



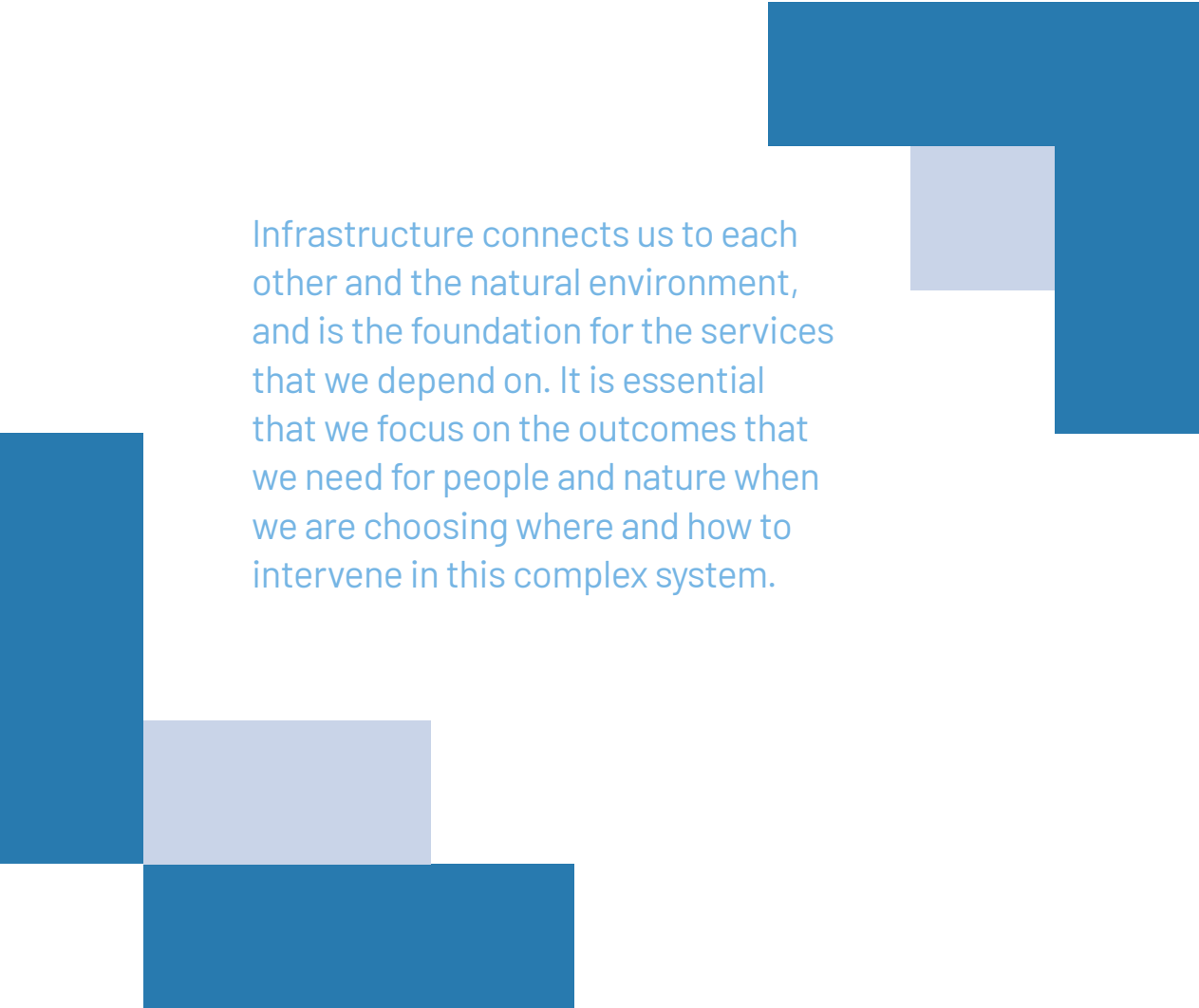
Infrastructure
and Projects
Authority

Reporting to Cabinet Office
and HM Treasury



Transforming Infrastructure Performance: Roadmap to 2030





Infrastructure connects us to each other and the natural environment, and is the foundation for the services that we depend on. It is essential that we focus on the outcomes that we need for people and nature when we are choosing where and how to intervene in this complex system.



Infrastructure
and Projects
Authority

The Infrastructure & Projects Authority (IPA) is the government's centre of expertise for infrastructure and major projects. We sit at the heart of government, reporting to the Cabinet Office and HM Treasury, and form a key part of the UK's infrastructure ecosystem:

- **National Infrastructure Commission:** established in 2015 to provide independent expert advice on the UK's long-term infrastructure needs
- **HM Treasury:** makes strategic decisions on infrastructure policy and spending
- **IPA:** drives best practice and innovation in infrastructure delivery
- **UK Infrastructure Bank:** established in 2021 to provide finance for local and private infrastructure projects

Contents

1 Ministerial Foreword – Lord Agnew and Financial Secretary to the Treasury	2
2 Introduction – Nick Smallwood	3
3 Industry statement, CLC	5
4 Purpose and vision	6
5 Building on success	8
6 Translating the vision into practice	10
7 Implementing the TIP programme	11
Focus area 1: Delivering new economic infrastructure to drive improved outcomes for people and nature	13
Focus area 2: Place-based regeneration and delivery	17
Focus area 3: Addressing the need for social infrastructure using a platform approach	24
Focus area 4: Retrofitting existing buildings to achieve net zero greenhouse gas emissions by 2050	28
Focus area 5: Optimising the performance of our existing built environment	31

8 Leading practices	35
9 Case studies	36
10 Trends and drivers	39
11 Action Plan	40
12 Implementation and next steps	50
Annex A: Progress since 2017	51
Annex B: Information Management Mandate	56
Annex C: Glossary of key terms	58
References	60

1 Ministerial Foreword – Lord Agnew and Financial Secretary to the Treasury



Lord Agnew
Minister of State at
the Cabinet Office
and Her Majesty's
Treasury

- 1.1. High quality, sustainable, resilient infrastructure is central to this government's vision for the future of the UK, as set out in the National Infrastructure Strategy and the Plan for Growth. The National Infrastructure and Construction Pipeline published today forecasts nearly £650 billion of investment in infrastructure over the coming decade.
- 1.2. Such infrastructure is critical if the Government is to achieve its long term ambitions for people and businesses across the United Kingdom: ambitions to level up across the country, strengthen the Union, meet the UN Sustainable Development Goals and put the UK on the path to net zero emissions by 2050.
- 1.3. We know the scale of the challenges we face; moving the UK to a net zero economy alone is a gigantic undertaking that has never been done before. The Government is confident in the ability and ingenuity of the people and businesses of the UK to rise to them. But for its part, government must rewire its decision making and other processes in order to embed respect for nature, better data sharing, greater safety and security for our society and a more effective long-term partnership with the private and voluntary sectors.
- 1.4. The Transforming Infrastructure Performance programme is central to this process of change. Its objectives and challenges are clear, and it falls to all of us now to step up and deliver.
- 1.5. We want government departments and their delivery bodies to think robustly about how they are translating intended outcomes into delivery. And we want our industry partners to bring forward innovative solutions that accelerate progress, to consistently deploy new technologies to improve project performance and to invest in the skills and training that will build our future workforce.
- 1.6. In developing this roadmap, we have been struck by the generosity of our partners and the collective commitment to change across government, industry and academia. The Government must now capitalise on this renewed appetite for reform, to lay firm foundations for UK infrastructure delivery well into the 21st century.



Rt Hon Jesse Norman MP
Financial Secretary to
the Treasury

2 Introduction – Nick Smallwood

- 2.1. Transforming Infrastructure Performance (TIP) is the IPA's flagship programme to lead system change in the built environment. Its purpose is to transform how the government and industry decide to intervene in the built environment, to drive a step change in infrastructure performance.
- 2.2. TIP's **Roadmap to 2030** describes a vision for the future in which we collectively prioritise the societal outcomes we need, and use modern digital approaches and technologies, alongside improved delivery

models to achieve them. Achieving that vision requires a system for designing, constructing and operating in the built environment that is more resilient, adaptive and sustainable, and that can better withstand the inevitable shifts and changes we will see in the coming decades.

- 2.3. The Roadmap builds on the progress we have made since the launch of TIP in 2017, and the landmark publication of the National Infrastructure Strategy in November 2020 and the 25 Year Environment Plan in 2018. Important steps have been taken in recent years, including resetting the Government's Major Projects Portfolio, increasing the granularity and breadth of the infrastructure pipeline, greater focus on delivery reform through Project Speed, launching the Construction Playbook, and improving discipline in project cost estimating. But there is clearly much further to go to ensure we maximise the impact of nearly £650bn infrastructure investment over the next decade, and meet the challenges of delivering infrastructure projects in the digital age, regenerating places across the UK, achieving net zero carbon and replenishing our natural environment.



- 2.4. To help define and address this transformation challenge we have developed a **Built Environment Model** with industry that draws a direct line between the outcomes we need as a society – characterised by the UN Sustainable Development Goals – and the decisions we make to build, maintain and renew our infrastructure. The Model shows how decisions on infrastructure must find balanced solutions for the natural environment, the built environment and the provision of services. The new Project Outcome Profile will be a key tool in supporting project sponsors to identify priority outcomes across these areas.
- 2.5. We have used **Focus Areas** to demonstrate the ways in which we need to change the nature of our interventions in the built environment; delivering new economic and social infrastructure, place-based regeneration, and optimising the performance of existing assets. These have been overlaid onto the Built Environment Model to show how we can apply a whole system view to decision taking.



Nick Smallwood
Chief Executive, Infrastructure
and Projects Authority

- 2.6. At the heart of the TIP Programme lies the need for a step change in productivity and efficiency in the ways we plan, design, manufacture, construct and operate infrastructure. It will require data from all parts of the system to inform decision making, from improved information management in delivery to the creation of digital twins for asset maintenance and optimisation.
- 2.7. Successful delivery will require clients and suppliers to develop and adopt new ways of working across the board; to share information and embrace new technologies that deliver better performance and more balanced outcomes across the asset lifecycle. Project leaders will need to steer innovative delivery in line with the government’s complex policy objectives, and embrace responsibility for the delivery of outcomes as well as outputs.
- 2.8. The TIP **Action Plan** sets out 5 themes for the changes that are needed to address cross-cutting issues and opportunities, and these will be managed through the TIP programme. As always, best practice in health and safety must be embedded across the supply chain and asset lifecycle. Building capacity and capability from project sponsors to the frontline will also be a critical enabler.
- 2.9. In the UK we have already advanced the use of Building Information Modelling in the creation and care of our built environment, incorporating more categories of data and integration across the different elements. However, we need to push this faster and further to apply available technology to government sponsored projects and encourage new developments. Fifth generation communications networks and Artificial Intelligence can increasingly support far greater use of digital solutions (from sensor and wireless technologies to the use of robotics and augmented reality) and significantly improve productivity.
- 2.10. As we look to the future, and a critical upcoming decade for the UK, the IPA will use the lessons and insights from the last four years of the TIP programme, and our engagement with industry, to change how government decides what to build and how to build it; not just looking at the delivery of projects and programmes to time and budget, but beyond to the successful delivery of whole life, balanced outcomes.
- 2.11. I would like to set out the challenge to industry to work with the government to grasp the opportunity for transformation described in this Roadmap, and drive the adoption of digital technologies and consistent data into the heart of our projects, to ensure we can meet the huge challenges of successful delivery together over the next decade.



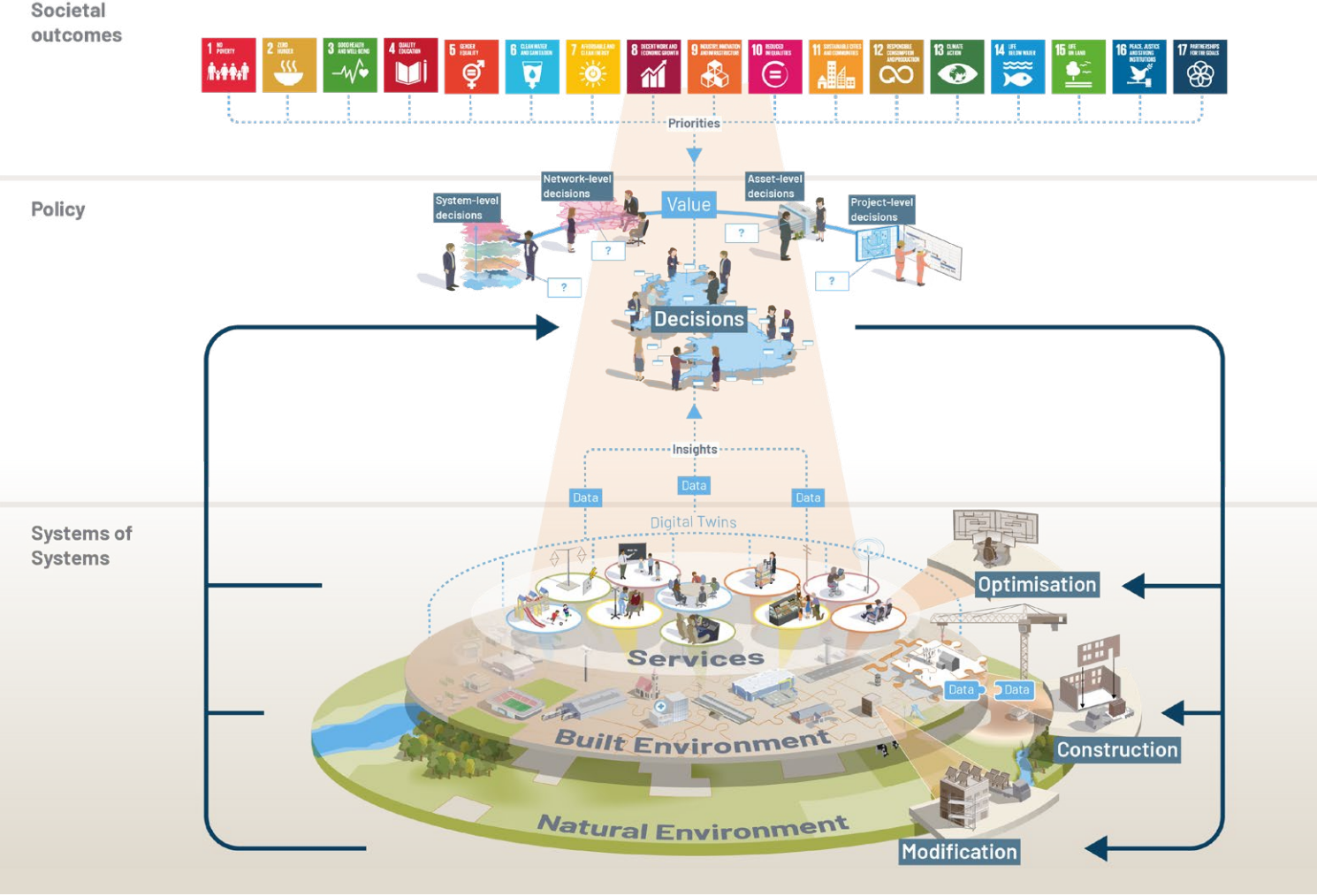
3 Industry statement, CLC



On behalf of the construction industry, the CLC welcomes the publication of the TIP: Roadmap to 2030. The industry has worked in partnership with the government to produce the Roadmap, building on the partnership that delivered the Construction Playbook and Our Vision for the Built Environment.¹ These publications set out a shared intent to improve the performance of the infrastructure and buildings the industry delivers, and also how these are delivered: by a world class industry that leaves a legacy of economic, social and environmental improvement.



4 Purpose and vision



- 4.1. The **purpose** of Transforming Infrastructure Performance is to transform how government and industry intervene in the built environment to drive a step change in infrastructure performance.²
- 4.2. Since launching TIP in 2017 there has been considerable progress in improving infrastructure performance in design and construction. This Roadmap to 2030 builds on that success and goes further to encompass the challenges of delivering infrastructure in the context of net zero³ and the wider requirements of society to balance building with the natural environment.
- 4.3. The Roadmap to 2030 presents a vision for the future where we collectively prioritise the societal outcomes we need, and use data, technology and improved delivery models to achieve them through our interventions in the built environment.

Figure 1 - The Built Environment Model

4 Purpose and vision

- 4.4. This **Built Environment Model** envisages a new approach to decision making that is founded on an understanding of the interlinked nature of our infrastructure systems. These systems provide the foundation for the services on which we all depend, and impact on the natural environment. By adopting policies and taking decisions that acknowledge the interconnected nature of these systems we can secure outcomes that maintain the right balance. [See animation here](#)
- 4.5. To support this approach policymakers, project sponsors and asset owners need to define clearly the required strategic outcomes, translate those outcomes into long term delivery strategies; balancing the impact of creating additional new built assets with the potential to maintain, renew or enhance existing ones, and measure the performance of the networks during construction and in operation to help inform future decision making.
- 4.6. The UN Sustainable Development Goals⁴ provide a basis upon which societal outcomes can be identified which address the real world problems of people and nature, providing an explicit rationale for the policies we set and the interventions that we may decide to make. Drawing the direct line between those goals and the delivery of projects and programmes on the ground requires us to collaborate digitally, to overcome cultural barriers, and to adopt more enduring delivery models and different ways of thinking about value and reward.
- 4.7. Central to our success is using the advances in technology that are now available to drive improved productivity and efficiency across the board, not only in the way in which assets are designed, built and operated but also to ensure that the goals of adaptation to climate change, net zero and environmental gain can be effectively addressed.

5 Building on success

5.1. The TIP Roadmap to 2030 builds on the progress made since the launch of TIP in 2017. It is anchored in government policy, supporting the work that has culminated in the 25 Year Environmental Plan,⁵ National Infrastructure Strategy, and Plan for Growth.

5.2. The principles that we set out in TIP 2017 remain valid and have driven positive changes in delivery performance, including:

- Benchmarking for better performance – establishing an initial **benchmarking capability within IPA** and publishing [best practice in benchmarking](#) and [Cost Estimating Guidance](#) to support better decision making across government.
- Alignment and integration – HMT’s review of the **Green Book** for evaluating investment decisions using a wider selection of benefits, implementation of the **Public Value Framework** to align decisions to priority outcomes, and updating **IPA Assurance criteria** to reflect wider priorities to support more

integrated design at the start of projects, such as the Oxford-Cambridge Arc and in the Thames Estuary. The government has endorsed the National Infrastructure Commission’s design principles for national infrastructure and committed to embedding them in infrastructure projects going forward.⁶

- Procurement for growth – the development and ongoing implementation of the **Construction Playbook** to support better informed contracting with the private sector.
- Smarter construction – supporting the delivery of the **Transforming Construction Challenge**; and progress against the **presumption in favour of offsite construction**, exemplified in the prisons building programme.

5.3. Driving modern methods of construction.

In December 2020 the IPA published [the Government’s summary response](#) to the Call for Evidence on a new approach to building – Platform Design for Manufacture and Assembly (PDfMA), including an overview of the progress made by the Departments who are committed to a presumption in favour of offsite construction. Highlights include:

- **The Department for Education’s (DfE)** Modern Methods of Construction (MMC1) framework went live in January 2020, valued at up to £3bn, it incorporates the next generation of standardised designs and methods of delivery, including panelised and component systems.
- **The Ministry of Justice (MoJ)** is aiming to increase the percentage of offsite construction on new build prisons, building on the 70% achieved at HMP Five Wells, and has developed a Modern Methods of Construction strategy that establishes a vision and structure for unlocking the delivery of better social, economic and environmental outcomes across the MoJ estate.

- **The Department of Health and Social Care (DHSC)** and NHS England/Improvement are developing and updating the Technical Standards to be set as guidance for the planning, design, configuration and delivery of healthcare buildings in the NHS in England, which will be particularly important for delivering the New Hospital Programme within the Health Infrastructure Plan.
- **The Transport Infrastructure Efficiency Strategy (TIES)** is a collaboration between the Department for Transport (DfT), its arms length client bodies and TfL that aims to deliver a step-change in the efficiency of transport infrastructure projects.
- **The Defence Infrastructure Organisation (DIO)** within the **Ministry of Defence** has embraced MMC where it represents value for money on a whole life basis and has developed Building Performance Standards which drive industry partners to apply MMC technologies.⁷ DIO will soon refresh all of its standard asset type designs to incorporate MMC and net zero aspirations into a full digital model for all new builds.

- 5.4. The Government Construction Strategy 2016-20 (GCS) set out a plan to deliver £1.7 billion efficiencies by 2020. This was delivered, with departments achieving improvements in efficiency and capability. The TIP: Roadmap to 2030 succeeds the GCS and will sit alongside the Construction Playbook and the National Infrastructure Strategy. It will end what is seen as an artificial separation between infrastructure and construction and articulate a consistent shared vision for the future of the built environment, including the role that the government plays through its construction projects.
- 5.5. The [Construction Playbook](#) will transform how the government assesses, procures and manages public works projects and programmes. It mandates 14 policies that, taken together, support: setting clear outcome-based specifications, developing new commercial models with industry, driving innovation and Modern Methods of Construction and increasing the end-to-end speed of delivery.
- 5.6. Implementation of the Playbook is essential to enabling a more efficient and innovative industry, and to driving important improvements in client capability. It will create an environment where building and workplace safety is improved, significant progress is made towards our net zero by 2050 commitment and social value is maximised. This will be a key focus for the IPA and government over the coming years and central to achieving the vision set out in the TIP Roadmap.
- 5.7. Industry and the public sector have started to use Building Information Modelling more consistently in the delivery of infrastructure and are beginning to incorporate more categories of data, such as time and cost, into our information models.
- 5.8. However, there are technical capabilities that are not yet being asked for or applied on government projects. Technology infrastructure and capabilities, from 5G networks to Artificial Intelligence, can increasingly support far greater use of digital solutions (such as sensor, monitoring and wireless technologies, robotics and augmented reality) in the delivery and operation of our built environment. Effective and more productive delivery and operations will require us to improve and accelerate our adoption of available technologies.
- 5.9. We have set out a small selection of case studies ([see page 36](#)) that showcase pockets of world class delivery using the latest digital and technology solutions, but these are not yet business as usual, and the government sees no reason why they shouldn't become so.

6 Translating the vision into practice

- 6.1. The TIP programme seeks to improve delivery and performance in the near term while also using the IPA's role at the centre of government and relationship with industry to take a longer term view. The Roadmap to 2030 does this by bringing together diverse expertise to articulate a vision for 2030 and the changes required to achieve it.
- 6.2. Drawing on best practice in futures thinking, the IPA has started to explore the trends and drivers that could shape infrastructure and major project delivery in the UK over the coming decades, and brought these back to 2021-2030. A critical driver of infrastructure performance during this period will be climate impacts and the need for adaptive capacity to be embedded in our infrastructure networks and systems. We must also work to align infrastructure and housing delivery if we are to create beautiful and sustainable communities for the long term.
- 6.3. The challenge is to use this foresight to make decisions and plans that build resilience and flexibility, and where possible, allow us to shape and adapt to the dynamic external environment. Uncertainty is a key feature of our operating environment, and our strategies, policies, frameworks and

interventions must recognise that. The IPA will lead the implementation of TIP as a cross-government change programme, in partnership with departments, industry and academia, iterating our approach as we go and championing adaptive policy making and delivery across government. This will complement cross-government efforts to improve infrastructure delivery led by HM Treasury via Project Speed.

- 6.4. To bring the vision to life and ensure it lands in practice and not just on paper, we have chosen five focus areas which illustrate the most significant opportunities and required transformations for how we intervene in the built environment. The focus areas are interconnected and aligned to the built environment model. By clicking on the links in the paragraphs below you can see how connections work.

Focus area 1: Delivering new economic infrastructure to drive improved outcomes for people and nature – [see page 13](#)

- 6.4.1. **Outcomes:** The starting point for all of our interventions in the built environment should be defining and incorporating strategic outcomes (that address a range of societal challenges – from changing patterns of use to the need for adaptation and resilience, particularly within the context of climate change) into longer

term collaborative delivery models in which industry partners are incentivised to deliver them. [See animation here](#)

Focus area 2: Place-based regeneration and delivery – [see page 17](#)

- 6.4.2. **Place-based decisions:** Strategic outcomes should be rooted in an understanding of local context and enabled by data and decision making structures that enable and support interventions that are joined-up across departmental, national, regional, and local silos. [See animation here](#)

Focus area 3: Addressing the need for social infrastructure using a platform approach – [see page 24](#)

- 6.4.3. **Platform approaches to construction:** Through platform approaches the government will generate greater societal outcomes from its pipeline, by enabling a disaggregated manufacturing industry that addresses aggregated demand, and creates stable and inclusive employment in appropriate place based contexts. [See animation here](#)

Focus area 4: Retrofitting existing buildings to achieve NZ GHG emissions by 2050 – [see page 28](#)

- 6.4.4. **Retrofitting existing assets:** Through public sector leadership and public-private collaboration and risk sharing,

the government will support the creation of a self-sustaining retrofit market with the means to adapt our buildings to address sustainability and climate change requirements, create green jobs through improvements in circular economy approaches, and respond to varying regional needs. [See animation here](#)

Focus area 5: Optimising the performance of our existing built environment – [see page 32](#)

- 6.4.5. **Optimisation:** Given finite resources, adding to the built environment cannot be our primary means of improving the outcomes we derive from it. Trusted information that allows cross-sector insight into a dynamic system must underpin the rationale for interventions that we make into our existing built environment. The effectiveness of the interventions in achieving the desired strategic outcomes must be monitored, with the relevant stakeholders incentivised to adapt the approach to achieve the optimum outcomes. [See animation here](#)

- 6.5. Each of these focus areas is a major transformation in its own right, however all five of them require common themes to be addressed to enable the TIP vision to be realised. These common themes will be addressed through collective effort, and are set out in the form of a single [Action Plan](#), describing who will do what and by when.

7 Implementing the TIP programme

7.1. The TIP Action Plan sets out measures and actions that will be required over the course of the next decade. We have organised the actions under 5 cross-cutting themes, delivery of which will involve public and private sector organisations across the industry, operating locally and nationally. The role of IPA will be to track and manage delivery through the TIP Programme.

7.2. Details of the action plan are set out [here](#) and key elements are summarised in the table adjacent.

Theme	Key Action areas
<p>Data & Insight Collect, collate, analyse and share data appropriately on infrastructure performance to provide the insight needed to improve productivity and deliver better societal outcomes.</p>	<ul style="list-style-type: none"> ■ Develop mechanisms to generate, record and store information on the design, construction and operation of infrastructure assets across public and private sectors and provide for effective shared access. Building on the Property Data Standard and development of InSite, the digital National Asset Register. ■ Support development of a future Digital Twin Mandate and the development of the IPA benchmarking hub to provide the baseline for continuous improvement, should cost modelling and carbon accounting. ■ As a first step; <ul style="list-style-type: none"> – Develop and embed agreed Construction Metrics and a Project Outcome Profile for all public projects. – Implement the Information Management Mandate. – Embed the design principles for national infrastructure in projects, programmes and portfolios.
<p>Business & Delivery Models Set up projects and programmes with governance and contracting arrangements that support cross department collaboration, industry innovation, the use of technology and delivery of balanced whole life outcomes.</p>	<ul style="list-style-type: none"> ■ Develop new delivery arrangements for cross government collaboration and governance. ■ Develop model partnerships for public and private sector delivery based on aligned principles and outcomes for design, construction and in operation. ■ Support a future mandate for Construction Platform approaches for relevant assets. ■ Harmonise, digitalise and rationalise specifications and standards. ■ As a first step; <ul style="list-style-type: none"> – Implement the Construction Playbook. – Increase uptake of government-funded R&D/innovation via the outputs from the Transforming Construction Challenge and the Construction Innovation Hub.
<p>Market Capacity & Productivity Deliver continuous improvement in the efficiency of infrastructure performance; matching the supply chain, capability and capacity to the pipeline of projects and programmes required and developing new ways of working.</p>	<ul style="list-style-type: none"> ■ Leverage the information provided through the IPA Infrastructure Pipeline to provide visibility of size, scale and nature of future projects. ■ Drive the use of technology to improve productivity and reduce risk in design, delivery and operations of infrastructure assets. ■ Invest in UK skills, technology and innovation to improve industry capacity and increase economic activity across the country. ■ As a first step; <ul style="list-style-type: none"> – Continue to improve the annual pipeline publication to include more data on workforce requirements, delivery solutions and carbon budget impact.

7 Implementing the TIP programme

Theme	Key Action areas
<p>Environment & Sustainability Embed outcomes for net zero, sustainability and environmental enhancement across the whole life of assets and systems.</p>	<ul style="list-style-type: none"> ■ Develop solutions that reduce carbon emissions during construction, operations and decommissioning of assets. ■ Decarbonise the construction industry and develop solutions that accelerate our transition to net zero and circular economy. ■ Work creatively to embed the natural environment in business models. ■ As a first step: <ul style="list-style-type: none"> – Develop and implement methodologies to measure whole life carbon performance for public projects and major built assets. – Progress Office of Government Property work to develop asset performance and sustainability metrics. – Embed resilience and climate adaptation in business cases, specifications and delivery models.
<p>Building expertise & capability Develop and deploy people with the skills, expertise and capability to act as clients and supply chain providers to deliver high quality, balanced outcomes in a complex and multi-stakeholder environment.</p>	<ul style="list-style-type: none"> ■ Continue to improve professional expertise in government, including through the Major Projects Leadership Academy and Commercial Assessments Centre. ■ Allocate expert resources to reflect project requirements/ complexity, including having dedicated project leaders for all major projects. ■ Co-develop new models for collaboration and capacity building across the public and private sector. ■ As a first step: <ul style="list-style-type: none"> – Implement best practice in cost and carbon estimation. – Deploy the refreshed Project Routemap.

7.3. The TIP: Roadmap to 2030 sets out a ten year Action Plan, but we are conscious that uncertainty will remain a feature of the operating environment and we will therefore need to be able to flex, adapt and respond. We must not rush to short term solutions, but build the frameworks, tools and expertise that will together create an environment in which transformation is possible.

7.4. Delivering the Roadmap will entail major and systemic change across the project and asset lifecycle, and this cannot be done without addressing behaviours and cultures. Our challenge is to combine shorter term interventions to improve delivery performance now, with the longer term system change required.

7.5. The government estate represents the cumulative result of investment and management decisions over many years and is a key part of this agenda. The Government Estate Strategy, prepared by the Cabinet Office in collaboration with all departments, will set the strategic direction for government property. Decision-making will be consistent

with the TIP objectives and principles, ensuring alignment with the Government Property Standard and Functional Plan.

7.6. The country has a significant pipeline of infrastructure investment to deliver, and a huge opportunity to drive better productivity, efficiency and ultimately outcomes for citizens. We will need to bring all available technologies, capability and capacity to bear if we are to succeed.

7.7. For the IPA, success by the mid-point of the decade will mean progress across all of the Focus Areas and:

- Government infrastructure projects aligned to the government's priority outcomes and set up for success to deliver tangible benefits for people and the natural environment;
- Digital-by-default infrastructure delivery, with clients and suppliers collaborating to make use of digital technologies to improve productivity, efficiency and quality; and
- Tangible improvements in skills, behaviours and delivery models to improve delivery confidence and support transformation by 2030.

Focus area 1: Delivering new economic infrastructure to drive improved outcomes for people and nature

The starting point for all of our interventions in the built environment should be defining and incorporating strategic outcomes (that address a range of societal challenges – from changing patterns of use to the need for adaptation and climate resilience) into longer term collaborative delivery models in which industry partners are incentivised to deliver them.

Problem

Too often when investing in new infrastructure, completion of the project is perceived as an end in itself. The built environment is seen as a series of unconnected construction projects, divorced from the wider system and their explicit purpose to deliver services that improve the lives of people and the natural environment in which we all live.

This approach means government doesn't always select the right projects to invest in, or deliver with a focus on improving the performance of the built and natural environment systems as a whole. Relationships with industry are often based on a narrow scope with predefined outputs rather than giving them the opportunity to offer more effective and innovative solutions. This siloed approach can also mean that government doesn't consider where the same skills are needed for different types of infrastructure projects, resulting in high demand for a limited skills base which impacts on cost and performance. It also prevents us from learning from innovations successfully adopted on other projects, thus missing opportunities to improve project delivery.

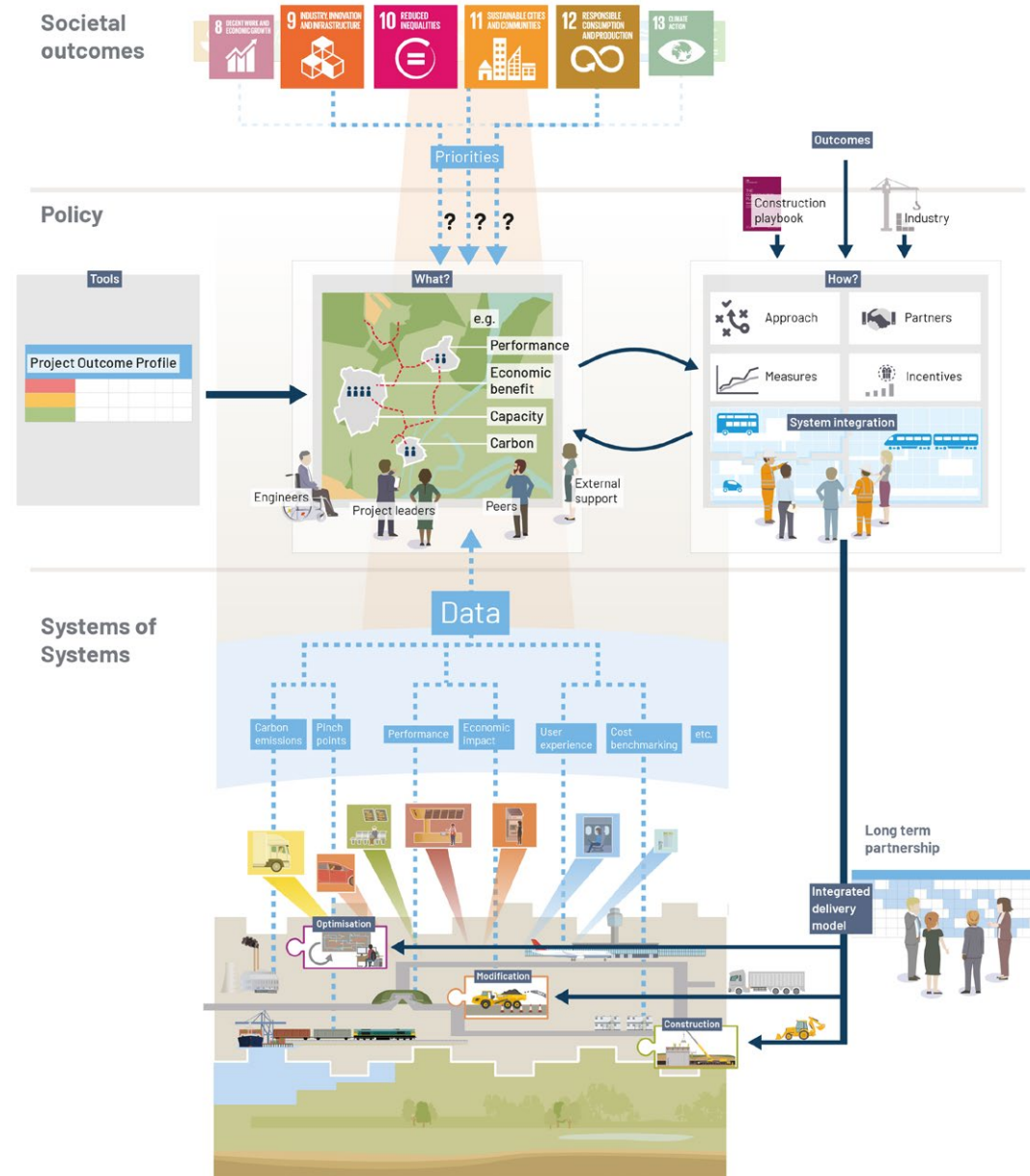


Figure 2 – Delivering new economic infrastructure to drive improved outcomes for people and nature.
[See here for a larger format](#)

Opportunity

To maximise the benefits from our significant pipeline of infrastructure investment, government must start by defining how the projects in the pipeline will contribute to the government's ambitions to level up and decarbonise the economy as set out in the National Infrastructure Strategy, alongside structured consideration of a range of delivery models. Government will need to explore ways to give industry the opportunity to offer more effective and innovative solutions and to incentivise the delivery of outcomes rather than outputs. Government will also need to leverage data more effectively, as an enabler to more effective delivery, and also as the means of determining whether the desired outcomes have been achieved.

Vision for 2030

Government and industry would have the means to define and understand the outcomes required from new assets, and to understand the integration of and interactions between new assets and the existing system. They would leverage common metrics and benchmarks to compare performance and make robust decisions on affordability. Further, government would bring these elements together to enable the formation of longer term relationships with the supply chain that incentivised the delivery of outcomes. These approaches would be supported by a mature project leadership skills base, with a digitally enabled industry becoming an increasingly attractive career pathway.

The Transformation Leadership and culture

Strong and accountable leadership is vital to the success of the government's infrastructure agenda and underpins successful delivery across every stage of the infrastructure lifecycle. Currently, delivery is primarily led by traditionally trained engineers, but anticipating a future of complex, technology-driven project environments will require a broader range of more adaptable leaders.

- **Project leadership:** The government is already investing in building the capability of its leaders through project delivery leadership programmes such as the Major Projects Leadership Academy. IPA is also injecting capacity into project leadership with the recruitment of an expert leaders pool drawing in skills and experience from the private sector to support the delivery of major projects. It is increasing activity to develop senior talent by facilitating talent/development moves across government and supporting wider ambitions for interchange with industry partners to transfer project leadership capability and build the pipeline of future major project leaders.

- **Workforce and succession planning:** Greater application of workforce and succession planning within departments, facilitated and supported by the IPA, will support better deployment of resources and skills, and also help broaden skills across the project delivery profession. The new accreditation framework for government project professionals, being introduced during 2021/22, will also increase the drive for development of expertise across the project lifecycle. Greater understanding and application of capability planning at project stage gates will see a matching of skill to the need of the project at temporal points. Strong governance and succession planning should allow project leadership to transition at agreed points whilst ensuring knowledge is not lost. The breadth of skills and expertise across the sponsor and delivery team will be considered as part of assurance reviews. To support the sustained shift in roles and responsibilities, the ICE will develop new career development pathways for leaders of complex infrastructure projects, complementing the work also underway within government, and offering potential for cross-sector collaboration on developing the future leaders of major infrastructure projects.

■ **Future skills:** A fundamental shift in the culture and makeup of the construction sector is required to make it a top choice for school leavers. It is critical this is forward looking and focuses on filling future skill needs in areas such as digital, automation, and sustainability, rather than simply filling current gaps. The [Industry Skills Plan](#) sets out the Construction Leadership Council's plans for high-quality training and development to build an industry that is a great place to work, with clear routes of entry and progression to attract and retain talented people. This starts by requiring leaders to be highly visible champions of diversity at all levels in their organisations.

New delivery approaches, including platforms and MMC offer wider benefits than just improving project delivery. They open up the construction sector to a more diverse workforce by providing a safer and more controlled working environment than traditional building sites, particularly for women and people with disabilities, who have historically been underrepresented in the sector. With more work occurring in fixed factory and manufacturing facilities, fewer workers will experience the stress of leaving their families to travel around the country to work on building sites. This can provide a more stable working environment, regular income and employment, and reduce the stress and mental health issues associated with traditional construction site working which have been serious issues for the sector.

“The Industry Skills Plan sets out the Construction Leadership Council's plans for high-quality training and development to build an industry that is a great place to work.”

Rewarding value based on outcomes

For the government to deliver on its ambitions to level up and decarbonise the economy, as set out in the National Infrastructure Strategy, decision making will need to be more focused on scrutinising whether investment will successfully deliver the government's priority outcomes. Establishing clear outcomes for assets and projects – that are aligned from strategic national priorities through to user requirements – should determine the focus for all stages of the delivery process and the way government establishes relationships with delivery partners.⁸

■ **Project Outcome Profile:** To support projects and programmes to better understand and articulate their contributions to the government's priority outcomes, the government has launched a new tool; the Project Outcome Profile. Following successful trials, the tool is now available for projects and programmes to use at the very outset, alongside Opportunity Framing,⁹ to establish clear intended outcomes. Once populated it will help to drive outcome-focussed decision making through the lifecycle. In the future, projects may also wish to use the [Value Toolkit](#) developed by

the Construction Innovation Hub and currently being tested on public, private and regulated projects by clients and industry partners. It is a suite of tools, processes and guidance to empower clients to make better informed outcome-led and value-based decisions.

■ **The Construction Playbook** represents a step change in the way the government assesses, procures and delivers public works. It sets out the need for longer-term aligned relationships with the construction sector to build a shared understanding of the whole life outcomes government is seeking to deliver, reward innovation that improves productivity and ultimately shift the sector to a more sustainable footing. Outcomes currently get lost in the emphasis on scope-based procurement. Government needs to focus on the outcomes to be delivered through investment in infrastructure by securing earlier supplier input to the development of optimised solutions and engaging with partners to deliver outcomes, not predetermined scope. The IPA will coordinate the collation of case studies that demonstrate effective collaborative delivery models, including through ongoing working with Project 13.¹⁰

■ **System level infrastructure performance metrics:** Collectively, we will need to establish a systematic framework for measuring the performance of our infrastructure in terms of the outcomes and services provided. Our current approach is limited, and does not support holistic decision-making that takes into account whole system performance and impact. Government, industry and academia will need to collaborate to develop a clear mapping between outcomes at the level of the Sustainable Development Goals and HMG priority outcomes, and the associated measures for the current performance of our infrastructure systems and networks and future interventions. Some key questions for which metrics will be required are set out in ‘Flourishing Systems’.¹¹

Feedback loops

Performance at the project, asset, network, and system level needs to be captured, quantified and openly shared, creating a virtuous circle as benefits are realised, or lessons are learnt and fed back into decision-making to support continuous improvement. The focus area for ‘Optimising the performance of our existing built environment’ sets out how Digital Twins can be used through the lifecycle of the asset.

- **Consistent Measures:** We will need more consistent measures for the delivery and operation of our built environment. In its 2018 assessment, the National Infrastructure Commission set out the performance measures needed to do this. These measures will underpin the Commission’s baseline analysis of the current state of each of the key infrastructure sectors, to be published in the Autumn.
- The IPA is leading cross-cutting work to establish consistent **Government Construction Metrics**, initially for the construction phase of public sector projects. These metrics are aligned to the government’s policy priorities and over time will create a balanced evidence base to inform future policy interventions and investment decisions.
- Later this year the IPA will also launch a new **cost and carbon benchmarking hub** and data platform, supported by recent [cost estimating best practice guidance](#), to ensure project assumptions are realistic and achievable at the outset, enabling more robust decisions at an earlier stage.

Value and benefits

Aligned outcomes and corresponding incentives:

Greater impact from investment, at the societal level as a direct result of outcome-led and value-based decisions. Greater realisation of benefits that industry can bring through innovation. Adopters of Project 13 are demonstrating how engaging partners to deliver the required outcomes and aligning reward models accordingly, enables a broader system perspective, for example opening up opportunities to incorporate the optimisation of existing assets alongside the delivery of new assets and also enabling modern methods of construction.

Improved understanding and ability to model

the impact of interventions: The role of data and digital twins in enabling us to move beyond the constraints of individuals, or single systems, to begin to understand the interactions of multiple systems (similar to how models which predict short term weather and longer term climate change consider the interactions of multiple different systems).

More attractive career pathway, an industry that is a great place to work, with clear routes of entry and progression to attract and retain talented people. The new technology and innovations in the construction sector, through far greater use of data, modelling and robotics, make it a more attractive career prospect, especially for young people.

Focus area 2: Place-based regeneration and delivery

Strategic outcomes should be rooted in an understanding of local context and enabled by data and decision making structures that enable and support interventions that are joined-up across departmental, national, regional, and local silos.

Problem statement

Our places, be they villages, towns, cities or regions, are diverse and unique. They are shaped by their location, connections, natural surroundings, history, culture, economies, and the people who live, visit and work in them. The built environment is responsive to this local context and complexity, both supporting and shaping the lives of citizens and in turn being adapted, used and reshaped by them. However, our interventions in the built environment do not sufficiently recognise the importance of local context, or the complexity of interconnected built and natural systems and the changing needs of the people that use them. The transformational potential of aligning decision-making to local assets and desired outcomes can all too easily be overlooked.

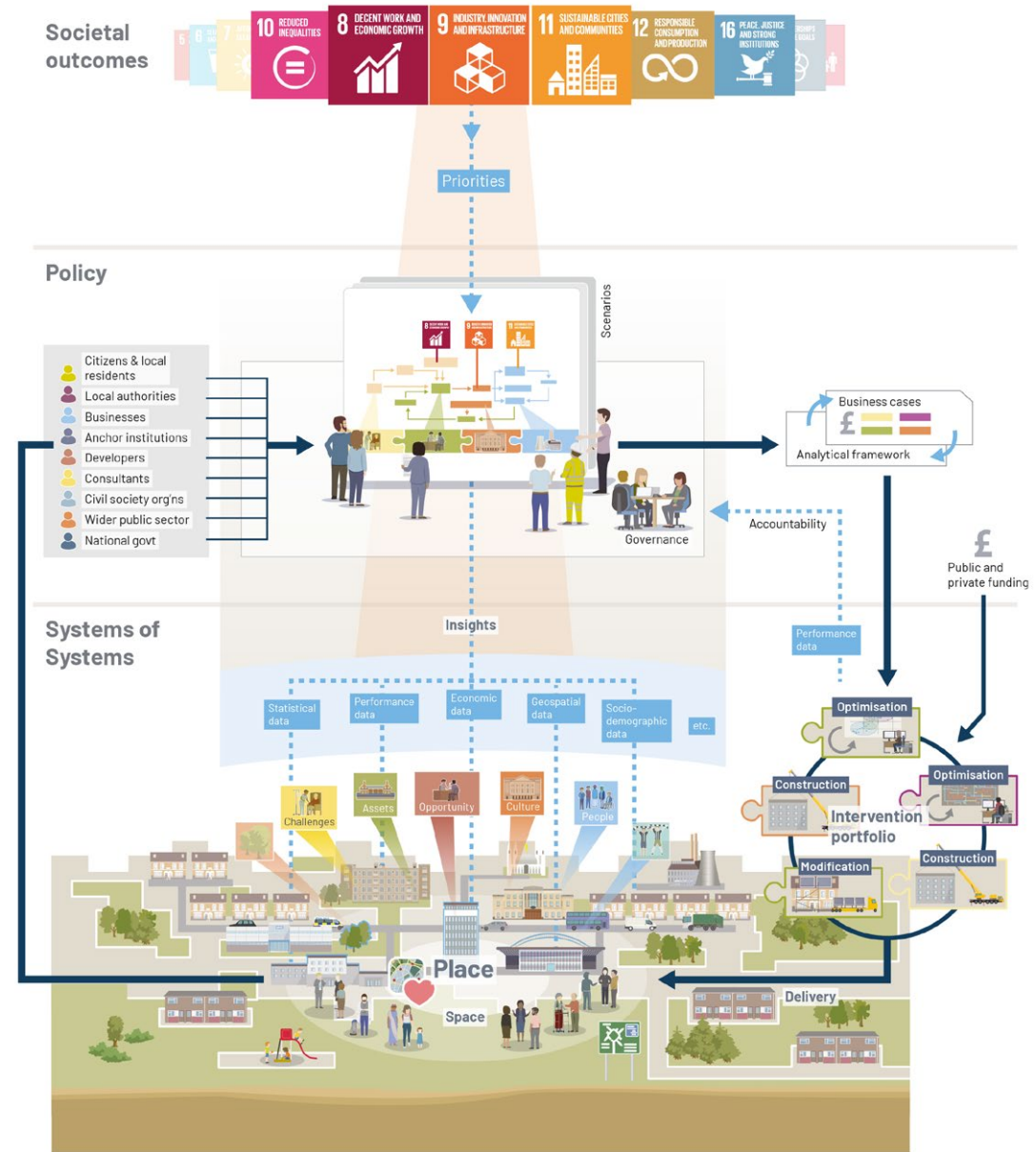
This reduces the impact of our interventions and can lead to ineffective 'one size fits all' approaches. By being unresponsive to the needs or unique features of places, we risk unintended consequences or counterproductive outcomes. We can collectively invest too little in places because we lack the analytical and policy tools to understand them properly, whilst disproportionate investment can exacerbate regional inequalities.

Opportunity

Government, civic society, businesses and communities are grappling with complex challenges that have been a long time in the making. Levelling up across the UK, achieving net zero carbon emissions by 2050, adapting to place-based climate impacts and building back better, greener and fairer from COVID-19; our policy priorities have never been so complex, nor more important to achieve.

The government is already funding the One Public Estate programme through which public sector partners have developed an approach to place-based regeneration that maximises local benefits through joint investment and planning.

Figure 3 - Place-based regeneration and delivery. [See here for a larger format](#)



Ensuring finite resources are deployed efficiently and effectively is always a priority, and this will be even more pronounced over the coming years as we build back from COVID-19.¹² More effective use of data, better engagement with local stakeholders, enhanced decision making expertise, and a reformed planning system can form the foundation for better decision-making. This foundation, when paired with integrated funding and financing, can create a system for more impactful and meaningful place-based interventions and regeneration, fit for the 21st century.

Key concepts

- **Place-based delivery** – interventions in the built environment that are shaped by the local context and delivered in partnership with local stakeholders and communities.
- **Regeneration** – a collaborative, long term process which seeks to build on the strengths and assets of a place to improve local outcomes for people and nature for the long term.
- **Local priorities and outcomes** – the translation of societal outcomes (UN SDGs) and national policy to the local context.

- **Integrated funding and financing** – the ability to align sources of funding and financing to outcomes and interventions in support of timely and effective delivery and good value for money.
- **Placemaking and design quality** – the idea that new development should be designed to fit into the life and texture of the place where it occurs, be an improvement of that place (i.e. regenerative for the physical and natural environment) and adapt to pressures such as climate change.

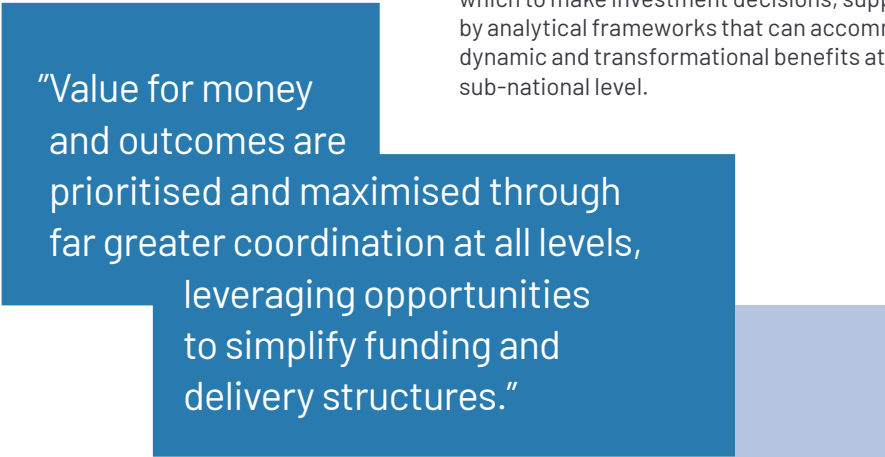
Vision for 2030

A holistic and data-enabled understanding of place and space, bringing together robust and accessible data on the local population, economy and environment, with insights and priorities from local stakeholders, to create the foundation for better decision-making and more impactful interventions.

Matrix working, across organisations, government departments and specialisms, breaks down silos and creates an environment where data and insight can be effectively translated into interventions and outcomes. Decision-makers are presented with robust business cases upon which to make investment decisions, supported by analytical frameworks that can accommodate dynamic and transformational benefits at the sub-national level.

Interventions are developed and delivered by the parties with the most appropriate mix of authority, expertise, capacity and capability. Value for money and outcomes are prioritised and maximised through far greater coordination at all levels, leveraging opportunities to simplify funding and delivery structures. Public and private investment flows into balanced portfolios of interventions, aided by an improved understanding of local assets, needs and priority outcomes. This supports policy objectives around levelling up, net zero carbon by 2050 and the 25 Year Environmental Plan, and reduces the risk of imbalanced and poorly performing portfolios.

The sophisticated and coordinated use of data, combined with inclusive decision-making structures and appropriate accountability, creates an effective and responsive feedback loop whereby local, regional and national outputs and outcomes are monitored, evaluated and fed back into the system. The emphasis on collaboration and local/regional solutions develops and strengthens new relationships between public and private sector partners, increasing resilience and supporting more effective long term planning and delivery.



“Value for money and outcomes are prioritised and maximised through far greater coordination at all levels, leveraging opportunities to simplify funding and delivery structures.”

Example: Oxford-Cambridge Arc

Spatial Framework Data Observatory Pilot

In February 2021, the government set out how it intends to develop a long-term [Spatial Framework](#) for the Oxford-Cambridge Arc. In line with the commitment made at the launch of the Spatial Framework process, we are planning to undertake wide public engagement and consultation this summer to shape a vision for the area, also seeking views on our approach to using data and evidence to support the Spatial Framework. The intention is to build a robust evidence base to inform development of the Framework, but at present data across local planning authorities, government agencies and infrastructure providers is in different formats, often inaccessible, and regularly held in documents rather than stored as data. In line with wider proposals in last year's Planning for the Future white paper, the government wants to use this

opportunity to support better use of data and digital tools in local planning and development of the Framework. The OxCam Unit in MHCLG recently completed a discovery into users and needs of the people who will use or benefit from creating a shared, open source digital evidence base across the Arc, acting as an exemplar nationally. Having built a strong understanding of the user needs in the discovery phase, we are now planning to build prototypes this summer, through the [alpha](#) phase of the project, focusing on solving the end-to-end service journey for the production of the evidence base. This digital platform will provide the basis for much more effective local and joint planning and investment, through a common, cross-boundary, standardised and accessible evidence base – and thereby encourage greater collaboration between local authorities.

Local Natural Capital Pilot

The LNCP project is the first project delivering under the Arc Environment pillar. It is a Defra Group-led project (cross-Defra, Natural England, Forestry Commission and Environment Agency), with a team hosted by the Environment Agency. It was conceived to develop a local natural capital plan (LNCP) for the OxCam Arc in order to support the delivery of environmental protection and enhancement as part of the planned growth and investment within the Arc. Within the 25 Year Environment Plan, the government committed to LNCPs, with the aim of embedding natural capital thinking into growth plans. A secondary aim of the OxCam LNCP project is to provide a scalable and replicable framework for local natural capital plans elsewhere.



Eddington, Cambridge

Transformation Leveraging Data

Robust decision making leading to impactful interventions in the built environment requires data and insight at national, regional and local levels. However, if we are to improve our understanding of place and space and make better decisions, we need to be able to generate, process and share information not only about location, but also about assets, connections, natural surroundings, history, culture, economies, and communities.

- For this to be feasible at a local level between organisations, as well as regionally and nationally, data will increasingly need to be made interoperable. The National Digital Twin programme is developing the Information Management Framework, as an enabler for the provision of the right information, at the right time, to the right people and to ensure the quality of the information is understood.
- The Information Management Mandate (see Annex B) sets out the requirements for improving information management using existing processes, standards and technologies. This will evolve to incorporate processes and standards which support greater interoperability of data and ultimately, the implementation of the Information Management Framework. Focus area five explores this in more detail.

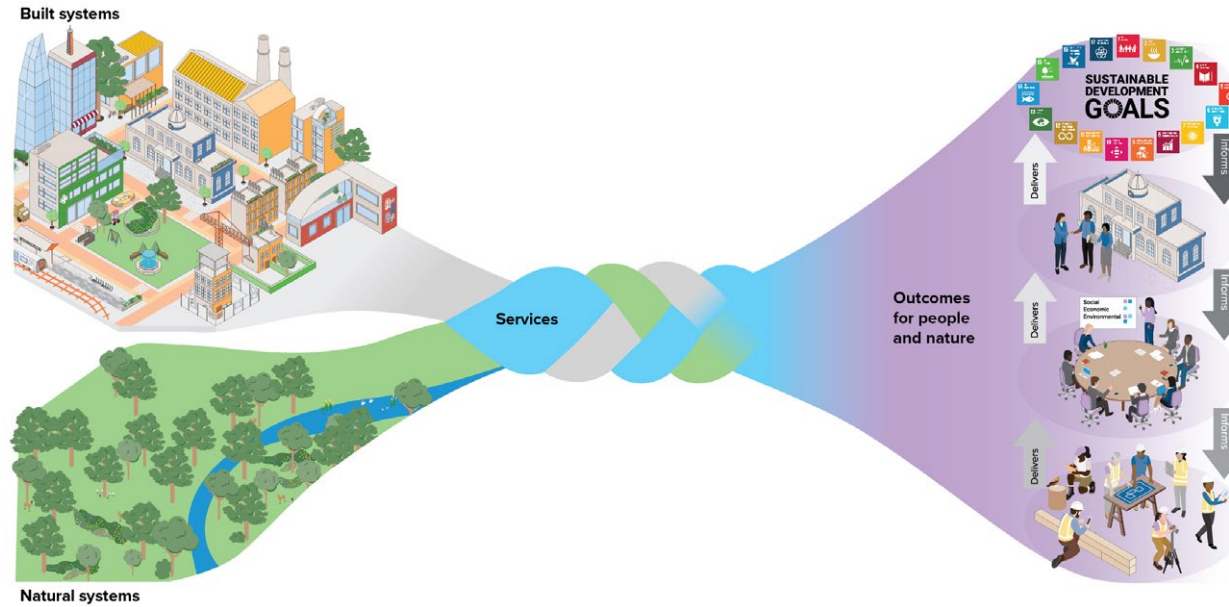


Figure 4 – Industry vision for the built environment – Source – Our vision for the built environment, April 2021

Insight and engagement

Transformational place-based delivery must be based on insight and engagement, as well as trusted data. The case for change will be shaped by national policy priorities and frameworks, such as the National Infrastructure Strategy, 25 Year Environmental Plan, Public Value Framework and the UN Sustainable Development Goals, and tailored to the local context. The development of local priorities and outcomes should focus initially on setting a direction of travel that is agreed by all parties and offers a reference point when examining and testing options in more detail later on.

- The National Infrastructure Commission’s **principles for effective and ambitious strategies** form a helpful framework for this process at a city level and include useful examples from across England.¹³
- At Budget 2021 the government confirmed that the NIC would be commissioned to carry out a **new study on towns and regeneration**,¹⁴ which will consider how to maximise the benefits of infrastructure policy and investment for towns in England.
- The government will bring forward a **Levelling Up White Paper** in 2021 to set out expanded devolution arrangements, building on the success of directly-elected Mayors in England.

Integrated funding and financing

Infrastructure investment can help to achieve economic outcomes by addressing constraints to growth, contributing to transformation, and by reducing differences in access and opportunity.^{15, 16}

Integrated funding and financing is critical to delivering transformational place-based interventions. The scale of public and private investment across place-based infrastructure, growth and regeneration projects represents a huge opportunity to collaborate and innovate to maximise value and impact. However, a focus on place and outcomes is not consistent with myriad funding streams administered by different teams and subject to different rules and criteria. Public value is maximised where funding is aligned to outcomes in the context of long term and stable policy-making, and is deployed as efficiently and effectively as possible.



Figure 5 – integrated funding for place-based outcomes

- The new **UK Infrastructure Bank (UKIB)** will provide financing support to private sector and local authority infrastructure projects across the UK, to help meet government objectives on climate change and regional economic growth. The Bank will be able to deploy £12 billion of equity and debt capital and be able to issue up to £10 billion of guarantees, alongside a range of financing tools to support private infrastructure projects and, from the summer, offer loans to local authorities for strategic infrastructure projects.
- Through **devolution deals** in England, the UK Government has committed £7.5 billion of un-ringfenced 'gainshare' investment over 30 years for the nine Mayoral Combined Authorities, to be spent on local priorities.
- SR20 confirmed over £2.5bn for eight city regions across England from 2022/23, maintaining the government's commitment of **£4.2bn for five-year, consolidated intra-city transport settlements**.¹⁷



Example: Tees Valley Investment Fund

Following the first round of the Local Growth Fund and then the Devolution Deal, Tees Valley Combined Authority (TVCA) chose to create a 'Single Pot' – the Tees Valley Investment Fund – which consists of a wide range of funds and income from Enterprise Zones and commercial investments.

Investment decisions are made on the basis of an agreed set of outcomes that cut across all thematic areas and all contribute to the regeneration of the 'place'; including Business Growth, Education, Employment & Skills, Infrastructure & Transport, Research, Development & Innovation and Creative Place.

Key features include:

- Currently 24 funding sources (some specific, some devolved) and leveraging other funds/sources.
- One TVCA Assurance Framework setting out decision making and governance for the 'Single Pot.'
- Removes constraints from 'ring fenced' funding envelopes which allows transformational interventions to be developed and delivered across multiple themes.
- Borrowing against the fund allows TVCA to secure additional resources to bring forward large scale transformational projects.
- Working with councils to ensure TVCA funds complement and support other funds they can access e.g. Towns Fund.

Government expertise and capability

Strategic outcomes will increasingly form the basis of central government planning, and performance management will be aligned to these outcomes – with citizens and partners able to track performance through public reporting. Central government therefore has an important role to play in improving coordination across departments, for example to enable the identification of cross-cutting outcomes and metrics.

- The **Public Value Framework (PVF)** seeks to ensure that the government can deliver maximum value with every single pound spent on public services. It was integral to Spending Review 2020, where provisional priority outcomes for each UK government department were agreed and published¹⁸. These included cross-cutting and shared outcomes where closer working between departments will achieve better results.
- The **Green Book Review**, and plans by HMT to improve how the Green Book is used, will enable improved appraisal and decision-making, particularly regarding sub-national and transformational economic impacts.

Example: New 'Place Model' for local outcomes

MHCLG's Place Model Project (announced by the Chancellor of the Exchequer in late 2020¹⁹) will focus on creating a new, more efficient and effective central-local dynamic – to both drive central efficiency and join-up across government and put more power into the hands of people and places at the local level, improving outcomes for all involved.

It will do this by working with partners and local people in up to 15 selected places to scrutinise how both central and local government currently works in each – to generate an evidence base to help make smarter, more effective spending decisions in the future which will improve – and certainly not hinder – local outcomes. By acting strategically and growing our partnership over time, we will generate the energy and evidence base needed to sustain us as we travel towards a better central-local way of working.

Planning reform

The planning system needs to be better at unlocking growth and opportunity in all parts of the country, at encouraging beautiful new places, at supporting the careful stewardship and rebirth of town and city centres and of nature, and at supporting the revitalisation of existing buildings as well as supporting new development. The Information Management Framework will set the enabling landscape for the interoperable data that would provide a reliable national picture of what is happening where.

- **The Planning for the future consultation** (August 2020) proposes reforms of the planning system to streamline and modernise the planning process, move to a process driven by data, bring a new focus to design and sustainability with a greater focus on placemaking and environmental net gain, improve the system of developer contributions to infrastructure, and ensure more land is available for development where it is needed.
- In January 2021 the government published its response to the **Building Better, Building Beautiful Commission's Living with Beauty report**, welcoming the Commission's findings and proposing to implement the vast majority of proposals. This includes making beauty, design quality and placemaking a strategic theme in proposed revisions to the National Planning Policy Framework.

- The government has established a **National Infrastructure Planning Reform Programme** to refresh how the Nationally Significant Infrastructure Projects (NSIP) regime operates, making it more effective and bringing government departments together to deliver more certainty in the process and better and faster outcomes.
- **Natural England** has a key role to play in supporting biodiversity net gain for local projects, district level licensing, Local Nature Recovery Strategies and the creation and maintenance of local Green Infrastructure.

Value and benefits

Improved evidence-base for local outcomes: Data, insight and engagement enabling better understanding and consideration of local outcomes. The combination of quality location and asset data could be transformational in improving our understanding of the performance of the existing built environment and how people are engaging with it, which in turn will provide a powerful evidence base for the development of interventions that are relevant to the local context and circumstances. This will be critical to achieving long term, complex policy objectives to reduce regional inequalities, improve prosperity and wellbeing, reduce carbon emissions and enhance the natural environment.

Innovative use of data and new technology to develop and deliver quality interventions: Rapid developments in technology and processing power will continue to increase our ability to use and manipulate data and embed it in decision-making and delivery processes. Integrated, strategic and dynamic modelling can be used to develop and test options quicker and cheaper than ever before, and this will be strengthened further as data quality, interoperability and availability improves.

Collaborative relationships between local and national authorities: The emphasis on collaboration and local/regional solutions develops and strengthens new relationships between public and private sector partners, increasing resilience and supporting more effective long term planning and delivery. Central government reforms to improve alignment and coordination will improve value for money and support more effective delivery.

Supporting ambitions for increasing housing supply and home ownership: The alignment of infrastructure planning and performance with wider housing supply and regeneration objectives boosts public confidence in new development by demonstrating that it will be preceded by the necessary infrastructure, and that increases in housing supply will leave a legacy of economic, social and environmental improvement.

Focus area 3: Addressing the need for social infrastructure using a platform approach

Through platform approaches the government will generate greater societal outcomes from its pipeline, by enabling a disaggregated manufacturing industry that creates stable and inclusive employment where jobs are most needed.

Problem statement

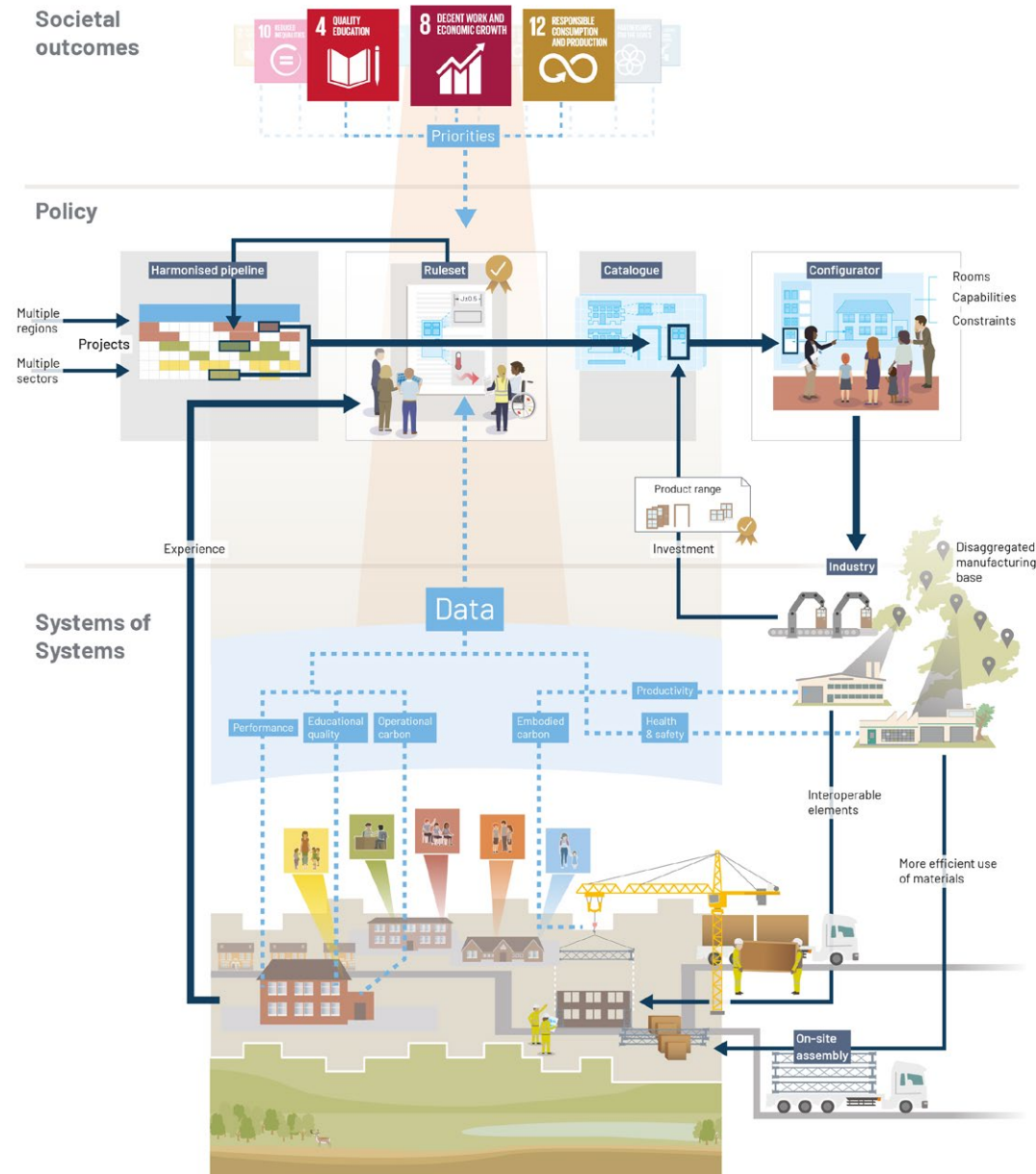
The way that we deliver our buildings is inefficient and too often based on delivery of bespoke outputs in sector and project silos, illustrated by fragmented approaches to standardisation. It is also essential that we improve safety and reduce risk in the way we design, deliver and manage our built environment. Missed opportunities to leverage scale through the use of standardised, interoperable elements leads to inefficiency in design, production, logistics and assembly. Further, these missed opportunities hinder the creation of a disaggregated manufacturing base and associated stable employment, continuous improvement, and the ability to reliably deliver high quality, high performing, energy efficient buildings at scale. The lack of a middle ground between bespoke and relatively inflexible standardised solutions offers limited choice, and the investment required with many of the current MMC approaches can be a barrier to entry.

Opportunity

An example can be seen in the need to improve the inconsistent quality of infrastructure, uneven spread of employment and the instability of construction's itinerant labour force. Addressing these needs requires consideration of outcomes beyond the constraints of individual projects or portfolios.

Government announced its commitment to Modern Methods of Construction in 2017 with the presumption in favour of offsite construction.²⁰ In December 2020 government expanded on this, via the Construction Playbook and by setting out specific proposals relating to 'A Platform approach to Design for Manufacture and Assembly (P-DfMA)'. Now, following the progress made through collaboration with industry on platform approaches and to support in achieving its strategic outcomes, the government is committing to enabling an increasing use of platform approaches in construction.

Figure 6 – addressing the need for social infrastructure using a platform approach. [See here for a larger format](#)



Key concepts

Defining platforms: Platforms identify features of assets that could be shared and then harmonise those features. This approach provides the opportunity to create common 'kits of parts', through which the platform embodies the shared features. Harmonised cross-sector demand for these 'kits of parts' can enable their manufacture in high volume, with configuration allowing delivery of multiple asset types across sectors (e.g., schools, apartments, healthcare facilities). By focussing on performance, interfaces and interoperability, the components making up these kits of parts can come from a range of suppliers whilst ensuring consistency of standards and quality. They can be designed to offer choices in assembly and support the widest range of architectural ambition and intended outcomes.

The greatest scale is enabled by harmonising features of the superstructure (such as structural grids, beams, columns, connectors and slabs) across sectors. Key aspects of assets (such as façade and fit out) can all be incorporated into the approach, and a repeatable grid and common dimensions make these easier to design and install. Mechanical, electrical and plumbing systems can be designed and prefabricated to fit into platform carrier frame superstructures.

Vision for 2030

A common ruleset through which the repeatable elements of the built environment would be harmonised – with open access to all. On an ongoing basis the pipeline would be filtered through this ruleset to provide visible demand.

The products to address the pipeline would be manufactured by a broad and disaggregated supply chain, creating stable and inclusive forms of employment. Products would be offered via a machine readable catalogue, with product competition based on a wide range of performance considerations, and manufacturing approaches enabling greater efficiency and sustainability in production.

Automation through the use of configurators would enable a greater focus on the value led elements of the design process. The assembly of the asset would then take on aspects of a factory, employing sophisticated digital workflows and increased use of innovative machinery and robotics. Digital models and twins would enable the tracing of data and digital assurance throughout the process, with feedback on performance in use providing insight back to the digital marketplace.

The Transformation

The transformation envisaged is significant. It will include cultural, process and skills challenges, as well as the development and management of the core elements of the technical solutions which will include:

- A digital catalogue, detailing the components available from the market to substantiate the physical asset.
- A set of 'rules' (to which the components in the digital catalogue would adhere) specifying supplier agnostic requirements relating to things like interoperability, adjacencies, interfaces, tolerances, thermal performance and so on.
- Configuration tools which marry the rules and the available components to automate the design process.

Throughout the technical solutions, product information will be required that meets the information requirements to plan, design, assemble, operate, optimise, repurpose and decommission the physical asset.

To change mindsets and enable a disaggregated manufacturing supply chain, government and industry collaboration will be needed across a range of areas, including collective efforts to:

Harmonise, digitalise, and rationalise:

Greater use of platforms will require government to harmonise its technical standards, for example increasing consistency in the naming of spaces.²¹ Technical standards will increasingly need to be in a digital form that enables machine readability. Those harmonised digital standards must, where feasible, be standardised across facets like performance, space types, spatial clusters for common configurations (e.g. standard teaching blocks) to enable repeatability. Advancing our technical standards in these ways can enable government and its suppliers to plan for re-use, net zero and wider sustainability goals at the earliest stages; considering and integrating the pertinent data in the earliest design concepts, locking in the value from the start.

Aggregate demand: Repeatable use of components across sectors enables the aggregation of demand, unlocking economies of scale. This principle has enabled the manufacturing sector to drive down time and cost, while increasing productivity, safety and quality. However, platforms aren't products that can be bolted on to a traditional process. The use of platforms demands a new design to construction process: integrating parts, operations, knowledge, people and relationships at the earliest stages, and a different mindset: making decisions at the portfolio and system level rather than that of individual assets. The approach considers the shared components and processes across a range of sector assets, giving rise to a form of mass customisation through which differentiated and higher quality buildings can be developed more efficiently; with reduced design time and development costs.

Develop Configurators: Some of the greatest design stage benefits of platforms will be realised through the use of applications referred to here as 'configurators'.²² These configurators marry the rules with component data in the digital catalogue to automate the generation of design, from a schedule of rooms to a digital asset model and could ultimately provide outputs such as a full cost breakdown or a list of approved suppliers. Configurators can result in much faster design and the consideration of a greater range of permutations. They can enable the involvement of local communities and professionals at earlier stages, and they can support the quality assurance process that enables the tracing and recording of critical data from design through to operation.

Adapt quality processes: Effective platform approaches will require the adoption and adaptation of manufacturing processes. Design, construction and manufacturing experts will need to work together to maximise the benefits. The development and application of product quality management systems will improve our collective ability to maximise the proportion of an asset that is raw material cost, while minimising costs associated with labour and handling, waste, and rework. For platforms to impact in the shorter term they will need to

leverage existing technology and materials to reduce risk and open up the supply chain to smaller manufacturing and product development companies. The platform approach will need the requirements around quality control to be reviewed and updated to ensure consistency across platforms. The Construction Innovation Hub has started this work, gathering requirements relating to areas such as classification, system control, actors and processes. Once developed and published, this rulebook will need oversight to ensure acceptance as a consistent standard.

Explore risk and delivery models: Whilst platform approaches can enable greater certainty, there is a need for a broader evidence base to show where risks occur, how they can be managed, and further exploration in relation to warranties, insurability and liability. This will include consideration of the use of fungible components from multiple suppliers and assembled by multi-skilled installation crews. Platform approaches point to the need for delivery models in which clients retain greater control and form closer relationships with contractors and suppliers. They also involve greater transparency and sharing of data and ideas than the industry is accustomed to.

A mandated approach: It has been demonstrated through experience by other sectors as well as early work and analysis that a platform approach can result in higher quality, more consistent, better value delivery of a significant proportion of our infrastructure needs. In advancing the enablers and technical solutions described above, government and industry will co-create the market and knowledge framework to enable clients to specify a platform approach with confidence. Building on this knowledge framework, in the next two years the government will set out a requirement for platform approaches to be adopted for social infrastructure with a repeatable design. A transition period for adoption will be defined within that requirement.

Value and benefits

By enabling the creation and application of platform approaches, improvements can be accelerated across the whole lifecycle of construction and into the wider system. These benefits include building productive capacity in the economy, improving energy efficiency and reducing waste, alongside:

Factory conditions in the construction stage:

Platform approaches deliver via a series of simple, repeatable, productive activities. This addresses challenges presented by the size of the build and enables predictability in the sequence of work. A mixture of simple human operations, low complexity automation, and lean manufacturing principles can improve health and safety,²³ help to increase productivity and speed of assembly, and address the skills gap.²⁴ The approach also enables low levels of waste, with commodities handled the fewest number of times, by the fewest number of people, via the least number of processes. Predicting operative numbers, their positioning on site, and accurate training and workload schedules is unremarkable in manufacturing. By extending the use of consistent, digital workflows into logistics and labour, similar capabilities can be achieved in construction.

Feedback loops and whole life: Currently operational data from an asset only informs the owner about the performance of that specific asset. Using digital twins a consistent connection can be made between the physical asset and the platform, enabling data regarding performance in operation to be fed back in to optimise the rules and the digital catalogue, creating a process of continual optimisation of design, delivery and operation to improve future assets. Further, where a platform-based asset needs to be rebuilt, there is great potential to recycle the components, reusing them on the next evolution or elsewhere, supporting a circular economy approach and transition to cradle to cradle carbon methodologies.

Structural industry benefits: The aggregation of demand into a consistent pipeline for platform solutions opens up the construction industry to some of the kinds of benefits that have been seen in the manufacturing industry. Predictable demand enables better planning. In turn a supply chain that can plan and act proactively is more resilient, and offers opportunities for a more diverse range of firms to supply services. By better enabling a diverse manufacturing and assembly capacity, a wider set of strategic outcomes can be assessed. Examples could include the sourcing of manufacturing supply based on regional capacity and skills, and incentivising investment in local capacity to mitigate the carbon implications associated with sourcing over greater distances.

“...the government will generate greater societal outcomes from its pipeline, by enabling a disaggregated manufacturing industry that creates stable and inclusive employment where jobs are most needed.”

Focus area 4: Retrofitting existing buildings to achieve net zero greenhouse gas emissions by 2050

Through public sector leadership and public-private collaboration and risk sharing, the government will support the creation of a self-sustaining retrofit market with the means to adapt our buildings to address sustainability and climate adaptation requirements, create green jobs and respond to varying regional needs.

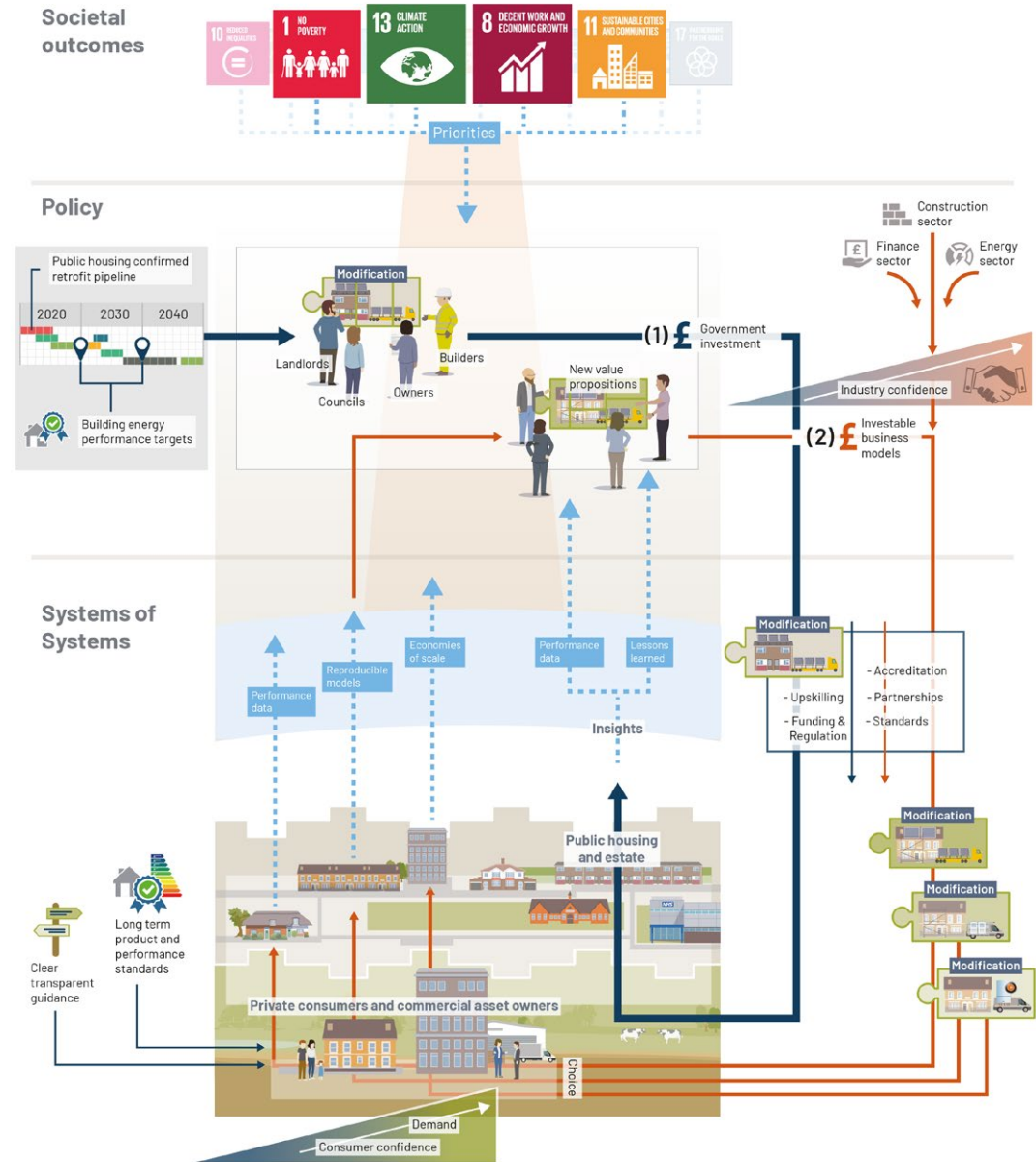
Problem statement

Buildings account for almost one third of the UK's total greenhouse gas (GHG) emissions with homes alone responsible for 22%, mainly through heating. The vast majority of the buildings that we will use in 2050 already exist, and most waste heat and money. The current landscape for retrofitting our existing buildings lacks the certainty, consumer confidence, demand and investment required to achieve the scale necessary to meet the UK's net zero targets.^{25,26} Further, badly insulated and poorly performing buildings are detrimental to a broader set of societal needs, illustrated by the impact buildings can have on our health and wellbeing, and the resulting increased pressure on the healthcare system.

Reducing emissions via smarter electricity consumption alone will not be sufficient according to the latest analysis and recommendations of the Climate Change Committee (CCC).²⁷ A joined-up approach to decarbonising heat, smart energy and improving existing buildings' thermal energy efficiency will be required to reduce the scale of additional power generation, production capacity and distribution upgrades needed, alongside reducing consumption from the natural environment.

Figure 7 – retrofitting existing buildings to achieve net zero GHG emissions by 2050.

[See here for a larger format](#)



Opportunity

Through a coordinated and sequenced delivery plan, and public-private sector collaboration on retrofitting, existing buildings' energy performance can be improved. Alongside decarbonising heat and driving smart energy consumption, we can achieve net zero carbon emissions by 2050, tackle fuel poverty, improve the nation's health and wellbeing, prepare for future climate impacts, and create clean-growth high-skilled jobs across the country.

The Government Property Function is developing a Sustainability Strategy for the government estate to support the transition to net zero and climate adaptation for existing and new buildings.

Key concepts

Defining Retrofitting: Retrofitting interventions address the existing built environment and include 'fabric first' thermal efficiency measures, such as wall, roof, loft, window, floor and door insulation, draught proofing and controlled ventilation. A 'whole building approach' considers these measures in conjunction with the installation of smarter, more energy efficient appliances, heating systems and controls. Retrofitting improves not only building energy performance and cost but also comfort – in terms of temperature (heating and cooling), air quality and noise protection.

Vision for 2030

A self-sustaining retrofit market with a steady and visible pipeline of demand for future retrofitting. This pipeline, along with clear and consistent delivery standards and measurement would have provided the necessary confidence for consumers and the market to invest. A virtuous circle of standardisation and economies of scale, innovation, and skills development would be a key enabler in achieving sustainability targets and the creation of an expanding market for green jobs.

The transformation

Realising this vision will require public and private sector leadership at key points this decade and collaboration across a range of areas. This will include addressing issues relating to consumer guidance and protection, providing long term certainty on energy performance requirements, and industry leading on the scalable delivery models, innovation, and financing options needed to support demand.

Creating certainty on required performance

By providing a clear delivery plan for greening our building stock, the government can lay the foundation for consumer trust, to encourage private demand, and industry confidence to expand supply, across the construction, energy and finance sectors.²⁸

Introduce minimum building energy

performance standards across all housing tenures – private rented, social rented, owner occupied – and stricter regulations for commercial and industrial buildings.²⁹ Standards should be aligned with the government's Heat and Buildings Strategy and plans for phasing out the installation of high-carbon fossil fuel heating. Minimum energy performance standards will need to be coupled with reform and implementation to improve energy performance certification. The government will consider how Energy Performance Certificates (EPCs) can move to actual, rather than modelled, performance of buildings through integration with smart metering and other data, subject to consumer consent.³⁰

Requiring disclosure by lenders of EPC ratings across mortgage portfolios, alongside setting improvement targets, can **incentivise the development of green finance products**, both at the point of sale and remortgaging.³¹ Building on the Green Finance Strategy,³² a diversified green finance market that meets different user needs should go beyond green mortgages, and establish financing options for unmortgaged stock which represents just over half of privately owned homes.^{33, 34}

Industry standards for retrofitting will need to address safety and sustainability and must be designed to extend the lifespan of our buildings

in terms of lifetimes, not just years. They will need to address whole life carbon and climate resilience (heating and cooling needs as well as other factors, such as flooding). Further, standards will need to consider the broader landscape, for example addressing building fabric upgrades in conjunction with energy network and other district level infrastructure upgrades. Ambitious industry standards, bringing together industry and regulatory requirements on safety and sustainability under the leadership of the BSI can help the UK to become a leading exporter of retrofit goods and services in a global market valued at USD 132.8 billion in 2019 and anticipated to grow at a compound annual growth rate of 4.1% to 2027.³⁵

Providing visible demand

The public sector pipeline creates the opportunity to pioneer 'no regrets steps towards net zero', in terms of integrated whole-building measures, and needs to be scoped in collaboration with the supply chain, with delivery plans put in place at the regional and national level. Performance data on interventions will need to be collected and shared openly between local government, housing associations and industry to allow for the evaluation and targeting of high-impact opportunities for innovation. With the right approach to data, each retrofit intervention can enrich the evidence on performance improvements, problems encountered and identify solutions to be brought back into

implementation. As the first virtuous circle of **greater standardisation, accumulated learning and economies of scale** from the public sector pipeline develops, the cost per building can improve commercial viability and significantly reduce the need for subsidies.

Performance measurement to ensure attainment, warranties and redress mechanisms will be key to meaningful assurance of performance standards. Industry and government have joint responsibility for evolving transparent, proportional and user-friendly consumer guidance and choice, including on fair pricing – as some may choose not to implement the most advanced standards aspiring to net zero carbon emissions at the individual building level.

Supply side innovation on scalable delivery models

Insights into scalable delivery models from the public pipeline and social housing sector need to be adopted and translated by the supply chain to feed a second virtuous circle that creates **investable business cases for private residential and commercial application**. By developing a market segmentation of building archetypes to provide greater visibility of the potential pipeline and enable increasing use of ‘kits of parts’ and industrialised retrofit solutions³⁶ industry could deliver easy wins compared to those requiring harder-to-scale bespoke solutions.

Firms – large and small – have a vital role to play in post-implementation monitoring and corrective actions, to ensure that learning and improvement takes place across the value chain. While large construction firms can advocate for high standards and support structured learning on scalable delivery models, small firms are particularly important to accelerating place-based approaches and creating delivery models for more bespoke solutions. Both will need to be supported to coordinate the growing sector and connect experts from aligned sectors such as manufacturing.

The need for new skills, roles, training and accreditation is a significant challenge. Industry and government jointly need to **assess and plug priority skills gaps**, creating trusted qualifications such as the recent Retrofit Coordinator Certification in further areas, such as independent assessors and ‘whole house’ designers and installers. This may be delivered through the Construction Industry Training Board, or using initiatives under the Construction Sector Deal, with support from the government’s Green Jobs Taskforce. Public funding support could explore innovative policies for upskilling and skills pooling such as region based retraining and accreditation opportunities for existing contractors and tradespeople in addition to new apprenticeships.

Value and benefits

Retrofitting existing buildings during this decade, underpinned by a coordinated and sequenced approach and delivered through public-private sector collaboration, will enable a range of benefits including:

- **Net zero:** Given that reducing emissions via smarter electricity consumption alone will not be sufficient to achieve legislated carbon budgets, enabling a retrofitting market to operate at scale during this decade will be an important step towards reaching net zero greenhouse gas emissions by 2050.
- **Employment and economic growth:** A retrofitting market can unlock a series of wider economic benefits, such as creating opportunities for the deployment of innovation and an expanding market for green jobs across the country.
- **Adaptation and resilience:** Retrofitting existing buildings can improve health and wellbeing, for example through improved insulation to address fuel poverty, in the context of our current climate. Further, retrofitting will be an important element in effective adaptation and resilience, recognising increasing climate risks.

Government, local authorities, social landlords, the construction sector, energy providers, Ofgem, consumer advice representatives, even the NHS – for integration with health awareness

campaigns – and financial institutions, need to continue to engage to build demand and achieve the retrofitting transformation.

In the short to medium term a flexible approach to testing and scaling what works, adapting to regional and local requirements, will be needed. By the middle of this decade, progress and ambition will need to be reviewed based on an enriched understanding of barriers, evolving enablers and overall decarbonisation progress.

Case study: Net zero concept design for low rise apartment buildings

An industry consortium initially supported by the EU’s ‘MustBe0’ programme and Energiesprong UK has been advancing a volume retrofit system that exceeds the requirements of the Energiesprong UK standard. It aims to create the leading energy performance standard which can deliver net zero emissions as an unsubsidised investable business model for private urban low and mid-rise apartment buildings. Further funding awarded by Innovate UK provides for the development of bespoke elements the consortium intends to patent as they aspire to bring down the unit cost of retrofits by as much as two thirds compared to current subsidised social housing retrofits as well as reducing the duration and hassle of retrofit works.

Focus area 5: Optimising the performance of our existing built environment

Given finite resources, adding to the built environment cannot be our primary means of improving the outcomes we derive from it. Trusted information that allows cross-sector insight into a dynamic system must underpin the rationale for interventions that we make into our existing built environment. The effectiveness of the interventions in achieving the desired strategic outcomes must be monitored, with the relevant stakeholders incentivised to adapt the approach to achieve the optimum outcomes.

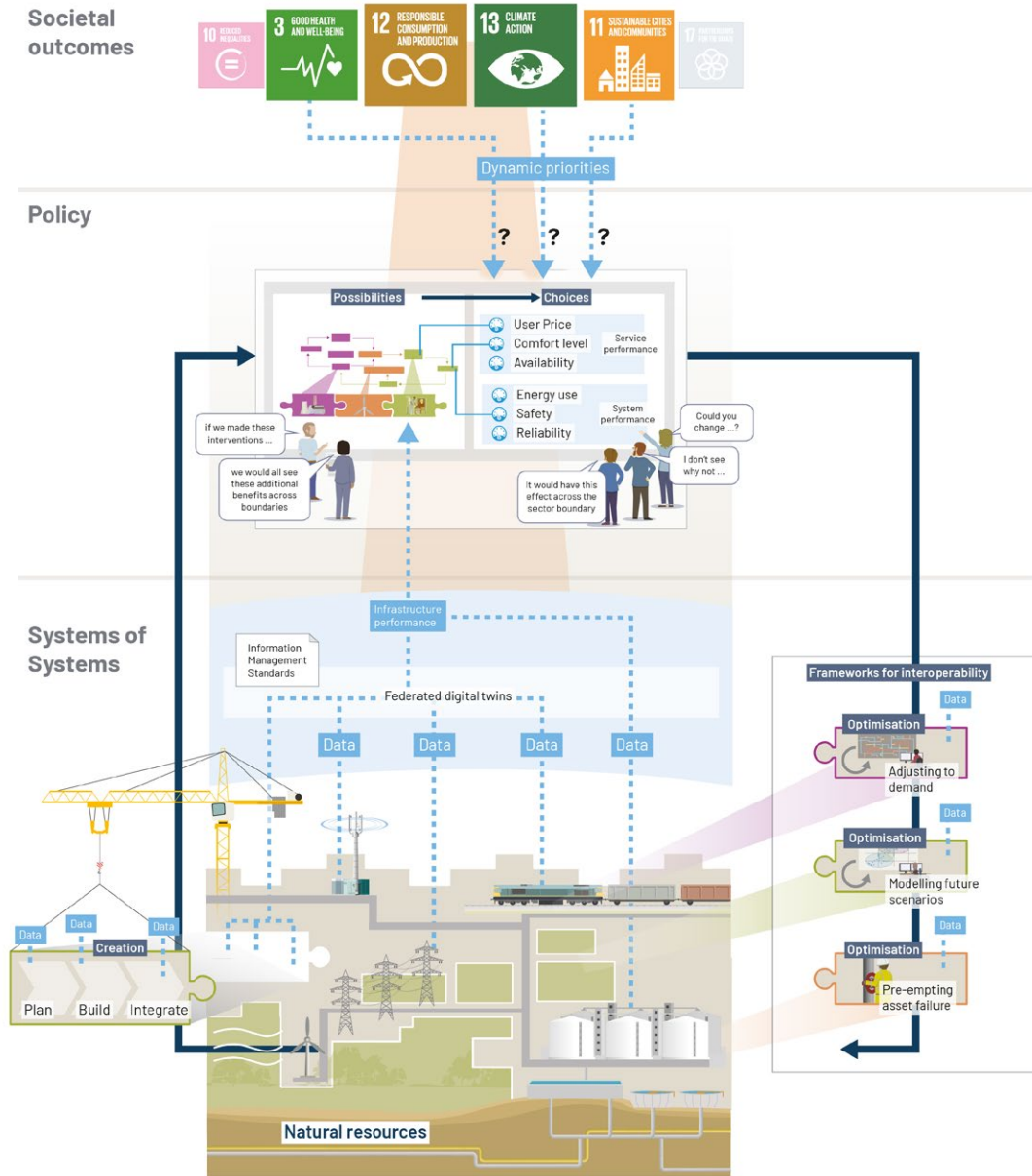
Problem Statement

Historically, it has been more straightforward to add new infrastructure to the built environment rather than trying to derive better outcomes from what we already have. This is predominantly because our built environment has evolved as an intricate system of systems, without an overall design or a strategy for its interconnections, resilience or long-term outcomes.³⁷

Our current preference to add new assets is unsustainable given resource constraints and the requirement to achieve net zero greenhouse gas emissions by 2050. It is also incompatible with the accelerated pace of change brought on through the COVID-19 pandemic, the corresponding impact on our needs from infrastructure, and with levelling up across the UK.

Not only is the current approach unsustainable, but the dynamic nature of the system of the built environment means that there will always be a need to intervene. This could be driven by factors such as a need to address changing standards, to respond to an emerging safety issue, or to ensure our assets have the capacity to adapt to a range of future climate impacts. The increasing complexity of the system of the built environment makes it ever more important that we improve our understanding of how the system is functioning, how our interventions will impact the system, and how they can be integrated into it.

Figure 8 – optimising the performance of our existing built environment.
[See here for a larger format](#)



Opportunity

As we create the means to make better decisions about if, how and when to intervene, both in response to our immediate needs and longer term strategic changes, we can intervene in a more resource efficient way. Shifting the emphasis from adding new to optimising the existing system can help to reduce greenhouse gas emissions from construction and the impact on the natural environment. Furthermore, we can achieve more for less. This is because despite significant investment in new infrastructure, the scale of the existing built environment means that the value of what we add each year is only 0.5% of the total existing stock. By optimising more effectively, we have the opportunity to impact on a wide range of services to drive enhanced societal outcomes. These interventions can often be achieved in much shorter timescales and offer better value than new infrastructure delivery.

Key Concepts

- **Optimisation:** The process of optimisation involves achieving better outcomes for society from the existing built environment, using data as an enabler for decisions about how we operate our systems, when to intervene and how to more effectively integrate new components. This could mean making a physical change or altering the way a service is provided through adjusting the operational regime, and interventions could take other forms including maintenance, strategy such as modelling and simulation, and repurposing and upgrades.
- **UK BIM Framework:** sets out the overarching approach to implementing Information Management using BIM and provides tools and resources. Adopting the UK BIM Framework will be compatible with the Information Management Framework.
- **Information Management Mandate:** [Annex B](#) sets out the information management requirements for government clients that will be delivered through the application of the UK BIM Framework.
- **Government Soft Landings:** a process which drives a structured and consistent approach to the delivery of built assets by focussing on early end-user engagement and operational requirements from the outset. Defined information exchanges allow the early testing of maintainability and performance targets as the design develops.
- **Interoperability:** Interoperability provides the ability to exchange information between proprietary technologies, so that it can subsequently be made use of in whichever system it is located. Without interoperability we have a limited ability to maintain and manage information across the whole asset lifecycle.³⁸ Interoperability supports the provision of a 'Golden Thread of Asset Information'.
- **Information Management Framework:** a common framework of standards and protocols that provides the means by which consistent data and information can be shared between organisations and sectors in a way that is effective, resilient and secure' will enable secure, resilient data sharing across organisations and sectors.³⁹
- **Digital Twins:** In The Gemini Principles⁴⁰ digital twins for the built environment are described as digital representations of assets, processes and systems where there is a data-connection between the 'digital' and 'physical'. A National Digital Twin is defined as an ecosystem of digital twins, connected via securely shared data.⁴¹ The principle of interoperability is fundamental to the development of an ecosystem of interconnected digital twins.

Vision for 2030

With this future realised we would understand the existing system and would be able to assess the effects of our interventions and their integration into it. This understanding would be founded on information generated, captured and recorded in accordance with information management standards adopted across the industry. Information would be shareable across sector and network boundaries, and would be stored and available over the lifetime of the asset.

With this understanding we would be able to make better, outcome focussed decisions about how to optimise our infrastructure across the system, and the protection and restoration of nature embedded in our decision making.

We would typically deliver via outcome focussed collaborative organisations which would be able to deal with complexity and integrate effectively with the existing systems. Assured information would enable proactive interventions and delivery organisations would be able to react from a position of knowledge as situations arose. They would leverage input from across the supplier ecosystem and bring together engineering and technology to deliver intelligent solutions and faster, more dynamic interventions.

The transformation

To improve outcomes from the existing built environment we need a better way of understanding how, if and when to intervene. We must put in place the enablers to support clear debate about system level and societal outcomes, so that we can make decisions about how to deploy our efforts and resources in the most impactful and effective way to deliver the desired improvements. We will also need different models for delivering that are outcome focussed and that can integrate with the existing system and respond to a dynamic environment. In the future we envisage the approach between interventions to deliver new assets and those to optimise existing will be more aligned in terms of achieving outcomes, key changes are therefore split between this focus area and focus area 1 – Delivering new economic infrastructure to drive improved outcomes for people and nature’.

Collective efforts will be needed to address the following areas:

Improved information management

Effective optimisation must be founded on quality data as the key enabler for making better decisions. We must increasingly treat data as an asset. To have quality data we must improve organisational capability in how we generate, process, manage and maintain the information and make this available in a meaningful way for decision makers. It is all too common that upon completion of a project information is lost, is of poor quality or not retained in a way that makes it available to inform the use of the asset, breaking the thread of information right at the very beginning.

■ **Information Management Mandate:** Set out in [Annex B](#) is a refreshed Information Management Mandate that will be delivered through the application of the UK BIM Framework, which builds on the 2016 BIM mandate This new mandate, which is applicable immediately, sets out a range of requirements for clients, including the definition of information concerning assets and projects. Public sector clients should comply with the Mandate as part of their implementation of the Construction Playbook. The UK BIM Alliance, BSI and Centre for Digital Built Britain (CDBB) are coordinating the ongoing work to embed awareness of the requirements of the UK BIM Framework.

■ **Digital Twins:** To enable better decisions, we must enable information to be shared across traditional sector silos. Through the creation and active management of digital twins of our infrastructure we will be able to better understand our built environment. The concept of a network of interconnected digital twins, a National Digital Twin, should unlock better overall performance through better management of the system of systems. The National Digital Twin programme is developing standards to enable this; the Information Management Framework (IMF). Initially the programme will establish the technical foundations, which will enable a consistent approach to data modelling and create the rules for effective information sharing. Within the next two years, as this work comes to fruition, the government will define a mechanism and timeline for incorporating the application of the IMF into a broadened Information Management Mandate.

System Performance Metrics

In order to optimise more effectively we need to establish a systematic framework for measuring the performance of our infrastructure in terms of the outcomes provided and services extracted by society as users of the system. Actions to drive progress are set out in more detail in the focus area on ‘Delivering new economic infrastructure to drive improved outcomes for people and nature’.

A value based methodology for assessing our interventions

We need to recognise the interconnectedness of natural, built and human systems, and manage infrastructure as a system of systems. Intervening in the built environment may create better outcomes, but can impact the natural environment both in the immediate term and over the life of any created assets. We need to develop and use a better methodology for calculating and comparatively assessing the value of the potential improved outcomes from an intervention against the cost over the whole life of an asset. This should be done in line with HMT’s supplementary Green Book guidance on valuing infrastructure investment.⁴² Organisations can use the methodology of the Value Toolkit to calculate and comparatively assess a range of interventions against the desired outcomes to ensure that interventions drive the optimal outcomes throughout the lifecycle of an asset.

Collaborative delivery models

At present, the way in which we manage our investment budgets creates a structural and managerial divide between capital and operational expenditure that can remove focus from whole life performance. This means decisions tend to be made based on capital cost and available budget, which is a comparatively small portion of the whole life cost, and not with the view to the potential impact across the lifecycle.

■ **Outcome based collaborative delivery models:** To implement our chosen interventions more effectively we will need to move toward more outcome based and collaborative delivery models that reward value and not output volume, like the Project 13 Enterprise model. These delivery models will need to collaborate in developing and implementing the tools to work more effectively across traditional boundaries. These delivery models will need to be able to deal with complexity and allow effective integration with the existing systems. They will need to leverage input from across the supplier ecosystem and bring together engineering and technology to deliver intelligent solutions.

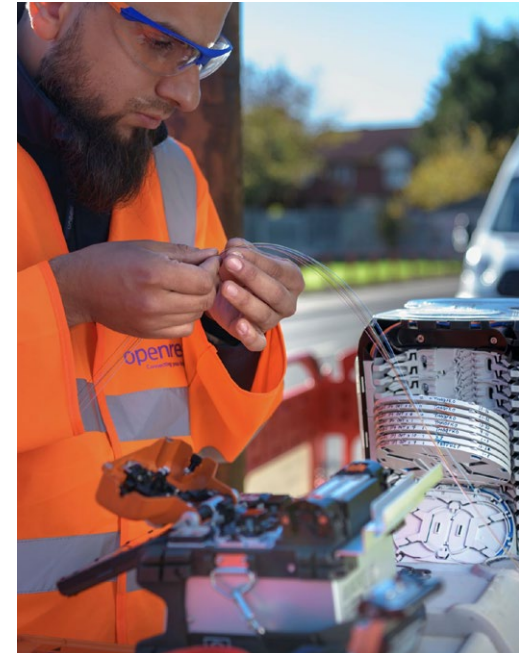
Value and benefits

By capturing and sharing quality information on which we can rely, we can create an optimised system in terms of performance and resilience, that takes into account our various societal priorities. By enabling an environment in which we can optimise the existing built environment, we can achieve better outcomes in a more resource efficient way, and we can achieve those outcomes in timescales that will often be significantly faster than the delivery of new assets. With less of a preference towards adding new assets, there are opportunities to deliver interventions that impact less on the natural environment.

From the use of interconnected and interoperable digital twins we will be able to optimise across the boundaries which exist at present, allowing the benefits from our system of systems to be greater than the constituent parts. With more outcome focussed delivery models we will see the creation of new roles, creating new forms of employment and new opportunities for firms to generate a higher return from the value added.

Case Study: BT Network Energy

BT uses about 0.7% of the UK's total electricity supply, which means that by reducing demand they can cut their own costs and help in the transition to net zero Carbon. BT initially created an energy model of the network and the solution has evolved over time towards a Network Energy Twin. The twin has already been used to identify opportunities to save energy and BT are beginning to track the impact of specific changes to the network and to recommend optimisation interventions based on predicted changes to energy use. The energy model has delivered benefits worth £40M in 20/21, helping BT achieve an 18.6% reduction in carbon emissions. At the moment the twin is used to inform human decision makers with future developments planned that would have the twin alert the decision makers on detection of certain changes.



“There are opportunities to deliver interventions that impact less on the natural environment.”

8 Leading practices

We have collectively made good progress in building the institutional capability across government to support the transformation described by TIP. There are pockets of world class delivery using the latest digital and technology solutions, but these are not yet business as usual, and the government sees no reason why they shouldn't become so over the next 12 months.

- 8.1. Modern design for the built environment invariably could, should or does manage and share digital information (both graphical and non-graphical) collaboratively. Architecture, engineering and construction firms typically integrate separate information models for various parts of a project, ultimately representing the completed asset. Firms are increasingly using 4D BIM, for example to coordinate construction to a critical path and undertake clash detection, often based on software with capabilities such as resource management, capacity planning and scheduling. Organisations are increasingly moving towards the use of digital twins for whole life asset management, albeit this is not yet business as usual.
- 8.2. 5D BIM is now within the capability of existing software solutions. Incorporating costed components and materials into the information model, alongside linked availability and access, can enable greater productivity. This starts in the planning phase with more detailed information and better integration to inform the work packages. It continues through the project lifecycle with the bill of materials produced from the model, automated approaches to earned value management, and optimised use of resources, both at the final worksite and in offsite manufacturing. While 5D BIM is now available for projects to implement, greater adoption by clients is needed to realise the benefits.
- 8.3. As 5G matures it will increasingly provide the underlying capabilities and connection densities for greater data collection and analysis. 5G is maturing in conjunction with AI, which is seen increasingly in automated design solutions, with rules-based engines and digital product catalogues which can provide insight into the industry solutions that meet the rules. Many additional technologies are already available, such as solutions to monitor and inform progress and provide assurance. Examples include fixed and mobile sensors, photogrammetry and 3D laser scanning, the use of drones and robotics, augmented reality, and wireless sensor technology to identify and track components as they move through the supply chain and installation process.
- 8.4. Adoption of these existing technologies will require the application of the Construction Playbook. Delivery model assessments should consider the client and supply chain capabilities and capacity to adopt and deploy these technologies. The creation of longer term collaborative contracting environments may require increasing use of integrators that can effectively coordinate design, production, logistics and assembly processes using digital technologies.
- 8.5. Below we summarise some of the leading practices and mature technologies in use on projects across the country. Many of these are being delivered by world-leading innovators in the private sector, and the government is committed to bringing more of this expertise into public sector delivery. Further detail on the government's approach to innovation was published in HMG's Innovation Strategy in July 2021.⁴³ The Strategy outlines how the government will achieve its ambitions in innovation over the next decade, pivoting towards a more innovative economy (It sets out commitments to increase the use of public procurement as a lever to drive innovation, through the publication of innovation outcome statements for all major projects and spending exercises, and setting up a cross-government working group to increase innovative procurement across public sector bodies).
- 8.6. To support greater adoption of these technologies the IPA will coordinate work to identify available technologies and barriers to adoption, including actions and guidance to unlock greater use of data, analysis and digital technologies on projects. This will focus on facilitating join-up between challenges and solutions to increase application in public sector delivery.

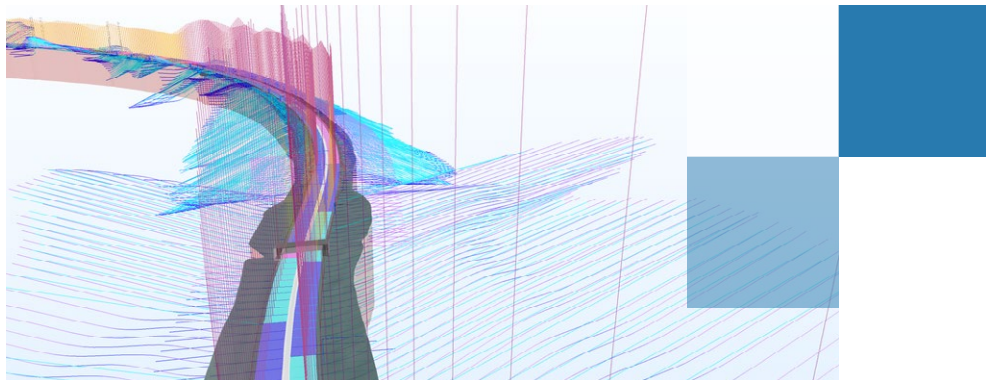
9 Case studies

National Highways: Automated Design via the Rapid Engineering Model (REM)

The problem: Construction schemes are typically designed as 'one off' solutions, resulting in duplication, inefficiency and unnecessary cost.

The action: National Highways Smart Motorways Programme (SMP) has been conceived around standardised rules and assets. Bryden Wood and National Highways created a platform combining a rules-based engine, data analytics and a digital product catalogue to automate the design of SMP schemes.

The result: The information generated through REM represents a single source of truth for SMP schemes, enabling automated design and seamless integration of connected construction activities (estimation, sequencing and costing). Now being applied across a wider range of National Highways major projects, machine-led, human aided tools are being used to create automated designs, improve accuracy of construction and cost planning. Transport for London (TfL) has adopted the same principles and approach to support cable route management works as part of the TIES [Living Lab](#), demonstrating that automated design could have broader benefits in infrastructure delivery.



HS2: Improving cost management using 5D BIM

The problem: Industry is seeking to improve cost management by incorporating information on carbon, materials and cost into engineering models.

The action: The Skanska, Costain, Strabag (SCS) team have developed engineering models for 5D estimating reducing the time taken to calculate quantities and prices. The structured information requires no manipulation, with all stakeholders collaborating to ensure consistency and transparency. The material quantities and costs change as the design is modified, enabling the team to assess the impacts on cost and carbon. With structured data aligned to industry standards, HS2 focuses on the areas most impacted by carbon, further optimizing materials and costs.

The result: The implementation of 5D BIM on HS2 resulted in 80% less resources than planned, which was proven to save £600,000 during an initial 5D trial. In terms of carbon management, the carbon footprint was calculated 80% faster while reducing waste.

Buro Happold: Generative design and game engine technologies for Energy Network Design as pathways to Net-Zero communities

The problem: Dealing with the complexity of developing net-zero pathways for communities by using generative design and game engine technologies for Energy Network Design.

The action: Buro Happold with strategic partners have developed a smart energy digital twin for Bridgend County Borough Council and Barcombe. ⁴⁴ It enables intelligent selection and validation of domestic heat network solutions by incorporating real-world data, generative design, gaming and 3D visualisation technologies.

The result: The tool uses an automated approach for a complex phased development plan and comparison of multiple options including distributed vs centralised systems. The outputs can be provided to multiple stakeholders to support decision making including local government, supply chain, and community energy organisations. For Barcombe, “the scheme will see an entire village switched from oil to electric heating that could become a blueprint for millions of homes”.



“The scheme will see an entire village switched from oil to electric heating that could become a blueprint for millions of homes.”

XYZ Reality: Engineering-Grade Augmented Reality with HoloSite – supported by UKRI

The problem: Construction often varies from the exact design, and traditional inspection methods are reactive, can be prone to errors and take time. Modern Methods of Construction requires less deviation from design tolerance, so more proactive approaches are needed.

The action: HoloSite is an engineering-grade augmented reality headset and end-to-end hardware, software and cloud platform. With HoloSite users view BIM models onsite to millimetre accuracy in the form of holograms through the augmented reality headset.

The result: Projects have used HoloSite proactively to eliminate errors before and during installation. Construction teams have reduced inspection times by 97%, and the technology has enabled them to build to the BIM model and build it right, first time, whilst achieving significant return on investment on the technology.



Landsec – The Forge: pioneering a Platforms approach for more productive and sustainable automated builds

The problem: for construction to emulate the productivity gains seen in the manufacturing sector over the last 20 years.

The action: Landsec, Easi-Space and Bryden Wood are leading a collaborative project to develop and test automated construction on a major commercial site in central London. Using a platform approach and BIM technology, the partners created an optimised structural frame that could be precisely manufactured offsite and assembled onsite using an automated assembly process.

The result: Against Landsec's typical benchmarks, the project is targeting reductions in capital cost and programme time, a predicted 19.4% reduction in embodied carbon compared with traditional construction. The Forge is designed to be the UK's first net zero carbon commercial building and, with automated construction processes and a multi-skilled workforce on the install, will result in a 13.5% productivity gain.

10 Trends and drivers

Looking to the future

10.1. Drawing on best practice in futures thinking, the IPA has started to explore the trends and drivers that could shape infrastructure and major project delivery in the UK over the coming decades, and brought these back to 2021-2030:

- **New leaders, new organisations, new values** – a new generation of leaders and citizens are emerging, with new values and expectations. This could have implications for organisational transparency, legitimacy and structure, and the distribution of wealth and opportunity across society.
- **The post-carbon transition and the sixth great extinction** – a paradigm shift in our economies and lifestyles will be required to address climate change and the emerging biodiversity crisis. This will impact everything from citizen behaviour to economic models and the basis on which decisions are made.
- **Emerging national resource, capacity and capability constraints** – in part driven by the COVID-19 pandemic, and also longer term trends in labour markets and the economy, this could result in a greater focus on cost, risk and value.
- **Innovation in urban policy and a renewed focus on ‘place’** – cities and towns are increasingly interested in wellbeing as a measure of good social outcomes, and aware of the costs of inequality and the connections between wellbeing, place, and social and economic inequality.
- **Increasing importance of new materials and methods** – in part driven by cost, efficiency, climate and regulatory pressures, but with significant opportunities to deliver greater value through innovation.
- **Increasing exposure to digital competition and security issues** – digital environments bring new risk profiles and add greater complexity to our understanding of resilience; global competition in this space is significant and likely to increase.

10.2. These trends are consistent with key milestones over the next decade and beyond, and illustrate how dynamic and unpredictable the delivery environment will continue to be:

- **Levelling Up White Paper** in 2021
- A number of net zero strategies in 2021, including **electric vehicle charging infrastructure, heat and buildings, hydrogen and industrial decarbonisation**⁴⁵
- **Spending Review 2021**
- The set up and operations of the new **UK Infrastructure Bank**
- **Government response** to the **Dasgupta Review** on the economics of biodiversity
- UK's second **National Infrastructure Assessment in 2023**
- Government commitment to increasing **economy-wide investment in R&D to 2.4% of GDP by 2027**
- Targeting **40GW of offshore wind, 5GW of low-carbon hydrogen and 4 industrial CCUS clusters by 2030**; growing the installation of **electric heat pumps from 30,000 to 600,000 per year by 2028** and publishing the UK's first **Energy Data Strategy** in 2021.
- **Carbon Budget Five (2028-2032)** limits annual emissions to an average of 57% below 1990 levels and **Six (2033-2037) requires a 78% reduction in UK territorial emissions between 1990 and 2035**, in effect bringing forward the previous 80% target by nearly 15 years.

11 Action Plan

11.1. The journey to 2030 is uncertain in parts, and will need to adapt to a dynamic operating environment and unforeseen events. Nonetheless, there is value in bringing together the diverse activities underway, planned and required, to deliver our shared objectives. The action plan below is not complete or final, it will iterate and sharpen in focus over time, but it does capture the scale of the system change we are collectively seeking, and the importance of genuine collaboration if we are to be successful.

TIP Action Plan

Where actions are not included for 2023 onwards it is because significant uncertainty in these areas means further work and an iterative approach is required. The Action Plan is a living document which will be updated annually on a rolling basis.

		0-2 years	2-5 years	5-10 years
Data and insight CLC – digital taskforces, baseline assessment with Smart Infrastructure Index, Digital Transformation Strategy	Metrics and benchmarking	<ul style="list-style-type: none"> Implementation of Government Construction Metrics (GCM), including whole life carbon methodologies, and continued emphasis on driving wider social value through construction activity. The IPA will work with government departments and industry, including the CLC, to evolve the current suite of construction metrics (e.g. to move towards measuring whole life performance) and to set out the interfaces and alignment between the Project Outcomes Profile, the CIH Value Toolkit, GCM and other relevant tools and processes. (IPA) Development of the IPA Benchmarking Hub for cost and carbon, including the capture of priority assets across all infrastructure departments. (IPA) We will need more consistent measures for the delivery and operation of our built environment. In its 2018 assessment, the National Infrastructure Commission set out the performance measures needed to do this. These measures will underpin the Commission's baseline analysis of the current state of each of the key infrastructure sectors, to be published in the Autumn. (NIC) Explore use of the CIH Value Toolkit to calculate and comparatively assess a range of interventions against desired outcomes, targeting interventions to drive optimal outcomes throughout the lifecycle of an asset. 	<ul style="list-style-type: none"> Annual GCM analysis provides a consistent evidence base for the performance of government construction projects and the impact of policy reforms. (IPA) Develop alignment and integration between GCM and the National Metrics Library (National Metrics Library referenced within the Value Toolkit and is currently under development by the Hub, Scottish Futures Trust and the CLC). Development of content such as proliferation studies and commonality metrics to accelerate the adoption of common and repeatable solutions. (IPA/BEIS and Departments) Defined metrics that capture cross-functional and departmental shared savings as a result of the use of shared/repeatable solutions. (IPA/BEIS and Departments) IPA Benchmarking Platform is available to all infrastructure projects and UK government is recognised as a world leader. (IPA) 	<ul style="list-style-type: none"> GCM are part of a national metrics library and database of historic project data. (IPA and partners)

		0-2 years	2-5 years	5-10 years
Data and insight CLC – digital taskforces, baseline assessment with Smart Infrastructure Index, Digital Transformation Strategy	Digital maturity	<ul style="list-style-type: none"> The IPA will work with industry and government departments to develop a consistent measurement of project digital maturity using a standard tool/framework and will monitor change in organisational digital maturity. (IPA) 	<ul style="list-style-type: none"> Contracting authorities and the supply chain will begin to consistently measure digital maturity, with benchmarks established and the approach co-ordinated by the CLC Digital Network. (CLC) 	<ul style="list-style-type: none"> Contracting authorities and the supply chain set targets to improve digital maturity, sharing learning via the CLC Digital Network. (IPA/CLC)
	Information Management	<ul style="list-style-type: none"> Publication of an updated 'Information Management Mandate', (applicable now Annex B) delivered through the application of the UK BIM Framework. (IPA/BEIS) The UK BIM Alliance, BSI and Centre for Digital Built Britain (CDBB) are coordinating efforts to embed awareness of the requirements of the UK BIM Framework, and work to improve interoperability is being led by the Centre for the Protection of National Infrastructure (CPNI). 	<ul style="list-style-type: none"> Within the next two years, and enabled by the creation of the system for connecting digital assets (the Information Management Framework), the government will mandate its application, setting out at that point a timeline for this to come into effect. (BEIS) 	<ul style="list-style-type: none"> The IMF mandate comes into effect.
	Government and Industry Interoperability Group (GIIG)	<ul style="list-style-type: none"> Creation of GIIG to advance interoperability, focussing on: Benefits; classification; information management platform; technologies; information requirements; and procurement and contracting. (GIIG, BEIS and IPA) GIIG will create practical guidance and identify synergies with the Information Management Framework. (GIIG, BEIS and IPA) 	<ul style="list-style-type: none"> Workstreams continue, alongside work to drive adoption, upskilling and progress monitoring. (GIIG, BEIS and IPA) 	<ul style="list-style-type: none"> Continue to support ongoing interoperability maturity, as/if required (GIIG, BEIS and IPA).
	Government Soft Landings	<ul style="list-style-type: none"> Implementation of Government Soft Landings (GSL) and continued focus on targeting high performing built assets to help realise better public-sector value from the construction process. The IPA will work with government departments and the Construction Innovation Hub to develop tools and guidance to enable objectives that will inform the purpose of the asset in operation to be set and tested from the outset. 	<ul style="list-style-type: none"> Informing future project performance setting based upon post occupancy evaluation and structured feedback loops. 	

		0-2 years	2-5 years	5-10 years
Data and insight CLC – digital taskforces, baseline assessment with Smart Infrastructure Index, Digital Transformation Strategy	Geospatial strategy Geospatial Commission	<ul style="list-style-type: none"> ■ Publish guidance for measuring the economic, social, environmental value of location data by Spring 2022. This will support the wider adoption and use of location data in optimising the way we operate in the built environment, by helping organisations articulate and value the benefits of its use. ■ In collaboration with key land policy owners, the GC will deliver land use data pilots to improve the findability and accessibility of land use data by Autumn 2022. This will help improve access to data on land use while demonstrating how a joined-up approach to data could support more coordinated policy making and local delivery. ■ The National Underground Asset Register, a standardised and interactive digital tool showing the location of underground pipes and cables, will complete a minimum viable product for three regions – the North East of England, Wales and London by 2023. ■ Improved data currency on Buildings and Structures within OS Mastermap will be launched through the Public Sector Geospatial Agreement in the second half of FY 21/22, with further enhanced data about buildings, structures and transport networks becoming available over the next 3 years. ■ Publish findings on how location data can support the future of mobility and next generation transport networks. It also will deliver a Transport Location Data Innovation competition to demonstrate the abundance of data-driven opportunities for this sector; and support innovators to bring new products and services to near-market readiness. 	<ul style="list-style-type: none"> ■ The National Underground Asset Register will be enhanced and rolled out across the remaining regions in England and in Northern Ireland, driving efficiencies in infrastructure delivery across the UK and helping improve worker safety. 	
	Product insight	<ul style="list-style-type: none"> ■ The Code for Construction Product Information drives increasing consistency and a standardised approach to construction product information. (Construction Products Association (CPA)) ■ Construction Products Regulator established. (BEIS/MHCLG) 	<ul style="list-style-type: none"> ■ Widespread adoption and application of the Code for Construction Product Information provides consistent and transparent product information, including definition of product insurance. 	<ul style="list-style-type: none"> ■ Digitised product information is increasingly mapped to strategic value drivers and linked through digital models. (CPA and CLC)

11 Action Plan

		0-2 years	2-5 years	5-10 years
Business and delivery models CLC – Value Toolkit, manufacturing skills initiative; Promote fair construction practice (incl fair payment); address risks associated with contractual disputes; improve productivity in commercial management using technology.	Pipeline and frameworks	<ul style="list-style-type: none"> Annual publication of the National Infrastructure and Construction pipeline, including additional insight on workforce requirements and delivery solutions, and a geospatial tool to aggregate IPA and Ordnance Survey data. (IPA) Implementation of Construction Playbook policies regarding long term portfolio contracting, effective contracting through updated boilerplate clauses and more robust contractual requirements for data, innovation and performance improvements.⁴⁶(IPA and GCF) Review of Frameworks completed and implementation of recommendations. (Cabinet Office) Public sector clients use Frameworks that demonstrate the Gold Standard characteristics described in the Review. (GCF/CCS) 	<ul style="list-style-type: none"> Increasingly the government pipeline will leverage digital data sources mapped to a common classification to enable greater insight from the pipeline. 	<ul style="list-style-type: none"> Predictive pipeline tool leveraging AI and machine learning to assess infrastructure needs and delivery constraints. (IPA) Procurement is founded on a digital marketplace leveraging common standards, solutions and configuration. (CCS)
	Platforms (delivery models)	<ul style="list-style-type: none"> The Construction Playbook set an aspiration for the procurement of construction projects based on platforms comprising standard and interoperable components. Building on this, in the next two years the government will set out a requirement for platform approaches to be adopted for social infrastructure with a repeatable design, with a transition period for adoption. (IPA) 	<ul style="list-style-type: none"> Procurement models seek adoption of standard, repeatable solutions, providing stimulus for development and delivery of platform delivery. (Departments and Delivery Bodies) 	<ul style="list-style-type: none"> Implementation of a requirement for platform approaches to be adopted for social infrastructure with a repeatable design. (Departments and Delivery Bodies)
	Platforms (technical enablers)	<ul style="list-style-type: none"> Development of the CIH Platform 'Rulebook', will set the framework for, and inform the development of, platforms and the configuration of different 'kits of parts', with Delivery tested through public projects. (Construction Innovation Hub) 	<ul style="list-style-type: none"> Government and industry collaboration will mature the platform rulebook and interface principles, alongside developed British Standards for major components. (Construction Innovation Hub) 	
	Assurance	<ul style="list-style-type: none"> Development and demonstration of Construction Quality Planning process and demonstration of Digital Compliance verification. (CIH) 	<ul style="list-style-type: none"> Increasing digitisation of statutory requirements enables the application of digital compliance checking and verification rulesets as quality assurance best practice. (Departments and industry) Integration of Advanced Product Quality Planning (APQP) processes and techniques within development of platform solutions(CIH). 	<ul style="list-style-type: none"> Automated compliance checking (inc. building regulations and building control compliance) (Departments and industry) Industry recognition and demand for 'advanced' product quality planning, in meeting a higher standard to ISO 9001.
	New delivery models – new roles	<ul style="list-style-type: none"> Delivery and implementation of the Transforming Construction Challenge and Construction Innovation Hub outputs. (BEIS/UKRI) CIH Value Toolkit. (BEIS/UKRI) 	<ul style="list-style-type: none"> New career development pathways for leaders of complex infrastructure projects. (ICE) 	

		0-2 years	2-5 years	5-10 years
<p>Market capacity and productivity CLC – talent retention scheme; improve the effectiveness of training levy schemes; single industry plan for recruitment, training and retention.</p>	<p>Skills</p>	<ul style="list-style-type: none"> ■ The Construction Skills Delivery Group (CSDG) was established as part of the Project Speed Task Force to improve skills delivery for new entrants and existing workers. The CSDG is a collaboration between DfE, BEIS and industry, engaging with DWP and OGDs. ■ Initial focus is around improving access to our existing skills offers through apprenticeships, T-Levels and bootcamps (National Skills Fund). ■ Longer term work will consider how these offers can be expanded to support future skills needs and gaps, and use of the public sector procurement framework to embed skills and job growth. ■ Recent work includes: <ul style="list-style-type: none"> – A bricklaying traineeship is due to start in June 2021 and others are being considered. – DfE has published Flexible Apprenticeships in Construction (April 2021) which explains how off-the-job training can be flexed to meet individual employer needs. – CSDG engagement with the work of the Green Jobs Taskforce, and wider DfE and DWP work where construction has been identified as a priority sector. – CSDG to use construction sector skills forecast analysis to help to identify and fill skills gaps and roles. ■ Procurement Policy Note 06/20 – Taking account of social value includes a delivery objective of ‘creating employment and training opportunities, particularly for people in industries with known skills shortages or in high growth sectors.’ 		
	<p>National Digital Twin (BEIS)</p>	<ul style="list-style-type: none"> ■ Initially the National Digital Twin programme will focus its technical work on: <ul style="list-style-type: none"> – A) creating the Foundation Data Model (FDM) (or ontology) and Reference Data Library that together define a common structure and meaning for information that is shared between organisations within and across sectors and domains – B) Developing the Integration Architecture – a combination of technologies that enable the sharing of data between databases and the systems that use them. 	<ul style="list-style-type: none"> ■ As the IMF matures, it facilitates the increasing ability to link digital models and twins within and across sectors’ ■ Work commences on embedding a quality management approach to information management, identifying and addressing perceived and actual cultural, procurement and legal blockers; and growing the information management skills and capabilities that are needed. 	<ul style="list-style-type: none"> ■ As the FDM and Integration Architecture become increasingly mature, the focus will shift more to the deployment of digital twins. ■ Software suppliers will increasingly provide the tools to service requests for cross-domain data.

11 Action Plan

		0-2 years	2-5 years	5-10 years
Market capacity and productivity CLC – talent retention scheme; improve the effectiveness of training levy schemes; single industry plan for recruitment, training and retention.	Platforms (roles, skills and solutions)	<ul style="list-style-type: none"> ■ Definition of required skills to understand, develop and apply platform solutions, with growth of training material to suit. ■ Emergence of new industry actors, relationships and roles along the supply chain (inc integrator, assembler, and logistics providers). ■ Independent platform solutions are being developed, with proprietary platform configurators that will apply generative design technologies. 	<ul style="list-style-type: none"> ■ Modernised skills and training that interacts with product design, development and manufacturing, alongside the emergence of new roles within organisations (e.g. 'Platform/Product Manager'). ■ Emerging familiarity in procuring standard and interoperable components, and emergence of a common configurator framework defining interoperability requirements enabling a range of individual configurators spanning the value chain and project lifecycle to interconnect. 	<ul style="list-style-type: none"> ■ In the longer term with a developed ecosystem of interoperable platforms, a sustainable supply chain, will work to a principle of collaboration on the standards, with competition in delivery against a range of value drivers.
	Insurance and risk	<ul style="list-style-type: none"> ■ Industry case studies demonstrate the benefits of platforms in affording commercial certainty and a diminished risk profile. 	<ul style="list-style-type: none"> ■ Agreed rates offered by insurers recognising standard, common design, with clear definition of liability for built asset and performance. 	<ul style="list-style-type: none"> ■ Developed insurance models offer benefits to collaborative and standardised solutions that are validated and configured digitally.
	Integrated funding and financing	<ul style="list-style-type: none"> ■ UK Infrastructure Bank operating in interim form from 2021; including continued recruitment, operationalise mandate and scope and finalise organisational design and Bank policies. (HMT) 	<ul style="list-style-type: none"> ■ Bank established in legislation as a statutory body to deliver on its mandate. ■ Review by spring 2024 of progress and financial performance. (HMT) 	

		0-2 years	2-5 years	5-10 years
Net zero and the environment CLC – net zero carbon roadmap; Construction response to COP26; Construct Zero	Metrics, targets and assessments	<ul style="list-style-type: none"> ■ Introduction of whole life carbon assessments for all government infrastructure and construction projects. (IPA) ■ Energy performance targets across all housing tenures and commercial and public buildings. (MHCLG) ■ Biodiversity Net Gain for all infrastructure projects. (Defra) ■ Develop a National Framework of Green Infrastructure Standards to help local authorities, developers and communities improve green infrastructure provision in their area. (Natural England and Defra) ■ Climate Change Allowances for flood risk assessments. (Environment Agency) ■ Infrastructure sponsors, owners and operators to respond to the findings of the UK Climate Risk Independent Assessment – www.ukclimaterisk.org/independent-assessment-ccra3/briefings/ ■ Use the Natural Capital Committee’s Green Book guidance to embed natural capital into public policy appraisal. 	<ul style="list-style-type: none"> ■ Introduce consistent benchmarking and targets for all government infrastructure and construction projects on a whole life basis (sector, project and asset specific, where relevant). (IPA) ■ Green infrastructure standards are embedded in national planning guidance and policy. (Defra and MHCLG) 	<ul style="list-style-type: none"> ■ Whole life carbon and sustainability is embedded in all government infrastructure projects and reported via the Government Major Projects Portfolio and the Annual Pipeline. (IPA)
	Materials	<ul style="list-style-type: none"> ■ Increase the use of timber and lower carbon construction materials to reduce embodied/capital carbon, lock away carbon long term and drive investment in tree planting and industrial decarbonisation. (Defra) 		
	Green finance	<ul style="list-style-type: none"> ■ UK Government Green Financing Framework⁴⁷ published and Green Savings Bonds launched. (HMT)⁴⁸ 		

		0-2 years	2-5 years	5-10 years
Building expertise and capability	Outcomes in decision making	<ul style="list-style-type: none"> ■ Launch and roll-out the Project Outcome Profile tool across government portfolio to ensure projects can clearly articulate their contribution to priority outcomes. (IPA) ■ Embed culture change in appraisal and decision making within departments building on Green Book 2020. (HMT) ■ PVF: Refine priority outcomes and metrics and link spending decisions to their delivery at the next Spending Review and embed a truly outcome-focussed approach into the departmental planning process. ■ Ministers will receive regular updates on outcome delivery, enabling them to track performance and take early action where delivery may be under pressure. Information on outcome delivery will be used to inform spending decisions, creating a greater link between financial allocations and the delivery of real-world outcomes that matter to citizens. ■ Embed the principles of the Public Value Framework into the day-to-day working of the teams across Whitehall, including as a policy design tool and a means of diagnosing and solving issues preventing successful delivery. Publish Outcome Delivery Plans and final priority outcomes and metrics. (HMT) ■ Increased transparency through business case publication, close out reports and evaluations for GMPP infrastructure projects. (Departments and Delivery Bodies) ■ Support the development and uptake of carbon literacy training for all staff, and promote organisational affiliation with environmental professional bodies. (DfT) 		
	Harmonise Digitise Rationalise	<ul style="list-style-type: none"> ■ Publication of guidance and resources in relation to harmonising, digitalising and rationalising government specifications and standards. (IPA) ■ Standards and specifications are translated into machine readable format via project delivery and departmental initiatives (e.g. Spec 21 for DfE or DMRB for National Highways), with increasing development of common, repeatable parameters, spaces and components. (Departments and Delivery Bodies) 	<ul style="list-style-type: none"> ■ Digitisation of standards and specifications (including building regulations) and planning policies across government is founded on the use of consistent structure, rules and language. ■ Increasing harmonisation and rationalisation of technical requirements, with open source designs (with standards for spaces, components and interfaces) to enable the market to respond with innovative product solutions. 	<ul style="list-style-type: none"> ■ A digital standards library for the public sector can interface with shared design content and rules (e.g. standard space types, interoperability rules, adjacencies and technical requirements).

		0-2 years	2-5 years	5-10 years
Building expertise and capability	Delivery model understanding	<ul style="list-style-type: none"> ■ IPA to collate a range of delivery model examples (with case study content) to support the process set out in the Construction Playbook. (IPA) ■ Implementation of refreshed IPA Project Routemap tool. (IPA) 		
	Government Projects Academy	<ul style="list-style-type: none"> ■ Establishment of the Government Projects Academy, refreshed learning curriculum and training programmes to develop skills and project delivery capability across government, including on data, digital technologies and environmental sustainability. (IPA) 		
	Standards and good practice	<ul style="list-style-type: none"> ■ Implementation of the Government Project Delivery Framework that sets out what projects need to do at each stage and will provide guidance and tools including: <ul style="list-style-type: none"> – Implementation of best practice in cost estimation guidance – Rollout of Opportunity Framing workshops and guidance – Refreshed Project Routemap tools. (IPA) ■ Identification of available technologies, barriers to adoption and facilitating adoption through improved technology navigation approaches. (IPA) ■ Update of the Government Functional Standard for Project Delivery. (IPA) 		
	Project leadership	<ul style="list-style-type: none"> ■ Recruitment of a new pool of major project experts and renewed requirements for MPLA and PLP attendance. (IPA) ■ All infrastructure projects to have a board level design champion in place by the end of 2021, supported where appropriate by design panels. (Departments and Delivery Bodies) 		

	0-2 years	2-5 years	5-10 years
Policy and delivery environment	<ul style="list-style-type: none"> ■ Planning reform, including Planning for the Future proposals, amended Permitted Development Rights for social infrastructure, a faster application process for larger social infrastructure developments and the National Infrastructure Planning Reform Programme. (MHCLG) ■ Levelling Up White Paper in 2021. (MHCLG) ■ A new National Model Design Code.⁴⁹ (MHCLG) ■ A new system of environmental assessment (including Strategic Environmental Assessments and Environmental Impact Assessments) and strategic approaches to the protection of habitats and species. (Defra) ■ Green Paper: Transforming public procurement – consultation response and next steps.⁵⁰ (Cabinet Office) ■ A number of net zero strategies in 2021, including electric vehicle charging infrastructure, heat and buildings, hydrogen, Energy Data and industrial decarbonisation.⁵¹ (BEIS) ■ Spending Review 2021. (HMT) ■ Government response to the Dasgupta Review on the economics of biodiversity. (HMT) ■ Government Estate Strategy. (OGP in CO) 	<ul style="list-style-type: none"> ■ Ambition to reduce timescales by up to 50% for projects entering the Nationally Significant Infrastructure Project (NSIP) regime by 2023. (MHCLG) ■ UK's second National Infrastructure Assessment in 2023. (NIC) ■ Environment Bill will include legally binding targets and Environmental Principles. (Defra) 	<ul style="list-style-type: none"> ■ Commitment to increasing economy-wide investment in R&D to 2.4% of GDP by 2027. (BEIS) ■ Energy White Paper – Targeting 40GW of offshore wind, 5GW of low-carbon hydrogen and 4 industrial CCUS clusters by 2030; growing the installation of electric heat pumps from 30,000 to 600,000 per year by 2028. (BEIS) ■ Carbon Budget Five (2028-2032) limits annual emissions to an average of 57% below 1990 levels and Six (2033-2037) requires a 78% reduction in UK territorial emissions between 1990 and 2035, in effect bringing forward the previous 80% target by nearly 15 years. (BEIS)

12 Implementation and next steps

- 12.1. The IPA is responsible for overall leadership and coordination of the TIP programme, reporting into Ministers in the Cabinet Office and HM Treasury. Many of the measures and reforms will be implemented by other government departments and/or industry, and overall implementation must be a shared endeavour delivered using a systems approach.
- 12.2. The successful implementation of the Construction Playbook will be central to the TIP programme and a key focus for the IPA over the coming years.

12.3. For the IPA this happens at four levels:

- **Project delivery system:** the IPA will leverage its position at the centre of government with responsibility for the project delivery system to shape policy, embed good practice and incentivise behavioural change.
- **Network** (organisations): we will work with departments and delivery bodies to increase expertise, capacity and capability; understand and share good practice and drive improved performance through portfolios.
- **Assets:** we will focus more of our attention on strategically important asset types and develop appropriate interventions to improve performance and value.
- **Projects and programmes:** we will develop and provide tools, support and guidance to projects and programmes to embed new ways of working, build capacity and capability and strengthen the evidence-base for continuous improvement.

12.4. **Interventions** will shape behaviours and culture, and impact will be monitored and evaluated using metrics and indicators.

12.5. We will monitor impact through:

- Public Value Framework priority outcomes and metrics
- Performance of infrastructure and construction projects on the GMPP
- Construction sector indicators
- Government Construction Metrics
- National Infrastructure Commission – system-wide performance metrics

12.6. Cross-government implementation will be overseen by the Infrastructure Steering Group (ISG), chaired by Alex Chisholm, Cabinet Office Permanent Secretary and Chief Operating Office for the Civil Service, and driven by the Government Construction Board (GCB), led by the IPA.

12.7. We have taken this opportunity to refresh and reform the GCB, a cross-government group of senior officials with responsibility for construction policy and project delivery, so it is aligned to the TIP Roadmap and can support its implementation across government. The Board will report into HMT and Cabinet Office Ministers via the IPA and the BEIS Minister of State for Energy, Clean Growth and Climate Change.

12.8. We will work in partnership with the Infrastructure Client Group and the Construction Leadership Council, with GCB working groups aligned to the cross-cutting TIP themes responsible for driving implementation across government and collaborating with their counterparts in industry.

12.9. Progress updates will be reported annually in the IPA Annual Report on Major Projects and the National Infrastructure and Construction Pipeline; with more substantive reviews aligned to the Construction Playbook and the parliamentary cycle.

12.10. There is an open invitation to collaborate with us to make this vision a reality, please share your ideas with us via projectfutures@ipa.gov.uk

Annex A: Progress since 2017

Benchmarking for better performance	
<p>We set out an ambition over 10 years to ensure all major projects and programmes are selected and prioritised using benchmarked data on costs and performance, so that only those projects that best meet the needs of users, asset owners and society are selected. This means ensuring that project sponsors have access to robust and sufficiently granular data against which to benchmark their cost and schedule estimates, and that this is consistently applied. We set out five priority interventions and have been working to implement these and promote a step change in the quality and consistency of benchmarking approaches in projects initiated by government.</p>	
We said	We did
<p>The IPA will establish a new benchmarking team to promote the effective use of cost and schedule benchmarking.</p>	<ul style="list-style-type: none"> A dedicated unit has been set up in the IPA to support benchmarking initiatives with the aim of embedding a consistent approach to benchmarking across major infrastructure projects and programmes.
<p>Cost and schedule benchmarking: support departments in providing benchmarked cost estimates, including whole life costs, as part of the business case approval process.</p>	<ul style="list-style-type: none"> Best practice in benchmarking (2019)⁵³ published and outlines the IPA's recommended methodology. Guidance⁵⁴ updated July 2021. In 2020 the Benchmarking capability tool⁵⁵ was made available to support organisations to measure and improve their benchmarking capability against industry best practice. March 2021 – Cost Estimating Guidance⁵⁶ published, setting out a best practice approach to the development of cost estimates for infrastructure projects and programmes. Work on developing a Benchmarking Hub is making good progress.

We said	We did
<p>Benefits realisation: ensure that infrastructure projects' business cases demonstrate how they have considered the widest possible range of benefits to be delivered through the planned investment.</p>	<ul style="list-style-type: none"> Developed a Project Outcome Profile Tool, which includes metrics to understand the delivery of outcomes over the project lifecycle. Trials of the POP were completed in 20/21 and it was published in July 2021.⁵⁷
<p>Performance measurement: the IPA will work across government and the wider sector to develop a system of performance metrics for government construction projects and programmes.</p>	<ul style="list-style-type: none"> The IPA has worked with stakeholders to develop construction metrics covering four themes: productivity; net zero carbon; levelling up; and innovation. From summer 2021 departments will begin to consistently collect this data, contributing to an evidence base for continuous improvement.
<p>International benchmarking: build support for greater international collaboration.</p>	<ul style="list-style-type: none"> IPA has had positive engagement with Hong Kong on transport assets and across Europe on prisons.

Alignment and integration

In 2017 we said we would join up how government selects, plans, and delivers major infrastructure projects and programmes by aligning objectives throughout the investment lifecycle and integrating planning and delivery of individual infrastructure projects across sectors. This would help to unlock opportunities to develop infrastructure networks and systems that support the UK's priority economic, social and environmental objectives. We set out three priority interventions to support this approach: alignment; integrated planning and supporting the devolution agenda.

We said	We did
Approaches used by the Environment Agency and the Department for Transport to assess and prioritise their investment programmes, and consider regional factors would be further developed.	<ul style="list-style-type: none"> In December 2020 a refreshed Green Book was published, supporting the principles set out in TIP on wider social benefits and integrated infrastructure delivery at the sub-national level. In 2021 we launched a new Project Outcome Profile tool to enable projects and programmes to identify how they will contribute to the government's priority outcomes. This complements the Public Value Framework (2019),⁵⁸ a tool for understanding how well public money is turned into policy outcomes.
Drive more effective implementation of existing tools and guidance, in particular the IPA Routemap tools.	<ul style="list-style-type: none"> The National Infrastructure Strategy confirmed that the Routemap should be used for all major complex and novel infrastructure projects. A refreshed Routemap,⁵⁹ incorporating new and emerging best practice was launched in July 2021. IPA has developed a new Government Project Delivery Framework to describe good practice and requirements at each stage of the project lifecycle.
Assurance processes would be used to: measure delivery of project objectives, benefits, cost and schedule, against the investment baseline; and create an evidence base to support continuous improvement and policy reform.	<ul style="list-style-type: none"> The new Project Outcome Profile tool will set a robust baseline against which delivery can be monitored and evaluated. From April 2021, all major infrastructure projects on the GMPP must publish: a summary business case following final approval; a close out report following completion; and a long-term evaluation five to ten years into operation. HMG Assurance workbooks have been updated to reflect new policy priorities and practices, including net zero carbon requirements.

Integrated planning and delivery remains a priority for the government, as set out in the [Planning for the Future White Paper \(August 2020\)](#) and NIS announcements on reform to the Nationally Significant Infrastructure Project regime. While the challenges of the last three years mean we have not yet made as much progress as we would have liked at a system level, we have seen progress and innovation in specific cases – particularly the OxCam Arc. The National Infrastructure Strategy reiterates the government's commitment to improving infrastructure delivery, and our focus on levelling up across the UK means effective and integrated delivery is more important than ever.

Support delivery of the Oxford-Cambridge Arc projects , and the wider development of the integrated approach being adopted for the programme.	<ul style="list-style-type: none"> Worked collaboratively with teams across government to deliver the vision for the Oxford-Cambridge Arc. Progress to date includes: funding confirmed and work progressing on East-West Rail; A421 upgrade complete and A34 improvements commenced. In February 2021 the government published a policy paper setting out its planned approach to developing the Oxford-Cambridge Arc Spatial Framework.
Applying the integrated approach to other suitable regional investments such as the Midlands Engine, Thames Gateway and Northern Powerhouse and the integrated strategy for the north.	<ul style="list-style-type: none"> Working with central government and local authorities to deliver the levelling up agenda, through the application of funding such as the Levelling Up Fund, Towns Fund and Future High Street Fund; and also spatial planning of major new settlements, building upon the launch of Ebbsfleet Garden City.
Support the devolution agenda as we move to more devolved project sponsorship and funding.	<ul style="list-style-type: none"> Local Government Scholarships will be available to project leaders working in local government, so that they can attend project leadership programmes offered by the new Government Projects Academy. We will continue to work with Local Partnerships and local government leaders to support effective infrastructure delivery. The new UK Infrastructure Bank will support this agenda.

Procurement for growth	
<p>The ambition we set out was to drive long-term value for taxpayers and users of infrastructure, and support a thriving, world-leading infrastructure industry in the UK, by creating smarter commercial relationships that support greater investment in innovation. This new strategic approach meant there was a need to develop sponsor and client capability. Five priority interventions were identified to support this approach and enable greater investment, innovation and productivity.</p>	
We said	We did
<p>The government’s assurance and approvals processes would support a longer-term, collaborative commercial relationship. This included extending long-term budget settlements to more departments where appropriate and sharing good practice on promoting longer term relationships.</p>	<ul style="list-style-type: none"> ■ The Construction Playbook encourages longer term contracting across portfolios for key asset types and programmes, where appropriate. ■ We have worked in partnership with the industry to develop good practice in long term collaborative relationships, including through Project 13.
<p>Build client and sponsor capability, using our client capability framework, to support government construction clients and develop additional procurement training for public procuring bodies.</p>	<ul style="list-style-type: none"> ■ The Government’s client capability assessment tool has helped four departments identify and assess critical areas for capability building. ■ Capability support will be available to contracting authorities as part of implementing the Construction Playbook.
<p>Contracts would be standardised and simplified and a more joined-up approach to procurement, contracting and risk allocation would be promoted.</p>	<ul style="list-style-type: none"> ■ In 2019 IPA worked with CCS to complete a suite of standard ‘boilerplate’ clauses for use on its construction frameworks ■ We are now updating the clauses to include the new policies set out in the Construction Playbook.

We said	We did
<p>Improve the procurement process to reduce bureaucracy and costs.</p>	<ul style="list-style-type: none"> ■ In March 2021 Build UK announced that the new industry-wide pre-qualification (PQ) system was up and running. ■ Our Project Outcome Profile tool will inform contractual processes, including informing the baseline for robust post-completion evaluation. ■ Published a PPN⁶⁰ on the role of social value in government procurement.
<p>Drive supplier performance: by piloting a system to measure and share best practice for the performance of suppliers.</p>	<ul style="list-style-type: none"> ■ Events, particularly the collapse of Carillion in 2018 and subsequent government response, negated the need for the pilot. ■ In 2019 CCS introduced strengthened financial assessment for contracts valued above £5 million per annum to ensure fair and prompt payment.⁶¹ This is endorsed by the Construction Playbook, which introduces a defined approach to market health and capability assessments.

Smarter Infrastructure	
<p>Our ambition is to deliver smarter projects and embed technologies that improve the performance of our existing infrastructure. The last three years have been challenging for the industry, particularly through the COVID-19 pandemic. However the industry has continued to operate effectively and we have seen the benefits of MMC and offsite approaches. In 2017 we set out four interventions to support this approach and good progress has been made by those departments that have adopted the presumption in favour of offsite construction.</p> <p>In November 2018 we published a call for evidence on a proposal for a new approach to building, using platforms to establish a more interoperable approach, which was generally well received – see the summary of responses.⁶²</p>	
We said	We did
<p>To support smart construction (demand side) we would use the government’s purchasing power to build critical mass in sectors amenable to modern methods of construction (MMC), starting with the five departments that have adopted a presumption in favour of offsite construction. Alongside this we would also explore opportunities to support uptake in potential sectors such as housing.</p>	<ul style="list-style-type: none"> ■ The progress made by the departments that adopted the presumption in favour of offsite manufacture is set out in the summary of responses to the call for evidence. ■ The Construction Playbook has an aspiration to procure construction projects based on product platforms and an expectation to set targets for the use of MMC in the delivery of projects and programmes. This links with the work underway to develop a common set of government construction metrics to better understand construction performance across government. ■ The Playbook also encourages contracting authorities to seek opportunities to collaborate and adopt shared requirements and common standards – Harmonise, Digitise and Rationalise demand. An example of this is the standards harmonisation element of the TIES Living Lab programme, which has assessed the benefits of harmonising the standards of the demonstrator assets within the Living Lab, and will look to harmonise standards for assets where there are benefits (e.g. Footbridges).

We said	We did
	<ul style="list-style-type: none"> ■ To increase the delivery of housing through MMC, MHCLG has developed a categorised definition framework for different forms of construction methodologies and is undertaking work on standardisation for home building. A study is underway to understand the comparative impact and performance of MMC versus traditional construction, and Budget 2021 announced the creation of a new MMC Taskforce to further increase adoption in the housing sector. ■ Through the Construction Sector Deal government has provided funding to the Construction Innovation Hub (CIH), which is supporting the aggregation of demand through its analysis of the elements of the pipeline deliverable through a platform solution.⁶³
<p>The government would commit to invest £170 million to support innovation in the sector (supply side). This included agreement of the Sector Deal, to ensure effective delivery of the key enablers to modernising construction, and to identify and help address workforce capacity or capability gaps.</p>	<ul style="list-style-type: none"> ■ The Construction Innovation Hub (CIH) is acting as a locus of collaboration to enable the market, bringing together a range of industry partners to collectively develop a platform solution.⁶⁴ The CIH is also enabling the evolution of the processes to support and enable manufacturing approaches, including Construction Quality Planning processes.⁶⁵

Smarter Infrastructure continued	
We said	We did
<p>Drive faster uptake of digital technology through the coordination of cross government and cross-sectoral uptake of technology solutions:</p>	<ul style="list-style-type: none"> ■ We have encouraged contracting authorities to use the UK Building Information Modelling (BIM) Framework to standardise the approach on data, including data security and exchange, and through the National Digital Twin programme government is supporting the development of the Information Management Framework. Government’s commitment to this was confirmed in the National Infrastructure Strategy and Construction Playbook. ■ Through UK Research and Innovation (UKRI) the Transforming Construction Challenge has funded a range of research and development, and demonstrator projects, including automated design, virtual and augmented reality solutions, and sensing and prediction technologies to save time and increase safety.
<p>Catalyse and disseminate innovation and best practice to support faster uptake of innovation and best practice, and to provide a coordinating role across government</p>	<ul style="list-style-type: none"> ■ Over the period of the COVID-19 pandemic there has been excellent collaboration between government and industry, in particular through the Construction Leadership Council, and other industry bodies and forums, including the Infrastructure Industry Innovation Partnership (i3P), Institute for Government (IFG), Association for Consultancy and Engineering (ACE) and Institution of Civil Engineers (ICE). ■ IPA leads the Government Construction Board to coordinate construction policy across departments and delivery bodies and share best practice.

Annex B: Information Management Mandate

An updated Information Management Mandate delivered through the application of UK BIM Framework

1. Building Information Modelling (BIM)⁶⁶ has been key to digital transformation, and the delivery of improved information management, across the UK built environment since the 2011 Government Construction Strategy⁶⁷ introduced the requirement for fully collaborative BIM as a minimum by 2016. This is referred to as the UK BIM Mandate.
2. BIM is currently defined by the UK BIM Framework⁶⁸ and is based on the emerging ISO 19650 series of standards and any of the remaining BS/PAS 1192 suite of standards. It was previously known as BIM Level 2⁶⁹ until it was superseded by the UK BIM Framework in 2018.
3. BIM is a combination of process, standards and technology through which it is possible to generate, visualise, exchange, assure and subsequently use and re-use information, including data, to form a trustworthy foundation for decision-making to the benefit of all those involved in any part of an asset's lifecycle. This includes inception, capital phase procurement and delivery, asset and facility management, maintenance, refurbishment, and ultimately an asset's disposal or re-use.
4. The implementation of BIM across Government projects, from delivery through operational handover, facilitated by the adoption of Government Soft Landings (GSL),⁷⁰ has resulted in greater collaboration, productivity and efficiency in the design and delivery of construction projects delivering both social and economic infrastructure.
5. The report of the BIM Interoperability Expert Group (BIEG) in March 2020,⁷¹ led in partnership by the Infrastructure and Projects Authority (IPA) and Department for Business, Energy & Industrial Strategy (BEIS) and delivered by the Centre for Digital Built Britain (CDBB), provided evidence that interoperability is fundamental to the ability to build on the success of BIM implementation to date and to the delivery of 'whole-life' beneficial outcomes to all parties.
6. Interoperability, by providing a means of information transfer between different technologies while preserving the integrity of the information transferred, results in beneficial outcomes not just for clients, suppliers and end-users who procure, deliver, own, operate, maintain and are served by assets. It helps to unlock societal, health and safety, environmental and economic benefits from the built environment, as well as improving its overall resilience; hence, interoperability is considered a key component of the updated BIM Mandate, now termed the Information Management Mandate.
7. Point 8 below sets out the Information Management Mandate which is delivered through the application of the UK BIM Framework.

8. The Information Management Mandate is applicable immediately and for the duration of the Transforming Infrastructure Performance 10 Year Plan and requires the client to:
 - a. ensure all procurement and contractual processes are compliant with the standards set out in the UK BIM Framework at the time of delivery;
 - b. follow the sensitivity assessment process set out in Clause 4 of ISO 19650-5 to determine whether to implement a security-minded approach. Where a security-minded approach is required, to develop and implement this following the requirements set out in ISO 19650-5 clauses 5 to 9;
 - c. have in place the capability to deliver and then fulfil its information management function, as set out in ISO 19650-1, either with people within its own organisation, people acting on behalf of it, or a combination of both;
 - d. define its information requirements concerning its assets and projects set out in ISO 19650 Parts 2 and 3 and to support its organisational/asset whole-life and project objectives, by producing:
 - i. Organisational information requirements (OIR) – organisational objectives;
 - ii. Project information requirements (PIR) – purpose, design and construction of an asset;
 - iii. Asset information requirements (AIR) – operation and maintenance of an asset;
 - iv. Security information requirements (SIR), where applicable – in relation to information security; and
 - v. Exchange information requirements (EIR) – in relation to an appointment;
 - e. have a digital mechanism for defining its information requirements and then procuring, receiving, assuring, and immutably storing, via a system of record, the information that it procures;
 - f. fully and properly specify its information requirements, and their satisfactory delivery, within contractual documentation, recognising that the information it procures and holds is an important asset with value, that is critical to undertaking and optimising the operations, maintenance and disposal of the asset; and
 - g. apply the same level of governance and rigour to the maintenance of its information, to ensure that it provides ongoing value and benefits to the client organisation. This will include the ability to share and exploit information, and also make information available for regulatory purposes.
9. The UK BIM Framework, in addition to standards, contains BIM guidance and useful up to date resources that help explain the Information Management Mandate clauses listed above and which can also be used to help implement them.
10. The Information Management Mandate will be periodically reviewed and updated alongside the UK BIM Framework and digital and technological advancements and will include aspects of BIM Interoperability. This will allow the UK to maintain its position as one of the leaders in delivering value to clients and projects through the use and management of built environment information.

Annex C: Glossary of key terms

- **Our vision:** A future where we collectively prioritise the societal outcomes we need, and use data, technology and improved delivery models to achieve them through our interventions in the built environment.
- **Our objectives:**
 - **Data and insight** – collect, collate, analyse and share data on infrastructure performance to provide the insight needed to improve productivity and deliver better societal outcomes
 - **Business and delivery models** – set up projects and programmes with governance and contracting arrangements that support cross department collaboration, industry innovation, the use of technology and delivery of balanced whole life outcomes
 - **Market capacity and productivity** – deliver continuous improvement in the efficiency of infrastructure performance; matching the supply chain, capability and capacity to the pipeline of projects and programmes required and developing new ways of working
- **Environment and sustainability** – embed outcomes for net zero, sustainability and environmental enhancement across the whole life of assets and systems
- **Building expertise and capability** – develop and deploy people with the skills, expertise and capability to act as clients and supply chain providers to deliver high quality, balanced outcomes in a complex and multi-stakeholder environment.
- **TIP Roadmap:** Shorthand description for ‘Transforming Infrastructure Performance: Roadmap to 2030’, i.e. this document.
- **TIP measures:** the activities and actions included in the TIP Action Plan.
- **System of systems:** This term describes the many different and interconnected assets and networks of the built environment, alongside their digital representations. Systems of systems: This term expands the ‘system of systems’ by pluralising the ‘system’ to encompass a) services (i.e. the interconnections and interfaces with services provided through the built environment, and b) the **natural world**. Both services and the natural world can be seen as systems in their own right.
- **Built environment:** the human-made surroundings that provide the setting for human activity.
- **Natural environment:** all living and nonliving things occurring naturally – i.e. not human-made.
- **Infrastructure:** the physical assets and services needed for the operation of human society.
- **Action Plan:** The short, medium and long term actions set out in section 11 of this document.

The IPA would like to thank all those from government and industry who have contributed their time and expertise, including through workshops, drafting groups and challenge panels, to develop the content for the TIP: Roadmap to 2030. They have helped make the Roadmap a reality and demonstrated once again how effectively government and industry can work together.

Departments/Organisations:

Association for Consultancy and Engineering (ACE)
Akerlof
Arup
Atkins
Department for Business, Energy and Industrial Strategy (BEIS)
Baxi
British Plastics Federation (BPF)
British Standards Institution (BSI Group)
Bryden Wood
Build UK
Buro Happold
Cabinet Office (CO)
Crown Commercial Service (CCS)
Civil Engineering Contractors Association (CECA)
Centre for Digital Built Britain (CDBB)
Construction Industry Council (CIC)
Construction Innovation Hub (CIH)
Construction Leadership Council (CLC)
Centre for the Protection of National Infrastructure (CPNI)

Department for Education (DfE)
dRMM Architects
Environment Agency (EA)
EY
Faithful+Gould
Fastrail
Federation of Master Builders (FMB)
Geospatial Commission
Global Infrastructure Hub (GIH)
Fore Consulting
Government Commercial Function (GCF)
National Highways
Health and Safety Executive (HSE)
Her Majesty's Treasury (HMT)
Homes England
HS2 and Skanska, Costain, Strabag (SCS)
Infrastructure Client Group (ICG)
Institution of Civil Engineers (ICE)
Jacobs
Laing O'Rourke
Landsec

Land Registry
Mace
Manufacturing Technology Centre (MTC)
Ministry of Defence
Ministry of Housing, Communities and Local Government (MHCLG)
Mixergy
Mott MacDonald
National Infrastructure Commission (NIC)
Ordnance Survey
Royal Academy of Engineering
Saint Gobain
Tees Valley Combined Authority (TVCA)
Department for Transport (DfT)
Turner & Townsend
UK Regeneration
UK Research and Innovation (UKRI)
Visual Meaning
WSP
XYZ Reality

References

- 1 www.visionforbuiltenvironment.com
- 2 Infrastructure defined in the broadest sense, including economic, social, defence and utilities.
- 3 Net zero refers to the UK's legal requirement to achieve net zero greenhouse gas emissions by 2050.
- 4 <https://sdgs.un.org/goals>
- 5 The 25 Year Environment Plan describes 10 goals, including 1) clean air, 5) using resources from nature more sustainably and efficiently, 7) mitigating and adapting to climate change and 8) minimising waste. www.gov.uk/government/publications/25-year-environment-plan/25-year-environment-plan-our-targets-at-a-glance
- 6 <https://nic.org.uk/studies-reports/design-principles-for-national-infrastructure/>
- 7 www.gov.uk/government/publications/mod-building-performance-standards-jsp-315
- 8 This continuity of alignment and support is referred to in the [Green Book Review 2020](#) as a "golden thread".
- 9 Opportunity Framing is a structured 1-2 day workshop to improve project definition and improve decision-making early in the lifecycle, leading to better project outcomes.
- 10 www.project13.info
- 11 www.cdbb.cam.ac.uk/files/flourishing-systems_revised_200908.pdf
- 12 The National Infrastructure Commission has undertaken analysis of a range of scenarios for how the use of public transport, broadband networks and utilities might change as a result of the pandemic. <https://nic.org.uk/studies-reports/behaviour-change-and-infrastructure-beyond-covid-19/>
- 13 <https://nic.org.uk/studies-reports/cities-programme/principles-for-urban-infrastructure-strategies/>
- 14 <https://nic.org.uk/studies-reports/infrastructure-towns-and-regeneration/>; This will report in September 2021 and any recommendations in reserved areas will be relevant to the whole of the UK.
- 15 <https://nic.org.uk/studies-reports/growth-across-regions/>
- 16 <https://nic.org.uk/studies-reports/annual-monitoring-report-2021/>
- 17 Greater Manchester, Liverpool City Region, West Midlands, West Yorkshire, Sheffield City Region, West of England and Tees Valley.
- 18 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/944491/Provisional_priority_outcomes_and_metrics.pdf
- 19 www.gov.uk/government/publications/spending-review-2020-documents/spending-review-2020#shared-outcomes-fund
- 20 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/941816/2020-12-8_response_-_Proposal_for_a_New_Approach_to_Building.pdf
- 21 The Construction Innovation Hub's 'Defining the Need' report highlights inconsistency in naming and finds that circa 70% of Government assets could use a single ~8m span.
- 22 Examples of configurators are the SEISMIC primary school configurator; <https://seismic-school-app.io/> and the PRISM housing configurator; www.prism-app.io/
- 23 Examples could include a reduced need to work at height, lift or carry heavy materials and exposure to dust and other hazardous substances.
- 24 Evidence shows a 55% reduction in onsite labour vs a traditional build and 30% faster assembly on site than a traditional steel and concrete structure.
- 25 UCL Report "Understanding Best Practice in Deploying External Solid-Wall Insulation in the UK" (2017), p.22 refers payback periods of 12 to over 40 years and an installation life of 25-30 years.
- 26 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/657772/UCL-EWI-2017.pdf
- 27 High capital costs are an even more significant barrier for rented properties because of the split incentive of the landlord incurring the cost while the tenant benefits from a reduction in running costs. www.theccc.org.uk/publication/sixth-carbon-budget/
- 28 More detail on the government's approach to energy efficiency for existing homes can be found in the response to the House of Commons Environmental Audit Committee Report – <https://committees.parliament.uk/publications/5810/documents/66321/default/>
- 29 In its Clean Growth Strategy, the government has already committed to getting as many homes as possible to Energy Performance Certificate (EPC) Band C by 2035. Government has: a) consulted on raising minimum standards to EPC Band C for Private Rented Sector homes by 2028 for all tenancies; b) committed to review the Decent Homes Standard for social housing, taking account of energy efficiency and decarbonisation of social homes; c) committed to consult on regulatory options for improving the energy performance of owner occupied homes in 2021.
- 30 EPC Action Plan https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/922660/EPC_Action_Plan.pdf
- 31 BEIS mortgage lender consultation currently in evaluation: www.gov.uk/government/consultations/improving-home-energy-performance-through-lenders
- 32 www.gov.uk/government/publications/green-finance-strategy

References

- 33 English Housing Survey 2019: www.gov.uk/government/statistics/english-housing-survey-2019-to-2020-headline-report
- 34 International examples include KfW (the state-owned German infrastructure development bank) which offers home owners loans through local financial institutions at favourable rates underwritten by the government – both for energy efficiency and age- or disability appropriate renovations: www.kfw.de/inlandsfoerderung/Privatpersonen/Bestandsimmobilie/
- 35 www.grandviewresearch.com/industry-analysis/energy-retrofits-systems-market
- 36 The Green Alliance identifies applicability of the whole house (energiesprong) retrofit model to about ¼ of UK privately owned homes (7m/29m, excluding social housing), p.8: https://green-alliance.org.uk/resources/reinventing_retrofit.pdf
- 37 www.icevirtuallibrary.com/doi/pdf/10.1680/jsmic.20.00023
- 38 www.cdbb.cam.ac.uk/files/cih_bim_interoperability_expert_group_report_april_2020_final_wm_removed.pdf
- 39 www.cdbb.cam.ac.uk/what-we-do/national-digital-twin-programme/explaining-information-management-framework-imf
- 40 www.cdbb.cam.ac.uk/system/files/documents/TheGeminiPrinciples.pdf
- 41 www.icevirtuallibrary.com/doi/pdf/10.1680/jsmic.20.00023
- 42 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/417822/PU1798_Valuing_Infrastructure_Spend_-_lastest_draft.pdf
- 43 www.gov.uk/government/publications/uk-innovation-strategy-leading-the-future-by-creating-it
- 44 www.communiheat.org
- 45 www.gov.uk/government/publications/industrial-decarbonisation-strategy
- 46 www.gov.uk/government/publications/the-construction-playbook
- 47 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1002578/20210630_UK_Government_Green_Financing_Framework.pdf
- 48 In line with Green Book guidance on valuing infrastructure investment – https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/417822/PU1798_Valuing_Infrastructure_Spend_-_lastest_draft.pdf
- 49 www.gov.uk/government/consultations/national-planning-policy-framework-and-national-model-design-code-consultation-proposals
- 50 www.gov.uk/government/consultations/green-paper-transforming-public-procurement
- 51 www.gov.uk/government/publications/industrial-decarbonisation-strategy
- 52 www.gov.uk/government/publications/improving-infrastructure-delivery-project-initiation-routemap
- 53 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/783525/6.5341_IPA_Benchmarking_doc_FINAL_Web_050319.pdf
- 54 www.gov.uk/government/publications/best-practice-in-benchmarking
- 55 www.gov.uk/government/publications/benchmarking-capability-tool
- 56 www.gov.uk/government/publications/cost-estimating-guidance
- 57 www.gov.uk/government/publications/green-book-supplementary-guidance-projectprogramme-outcome-profile
- 58 www.gov.uk/government/publications/public-value-framework-and-supplementary-guidance
- 59 www.gov.uk/government/publications/improving-infrastructure-delivery-project-initiation-routemap
- 60 Procurement Policy Note 06/20 – taking account of social value in the award of central government contracts
- 61 Procurement Policy Note 07/20 – Taking account of a bidder’s approach to payment in the procurement of major government contracts
- 62 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/941816/2020-12-8_response_-_Proposal_for_a_New_Approach_to_Building.pdf
- 63 https://constructioninnovationhub.org.uk/wp-content/uploads/2020/12/FINAL_VERSION_DEFINING-THE-NEED-REPORT-DEC-2020.pdf
- 64 <https://constructioninnovationhub.org.uk/platform-design/>
- 65 <https://constructioninnovationhub.org.uk/construction-quality-planning-cqp-consultation-findings/>
- 66 www.cdbb.cam.ac.uk/BIM
- 67 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/61152/Government-Construction-Strategy_0.pdf
- 68 <https://ukbimframework.org/>
- 69 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/510354/Government_Construction_Strategy_2016-20.pdf
- 70 https://ukbimframework.org/wp-content/uploads/2019/11/GSL_Report_PrintVersion.pdf
- 71 www.cdbb.cam.ac.uk/files/cih_bim_interoperability_expert_group_report_april_2020_final_wm_removed.pdf



Infrastructure and Projects Authority

Contact IPA

www.gov.uk/IPA

IPA@ipa.gov.uk

[@ipagov](https://twitter.com/ipagov)

Cabinet Office

Correspondence team

70 Whitehall

London

SW1A 2AS

publiccorrespondence@cabinetoffice.gov.uk

General enquiries: 020 7276 1234

HM Treasury

Correspondence team

1 Horse Guards Road

London

SW1A 2HQ

public.enquiries@hmtreasury.gsi.gov.uk

General enquiries: 020 7270 5000

© Crown Copyright 2021

Produced by the Infrastructure and Projects Authority

You may re-use this information (excluding logos) free of charge in any format or medium, under the terms of the Open Government Licence. To view this licence, visit www.nationalarchives.gov.uk/doc/open-government-licence/ or email: psi@nationalarchives.gsi.gov.uk

Where we have identified any third party copyright material you will need to obtain permission from the copyright holders concerned.

Alternative format versions of this report are available on request from ipa@ipa.gov.uk