Scottish Futures Trust

Guidance on pathways to net zero for assets delivered under PPP contracts

June 2022

SCOTTISH FUTURES TRUST

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Executive Summary

The Scottish Government is committed to all of Scotland's Public Sector buildings achieving net zero emissions by 2045 and for all publicly owned buildings to meet zero emission heating requirements by 2038.

To achieve this, a step change in attitudes to energy use in the built environment is required. Public bodies have already demonstrated an ability to make significant reductions in emissions from their operational estates by working collaboratively to reshape them to better suit the needs of their users and the services which they support.

These reductions have been achieved by refurbishing or repurposing existing buildings, co-location with partner organisations and other options that improve the efficiency of existing assets, as well as the construction of new ones.

Executive Summary (continued)

In 2021, the Scottish Government published the Net Zero Public Sector Buildings Standard (the **Standard**) developed by the Net Zero team at the Scottish Futures Trust. This was developed in collaboration with Zero Waste Scotland and Health Facilities Scotland, with input from the wider Scottish construction and public sectors. This collaboration resulted in publication of a methodology which enables public bodies to meet their Net Zero (**NZ**) commitments for their new build and major refurbishment infrastructure projects.

The intent of this Standard and the counterpart Net Zero Public Sector Buildings Standard for Existing Buildings ('**NZPSBS for Existing Buildings**') is to set a clear route map to NZ within the Net Zero Deadlines set by each public sector organisation, and when reading this Guidance please refer to the latest version of the Standards.

Within the existing Scottish Public Estate, there are around 120 PFI, PPP, hub and NPD (collectively **PPP**) projects across the education, health, office and custodial sectors. These include major acute, mental health and primary healthcare facilities, as well as multiple schools' projects, many of which have been operational for in excess of 15 years.

The objective of this guidance is to provide direction on how to adopt a systematic approach to the delivery of a NZ transition within this unique sector. The guidance recognises the requirement for consistency in the design, implementation and monitoring of the transition. In doing so, it recognises that public bodies are unable independently to put in place effective carbon reduction strategies or to set carbon reduction targets. Due to the unique nature of operational PPP projects, the cooperation and collaboration of all interested parties including funders, investors, the project companies' management services providers and FM service providers, is required.

This document is not intended to provide exhaustive guidance for the design and implementation of NZ pathways for all public sector buildings or property in Scotland. Pathways tend to differ in the extent to which they focus on the use of technology, particularly those for greenhouse gas removal. These pathways are not mutually exclusive not least for operational buildings and facilities, because operational buildings and facilities are particularly challenging in reducing emissions in entirety, including those procured and operated under PPP arrangements.

This document focuses on the improvements which can currently be achieved under PPP arrangements. The Scottish requirements for public buildings to achieve zero direct emissions from heating, cooling and hot water (ZEH) by 2038 will be challenging and this guidance will require to be considered in conjunction with the developing direction from Scottish Government to meet the targets.

The pathway to NZ is fundamentally about reducing global greenhouse gas emissions rapidly and emitting as little greenhouse gas as possible on the way to 'net-zero' which will help minimise further changes in the climate. The guidance recognises that pathways to NZ can be wide ranging and need to address all greenhouse gases. Consequently, there are multiple 'pathways' which can be adopted in the Net Zero transition.

This guidance has been developed to assist the Public Sector in structuring the right questions and identifying the primary areas which will likely need to be addressed to successfully transition to NZ and to help minimise the impact of further changes in the climate during the transition period.

The core of the guidance focuses upon operational energy related carbon reduction, but there will undoubtably be other opportunities for broader

carbon reduction in PPP assets and projects. This is particularly the case on some of the earlier PPP projects where the scope of the facilities management service includes an extensive range of non-building related services typically waste, water, travel, fleet and food, all of which are influenceable by the procuring public body and the PPP project company. Public bodies, when using this guidance, should do so in conjunction with their wider carbon footprint reduction strategies to limit the environmental impact of their service in the broader sense.

It is recognised that there are few commercial levers available to public sector participants operating PPP projects that enable them to enforce the required net zero related changes. Whilst contractual provisions do exist in the Change provisions of PPP contracts where project companies are formally obliged to implement a Change once formally instructed by the procuring Authority, the guidance, in the main, promotes a collaborative approach between the public and private sector stakeholders. It does so by recognising that it is likely that all parties will understand the benefits associated with adopting environmental, social, and governance (**ESG**) based approaches and that socially responsible/conscious investors will support the adoption of a net zero transition policy.

Scotland's public sector is already playing a strong leadership role in the national endeavour to deliver a just transition to NZ by 2045. Many Scottish public sector bodies have targets consistent with the national target to achieve NZ by 2045, and in some cases are pursuing efforts to achieve an earlier NZ transition date. For example, NHS Scotland aims to become a net-zero greenhouse gas emissions health service by 2040 or earlier in line with Scottish Government policy for NHS Scotland on the climate emergency and sustainable development and contained within the consultation draft NHS Scotland climate emergency and sustainability strategy 2022 to 2026 – draft.

This guidance therefore outlines how to plan, look at funding options and to deliver and manage the journey to net zero carbon which supports the wider Scottish Government objectives described above. This guidance gives both technical and non-technical guidance which is easy to understand and follow and its key objective is to recognise and explain the variances in approach which should be adopted on a PPP project.

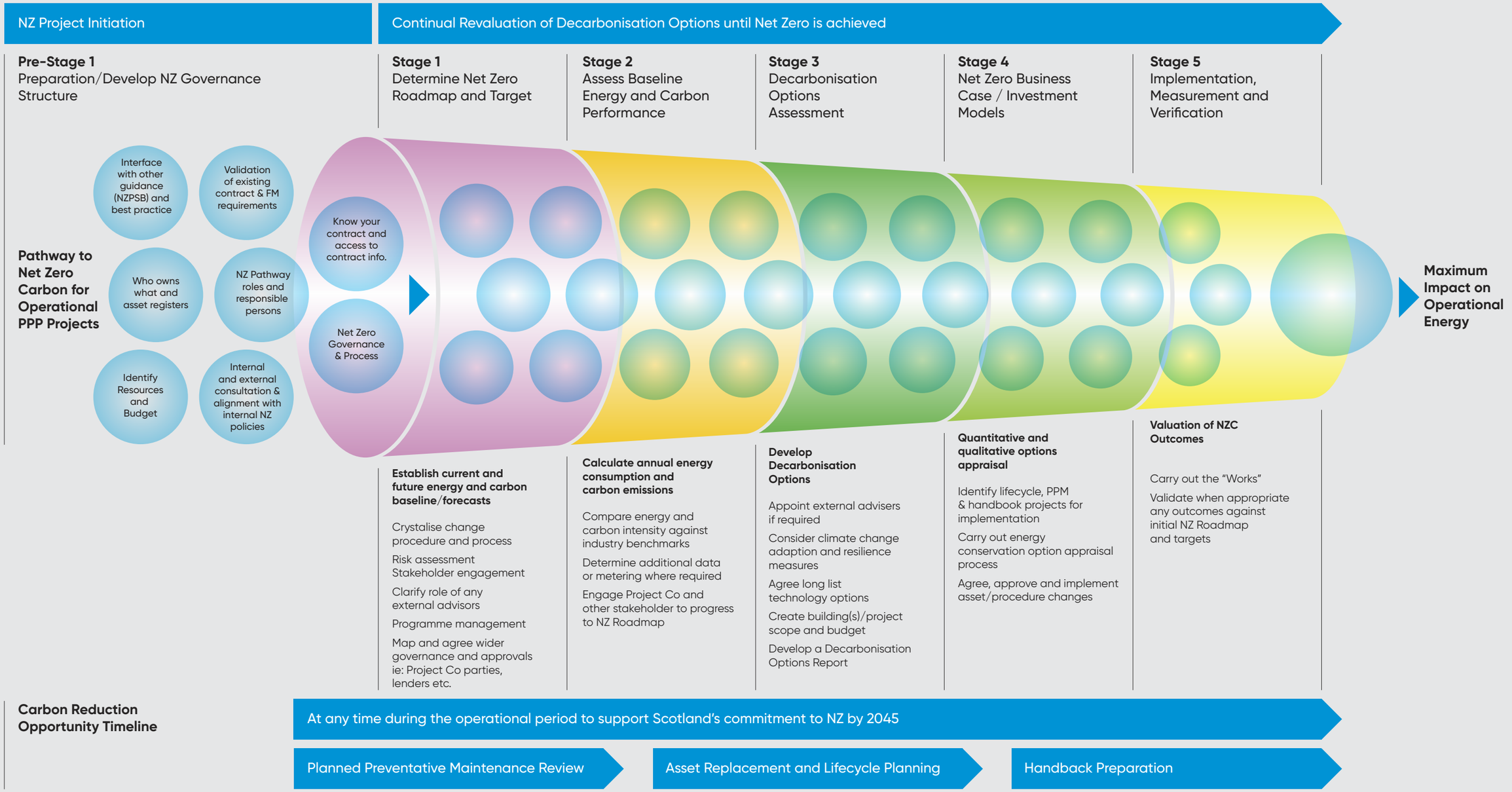
The guidance identifies a process and measures to follow, so that discreet elements of existing operational PPP assets (including projects approaching handback) are on the path to NZ.

The guidance outlines how measures should be rolled out within contract lifetimes including as part of the asset handback process, where relevant.

Please see Figure 1 below which summarises the decarbonisation process for operational PPP projects and assets as described.

Executive Summary (continued)

Figure 1:
Decarbonisation process for operational PPP projects and assets



Executive Summary (continued)

This guidance provides an overview of issues to be considered by public sector PPP practitioners, private sector providers and investors, ahead of implementing a net zero transition strategy. The focus of this guidance is on existing operational PPP facilities and buildings and is not intended to provide exhaustive guidance for the design and implementation of NZ pathways for all public sector buildings or property in Scotland.

It also provides templates and tools in relation to the physical alterations to facilities to transition discreet elements of operational PPP assets onto a pathway to net zero, in the context of Scottish Government policy and objectives. The guidance is not about operational energy management per se, although this is a key contributor to NZ for PPP projects. Public bodies, when using this guidance, should do so in conjunction with their wider carbon footprint reduction strategies, to limit the environmental impact of their service.

In summary this guidance:

a) outlines the need to transition discreet elements of existing operational PPP assets onto the path to net zero in the context of Scottish Government policy and objectives;

b) assists public sector PPP practitioners and technical teams to transition assets to the path to net zero through decarbonisation of existing facilities and system building elements via a net zero-driven approach;

c) provides a methodology to produce a net zero carbon roadmap to identify carbon reduction opportunities around lifecycle planning and potential alterations within a PPP context;

d) directs readers to other tools/guidance etc that might be useful; and

e) provides specific PPP support on contractual and other barriers to be overcome.

Further details can be found using the references to external guidance provided throughout, with active hyperlinks where publicly accessible, as well as a linked index in appendix 4 of this document.

This guidance has been designed to support public sector PPP practitioners, private sector providers and investors to manage better current operational assets in a way that helps to future proof investments and considers the impending requirements of the Scottish Government's route to net zero. It is recommended that Authorities using this guidance would take appropriate advice from technical, legal and other advisers as required in this regard.

If users have any questions in relation to this guidance or require any additional information, SFT can be contacted through the following email link: mailbox@scottishfuturestrust.org.uk

Chapter 1: The Project Agreement

1.1 The differences among different generations of contract forms

In Scotland there are several different forms of revenue funded schemes which broadly fall into three categories: bespoke early PFI type projects (**Bespoke Contracts**); projects based on schools or health standard forms (**Standard Form Contracts**) and, most recently, NPD/hub projects (**NPD/hub Contracts**). There are several commercial and financial differences among the forms of contract but, here, the focus will be around the operational and facilities management service (**FM Service**), the principal energy consumption provisions and the change or variation provisions (in this guidance alterations, additions or deletions to the facilities or services are referred to as **Changes**).

As the Bespoke Contracts (as their name suggests) vary, this guidance will not go into detail to their various provisions and comment will be made in relation to Standard Form and NPD/Hub projects. As with other issues arising in relation to operational contract management of PPP projects, support can be sought from SFT's operational PPP team in relation to issues within its remit and it is expected that public Authorities operating PPP projects will seek external advice, including as to technical and legal matters in relation to the carrying out of Changes on the pathway to NZ.

1.2 PPP projects: risk transfer

In all forms of PPP projects, the procuring Authority allocates the design and construction risks to the project company established to design, build finance and maintain the asset (**Project Co**) as it is best positioned to manage them and is thus willing to assume their responsibility without a high premium.

A major characteristic of PPP projects is the transfer of risk from the public sector to the private sector. Among the major risks allocated to the Project Co under all forms of PPP projects are:

- Design and construction risk, and
- Availability and performance risk, through the operation of payment mechanisms whose forms have developed over the years with considerable variation in Bespoke Contracts compared with Standard Form or NPD/hub contracts.

The transfer of design and construction risk is reflected in all of the forms of PPP Contracts to require the meeting of the defined Authority's Requirements (and relative, and usually more detailed contractor's proposals) as a condition of achieving practical completion and the availability date, thus triggering payment of the unitary charge. Both the Standard Form Contracts and the NPD/hub Contracts make it clear that the Authority's Requirements continue to be relevant during the operational period, particularly through the operation of the FM service level specification (**FM SLS**) that underpins the ongoing FM service.

1.3 Construction Requirements: Energy

The defined Authority's Requirements in each contract will set out the specification and standards including as to energy efficiency that the facility is to meet, typically in the form of an energy target. In addition, later PPP contracts and the NPD/hub contract provides for an energy model to be developed and for thermal and energy efficiency testing to be undertaken prior to handover to the operational phase. The primary aim of this testing is to establish if the energy efficiency ambitions of a buildings design has been successfully delivered and determine the baseline for operational energy consumption going forward.

Authorities should therefore check their Project Agreements at the outset to identify and consider the standards and specification in the Authority's Requirements in relation to energy efficiency, the continuing impact of those provisions in the context of their respective projects and the results of the testing that took place prior to handover, including the specific testing arrangements in NPD/hub Contracts.

1.4 Consumption risk

The approach to operational consumption risk varies among the different forms of contract. In particular, the Standard Form contracts provide for Project Co to accept a measure of consumption risk (subject to periodic rebasing through the normalised performance indicators (NPI) or energy target provisions) whereas the NPD/Hub Projects provide for Authorities to accept consumption risk, subject to the ongoing obligations of Project Co in relation to the FM Service (e.g. to maintain the plant to the contractual standard). Generally pricing risk for utilities rests with Authorities. When utilities invoices are received, it is worth checking that the optimal tariff is in place and there are no late payment charges (if Project Co has delayed payment it should not

have passed those costs onto the Authority) and that the consumption is correct and related to the tariff.

It is important for Authorities to be clear at the outset as to the contractual arrangements in their relevant contract in relation to consumption risk. While there are some forms of contract that include provision for interim energy target adjustment in the event of material change, where Project Cos have accepted consumption risk, these provisions would need to be considered and consequentially amended as part of the Change provisions so that where or to the extent that Authorities are making additional payments to effect the Change they receive the benefit of any reduction in energy costs as a result of reduced consumption.

1.5 Maintenance requirements

Generally, in terms of the FM Service (this may vary from project to project) Project Co is obligated to maintain all building plant, fittings and infrastructure in line with Good Industry Practice. Project Co is also required to replace building fabric, plant and infrastructure when life expired (or to meet handback condition requirements), utilising a periodically agreed Lifecycle Plan and fund. Also, Project Cos have a responsibility to report on energy performance (i.e. energy consumed and costs incurred) and the FM SLS often contains provisions that might assist Authorities in reducing consumption from an operational perspective e.g. to perform its operations so as to minimise Utilities consumption whilst achieving the optimum environmental conditions required by the Authority. A typical service requirement is noted below.

1.6 Typical PPP FM Service Specification: energy and utilities requirement

The Authority requires that the FM services are fully integrated, efficient, responsive, comprehensive and effective, and based on sound technical and operational requirements and standards.

- **Overall Objective** - Ensure energy and utility services are supplied and maintained in accordance with Legislation, Applicable Standards, Guidance and Good Industry Practice;
- **Description of Outputs** - Operate energy consumption monitoring and management systems. Records of consumption are maintained, use is monitored, and patterns of use advised, meter readings to be included within monthly monitoring report;
- **Specific Requirement** - Records maintained, use monitored, patterns of use advised, meter readings included within monthly monitoring report and reports produced as agreed between the Authority and the Contractor both acting reasonably; and
- **Performance Standards** - Develop energy saving strategies (including separate heating, lighting and ventilation strategies) in consultation with the Authority, acting reasonably and implement such strategies and cooperate with the Authority in achieving objectives of the strategies, operate buildings efficiently, have an effective Building Management System (BMS).

Chapter 1 (continued)

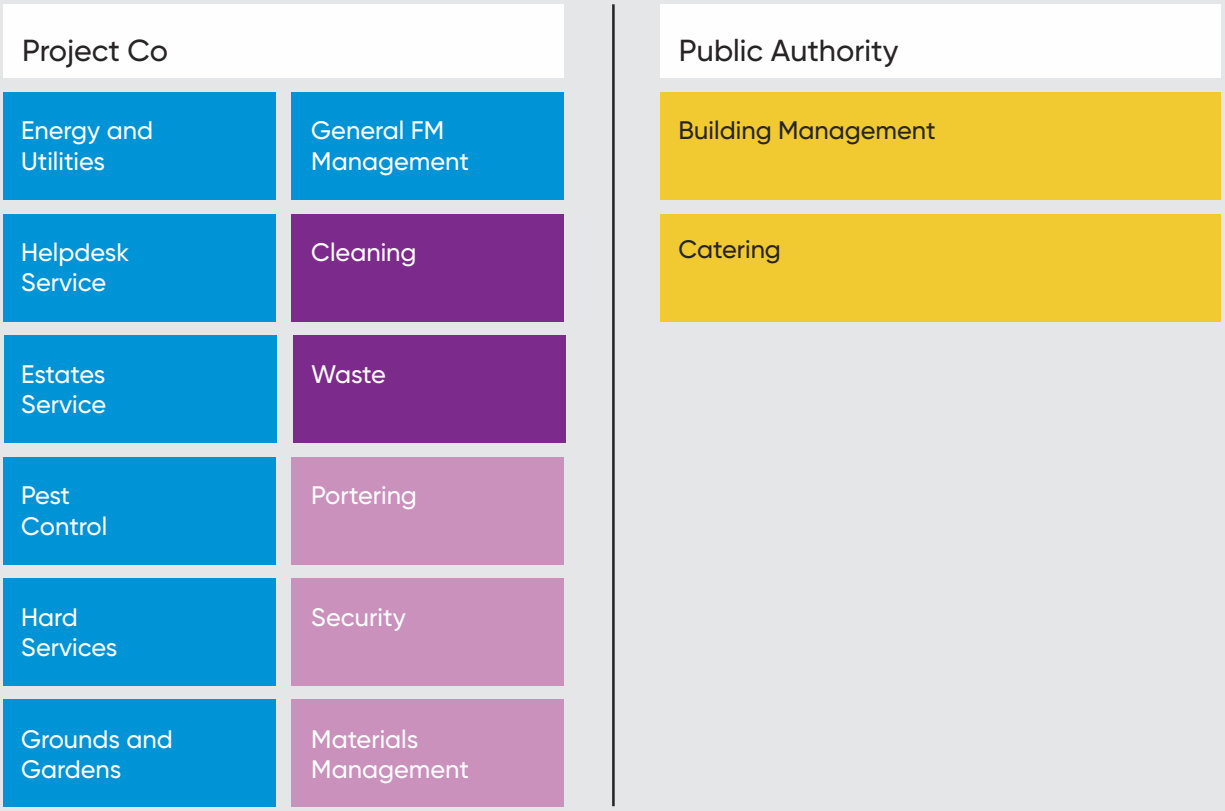
1.7 Scope of FM Services

The scope of FM services varies across projects. Broadly there are two main approaches: a full service providing hard and soft FM services that is typical in Bespoke Contracts and Standard Form Contracts, except for most health projects and a more limited hard FM services scope contained in NPD/Hub projects, each as illustrated below.

Bespoke and Standard Form (excluding some health projects) Facilities Management Service

In terms of the FM service, the scope of service contracted out to Project Co is generally comprehensive (i.e. a turnkey FM solution). The diagram below illustrates the number of services that generally reside with Project Co and its sub-contractor, the FM provider.

Figure 2
Typical PPP/PFI Facilities Management Service

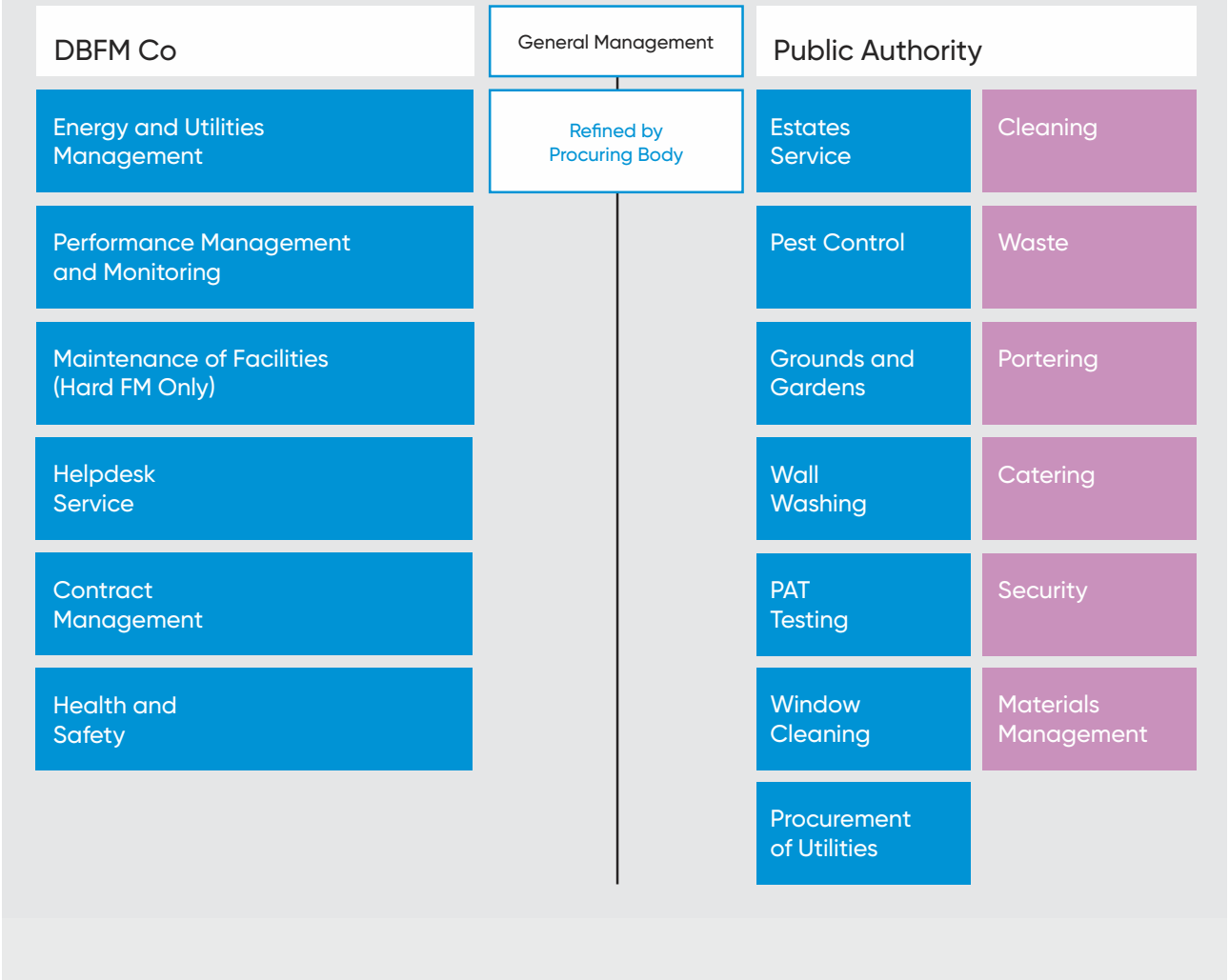


Chapter 1 (continued)

1.8 Typical NPD/hub Projects Facilities Management Service

Under this model, Project Co is to deliver a somewhat reduced FM service offering, as illustrated in the diagram below.

Figure 3
Typical NPD/hub Initiative Facilities Management Service



1.9 Utilising the Change procedure in the journey to achieving Net Zero

This section considers a number of issues in relation to the options in relation to the change or variation provisions or protocol (referred to as the **Change Procedure** for ease of reference) in the various forms of PPP contracts. The Change Procedure will be the key provisions for all parties to consider when an Authority is progressing and concluding an instruction for the installation of alternative plant or equipment or to make other alterations which would contribute to and assist in the journey to NZ.

1.9.1 Stakeholder engagement

We would recommend that Authorities proactively engage at an early stage and then on an ongoing basis with the key stakeholders: both public and private.

Public sector stakeholders are likely to include Scottish Government, both from a policy perspective and if funding external to the Authority is to be sought.

From a private sector perspective, Project Co (both the investors and the MSA provider), the funders and the funders technical adviser and the FM provider will all be relevant. It will be useful to establish that the processing of the Change so as to facilitate the pathway to NZ is a common goal and to be clear as to any areas of difference on the part of key private sector stakeholders.

In particular, given the importance of the effect of Changes that assist in achieving NZ targets, it will be useful to understand the stakeholders' own policies and goals in this area in the context of their Environmental, Social and Governance responsibilities. ESG has gained increasing attention over the past few years, with many institutional investors investing only in those companies that provide ESG performance reporting. Considerations around ESG are relevant to investors, consumers and employees, and has become a key topic of discussion by directors at board level. There is evidence that institutional investors are moving on from the baseline of traditional financial targets to include, for example, mapping the transitions from fossil fuels, supply chain overhauls, investing in upskilling or assessing and committing to decarbonisation targets etc. Authorities should leverage their long-term relationships with their respective Project Cos and their investors and start the strategic dialogue with questions of ambition of how investors can help fund, manage and reduce the impact of their environmental footprint. To support this approach, we have had informal feedback to the effect that lenders, with whom Changes to effect NZ goals was discussed, were very positive given their desire to improve the NZ performance of their portfolio.

Other areas to be discussed at an early stage are the processes around the implementation of the Change, for example, ensuring that there is a common understanding as to the commercial effect of the Change Procedure in the Project Agreement, the extent of due diligence required (both legal and technical), the procurement arrangements for effecting the Change and the target costs and timescales.

While there might not be a contractual obligation to require Project Co to engage in respect to the identification and delivery of any NZ opportunities (though some FM SLSs do contain some helpful provisions in relation to energy management), the collective responsibility for NZ, subject to the Change Provisions, should ensure a collaborative, pragmatic and positive outcome for Project Cos and their investors, lenders and supply chain.

Thus, throughout the process it is important to keep open the dialogue with the private sector parties and a collaborative approach is essential. Contact should be at the right levels for relevant issues encompassing both practical and/or technical matters and any resolution of any commercial issues.

It is important from the outset to ensure that there is a common understanding of the required NZ objectives and the likely timescales involved, including as to the implications of the contract as a result of energy efficiency retrofitting work or NZ-related contract Changes.

1.9.2 Understanding your contract

We discuss below some key underlying principles around the Change Procedure process and provides guidance of approaches to be considered as the process progresses. References to contractual provisions are to the NPD/hub contract standard form and the Standard Contracts. Authorities should note that some of the specific provisions which are noted in this section may differ in their own contract as the standard forms might have been altered during the original negotiations.

Accordingly, Authorities, having decided to embark on the process of making Changes to contribute to the journey to NZ, in parallel with the technical

identification and appraisal of options (as to which see below), Authorities should consider and be clear as to the contractual provision applicable to their individual project and the commercial and practical implications (including as to timescale) to which these give rise.

Authorities should consider lessons learnt from Changes that have previously been instructed under their PPP contracts and, through the collaborative groups that are supported by SFT, Authorities will be able to draw on the experience of others.

1.9.3 Change procedure context

Contracts typically require the replacement of plant and equipment with a like for like item. However, an Authority could consider amending that requirement through the Change Procedure. Changes could be instructed in advance of or at the time that an item of plant or equipment is being replaced either through the lifecycle programme, or as part of the handback process. These Changes can be implemented towards the end of a contract term or indeed at any point during the services period.

An Authority should consider the cost of any new plant or equipment being discounted where possible against the net amount that would ordinarily be included in the lifecycle model (see further Costs of the Change below).

The opportunity to utilise the Change Procedure should be seen as a positive one and should be approached in that context with the involvement of the various stakeholders referred to above.

While it might be better value for money in strictly financial terms if an item of plant or equipment was replaced when it was scheduled and modelled to be replaced rather than replacing it part way through its expected life, an Authority is entitled to instruct a Change to bring about the replacement of an item at any time should it decide to do so. The balance of carbon reduction opportunities in the pathway to NZ versus the financial cost of making an early Change may therefore need to be considered in the context of the potential to introduce alternative plant and equipment through the Change Procedure at an earlier stage.

The Change Procedure processes in PPP contracts can be complex, time consuming and, depending on value, may require a dedicated team to be assembled to manage the process: again early engagement and a clarity over goals, process and target costs and timescales are important from the outset.

1.9.4 Change procedure: key provisions

Grounds for Objection

The Change Procedure provisions were incorporated into the PPP contracts to provide an in built mechanism to allow Authorities to change the facilities and services over time. Accordingly, the extent of grounds for objection (i.e. a Project Co being entitled to refuse outright to carry out a Variation) are limited.

An example, taken from the NPD/hub Contract, relating to High Value Changes, is

1.2 "DBFM Co shall be entitled to refuse a High Value Change that:

1.2.1 requires the Works and/or the Services to be performed in a way that infringes any law or is inconsistent with Good Industry Practice;

1.2.2 would cause any Consent to be revoked (or would require a new consent to be obtained to implement the relevant change in the Works and/or the Services which, after using reasonable efforts, DBFM Co has been unable to obtain);

1.2.3 would materially and adversely affect DBFM Co's ability to deliver the Works and/or the Services (except those Works and/or Services which have been specified as requiring to be amended in the High Value Change Notice) in a manner not compensated pursuant to this Section 4 (High Value Changes);

1.2.4 would materially and adversely affect the health and safety of any person;

1.2.5 would, if implemented, materially and adversely change the nature of the Project (including its risk profile);

1.2.6 is the subject of a High Value Change Notice that cannot reasonably be complied with;

1.2.7 the Authority does not have the legal power or capacity to require implementation of; or

1.2.8 would if implemented adversely affect the enforceability or priority of the security held by or on behalf of the existing Senior Lenders."

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We would expect that, in practice these are unlikely to be applicable to Changes to assist in the pathway to NZ, though requests for Changes are likely to require senior lenders consent in most cases (see below) and there is protection for Project Co and the other private sector parties in the provisions relating to required amendments to the Project Agreement and Project Documents (see below).

It is also worth noting that once a formal Change Procedure has been processed to the point where there is an instruction from the Authority to proceed (on the basis of the arrangements agreed through the Change process, Project Co is under a duty to implement that Change on the basis agreed.

Costs of a Change

The Change Procedure provides the basis upon which the Authority, if it instructs and Authority Change, is responsible for the costs of that Change.

A key definition, taken from the NPD/Hub Contract is:

"Change in Costs"

means in respect of any Relevant Event, the effect of that Relevant Event (whether of a one-off or recurring nature, and whether positive or negative) upon the actual or anticipated costs, losses or liabilities of DBFM Co and/or the Contractor and/or any Service Provider (without double counting), including, as relevant, the following:

(a) the reasonable costs of complying with the requirements of Clauses 24.9, 29 (Delay Events), 32 (Changes in Law) and/or Sections 2 (Low Value Changes) to 4 (High Value Changes) of this Schedule Part 16 (Change Protocol), including the reasonable costs of preparation of design and estimates;

(b) the costs of continued employment of, or making redundant, staff who are no longer required;

(c) the costs of employing additional staff;

(d) reasonable professional fees;

(e) the costs to DBFM Co of financing any Relevant Event (and the consequences thereof) including commitment fees and capital costs interest and hedging costs, lost interest on any of DBFM Co's own capital employed and any finance required pending receipt of a lump sum payment or adjustments to the Annual Service Payment;

(f) the effects of costs on implementation of any insurance reinstatement in accordance with this Agreement, including any adverse effect on the insurance proceeds payable to DBFM Co (whether arising from physical damage insurance or business interruption insurance (or their equivalent)) in respect of that insurance reinstatement and any extension of the period of implementation of the insurance reinstatement;

(g) operating costs, or lifecycle maintenance or replacement costs;

(h) Capital Expenditure (or, in the case of a Relevant Event which is a Relevant Change in Law, Capital Expenditure for which the Authority is responsible);

(i) the costs required to ensure continued compliance with the Funding Agreements;

(j) any deductible or increase in the level of deductible, or any increase in premium under or in respect of any insurance policy; and

(k) Direct Losses or Indirect Losses, including reasonable legal expenses on an indemnity basis;

This definition is quite wide ranging but makes it clear:

- In paragraph (a) that the costs must be reasonable;
- that the costs might be positive or negative in savings (e.g. replacement costs of boilers if they are being removed and replaced by an alternative heat source or reduced lifecycle cost (if the replaced plant and equipment has a longer lifecycle period or reduced lifecycle cost), and thus will be the net additional costs.

In addition within the process there are provisions that seeks to restrict or define costs, for example:

- in Low Value Changes there is reference to catalogue rates and various other restrictions on costs (see below);
- In Medium Value Changes, linking unit costs and lifecycle and maintenance cost so the costs set out in the Schedule to the Project Agreement and removing any mark up or cost of time for Project Co;

Chapter 1 (continued)

- in High Value Changes there is a concept of a Target Cost and concept of a Change Management Fee to manage the costs of the Change; and
- there are restrictions in relation to the extent of due diligence in relation to the Change.

By way of another example, the Schools Standard Form contract, the "Estimated Change in Project Costs" definition is

> *"the aggregate of any estimated increased construction, operating, insurance and financing costs or loss of revenue less the aggregate of any reduced construction, operating, insurance and financing costs or increase in revenue, which result directly from a Works Compensation Event, a Services Compensation Event, a Qualifying Change in Law or an Authority Change in terms of Clause 56 (Variations) (as the case may be) which (a) in case of works to be undertaken by the Contractor or a Building Contractor:*
>
> *(i) prior to the commencement of the Services Period for the relevant Project Facility; or*
>
> *(ii) at any time during the Services Period for the relevant Project Facility where the estimated revised construction cost is less than £[•]*
>
> *will comprise a Benchmarked Price and otherwise shall comprise a Competitive Tender; and (b) in the case of services to be provided by the Contractor or FM Contractor shall comprise a Benchmarked Price, other than where the relevant services are to be subcontracted by the FM Contractor (in which case the costs will comprise a Competitive Tender);"*
>
> again, makes it clear that it is the net effect that is relevant and there is benchmarking or competitive tendering to manage costs.

Consistent with the above, it is worth emphasising in the context of Changes likely to be proposed to assist the pathway to NZ (including during the handback period) consideration needs to be given when agreeing the costs of replacing plant or equipment through the Change procedure as to any costs that will not be incurred whether in relation to plant and equipment that will not be required or reduced lifecycle or maintenance costs so that these are fully taken in to account in calculating the net effect of the Change.

1.9.5 Changes to the Project Agreement

The NPD/hub Contract provides for a High Value Change Proposal to include information on, amongst other items:

> *"3.4.6 any requirement for relief from compliance with obligations, including the obligations of DBFM Co to achieve the Actual Completion Date by the Completion Date [the Phase Actual Completion Date by the relevant Phase Completion Date] and meet the requirements set out in the Authority's Construction Requirements and/or the Service Level Specification during the implementation of the High Value Change; …*
>
> *3.4.8 any amendment required to this Agreement and/or any Project Document as a result of the High Value Change;"*

This is to cover the issues that:

- Project Co might require relief from deductions to an extent during the agreed period for the carrying out of the works required to effect the Change to the extent that these are caused by the Change being affected (e.g. if access to a room is affected); and
- There might be amendments required to the Project Agreement (or Project Documents such as the FM subcontract as a flow through issue) if, for example, the FM SLS or calibration of the payment mechanism requires to be adjusted or a third party is to be responsible for a heat source (such as in case of connection to district heating).

Any amendments to the Project Agreement would be agreed as part of the finalisation of the Project Agreement and is normally documented by way of a supplemental agreement.

Provide lifecycle and maintenance costs are taken into account the intention would be to achieve a position where the FM SLS and payment mechanism continue to operate for the whole of the facilities in the same way as before. This is consistent with Project Agreement definition in the NPD/hub Contract of Facilities:

"[the buildings and other facilities, together with all supporting infrastructure (including the Plant and [the Group 1 Equipment]), external hard-standings, specialist surfaces and other amenities located on the Site (including as a minimum all aspects detailed within

Chapter 1 (continued)

Appendix B to Section 1 (Service Level Specification) of Schedule Part 12 (Service Requirements), as required to enable DBFM Co to comply with its obligations under this Agreement, *all as the same may be varied, amended or supplemented from time to time in accordance with this Agreement*];"

As indicated above an exception would be where the heat source is under the control of a third party (as is the case in respect of district heating) where different considerations would apply.

1.9.6 Lenders' consent

In most cases lenders' consent will be required for the Change and any consequent changes to the Project Agreement and/or any Project Document. Lenders will ask their technical adviser to advise them on the technical aspects of the Change and will appoint legal advisers to advise on any amendments to the contractual documentation. The Lenders will look to see the financial effect being appropriate and also consider the risk profile of the project.

It is therefore important to engage at an early stage with lenders and their advisers so that a mutually agreeable way forward can be mapped out as part of the project plan for Change Procedure.

1.9.7 Advisers' costs

It is expected that Authorities will appoint external legal and technical advisers and the Project Co and its lenders will also do so. As will be clear from the discussion on costs above, Authorities, when instructing an Authority Change, will be responsible for meeting the costs of Project Co and of its lenders' legal expenses. There is also the potential for delay if negotiations through the Change process become protracted.

It is therefore important to engage at an early stage to identify ways of minimising the time and cost impact of documenting the contractual arrangements in relation to the Change.

1.9.8 Change Procedure: processes

The level of complexity of a Change Procedure may also vary depending on whether the contract in question has different processes based around different values of any proposed change.

In the NPD /Hub Contracts, the Change Protocol is split into three distinct sections: Low Value Changes, Medium Value Changes and High Value Changes. This section provides an overview of each category to assist an Authority's understanding of each one should it decide to use the Change Procedure within its NPD/hub Contract to assist in the journey to NZ.

Chapter 1 (continued)

Low Value Change (LVC)	Medium Value Change (MVC)	High Value Change (HVC)
Typically with an individual cost not exceeding £5k – index linked (though the amount can vary)	A Change requested by an Authority which is neither an LVC or an HVC	Typically a Change requested by an Authority which is likely to cost more than [£100k – index linked]
Includes those works and services listed in the Catalogue of Small Works and Services	This would typically be a Change that had a cost of between [£5k] and £100k (index linked)	Where a Change is likely to result in the Annual Service Payment rising by more than a stated percentage e.g. 2%
Derogated LVCs enable an Authority to undertake changes itself (or through its supply chain) rather than through Project Co		Where the Parties agree that a Change is to be treated as a High Value Change

Some general principles to be followed in preparing and submitting estimated costs relating to a proposed Change include that costs must be kept to a minimum, capital expenditure is being measured in a cost-effective manner and in a manner that takes into account any foreseeable Changes in Law.

1.9.10 Low Value Change (LVC)

Whilst the type of Change being considered in relation to NZ is unlikely to be listed in the Catalogue, there might be opportunities to utilise the Low Value Change individual cap and this should be considered, where applicable, by an Authority as it may represent the best option in terms of value for money. The process steps set out below assume that the Catalogue is not relevant in this scenario.

No changes are to be made to the Project Agreement or any Project Document as a result of a Low Value Change, unless otherwise agreed between the parties.

LVC Process Steps (abridged)

Authority Change Notice	Notice issued by the Authority in accordance with the Change Protocol schedule.
Project Co response	Project to notify the Authority of: - cost of implementing the Change - timeframe for implementation.
It should be noted that Project Co is not entitled to charge an Authority management fees, margin, overheads, contingencies etc. and may not charge an Authority for processing, implementing or managing a Low Value Change.	
Derogated Low Value Change Notice	Notice issued by the Authority in accordance with the Change Protocol schedule.
SPV response	Project Co has the right to reject the Notice if it considers that the proposed Derogated LVC does not comply with the requirements as set out in the contract.

1.9.11 Medium Value Change (MVC)

Where an Authority considers that the cost of a proposed change is likely to be above the limit set in the Low Value Change category, the Authority may want to consider the MVC category. This brings into play some further steps that are required to be followed.

The MVC category also brings into the equation whether or not the Authority, through the Change Notice, requires Project Co to provide ongoing maintenance services or lifecycle replacement. This in effect gives the Authority the option to pay for only the capital expenditure, for the capital expenditure plus ongoing maintenance costs or for the capital plus maintenance and also for future lifecycle replacement.

In terms of lifecycle replacement, an Authority should be careful to consider the length of time left in the contract term and assess whether or not replacement of an item is likely to be required within that timeframe. For example, if there were only eight years left in the contract term and the asset being replaced had an expected lifespan of 12 years, there would be no point in paying Project Co for lifecycle replacement costs during that remaining period as there would be very low likelihood of the asset needing to be replaced until after Project Co had ceased to be part of the project.

Only amendments that are required to the Project Agreement are to be made as a result of a High Value Change, while no changes are to be made to the Project Documents as a result of a Medium Value Change unless the parties otherwise agree.

MVC Process Steps (abridged)

Authority Change Notice	Notice issued by the Authority in accordance with the Change Protocol schedule stating that it is an MVC.
Project Co response	Project Co can refuse the Notice under circumstances as set out in the Change Protocol schedule. Project Co response will include a timeframe for providing the Estimate and an estimate of Third Party Costs it will incur in preparing the Estimate.
Submission of the Estimate	The Estimate must contain the information as set out in the Change Protocol schedule including, for example, a timetable, a proposed design solution, a VfM justification, a breakdown of fees, costs etc. A set of principles which must be followed in preparing the Estimate is set out in the schedule.
Determination of the Estimate	The parties meet to discuss and hopefully agree the Estimate.
Confirmation or Withdrawal	The Authority confirms to Project Co whether the change is to go ahead or be withdrawn.
Implementation of the MVC	Undertake the works required to implement the change (subject to necessary consents) and in accordance with the Estimate.

1.9.12 High Value Change (HVC)

The process around instructing and implementing a high value change is similar to the MVC process but introduces additional measures, predominantly because of the higher costs involved at this level.

Whilst a management fee is permitted, this fee level is capped in line with the Change Procedure. Third party involvement incurring costs, such as design fees, are required to be budgeted in Project Co's response

Only amendments that are required to the Project Agreement and/or any Project Document are to be made as a result of a High Value Change.

HVC Process Steps (abridged)

Authority Change Notice	Notice issued by the Authority in accordance with the Change Protocol schedule stating that it is an HVC.
SPV response	The parties must discuss and review the HVC Notice.
HVC Proposal	Once through the discussion stage, the SPV is required to submit a High Value Change Proposal. The Proposal must contain the information as set out in the Change Protocol schedule including, for example, an outline of the proposed solution, information relating to fees, an estimated programme, details of any contractual amendments required, costs associated with the proposed change etc.
Approval of HVC Proposal	Once approved by an Authority, the Proposal becomes a Stage 1 Approved Project.
Stage 2 Submission	The parties agree the timeframe for the next stage of the process and the SPV develops the Stage 1 Approved Project into a detailed submission which then becomes the HVC Stage 2 Submission.
HVC Stage 2 Submission	Once submitted to an Authority, the Submission remains valid for a limited period, typically three months.An Authority has a defined time within which to approve or reject the proposal and is permitted to request any reasonable information to assist in the decision making process.
Approval Criteria	These set out the criteria against which the Submission is to be judged.
Stage 2 Approved Project	Once approved, Schedule Part 16 sets out the next stages in terms of commencing the works, managing disruption and the processes for paying for capital expenditure and amending the unitary payment, as required.
Implementation of the HVC	Project Co is required to implement the HVC in a way that minimises inconvenience to the Authority and in line with what has been approved, including timeframe.

Chapter 1 (continued)

The above provides a commentary on the Change Protocol within the standard NPD/Hub Contract, those projects procured under the Standard Form contracts follow similar processes albeit with different steps. They also only have two processes: on dealing with Small Works and the other with other Changes.

1.9.13 Additional considerations

Specialist team to manage the change process

As can be seen from the above sections, the Change processes in PPP contracts can be complex and time consuming. Add to that the potential technical complexity when considering what may be new technology, and this is likely to be over and above the skill set available within an Authority's contract management team. Consequently, consideration should be given to putting in place a specialist team to deal with, initially, the assessment of the technical opportunities that may be available and then to be focused specifically on the management and implementation of any formal changes required under the contract. Where an Authority does not already have in-house technical or contractual expertise, consideration to procuring this from external sources will be necessary.

Register of variations completed to date

An Authority should have an up-to-date register detailing all variations completed to date on its project. This would typically include the capital cost of the variation, whether maintenance and/or lifecycle replacement was included in the variation and the change to the unitary payment as a result of its implementation. Other useful information would include add on costs such as management fees or markups where appropriate. Also of note would be any changes to the services specification, any alterations or additions to the Authority's Requirements documentation or Room Data Sheets and any impact on the project's payment mechanism.

Options appraisal relating to potential technical solutions and associated cost appraisal

Where an Authority has in house technical knowledge or expertise relating to carbon reduction opportunities, this should be utilised as early as possible in the process. Like for like replacement would be a typical starting point, however, other options, should be given consideration.

As well as understanding the available options as workable technical solutions in the facility, knowledge in relation to costs of installing and then operating different options will be invaluable. Where this is possible to be assessed within an Authority prior to approaching Project Co, as detailed as possible options appraisals should be undertaken. An important outcome from that process will be an accurate idea of costs involved which will enable an Authority to maximise the value for money it will be able to gain from any subsequent implementation of the change protocol within its contract. If this information can be further developed into a whole life cost model this will give an Authority an even greater ability to fully assess value for money.

Where in-house technical knowledge is not available, an Authority should consider making use of external expertise.

Assessment of reasonableness of costs

Where the Change process in a contract allows mark-ups, management fees and the like to be charged by Project Co as part of the variation, an Authority should take active steps to ensure that such add-ons are reasonable and commensurate with the value of the change being proposed. Individual contracts should be checked in order to ascertain if there is any limitation on fees and other associated costs which could legitimately be charged by Project Co. For example, as noted above, in the Low Value Change category of the NPD/hub contracts, no management fees relating to changes are permissible. An Authority should also check if any scheduled update of the financial model is due, in which case the cost of that should not be added to the costs of the Change process.

Impact of any NZ contract changes

The Project Agreement drafting related to energy in PPP contracts can be complex and procuring Authorities should have a clear understanding of the existing contract before considering any NZ changes to the contract. The FM SLS and payment mechanisms associated with the contract mean that careful consideration is required in respect of how contractually and commercially NZ changes could be implemented particularly relating to the apportioning of performance risk, and associated contractual mechanisms, with third party involvement in installing and/or operating building systems.

Chapter 1 (continued)

This is particularly important where on some projects improving energy efficiency or introducing carbon reduction technologies may have a wider impact as suggested above, consideration needs to be given other possible changes to further aspects of the contract, for example:

- the Authority Requirements and Room Data Sheets where, for example, there are changes to the original environmental requirements, typically lighting lux levels, air changes and/or temperature and air and humidity changes;
- the FM SLS; and
- impact on utilities and energy consumption performance regimes where any NZ changes impact on the building's operational energy consumption, typically around the agreed standard for maximum/minimum annual energy consumption in the contract for example in relation to energy consumption costs where there are cost/gain share mechanisms.

The key to achieving successful NZ outcomes is to work collaboratively with all parties to understand what in the first instance is required to implement any formal change in relation to NZ (including any commercial interfaces with other parts of the contract).

The starting point should be in a landscape of proportionate operational contract management and monitoring by the Authority and with Project Co meeting their minimum service requirements set out in the contract. This means the Authority checking that the existing contract is being managed effectively, checking whether the payment mechanism is being applied and with effective performance and monitoring and payment deductions being applied where relevant. The Authority should also consider the costs and benefits of changing the contract and if contract changes are still required, agree suitable cost transparency measures and Change/Procedure with Project Co.

As part of the service, Project Co and the FM service provider should be encouraging users to reduce energy consumption as it is widely acknowledged that successful energy management is dependent on a good level of energy awareness. Key actions which Authorities and Project Cos should pursue is to implement energy awareness strategies and campaigns which raise the profile of energy consumption amongst the facility occupants. Costs to implement energy awareness campaigns are minimal, a small amount of funding may be required for the use of branded awareness content, alternatively there are plenty of existing resources available and some of those are included in Appendices 4 and 5. Resources will also be required to monitor energy consumption.

1.9.14 Net Zero Carbon contract changes and classification rules under the European System of Accounts 2010

This section considers the impact of any NZ changes proposed by an Authority and/or Project Co and the potential impact those changes may have in respect to the classification rules under the European System of Accounts 2010 (**ESA 10**) introduced in September 2014.

All PPP contracts recognise a right for the Authority to propose changes to the terms of the contract (including the agreed terms of the asset's design, construction, operation and maintenance) and that Project Co is entitled to relief and/or compensation for the consequences of complying with those changes.

Most PPP contracts provide that the Authority benefits from any cost savings or increases in revenues that arise from Authority changes. Some PPP contracts provide that the Authority can require Project Co to finance the change, although it is expected that the vast majority of any proposed NZ changes will be funded through the use of Authority capital rather than any Project Co's finance.

Typically, where an Authority is proposing a NZ Change (or any Change for that matter) and the Authority is proposing to pay for the works through a capital payment to Project Co and the contract that was signed before ESA10 came into effect and the contract was assessed as privately classified / off budget for classification purposes under the old rules, it is therefore necessary to assess whether the change itself affects the original statistical treatment.

The Guide to the Statistical Treatment of PPPs (the **Guide**) was published in September 2016 to explain the application of the ESA10 rules and has been made available to public sector PPP stakeholders, and in particular PPP practitioners (i.e. Authorities in charge of PPP policy, decision-making and the preparation and procurement of PPP projects) and can be accessed from the hyperlink listed in Appendix 4.

Chapter 1 (continued)

The Guide says that, when a contract is changed, this requires an assessment of the change itself under the rules that exist at the time of the change and if the change itself alters the statistical treatment, the original assessment must be revised.

Subsequent clarification around the application of the Guide to projects that were signed prior to September 2016 has indicated that cumulative alterations to the risk profile of the project since financial close and since the Guide was published should be assessed and if the total of all of these changes were sufficient under the Guide to lead to a public classification, then the contract would be reclassified. Therefore, whilst the NZ changes are likely to implicate mainly capital contributions which are discussed more below, consideration will also need to be given to other changes which have transferred more risk to the Authority since September 2014 such as change in law (Theme 8) and insurance risk (Theme 9) provisions.

Payments made by the Authority for NZ alterations (or other changes) are treated as capital contributions under the Guide and hence regarded as government financing. Theme 14 of the Guide sets out how government financing influences the statistical treatment. Therefore the capital payment for the change/alteration works must be aggregated with government financing already committed to the project. In other words, the aggregation means that the capital payment for the proposed change/alteration needs to be assessed along with all the legacy or previously agreed capital funded changes, as well as any capital contributions. Therefore, if the capital payment brings the aggregate amount of government financing to 50% or more of the total capital expenditure incurred in the construction (and alteration) of the asset, this alone would be sufficient for the PPP contract to be classified as public and recorded on budget for government.

If, on the other hand, the capital payment for the change brings the aggregate of government financing to less than 50% of the capital expenditure incurred in the construction, (and assuming there are no other relevant changes to risk profile as discussed above) then the PPP will remain off budget for the purposes of classification.

In summary, it is unlikely that any capital funded NZ change will on its own bring the project close to the aggregate amount of government financing of 50% of the capital expenditure incurred in the construction, however it is important that a thorough review all legacy changes is undertaken to ensure the aggregate value of all legacy and proposed changes remains below the 50% threshold and there is no other amounts treated as government financing nor other significant changes to risk profile elsewhere in the contract since September 2016 that would contribute towards reclassification in the Guide.

Chapter 2:
Net Zero and PPP Projects Nearing End of Contract

2.1 Project timeline

This section considers the impact of any NZ opportunities on operational PPP contracts as they approach their natural end of contract. In April 2020, the Scottish Futures Trust (**SFT**) published a guidance document setting out guidance around a programme approach to issues for consideration in relation to handback of facilities. Please see Appendix 4 – PPP Projects Nearing the End of Contract: A Programme Approach. There are over 20 projects that will reach the end of contract in the next decade.

For context, the following diagram illustrates the project timeline for a typical PPP project from construction to the post handback period:

Figure 4
PPP Project Timeline

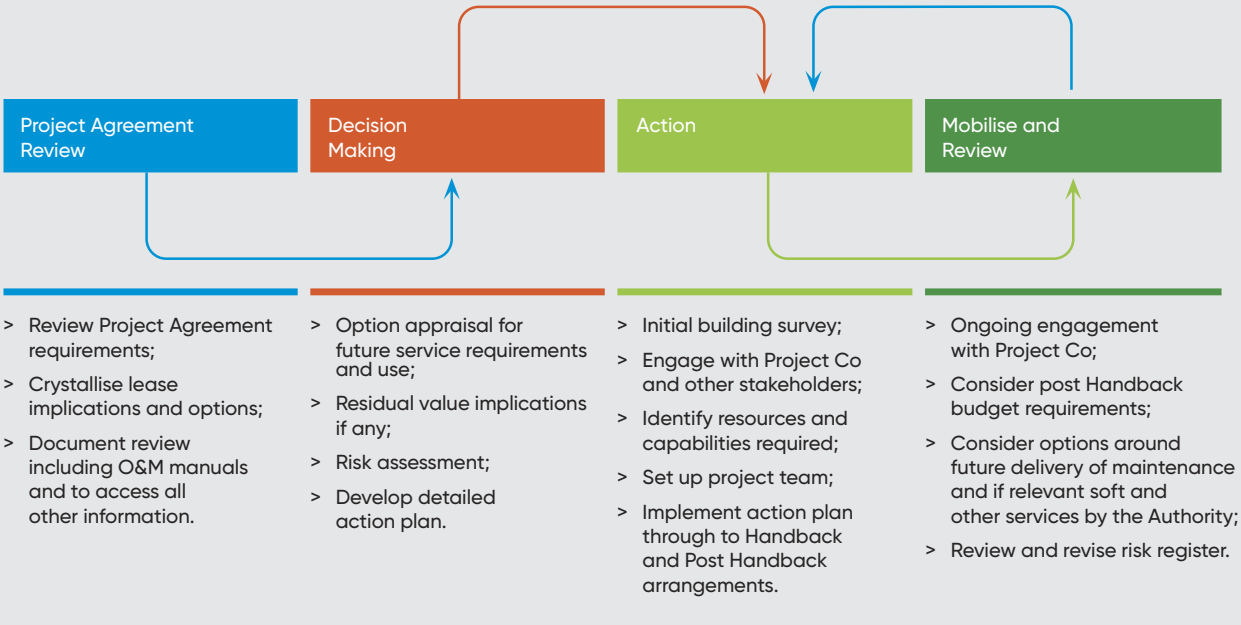
Chapter 2 (continued)

2.2 The handback process

In terms the handback period, the following flowchart illustrates the handback process through to the post handback period and identifies key actions flowing from a review of the contract documentation, through an option appraisal and decision-making phase to implementing an action plan, while ensuring a process of review as the project proceeds:

While the formal handback provisions in most contracts do not commence until eighteen months or two years before the end of contract, SFT's view is that preparation for handback needs to commence at least five years out and, in case of more complex facilities such as acute hospital contracts, between eight and ten years before the end of contract.

Figure 5
Summary Handback Process



2.3 The NZ opportunity

This section builds upon that handback work and discusses some key NZ opportunities that might arise in relation to handback, recognising that each project will be affected by its own individual circumstances.

Ongoing work by SFT working collaboratively with a number of public bodies and private sector partners is seeing both private and public sector stakeholders approach handback positively rather than viewing it as a challenge with private sector partners seeing it as an opportunity to help the route to net-zero, introduce ESG objectives and to make buildings and assets more fit for purpose in the 2020s and beyond.

This means that for contracting Authorities, Project Cos and facilities management providers alike, this presents an opportunity to shape the project and make it fit for the future.

It is recognised that Project Cos, facilities management and service providers should likewise view expiry as an opportunity and actively explore a number of options for post expiry life and in particular by considering ways in which they can assist NZ targets.

A collaborative relationship is often easier to establish and maintain where there is a desire to create or maintain a longer-lasting working relationship. Where PPP contracts are close to their expiry and handover process, opportunities for creating longer lasting working relationships may mean looking beyond specific Project Agreement requirements, while respecting any procurement requirements. This could involve considering opportunities for re-assessing FM service provision, configuration of facilities, (for instance, utilising the skills of the private sector partners to retrofit PPP buildings to meet the net zero/energy transition challenge).

2.3.1 Initial condition survey

While most, but not all early contracts, provide for the carrying out of a handback survey this is often close to the end of contract, our view is that Authorities should carry out an initial condition survey at least five years from the end of contract (or earlier in case of complex facilities such as acute hospitals). This should ensure that there is still sufficient funding in Project Co to pay for any required handback works which may not be the case if there is only two years remaining of the contract and equally as important, to look at opportunities to introduce NZ transition opportunities.

2.3.2 Joint review of lifecycle planning

It is at this point at a project level in the handback process i.e. at the initial condition survey stage or formal contractual handback survey milestone, that the opportunity to consider implementing a change in respect to how NZ ambitions will be achieved, or decisions made at this point about replacing carbon emitting assets other than on a 'like for like' basis as in the absence of any NZ interventions will mean that carbon emissions will be locked in for years to come.

Lifecycle planning and funds form part of the Project Agreement and are subject to regular reviews and drawdown by Project Co to meet the needs of the facilities and Project Agreement terms. Even if there might be no formal obligations on Project Co to share the detail contained within the lifecycle financial model, a joint review of lifecycle plans with a view to incorporating or optimising replacement activities that can benefit the energy and emissions performance of the facilities is highly recommended.

Project Cos are generally only obligated to replace plant, infrastructure or equipment on a 'like for like' basis, however, as noted above, the Authority may provide financial support with the 'uplift' in costs of procuring and installing more efficient systems on replacement, to benefit whole life costs and emissions but mindful, as noted above, to ensure that the Authority does not pay twice for elements and/or sub elements of the building.

This first step of assessing any NZ opportunities is around framing the discussion and identification of wider NZ benefits. First and foremost, it is critical to ensure that the facilities are maintained to the required standards in order to minimise breakdowns and extend asset life therefore reducing the risk of facilities being handed back to public bodies with large liabilities in terms of replacement works which should have been conducted during the contract term.

2.3.3 Utilising technical expertise

Similarly, the Authority must be fully aware of all rights and obligations in relation to programmed maintenance and lifecycle replacement and should allocate resource with a technical background to ensure that proposals are fully and appropriately assessed. Any NZ ambitions should be aligned with existing commitments under the existing contractual arrangements i.e. the Project Agreement as far as possible. For example, the need to reduce emissions, and that wherever possible,

maintenance or the replacement of equipment is done in a way that improves energy efficiency and reduces emissions. Authorities should work to ensure that these factors are considered in any investment decisions.

2.3.4 Evaluation of survey findings

As mentioned above, the outcome from the handback condition surveys presents an ideal opportunity to engage with Project Co and FM service providers to consider opportunities for the development of both monetary and emissions savings opportunities. However, this is predicated on the Authority in the first instance using the survey report and any recommended course of remedial actions in conjunction with a consideration of the standards and remedies under the Project Agreement.

The reports issued by the Authority's (or indeed jointly appointed) building surveyor will set out on an elemental basis a condition appraisal of the facilities, anticipated remaining lifecycle based on condition and or accepted good industry standards including a potential expenditure cashflow/profile typically for the next 10 years. The reports typically contain a status and condition appraisal of all engineering services, building fabric elements and equipment including a photographic schedule.

The information contained within the handback reports, combined with the project asset registers, planned preventative maintenance and lifecycle plans provide a robust platform to initiate a discussion with Project Co and their service providers. These discussions should focus on the possibility of NZ interventions and opportunities mindful of the Authority's own NZ aspirations and corporate objectives.

2.3.5 Lifecycle fund transparency

Some of the identified opportunities will undoubtably include bolting on decarbonising technology onto project assets or sites or working with Project Cos to add energy solutions like solar panels and heat pumps, combined heating and power units or considering how to link projects with district heating networks where applicable.

One other option would be for Project Co to adopt a collaborative and transparent approach by opening up the lifecycle maintenance fund for review as part of the handback process thus allowing the Authority to see where it could prioritise the remaining years of lifecycle spend in the context of NZ opportunities. Project Co could then undertake the lifecycle works topped up as appropriate by Authority funds or borrowings to meet its NZ aspirations and corporate objectives.

2.3.6 Project Agreement constraints and apportionment of risk

Regardless of what approach is deployed, the key is to work collaboratively with all parties to understand what in the first instance is required to bring the facilities up to the required standard (if any) identified by the handback surveys. Where investment is already planned within the Agreement for certain systems, and/or where additional Authority funding may benefit such plans in respect of reducing consumption and associated costs and reduction in carbon emissions.

Generally (this may vary from project to project) the Project Co is obligated to maintain all building plant, fittings and infrastructure to Good Industry Practice. The Project Co is also required to replace building fabric, plant and infrastructure when life expired (or to meet handback condition requirements), utilising an agreed Lifecycle plan and fund. Also, the Project Co has a responsibility to report on energy performance (i.e. energy consumed and costs incurred), however utilities invoices are generally either paid directly by or a 'pass through' cost to the Authority for payment while, as noted above, on some projects, there are provisions within the Agreement related to energy performance targets, and 'pain/gain' calculations for which the Project Co takes an element of risk based on the annual energy consumption of the buildings.

The FM SLS and payment mechanisms associated with the Project Agreement mean that careful consideration is required in respect of how contractually and commercially NZ changes could be implemented particularly relating to the apportioning of performance risk, and associated contractual mechanisms, with third party involvement in installing and/or operating building systems.

Development and delivery of NZ opportunities within the constraints of the Project Agreement itself, either through Project Co lifecycle works or Authority instructed Change, is the most pragmatic opportunity for implementation.

Chapter 2 (continued)

2.3.7 Robust information at handover to support maintenance, resilience and performance.

To enable smooth transition and ongoing maintenance of the facility, it is paramount that the knowledge and up to date technical information on that asset is collated and then handed over to the Authority. The Project Co should seek to begin the development of robust digital handover information including Operation and Maintenance, Health & Safety and all other information pertinent to the ongoing maintenance of the asset. The existing agreement will set out the handover information deliverables, however, where the change procedure is applied, the Authority should consider and clearly set out their information requirements at handover.

At a programme level, the Authority may consider the development of an organisational standard Operational & Maintenance information at handover. There are existing best practice approaches to effectively enable a Project Information Handover and a link to Building Information Modelling Level 2 - Stage 6 Handover and Close Out, and Stage 7 Operation in Use is included in Appendix 4.

Chapter 3:
Examples of Low Carbon and Invest to Save Opportunities

3.1 Introduction of decarbonisation schemes

The introduction of NZ solutions is not a new process under PPP projects and a variety of decarbonisation schemes with varying levels of complexity have been successfully delivered across a range of facility types and contract models. A review of existing PPP schemes in Scotland identified that 56 percent of stakeholders that responded had successfully introduced decarbonisation measures with a further 12 percent planning to or attempting to introduce decarbonisation measures. Where respondents had not sought to introduce measures, this was typically linked to newer projects that incorporated many newer technologies within the initial design.

3.2 Schemes delivered through joint approach

The overwhelming majority of projects that had successfully introduced initiatives stated that they were initiated jointly between the public and private sector with the bulk of schemes benefiting from private sector investment fully or partially funding their delivery. This shows the degree of willingness from both the public and private sector to engage in the process, making evident the benefit of collaboration in PPP projects in delivering successful carbon reduction measures. A common factor in this was the use of open communication forums, whether the monthly liaison meetings or dedicated energy forums, to discuss the issues to be addressed and openly discuss potential solutions.

3.3 Alignment of proposed schemes with programmed lifecycle works

A key driver in the leveraging of private sector investment has been the alignment of decarbonisation works with scheduled Planned Preventative Maintenance (PPM) or Lifecycle Maintenance (LCM) obligations. However, while this represented a majority of such initiatives, this was not always the case and some initiatives were introduced without the presence of a business as usual or contractual driver. The review highlighted that typically the drivers for introducing improvements were the improvement of energy efficiency/carbon footprint and to reduce energy expenditure. These factors were consistent across public Authority, Project Co and FM provider responses, aligning with wider construction industry sentiment to reduce the carbon footprint of infrastructure projects.

3.4 Lender and investor support

As part of this wider industry sentiment, lenders and investors are also proactively supporting such initiatives as it enables them to record successful implementation of decarbonisation within their PPP portfolios alongside similar initiatives within their wider portfolios to underpin their environmental policies and agendas. This provides a positive basis upon which variations can be developed.

3.5 Range of solutions

This common driver results in a wide variation in the types of carbon reduction or energy improvement methods being introduced to projects. While the majority of schemes had targeted lower risk solutions such as LED lighting replacement, more complex solutions are also being considered and introduced.

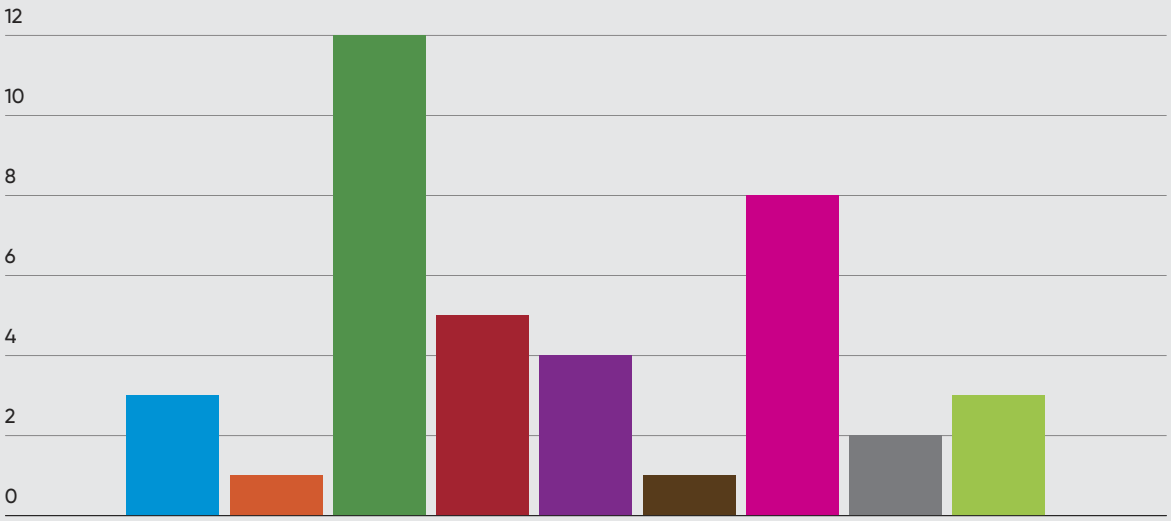
Opportunities such as improved building and lighting controls can represent a range of solutions and the systems introduced within the reviewed projects included automated lighting controls and enhanced building management systems. Enhanced building management systems enable users to assess utilisation on a zonal basis and even in some circumstances on a room by room basis with the introduction of additional thermostatic controls and zone valves. One project did consider the feasibility of introducing automated ICT switch-off to reduce overnight consumption and, while ultimately this was not taken forwards for that specific project, it does demonstrate the variety of solutions that can be considered within a PPP context.

Other public bodies have worked closely with their FM providers to roll out a range of solutions across their PPP estate including LED lighting, lighting controls, HVAC system optimisations, building controls/BEMS, onsite renewable generation, and sub-metering. This approach has been delivered iteratively to meet a range of factors, including small scale rollout to provide a proof of concept to working within timescale constraints whether fiscal or core function related. Project Cos that were involved also found this beneficial in working with their lenders and investors to improve confidence of low-risk delivery.

Chapter 3 (continued)

Figure 6 below illustrates the range of opportunities that have been taken forward across the PPP/PFI estate to date.

Figure 6
What Carbon Reduction or Energy Improvement Opportunities were taken forwards



Sub-metering	3
Building fabric improvements	1
LED lighting	12
Lighting controls	5
HVAC system optimisations	4
HVAC system replacements	1
Building controls/BEMS	8
Onsite renewable generation	2
Other	3

A number of projects highlighted the implementation of non-typical approaches to delivering energy savings and carbon reduction, noted as other within Figure 2. These include the introduction of biomass heating, voltage optimisation and boiler optimisation. Approaches such as these are all beneficial and should be considered particularly in relation to optimisation of systems. Where more significant changes such as a change of heat source are considered then these should be looked at in their full context to account for factors such as robustness of supply chain for fuel and implications for air quality management in the surrounding area.

3.6 Understanding the problem

A key challenge in delivering decarbonisation and reducing energy consumption is understanding the nature and scale of the issue. Gaining access to the right data and understanding what they are saying is crucial to knowing how best to invest most effectively. Nearly all PPP schemes will have a level of energy reporting requirements included within their contracts, however, the supporting detail can vary significantly. Working collaboratively with private sector partners to improve energy reporting whether through improving the link between metering and the building management system or where necessary providing additional metering or data logging will help to better understand the challenges and identify the best solution.

3.7 Identifying suitable opportunities

Many of the organisations that have successfully implemented NZ solutions identified the importance of having a forum which focused on energy and carbon. A number of organisations had established such forums as part of the PPP management process. For example, one local Authority's schools have established an energy forum involving all of the PPP partners which meets to discuss energy saving opportunities. Other public bodies also have energy forums in place, and these are recognised as helping support energy savings actions including approaches such as proof of concept before wider roll out of initiatives. This also provides an open forum to discuss how any derived savings can be addressed through contractual mechanisms.

It is worth noting that the establishment of such forums indicates a maturity to the relationship between the PPP partners and the maturity of these relationships goes a long way to finding solutions to which all can agree. The forums also allow for an exchange of information drawing in collective experience of measures that have been successful in other settings.

This recognised communication forum can be especially crucial where the implementation of NZ solutions is reliant on external factors such as timescale constraints or funding caps where the clear communication of such challenges can aid a strong buy-in of all parties to find solutions to meeting such constraints.

The structure of PPP agreements can result in additional challenges to the implementation of NZ objectives within the PPP estates whether through the imposition of contractual provisions such as Change Procedures or achieving specific timescales due to funding constraints. A number of existing projects have successfully implemented energy efficiency and in doing so have faced and found solutions to various challenges along the way, often through open discussion in their energy forums.

3.8 Agreeing the outcome and any sharing of benefit

A number of stakeholders identified the implications of contractual energy mechanisms on successful outcomes as a real challenge and a potential risk to success. This was more prevalent where a significant proportion of the funding is derived from either public or private sector, but the energy mechanism realises significant savings/benefit to the other party. Where this is the case consideration should be given to discussing the contractual process at an early stage to reach agreement on who will take benefit and, if necessary, provide suitable drafting to reflect this within any supplementary agreement.

3.9 Full stakeholder engagement

Many public sector bodies are dissuaded from making changes due to a perception of drawn out timescales and of blockages. This is often attributed to lender and investor diligence processes and reviews. As noted above the increased awareness of climate change and how both public and private organisations are signing up to NZ targets creates a backdrop that better aligns public and private sector ambitions. This includes lenders and investors who are equally keen to

Chapter 3 (continued)

demonstrate engagement in the decarbonisation agenda. This is beneficial to the decarbonisation of the PPP estate, as it results in an engaged lending market that is actively embracing finding positive solutions.

This active involvement from all parties increases the possibility of existing contract mechanisms being utilised in adopting NZ measures, and improved understanding of the beneficial outcomes. This could be as simple as embracing the use of lifecycle mechanisms to deliver improvement to a more positive view of changes within the contract targeting improvement.

Collaborative approaches and in particular the establishment of dedicated forums with energy and carbon savings as a key objective provide a recognised environment where aims and objectives can be discussed. This allows initiatives to be identified and any challenges that arise to be discussed collectively to design realisable solutions.

Chapter 4
NZ Opportunities During Maintenance and Lifecycle

4.1 Asset lifecycle position and contract period

PPP contracts include for the provision for Project Co to maintain all building plant, fittings and infrastructure to a specific level as set out in the contract. Project Co is also required to replace building fabric, plant and infrastructure when life expired.

The provision for these requirements typically resides within the Project Agreement, specifically within the FM SLS, and falls into three categories:

- **Planned Preventative Maintenance (PPM)** – A regime of inspections, checks and maintenance tasks that are undertaken in a scheduled routine. This approach is designed to ensure that building plant, fittings and infrastructure are all maintained at regular intervals and any potential issues are identified early, therefore reducing breakdowns and, in regard to energy, can help to maintain the efficiency of plant.
- **Reactive Maintenance** – Despite the inclusion of PPM, reactive maintenance, the process of repairing something once it has broken or no longer meets the required standard, remains a requirement.
- **Lifecycle Maintenance** – A regime of replacing components at end of economic life. This can include replacement of components that are resulting in increased planned maintenance regimes or show increasing trends of short-term failures. Lifecycle maintenance can also include cyclical maintenance tasks such as painting and decorating or replacing floor coverings.

Robust PPM and Lifecycle maintenance regimes will maintain the efficiency of building plant and reduce energy consumption. They also represent potential opportunities for introducing NZ technologies.

4.2 Planned Preventative Maintenance (PPM) within PPP Projects

All Project Agreements for PPP Projects will have a minimum requirement for the provision of a 12 month look ahead Schedule of Programmed Maintenance. The focus of this schedule is primarily on demonstrating a robust maintenance regime that may be required to align with best or good industry practice and inform the Authority of timings and any potential impacts in relation to undertaking planned maintenance.

The FM SLS will typically include a requirement to provide the maintenance schedule and also a further requirement to deliver maintenance in accordance with the schedule. However, the impact of most maintenance shortfalls or failings is measured on the outcome of any such failure, with performance measured on the output of building systems, primarily through the payment mechanism.

Most PPP projects will also include a requirement for the provision of a five year maintenance plan that provides an Authority with greater foresight of upcoming works and in some cases may also give advanced sight of upcoming lifecycle works.

When undertaking a review of the schedule of programmed maintenance, consideration should be given to what tasks are included in respect of improving or maintaining the efficiency of building systems. A key consideration is the review of building controls, this is a task that should be undertaken on a regular basis to ensure that systems are optimised to balance outputs that might be required under relevant availability standards and reduced energy consumption.

4.3 Lifecycle Maintenance within PPP Projects

A key component of PPP projects is the inclusion of lifecycle maintenance provisions within the Project Agreement. Most PPP projects include an operational maintenance period of 25 to 30 years. With the exception of the main structural components and the utilities infrastructure, most components can be expected to expire within this operational period.

Project Co will typically be required to submit its plans for lifecycle replacement annually for the forthcoming year, however, the Authority does not always have specific mechanisms to influence its content significantly due to maintaining the risk allocation noted above, subject to the contractual standards continuing to be met. While the Project Agreement will have specific provision in respect of lifecycle plans, the plans are ultimately considered a deliverable under the contract and are usually subject to the review procedure. The Authority should utilise this opportunity to seek information and dialogue around lifecycle plans and costings and to object timeously where appropriate and necessary. This may include requesting any underlying condition surveys that have been undertaken to support the plan and may identify areas that are less immediate

but may allow early dialogue between the parties on the achievement of NZ objectives in the future.

Authorities should have a clear understanding of any provisions to comment, amend or influence lifecycle replacement including any FM SLS provisions around the selection or impact of replacement plant or equipment.

4.4 Lifecycle funding

Lifecycle funding is incorporated into the unitary charge for a project with provisions typically included within the Project Agreement or associated agreements such as the FM agreement and the credit agreement for the allocation of funds to a maintenance reserve account(s).

Project Co will develop a lifecycle expenditure profile in the early stages of a project, typically based on manufacturers' recommendations or industry guidance, to establish a notional replacement schedule that is incorporated into the financial model.

These expenditure profiles will have been utilised to derive the funding profile for the maintenance reserve account(s) contained within the base financial model. Where, as should normally be the case, Authorities have copies of the financial model, this can provide an insight into the funding for lifecycle within the project.

Under the Project Agreement, Project Co takes the risk on funding and delivery of lifecycle, whereby if a component has a reduced economic life compared to the one modelled, then the additional cost of more frequent or early replacement is borne by Project Co. Conversely, if through good component choice or good maintenance, the economic life of a component is extended resulting in fewer replacements over the operational period, Project Co takes the benefit. It is noted that this risk is typically passed down to the FM service provider as it is responsible for the management and delivery of maintenance within a facility, though this is not always the case.

4.5 Standard of replacement

Procuring Authorities should consider how lifecycle replacement can be utilised as a key part of seeking to introduce NZ. Contractually, Project Co is generally required to replace components on a like for like basis, unless there has been legislative change. It should be noted that, where legislative change results in additional cost there is typically provision for recovering additional cost from the Authority under the Project Agreement, subject in the Standard Form contracts to a sharing mechanism. Where technological obsolescence occurs, a component is no longer available due to the technology being superseded to the point of obsolescence, then this risk is owned by Project Co.

There is a mixed approach across the industry in respect to how the principle of "enhancement" has been addressed within PPP projects. Enhancement is a term that is often applied where, at time of component renewal, rather than a like for like replacement being installed, an alternative product with an improved specification is utilised.

The installation of LED lighting is often considered as an enhancement, this is because lighting in PPP projects is typically assessed on an output basis, for example, achieving a given lux level within an area. This output can be achieved through a variety of products ranging from fluorescent tubes to halogen bulbs to LED. When LED lighting first started to be installed, it typically attracted a higher unit price that might not have been considered within the lifecycle model, particularly in early PPP projects. This was therefore considered as an enhancement by moving to a more expensive solution when a cheaper specification was available to meet the contract requirements, though maintenance and replacement costs should also have been taken into account as they are cheaper for LED lighting systems. LED lighting is now considerably cheaper as well as being more technologically advanced so any enhancement that existed when it initially became available has now reduced and, in most cases, is now a cheaper and more readily available alternative to halogen or fluorescent replacements.

Thus, while some technologies are considered enhancements, this does not necessarily mean an additional cost is always warranted. There are examples of projects where the introduction of technologies, such as LED lighting, have been fully funded through lifecycle because, while they are technically an enhancement there is also cost benefit to Project Co parties through lower maintenance cycles and longer life expectancy. Authorities should consider testing these factors in any discussions with their respective private sector partners to drive improved value in the implementation of NZ initiatives. It should be noted that this is dependent on the point of time within the project term, those projects that are closer to handback will see reduced benefit to

Chapter 4 (continued)

Project Co and the FM provider because of the shorter project term remaining.

There is some evidence that lifecycle funds have been utilised to fund rectification and remedial works that would otherwise be considered defects, in particular the remediation of building or latent defects. While this remains a Project Co risk to draw funds from lifecycle reserves for such works that were unlikely to have been forecast, it demonstrates that deviations from the standard practices do occur. In this regard, Authorities should explore this in the context of their own projects to see if this provides options for discussion around funding of NZ solutions when undertaking lifecycle replacement.

Chapter 5:

NZ Opportunities Prior to Project Handback

5.1 Identification of handback opportunities

Given the general condition of much of the PPP estate, many projects have seen prolonged component life through strong maintenance programmes. This means that as they approach handback many of the larger building systems and components such as heat and power sources have not been subject to lifecycle replacement. Depending on the handback provisions within the Project Agreement, there is a need to replace these major components prior to handback.

The handback process presents both a risk and an opportunity to procuring Authorities' NZ ambitions. If handback is delivered in strict adherence to the Project Agreement, then building components and systems will be replaced on a like for like basis. Given the period when, in particular, many early PPP projects were developed, this will mean a continuation of fossil fuel-based solutions and less efficient systems.

As noted above, the handback process provides a significant opportunity for procuring Authorities to work in partnership with Project Cos and their FM providers to identify where handback offers opportunities to meet NZ ambitions.

This could be through delivery of an alternative product type that may only require a variation of specification or through agreement to enhance the proposed handback works to a NZ option with an Authority meeting the cost differential. Either option is still beneficial to the Authority as it is likely ultimately to be cheaper to adopt these types of approach than replace systems at full cost after the end of the contract term.

As noted, where projects have had robust maintenance regimes in place, many larger system components will likely require replacement within the extended handback period (five years pre handback), where this is applicable, and this will include components such as boilers, combined heat and power units and air handling units. These are significant components and are highly linked to energy consumption and energy source and subsequently carbon emissions generated. NZ technologies that replace these types of components are unlikely to be straightforward like for like replacements.

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5.2 Potential options for larger building systems

Original Technology	Potential NZ Technology	Variation Considerations
Gas/Oil Boiler	Air or Ground Source Heat Pump	The connection and powering of a Heat Pump is significantly different to a traditional boiler installation requiring additional modifications to wider systems and to the building to allow successful installation. These modifications would be considered a Change and would likely require additional funding.
	District Heating Network	Where feasible there is potential to add PPP assets to district heating networks as an alternative heat source. Where this occurs the cost impacts may be limited however depending on the length of the remaining project term, contractual amendments may be required to offer Project Co protections around risks that are specifically linked to district heating networks.
Gas Combined Heat and Power Plant (CHP)	Air or Ground Source Heat Pump and Photovoltaic Panels	A key benefit of CHP is its combination of onsite electricity generation and utilising waste heat as a heat source heat. CHP viability has always been heavily linked to market conditions for utility supplies, but a further consideration is the decarbonisation of the electricity grid making electricity a greener source than gas. These combined factors mean a direct NZ replacement for CHP does not readily exist and would require a combination of measures that would achieve the same benefits. As noted above such measures require additional modifications to wider systems and the building to allow successful installation. These modifications would be considered a Change and would likely require additional funding.
Air Handling Unit	Introduce smart Air Handling Unit (AHU) technology and motor controls	Where components linked to the building's environmental controls are subject to replacement, consideration should be given to the drivers for these components. Authorities should consider the current and future function of any building subject to handback and consider whether environmental parameters that were derived 20-25 years previously are still applicable and justified. Where they are no longer required, a variation of such requirements might allow smaller scale replacements to be installed reducing energy consumption and subsequently carbon emissions. Evidence continues to suggest that in poorly ventilated indoor spaces, airborne aerosols are a possible transmission route of SARS-CoV-2, and the precautionary advice remains valid. Maintaining good levels of ventilation remains the key focus, even in colder weather conditions, whilst minimising occupant discomfort due to draughts and lower indoor temperatures. Any proposed changes to airflows and/or air handling equipment should be risk assessed to decide which appropriate actions to take. Authorities would need to carry out an appropriate COVID-19 risk assessment, just as you would for other health and safety related hazards recognising current guidance and good industry practice.

5.3 Utilising private sector expertise

While it is noted that all of the above examples will require the implementation of a Change and in some cases additional costs to the Authority, it is worth considering the alternative scenario. If Project Co proceeded to meet its obligations under the Project Agreement and replace on a like for like basis then this would leave the Authority to bear the full cost to implement NZ initiatives at a later date and would also generate further embodied carbon wastage through the potentially early replacement of functional and relatively new components. It should therefore be considered as a saving in whole life costing terms to undertake works on a Change basis within the handback window.

There is strong evidence of a willingness of private sector parties to work collaboratively with the public sector to assess potential solutions that will still meet the requirements of the Project Agreement but also help the public sector achieve its NZ aims. Within the private sector, FM service providers, in particular, often have building services and energy specialists within their resource pools. In addition, they are very familiar with the buildings and their systems having maintained them for 20-25 years by the time of early handback engagement. They therefore provide a significant source of knowledge both in terms of the buildings but also their experiences of delivering NZ solutions within the built environment. Tapping into this source of knowledge and expertise is strongly recommended.

Authorities should take advantage of this knowledge in working through any condition survey results to assess the NZ benefits that can realistically be achieved for all components scheduled for replacement and identify the most advantageous options and therefore the best returns on investment that can be achieved from a collaborative approach to enhancement of the handback works and review of the Authority's Requirements. This should take the form of a constructive assessment of ways the carbon footprint of the project can be reduced in a practical manner.

5.4 Understanding performance through data

To deliver a sustainable NZ facility, there requires a holistic understanding on the performance of that asset and how this is measured and monitored. Prior to handback, the Authority should work with the Project Co to fully understand the systems, data streams and approach in how NZ performance is monitored within that asset.

This may include, but not be limited to, at handback the Project Co setting out the insight provided and capability of any existing BMS systems, a clear schedule of existing assets and sufficient detail specifically for high energy consuming assets, details on supplementary technologies that will support performance (e.g. sensors, data feeds) and a summary of historic trends and insight that will create the conditions for successful ongoing maintenance of the asset by the Authority. This information can be developed prior to handback and incorporated within the handover information (refer to section 2.3.7).

Prior to handback, consideration should be given to enhance the performance monitoring and data insights within the asset through the installation of digital twin technologies (IoT sensors) to capture enhanced insight into the performance, utilisation and behaviours of occupants of the assets to further inform management regimes and support the delivery of NZ assets.

Chapter 6
Barriers to Achieving Pathways to Net Zero

6.1 Participation of all parties

As noted above, Changes under the Project Agreements are required in order to put in place key strategies to allow facilities to work towards NZ. This requires the participation of all parties to the contract – the Authority, the Project Co, the FM provider, the MSA provider and, in the majority of cases, the funders and investors, all on the basis of the Change provisions of the contract as discussed at Chapter 1 above.

6.2 Key challenges for Change progression

Key areas that will need to be addressed to successfully engage with all parties are as follows:

- project risk profile will need to be considered consistent with the provisions in the Project Agreement in order to enable sign off by Project Co and lenders of the Change.
- the integrity of the building or facilities will need to be maintained should there be a requirement to install or develop new systems or energy mediums (for example, solar panels, rainwater harvesting, CHP or wind turbines).
- the FM provider's ability to deliver services to the standards required within the Project Agreement, with service fee and profit at a level so that the FM provider is in a neutral position following the Change.
- Project Co and its lenders would typically require a due diligence process to be followed in order to facilitate credit approval for any Change which may necessitate the additional cost of advisor fees. Any costs of the approval of the Change would typically be recovered as part of the Change cost itself.
- the Project IRR will need to be maintained.
- the practical implications of undertaking the Change and resultant works in respect to the services and indeed the users of the facility will need to be considered.

In order for parties to engage, the Authority should highlight the protections for Project Co in the Change provisions of the Project Agreement. Dialogue should be held at the earliest opportunity so that all parties have the opportunity to identify potential solutions, strategies, risks or issues with a view to developing a joint NZ strategy for the facility.

6.3 Private sector parties' own corporate goals

As referred to previously, it is likely that the FM provider (and other project parties, including funders and investors) will have their own corporate goals to achieve NZ targets. Any reductions in carbon for each individual project would go some way to supporting and achieving those goals and therefore the journey to NZ should be promoted as a partnership objective and an incentive to work together to achieve the NZ goals of all organisations. The involvement of all parties at an early stage should give all parties a sense of buy-in to the proposals which are eventually progressed, with the added benefits of being able to utilise NZ experiences from a wider group.

It is possible that some projects will be part of a wider portfolio of facilities and in these cases it is recommended that a portfolio-wide integrated energy strategy is considered. This can be helpful for installations such as wind or solar power, where the optimum location within the site can be utilised rather than limited to an individual building, thermal bore holes where the optimum locations can be identified for the bore holes and also waste management where the costs of additional waste segregation or on-site composting can be shared.

6.4 Changes: Risk Mitigation

In order to allow for the progression of any NZ changes, any identified risks or issues will require mitigation or to be otherwise dealt with appropriately. Examples of mitigation strategies seen on other projects include the following:

Net Zero Carbon Strategy	Risk	Mitigation
Installation of solar panels and wind turbines on facility roof	Potential implications for the structural integrity of the building due to increased loading on the roof. Grid capacity and constraints.	Structural surveys to assess the structural load which can be supported by the building and identify any additional structural considerations that will need to be made to allow for the installation. Engage with the distribution network operator (DNO) at feasibility stage to resolve any capacity issues.
Installation of solar panels and wind turbines on facility roof	Implications for the delivery of maintenance and lifecycle for the roof due to reduced access, meaning increased potential for cost overruns for the FM provider and increased potential for deductions should the maintenance regime not be appropriate.	Review of maintenance and lifecycle strategy and agreement of any required change to timings and costs.
Increased waste segregation to reduce landfill	Additional time required by waste management operatives, for sorting and collection of waste, additional waste bins around site and potentially additional KPIs which could incur higher deductions.	Review of the service requirements and KPIs and agree appropriate cost adjustments, review of deduction thresholds, if appropriate. Potential to include a bonus-malus mechanism based on reducing waste tonnages going to landfill.
Installation of heat pump as a replacement of fossil fuel	Additional plant requirement, may require site re-configuration, additional land purchase or additional planning applications, impacting on operational functionality, additional requisites for the site from the planning approval.	Use of an experienced design team working with all project parties should ensure a workable solution from an operational perspective, any land or planning risks should be maintained outside the PPP Project. Any planning obligations would need to be managed as a team.

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Net Zero Carbon Strategy	Risk	Mitigation
Use of innovative or unproven technologies	Early examples such as use of thermal bore holes, biomass technology for example, impacted the project in terms of the volume of energy they were able to deliver, inefficiencies and lack of providers able to support maintenance regimes. This tends to improve as technologies become more established, however, the initial installation may cause concern over the achievement of the availability criteria causing additional deductions.	Mitigation can include the inclusion of a provision to allow for the previous system to be maintained as a backup until the new systems have been successfully delivering the requirements. The Supplemental Agreements documenting the Change should include any adjustments to the FM SLS and payment mechanism required by the Change.
Requirement to install energy efficient lighting throughout the facility	Whilst the end result is typically positive, with a reduction in energy consumption and maintenance and lifecycle costs, the initial installation can be disruptive.	Clear phasing of the works developed with the Authority to minimise disruption to core operations. As noted in Chapter 1, provision can be made for relief from deductions caused directly by the delivery of the works in accordance with the agreed provisions.
Amendment to Grounds Management requirements to increase biodiversity, support waste management obligations etc.	Actions include increasing the range of planting, supporting natural hedgerows, maintaining wild areas, introducing facilities for onsite composting of food/organic waste. Risks include increased risk of pest infestation, additional costs for service delivery (for example due to increased requirements, different work scheduling, use of less time efficient working methods), additional KPIs for the service affecting the potential for deductions.	Re-costing of the service on an omissions/additions basis and recalibration of the payment mechanism thresholds to ensure that risk is maintained at a consistent level.

It is noted from previous project experience that, whilst additional risks arise out of the NZ strategies that are being progressed, management and mitigation of the risks is achievable.

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6.5 Lender approval process

Where the senior lender remains an active party on a project, there will be a requirement to seek the approval of the lender or the lending group. In some cases, the Loan or Facilities Agreement may have a threshold for Change Orders to require Lender Approval and, should this not be breached, then the Borrower and the Authority can agree and approve the changes requirement without needing recourse to Lender engagement. It should be noted that these thresholds can be quite low and it is likely that the majority of NZ strategies would fall above the threshold.

However, the rise of ESG Reporting and the interest in green investment should increasingly push lenders in the direction of NZ funding opportunities.

Whilst the specific processes for credit approval of change will vary between lenders, the typical process is demonstrated below:

Figure 7
Lenders Approval Process

Depending on the complexity of the change request, the process can be lengthy. It is not uncommon for approval to be required for larger changes at different stages of the process. For example, approval to issue tender documentation, approval of the preferred tenderer documentation and final approval which will require any changes to the unitary payment and any payment mechanism re-calibration to be completed.

Some lenders may be content with an initial Letter or Deed of Indemnity to allow works to commence, whilst the final Supplemental Agreement is being prepared, which can enable the initial approval to be granted at an earlier stage. Noting this, lenders will require advisor review of all final documents prior to sign off.

6.6 Key factors for consideration

The following key factors are noted from this section.

- Establish a partnership approach as early as possible to agree a collective approach to NZ. It is likely that many of the parties will have their own NZ targets and therefore working together will have a mutually beneficial impact on achieving targets. The partnership approach will also allow all parties to bring ideas from work outside of the project as well as a view as to what is achievable for the specific project.
- There might be additional project risk generated by NZ strategies, however, other projects have demonstrated that these are manageable and can be mitigated via a number of approaches which have proved acceptable to private sector parties.
- Consideration of incentivisation through bonus-malus mechanisms.
- Investor approval processes can be lengthy as there is often a need to engage advisors and meet credit committee requirements. Early engagement with lenders is recommended to establish what their requirements are and the typical timeframes they will be working with to gain credit approval. This is typically managed via Project Co.
- A site wide integrated energy strategy should be considered where a facility is part of a wider site. This will enable the whole site to be considered when locating installations and any capital costs can be shared with all site occupants. Early engagement with all parties is recommended.
- The Authority and Project Co to assess any change for impact on the risk profile and to develop mitigation or management to ensure that the requirements of the Change provisions in the Project Agreement are met following the change.

Chapter 7
Methodology and Roadmap to Achieving Net Zero

7.1 Use of guidance in conjunction with other strategies

This section of the guidance outlines the approaches that can be taken to support the process Authorities can use in the identification and implementation of carbon reduction opportunities within buildings to achieve NZ for Operational Energy. The core of the guidance focuses on operational energy carbon reduction but there will undoubtably be other opportunities for broader carbon reduction in PPP assets and projects. This is true particularly on some of the earlier PPP projects where the scope of the facilities management offering includes an extensive range of non-building related services typically, waste, water, travel, fleet and food all of which are influenceable by the procuring public body and the Project Co. It is recommended that Authorities when using this guidance should do so in conjunction with their wider carbon footprint reduction strategies to limit the environmental impact of their service in the broader sense.

7.2 Cooperation of all parties

When considering NZ for operational energy roadmaps and methodologies, it is recognised that on PPP projects, Authorities are unable put in place effective carbon reduction projects and set achievable carbon reduction targets in isolation. To achieve the maximum impact of NZ for operational energy, cooperation and buy-in of all interested parties including funders, investors, MSA providers and FM service providers is key to achieving successful NZ outcomes. Helpfully, there are commercial levers available to public Authorities operating PPP projects to enforce the required NZ changes through the contractual provisions that exist in project agreement Change procedures.

It is worth noting when Authorities are considering a formal contract Change to implement carbon reduction opportunities within buildings to achieve NZ for operational energy, Project Cos are formally obliged to implement a Change once formally instructed by the Authority and whilst there are general timescales for doing so, no payment mechanism deductions are applicable if timescales are missed. It is worth noting that any failure to carry out a formal change would be a breach of contract.

Putting these systems in place is time consuming, not least because organisational commitments to reduce carbon emissions by a particular percentage in the short term and to NZ in the long term must be firmly based on fact. Therefore, when developing roadmaps to achieving NZ, successful outcomes are dependent upon both public and private sector stakeholder participation, transparency and collaboration, including leveraging any commercial, environmental, social, and governance criteria that socially conscious investors and funders utilise.

With the majority of operational PPP projects having a concession period of circa 25 years or more, there will be multiple gateways to consider NZ for operational energy. Typically these would be at stages of the contract period where either an Authority as part of their operational contract management function is validating/reviewing their project maintenance plans, lifecycle replacement maintenance schedules or handback considerations in terms of asset condition and any corporate NZ ambitions or indeed, at any point during the concession period where funding or operational energy opportunities become available.

Regardless of which NZ opportunities are identified, it is important to consider implementing a formal Change in relation to the achievement of NZ ambitions, or decisions made at this point about replacing carbon emitting assets other than on a ‘like for like’ basis noting that in the absence of any NZ interventions, carbon emissions will be locked in for years to come.

7.3 Opportunities identified from condition surveys

As an example, the outcome from the handback condition surveys presents an ideal occasion to consider opportunities for the development and implementation of carbon reduction projects/technologies. However, this is predicated on the Authority, in the first instance, using the Condition Survey Report and acting upon any recommended course of remedial actions, in conjunction with a consideration of the standards and remedies under the Project Agreement.

The reports issued by the Authority’s (or jointly appointed) building surveyor, will set out on an elemental basis, a condition appraisal of the facilities, the anticipated remaining lifecycle based on condition and or accepted good industry standards, including a potential expenditure cashflow/profile typically for the next 10 years. The reports typically contain a status and

condition appraisal of all engineering services, building fabric elements and equipment including a photographic schedule.

The information contained within the handback reports, combined with the project asset registers, planned preventative maintenance and lifecycle plans, provide a robust platform to inform additional Decarbonisation Options Assessments that could be undertaken to identify carbon reduction opportunities. The Decarbonisation Options Assessments in turn can be used to initiate discussions with Project Cos and their FM service providers around the possibility of carbon reduction opportunities, mindful of the Authority's own NZ aspirations and corporate objectives and those of the Project Co and FM service provider.

7.4 Key concepts and terms

At the time of writing this guidance there is a range of interchangeable terms to describe the process to identify decarbonisation options within a building, such as: Decarbonisation Options Assessment, Decarbonisation Audit, Energy Appraisal, Energy Audit, Energy Feasibility Study and others.

For the purpose of this guidance, we will refer to the process as a Decarbonisation Options Assessment, which will be used to describe the process of identifying and evaluating decarbonisation options that could be implemented to reduce energy demand, optimise energy efficiency, and/or deploy low and zero carbon technologies within/across a building(s) or estate, in order to achieve Net Zero Carbon for Operational Energy.

7.4.1 Operational Energy

Is the total energy supplied to the building by grid supplies, onsite generators, private wire, district heating and other sources for all onsite energy uses.

7.4.2 Net Zero Carbon (for operational energy)

The UK Green Building Council Framework Definition of Net Zero Carbon Operational Energy (April 2019) is when the amount of carbon emissions associated with the building's operational energy on an annual basis is zero or negative. A net zero carbon building is highly energy efficient and powered from on-site and/or off-site renewable energy sources, with any remaining carbon balance offset. A link to the UK Green Building Council (April 2019) Net Zero Carbon Buildings Framework is included in Appendix 4.

7.5 Key elements of a Net Zero Carbon roadmap

An NZ Roadmap sets the overarching strategy and approach to NZ for a building(s) and/or estate. This is likely to include initial energy and carbon forecasts, potential decarbonisation target deadline and model the relative contribution of individual/integrated decarbonisation options to achieve the target deadline. It is important to note that a Net Zero Carbon Roadmap will need to be updated and refined over time as more knowledge is gained – it will essentially be an iterative process of continual review and improvement.

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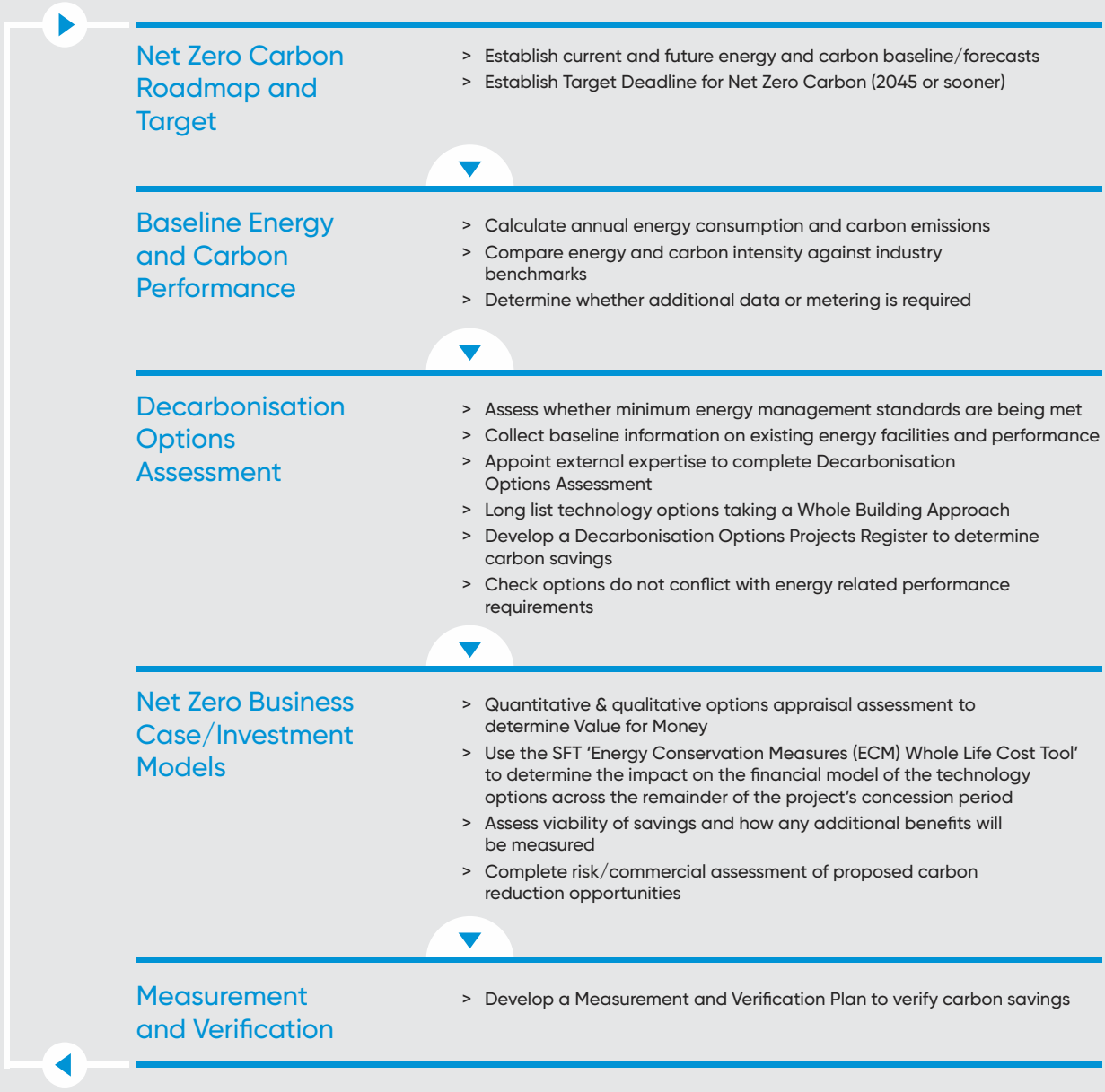
7.6 Net Zero Carbon roadmap process summary

Whilst specific Net Zero Carbon Roadmap processes will vary between projects, the typical process is demonstrated in the table below:

Figure 8
Net Zero Carbon roadmap process summary



Chapter 7 (continued)

Throughout the process of developing a Net Zero Carbon Roadmap it is important to keep open the dialogue with Project Co and the FM service provider to achieve a collaborative approach. Contact should be at the right levels for relevant issues encompassing both practical and or technical matters. Key elements of the NZ roadmap (e.g. timeline of implementation) will be dependent upon the requirements of the Project Agreement.

The NZ Roadmap processes are outlined in further detail in the following sections.

7.7 Current and future energy and carbon baselines/forecasts

To develop a NZ roadmap, it is important to forecast a current (see section 7.10) and future energy and carbon emissions baseline for a building(s) and/or estate in order to determine a business-as-usual scenario (see section 7.9) and to determine a representative rate of decarbonisation that would be required to align with target deadlines (see section 7.8). As part of this forecasting, it is important to consider factors that will affect future energy consumption and associated carbon emissions.

One of the most significant factors that will affect future carbon emissions from electricity consumption is Grid Decarbonisation, which reflects that increasing amounts of renewables contributing into the National Grid are going to result in the amount of carbon emissions associated with electricity consumption reducing per unit of electricity consumed over time. It is important that the impact of grid decarbonisation is modelled as this will have an increasing impact over time on the types of decarbonisation options that will be required to reduce carbon emissions – in practice this will mean that resource should be prioritised on the decarbonisation of heat (from fossil fuels) and shifting heating to electrically sourced solutions, if viable alternates such as converting fossil fuel heating to green hydrogen are not available.

Guidance and emissions factors for modelling Grid Decarbonisation on individual projects, building(s) and/or estates is available from the Green Book Supplementary Guidance: Valuation of Energy Use and Greenhouse Gas Emissions for Appraisal – see Appendix 4 for relevant link. This contains electricity emissions factors to 2100 (in $kgCO_2e$ / kWh). This guidance contains long-run marginal emissions factors that should be used for measuring small changes in consumption or generation, and grid average emissions factors which are used for foot printing.

Other factors that can affect future energy consumption and carbon emissions, include:

- Changes in building use or occupancy patterns
- Current or planned energy reduction projects
- Improvements in technology performance (i.e. energy performance)

Where possible these factors should be considered as part of any modelling on future energy and carbon emissions.

7.8 Target deadline

It is important from the outset to ensure that there is a common understanding of the required NZ objectives/targets and the timescales involved, including as to the implications of the contract as a result of energy-efficiency retrofitting work or NZ contract changes or variations. With reference to setting a NZ target deadline in the context of a NZ Roadmap, it is recommended that the target deadline should be the soonest of:

- The Scottish Government's Net Zero Deadline (2045) or interim targets in 2030 and/or 2040[1]
- The Local Authority Area Net Zero Deadline
- The Sectoral Net Zero Deadline (where applicable) - for example, NHS Scotland becomes a net-zero greenhouse gas emissions health service by 2040 or earlier in line with Scottish Government policy for NHS Scotland
- The Authority and/or private sector company Net Zero Target Deadline

It is the target deadline that is used as the backstop for the modelling scenarios – see section 7.9.

1 Reducing greenhouse gas emissions - Climate change - gov.scot (www.gov.scot)

Science Based Targets

Science based targets provide a clearly defined pathway for companies and financial institutions to reduce greenhouse gas (GHG) emissions, helping prevent the worst impacts of climate change and future-proof business growth. Targets are considered 'science based' if they are in line with what the latest climate science deems necessary to meet the goals of the Paris Agreement – limiting global warming to well-below 2°C above pre-industrial levels and pursuing efforts to limit warming to 1.5°C. The Science Based Targets Initiative (SBTi) provides a robust methodology for setting science-based emissions reduction targets. Following the SBTi methodology for Science Based Targets are advantageous because it can be used to set both near term targets (5 – 10 years) and longer-term targets (no later than 2050), with annual percentage rates of decarbonisation clearly quantified. Many organisations are seeking to adopt Science Based Targets recognising that they are an internationally recognised standard for best practice – particularly where these are developed in support of wider ESG and CSR frameworks (see section 8.2.1 and Appendix 4).

7.9 Modelling scenarios

Once current and future energy and carbon emissions baseline forecasts (aka business-as-usual) have been combined with a target deadline, there are several NZ scenarios that can be modelled to reflect differing levels of ambition for decarbonisation.

Example scenarios include:

> **'Do nothing'** scenario (i.e. carry on in a business-as-usual fashion)

> **'Minimum'** decarbonisation strategy with some of the more cost-effective interventions applied

> **'Preferable'** option which outlines the strategy modelled as most effective

> **'Maximum'** strategy which reflects as much intervention work as feasibly possible to achieve NZ

Scenarios may need revision and remodelling as discussions are held upon which decarbonisations best fit within these respective scenarios, and this should be encouraged to ensure the most effective solution, which provides that value for money has been identified (see section 7.17).

The purpose of developing these differing scenarios is to evaluate the impact of different combinations of decarbonisation options on the energy consumption and carbon emissions baseline. These scenarios can then be used to support the development of any further business case writing (such as Outline Business Case or Full Business Case) and to aid discussions between Project Co/FM service and the Authority on which decarbonisation options best support the required NZ objectives/targets and timescales of the parties.

The Role of Carbon Offsetting

Carbon Offsetting is the undertaking of actions to remove emissions from the atmosphere as a counterbalance to residual emissions that have not been eliminated after all decarbonisation options have been taken that could be implemented to reduce energy demand, optimise energy efficiency, and/or deploy low and zero carbon technologies in order to achieve NZ for Operational Energy. This guidance deliberately limits the requirement for offsetting of residual emissions. The valuable role that offsets can play in the transition to a NZ economy is recognised, but it is not seen as a replacement for actual emissions reductions which is the key focus of this guidance.

7.10 Baseline NZ opportunities - energy and carbon performance

In order to inform the Decarbonisation Options Assessment process, (the process of identifying and evaluating decarbonisation options that could be implemented to reduce energy demand, optimise energy efficiency, and/or deploy low and zero carbon technologies), the baseline energy/carbon performance of the building(s) should first be assessed and validated.

Setting a baseline year for energy /carbon performance gives a set point against which any change can be measured. For emissions reduction of an operational estate this must reflect the energy and associated emissions used within. Typically, a baseline year will cover a reporting period of 12 months, often either

the calendar or fiscal year. It is also sensible to pick a year where there is relatively good data, both on the organisational estate and portfolio, and its energy consumption.

This performance information can firstly be used to support the selection of suitable building(s) for a Decarbonisation Options Assessment, and secondly, would be used to calculate the relative carbon savings potential of individual or aggregated carbon/energy reduction opportunities identified during a Decarbonisation Options Assessment.

To baseline the energy/carbon performance the following information should be obtained:

- Building Type/Use
- Building Floor Area
- Energy consumption data (kWh) for a representative (minimum) 12-month period, utilising half-hourly / smart meter data as a priority. Consumption data should be disaggregated for all energy types (e.g. electricity, natural gas, district heating, fuels, other). When determining the 12-month period, it is important to ensure that a representative 12 month-period is chosen, particularly with the impact of COVID-19, which could have resulted in abnormal energy consumption for some building types
- Renewables generation / onsite consumption for a (minimum) 12-month period
- Available information on patterns of energy use (e.g. building use, building occupancy)
- Energy Performance Certificates (EPCs)

Appendix 2 includes a Baseline Energy/Carbon Performance and Benchmarking template which can be used to record the baseline energy/carbon performance and the following information.

Under a typical PPP FM SLS, the FM services would generally include for monitoring and reporting of energy consumption records (incl. meter readings) and may additionally require specific monitoring reports to be produced as agreed between the Authority and Project Co. Therefore energy/carbon performance data should be readily available.

Energy data can vary in type and quality dependent on what is available. In all instances the best available data should be used. A guide to the order of energy data preference is as follows:

- Energy data through a half hourly meter – this could be through a fiscal meter or sub-meter
- Energy data through a manual meter read– this could be through a fiscal meter or sub-meter
- Energy data through an apportionment of the building area for use (for example where the building is partially occupied by the organisation)
- Applying similar energy performance of similar buildings where no data is available
- Using ratings from assessments such as an Energy Performance Certificate (EPC)

Energy data should be collected in consistent units, typically kWh, which may require some conversion for certain energy sources such as oil, LPG, or natural gas which can be recorded in volume. A useful conversion table is provided in Greenhouse gas reporting: conversion factors 2021 - GOV.UK (www.gov.uk) detailed reference contained within Appendix 4.

For the purposes of setting a baseline, only annual energy consumption is required. However, it is recommended that at least three years' worth of data is used particularly with the impact of COVID-19, which could have resulted in abnormal energy consumption for some building types, as this enables any anomalies to be identified. Data analysis should be completed to ensure that the three years' consumption data (ideally one either side of the baseline if possible) are similar. If there are any significant variations, then these should be investigated to ensure that a representative dataset is utilised for the baseline.

7.11 Converting energy data into carbon emissions

In order to report the greenhouse gas (GHG) emissions associated with a building's energy performance the energy data collected needs to be converted into carbon emissions.

The GHG Protocol Corporate Accounting Guidance and UK Company Reporting Guidance should be followed to calculate the annual carbon emissions of the Operational Energy consumption. Please see Appendix 4 for the relevant links.

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The table below summarises the Scope 1 and Scope 2 GHG Emissions that should be included in the baseline:

	Scope 1 GHG Emissions	Scot 2 GHG Emissions
Definition	Direct on-site emissions from owned or controlled sources relating directly to operational energy consumption of the building.	Indirect emissions produced from the generation of purchased energy because of the use of grid-supplied electricity, heat, steam, and/or cooling consumed by the entity.
Example	Emissions from combustion in on-site or controlled boilers and power facilities, such as backup generators or incinerators on large sites. It also includes refrigeration.	Use of purchased electricity, steam, heating or cooling.

This guidance focused on energy, and other emissions related building activity has been excluded. It is also recognised that usage associated with transport such as petrol and diesel vehicles is not captured, though electric vehicle (EV) charge points should be taken into consideration, with installations adding additional electrical demand. Given the focus on energy, and other building emissions related building activity, it is recommended that Authorities when using this guidance should do so in conjunction with their wider carbon footprint reduction strategies to limit the environmental impact of their service.

7.12 Benchmarking and prioritisation of buildings for decarbonisation options assessments

If an Authority is intending to use the baseline information to support the selection of a suitable building(s) for a Decarbonisation Options Assessment, for example, in the scenario that an estate-wide PPP schools portfolio review is being conducted, then performance benchmarking should be undertaken to identify priority sites for Decarbonisation Options Assessments. Benchmarking also supports the assessment of how buildings compare against typical and/or best practice performance standards.

Prioritisation could be established on several factors including:

- Industry benchmarking for building types (for example CIBSE Guide F – Energy Efficiency[2])
- Industry benchmarking for building types (for example Building Energy Efficiency Survey[3])
- Industry benchmarking for building types (for example CIBSE's Energy Benchmarking Tool[4])
- Estate benchmarking comparing buildings within the same operational estate (kWh per m^2 or tCO_2e per m^2)
- Buildings with/without energy provided from natural gas, fuels, other
- The anticipated remaining lifecycle of assets based on condition
- Whether the building has already been extensively decarbonised
- Whether the building is structurally unfit for modification or adaptation

2 https://www.cibse.org/Knowledge/knowledge-items/detail?id=a0q20000008I7oTAAS
3 Building Energy Efficiency Survey (BEES) - GOV.UK (www.gov.uk)
4 CIBSE - Digital Tools - CIBSE Symbols

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Outlined below are some examples of the typical building categories and their respective Energy and Carbon Intensity benchmarks, as derived from the Benchmark Table provided by CIBSE in TM46: 2008 Energy Benchmarks Publication.

CIBSE TM46: 2008 Energy Benchmarks Publication (Example Benchmarks)

Name and description		Building Energy Intensity benchmarks		Building Carbon Intensity benchmarks		
Category	Name	Electricity typical benchmark (kWh/m²/yr)	Fossil Fuel typical benchmark (kWh/m²/yr)	Electricity typical benchmark ($kgCO_2/m^2/yr$)	Fossil Fuel typical benchmark ($kgCO_2/m^2/yr$)	Total typical benchmark ($kgCO_2/m^2/yr$)
1	General office	95	120	52.3	22.8	75.1
10	Cultural activities	70	200	38.5	38.0	76.5
12	Swimming pool centre	245	1130	134.8	214.7	349.5
14	Dry sports and leisure facility	95	330	52.3	62.7	115.0
16	Public buildings with light usage	20	105	11.0	20.0	31.0
17	Schools and seasonal public buildings	40	150	22.0	28.5	50.5

Buildings could be prioritised for a Decarbonisation Options Assessment if they have a higher than average industry or estate energy/carbon benchmark. Alternatively, buildings could be prioritised if they have energy sources that will not benefit from National Grid Decarbonisation (which will result in reduced carbon emissions associated with electricity generation), such as natural gas, fuels, other. For more information on National Grid Decarbonisation refer to sections 7.7 and 7.14.3.

In addition to the above processes for prioritisation, due consideration should be given for buildings that may be part occupied or controlled by other parties (i.e. additional occupiers). In these instances, additional information ought to be collected on how the buildings' energy and carbon performance is impacted by the Authority's own emissions, versus those that other organisations are accountable for e.g. third-party developments on hospital sites, typically, catering facilities, retail outlets, charitable organisation and other third sector organisations. In these cases, this should also be input into the Decarbonisation Options Assessment process as part of the evaluation of decarbonisation options (see section 7.14).

7.13 Data metering strategies - quality and sub-metering:

Following completion of benchmarking and in advance of conducting a Decarbonisation Options Assessment, it may be appropriate to consider additional data collection and/or deployment of sub-metering. There may be differing levels of data availability and quality between building(s) and it is advantageous to have half hourly energy consumption data available, which offers the following benefits:

- A more accurate baseline than may be currently available which can be used as a comparison after anything has been installed
- An opportunity to improve operational performance through the identification of anomalies including excessive consumption
- Data which will help the design and optimisation of the Decarbonisation Options (see section 7.14)
- Verification of any savings that are achieved (see section 7.20)

To improve the quality of data provided on sites and buildings, sub-metering is a common solution – this can be either the installation of new sub-metering or the

enhancement of existing sub-metering. The sooner that good metering is installed/enhanced, the longer the period of data available and therefore the better the quality of the site baseline data. This is particularly important in large, complex sites, buildings with multiple occupants and/or buildings which rely on manual meter readings. Consideration should be given the internet enabled, smart electric meters suitable for commercial and industrial applications. These systems can be deployed as a primary meter, submeter or used for other electric metering applications such as energy usage tracking, demand reduction, power factor correction, etc. Besides tracking peak demand (kW) and energy consumption (kWh), advanced meters integrate many important features and provide enhanced functionality such as automatic outbound reporting using 100% open protocols.

In addition to primary and submetering, temporary or mobile monitoring of energy could be used to compliment the quality of building baseline data or to monitor energy consumption on a temporary basis e.g. in a specific area of use, on-site individual circuits or equipment supplies. Temporary metering allows easy metering of large three-phase plug-in equipment such as refrigeration units, catering equipment. Also, temporary or portable meters can be used to quantify the effect of implementing energy saving initiatives.

Traditionally sub-metering has been on electricity meters however with a need to move away from fossil fuels it is now more important to ensure that sub-metering covers both electricity and heat use. This can be done through the metering of the fossil fuel used or the heat being distributed across the building(s). Sub-meters should be incorporated into a BMS system (either new or existing) where possible.

Sub-metering can also outline the energy performance of different zones within a building and/or different energy systems (such as heating, cooling, hot water, lighting, specialist equipment, lifts and small power). This can be used to evaluate areas of higher/lower energy efficiency and prioritise areas of focus for the Decarbonisation Options Assessment.

Guidance on metering, monitoring and reporting frameworks can be found in the following standards and the relevant links can be found in Appendix 4.

> **CIBSE TM39:** Building energy metering (currently in revision), which promotes best practice in the design of energy metering and sub-metering in non-domestic buildings

> **CIBSE TM63:** Operational performance: building performance modelling and calibration for evaluation of energy in-use

> **CIBSE TM22:** Energy assessment and reporting methodology, which provides a method for assessing the energy performance of an occupied building based on metered energy use and a 'bottom up' assessment of the installed plant and equipment present in the building

7.14 Net Zero Roadmaps

7.14.1 Decarbonisation Options Assessment

Having determined the relevant project facilities baseline year, energy /carbon performance benchmarks and energy consumption data, this baseline energy and carbon performance data is then used to inform the Decarbonisation Options Assessment process. Secondly, this data would also be used to calculate the relative carbon savings potential of individual or aggregated carbon reduction opportunities/ NZ changes identified during a Decarbonisation Options Assessment.

7.14.2 Decarbonisation Options Assessment – purpose

It will be expected that the FM SLS general performance standards described in chapters 1.3 – 1.8 are met in relation to energy management, for example the development of energy saving strategies (including separate heating, lighting and ventilation strategies) in consultation with the Authority, acting reasonably and implementing such strategies and cooperating with the Authority in achieving objectives of the strategies.

As a starting point, it is recommended that an assessment is made of the energy management and energy saving strategies/standards where required under the FM SLS service standards. Once the Authority has analysed the contractual requirements, a gap analysis should be undertaken to access whether in the first instance, Project Co and its supply chain partners are meeting the minimum required standards

A Decarbonisation Options Assessment is intended to go further than these expected FM SLS energy performance standards. The purpose of a Decarbonisation Options Assessment is to identify

decarbonisation options that could be implemented to reduce energy demand, optimise energy efficiency, and/or deploy low and zero carbon technologies in order to achieve NZ for Operational Energy. Low and zero carbon technologies generate heat, power and cooling with lower emissions than conventional, fossil fuel-based generation technologies.

Technologies that require a combination of fossil fuel and renewable energy sources are defined as low carbon technologies (such as heat pumps supplied by grid electricity to generate heat). Technologies that input energy entirely from renewable sources (such as solar photovoltaic panels and wind turbines) whist in the main are uncommon, are defined as zero carbon.

As an output from the Decarbonisation Options Assessment, it will be clear which decarbonisation options are applicable to building(s) / estate, including their proportionate carbon reduction potential, and the estimated cost and delivery process for each of them.

Once the building(s) and/or decarbonisation options have been prioritised for further investigation, the Decarbonisation Options Assessment should be undertaken by in-house teams and/or commissioned by an external provider(s). Consultancies, design houses for specific technologies, and specialist energy services firms can be used to support in the scoping and determination of decarbonisation solutions. Where external support is required, requirements should be clearly stated, asking for project outputs and all assumptions that have been made in developing their recommendations – including which methodologies and standards have been followed to complete the Decarbonisation Options Assessment. The Decarbonisation Options Assessment should be discussed with Project Co and the FM provider to encourage stakeholder buy-in and create a dialogue to discuss and raise potential implications of the proposed decarbonisation options.

7.14.3 Decarbonisation Options Assessment – methodology and standards

This guidance provides a simplified approach for what should be included in a Decarbonisation Options Assessment and has been developed in alignment with industry standards and methodologies such as PAS 2038: 2021 (Retrofitting Non-Domestic Buildings for Improved Energy Efficiency), BS EN 16247-1:2012 (Energy Audits Part 2: Buildings) and ISO 50002 (Energy Audits Requirements with Guidance for Use) - please see Appendix 4 for the relevant links.

A Decarbonisation Options Assessment may require baseline information to be collected relating to:

1. **Context and setting** – the building(s) architectural, cultural and historic context, and its physical setting, including aspect and exposure, access, planning constraints.
2. **Condition** – the building's structural condition, and its construction, services and controls, the presence of defects and the need for repairs or maintenance.
3. **Occupancy** – the number of occupants and their pattern of use of the building, including set-points and operational limits of indoor environmental conditions (such as temperatures, air flows, illuminance, noise) and any seasonal variations.
4. **Energy performance** – how much energy the building uses, broken down by uses and fuel type(s), and how its energy performance relates to typical and/or good practice benchmarks – (see section 7.19).

This preliminary information should be collected in advance of site-based assessments to support the identification and prioritisation of suitable decarbonisation options. During a site-based assessment a competent assessor should then evaluate decarbonisation options. For information on sampling and extrapolation options see figure 4 below.

Figure 4 Sampling and extrapolation for similar assets:

Where similar assets are within the estate, then consideration can be given to whether assets can be grouped into archetypes (i.e. similar types of buildings, where similar decarbonisation options would be applicable). This would enable a sampling of a subset of these buildings to establish relevant decarbonisation options, costs and installation options. These results can then be extrapolated back up to understand what the requirements would look like for the whole estate.

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Whilst Decarbonisation Options will be specific to individual buildings, there are likely to be some common interventions and technologies which are required across an estate. Prior to the development of an evaluated shortlist of Decarbonisation Options for each site, an initial longlist of potential solutions should be researched to fully understand their potential, and to understand which scope of emissions the different solutions address. Appendix 2 includes a template Decarbonisation Technology Long List to assist the identification of an initial longlist of potential solutions.

This should not exclude any particular activity and include technology groups from energy reduction technologies (e.g. LED lighting, BMS, and fabric improvements) to low carbon technologies (e.g. heat pumps) and zero carbon technologies (e.g. Solar PV), as well as any other innovative measures.

Many Decarbonisation Options need to be considered within a system of interventions and metering/monitoring systems, this offers the optimum to drive decarbonisation both from a technical and cost perspective. This is referred to as a Whole Building Approach (see figure 5 below for further information).

Figure 5 Whole Building Approach

Preference should be given to taking a Whole Building Approach to decarbonising a building, particularly with reference to decarbonisation of heating systems. A whole building approach is where all possible carbon reduction opportunities (technologies/solutions) across a building, and their relative interactions, are carefully evaluated to identify the maximum decarbonisation potential for the building through the best selection and prioritisation of carbon reduction opportunities. A Whole Building Approach is important to ensure that carbon reduction opportunities are designed to match the required future energy demand, and are not under/over specified, resulting in excess carbon emissions. For example, it is important that building fabric is optimised to reduce heat losses before a heat pump is installed. This ensures that the installed heat pump size and cost is minimised, and that the ongoing costs of and emissions (prior to Grid Decarbonisation) from operating are reduced. If a heat pump was installed before the building fabric had been optimised, then in time the heat pump would providing excess heating, resulting in excess carbon emissions and potentially other issues such as poor thermal comfort for building users.

In addition to the Whole Building Approach, consideration should be given to how energy is supplied to different technology options, particularly with regard to Grid Decarbonisation (see figure 6 below for further information).

Figure 6 Grid Decarbonisation

Decarbonising the National Grid means reducing its carbon emissions, as in, decreasing the emissions per unit of electricity generated. Renewable energy generation is on the rise, with more renewable generation such as wind and solar farms being connected to the National Grid. Ultimately this means that the carbon emissions associated with electricity consumption will reduce per unit of electricity consumed over time. It is important that the impact of grid decarbonisation is modelled into decarbonisation options when assessing the carbon savings of electricity projects. Continuous grid decarbonisation means that all-electric options are likely to be the way forward in many cases. This is likely to put additional burden onto the local electricity network which may mean that electrifying a building(s) will require grid reinforcement and an additional cost burden. The UK Government have published a trajectory of carbon emissions factors for grid electricity which users can utilise in their evaluation of carbon impacts. Please see Appendix 4 for the relevant link.

When conducting a Decarbonisation Options Assessment, the following Decarbonisation Options should be considered to optimise the decarbonisation potential. Also, consideration should be given to sequencing that also considers age of an asset and likely replacement timeline.

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Whole Building Approach

Fabric First	> Insulation details and airtightness provided for thermal envelope, reducing heat losses > Internal/external wall, cavity, floor and roof insulation to ensure appropriate thermal performance > Use of high-performance glazing to reduce unwanted solar gain and minimise heat loss whilst optimising natural daylight
Passive Heating, Ventilation and Cooling (HVAC) Systems	> Natural ventilation > Any proposed changes to airflows and/or air handling equipment should be risk assessed to decide which appropriate actions to take. Authorities would need to carry out an appropriate COVID-19 risk assessment, just as you would for other health and safety related hazards recognising current guidance and good industry practice
Heat and Energy Networks	> Options for joining a heat/energy sharing network should be properly considered and where appropriate prioritised, and where possible this should be served by low or zero carbon technology or at least there should be some longer-term strategy for decarbonisation of any heat network heat raising plant
Building Level Systems - Heating, Cooling and Hot Water	> Heating, cooling and hot water systems should be served by low or zero carbon technology local heating systems such as heat pump technologies assessing various heat sources (air, water, ground) > Efficient zoning of heating, ventilation and air conditioning systems and controls should be adopted to enhance energy performance > Options for enhanced or newly added heat recovery
Building Level System - Ventilation and Cooling Strategies and Systems	> Where mechanical ventilation or cooling systems are required, low fan powers, variable speed drives and energy recovery should be implemented to enhance energy performance > Efficient zoning of heating, ventilation and air conditioning systems and controls should be adopted to enhance energy performance > Any proposed changes to airflows and/or air handling equipment should be risk assessed to decide which appropriate actions to take. Authorities would need to carry out an appropriate COVID-19 risk assessment, just as you would for other health and safety related hazards recognising current guidance and good industry practice > Options for enhanced or newly added heat recovery
Lighting	> Low energy lighting (LEDs) should be implemented alongside optimisation of daylighting and daylighting controls, automated/sensor controls, time scheduling and dimming functions
Building Energy Management Systems (BEMS) and Controls	> BEMS to enable manageable optimisation of control set points and time schedules centrally. Integration of BEMS with energy metering and sub-meters to enhance energy efficiency and allow identification and implementation of improvements

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Whole Building Approach (continued)

Specialist Equipment, Lifts and Small Power	>	Specialist Equipment, Lifts and Small Power should be reviewed for energy efficient alternatives
Low and Zero Carbon Technology	>	Low and zero carbon technology options should be reviewed to support options outlined above (such as heating, cooling, hot water), and also to support additional onsite renewables generation (e.g. Solar PV, Wind) Energy storage solutions can be considered alongside low and zero carbon technology

For some sites it may be that multiple decarbonisation options are equally suitable and provide similar results (e.g. Solar PV and Wind generation), and a choice of technology should therefore be made based on a wide range of metrics such as installation cost, ease of installation, lifetime, operational maintenance costs, cash flow.

In addition to the above, consideration should be given to bespoke and innovative technologies. Gaps in existing technologies are likely to occur where innovative and new technologies are evolving, this currently includes areas such as heat and battery storage, demand side management and artificial intelligence. These should be considered and monitored but may not currently be suitable for a significant contribution to decarbonisation. Furthermore, consideration should also be given to the embodied carbon and overall environmental performance of energy related equipment (see figure 7 below for further information).

Figure 7 Embodied Carbon and Overall Environmental Performance of Energy Related Equipment

When purchasing new energy related equipment for a building, selection should be based on the 'overall' environmental performance and specifically the associated embodied carbon of the product. The embodied carbon represents the carbon emissions already associated with the product/service associated with the upstream and downstream processes relating to the product, installation, ongoing maintenance and disposal. This guidance has principally been developed to encourage and enable collaboration around NZ strategies for Operational Energy, but some principles for evaluating embodied carbon are outlined below:

Upstream Embodied Carbon: is attributed to the emissions associated with the extraction, transport and manufacturing of the raw materials used in the product/materials before it is supplied to the customer. The Environmental Product Declaration should be requested to draw a direct comparison with market alternatives (more information in ISO 14025: 2006). An EPD is a transparent and objective report which reflects what a product is made from and how it impacts the environment across its entire life cycle.

Downstream Embodied Carbon: is attributed to the emissions arising from the ongoing maintenance and servicing of a technology and how the service is provided and the supply of spare parts. Prioritisation should be given to technologies serviceable within the local area first, before wider geographies, and parts that can be sourced within first the UK, then EU before the Rest of World.

7.14.4 Decarbonisation Options Assessment – report

The Decarbonisation Options Assessment should lead to the generation of a Decarbonisation Options Assessment Report that summarises the findings of all data analysis and survey outputs.

The surveyor/assessor/auditor should prepare a Report that provides the following items of information for each decarbonisation option being assessed:

> Baseline Summary:

- Context and setting – the building(s) architectural, cultural and historic context , (where appropriate) and its physical setting, including aspect and exposure, access, planning constraints.

- Condition – the building's structural condition (as appropriate to the assessment), and its construction, services and controls, the presence of defects and the need for repairs or maintenance.
- Occupancy – the number of occupants and their pattern of use of the building, including set-points and operational limits of indoor environmental conditions (such as temperatures, air flows, illuminance, noise) and any seasonal variations.
- Energy performance – how much energy the building uses, broken down by uses and fuel type(s), and how its energy performance relates to typical and/or good practice benchmarks – (see sections 7.19 and 7.20).
- Consideration of current energy management, whether through observations of occupant behaviour or review of building control arrangements.

> Project Information:

- Technology type (see sections 7.20 and 7.21).
- Demonstration of Whole Building Approach to technology selection and proposed interactions with other proposed recommendations.
- Conceptual design including system sizes and locations.
- Complexity and difficulty of installation including capability and skills required and potential risks (e.g. presence of asbestos).
- Maintenance requirements including capability and skills required.
- Assumption uses in calculations and resulting accuracy of recommendations.

> Emissions Information:

- GHG Emissions Scope(s) where reductions will be achieved (Scope 1, Scope 2, Scope 3).
- Impact on emissions reduction (often this will be quoted in percentages) ranked in order from greatest to least decarbonisation potential.
- Cost (£) per tCO_2e over the lifetime of the technology (£/LT tCO_2e).
- How and what would need to be done to ensure that changes in emissions are monitored through sub-metering (see section 7.13).

> Financial Information:

- Expected capital cost ranges.
- Expected operational costs.

> Other Useful Information:

- Additional potential benefits (see section 7.14.2).

There are several useful Annex's within BS EN 16247-2 (2014) that provide checklists for energy audits, and also examples of how energy reports can be structured – these can be applied appropriately to the Decarbonisation Options Assessment.

Appendix 2 includes a template decarbonisation options projects register which logs and records the summarised findings of all data analysis and survey outputs and decarbonisation options.

7.15 Net Zero roadmap assessment tool

Scottish Futures Trust has developed an 'Energy Conservation Measures (ECM) Whole Life Cost Tool' designed to assist public sector partners managing operational PPP projects to make informed decisions to optimise a built asset's NZ performance where formal NZ changes or variations are being considered.

It is worth noting that the refences to Energy Conservation Measures fall under the same banner as Decarbonisation Options and when implemented, reduce energy demand, optimise energy efficiency, and/or deploy low and zero carbon technologies for Operational Energy. Further details can be found in Section 7.17 - Net Zero Business Case / Investment Models with the links to both the ECM appraisal tool and user guide included in Appendix 2.

The appraisal tool provides a consistent method of comparing ECM outcomes where an Authority is considering NZ changes or variations in existing operational PPP projects. It is both a qualitative and quantitative process that looks at the energy conservation outcomes in costs and relative savings over the remaining period of the PPP contractual period. The

appraisal tool promotes the analysis of whole life outcomes across three assessment criteria: commercial; environmental performance and environmental savings against a business-as-usual baseline.

7.16 Net Zero roadmap and conflicting requirements

Generally, in terms of the FM Service (this may vary from project to project) but in the majority of cases Project Cos are obligated to maintain all building plant, fittings and infrastructure to Good Industry Practice. Project Co is also required to replace building fabric, plant and infrastructure when life expired (or to meet certain handback condition requirements), utilising an agreed Lifecycle Plan and fund.

In addition, there will be energy related performance requirements (again this will vary from project to project), but it will be important to ensure that the decarbonisation options being considered and the NZ Roadmap are developed in such a way so as not to conflict with these key requirements.

Examples of these are outlined below:

Example	Description:
Lighting	Ensure that required lux levels can be met by new lighting technology; enable shading of the glare from sunlight.
Thermal Comfort	Ensure internal temperature requirements can be met and maintained for the building type.
Air Quality and Ventilation	For naturally ventilated areas, ensure sufficient air flow to prevent build-up of damp and mould issues; for mechanically ventilated areas monitor CO_2 levels so that concentrations stay within guidelines for the building type.
Water Temperature	Ensure hot water temperatures are sufficiently high and within appropriate ranges to prevent preferential environmental conditions for microbial build up whilst preventing the risk of scalding; ensure water testing can be carried out from all water-based systems.
Acoustics	Ensure acoustic criteria for building type is met; and that sound insulation is appropriate to ensure performance in relation to indoor ambient noise levels and room acoustics.

7.17 Net Zero business case/investment models

Following a Decarbonisation Options Assessment, a variety of decarbonisation options will have been identified that could be implemented to reduce energy demand, optimise energy efficiency, and/or deploy low and zero carbon technologies in order to achieve NZ for Operational Energy.

Whilst decarbonisation options will have been assessed for their relative carbon reduction potential and alignment with a NZ Roadmap, it is still important to ensure that decarbonisation options demonstrate Value for Money (**VfM**). This means that VfM at a decarbonisation option (at project level) would be achieved when the optimum available combination of whole-life costs and quality (or fitness for purpose) is achieved whilst delivering the anticipated carbon emission savings. It is worth remembering that VfM is not simply the choice of goods and services based on the lowest cost bid.

VfM appraisals should include an options appraisal to consider the relative costs and benefits of the shortlisted decarbonisation options being considered. Given that a variety of decarbonisation options may be available, consideration should be given to whether there are comparative or alternative decarbonisation options, or a combination of decarbonisation options with an optimal interactive effect, that could be used to achieve the same or similar carbon emissions savings but achieving better VfM.

In the context of decarbonisation, a comprehensive options appraisal should include quantitative and qualitative assessments to determine VfM but should also evaluate the carbon savings potential (see section 7.14) and additional Benefits and Outcomes that could be achieved through the decarbonisation option(s), such as meeting NZ Deadlines, Social Value and Building Level Benefits (see sections 8.2 and 8.3). The quantitative and qualitative options appraisal assessment to determine VfM should also include the impact of other costs specific to PPP projects, i.e., the additional costs associated with time, technical advisor and other professional advisor fees. The Change processes in PPP contracts can be complex, time consuming and, depending on value, may require a dedicated team to be assembled to manage the process. The level of complexity may also vary depending on whether the contract in question requires a different process based around different values of any proposed change i.e., Low, Medium and High value changes.

Other key factors that should be considered in the assessment of VfM will be:

- Viability of decarbonisation option(s) e.g. can the proposed decarbonisation option(s) integrate with each other and with the building?
- Desirability of decarbonisation option(s) e.g. can service requirements be met with a less carbon intensive solution?
- Achievability of decarbonisation option(s) – is there market appetite (this is particularly pertinent with decarbonisation options that are new/emerging technologies or markets)?

The HM Treasury Green Book sets out methods and frameworks for the appraisal and evaluation of projects and policies and many of these concepts will be relevant for public sector organisations. As a minimum, a VfM assessment should compare the costs of the decarbonisation options at a project level against 'do nothing' and 'minimum' scenarios (see section 7.9 for how these are modelled in terms of a NZ Road Map).

7.18 Energy Conservation Measures (ECM) Whole Life Cost Tool

As stated in section 7.15, Scottish Futures Trust has developed an 'Energy Conservation Measures (ECM) Whole Life Cost Tool' designed to assist public sector partners managing operational PPP projects to make informed decisions to optimise a built asset's NZ performance where formal NZ changes or variations are being considered.

The appraisal tool provides a consistent method of comparing ECM outcomes where an Authority is considering NZ changes or variations in existing operational PPP projects. It is both a qualitative and quantitative process that looks at the energy conservation outcomes in costs and relative savings over the remaining period of the PPP contract. The appraisal tool promotes the analysis of whole life outcomes across three assessment criteria: commercial; environmental performance and environmental savings against a business-as-usual baseline.

The Tool (and Guidance Note) has been developed to support organisations operating PPP projects, in order to assess the differing impacts and outcomes associated

with investing in ECMs within such building contracts. The Tool covers energy (kWh) and GHG emissions costs saving forecasts, alongside potential lifecycle cost/benefits when investing in differing ECMs.

Prior to using the Tool, it is the expectation that users will already have identified ECM opportunities and associated cost inputs (energy performance and cost data), ideally through Decarbonisation Options Assessments (aka energy audits) as set out in this chapter with subsequent ECM analysis by Project Co or Authority appointed specialists.

Users should refer to the ECM Whole Life Cost Tool user guide for detailed guidance on how to use the tool, with particular reference to 'ECM Options Data' and 'ECM Savings', with Annual Emissions Forecasting results displayed on the Dashboard.

Further details with the links to both the ECM appraisal tool and user guide are included in Appendix 2.

7.19 Viability of savings, delivery measures and measuring benefits

Where an Authority has in-house technical knowledge or expertise relating to decarbonisation options, this should be utilised as early as possible in the process to assess the viability of savings. This should be applied not only in terms of understanding the available decarbonisation options but also their viability as technical solutions in the facility.

Given that some decarbonisation options, or combination of decarbonisation options, could be utilising new(er) technologies and/or have complex design interactions to optimise carbon savings potential, it is possible this will be over and above the skill set available within an Authority. Consequently, consideration should be given to utilising best available in-house technical knowledge or expertise to manage the initial outline feasibility of the decarbonisation options that may be available. Where an Authority does not already have in-house technical capability or the appraisal has moved to a more detailed design stage, consideration to procuring this from external technical knowledge or expertise will be necessary.

SFT has been actively involved in this area for several years and has a network of advisors that could be utilised where necessary and subject to the Authority's procurement and governance arrangements through the following email link mailbox@scottishfuturestrust.org.uk

This expertise will be essential to ensuring that the decarbonisation option(s) design and configuration is robust, credible and provides a high level of accuracy regarding the viability of energy/carbon savings and where relevant cost savings. Cost savings may not always be achieved, for example where there is an anticipated increase in ongoing utilities costs i.e., where a heat pump replaces a gas boiler, gas consumption will reduce, however electrical consumption will increase and overall there could be an increase in cost depending on utility rates. Similarly, it is expected that some decarbonisation options will have an interactive effect on one another that would affect savings potential e.g. the benefits of Voltage Optimisation would be drastically reduced where a project also seeks to replace existing fluorescent lighting with LEDs.

7.19.1 Delivery of measures

Throughout the process it is important to keep an open and collaborative dialogue between the Authority and Project Co. This approach will be essential for the successful delivery of decarbonisation options, which may involve a range of scenarios. These options may include installing decarbonising technology onto project assets or sites or working with Project Cos to add additional/replacement energy solutions like solar panels and heat pumps, combined heating and power units or district heating networks.

7.19.2 Measuring benefits

Decarbonisation options should be measured in a consistent approach to enable benefits to be measured and compared. Refer to Appendix 2 for a detailed checklist on information/units of measurement that should be obtained as part of a decarbonisation options assessment.

A summary of key benefits and units of measurement are outlined in the table below:

Benefit	Measurement
Energy Savings	kWh savings p/annum kWh/m^2/year
Carbon Savings	tCO_2e savings p/annum
Cost Savings	£ savings p/annum £ per LT CO_2e

As outlined in the table above, a useful way to measure the relative carbon savings of different decarbonisation options is in terms of £ / LT CO_2e, which is determined from the estimated CAPEX of a decarbonisation project and the persistence factor for a given technology. This allows the relative cost/carbon 'benefit' to be assessed i.e. the most carbon savings for least CAPEX.

Furthermore, there is a range of additional Benefits and Outcomes that could be achieved from implementing decarbonisation options – these are outlined in further detail in sections 8.2 and 8.3. Whilst some of these benefits are more strategic, such as achievement of NZ Targets and ESG/CSR, there are others that have more direct direct/immediate benefits that can be measured – a summary of these and units of measure are outlined in the table below:

Benefit	Measurement
Thermal Comfort	Operative design temperature Overheating
Lighting Optimisation	Illuminance levels Glare control
Improved Air Quality & Ventilation	Temperature Relative Humidity CO_2 Total Volatile Organic Compounds Formaldehyde PM2.5 PM10 Ventilation rates
Acoustic Comfort	Acoustic standards specific to building type

It is prudent to compare direct benefits (energy/carbon/cost savings) with indirect benefits (asset level benefits) to effectively evaluate decarbonisation options and inform the overall risk/commercial assessment.

7.20 Measurement and verification plans

The NZ roadmap sets out the purpose for developing different scenarios and the methodology to evaluate the impact of different combinations of decarbonisation options on energy consumption and carbon emissions. Included within the NZ roadmap is the Measurement and Verification (M&V) process of verifying energy savings in a transparent and fair manner. Various protocols for good practice in Measurement and Verification exist globally but the most widely used is the International Performance Measurement and Verification Protocol (IPMVP), which defines common terminology and the key steps in implementing a robust M&V process. A key part of the M&V process is the development of an 'M&V Plan', which provides a comprehensive outline to guide the M&V process in line with IPMVP requirements.

7.20.1 International Performance Measurement and Verification Protocol (IPMVP) approach

Measurement and Verification (M&V) is the process of verifying whether the intended energy savings from an energy saving project are actually achieved. This process gives confidence to the client and solution provider as to how much, if any, savings have been achieved. The International Performance Measurement and Verification Protocol (IPMVP) is a widely accepted authoritative framework for the fair and transparent evaluation of the effects of energy saving projects and should be followed when assessing the performance of energy efficiency projects. The fundamental principles of IPMVP can be summarised as follows:

1. Evaluations should be as accurate as possible,
2. Interactive effects should be taken into account,
3. The analysis should be conservative,
4. All significant and relevant factors are measured,
5. Data is recorded and analysed in an open manner.

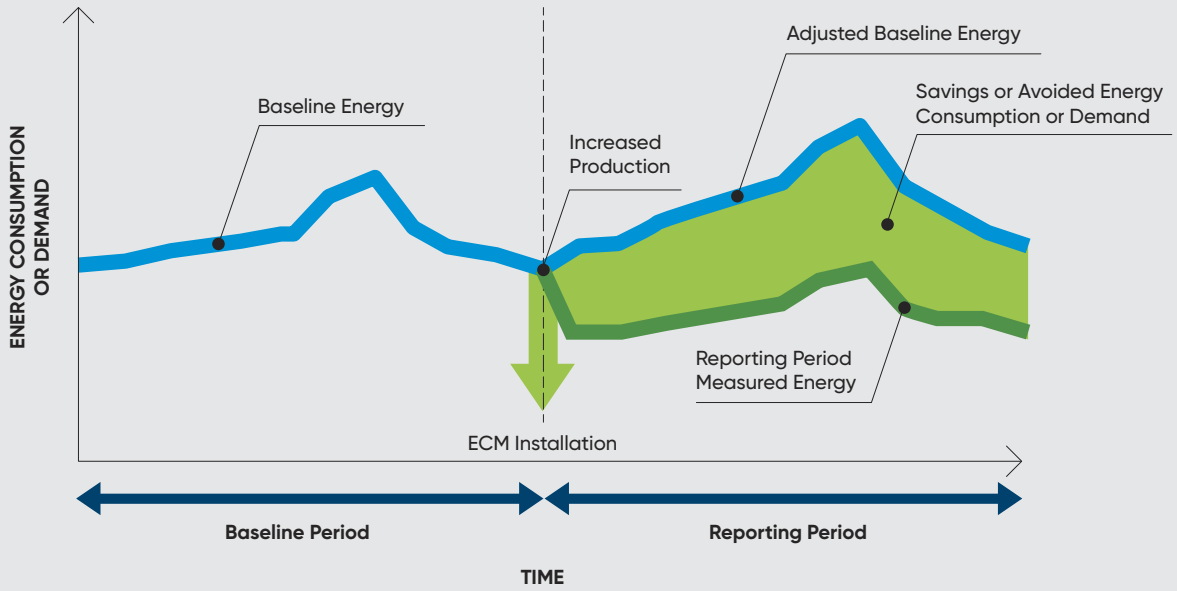
7.20.2 Measurement and Verification key concepts

Two key concepts form the basis for IPMVP. The first is that the post project consumption is not compared with a fixed baseline but with an estimate of what the energy consumption would have been under the conditions after implementation of the project. This requires an understanding of the factors which are driving the energy use (e.g. weather, building use, building occupancy) and developing a mathematical model to relate energy to the relevant factors. The baseline energy is then adjusted according to the level of these factors in the post-installation (reporting) period. This is illustrated in Figure 8 where an increase in production post baseline has led to an upward adjustment of the baseline energy being applied, which is then measured against the actual reported energy to determine savings or avoided energy consumption.

Chapter 7 (continued)

Figure 9: Core Concepts EVO 10000 – 1: 2016

Figure 9
Core Concepts EVO 10000 - 1: 2016



Secondly, IPMVP also requires an M&V Plan to be produced prior to the energy saving project being implemented. This must be agreed among the Authority, Project Co and FM service provider so that evaluation procedures and key data requirements are set before the savings evaluation after project implementation (see further details below).

7.20.3 Measurement and Verification – savings evaluations

For a given group of energy conservation measures (ECMs) in a facility, savings evaluations may be carried out for equipment taken in isolation (Option A/B), or at the facility level if a whole building retrofit has occurred (Option C) or, or as a mixture of the Options A, B and C. This will dictate the metering required, whether whole building metering or sub-metering of equipment is applicable. Below is further detail on the Options and the measurements required:

> **Option A: Retrofit isolation, key parameters measurement**

Savings are determined by measurement of the key parameter(s) which define the energy consumption of ECMs affected systems. Parameters which are not measured are estimated. An example would be a lighting retrofit where power draw is the key parameter measured and lighting operating hours are estimated based on facility schedules and occupant behaviour.

> **Option B: Retrofit isolation, all parameters measurement**

Savings are determined by field measurement of the energy consumption and/or related independent or proxy variables of the ECM affected system. An example would be solar PV where generated energy is recorded during the report period.

> **Option C: Whole Facility**

Savings are determined by measuring energy consumption at the whole facility utility meter level. Examples would be a multifaceted energy management programme affecting many systems in a facility.

7.20.4 Selecting appropriate savings evaluations approaches

Following a Whole Building Approach to Decarbonisation will likely result in a fabric first approach in combination with the core heat decarbonisation project(s) (for example a heat pump(s) to replace fossil fuels) and some electricity saving projects (e.g. LED lighting, Solar PV).

For some of these energy conservation measures a whole building approach would be preferred (Option C) as it would be difficult to meter the impact of say a fabric improvement, whereas for electrical savings it is often possible to meter the equipment individually so a retrofit isolation approach would be more suitable (Option A or B). Heat pump(s) may have a whole facility (Option C) approach for heat savings but a retrofit isolation (Option B) approach for the input electricity and heat generated. The latter would also allow the system to be monitored and optimised in real time.

There is a further whole facility approach which is used where there is no baseline period: Option D – Calibrated Simulation. This involves using building energy software to predict facility energy use in the baseline period. This might typically be used to determine building performance relative to a standard for new buildings.

Apart from Option D, energy metering data should cover the baseline period and post-implementation (reporting) period. In addition, all routinely varying factors which drive consumption (e.g. heating degree days, which reflect the external air temperature) should be recorded for both periods, as well as any factors that could significantly influence the energy consumption but which do not routinely vary, such as building floor area, occupancy, etc. More comprehensive guidance on metering strategies is provided in CIBSE TM39 - Building Energy Metering (2009).

7.21 Good practice for data collection and metering

7.21.1 Meter data quality

The best data available should be used where there are multiple data sources for a given meter. Care should be taken with invoices (for fiscal meters) to ensure they are based on actual meter readings rather than estimates, and that half hourly data is complete over the reporting/operational period. Manual meter reads taken regularly (say monthly) can be used as a check, particularly on the fiscal meters.

Energy may be supplied indirectly to a facility through on-site bulk storage, such as for biomass, oil or LPG. In this case the supplier's delivery notes do not represent the facility's actual consumption between deliveries. Ideally, there would be a meter downstream of the storage facility to measure energy consumption. Where this does not exist inventory level adjustments between deliveries can be used to supplement the delivered volumes.

If data is missing from the reporting period, a reporting period mathematical model can be created to estimate the missing data. The M&V Plan should establish a maximum rate of data loss and how it will be measured, as well as a methodology to estimate missing or erroneous data. However, baseline data should not be estimated; where data is missing the baseline period may be changed.

A more comprehensive set of guidance on metering strategy is provided in CIBSE TM39 - Building Energy Metering (2009).

This provides best practice guidance for energy metering and sub-metering in non-domestic buildings. The objectives of the guidance are to ensure that the metering strategies:

> Gather accurate and useful energy consumption data (kWh)

> Determine where the energy is used (site, building, tenancy, activity area, etc.)

> Provide this information, in a user-friendly format, to whoever needs it, in order to:

- manage buildings and improve operational efficiency
- isolate 'separable uses' and other items not typically included in energy benchmarks
- take account of renewable energy systems by measuring their performance

> Document the metering strategy in the building logbook

Chapter 7 (continued)

The methodology comprises 10 steps:

1. Select the TM39 boundary
2. List all energy imported and exported across the boundary
3. List all energy-using items within the boundary
4. Decide which items should be metered
5. Select appropriate meter for each item
6. Decide location(s) of meter(s)
7. Decide how meters are to be read
8. Review the metering strategy
9. Specify, implement and commission the metering
10. Document the strategy

For systems which are not directly metered, then 'CIBSE TM22 - Energy assessment and reporting method' (2006) can be used to help estimate consumption.

7.21.2 Other data to be collected

Key energy driving factors need to be identified and recorded for the baseline and reporting periods. These may include local heating degree days (See Appendix 4 Degree Days Calculated Accurately for Locations Worldwide) and cooling degree days (where cooling demand is significant). A good source is degree days net which provides degree days freely for the last 3 years from a wide range of locations. The quality and coverage of the data should be considered; in general airport weather stations have good quality data over a long period, but other sources may be considered if there are no airport weather stations close to the facility. On site weather monitoring equipment may be used where it is regularly and properly calibrated and situated properly at or near the facility.

Other factors which influence energy use but are not expected to change routinely should also be recorded such as building operating hours, occupancy levels, set points, outages etc. Where energy changes due to these changes are deemed significant this data may be used to make what is termed a non-routine baseline adjustment. This allows the savings calculation to take account of the change without over or under reporting the savings.

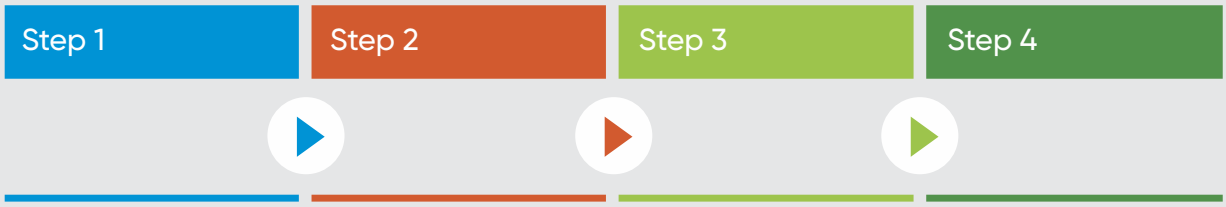
7.21.3 Measurement and Verification Plan

An effective Measurement and Verification Plan that complies with the requirements of the IPMVP would include the following non-exhaustive list of components:

- Facility and project overview
- Energy saving project intent
- Selected IPMVP Option and measurement boundary
- Baseline: period, usage and conditions
- Reporting period
- Basis for adjustment
- Calculation methodology and analysis procedure
- Energy prices
- Meter specifications
- Monitoring responsibilities
- Expected accuracy
- Budget
- Report format
- Quality assurance

In summary, the table below outlines the steps involved in developing a project which is adherent with IPMVP.

Figure 10
Summary Measurement and Verification Plan



Further information can be obtained by downloading the IPMVP Core Concepts from IPMVP - Efficiency Valuation Organization (EVO) (evo-world.org)

7.22 NZ Roadmap - operational energy conclusion

This guidance has outlined the approaches that can be taken to support the process that Authorities can use in the identification and implementation of carbon reduction opportunities within buildings to progress to NZ for Operational Energy.

However, it is unlikely that there will be sufficient technically and/or economically viable decarbonisation options available to 'achieve' NZ for Operational Energy on a PPP project in one go. Instead, NZ for Operational Energy should be considered as a longer-term target, potentially to 2045, that will require a process of continual review and assessment of decarbonisation options over time.

The viability of decarbonisation technology options could change over time as existing facilities approach end of life, market prices of technologies become more affordable and newer/emerging technologies come to market. Equally as important will be any change in national targets and/or stakeholder led initiatives on NZ, particularly where these might require a PPP project to achieve NZ for Operational Energy in advance of the national NZ target. As previously described, Scottish public sector bodies have targets consistent with the national target to achieve NZ by 2045, and in some cases are pursuing efforts to achieve an earlier NZ transition date. For example, that NHS Scotland becomes a net-zero greenhouse gas emissions health service by 2040 or earlier in line with Scottish Government policy for NHS Scotland on the climate emergency and sustainable development, and contained within the consultation draft NHS Scotland climate emergency and sustainability strategy 2022 to 2026 – draft.

Therefore, it is important to note that a NZ Roadmap will need to be updated and refined over time as more knowledge is gained – it will essentially be an iterative process of continual review and improvement.

Chapter 8
Benefits and Outcomes

8.1 National policy, guidance and statutory requirements

8.1.1 Scotland Net Zero by 2045:

Scotland has a target to achieve NZ by 2045, which is ahead of many countries including the UK whose target to reach NZ is 2050. Scotland has an interim target of a 75% reduction in emissions by 2030 and 90% by 2040, both relative to 1990 levels of carbon dioxide, methane and nitrous oxide and 1995 levels of hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride and nitrogen trifluoride.

Scottish Government also recognises the need to adapt to Climate Change. During the identification, design and development of decarbonisation options, there is a range of Climate Adaptation co-benefits that can be achieved – dependent on the decarbonisation option(s) selected. These are largely linked to Building Level Benefits (see section 8.3) but could result in better resilience to changing temperatures (particular hotter summers), resilience to severe weather and adaptation to changing amounts and frequencies of rainfall.

8.1.2 The Scottish Government's Heat in Buildings Strategy - achieving net zero emissions in Scotland's buildings: Chapter 6 Kick-starting Investment in the Transition

Transforming Scotland's homes and buildings over the next 24 years is a significant investment opportunity that will support supply chains, jobs and a healthy economy.

Alongside raising awareness of the scale of the transition needed for Scotland's building stock, improving quality and consumer trust in the supply chain will be an important part of the journey. The public sector must demonstrate its commitment to transforming Scotland's buildings by taking early and sustained action to decarbonise the public sector estate and improve the energy performance of all public buildings. To achieve this the Scottish Government will consult the Scottish public sector during 2022 to develop and agree a series of phased targets with increased funding available to support delivery of these targets. This will start in 2024, with the most difficult buildings such as acute hospitals being decarbonised by 2038 – for all publicly owned buildings to meet net zero emission heating requirements by 2038. Please Appendix 3 for the relevant link.

8.1.3 Sectoral Commitments to Net Zero

Scotland's public sector is already playing a strong leadership role in the national endeavour to deliver a just transition to NZ by 2045.

Scottish public sector bodies have targets consistent with the national target to achieve NZ by 2045, and in some cases will be pursuing efforts to achieve NZ earlier than the national target. For example, NHS Scotland is looking to bring forward its target date for NZ from 2045 to 2040.

As previously mentioned in chapter 7, it is recommended that a NZ Route Map is set against a target deadline consistent with Scotland's commitment to NZ by 2045, or earlier, particularly in the case that the relevant sectoral commitment is in advance of the national target.

8.1.4 Statutory requirements – Net Zero

In addition to the overarching commitment to achieving NZ at a national and sectoral level, progressing towards NZ will also support public and private sector organisations to comply with existing statutory requirements, and be resilient to future changes. There is a range of statutory requirements that will be supported by the implementation of a NZ Roadmap such as those applied by:

- Energy Savings Opportunities Scheme (ESOS)
- Streamlined Energy and Carbon Reporting (SECR)
- Energy Performance Certificates (EPCs) via the Energy Performance of Buildings (Scotland) Regs

With anticipated strengthening of the above statutory requirements, a NZ Route Map should be developed mindful of both current and future statutory requirements.

8.2 Commercial benefits

8.2.1 Environmental Social Governance (ESG) and Corporate Social Responsibility (CSR)

ESG and CSR (often used interchangeably) frameworks and strategies are being increasingly adopted by public and private sector organisations across Scotland to structure their commitments to operate in a socially and environmentally responsible manner.

A significant pillar of ESG/CSR frameworks is 'environment' and there are typically commitments made both externally to investors/customers/public and internally to shareholders/employees/stakeholders on topics such as:

- Net Zero Carbon
- Science Based Targets
- Climate Change Mitigation and/or Adaptation
- Environmental Management and Compliance
- Circular Economy and Materials Use
- Built Environment or Buildings Management

Following this guidance can support organisations to make a meaningful contribution to their ESG/CSR frameworks and actively support their corporate level decarbonisation agendas.

8.2.2 Social value

Social Value measures the positive value that organisations create for the economy, communities, and society, and is typically structured under five key themes: Jobs, Growth, Social, Environment and Innovation. Organisations can seek to deliver social value when taking forward decarbonisation options as part of their NZ Roadmap.

Some examples of Social Value that can be delivered through decarbonisation options could include:

- Reduce Climate Change – by investing into decarbonisation options
- Procurement – embed social value into procurement processes for suppliers
- Local spend – prioritise the use of local business to deliver services and provide goods and works
- Employment & Skills – support jobs and skills in the low carbon economy
- Resource management – minimising waste

Following this guidance can enable organisations to make a meaningful contribution to Social Value whilst working towards their NZ Roadmap.

8.3 Building level benefits

During the identification, design and development of decarbonisation options, there is a range of additional co-benefits that can be achieved – dependent on the decarbonisation option(s) selected. These primarily relate to Indoor Environmental Quality (IEQ) benefits. These are summarised below:

Benefit	Description
Thermal Comfort	Decarbonisation options that affect thermal performance and subsequently building user comfort (such as fabric/glazing improvements and Low and Zero Carbon heating solutions) can offer an opportunity to address existing thermal issues (e.g. buildings/zones that are too hot/too cold). Climate Change could further exacerbate existing thermal issues with average temperatures increasing, creating excessive temperatures within buildings. Excessive temperatures can lead to overheating, particularly in summer months, which can impact the health and wellbeing of building users.
Lighting Optimisation	Decarbonisation options that affect lighting levels (such as optimisation of natural light, upgrading to LEDs, optimisation of daylighting and daylighting controls, automated/sensor controls, time scheduling and dimming functions) can offer an opportunity to optimise lighting levels. Different building types/zones will have different lighting requirements, but, in general, optimisation of lighting levels is important to minimise discomfort and distraction of building users. Where lighting levels are too high/harsh (i.e. direct and not dispersed), glare can occur. If lighting levels

Chapter 8 (continued)

	are too low this can cause visual straining. Both these instances can result in discomfort and distraction, as well as cause health adversaries such as headaches. Maximising natural light in buildings reduces the need for artificial lighting and can provide building users with exposure to natural daylight cycles. This is considered important for buildings running 24 hours a day as it can aid in the maintenance of natural rhythms.
Improved Air Quality & Ventilation	Decarbonisation options that affect air quality and ventilation (such as fabric/glazing improvements and passive/active HVAC) can offer an opportunity to improve air quality and ventilation. Different building types will have differing optimal air quality and ventilation requirements, but in general good air quality can minimise the risk of respiratory or dermatological conditions/illness, minimise excessive humidity and improve cognitive functionality.
Acoustic Comfort	Decarbonisation options that can affect acoustics (such as fabric/glazing improvements, mechanical and electrical systems) can offer an opportunity to achieve better acoustic comfort (from both internal and external noise sources). Excessive or continuous noise can affect building users in a variety of ways for example, loss of concentration, sleep disturbance and general irritation.

The applicability of these building level co-benefits will vary project to project but should be considered alongside the energy/carbon savings potential as a means of assessing the business case.

Appendices

Appendix 1

Case Studies

This selection of case studies showcases some of the ways where through implementing energy efficiency measures, significant energy saving and carbon reduction benefits can be realised.

It is acknowledged that these case studies are not necessarily all PPP projects, however the underlying principles, approaches and implementation techniques to identify carbon reduction opportunities within buildings to achieve NZ for Operational Energy are similar, particularly at a technical/building level regardless of the initial procurement route.

Appendix 2
Tools and Templates

Energy Conservation Measures (ECM) Whole Life Cost Tool

Scottish Futures Trust has developed an 'Energy Conservation Measures (ECM) Whole Life Cost Tool' designed to assist public sector partners managing operational PPP projects to make informed decisions to optimise a built asset's NZ performance where formal NZ changes or variations are being considered.

The appraisal tool provides a consistent method of comparing ECM outcomes where an Authority is considering NZ changes or variations in existing operational PPP projects. It is both a qualitative and quantitative process that looks at the energy conservation outcomes in costs and relative savings over the remaining period of the PPP project.

The appraisal tool promotes the analysis of whole life outcomes across three assessment criteria: commercial; environmental performance; and environmental savings against a business-as-usual baseline.

This can be used to determine the impact on the financial model of the ECMs across the remainder of the project's concession period. This tool consists of:

- ECM Whole Life Cost Tool
- ECM Whole Life Cost Tool Guidance Note

Users should refer to the ECM Whole Life Cost Tool user guide for detailed guidance on how to use the tool, with particular reference to 'ECM Options Data' and 'ECM Savings', with Annual Emissions Forecasting results displayed on the Dashboard.

Baseline Energy/Carbon Performance and Benchmarking.

This Baseline Energy/Carbon Performance and Benchmarking template is designed to assist users in recording the initial baseline the energy/carbon performance information when evaluating the building (s) base line energy data.

- Template 1 – Baseline Energy, Carbon Performance and Benchmarking. This template structures the approach to collecting information on the physical asset including construction year, building type/use, floor area, listed status, EPC ratings and whether there are existing renewable generation technologies.

Template 1 should be used to validate energy data by collecting information on what data is available, where the data is collected from and its integrity. Template 1 will enable the user to identify any gaps in the data and to provide comment on what information is required in order to obtain a full data set over a 12-month period.

Template 1 should be used to collate annual energy consumption data from all fuel types within the building. Template 1 enables users to insert carbon and energy benchmarks, which can be cross-referenced against industry benchmarks.

Decarbonisation Technology Long List.

This template Decarbonisation Technology Long List is designed to assist users in the identification of the initial longlist of potential technical solutions when considering decarbonisation options for a building(s). The Long List is a helpful checklist for users to identify and evaluate different decarbonisation options, taking a Whole Building Approach.

- Template 2 can be used to identify decarbonisation options that already present in the building and to record whether decarbonisation is considered to be viable in the building.

Decarbonisation Options Projects Register.

This template Decarbonisation Options Projects Register enables projects identified within the decarbonisation options assessment to be catalogued. The project description, technology category/type and relevant energy source type/fuel cost should be input. The project information should then be input which includes total project cost, financial/energy/carbon savings, simple payback and Lifetime Carbon Savings.

- Template 3 supports users to catalogue potential decarbonisation options and to prioritise project opportunities.

Appendix 3
Legislation and Policies

Scottish Government Policy

The Scottish Government designated **energy efficiency** as a **national infrastructure priority** in **June 2015**, covering energy efficiency and heat decarbonisation of both domestic and non-domestic buildings.

Scottish Government's Energy Efficient Scotland programme (2018)

This programme set a structure and "Route-map" for addressing these priorities, with the main objective of removing fuel poverty and reducing greenhouse gas emissions (GHG) in line with national, progressive GHG reduction targets.

- In support of this, the following broad national targets have been set:
- 59% reduction in emissions from non-domestic buildings by 2032 from 2015 levels
- 70% of heat from low carbon sources by 2032
- 20% reduction in non-domestic heat demand by 2032 from 2015 levels
- The equivalent of 50% of the energy for Scotland's heat, transport and electricity consumption to be supplied from renewable sources by 2030.
- Net Zero Carbon by 2045

Climate Change (Emissions Reduction Targets) (Scotland) Act 2019

The Climate Change (Emissions Reduction Targets) (Scotland) Act 2019 set legally binding targets for us to achieve net zero greenhouse gas emissions by 2045, with interim targets requiring a **75% reduction by 2030**, and **90% by 2040**

- Scotland also has higher ambition than UK for 2030 with a commitment to reduce emissions by 75% compared to the UK's 68%.

Heat in Buildings Strategy published on 7th October 2021

"By 2045, emissions of greenhouse gases from heating our home and buildings will have all but disappeared, with the demand for energy reduced and space and water heating provided by zero emissions alternatives".

Summary of heat targets

- Principal emissions reduction target: 68% reduction in emissions from buildings by 2030 against a 2020 baseline as set out in the Climate Change Plan Update.
- Heat networks target: the combined supply of thermal energy by heat networks to reach 2.6 TWh of output by 2027 and 6 TWh of output by 2030.
- New Renewable heat target (provisional): at least 22% of heat in buildings to be directly supplied from renewable sources by 2030.

This strategy also plans to phase out the need to install new or replacement fossil fuel boilers, in off gas from 2025 and in on gas areas from 2030, subject to technological developments and decisions by the UK Government in reserved areas.

Appendix 4
References

- 4.1 The policy for NHS Scotland on the climate emergency and sustainable development – DL(2021) 38
- 4.2 The Consultation Draft NHS Scotland Climate Emergency and Sustainability Strategy 2022-2026
- 4.3 Better Buildings Partnership
- 4.4 British Standard BS EN 16247-1:2012 Energy Audits Part 2: Buildings
- 4.5 British Standard BS EN 16247-2:2014 Energy Audits Buildings
- 4.6 British Standard BS15232
- 4.7 Buildings Energy Efficiency Survey
- 4.8 COVID-19 ventilation guidance is for business owners, employers, building owners, managers, operators and those maintaining buildings
- 4.9 CIBSE F: 2012 Energy Efficiency in Buildings
- 4.10 CIBSE TM22 Energy Assessment
- 4.11 CIBSE TM39 Building Energy Metering
- 4.12 CIBSE in TM46: 2008 Energy Benchmarks Publication
- 4.13 CIBSE's Energy Benchmarking Tool
- 4.14 Degree Days Calculated Accurately for Locations Worldwide
- 4.15 CIBSE TM44: 2012 Inspection of air conditioning systems
- 4.16 CIBSE TM54: 2022 Evaluating Operational Energy Use at Design Stager
- 4.17 CIBSE TM63 Operation performance
- 4.18 Energy Savings Opportunity Scheme
- 4.19 EVO IPMVP - International Performance Measurement and Verification Protocol (IPMVP)
- 4.20 GHG Protocol Corporate Accounting Guidance
- 4.21 Green Book Supplementary Guidance – Valuation of Energy Use and Greenhouse
- 4.22 Gas Emissions for Appraisal
- 4.23 Greenhouse gas reporting: conversion factors 2021
- 4.24 Defra: Guidance on how to measure and report your greenhouse gas emission
- 4.25 ISO 14025:2006 Environmental Labels and Declarations
- 4.26 ISO 5001 Energy Management
- 4.27 ISO 50002:2014 Energy Audits Requirements with Guidance for Use
- 4.28 PAS 2038: 2021 Retrofitting Non-Domestic Buildings for Improved Energy Efficiency
- 4.29 PAS 2060 Carbon Neutrality
- Science Based Targets
- 4.30 UK Company Reporting Guidance
- 4.31 UK Green Building Council (April 2019) Net Zero Carbon Buildings: A Framework Definition
- 4.32 The Carbon and Energy Fund
- 4.33 PPP Projects Nearing the End of Contract: A Programme Approach
- 4.35 Greenhouse gas reporting: conversion factors 2021
- 4.36 Heat in Buildings Strategy - achieving net zero emissions in Scotland's buildings
- 4.37 A Guide to the Statistical Treatment of PPPs
- 4.39 The BIM Level 2 guidance dashboard: Information weblink.

Appendix 5
Other Guidance

Property Asset Strategy in the Scottish Public Sector

The Scottish Government and Scottish Futures Trust are finalising guidance relating to public sector property asset management that introduces the concepts of a systems approach and application of the Scottish Government's investment hierarchy. The guidance suggests that the guiding principles within a property asset strategy should include the adoption of sustainable practices and a route map to net zero carbon emissions which is covered in detail within chapter 7 of this document.

Property Asset Strategy in the Scottish Public Sector will be available on SFT's website from July 2022.

NZPSBS for Existing Buildings

The Scottish Government developed the Net Zero Public Sector Building Standard in 2021. The intent of the NZPSBS for Existing Buildings is to set a clear route to achieving NZ outcomes for buildings in line with the Net Zero Deadline set by each public sector organisation.

Following the principles of the original Standard for New Builds and Major Refurbishments, the NZPSBS for Existing Buildings explores the impact of construction, maintenance and lifecycle interventions under three core principles.

Whilst a voluntary standard, the NZPSBS for Existing Buildings supports organisations consider the impact of not only operational energy carbon impacts of NZ interventions, but the impact on the 'Place', 'Environment' and 'Whole Life' of the building setting outcomes and targets associated with each, in order to 'prove compliance' of achieving healthy, inclusive buildings along a Net Zero path. Standard compliant projects also need to commit to Zero Direct Emissions Heating technology to be compliant; majoring on electrification of heat or opportunities to connect to, or create heat networks.

The NZPSBS for Existing Buildings also majors on 'verifying' outcomes related to NZ investment, proving outcomes 'in use'. Generally, PPP projects benefit from structured energy and internal environmental performance reporting over traditional public sector operating buildings, through monthly reporting and Helpdesk logs. Such activities place PPP projects that at the forefront of buildings where 'in use' outcomes of investments may be appropriately monitored and verified with limited additional time and expense over business as usual activities.

As the NZPSBS for Existing Buildings develops, organisations are encouraged to engage with it and should refer to the latest version of the Standards. Further details of the Standard can be found on SFT's website.

Appendix 6
Glossary and Abbreviations

Introduction

This document provides a consolidated glossary of terms and abbreviations for SFT guidance to identify and deliver carbon reduction opportunities for lifecycle planning and potential alterations on operational PFI, PPP, NPD, hub and DBFM projects and its supporting Requirements, Guidance, templates and tools.

Glossary

Authority's Requirements	Generally means of the requirements set out or identified in Project Agreement in respect to the general construction requirements amended from time to time in accordance with the terms of Project Agreement.
This Energy Conservation Measures (ECM) Whole Life Cost Tool	Developed by the Scottish Futures Trust for identifying carbon reduction opportunities in lifecycle planning and potential alterations on operational PFI, PPP, NPD, Hub and DBFM Projects.
Carbon	The term 'carbon' is used to denote the carbon dioxide equivalent of all greenhouse gas emissions. For example, in referring to the carbon emissions of a gas-fired boiler, this would be deemed to include the carbon dioxide and nitrous oxide products of combustion and methane from any unburnt fuel.
Carbon Offsetting	Carbon Offsetting is the undertaking of actions to remove greenhouse gas emissions from the atmosphere as a counterbalance to a Project's residual emissions that have not been eliminated after exemplary demand reduction and decarbonised supply options have been exhausted.
Carbon Strategy	Carbon Strategy is the strategy that an Authority produces for an existing or planned new building to ensure it progresses from its current condition of emitting carbon to achieving net zero energy supplies by the NZ Deadline applicable to the project, sector and Local Authority Area. A Carbon Strategy will apply appropriate emission factors to energy used in the project, forecasting updates to them as they change overtime. For example, a Carbon Strategy will take account of plans to connect to low carbon heat and power sources that become available through LHEES and other local delivery plans relevant to a specific project. It should also take account of national and UK wide plans for decarbonisation of electricity and gas grids that could affect the project in the future. It will take account of the building's position within the context of the Authority's estate and the locality of the building and will include the temporary application of Carbon Offsetting, where appropriate. Carbon Strategies can include approaches that achieve a balance between onsite renewables, grid connections and other LZC technologies. As the range of technically and commercially viable approaches extends in the future, this may include demand response; continuous selection of onsite generation in response to variations in grid emission factors and price

	signals; deployment of battery storage; electric vehicle charging, combined with vehicle-to-grid supplies; smart technologies; the internet of things; and other innovative approaches and technologies intended to minimise constraints on onsite generators and reduce grid reinforcement requirements. Carbon Strategies should be regularly reviewed to ensure that they are up to date, minimise reliance upon temporary Carbon Offsetting solutions and provide value for money in the transition to net zero energy supplies.
Certified Measurement and Verification Professional (CMVP)	A Certified Measurement and Verification Professional is an accreditation from the Association of Energy Engineers and the Efficiency Valuation Organisation. It is awarded to professionals who demonstrate proficiency in Measurement and Verification and demonstrate the necessary competences to write a Measurement and Verification Plan and support in delivering its planned outputs.
Good Industry Practice	Good Industry Practice means using standards, practices, methods and procedures conforming to the Law and exercising that degree of skill and care, diligence, prudence and foresight which would reasonably and ordinarily be expected from a skilled and experienced person engaged in a similar type of undertaking under the same or similar circumstances.
Guidance	Guidance documents are presented to support public Authorities to better manage current operational assets in a way that helps to future proof investments and considers the impending requirements of the Scottish Government's route to net zero. Where a Participant intends to deviate from Guidance, or where Guidance is not clear for an Authority's specific building category or operations, it is an expectation that the Participant would demonstrate a comparable level of rigour and exemplary performance in the development of the Project's own approach.
Handover	The date at which full occupancy and operations of a Project commences following Project construction and commissioning completion. Largely interchangeable with "Practical Completion".
Inclusive Net Zero Economy Outcomes	In its Key Findings Report (January 2020), the Infrastructure Commission for Scotland established Inclusive Net Zero Economy Outcomes as priorities against which infrastructure investment options should be assessed. It advises: *"To achieve an inclusive net zero carbon economy, the Scottish Government should put "place" at the heart of coherent, infrastructure prioritisation and planning" and that it is essential that existing "assets are, most effectively and efficiently utilised, maintained and enhanced to net zero carbon readiness".* A sample of recommendations from the Key Findings Report relevant to this Guidance is for public sector buildings, drawn from categories Place and Making the most of existing assets, includes: > a place-based approach to ensure delivery of an integrated and coherent outcome-based approach to planning spatial land use undertaken at regional, local and community level

- presumption in favour of enhancing, re-purposing, or maintaining existing infrastructure over developing options for new infrastructure
- new build should only be considered where Authorities have demonstrated this is the most appropriate response
- presumption against like-for-like replacement of existing assets with new single organisation assets in favour of shared facilities
- support the creation of a vibrant circular economy

Low and Zero Carbon (LZC) technologies	Low and zero carbon technologies generate heat, power and cooling with lower emissions than conventional, fossil fuel-based generation technologies. Technologies that input energy entirely from renewable sources, such as kinetic energy from the wind, or heat from the sun are defined as zero carbon. Where a combination of fossil fuel and renewable energy sources are input into a generating technology system, it is defined as low carbon. These definitions exclude embodied carbon. Two examples of zero carbon electricity generating technologies are wind turbines and photovoltaic (PV) panels. Heat pumps supplied with electricity from the grid to generate heat are low carbon heat generating technologies.
Major Refurbishment	This Guidance applies to major refurbishment, i.e. which goes beyond cosmetic renovations (such as painting and decorating). It is intended to apply to lifecycle replacement of significant elements of a building or its services and to remodelling work and alterations intended to modernise or improve a building.
Measurement and Verification (M&V)	Measurement and Verification (M&V) is the process of quantifying and analysing Operational Energy use in a transparent and fair manner. Various protocols for good practice in Measurement and Verification exist, including the International Performance Measurement and Verification Protocol (IPMVP), which defines common terminology and the key steps in implementing a robust M&V process. A key part of the M&V process is the development of an 'M&V Plan', which defines how energy performance analysis will be conducted and the Remediation Actions that may be required where failure to meet set targets is identified.
M&V Plan	A detailed M&V Verification Plan which is developed specific to Objective 3 Operational Energy, in line with the requirements of the IPMVP and approved by a Certified Measurement and Verification Professional (CMVP). The M&V Plan is a part of the Objective 3 Verification Plan, and is only required to be enacted on the failure of the Project's first year's energy performance exceeding the OET.
Mechanical Ventilation (MV)	Where the driving force for the supply of fresh air and/or extract of stale air is provided by a fan.
Natural Ventilation (NV)	Where the driving force for the supply of fresh air and extract of stale air is buoyancy or wind.
Net Zero (NZ)	NZ is the achievement of a balance of zero greenhouse gas emissions by exemplary demand reduction and sourcing decarbonised supplies, followed by taking actions to remove the same quantity of greenhouse gases from the atmosphere as all of the activities under consideration

	generate. For example, an energy efficient house that meets all its energy needs when the sun is shining, exporting surplus generation to the grid, would be able to claim that it had NZ operational energy carbon impacts if the exported electricity was greater or equal to its consumption of grid electricity when the sun is not shining. Alternative routes to NZ in this scenario would include Carbon Offsetting.
Net Zero Deadline	The date by which a Project will achieve Net Zero Operational Energy emissions, as determined in line with National, Local Authority Area or Organisational policy requirements, and incorporated into the Project's Carbon Strategy.
Operational Energy	Operational energy is the total energy supplied to the building by grid supplies, onsite generators, private wire, district heating and other sources for all onsite energy uses, including both regulated and unregulated loads and Separable Uses.
Practical Completion	The point at which a Project initiates operations following successful construction and commissioning of the Project. Largely interchangeable with "Handover".
Project	A new or Major Refurbishment building project as developed by a Authority using this Guidance.
Project Agreement	The Project Agreement means the agreement between the procuring public body and the Implementing project company or special purpose vehicle relating to the implementation of all or part of the project facility(s), as such agreement may be amended from time to time. "Project Agreement", and all appendices, schedules and agreements supplemental to the Project Agreement
Private Finance Initiative	PFI is a procurement method where the private sector finances, builds and operates infrastructure and provides long term services and facilities management through long term contractual arrangements (sometimes referred to as concession agreements).
Public Private Partnerships	Public-private partnerships involve collaboration between a government agency and a private-sector company that can be used to finance, build, and operate projects, such as hospitals, schools and offices and typically includes long term services and facilities management through long term contractual arrangements (sometimes referred to as concession agreements).
Separable Uses	Separable Uses of energy are significant process or equipment loads beyond that which would be expected to occur in the building.
Thermal Energy	Heating, hot water and cooling are thermal energy needs in buildings.
Verification	The process of proving objective target outcomes to prove compliance with the Standard.

Verification Plan	The plan developed by an Authority and its Project Team, finalised at the Detailed Design Stage, to set the activities and reporting required to prove compliance of the individual Objective targets. For Objective 3, the Verification Plan includes the requirement for a more formal Measurement and Verification Plan, as approved by a Chartered Measurement and Verification Professional.
Volatile Organic Compounds (VOCs)	Compounds (a chemical that combines two or more elements) containing carbon that changes easily into a gas and that can be harmful to people's health and/or to the environment. Concentrations of many VOCs are consistently higher indoors than outdoors due to their release from certain solids or liquids within a building.
Whole Life Carbon	Under the Net Zero Public Sector Buildings Standard, Whole Life Carbon relates to the embodied carbon of non-energy operational impacts, such as water supplies, waste disposal and maintenance activities and products for the life of the building.

Abbreviations

BEMS	Building Energy Management System
BMS	Building Management System
CIBSE	Chartered Institution of Building Services Engineers
CMVP	Certified Measurement and Verification Professional
ECM	Energy Conservation Measures or Decarbonisation Options
EPC	Energy Performance Certificate
EPD	Environmental Product Declaration
ESA10	European System of Accounts 2010
ESAG	Environmental, Social and Governance responsibilities
FM	Facilities Management
Hub	The hub Initiative
HVC	High Value Change
HVAC	Heating, ventilation, and air conditioning
hubCo	hub Company
IEQ	Indoor Environmental Quality
IRR	Internal Rate of Return
IPMVP	International Performance Measurements & Verification Protocol
LCM	Life Cycle Maintenance
LVC	Low Value Change
LZC	Low and Zero Carbon
MVC	Medium Value Change
M&V	Monitoring and Verification
NPD	Non-Profit Distributing
NPI	Normalised Performance Indicators
NPV	Net Present Value
NZ	Net Zero Carbon
PA	Project Agreement
PFI	Private Finance Initiative
PPM	Planned Preventative Maintenance
PPP	Public Private Partnerships
PV	Solar Photovoltaics
RACI	Responsible, Accountable, Consulted and Informed matrix for task assignation
SFT	Scottish Futures Trust
SLS	Service Level Specification
UKGBC	UK Green Building Council
VfM	Value for Money