move further up the table. With the current political and policy uncertainty, any gains we have made in these rankings over the past few years are likely to be lost in the next few.

In terms of public money, the European Investment Bank (the EIB) has invested £16 billion in UK projects over the last three years, including the extension of the M8 motorway between Edinburgh and Glasgow and a £700m loan to the Thames Tideway Tunnel. At the moment, the UK is the joint largest shareholder in the EIB but will have to give up its equity upon leaving the EU, meaning that the UK will lose billions of pounds in infrastructure funding. This is likely to have an impact on some of the larger infrastructure projects such as Crossrail 2 and London Underground upgrades. It is unlikely that HM Treasury will be directly able to make up the amount in the short to medium term.

In our view, this all points to the need for an urgent debate about the financing of infrastructure. The questions that need answers alongside those outlined above are many, but important: what percentage of GDP should we spend to deliver a sustainable rate of economic growth and international competitiveness? How much should the taxpayer fund and how much should be privately funded? And what are the new financing mechanisms that could be explored, alongside initiatives such as British Wealth Funds and Infrastructure Premiums to make up the shortfall in international investment and investment from EU sources?

Of course, every set of challenges also presents opportunities. While a possible recession would mean lower tax receipts for the Treasury, the current low interest rates - predicted to sink even lower - mean that now is an ideal time for government to borrow money in order to finance infrastructure projects. This is far from being an irresponsible course of action as some maintain. Infrastructure investment delivers significant benefits, not only in terms of direct employment relating to the build and long term maintenance of a scheme and the spend that goes via the supply chains; there is also a well-documented multiplier effect. Economists estimate that every £1 spent on construction generates £2.84 in total economic activity at least 90% of which stays in the UK.

Finally, this could be an opportunity for the much talked about diversification of the economy away from financial services and back towards industries such as engineering, construction and manufacturing, as the UK may no longer be bound by single market

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2 National Infrastructure Pipeline, July 2015
3 LEK Consulting, Construction in the UK Economy, 2010
4 CBI, Construction bridging the gap, June 2012
rules which restrict a more active industrial policy. This, in turn, would support the rebalancing of the economy more evenly across the regions.

Any potentially positive consequences of Brexit will of course rely on the detailed outcomes of the negotiations. We urge those undertaking the negotiations to maintain their focus on the crucial role infrastructure and skills play in economic growth and therefore in the future of the country.

**Beyond Brexit**

Beyond Brexit, the challenges for those predicting future need are many, including demographic change, the need to decarbonise and adapt to a changing climate and to upgrade aging infrastructure and build new infrastructure that helps give us the competitive edge on other countries. The way people use infrastructure and expect it to perform for them is also changing. For example, the increasing use of mobile technology, clean tech and the internet of things networking all our electronic devices; how people want to travel and work; and the use of smart technology in building design to help individuals control the space around them and the amount of energy they use. This trend is likely to continue and the use of technology will become increasingly integral to how we design, build and maintain our infrastructure.

Better technology will also result in improved scenario planning, helping us manage the demand and risk facing our infrastructure, which will in turn enable future infrastructure systems to be designed based on more accurate data. This should ensure that our infrastructure is fit for purpose, delivers value for money and is resilient. However, it requires us to continue to invest in high-quality technology and to ensure that it is used when assessing national infrastructure need.

Finally, we also need to create a skilled workforce with the capacity to deliver the planned infrastructure. New technologies, for example, smart motorways and the digital railway, mean that we will need people trained with new skills to maintain a more technically advanced and data rich infrastructure. This is a significant issue even in the short term. The government is investing record amounts in rail, roads, ports and airports. There is an anticipated infrastructure investment of £411bn in 564 projects and programmes from 2015/16 onwards. There will be £61bn of capital investment in transport infrastructure within this parliament alone⁵. We will need skilled people to build, maintain and operate this infrastructure once it is in use and yet the industry is already facing a skills shortage. Professionals such as high voltage overhead line workers are now listed on the Home Office shortage occupation list and it is predicted that there will be a shortfall of 55,000 skilled workers in the transport sector overall by 2020⁶: in a decade, over half of the transport infrastructure workforce will have retired (a predicted 33,400 workers, of whom 53% are at Level 3 and above⁷). Those that remain will need to seriously upskill.

Skills shortages are a problem for a variety of reasons. Of course, the most obvious issue is that there may not be enough people to build and maintain the infrastructure we as a society need. A further issue is that a lack of skilled workers leads to wage inflation. For example, within the railway industry, the shortage of critical resources such as linesmen, signalling designers, and test and commissioning engineers is predicted to lead to wage inflation over the next five years of between 25 and 40%⁸.

We will need to take concerted, strategic action to remove existing barriers to young people entering training and the infrastructure industry. These barriers include the cost of higher education; the remaining perceptions that apprenticeships are not for intelligent people; the appetite for working in innovative ‘new’ industries rather than those that are more traditional; the perceived unattractiveness of the industry to women and people from minority backgrounds; as well as the previous trend of ‘boom and bust’ in the construction industry.

This paper does not aim to provide the solutions to all of these problems. Rather, it sets out Balfour Beatty’s expert views on the infrastructure developments planners need to make sure we are taking into account and are ready for. We look at six areas that are key in terms of infrastructure and where Balfour Beatty has considerable experience and expertise:

- Roads
- Rail
- Aviation
- Energy
- Nuclear decommissioning
- Flooding

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⁵ Transport Infrastructure Skills Strategy, DfT, January 2016
Summary of recommendations

1. We must ensure that the political and policy landscape are stable enough to attract private infrastructure investment. To achieve this, we need government action to maintain economic stability, a timeline for the UK’s exit from the EU, and early answers to the many practical questions about doing business during and after Brexit.

2. The Government should continue to invest in high-quality technology and to ensure that it is used when assessing national infrastructure need.

3. New transport investments will need to show that their business cases are robust to automated technologies.

4. Future infrastructure will need to be better planned and coordinated and to rely on improved modeling of future demand and long-term weather and environmental changes.

5. We will need to take concerted, strategic action to remove existing barriers to young people entering training and the infrastructure industry. These barriers include the cost of higher education, the attractiveness of traditional industries in comparison to other, new industries, the perceived unattractiveness of the industry to women and people from minority backgrounds, as well as the previous trend of ‘boom and bust’ in the construction industry.

6. A far-reaching vision should be set out for the national rail network. The vision should encompass future rail infrastructure projects such as HS3, HS Scotland, HS Southwest, the reinstatement of the HS2 link and Heathrow spur, another Channel Tunnel, a new East Coast line, Crossrail 3 and 4.

7. There should be a full review of aviation capacity and connectivity beyond the South East of England, with the aim of producing a robust UK aviation strategy to 2050, which would also consider what our regional and sub-regional airports could offer in terms of our connectivity. This should include a national strategy for improving road and rail links to UK airports both in the short-term, future-proofed to ensure that we have the infrastructure we need for the long-term; and an assessment of other ways smaller airports might be supported and given the opportunity to thrive.

8. To ensure a smooth transition to having autonomous vehicles on our roads will require a regulatory regime that ensures an effective balance between public safety, the flexibility necessary to embed the new technology and the predictability to support the multi-year research-and-development required.

9. There will also need to be standardisation of the road environment, especially street furniture, that directs autonomous vehicles and people during the period when there are mixed human/automated traffic streams.

10. A clear long-term vision for UK energy policy needs to be developed, agreed, communicated and retained to provide investors with certainty.

11. Further initiatives to improve climate projections of wind and extreme weather events should be implemented by the Environment Agency. Improving accuracy in future short-term climate projections and impacts would help companies make the right choice on whether they extend an asset life or not.

12. The next UK Climate Change Risk Assessment should focus on interdependencies and the next National Adaptation Plan should further enforce cooperation between regulators, government departments and infrastructure operators across sectors — for example via the UK Regulators Network or the Infrastructure Operators Adaptation Forum.

13. In order to decarbonise the UK’s electricity sector at the lowest possible cost, the Government must continue its support for the current 16GW nuclear new build programme.

14. We must also push ahead with plans for a geological disposal facility to safely house the country’s nuclear waste and ensure that the infrastructure, regulatory and grid changes are in place to support small modular reactors in nuclear.

15. The government should support the development of interconnectors, smart grids and smart networks and energy storage through the removal of regulatory barriers to develop these markets, in order to help deliver £8bn a year savings to the UK consumer.

16. There is a real opportunity for the UK to become a global expert in the decommissioning market, enabling expertise, products and services to be exported, something the UK should ensure it takes advantage of. We call on the Government to update the industrial strategy launched under the Coalition Government, following the vote to leave the EU, to enable the UK to seize opportunities for economic growth in nuclear decommissioning and in the nuclear industry more broadly.

Smart Power, National Infrastructure Commission, March 2016
17. It will become imperative to think about future flood impact when designing and installing new infrastructure, homes and other buildings, to ensure that they are inherently more resilient.

18. After a major flood event, it will become increasingly important to take a “Build Back Better” approach and to consider how to improve local resilience when replacing or repairing damaged properties and assets.

19. It is time to rethink the approach to flooding on a catchment wide basis assessing risk from source to the sea and joining up policy across government departments to reduce risks of infrastructure flooding.

20. The planning of flood prevention measures should be the shared responsibility of government, the Environment Agency, local communities and the owners/operators of infrastructure. Together, they must consider the long-term economic growth plans for a region.

21. We would support an asset whole life approach on flood defences, which would involve both investing in capital improvements and ensuring revenue support to enable the maintenance of assets. The extra £700m in flood defence funding announced in March 2016 does include £140m for maintenance. We welcome this announcement and encourage the government to maintain this spend.
What should we be ready for?

Historically, infrastructure has been built in response to a specific problem, for example, tackling localised issues such as sanitation, flooding or fire or the need to travel from A to B. In most cases, little thought has been given to future conditions or needs, a situation which has been exacerbated by short-term political cycles. This has meant that infrastructure has quickly reached capacity and become unfit for purpose.

In our view, future infrastructure will need to be better planned and coordinated and will need to rely on improved modeling of future demand and long-term weather and environmental changes. Society will come more and more to demand intelligent infrastructure which makes the most of energy generation and distribution, makes buildings smarter and keeps traffic flowing. We believe that this is likely to improve with increased usage of smart systems using feedback data loops which provide evidence for informed decision-making and better data on which to base projections.

Our work on this paper has brought us to the conclusion that there are some principles common to all of the sectors we have considered in order to ensure a resilient, cost-efficient and fit-for-purpose national infrastructure to 2050 and beyond. In our view, these principles should be applied to all future national infrastructure planning. These are:

1. Interoperability
2. Climate resilience
3. Digitisation
4. Smart-maintenance
5. Financial sustainability
According to the National Audit Office, the UK’s roads are among the most heavily used in Europe\(^\text{10}\). To keep up with demand, we need to make sure we are staying on top of new developments, which in this case means the infrastructure required to support electric, hydrogen or driverless vehicles. These are predicted to be on our roads within just 15 years, although to begin with there will be a combination of autonomous, technology assisted and human-controlled cars.

The infrastructure needs will change in a variety of ways, for example:

- **Lane compression** – fully autonomous vehicles could drive in narrower lanes, potentially facilitating the existing road space being divided into a greater number of lanes providing additional road capacity.

- **Distance compression** – fully autonomous vehicles can travel as electronically connected “platoons” enabling reduced distance between vehicles and therefore increased flow and road capacity.

- **Time compression** – smart roads are better managed and controlled. Travel speed is increased at the same time safety is improved. Highways England’s recently published Innovation, Technology and Research Strategy\(^\text{11}\) has confirmed that a connected corridor or ‘wi-fi road’ could see cars and infrastructure wirelessly connected, with drivers receiving news of advanced road closures or congestion warnings, making journeys more efficient by allowing drivers or vehicles to select alternative routes away from congestion. Additionally, radar technology on motorways and in tunnels enables breakdowns to be detected.

- **Road maintenance** – technology embedded into assets will allow remote monitoring and assist with determining the life expectancy of an asset and its optimal repair or replacement.

- **Safety and disruption** – optimal asset management will facilitate timely and safe renewal.

- **More space for development and decluttered roads** – introducing autonomous vehicles could free up to 15-20% developable land worth billions to build homes, workplaces and green spaces, according to research\(^\text{12}\) undertaken by WSP | Parsons Brinckerhoff and architects Farrells. This is due to reduced parking requirements once people have access to shared autonomous vehicles for everyday journeys. Autonomous vehicles could also potentially mark the end for common street furniture such as traffic lights and road signs.

- **Charging and hydrogen fuelling centres** – other changes will be needed to support autonomous cars, for example, sufficient, conveniently located charging and hydrogen refuelling centres will need to be built to ensure that the system is able to operate seamlessly.

- **There will also need to be standardisation of the road environment, especially street furniture that directs autonomous vehicles and people during the period when there are mixed human/automated traffic streams.**

\(^{10}\) NAO, Planning for economic infrastructure, HC 595, January 2013
\(^{11}\) Innovation, Technology and Research Strategy, Highways England, April 2016
\(^{12}\) Making better places: Autonomous vehicles and future opportunities, WSP | Parsons Brinckerhoff and Farrells, 2016
Rail

We believe that autonomous cars will reduce the requirement for slow, local train services (and certainly buses), as passengers in self-driving cars will be able to enter their destination and be driven door-to-door at around 100mph (161kph), while working or watching films.

However, in our view, rail will still be the transport mode of choice over longer distances, not least because, by the year 2050, the World Economic Forum estimates that 70 - 75% of the population will live in cities and high speed trains will be able to carry passengers at up to 250mph (402kph) between these key urban centres. Whether automated or not, road vehicles will be slower than trains and will not have the same freight capacity, although there is potential to improve transportation of freight on roads through the use of platoons of closely-spaced automated lorries.

While it is our contention that, no matter how advanced driverless technology becomes, rail will fulfil a role that road transport cannot, it is certainly the case that future transport investments will need to show that their business cases are robust to automated technologies. We also believe that the two technologies will work together to ensure smoother door-to-door journeys, with driverless cars providing the ‘last mile’ solution currently often fulfilled by taxis or buses adhering to rigid timetables.

Of course, the public will rightly expect trains to become faster, quieter, more convenient, reliable and attractive. In the railway of the future, passengers will have increasingly high expectations of transport systems and will expect providers to deliver a passenger experience that is genuinely fit for the 21st Century. This will require, in an industry where technology tends to change only slowly, not only the completion of projects such as the digital railway, in which everything – from signalling to trains, infrastructure and ticketing – is managed digitally with the aim of boosting capacity, efficiency and customer experience, but going far beyond that as well. The key question is whether we have the right legal and commercial framework in place to deliver these changes: the current framework was set up in the 1990s, when passenger numbers were declining. We believe the existing frameworks need close examination to ensure that these changes can be delivered.

While Balfour Beatty supports devolution, it is also the case that it could slow down some of the changes needed to ensure the railways are able to embrace technological advances. For example, if policy is no longer driven nationally it may be difficult to retain oversight and drive changes to ensure that the system, nationally, is as robust as it could be. It will be necessary therefore to ensure that there remains an interface, at a strategic level, between the various devolved organisations in order to ensure the country as a whole has the rail network it needs for the future.

We believe that intermodal travel will become ever more important as population growth continues in the UK. Passengers will expect a seamless interchange between road, rail, air and sea with one e-ticket, for example, while intelligent infrastructure and assets that run on it will communicate with each other to minimise travel time, manage capacity, and optimise the passenger experience. To this end, Balfour Beatty would welcome a far-reaching vision being set out for the national transport network. The vision should take into account likely developments in all forms of transport and consider rail as part of a wider solution. The vision should encompass future rail infrastructure projects such as HS3, HS Scotland, HS Southwest, the reinstatement of the HS2 link and Heathrow spur, another Channel Tunnel, a new East Coast line, Crossrail 3 and 4.

In line with the imperative to decarbonise the economy, it is also important that rail remains a carbon friendly means of transportation. The more people there are using the train, the “greener” the journey is on a per person basis.
We believe that, with the advent of autonomous cars and high speed rail, air travel in the UK will become largely used for international travel: short-haul, domestic flights will fall away. However, demand for air travel is forecast to continue to increase within the range of 1% - 3% a year up to 2050\(^\text{13}\), with an estimated total of 445 million people using UK airports each year by 2050. Unless work begins on a new runway in the near future, the major airports in the South East of England are forecast to be full by 2030\(^\text{14}\).

Even if a new runway is commissioned in the South East, we do not believe that it will provide sufficient capacity to meet increasing demand over the long term. The Davies Commission in 2015 decided not to shortlist proposals for expanding Stansted or Birmingham, but said they could be considered as “potential options” for any second new runway by 2050.

We believe that there should be a full review of aviation capacity and connectivity beyond the South East, with the aim of producing a robust UK aviation strategy to 2050, which would consider what our regional and sub-regional airports could offer in terms of our connectivity. This should include a national strategy for improving road and rail links to UK airports both in the short-term, but future-proofed to ensure that we have the infrastructure we need for the long-term; and an assessment of other ways smaller airports might be supported and given the opportunity to thrive.

To meet the energy trilemma challenge – developing a sustainable, affordable and reliable energy system – requires clear and sustained regulation and policy. For the UK this challenge encompasses a largely decarbonised energy system before the middle of the century, whilst maintaining affordability for homes and businesses, in the likely event that power consumption could as much as double by 2050\(^\text{15}\) as transport systems and heating are electrified.

A continuous, reliable and low carbon energy supply is crucial for economic growth and stability as well as social well-being. However, today’s grid infrastructure was not designed to handle the growing power requirements particularly in the face of the electrification of heat and transport networks or the increasing proportion of fluctuating, distributed power generated by renewable sources. There is a growing risk of shortfall between UK energy generation and demand, as ageing power stations close and the construction of new, constant sources of generation to replace them is not keeping pace, leading to predictions that the country will face an ‘energy crunch’ in the coming years, worsening by 2030\(^\text{16}\).

These trends, in addition to power outages caused by storms and excessive pressure on the networks from supply and demand, could have a significant impact on businesses and households alike. If the power supply fails, there will be repercussions across all infrastructure domains.

- **Long term strategy** – a clear long-term vision for UK energy policy needs to be developed and communicated to facilitate the hundreds of billions of pounds worth of investment in the energy supply infrastructure required by 2030. The recent announcement that all coal-fired power stations will be phased out is an example of a clear, long-term policy which provides the certainty required by investors. The same certainty needs to be provided for other energy-related policies in order to provide investors with confidence. At the same time the electricity networks and their regulator need to be given the opportunity to be flexible in order to adapt to technological changes and a changing generation mix. This flexibility should enable network operators to expand and modernise the networks to adopt increasing amounts of distributed generation, reducing the risk of demand exceeding supply and the reliance on carbon intensive back-up systems.
generation. Further initiatives to improve climate projections of extreme weather events should be implemented by the Environment Agency to improve confidence in forecasting capability. Improving accuracy in future short-term climate projections and impacts should help companies make the right choice on whether they extend an asset life.

- **Interdependencies** — critical interdependencies between the energy sector and the water, transport and information communication technology sectors, although known, are not effectively understood and assessed within the industry. The next UK Climate Change Risk Assessment should focus on interdependencies and the next National Adaptation Plan should further enforce cooperation between regulators, Government departments and infrastructure operators across sectors — for example via the UK Regulators Network or the Infrastructure Operators Adaptation Forum.

- **More nuclear** — in order to provide a baseload of constant power and support the decarbonisation of the UK’s electricity sector, the UK Government should continue to support the current 16GW nuclear new build programme. Hinkley Point C will generate 7% of the UK’s electricity at a stable cost whilst avoiding 10 million tonnes of carbon dioxide emissions a year. We must also push ahead with plans for a geological disposal facility to safely house our nuclear waste. Furthermore, the UK has the opportunity to become a leader in the development of small modular nuclear reactors. The Government must ensure that the infrastructure and regulation is in place to support the development of this industry.

- **Smart grid** — smart grid technologies make it possible to modernise and adapt existing power grids to future demands. They can enable power operators to manage energy more efficiently, react with increased flexibility to changing demands and boost efficiency in the network, as well as incorporating electricity from distributed and renewable sources. The adoption of smart grid technologies could make the grid infrastructure more efficient in order to reduce fault and refurbishment work and reduce losses from the network; however this will require an increase in short term capital expenditure in order to retrofit existing infrastructure with smart grid technologies or include the equipment in new build assets.

- **Energy storage** — energy storage is a growing market across the energy sector, which could unlock the full potential of renewable generation in order to deliver a low carbon electricity market. Storage will affect the traditional electricity transmission and distribution business models, creating a requirement for system operations to be managed at both national and local levels. Energy storage can be used to complement low carbon and renewable generation sources if utilised as a balancing mechanism and appropriately regulated, creating a multi-billion pound industry. However, if storage has to compete with other sources of generation then it could drive the price of electricity up rather than down. Together with interconnectors, smart grids and smart networks, energy storage could save the UK consumer £8bn a year\(^\text{17}\), but only if regulation removes barriers to the development of the markets.

- **Interconnectors** — interconnectors can provide a balancing mechanism and help to drive down the cost of energy. The UK should ensure that the regulatory framework continues to support the private sector in developing further interconnectors to appropriate markets across Europe and ensure that the onshore infrastructure in the UK is fit to incorporate these interconnectors.

\(^{17}\) Smart Power, National Infrastructure Commission, March 2016
Nuclear decommissioning

It was the UK which pioneered, first delivered and safely operated nuclear power. The country therefore has a wealth of experience and accumulated knowledge of civil nuclear energy and the safe exploitation of nuclear power. However, the UK’s previous generations of nuclear power has left a legacy which needs careful management – as cost-effectively as possible for the taxpayer. Many of the country’s nuclear reactors have been or are being taken off the grid in readiness for decommissioning and eventual dismantling. Several nuclear research facilities and fuel plants have also reached the end of their working lives. This means that there are decades worth of spent fuel and waste material which must now be safely and responsibly stored or disposed of, with 19 nuclear sites across the country currently being managed through the process. In addition the Sellafield facility is approaching a change in use with the end of reprocessing of fissile material and a move to storage. This means an acceleration of the build programme to build storage assets and a large workforce which can be redeployed.

Of course, the expanding decommissioning programme presents many challenges which will require flexibility and innovation from contractors and the wider supply chain. In many cases, decommissioning systems and products are as large and as complex as those required for new reactors and the manufacturing quality requirements are, rightly, similar. These are decommissioning programmes and projects which have little national or international precedent, as the UK decommissioning programme is more advanced than many due to the early adoption of nuclear and the end of life of many assets. Added to this, there are uncertainties surrounding the condition of the assets and a need to reduce the risk at some sites. Approaches that are more closely with their supply chain to increase collaboration and improvement of staff across the parties and drive greater long term thinking. In terms of skills, this enables the development of local talent and the building of careers that support people, the industry and the local communities.

However, once these challenges have been overcome, there are significant opportunities for growth and sustained employment in nuclear decommissioning over the coming decades. Indeed, the total cost of the UK’s decommissioning programme is estimated as being worth around £1.5 billion a year to the supply chain for the next 120 years, according to the Nuclear Industry Association. This offers the opportunity for the UK to become a global expert in the decommissioning market, enabling expertise, products and services to be exported, something the UK should ensure it takes advantage of as over the next 20 years, it is forecast that globally there will be £250 billion spent on decommissioning following the worldwide shutdown of older reactors. To this end, we call on the Government to update the industrial strategy launched under the Coalition Government, following the vote to leave the EU, to enable the UK to seize opportunities for economic growth in nuclear decommissioning and in the nuclear industry more broadly.

Of course, as in all areas of infrastructure, a skilled workforce is essential to the safe delivery of decommissioning. The energy sector is currently facing a shortage of highly-skilled engineers and technicians. The UK nuclear industry has been at the forefront of collaboration on developing skills for the sector. We understand that working in isolation as individual companies is not the most effective way to tackle the skills challenge. This is why the industry established the National Skills Academy for Nuclear (NSAN), which Balfour Beatty joined in March 2010. We believe that maintaining the momentum behind this collaborative approach is essential if we are to successfully deliver the skills we need in this sector. However, we also believe that we need to take a broader approach, such as helping to retrain those highly-skilled workers currently in nuclear reprocessing and fuel manufacture, or those in the North Sea oil and gas industries who are being made redundant and may have transferable skills. It is also important that we as a company are training the next generation, for example, by implementing a traineeship programme at the Sellafield nuclear site in West Cumbria. Finally in this area, it is important that all of the relevant parties are committed, and we welcome the fact that clients such as Sellafield are working more closely with their supply chain to increase collaboration and improve productivity, increase transferability of staff across the parties and drive greater long term thinking. In terms of skills, this enables the development of local talent and the building of careers that support people, the industry and the local communities.

However, to deliver in the skills arena, it is vital to have clarity regarding project pipelines and certainty of timings. This is required to enable live projects where we can support and train people and then retain the pool of talent in a way the industry can sustainably afford. This is particularly important because, while demand for people who can deliver to the quality standard required by nuclear will grow substantially, there is currently insufficient high integrity work to provide sustainable opportunities

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19 Real performance, real results, Nuclear Industry Association
18 http://www.niauk.org/facts-and-information-for-nuclear-energy
to train, and training people up to the standard required takes several years. Furthermore the nuclear market is being increasingly affected by the move of many people to self-employment due to significant personal tax advantages. This is, in turn, increasing pressure on cost and making the workforce more volatile and with less incentive to train and then not be able to retain.

Finally, the decommissioning programme operates and will continue to operate for the foreseeable future in an environment of funding constraints. This means that those involved will need to ensure that they operate as efficiently as possible and may have to face difficult decisions.

The Nuclear Decommissioning Authority has already warned that it is possible that some work may need to be deferred\(^{20}\); we agree with and support its commitment to ensuring that, should this be the case, the priority should be to ensure that we are not making short-term efficiencies that result in an accumulation of future liabilities for the next generation to deal with.

However, we believe that the coming decades could see significant opportunities for cost savings through the use of new technology, innovation in equipment and the application of new techniques.

Our clients in this sector are challenging design and delivery approaches to maintain safety, but where possible provide commercial off the shelf technology and approaches. Balfour Beatty’s team of architects and engineers have already used Building Information Modelling to create a 4D representation of the finished silos’ maintenance facility at Sellafield, aimed at reducing the time it will take to construct the project and we continue to explore new innovation to ensure safe, efficient and cost-effective ways to deliver our projects.

\(^{20}\) Consultation outcome, Nuclear Decommissioning Authority: Draft Strategy, Nuclear Decommissioning Authority, Updated April 2016
Flooding

According to the Committee on Climate Change, storms, flooding and drought already account for 10-35% of all delays or interruptions of service to electricity, road and rail customers. Flooding, in particular, has become a regular event, with annual occurrences bringing an increased appreciation of both the human impacts and financial costs. For example, the cost of the December 2015 flooding following storms Desmond, Eva and Frank is predicted to exceed £5bn.

The same report outlines that climate change will lead to an increase in the number of infrastructure assets exposed to phenomena such as flooding over the coming decades, up to and beyond 2050. This means that the Government Strategy for managing flood risk will be impacted by climate change, making design judgements and decisions more difficult as infrastructure designs will not only have to anticipate short-term, local conditions, but long-term, global phenomena as well.

Conventional infrastructure repairs have used a robust engineering approach, elevating hard flood walls to respond to predicted future sea levels and earthworks strengthened to protect against more intense rainfall events. However, we believe that what will be required moving forward will be a combination of responses including green infrastructure or ecosystem-based adaptation, such as better upstream catchment and storage, working with natural processes (vegetation, planting and sand dunes, for example), alongside traditional, hard defences.

Above all, it will become imperative to think about future flood impact when designing and installing new infrastructure, homes and other buildings, to ensure that they are inherently more resilient. Taking this approach does not always necessarily mean trying to achieve future climate change predicted levels of resilience immediately, but rather ‘future proofing’: building in the capacity to elements such as the foundations, connections and access for example, to enhance the level of protection at a reasonable cost later, when it is needed.

Similarly, after a major flood event, it will become increasingly important to take a “Build Back Better” approach and to consider how to improve local resilience when replacing or repairing damaged properties and assets. This is not something which always happens at the moment, as there are few incentives for local authorities or home owners to do so. We note and welcome

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21 Managing climate risks to well-being and the economy, CCC Adaptation Sub-Committee Progress Report, 2014
22 Flooding economic impact will breach £5bn, KPMG, 28 December 2015
the fact that the Local Government Association\(^2\) has recently brought forward proposals for mandatory anti-flood requirements to be put in place for new homes and businesses in at-risk areas, however this has been met with resistance elsewhere and is unlikely to become a requirement in the near future.

In our view, taking a more strategic approach in this way would be more economical than trying to retrofit protection at a later date.

We also believe it is time to rethink the approach to flooding on a catchment wide basis, assessing risk from source to the sea and joining up policy across government departments to reduce risks of infrastructure flooding. Infrastructure UK identified the need for bodies including the Major Projects Authority, Infrastructure UK (the two bodies merged in January 2016 to become the Infrastructure and Projects Authority), the Economic Regulators Network, and now the National Infrastructure Commission to work together to take a more systematic approach to assessing long-term system performance and resilience rather than an approach focussed on individual projects. This is a recommendation we strongly support, although we note that progress towards achieving this objective has been slow.

In our view, we need improved, robust scenario planning to underpin both the planning of future infrastructure and the protection of existing assets. We would also support an asset whole-life approach, which would involve both investing on capital improvements and ensuring revenue support to enable the maintenance of assets. The extra £700m in flood defence funding announced in March 2016 does include £140m for maintenance. We welcome this announcement and encourage the government to maintain this spend.

Furthermore, we believe that the planning of flood prevention measures should be the shared responsibility of government, the Environment Agency, local communities and the owners / operators of infrastructure. Together, they must consider the long-term economic growth plans for a region. This would allow for a forward looking approach that protects current and future infrastructure assets.

In preparation for flooding incidents, skilled workers from the construction sector should be trained and ready to work alongside the multi-disciplinary response team that is currently in place. This additional manpower combined with using data for better forecasting of where floods will occur would allow for high quality temporary defences to be put in place and provide more first responders during flooding.

Similarly, it is our view that, in the period after a flood, contractors should be utilised to construct temporary structures e.g. accommodation, bridges etc. in place of those that are damaged to help communities to recover more quickly.

Finally, not enough of those in a flood area know what needs to be done when they receive a flood warning, so more should be done on educating homeowners on how best to protect their properties. For example, a new British Standard would help the public to differentiate between high quality and high price flood prevention measures and make informed choices, while better promotion of government schemes such as the ‘Repair and Renew’ grant would improve the scheme’s uptake and help property owners to be better prepared.

\(^2\) Local Government Association, 30 April 2016