Resolution Foundation

Euston, we have a problem

Is Britain ready for an infrastructure revolution?

Andrew Bailey, Richard Hughes, Lindsay Judge & Cara Pacitti

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Executive Summary

The government has promised an 'infrastructure revolution'

The new government has made public investment the centrepiece of its fiscal policy, promising to take advantage of historically low borrowing costs to deliver an 'infrastructure revolution' over the coming Parliament. It has already proposed a set of pro-investment revisions to the fiscal rules, committed to spending up to an additional £100 billion on infrastructure over the next five years, given the go-ahead to several major transport projects and promised to publish a National Infrastructure Strategy. Further details on the scale, objectives and management of this revolution are expected alongside the Budget on 11 March. It is crucial that this additional public investment is spent effectively so that has the maximum impact on growth, living standards and the environment.

Delivering a revolution on time and on budget

Like revolutions, infrastructure projects can involve more costs and deliver fewer benefits than originally promised, and they are often easier to start than to finish. This report looks at how the government's 'infrastructure revolution' can successfully deliver on its promises to: 'level up' transport connectivity between regions; improve access to housing, healthcare and other vital public services; and equip the country to meet the environmental and economic challenges of the future – while

also maintaining fiscal discipline and sustainability. It does so by considering the following questions:

- **How much should the government invest?**
- **Where should the government invest?**
- **What can the government afford to invest?**
- **How should the government invest in order to get the maximum economic, social and environmental return?**

Public investment is important, but hard to get right

Public investment – that is, spending by government entities that creates durable assets - has the potential to support economic growth, improve living standards and protect the environment. However, the returns on that investment can differ greatly depending on how governments contend with the various challenges associated with managing major infrastructure projects. These challenges derive from the fact that such projects are often large, complex, multi-year, lumpy and in need of ongoing maintenance. In the UK, as in many other countries, this can lead to public investment projects being marred by short-termism, opacity, disputes, volatility, delays, cost overruns and long-term neglect. The IMF estimates that the average country loses about 30 per cent of the potential return on their public investments due to inefficiencies in the way in which that expenditure is planned, allocated and executed. It also found that closing this 'efficiency gap' could double the impact of public investment on economic growth.

The UK is a low public investor by historical and global standards

Despite a fitful recovery over the past two decades, public investment and the stock of public assets in the UK remain low by historical and international standards. After falling from a peak of 7.5 per cent of GDP in the late 1960s to close to zero in the late 1980s and again in the late 1990s, UK public sector net investment (gross investment minus depreciation of the

capital stock and asset sales) has recovered to 2.0 per cent of GDP. However, this is still 0.7 percentage points below the UK's post-war average, and 0.5 percentage points below the advanced country average.

But what really matters for the economy and public services is the value, coverage and condition of the stock of public assets. And it is this that should inform the Chancellor's decision about the scale of and priorities for the 'infrastructure revolution'. Relatively weak public investment coupled with the privatisations of the 1980s and 1990s saw the value of the accumulated government capital stock in the UK fall from a peak of 84 per cent of GDP in 1975 to a low of 42 per cent in 2007. Recent increases in public investment have been sufficient to stabilise the government capital stock at 46 per cent of GDP. However, this is only three-quarters of the advanced economy average of 63 per cent of GDP. Even taking account of the more active role of the private sector and the additional private capital that has attracted over the past 20 years, the value of the UK's total economic infrastructure investment and assets remain below the average of other European countries.

UK public investment is volatile, centralised and geographically concentrated

In addition to being low by international standards, the other argument for looking carefully at public investment now is that UK public investment is relatively volatile, centrally controlled and geographically concentrated. The UK has the second highest year-on-year volatility in government investment in the G7 after Japan, a country which has made very active use of infrastructure expenditure as a fiscal stimulus tool. This disruptive boom-bust investment pattern in the UK, which increased unit costs in some sectors by between 10 and 20 per cent, is due in part to the fact that capital expenditure has typically been the residual in the government's fiscal policy: ramped up in good times and cut back following recessions. The UK also has one of the most centralised models for funding public investment, with only 36 per cent of total investment funding being managed by local governments compared with 51

per cent among advanced economies. This may, in part, explain the relative concentration of public investment spending in London and the South East, where the £1,200 in public investment per capita is more than 35 per cent higher than the average of £885 per capita in other regions.

£100 billion would raise UK investment to the OECD average

The new government's commitment to invest an additional £100 billion over the next five years would bring UK government investment up to 3 per cent of GDP. That is close to both UK post-war and current advanced economy averages. However, the UK has underinvested relative to other advanced economies for four decades and our peers are also under pressure to increase public investment to boost demand, revive ailing infrastructure and cut carbon emissions. The UK's historic underinvestment in public assets is reflected in the uneven quality of its current stock of infrastructure relative to other advanced economies. While it is possible for the government to do too much investment, as seems to be the case in Japan during the post-war years, the UK appears to be in little danger of overinvesting even after taking account of the government's plans. This is particularly the case when one considers not only the legacy of past underinvestment in some sectors and regions but also the need for new investment to meet future economic and environmental challenges.

The quality of the current infrastructure stock should inform future investment priorities

The quality of today's stock of public sector assets reflects the pattern of investment over previous decades, not just the level of current public investment. So to assess future investment priorities, this report looks at a basket of 24 indicators of their quality. By comparing these indicators with estimate of the monetary value of the public capital stock, we provide an estimate of the efficiency of UK public investment relative to other advanced economies.

Investment is needed to improve internal connections

The UK's investment in, and quality of, economic infrastructure still lags behind other advanced economies, with significant regional variation in coverage and efficiency. Economic infrastructure (which includes a country's transport, energy, water and telecommunications networks and stocks of intellectual and environmental assets) plays a critical role in supporting sustainable economic growth. Despite a recovery in recent years, the UK still invests slightly less than other advanced economies in economic infrastructure, even after accounting for private spending. This is reflected in the varied state of the UK's economic infrastructure both across the different networks and along the different dimensions of coverage, quality, and cost within those networks. While road, rail and air and seaports make the country relatively well connected internationally, the UK scores below other major economies for the reliability and efficiency of those connections. There are also significant regional disparities in access to efficient internal transport and telecommunications networks.

Energy provision is relatively clean and affordable, but this may come at the expense of efficiency and reliability. The UK ranks 12th among 34 advanced economies for resident patent applications per capita, a proxy for the level of intellectual capital. With more than half of capital spending commitments in the Conservative's 2019 General Election manifesto relating to economic infrastructure and a number of high-profile announcements since relating to transport projects such as HS2, economic infrastructure is likely to feature prominently in the forthcoming Budget.

Investment should also respond to a legacy of underinvestment in health, housing and prisons

A comprehensive 'infrastructure revolution' should also look to revitalise the country's social infrastructure (which includes schools, hospitals, social housing, prisons, public sports facilities and care homes) which is an important determinant of the quality of public services and their impact on people's lives.

While the UK invests similar amounts in social infrastructure today as other advanced economies, this sector suffered the most from previous periods of retrenchment in capital spending. Following significant investment in the 2000s, school infrastructure is now of relatively high quality with access to computers, science labs and libraries all above advanced country averages.

However, there is a legacy of past underinvestment in health, housing and criminal justice infrastructure. In health, numbers of hospital beds and diagnostic machines like CT scanners and MRI units per capita are among the lowest in Europe. The UK's social housing stock is also of relatively poor quality and housing costs are more of a burden on low-income families in the UK than in other advanced countries. And the UK has the 7th highest rate of prison occupancy among 34 advanced countries. This, combined with plans for longer sentences, is likely to place further pressures on prison places.

Despite the relatively poor quality of the UK's health, housing and prison assets, social infrastructure accounted for only 6 per cent of the capital spending commitments in the Conservative manifesto. The 2020 Budget and Spending Review should look to redress this imbalance.

Public investment also needs to respond to new challenges

- In addition to addressing these gaps in the UK's existing stock of public assets, the 'infrastructure revolution' also needs to equip the UK to cope with new challenges. Most important of these is mitigating and adapting to climate change to meet the government's target of net zero carbon emissions by 2050. Independent experts estimate that expenditure of around 1-2 per cent of GDP per annum will be required to reach the government's objective of net zero carbon emissions by 2050.
- Around one-quarter to one-half of this expenditure will need to consist of public investment, especially in the retrofitting of existing buildings to improve energy efficiency and

introduce low-carbon heating as well as so-called 'engineered greenhouse gas removals' including development of new bioenergy and carbon capture and storage technologies. The UK's departure from the EU also poses investment challenges for government both in the need to replace formerly EU-funded research projects and equip the UK to compete in the knowledge-driven global economy of the future. Finally, digitalisation opens up new opportunities for more efficient utilisation of infrastructure networks but is also likely to increase up-front investment costs and delivery risks.

The UK needs a comprehensive and balanced infrastructure strategy

Addressing these economic, social and environmental infrastructure needs will require a sustained increase in the level of public investment in:

- economic infrastructure, in particular to boost regional connectivity and alleviate intra-urban congestion in cities around the country;
- social infrastructure, in particular to address the legacy of historic underinvestment in health facilities and equipment, social housing and prisons; and
- meeting new challenges, in particular delivering the government's target of net zero carbon emissions by 2050, boosting productivity, through world-leading research and development, and by adopting smart technologies.

The 'infrastructure revolution' could have a range of price tags

Depending on the scope, level and pace of its ambitions, the government's 'infrastructure revolution' could require anywhere between 0.6 per cent (£25 billion) and 1.6 per cent of GDP (£40 billion) in additional investment per year by 2024-25. Specifically:

- Returning public investment to its **post-war average** of 2.7 per cent of GDP would require an additional 0.6 per cent of GDP (£15 billion by 2024-25).

- **Levelling up** per capita public investment spending across regions, without reducing real per capita spending in any region, would require an additional 0.8 per cent of GDP per year (£19 billion in 2024-25).
- The new government's commitment to invest an additional **£100 billion** over the next five years would require an additional 0.9 per cent of GDP per year (£22 billion in 2024-25).
- Keeping pace with the **advanced economy average** flow of government investment would require an additional 1.0 per cent of GDP per year (£25 billion in 2024-25).
- Reversing the 'hollowing out' of the public asset base between the 1970s and 2000s and bringing the value of the total government capital stock back to today's **advanced country average stock** of 63 per cent of GDP over the next ten to twenty years would require an additional 1.6 per cent of GDP per year (£40 billion in 2024-25).
- The comprehensive and **balanced portfolio** of investments identified in this report aimed at (i) tackling the legacy of past underinvestment in health, housing, and prisons; (ii) levelling up transport investment between regions; and (iii) meeting the government's commitments on climate change and scientific research would require an additional 1.2 per cent of GDP (£31 billion by 2024-25 or £127 billion over the next five years).

The current fiscal rules will require trade-offs among priorities

Affording these increases in investment will pose a challenge for the government's new fiscal rules. In their manifesto the Conservatives committed to: (i) a 3 per cent of GDP ceiling on public sector net investment on average over five years; (ii) balancing the current budget by 2023-24; and (iii) keeping the debt interest/revenue ratio below 6 per cent. Of these, the current balance target is likely to be the binding constraint on the government's investment ambitions given the depreciation, interest and other recurrent costs associated with their

additional investments. The depreciation costs alone on the Conservatives' £100 billion investment commitment would be sufficient to reduce the, already very low, headroom against their commitment to balance the current budget by £3 billion. While the 3 per cent of GDP ceiling on investment would allow a significant increase in investment spending, it will still require the government to choose between its economic, social and environmental investment needs and objectives.

The UK could make its fiscal rules even more investment-friendly

The 3 per cent of GDP ceiling on public investment sits oddly within a fiscal framework which is otherwise trying to encourage investment, already includes an affordability constraint in the limit on the debt interest/revenue ratio and only brings UK public investment up to the OECD average after decades of relative underinvestment. While the current costs of additional investment should be met by current receipts over the medium-term, there is a case for making other aspects of the government's proposed fiscal framework more investment-friendly. Both the government's current £100 billion investment plans and the more ambitious of the investment scenarios discussed above could be met within a set of fiscal rules which:

- focuses on improving public sector net worth and thereby captures not only the government's cost of financing but also the value of the assets it is creating;
- commits to a target (rather than a ceiling) for the level of public sector net investment as a share of GDP to protect capital spending from the boom and bust cycles of the past; and
- retains the 6 per cent of revenue limit on the interest burden to ensure that the debt issued to finance that investment remains affordable.

The UK loses around 10p in the pound on its public investments

The actual benefits derived from this ramping up of capital spending will depend on the efficiency with which the government's investments are translated into actual improvements in infrastructure assets. A comparison between the monetary value of the UK's stock of public capital and physical indicators of infrastructure coverage, quality and cost suggests that the UK loses around 10 per cent of the potential value on its public investments relative to the most efficient advanced economy. This compares with an average 'efficiency gap' of around 13 per cent for all advanced economies. Eliminating this 10 per cent efficiency gap would be equivalent to investing an additional £5.4 billion more per year by 2024-25. According to IMF estimates, up to two-thirds of the gap between the least and most efficient public investors could be closed by improvements in the way in which those investments are planned, allocated and implemented.

The management of infrastructure projects needs to improve

The UK's public investment management arrangements display both significant strengths and important weaknesses. Based on the IMF's Public Investment Management Assessment (PIMA) framework, which looks at the quality of institutional arrangements at 15 different stages of the public investment cycle, the overall strength of the UK's infrastructure governance is broadly in line with other advanced economies. Britain boasts world-leading practices in the areas of fiscal frameworks, long-term infrastructure needs analysis, project appraisal methodologies, capital budgeting and asset accounting. At the same time, investment decision-making in the UK is plagued by inconsistent and shrinking planning horizons, a highly centralised funding model, opaque project selection processes, a stop-start pattern of project approvals, chronic cost and timing overruns on major projects, a lack of systematic ex-post evaluation and inadequate monitoring of asset conditions.

Britain can get more punch for its investment pound

Addressing these management shortcomings will require a strengthening of institutional arrangements across the public investment cycle. Working from the beginning to the end of the investment process, there is a need to:

1. Extend investment planning horizons by providing a 30-year National Investment Strategy, 10-year funding guidelines for each major infrastructure sector, as well as rolling 5-year capital budgets for major investing departments and metro mayors. This would support better coordination of investment decisions between government departments, local authorities and the private sector and end the tendency for planning horizons to shrink as one approaches the end of a Spending Review period;
2. Devolve more investment funding to cities and local authorities and place greater emphasis on reducing regional economic disparities in the choice of centrally funded strategic investment projects. Doing so would help to redress the regional disparity in investment expenditure and allow more local input in the setting of infrastructure priorities;
3. Review the Green Book's project appraisal methodologies to better reflect the costs and benefits of climate change. This would ensure that the long-term net benefits of potentially transformational investments in climate change mitigation that support the UK's transition to a net-zero economy by 2050 are fully captured;
4. Require government departments to publish business cases and cost-benefit analyses (CBAs) prior to the approval of major investment projects. This would improve not only the transparency of investment decision-making but also the quality of the supporting analysis;
5. Reinforce the independence of the National Infrastructure Commission (NIC) and require it to certify the analysis (including the BCRs) underpinning the business cases for all projects above a certain size that fall within their remit. This

would provide an expert check on the clarity of project aims and the realism of estimated project costs and benefits;

6. Require the Treasury to specify basic requirements for those business cases, including indicative minimum thresholds for the benefit-cost ratio (BCR) of major projects under consideration. While not prohibiting departments from going ahead with projects below those thresholds, it would require them to provide fuller justification for why they were being prioritised over higher return projects;

7. Require Parliament to authorise the total budgets for all major investment projects as part of a Hybrid Bill or other legal instrument with an affirmative vote required for those with BCRs that fall below the government's indicative minimum thresholds. This would provide greater transparency, flexibility and discipline over the management of overall project costs and raise the bar for proceeding with lower value projects;

8. Give managers of all major investment projects realistic, fixed, global budgets covering the whole life of the project and full flexibility to move resources between years. This would improve incentives and accountability for cost control and enable work to commence on all aspects of the project at the point of Parliamentary approval;

9. Subject all major projects to a published ex-post evaluation of realised costs and benefits and incorporate the findings into the planning of future projects. This would help to identify patterns in under-estimation of costs and under-realisation of benefits and enable departments to learn from project management successes and failures; and

10. Require major investing departments to report not only on the value of their fixed assets but also on their condition and performance against benchmarks for quality and access. This would ensure that investment decisions focus not only on initiating new projects but maintaining and getting the most out of the existing stock of infrastructure assets.

Section 1

Introduction

Public investment is important because it has the potential to support economic growth, improve living standards and protect the environment. But undertaking public investment comes with major challenges, not least because projects are often large, complex, multi-year, lumpy and need to be maintained. The government has committed to an 'infrastructure revolution' and intends to publish a National Infrastructure Strategy alongside the 2020 Budget. To help inform this strategy, this report considers (i) how much the government should invest; (ii) where the government should target its investment between sectors and regions; (iii) what the government can afford to invest under its existing and alternative fiscal rules; and (iv) how the government can get the maximum economic, social and environmental return on that investment.

The new government has made increasing public investment the centrepiece of its fiscal policy, promising to take advantage of historically low borrowing costs to deliver an 'infrastructure revolution' over this parliament. It has already proposed a set of pro-investment revisions to the fiscal rules, committed to spending at least an additional £100 billion on infrastructure over the next five years, given the go-ahead to several major transport projects and promised further details, including a new National Infrastructure Strategy, alongside the upcoming Budget. It is important that this additional public investment is focused on the right areas and spent in the right way, so that has the maximum impact on growth, living standards and the environment.

What is public investment?

Public investment (also referred to as capital expenditure) is expenditure by any public body which creates a durable asset. The assets created can be tangible (such as roads, hospitals, or flood defences) or intangible (such as software, patents and data).[1] This

1 This report focuses on government investment in tangible (fixed) and intangible assets which count as capital expenditure in the national accounts, but does not discuss the important issues related to the management of the government's significant investments in financial assets.

investment can be undertaken by a range of different public entities including central government departments or agencies, local authorities, or publicly owned or controlled corporations. The investment is often undertaken in partnership with the private sector through the private finance initiative (PFI), public-private partnerships (PPPs), or contracting out arrangements. In the area of economic infrastructure in particular, investment in what used to be publicly-owned networks (including for electricity, water, gas, telecommunications and some transport) is increasingly undertaken entirely by private companies (or public corporations owned by other countries) within markets that are independently regulated to ensure appropriate competition, access, pricing and standards. As discussed in Box 1, these different models for infrastructure financing and operation can make it difficult to compare levels of public investment between countries and over time.

BOX 1: **Comparing public investment across countries and over time**

In an effort to identify the UK's future infrastructure needs, this paper attempts to benchmark the level and composition of UK public investment both historically and internationally. There are several factors that can complicate direct comparison of infrastructure investment over time and between countries, including:

- **Public vs. private sector provision:** Comparing investment levels in the UK over the post-war period requires consideration of the changing roles of the public and private sectors in the provision of infrastructure, particularly during the 1980s and 1990s. The privatisation of the energy, telecommunications, water and some parts of the transport sector, as well as asset sales in the housing sector, contributed to 'negative' investment over the 1980s in these areas as the capital stock was reduced. This lowers the 'flow' of public sector net investment over the period – although gross investment also remained low over the decade. Similarly, the differing degrees of public and private provision of infrastructure across countries can complicate international comparisons of investment levels. For example, public investment in Sweden includes all investment in their publicly-owned energy sector, while in the UK this is carried out mainly by the private sector.
- **General government vs. public sector:** Comparing UK public investment levels with other advanced economies is further complicated by differences in the scope of public institutions covered

between countries. In the UK, the most common measurement for government investment spending is 'public sector net investment'. This captures all investment undertaken not only by central and local government, but also by 'public non-financial corporations' (PNFCs) such as Network Rail and Scottish Water. In most other advanced economies, the scope of government accounts is limited to the 'general government' which includes only central and local government, but excludes PNFCs that operate on a commercial basis but can play an important role in infrastructure provision such as Électricité de France (EDF) and Société nationale des chemins de fer (SNCF) in France.

- **Classification of capital spending and government functions:** Comparing the composition of public investment spending between countries relies upon the standardised Classification of the Functions of Government (COFOG) developed by the Organisation for Economic Co-operation and Development (OECD). This is based on 10 policy areas of government activity including economic affairs, education, health and environmental protection. However, countries' practices in the classification of capital expenditure between these categories vary. For example, some countries classify all investment carried out by local governments under the catch-all 'general services', whereas the UK splits local government investment between each separate function. International accounting standards have also reclassified certain types of spending between capital and current, such as defence equipment which was reclassified from current to capital spending in 2017-18. This can result in artificial 'shifts' in measured investment spending over time if back series are not restated.[2]

This is not to say that historical and international comparisons are not informative. It is important, however, to ensure one is making like-for-like comparisons by taking account of different models of infrastructure provision, changes in international accounting standards and variations in national accounting practices.

Why is public investment important?

Public investment rightly attracts special attention from economists, policymakers and the general public because of the important role that it plays in supporting economic

2 Defence spending is largely out of the scope of consideration of this paper, under the assumption that the UK will continue to invest in line with its NATO obligations.

growth and living standards. While all forms of public spending can stimulate economic activity, investment in infrastructure generates some of the largest economic returns by reducing the communication, search and transaction costs associated with the production and exchange of goods, services and information.[3] The IMF's 2014 World Economic Outlook estimated that an increase of 1 per cent of GDP in public investment in advanced economies increased output by 0.4 per cent in the same year and by 1.5 per cent after four years.[4] In its macroeconomic projections for the UK, the Office for Budget Responsibility (OBR) attaches a 'fiscal multiplier' (an estimate of the impact of the public finances on economic output) of 1 to public investment for the UK, the highest of any category of government spending.[5] However, the impact of public investment on economic growth and living standards depends crucially on the efficiency with which those investments are managed. A 2015 IMF paper found that the most efficient public investors get twice the economic bang for their investment buck than the least efficient governments.[6]

Why is public investment different from other spending?

In their efforts to maximise the economic, social and environmental returns on their investments, governments have to contend with certain features which distinguish capital expenditure from other categories of public spending. Specifically, public investments are:

- **Large:** Major infrastructure projects, such as the Olympics, Crossrail or HS2 can carry price tags of £10, 20, 50 or even 100 billion for their construction alone and are typically among the single largest expenditure items in the government budget at the time. Given the opportunity cost of tying up public funds on this scale, such major undertakings merit heightened scrutiny before funds are irreversibly committed.
- **Complex:** Public investment projects are typically among the most complicated peacetime undertakings of any government. They often involve multiple ministries and agencies, several levels of government, both public and private sectors, and diverse sources of finance. This means they require sophisticated governance arrangements to ensure: effective coordination, oversight and accountability for delivering each component, and the project as a whole, on time and on budget.

3 N Pain et al., A model-based analysis of the effect of increased public investment, National Institute Economic Review Issue 244, May 2018.
4 International Monetary Fund, World Economic Outlook: Legacies, Clouds, Uncertainties, October 2014.
5 Office for Budget Responsibility, Economic and fiscal outlook, Box 3.2, October 2018.
6 International Monetary Fund, Making Public Investment More Efficient, June 2015.

- **Multi-year:** Public investment projects often take a number of years to complete. This requires a planning horizon which extends beyond annual Budget or even five-year Spending Review horizons to ensure that the full lifetime cost of a proposed project can be accommodated within long-term fiscal constraints. Once approved, the projects themselves typically require multi-year budgets to maintain discipline over the total cost of the undertaking.
- **Lumpy:** Compared with expenditure on recurrent items such as salaries or pensions, public investment projects often entail large and unexpected variations in the profile of expenditure from year to year. Moreover, once a project is completed, the capital resources are available for redeployment to other priorities. For this reason, capital budgeting rules often take a 'zero-based' approach to the setting of future investment plans (as opposed to the incremental approach adopted for recurrent expenditure) and allow for greater flexibility to carry over appropriations between years (as opposed to the strict annularity applied to spending authorisation for recurrent items).
- **Durable:** Once completed, public investment projects create a durable asset (such as a school, hospital or railway) which supports the delivery of a stream of services (education, healthcare or transport) well into the future. Because the lives of these assets can extend for decades or even centuries, investment decisions need to be based upon a rigorous assessment of the social needs of not only current but also future generations. Also, for the full benefits of public investments to be realised, the resulting assets need to be maintained. This requires regular surveys of asset conditions, dedicated funding for asset maintenance and periodic reinvestment in asset renewal or reconfiguration.

Why is public investment so hard to get right?

It is for these reasons that the efficient management of public investment projects is so important but also so difficult for governments to get right. The large scale of public investments can often mean that important projects are repeatedly postponed for reasons of affordability, capacity or opportunity cost. The complexity of investment projects can result in cost overruns, delays and contractual disputes which reduce the net benefits from the projects. The long time horizons involved can result in projects with significant longer-term economic, social or environmental benefits being supplanted by those with lower but more immediate political returns. The lumpiness of investment spending can result in projects being delayed or cancelled due to lack of available financing at the time. Finally, the incremental - and often invisible - nature of depreciation can lead governments to neglect expenditure on asset maintenance in favour of

investment in more conspicuous new projects. Public investment in the UK has suffered from all of these afflictions over the past half-century despite the efforts of successive governments to address them.

How do we make the 'infrastructure revolution' a success?

To help inform the government's National Infrastructure Strategy and maximise the returns on this historic increase in public investment, this paper considers the following key questions that are key to making the 'infrastructure revolution' a success:

- **How much should the government invest** today relative to the past and comparator countries (Section 2)?
- **Where should the government invest** across different sectors and regions and between addressing the legacies of past underinvestment and responding to new challenges (Section 3)?
- **What can the government afford to invest** under its proposed fiscal rules and alternative fiscal frameworks (Section 4)?
- **How should the government invest** in order to get the maximum economic, social and environmental return for taxpayers' money (Section 5)?

Section 2

How much should we invest?

Over the next five years, the government has committed to increasing public investment by up to £100 billion to 3 per cent of GDP. This would return UK public investment to its highest sustained level in over four decades and match average levels in other advanced economies. However, it would only address part of the legacy of underinvestment and volatility that has left the UK's stock of public infrastructure significantly depleted relative to comparable countries. This hollowing out of the public capital stock over the past four decades has been especially evident in social infrastructure – especially in the housing and health sectors.

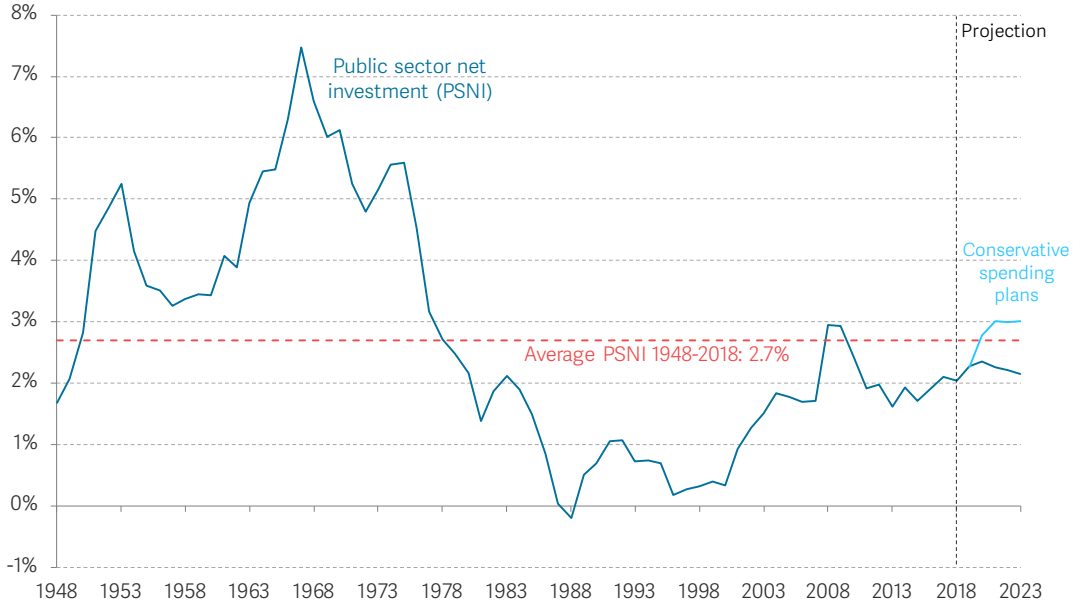
The 'infrastructure revolution' entails a big increase in investment

While the exact scale of the government's promised 'infrastructure revolution'[7] will not be known before Budget day, commitments made during the 2019 General Election campaign suggest that it could return total public investment to around 3 per cent of GDP, a level not sustained in the UK since the mid 1970s (Figure 1). The Conservative manifesto promised to invest £100 billion in additional infrastructure spending over the next five years from 2020-21 to 2024-25. While only around £30 billion of this was committed to specific projects in the manifesto, it also promised further detail would be set out by the Chancellor at the Budget.[8]

7 'Infrastructure revolution' in March Budget', BBC News, January 2020.
8 Conservative Party, General Election Manifesto, 2019.

FIGURE 1: **Public investment recovered in the 2000s but remains low historically**

Public sector net investment, as a proportion of GDP: outturn, forecast and 2019 Manifesto plans



SOURCE: RF analysis of ONS, Public Sector Finances; 2019 Conservative Manifesto.

The 'infrastructure revolution' in historical context

While the government's 'infrastructure revolution' would increase the level of capital spending by almost 40 per cent, this dramatic increase has to be set in the context of a half century of peaks and troughs in public investment and the legacy they have left on the UK's infrastructure stock.[9] Fuelled by the post-war social housing boom, public sector net investment reached a peak of 7.5 per cent of GDP in 1967-68. It then fell steadily over the subsequent two decades to a post-war low of -0.2 per cent in 1988-89 and then fluctuated between 0 and 1 per cent of GDP in the following decade. The steady decline in investment was driven by the cumulative effect of a fall in local authority house-building in the 1970s, privatisation of state-owned enterprises and council housing in the 1980s and cutbacks in central government investment in transport, health and education during the 1990s.[10] The election of a Labour Government in 1997, whose new fiscal framework allowed it to borrow for capital expenditure, ushered in a recovery in public investment. Investment briefly reached a thirty-year peak of 3.0 per cent in 2008-09, partly as a result of capital spending brought forward to stimulate the economy in the wake of the financial crisis. Capital spending then bore a significant part of the 2010

9 The discussion of post-war trends in the level and composition of public investment in the UK draws on and extends a dataset first development by Tom Clark, Mike Elsby and Sarah Love of the Institute for Fiscal Studies in their paper Twenty-five years of falling investment? Trends in capital spending on public services, IFS Briefing Note 20, November 2001.

10 The 1990s also saw the rise of off-balance sheet funding of capital spending through Public Finance Initiatives (PFIs), whereby private companies carried out initial investment in capital, which was then leased back to the public sector.

Coalition government's fiscal consolidation efforts, settling at around 2 per cent of GDP over the past decade.

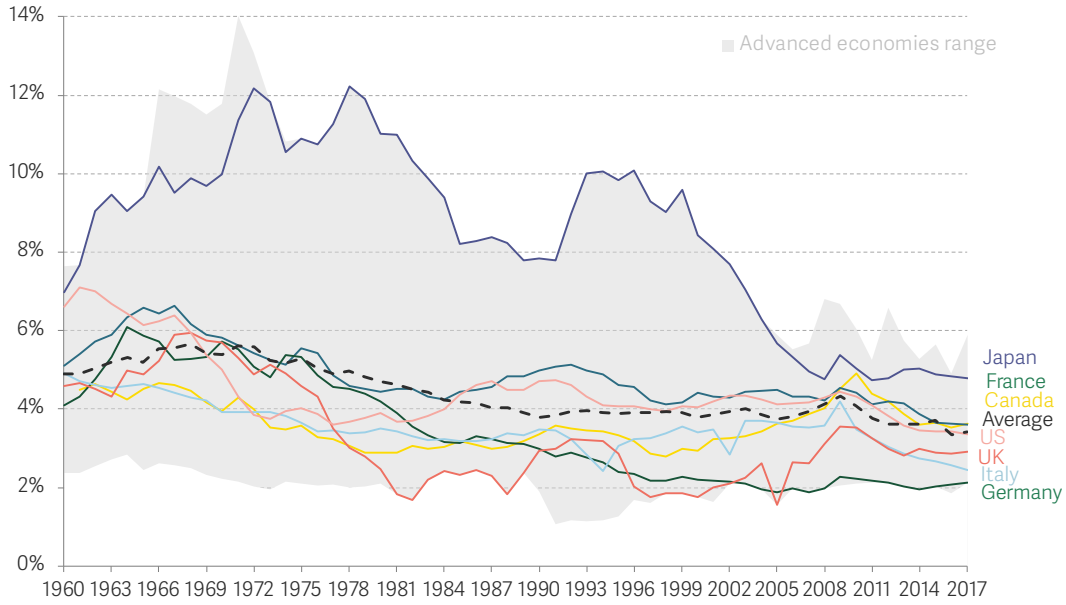
The 'infrastructure revolution' in an international context

UK public investment has been consistently below other advanced economies

The UK government has consistently invested less than other advanced economies over most of this period. While other advanced economies also started scaling back government investment in the 1970s, the UK cut faster and deeper than most (Figure 2). Between 1970 and 2000, UK government investment averaged 3 per cent of GDP, compared with 4.2 per cent of GDP among all advanced economies.[11] Over that 30-year period, the UK government was the lowest investor in the G7 in 19 of those years and the lowest investor among 29 OECD countries in 8 of them. While the post-2000 recovery saw UK government investment rise above Italy and Germany to 2.9 per cent of GDP in 2017, Britain still remains 0.5 percentage points below the advanced economy average of 3.4 per cent of GDP today.

FIGURE 2: **The UK government still invests less than other advanced economies**

General government gross fixed capital formation as a proportion of GDP, advanced economies: G7 and advanced country average



SOURCE: RF analysis of IMF, Investment and Capital Stock Dataset: 1960-2017.

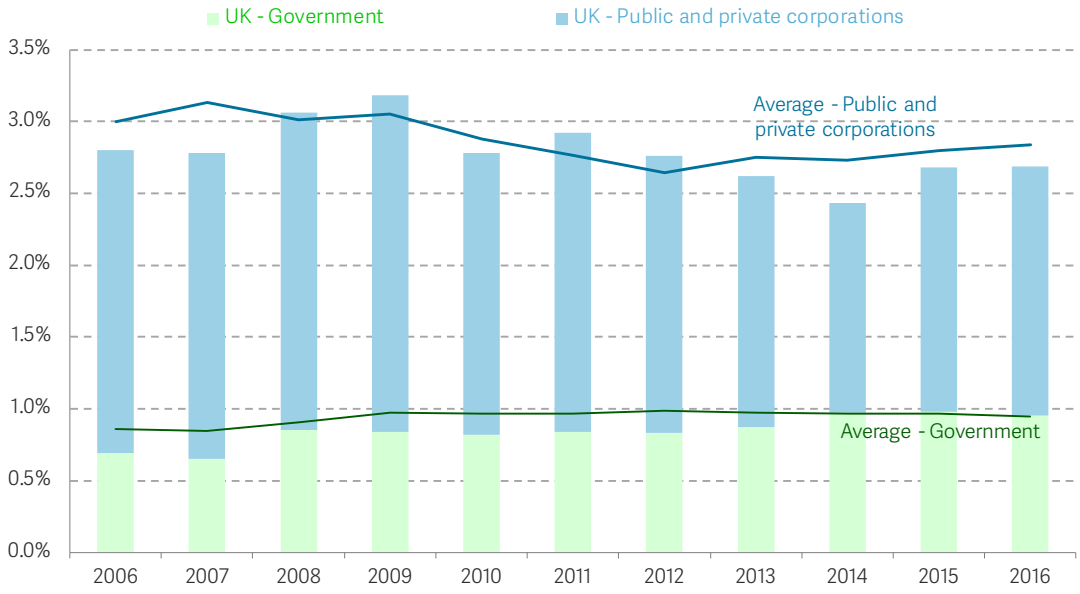
11 Measured in terms of general government gross fixed capital formation. In contrast to public sector net investment, this measure covers only central and local government and excludes investment by public non-financial corporations and does not include assets disposed of, or depreciation costs.

UK infrastructure investment is low, even taking account of the private sector

Even taking account of the greater role of the private sector in the provision of infrastructure in the UK, total infrastructure investment in the UK remains low by international standards. The UK was a pioneer in the privatisation of economic infrastructure in the 1980s and has gone further than many countries in private provision of infrastructure services (including in energy, telecommunications, gas, water and rail). However, there are a number of major sectors in which the private sector plays a relatively limited role in the UK. These include the provision of roads (where the M6 is the only major privately-operated tolled motorway in the country) and healthcare (where the public sector accounts for 79 per cent of total spending compared with 69 per cent for the OECD).[12] New experimental figures published by the ONS on total investment in economic infrastructure spending as a proportion of GDP suggest that, even after including private investment, the UK invested 0.2 per cent of GDP less than the European average in 2016 (Figure 3).

FIGURE 3: **Total UK investment is somewhat below the European average**

Infrastructure investment as a proportion of GDP by government and public and private corporations, UK and EU average: 2006-2017



NOTES: Average relates to Belgium, Denmark, France, Germany, Italy, Netherlands, Norway and Sweden.
SOURCE: RF analysis of ONS, International comparisons of infrastructure, May 2019.

Recent investment increases have stabilised the government capital stock

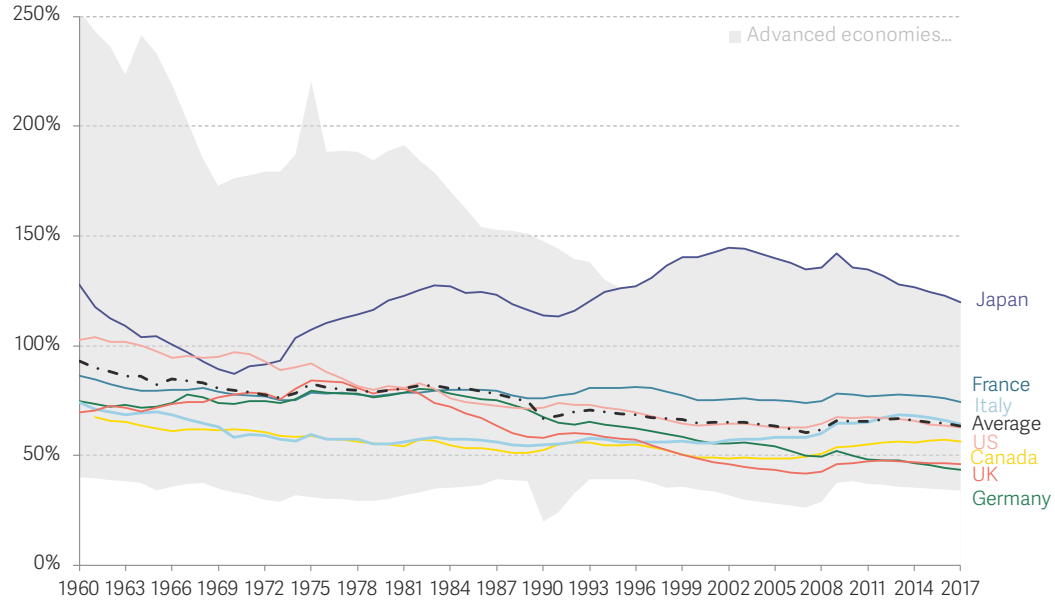
The current level of investment spending, however, makes only a small contribution to the stock of infrastructure assets that support the economy and public services. Instead,

12 Office for National Statistics, How does UK healthcare spending compare with other countries?, August 2019.

it is the value, coverage and condition of the stock of public assets that should inform the Chancellor's decision about the scale of and priorities for 'infrastructure revolution'. In this context, recent increases in government investment have only been sufficient to stabilise the public capital stock after a quarter-century of decline that began in the 1980s. For most of the past 40 years, government investment levels in the UK were not sufficient to keep pace with the growth in the economy and depreciation of the existing stock of government assets. As a result, the UK government capital stock steadily declined from a peak of 84 per cent of GDP in 1975-76 to 46 per cent in 2017 (Figure 4). While this reflected a wider trend among advanced economies over the 1980s and 1990s, the 'hollowing out' of the UK government's capital stock was more sustained and dramatic, partly as a result of privatisations in the energy, water and telecommunications sectors in this period.[13] As a result, the difference in the value of the government capital stock between the UK and OECD average increased from zero in 1980 to 20 per cent of GDP at its peak in 2003. Recent increases in public investment have arrested the decline in the public capital stock as a share of GDP, but the gap with other advanced economies remains significant at 17 per cent of GDP in 2017.

FIGURE 4: **Government capital stocks have stabilised after 30 years of decline**

General government capital stock as a proportion of GDP, advanced economies: G7 and advanced country average



SOURCE: RF analysis of IMF, Investment and Capital Stock Dataset: 1960-2017.

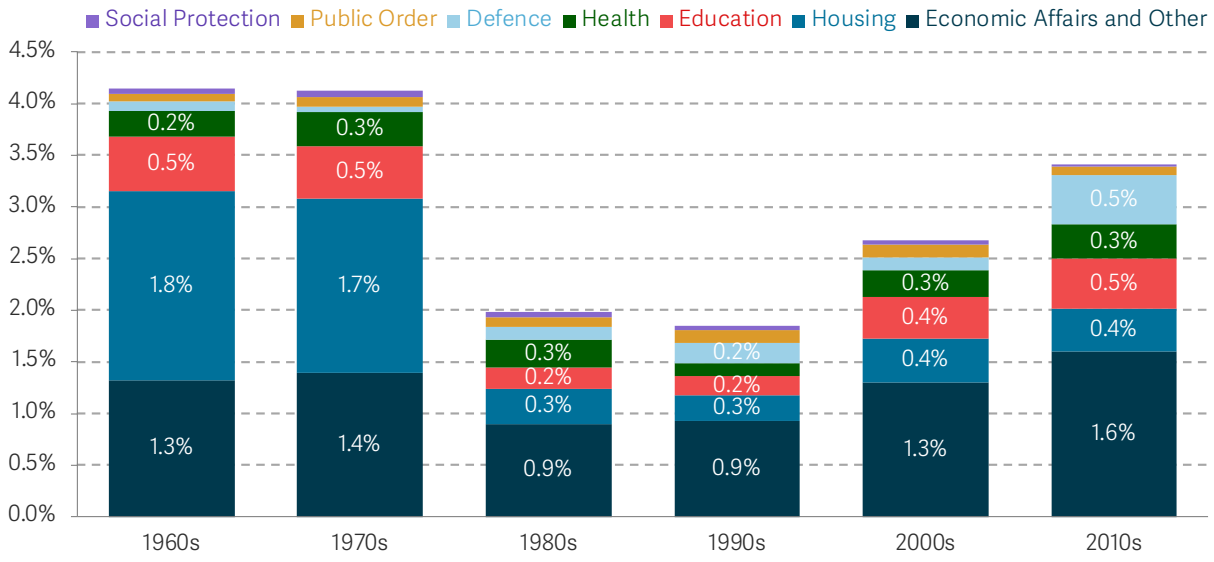
13 Despite the increase in private investment in infrastructure in the UK in recent years, experimental figures published by the ONS suggest that the value of the total (public and private) stock of infrastructure capital was below the European average in 2016. See: ONS, Experimental comparisons of infrastructure across Europe, May 2019.

Public investment has become increasingly focused on economic infrastructure

The composition of public investment has become more skewed toward economic infrastructure over the past decade. Looking at the composition of public investment spending over time, the collapse in public investment in the 1980s and 1990s affected all areas of government policy, but was most pronounced in the areas of housing, education and health (Figure 5). The recovery of public investment over the past two decades has been driven by economic infrastructure, where capital spending has returned to levels not seen since the 1970s. While government investment has also significantly recovered in education and health in recent years, capital spending on housing remains less than one-quarter of the levels seen a half-century earlier. This trend toward a greater concentration of public investment on economic infrastructure would be perpetuated by the priorities reflected in the Conservative manifesto which focus more than half of its programmed increase in capital spending on economic infrastructure.

FIGURE 5: **Public investment has become increasingly skewed towards economic infrastructure**

General government gross fixed capital formation as a proportion of GDP, by function: 1960-2020, average by decade



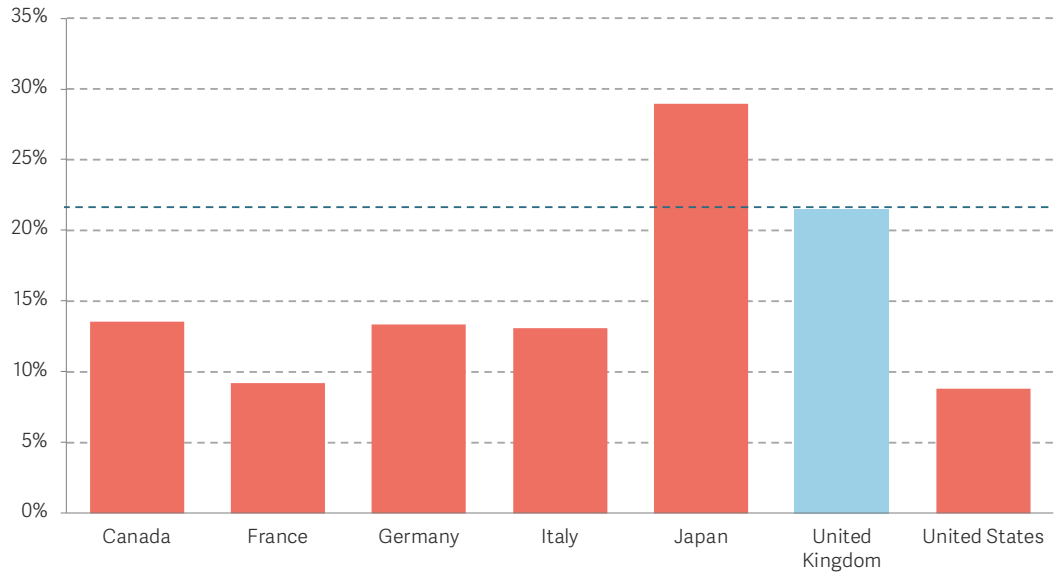
NOTES: 'Economic affairs and other' refers to enterprise and economic development; science and technology; employment policies; agriculture, fisheries and forestry; transport and recreation, culture and religion.
SOURCE: RF analysis of Institute for Fiscal Studies, 'Twenty-Five years of falling investment? Trends in capital spending on public services', November 2001; HM Treasury, Public Expenditure Statistical Analyses.

UK public investment has suffered from repeated boom-bust cycles

If the 'infrastructure revolution' is to have a lasting impact on the economy and public services, investment levels need to be sustained over time. UK government investment has not only been lower but also more volatile than in other major economies. Capital spending has typically been treated as the residual in fiscal planning in the UK with investment spending being ramped up during boom times and cut back following recessions. This has resulted in the UK having the second highest year-on-year volatility in government investment spending after Japan – a country which has made active use of government investment as a (decreasingly effective) economic stimulus tool (Figure 6). Volatility in public investment is often associated with weak institutional arrangements for planning, budgeting and executing public investment projects and can undermine the efficient delivery of those projects.[14] HM Treasury's 2010 Infrastructure Cost Review found that the stop-start nature of investment planning and lack of long-term funding certainty led to increases in unit costs of between 10 and 20 per cent across different suppliers and sectors.[15]

FIGURE 6: **UK public investment has been the second most volatile in the G7**

Coefficient of variation in year-on-year growth in general government gross fixed capital formation in the G7: 1990-2017



SOURCE: RF analysis of IMF, Investment and Capital Stock Dataset: 1960-2017.

14 International Monetary Fund, Making Public Investment More Efficient, June 2015.
15 HM Treasury, Infrastructure Cost Review: Main Report, December 2010.

The UK needs a sustained and balanced increase in public investment

The government's proposed £100 billion increase in capital spending over the next five years would be enough to return UK public investment close to historical and international averages. However, the UK's chronic underinvestment relative to other advanced economies over the past forty years leaves it 17 per cent of GDP below OECD averages in terms of total capital stocks. While past cuts in public investment were most acute in housing and health, the governments published plans for further investment place more emphasis on economic infrastructure, and especially transport. To provide a more informed basis for the allocation of investment between sectors, the next section looks at the quality of the UK's stock of infrastructure assets in different sectors and regions.

Section 3

Where should we invest?

The government's election manifesto and subsequent announcements suggest that the 'infrastructure revolution' will be focused on economic infrastructure. A comprehensive evaluation of the level of investment and physical condition of the UK's infrastructure stock suggests that additional investment in economic infrastructure is required, in particular to improve inter- and intra-regional transport links. However, there is also a need to address the legacy of past underinvestment in social infrastructure, particularly in housing, health and prisons, where the UK performs poorly relative to other advanced economies. Finally, the government's 'infrastructure revolution' must also respond to emerging challenges by helping the UK to tackle climate change, boost productivity and competitiveness post-Brexit, and to integrate smart technologies into infrastructure networks.

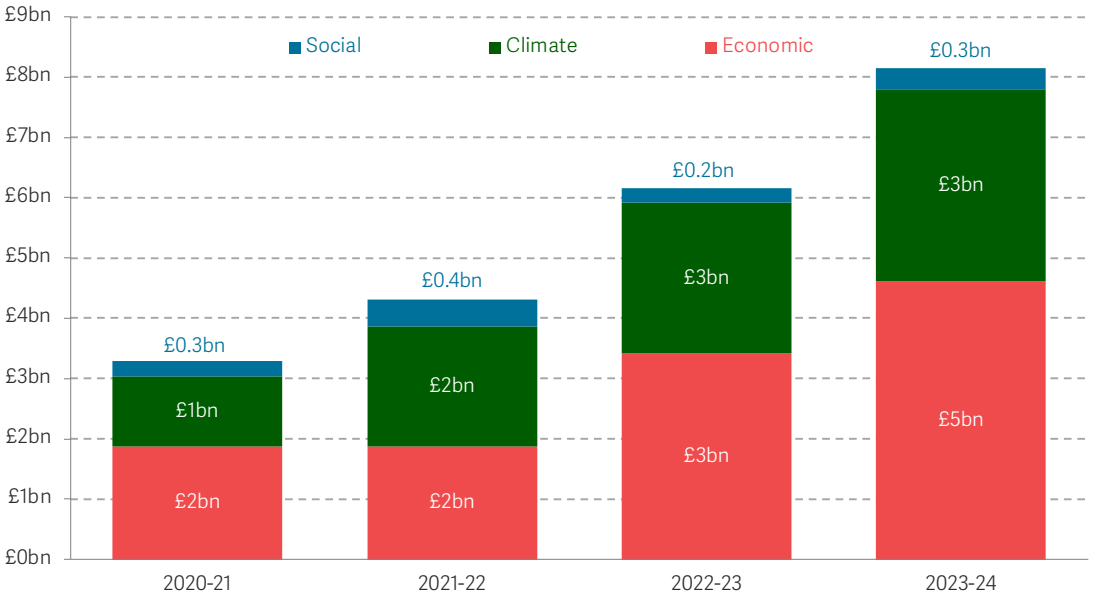
The new government's revealed investment preferences

While the government's commitment to a sustained rise in public investment is welcome, what this investment is actually spent on remains to be fully elucidated. The government's manifesto gives some indication of their priorities, with over half of promised capital spending related to economic infrastructure, 40 per cent going on climate change, and just 6 per cent going on social infrastructure (Figure 7). High-profile announcements since, such as the £35-£45 billion for HS2 and £5 billion on buses and bikes, have reinforced the impression that economic infrastructure will be a key priority.[16] Levelling-up regional disparities in capital spending and investment to deal with the challenges of climate change are also high on the government's agenda. However, less has been publicly committed to social infrastructure so far – particularly in housing.

16 G Topham, 'What Boris Johnson's HS2 announcement will mean for the country', The Guardian, 11 February 2020.

FIGURE 7: **Manifesto capital spending commitments mainly relate to economic infrastructure and climate change**

2019 Conservative Manifesto capital spending commitments, by type of infrastructure



SOURCE: RF analysis of 2019 Conservative Manifesto, Costings Document.

Priorities for the 'infrastructure revolution'

While the level of public investment is important, what matters for economic growth and living standards is the quality of the infrastructure assets it produces. This section considers what the government's sectoral and regional investment priorities should be based on the physical state of the UK's current stock of economic and social infrastructure and the emerging pressures on those assets. Using a basket of 24 indicators of the relative coverage, performance and cost of the UK's infrastructure, it identifies a set of priorities for additional investment over the coming Parliament. These indicators are compared against the value of the UK capital stock in the next section to assess the relative efficiency of UK public investment.

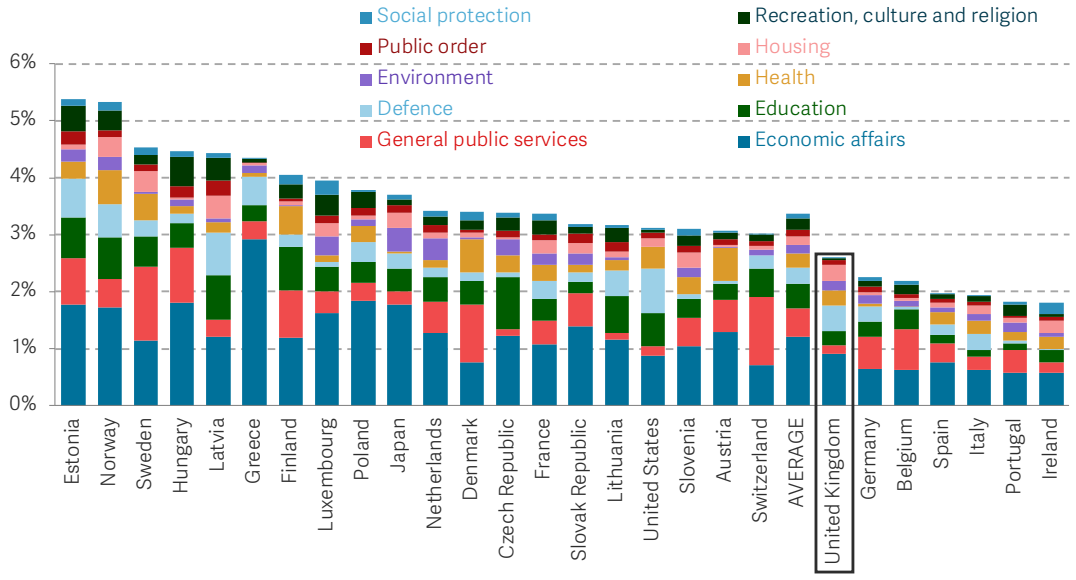
State of economic infrastructure

By international standards, the current composition of UK government investment is slightly skewed towards economic infrastructure (defined as transport, energy, water and telecommunications networks and stocks of intellectual and environmental assets), as shown in Figure 8. This is especially true after considering the larger role played by the public sector in education, health and housing in the UK. While the UK government invests about 0.8 per cent of GDP less than the OECD average, the share of that investment going to economic infrastructure (41 per cent) is somewhat above the OECD average of 40 per cent. Measured stocks of UK economic infrastructure, taking account

of both public and private investment stood at 47 per cent in 2016, 1 percentage point above the EU average of 48 per cent.[17]

FIGURE 8: **UK public investment is slightly skewed to economic infrastructure**

General government gross fixed capital formation by function as a proportion of GDP across OECD countries: 2017



SOURCE: RF analysis of OECD.

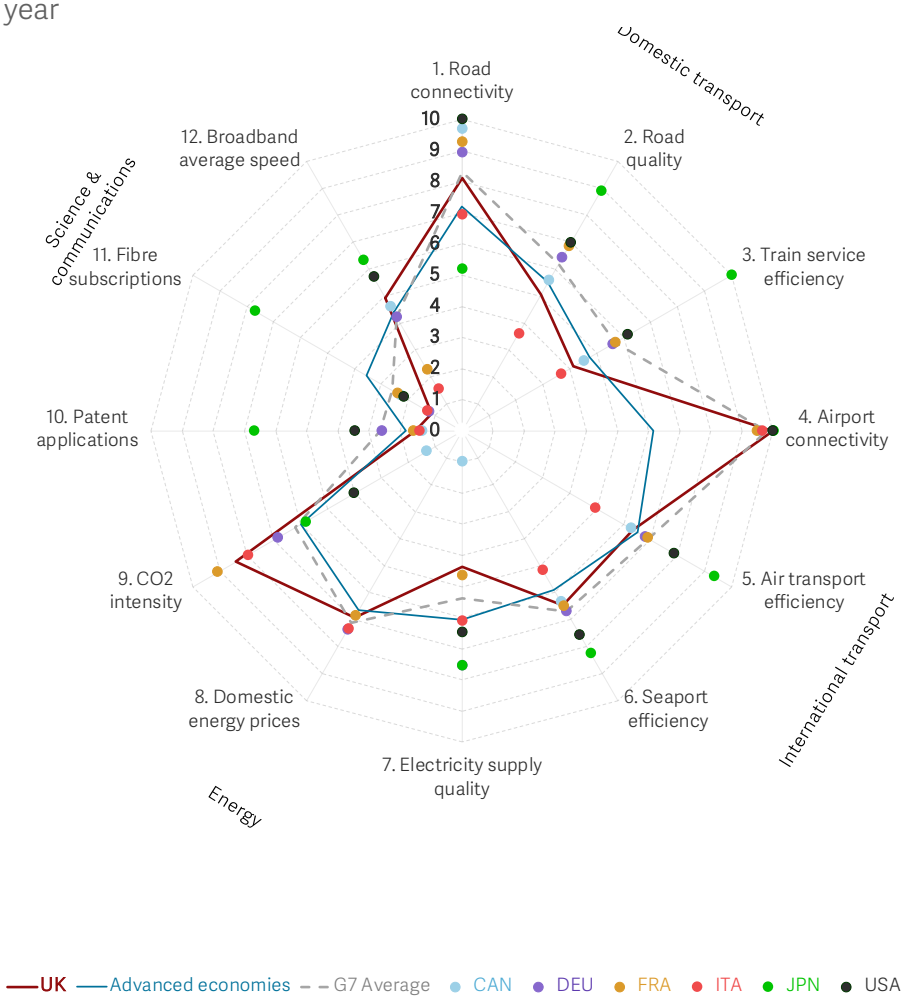
The UK's economic infrastructure is well connected but highly congested

While the monetary value of the UK stock of economic infrastructure is close to that of other European countries, indicators of the relative condition of the UK's economic infrastructure networks vary both across sectors and in coverage, quality and cost within sectors (Figure 9). The World Economic Forum's (WEF) 2019 Global Competitiveness Report ranked the UK 11th out of 141 countries for the overall quality of the UK's economic infrastructure (covering transport, electricity, water and telecommunications). A more comprehensive economic infrastructure index constructed for this paper looks at 12 indicators of the coverage, performance and cost of domestic and international transport, energy, research and development and telecommunications. Overall, the UK scores above the advanced country average for half of those metrics, but scores better than the G7 average on only three dimensions. Japan's above average scores on nine of the 12 dimensions highlights that fact that high levels of infrastructure investment can buy very high-quality economic infrastructure, but not necessarily higher economic growth.

17 Office for National Statistics, Experimental comparisons of infrastructure across Europe, May 2019.

FIGURE 9: **UK's economic infrastructure varies across and within sectors**

Relative quality of economic infrastructure across 12 indicators (10 = best, 1 = worst), latest year



SOURCE: Detailed description of metrics and data sources is provided in Annex 1a.

- For transport, the UK scores above the advanced country average for measures of both domestic and international connectivity. However, on measures of the quality and efficiency of road, rail, air and seaports, the UK is below G7 averages. While road and rail infrastructure have been the focus of significant investment in recent years, which would be expected to improve reliability and alleviate congestion over time, it remains to be seen whether reform of the current rail franchising model will succeed in tackling persistent issues with service quality and cost. The relatively low rating for the efficiency of seaports raises concerns in light of the additional capacity that may be needed to handle border checks for goods coming in and out of the EU, and measures of air transport efficiency are unlikely to improve imminently given the ongoing delays to increasing runway capacity in the South East of England.

- In the energy sector, the UK's efforts to tackle climate change are evident in its relatively good performance for carbon intensity (measured by carbon dioxide produced per unit of GDP). Despite being relatively climate-friendly, domestic energy prices before tax are broadly in line with peers. However, electricity supply efficiency (measured as energy loss during transmission and distribution) is relatively poor compared to peers.
- The picture is mixed for science and communications. While the UK's average broadband coverage and speed compares favourably with peers, the UK lags significantly behind in more rapid fibre subscribers although the government has committed to accelerating roll-out of this new technology. On research and development (R&D), the UK ranks 12th of 34 advanced economies for the number of resident patent applications per capita, taken as a proxy for intellectual capital creation (or 5th in the G7, some way behind Japan, the USA and Germany, and close to France). The UK ranks 19th among advanced economies for gross domestic spending on R&D as a share of GDP (at around 1.7 per cent in 2017).[18] However, the government's share of this is relatively low with UK government funding of domestic R&D as a share of GDP at around 0.44 per cent, just 24th among advanced economies and compared with 0.6 per cent on average among OECD countries.[19] The 2019 Conservative manifesto pledged to increase total R&D investment to 2.4 per cent of GDP, and anticipates that this will require increasing public funding as a share of GDP to above the OECD average.

Greater reliance on the private sector does not appear to imply higher bills

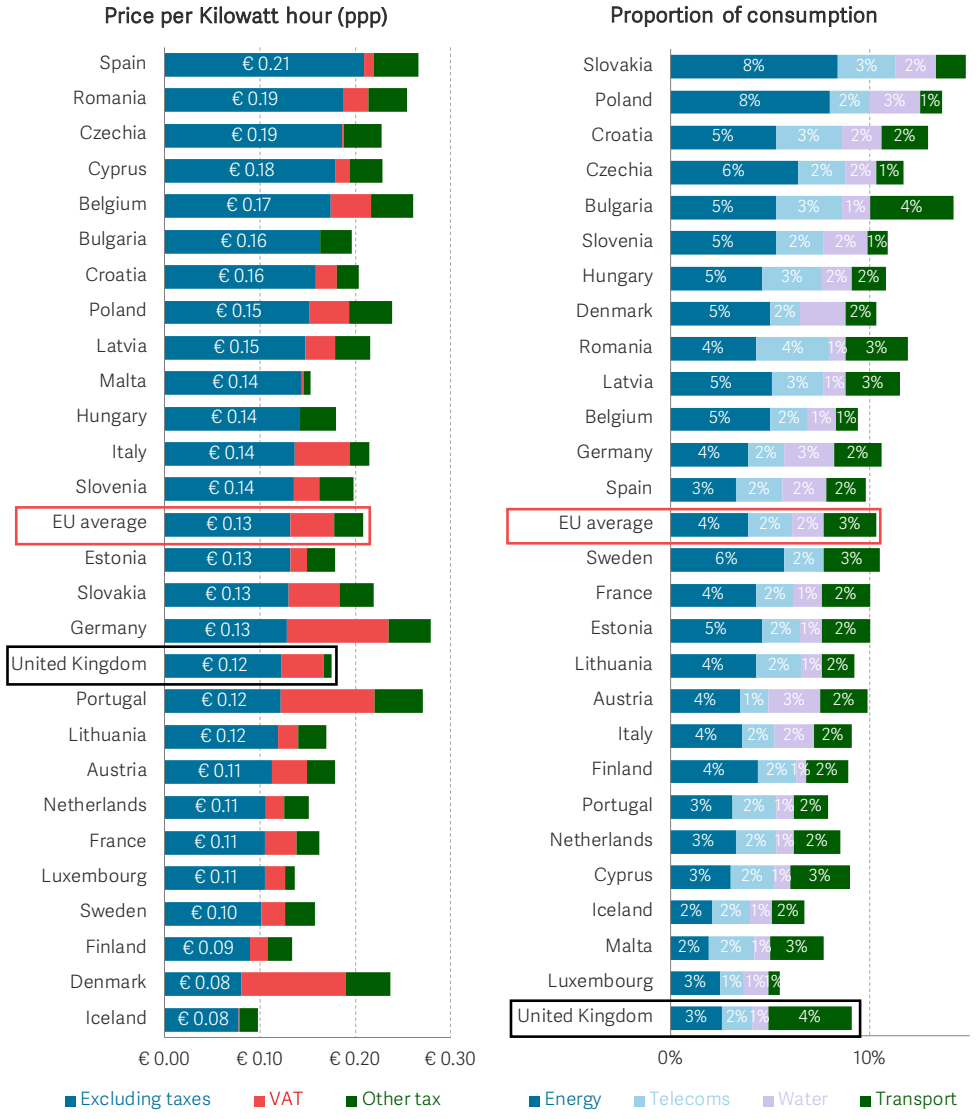
Despite its greater reliance on the private sector in the provision of economic infrastructure, UK consumers do not seem to pay significantly more than those in other advanced economies for their services, except in the area of transport (Figure 10). One might expect UK consumers to pay more for public utilities given the lower explicit or implicit public subsidy given to private operators, the need to compensate those operators for their higher cost of capital relative to the public sector and the need for private companies to return a profit for their shareholders. However, comparative data on costs of economic infrastructure services suggests that energy, telecoms and water prices for households are near or below EU averages.[20] However, energy consumption in the UK is below average compared to other EU countries and total household consumption considerably higher. This results in the comparatively low proportion of UK household consumption being spent on energy compared to EU average. An important exception to UK consumers paying close to European averages for economic

18 RF analysis of OECD data https://data.oecd.org/rd/gross-domestic-spending-on-r-d.htm.
19 RF analysis of OECD data https://stats.oecd.org/Index.aspx?DataSetCode=GERD_SOF.
20 M Pisu, B Pels & N Bottini, Improving Infrastructure in the United Kingdom, OECD, July 2015.

infrastructure is rail transport, where UK passengers pay significantly more than those in other European countries owing in part to the lower levels of public subsidy provided to UK rail operators.[21]

FIGURE 10: **UK households economic infrastructure services**

Proportion of household consumption expenditure on water, energy and telecoms, and price of energy per kilowatt hour (purchasing power standard): UK and EU-15 countries, 2017



SOURCE: RF analysis of Eurostat.

State of social infrastructure

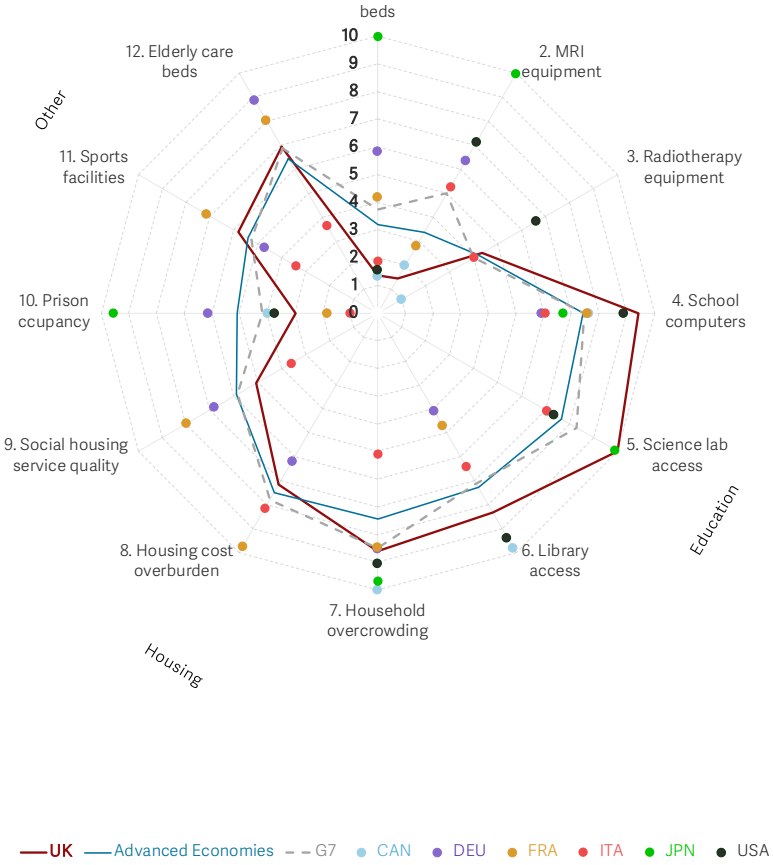
While current levels of UK investment in social infrastructure are similar to the advanced country average, the quality of the UK's stock of social infrastructure, which bore the

21 European Commission, Study on the prices and quality of rail passenger services, April 2016.

brunt of past cuts and benefited less from the recent recovery in public investment, is more mixed. The basket of 12 indicators of social infrastructure quality covers health, education, housing, prisons, sports facilities and elderly care. Across these, the UK scores at or above the advanced country and G7 averages for seven of the 12 metrics, as shown in Figure 11, but significantly below average in others.

FIGURE 11: **Social infrastructure reflects a pattern of past underinvestment**

Relative quality of social infrastructure across 12 indicators (10 = best, 1 = worst), latest year



SOURCE: Detailed description of metrics and data sources is provided in Annex 1b.

The UK has a relatively labour-intensive health service

In the health sector, the UK's number of hospital beds per capita, as a measure of overall capacity of the infrastructure, is among the lowest in Europe.[22] As a result of below-average investment, the UK has an increasingly labour-intensive health service with levels of capital per worker having fallen by around 35 per cent in real terms since 2000 and standing at just above half of the advanced European country average in 2017.[23]

22 RF analysis based on OECD data: www.data.oecd.org/healtheqt/hospital-beds.htm#indicator-chart.
23 J Kraindler & B Gershlick, International comparisons of capital in health care: Why is the UK falling behind?, Health Foundation, October 2019.

The capital scarcity of the UK health service is especially pronounced in the area of machinery and equipment. Here, the UK ranks lowest among the 14 European countries sampled, based on the value of machinery and equipment per worker in healthcare - with some countries having five times the value per worker compared with the UK. This capital scarcity is particularly evident in diagnostic equipment where the UK ranks among the lowest of all advanced economies for numbers of MRI units and CT scanners per capita. Some European countries have three to four times the number of CT scanners per capita than the UK and Germany has almost five times the MRI units per capita (and Japan even more).[24] The growing labour-intensity of the NHS has been exacerbated by a tendency in recent years for initially generous capital budgets to be raided to meet current pressures. In each of the past four years to 2018-19, the Department of Health has switched between £0.5 and £1.2 billion (around 10 per cent of the £7 billion NHS investment budget) from capital to resource expenditure to cope with pay and other day-to-day pressures.[25]

UK educational facilities compare well internationally

In education, investment levels have risen significantly over the past two decades. Total public investment in education has more than doubled from 0.2 per cent of GDP in 1998-99 to over 0.4 per cent of GDP in 2018-19. This was driven in part by the 'Building Schools for the Future' programme which, launched in 2003, had rebuilt or refurbished 310 schools by March 2011, after which it was replaced by the new capital spending programme.[26] UK schools' infrastructure now compares favourably to that in other advanced economies in terms of the availability of computers, and access to science labs and school libraries. A 2015 survey of asset conditions in 19,000 schools (85 per cent of all schools in England) found that 94 per cent of estate blocks surveyed were in either 'Good' or 'Satisfactory' condition. [27]

UK social housing is relatively expensive and of poor quality

While measures of overcrowding in housing are relatively low by advanced country standards, the UK performs relatively poorly on indicators of housing cost and social housing quality. Overburdening of lower income households by housing costs (those lower income households for whom housing costs net of housing allowances represent more than 40% of disposable income net of housing allowances) is worse than the average of other advanced economies. This reflects the relatively high cost of housing in the UK. The quality of social housing services is also judged to be relatively poor compared to advanced country averages. This partly reflects the comparative age of the

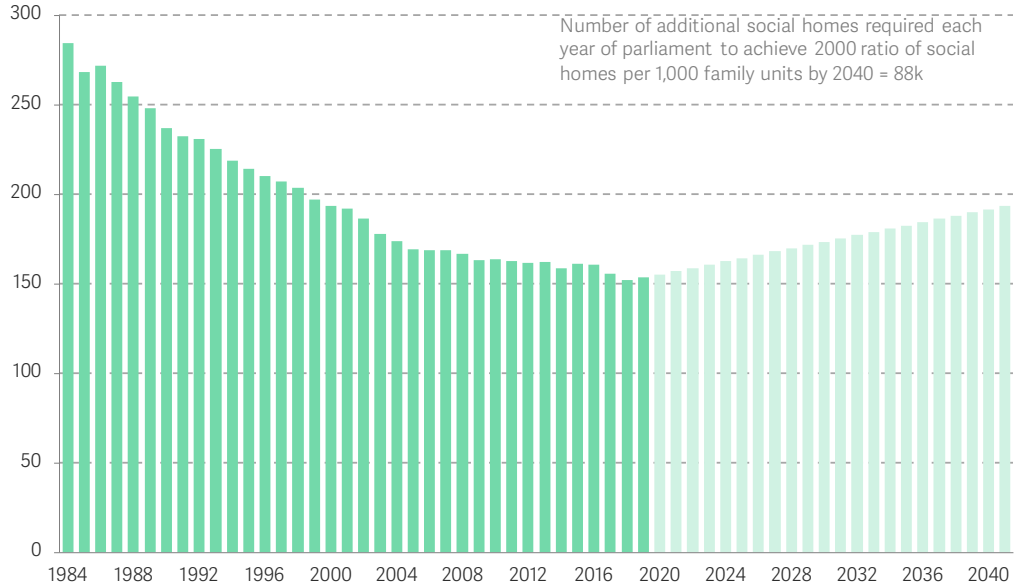
24 OECD, Health at a Glance 2017, November 2017.
25 G Stoye & B Zaranko, UK health spending, Institute for Fiscal Studies, November 2019.
26 S James, Review of Education Capital, April 2011.
27 Education Funding Agency, Property data survey programme: summary report, January 2015.

UK's housing stock given much it was built over 50 years ago, with 1978 the last year that councils and local authorities built in excess of 100,000 homes.[28] Given the relatively high proportion of the housing stock under public ownership compared with OECD average, the UK would need to invest more than the average advanced economy just to maintain the quality of the current stock let alone improve its relative quality of social housing stock.

The collapse in social housing construction in the 1970s and privatisation of parts of the stock starting in the 1980s can been seen in the steady decline in the availability of affordable housing. Figure 12 shows that the stock of affordable homes (social housing and sub-market affordable housing) has fallen steadily relative to the number of families since the 1980s. In order to return to the family unit to stock ratio of the year 2000, 440,000 new affordable homes would have to be built over the next five years, nearly 300,000 more than look set to be achieved given the current rate of construction. Compounding this issue is the change in the composition of the government's provision of affordable housing, which has shifted from over 65 per cent social rent in 2011 to just 11 per cent in 2018.[29] This shift towards 'affordable rent' and shared ownership tenure types may suit some tenants, but social rent remains the most secure and low-cost form of affordable housing.

FIGURE 12: **Availability of affordable housing has fallen steadily for thirty years**

Number of sub-market homes per 1,000 family units: England, aged 20+



NOTES: A family unit is a single adult or couple and any dependent children.
SOURCE: RF analysis of ONS, Labour Force Survey & ONS, Household projections.

28 Ministry for Housing, Communities and Local Government, Live Table 244.
29 Ministry of Housing, Communities and Local Government, Live Table 1000.

UK prison conditions are relatively poor

For other social infrastructure assets, measures of the UK's infrastructure quality are mixed. The UK also scores relatively well for satisfaction with sports facilities and is broadly on par with the G7 average for number of elderly and nursing care beds per capita (as a measure of elderly care infrastructure). However, prison overcrowding, as a proxy for the quality of prison infrastructure, is relatively high. While the Department for Justice was promised a 50 per cent increase in capital spending between 2019-20 and 2020-21,[30] given the condition of the prisons estate and plans for tougher sentencing this is unlikely to be enough to reduce overcrowding in the long-term. Analysis by the Institute for Government also suggests that funds were redirected from the Ministry of Justice capital budget to current spending in both 2017-18 and 2018-19 to deal with unexpected current costs. Resource pressures in the prison system are evident on almost all performance metrics – including rises in incidents of prison violence, prisoners self-harming and lower numbers of prisoners accessing rehabilitative activity.[31]

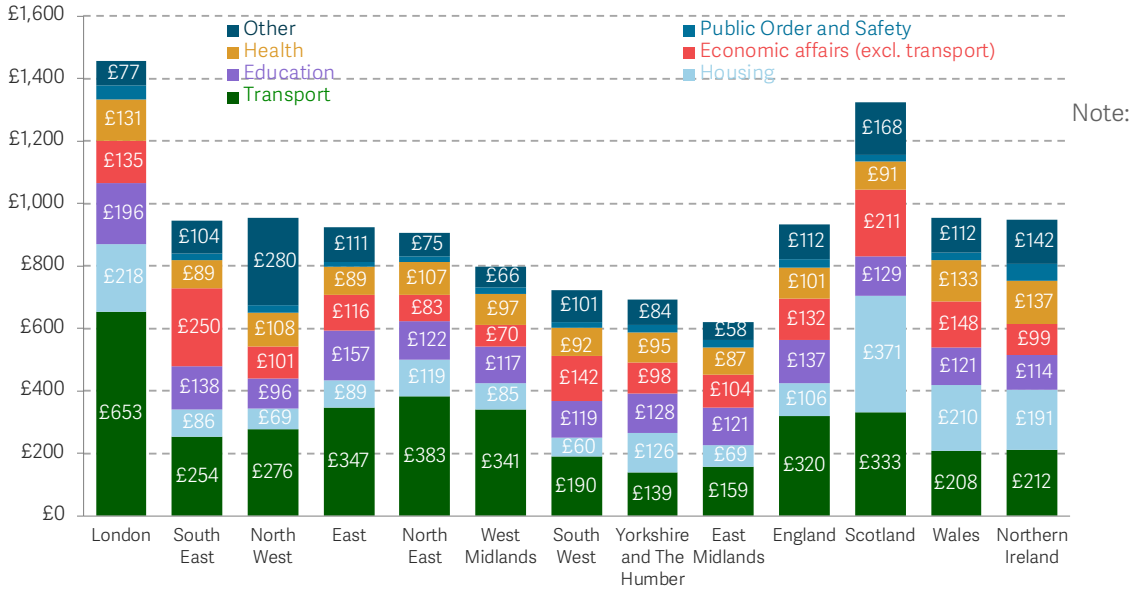
Addressing regional disparities in investment

There are significant disparities in public investment levels and infrastructure quality not only between sectors but also across regions – especially between London and the rest of the England and particularly in the area of transport. In 2018-19, total public investment per capita was £1,200 in London and the South East of England, over 35 per cent higher than the £885 per head invested in the other regions (Figure 13). Much of this difference is driven by disparities in public investment in transport in London which, at £653 per capita, was over two and a half times the average level of spending in other regions of £258 per head. However, some of this difference in transport investment is driven by the fact that London and the South East are heavily reliant on overground and underground rail, a relatively expensive means of transporting people, for daily commuting. Moreover, a significant proportion of transport investment in London is locally financed via the farebox, local borrowing and local taxes collected by Transport for London (TfL) and the Greater London Authority. However, even excluding TfL's own-financed investment, transport investment per capita in London was 2.4 times that in other regions in 2017-18. There are also significant disparities in public investment among the four nations of the United Kingdom, with Scotland investing significantly more per capita than England, Wales and Northern Ireland, especially on housing.

30 A Corlett, D Tomlinson, M Whittaker & T Bell, Rounding up: Putting the 2019 Spending Round into context, September 2019.
31 G Atkins, N Davies, F Wilkinson, T Pope, B Guerin & G Tetlow, Performance Tracker 2019: A data-driven analysis of the performance of public services, Institute for Government, November 2019

FIGURE 13: **Regional disparities in public investment are driven by transport**

Per capita capital spending by government function and region: 2018-19



Note:

Capital spending on transport includes capital spending through Transport for London. North West 'other' includes environmental protection spending on the decommissioning of Sellafield.
SOURCE: RF analysis of HM Treasury, Country and regional analysis: November 2018.

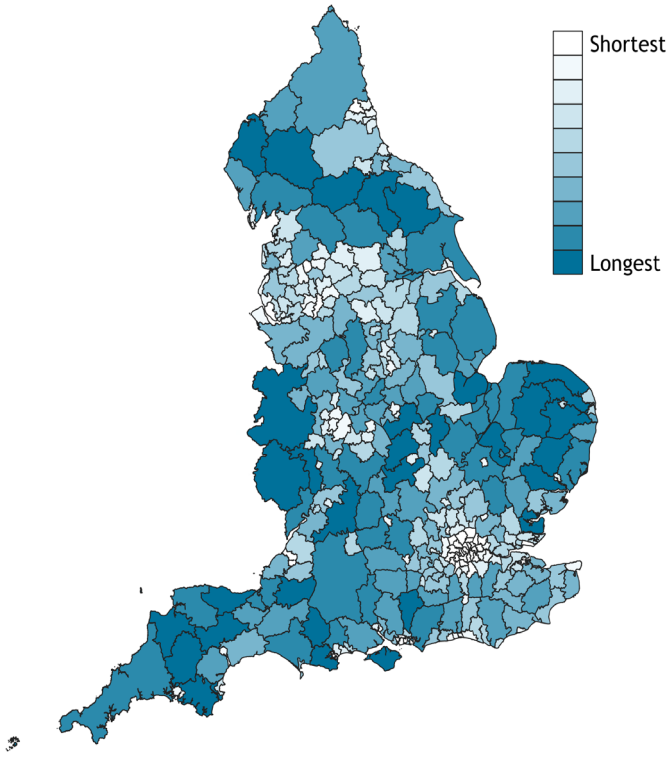
The UK's urban transport networks have not kept pace with growing demand

The concentration of transport investment in London is reflected in regional disparities in both inter- and intra-urban connectivity. Much recent criticism has focused on the fact that decades of public investment in transport has favoured London over other regions. Recent analysis by the NIC based on their 'connectivity metric' does find that London is far ahead of any other region with regard to connectivity *between cities* on public transport (though other regions are better connected by car). Less attention has focused on regional disparities in connectivity *within cities* where Greater London also outperforms other areas of the country on average minimum journey times to employment, key public services (such as schools and hospitals), and amenities (such as food shops and the town centre), as shown in Figure 14.[32] The average minimum time taken to travel via public transport to key public services in London local authorities was 12 minutes, shorter than the 20 minute average across all other UK local authorities. Addressing these regional disparities will therefore require not only greater investment in inter-urban rail and other connections but also in more extensive and frequent local transport connections outside of London.

32 Department for Transport, Journey time statistics: 2017, December 2019.

FIGURE 14: **UK intra-urban connectivity is poor by international standards**

Minimum travel time via public transport to key services by local authority: 2017



SOURCE: RF analysis of Department for Transport, Journey Time Statistics, England: 2017.

Research and development spending across the regions

Investment in research and development (R&D) is also significantly skewed towards the South with capital spending on science and technology over 30 per cent higher in London and the South East than other regions of the UK. Including the private sector, 31 per cent of all R&D spending in the UK took place in the three sub-regions of Oxford, Cambridge and inner West London.[33] There has been an active debate in recent months about how best to 'level-up' R&D spending. The balance between ensuring economies of scale in research and development and boosting regional growth through fostering local specialisation in research fields is not a simple one to strike. Much of this will rest on how the government chooses to allocate its share of the proposed increase to 2.4 per cent of GDP on R&D. Focussing most of this funding on universities could compound the regional imbalance of research spending, whereas proposals similar to the US's Defence Advanced Research Projects Agency (DARPA) where public initiatives promote private R&D spending could result in a broader regional focus.[34]

33 R. Jones, A Resurgence of the Regions: rebuilding innovation capacity across the whole UK, May 2019.
34 D Willetts, The road to 2.4 per cent: Transforming Britain's R&D performance, December 2019.

New infrastructure requirements: addressing future challenges

Past trends in investment and current surveys of infrastructure quality can provide important information about the UK's future investment needs. However, in addition to addressing the gaps in and pressures on existing infrastructure, three emerging environmental, technological and economic challenges are likely to require additional public investment in new areas:

- The first is **climate change** which will require significant additional public investment in both mitigation and adaption. In its 2019 report, the UK's Committee on Climate Change (CCC) estimated the cost of delivering net zero carbon emissions by 2050 to be between 1 and 2 per cent of GDP per year, as shown in Figure 15.[35] While the CCC did not specify the public/private split of these costs, more than half are estimated to arise from either the retrofitting of existing buildings to improve energy efficiency and introduce low-carbon heating or so-called 'engineered greenhouse gas removals' including development of new bioenergy and carbon capture and storage technologies. Given that both of these activities are likely to require a large measure of public subsidy to generate a sufficient volume of activity, particularly in the retro-fitting of existing buildings, it is not unreasonable to assume that just over a third to a half of the estimated investment (or around 0.4 to 1 per cent of GDP per year) will need to come from the public sector. A more detailed assessment of the public/private split of the cost of climate change mitigation and adaption is expected in HM Treasury's Net Zero Review expected to report in autumn 2020.[36]

- The second is **smart technologies** which offer significant long-term opportunities for improving the efficiency of infrastructure utilisation, but are likely to involve significant up-front costs to adapt existing networks. The investments include adaptation of energy grids to allow small scale renewable generators to sell into the grid, upgrading of roads to make them legible to driverless cars and allow active management of traffic flow through variable speed limits and traffic signals, and retrofitting existing water, power and transport networks to provide real-time data on asset conditions and performance.[37]

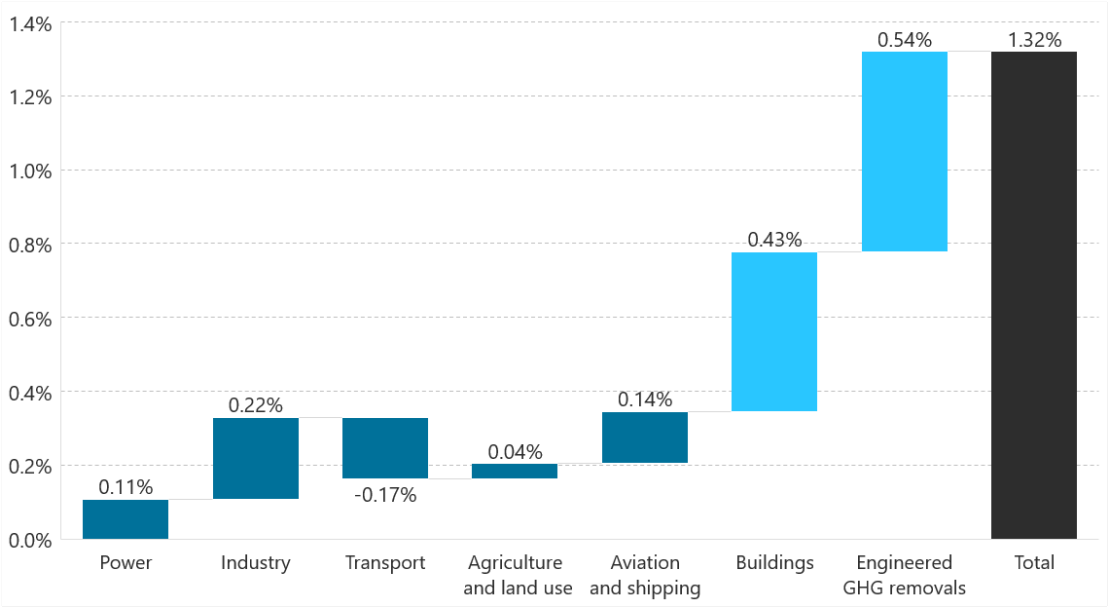
- The third is **Brexit** which may require additional investment to ensure the UK retains its attractiveness as a destination for innovative companies and skilled professionals once it has left the EU single market, customs union, and common labour market. Estimating the nature and cost of the investment required is difficult

35 Committee on Climate Change, Net Zero: The UK's contribution to stopping global warming, May 2019
36 See HM Treasury, Net Zero Review: Terms of Reference, November 2019.
37 For a discussion of how data and emerging technologies to transform infrastructure delivery and operations see: B Goodwin, What should be in the National Infrastructure Strategy?, Institution of Civil Engineers, Juley 2019

while the precise nature of the UK's future economic relationship with the EU remains unknown. However, at the very least the UK will need to consider how it will replace the several billion pounds a year it receives in infrastructure funding from the European Investment Bank (EIB) and European Investment Fund (EIF), [38] and the R&D funding it receives under the Horizon 2020 and other EU R&D programmes. [39]

FIGURE 15: **Delivering net zero carbon emissions may need public investment of 0.4 – 1 per cent of GDP a year**

Central estimates for annual resource gross cost of meeting a net zero greenhouse gas (GHG) emissions target by sector: proportion of GDP, 2050



NOTES: Estimates shown are based on the investment costs plus ongoing upkeep net of the savings (for example as a result of increased full efficiency) from the emissions reduction technology/approach. This means that these do not represent costs to the government, rather an estimate of the resources required in the economy to reach net zero emissions. These estimates are also gross of the economic costs of climate change. See the source report for full details.
SOURCE: Committee on Climate Change, Net Zero: The UK's contribution to stopping global warming, May 2019

Priorities for the coming 'infrastructure revolution'

Addressing these infrastructure needs, pressures and priorities requires a sustained, balanced and forward-looking portfolio of public investments. While transport has been the focus of the government's early announcements, investment also needs to take account of a legacy of under investment in, and growing pressures on, the countries social infrastructure. It also needs to equip the UK to face the economic and

38 European Union Committee, Brexit: the European Investment Bank, House of Lords, January 2019
39 A Smith & G Reid, Changes and Choices: Advice on future frameworks for international collaboration on research and innovation, commissioned by the Minister of State for Universities, Science, Research and Innovation, July 2019

environmental challenges of the future. The benefits of this investment also need to be felt in all parts of the country.

In light of the above discussion of the UK's future infrastructure needs, the next section proposes a comprehensive and balanced portfolio of new public investments in three key areas:

- Economic infrastructure, particularly to boost regional connectivity and alleviate intra-urban congestion in cities around the country by levelling up per capita transport investment between London and the South East and other regions of the country;
- Social infrastructure to address the legacy of historic underinvestment in health facilities and equipment, reverse the decline in social housing stocks compared to family units, and to reduce overcrowding and improve conditions in prisons; and
- Emerging challenges to deliver the government's target of net zero carbon emissions by 2050 and to boost productivity by closing the gap with other advanced economies in public spending on research and development.

Section 4

What can the government afford to invest?

Depending on the government's objectives, meeting the UK's future economic, social and environmental infrastructure needs could require additional public sector investment of anywhere between 0.6 and 1.9 per cent of GDP (£15-50 billion in 2024-25). The government's proposed fiscal framework would limit some of the more ambitious scenarios and require it to choose between its desire to level up investment between regions, revive our social infrastructure, and equip Britain to meet the economic and environmental challenges of the future. However, there is a case for modifying the proposed fiscal framework to make it more investment-friendly by (i) focusing on improving net worth rather than reducing net debt and (ii) committing to a target (rather than ceiling) on public investment while (iii) retaining the 6 per cent limit on the debt interest/revenue ratio to ensure that investment remains affordable. Such a framework would enable the government to invest in a comprehensive and balanced portfolio which (i) tackles the legacy of past underinvestment in health, housing and prisons; (ii) levels up transport investment between regions; and (iii) meets the government's commitments on climate change and scientific research.

Priorities for additional investment

Addressing the economic, social and environmental infrastructure needs discussed in the previous section will require a further sustained increase in the level of public investment in:

- Economic infrastructure, in particular to boost regional connectivity and alleviate intra-urban congestion in cities around the country;
- Social infrastructure, in particular to address the legacy of historic underinvestment in health facilities and equipment, social housing and prisons; and
- Emerging challenges, in particular delivering the government's target of net zero

carbon emissions by 2050, and boosting productivity and competitiveness through additional investment in research and development.

Alternative public investment scenarios

Depending on the scope, level and pace of the government's ambition in these different areas, the additional public investment required over the next five years could range from 0.6 per cent of GDP (£15 billion) to 1.6 per cent of GDP (£40 billion) per year in 2024-25 (Figure 17). More specifically, the government would need to invest:

- **0.6 per cent of GDP** (an additional £6 billion per year by 2024-25) to return total public investment to its **post-war average** of 2.7 per cent of GDP;
- **0.8 per cent of GDP** (an additional £19 billion per year by 2024-25) to **level-up** investment spending between regions to the level or per capital spending in London (excluding TfL) and the South East (details of how this figure is arrived at are provided in Table 1);
- **0.9 per cent of GDP** per year (an additional £22 billion per year in 2024-25) to meet the new government's commitment to invest an additional **£100 billion** over the next five years;
- **1 per cent of GDP** (an additional 25 billion per year by 2024-25) to match **OECD average flows** of public investment (in terms of general government gross fixed capital formation);
- **1.6 per cent of GDP** (an additional £40 billion per year by 2024-25) to catch up with the **OECD average stock** of public capital stock over ten to twenty years; and
- **1.2 per cent of GDP in 2024-25** (an additional £37 billion by 2024-25 or £127 billion over the next five years) to deliver a comprehensive **balanced portfolio** of investments which (i) addresses the legacy of past underinvestment in health, housing and prisons, (ii) responds to current pressures to 'level up' transport investment between regions, and (iii) tackles future challenges in the areas of scientific research and climate change. As shown in Figure 16, by 2024-25, this includes:
    - £2 billion per year to build the first 20 of the 40 new hospitals promised during the election campaign over five years;[40]
    - £5 billion per year to increase the social housing stock by 440,000 dwellings over five years;

40 Using lower range estimates from the Institute for Fiscal Studies quoted in D Campbell, Johnson's "40 new hospitals" pledge costed at up to 24bn, The Guardian, December 2019.

- £12 billion to level up per capita capital spending on transport in other regions to that of London (excluding TfL) and the South East;
- £12 billion to begin adapting buildings to reach the net zero carbon emissions target by 2050 plus £0.84 billion to mitigate flooding; and
- £5 billion to match the public sector's portion of the gap in research and development spending between the UK and OECD average.[41]

TABLE 1: **Levelling up investment between regions costs c. £20 billion a year**

Per-capita public capital spending needed in 2018-19 to match the London and South East average, by government function: UK

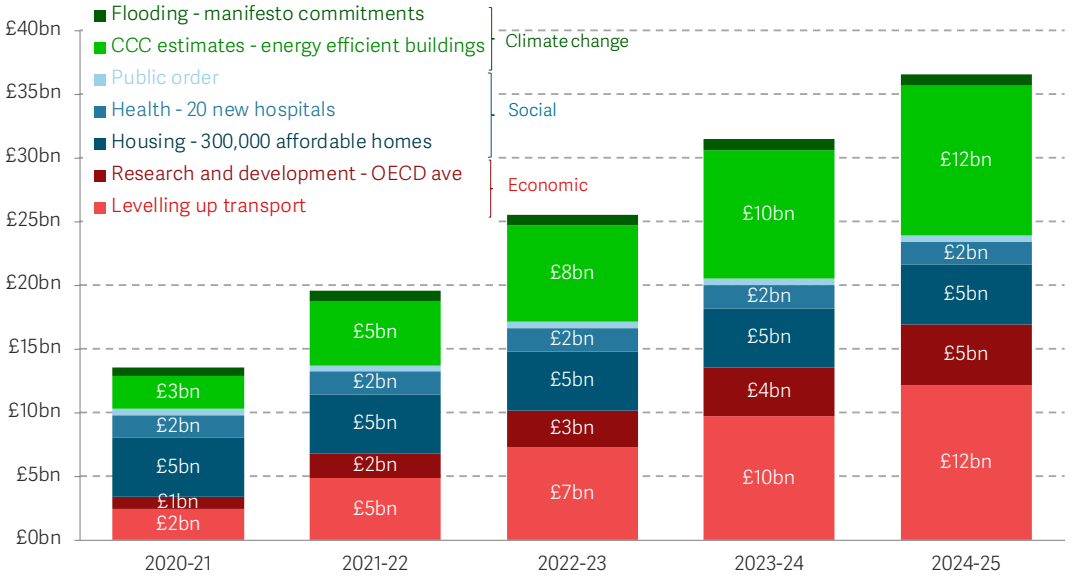
SOURCE: RF analysis of HM Treasury, Country and regional analysis: 2018, November 2018.

London and South East average	North East	North West	Yorkshire and the Humber	East Midlands	West Midlands	East	South West	Scotland	Wales	Northern Ireland	**All regions/nations other than London/SE**
£28	£3	£6	£4	£18	£2	£1	£7	-£24	£2	-£11	**£8**
£34	£17	£9	£10	£10	£11	£19	£15	£12	£10	-£21	**£93**
£635	£172	£258	£405	£372	£224	£172	£303	£113	£298	£358	**£2,673**
£97	*£88*	*£67*	*£80*	*£65*	*£88*	*£55*	*£39*	*£3*	*£30*	*£82*	***£598***
£92	*£25*	*£24*	*£21*	*£22*	*£28*	*£11*	*£11*	*-£2*	*£34*	*£46*	***£220***
£1	*-£1*	*£0*	*£0*	*£0*	*£0*	*£0*	*£0*	*£0*	*£0*	*-£1*	***-£2***
£4	*-£2*	*£1*	*-£7*	*£1*	*£7*	*£10*	*£1*	*-£19*	*-£19*	*-£34*	***-£61***
£442	£59	£165	£303	£283	£100	£95	£252	£109	£234	£230	**£1,832**
£25	£6	-£194	£0	£7	£11	-£24	-£20	-£35	-£17	£12	**-£254**
£152	£34	£83	£26	£83	£67	£63	£92	-£219	-£58	-£39	**£134**
£110	£3	£2	£15	£23	£13	£22	£18	£20	-£23	-£26	**£66**
£30	£8	£2	£1	£7	£12	£2	£0	-£11	-£3	-£61	**-£43**
£167	£45	£71	£38	£46	£50	£10	£48	£38	£46	£53	**£444**
£7	£0	-£4	£1	£0	£0	£0	£2	-£8	-£3	£7	**-£4**
	£286	£432	£502	£567	£390	£289	£485	£182	£356	£430	£3,395
	£760	£3,152	£2,748	£2,724	£2,302	£1,790	£2,717	£989	£1,119	£810	**£19,110**

41 Increasing the housing stock by 440,000 would return the benefit-unit-to-housing-stock ratio to that of the year 2000 (see Figure 12), assuming all new housing built is full social rental, using unit price estimates from the 2017 Conservative Party Conference. Climate change adaptation figures assume that the full proportion of estimated costs for retrofitting buildings in the Committee on Climate Change's Net Zero report is borne by the public sector. See: Committee on Climate Change, Net Zero: The UK's contribution to stopping global warming, May 2019.

FIGURE 16: **A comprehensive and balanced portfolio of public investments**

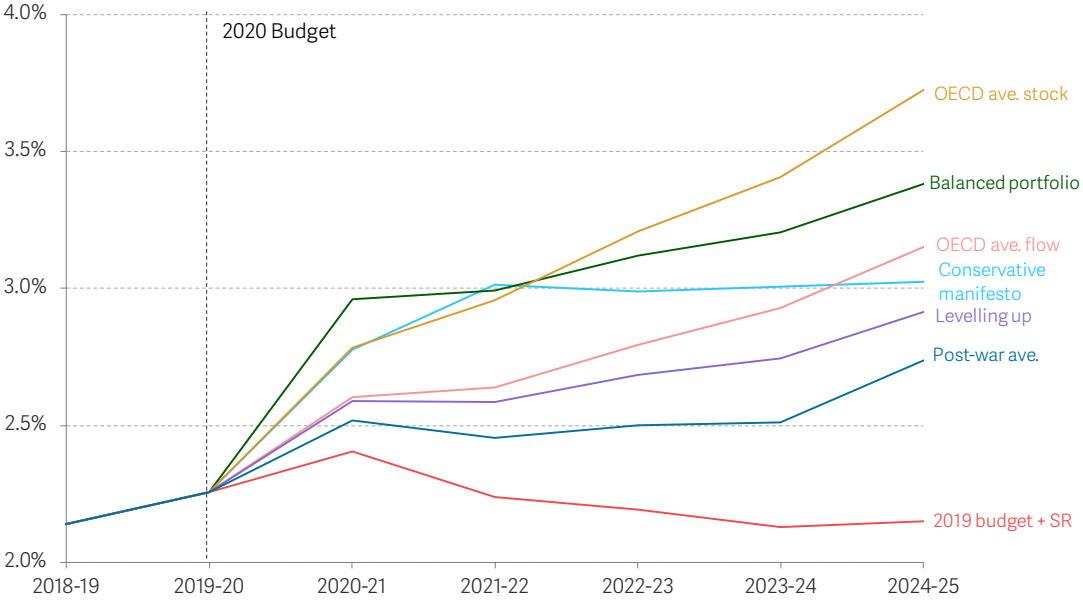
Additional gross fixed capital formation, by purpose: UK, 2020-21 – 2024-25



SOURCE: RF analysis of Conservative Manifesto, December 2019; Committee on Climate Change, Net Zero: The UK's contribution to stopping global warming, May 2019; HM Treasury, Country and regional analysis: 2018, November 2018; ONS, Labour Force Survey; ONS, Household projections; OECD.

FIGURE 17: **Alternative public investment scenarios**

Public sector net investment as a proportion of GDP under different long-run objectives, outturn and forecast: UK



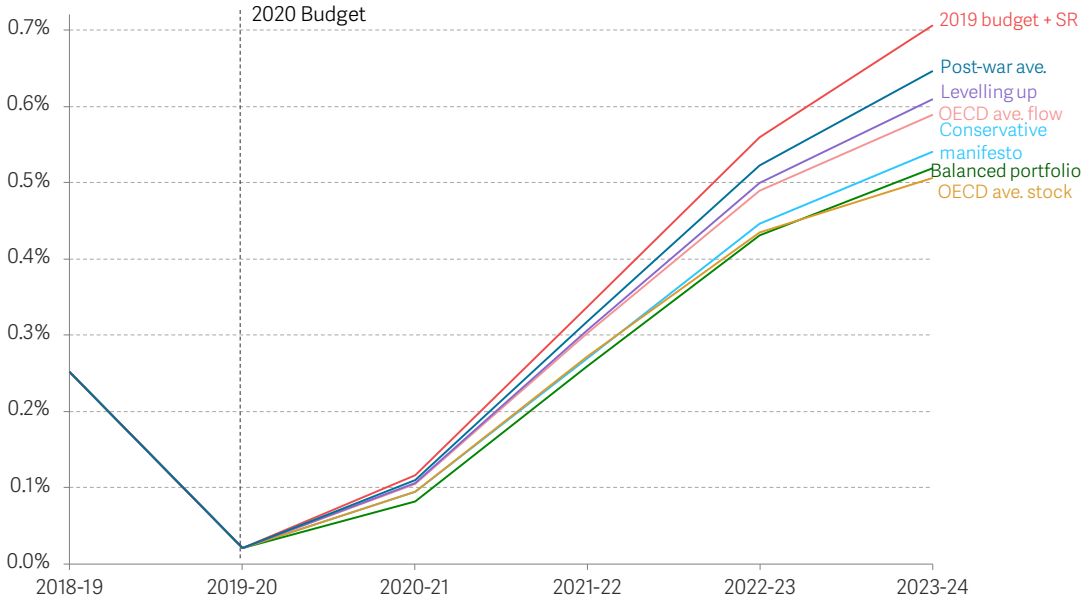
SOURCE: RF analysis of OBR, Restated March 2019 forecast, December 2019; Bank of England, Monetary Policy Report, January 2020; Conservative Manifesto, December 2019.

Implications for the new fiscal framework

Delivering these increases in investment is likely to pose challenges for the government's new fiscal rules. In their 2019 General Election manifesto the Conservatives committed to (i) a 3 per cent of GDP ceiling on public sector net investment on average over five years, (ii) balancing the current budget on average by 2023-24, and (iii) keeping the debt-interest-to-revenue ratio below 6 per cent. Of the three rules, it is actually the current balance rule which is likely to be most constraining on the government's investment ambitions because of the additional interest, depreciation and staffing costs associated with financing, maintaining and operating this new infrastructure. The depreciation costs alone of the Conservatives' £100 billion investment commitment would be sufficient to reduce headroom against their commitment to balance the current budget from £11 billion to £7 billion – the lowest headroom any Chancellor has had at the time of setting fiscal rules.[42] The impact of different investment scenarios on the current balance is shown in Figure 18.

FIGURE 18: **More depreciation means less headroom against the current balance**

Current balance as a proportion of GDP under different long-run objectives, outturn and forecast, UK



NOTES: For all scenarios, the amount of depreciation for the average proportion of investment undertaken through capital grants is excluded from total additional depreciation.
SOURCE: RF analysis of OBR, Restated March 2019 forecast, December 2019; Conservative Manifesto, December 2019.

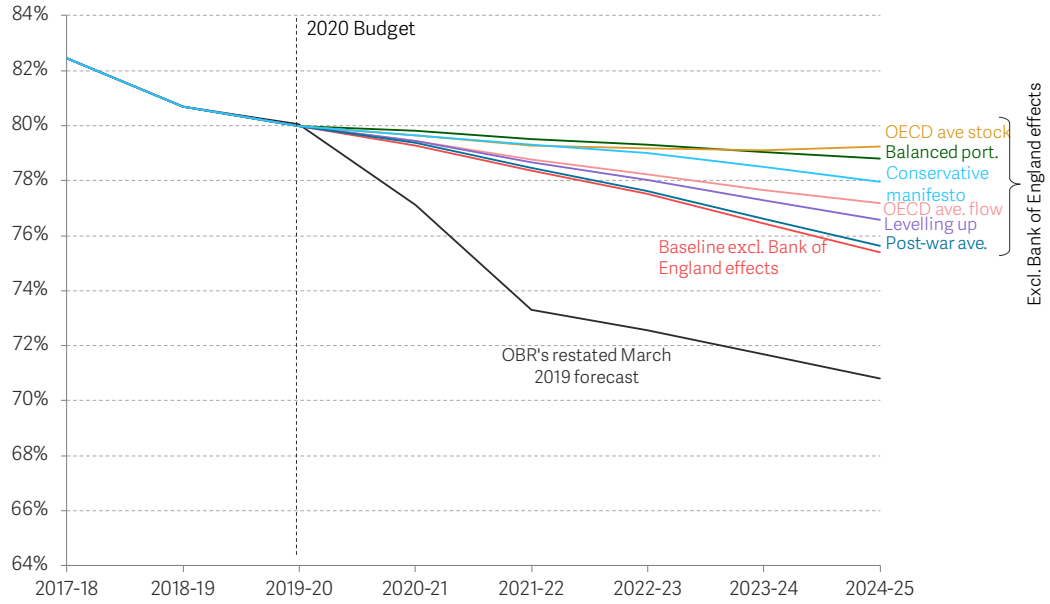
42 A Corlett, J Leslie & D Tomlinson, The trillion-pound question: Spring Budget 2020 and the tension between higher spending, low taxes and fiscal credibility, Resolution Foundation, February 2020.

Is three really the magic number?

The 3 per cent of GDP ceiling on investment would also require the government to choose between levelling up transport investment across regions, reversing the legacy of past underinvestment in social infrastructure, and delivering the additional investment needed to begin tackling climate change and meet the R&D target over the coming Parliament (as illustrated in Figure 17). The choice of 3 per cent of GDP as a limit derives from the fact that it is the level beyond which debt starts to rise as a share of GDP if the current budget is in balance, excluding the temporary effects of the Bank of England (Figure 19). However, this net investment ceiling sits oddly within a framework that (i) is otherwise trying to encourage investment; (ii) already includes an affordability constraint in the 6 per cent limit on the debt-interest-to-revenue ratio; and (iii) only brings the UK public investment up to the OECD average, despite the UK having underinvested relative to its peers for decades.

FIGURE 19: **A 'debt falling' rule relies a lot on the Bank of England**

Public sector net debt as a proportion of GDP, including and excluding the effects of Bank of England funding schemes and under different long-run objectives, outturn and forecast: UK



SOURCE: RF analysis of OBR, Restated March 2019 forecast, December 2019; Bank of England, Monetary Policy Report, January 2020; Conservative Manifesto, December 2019.

Making the government's fiscal rules more investment friendly

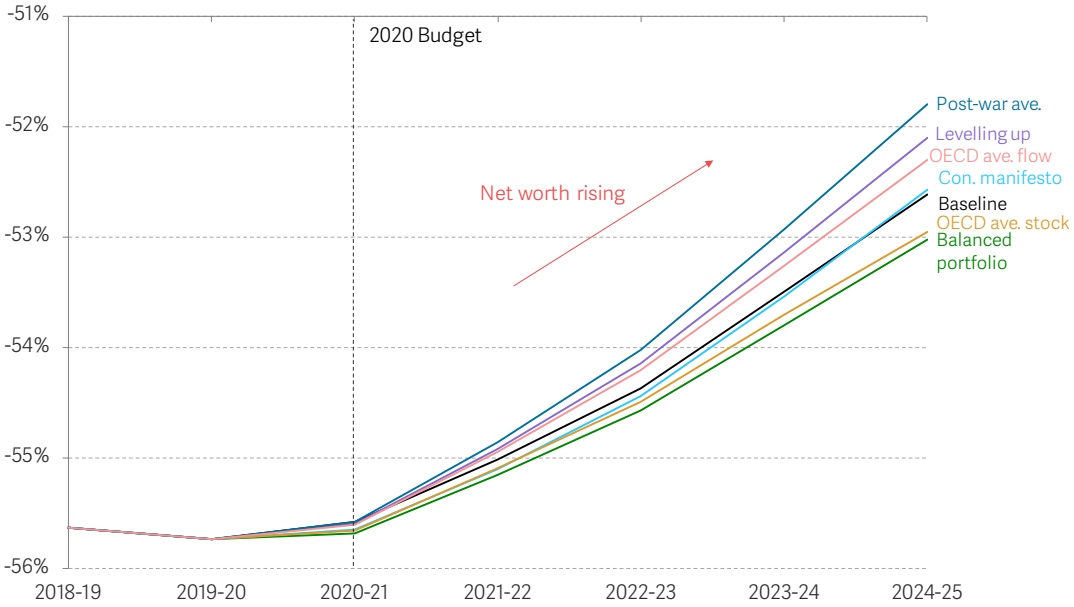
While the current costs of additional investment should be met by current receipts, there is a case for making other aspects of the government's proposed fiscal framework more

investment friendly. As shown in Figure 20, both the government's current £100 billion investment plan and the more ambitious Balanced Portfolio option could be met within a set of rules that:

- Focuses on improving net worth (rather than reducing net debt) and thereby captures not only the government's cost of financing that investment but also the value of the assets it is creating;[43]
- Commits to a target (rather than a ceiling) for the level of public sector net investment as a proportion of GDP to protect capital spending from the boom-and-bust cycles of the past; and
- Retains the 6 per cent of revenue limit on the interest burden to ensure that the debt issued to finance that investment remains affordable.[44]

FIGURE 20: **Public sector net worth as a proportion of GDP rises in all scenarios**

Public sector net worth as a proportion of GDP under different long-run objectives, outturn and forecast: UK



NOTES: For all scenarios, the amount of depreciation for the average proportion of investment undertaken through capital grants is excluded from total additional depreciation.
SOURCE: RF analysis of ONS, Public Sector Finances, HM Treasury, Whole of Government Accounts, OBR, Restated March 2019 forecast, December 2019, OBR, Economic and Fiscal Outlook, March 2019, OBR, Economic and Fiscal Outlook, October 2018; Bank of England, Monetary Policy Report, January 2020.

43 For more detailed discussion of balance sheet targeting in fiscal policy, see: R Hughes, Seeking public value: The case for balance sheet targeting in fiscal policy, Resolution Foundation, September 2019.
44 A more comprehensive set of proposal for the UK's new fiscal framework can be found in: R Hughes, J Leslie, J Smith & C Pacitti, Totally (net) worth it: The next generation of UK fiscal rules, Resolution Foundation, October 2019.

Section 5

How should government invest?

The impact of the government's 'infrastructure revolution' will depend crucially on the efficiency with which its planned increase in investment is translated into infrastructure assets. The UK is a relatively efficient public investor by international standards but still loses around 10 pence in the pound relative to the most efficient public investor. Strengthening public investment management arrangements can significantly increase the bang governments get for their infrastructure bucks. The UK is a world-leader in some areas of investment management, like infrastructure needs analysis, project appraisal methodology, capital budgeting and asset accounting. However, there is a need to further strengthen investment decision-making by: (i) providing a more stable and devolved framework for investment planning across levels of government; (ii) taking a more transparent approach to project appraisal, selection and approval; and (iii) improving cost control and benefit realisation during project implementation.

The UK also needs an 'infrastructure management revolution'

With public investment set to rise to levels not seen in a generation, it is critical that these additional resources are spent well. The economic, social and environmental returns derived from government capital expenditure depend on the efficiency with which those resources are translated into actual improvements in the quality of infrastructure assets. And the institutions and processes for managing public investments are a key determinant of the efficiency of this process. With that in mind this section:

- Evaluates the efficiency of public investment in the UK relative to other advanced economies;
- Assesses the strengths and weaknesses of the UK's public investment management institutions and procedures; and

- Recommends ten ways in which the government can increase the return it gets from its investment expenditure.

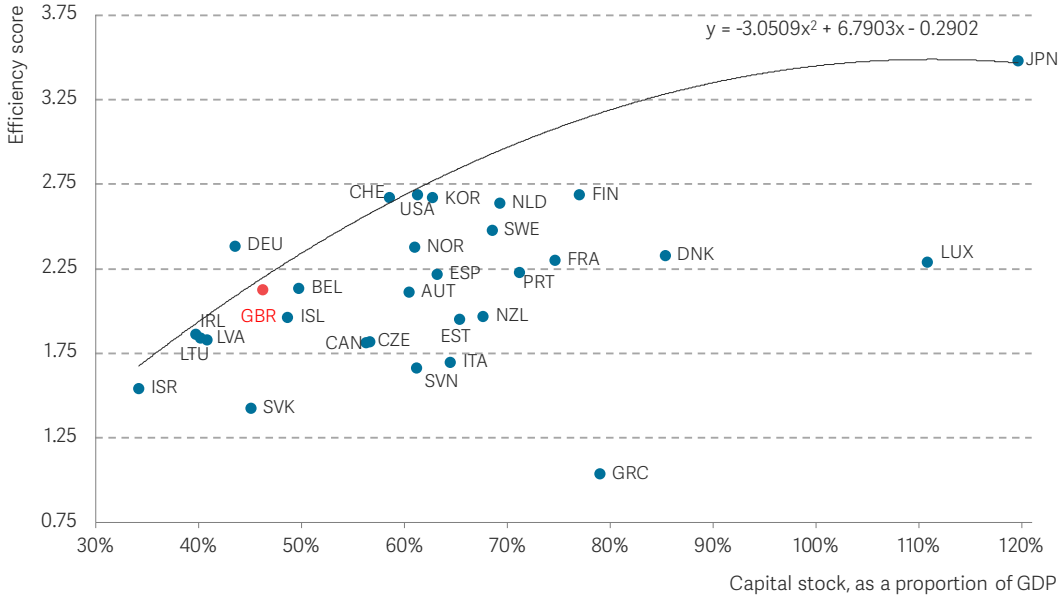
The efficiency of UK public investment

The UK is a relatively efficient investor, but still loses around 10p in the pound

The UK government is a relatively efficient investor, but still loses significant potential value in the process. The efficiency of public investment can be measured by comparing cumulative levels of public investment against measures of the quality of the capital stock that investment produces, as illustrated in Figure 21. A 2015 IMF survey of the relationship between the value of public capital stock and measures of infrastructure coverage and quality across over 140 countries found that the average country loses about 30 per cent of value in the process. Using the more comprehensive infrastructure quality indices constructed for this paper, the UK appears to be a relatively efficient public investor. However, the UK still loses around 10 per cent of potential bang for its buck relative to the most efficient advanced economy. This compares with an average efficiency gap of 13 per cent for all advanced economies based on the IMF's more limited public investment efficiency index.[45]

FIGURE 21: **The UK has a public investment efficiency gap of around 10 per cent**

Average 'efficiency' of social and economic investment, by capital stock: OECD countries



NOTES: For full explanation of the calculation of the efficiency frontier line, see Annex 2.
SOURCE: RF analysis of IMF, Investment and Capital Stock Dataset: 1960-2017; see Annex 1.

45 A description of the methodology used to derive efficiency for this paper is provided in Annex 2.

Public investment management in the UK

The institutional arrangements for managing public investments are an important determinant of public investment efficiency. While the impact of public investment on infrastructure coverage and quality is mediated by a range of factors, the same IMF study found that improvements in public investment management could close up to two-thirds of the 'efficiency gap' between the least efficient and most efficient public investors.[46] Therefore, the quality of the institutions and procedures for managing public investments is at least as important as, if not more important than, the quantity of investment spending passing through them.

The IMF has developed a new Public Investment Management Assessment (PIMA)

The efficient management of public investment requires comprehensive, rigorous and transparent institutional arrangements at each stage of the investment cycle. The IMF's Public Investment Management Assessment (PIMA), which has been used to evaluate the strength of infrastructure governance in more than 50 countries around the world, looks at the strength of 15 key institutions at three key stages of the investment decision-making process:

- **Planning** sustainable levels of investment across the public sector;
- **Allocating** that investment to the right sectors and projects; and
- **Implementing** those projects on time and on budget.

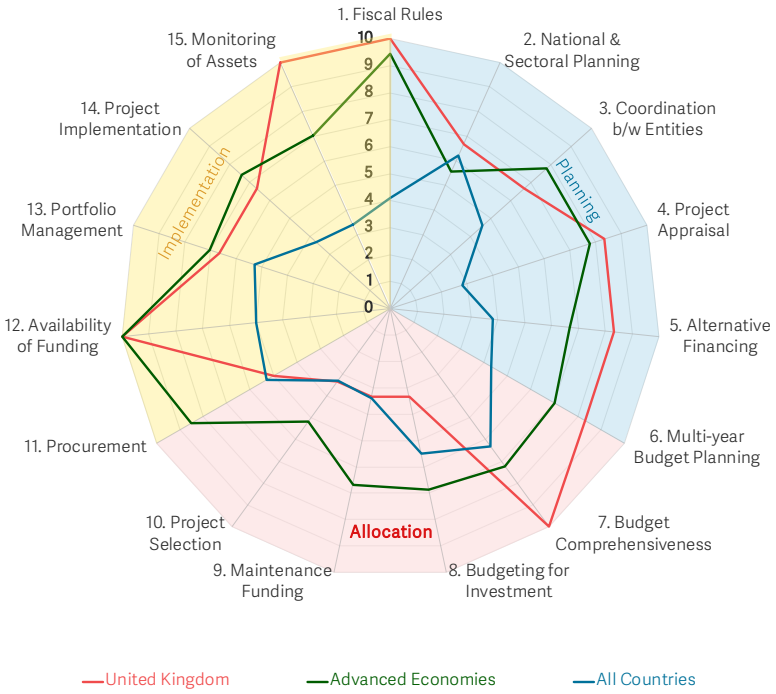
Evaluating the UK's public investment management arrangements

Applying the PIMA framework to the UK suggests that the overall quality of the UK's public investment management arrangements is similar to that of other advanced economies – with an overall PIMA score of 7.4, compared with and advanced country average of 7.3 out of 10 (Figure 22). Within this, the UK has relative strengths in the area of long-term investment planning, but significant weaknesses in processes for selecting specific projects and, to a lesser extent, implementing those projects once approved.

46 International Monetary Fund, Making Public Investment More Efficient, May 2015.

FIGURE 22: **The UK is good at planning, weak on selection and OK on delivery**

Strength of public investment management arrangements across 15 key institutions (0 = weak; 10 = strong)



SOURCE: RF analysis of Conservative manifesto, December 2019; NIC, National Infrastructure Assessment; Government Transport Investment Plan; Green Book; UKGI; OBR, Economic and Fiscal Outlook, March 2019; HM Treasury, Public Expenditure Statistical Analyses.

Public investment management strengths

The areas of strength highlighted by PIMA include a number of areas in which the UK has been considered a world leader in public financial management:

- Since 1997, the UK's **fiscal rules**, including the most recent set proposed by the new Conservative government, have typically had targeting some form of the current balance as their principal flow objective. This has allowed the government to borrow to invest subject to an overall sustainability constraint expressed either in terms of debt-to-GDP or, most recently, debt-interest-to-revenue.
- Established in 2015, the **National Infrastructure Commission (NIC)** provides impartial, expert advice on the country's major economic infrastructure requirements. This advice takes the form of a quinquennial National Instructure

Assessment (NIA), which provides a comprehensive assessment the UK's economic infrastructure needs over the next 30 years, as well as specific studies on pressing infrastructure issues.[47]

- For nearly half a century, HM Treasury's **Green Book** has represented the gold standard in project appraisal and evaluation, including cost-benefit analysis methodologies.[48] The Green Book was most recently updated in 2018, but the new Government has signalled its desire to revisit certain aspects of the guidance. These include the relative weightings given to economic versus social returns, economy-wide benefits versus reductions in regional inequalities, and short-term versus long-term costs and benefits.[49]
- Since the mid-1990s, the Treasury has also provided all Government departments with **multi-year capital budgets** which, since 2010, extend five years ahead.[50] Major investing departments such as transport in the early 2000s)[51] have been given longer-term funding guidelines covering a 10-year horizon.
- Established in 2016, the **Infrastructure and Projects Authority (IPA)** provides expert scrutiny and advice on the management and delivery of all kinds of infrastructure and major projects. The IPA also maintains the **National Infrastructure Delivery Plan and Pipeline**, setting out plans for over £400 billion of public and private investment in over 600 different economic and social infrastructure projects.[52]
- Since 2010, the UK Government has published consolidated **Whole of Government Accounts (WGA)** which capture the value of all the fixed and financial assets of over 8,000 public sector entities.[53] Around 60 per cent of these assets are infrastructure, land and buildings, and equipment, which are valued according to International Financial Reporting Standards (IFRS).
- The **National Audit Office (NAO)** has long been active in providing independent evaluation of the planning and delivery of major economic and social infrastructure projects by both the public and private sectors.

Public investment management weaknesses

Despite these institutional strengths, the UK's track record in the funding, selection and implementation of major investment projects has highlighted a number of important

47 National Infrastructure Commission, National Infrastructure Assessment 2018, July 2018.
48 HM Treasury & Government Finance Function, The Green Book: appraisal and evaluation in central government, April 2013.
49 F Islam, Can the Treasury computer say 'Yes' to northern spending?, BBC News, January 2020.
50 HM Treasury, Spending Review 2010, October 2010.
51 Department for Transport, Towards a Sustainable Transport System: Supporting Economic Growth in a Low Carbon World, October 2007.
52 www.gov.uk/government/organisations/infrastructure-and-projects-authority.
53 HM Treasury, Whole of Government Accounts, 2017 to 2018, May 2019.

institutional weaknesses. These management weaknesses are reflected in the lower score on certain dimensions of the PIMA framework as well as in evidence on the management of specific projects (Figure 22). These specific areas of weakness in public investment management are discussed in more detail below.

Inconsistent and shrinking planning horizons

Investment planning horizons vary across government and over time, and integration of national, sectoral and local planning is limited. The 30-year fiscal remit provided to the NIC applies only to economic infrastructure and for the purposes of preparing the NIA, rather than serving as a basis for planning, approval, and management of the projects therein. The practice of giving the major investing departments' longer-term funding guidelines ended in 2010. While departments were given five-year capital budgets in the 2010 and 2015 Spending Reviews (SRs), these were provided for fixed periods meaning that planning horizons shrank as the next SR round approached. Today, all departments other than health have capital budgets covering only the next 12 months and may be waiting a further eight months before they know their capital budgets for 2021-22 and beyond. As discussed in a recent Institute for Government paper by Graham Atkins, Gemma Tetlow and Tom Pope, the problem of shrinking time horizons for capital budgets is exacerbated by the Treasury's tendency to top-up or cut departments' capital budgets outside of the multi-year spending review cycle.[54]

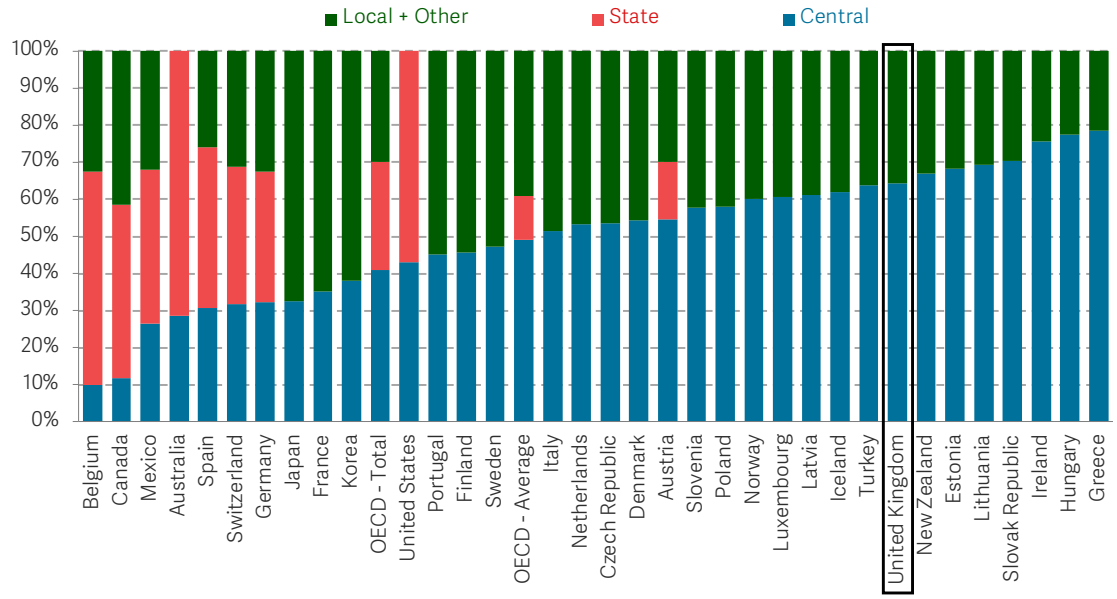
A highly centralised funding system

The UK has one of the most centralised systems of infrastructure funding in the advanced world. Local government accounts for less than 36 per cent of total general government investment in the UK, the 8th lowest among 35 OECD countries surveyed and well below the OECD average of 51 per cent, as shown in Figure 23. This partly reflects the relatively fragmented structure of subnational government in the UK, with subnational administrative structures being either too large (nation or region) or too small (local authority) to serve as a meaningful focus for infrastructure planning. It also reflects the relatively limited options available to subnational governments to raise finance for investment, either through local taxation or borrowing.

54 G Atkins, G Tetlow & T Pope, Capital investment: why governments fail to meet their spending plans, Institute for Government, February 2020.

FIGURE 23: **Public investment funding is highly centralised in the UK**

Capital expenditure by level of government, as a proportion of total general government fixed capital formation, across advanced economies: OECD



SOURCE: RF analysis of OECD.

Opaque project selection processes

While the government has one of the most sophisticated systems for project appraisal, the project selection process is relatively opaque. The government has no established criteria for project selection. Business cases (including cost-benefit analyses) for projects under consideration are not routinely published, even after the projects are given the go-ahead. While the assumptions underpinning the business cases for major projects are scrutinised by the Treasury, and in some cases the IPA (an executive agency which reports to both the Cabinet Office and Treasury), they are not routinely subjected to public scrutiny by an independent expert body prior to the commitment of funding.

Inadequate parliamentary oversight

Parliamentary oversight of major investment commitments is limited. The UK is unusual in not requiring the government to seek separate parliamentary approval of major, multi-year public investment projects. Departments are required to seek Treasury approval before committing resources to large capital projects whose total size exceed their 'delegated limit'. However, unlike in many other countries, the government is not required to seek parliament's approval before it commits significant taxpayer resources to these projects, often for a period of many years. Instead, parliament approves the annual expenditure on the project as it arises though the Supply Estimates process. Ex ante parliamentary approval is sometimes sought via so-called 'hybrid bills' (e.g. for the Channel Tunnel, Dartford Crossing and Crossrail) for major infrastructure projects that

affect both public and private interests. However, these bills are focused on granting planning permission to the project and do not include or authorise its budget.

Cost overruns and delays during project implementation

A number of major infrastructure projects in the UK have been plagued by repeated cost overruns and delays during implementation. As discussed in Box 5, these overruns can be the result of multiple points of management failure including: the lack of a clearly defined scope for the project, excessive optimism in the initial estimates of the cost of the project, the absence of a comprehensive and hard budget constraint for the project, a start-stop pattern in the granting of project approvals, and a lack of flexibility in the employment of project resources.[55]

Lack of reporting on benefit realisation

There is no systematic reporting on benefit realisation upon completion of major projects. Another way in which the value for money of a project can be undermined is through over-estimation or under-realisation of the proposed benefits. A 2018 NAO report looked at 48 of the projects which had left the IPA's Major Projects Portfolio since 2011. It found that in only 12 (25 per cent of) cases was there sufficient evidence that the project had achieved its stated objectives. While the IPA has since begun conducting exit reviews of the majority of projects leaving its portfolio, these are not published.[56]

Limited monitoring of asset conditions

Despite having some of the most comprehensive, frequent and reliable data in the world on the financial value of public sector assets, information on the physical condition of those assets is not routinely reported nor incorporated into investment decisions. For over a decade, government departments and agencies have collected data on the financial value of their fixed assets. While this information is used by the Treasury to produce a consolidated balance sheet for the whole public sector, the underlying asset surveys do not routinely inform decisions about where further investment is needed.[57]

Strengthening public investment management

Addressing the management weaknesses identified above will require stronger institutional arrangements at each stage of the public investment cycle. Addressing the public investment management weaknesses discussed above requires reforms to institutions and practices in order to:

55 A more comprehensive overview of the causes of poor megaproject performance across countries, based on a literature review of 86 papers on the subject, is found in: J Denicol, A Davies, & I Krystallis, What are the causes and cures of poor megaproject performance? A systematic literature review and research agenda, Project Management Journal, February 2020.
56 National Audit Office, Projects leaving the Government Major Projects Portfolio, October 2018.
57 HM Treasury, Whole of Government Accounts.

- Provide a more stable and devolved framework for medium and long-term **investment planning** across levels of government;
- Take a more transparent approach to **project appraisal, selection and approval**; and
- Improve cost control and benefit realisation during **project implementation**.

A more stable and devolved framework for investment planning

Extending investment planning horizons

To eliminate the investment planning blight associated with current fixed-term spending rounds, investment planning horizons need to be extended, maintained and integrated across departments and levels of government. Setting a target level (rather than ceiling) for public investment as a proportion of GDP would facilitate long-term planning of both economic and social infrastructure projects across levels of government. Under such an approach:

- The government's National Infrastructure Strategy should respond to NIC's National Infrastructure Assessment. This should look a generation ahead to provide a 30-year plan for prioritising investment between broad sectors and challenges identified by the NIC.
- The Treasury should provide 10-year funding guidelines for major policy areas such as transport, housing, health, education, defence, energy and communications. This would enable central government departments, local authorities and the private sector to develop coordinated and costed investment plans consistent with those guidelines.
- Major investing departments, key agencies and cities should be given five-year capital budgets that are renewed every three years, to ensure they always maintain at least two years of funding certainty for capital expenditure.

Redressing regional investment imbalances

Reducing regional disparities in economic infrastructure will require a revision to project appraisal methods and eventually greater devolution of infrastructure funding and decision-making. The most straightforward means of reducing regional disparities in economic infrastructure would be to devolve a greater share of infrastructure funding to subnational governments. The challenge in doing so in the UK is the absence of accountable and capable institutional structures at the right level of regional aggregation outside of London, and poor central-local coordination of investment decisions (discussed in Box 2). The establishment of directly elected mayors of combined urban

authorities for Manchester, Liverpool and three other areas provides a promising locus for devolution of investment funding. Their capacity in infrastructure planning, appraisal and management needs to first be established, though work as part of the NIC's cities programme suggests that cities have more capacity in this area than they are often given credit for.[58] In the meantime, the Green Book methodology used to guide project appraisal for centrally funded projects could place greater weight on narrowing regional disparities in productivity and living standards, as opposed to maximising aggregate wellbeing. In addition, as argued by Diane Coyle and Marianne Sensier, regional development projects involving a range of different interventions (including transport, housing and business promotion) could also be appraised together to capture the potential spillovers on local regeneration arising from their combined activities.[59]

BOX 2: **Central-Local Coordination of Investment Decision-making**

Coordinating national and local government infrastructure decisions is vital both because national governments are often an important source of local investment funding, and because of the positive and negative spillovers between investments at different levels.[60] However, the UK has struggled to make central-local investment coordination work, as highlighted by a Royal Town Planning Institute (RTPI) study combining surveys, interviews and case studies of local authority (LA) planners. The study found that: [61]

- **Many LAs are too small to serve as a viable unit for multi-modal infrastructure planning**. Planning and investment at a 'larger than local' scale is vital since local authorities' boundaries do not always reflect where people live, work and travel, and schemes can have beneficial impacts across borders. Many survey respondents argued that local districts were too small to carry out strategic infrastructure planning, while integrated planning across local authorities was hindered by complex governance arrangements at different geographic scales.
- **Funding is fragmented, short-term and uncertain.** LAs want flexible long-term funding instead of ad hoc short-term bidding pots. Respondents were frustrated by the time-intensive

58 www.nic.org.uk/our-work/cities-programme.
59 See: D Coyle & M Sensier, The imperial treasury: appraisal methodology and regional economic performance in the UK, Regional Studies 54(3), 2020. Similar arguments are put forward by Tom Forth in his blog: www.tomforth.co.uk.
60 T Ter-Minassian, Promoting effective and fiscally sound local investments in infrastructure, Brookings, September 2017.
61 Royal Town Planning Institute, A smarter approach to infrastructure planning, September 2019.

and uncertain nature of seeking such funding, lack of local revenue-raising and spending power, and need to build funding packages for projects in a piecemeal way making strategic infrastructure planning difficult.

- **There is no forum for the coordination of infrastructure planning**. At a subnational level in England, infrastructure roles are held by bodies including local authorities, combined authorities, local enterprise partnerships and subnational transport bodies, with a set of different structures in devolved administrations. The abolition of Regional Spatial Strategies in 2010 left England as the only major country in North Western Europe without an effective subnational governance structure (beyond London) for spatial planning.[62] A few regional bodies such as Midlands Connect are acting as an interface between local authorities and central government.

Countries with a strong tradition of fiscal federalism have found ways of effectively managing central-local infrastructure planning, funding and delivery through:

- **Consolidation of local governments.** In 2007, Denmark combined 14 counties into five larger regions (regioner) and 271 municipalities (kommuner) into 98 to drive a stronger regional approach. Each new region created a Regional Growth Forum to steer regional development strategies and the allocation of regional funds. Annual 'Partnership Agreements' formalise national-regional dialogue and align regional initiatives and national policy goals.[63]
- **Longer-term funding.** Canada's provinces, territories and municipalities own over 95 per cent of public infrastructure.[64] The 2014 New Building Canada Fund gave provinces and territories certainty on federal infrastructure support over 10 years.[65] Each received $250 million and an additional per capita allocation from the $10 billion 'Provincial-Territorial Infrastructure Component' for major infrastructure projects, of which $1 billion was reserved for communities of fewer than 100,000 residents.[66]
- **Coordination of spatial planning.** Vertical coordination of strategic planning in Austria is enabled through the Austrian Conference on Spatial Planning (ÖROK) which acts as an interface between federal, state (Länder) and municipality for decisions on regional polices and the

62 D McGuinness & J Mawson, The rescaling of sub-national planning: can localism resolve England's spatial planning conundrum?, Town planning review 88(3), 2017.
63 Organisation for Economic Co-operation and Development, Effective Public Investment Across Levels of Government: Denmark.
64 www.infrastructure.gc.ca/plan/cs-pc-eng.html.
65 The federal contribution is typically for one-third of project costs, with exceptions including for major roads and disaster mitigation projects.
66 www.infrastructure.gc.ca/plan/nrp-pnr-prog-eng.html.

EU's Structural Funds programmes. The executive body, where decisions are made by consensus, is chaired by the Federal Chancellor, and comprises all federal ministers, Länder governors, Presidents of the Austrian Union of Towns and the Austrian Union of Communities, and advisors from social and economic partner organisations.[67]

More transparent project appraisal, selection and approval

Recognising climate change risks in project appraisal

Prioritising tackling the longer-term challenge of climate change will require a more explicit recognition of the growing cost of doing nothing, and the wider benefits of doing something. As discussed in Box 3, investment project appraisals are typically conducted against a business-as-usual (BAU) baseline in which current conditions remain unchanged. However, climate change-related investment needs to be evaluated against a baseline in which rising global temperatures impose growing environmental, economic and social costs on society, with potentially irreversible consequences. All things equal, this would tip the balance in favour of investment options that help reduce carbon emissions. Moreover, because investments in climate change mitigation benefit not only the UK but also the rest of the world, these global spillovers may be underestimated or overlooked in conventional cost-benefit analysis. Finally, investments in climate change mitigation need to take account of wider efforts in the areas of taxation, regulation and subsidies which can magnify their impact on carbon emissions. Taking account of the growing and irreversible costs of the BAU scenario - and the global and potentially transformational benefits of taking action - would help to provide a better reflection of the net benefits of investments in climate change prevention and mitigation.

BOX 3: **Capturing climate change risks in project appraisal**

The UK's 'Green Book' manual on project appraisal and evaluation is an international benchmark for cost-benefit analyses (CBA) of public policies. [68] Its guidance on the calculation of the Net Present Social Value (NPSV) of alternative interventions requires that all impacts (social, economic, financial and environmental) be assessed relative to continuing with what would have taken place ('business as usual' or BAU). The Green Book already provides supplementary guidance on recognition of non-monetary environmental costs and benefits and on accounting for

67 Organisation for Economic Co-operation and Development, Effective Public Investment Across Levels of Government: Austria.
68 HM Treasury, The Green Book: Central government guidance on appraisal and evaluation, 2018.

climate change.[69] However, as we discover more about the consequences of climate change, methodologies for environmental impact analysis develop, and the effects of climate change begin to manifest themselves, there is a need to update the Green Book and related guidance in the following areas to ensure climate risks are fully captured in investment decisions:

- **Adaptation vs. mitigation**: The Green Book's supplementary guidance on climate change dates from 2009 and focuses mainly on adaption of conventional infrastructure projects. For example, its only case study looks at making the Thames Barrier resilient to sea level rises. This guidance should be updated to provide more advice on evaluation of projects aimed at climate change mitigation.
- **Discount rates**: NPSV calculations involve comparisons of costs and benefits over the life of the asset or intervention, which requires a rate for discounting the future. The Green Book includes a standard discount factor based on an estimated social time preference rate (STPR) of 3.5 per cent, which declines beyond 30 years to 3 and then 2.5 per cent after 75 years. A lower STPR of 1.5 falling to 1.07 per cent is allowed for interventions that have effects on human life or health. A more rapidly declining STPR is used for evaluations involving irreversible wealth transfers between generations but remains relatively high (above 2 per cent) even after 75 years.[70] Given its potentially catastrophic welfare consequences, it would seem appropriate to use an STPR at least as low as the 'health' STPR for interventions that exacerbate or mitigate climate change. [71]
- **Business as usual**: The costs and benefits of interventions are compared against a BAU counterfactual which is often taken to mean 'no change.' However, for any activity which contributes materially to climate change, BAU involves rising costs to the economy and society which should be captured in the CBA baseline.
- **Scope of costs and benefits:** Green Book guidance limits the scope of costs and benefits captured in NPSV to those which impact UK society. However, UK reductions in carbon emissions have important spill-over benefits for the rest of the world (directly in the form of less global warming, indirectly via development of new technologies which could

69 HM Treasury, Green Book supplementary guidance: Environment, April 2013.
70 HM Treasury, Green Book supplementary guidance: Intergenerational wealth transfers and social discounting, 2008.
71 A lower discount rate averaging 1.4 per cent and declining to 0.1 per cent over 300 years was used in the 2006 Stern Review. This proved controversial with some other economists. See W Nordhaus, The 'Stern Review' on the economics of climate change, NBER Working Paper No. 12741, December 2006. Nonetheless Ireland's National Economic and Social Council has recently proposed a lower discount rate of 1.7 per cent be used for climate change-related effects. See: National Economic and Social Council, Cost-benefit analysis, environment and climate change, NESC Secretariat Papers, Paper No. 10, November 2018.

be taken up by other countries, and via a demonstration effect). These global benefits from UK climate change mitigation efforts, and costs of continued UK carbon emissions, should also be captured.

- **Marginal analysis vs. systemic transformation**: Narrowly-cast CBA may be an inadequate way to capture the full implications of the systemic changes required to transition to a low-carbon economy. CBA is typically used to make marginal decisions about specific investment projects. Climate change mitigation requires a range of investments (in energy, transport, housing and enterprise) and other interventions (taxes, subsidies and regulations). Individual projects should be evaluated not for their stand-alone cost-effectiveness but on whether they are an efficient element of a wider strategy for transitioning to a low-carbon economy.

Greater transparency around project appraisal

Business cases and CBA for all major projects should be published prior to their approval and commencement. This would improve not only the transparency of decision-making but also the quality of the supporting analysis. As discussed above, the UK has one of the most developed methodological frameworks for project appraisal, including CBA, based on the Green Book. However, unlike in other countries, CBAs for major investment projects are not routinely published. This reduces the opportunities for public and parliamentary scrutiny of the analysis underpinning significant commitments of public resources. It also makes it easier for these decisions to be driven by political rather than social welfare considerations.

Independent scrutiny of project appraisal

The NIC should be required to certify the analysis underpinning the business cases, including the BCRs for all projects above a certain size that fall within their remit.[72] As discussed in Box 4, a number of advanced countries, including Australia and Norway, make use of independent institutions to publicly validate the economic and financial assumptions underpinning the business cases for major investments *before* the projects are given the go-ahead. In the UK, the National Audit Office's rule in auditing the ex-post performance of major projects rules them out of any ex-ante involvement in the decision-making process on conflict of interest grounds. The IPA was established to provide internal and confidential challenge and support concerning project governance and management and is therefore not well suited to provide this independent check either.

72 The NIC's remit covers energy, transport, water and wastewater, waste, flood risk management and digital communications.

The NIC has the both expertise and breadth to provide such scrutiny for major economic infrastructure projects which account for most of the largest discrete investment projects. Were it to take on this role, its independence from government would need to be bolstered by putting it on a statutory footing, providing it with security of resources, and giving parliament a role in the confirmation of its leadership.[73]

BOX 4: **Independent Scrutiny of Project Selection**

While independent fiscal councils (like the UK's OBR) play an increasingly important role in scrutinising official economic and fiscal forecasts and the costing of government policies, relatively few countries make use of independent institutions to scrutinise the economic and other analytical assumptions underpinning major investment decisions. A number of countries have established specific bodies responsible for facilitating long-term investment planning (like the UK's NIC) or supporting project delivery (like the UK's IPA), but are these typically executive agencies of the ministry of finance or prime minister's office with no legal independence from government and no formal role in the appraisal of specific project proposals.

Two exceptions to this are Australia and Norway, both of whom make use of independent evaluation of the business cases and cost-benefit analyses underpinning proposed investment projects before they are approved by the government.

Infrastructure Australia: Infrastructure Australia (IA) is an independent statutory body established in 2008 by the Federal government. It conducts an independent evaluation of project proposals for all infrastructure proposals where funding of more than $100 million is sought from the Commonwealth (excluding defence projects). In 2018-19, IA conducted 11 business case evaluations, using discounted cash flow modelling to generate their own cost-benefit analysis and provide an independent estimate of net benefits for each project. Their evaluations are published on the IA website and open to public scrutiny. IA also provides a best-practice guide for business case development and runs Business Case Improvement workshops focused on improving cost-benefit analysis.[74]

73 The Institute for Government recommends giving this function to the Infrastructure and Projects Authority. See: G Atkins, N Davies, & T Kidney Bishop, How to value infrastructure: Improving cost benefit analysis, Institute for Government, September 2017.

74 www.infrastructureaustralia.gov.au.

Independent Quality Assurance in Norway: Responding to chronic cost overruns, delays and quality standard failures in major projects, the Norwegian government launched a Quality Assurance (QA) process for public investment projects in 2000. [75] In its current form, all public investment projects with an expected budget of NOK 750 million (£63 million) are subjected to a compulsory QA conducted by one of six selected independent consultancy organisations at two stages:

- The first independent review (QA1) is performed at the end of a pre-study phase before the Cabinet decide to commence a pre-project phase and is intended to ensure that the choice between alternative concepts and decision to proceed to the next phase are subject to political control and based on high-quality documentation. Independent consultants review inputs from the ministry or agency (including alternatives in the form of cost-benefit analyses) and conduct their own uncertainty analysis and cost-benefit analysis, providing recommendations on ranking of alternatives and decision strategy.
- The second independent review (QA2), focused on cost, is carried out after the pre-project phase, before the project is submitted to Parliament for approval. It includes independent quantification of uncertainty in the cost estimate, and recommendations for the project cost frame, contingency reserves and cost-management approach.

Analysis of cost overruns for large road projects before and after the QA regime suggests that there has been a reduction in cost overruns and that the estimates of independent consultants are more accurate than those of the authorities.[76]

Clearer thresholds for project selection

The Treasury should specify clearer ex ante criteria for project selection, including one or more indicative thresholds for the BCR of major projects under consideration. One of the challenges in using cost-benefit analyses to make investment allocation decisions is that most projects under consideration have positive BCRs. The key question is where to draw the line among a range of projects all of which offer net social benefits. For private listed companies, their weighted average cost of capital (WACC) provides a starting point for calculating a hurdle rate for evaluating alternative investments, often adjusted for the risks associated with those investments. In the public sector, the threshold value

75 www.ntnu.edu/concept/qa-scheme.
76 E Odeck, M Welde & G Volden, The impact of external quality assurance of cost estimates on cost overruns: Empirical evidence form the Norwegian road sector, European Journal of Transport and Infrastructure 15(3), 2015.

depends more upon overall resource constraints (where most government income comes from taxes rather than commercial activities) and opportunity costs (where there are many competing demands on those resources). Such threshold values have been articulated by some public institutions, such as the Department for Transport, but have never been used by the Treasury or centre of government to justify its choice of projects within or across different sectors.[77]

Parliamentary approval of the total budgets for major projects

Parliament should authorise the total budgets for all major investment projects with an affirmative vote required for those with BCRs below the government's hurdle ratio. Given the fact that such projects can tie up large sums of public money for an extended period of time, parliament should approve the entire multi-year budgets for major infrastructure projects at the time they receive the formal go ahead via a hybrid bill or other mechanism. This could be done as part of the hybrid bill itself or another legal mechanism, enable project managers to commence work immediately upon approval, and improve discipline and accountability in the use of public funds. Were a given project's NIC-certified BCR to fall below the government's established threshold, an affirmative resolution could be required to authorise capital for this purpose – raising the bar for approval of low value-for-money projects.

Better cost control and benefit realisation during implementation

Budgeting for major projects

Managers of all major investment projects should be given fixed, realistic, multi-year budgets covering the life of the project. Requiring parliament to authorise the full cost of the investment project would help to ensure that project managers are given comprehensive budgets. It would also help to address the problem of stop-go authorisation that has undermined efforts at whole-of-life planning and contracting of delivery partners. These comprehensive budgets should include full provision for the standard levels of optimism bias inherent in projects of a similar type, as certified by the NIC. Managers should also be given full flexibility to move money within those budgets between years, activities and delivery agents to meet project costs and mitigate risks as they arise.

77 In evaluating alternative projects, the Department for Transport's Value for Money Framework considers projects with a BCR greater than 5 to be 'very high,' between 2 and 4 to be 'high', between 1.5 and 2 to be 'medium', between 1 and 1.5 to be 'low', between 0 and 1 to be 'poor', and less than or equal to zero to be 'very poor.' See: Department for Transport, Value for Money Framework, July 2017.

BOX 5: Lessons from Major Project Implementation in the UK

The UK has a mixed record in the management of major infrastructure projects. In its review of the London 2012 Olympic and Paralympic Games, the NAO praised the Games' success and value for money, noting specifically that the "scale of the construction programme and the fact that it was completed on time and within budget is impressive".[78] By contrast, some of today's biggest infrastructure programmes are facing cost overruns and delays, including Crossrail, currently forecast to be three years late and £2.8 billion (19 per cent) over budget,[79] and HS2 which is now expected to cost anywhere between 20 and 70 per cent more than the initial £62.4 billion budget with the first phase delayed by between three and five years.[80] With the government set to spend even greater sums on infrastructure, what can be learned from these successes and failures to guide delivery of major projects in the future?

Set a clear, realistic budget with adequate contingency upfront. London 2012 is widely remembered for coming in within its £9.3 billion public sector funding package. In fact, its budget of £4.1 billion at the time of the bid was far too low (partly a result of a lack of scrutiny of a bid thought unlikely to win). It took two years after that point to agree a new budget. This time, though, it was reached in a process characterised by openness between Treasury, Department for Culture, Media and Sport and the Olympic Delivery Authority (ODA), and included a generous contingency provision to provide certainty and make further renegotiation unlikely.[81] HS2, by contrast, has been criticised for optimism bias throughout the budget-setting process. In 2012, a Department for Transport (DfT) review justified accepting HS2 Ltd's optimism bias provision of just 34% compared to the standard 66% for the most complex projects[82]. The NAO found that even revised estimates in 2017 did not allow for the degree of risk and uncertainty in the programme, and assumed delivery of efficiencies without changes in approach to deliver them.[83]

Balance freedom and flexibility with accountability and transparency. The London 2012 programme had clear financial accountability, strong incentives for reducing costs, and effective management of contingency

78 National Audit Office, The London 2012 Olympic Games and Paralympic Games: post-Games review, November 2010.
79 National Audit Office, Completing Crossrail, May 2019.
80 Oakervee review of High Speed 2, December 2019.
81 E Norris, J Rutter, & J Medland, Making the Games, What government can learn from London 2012, Institute for Government, January 2013.
82 Department for Transport, The economic case for HS2: Value for money statement, January 2012.
83 National Audit Office, High Speed Two: A progress update, January 2020.

and risk budgets. The Government Olympic Executive was empowered to make decisions on the reallocation of reductions of cost and risk in the programme that, combined with incentivisation, created a culture of cost awareness and accountability. This was accompanied by an 'open book' approach with the Treasury, building trust and confidence. For Crossrail and HS2, the balance between autonomy and government oversight may have shifted too far. DfT accepts that its governance arrangements for Crossrail were not commensurate with programme risks and that the autonomy afforded to Crossrail Ltd restricted the department's ability to understand and challenge the process.[84] The openness of the Olympic project has not been replicated for HS2 either, with allegations of a culture of secrecy around costs.[85] The IPA has highlighted the importance of culture, and the role of transparency in creating the right behaviours.[86]

Challenge optimism bias with intense planning and scrutiny throughout. London 2012 delivery was characterised by detailed planning and multiple layers of internal and external assurance of delivery plans, risks and contingency planning. The ODA also resisted the temptation to innovate, preferring to use proven systems. While arguably of a different level of technical complexity, both Crossrail and HS2 have underestimated complexity and overestimated delivery capability. The NAO found that the over-optimism that allowed Crossrail Ltd to believe as late as July 2018 that the central section would open in December that year was prevalent throughout. The NAO found that the organisation did not have a fully integrated plan for completion of the programme nor the skills required to understand the full scale of the risks and challenges involved in systems integration. As infrastructure projects are increasingly technically complex, time for systems testing, clear accountability for systems integration and controlling complexity will be increasingly important.

Ex-post evaluation

All major projects should be subject to published ex-post evaluation of realised costs and benefits with findings systematically incorporated in the planning of future projects. Project cost or delivery overruns can result from failures at various stages of the

84 House of Commons Committee of Public Accounts, Completing Crossrail, July 2019.
85 G Plimmer, Why HS2 rail line is way over budget and badly delayed, Financial Times, September 2019.
86 M Vickerstaff, Adapting our approach: Three lessons learned for future infrastructure delivery, Infrastructure and Projects Authority, April 2019.

investment management cycle. However, major projects are not systematically subject to post-completion reviews to identify recurrent sources of error or oversight. A 2013 NAO review found that out of 15 major spending departments, only two (the Department for International Development and the Department for Transport) had published evaluation strategies.[87] However, even these existing strategies focused on providing a progress report on the range of different evaluations the department was undertaking, rather than seeking to extract common lessons or implications from those evaluations. More systematic studies of projects have occasionally been undertaken, such as the 2002 study commissioned by the Treasury into optimism bias in cost estimates of major procurement projects.[88] However, it is not clear that the lessons from this study are rigorously applied to the costing of major projects.[89] Either the NAO or IPA should be tasked with the publication of quantitative ex-post evaluations of the implementation of major projects to identify the sources of significant cost or time over-runs or under-realisation of benefits relative to initial business cases, and make recommendations for how these can be avoided in future projects.

Reporting on asset conditions and performance

Departments should report not only on the value of their fixed assets but on their condition and performance against benchmarks for quality and access. To ensure that investment decisions focus not only on financing new projects but maintaining and getting the most out of the existing asset stock, major investment departments should conduct periodic surveys of the quality of their asset base. An example of such a survey was the Education Funding Agency's 2015 Property Data Survey Programme, which provided a comprehensive overview of the estates of almost 19,000 schools and 85 per cent of all schools in England.[90] It found that 94 per cent of estates surveyed were in either 'good' or 'satisfactory' condition, and assigned priority ratings for remedial investment in those areas of the estate that fell below established standards. Conducting such surveys in the lead-up to multi-year Spending Reviews can help to ensure that up-to-date estimates of maintenance and remediation needs are factored into forward investment plans.

87 National Audit Office, Evaluation in Government, December 2013.
88 Mott MacDonald, Review of Large Public Procurement in the UK, July 2002.
89 For example, a 2012 DfT review accepted HS2 Limited's proposed reduction in the total optimism bias provision from the standard 66 per cent for the most complex projects to 34 per cent. See: Department for Transport, The economic case for HS2: Value for money statement, January 2012.
90 Education Funding Agency, Property data survey programme: Summary report, January 2015.

Section 6

Conclusion

Britain needs more public investment

Britain needs to invest more in its public infrastructure - to reverse the legacy of past underinvestment, address regional economic disparities, and meet the economic and environmental challenges of the future. Despite a modest and fitful recovery in the past two decades, the UK's current level of public investment and stock of public assets remain low by both international and historical standards. The legacy of past underinvestment is especially evident in the UK's relatively poor performance on indicators of transport efficiency and regional connectivity, availability of hospital beds and diagnostic equipment, access to good quality affordable housing quality and prison capacity. In addition to addressing these existing pressures on our economic and social infrastructure, the UK government also needs to invest in new areas in order to mitigate and adapt to climate change, retain our competitive advantage following our departure from the EU, and take advantage of smart technologies to get more from infrastructure networks.

But three may not be the magic number

Meeting these investment needs and responding to these challenges over the next five years would require a more investment-friendly set of fiscal rules than the ones proposed by the government. The government's proposed fiscal rules would limit public sector net investment over the next five years to an average of 3 per cent of GDP, which would be sufficient to match international levels of public investment. However, it would not enable the government's capital spending to reach the 3.4 per cent of GDP needed to deliver a more comprehensive and balanced portfolio of investments that levels up transport investment between regions, reverses the legacy of past underinvestment in social infrastructure, and delivers on climate change and R&D targets.

We need a more investment-friendly fiscal framework

Anchoring the fiscal framework around an objective to increase public sector net worth would not only allow the government to fund these additional investments, but would also place greater focus on the quality of the assets being created. A target to improve net worth over the next five years would allow the government to fund a more comprehensive investment plan which balances levelling up of transport investment between regions with revitalising our hospital, housing and prison estates, and meeting commitments to increase research and development spending and deliver net zero carbon emissions by 2050. By capturing not only the debt incurred to finance those investments but also the value and quality of fixed, financial, and intangible assets created, targeting public sector net worth would also bring a stronger focus on the returns on investment.

But we also need to get a better return on that investment

Realising the full economic, social and environmental returns on this increased investment will require improvements in the way in which infrastructure projects are planned, selected and executed. The UK is a relative efficient public investor by international standards, but it still loses around 10 per cent of the potential value of its investments relative to the most efficient advanced economy. And investment decision-making in the UK is plagued by inconsistent planning horizons, a highly centralised funding model, opaque project selection processes, a stop-start pattern of project approvals, chronic cost and timing overruns on major projects, a lack of systematic ex-post evaluation, and inadequate monitoring of asset conditions. Strengthening its public investment management system could significantly increase the punch Britain gets for its public investment pound.

This requires better investment management

While the UK is a world leader in the areas of investment needs analysis, project appraisal, capital budgeting and asset accounting, institutions and procedures fall short of international best practice in a number of areas. Reforms in the way we manage public investments are needed at three key stages of the decision-making cycle:

- At the planning stage, there is a need to provide longer funding guidelines for sectoral and regional investment planning, devolve more investment funding to metro mayors, and place greater weight on narrowing regional economic disparities in the allocation of central funding;
- At the project selection stage, project appraisal methodologies need to more

comprehensively account for the costs and benefits of climate change investments, business cases and cost-benefit analyses need to be published and subjected to external scrutiny by a more independent National Infrastructure Commission against criteria and thresholds set by the Treasury; and

- Regarding the execution of major investment projects, parliament should authorise the total budgets for the projects as part of a hybrid bill or other legal mechanism, project managers should be given flexibility to manage resources within this total envelope subject to meeting key delivery milestones, there should be routine ex-post evaluation of realised costs and benefits upon completion, and regular reporting on the condition and performance of the assets created.

Annex 1 – Infrastructure quality measures

a. Economic Infrastructure Index - metrics and data sources

Metric	Description	Source	Time period	Country coverage /34 [/G7]
Domestic transport				
1. Road connectivity	Road Connectivity Index (ave. speed & straightness of driving itinerary connecting the 10 or more largest cities that together account for at least 15% of the economy's total population)	WEF Global Competitiveness Report 2019	2019 report	34 [7]
2. Road quality	Response to the survey question "In your country, what is the quality (extensiveness and condition) of road infrastructure?"	WEF Global Competitiveness Report 2019	2019 report | 2018–2019 weighted ave. or most recent	34 [7]
3. Train service efficiency	Response to survey question: "In your country, how efficient (i.e. frequency, punctuality, speed, price) are train transport services?"	WEF Global Competitiveness Report 2019	2019 report | 2018–2019 weighted ave. or most recent	33 [7]
International transport				
4. Airport connectivity	This represents the IATA airport connectivity indicator, which measures the degree of integration of a country within the global air transport network	WEF Global Competitiveness Report 2019	2019 report |2018	34 [7]
5. Air transport efficiency	Response to survey question: "In your country, how efficient (i.e. frequency, punctuality, speed, price) are air transport services?"	WEF Global Competitiveness Report 2019	2019 report | 2018–2019 weighted ave. or most recent	34 [7]

6. Seaport efficiency	Response to the survey question "In your country, how efficient (i.e. frequency, punctuality, speed, price) are seaport services (ferries, boats)?"	WEF Global Competitiveness Report 2019	2019 report | 2018–2019 weighted ave. or most recent	34 [7]
Energy				
7. Electricity supply quality	Electric power transmission and distribution losses as a percentage of domestic supply	WEF Global Competitiveness Report 2019	2019 report | 2016 estimate	34 [7]
8. Domestic energy prices	Annual prices of gas / electricity to domestic consumers before tax, weighted by mix of household consumption of gas / electricity	Prices: BEIS 'Domestic gas prices in the IEA' / 'Domestic electricity prices in the IEA' (derived from IEA 'Energy Prices and Taxes') Household fuel mix: Eurostat, Final energy consumption in households by fuel (%)	2018	17 [4]
9. CO_2 intensity	Ratio of CO_2 emissions from fuel combustion over GDP measured in constant USD at PPP91	Enerdata: yearbook.enerdata.net	2018	19 [7]
Science & communications				
10. Patent applications	Resident patent applications per capita	Patent applications: WIPO Patent Report: Statistics on Worldwide Patent Activity via data.worldbank.org/indicator/IP.PAT.RESD Population: World Bank WDI	2018	34 [7]
11. Fibre subscriptions	Fibre-to-the-home/building internet subscriptions per 100 population	WEF Global Competitiveness Report 2019	2019 report | 2017 or most recent available	34 [7]
12. Broadband average speed	Average broadband connection speed	'Akamai's state of the Internet report: Q1 2017 report',via www.oecd.org/internet/broadband/broadband-statistics/	Q1 2017	33 [7]

91 GDP expressed at constant exchange rate and purchasing power parity to remove impact of inflation and reflect differences in general price levels and relate energy consumption to the real level of economic activity.

b. Social Infrastructure Index - metrics and data sources

Metric	Description	Source	Time period	Country coverage /34 [/G7]
Health				
1. Hospital beds	Total hospital beds per 1,000 inhabitants	OECD	2018 or most recent available	34 [7]
2. MRI equipment	Total MRI per 1,000,000 inhabitants (ambulatory and hospital)	OECD. UK data from 'The NHS at 70: How good is the NHS', Nuffield Trust, 2018	2018 or most recent available	28 [7]
3. Radiotherapy equipment	Total radiotherapy equipment / 1,000,000 inhabitants (ambulatory and hospital)	OECD	2018 or most recent available	25 [4]
Education				
4. School computers	Students per computer	OECD 'Students, Computers and Learning: Making the Connection, 2015'	2012	34 [7]
5. Science lab access	8th grade access to science lab	OECD Measuring Innovation in Education 2019. UK based on 'England' data only	2015	15 [5]
6. Library access	4th grade access to school library	OECD Measuring Innovation in Education 2019. UK based on 'England' data only	2016	26 [6]
Housing				
7. Household overcrowding	Share of households overcrowded (total households)[92]	OECD 'Overcrowding rates in households across the income distribution'	2018 or most recent available	31 [7]
8. Housing cost overburden	Housing cost overburden rate for households below 60% of median equivalised income[93]	Eurostat 'Housing cost overburden rate by poverty status - EU-SILC survey'	2017	25 [4]

92 The OECD considers a household to be overcrowded if it does not have a minimum number of rooms equal to: one room for the household; one room per adult couple in the household; one room for each single person aged 18 and over; one room per pair of single persons of the same sex between 12 and 17 years of age; one room for each single person between 12 and 17 years of age and not included in the previous category; one room per pair of children under 12 years of age.

93 The percentage of the population living in a household where the total housing costs (net of housing allowances) represent more than 40 per cent of the total disposable household income (net of housing allowances). For households below 60 per cent of median equivalised income.

9. Social housing service quality	Mean value when asked 'How would you rate the quality of social housing services in your country?'	Eurofound, European Quality of Life Survey 2016	2016	23 [4]
Other				
10. Prison occupancy	Prison occupancy level (share of official capacity)	Occupancy: Prisonstudies.org. UK figure derived by weighting occupancy rate of individual nations by prison population in May 2018 (England, Wales), June 2018 (Scotland), March 2018 (N Ireland) from 'UK Prison Population Statistics', Commons Library Briefing, 23 July 2019	Most recent available	34 [7]
11. Sports facilities	Share of respondents very or rather satisfied with sports facilities in city, capital cities only	Eurostat Perception survey results	2015	22 [4]
12. Elderly care beds	Nursing and elderly home beds per 100,000 population	WHO European Health Information Gateway	2015 or most recent available	25 [4]

Annex 2 – Calculating the UK's infrastructure investment efficiency gap

Methodology

The infrastructure investment efficiency index (PIE-X) is calculated based on the methodology used by the IMF in their 2015 paper Making Public Investment More Efficient.[94] Measures of the monetary value of the public capital stock (input) are compared with an index of the quality of the infrastructure assets (output) for each country to estimate a production function representing the technical efficiency frontier for the production of infrastructure. An 'efficiency gap' can then be calculated for each country based on the vertical distance from the efficiency frontier for a given level of the public capital stock. Compared to the original IMF 2015 calculation, the sample of countries used has been limited to OECD countries, capital stock estimates have been updated to take account of the latest outturns, and the infrastructure quality index has been extended to capture a broader array indicators available for advanced economies.

Public capital stock data (input variable)

The input variable used is the monetary value of public capital stock as a proportion of GDP, taken from the IMF's Investment and Capital Stock Dataset.[95] The value of the public capital stock is estimated for 170 countries using a perpetual inventory model and based on cumulative government investment between 1960 and 2017, net of depreciation. Values for the capital stock are expressed in real 2011 US dollar terms and divided by real 2011 US dollar GDP to arrive at an estimate of the size of the public capital stock as a proportion of the economy. For the purposes of this paper, only the 34 OECD economies are included in the calculation as all other international comparisons are made relative to other advanced economies.

Infrastructure quality (output variable)

The output variable, infrastructure quality, is based on a synthetic index constructed using a basket of the 24 indicators of economic and social infrastructure quality presented in this paper and described in Annex 1. All variables are standardised, since

94 International Monetary Fund, Making Public Investment More Efficient, June 2015.
95 International Monetary Fund, Investment and Capital Stock Dataset.

they are measured in different scales, and rescaled to avoid negative values which can be produced by the standardisation. [96] The arithmetic mean of all available variables for each country is taken to produce a composite infrastructure quality index by country.

Production function (efficiency frontier)

A production function is estimated using the quadratic line of best fit between the input and output variables for the countries with the highest infrastructure quality scores for a given level of the public capital stock. These countries represent the most efficient public investors among advanced economies and include Israel, Ireland, Germany, Switzerland, USA, Korea and Japan.

Efficiency gap estimates

A public investment efficiency gap for the UK is estimated in two ways. The first takes the vertical distance between the UK's position relative to the efficiency frontier in percentage terms. The second takes the vertical distance between the UK's position and that of the most efficient country with a similar level of capital stock (in this case Germany). An average of the two values is used to generate the 10 per cent efficiency gap for the UK.

96 Standardisation takes the individual variable for the individual country minus the mean for that variable across advanced economies, divided by the standard deviation for that variable across advanced economies.

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