Government Commercial Function

Promoting Net Zero Carbon and Sustainability in Construction

Guidance Note

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1. Policy Context

1.1 Overview

1.1.1 On 27 June 2019, the UK legislated to introduce a target for achieving at least a 100% reduction of greenhouse gas emissions, compared to 1990 levels by 2050. This target is known as the Net Zero Target, and since its passing into legislation, the Government has released the Net Zero Strategy to help drive its achievement.

1.1.2 Both the target and the Net Zero Strategy alongside the Climate Change Act 2008 are set with high ambition. There are multiple ways that those designing and executing procurements in public infrastructure and construction projects can drive decarbonisation through their approach. This could be by signing up to a environmental or carbon standard for built assets (such as PAS 2080, EN15643, PAS 2035, and BREEAM), through ensuring that they maximise the application of existing procurement policy to do so (such as the National Procurement Policy Statement, PPN 06/21 and the Social Value Model), or by setting ambitious reduction targets at project level for carbon and material use (as HS2, for example, have done). Many of these initiatives and approaches will be expanded on in the text below – with information and guidance highlighted for Contracting Authorities to tackle carbon emissions and waste through different stages of the procurement process, or to support other objectives such as enhanced biodiversity.

1.1.3 For the UK to meet its statutory climate targets, including its carbon budgets, requirements are only likely to increase in their stringency. Thus, being forward thinking and innovative, especially on high-value construction projects, is in the interests of both the government and industry. The most effective way to reduce carbon is to 'design it out', or rethink how we can achieve our objective without necessarily relying on the traditional infrastructure required to do so, getting the thinking right at the outset remains key. Once this has been done – applying the same approach to the design and execution of the procurement is important. Major infrastructure projects give us the chance to lead the way, experiment and innovate as we seek to decarbonise.

1.2 Scope, Application and Dissemination

1.2.1 This guidance note collates and builds on practical resources on decarbonisation for those procuring construction and infrastructure projects and programmes. The contents

of this Guidance Note apply to all Central Government Departments, their Executive Agencies and Non-Departmental Public bodies from the time of publication. Contracting Authorities within the wider public sector are also encouraged to apply this advice. It should be disseminated accordingly.

1.2.2 This guidance note is to be applied on the same 'comply or explain' basis as the Playbooks – this is in addition to the policies, standards and methodologies referred which have their own scope, requirements, and/or qualifying criteria. Proportionality and relevance remain key guiding concepts in procurement law - so application should be in line with these principles when applied to individual procurements.

1.3 Contact

1.3.1 The Cabinet Office Markets, Sourcing & Suppliers team (commercial.support@cabinetoffice.gov.uk) provides support to complex outsourcing projects and market insight.

1.3.2 Enquiries about this Guidance Note should be directed to the Sourcing Programme team at markets-sourcing-suppliers@cabinetoffice.gov.uk.

2. Pipelines, Portfolios and Longer-Term Contracting

2.1 Definitions of Net Zero and sustainability, and how this relates to value

2.1.1 In 2019, the Government amended the Climate Change Act 2008 by introducing a target of at least a 100% reduction in the net UK carbon account i.e. a reduction of greenhouse gas emissions, compared to 1990 levels by 2050. This created a statutory Net Zero target. This target is managed through carbon budgets set by the UK Climate Change Committee, which quantifies the allowable emissions during a 5 year period, and sets a trajectory to net zero. This includes the intermediate targets of reducing carbon emissions by 68% by 2030, and 78% by 2035. The Climate Change Committee has also emphasised the importance of climate adaptation, and improving the resilience of the built environment to changing conditions, such as a greater range of temperature and more extreme weather conditions.

2.1.2 To achieve Net Zero, the UK's total greenhouse gas (GHG) emissions will need to be equal to or less than the emissions the UK removed from the environment, to achieve a level compatible with the target of limiting global warming to 1.5 degrees Celsius. This can be achieved by a combination of emissions reduction (the reduction of the level of carbon emitted by a particular activity or in a specified area over a period of time) and emission removal (the removal of carbon dioxide in the atmosphere, for example through sequestration).

2.1.3 The phrase Net Zero Carbon does not just refer to CO_2 – but also to other relevant GHG emissions – which are often measured in carbon dioxide equivalent units (CO_2e). The use of CO_2e allows for more accessible reporting and straightforward tracking and reporting of emissions over time. CO_2e includes all seven of the greenhouse gases defined within the Kyoto protocol: carbon dioxide (CO2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFC), perfluorocarbons (PFC), sulphur hexafluoride (SF_6) and nitrogen trifluoride (NF_3). Each of these greenhouse gases has a conversion factor to its carbon equivalent.

2.1.4 Achieving net zero should be considered as part of a broader approach to achieving sustainable outcomes, and the design, delivery and operation of all infrastructure and construction projects and programmes should support this policy objective. At the level

of the project or programme, net zero carbon can be defined as the reduction of carbon emissions to zero, or a residual level consistent with the eligible pathways for achieving the 1.5 degrees Celsius target (by 2050), and reducing the impact of residual emissions by removing an equivalent volume of carbon.

2.1.5 Sustainability is defined by the United Nations (Brundtland Report 1987) as a balance between the economic, social and environmental elements of society in a way that meets the needs of the present without compromising the ability of future generations to meet their needs. At the level of a project, this can consist of measures to reduce use of energy and or natural and manmade resources, to improve waste management, to improve employment and training opportunities for disadvantaged groups, and otherwise to protect or improve the condition of the environment or the well-being of people. The environment is defined as 'all and any land, water and air within any natural or man-made structure above or below ground'.

2.1.6 Currently, Contracting Authorities must pursue the Most Economically Advantageous Tender (MEAT), but the Government has signalled its intention to change this, via the Procurement Reform Bill, to the Most Advantageous Tender (MAT). This is to signal clearly that procuring on the basis of lowest up-front capital cost is unlikely to deliver the best value for the tax-payer.

2.1.7 The Government has made it clear that it is incumbent upon all Contracting Authorities to make immediate progress towards achieving Net Zero. The National Procurement Policy Statement (see PPN 05/21) states that *tackling climate change and reducing waste* is a national priority outcome that Contracting Authorities should have regard to when formulating their procurement strategy.

2.1.8 A programme, project or individual asset's carbon and environmental impact is integral to its value and the social value it creates. The next generation of built assets is likely to exist far beyond 2050: if they are not designed and procured to deliver carbon and environmental performance consistent with the 2050 target, significant sums of money would be required to retrofit or replace them in future. There are numerous ways that sustainability can be reflected through the overall design of the procurement, the evaluation criteria selected, and the relative weighting of those criteria. The Construction Innovation Hub's Value Toolkit provides a comprehensive suite of tools

designed to help procurers with the above, and the Government's Social Value Model (see PPN 06/20)[1] sets out model criteria that can be applied.

2.2 Net Zero/environmental strategies

2.2.1 This decade has been identified by the Intergovernmental Panel on Climate Change as the critical decade for reducing carbon emissions. The IPCC has calculated that to have an 83% chance of achieving the target of limiting global warming to 1.5 degrees Celsius, significant reductions to global carbon emissions are required by 2028. Delaying this by 12 months would reduce the chance of limiting global warming to 1.5 degrees Celsius to 67%.

2.2.2 Around 40% of UK carbon emissions are linked to the built environment. This includes emissions linked to heating buildings, the energy they consume to support operations and the operation of transport infrastructure. Construction activity accounts for around 50m tonnes of CO_2 emissions, over half of which is linked to construction product and materials production, particularly materials such as steel and cement, which account for around 15% of global carbon emissions. The construction sector also generates around 60% of waste produced in the UK. Reducing and ultimately eliminating these emissions, through minimising materials requirements, particularly those of carbon-intensive materials, maximising the energy and heat efficiency of built assets and improving levels of reuse and recycling is critical to the delivery of the 2050 target.

2.2.3 Contracting authorities have a responsibility to act now to reduce these emissions, consistent with the trajectory of reducing UK emissions by 68% by 2030, 78% by 2035, and achieving net zero carbon by 2050. The Construction Playbook states that all Contracting Authorities should have strategies in place to achieve net zero carbon in relation to construction and operational emissions across their estates and other built assets by 2050, as part of a Strategic Asset Management Plan. In considering how to reduce carbon emissions, Contracting Authorities should take a whole life approach to mitigating carbon, and ensure due consideration is given to issues such as waste and recycling, sustainable sourcing of products and materials, and the objective of developing a circular economy.

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1 https://www.gov.uk/government/publications/procurement-policy-note-0620-taking-account-of-social-value-in-the-award-of-central-government-contracts

2.2.4 In addition, Contracting Authorities should consider how to incorporate other environmental objectives in their organisational strategies. This includes the delivery of mandatory requirements, such as biodiversity net gain, but also wider environmental benefits such as better air, water and soil quality, consistent with the UN Sustainable Development Goals.

2.2.5 The objectives of these strategies and the approach to delivering them should be reflected in projects and programmes commissioned by the contracting authority. These strategies should form the start of a clear line of sight that informs the development of outcome specifications, decisions on the delivery model, contractual terms and contract management arrangements, the setting of Key Performance Indicators (KPIs) and the monitoring and reporting of progress. Asset handover, the transition to operation, and the operational management of the asset, as well as the approach to managing it out of commission at the end of its lifecycle, should also be consistent with these objectives.

2.3 Supply chain decarbonisation

2.3.1 In major construction and infrastructure programmes and projects, supply chains will contribute significantly to total emissions. Contracting authorities should be aware of this when developing their procurement strategies, analysing market capacity and capability early on, and ensuring that potential tier one contractors understand the likely implications not just for themselves, but for their potential suppliers too.

2.3.2 At the supplier selection stage, the Government has already put in place a practical measure which is likely to encourage supply chain decarbonisation. PPN 06/21 requires suppliers who are bidding on central government contracts (over £5 million p/a in value) to commit to achieving net zero by 2050 and to detail their organisation's UK greenhouse gas emissions via the publication of a Carbon Reduction Plan. Failure to do so is likely to lead to exclusion at the supplier selection stage.

2.3.3 PPN 06/21 and associated guidance[2] sets out exactly which contracts qualify and makes clear that proportionality and relevance must be considered. PPN 06/21 also requires reporting on all Scope 1, and Scope 2 emissions – and a subset of Scope 3

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2 https://www.gov.uk/government/publications/procurement-policy-note-0621-taking-account-of-carbon-reduction-plans-in-the-procurement-of-major-government-contracts.

(indirect) emissions. A template for the Carbon Reduction Plan is also included in the published guidance.

2.3.4 Contracting authorities should work with their supply chains to increase awareness of shared decarbonisation objectives and how these can be achieved. The Supply Chain Sustainability School[3] offers a number of free courses to assist procurers increase their understanding of supply chain decarbonisation, and their ability to influence it.

2.4 Digital and MMC

2.4.1 Adopting digital and offsite manufacturing technologies in the delivery of projects and programmes is essential to improving carbon and sustainability outcomes, and Contracting Authorities should seek to use these to deliver their projects and programmes. These technologies support:

- Improved designs that require fewer materials, and which are produced to support higher levels of reuse and recycling;
- Designs that deliver improved energy and heat performance, and which allow the use of new and more sustainable products and materials;
- The precision manufacturing of buildings to achieve these specifications, and reduce material waste and emissions linked to the construction processes;
- The opportunity for firms based at a distance from where a project is being delivered to benefit from participating;
- Increased incentives for investment in technologies, capital equipment and workforce skills;
- Improved management of construction operations, logistics and the supply chain, as well as built assets; and
- Accurate monitoring, quantification and reporting of carbon emissions, and the comparison of projects and programmes, identifying best practice and supporting performance improvement.

2.4.2 The use of these technologies will also support the delivery of wider Playbook objectives, in relation to improved construction productivity, quality and building safety. Evidence from the UKRI Transforming Construction Challenge demonstrates that digitising and industrialising construction delivers significant economic, social and

[3] https://www.supplychainschool.co.uk/

environmental benefits.[4] The case studies in this Guidance Note, the Foleshill Community Health Centre and the SEISMIC Product Platform, also demonstrate how digital and MMC technologies can be utilised to achieve exceptional built asset performance.

2.5 Waste and resource efficiency

2.5.1 The Government has committed that this will be the first generation to leave the environment in a better state than that in which it inherited it. The Environment Act 2021 has established a number of environmental principles that Ministers and policymakers must consider when developing policies. Whilst these are likely to have been considered prior to procurement design – an awareness of them is likely to assist Contracting Authorities as they create procurement strategies. The five principles are:

- The integration principle;
- The prevention principle;
- The rectification at source principle;
- The polluter pays principle; and
- The precautionary principle.

2.5.2 The **integration principle** proposes that policymakers should look for opportunities to embed environmental protection in fields of policy that have environmental effects. In essence this involves considering whether the policy has the potential to cause a negative environmental effect which could be avoided, minimised or reduced through alterations to the policy in proportion to other policy aims.

2.5.3 The **prevention principle** means that government policy should aim to prevent environmental harm and look to ensure that environmental damage, such as CO2 emissions, pollution or biodiversity loss, is avoided. Policy design options should prevent environmental damage either before it has occurred, or to contain existing damage.

2.5.4 The **rectification at source principle** states that environmental damage should, as a priority, be addressed at its origin to avoid the need to remedy its effects later. Rectification at source should result in approaches that are more cost-effective, efficient, and equitable in the long-term.

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[4] https://www.ukri.org/what-we-offer/our-main-funds/industrial-strategy-challenge-fund/clean-growth/transforming-construction-challenge/

2.5.5 The **polluter pays principle** means that, where possible, the costs of pollution should be borne by those causing it, rather than the person who suffers the effects of the resulting environmental damage, or the wider community. It can be used in the design of a policy (before the damage has occurred) to prevent or deter environmental damage.

2.5.6 The **precautionary principle** assists the decision-making process in the face of a lack of scientific certainty. The principle helps policymakers deal with risks which may not be precisely calculable in advance. The UK government is a signatory to the 1992 Rio Declaration.[5] Its definition of the precautionary principle states that 'where there are threats of serious or irreversible environmental damage, a lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation'.

2.5.7 Contracting authorities should have regard to these principles in the design of projects or programmes, identify what outcomes are required to achieve them, and ensure these are incorporated in the outcome specification alongside other outcomes such as reduced carbon emissions and promoting biodiversity, which is also a requirement of the Environment Act 2021.

5 https://www.un.org/en/development/desa/population/migration/generalassembly/docs/globalcompact/A_CONF.151_26_Vol.I_Declaration.pdf

3. Early Market Engagement and Clear Specification

3.1 Purpose

3.1.1 Approaches to reducing environmental impact in the built environment are developing rapidly. These include achieving net zero carbon but also; reduced waste, greater levels of recycling, biodiversity and environmental net gain. Innovations in construction technologies and techniques, data collection and analysis and contractual terms and conditions, are continually being brought to market and adopted by clients and firms in the supply chain.

3.1.2 To deliver Government policy in relation to net zero carbon and sustainability, it is vital that projects and programmes embed a clear and comprehensive approach to carbon mitigation and improving sustainability outcomes across the lifecycle of the asset, consistent with wider organisational objectives and estate management strategies, that is effectively communicated to the market. This approach should be developed through engagement with the whole supply chain, including Tier 1 contractors, sub-contractors, consultants and product and material suppliers. Government clients should also actively seek to learn from and share best practice with other organisations across the public sector, and with the academic and voluntary sectors. Approaches should be adopted throughout each stage of the process and Contracting Authorities should adopt a proportionate approach.

3.2 Approach to whole life carbon and environmental assessment

3.2.1 The Construction Playbook states that all Contracting Authorities should have strategies in place to achieve net zero carbon across their portfolio of estates and/or infrastructure assets by 2050. Guidance on how to approach the design, implementation and monitoring of a net zero estate strategy and delivery programme is set out in the Net Zero Estate Playbook. This requires organisations within Government to develop decarbonisation plans relating to construction and operational emissions, as part of a Strategic Asset Management Plan (SAMP) for the organisation.

3.2.2 In order to deliver this, Contracting Authorities should embed a whole life approach to sustainability, including carbon management and wider environmental benefits during

the development of the business case, then into the project design phase. Whole life carbon is the sum of all emissions over the lifecycle of the asset, including carbon embodied in the construction phase, operational carbon and end of life emissions. This approach should consider how to reduce greenhouse gas emissions through greater energy and heat efficiency, but also reduce waste, promote the reuse and recycling of materials, improve air, water or soil quality and enhance biodiversity. It should be aligned with both wider organisational strategies, and with the approach to delivering wider social value from the project or programme. It should also be consistent with the approach adopted by other projects within a portfolio or in the delivery of a related programme.

3.2.3 As part of the procurement of new built assets, or the large-scale refurbishment of existing buildings and infrastructure, Contracting Authorities should require a Whole-Life Carbon Assessment (WLCA) as part of the tender requirement. A WLCA should be conducted in accordance with contracting authority specific guidelines. [or in the absence of that, guidelines released by the Greater London Authority for WLC can be used]. The WLCA guidelines must be built upon industry recognised standards and guidance; in effect, the WLCA guidelines should provide instruction on the consistent use of these standards and guidance such that the WLCA results can be used for benchmarking and target setting.

3.2.4 Embedding a whole life approach at an early stage will enable greater consistency in delivering higher quality and sustainable outcomes across the life of projects and built assets. In order to embed an effective approach, Contracting Authorities should:

- Ensure that the approach to net zero and delivering wider environmental benefits are embedded during the project design phase, and that these areas are resourced by the project team;
- Include sustainability, net zero carbon and wider environmental benefits as part of pre-procurement market and supply chain engagement activities, to enable the identification of options and approaches to minimise GHG emissions during the construction and operation of the asset, including innovative solutions;
- Focus on maximising heat efficiency and minimising energy consumption, working on the basis of the fabric first principle for the design of the building;
- Consider how to ensure the built asset will be resilient and able to adapt to climate change during its design life;

- Engage other external sources of expertise, including other public sector bodies, academia and the voluntary sector;
- Assess options and select a relevant approach to whole life carbon and environmental assessment at an early stage, which should include data collection, benchmarking, monitoring and reporting over the life of the project, including specific standards or methodologies to be used for this purpose (e.g. PAS 2080 for infrastructure);
- Develop clear sustainability outcomes for net zero carbon and the environment, based on benchmarking, and which can be included in the Should Cost Model for the project or programme; and
- Include a requirement for a Whole Life Carbon Assessment in the tender documentation.

3.3 Engagement with non-government initiatives

3.3.1 There are a significant number of decarbonisation initiatives that have been developed by business, academia and voluntary sector organisations, which are broadly aligned with Government policy objectives. Given the scale of Government and wider public sector activity in construction, the design and delivery of projects and programmes can enhance the impact of these.

3.3.2 It is recommended that Contracting Authorities should seek to identify, and where possible support, relevant initiatives, particularly in relation to the decarbonisation of construction materials, where the scale of procurement activity is an important driver for creating a market for more sustainable products. Contracting authorities may also wish to consider participation in particular initiatives where these are aligned with their organisational strategies, and where commitments do not conflict with procurement regulations or existing policy. Initiatives Contracting Authorities should be aware of include:

- The UK Green Building Council **Net Zero Carbon Buildings: A Framework Definition**[6], provides organisations with guidance on how to deliver net zero carbon buildings in both the construction and operational phases. It includes guidance on establishing the scope of emissions, reducing construction impacts and operational energy use, offsetting and public disclosure. There is also

[6] https://www.ukgbc.org/ukgbc-work/net-zero-carbon-buildings-framework/

additional detailed guidance on levels of energy performance with a trajectory to 2035, upfront embodied carbon and energy targets, avoiding fossil fuel consumption and high-quality carbon offsets. This suite of guidance is being continuously developed to take account of developments in policy and practice.

- The **Carbon Reduction Code for the Built Environment**[7], developed by an industry group convened by the University of Cambridge, aims to facilitate collaboration and action between clients and the supply chain to reduce carbon emissions (CO_2 equivalent for other GHGs) related to design, construction, maintenance, operation and decommissioning of built assets. It provides a framework for organisations to make a public commitment to decarbonisation and to report on progress in relation to this. It is designed to align with the requirements of PPN 06/21 in relation to carbon mitigation plans. The Code contains core commitments for all organisations, and specific commitments for clients and supply chain organisations, and three levels of commitment: pledger; signatory; and champion.
- **CO_2nstruct Zero**[8] is a performance framework for decarbonising the construction and built environment sector developed by the Construction Leadership Council (CLC), to ensure coordination of net zero carbon initiatives within the industry. It is based on 9 strategic objectives, in relation to built assets, supply chain operations and improving the sustainability of products and materials, with a set of performance metrics that enable the CLC to track progress over time. Performance reports, based on industry reporting and data gathered from a range of sources, are published regularly.
- The **Low Carbon Concrete Routemap**[9], developed by the Institution of Civil Engineers and the Green Construction Board, sets a pathway to significantly reduce and eliminate carbon emissions from concrete. It provides advice on design to minimise the need for concrete, avoiding waste, specification of lower carbon concrete and carbon measurement and benchmarking of emissions. It also contains case studies of successful approaches to reducing concrete-related emissions.
- The **2050 Steel Decarbonisation Roadmap**[10], developed by the British Constructional Steelwork Association (BCSA), sets a pathway to creating a

[7] https://www-smartinfrastructure.eng.cam.ac.uk/carbon-reduction-code
[8] https://www.constructionleadershipcouncil.co.uk/constructzero/
[9] https://www.ice.org.uk/knowledge-and-resources/briefing-sheet/low-carbon-concrete-routemap
[10] https://steelconstruction.org/bcsa-launches-roadmap-to-net-zero/

sustainable and circular economy for steel fabrication. This is supported by the National Structural Steelwork Specification for Building Construction which specifies requirements and practices for achieving environmentally sustainable steel building construction.

3.4 Including sustainability in outcome-based specification

3.4.1 Clear and measurable outcomes should be set at the outset of a project or programme, taking account of the Government's economic, social and environmental objectives, and relevant organisational strategies for delivering social value and decarbonisation. These should define what constitutes best value over the lifecycle of a project or programme, including in terms of carbon and sustainability performance. When developing the outcomes for a project or programme, Contracting Authorities should consider the full range of potential outcomes, including sustainability outcomes, and which the project or programme is best able to deliver, based on its location, scope, duration and the needs of future users.

3.5 Construction Innovation Hub Value Toolkit[11]

3.5.1 Clear outcome-based specifications will facilitate effective supply chain and stakeholder engagement, by providing clarity about the outcomes sought, but without being prescriptive about how these are achieved. This will enable the supply chain to develop proposals that provide for the cost effective delivery of best value, wider social value, and net zero and improved sustainability as a key element of this.

3.5.2 The Value Toolkit has been developed to support Contracting Authorities to define what constitutes value in relation to a project or programme, and to deliver better economic, social and environmental outcomes. The Toolkit does not specify what outcomes should be, or apply weightings to particular elements of social value, which are decisions for Contracting Authorities. It aims to provide a suite of 5 complementary streams, which can be deployed over the lifecycle of a project, and enable Contracting Authorities to consider the definition of value and approach to the delivery of a project in a structured way, to support effective decision-making. The streams are:

1. **Value Definition Framework**: identifying the value drivers and desired outcomes;

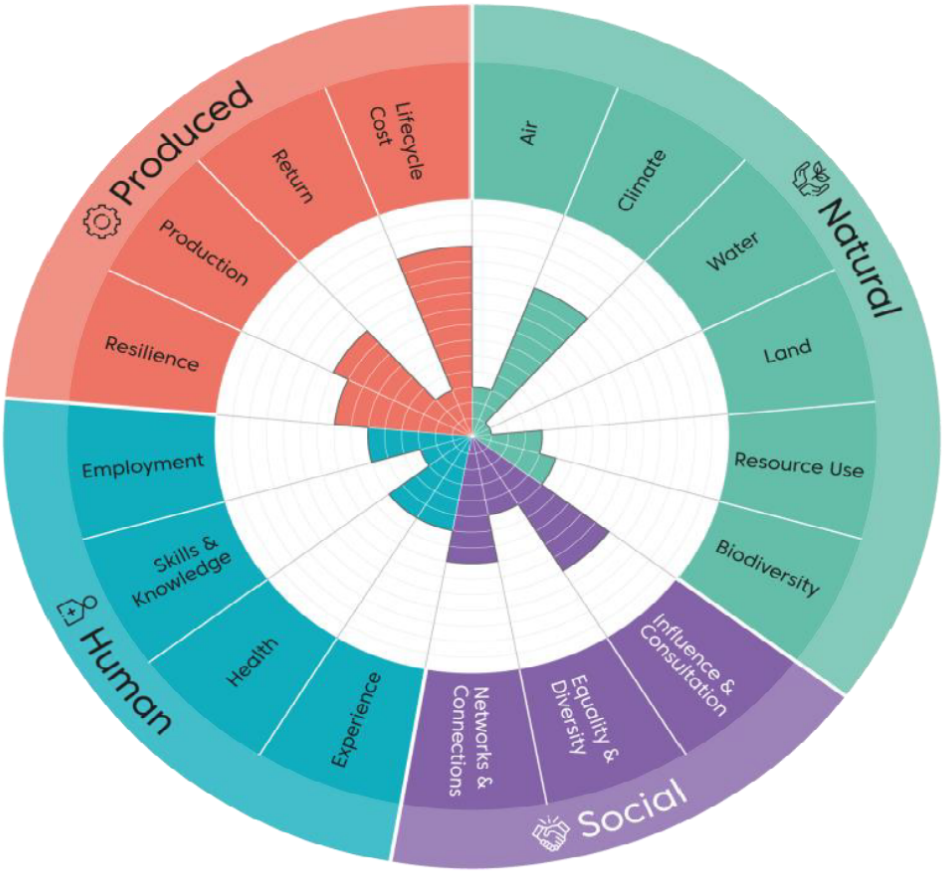
[11] https://constructioninnovationhub.org.uk/value-toolkit/

2. **Client Approach**: selection of a delivery model and commercial strategy consistent with the value definition;
3. **Risk**: developing a risk model based on the definition of value and delivery approach;
4. **Measurement and Evaluation**: options evaluation and the measurement of performance against the defined outcomes;
5. **Appointments**; creation of a team and contractual relationships based on the delivery of best value.

3.5.3 The Value Definition Framework provides a model to define outcomes based on 4 capitals:

- **Natural Capital**: the stock of renewable and non-renewable natural resources, including reducing whole life carbon emissions linked to the built asset, reducing waste, maintaining air, water and soil quality, and enhancing biodiversity.
- **Human Capital**: increasing high quality employment opportunities, supporting skills development, supporting better mental and physical health and ensuring that the construction and use of an asset provides a positive experience.
- **Social Capital**: community and stakeholder engagement at all phases of the project, promoting equality and diversity, and enhancing networks and connections linked to the project or programme.
- **Produced Capital**: taking account of lifecycle costs (capital and operational costs), the return on investment generated by the asset, enhancing the quality and efficiency of the construction process and ensuring the resilience of the asset to future risks, including climate and environmental risks.

Value Definition Framework



3.5.4 It is recommended that Contracting Authorities use this model to define value as the adoption of a consistent approach to defining best value, and a methodology for determining this, will improve the quality of engagement with the supply chain and other stakeholders. In the longer term, it will also support the development of supply chain capability to develop proposals which address the full range of Government policy objectives and support the implementation of organisational strategies.

3.5.5 The Royal Institution of Chartered Surveyors (RICS) is in the process of developing a Professional Practice Statement and associated guidance for its members on the use of the Value Toolkit, which is intended to support its members to apply the Toolkit on HMG-funded projects.

3.6 Standards and decarbonisation

3.6.1 Standards establish requirements for the performance or delivery of a product, material, component, process or service. Standards support the functioning of markets

by providing clarity for consumers about the level of performance that they can expect from a product or service, and the organisation delivering this. Whilst standards are voluntary, they are used by many firms to demonstrate the quality of their product or service. Firms often need to obtain independent third party verification of the performance of a product or service, in order to receive accreditation and to be able to state they comply with a standard.

3.6.2 Standards can be developed by international bodies e.g. the International Standards Organisation, CEN (the European Committee for Standardisation), at national level e.g. the British Standards Institution in the UK, or by other industry and voluntary sector organisations. The majority of standards are developed through collaborative and structured processes that allow for stakeholder engagement in relation to the development of the standard.

3.6.3 There are a large number of standards relating to environmental performance. Contracting authorities can adopt certain standards themselves e.g. PAS 2080, BREEAM, or use standards within procurement processes. Whilst a requirement for bidders to be accredited to a particular standard within a tender process is likely not to be justifiable under the procurement regulations, Contracting Authorities can accept evidence of a firm being accredited to a standard as being evidence of their ability to deliver specific requirements. See Annex I for tables of useful standards and guidance.

3.7 Carbon reduction plans and carbon reporting

3.7.1 Under PPN 06/21,organisations bidding for major government contracts (over £5 million, where this is relevant and proportionate) must complete and publish a Carbon Reduction Plan. The Carbon Reduction Plan must detail: the organisation's commitment to achieve Net Zero in the UK by 2050; report their current emissions for Scope 1 (direct emissions linked to operations), Scope 2 (indirect emissions linked to energy, heating and cooling used), and a subset of Scope 3 emissions (indirect emissions within the firm value chain); provide data on emissions reported in CO_2e (Carbon Dioxide equivalent) and set out the environmental management measures they have in effect. The Carbon Reduction Plan must be updated regularly (the minimum requirement is annual updates) and published on the organisation's website.

3.7.2 Data gathering and metrics

3.7.2.1 Data gathering and reporting of GHG emissions should follow recognised standards, such as those developed by the Greenhouse Gas Protocol, the World Business Council for Sustainable Development and the World Resources Institute.

3.7.2.2 The GHG Protocol's Corporate Accounting and Reporting Standard was designed to:

- Help companies prepare a GHG inventory that represents a true and fair account of their emissions through the use of standardised approaches and principles;
- Simplify and reduce the costs of compiling a GHG inventory;
- Provide business with information that can be used to build an effective strategy to manage and reduce GHG emissions; and
- Increase consistency and transparency in GHG accounting and reporting among various companies and GHG programs.

3.7.2.3 The GHG Protocol also provides technical guidance on calculation methodologies. These typically require firms to ascertain their Scope 1, 2 and the relevant subset of Scope 3 emissions, then to multiply these by a conversion factor for the UK. The conversion factor represents the typical quantity of CO_2 or other greenhouse gas emitted by the consumption of a given unit of fuel, and is updated annually by BEIS and DEFRA[12].

3.7.2.4 There are a range of carbon calculation tools available online, provided by firms in the private sector and other organisations. These tools and resources are often free for SMEs or organisations in the voluntary sector, and are available to organisations at all levels of the supply chain. Tools that are available include:

- The **BREEAM Life Cycle Assessment Tool** supports BREEAM and the Code for Sustainable Homes assessments, through modelling how products, materials and systems used in producing the building will perform;
- The Environment Agency's **ERIC Tool**, which enables whole life carbon assessment and reporting, based on carbon data from publicly available sources, and information from across the supply chain;
- The **Carbon Infrastructure Transformation Tool**, which aims to align the supply chain, through the identification of key carbon management challenges and the efficient design of incentives; and

[12] https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2020

- **ECCOLAB**, a digital platform which provides rapid energy, carbon, cost and materials lifecycle analysis.

3.7.2.5 Contracting authorities should not be prescriptive about the tools used, but may choose to seek assurance about the approach used by firms and supply chains, and to ensure that these are consistent with any standards or whole life carbon methodologies that are being applied to the project. An alternative approach is to assess supplier accreditation to standards for emissions reporting. ISO 14064-3 and ISAE 3410 are widely used standards for the verification of emissions reports.

3.7.3 Supply Chain Sustainability School Carbon Tool

3.7.3.1 One resource available to Contracting Authorities and firms within the supply chain is the Supply Chain Sustainability School Carbon Tool. This is a cloud-based system for collecting, analysing and reporting on carbon data, which provides SCSS partners with a clear and transparent method for tracking carbon outputs and identifying areas of better and weaker performance. The data can be included as it is measured, providing all those with access to timely and accurate data about project carbon emissions. The tool is based on a 5 step process:

1. The supplier enters consumption data relating to energy, fuel and distance travelled;
2. The system calculates the organisations' carbon footprint;
3. A dashboard tracks carbon emissions over time, and enables these to be monitored, as well as identifying hotspots of weaker performance;
4. Suppliers can opt to share carbon data with clients and other firms in the supply chain, through allowing them access to the system, and apportion emissions to client projects during the reporting period; and
5. Clients receive reports about carbon emissions linked to their supply chain that are calculated according to a common and comparable formula.

3.8 Delivering environmental outcomes

3.8.1 Biodiversity

3.8.1.1 Contracting authorities should also take account of the future requirement to deliver biodiversity net gain through their projects and programmes. This is an approach to

land management that aims to increase the biodiversity of a given area, through improving the natural environment. Biodiversity net gain in the UK has been introduced through the Environment Act 2021, and is expected to become mandatory in 2023. This will require:

- Minimum 10% gain required calculated using the Biodiversity Metric & approval of net gain plan;
- Habitat secured for at least 30 years via obligations or a conservation covenant;
- Habitat can be delivered on-site, off-site or via statutory biodiversity credits;
- There will be a national register for net gain delivery sites (expected in 2023);
- The mitigation hierarchy still applies of avoidance, mitigation and compensation for biodiversity loss; and
- Will also apply to Nationally Significant Infrastructure Projects (NSIPs)

3.8.1.2 To support implementation of this requirement, a British Standard for biodiversity net gain and development projects has been developed, BS 8683:2021 Process for designing and implementing Biodiversity Net Gain. The standard is consistent with the provisions of the Environment Act 2021, and specifies requirements for a process to design and implement BNG for development projects, and provides a framework to demonstrate that a project has followed a process based on established good practice.

3.8.2 Circular economy

3.8.2.1 The construction sector generates around 60% of waste in the UK. Reducing waste and increasing levels of reuse and recycling, is essential to achieving net zero carbon and supporting sustainable development

3.8.2.2 Contracting authorities should consider how they can promote increased levels of reuse and recycling through their projects and programmes. This could be achieved through including requirements for these within tenders or specifications, the adoption of standards, or by encouraging the supply chain to demonstrate best practice through participation in private or other non-government sector initiatives. These could include:

- **BES 6001** is a standard that enables construction product manufacturers to prove that their products have been produced with responsibly-sourced materials. It provides a framework for governance, supply chain management and environmental and social management, and can be used by a manufacturer of any construction product that uses a foundation product such as cement, steel,

timber, plastics or ceramics. Certification of meeting the standard is provided by independent third party bodies. It is designed to support the delivery of buildings to the BREAAM and Code for Sustainable Homes standards.

- **BS 8001** is a voluntary guidance standard for the circular economy (i.e. organisations cannot be certified and accredited against it). It aims to provide a practical framework and advice for organisations of any size or sector to implement the principles of the circular economy, through evaluating how their business models, processes, products and services are managed to maximise the economic, social and environmental benefits. BS8001 was developed by a panel of experts from the public, private academic and voluntary sectors, with oversight from a committee including representatives of HMG, and the Devolved Administrations.
- **Cradle to Cradle** is a global standard for certifying product safety and environmental impact. It assesses these against 5 criteria: safety of materials used in production; reusability and recyclability; air quality and carbon reduction; water and soil quality; and social impact. Assessments are undertaken by independent assessment bodies to ensure they meet the required criteria every 2 years.

3.9 Supporting resources and data sources

Net Zero Estate Playbook	Supply Chain Sustainability School Carbon Tool
IPA Best Practice in Benchmarking guidance	Greater London Assembly Whole Life Carbon Assessment Tool
Greenhouse Gas Protocol Corporate Standard	BS 8683:2021 Process for designing and implementing Biodiversity Net Gain
GHG Protocol Calculation Tool	BES 6001
HMG Conversion Factors	BS 8001
Transforming Construction Challenge Stronger Stories	Cradle to Cradle Certification from the Cradle to Cradle Products Innovation Institute

4. Delivery Model Assessments and Effective Contracting

4.1 Purpose

4.1.1 Selecting the delivery model, the procurement process, and the structure and terms of the contract are key phases in project or programme delivery. They will also determine whether and how effectively projects and programmes will deliver desired outcomes for carbon mitigation and wider sustainability.

4.1.2 The aim of Contracting Authorities should be to ensure that there is a clear line of sight from the business case, through the outcome specification and Should Cost Model, through to the approach to selecting the delivery model and procurement process. If this line of sight is embedded in the project or programme delivery process, it will facilitate tender evaluation, the selection and alignment of KPIs that will be applied at each stage of the project, the structure of the contract and contractual terms and the structures that will be used to monitor and manage supplier relationships, as well as ongoing monitoring of the asset once it enters the operational phase.

4.1.3 It is also important that the approach to delivering carbon and environmental outcomes in the outcome specification, delivery model, contractual terms and the structures used for project and programme management facilitate active collaboration between clients and the supply chain. Firms within the sector possess different levels of capability to manage delivery of these objectives, and Contracting Authorities need to actively engage with the supply chain to achieve intended outcomes. This may also require flexibility or innovation in a number of areas, including contractual terms and conditions, as traditional approaches may prove insufficient to deliver these outcomes. Contracting authorities should:

- Regularly review the suite of project and programme documentation, and ensure that these are aligned around key objectives, including those relating to sustainability and achieving net zero carbon.
- Ensure that the sustainability and carbon objectives incorporated into the output specification are included in the Should Cost Model.
- Select a delivery model that will support collaboration between clients and the supply chain in relation to sustainability objectives, informed by early supply chain

engagement and best practice sharing with other client organisations and academia.

- Identify KPIs that enable reporting against strategic outcomes and can be used to monitor progress in each phase of the project or programme delivery process, and that these are practical for the supply chain to gather and report.
- Embed sustainability and carbon objectives and associated KPIs in contractual documentation. Review and update this documentation regularly to take account of developing best practice, and learning from other projects.
- Ensure sustainability and carbon objectives are embedded in project and programme management structures, and these have the resources required to deliver these objectives.

4.2 Delivery model

4.2.1 As specified in the Construction Playbook, Contracting Authorities should consider the most suitable delivery model, in parallel with the development of the value model and outcome specification for the project or programme. Selection of a delivery model should be undertaken through a delivery model assessment (DMA), an analytical, evidence-based approach to determining the suitability of a delivery model, and inform the Strategic Outline Business Case (SOBC).

4.2.2 Whilst selection of the delivery model should be informed by a range of factors, including organisational capability and the nature of the project or programme. To ensure it can deliver sustainability and carbon objectives, Contracting Authorities should:

- Consider organisational strategies and objectives in relation to sustainability, including net zero carbon, and the objectives they are seeking to deliver through the project or programme.
- Assess the market capability to deliver these objectives, and what level of engagement will be required with the supply chain to enable this.
- Determine the KPIs and reporting methodologies to use to track and measure outcomes over the life of the project, and what capability will be required, including to meet mandatory requirements e.g. PPN 06/21.
- Review the key risks and potential for developments in the market that could jeopardise the achievement of these objectives.

- Identify the whole life costs and value linked to the delivery of these objectives, and incorporate these into the Should Cost Model.
- Consider which delivery model, approach to contract management, project management and supplier relationship management best align with the intended outcomes.

4.3 Carbon/sustainability within the Should Cost Model

4.3.1 The costs and benefits of improved sustainability and reduced carbon emissions should be included in the business case and value profile for the project, to support effective decision-making in relation to the project or programme, and allow these to be assessed alongside other factors. The costs of delivering these objectives should be included in the Should Cost Model for the project.

4.3.2 Contracting authorities should ensure that in developing the Should Cost Model, they take account of capital, operational and end of life costs and savings linked to the delivery of these objectives across the project life cycle. It is likely that in many cases, there will be increased capital costs linked to the delivery of sustainability benefits and reduced carbon emissions. However, these may be more than offset by improved performance of the asset and reduced operational costs, for example improved heat and energy efficiency, or from reduced costs for the disposal of waste, due to the incorporation of more sustainable materials.

4.4 Baselining and Benchmarking carbon/sustainability

4.4.1 Projects and programmes should undertake baselining and benchmarking of sustainability objectives and GHG emissions. This should draw on the experience of other projects or programmes managed by the contracting authority, information from comparable projects or projects with comparable elements or objectives undertaken by other bodies, and resources such as the IPA benchmarking hub.

4.4.2 As with the cost profile for the project, the objective is for a contracting authority to develop a profile for sustainability impacts and GHG emissions over the life cycle of the project, based on the whole life carbon assessment and other suitable economic, social and environmental assessment methodologies. This will inform decisions about investments in aspects of the project related to sustainability outcomes, to identify those that will deliver the greatest value over the life cycle of the asset.

4.4.3 Establishing a robust baseline for carbon emissions is also essential if credible plans for delivering emissions reductions are going to be sought as part of tendering, and assessed through evaluation models. They are also required if effective emissions reduction targets are to be set for the supply chain, and included in contractual documentation.

4.4.4 Contracting authorities should also take account of the need for consistent data gathering and reporting across projects and programmes. These will support reporting on progress in relation to strategic objectives, effective monitoring of delivery and the benchmarking of projects and identification of best practice.

4.5 Key Performance Indicators (KPIs)

4.5.1 The selection of KPIs to apply over the lifecycle of a project or programme is an essential element of both the delivery model and approach to project management, and also the contracting model and contractual terms. The selection of KPIs for individual projects should reflect organisational strategies, and be clearly linked to and cover the full range of intended outcomes, and consistent with the approach taken in comparable projects. Whilst it is for Contracting Authorities to determine the most suitable KPIs for a particular project or programme, it is expected that at a minimum these will cover the key sustainability outcomes, GHG emissions, and support required carbon reporting and other mandatory aspects of social value such as biodiversity. However, Contracting Authorities should also consider whether KPIs in relation to other aspects of sustainability, e.g. waste, should be included.

4.5.2 As part of the process of selecting KPIs, Contracting Authorities should take account of the availability, practicality and financial and administrative cost of methodologies for collecting these, for both particular KPIs as well as the cumulative burden. The most practical, efficient and cost-effective means of providing the necessary data to enable an assessment of whether KPIs have been met should be used. Contracting authorities should also work proactively with the supply chain to explore means of improving data quality, collection and reducing the burden of this, particularly through encouraging the adoption of digital technologies.

4.5.3 It is also important that both the contracting authority and the supply chain that will be delivering the project have a clear and shared understanding as to which KPIs will be applied at each stage of the contract, and how performance and progress against GHG

emissions reductions or other milestones and outcomes should be reported and monitored. Supplier engagement activities should cover these issues, and where Contracting Authorities have a clear policy in relation to reporting and KPIs, this information should be made publicly available and reflected in all relevant documentation.

4.6 Contracting for climate and sustainability

4.6.1 The inclusion of climate and sustainability clauses within construction contracts is becoming more common, including clauses developed for widely used construction contracts such as the NEC and FAC1 suite of contracts. The FAC1 suite now includes sustainability within its definition of value. Increasingly specific contract terms are also being designed for inclusion of particular types of contractual structure or transaction, and this trend will continue and intensify.

4.6.2 Whilst these provisions are becoming a standard feature of contracts, this is a rapidly developing area of construction law, with significant innovation and experimentation in response to client demand, and contractual terms developing based on experience, best practice and legal thinking. At this stage, the priority is for Contracting Authorities to facilitate this process of innovation by seeking to identify and adopt best practice in their own contractual terms, whilst being prepared to adapt these more frequently than other contractual provisions. Contracting authorities should also review other provisions within their suite of contractual documentation to ensure that these do not inadvertently act as barriers to innovations that will support climate and sustainability outcomes.

4.6.3 Contracting authorities should also consider what provisions are required by current HMG policy, and which are discretionary, and are linked to the delivery of organisational strategies or social value from the project or programme. Clauses requiring carbon monitoring and reporting should normally be included within contracts. Similarly, projects are required to deliver biodiversity net gain, as specified by the Environment Act 2021, and clauses requiring this should be a standard provision of contractual documentation. In relation to other objectives, for example carbon reduction commitments, or those in relation to waste and recycling, Contracting Authorities have more discretion in relation to the nature of the commitment and the contractual terms applied. However, consistency of approach is likely to increase the ability of the supply

chain to respond to these requirements, particularly in relation to large programmes or framework contracts.

4.7 Framework contracts

4.7.1 Frameworks are widely used within the public sector, as an efficient means of delivering large programmes of work, or a large number of projects across different organisations. Frameworks can support the delivery of sustainable outcomes, including those relating to climate change and environmental benefits, through embedding a consistent approach to this across projects and programmes, as well as the pipeline of work they provide, creating an incentive for the supply chain to invest in increasing its capability to deliver these outcomes.

4.7.2 Contracting authorities should seek to embed the principle of achieving sustainable development, including carbon and environmental objectives, in frameworks whilst these are being developed. An effective framework will align strategic outcomes with targets, success measures, incentives and management structures, as well as transparency in relation to performance and best-practice sharing. They should also consider whether frameworks should be aligned with achieving specific standards of performance for the built assets that they will deliver. As frameworks are designed to last several years, it is important that there is flexibility to adapt outcomes, targets and approaches to measurement in response to policy changes or new organisational priorities. In developing frameworks, Contracting Authorities should take the following considerations into account:

- Are the outcomes relating to sustainability and carbon sufficiently clear and stretching, and should these be linked to the achievement of specific standards?
- Is there a clear plan for communicating these and any changes to the supply chain and wider stakeholders, prior to procurement and during the operation of the framework?
- Will the framework support the delivery of mandatory objectives e.g. carbon reporting and mitigation plans and biodiversity net gain?
- Is there a consistent approach to defining targets, the methodologies that will be used to assess these and reporting, and are these aligned with incentives and management structures?

- Does the framework allow for the adaptation of contractual terms or schedules over its life, to enable the iteration of these in response to changes in policy or best practice?

4.8 Incorporating sustainability and climate objectives into contract terms

4.8.1 As general principles, the objectives of the outcome specification and commitments required of the supply chain to report and mitigate GHG emissions and improve environmental performance should be included in relevant contractual documentation, and the terms pertaining to these treat them in the same way as other contractual requirements, for example asset performance. This will ensure that projects and programmes deliver the Government's social value objectives, and incentivise the supply chain to build its capability to achieve these. Including these commitments within contractual documentation will also provide certainty to the contracting authority and firms in the supply chain as to the nature of the commitments required, how these will be monitored, and what provisions will apply in the event that these are not delivered.

4.8.2 In determining the specific type and terms of contractual provisions, Contracting Authorities should adopt a proportionate approach, and take account of the scale of the project or programme, the value profile for the project and which sustainability, climate and environmental performance provisions would contribute most to the delivery of these outcomes, the cumulative requirements being imposed on the supply chain and the capability of the supply chain to deliver these. The same approach should apply in relation to determining how these provisions should be included in contractual documentation, and whether this should be included in the contract itself, or the associated specification. Including these in the specification may be a more effective and pragmatic approach when individual contracts are for smaller projects, or awarded within a multi-year framework.

4.8.3 Where possible, Contracting Authorities should seek to ensure that risks and issues relating to the delivery of sustainability, climate and environmental performance provisions within contracts are managed through the same mechanisms for identifying and resolving issues before these escalate into disputes. This should include the conflict avoidance provisions within the contract, or other mechanisms for addressing non-performance in relation to commitments entered into.

4.8.4 Contracting authorities should:

- Actively monitor developments in relation to legal and contractual issues, share best practice, and seek to draw on external expertise within other public and private sector organisations, the voluntary sector and academia.
- Develop an organisational policy on the inclusion of sustainability, climate and environmental performance clauses into contractual documentation, taking account of the strategic objectives of the organisation and the requirements of projects and programmes.
- Determine what the most effective and proportionate approach is to incorporating these provisions into contractual documentation, taking account of the delivery model and nature of the contractual documentation used.
- Review existing contractual documentation, including risk allocation, liabilities, payment and incentive structures, to ensure this does not unintentionally create barriers to provisions that will deliver these objectives.
- Where a framework is used, consider what provisions should be included as a requirement of qualifying for the framework (e.g. a requirement for carbon reporting and mitigation consistent with PPN 06/21), and which should be included in the contractual documentation for individual projects.
- Seek to standardise Z clauses relating to sustainability, climate and environmental performance clauses across contractual documentation, particularly in relation to required objectives e.g. carbon reporting. These clauses should be reviewed and updated in a structured way, with supply chain and stakeholder engagement as part of this process.

4.9 Performance incentives within contracts

4.9.1 In some circumstances, Contracting Authorities may also consider whether to include performance incentives within contractual terms. These could include incentives for the supply chain to deliver GHG emissions reductions, improve environmental performance (e.g. waste, recyclability), or gain share arrangements in relation to cost savings. These provisions can be an effective means of mobilising the supply chain to deliver greater benefits than might otherwise be delivered. In determining whether or not to include incentives, Contracting Authorities should take account of whether it is possible to set targets for performance beyond the benchmark that the supply chain might reasonably

be expected to deliver, the level of risk for the client and supply chain, and the ability of the supply to accurately monitor and report on emissions or other outcomes.

4.10 Schedules to Contracts

4.10.1 Where Contracting Authorities make use of multi-year frameworks, or for lower value contracts with smaller contractors, the most practical and proportionate approach to including provisions on sustainability, climate and environmental performance may be to include these in schedules to contracts. A number of Contracting Authorities have successfully used this approach, which has enabled them to use shorter form contracts, retain the standard form of the contract and reduce the need to insert new clauses. It is also possible to link schedules to the specifications for projects, meaning that these can be used flexibly to adapt provisions where contracts are being awarded under a multi-year framework, enabling these to be adapted as best practice evolves, without the need to develop a new framework. Schedules can also be used to supplement contractual provisions, in cases where a contract sets a broad objective or reporting requirement through a Z clause, but the specification is used to set detailed requirements for the supply chain in relation to a specific project.

4.11 The Chancery Lane Project

4.11.1 A resource available to support Contracting Authorities to develop contractual provisions that address carbon and sustainability issues is The Chancery Lane Project (TCLP). The Chancery Lane Project (TCLP) is an independent, collaborative forum of legal and sustainability professionals working to ensure contractual terms address the climate crisis. They provide free resources that Contracting Authorities can use in their agreements to deliver innovative solutions to climate change.

4.11.2 Their resources include over 100 draft contract clauses for use with a number of common contract types. Issues covered in the clauses include carbon benchmarking, measurement and mitigation provisions, sustainable onsite working arrangements, the use of MMC in developments, materials procurement and construction waste management. In addition to the climate clauses, TCLP has also developed:

- A Net Zero Toolkit;
- A clause timeline that maps clauses across the contract lifecycle;

- Several case studies demonstrating how clauses have been used by a number of public and private sector organisations, including the Environment Agency; and
- Podcast interviews with sector experts, offering practical tips on using TCLP clauses in your construction contracts.

4.12 Integrating contracts with strategy, procurement and management

4.12.1 Contractual clauses alone will not deliver improved sustainability, carbon or environmental performance outcomes, and an effective strategic approach depends on new contractual relationships and processes being aligned with the client's strategy, with evaluation of bidder proposals and with collaborative management systems. King's College London research published in April 2022 by the Society of Construction Law examines how procurement should integrate the following elements in order to increase the ability of the construction sector to meet Net Zero Carbon targets:

- Client strategy and expectations.
- Team evaluation and bidder proposals.
- Early supply chain involvement and preconstruction activities.
- Long-term contracts and industry investment.
- Specialists and supply chain collaboration.
- Contract governance and joint risk management.
- Framework alliances and shared learning.
- Whole life procurement and digital information.
- Action plans and leadership.

4.13 Resources

- IPA cost estimating guidance: https://www.gov.uk/government/publications/cost-estimating-guidance.
- FAC1 Framework Alliance Contract, which includes sustainability in its definition of value: https://allianceforms.co.uk/about-fac-1/.
- Society of Construction law paper on procurement for NZC construction: https://www.scl.org.uk/resources/news/scl-and-procuring-net-zero-carbon-construction.
- TCLP climate clauses: https://chancerylaneproject.org/climate-clauses/ and case studies: https://chancerylaneproject.org/case-studies/.
- The National Association of Construction Frameworks https://nacf.org.uk/.

5. Successful Delivery and the Transition to Operation

5.1 Overview

5.1.1 The Construction Playbook emphasises the importance of Government projects and programmes procuring on the basis of value. Value for money is defined as securing the best mix of quality, performance, sustainability and social value for the least outlay over the life of a project or programme. Contracting authorities should ensure that there is a consistent focus on the identified outcomes, and a clear line of sight linking government policies, organisational strategies with project outcomes, the selection of the delivery model, commercial strategy, procurement, evaluation, contracting, delivery management and operation, that can be referred to through the project life cycle. This includes carbon and sustainability objectives.

5.2 Evaluation and Contract Award

5.2.1 Sustainability, carbon and environmental objectives are considered to be a key element of social value, as set out in the Social Value Framework, and are consistent with the legislative requirement to achieve net zero carbon by 2050. The Construction Playbook requires that a minimum 10% weighting of the total score for social value should be applied, and that a higher weighting can be applied if justified. Award criteria, including Social Value, can be used to assess how suppliers will deliver sustainability and mitigate their environmental impact during the delivery of the contract.

5.3 Developing the Evaluation Model

5.3.1 Sustainability, carbon and environmental performance are essential to the delivery of quality and social value, and should be embedded in the Evaluation Model, with an appropriate weighting. Evaluation Models should fully reflect these elements of the outcome specification for the project, and establish clear criteria that bids can be assessed against, and enable evaluators to differentiate between bids against these criteria.

5.3.2 It is essential that Evaluation Models assess the proposed approach to reducing delivering improved sustainability, carbon and environmental performance across the project lifecycle, the capability of the bidders to deliver these proposals, and how robust

the proposed monitoring and reporting mechanisms are. Evaluation Models should also allow scope for the supply chain to propose innovations or transformational solutions that can deliver significant improvements in relation to these outcomes. Contracting authorities should:

- Ensure that the Evaluation Model forms part of the clear line of sight from strategic policy objectives, the outcome specification, value profile, tender specification, delivery model, key performance indicators and contractual documentation.
- Ensure that quality and social value are appropriately weighted, and consider including specific criteria and weighting for GHG emissions reduction, consistent with achieving net zero carbon by 2050.
- Ensure the Evaluation Models enable the assessment of tender responses on the basis of their ability to deliver sustainability, GHG emissions reduction and environmental performance outcomes over the project lifecycle, and consider embodied carbon, operational carbon, and emissions linked to supply chain operations.
- Ensure that the Evaluation Model is appropriate and proportionate to the contract.
- Ensure the Evaluation Model includes an assessment of proposed approaches to monitoring and reporting against these criteria.
- Use market and supplier engagement to ensure firms across the supply chain understand the Evaluation Model.
- Use consistent criteria relating to sustainability, carbon and environmental performance in Evaluation Models across programmes or portfolios of projects.
- Consider whether the Evaluation Model allows scope for innovation, and whether elements of the model may act as a barrier to the supply chain proposing transformational solutions.

5.4 Capturing lessons learned and disseminating good practice

5.4.1 The potential to improve the sustainability of, and reduce GHG emissions linked to, infrastructure and buildings is increasing all the time. New technologies, standards, construction techniques and contractual and supply chain management approaches are all combining to deliver this. However, further innovation and improvements are required to achieve net zero carbon, and enable the built environment in the UK to

deliver the vision for the built environment where developments enhance environmental quality and promote sustainability.

5.4.2 It is essential that Contracting Authorities seek to both develop and learn from best practice in the delivery of construction projects, with the aim of continuously improving the performance of projects or across the life of programmes and portfolios. It is good practice to undertake reviews of project performance during the project delivery phase, as well as undertaking post-occupancy reviews, and to share this information with other public bodies and the supply chain. Whilst these reviews will cover a range of issues, including costs and schedules, in relation to sustainability, carbon and environmental performance, Contracting Authorities should ensure these reviews include:

- The social value delivered by the project, and whether this achieved the specified sustainability, carbon and environmental outcomes (or is on/off trajectory to deliver these).
- GHG emissions and environmental performance over the life of the project, and whether KPIs and milestones were achieved during each phase, and how the project performed against the benchmarks and any comparable projects.
- The energy and heat performance of a building, and whether it attained the level of performance or standard (e.g. BREEAM Excellent) it was designed to achieve.
- Specific innovations in either design, materials, technologies or processes that have contributed to reducing GHG emissions and improving sustainability, and how they have done this.
- Use of contractual provisions, including specific commitments or incentives, that helped deliver sustainability, carbon and environmental performance outcomes.

5.5 Government Major Projects Portfolio (GMPP) Projects and Programmes

5.5.1 Projects and programmes within the GMPP are required to publish close out reports within 6 months of project completion, considering achievements against; cost, schedule and identifying best practice and lessons learned. These reports should include an assessment of the social value delivered, including GHG emissions reduction or other environmental benefits delivered by the supply chain during the design, construction, and the transition and early phase of operation, and whether it is on target to achieve the projected performance over the lifecycle of the assets. The further report required after 5-10 year on longer term social and economic benefits

should also include an assessment of sustainability, reductions in GHG emissions (actual and projected over the life of the project) and environmental impacts.

5.6 Asset performance monitoring into the operational phase

5.6.1 Contracting authorities should continue to monitor and report on asset performance at regular intervals during the operational phase. Evaluating key aspects of the sustainability performance of the building, for example energy and heat efficiency, should be a standard element of this reporting, as the benefits of more efficient designs and technologies, or environmental enhancements, will accrue over time. Some benefits, for example the reuse or recyclability of components or materials, may only be realised at the end of the life of the asset. Where additional capital investment has been agreed in order to reduce operating costs, this should be monitored to assess whether the asset is delivering its anticipated performance. Ongoing monitoring is also essential in situations where suppliers have been incentivised to achieve sustainability, carbon or environmental performance targets in relation to the asset or project.

6. Case Studies

6.1 Foleshill Health Centre - Delivering a Net Zero NHS Estate

6.1.1 Introduction

6.1.2 This case study covers the design and delivery of the Foleshill Health Centre in Coventry. Foleshill is a 612m^2 £3.3 million project, developed in partnership between Community Health Partnerships (CHP) and NHS Coventry and Warwickshire Clinical Commissioning Group (CCG). The facility is built over 2 storeys, and contains 2 consulting rooms, 5 treatment rooms, offices, a reception area and a waiting room. It has been constructed on a brownfield site.

6.1.3 It was designed and manufactured to deliver exceptional energy and carbon performance, and has achieved Passivhaus certification, the only healthcare building in the UK to have achieved this standard.

6.1.4 Foleshill Health Centre – Summary of Project Approach and Outcomes

- Designed to achieve outstanding environmental performance from the outset, based on a whole life carbon approach and focusing on the fabric of the building.
- Procured using an outcome based specification, aiming for the Passivhaus standard, through the NHS Modular Framework.
- Manufactured offsite and assembled onsite, taking advantage of a known performance platform, enhanced to achieve the Passivhaus standard.
- Use of a modular approach based on an existing platform provided a stable fixed cost base for Should Cost Modelling.
- Reduced duration of onsite activity by 13 weeks.
- Certified as achieving the Passivhaus standard in 2021. Has an Energy Performance Certificate (EPC) A rating, and consumes less than 20% of the energy of a typical NHS clinic, saving an estimated 411 tonnes of CO_2 pa.

6.1.5 Defining the Specification

6.1.6 The vision for Foleshill Health Centre was to deliver a facility with exceptional carbon performance, consistent with the NHS strategy for decarbonising its estate and operations that has been implemented since 2010. This aims to reduce the estimated 4% of UK emissions that are linked to NHS sites, recognising that climate change poses a significant risk to human health and wellbeing.

6.1.7 In October 2020, the NHS became the world's first health service to commit to a target of reaching net-zero carbon emissions by 2040. The NHS has already cut emissions by 30% since 2010. Many of these changes are already improving care today, as well as the health and wellbeing of staff, patients and the public. The Greener NHS programme plans to deliver long-term positive change for the planet and the health of its people. Find out more: england.nhs.uk/greenernhs.

6.1.8 To deliver the vision, CHP appointed an integrated design and construction team for the project, including the whole supply chain of designers, contractors and product manufacturers, at an early stage. CHP also set an outcome of achieving the Passivhaus standard for carbon and energy performance, with no use of fossil fuels, as a clear objective for the project team to deliver. CHP chose the Passivhaus approach because of its overall sustainability ethos, which would minimise operating costs and deliver health benefits. Passivhaus is an international low energy, design standard which has been adopted by over 65,000 building worldwide, but this project is the first time that NHS Estates has approved a building using this standard for the NHS in England. Foleshill Health Centre has also achieved a BREEAM rating of excellent.

6.1.9 In developing the design for the project, the design team had to overcome a number of challenges to ensure it was consistent with the technical specifications for healthcare facilities, including the specification for ventilation in healthcare buildings, as set out in HTM 03-01 (2007), where the AC requirements exceeded the Passivhaus standards. Through combining their expertise, the project team developed a design for the Foleshill Health Centre consistent with the Passivhaus standard, and to achieve energy consumption figures of about a quarter of a typical health centre of the same size. Photovoltaic (solar) panels on the roof provide electricity and all the lighting is provided by energy efficient LED lamps. Other energy-efficient features include triple glazed windows, which can be opened if required. Triple glazed windows are more energy efficient than double glazing, and can be more comfortable to sit next to as less cold air is created next to the glass.

6.1.10 The building is highly insulated, so it is warm in winter and cool in the summer. The insulation exceeds the Building Regulations fabric insulation values by about 40%. There is a small heating system using air source heat recovery pumps connected to small radiators. The design maximises natural light, and each window has a sun shading system (called brise soleil) that breaks up the sun's rays to reduce direct

sunshine entering the building, with different sizes on each side of the building, delivering comfortable internal summer temperatures.

6.1.11 Foleshill Health Centre is also airtight – the leakage rate roughly equates to a hole the size of a golf ball across the whole building – and fresh air is circulated 24/7. All rooms have filtered 100% fresh air from ducts in the ceiling, supplied from ventilation units that recover heat from stale air leaving the building via the mechanical heat recovery unit. The air is filtered to a similar standard as an operating theatre, ensuring a safe and clean environment (ISO ePM1 – June 2021).

6.1.12 Delivering the Project

6.1.13 The project was delivered by an integrated project team of designers, contractors and product suppliers. Delivery partners included Portakabin (main contractor), Tooley Foster Architects (Passivhaus specialists), AECOM (infrastructure consultants) and Arden Estate Partnerships Ltd (development project management). Building an integrated design and construction team, and embedding a collaborative approach from the outset, enabled the design for the building to be developed to suit a modular solution, improved project management, and enabled the team to deliver the project despite the challenge of Covid19, and the need to adopt safe working methods during the construction phase. It also established a clear approach and responsibility for managing costs, quality and delivery to schedule.

What is Passivhaus?

Fabric first construction: Triple glazed opening windows, thermal bridging prevention, impermeable membrane skin, highly insulated floating raft substructure

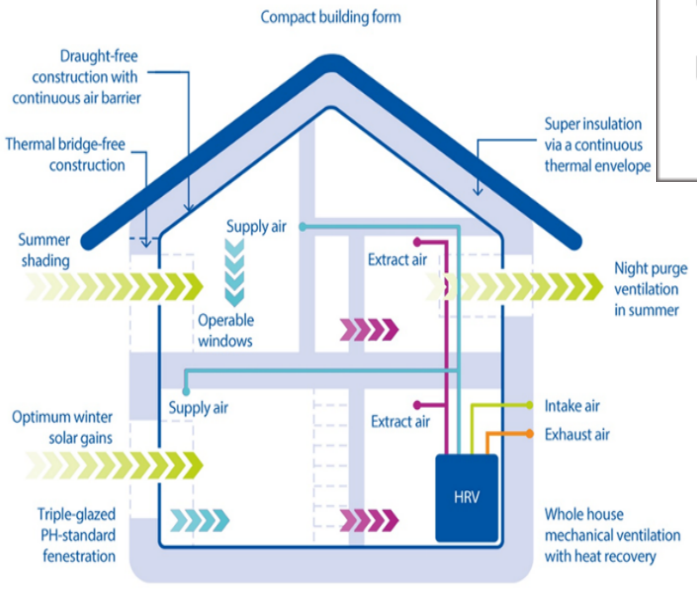
Heating via heat pumps

MVHR ventilation with heat recovery, limited cooling and variable air volume for treatment rooms

Renewable energy source – PV panels

Point of Use electric heated domestic hot water

Primary Energy Source - Electricity



6.1.14 CHP took an early decision to use factory-built modules, to improve quality and accelerate the delivery of the project. The CHP Developments team, Portakabin and the Tooley Foster teams planned the interiors and engineering services at the offsite construction stage. The facility was then manufactured with a high level of precision (tolerances of 1mm). Using an offsite manufacturing approach also enabled accurate measurement of resources used and waste generated, supporting accurate carbon and sustainability reporting. The internal fit out was also undertaken at the Portakabin specialist manufacturing facility, and largely completed offsite. This enabled the building to be transported to site, assembled and installed in only three days in December 2020. The overall duration of the works was reduced by 13 weeks, a schedule reduction of 26.5% compared to the project benchmark, a health centre in the West Midlands constructed in 2019.

6.1.15 Benchmarking Delivery Performance

6.1.16 Comparative Performance: Foleshill compared to the benchmark (health centre construction in 2019)

	Benchmark	Foleshill
GIA (m^2)	664	619
Floor Levels	2	2
Site Works Programme (Weeks)	49	36
Capital Cost (%)	100	116.7
25 year Costs (Renewals + Maintenance)	100	86.3
25 year Costs (Utilities/Energy)	100	98.5
40 year Total Costs	100	93.7
EPC Rating	B	A
EPC CO2 emissions ($kgCO_2/m^2/annum$)	36.28	11.9
EPC Primary Energy Usage ($kWh/m^2/annum$)	212	93

6.1.17 Foleshill Delivery Timeline

- August 2018 Outline Business Case approval
- 17 July 2020 Final Business Case approval
- August 2020 Works contract signed
- 1 September 2020 Groundwork begin
- September 2020 Module construction begins at Portakabin
- 2 December 2020 Foundations cast
- 9 - 11 Dec 2020 Delivery and installation of modules
- 11 December 2020 Building watertight
- Jan to May 2021 Construction continues

- Feb 2021 Power & Water connected
- March to May 2021 Three air tests for Passivhaus certification
- 4 June 2021 Practical Completion
- 9 Aug 2021 GP team move in and begin seeing patients
- Octr 2021 Passivhaus Certification awarded

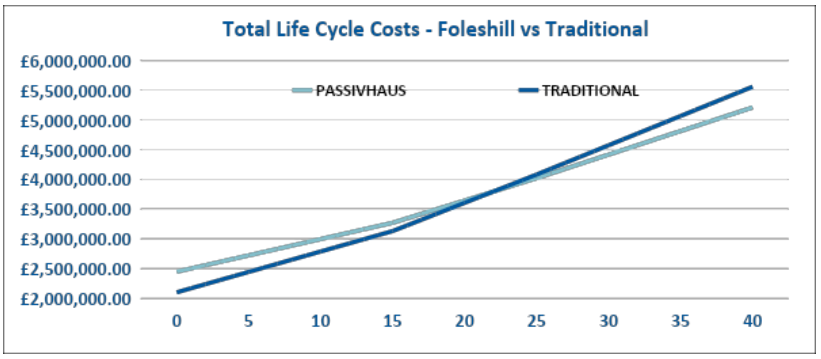
6.1.18 Measuring and Monitoring Asset Performance

6.1.19 Whole Life Value

6.1.20 The capital cost of Foleshill was £3.3m. Whilst the initial capital cost exceeded the cost of delivery using traditional approaches by 16.7%, it is projected to deliver significant savings over the lift of the asset. The cost model for Foleshill was developed to account for capital, operational (including utilities) and refurbishment costs, modelled over the anticipated 40 year life of the building.

- The annual utility costs of Foleshill are projected to be 33.5% of the cost of a traditional building. This will deliver minimum annual savings of 3.3% over 40 years, based on a 1% energy inflation assumption.
- Total savings start to accrue from Year 22, just over halfway through the planned life of the building.
- Forecast total lifecycle savings over 40 years are forecast to be £347,565 (£571.65 m^2) compared to the benchmark.

6.1.21 Lifecycle Costs Projection

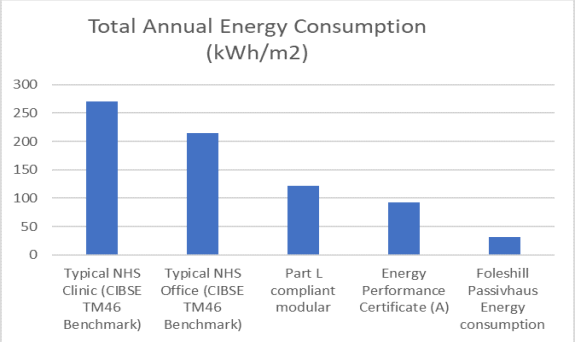


6.1.22 Energy and Carbon Performance

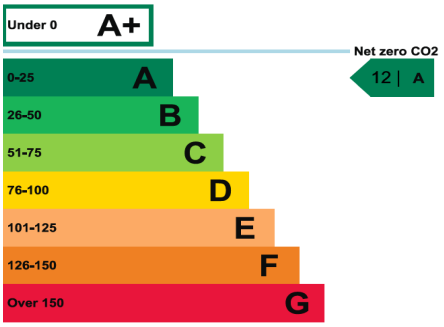
6.1.23 Foleshill has delivered significant reductions in carbon emissions and energy consumption in comparison to similar buildings, with an emissions rating of 11.9kg CO_2 per metre squared per annum, compared to the requirement of Park L of 28.3kg CO_2 per m^2 per annum. This is projected to deliver significant annual carbon emissions

savings of 411 tonnes CO_2/pa. The building has an EPC rating of A (May 2021), with a score of 12, and consumes 93 kWh/m^2 per annum in primary energy usage, compared to the Part L performance requirement of 165.78 kWh/m^2 per annum. It has an Energy Performance Certificate (EPC) A, with a score of 12, very close to net zero.

Total Annual Energy Consumption



Foleshill EPC Rating



6.1.24 Foleshill Health Centre was tested during the commissioning phase to attain Passivhaus certification, and subsequently assessed as achieving a BREEAM Excellent rating. Additionally, there is a three-year post-occupancy monitoring process, using sensors, to validate performance, measuring energy consumption, environmental performance and occupant comfort levels, with quarterly reporting to ensure the building is achieving the specified performance. Early indication of in use energy performance shows the building is performing better than designed. With the rising cost of energy, this will increase the savings over the life of the building. A post-occupancy Design Quality Indicator (DQI) review was undertaken, with Stage 5 scheduled for Autumn 2022.

6.1.25 Lessons Learned

6.1.26 Foleshill Health Centre demonstrates what can be achieved with a shared vision and teamwork across organisations, the benefits of early supply chain engagement, a detailed business case, accurate cost and timetables, the use of modular construction techniques and effective monitoring. The project has delivered an innovative, award winning health centre incorporating a range of 21st Century sustainable innovations on time and on budget.

6.1.27 Foleshill Health Centre is a first for the NHS; the first of many net zero carbon or Passivhaus health care facilities, built in response to the profound and growing threat to health posed by climate change.

6.1.28 **Watch:** Foleshill Health Centre video

6.1.29 **Read:** Foleshill Case study on Community Health Partnerships website

6.2 SEISMIC Design for Manufacture and Assembly

6.2.1 Introduction

6.2.2 This case study covers the SEISMIC product platform for delivering low carbon buildings. SEISMIC is a system for delivering buildings that was developed and demonstrated through two projects supported by the Transforming Construction Challenge, funded by UK Research & Innovation. It is a modular product platform based on standardised component parts, manufactured to a standard set of design rules in relation to dimensions and interfaces. These components have been designed to be part of a flexible system that can be used to deliver a range of buildings, initially focusing on schools, but the platform could also be used to deliver offices, healthcare facilities, residential accommodation and retail. SEISMIC is designed to be faster to deliver than 2D hybrid MMC construction, or 3D Volumetric MMC construction.

6.2.3 Summary of Approach and Planned Outcomes:

- A 47% improvement in whole life value compared to traditional construction methods.
- A 75% reduction in time to deliver the project compared to traditional onsite construction, and 35% quicker than 3D Volumetric MMC construction.
- A 70% reduction in whole life carbon emissions, through reduced waste, improved building heat and energy performance and the recyclability of the components.
- An 80% reduction in the number of Health & Safety incidents, compared to projects built using traditional techniques, with much of the build taking place in specialist manufacturing facilities.

6.2.4 It is designed to be consistent with the DfE strategy for decarbonising schools, and the development of a consistent set of design rules for net zero schools.

6.2.5 Design

6.2.6 The SEISMIC product platform was designed by a consortium from across the construction supply chain, including the contractors McAvoy and Elliott, consultants Blacc, the architectural practice Bryden Wood, and Tata Steel, supported by the Manufacturing Technology Centre and the National Composites Centre, both part of the

High Value Manufacturing Catapult, and the Active Building Centre. This combined expertise has enabled the development of a digitised product platform that can accelerate the design and delivery of construction projects. The key benefits of this approach are:

- The design was developed through a collaborative R&D project involving firms from across the supply chain, as well as technology and innovation centres that utilised expertise developed in other sectors and applied this to construction.
- The platform-based approach, supported by a digital modular build design library for schools reduces the design time required by 25% compared to other forms of MMC. Standard elements can be easily repeated, freeing up time to focus on the areas that add the most value to the design.
- All components are designed, then precision engineered, manufactured and tested to exacting quality standards, and to deliver high energy and thermal performance. A test building using the whole system has also been installed and tested at the BRE in Watford.
- Because modules are designed to minimise materials use, there is little wastage during production, assembly and on-site construction. 95% of the steel frame can be recycled, 20% of the other materials used can also be reused, and 40% fully recycled. It is estimated that only 10% of the products and materials used will become waste, mainly insulation products and sealants.

6.2.7 Project Delivery

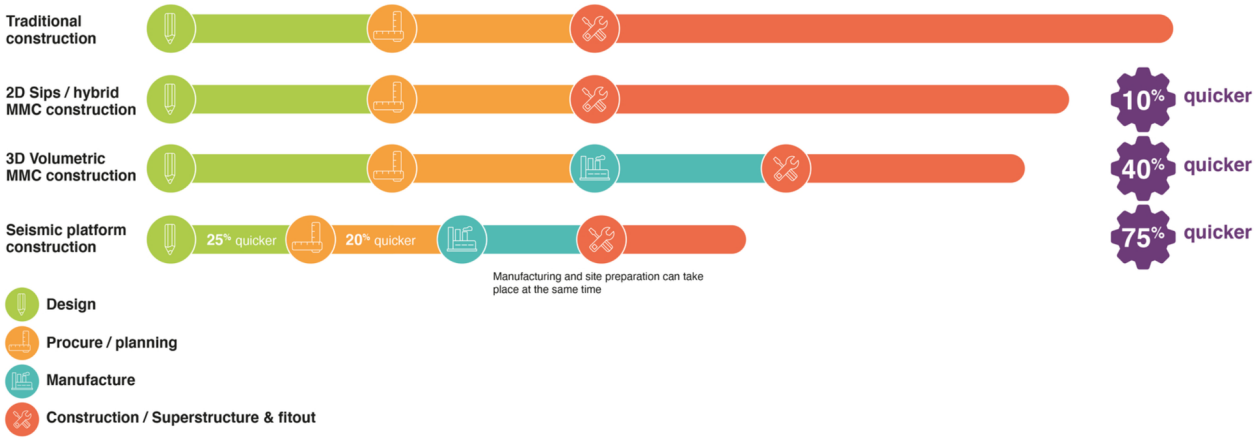
6.2.8 SEISMIC offers a number of advantages compared to both traditional onsite construction techniques, and also early generations of modular offsite construction. It can accelerate the time taken to deliver projects, improve supply chain resilience, greater flexibility for repairs and refurbishments, as well as providing for full traceability of the components used.

- The platform-based approach means clients can source components from, or even use, multiple manufacturers to produce component parts for the same project, increasing supply chain resilience and reducing delivery and schedule risk.
- As manufacturing technologies are developed, the standard design of the platform means that improved components or materials can be incorporated

easily, improving performance. New components can also easily be incorporated into existing buildings to expand or repurpose them.

- Site preparation works take place in parallel with the manufacturing process, saving time.
- Every component is tracked, tagged and linked to a 3D model so it is fully traceable, making for a safer, easier to maintain building.

6.2.9 Project Delivery Timetable: SEISMIC compared to traditional construction and modular



6.2.10 The SEISMIC platform will be used by Elliott to deliver Phase 2 of the Lawrence Calvert Academy in Leeds, a £27m secondary school development which will use 192 SEISMIC modules, with production starting in June 2022. There are a number of other school projects that will be delivered by McAvoy and Elliott which are also planning to utilise the system.

6.2.11 Energy and Carbon Performance

6.2.12 SEISMIC is designed to deliver significant reductions in embodied and operational carbon, based on design efficiency, materials selection and precision manufacturing. A standard SEISMIC module generates lifecycle carbon emissions of 580kg CO_2 per m^2, below both the current RIBA target of 800 kg CO_2 per m^2 and the London Energy Transformation Initiative (LETI) 2020 target of 600 kg CO_2 per m^2. If components are reused, the whole lifecycle carbon performance of the SEISMIC platform could achieve 347.3kg CO_2 per m^2, which is just under the 2030 stretch target set by LETI for building performance, of 350kg CO_2 per m^2.

6.2.13 Resources: https://tc-catalogue.strongerstories.org/stories/seismic-i/

6.2.14 SEISMIC Demonstrator – BRE, Watford

6.3 HS2: Approach to Carbon Management and Mitigation

6.3.1 Introduction

6.3.2 HS2 is Britain's new high speed rail line being built from London to the North-West, with HS2 trains linking the largest cities in Scotland with Manchester, Birmingham and London. HS2 will be integrated with new lines and upgrades across Britain's rail system, to deliver faster travel to many towns and cities across Britain not directly on the HS2 route, including Liverpool, Sheffield, Leeds, Nottingham, Derby.

6.3.3 170 miles of new high-speed line is already under construction between Crewe and London, employing around 25,000 people. In total, the Government is planning over 260 miles of new high speed line across the country.

6.3.4 The construction of the new railway is split into three phases:

- Phase One linking London and the West Midlands;
- Phase 2a linking the West Midlands and the North via Crewe; and
- Phase 2b completing the railway to Manchester, the East Midlands and the North.

6.3.5 Reducing infrastructure carbon emissions is key to achieving national carbon emission reductions and is fundamental to addressing the global challenge of climate change. There is also a compelling business case for reducing infrastructure carbon emissions.

Reducing carbon emissions can reduce costs, unlock innovation and drive better solutions, drive resource efficiency and deliver better-performing infrastructure.

6.3.6 Alignment with Organisational Strategies

6.3.7 Carbon reduction is one of the aims of HS2, and formed part of the justification for the investment in the business case. HS2's vision is to provide zero carbon rail travel for a cleaner, greener future. This is supported by the HS2 Environment Policy, which articulates a commitment to "*minimise the carbon footprint of HS2 towards a goal of net zero carbon emissions…and deliver zero carbon journeys from day one of operation*" and the HS2 Net Zero Carbon Plan which sets out how we intend to work towards net zero carbon from 2035.

6.3.8 Delivery framework

6.3.9 High Speed Two Limited (HS2 Ltd) is responsible for developing and promoting the UK's new high-speed rail network. It is funded by grant-in-aid from the Government. HS2 Ltd is an executive non-departmental public body, sponsored by the Department for Transport. The company is responsible for procuring and bringing together a supply chain of designers and contractors to deliver billions of pounds worth of contracts, to build, maintain and operate HS2.

6.3.10 Integrated Project Teams (IPTs) have been established to deliver Phase One civil and station works, with clear accountability between client and contractor. The IPTs are each aligned to and formed of the main works contractor, their design partners and embedded HS2 staff. IPTs enable integrated delivery and greater collaboration between Main Works Contractors Joint Ventures, Design Joint Ventures (DJVs) and HS2 Ltd.

6.3.11 Each IPT is a single, co-located organisation. They are unified with one leader and empowered to make informed, high-quality and timely decisions to achieve aligned objectives. A consistent operating structure underpins each of the IPTs. However, each is different in scope, risk profile and location.

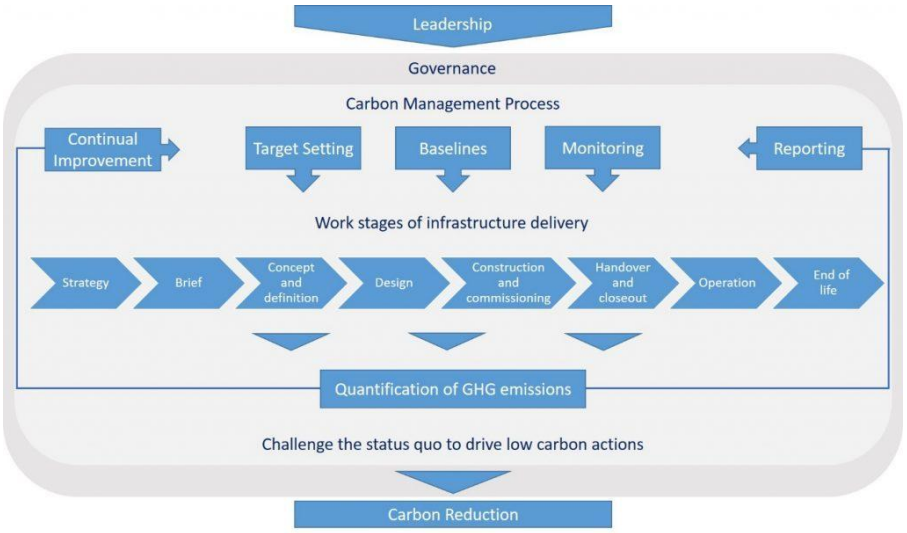
6.3.12 Carbon Management

6.3.13 HS2 implements a carbon management system verified to the best practice specification, PAS 2080: 2016 – Carbon management in infrastructure, to support the successful delivery of the programmes carbon reduction objectives. PAS 2080 provides

a common framework for all infrastructure sectors and firms across the value chain on how to manage whole-life carbon when delivering infrastructure assets and programmes of work. The PAS promotes reduced carbon, reduced cost infrastructure delivery, more collaborative ways of working and a culture of challenge in the infrastructure value chain through which innovation can be fostered. It includes requirements for all value chain members to demonstrate leadership and to establish effective governance systems for reducing whole-life carbon.

6.3.14 HS2's tier 1 contractors are required to implement the same carbon management best practice. This means that HS2 and our supply chain are working within a common carbon management framework, with compatible and complementary processes in place to support effective and efficient delivery of our carbon reduction objectives. This framework is set out in the diagram below.

Figure 1: Key components of a PAS 2080 carbon management system



6.3.15 <u>Baselining Carbon Emissions</u>

6.3.16 HS2 has adopted ambitious carbon reduction targets. The civil engineering works, stations and rail system assets are required to achieve a 50% reduction in whole life carbon emissions. Performance is measured against contract specific carbon baselines. The carbon baseline allows for meaningful application of carbon reduction targets, monitoring of carbon reduction performance and reporting and communication to stakeholders. Carbon baselines are also critical to making carbon reduction performance visible throughout delivery and in informing decision-making to manage whole-life carbon emissions.

6.3.17 As a ‘pop up’ client, HS2 Ltd does not have an inventory of historical ‘as built’ data from which activity data can be derived to establish carbon baselines. There is also a lack of good quality – relevant – industry benchmarks. Establishing robust carbon baselines for the Phase One civils and stations relied on collaborative working with – and between – supply chain partners. Briefings – led by HS2 Ltd subject matter experts – took place upon contract award to ensure common understanding of the programme’s carbon requirements. This was complemented by collaborative working with – and between – supply chain partners to ensure, where appropriate, consistency of system boundaries, inclusions and exclusions, commonality of key assumptions and tools and consistent application of carbon accounting principles, rules and requirements.

6.3.18 Subject matter experts from HS2 Ltd applied a progressive assurance approach as a means to check compliance with the programme’s carbon requirements and, in particular, to ensure relevance, completeness, consistency, accuracy and transparency. Table 1 presents the carbon baselines for the Phase One civil assets and stations respectively.

Asset	Life cycle modules													
	A1-3	A4	A5	B1	B2	B3	B4	B5	B6	B7	B8	B9	C1-4	D
Euston (High Speed Rail) Station	2.21 E+03	9.99 E+01	1.38 E+02	0	0	0	1.96 E+02	0	2.25 E+03	7.11 E+00	0	0	1.42 E+01	2.21 E+03
Old Oak Common Station	3.70 E+03	1.38 E+02	4.99 E+02	0	0	0	4.14 E+02	0	3.21 E+02	1.75 E+01	0	0	2.01 E+02	3.70 E+03
Birmingham Interchange Station	6.00 E+03	7.97 E+02	3.34 E+02	0	0	0	5.92 E+03	0	6.66 E+03	4.03 E+02	0	0	7.87 E+01	6.00 E+03
Birmingham Curzon Street Station	1.75 E+03	9.34 E+01	3.04 E+01	0	0	0	3.31 E+02	0	3.88 E+02	3.81 E+01	0	0	5.56 E+01	1.75 E+03

Table 1. Whole-life carbon baselines for Phase One stations by life cycle module, normalised by square metres of internal floor area, in kilograms of carbon dioxide equivalent ($kgCO_2e/m^2$)

6.3.19 Continuous improvement

6.3.20 Driving continuous improvement is a core part of HS2's carbon management system and an ongoing process. The carbon collaboration group, chaired by HS2 and attended by supply chain partners, is a key forum for driving continual improvement. We host this group to bring together civil engineering and construction partners to share challenges and best practice on carbon reduction.

6.3.21 Carbon reduction is as much about changing behaviours as about changing processes. To that end, HS2 has partnered with the Carbon Literacy Project to develop a programme of learning which seeks to provide colleagues with the motivation and

capability to take action to reduce carbon emissions. The carbon literacy learning has been rolled out amongst the HS2 Board, HS2 Executive Leadership Team and senior leaders from the tier 1 joint ventures. The learning is being rolled out across our organisation and the resources have been shared with tier 1 contractors to support them build capability within their organisations.

6.3.22 Carbon Literacy

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6.3.24 Innovation

6.3.25 The HS2 Innovation Programme is a key part of the delivery of net zero carbon objectives. The scale and duration of the HS2 programme provides the opportunity to deliver innovation at significant scale. HS2 is championing innovation in design and construction, and encouraging the supply chain to use new technologies to improve our carbon reduction targets. Implementing ideas requires engagement across the delivery team, so HS2 has engaged firms across the supply chain, worked with academia and sought to adopt innovative ideas from technology-based SMEs, including start-ups.

6.3.26 The HS2 innovation programme provides an approach that enables the organisation to step outside its comfort zone, experiment and innovate, learn new things and learn from failure. To date, HS2 has a pipeline of over 150 projects, with projected savings of 1.6 million tonnes of carbon emissions. It is supporting the development of fuel-switching technologies and collaborating with partners to trial advanced technologies, materials and products.

6.3.27 It has also established the HS2 accelerator, a nursery to develop the supply chain for HS2's future. This supports 5 small companies per cohort to come and work with HS2 and its suppliers. We support these companies through mentoring, and providing them with access to expertise and a large customer in HS2. For example, HS2 is working

with Cloud Cycle – a small tech startup – to reduce the waste in concrete whilst in transit, driving cost and carbon savings. To date, 20 HS2 accelerator partners have passed through the programme, and HS2 has built strong relationships with these innovators, with over 60% of these firms continuing to work with HS2 after their time in the accelerator.

6.3.28 Importantly, HS2 is learning and adapting from these companies, and absorbing ways of improving its performance, becoming more agile and productive through embracing innovation and embedding this within HS2, delivering wider organisational benefits through the accelerator programme.

6.3.29 HS2 Main Works Civil Contractors Supply Chain Collaboration Hub ("the Hub")

6.3.30 "The Hub" is comprised of the procurement/supply chain leads from HS2's four Main Works Civil Contractors (MWCCs) and has been set up to identify opportunities and threats in relation to common procurement categories between the civil and station IPTs. The main objective is to deliver best for project and/or programme procurement and efficiency decisions, whilst ensuring capacity constraints are appropriately identified and mitigated within the HS2 supply chain, and to facilitate sharing market intelligence.

6.3.31 The Hub also pursues opportunities to leverage buying and works collaboratively in the interests of the programme in other areas of mutual benefit and efficiency (e.g. logistics, interfaces, carbon reduction, innovation, schedule etc). An example of this that highlights the benefits of collaboration between HS2 and its contractors is the procurement of electricity. The Hub has worked closely with HS2 Legal to enable the use of the Crown Commercial Services framework for the purchase of electricity. Not only has the use of this framework delivered rates more favourable than the wider market, but it also delivers electricity from 100% renewable sources.

6.4 Colne Valley Viaduct - carbon reduction case study

6.4.1 Colne Valley Viaduct – which will be the UK's longest railway bridge – is on track to cut the amount of embedded carbon by at least 28.4%. Applying lessons from the construction of the latest European high speed railway bridges, the team has cut the amount of embedded carbon in the viaduct by 63,300 tonnes – the equivalent of 234,500 flights from London to Edinburgh.

6.4.2 The production of concrete and steel are major sources of carbon emissions, so narrowing the width of the viaduct allowed a significant reduction in carbon, and helped reduce disruption for local residents by reducing the number of HGVs on local roads. Starting from the reference design produced as part of the HS2 parliamentary process, they refined the design, challenged assumptions, and found efficiencies to help reduce the amount of steel and concrete in the structure.

6.4.3 This included working closely with rail systems experts at HS2 Ltd to allow the structure to be narrowed by over 1m, while still allowing sufficient space for signalling and control equipment alongside the line. They also worked to bring the northbound and southbound tracks closer together further north, which in turn significantly reduced the amount of earthworks required for the approach embankment. This will reduce carbon emissions from transport of materials to site and help to reduce disruption for local residents by reducing the number of HGVs on local roads.

6.4.4 <u>Diesel free construction sites</u>

6.4.5 The HS2 Net Zero Carbon Plan, published in January 2022, includes the target of achieving a diesel-free construction site during 2022, with all construction sites being diesel-free by 2029. In partnership with our supply chain and wider stakeholders, including the Manufacturing Technology Centre, HS2 is testing and deploying alternative low and zero carbon emission equipment across its construction sites.

6.4.6 This is part of the HS2 innovation programme aimed at supporting the transition from diesel to zero emissions, through developing and trialling alternative technologies to inform future solutions. HS2 announced its first completely diesel-free construction site in May 2022. The site, Canterbury Road Vent Shaft site in South Kilburn, is operated by HS2's a joint venture between Skanska Costain and STRABAG (SCS JV). These civil engineering contractors have introduced a range of diesel-free technologies and greener equipment. Innovations being trialled and introduced on other sites include:

- '**Clean Air Gas Engine'** funded through Innovate UK and led by OakTec, which replaces diesel power with ultra-low (bio-LPG) emission engines in Advante Welfare units and standalone units.
- **'EcoNet'** developed by Invisible Systems, Balfour Beatty and Sunbelt, which controls and reduces energy output from key appliances, reducing power demand by 30%.

- **Non-Road Mobile Machinery retrofit solutions**, which adds pollution control equipment onto older vehicles as an alternative to replacing the machine or the engine, reducing emissions.
- **CESAR Emissions Compliance Verification**, which is a resilient system to show the EU Stage engine emission class of all construction plant.
- **Proactive dust management solutions** reducing impacts associated with on-site activities.
- **Fully Electric Renewable Energy through** using solar and wind to power noise and air quality monitors, site security cameras and site briefing areas, and solar pods powering sites by combining solar PV, battery storage and a back-up generator.
- **Hydrogen Technology** trials across sites considering both fuel-cell technology and combustible hydrogen solutions.

6.5 TEAM2100: Delivering the Circular Economy in Infrastructure

6.5.1 Introduction

6.5.2 Thames Estuary Asset Management 2100 (TEAM 2100) is a £300m+ 10-year programme to deliver improved flood risk management, using an asset management approach. Sustainability is a key part of asset management planning (AMP) as it is centred on a framework to deliver best value as a broad concept, including the level of service, sustainability and cost. For TEAM2100, in the tidal Thames estuary, this means delivering a programme of refurbishment, improvement and replacement projects to provide ongoing flood risk management, aligned with the Environment Agency's Thames Estuary 2100 Plan – a 100 year strategy.

6.5.3 TEAM2100 was set up as an Environment Agency Pathfinder Programme, to deliver better outcomes more efficiently. Seven years into this ten year programme, TEAM2100 has a maturing sustainability programme that is aligned with the EA's EA2025 Plan, Flood and Coastal Erosion Risk Management Strategy, ISO55001 (Asset Management) and the EA's organisational sustainability strategy (Figure 1 – the EA's circular economy ambitions are named 'Optimising Our Use of Resources'). Continued focus on the latter has enabled delivery of the EA's and TEAM2100's circular economy ambition.

6.5.4 A key outcome of the TEAM2100 Programme is to share learning to support others in similar sectors, so what has been developed in TEAM2100 has been done with consideration of the adoption of this approach by others.

Figure 1: EA Organisational Sustainability Strategy Ambitions

6.5.5 Selecting the circular economy standard

6.5.6 To manage the transition from defining strategic ambitions to the operational implementation of this, a step by step approach was developed through an iterative process, which considerably simplified this for TEAM2100 and its supply chain. This started with a set of simple questions, then moved to consideration of certification standards, metrics and the commercial approach and delivery model. All required proactive work on communicating intentions to a very broad group of professions and organisations across the supply chain,with a role in supporting project and programme delivery.

6.5.7 The approach to developing metrics and certification standards was a vital stage in the process. Identifying certification standards was the first step, to ensure these were robust, verifiable and would enable the comparison of circular economy material performance. Defining the criteria for certification schemes allowed the identification of those that could be suitable for adoption. These criteria covered:

- Address all four of the EA organisation sustainability strategy ambitions;
- Be auditable; and
- Be transparent.

6.5.8 Two certification schemes, the Ethical Stone Register, and Cradle to Cradle Certified™ were found to be suitable. Metric development for the circular economy was set within the context of being able to provide a measure which was both applicable at a project

delivery level, and also to be able to report performance at a programme level. Several commercial approaches to performance measurement were considered, the chosen approach being based on a percentage - expressed as a proportion of total construction material cost. This approach removed the potential impact of varying labour intensity of differing project types, provided flexibility for the supply chain for the design and delivery of the project, and choice about how to meet the performance standard. For example by permitting innovation through choice in: certified material selection; where certified materials are used in a project, and their relative contribution in meeting the performance target.

6.5.9 Moving to Delivery

6.5.10 At its inception TEAM2100 was unique in operating an integrated delivery team (IDT) of public and private sector groups working together in a fully co-located space to pioneer the adoption of the asset management approach. To deliver outcomes at a project level, the established ways of working within the IDT supported a focus on the use of circular economy certified materials. Effective communication between client, consultant and contractor at all stages of the project was essential to achieving this objective.

6.5.11 To provide an evidence base for this metric, TEAM2100 is integrating the identification of C2C® Materials early into the option selection and design of TEAM2100 projects. Early signposting of requirements provides a focus on the performance target through: inclusion in outcome specifications/scopes of work; assurance processes focused on delivery of the organisational sustainability strategy ambitions; and identification of the need for specialist circular economy consultancy support. Use of circular economy specialists on a project with over 200 construction materials identified that for around a third of these C2C® Certified are available. This early work identified common construction materials such as timber, structural steel and concrete, and provided confidence to TEAM2100 of the considerable scope across projects that makeup the programme. The same piece of work also found that a further 100 materials could achieve certification with relatively minor adjustments.

6.5.12 The C2C Certified™ Products Registry is constantly expanding, with recent projects such as the World Trade Centre development in Brussels and the Plan20/20 masterplan mixed-use development near Amsterdam providing a catalyst for many newly certified materials. These examples provided support to the decision to integrate

C2C® Materials into the circular economy performance metric. As a pathfinder programme this approach also provides a demand-pull, along with other C2C® Materials users, that will result in certification of new materials through the drive to incorporate C2C® Materials into projects.

6.5.13 TEAM2100 has recognised that integrating C2C® principles into design provides further scope for optimising resources and developing products. This has brought consideration of C2C® materials into the very early stages of our projects to drive sustainability and resource efficiencies.

6.5.14 Finally, delivering sustainable flood resilience requires rethinking how to approach numerous questions, from adopting natural flood management solutions that mimic natural processes, to the materials used in flood risk management assets that protect people and the environment. For TEAM2100 working in the Thames Estuary, Cradle to Cradle Certified™ provides a way of thinking about the construction materials assets use, and helps address the aims of a circular economy. In turn, using materials that consider the effects of their production on the environment, minimise energy and water use and aid social fairness, supports the delivery of sustainable assets.

6.6 The Collaborative Delivery Framework and BREEAM Infrastructure

6.6.1 Introduction

6.6.2 The Collaborative Delivery Framework (CDF) is a framework contract established by the Environment Agency in 2019, primarily for the delivery of flood resilience infrastructure, but with the intent to extend this to other types of assets. The duration of the framework is four years with an anticipated continuation for a further four years. As the name suggests the framework establishes a collaborative arrangement between the client (Environment Agency), the designer and the contractor. Each of six Integrated Delivery Teams (IDTs) includes one designer and one contractor (the delivery partners) with the intent that they undertake all the work within their geographical areas (see Figure 1).

Figure 1: Geography of the Integrated Delivery Teams

6.6.3 Given the duration of the framework, which is expected to be eight years in total, a reasonable assumption was made that sustainability requirements would be likely to become more prominent and more demanding over this period. An approach to sustainability was required that would demand and deliver high standards of performance, and include the ability to raise these standards over time. The Environment Agency worked with the Building Research Establishment to establish a bespoke version of BREEAM Infrastructure (formerly known as CEEQUAL) that could be applied to the entire programme work undertaken by the CDF.

6.6.4 Summary of Approach and planned outcomes

6.6.5 The key features of this approach are:

- The management of sustainability to be applicable to large and smaller projects;
- Measurable performance incorporated into programme key performance indicators (KPIs);
- Embedding an improved sustainability culture within project teams and each of the delivery partners; and
- Framework performance aligned with the objectives of the Environment Agency sustainability strategy.

6.6.6 <u>Programme Design</u>

6.6.7 At the time of the development of CDF there were clear indicators that the sustainability of the delivery of flood resilience infrastructure would need to improve considerably. The publication of the Intergovernmental Panel on Climate Change report on global

warming of 1.5ºC, and the Government's 25 Year Environment Plan required new sustainability objectives. The 25 Year Environment Plan established the intent to require new developments to deliver Biodiversity Net Gain. As a result of this, a new sustainability strategy for the Environment Agency was developed and launched in 2020.

6.6.8 The Environment Agency had achieved mixed results through the use of outcome or emission based sustainability targets. During the process of developing the Framework, research was undertaken into best practice by other infrastructure providers. Crossrail demonstrated how they had improved performance over time using a mix of leading and lagging indicators. The lead indicators being focused on the degree to which the management systems of the delivery organisations are set up to deliver good sustainability performance.

6.6.9 BREEAM Infrastructure (formerly known as CEEQUAL) is an evidence-based sustainability rating and award scheme owned and operated by the Building Research Establishment (BRE). Performance is assessed across eight categories covering the early strategy stages of a project, through design and construction. The assessment is then subject to an independent verification to confirm that the evidence supports the results of the assessment.

6.6.10 The Environment Agency initiated a discussion with BRE on how BREEAM Infrastructure might be applied to the programme of work delivered by CDF. Key considerations were:

- To use BREEAM Infrastructure to influence a culture change in how sustainability is addressed in projects it had to apply to the whole programme rather than the few very large projects;
- The majority of the flood risk resilience programme is made up of projects costing less than £10million; and
- A programme approach would require more than just an aggregation of individual projects.

6.6.11 The scheme developed in collaboration with BRE provided for three levels of assessment as shown in Figure 2:

- The national once assessment focuses on corporate policies, targets, strategies and processes that set the framework for how sustainability is addressed on

projects. This national assessment is primarily providing efficiencies by presenting the evidence once, rather than having to reproduce it for each individual project;

- The IDT assessments are similarly providing efficiencies where the evidence for local ways of working and delivery partner policies and processes can be presented once. Additionally, the IDT can seek opportunities for improving sustainability across the programme (e.g. managing or exchanging materials between projects) that will contribute to improved delivery of the individual projects; and
- Project level assessments are scoped to address the assessment issues that are significant to each individual project and ensure that they are proportionate to its scale and impact. Assessing how carbon emissions have been addressed is mandatory on all projects. Across the programme of work in each hub it is expected that all the sustainability issues will have been addressed.

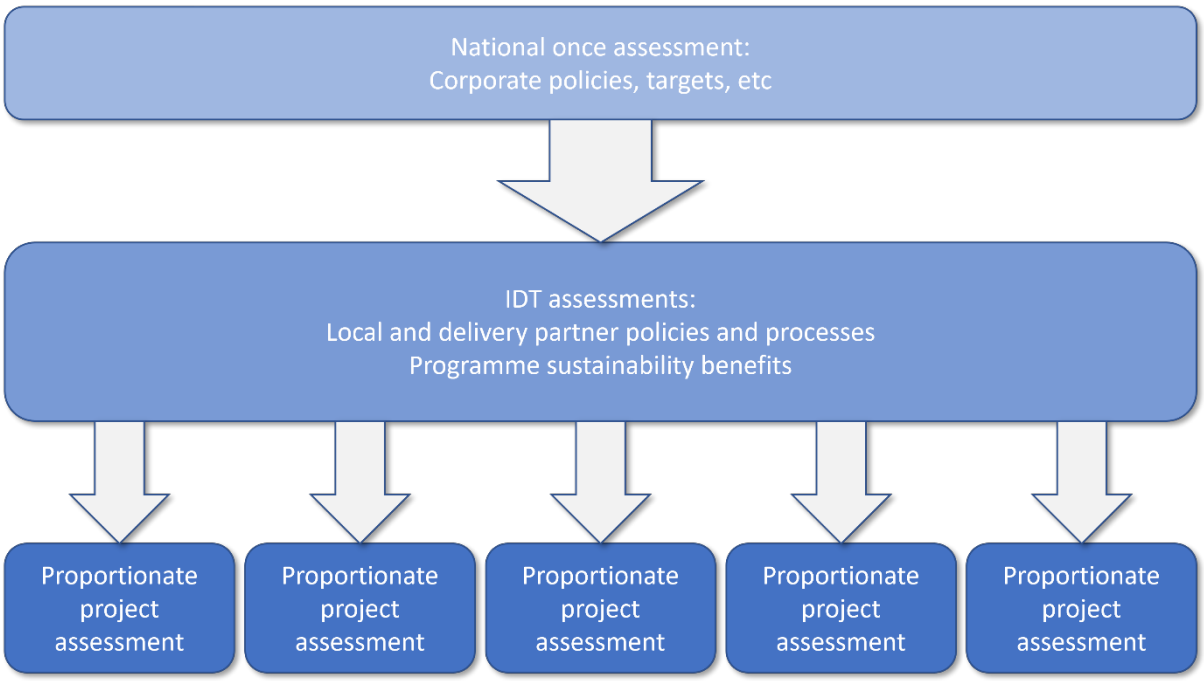

Figure 2: BREEAM Infrastructure levels of assessment as applied to the Environment Agency's CDF

6.6.12 All three levels of assessment are subject to independent verification. For projects, the verification takes place at the end of detailed design and construction. This is undertaken for the 'bundle' of projects that have passed those milestones during the financial year. The result of the verification is a rating of sustainability for Integrated Delivery Team. This IDT rating is then used as one of the KPIs that contribute to the award of programme level incentivisation. Over the lifetime of the framework, the

‘threshold’ rating will be increased to reflect increasing sustainability demands and the more mature sustainability culture within the delivery teams.

6.6.13 Delivery

6.6.14 On implementation, the priority was to ensure the assessments on the individual projects were being undertaken. This was followed by the national assessment of evidence and finally the IDT based assessment. The BREEAM Infrastructure assessments and supporting evidence are all stored on a BRE portal, BREEAM Projects. A link to the portal enables the Environment Agency to capture the data related to its projects and develop its own dashboards to monitor progress nationally and at the IDT level. There are early tangible results in how BREEAM Infrastructure is affecting the project delivery culture:

- Sustainability leads have highlighted that it has enabled conversations on the processes and practices that would not previously have been countenanced;
- Practice is being changed to ensure that sustainability is explicitly addressed early in the life of a project;
- Occasionally, the assessment is highlighting gaps in processes or where issues have been allowed to ‘slide’ and provides a valuable ‘lessons learned’ for future practice; and
- Delivery partners are engaging well in the process and have taken the initiative to work with the Environment Agency to develop a handbook to facilitate its implementation.

6.6.15 Carbon is addressed as a specific issue within CEEQUAL, but the wider consideration of sustainability offers the opportunity to achieve wider carbon benefits that might not be achieved with a narrowly-focused approach. For example:

- Resilience to climate change could include a role for nature-based solutions;
- Considering biodiversity and opportunities for net gain could lead to reducing or potentially increasing carbon sequestration on a site; and
- Efficiencies in resource use and embedding circular economy reduces the carbon embedded in materials.

6.6.16 The Environment Agency is the first organisation in the world to apply BREEAM Infrastructure at a programme level. This inevitably generated challenges when theoretical models and approaches were applied to specific projects and being

integrated into supply chains. However, the model has proved to be robust, and has created a framework within which the Environment Agency can work collaboratively with both BRE and Delivery Partners to resolve any issues that arise.

7. Annex I - Standards and Guidance

Environment and Carbon Assessment	
Standards	**Aim**
BS EN 15978:2011 Assessment of environmental performance of buildings - Calculation methods	This standard sets out a calculation method for the sustainability of construction works and assessing the environmental performance of new and existing buildings, based on a life cycle assessment. It includes how to define the system boundary, indicators and the procedures used for making calculations based on these and reporting requirements. It covers all construction products, processes and services used over the lifecycle of the building. This standard also directly satisfies the requirement of Mat01 under the BREEAM requirements.
BS EN 17472: 2022[13] Sustainability assessment civil engineering works - calculation methods	This standard establishes the requirements and specific methods for the assessment of the environmental, economic and social performance of a civil engineering project across all stages of its life cycle. It covers all products, processes and services used in the delivery or upgrading of the asset. It is applicable to both new and existing civil engineering works, and is also capable of supporting the design process through allowing the comparative evaluation of options.
Professional Guidance	

[13] https://www.en-standard.eu/bs-en-17472-2022-sustainability-of-construction-works-sustainability-assessment-of-civil-engineering-works-calculation-methods/

RICS Professional Standard	The Royal Institution of Chartered Surveyors has published a professional standard on whole life carbon assessment. This sets out mandatory principles and supporting guidance for the interpretation and implementation of the EN 15978 methodology. The specific objectives of this professional statement include providing a consistent whole life carbon assessment implementation plan and reporting structure for built projects, and promoting the reliability of whole life carbon assessments by acting as a common point of reference for the industry.
IStructE	The Institution of Structural Engineers has issued guidance to its members on calculating embodied carbon, to provide a common approach for the structural elements of infrastructure and construction projects. This aims to help improve the carbon efficiency of designs, support the use of less carbon-intensive materials, and quantify the benefits of reducing embodied carbon for clients. This is supplemented by an open source carbon estimator.

Guideline	Aim
GLA	The GLA has provided guidance on undertaking Whole Life Carbon Assessments, which are a requirement for development proposals in London. This covers all stages of the life of a building, including materials, construction and demolition, and was developed jointly with industry and other stakeholders. [https://www.london.gov.uk/what-we-do/planning/implementing-london-plan/london-plan-guidance/whole-life-cycle-carbon-assessments-guidance]
UKGBC Client Brief	The UK Green Building Council has developed guidance and a model client brief on embodied carbon, which aims to provide practical advice on how to measure embodied carbon, and approaches to mitigating this and through engaging the supply chain for the project. This is designed to be suitable for use in relation to both new build and refurbishment projects. [https://www.ukgbc.org/ukgbc-work/embodied-carbon-practical-guidance/]

Carbon management framework and Sustainability Assessments	
Framework	**Aim**
PAS 2080[14]	PAS 2080 is a global infrastructure standard for managing infrastructure carbon across the life of an asset. It can be adopted by any organisation involved in the delivery of infrastructure, including asset owners and managers, designers, contractors and product and material suppliers. PAS 2080 provides a framework for identifying and mitigating carbon emissions across the value chain, through improved design, facilitating the adoption of innovation, and more efficient construction and use. PAS 2080 also ensures carbon is consistently and transparently quantified at key points in infrastructure delivery, enabling effective data sharing, monitoring of supply chain performance and reporting. The British Standards Institute (BSI) can assess and verify organisations that adopt this standard. PAS 2080 is currently being updated, and a new version is expected to be published at the end of 2022, which will also be suitable for use in relation to buildings.
Sustainability	
Building Research Establishment Environmental Assessment Model (BREEAM)[15]	BREEAM is a sustainability assessment for master planning, infrastructure and projects. It assesses the economic, social and environmental sustainability of a built asset, against standards developed by the BRE. BREEAM certification uses a process of independent expert assessment of whether a building or project meets the specified performance standards. This assessment can take place at various stages in the projector asset life cycle, from design and construction to operation and during refurbishments.

[14] https://www.bsigroup.com/en-GB/our-services/product-certification/product-certification-schemes/pas-2080-carbon-management-in-infrastructure-verification
[15] https://www.breeam.com/

The Civil Engineering Environmental Quality Assessment & Award Scheme Manual (CEEQUAL)	CEEQUAL is an approach to sustainability assessment for civil engineering, infrastructure, landscaping and public realm projects. It was developed by the BRE and Institution of Civil Engineers. It aims to drive improved sustainability performance, including reduced carbon emissions, reduce costs, minimise waste and deliver ecological enhancement. The assessment of a project is undertaken by a trained assessor, following the CEEQUAL Manual. This assessment is then independently verified, and the project awarded one of six grades, depending on the outcomes achieved.

Carbon reduction initiatives/ neutrality standards	
Standard	**Aim**
PAS 2060[16]	PAS 2060 is the internationally recognized specification for carbon neutrality developed and published by the British Standards Institution (BSI). The document builds on the environmental standards such as ISO 14001 and PAS 2050. It sets out requirements for quantification, reduction and offsetting of greenhouse gas (GHG) emissions for organisations, products and events. To obtain certification, an organisation has to set carbon measurement and reduction targets, and progress through the stages of measuring their carbon footprint, develop a plan for emissions reduction and make a public commitment to carbon neutrality, offset residual emissions, and publicly report on emissions and progress.
PAS 2035:2019[17]	PAS2035:2019 is a best practice framework for the retrofitting of energy efficiency measures into residential buildings in the UK, through identifying where improvements can be made and supporting the design of measures that can deliver these. It takes account of the requirements of the entire building, from both a technical perspective and that of the occupants. It is designed to be used in conjunction with PAS2030:2019, which sets the standards required when installing energy efficiency measures, and is the standard installers are accredited to.

[16] https://www.bsigroup.com/en-GB/pas-2060-carbon-neutrality/
[17] https://shop.bsigroup.com/products/retrofitting-dwellings-for-improved-energy-efficiency-specification-and-guidance-1/standard

Passivhaus[18]	Passivhaus is an international standard to support the delivery of net zero ready new and existing buildings, with a focus on minimising energy used in heating and cooling through improved thermal performance, ensuring the building is ready for a decarbonised grid, and delivering a high standard of occupant comfort. It adopts a whole building approach, with targets for different elements of the build, and applies a certification process to ensure the quality of construction and asset performance. Projects, designers, contractors and products can all be certified as achieving the Passivhaus standard. There is a separate EnerPHit standard for retrofit, which can be used in buildings where achieving the Passivhaus standard is impractical e.g. for older or listed buildings.
PAS 2035:2019[19]	PAS2035:2019 is a best practice framework for the retrofitting of energy efficiency measures into residential buildings in the UK, through identifying where improvements can be made and supporting the design of measures that can deliver these. It takes account of the requirements of the entire building, from both a technical perspective and that of the occupants. It is designed to be used in conjunction with PAS2030:2019, which sets the standards required when installing energy efficiency measures, and is the standard installers are accredited to.
Carbon Certification and Verification Standards	
Standard	**Aim**

[18] https://www.passivhaustrust.org.uk/
[19] https://shop.bsigroup.com/products/retrofitting-dwellings-for-improved-energy-efficiency-specification-and-guidance-1/standard

International Cost Management Standard (ICMS) 3[20]	ICMS3 is an international classification framework that aims to provide a consistent basis for defining, measuring, analysing and reporting on lifecycle costs, carbon emissions and other aspects of the performance of construction projects, including infrastructure, buildings and other structures. This enables accurate comparisons to be made, and supports improved decision-making. It covers construction carbon (site and embedded), operational carbon, maintenance and end of life carbon emissions (reported as kilograms of CO2 emissions equivalent). ICMS3 has been developed by a range of professional construction bodies in the UK, Europe, Latin America, North America, Asia and Africa, and is designed to enable comparisons between built assets in different countries that use different standards. It enables data based on a range of standards (e.g. ISO21930/21931), EN15643 or PAS 2080 to be used, and allows flexibility for new standards to be adopted.
ISO 14064-3[21]	ISO 14064-3 specifies principles and requirements on the quantification, validation, verification and reporting of GHG emissions statements made about organisations, projects or products, together with supporting guidance. It aims to ensure credible, consistent and transparent reporting of GHG emissions and the effectiveness of measures taken to reduce these, including for purposes of regulatory compliance or delivering against other requirements e.g. imposed by contracts.

[20] https://www.rics.org/uk/upholding-professional-standards/sector-standards/construction/icms3/
[21] https://www.iso.org/standard/66455.html

International Standard on Insurance Engagements (ISAE) 3410[22]	ISAE 3410 is produced by the International Auditing and Assurance Standards Board, for use by auditors when assessing GHG emissions reporting by firms and the processes followed to develop these. It aims to ensure that statements made by firms are free from material misstatements, and provide a sufficiently accurate statement of GHG emissions. It also aims to ensure consistency across the audits of different organisations.

[22] https://www.iaasb.org/publications/glance-international-standard-assurance-engagements-isae-3410-assurance-engagements-greenhouse-gas