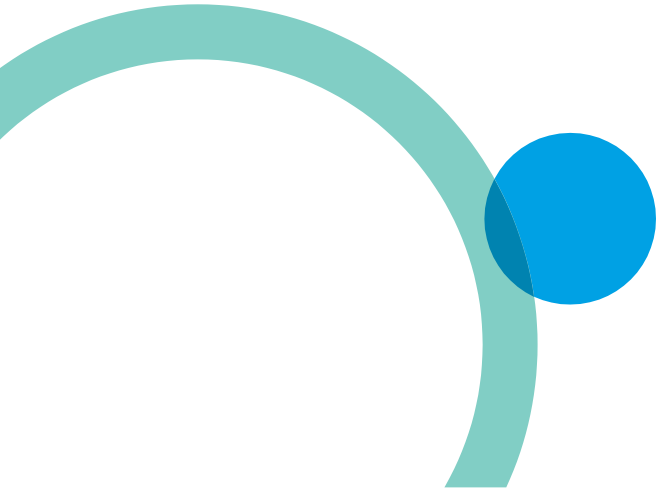
NHS National Services Scotland

Scottish Health Technical Note 02-01

NHSScotland Sustainable Design and Construction Guide (SDaC)



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Background

Sustainable development policy drivers

The NHS in Scotland (NHSS) is committed to the delivery of a resilient, high quality and person-centred healthcare service. In addition to adopting a quality focussed approach that enables this vision to become a reality, NHSS also recognises that a response to the recognised climate emergency is needed to mitigate the health impacts of climate change and to achieve sustainable quality in the present and future delivery of healthcare services across Scotland.

Over recent years the current and future impact of climate change has been well documented, with various associated health risks highlighted within Scotland's summary report of the UK Climate Change Risk Assessment (CCRA)[1]. The European Centre for Disease Prevention and Control[2] recognises the consequences for human health from:

- Changing patterns of infections from vector-borne, and water-borne diseases;
- An increase in the frequency and magnitude of climate events causing flooding and direct injury, as well as the mental health impacts associated with these events;
- Increased illness and premature deaths from poor air quality;
- Increased deaths due to heat waves; and
- Reduced water and food security, leading to malnutrition and diarrhoeal disease.

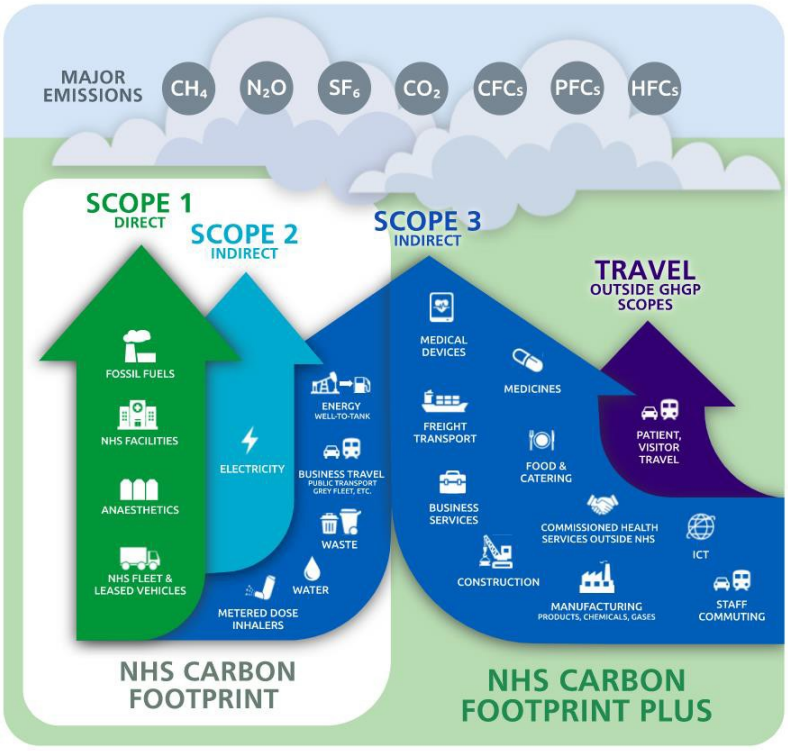
In 2015, all United Nations Member States adopted the 2030 Agenda for Sustainable Development[3]; a shared blueprint that at its heart are the 17 Sustainable Development Goals (SDGs). The Scottish Government has embedded the SDGs throughout the current National Performance Framework[3] (NPF). The NPF sets out a vision for Scotland across a range of social, economic and environmental factors. The NPF highlights the need for a 'whole system approach' to successfully deliver the NPF's national outcomes for Health and recognises the important role that NHSS has in helping to achieve this, ensuring quality healthcare services are available and accessible to all.

The Climate Change (Emissions Reduction Targets) (Scotland) Act 2019[4], which amends the Climate Change (Scotland) Act 2009, sets targets to reduce Scotland's emissions of all greenhouse gases to net-zero by 2045 at the latest, with interim targets for reductions of at least 56% by 2020, 75% by 2030 and 90% by 2040. The Act also details specific climate change duties for public bodies, which includes:

- Climate change mitigation - contribute to the delivery of the reduction targets;
- Climate change adaptation – support Scottish Government programmes;
- Act in such a way that is considered most sustainable.

Sustainable development is now recognised as the core principle underpinning planning and at the heart of healthy and inclusive communities, having a crucial role to play in ensuring a better quality of life for everyone.

Figure 1: Greenhouse Gas Protocol (GHGP) scopes in the context of NHS Source: Delivering a net zero National Health Service, October 2020 www.england.nhs.uk/greenernhs/a-net-zero-nhs/



The NHS in Scotland commitments

In response to Scottish Government's climate emergency declarations and related national commitments, NHSS agreed to a framework of actions to:

- Address the various associated health risks and social impacts that climate emergency brings;
- Meet Scottish Government direction regarding greenhouse gas (GHG) emissions; and
- Meet Scottish Government direction regarding the National Performance Framework outcomes.

Embedding and meeting these needs will require considerable collaborative effort from all who specify, design, deliver and ultimately make use of and benefit from the NHSS estate and assets.

This guide details the various approaches, actions and considerations that are required to deliver valuable performance outcomes relevant to the framework criteria.

Throughout this guidance document, additional supporting standards, signposting to good practice case studies and reference to a number of leading industry frameworks, methodologies and sustainability targets*is provided. Recent good practice case studies, demonstrate that net zero operational carbon and delivering in a truly sustainable way is possible. The challenge is to extend good practice to all future investments and to continue to make improvements from the lessons and learning continuously captured on the way.

Priority themes

In response to national policy drivers and the Scottish Government's Net Zero Public Sector Building (NZPSB) Standard[5], and recognising the importance of the valuable link between sustainable development and health and wellbeing, NHSS has identified the following priority themes to positively influence the future development of their estate, namely:

- **Wellbeing**
- **Circularity**
- **Climate Change**

NHSS has considered key issues under each of these identified themes and a requirement for the wider healthcare estate to responsibly address these issues and to evidence the effective delivery of the desired outcomes. There is also an overarching theme across the whole Guide of 'optimising operational performance'. This is achieved by early and regular engagement of key stakeholders, with decision-making workshops at each key stage to interactively record optimisation of operational performance across each priority theme.

Wellbeing

Issues under the wellbeing theme promote the design and operation of an estate that is considerate to and prioritises the wellbeing of users (including staff, patients, visitors and wider community), through the creation of comfortable, inclusive and healthy internal and external places, with a place-making led approach. These include:

- Healthy Places: Total wellbeing;
  - Total Wellbeing;
    - Social wellbeing;
    - Mental wellbeing;
    - Physical wellbeing;
    - Economic wellbeing;
    - Occupational wellbeing.
  - Place-making;
  - Quality of space.
- Indoor environmental quality;
  - Thermal comfort;

  - Indoor air quality;
  - Air pollutants;
  - Acoustics;
  - Visual comfort;
  - Water quality.

Circularity

Issues under the circularity theme focus on establishing practices that support a more circular economy by aiming to eliminate waste and extract maximum value from resources. This includes:

- Circular design and construction practices;
  - Designing out waste and pollution;
  - Keeping products and materials in use;
  - Regenerating natural systems;
- Circular procurement;
  - Responsible sourcing and supply chains.

Climate change

Issues under the climate change theme seek to enable the delivery of a sustainable and resilient estate that effectively manages climate and ecological risk. These include:

- Operational energy and emissions;
- Embodied carbon;
- Water consumption;
- Environmental security;
- Active travel and sustainable transport.

Optimisation

There is an overarching theme introduced at the start and threading across this guide: ‘optimising operational performance’. This theme aims to govern all projects delivered by all NHSS Boards and signposts to the NHSS Soft Landings and Post Occupancy Evaluation requirements. This is further supported and addressed through the NHSS NDAP, Assure and KSAR processes, which are referenced across this document.

This sustainable development guide has been prepared to support new build developments and refurbishment projects address the commitments and ambitions of NHSS, whilst also enabling these projects to demonstrate their response to national and global policies. This guidance document introduces each priority theme in detail,

highlighting the importance that each plays in enabling the sustainable development of the NHSS estate. Each issue and targeted outcome are referenced, along with detailed guidance that covers all projects lifecycle stages.

An interactive matrix is available to allow early and regular project stakeholder decision-making workshops that effectively consider all issues, confirm each project's aspirations, plus monitor and evidence the projects progress throughout each development stage.

It is a requirement for all NHSS Boards to adopt and follow this guidance for their new build development and major refurbishment projects.

Overarching theme: Optimising operational performance

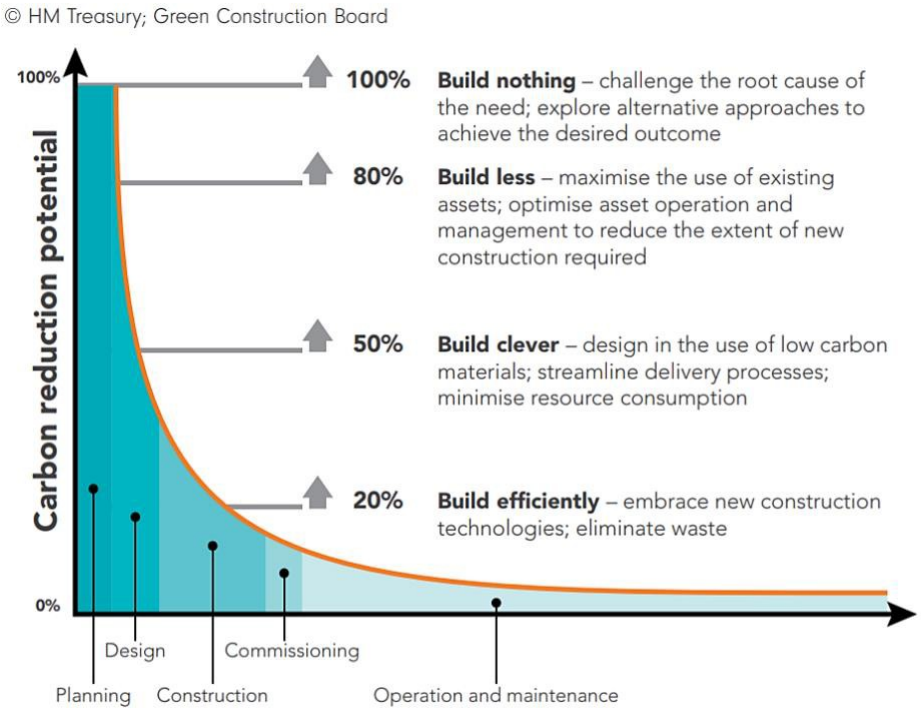
Issue	**Soft landings & Post Occupancy Evaluation**
Outcome	Maintaining a focus on end user needs and narrowing the performance gap between design intent and operational outcomes.
Performance verification	Smooth transition from construction to operation & operational performance outcomes verified in use.

Approach

Importance of early project stages

Key decisions made at the initial stages of a project have the greatest influence on the Sustainability and Net Zero outcomes throughout its lifecycle. In particular evidence of incorporation of this Guide is required for Option Appraisal / Site Selection decisions.

Figure 2: Carbon reduction potential across the lifecycle, Source: PAS 2080, Carbon Management in Infrastructure



Client champion

NHSS Board is required to nominate an independent client-side champion (or champions where deemed appropriate) to liaise with the project team and coordinate efforts in identifying and ensuring the successful delivery of the desired project outcomes. The champion(s) will be required to demonstrate a breadth of knowledge and a level of competency to both challenge and inform the design and delivery process across all lifecycle stages – this will be crucial in successfully steering the project through the soft landings process and achieving the performance outcomes that are referenced within this guidance document. Where appropriate, the champion will also engage with end user groups to identify and promote mechanisms that encourage positive occupancy behavioural changes, for example, in relation to operation, management, maintenance and interaction with the building and its services, features and controls.

Soft landings

NHSS promotes a soft landings approach on projects with the specific goal “to align interests between those who design and construct our assets and those who subsequently use it”.

From the strategic stage, NHSS Boards can practically apply Government Soft Landings (GSL) by utilising the NHSS Interactive Navigator and resource suite[6], assisting projects to align with NHSS values and purpose.

NHSS Boards can take steps to become more informed clients by collating and utilising learning from projects previously delivered; identifying areas of best practice and also considering the reasons as to why any similar projects are not achieving desired outcomes.

Early stakeholder engagement is a key focus of the soft landings process. Early and detailed engagement with end user groups enables design teams to develop a better level of understanding of functional requirements and also better anticipate operational issues.

In accordance with the NHSS GSL Interactive Navigator, projects are expected to integrate the soft landings framework and promote a soft landings approach to ensure that the decisions that are made during all life cycle stages of the project are based on improving operational performance once the development is in use. A strategy should be prepared to integrate this approach and should include detailed activities and critical review stages for the project. This should cover:

- Inception and briefing;
- Option Appraisal / Site Selection
- Concept to technical design;
- Construction;
- Pre-handover & handover;
- Initial aftercare;
- Extended aftercare and post occupancy evaluation.

Post occupancy evaluation

The purpose of a Post Occupancy Evaluation (POE) is to provide a structured evaluation of the process of delivering a project, obtain feedback on the performance of the building / development and verify performance outcomes in use. This allows valuable learning to be captured and recorded that can be applied to new projects as well as providing recommendations that can further enhance the performance of the building / development in use.

The POE process will be required to cover, as a minimum, the first 3 years of building occupation. It is expected that the client-side GSL champion will continue to maintain the 'golden thread' (ensuring the creation of an asset is linked to its intended purpose) and will coordinate and support the delivery of POE. Key performance outcomes and suitable metrics should be agreed during the early stages of the soft landings process.

A mix of qualitative and quantitative data is expected to be captured and analysed during the delivery of the POE to verify how far the intended outcomes have been met and to assess the overall functionality and effectiveness of the development during operation. The proposed methodology and mechanism for data capture and reporting will be agreed with the client in advance.

As a minimum, the following building performance data, along with feedback from occupant consultation activities, is expected to be captured, analysed and reported during POE:

Wellbeing

- Occupant comfort and satisfaction;
  - Level of thermal comfort (e.g. monitored internal temperatures and comparison with design stage assumptions and predictions, such as CIBSE TM52 compliance);
  - Noise (e.g. review of acoustic strategy and perceived performance in use);
  - Healthy indoor spaces (e.g. quality and provision of light, monitored / perceived level of air quality, responsiveness and effectiveness of controls);
  - Positive connection with surroundings (e.g. perceived state of wellbeing);
  - Valued greenspace (e.g. quality including level of biodiversity and / or Green Space Factor, condition and attractiveness of outdoor space, accessibility and reported use by clinical and non-clinical staff, patients and local communities).
- Space fit for purpose (e.g. functionality, effectiveness, accessibility of internal and external spaces);
- Adaptability and flexibility of space (e.g. accommodates change in use or expansion);
- Travel patterns and level of active travel (e.g. travel survey data).

Circularity

- Resource efficiency and carbon reduction (e.g. operational phase review, considering both biological and technical cycles and where these are restorative and regenerative);

- Operational, management and maintenance review (e.g. review of Life Cycle Costing analysis predictions);
- Restoration and regeneration of natural systems (e.g. biodiversity, tree-cover, landscape restoration, soil amelioration and regeneration, water management);
- Circular procurement and supply chains (e.g. the purchase of works, goods or services that contribute to the closed energy and material loops within supply chains, whilst minimising / avoiding negative environmental impacts and waste creation across the whole life-cycle).

Climate Emergency

- Carbon footprint and reporting;
- Operational GHG emissions (e.g. tCO2e per annum);
- Energy Use Intensity (e.g. kWh/m2.yr);
- Confirmation of total energy demand satisfied by renewable technology (e.g. type and contribution);
- Performance and security of energy supply (e.g. on-site generation, demand response, storage);
- Water efficiency strategy (e.g. annual consumption, avoidance of leaks);
- Life Cycle Costing review (e.g. planned and unplanned maintenance, replacement, refurbishment, carbon impacts etc.);
- Review of greenspace management / green infrastructure / landscaping / biodiversity on site (e.g. effectiveness of strategy and operational costs);
- Review of pollution control strategies (e.g. flood risk, water management, air or noise pollution).

Projects will be required to undergo a KSAR POE and should capture and report data utilising the POE report data on the foregoing topics utilising the POE template included within the interactive matrix which accompanies this guidance document and for inclusion in the KSAR process.

Wellbeing Guidance

Issue: Healthy Places - Total wellbeing

The World Health Organisation states that wellbeing is *"a state of complete physical, mental, and social wellbeing, and not merely the absence of disease or infirmity*". It is therefore vitally important that the design and operation of healthcare buildings strive to support and enhance the total wellbeing of all users.

Research has demonstrated that wellbeing can be linked to a number of different benefits including improved physical and mental health, faster recovery times from illness, greater productivity and an overall healthier lifestyle.

The relationship between building design, green and blue infrastructure and wellbeing is one that is well documented and recognised as having significant impact on an individual's health and wellbeing. For a development to be considered truly sustainable, the health and wellbeing of all users should be prioritised and considered alongside the environmental and economic impacts.

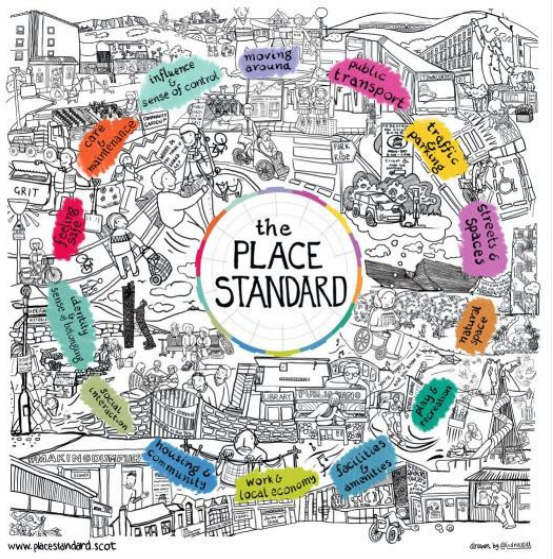
Place Based Approaches

The National Performance Framework (NPF) is Scotland's wellbeing framework. It recognises the importance of understanding, respecting and developing relationships between people and place and how this can improve wellbeing.

The Place Standard supports the national outcomes that are referenced within Scotland's NPF and provides a framework that enables these to be delivered. The Place Standard tool[7] can be used to identify aspects of a Place within a community setting that need to be targeted to improve people's health, wellbeing and quality of life.

'Our wellbeing is shaped by the places where we live, learn, work and visit'- Place Standard Strategic Plan.

Figure 3: Alignment of NPF and the Place Standard outcomes Source: Scottish Government



The Place Standard tool provides a simple framework that enables users to structure conversations about new and existing developments, focussing on place-making and community. Project teams can utilise the tool to assess:

- **The physical environment** - the buildings, streets, public spaces and natural spaces that create a place;
- **The social environment** - the relationships, social contact and support networks (e.g. social, emotional, informational, instrumental) that make up a community.

The Place Standard recognises a community setting place-based approach as '*a holistic approach to identifying opportunity and needs within a particular place and addressing issues through collaboration across services and sectors*'. It is important to understand a place and its influence on individuals and the community to ensure views, stories and experiences are captured and recognised and positively influence the decision making process on a project.

For Healthcare settings, Scottish Government mandates the use of NHSS specific Place Standard type tool: AEDET (Achieving Excellence in Design Evaluation Tool). Guidance and the Tool is available to view online:
www.pcpd.scot.nhs.uk/Capital/scimpilot.htm

- AEDET guide;
- AEDET spreadsheet.

This Scottish Government website also hosts NHSScotland Design Assessment Process (NDAP) guidance:

- NDAP guide;
- NDAP form.

The NDAP is recommended for all NHSS development projects, plus is mandated under A Policy on Design Quality for NHSScotland (CEL-19-2010) as part of the Scottish Capital Investment Manual (SCIM) for any project requiring Business Case approval by Scottish Government. The initial stage is stakeholder group coproduction in facilitated workshops of the NDAP Design Statement. This sets bespoke qualitative benchmarks, for use in creating and assessing the design proposals throughout.

The transition to a net-zero society will require a significant level of adaptation and will have some impact on every individual. A place-based approach can support coordinated and collaborative action to mitigate the effects of climate change and it can also support and involve local communities in planning, shaping and preparing for the changes that will be required. The level of community acceptance, support and ownership can have a significant impact on how well received and how successful a project is perceived to be.

The environmental benefits include:

- Improving air quality;
- Supporting green infrastructure;

- Climate change mitigation strategies; and
- Local biodiversity enhancements.

The wellbeing benefits include:

- Creating internal and external places that people can engage with and relate to;
- Increasing accessibility and inclusion; and
- Greater levels of physical activity amongst end users and key community groups.

Place and placemaking are also important components for enabling and prioritising a number of the other issues that are addressed within this guide, including active travel, sustainable transport and environmental security.

Social wellbeing

The design and quality of the built environment influences social wellbeing and presents opportunity for positive interaction. The Place Standard should be applied during the early design stages to help drive more positive outcomes. The Place Standard tool can help to identify the needs of a project, align priorities and investment and empower communities by allowing their views to be articulated. The Place Standard should be re-applied during the design development stages to help improve and finally assess the impact of the proposed development.

Economic wellbeing

Inclusive growth is a central component of Scotland's economic strategy; one which aims to tackle inequalities in outcomes and in opportunities. Inclusive growth encourages all public sector bodies to work together and to promote collaborative approaches focused on achieving multiple economic and place outcomes.

At a community level, a thriving local economy can provide work opportunities and help create vibrant places where people want to spend time and where businesses want to invest. Healthcare development can be viewed as the 'anchor store' or linchpin of local economy. Healthy places that are accessible to all that they serve and that support a variety of desirable purposes, including healthcare, employment, education, leisure, recreation and attractive public spaces, have the potential to demonstrate resilience to wider economic change and can more easily adapt to changing circumstances.

Clients and project teams should work together to identify where collaborative opportunities could exist between professions, public sector organisations, businesses and communities to maximise prospective wellbeing benefits and further integrate healthcare services. This should include exploring the potential for Community Wealth Building[8] as an approach to delivering inclusive economic growth.

Physical wellbeing

Physical inactivity is one of the leading causes of premature death in Scotland. Evidence shows that even small increases in activity can help to prevent and treat chronic diseases and improve quality of life. Within hospitals, immobility leads to deconditioning, a loss of physical and cognitive functionality, that potentially lengthens patient stay and increases risk of complications. Environments that enable

healthy choices for all, and reduce bedbound-ness, together with initiatives like https://endpjparalysis.org/ can promote wellbeing.

Promoting greater levels of physical wellbeing can be achieved through a considered and purposeful design approach, encouraging and enhancing opportunities for safe physical activity and promoting more active lifestyles. Design examples could include stairs which are purposely visible and accessed beside lifts, active or standing workstations for some desk-based duties, regular resting places, window seats, accessible landscaped areas, displays of public art, external water features, external seating, space designed to encourage walking / wheeling, dedicated and convertible exercise space, and activities such as growing spaces or outdoor meeting space etc., all of which can encourage small amounts of physical activity throughout the day.

Healthcare developments can also positively impact the health and wellbeing of individuals at a community level, through integrated planning and inclusive delivery approaches that promote and support people in being active regularly. Providing opportunities to participate in physical activity can build confidence and an individual's level of ability. This can enable people to be physically active throughout their lives and achieve multiple health, social and economic benefits.

Occupational wellbeing

Occupational wellbeing focuses on the ways in which a working environment affects health and wellbeing.

Occupant wellbeing can be enhanced through design by ensuring the surrounding environment adequately supports the individual in the delivery of their role.

Research has shown that happier workforces that are motivated by their place of employment maintain higher standards of practice and demonstrate levels of increased productivity. There is also evidence to suggest that design which promotes greater interaction, respect and ownership of or connection with surroundings, ensures a number of benefits including lower levels of absenteeism, improved morale and motivation and fewer work-related injuries.

Occupational wellbeing should be enhanced through the creation of desirable spaces that are fit for purpose and by design choices that encourage enjoyment and appreciation of the work place and surroundings. End user engagement and developing an understanding of end user needs can help to inform design that supports occupational wellbeing for all.

Mental wellbeing

An individual's mental health is influenced by several biological, psychological, social and environmental factors. Mental health can have a strong influence on physical health, learning, performance and productivity and on the quality of interpersonal relationships.

Mental wellbeing has been described as the positive aspect of mental health. Steps to promoting mental wellbeing can include connecting with other people, engaging in physical activity and mindfulness. These steps can all be positively influenced through the design of buildings and their interaction with external spaces.

Biophilic design seeks to incorporate elements of nature within a building, better connecting occupants with the outdoor environment. Biophilic designs have been proven to enhance wellbeing, reducing stress, enhancing clarity of thought, lowering blood pressure and aid healing and recovery[9]. Examples include:

- A view of nature;
- Non-visual stimuli, such as sense, touch, smell, sound;
- Presence of water e.g. in the external landscaped space;
- Dynamic lighting, varying intensity of light to mimic natural daylight rhythms;
- Biomorphic patterns and shapes of nature, or mimicking natural designs; and
- Spatial hierarchy, creating a natural alignment of space throughout the building.

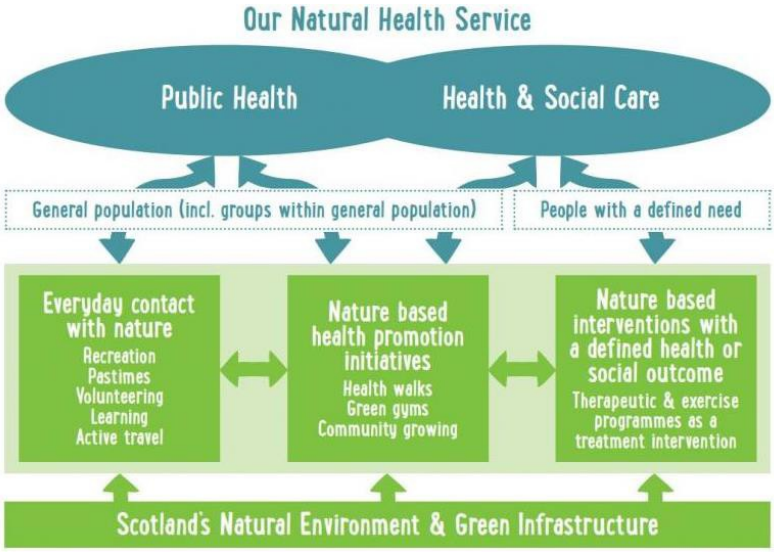
Supporting mental wellbeing is important for public health, education, the economy and society and should be recognised and promoted through the design and operation of healthcare buildings.

Quality of space

The quality of internal and external environments is of significant importance due to the effect that this is known to have on the wellbeing of users with the recognised health benefits being of particular interest to NHSS. Well designed, natural spaces and high-quality green infrastructure that supports a network of multi-functional green space, along with other sustainable circularity and climate change co-benefits, can deliver enhanced social, physical and mental wellbeing and aspects of environmental security that benefit whole communities.

The Building with Nature Standard[10] is an example of one resource that offers practical advice that can be applied at every stage of the development process, from policy and planning to management and maintenance, supporting developments in the delivery of high-quality green infrastructure. NHS Forth Valley Royal Hospital and Larbert Woods is a featured Building with Nature case study, showcasing the fusion of the built and natural features on the site and documenting the health, therapeutic and environmental benefits that have resulted from a landscape led approach.

Figure 4: Natural health service diagram Source: NatureScot, Our Natural Health Service



WELBEING: W1. Healthy Places - Total wellbeing

Issue	**W1. Healthy Places - Total wellbeing**
Outcome	Design that promotes a state of total wellbeing through the creation of healthy, accessible, desirable and conscious spaces.
Performance verification	Adoption of the Place Standard engagement tool for Community settings, plus AEDET and NDAP tools for Healthcare settings, to identify, coproduce and assess design quality benchmarks that deliver healthy spaces for all.

SCIM	RIBA Plan of work	Guidance
Strategic Assessment	 0: Strategic Definition	**W1.1** **Strategic priorities** Consider how a service design that delivers healthy places and supports total wellbeing through the creation of quality, accessible and desirable spaces will support NHSS values and sustainability strategic investment priorities.
Action: Apply POE learning & adopt soft landings approach		
Initial Agreement	 1: Preparation and Briefing	**W1.2** **Total wellbeing** Within the brief, commit to promoting design that supports and prioritises physical, social, mental, occupational and economic wellbeing of all users. Commitment to: • Promote social wellbeing by encouraging inclusive design that creates opportunities for integration and positive connection with others, in both indoor and outdoor environments. • Encourage design that promotes inclusive growth, enabling greater equality and more inclusive practices. • Promote physical wellbeing through the design and delivery of healthy, comfortable and active places. • Encourage design that promotes the occupational wellbeing of all users through attractive and supportive internal and external environments. • Support Mental wellbeing through sensitive internal and external design solutions and the creation of conscious spaces. **Place standard, AEDET & NDAP** The clinical and functional requirements of the development must be clearly defined and understood as this will inform and influence early option and / or site appraisal activity. The Place Standard, AEDET and NDAP should be adopted early, and evidenced throughout the briefing, design and POE stages to establish, drive and realise positive outcomes. Engage diverse stakeholder groups through collaboration and coproduction to access knowledge and views that will help influence and shape change that will enable the delivery of functional, healthy, welcoming, active, inclusive and accessible environments, inside and out. Stakeholder engagement should include staff, patients, carers, visitors and the wider community groups. This activity is also a key role of the Soft Landings Champion.

WELBEING: W1. Healthy Places - Total wellbeing

The Place Standard, AEDET & NDAP must be re-applied for key decision-making during the design development stages to improve and challenge the proposed development solutions as they emerge.

To optimise operational function as a community asset, consideration should be given to site location and supporting sustainable growth models: access to and provision of more sustainable and active travel; local communities and housing; complementary amenities and service provisions (e.g. catering, supplies etc.).

Quality of space

The brief should also require the delivery of high-quality green infrastructure that supports a network of multi-functional green space, delivering enhanced wellbeing and environmental security aspects that can benefit full communities. The Building with Nature principles should be applied.

Additional support is available to Boards through Architecture and Design Scotland and is encouraged to be sought at an early stage to maximise the opportunity to positively influence the strategic briefing stage.

Early OBC

2: Concept Design

Evidence of the optimisation for operational performance of this Guide, including Wellbeing, Circularity and Climate Change will be required for key decision-making throughout, and assessing potential for Healthy Spaces will be crucially important at key early project stages e.g. Option Appraisal / Site Selection.

W1.3

Holistic approach to wellbeing

Adopt an approach that recognises, establishes and promotes the relationship between building design, valuable external space and total wellbeing.

Create a clear connection between design and users (including staff, patients and local community). Acknowledge stakeholder feedback and respond to this when developing a holistic design approach to addressing wellbeing. This should also include any proposed outdoor and / or green health activities and arts strategies, which should be developed collaboratively with a landscape architect and arts co-ordinator.

Prioritise the inclusion of valuable green and blue infrastructure that can provide attractive spaces for people to connect with nature, receive care and socialise. Actively consult with clinicians to explore opportunities and inform designs for outdoor spaces that enable outdoor therapies (e.g. physio therapy spaces, sensory spaces, destination spaces, green gyms, counselling, places of sanctuary, growing spaces for horticultural therapy and healthy food production education, laundry and domestic activities in mental health settings and complementary activities etc.). Consider how these spaces interact with and support the aims of the ‘Environmental security’ issue.

Incorporate accessible natural and semi-natural spaces that offer environmental and wellbeing benefits, improving both physical and mental health. This should promote access to physical activity and interaction as well as encourage active

space, for therapeutic interventions, calm and contemplation spaces that allow f travel. Promote the inclusion of green spaces that are well designed and easily maintained and that are attractive to end user needs e.g. for use as a relaxation or one-to-one dialogue and areas for community use.

Design for integration of inclusive, safe and valuable internal and external spaces that promote positive social interaction.

Promote mindfulness through an integrative design approach; provide an element of therapeutic connection and interaction for users.

Promote design that encourages enjoyment and appreciation of the work place / surroundings; demonstrate that the design has recognised and responded to end user needs.

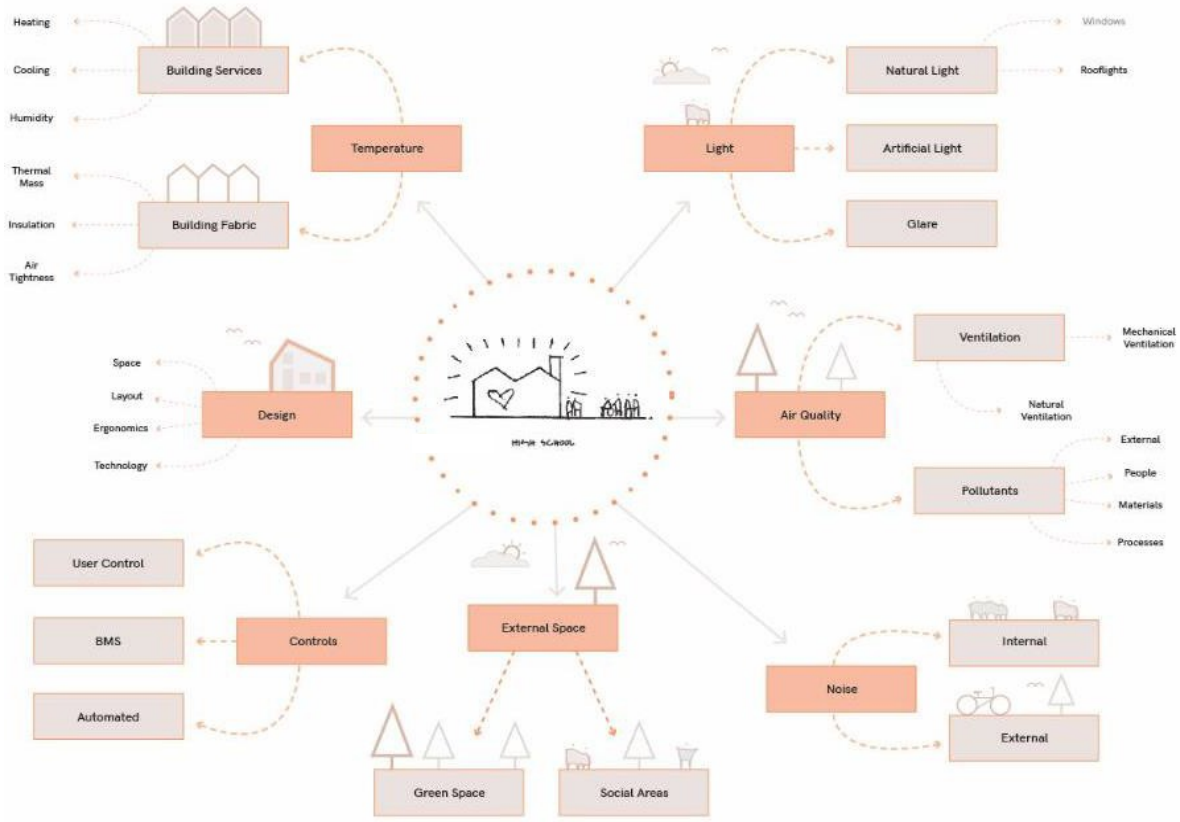
WELBEING: W1. Healthy Places - Total wellbeing		
Final Design Statement		Consider how the principles of the Community Wealth Building initiative can support the inclusive growth and economic wellbeing aspirations of the project. Consider any negative wellbeing impact of the design (internal or external) or that the building operations may have on any neighbouring properties and ensure appropriate mitigation measures are adopted. Examples include ensuring the external lighting strategy is in compliance with the Institution of Lighting Professionals guidance and the reduction of obtrusive light, and that a noise impact assessment is carried out by a qualified acoustician to ensure there will be no cause of disturbance to any noise sensitive areas. Identify and adopt appropriate design performance parameters that support the agreed wellbeing and quality outcomes. The holistic design approach to total wellbeing and associated benefits should be summarised and communicated with the full project team.
Final OBC	 3: Spatial coordination	**W1.4** **Integrated approach** A properly structured dialogue with clinicians and end users is essential to inform ergonomic design solutions and the creation of healthy, high-quality internal and external spaces that work together to support and enhance the wellbeing of all users. The coordinated design strategy should address how each of the following aspects of wellbeing integrate and support each other: • **Physical**: Design and spaces that encourage individual's good public health behaviours e.g. movement, vitamin D, hydration, autonomy; Inclusion of active routes, furnishings etc, reducing sedentary behaviour; • **Social**: Spaces that encourage engagement and social relationships; promote positive interaction with space and others; • **Mental**: Design that creates conscious spaces and heightened awareness - users take notice, engage and learn; Biophilic design and sensory stimulation – promotes an increase in occupant connectivity to the natural environment and aids healing and recovery; • **Occupational**: Creation of desirable places that are fit for purpose; Design promotes interaction, respect and ownership of surroundings; • **Economic:** Accessible healthcare provision and complementary amenities; Affordable and healthy consumables (e.g.freely available and accessible drinking water, affordable and healthy food and snacks), Inclusive, well-developed internal and external spaces; Community growing space and wealth building.
Performance review - pre-planning:		Internal approval required – Complete evaluation matrix and report on Place-based tool outcomes. Summarise proposed wellbeing strategies and desired level of impact.
Final FBC	 4: Technical Design	**W1.5** **Approve final specifications** Utilise stakeholder feedback to inform final specification details. Ensure communication with end user groups is maintained and expectations are managed. Detailed technical design requires knowledge sharing, co-ordination and an integrated approach across all design disciplines to ensure the building and all indoor and outdoor spaces are progressed, developed and finalised in a harmonised way.

WELBEING: W1. Healthy Places - Total wellbeing		
		Consider end user experience (level of control, influence and connection with different spaces and the development as a whole) and usability testing through the use of mock-ups and / or simulation walkthroughs with end user groups. Review all management and maintenance requirements, seeking FM and / or estates management input where appropriate. This activity will feed into the Soft Landings process and should inform the FM strategy.
Performance review - pre-construction:		Internal approval required – Update evaluation matrix and place-based tool outcomes and report any changes. Summary of design contribution against wellbeing issues.
Construction and Commission-ing	 5: Manufacture and Construction	**W1.6** **On-going engagement** Level of expected user interaction with internal and external spaces and features should be documented, communicated and demonstrated to building users. Detailed information on the wellbeing strategy should be included and promoted within the development user guides.
Project Monitoring and Evaluation	 6: Handover	**W1.7** **Aftercare** Showcasing of all wellbeing aspects to end users during handover and aftercare sessions. Signposting to wellbeing information included and promoted within the Building User Guide, detailing design features, intended use and associated benefits.
Performance verification – 'as built' / pre-occupation		Internal approval required – Update evaluation matrix. Summarise wellbeing strategy and intended benefits.
Project Monitoring and Evaluation	 7: Use	**W1.8** **Structured POE programme** Functional performance monitoring and analysis through qualitative and quantitative data to assess impact of wellbeing strategy and quality of space: occupant consultation and review of management and maintenance strategy. **Data disclosure** Encourage full transparency and knowledge share, supporting learning and providing data that can help inform future strategies.
Performance verification – in use		Internal approval required – Completed POE reporting template including qualitative and quantitative measurements and reporting. Include end user wellbeing survey results.
Resources		The Place Standard Tool[7]; AEDET; NDAP Warwick and Edinburgh Mental Wellbeing Scale[11]; NHS 5 steps to mental wellbeing[12]; Unlocking the potential of NHS Greenspace for Health and Wellbeing[13] Building With Nature[10] Greenspace Scotland[14] NatureScot[15]

Issue: Indoor Environmental Quality

A building's internal environment can have a significant impact on the health and wellbeing of the occupants. With building standards and passive design strategies requiring buildings to be more tightly constructed, a greater importance is being placed on the quality and comfort levels of the indoor environment.

Figure 5: Design considerations and the impact on Internal Environmental Quality



An Indoor Environmental Quality (IEQ) plan can be used to determine the quality of conditions inside a building. IEQ can be determined by a number of factors and consists of both qualitative and quantitative measures. Factors to consider include:

- Thermal comfort: Temperature and humidity levels and responsiveness of building controls;
- Indoor air quality: Levels of CO_2 concentrations, moisture and ventilation rate;
- HAI-SCRIBE duties: e.g. location of fresh air intakes;
- Odours: Movement of air, dispersion of odour and air pollutants;
- Acoustics: Internal acoustic levels and internal and external sources of noise pollution;
- Quality of light: Quality and use of natural and artificial lighting levels and glare;
- Functional aspects of space: Adequate provision, layout and access to equipment and sufficient space for occupants;
- Controllability: Level of local and centralised control and the management and effectiveness of these;

- Occupant satisfaction: Perceived comfort and wellbeing levels.

Thermal comfort

Healthcare buildings should be designed to provide comfortable internal environments for the diverse healthcare services and occupancy groups that they serve. Thermal discomfort can have an immediate and serious impact on occupant health and wellbeing and temperature extremes can worsen chronic conditions. Heat also has indirect health effects, including altering human behaviour, the transmission of diseases, health service delivery, air quality and critical social infrastructure. It is therefore vitally important that the design of buildings is accurately modelled to ensure that they deliver comfortable and stable internal environments for all occupants, during all seasons and for both present and predicted future climatic events.

When considering the benefits of natural light, careful consideration should be given to building orientation, the balance of window to wall areas and the volume of glazing and provision of shading on each elevation, ensuring that the design identifies and mitigates any significant overheating risk. External glazing solutions should be considered and designed to effectively reduce the risk of overheating, whilst still offering occupants access to daylight and views out. Window design and internal layout should be influenced by building orientation and the impact on daylighting provision and user comfort. Glazing on the East / West facing facades can present higher overheating risk due to low angle winter sun and similarly southerly orientations can present risk due to high angle summer sun. A passive design approach and detailed dynamic simulation modelling should be delivered at an early project stage to assess and identify suitable mitigation measures, therefore minimising any significant risk of overheating, whilst ensuring that the building can still benefit from good levels of daylight. Considerate design and external shading strategies can help to ensure adequate levels of thermal comfort.

For a thermally enhanced building, with almost zero thermal bridges and low air permeability, to be at risk of overheating, it could be as a result of one of or a combination of the following:

- Excessive glazing and / or no adequate external shading provision, resulting in excess solar gain;
- Lack of appropriate means of ventilation, unable to cool the building effectively;
- Absence of adequate night time purging to remove heat from the building by bringing in cooler night air;
- Air temperature outside is higher than that inside, any air brought in to the building could increase the temperature (known as urban heat island effect, with a higher likelihood in densely built-up city areas than rural locations);
- Internal heat gains not effectively managed or accurately reflected in design modelling; the rate of heat emissions from occupants as well as the contribution from systems / equipment can be significant and should be recognised and factored into early design considerations.

Achieving a highly energy efficient building, that offers good levels of thermal comfort and air quality, should consider all of the above, in a holistic and integrated way, and

adequately address the following from the very start of the feasibility and design process:

- **Fabric:** Improving the thermal performance of fabric may be beneficial in terms of retaining heat during cold weather, however it can also be effective at managing excess heat gains and maintaining a better thermal balance by keeping heat out of a building's occupied spaces during warmer months;
- **Thermal details:** Thermal bridging is very important, particularly as the thermal performance of fabric improves. Eliminating thermal bridges aims to ensure that there are no cold spots in the building which could easily lead to one or a combination of issues, such as:
  - Dampness;
  - Condensation;
  - Mould growth;
  - Poor air quality; and
  - Lower comfort levels.

  It is recommended that design teams assess the projects thermal details to help understand and mitigate this risk.
- **External shading:** To effectively manage and control the level of solar gain through glazing, adequate external shading solutions and the provision and location of glazing should be considered right from the very start of the design process. The design and provision of external shading is vitally important in successfully managing and mitigating overheating risk. Building orientation and sunpath modelling should be considered and modelled very early in the design development stages. Elevations that face from South through to West are more susceptible to solar gain. Glazing on Southwest, West and also East elevations can often present higher overheating risk due to low angle sun and are likely to require angled, vertical external shading solutions. Similarly, south orientations can present risk due to high angle summer sun and are likely to require horizontal shading solutions. A number of good practice case studies demonstrate, through post occupancy monitoring of passive design buildings, that by incorporating a level of glazing on the south elevation and successfully managing solar gain by means of installing adequate external shading solutions, thermal comfort can be maintained, whilst achieving good levels of daylight and views out that enhance occupant wellbeing in use;
- **Thermal mass:** Design and construction also plays a part in managing overheating in any building. Buildings with high thermal mass can help to effectively regulate daily internal temperatures. During colder periods the heat stored during day time is slowly released at night. During warmer periods, heat stored during day time may need to be effectively rejected at night - this is often when an effective ventilation strategy is required;
- **Massing and form factor:** Massing refers to a building in three dimensions, the general shape and form as well as size. A building's form factor is the ratio of its external surface area (parts exposed to external conditions) to the internal floor area. The greater the ratio, the less efficient the building and the higher the energy demand. For example, a form factor of less than 3 could help to improve the energy efficiency of a building;

- **Ventilation:** The required ventilation strategy will be dependent on the building, its use and location. This should be modelled using detailed simulation software and making use of accurate building information and operational patterns (obtained via early detailed user engagement sessions). Building design and full passive analysis should be delivered first to drive down the energy requirement for ventilation and heating;
- **Heat gains:** The impact of internal heat gains should be fully and realistically addressed. Early detailed simulation modelling can be used to measure and assess the impact on the internal environment and user comfort levels. Occupancy patterns and activity levels should be fully considered along with a realistic understanding of the type of equipment that is likely to be present and operable within a space. Every effort should be taken to optimise the efficiency and performance of equipment. All internal heat gains, including those from specialist healthcare equipment, should be recognised and accurately reflected during the early stage detailed modelling analysis. End users are ideally placed to help advise on typical operational scenarios and engagement with these groups is vitally important to understand how spaces should and need to operate; it is expected that the Soft Landings Champion will be engaged on this task;
- **Other factors:** The location of the building may present a number of different challenges, all of which need to be recognised and considered in any design decision making. This could, for example, include external air pollution or noise levels and the impact that these may have on any design and / or proposed services strategy. The purposeful integration of the natural landscape can often deliver significant benefits e.g. existing or established planting can offer shading provision, noise baffling, improved air quality and support an increase in biodiversity levels;
- **Detailed simulation modelling:** It is recommended that an overheating assessment is delivered in accordance with CIBSE TM52 and CIBSE TM59 guidance. This will consider hours of exceedance, daily weighted exceedance and upper limit temperature. Care should be taken to ensure accuracy of details that are fed into any detailed simulation model as this will influence the accuracy of data that comes out. CIBSE TM54 and CIBSE TM61 provide guidance on input data requirements.

Indoor air quality

Indoor air quality can have a significant impact on occupant health. Poor levels of indoor air quality can have immediate negative impacts on the physical wellbeing of occupants and may result in eye, nose and throat irritation, headaches, dizziness and fatigue. The World Health Organisation reports that continued exposure to poor levels of air quality can contribute to more severe long-term health issues such as asthma, respiratory diseases, heart disease and cancer.

Detailed planning and analysis can help to inform measures that ensure good levels of internal air quality are maintained at all times, which in turn can help to reduce the presence of common indoor air pollutants and irritants such as carbon dioxide, nitrogen dioxide, and volatile organic compounds, thereby reducing the level of risk to occupant health.

The preparation of indoor air quality plans and detailed modelling can help to identify potential contaminant sources and appropriate mitigation strategies. Computational

fluid dynamic (CFD) modelling can examine the airflow within a space in great detail and can help to assess the performance of a building HVAC system. CFD enables the study of the variation in flow patterns due to the space conditions, meaning that greater consideration can be given to occupant comfort, air mixing, stale air and pressure distribution for diffuser selection. The CFD model should include specifics of the space environment, such as furniture arrangements which will have a direct effect on airflow direction along with capitalising on surface boundary data, temperatures and flow rates, available from an energy model to enhance the model quality.

Visual comfort analysis

Visual comfort is an important part of promoting occupant health, comfort and wellbeing. Naturally lit environments are proven to support the regulation of circadian rhythms, increasing occupant comfort and patient recovery times. Glare and poor quality lighting can cause occupant discomfort and distraction. Maximising exposure to good levels of natural daylight and providing an external view out provides users with a connection to nature and enhances overall wellbeing.

Climate based daylight modelling (CBDM) is a process that can analyse daylight profiles and the quality of daylight that is expected inside a building throughout a typical year. CDBM uses local climate weather data to analyse the light received under varying external conditions throughout a typical year. Climate-based modelling delivers predictions of absolute quantities that are dependent on the location and the building orientation, in addition to the building's composition and configuration. Traditionally, buildings may have only targeted a Daylight Factor; however, this methodology assumes an overcast sky at a static period of time, which does not accurately represent the overall annual building performance. CBDM takes into consideration the whole year and the seasonal variations of sunlight throughout.

The quality and provision of artificial lighting is important in terms of occupant wellbeing and operational efficiency. Inappropriately specified artificial lighting could result in lighting levels that are two or three times greater than the level required.

Acoustics

The acoustic performance of a building plays a significant part in supporting the overall wellbeing of users. Care should be taken to ensure that sources of noise pollution, from within and external to a building, are not expected to have an adverse effect to occupants or neighbours. Potential sources of noise pollution could include building systems, occupants, equipment and external sources, such as the operation of building services equipment, transport, noise from street sounds etc. Exposure to levels of noise pollution over a period of time can have a negative impact on occupant wellbeing and can cause disturbance, loss of concentration, decreased productivity and performance levels and disrupted sleep.

Patient care and confidentiality must also be carefully considered within the acoustic design strategy. The design should aim to avoid scenarios where there is a perceived risk of transfer of sound from any patient care / consultation area to other areas within or external to the building (e.g. through any openable windows).

Building acoustics therefore play an important part in ensuring the operational building continues to support occupant wellbeing and that there is no adverse impact as a result of any sources of noise pollution (to or from the building).

WELBEING: W2. Indoor Environmental Quality

Issue	**W2. Indoor Environmental Quality.**
Outcome	Internal environments are designed to create healthy and comfortable spaces for all occupants.
Performance verification	Indoor Environmental Quality monitoring to be predicted during design stage and verified in use.

SCIM	RIBA Plan of work	Guidance
Strategic Assessment	 0: Strategic Definition	**W2.1** **Strategic priorities** Consider how indoor environmental quality will support NHSS values and sustainability strategic investment priorities (Person Centred, Safe, Effective Quality of Care, Health of Population and Value & Sustainability).
Action: Apply POE learning & adopt soft landings approach		
Initial Agreement	 1: Preparation and Briefing	**W2.2** **Indoor Environmental Quality** Within the brief commit to promoting and prioritising Indoor Environmental Quality factors. This issue focusses on particular aspects of design that are closely linked with physical wellbeing. This requires internal environments to be designed in an inclusive and integrated way, creating healthy and comfortable spaces for all occupants. **IEQ strategy** There is a requirement to produce an IEQ strategy (environmental matrix). The strategy should adopt best practice guidance in respect of the healthy internal spaces, such as those described within CIBSE TM40: Health and wellbeing in building services, and should consider an appropriate approach for the following: • **Thermal comfort**: Temperature and humidity levels and responsiveness of building controls. • **Indoor air quality**: Levels of CO_2 concentrations, moisture, ventilation and provision of fresh air intake (ensuring extract and intakes are adequately positioned to avoid recirculation of air and all intakes mitigate any source of pollution). • **Odours**: Movement of air, dispersion of odour and air pollutants (considering also the impact of any management and maintenance issues, e.g. cleaning products and toxicity levels). • **Acoustics**: Acoustics, internal and external sources of noise pollution and patient care and confidentiality. • **Visual comfort and quality of light**: Quality and provision of natural and artificial lighting and glare avoidance. The appropriateness and benefits of circadian lighting. • **Water quality:** Water quality that is suitable for use and consumption, encouraging users to stay hydrated. • **Controllability**: Level of local and centralised control and the management, effectiveness and responsiveness of these systems.

WELBEING: W2. Indoor Environmental Quality

- **Functional space**: Adequate provision, layout and access to equipment (management and maintenance) and sufficient, comfortable space for occupants**.**
- **Occupant satisfaction**: Perceived comfort and wellbeing levels, staff happiness and wellbeing levels.

Stakeholder engagement

This activity should link closely with the Soft Landings activity. Stakeholder engagement exercises should be used to obtain adequate levels of feedback from future occupants. Previous lessons and learning should be captured and used to inform future strategies.

The accuracy of dynamic simulation modelling results is greatly influenced by the accuracy of the information that is utilised during the modelling exercise. Therefore, every effort should be made to ensure user profiles and all assumptions are considered and reviewed. It is expected that 'sense checking' with appropriate end user groups (including HFS / FM / Estate Management representatives) will commence at an early stage and continue throughout all project delivery stages.

Early OBC

2: Concept Design

Evidence of the optimisation for operational performance of this Guide, including Wellbeing, Circularity and Climate Change will be required for key decision-making throughout, and assessing Indoor Environmental Quality potential will be important at key early project stages e.g. Option Appraisal / Site Selection

W2.3

Thermal comfort analysis

A thermal comfort analysis should be delivered during early concept design stages to assess the overheating risk. For example, to assess comfort and risk, a full detailed thermal analysis should be delivered in accordance with the NHSS Detailed Energy Modelling Guide and with CIBSE AM11. All results should be communicated to the client for consideration (with input from the wider delivery team) and next stage approval.

As part of this analysis, the following should be addressed:

- Scottish Health Technical Memorandum 03-01 Specialised ventilation for healthcare premises should be followed. Thermal comfort levels in patient and clinical areas should be in accordance with the temperature and humidity ranges set out in NHSS guidance e.g. SHTM 03-01. Other occupied spaces not covered in this guidance should be considered in accordance with CIBSE Guide A Environmental Design, or otherwise instructed by the Board.
- The building should be designed to limit the risk of overheating both now and in the future. The building design should demonstrate an element of resilience and is required to also consider the risk of overheating for a projected climate change environment, specific to appropriate geographic locations and predicted weather variations (typically 2050 and 2080 impact scenarios). This will be demonstrated in accordance with CIBSE TM52 and where appropriate CIBSE TM 59. There are 3 criteria which assess the level of overheating and projects are required to provide demonstratable compliance with all 3 criteria, or provide appropriate mitigation measures where necessary;
  - **Criterion 1:** Hours of Temperature Exceedance
  - **Criterion 2:** Daily Weighted Temperature Exceedance
  - **Criterion 3:** Upper Limit Temperature

WELBEING: W2. Indoor Environmental Quality

- A zoning and control (central and local) strategy and how this will link to and operated via the Building Energy Management System (BEMS) must be discussed and agreed with the client. This should be informed by end user engagement and reflect the needs of the building in use.
- The results of the full analysis should also be shared with and discussed with the client, with a clear indication of any predicted comfort issues and potential mitigation measures.
- The building should be designed to offer adequate levels of external shading to help manage direct solar heat gains. Fixed and moveable options should be explored to allow optimum use of direct solar gains from the lower angle winter sun and reduce excess gains during summer. The natural environment should be considered and where shading from planting (existing or new) can be achieved this should be recognised. Other design features such as green roofs, reflective/absorbance levels of materials and finishing etc. should be incorporated into the design. Care should be taken to ensure that the provision or location of shading does not conflict with the operation of artificial lighting control systems.

Visual comfort analysis

To enhance occupant wellbeing, occupied patient, staff and visitor areas should benefit from a view to an outside space via a window or opening that is within 8m. Ideally, this should be to a landscaped or external space that offers a connection with nature.

Internal areas that are considered to be at risk from glare must be identified. The results from a glare control and climate based daylight modelling (CBDM) analysis must be used to inform early design development. A report on the predicted impact of glare and mitigation strategies must be shared and discussed with the wider design team. Consideration should be given to internal surfaces, colour schemes and reflective finishes in addition to shading provision.

The CBDM results should be shared and discussed to consider whether or not internal spaces are adequately illuminated by daylight and if there is the potential for visual discomfort from too much direct or in-direct sunlight. The CBDM should investigate and report on the following:

- Useful Daylight Illuminance
- Annual Sunlight Exposure
- Spatial Daylight Autonomy

The CDBM should explore the potential for employing daylight harvesting to reduce artificial lighting energy use. Trusted sources should be referenced when considering setting limits for lighting loads and power density. CIBSE recommended illuminance levels for healthcare should be followed. Optimum illuminance levels and colour rendering index should be discussed and agreed, ensuring that these are appropriate for the end use and follow the relevant SLL Code for Lighting standard. Good quality and provision of natural light in all occupied spaces should be sought and agreed where appropriate e.g. between 300 lux and 3000 lux for regularly occupied spaces. Projects are expected to demonstrate compliance with LG02: Lighting for healthcare premises (2019). The most appropriate lighting solutions and levels must be considered for each functional space. Power density should be reviewed and agreed with the client / Soft Landings Champion and should support the end use/function requirements.

The provision and quality of daylight should be considered holistically; occupied areas should promote good levels of occupant comfort at all times (such as visual, thermal and acoustic). Glazing ratios and fenestration must also consider overheating risk, with effective mitigation. Effective internal and external shading solutions should be explored and should be designed to meet the needs of the end user, with appropriate level of control. Care must be taken to ensure

WELBEING: W2. Indoor Environmental Quality

shading strategies do not compromise the desired levels of natural light within occupied spaces.

Acoustics

Early engagement of an acoustician is expected to advise on the acoustic design strategy and performance of the building, referencing SHTM 08-01 and HBN 08-02. The outcomes and recommendations from an early-stage review should be presented to and fully discussed with the client.

End user feedback should be recognised and the proposed acoustic strategy should be reviewed and agreed with the client. Care should be taken to ensure that acoustic comfort levels or client confidentiality is not compromised in any way during the building operational stages (e.g. as a result of sound transmission via an openable window within a patient treatment or consultation area).

Indoor air quality

An indoor air quality plan should be prepared to minimise and manage risk of indoor air pollution during occupation. A site assessment will be required and the plan should consider external air quality and any emissions from the ground, such as radon.

The plan should identify and address any potential contaminant sources that can impact indoor air, such as PM2.5, PM10, CO_2, VOCs, Formaldehyde and biological contaminants. Consideration must be given to internally generated emissions, such as mitigating any harmful emissions from construction products and installed equipment, and externally generated emissions, such as those from transport or industrial processes, that may migrate indoors through openable windows, doors or ventilation systems. Proposed systems must function with no air recirculation and consideration must also be given to the location of intakes and extracts, ensuring that these are located far enough apart and from sources of external pollution, for example no less than 10m.

The plan must adequately consider the effective management and maintenance of a healthy indoor environment in use. This must include proposals for the removal of contaminant sources, dilution and control of contaminant sources and procedures for pre-occupancy flush out.

The design should target CO_2 levels of <900ppm for staff and patient occupied internal spaces where areas are mechanically ventilated. End user feedback must be recognised (typically gathered via Soft Landings activity) and the air quality strategy should be reviewed and agreed with the client (including spaces where extra precautions may be required and lower levels of CO_2 concentrations may be desirable). The strategy must reflect the complexity of the building and needs of the building users, this will include input and review from relevant FM / Estate Management representatives.

The plan should include details of requirements for post completion internal air quality testing.

It is advised that CFD modelling is considered to analyse and predict internal air movement, particularly for more complex buildings and / or service solutions.

Water quality

Public water provided by Scottish Water is regulated to ensure water is of an appropriate quality to be fit for human consumption, defined in legislation as ‘wholesome’. If a Board own or use a private supply, it is important to assess the quality of the supply and mitigate any associated risks to ensure that water is wholesome (potable). Testing should be undertaken in conformance with NHS Scotland guidance, e.g. SHTM 04-01 Part C.

Final Design Statement

WELBEING: W2. Indoor Environmental Quality

Final OBC	 3: Spatial coordination	**W2.4** **Monitoring indoor environments** Occupied areas (staff and patient) are likely to benefit from indoor air quality monitoring and as a minimum, levels of CO_2 concentration (measured in ppm) and internal temperature should be monitored. Additionally, where there are areas that may be subject to large / variable occupancy patterns air quality sensors should be specified and have the ability to alert the user or automatically control demand when pre-determined air quality levels are breached. All sensors should be monitored and programmable via an integrated BMS. The location of sensors and the operation of management and monitoring systems should be discussed and reviewed with the client – this should include engagement with Estates Management representatives. To minimise the negative impact on air quality and human health from emissions associated with construction products (such as interior paints, wood-based products, adhesive, sealants and acoustic, insulation, flooring, ceiling and wall materials) following indoor air emission concentration limits should be met through the specification of natural and low / zero emission materials: • Total VOCs <0.5mg/m^3 • Formaldehyde <0.1mg/m^3 **Local control** In addition to centralised control options, ensure users are provided with an adequate level of local control over their internal environments where appropriate. All controls should be intuitive and responsive. This should be discussed and agreed with the appropriate end user groups, likely to be coordinated via the Soft Landings Champion.
Performance review - pre-planning:		Internal approval required – Complete evaluation matrix and report on IEQ strategy and targets.
Final FBC	 4: Technical Design	**W2.5** **Modelling and change control** All modelling should be updated at technical design stage and results should confirm compliance with the targeted IEQ outcomes. Change control procedures should require any changes in specification and outcomes to be communicated and agreed with the client. **Management and maintenance** A review of planned management, maintenance and cleaning strategies, ensuring that these continue to support healthy internal environments through reducing the use of toxic products. This should be discussed and reviewed with the Soft Landings Champion. Building User Guides (BUGs) should be prepared for visitors, the everyday building occupier (non-technical guide) and for the estates and maintenance teams (a technical guide). An overview of both the building and landscaping and external features should be provided. The guides are expected to effectively communicate: • The environmental strategy; • Provide an overview of systems and services and the expected level of end user engagement / control / effective operation; • Highlight any building specific operational procedures; • Procedures for any incident reporting;

WELBEING: W2. Indoor Environmental Quality		
		• Travel and amenities; and • Access and security procedures. Final content and level of detail should be reviewed and agreed with the client.
Construction and Commission-ing	 5: Manufacture and Construction	**W2.6** **Acoustics testing and inspection** A programme of pre-completion acoustic testing should be carried out in accordance with the requirements of Section 7 of SHTM 08-01 and there is a requirement for a post installation inspection to confirm compliance with the SHTM08-01 criteria (or identified acoustician recommendations that have been pre-approved by the client). **Indoor air quality testing** Indoor air quality testing, confirming levels of TVOCs and formaldehyde, must be undertaken prior to occupation of the building. Where the limits for these are exceeded, adequate remedial measures must be carried out and any re-testing requirements delivered. The client should consider and agree with the team if additional internal monitoring programmes / testing is required.
Performance review - pre-construction:		Internal approval required – Update evaluation matrix and report any changes. Confirmation of model in use predictions.
Project Monitoring and Evaluation	 6: Handover	**W2.7** **Aftercare** Communication and promotion of IEQ strategy, local control provision and physical wellbeing aspects to end users during handover and aftercare sessions. Inclusion of IEQ strategy and level of user interaction to be included within the BUGs, to be prepared prior to handover.
Performance verification – 'as built' / pre occupation		Internal approval required – Confirmation that models represent 'as built' and information is updated in the 'digital twin' for operational monitoring.
Project Monitoring and Evaluation	 7: Use	**W2.8** **Structured POE programme** Functional performance monitoring and analysis through qualitative and quantitative data to assess internal environment: occupant consultation and internal environment monitoring. Activities linked with wellbeing issues (including water quality, cleaning and the use of toxic products, infection control etc.) should be addressed and required information documented and reported as part of the Key Stage Assessment Review (KSAR) process. **Data disclosure** Encourage full transparency and knowledge share, supporting learning and providing data that can help inform future strategies.
Performance verification – in use		Internal approval required – Completed POE reporting template including qualitative and quantitative measurements and reporting.

WELBEING: W2. Indoor Environmental Quality	
Resources	BSRIA Indoor Environmental Quality[16]; The WELL Building Standard[9]; RIBA Sustainable Outcomes Guide[17]; CIBSE Guide L Sustainability[18]; WGBC Air Quality in the Built Environment[19]; WHO Air Quality Guidelines[20].

Circularity guidance

Issue: Circular design and construction practices

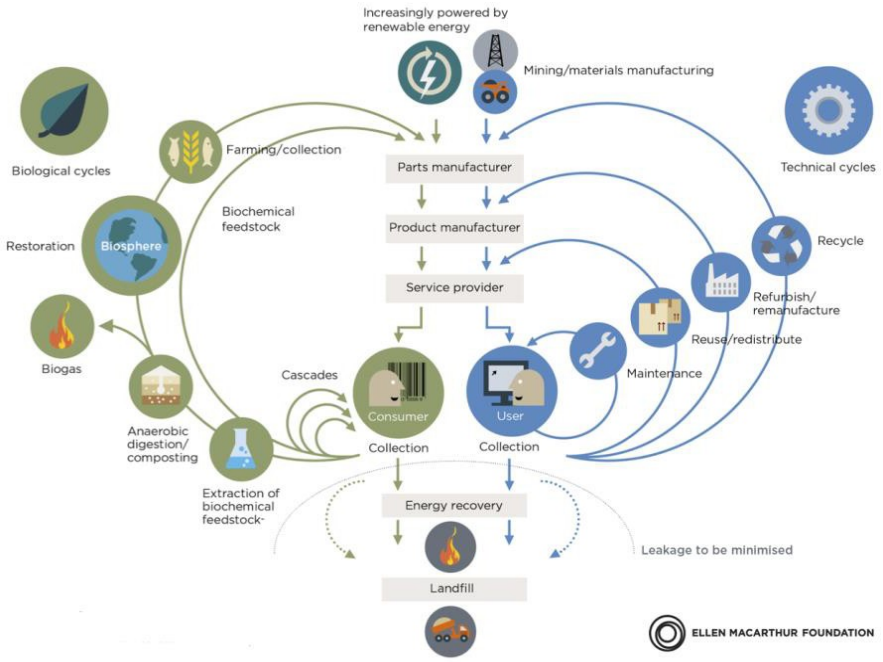
A circular economy is now considered an essential part of the solution to the recognised global climate emergency; where products, services and systems are designed to maximise value and minimise waste.

"A circular economy is one that is restorative and regenerative by design, and which aims to keep products, components and materials at their highest utility and value at all times, distinguishing between technical and biological cycles" – Ellen MacArthur Foundation[21].

Moving towards a more circular economy can have a hugely positive impact on communities, the environment and businesses. Adopting circular design and construction processes increases supply chain resilience and certainty and reducing the amount of money lost on wasted construction materials. 80% of Scotland's carbon footprint is caused by the goods and materials which we produce consume and often waste. Switching to a circular economy is a key part of the solution to responding to the climate emergency. Some studies estimate that making this shift could eradicate almost 20% of Scotland's overall carbon footprint by 2050.

Guidance published by Zero Waste Scotland (ZWS) estimates that Scottish public sector spending on products and services amounts to £11 billion (10% of the Scottish GDP) annually[22]. Considering that the built environment sector accounts for around 50% of Scotland's resource use, with some studies reporting that 13% of construction waste is new, unused material, it is evident that there are significant environmental and economic benefits as a result of transitioning to a more circular economy. Furthermore, Circular Economy case studies published by ZWS estimate that taking action on reducing waste in projects can result in savings of up to 2% of the total construction project value.

Figure 5: : The Circular Economy, Source: Ellen MacArthur Foundation



Key principles

A Circular Economy seeks to conserve and value all resource use and is guided by principles that:

- **Design out waste and pollution**: Adopting waste-efficient procurement and construction practices; designing for material optimisation and resilience; planning for deconstruction; and responsibly managing site waste.
- **Keep products and materials in use**: Recover and restore products, components, and materials through reuse and repair strategies, remanufacture or recycling.
- **Regenerate natural systems**: Avoid the use of non-renewable resources and preserve or enhance renewable ones, for example by returning valuable nutrients to the soil through food waste composting, or using renewable energy as opposed to consuming fossil fuels.

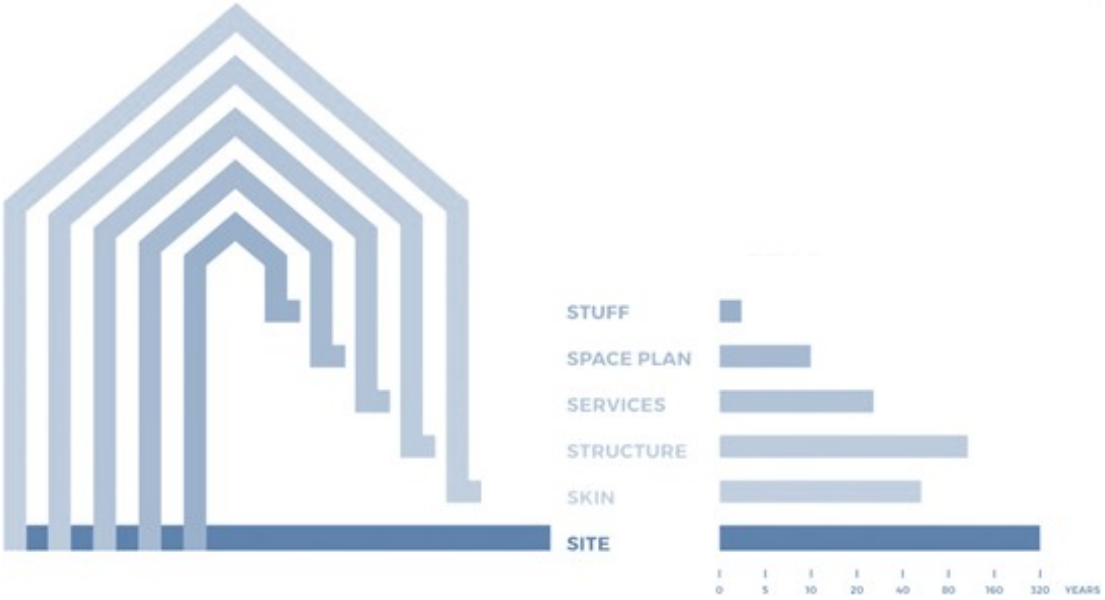
Applying these principles to the built environment should be at a strategic planning stage and a detailed design level in order for all future development to be resource efficient across all stages of its lifecycle. The design and construction of buildings plays an influential role in helping to transition to a more circular future. Adopting a circular design and construction approach will conserve resources and reduce carbon emissions, by keeping products and materials in use for longer.

Design in layers

Consider the lifetime of each element of a building project separately and aim to optimise durability, resilience and lifespan. An example of this approach is provided below:

- Building Shell (e.g. 50-75 years lifespan): Spacious cores and risers enable flexibility to adapt to changing demands; Use bolted rather than welded connections.
- Services (e.g. 15-20 years lifespan): Ensure services are accessible for ease of repair or replacement; Consider modular systems that will allow simple upgrades to services without the need for whole system replacement; Consider products as services (e.g. lighting as a service offering, leasing a lift service or leasing a façade). Product manufacturers may have the opportunity to offer or establish circular economy principles to their own business strategies, which could result in more cost and resource efficient solutions.
- Interiors (e.g. 5-10 years lifespan): Consider modular designs that enable partitions to be dismantled and relocated into different configurations, allowing a space to be easily modified.
- Settings, furniture and equipment: Consider the ease of repair or replacement of consumables; Specify products that can easily be recycled or broken down at the end of life.

Figure 6: Design in layers – element lifespan



Circular concepts

To capitalise on the opportunity and achieve the desired impact, the strategies, structures and operations that currently exist to support a more linear approach to growth should be challenged and evolve in such a way that they enable and promote circular approaches.

All projects should consider design and construction processes and the procurement of products and services that could benefit from one of the following concepts:

- **Optimisation** – Where there are opportunities to design out waste, to optimise / increase performance across every project lifecycle stage or to remove waste in production and supply chain;
- **Regenerate –** A shift away from fossil fuels towards renewable energy and opportunities to reclaim, retain, and restore health of ecosystems;
- **Circular supplies** – Where there are opportunities within the supply chain to specify renewable resources and recycled / recyclable products and materials;
- **Product as a service** – Where the procurement of a service could be considered as opposed to a product (e.g. lighting, lifts, flooring, office and IT equipment etc.);
- **Sharing resources** – Where there is the opportunity for more efficient use of resources through shared partnership agreements (e.g. Rooms, equipment, fleet - overcapacity or underutilisation addressed through shared public partnership);
- **Prolong product life** – Where there is the opportunity for buildings or products to be reused or to prolong life through maintenance and design for durability, adaptability or upgradability;
- **Resource recovery** – Where products are designed and optimised for a cycle of disassembly and reuse; designing for deconstruction and enabling remanufacture and reuse, giving a new life to products at the end of their initial lifecycle;

- **Digitalisation** – Where there is opportunity to digitalise resources that previously may have required equipment to prepare them and space to store them (e.g. printed paper documents) and where there is opportunity to expand a digital health care offering.

Resources

Zero Waste Scotland (ZWS) is funded by the Scottish Government to provide free support to help accelerate circular economy in the construction sector. A number of resources, including guides and support, are available and can be accessed via the ZWS website.

In June 2020, ZWS published a resource 'Construction Resources For a Circular Economy'[23] that signposts to a number of general circular economy construction resources and good practice examples and provides more detailed information on the key principles and how best to apply these.

In April 2019 the UK Green Building Council added a resource to their website 'Circular economy guidance for construction clients'[24]. This is a detailed step-by-step guide aimed at assisting clients in understanding the key principles and how to practically apply circular economy principles at the project brief stage.

The Ellen MacArthur Foundation[21] is an organisation dedicated to working with businesses, government and academia to build a framework for an economy that is restorative and regenerative. There are number of resources, including circular design guides and signposting to case studies, made available online.

Cradle to Cradle Certified™ is global certification scheme, recognising more sustainable products made for the circular economy. The freely available and searchable product registry can support responsible design and procurement decisions[25].

CIRCULARITY: CE1. Circular design and construction processes

Issue	**CE1. Circular design and construction processes**
Outcome	Promoting a more circular economy through circular design and construction processes.
Performance verification	Confirmed increase in the level of recycled and the level of recyclable materials utilised & a significant reduction achieved in the amount of construction waste generated.

SCIM	RIBA Plan of work	Guidance
Strategic Assessment	 0: Strategic Definition	**CE1.1** **Strategic priorities** Consider how circular economy principles will support NHSS values and sustainability strategic investment priorities.
Action: Apply POE learning & adopt soft landings approach		
Initial Agreement	 1: Preparation and Briefing	**CE1.2** **Zero waste solutions** Within the brief, commit to promoting circular economy principles and circular business models by requiring all projects to adopt circular design and construction processes, work towards achieving zero waste solutions and regenerating natural systems. **Approach** Commit to a circular procurement hierarchy approach, as defined by Zero Waste Scotland: • Prevention; • Reduce; • Reuse; • Recycle; • Recover; The above approach will include full consideration of reuse of an existing asset where this is a viable option. The following should be explored via a pre-refurbishment / pre-demolition audit: • Opportunity for refurbishment or repurpose of an existing asset; • Opportunity to recover materials and products on site (or from another site) for reuse; and • Opportunity to share materials or products for onward reuse (where they cannot be used on this site). **Opportunity for intervention** Consider the options available and identify the most suitable circular economy approaches for the project. Discuss and agree these with the project team and relevant stakeholders. This should act as a guide for the project as the design starts to develop.

CIRCULARITY: CE1. Circular design and construction processes

There are opportunities to apply circular economy principles at every stage of the building lifecycle, these should be identified and planned for. Best practice industry resources should be consulted, for example the UK GBC's 'Circular economy guidance for construction clients[24]'.

Early OBC

2: Concept Design

CE1.3

Option / Site Assessment and Project strategy

Assessment for circularity will inform Option / Site selection process.

A project specific circular economy strategy must be prepared to guide design development. This should be informed by considering each identified opportunity for intervention against the following and identifying suitable metrics:

- Design out waste and pollution from the start
  - Work towards achieving zero waste solutions. Host focused design and construction workshops and encourage a collaborative approach to determining the most suitable approaches for the project to design out waste and pollution; and to maximise reuse during demolition, construction and future life of the building components;
  - Design out the need for components or materials (e.g. through prioritising and optimising passive design solution; specifying finishes that avoid the need for paint etc.);
  - Consider options for alternative methods of design and construction (e.g. waste reduction and higher quality assurance levels that could be achieved from modern methods of construction such as off-site manufacturing);
  - Utilise BIM to create a materials library / knowledge bank of what materials and products are specified for use in the building. Host review workshops with the aim of reducing material intensity;
  - Apply standardised elements or modular designs for materials and products that enable a reduction in construction waste and support reuse. This information can be easier to quantify and represent within BIM and can also support the future disassembly and retrieving of materials. Consider working towards achieving <5% 'special' components across standardised and/or modular designs;
- Adopt responsible design, procurement and construction practices;
  - When specifying new materials, whole life impacts should be considered (as addressed under the Operational Emissions and Embodied Carbon issues). Care should also be taken to ensure the specification of materials and products have minimum adverse effect on the environment or on human health (as addressed within the Wellbeing section and particularly in relation to air quality);
  - Maximise the use of recycled content and secondary aggregates. Where available, a high proportion of locally sourced material with recycled content and secondary material should be prioritised and specified. Agree and commit to setting targets for quantities of reused content and sourcing of recycled content per element / sub-element;
  - For example, as a minimum, aim to maximise recycled content and minimise embodied carbon impact by considering the following:
    - Engineered fill, up to 100% recycled content;
    - Maximising local recycled aggregate use;
    - Blockwork and concrete paving, at least 50% recycled content;
    - Insulation, at least 50% recycled or natural content;

CIRCULARITY: CE1. Circular design and construction processes

  - Plasterboard, 100% recycled content with option to recycle any waste;
  - Carpet tiles, at least 50% recycled content;
  - Asphalt roads and surface course mixes, maximise recycled content;
  - Maximising Ground Granulated Blast furnace Slag (GGBS) cement substitutes, aiming for at least 50% substitution;
  - Minimum 90% recycled steel.
- A responsible procurement strategy should be prepared. For new products, request evidence of responsible sourcing (e.g. C2C certified, PEFC, BES 6001 etc.) and prioritise the use of products that eliminate hazardous substances and increase recycled and recyclable (e.g. opportunity for re-use, remanufacture, repair or recycling) content. Report the predicted levels of recycled and recyclable products within the building;
- Ensure unnecessary toxic treatments and finishes are avoided;
- Design for waste efficient procurement (e.g. utilise delivery and return logistics options with material suppliers; use suppliers' incentivised return options);
- Design for longevity by considering the impact of operational wear and tear and provide adequate levels of protection / robustness. High risk building elements and landscaped areas should be identified and appropriate measures identified to avoid unnecessary cost and material use resulting from the need to repair and replace damaged elements;
- Design for durability and resilience, minimising costs and disruption resulting from wear and tear and environmental degradation to building elements as a result of avoidable weathering and changing climatic conditions. Identify the building elements and landscaped areas considered to be at risk and detail proposed mitigation strategies;
- Balance the needs of the present with consideration of how these may change in the future. Ensure that the built asset allows for a level of flexibility and functional adaptability to cope with a diverse range of future scenarios (to be discussed and agreed with the client and key stakeholders). Ensure the design and location / provision of services etc. do not compromise the level of adaptability that may be required;
- Identify all operational waste streams and enable the responsible management of these. Provide solutions that can accommodate the predicted levels of operational waste and support the segregation and responsible storage / management of waste. Design should support circular business models. This should be in accordance with SHTN3 NHS Scotland Waste Management Guidance Part A-Best Practice Overview and Part B Waste Management Policy template;
- The contractor is required to prepare a resource management plan and commit to work towards achieving zero waste targets. This should complement the circular procurement hierarchy; prevention, reduce, reuse, recycle and recover best practice resource management practices;
- Onsite waste management should be set up to enable reuse, with recycling as a final option. It should be agreed that packaging from all products that are delivered to site should be taken back by the supplier for reuse or recycling;

CIRCULARITY: CE1. Circular design and construction processes

- Design to restore and regenerate natural systems;
  - The approach should consider and identify how best to:
    - Assess, protect and enhance site and local biodiversity;
    - Support landscape restoration;
    - Maximise use of natural and non-toxic products;
    - Support soil amelioration and regeneration;
    - Support efficient water management and pollution control strategies.
- Design for assembly, disassembly and recoverability
  - Consider the strategy for end of life and how the design and construction approach will support this. The design should enable ease of assembly and reconfiguration for alternative future uses with minimal disruption (e.g. design of interior systems for disassembly);
  - There is a requirement to design for deconstruction and disassembly. Materials should have the option to be taken apart through mechanical and reversible fixings to allow for future reuse. Ensure fixings are easy to access to enable disassembly;
  - The design should promote layer independence, while ensuring safety. Ensure the removal, adjustment or replacement of some elements is feasible; recognising different components have different life spans and maintenance needs;
  - Plan for reuse, recovery and recycling and report on the estimated volume of reusable and recyclable materials at an element / sub-element level (e.g. kg/m^2). The BIM materials inventory should provide a detailed breakdown of all of the building elements and the suitability for each material to be reused/recycled;
  - Product manufacturer information should be captured and recorded, outlining the future life of the products and how these can be reused or repurposed.

Product life spans

Realistic and expected product lifespans should be considered for each element of the building, identifying where there is likely to be a need for planed refurbishment or replacement. This can be achieved by following the ‘designing in layers’ principles. This will allow for intervention points to be identified for the structure and skin, services, interior spaces, settings/furniture and equipment and for suitable objectives and metrics to be identified.

Analyse the design

Aim to extend the life of the components that are considered as ‘durable’ (e.g. building services).

Where components are considered as ‘consumables’ (e.g. carpets), ensure that these can be easily recycled into new products.

Consider the management and maintenance implications of the design and products (e.g. products designed for swap-outs, remanufacture and replacement).

Consider the opportunity for reused / recycled and recyclable product use and integrate this with Life Cycle Assessment (LCA), Life Cycle Costing (LCC) and carbon budget reporting.

CIRCULARITY: CE1. Circular design and construction processes		
Final OBC/ Final Design Statement	 3: Spatial coordination	**CE1.4** **Supply chain** Engagement with the supply chain is essential in order to determine viability and to further explore available options. Develop relationships with supply chain partners to better understand what possibilities exist to successfully deliver the project whilst meeting the principles of a circular economy. Utilise available resources e.g. UKGBC and Ellen MacArthur Foundation published case studies and resources made available via Zero Waste Scotland's website to help signpost to businesses and manufacturers that are embracing circular economy principles. **On-going reviews** Monitor variations in project or material specification and highlight any impact to the project overall. This is expected to be a circular process that will be repeated throughout as new designs, materials and service models become available and are incorporated into the final design.
Performance review - pre-planning:		Internal approval required– Complete evaluation matrix and report on targeted levels of responsibly sourced recycled material use and targeted levels of recyclable content. Detail proposed strategies for designing out waste and pollution.
Final FBC	 4: Technical Design	**CE1.5** **Technical update and contractual clauses** Continue to investigate alternative materials/products that support circular design and construction principles. Consider where digital solutions are available and appropriate for use to enhance efficiency - design, manufacture, logistics and distribution. Monitor the design against agreed metrics, ensuring LCA, LCC and carbon budget reporting are updated. Communicate this information with contractor(s) and supply chain. Prepare clauses for inclusion within procurement packages and tender documentation that include metrics and support outcomes.
Performance review - pre-construction:		Internal approval required – Update evaluation matrix and report any metric or strategy changes. Confirm viability, as a result of supply chain engagement. Confirm targeted resource management metrics for construction stage.
Construction and Commission-ing	 5: Manufacture and Construction	**CE1.6** **Responsible construction practices** Ensure procedures are in place to encourage, manage and monitor responsible construction practices. Contractors will be required to operate responsible procurement and resource management strategies and provide monthly reports. Contractors should be encouraged to work towards zero construction waste to landfill. Industry best practice targets should be set for the non-hazardous construction waste (including demolition and excavation waste where appropriate), for example achieving less than 1.6 m^3 or less than 1.9 tonnes per 100m^2 (gross internal floor area). **Change control** Continue to monitor metrics during construction (these should also feed into the embodied carbon calculations that are considered under issue CC2 of this guide). Ensure specification is managed through change control procedures and

CIRCULARITY: CE1. Circular design and construction processes		
		client approval is requested where any changes would impact quality or performance.
Project Monitoring and Evaluation	 6: Handover	**CE1.7** **Lessons learned and measuring success** The benefits of applying circular economy principles to the project should be documented, calculated and quantified. This should include reporting against the agreed metrics that are considered as part of this issue (such as quantities of reused and recycled materials and the opportunity for future reuse and recycling of materials). Reporting should also include tonnes / m^3 of construction waste avoided per 100m^2 of Gross Internal Floor Area (GIFA) compared to a standard approach and should include an estimate of disposal costs saved. The contractor, project team and client should prepare a summary of lessons learned and challenges that were overcome.
Performance verification – 'as built' / pre-occupation		Internal approval required – Confirm levels of recycled and recyclable material use. Confirm tonnes / m^3 of waste generated and tonnes avoided. Confirm estimated cost savings.
Project Monitoring and Evaluation	 7: Use	**CE1.8** **Structured POE** This will involve a review of circular business models in operation. Activities will involve capture of data and monitoring of in-use practices and associated impacts; including a review of LCC and Whole Life Carbon models. Encourage full transparency and knowledge share, supporting learning and providing data that can help inform future strategies.
Performance verification – in use		Internal approval required – Quantify reduction in operational waste. Evidence of circular procurement and responsible resource management. Demonstrate progress towards zero waste targets.
Resources		Zero Waste Scotland Circular Procurement resource suite[23]; UKGBC Circular Economy Guidance for Construction Clients[24]; The Ellen MacArthur Foundation Circular Economy Case Studies[21].

Climate change guidance

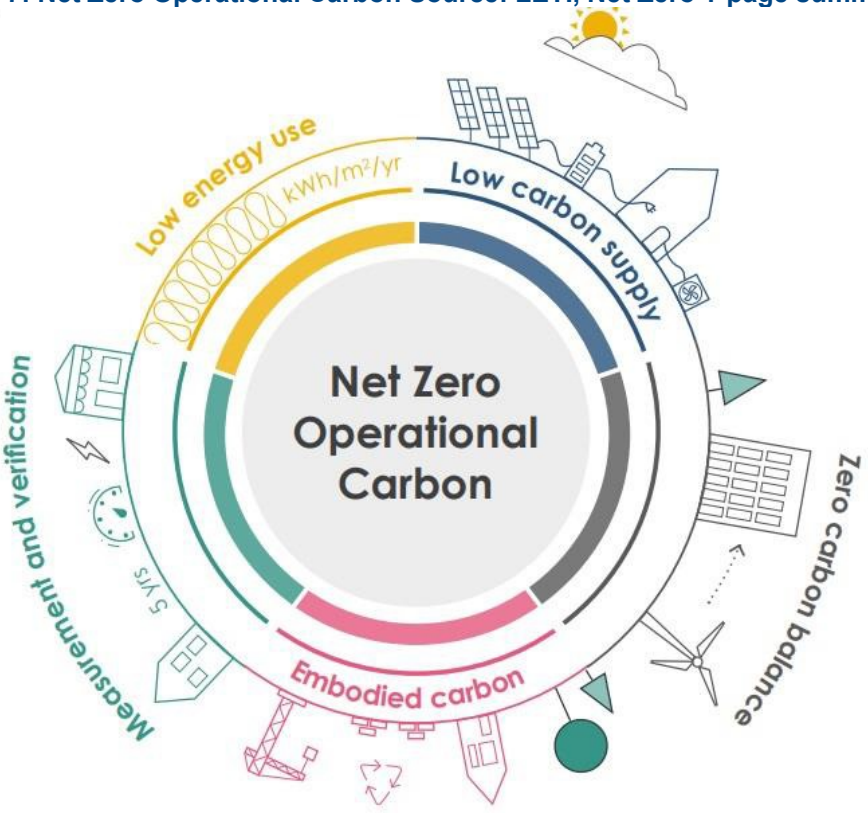
Issue: Operational emissions

Net Zero

Net zero is defined as a building with net zero operational greenhouse gas (GHG) emissions that has zero or negative emissions associated with its annual operational energy usage. The building is highly energy efficient and provided with 100% on-site and / or off-site renewable energy and is achieving a level of energy performance in-use in line with Scottish Government's Net Zero Public Sector Buildings Standard[5] or NHSS equivalency.

NHSS is currently contributing around 379,000 tCO2e of GHG per annum from around 1,500 buildings. To meet the net zero aspirations of the Scottish Government, NHSS has committed to all new buildings will be delivered to achieve net zero operational emissions. Every effort should be made on all new developments to optimise solutions in a responsible way and evidence appropriate levels of resilience.

Figure 7: Net Zero Operational Carbon Source: LETI, Net Zero 1-page summary



EUI

Energy Use Intensity (EUI) is a measure of the total energy consumed in a building annually, commonly measured in kWh/m^2.yr. and is derived from benchmarks from existing and similar buildings. Indicative healthcare values can be found in HTM 07-02: EnCO2de 2015, however the values must be considered circumspectly as they are simply the mid-point (median) values from a very wide range of possible values.

In this context, the EUI includes regulated and unregulated energy consumption. Leading government and industry advisory organisations, such as UK Green Building Council, are recommending that EUI and / or and Operational Energy Targets (OET) are developed for buildings in use and that these are utilised to enable net zero targets and climate change targets to be met at a national level.

The nature of healthcare provision, the energy intensive requirements of healthcare equipment and the differing functions of the many healthcare building types means that it would not be beneficial for the sector to recognise a single EUI target for all projects. Instead NHSS Boards will consistently monitor and report this target to enable a library of EUI data for varying building types and functions to be developed over a period of time and for more suitable benchmarks to be made available from this data at a point in the future.

Passive design analysis

Factors such as building form, massing, orientation, layout, fabric design, window design and daylighting provision, ventilation strategies, thermal mass and green and blue infrastructure can significantly affect the heat gains and losses and other user comfort issues in a building. An early passive design analysis can help to inform a design solution that minimises reliance on active building services systems. A passive, fabric first approach should be adopted on all projects.

This will require an integrated landscape and building design approach to be adopted. At the earliest possible opportunity, input should be sought from the relevant design specialists (e.g. architectural, sustainability, landscape, civil, ecologist etc.) to maximise opportunity and successfully realise multiple benefits that will support the operational building and the wider site.

Thermal bridges

Thermal bridges can account for considerable fabric heat loss in a building (over 30%) and as buildings have increased levels of insulation this becomes even more significant. Thermal bridges create localised cold spots, leading to condensation build-up or mould growth, which in turn pose a risk to occupant health and wellbeing.

The Psi-value (or ψ-value) is a measurement used to determine the rate of heat loss through a junction (where two thermal elements meet e.g. external walls and ground floor). The heat loss at these junctions is referred to as non-repeating thermal bridges, in which the Y-value is the term used to describe the sum of all the non-repeating thermal bridges divided by the total heat loss area of the building.

Losses are calculated based on the junction Psi-values and a building's Y-value. The lower the U-values, Y-values and Psi-values, the less opportunity for heat to escape through the building element (such as a wall or roof) or through a junction (such as wall or window junction), therefore the lower the total level of fabric heat loss overall.

Space heating and cooling demand

The building's energy demand for space heating and cooling can be significantly reduced through enhanced fabric performance and passive design measures. Performance measures should be specified within the project brief to encourage design development that promotes a fabric first approach.

Operational templates

The accuracy of output from a detailed and dynamic simulation model is highly influenced by the level of accuracy and detail which is fed into the model. In order to help adequately address any perceived performance gap issues, it is vitally important that the information collated and used to predict theoretical performance during design development stage accurately represents the presence and use of systems and services and actual operational patterns, as far as reasonably possible. This will be a collaborative process. It is advised that the client (assumed NHS regional Boards) develops detailed operational templates for standard or repeatable room types and, over time, builds a library that can be used as a source of information. It would be to the advantage of all regional NHS Boards if this resource was developed into a shared central resource.

Detailed dynamic simulation modelling

Detailed dynamic simulation modelling (DSM) will play an important part in the transition to net zero. Modelling should evolve from option / site selection through the entire design process, with requirements for different types and levels of information at each stage.

The accuracy and robustness of detailed simulation models are heavily influenced by the accuracy of the information that is provided and utilised when predicting in-use building performance scenarios. To deliver credible and valuable results, information that accurately reflects how the building will be operated when in-use should be sourced, verified and utilised. Clients, project teams and wider stakeholders must all take responsibility in providing this information and ensuring its accuracy. The results of the modelling should be shared with stakeholders to co-produce decisions.

System efficiency

Prior to optimising building systems to satisfy predicted consumption levels, energy demand should first be limited, as far as reasonably possible, through the building fabric and passive measures. To further increase the overall efficiency of the building in-use, the specification of energy efficient building systems and the integration of smart energy management systems (that enable adequate levels of monitoring, programming, control and reporting and allow for a suitable level of remote control) are required. Improvements should include highly energy efficient Heating, Ventilation and Air Conditioning (HVAC), lighting and vertical transport systems as well as the integration of intuitive and responsive building management systems. Designs should take account of recommended heating and hot water generation efficiencies and environmental impact and, where appropriate, coefficients of performance (COP) and seasonal performance factors (SPF).

The wellbeing of building occupants must be considered alongside energy reductions. These include considerations around indoor air quality, daylight and overheating. Further guidance is included within the Wellbeing section.

Management, monitoring and control

Building Management Systems (BMS) can provide real-time remote monitoring and integrated control of a number of connected building services. This allows operational patterns, energy use and internal environmental conditions to be monitored and managed. A BMS can also allow for the efficient programming and delivery of

services by setting hours of operation and allowing for environmental set points to be adjusted. Fine-tuning of set points during the seasonal commissioning stages can help to optimise operational performance and occupant comfort levels.

It is expected that all NHSS buildings will benefit from an integrated and fully commissioned Building Management Systems (BMS), with a fully integrated energy management system, to control, monitor and adjust engineered systems that provide environmental security and meet the NHSS Duty of Care. To assist, guidance is provided within the following documents:

- SHTM 08-05 Specialist services Building management systems suite of documents:
  - Part A Overview and management responsibilities;
  - Part B Design considerations;
  - Part C Validation and verification;
  - Part D Operational management.

A BMS with integrated energy management functions can be programmed to activate a number of alerts (including for both energy and water), highlighting any potential issues or need for maintenance to users. Increasingly ambitious environmental targets and the drive for more data disclosure has resulted in the growing demand for the integration of intelligent BMS to enable and support the monitoring, benchmarking, reporting and evaluation of a building's operational performance.

In order for a BMS to optimise energy and resource use without compromising comfort or performance, a thorough understanding of how the building is designed to perform and how each of its different systems and services interact is imperative. The buildings zoning of services and sub-metering strategy will play an important part in supporting the efficient operation and management of the BMS.

The Building Controls Industry Association[26] (BCIA) represents the building controls and BMS sector in the UK and aims to promote a better understanding, application and use of building controls. BCIA references a class system when considering the control functions for various building services and the efficiency and management of these. A number of publicly available resources are available, many are accessible online and can assist a client in understanding the functionality that they require from a BMS and the specification that should be developed.

Supply of heat and power

The carbon conversion content of the energy supplied should be considered as this is has a significant impact depending on the energy source and given the advances that are being made in decarbonising the national electric and gas grids and the transition to net zero. The UK Government publishes conversion factors for greenhouse gas emissions and future projections online[27].

The Scottish Government also hosts an online interactive tool which houses Scottish energy data[28].Demand side response

Demand side response and on-site energy storage can provide some level of resilience and flexibility in relation to managing energy demand and consumption for

some buildings. This level of flexibility is required in order for the national grid to continue to harness renewable energy sources that allow it to decarbonise.

Active demand response measures can further drive efficiencies and GHG reduction through the ability to reduce the electricity consumption during certain period; which is of particular benefit during time periods of national grid high electricity demand.

Building performance predictions

To evaluate and ensure robustness of operational performance predictions, a client should request disclosure of key building performance metrics prior to planning approval, for healthcare buildings this should include an approach that demonstrates compliance with the principles set out within the Net Zero Public Sector Buildings Standard. If targets are not being met, this allows for an opportunity to obtain further clarification and make changes where required.

Prior to work commencing on site, undertake a performance verification exercise of the final design. Request a compliance summary report from the project team and ensure all agreed performance targets are being met. Effectively communicate the project ambitions with the contractor and plan for quality assurance throughout every stage of the construction and handover stages.

Quality assurance through construction

Manage risk and promote high quality throughout the construction stage by ensuring:

- Regular quality assurance inspections are taking place, for example general review of build quality and workmanship, particular focus on junction details, visual inspection of building's air seal line, installation of ductwork etc;
- All change control procedures require client approval; and
- Requirement for physical testing is put in place, for example this could include thermography to continuity of insulation installation, air permeability testing to assess leakage rates or air quality sampling to measure levels of Volatile Organic Compounds prior to occupation.

Prepare for handover

It is important to understand how and who will be operating and interacting with the building and making sure that the Building Information is in a useable and accessible format. Identify the levels of information that will benefit each user group and ensure that this is provided prior to handover; a standard Building Manual for detailed information, a quick start guide of key asset information (for estates team / facility managers) and a Building Users Guide for the every day user groups.

To accurately monitor and compare predicted performance with actual in use performance, a client should be provided with an updated multi-disciplinary model with 'as built' information. This model can support asset management, inform maintenance strategies, monitor in-use performance, consider the viability and impact of future adaptation, and plan for end of life.

CLIMATE CHANGE: CC1. Operational emissions

Issue	**CC1. Operational emissions**
Outcome	Buildings designed to achieve net zero operational Greenhouse Gas emissions.
Performance verification	'As built' building information confirms that the amount of Greenhouse Gas emissions associated with the building's operational energy on an annual basis is zero or negative.

SCIM	RIBA Plan of work	Guidance
Strategic Assessment	 0: Strategic Definition	**CC1.1** **Strategic priorities** Consider how a building designed to achieve net zero operational GHG emissions will support NHSS values and sustainability strategic investment priorities.
Action: Apply POE learning & adopt soft landings approach		
Initial Agreement	 1: Preparation and Briefing	**CC1.2** **Net zero** Set clear project outcomes, that are in accordance with Scottish Government's Net Zero Public Sector Building standard, to be included in the project brief. This will include aspirations in relation to operational energy targets and emissions and a requirement to deliver a net zero GHG emissions development, where early OBC option appraisal selects a major construction investment. **EUI** Identify an EUI benchmark that can be specified in the brief and utilised during early design stages. Utilise existing data captured on the NHSS energy monitoring site, identifying best practice projects where possible, to help inform the EUI. This figure will serve as an Operational Energy Target for the building. **Responsible energy hierarchy approach** Within the brief, require a responsible energy hierarchy approach to be adopted. This will require all development proposals to first minimise energy demand by adopting passive design and fabric first approaches. Once the building form, orientation, fenestration and is façade is optimised, further efficiencies should be achieved through the design and integration of highly efficient systems and services. Finally, once the design and energy performance requirements have been optimised, the remaining energy demand should be generated from renewable sources that support the NHSS net zero aspirations. **Space heating and cooling demand** Within the brief, adopt a passive design targets, for example <15 kWh/m^2.yr for heating demand and similarly for cooling demand or utilise existing data on the NHSS energy monitoring site, identifying best practice projects that then informs an indicative benchmark that can be referenced within the brief – this can be reviewed and agreed with the project team during next project delivery stage. **Fabric performance** Within the brief, require the specification of highly efficient fabric and external shading design to reduce the heating and cooling demand.

CLIMATE CHANGE: CC1. Operational emissions

Initial Design Statement

Promote passive design and fabric efficiency by requiring enhanced fabric performance measures, for example:

Walls	≤0.13 W/m²K
Windows	≤1.0 W/m²K
G-value of glass	0.6 – 0.3
Floor	≤0.12 W/m²K
Doors	≤1.2 W/m²K
Roof	≤0.12 W/m²K
Air permeability	≤0.6 m3/h.m2@50Pa

Thermal bridge losses

Within the brief, limit the overall heat loss arising from thermal bridge losses by setting a maximum y-value of 0.04 W/m²K. Request that junction Psi-values, for each of the junctions where the building elements meet, are quantified and improved where possible.

System efficiency measures

Within the brief, require space planning to also consider optimised plant efficiency. The location of plant and localised plant strategies should be considered as part of the strategy for reducing operational carbon.

Within the brief, encourage a responsible approach to lighting design and compliance with the guidance and recommendations of CIBSE Lighting Guide 02: Lighting for healthcare premises (2019). The most appropriate lighting solutions and levels must be considered for each functional space.

Power density should be referenced and appropriate for the end use / function requirements, for example lighting power density of 4.5 W/m² in reception areas and 2.0 W/m² for small power. Require lighting power densities to be reported during design development stages, appropriate to end use and / function.

Within the brief, confirm that systems with high levels of efficiency will be required. This could include the specification of energy efficient heat pumps, for example with a Seasonal Coefficient of Performance of ≥ 3.

Where mechanical ventilation is deemed the most suitable system, high efficiency heat-recovery systems (e.g. >90% efficiency) with completely physically separated supply and extract streams, for example twin coil units or plate heat exchangers, should be considered. Adequate ventilation rates should be achieved using 100% outside air, without any recirculation. The position of air intakes and openable windows should be such that they avoid recycling air from exhausts or external sources of pollution, for example at least 10m from any potential pollution source. All relevant CIBSE and NHSS guidance must be followed with regards to operation and infection control. Detailed management and maintenance guidance must be provided, including appropriate filter maintenance, frequency of system inspections and cleaning regimes (including duct-cleaning procedures).

Energy efficient solutions are required to be specified for passenger and goods lifts, with the number and size dictated by demand and usage patterns. The use of regenerative drives should be considered and energy efficient features should be specified for lighting, standby options and variable voltage variable frequency control of the drive motor.

CLIMATE CHANGE: CC1. Operational emissions

Early OBC

2: Concept Design

CC1.3

Passive design analysis

Require a detailed passive design analysis to be delivered and for the results to inform the conceptual designs. The initial findings should be presented to the client during early concept design stages and the results should be updated and discussed during more detailed options appraisal stage.

As a minimum, the passive design analysis should cover:

Site location / appropriate weather files / microclimate / site impact / site planning / self-shading and external shading features / building location and layout / building orientation / massing / reduced form factor/ building fabric / thermal mass or other fabric thermal storage / building occupancy type and patterns / daylighting strategy / window to wall ratio / ventilation strategy / adaptation to climate change.

Healthcare operational process

Careful consideration must be given to the various operational processes and the associated unregulated energy demands and any resulting 'waste heat'. This should include ICT server rooms, lab and medical equipment, catering and retail units etc. The opportunity to harness and utilise 'waste heat' should be thoroughly explored (e.g. as a means of achieving desired DHW temperatures).

Supply of heat and power

The potential for harnessing heat from waste should be considered for all available sources, on or close to the site. Options for joining a heat sharing network should also be explored.

Careful consideration is required when considering connection to District Heat Networks (DHN) that are solely reliant on fossil fuels; this should be avoided unless there is a robust route map in place for a transition to net zero, well in advance of 2045.

If energy from waste options are to be considered, the impact on local air quality and all GHGs should be evaluated.

A renewable energy feasibility study should be instructed during concept development stage to identify opportunities for renewable energy generation on and close to the site and generation and storage capacities that could support a net zero solution. Heat pump and solar technologies are amongst those that are currently considered to offer the most potential for net zero solutions. Feasibility studies should seek to explore the maximum opportunity for renewable energy generation on site, which will include utilising existing roof space for solar technology installation; exploring structural design and orientation options.

The opportunity to reclaim any identified 'waste heat' within a heat pump network should be explored.

The sizing of the building services should be informed by detailed load modelling exercises, ensuring plant is more accurately sized.

Zoning and metering

Ensure that the zoning strategy for heating, cooling and lighting systems addresses the occupants' needs and supports the efficient delivery of services to areas of the building that require these.

Thermal zoning, lighting zones and the level of occupancy control should reflect the needs of the space and the user. Programming, sensors (provision, location and operation) and control strategies should be informed using end user stakeholder feedback (this should include estate management and every day user feedback) and reviewed with the client estates management representative. The need for any manual override should be discussed and

CLIMATE CHANGE: CC1. Operational emissions

agreed with the client. Different occupancy patterns, user requirements, seasonal changes and the associated impacts should be considered.

Care should be taken to avoid the need for larger spaces or entire floorplates to be serviced when only smaller spaces are occupied or are expected to be in use, particularly for shared or out of hours use.

Consideration should be given as to how each of the different services and systems will operate and interact with each other, ensuring no conflict in operation.

A sub-metering strategy should allow for the monitoring of energy and water consumption, enabling the client to efficiently and effectively monitor and manage operational needs and record and report data:

- A metering strategy should be agreed with the client (with appropriate FM / estates management representation). The sub-metering strategy should be intuitive, have purpose and reflect the building operational needs and reporting and verification requirements. A list of proposed meters, labelling and types should be agreed. The accessible location of meters should be confirmed;
- The metering strategy should allow the client to clearly and easily monitor and differentiate between regulated and unregulated consumption and identify any separable loads which may benefit from separate metering. All sub-meters should be clearly identifiable and this should be agreed with the client;
- Sub-meters should be present for each different energy source utilised;
- Different tenancy, function areas and end use categories should be identified with the client estates management representative and sub-metered where there is benefit in doing so;
- All meters should be pulsed output meters and linked directly to a Building Management System (BMS) and / or Automatic Meter Reading (AMR) system to allow for remote access, ease of monitoring and reporting;
- System specification should support wider integration of systems across sites;
- Stakeholder feedback from client estates management representatives should inform this strategy, acknowledging previous POE feedback and lessons and learning captured during the Soft Landings process.

Monitoring and control

Smart metering, energy monitoring and effective control strategies should be developed to allow building operators to review, adjust and optimise accordingly.

The control of heating, cooling, ventilation and lighting systems must be such that it can support the energy efficiency aspirations of the building in operation. Zonal and programmable heating and hot water systems should reflect the building user and operational requirements, allowing an element of flexibility and minimising heating demand.

Lighting should be zoned, controllable and, where appropriate, based on occupancy to minimise unnecessary use. Where there are wards or bedded areas it is expected that in addition to individual zoned lighting control for each bed space, control will also be provided for staff over groups of bed spaces. Similarly, for circulation space lighting controls are expected to be accessible to staff.

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Utilise the SHTM 08-05 and other available relevant guidance to develop a preliminary overview of requirements for controls and BMS. A useful resource could include the BCIA 'end user specification checklist'[26].

Demand response

Consider the suitability of and opportunities for integrating demand response and energy storage solutions for buildings, allowing a greater level of flexibility in relation to demand on the national grid for power. This could consider strategies for electric vehicle charging and for example, night-time programmes for charging of electric fleet vehicles.

Design a system that supports the buildings energy demand and consumption by first understanding how the building and services will be used. Develop daily usage profiles to consider peak periods of energy consumption during each day and throughout the year.

Utilise data captured within the 'operational templates' to help improve accuracy and review assumptions with end user groups.

Review proposed metering, control and monitoring strategies with the client estate manager representative to ensure locations, accessibility and performance will support operational efficiencies when in use.

Active demand response

Design for an integrated active demand response strategy that will incorporate measures that will support the operational building both in the present and in the future e.g. heating and cooling set point control (controlled via BMS, heat pump systems with integrated control and metering etc.).

Consider onsite electricity generation and storage options, including battery storage systems and the viability of solar to hot water heat storage (e.g. to support cooking, cleaning, laundry needs).

Consider the impact of full electric vehicle (EV) fleets in the very near future; NHSS staged fleet 2025 and 2030 targets and the 2030 target for Scotland. To ensure greater levels of stability demand response measures will be essential. Explore options for electric vehicle turn down and vehicle to grid reverse charging technology.

Operational templates

Assumptions in relation to occupancy rates and usage patterns should be realistic and accurately reflect how the operational building will function. Detailed information on the use of the building should be collated during detailed stakeholder engagement exercises (supported through Soft Landings activity).

Operational templates are required to be populated with information captured during stakeholder engagement sessions. This will detail how each intended space is required to operate, expected behavioural and occupancy patterns and will identify the required equipment and services to allow this space to be fully functional. This information should be sourced from end user groups and agreed with the client at as early an opportunity as possible.

The work NHSS is undertaking in relation to 'repeatable rooms' should be considered and, where appropriate, utilised as part of the early concept modelling exercise. The use of 'repeatable rooms' could help to enhance the accuracy of data that is used during the design development stages (and should be reflected in any detailed simulation modelling) and is also considered to support users during the operational phase, through occupant familiarity and reducing medical errors.

Detailed Simulation Modelling

Refer to the Net Zero Public Sector Building Standard's energy modelling guide.

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Detailed and accurate dynamic simulation modelling will play a key role in influencing the design of a net zero building with healthy internal spaces. Modellers are expected to have undertaken the required level of training and demonstrate competency in order to deliver and adequately analyse results and provide credible recommendations at each stage of project development.

DSM should take place at the earliest opportunity and should aid the design development process in accordance with the required performance outcomes of this document. At concept development stage it is expected that as a minimum sample room types and key function spaces will be modelled and analysed. There is a requirement for full transparency to review the input data, all assumptions, all variables and DSM outcomes with the client and wider delivery team at every project stage. This should be a regular item on meeting agendas.

Evidence of Quality Management is a requirement and is expected to include a review and verification of input data and output results by suitably qualified and experienced, independent 3rd party experts at each stage in the project where modelling has been carried out (at the end of conceptual development and detailed design stage as a minimum).

There is a need for collective responsibility and collaboration when collating comprehensive data relating to the forecasting of the building performance in-use. All assumptions should be reviewed and agreed with the client.

Accuracy of input data is crucial – the DSM should accurately reflect the building design, operation of systems and services and expected in use scenarios. Operational templates (for each room and space) should be prepared and agreed with wider stakeholder and end user groups to ensure accuracy of input data. Early, in-depth stakeholder consultation with appropriate user groups is expected to ensure provision and accuracy of this data. The nearest CIBSE Test Reference Year (TRY) weather file should be used and designs should be tested against present and future scenarios.

Final Design Statement

The client and wider project team should have the opportunity to spend adequate time with the modeller to conduct an in-depth review of input data, ensuring accuracy and robustness, at an early stage in the project, at critical review stages and throughout.

EUI reporting required during appraisal of concept design.

Final OBC

3: Spatial coordination

CC1.4

Performance review workshop

The project team are required to arrange a detailed performance review workshop with the client prior to planning submission. The client-side estate management team should be represented at this workshop.

The workshop will focus on model-based performance analysis and will include a detailed DSM walkthrough, ensuring accuracy and robustness:

- Review of minimum design performance measures, predicted operational performance and EUI;
- Review of operational assumptions and variable inputs (based on information from operational templates and client / Estates input / performance specifications);
- Internal environmental quality conditions (ensuring comfort and wellbeing of occupants);
- Review of metering, management, zoning, programme and control strategy (opportunity for optimising operational efficiency and assurance that the strategy will support required reporting and verification activity); and

CLIMATE CHANGE: CC1. Operational emissions		
		• Appropriate sizing / specification of building systems to limit over-engineering (demonstrate passive design measures and fabric enhancement have significantly reduced demand and resilience strategies are considered appropriate for project needs). This workshop should also be used as an opportunity to review the Soft Landings strategy and to discuss commissioning, training and handover (CTH) as well as estate / facilities management requirements.
Performance review - pre-planning:		Internal approval required– This is expected to coincide with the completion of Final OBC stage. Complete evaluation matrix and report on net zero aspirations and EUI predictions.
Final FBC	 4: Technical Design	**CC1.5** **Change control** Establish a change control procedure that requires full communication and client sign-off. Request that full consideration is given to the level of impact that any proposed change may have on the building's operational performance and that this is highlighted and discussed with the client prior to any changes being made or agreed. **Quality assurance** It is expected that a quality assurance plan will be developed to monitor and promote good standards and practices during the construction stage. An on-site inspection programme is expected to communicate who will lead on this (e.g. lead designer), how often quality inspections will take place and what level of detail will be required. **Soft Landings review** Technical design review and reality checking for Soft Landings should take place to evaluate design and construction proposals against operational outcomes and key performance indicators. Management and maintenance strategies should be reviewed with FM representatives, covering all relevant hard FM and soft FM services. All systems and service routes should have safe access and allow maintenance / replacement with minimum disruption operations. Ensure design aspirations, project outcomes, change control procedures and quality assurance measures are all clearly communicated with contractor before any work starts on site.
Performance review - pre-construction:		Internal approval required – Update evaluation matrix and report any changes. Confirm net zero and EUI predictions.
Construction and Commission-ing	 5: Manufacture and Construction	**CC1.6** **Quality monitoring** It is expected that quality assurance will be monitored and reported on-site and that regular inspections and reporting takes place. An appropriate individual should be identified to manage this task and a quality assurance plan should be developed and agreed. This requires particular attention to detail in relation to quality of workmanship that could compromise the fabric integrity (e.g. enhanced building details, storing, preparation and installation of insulation materials and where services penetrate the building fabric). Regular inspection reports / feedback should be provided to the client. **Commissioning**

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A schedule of commissioning must be prepared and should identify and include suitable timescale for commissioning and re-commissioning of all complex and non-complex building services and control systems. The commissioning schedule must identify the appropriate standards for all commissioning activities to be conducted and should:

- Provide general information about the project;
- Appoint a commissioning manager and identify the commissioning team members for each stage of the commissioning process;
- Define roles and responsibilities for each commissioning team member;
- Identify the systems to be commissioned;
- Create a schedule of commissioning activities for each stage of the process;
- Establish documentation requirements associated with the commissioning process;
- Provide details of the seasonal commissioning activity that will take place over a period of at least 12 months, once the building is occupied. This will include: a review of performance, identifying where any changes may have impacted operational performance; testing all building services under full load conditions and during seasonal changes; testing during periods of extreme occupancy (high or low); interviewing building occupants to identify any concerns; compare sub-metered and user comfort data with predicted performance; identify any areas in need of improvement; and re-commission systems (following any work needed to serve revised loads), and incorporate any revisions in operating procedures into the operations and maintenance manuals;

The commissioning plan should identify a list of commissioning activities that will be undertaken, such as:

- Ensuring client access and providing client training and demonstrations;
- Completing operating and maintenance manuals, record drawings, software and test certification;
- Obtaining statutory approvals and insurance approvals;
- Manufacturers work testing;
- Component testing;
- Pre-commissioning tests;
- Set to work: the process of switching on (i.e. setting to work) items such as fans and motors to ensure that they are operating as specified (for example checking that fans are turning the right way);
- Balancing: this follows setting to work and involves looking at whole systems (rather than individual components) to ensure that they are properly balanced (i.e. water is coming out of all the taps at the correct pressure, air is coming out of the correct diffusers, etc);
- Commissioning checks and performance testing;
- Post commissioning checks and fine tuning during occupancy.

FM Strategy

There is a requirement to feed into the FM Strategy, with a key focus on running the building efficiently and responsibly. This will include information that could be used to support service level requirements and sourcing strategies, in

CLIMATE CHANGE: CC1. Operational emissions

addition to supporting the environmental, health and social wellbeing aspirations of the project during operation.

- Service level requirements should be aimed at optimising the building performance, managing waste, energy and water consumption whilst maintaining good comfort levels for occupants;
- Sourcing strategies should ensure the responsible and ethical procurement of goods and services. The Board has the opportunity to consider and explore opportunities for enhanced social value through the development of local and SME supply chains;
- A strategic and integrated FM approach will be required to support net zero aspirations and should be reflected in the plan. Engagement with end users, understanding their needs and how these may change over time is essential;
- The approach to Hard and Soft FM aspects should complement the overall ambitions of the project e.g. repairs and replacements should consider whole life carbon and wellbeing impacts and cleaning products must not contain harmful chemicals that would negatively impact on internal air quality or the environment.

Physical testing

Ensure a programme of physical testing is completed prior to handover. This should include testing of the fabric integrity and is expected to include air permeability testing and thermography to demonstrate performance with design stage predictions, continuity of insulation and no services leaks.

Project Monitoring and Evaluation

6: Handover

CC1.7

Commissioning, training and aftercare support

Request and plan for the following commissioning, training and aftercare support as part of the Soft Landings approach, include (but not be limited to):

- Commissioning manager to schedule a review of the operational systems and services with a representative from the estates team and FM, allowing an opportunity for early fine tuning and full integration of systems and services, commencing prior to occupation. Confirmation will be provided that all commissioning has been delivered in accordance with the NHSS Commissioning Guide;
- All operational requirements in respect of management of systems, required cleaning, expected maintenance etc. should be clearly documented and reviewed during handover. This will influence the performance and efficiency of systems and could impact on wellbeing issues (e.g. proposed use of toxic cleaning products) and must be identified and considered in consultation with appropriate end user representatives;
- End user interactive workshops and guided tours scheduled to take place prior to occupation to smooth transition and aid understanding of the level of interaction and control each user group can expect to exercise. Content should be tailored to support those who use the building and those who manage the building;
- Contractor to identify an aftercare manager and agree aftercare plan with client. As a minimum this will include commitment to a series of defect review meetings, dates for the seasonal commissioning of building services and a commitment to support post occupancy evaluation. The details of the seasonal commissioning programme will be agreed as part of the soft landings process, with appropriate input from the client-side estates management and FM representatives.

CLIMATE CHANGE: CC1. Operational emissions		
		Prior to handover, the following should be provided: • Section 6 compliance report & EPC – confirming Net Zero 'as-built'; • Building User Guides; • Seasonal Commissioning Programme; • Level of Aftercare and post occupancy monitoring. **Multi-disciplinary model updated with 'as built' information and including:** • BIM & DSM models (confirming operational energy & IEQ); • Life Cycle Costing (maintenance & replacement planning); • Whole Life Carbon ('as built' assessment).
Performance verification – 'as built' / pre-occupation		Internal approval required – Update evaluation matrix and report any changes. Copy of the 'as built' Section 6 report and EPC Confirm the 'as built' operational performance predictions - net zero and EUI Client in receipt of operational energy model / 'digital twin'
Project Monitoring and Evaluation	 7: Use	**CC1.8** In order to support the efficient operation of the building in use and to collate valuable information that can be used to optimise performance as well as provide knowledge and learning for others, the following should be promoted: • **Performance based contracts:** FM / asset management contracts to be performance based in relation to energy consumption. These should also promote user comfort (as per the Wellbeing section of this guide); • **Structured POE programme**: Capture data and verify performance outcomes over a minimum period of 3 years (ideally indefinitely); and • **Data disclosure:** Encouraging full transparency and knowledge share, supporting learning and performance improvement.
Performance verification – in use		Internal approval required – Completed POE reporting template
Resources		Climate Change (Emissions Reduction Targets) (Scotland) Act 2019[4]; Scottish Government Net Zero Public Sector Building Standard[5]; UKGBC Net Zero Carbon Buildings: A Framework Definition[29]; Climate Change and sustainability tools, NHS NSS[30]; SMASH Introduction, Public Health Scotland[31]; Delivering a net zero NHS, NHS England[32]; Various publications, LETI[33]; A Healthcare Engineering Roadmap for Delivering Net Zero Carbon[34]; Resource suite, Climate Framework[35]; Net Zero Carbon Industry Initiative, Construction Leadership Council[36]; Various resources, RIBA[37].

Issue: Embodied carbon

Embodied carbon

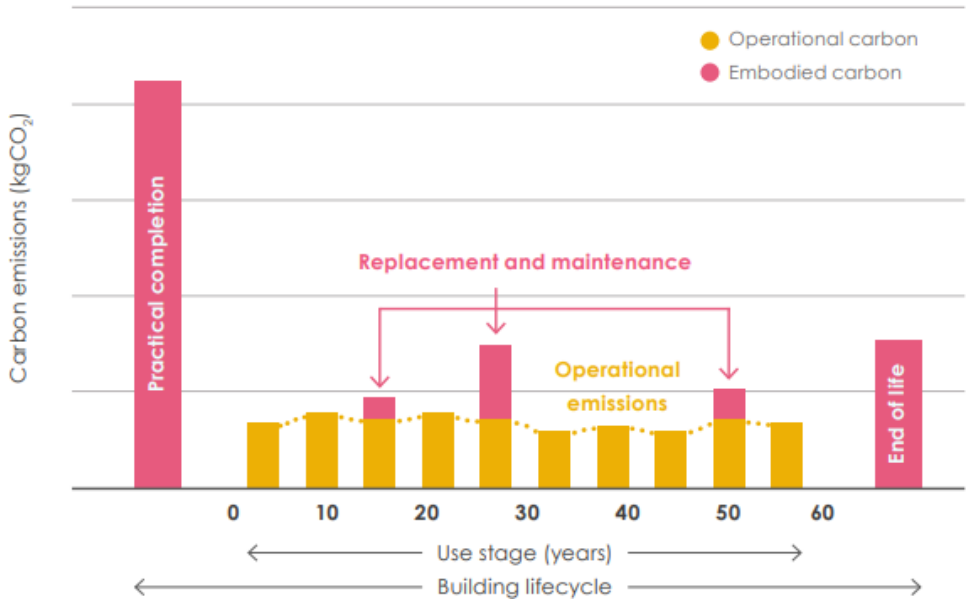
Whole Life Carbon (WLC) refers to operational carbon plus embodied carbon. Whole Life Net Zero Carbon means a building that achieves net zero operational emissions and significantly reduced levels of embodied carbon, as per industry best practice approaches and circular economy principles, with remaining carbon balance offset.

Embodied carbon refers to the amount of greenhouse gas (GHG) emissions generated to produce a built asset. This includes emissions associated at the following life cycle stages:

- **Product:** extraction, transportation to manufacturing plant and manufacture/processing of materials.
- **Construction**: transportation of products and materials to site and assembly of every product and element in the building (includes energy consumption and waste generation).
- **In-use:** maintenance, repair, refurbishment, replacement and emissions associated with refrigerant leakage.
- **End of life:** demolition, disassembly waste processing and disposal of any parts of product or building and any associated transportation.

The Royal Institution of Chartered Surveyors (RICS) has published findings that report the embodied carbon emissions from construction for new buildings can account for as much as 70% of the total carbon impacts associated with the building over its life cycle, with the most significant embodied carbon contributions being made right at the start of the project as a result of the products and materials that are specified for use. This demonstrates the significance of embodied carbon and the urgency to take steps towards drastically reducing this contribution to GHG emissions on all potential construction projects from their outset /earliest opportunity i.e. 0: Strategic, 1: Briefing, and 2: Concept design.

Figure 8: Operational and embodied carbon contributions throughout the lifetime of a building Source: LETI, Climate Emergency Design Guide



Life Cycle Assessment

A WLC assessment should be used to inform a building design and products that generate the lowest carbon emissions over its whole life; supporting a transition towards a net zero future. This can be measured through a Life Cycle Assessment (LCA), which accounts for the associated emissions at every life cycle stage of a building's materials and products.

The LCA should typically consist of four key steps:

1. **Define goal and scope** – Promote the design with the least environmental impact. A clear and consistent approach should be adopted for all projects and across all life cycle stages. An accurate representation of the project site and building, including the building's components, should be included within the study.
2. **Estimate quantities of materials, products and processes** – Ensure the most accurate building level material quantities are used and that all materials are identified. It is recommended that BIM models are used to identify this information. Realistic operational energy, water and associated carbon estimations should be used; the 'operational emissions' guidance section of this report should be followed.
3. **Assess environmental impact** – A consistent assessment method should be adopted and used throughout, for the building level and product level.
4. **Interpret the results, refine and re-iterate** – An iterative process that will inform design decisions and construction approaches. Carbon budgets should be created; identifying where there is most opportunity for reductions and allowing lower carbon, cost neutral options to be prioritised. To ensure positive outcomes, supply chain engagement is essential and detailed information should be included within the contractor tender documentation.

Environmental Product Declaration

Environmental Product Declarations (EPDs) can be used as credible sources of information that can support LCA studies. EPDs are independently verified and registered documents that communicate information about the life cycle environmental impact of a product in a transparent and comparable way.

There is a growing interest across the built environment and a desire to significantly reduce embodied carbon. The availability of materials and products with lower embodied carbon and EPD certification is steadily increasing. Supply chain engagement is an important step in allowing clients and project teams to understand the level of existing opportunity for embodied carbon reduction.

Monitoring and updating results

Carbon budgets will be established during design stage and should be reviewed and agreed with the contractor prior to work starting on site. During project delivery, monitor the carbon impact from construction by requesting regular updates and reporting.

Establishing a baseline for comparison

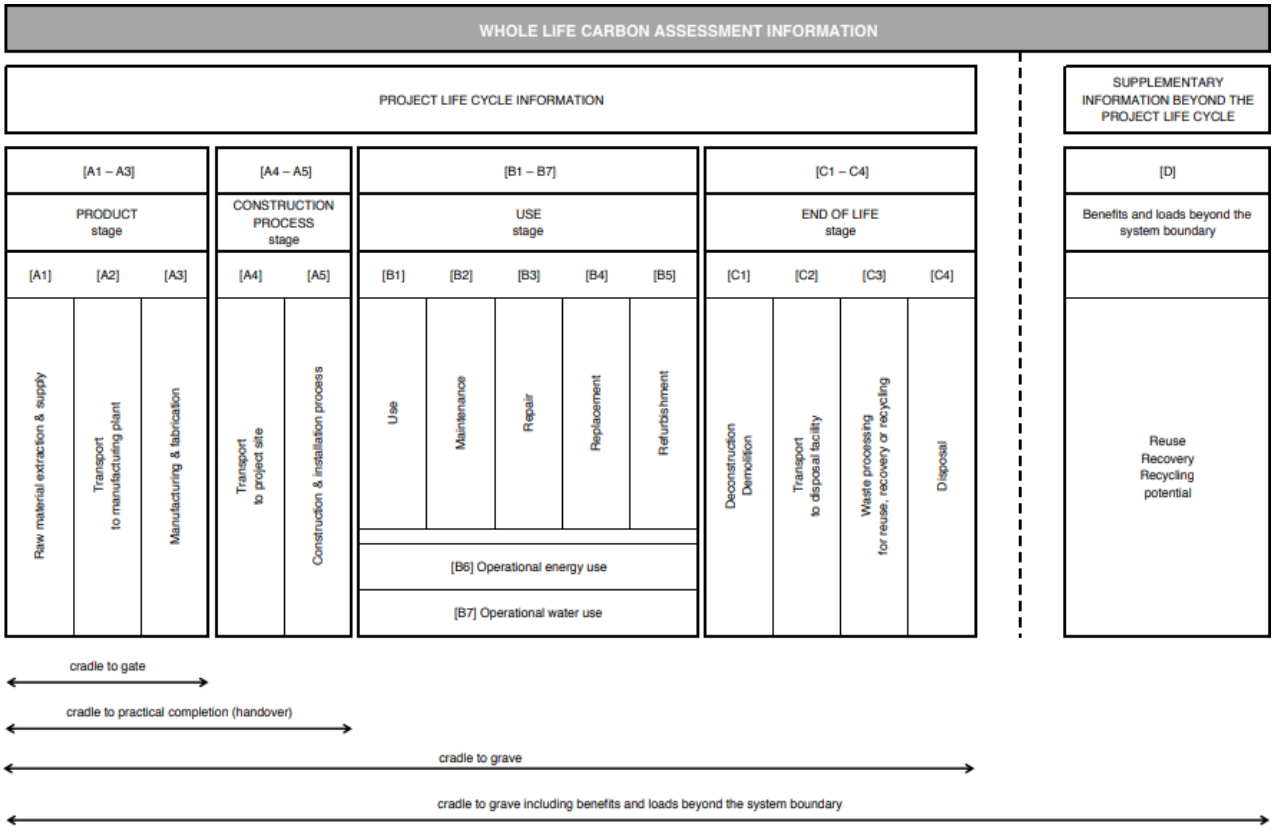
Utilise the outputs from the LCA to build an NHSS database of results that can be referenced and that can act as a baseline to help inform future projects. In the

meantime projects are encouraged to consider adopting the Net Zero Public Sector Building Standard embodied carbon targets.

Life cycle stages

All life cycle stages relevant to the development should be considered in the LCA study, as defined by BS EN 15978 and summarised in the image below. Module D should be considered separately, following circular economy principles.

Figure 9: Whole Life Carbon Assessment Information in modules A-D, Source: BS EN 15978



Module B6 refers to operational energy use and is addressed under the previous issue in this guide (CC1).

Module B7 refers to operational water use and is addressed under the next issue in this guide (CC3).

LCA building elements

To allow for an appropriate level of comparability, allow for the inclusion of all applicable sub-elements listed in the *'LCA building elements'* table below:

Building Elements

0	Facilitating works	0.1 Temporary/Enabling works/Preliminaries 0.2 Specialist groundworks
1	Substructure	1.1 Substructure
2	Substructure	2.1 Frame 2.2 Upper floors incl. balconies

		2.3 Roof 2.4 Stairs and ramps
	Superstructure	2.5 External walls 2.6 Windows and external doors
	Superstructure	2.7 Internal walls and partitions 2.8 Internal doors
3	Finishes	3.1 Wall finishes 3.2 Floor finishes 3.3 Ceiling finishes
4	Fittings, furnishings and equipment (FF&E)	Building-related Non-building-related
5	Building services / MEP	5.1 – 5.14 Building related services Non-building-related
6	Prefabricated Buildings and Building Units	6.1 Prefabricated buildings and building units
7	Work to Existing Building	7.1 Minor demolition and alteration works
8	External works	8.1 Site preparation works 8.2 Roads, paths, pavings and surfaces 8.3 Soft landscaping, planting and irrigation systems 8.4 Fencing, railings and walls 8.5 External fixtures 8.6 External drainage 8.7 External services 8.8 Minor building works and ancillary buildings

LCA building elements table – classification codes based on the RICS New Rules of Measurement (NRM) classification system

CLIMATE CHANGE: CC2. Embodied carbon

Issue	**CC2. Embodied carbon**
Outcome	Significantly reduced levels of embodied carbon achieved by adopting an ambitious embodied carbon target and aspiring to whole life net zero.
Performance verification	Whole Life Carbon (WLC) assessment confirms a marked reduction in the level of embodied carbon over the building life cycle.

SCIM	RIBA Plan of work	Guidance
Strategic Assessment	 0: Strategic Definition	**CC2.1** **Strategic priorities** Consider how a building that achieves significantly reduced levels of embodied carbon will support NHSS values and sustainability strategic investment priorities.
Action: Apply POE learning & adopt soft landings approach		
Initial Agreement	 1: Preparation and Briefing	**CC2.2** **Life Cycle Assessment** Communicate within the project brief: • A whole life approach to carbon reduction is required, requiring design and delivery of a development with the lowest possible carbon emissions over its life cycle; • Clinical and functional requirements must be clearly defined to enable projects the opportunity to fully consider reuse and / or repurposing of an existing asset, recognising that there may be significant embodied carbon savings as a result. • An LCA study utilising an IMPACT compliant LCA tool is required to quantify and help reduce the embodied carbon impacts; • The LCA should follow a robust methodology, for example adoption of the methodology outlined in the RICS Professional Statement for Whole life carbon assessment for the built environment and alignment with the UK Green Building Council Net Zero Carbon Buildings: A Framework Definition; • Reference should be made to industry best practice targets. It is expected that the project will adopt an embodied carbon target as per the requirements of the Net Zero Public Sector Building Standard, or NHSS equivalency. This target should be reviewed and agreed with the client during conceptual stage; • Results for measuring embodied carbon are expected to be presented as $kgCO_2e/m^2$ and tCO_2; • A 60 year study period should be referenced; • To allow for an appropriate level of comparability, the inclusion of all sub-elements listed in the 'LCA Components' table on the previous page of this document should be included in the building LCA study, where present in the development;

CLIMATE CHANGE: CC2. Embodied carbon

- A carbon reduction strategy should be prepared and should inform the most appropriate options for reducing the whole life carbon impact of the project;
- All life cycle stages relevant to the development should be considered in the LCA study, as defined by BS EN 15978 and these should be comparable for each iteration of the assessment. It is expected that, as a minimum, projects will provide a quantified life cycle assessment of TCO_2e for life cycles modules A1 – A5 (product and construction process stages or cradle to handover), demonstrating that the adopted embodied carbon to practical completion target has been met. Please note that external works must be considered and should follow the project strategy for reducing whole life and embodied carbon impacts, however these can be excluded from the adopted embodied carbon to practical completion target (to allow for a better level of comparability between projects);
- The embodied carbon impacts associated with the Use life cycle stage is significant for the healthcare sector. Objectives must be agreed for Modules B1 – B5 (Use stages – including repair, replacement, refurbishment, maintenance) and the LCA should demonstrate a targeted carbon reduction;
- Module C should also be considered and a disassembly guide should be included in the package of information provided to the client. The design should consider and promote ease of disassembly at the end of the building's life and encourage opportunity for renovation and reuse, as opposed to demolition, where possible;
- Supplementary module D should be considered separately and should support the aspirations of transitioning towards a more circular economy;
- The project is required to closely monitor and quantify the carbon impact associated with the product and construction process stages A1 – A5, targeting an ambitious level of reduction. The project is also expected to set ambitious objectives for reducing carbon during the Use stage. This is expected to be an iterative process during design and construction stages;
- Product stage is recognised under modules A1 – A3 and construction process stage is recognised under modules A4 and A5 as per BS EN15978;
- Aspirational levels of performance would typically expect a carbon offsetting plan to be prepared to help achieve construction embodied net zero targets for modules A1 – A5. Where aspirational levels of performance are sought (at present these are optional), offsetting frameworks that could be considered include those recognised by Scottish Government, or where an alternative is required, those recognised by the UK GBC, such as Gold Standard;
- LCA is an iterative process, where baseline targets will be identified and reviewed, and will require regular monitoring and reporting.

Initial Design Statement

Early OBC

2: Concept Design

CC2.3

Embodied carbon

At this stage, an options and site selection process should adopt a resource hierarchy approach and is expected to optimise opportunity for refurbishment, repurpose, extension & tests fits for other possible uses.

CLIMATE CHANGE: CC2. Embodied carbon

Commit to a Whole Life Carbon approach by setting a requirement in the project brief for a reduction in embodied carbon to be demonstrated over the building life cycle.

Accuracy of data

For efficiency and accuracy reasons, it is recommended that the information recorded in BIM models (as this becomes available) is used to identify building quantities, overall and at material product level.

Environmental Product Declaration

Design teams are expected to refer to and specify the use of products and materials with EPDs where possible. Early supply chain viability testing should take place - this should also consider and prioritise responsible sourcing of products with zero / low Volatile Organic Compounds and GHG emissions.

When assessing Life Cycle Assessment (LCA) results, the assessment method used at building level should be consistent with the methods used at product level.

Establishing a baseline

It is expected that during early concept development, the first design iteration will be used to inform a robust baseline model. The most significant carbon contributors should be identified and a carbon reduction strategy should be prepared and reviewed with the client.

Indicative carbon budgets are expected to be provided during early design stages. This will be informed using the initial results from the early LCA and will be aligned with Life Cycle Costing (LCC) studies. The WLC assessment should be synchronised with the LCC, both are required to be updated as the design progresses.

Design options and construction approaches and the respective impacts on the carbon budget (and operational carbon footprint) should be considered, summarised and presented to the client.

Carbon reduction strategy

A carbon reduction strategy should be prepared highlighting considerations and actions that will be required at each project life cycle stage for identifying opportunities for reducing carbon. This should include:

- Material selection (modules A1 – A3);
- Transport of materials and staff to site (module A4);
- Construction installation process (module A5);
- Sustainable, circular, responsible supply chains (supports all modules);
- Use stage: use, maintenance, repair, replacement and refurbishment, energy and water (B modules);
- End of life: designing for deconstruction, recovery and responsible disposal (C modules).

Supplementary module D should be considered separately and should support the aspirations of transitioning towards a more circular economy.

It is recommended that projects identify indicative carbon targets for each building element, to incentivise the projects overall embodied carbon reduction. Where Boards to not have existing available data to draw from, LCA tools could be used to provide indicative values that represent the average split of embodied carbon per building element.

Typically the superstructure and substructure are identified as building elements that can make significant contributions to embodied carbon. Further carbon

CLIMATE CHANGE: CC2. Embodied carbon

contributions result from internal finishes, façade and MEP. It is recommended that teams start the carbon reduction process by considering the most contributing elements and identifying design and construction approaches that offer notable reductions.

It may be helpful to consider the following:

- The use of responsibly sourced timber could reduce embodied carbon impacts by, for example, 50% when compared with concrete and as much as 70% when compared with steel. Timber may also offer sequestration benefits when considered as a part of a whole life carbon assessment;
- The embodied carbon of concrete can be significantly reduced when procured with high recycled substitute mix. For example, the inclusion of Ground Granulated Blast Furnace Slag (GGBS) 50% replacement mix could reduce the embodied carbon on concrete by as much as 40%.
- Using recycled steel can significantly reduce the embodied carbon impact on a project. A high content of recycled steel manufactured on Electric Arc Furnace as opposed to low recycled content manufactured on Basic Oxygen Furnace could reduce the embodied impact by considerably more than half. The choice of finishing for steel must also be considered as, for example, PPC could offer almost 30% less embodied carbon impact when compared with anodised.
- Natural and recycled products are now being used in a number of insulation products, with some achieving embodied carbon figures of less than $5kgCO_2/m^2$. XPS and spray foam insulation with HFC blowing agents can be several thousand times more impactful and should be avoided;
- A growing number of construction products, from bricks to flooring and acoustic panels, are now being manufactured with very high recycled content. This usually results in the embodied carbon of these products being significantly reduced;
- The energy source of manufacture of products should be considered, with preference given to those who avoid intensive processes and the use of fossil fuels;
- EPDs can help to communicate embodied carbon impacts in a credible and clear way and should be sought early. It is recognised that EPDs may not be as readily available for MEP products and therefore project teams are encouraged to make use of the CIBSE TM65 resource suite to consider embodied carbon and make informed design and construction decisions;
- The carbon impacts associated with brining materials to site are included in the embodied carbon calculations. The use of locally sourced products and supply chains that utilise ultra-low emission vehicles should be promoted (recognising that there are also social benefits from local sourcing and procurement);
- The carbon impacts associated with the energy used and waste generated on site during the construction phase are also included in the embodied carbon calculations. To mitigate impact, circular construction principles should be followed as per the guidance under CE1. The Contractor should also consider the use of renewable energy technology and the avoidance of diesel generators on site. The use of lower embodied carbon fuels, for example HVO diesel replacements, could be considered.

CLIMATE CHANGE: CC2. Embodied carbon		
Final Design Statement		**Refrigerants** Refrigerant use and leakage can significantly contribute to the overall carbon footprint of a development and are harmful to the environment. Refrigerant use should be avoided where possible in the design and construction of the building and only where it is required, the lowest environmental impact refrigerants should be specified for use where possible, following leading industry guidance and aiming for a Global Warming Potential of Zero or as close to Zero as reasonably possible. Where the use of environmentally harmful refrigerants are unavoidable, a leak detection system should be specified. This should be capable of continuously monitoring for leaks and have an alert and management function to help mitigate the impact of any leaks.
Final OBC	3: Spatial coordination	**CC2.4** **Reporting and updates** There is a requirement to update the LCA study as the design develops. Carbon budgets should be updated in line with any amendments to the LCC analysis and updates. The results from the options appraisals exercises should be shared with the client and should clearly summarise carbon budgets and reductions in embodied carbon over and above the baseline comparator.
Performance review - pre-planning:		Internal approval required– Complete evaluation matrix and report on embodied carbon target (kgCO2e/m^2) and carbon budget.
Final FBC	4: Technical Design	**CC2.5** **Communication and engagement** Project teams are required to engage with supply chains to assess product viability. There is a requirement at this stage to update the LCA and LCC analysis and review the carbon budget with the lead contractor. The LCC should consider both elemental and component level options analysis. Results should be reviewed in detail with the client, highlighting maintenance and management implications. The final detailed design LCA results should be reviewed by a competent, independent 3rd party, for example the LCA software provider.
Performance review - pre-construction:		Internal approval required – Update evaluation matrix and report any changes. Confirm on embodied carbon target ($kgCO_2e/m^2$) and carbon budget.
Construction and Commission-ing	5: Manufacture and Construction	**CC2.6** **Monitoring and reporting** As part of the carbon management strategy, there will be a requirement for associated carbon impacts from all construction activities to be monitored, reported and accurately reflected in the WLC assessment and carbon budget reporting. The lead contractor will have responsibility for monitoring, reporting and incentivising carbon reduction whilst on site. Regular monthly client reporting is expected to take place.

CLIMATE CHANGE: CC2. Embodied carbon		
Project Monitoring and Evaluation	 6: Handover	**CC2.7** **Final reporting** There is a requirement for the final WLC assessment and carbon budget to be updated to reflect the 'as built' information. The updated LCC analysis and LCA analysis will inform the WLC. This will be presented to the client prior to handover and should include a comparison with the initial carbon budgets that were set and a summary of lessons learned.
Performance verification – 'as built' / pre-occupation		Internal approval required – Update evaluation matrix and report any changes. 'As built' WLC assessment results confirming embodied carbon to practical completion reduction target ($kgCO_2e/m^2$) and whole life objectives have been met.
Project Monitoring and Evaluation	 7: Use	**CC2.8** **Structured POE programme** Capture data, monitor actual performance and compare this against predicted performance (this will include LCC and LCA predictions for whole life scenarios). **Data disclosure** Encouraging full transparency and knowledge share, supporting learning and providing data that can help inform future baseline comparators.
Performance verification – in use		Internal approval required – Completed POE reporting template.
Resources		UKGBC Embodied Carbon: Developing a client brief[38]; RICS Professional Statement, Whole life carbon assessment for the built environment[39]; Delivering a Net Zero NHS, NHS Supply Chain[40]; GGHH agenda and its sustainability goals, GGHH[41]; 2030 Climate Challenge, RIBA[42]; Various publications, LETI[33]

Issue: Water consumption

Water efficiency

The design and specification of water efficient features can significantly help to reduce water consumption levels in use; this can contribute to overall reductions from the water industry's contribution to greenhouse gas emissions, pollution impacts and associated costs, as well as reducing costs related to water consumption and water leaks.

Leak detection

Water leakage refers to the volume of water escaping from water pipes each day. Scottish Water estimate leakage to be 480 million of litres of water per day, with some reports estimating that water leakage in buildings can represent around a quarter of this total figure.

Water leaks that go undetected in buildings, within the building and / or within the site boundary, can be very costly and can cause significant damage to property. Remediation often results in significant disruption and costs. It is, therefore, important to ensure that water leaks are detected and controlled as early as possible.

Installing a permanent water leak detection system, capable of detecting leakage within the building and up to the site boundary, offers environmental and financial benefit. The system should be permanent, programmable and trigger an alarm capable of alerting a building manager when a leak is detected. The system should also be fully compatible with the BMS to allow ease of use, monitoring and reporting.

Flow control devices

Flow control devices can regulate the water supply to each WC area or sanitary facility according to demand, in order to minimise undetected wastage and leaks from sanitary fittings and supply. These should be considered only where there is no perceived conflict with SHTM guidance in respect of infection prevention and control.

Responsible water management and pollution prevention

Waste water discharge best practice guidance should be followed to help ensure the most efficient use of water within the healthcare estate and to also prevent pollution in national sewerage systems. It is important for maintenance strategies to be developed and for these to be effectively communicated with clients and implemented during operational stages to ensure the efficient and safe operation of water systems for responsible consumption and treatment and disposal of waste water.

Commissioning

It is advisable for the client estate management representative to be present during the commissioning exercise and when any fine tuning of systems and services is taking place. All pre-set values and programming information should be communicated to the client prior to handover and will form part of the soft landings training and aftercare programme.

CLIMATE CHANGE: CC3. Water consumption

Issue	**CC3. Water consumption**
Outcome	Integrated water efficiency strategy that supports an overall reduction in the operational carbon footprint of the development.
Performance verification	'As built' building information confirms the targeted level of reduction of water consumption, as a result of the installation of safe and efficient components, systems and equipment.

SCIM	RIBA Plan of work	Guidance
Strategic Assessment	 0: Strategic Definition	**CC3.1** **Strategic priorities** Consider how a building that integrates a water efficiency strategy can support an overall reduction in the operational carbon footprint and will support NHSS value and sustainability strategic investment priorities.
Action: Apply POE learning & adopt soft landings approach		
Initial Agreement	 1: Preparation and Briefing	**CC3.2** **Water hierarchy** Commit to adopting a strategy that prioritises the most responsible options for water management and efficiency for the development. The following water hierarchy should be applied: • Eliminate; • Alternative; • Reduce; • Reuse; • Recycle; • Disposal. Note: Clinical areas can be omitted from this issue. There should be no perceived conflict with the relevant SHTMs, in particular SHTM 04-01. **Water efficient components** Require the specification of water efficient components that do not compromise current NHSS guidance. Water efficiency strategies to be implemented. Projects should adopt best practices water consumption targets, for example such as those referenced in the updated RIBA 2030 Climate Challenge guidance. The most water efficient appliances, fixtures and fittings should be considered. Guidance on water efficient fixtures and fittings can be obtained via the Unified Water Label Scheme[43]. **Water consumption monitoring** To support the effective management and monitoring of water consumption once the building is in use, the following is required: • The specification of sub meters, where following end user engagement these are deemed beneficial; and • A leak detection system, covering the building(s) and site boundary.

CLIMATE CHANGE: CC3. Water consumption

Initial Design Statement

Waste water discharge

Require a strategy that will ensure the responsible disposable of waste water. Water UK's National Guidance for Healthcare Waste Water Discharges should be referred to and where applicable the guidance should be followed.

Early OBC

2: Concept Design

CC3.3

Water efficiency

The water efficiency hierarchy should be considered to help prioritise the most suitable option selection/ site solutions. The response and conclusions should be discussed with the client.

This should include the following:

- All external landscaping and planting to be designed to avoid the need for any dedicated irrigation;
- Where appropriate, the contribution of a rainwater harvesting system should be considered and a feasibility exercise completed;
- Responsible design practices that support the safe and effective distribution of water (for example, ensure drinking water is not at risk of overheating when passing through ceiling voids, therefore avoiding significant volumes of water having to be disposed of).

Waste water pollution

The waste water management strategy should consider how best to manage water. The strategy should consider how the building itself can reduce the need for water disposal as well as examining the most appropriate water pollution prevention strategies.

The findings of an options appraisal should be shared with the client to identify the most suitable options available for the responsible use, treatment and disposal of water.

Final Design Statement

Guidance for Pollution Prevention for Hospitals and healthcare establishments: GPP25 should be referred to in relation to water management, use and efficiency.

Final OBC

3: Spatial coordination

CC3.4

Sub-metering strategy

The water sub-metering strategy, including the provision and location of all sub-meters, should be discussed with the client side estate management team.

All sub-meters should be pulsed output and compatible with and linked to the BMS prior to handover. The metering and reporting strategy should be communicated with the client to ensure that this meets their operational needs. The estates management representative should be consulted with and advice should be sought, ensuring adequate provision and accessible and convenient locations of all sub-meters.

Separate sub-meters should be specified on the supply to the following areas where present and where deemed beneficial (as a result of stakeholder engagement feedback), for example this may include:

- Staff and public areas;
- Clinical areas and ward;
- Letting areas: on the water supply to each tenant unit;
- Laundries;
- Main production kitchen;

CLIMATE CHANGE: CC3. Water consumption		
		• Hydrotherapy pools; • Laboratories; • Central sterile supply department, hospital sterilisation and disinfection unit, pathology, pharmacy, mortuary and any other major process water use. • Supplementary supply of water from a cold water tank.
Performance review - pre-planning:		Internal approval required– This is expected to coincide with the completion of Final OBC stage. Complete evaluation matrix, confirm the presence of sub-meters and leak detection and report on the efficiency improvement for each component type.
Final FBC	 4: Technical Design	**CC3.5** **Leak detection** There is a requirement for the specification of a programmable leak detection system, capable of triggering an alert, to be installed to cover the building and site boundary. **Linkage to BMS** The sub-metering and leak detection system should be fully compatible with the BMS, with full remote access for monitoring, programming and reporting allowed for. All monitoring and reporting requirements should be identified through engagement with appropriate end users groups, with systems designed to support end user needs.
Performance review - pre-construction:		Internal approval required – Update evaluation matrix and report any changes. Confirmation that sub-metering and leak detection will be fully compatible with BMS.
Construction and Commission-ing	 5: Manufacture and Construction	**CC.3.6** **Change control** Ensure specification is managed through change control procedures and client approval is requested where any changes would impact quality or performance. **Commissioning** The leak detection system should be fully programmed and compatible with the BMS. This should be trialled (with the client estates management representative present) prior to handover. Any required pre-commissioning activities should take place well in advance of handover, this should include cleaning of pipework systems and similar activities (in accordance with relevant industry best practice guidance) that will support operational performance and efficiencies during the in-use stages.
Project Monitoring and Evaluation	 6: Handover	**CC3.7** **Communication of information** All sub-meters and leak detection system should be fully operational, linked to the BMS and fully commissioned prior to handover. All programme information and set values should be recorded and presented to the client.

CLIMATE CHANGE: CC3. Water consumption		
		All pollution prevention and control strategies should be documented and clearly communicated and illustrated to the client and estates management representatives. There is a requirement to review the water management and waste disposal strategy as part of the seasonal commissioning programme.
Performance verification – 'as built' / pre-occupation		Internal approval required – Update evaluation matrix and report any changes. Confirmation that all sub-meters and the leak detection system are fully commissioned and linked with the BMS. Confirmation of programmed information and set values.
Project Monitoring and Evaluation	 7: Use	**CC3.8** **Structured POE programme:** POE activity should monitor actual performance and compare this against predicted performance for consumption, maintenance and management. Activities linked with safety and pollution control should be addressed and required information documented and reported as part of the Key Stage Assessment Review (KSAR) process.
Performance verification – in use		Internal approval required – Completed POE reporting template.
Resources		RIBA 2030 Climate Challenge – Potable Water Use Targets[42]; Unified Water Label Scheme[43]; UK Water National Guidance for Healthcare Waste Water Discharges[44]; Hospitals and healthcare establishments: GPP 25[45]; BSRIA Pre-commission Cleaning of Pipework Systems[46].

Issue: Environmental security

Environmental security

Environmental security can be significantly improved through a considered approach to landscape design; making places safer, more sociable and sustainable. The creation of multi-functional green infrastructure can help to mitigate associated present and future climate risk and create significant value.

The building and the wider site have an opportunity to support and enhance clinical intervention and care programmes in addition to protecting and enhancing our natural and built environments, at this present time and in the future.

Early appraisals

Early options, site and strategic planning appraisals can help to explore the various issues, principles and ambitions associated with each at an early development stage. Early engagement and involvement of a landscape architect can support the options / site selection process and offer valuable insight and contributions to important issues in relation to planning and sustainability, which are often much more cost effective to consider at as early a stage as possible.

This activity provides a method of assessing how a plan or strategy can contribute to environmental security and wider sustainable development aspirations. Early consideration should be given to the opportunity and challenges that the site may present in relation to sustainable health and care; managing the risk of pollution; site optimisation and positioning and orientation of buildings; and sensitively conserving and enhancing biodiversity.

For all new developments, brownfield site selection should be prioritised over greenfield development and any existing natural features should be protected and retained. The Scottish Land Commission has mapped long-term derelict urban sites (the DUSTEs)[47] that are identified as priorities for reuse. In addition, a Community Impact Tool[48] is also available and could assist in identifying local priority sites by gauging community perception of these.

Landscape-led

Utilising a baseline assessment and adopting a landscape-led approach during early conceptual development stages can add value by finding the right balance between buildings and external spaces. This also ensures that functional green infrastructure is provided which supports the site and its operational needs. It is important to ensure that this is explored during the very early conceptual stages to allow maximum opportunity and benefit to be achieved for the site and the building(s). Adopting holistic approaches can support the successful integration of placemaking and green infrastructure requirements, ensuring the delivery of safe, useable and functional designs and features.

Green Space Factor

The use of Green Space Factors (GSF)[49] is a way of evaluating and quantifying the amount and quality of green space that a project delivers. GSF can help to ensure better planned and quality green space that contribute to a functioning green infrastructure network.

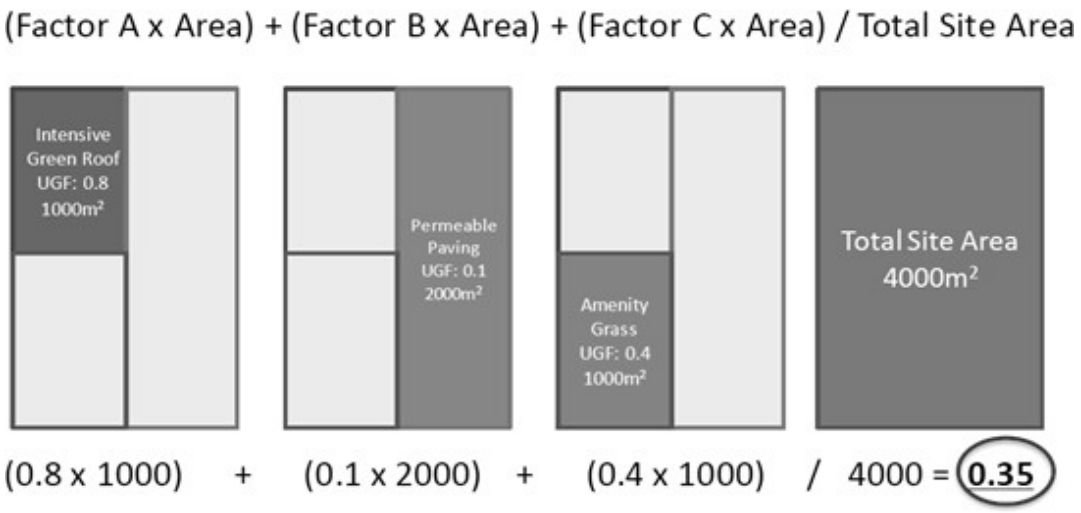
The use of GSF as a planning policy tool originated in Berlin and has since been adopted and adapted in a number of other cities in Europe and North America to encourage urban greening. The benefits of GSF are being documented from evidence gathered from similar schemes that have implemented the use of GSF internationally and in the UK. This has resulted in number of leading organisations, including RIBA, recognising GSF targets in the setting of their future sustainability targets. The RIBA 2030 Sustainable Outcomes targets for sustainable land use and biodiversity are to achieve net positive species impact and 0.3 – 0.4 urban green factor on all new sites.

The GSF is calculated based on a range of factors that are referenced for different greening factors. Examples of these are provided in the table below:

Surface Cover Type	Factor
Semi-natural vegetation (e.g. trees woodland, species rich grassland) maintained or established on site.	1
Wetland or open water (semi-natural; not chlorinated) maintained or established on site.	1
Intensive green roof or vegetation over structure. Substrate minimum settled depth of 150mm- see linvingroofs.org for descriptions.	0.8
Standard trees planted in connected tree pits with a minimum soil volume equivalent to at least two thirds of the projected canopy area of the mature tree – see Trees in Hard Landscapes for overview.	0.8
Extensive green roof with substrate of minimum settled depth of 80mm (or 60mm beneath vegetation blanket) - meets the requirements of GRO Code 2021.	0.7
Flower-rich perennial planting – see Centre for Designed Ecology for case-studies.	0.7
Rain gardens and other vegetated sustainable drainage elements – see CIRIA for case-studies.	0.7
Hedges (line of mature shrubs one or two shrubs wide) – see RHS for guidance.	0.6
Standard trees planted in pits with soil volumes less that two thirds if the projected canopy area of the mature tree.	0.6
Green wall – modular system or climbers rooted un soil – see NBS Guide to Façade Greening for overview.	0.6
Groundcover planting – see RHS Groundcover Plants for overview.	0.5
Amenity grassland (species-poor, regularly mown lawn).	0.4
Extensive green roof of sedum mat or other lightweight systems that do not meet GRO Code 2021.	0.3
Water features (chlorinated) or unplanted detention basins.	0.2
Permeable paving – see CIRIA for overview.	0.1
Sealed surfaces (e.g. concrete, asphalt, waterproofing, stone).	0

In order to calculate the GSF, the area of each surface cover type is calculated and is multiplied by the corresponding Factor (as listed above). This is then divided by the total site area to provide a GSF. Existing green cover on a site that is retained can contribute towards the score. The GSF calculation is summarised below:

Figure 10: Green Space Factors (GSF) calculation methodology for a site



CLIMATE CHANGE: CC4. Environmental security

Issue	**CC4. Environmental security**
Outcome	Purposeful approach to landscape design that creates valuable greenspace and delivers environmental security.
Performance verification	No negative environmental impact; a considerate site wide approach to managing environmental risk, optimising layout and orientation and enhancing ecological function.

SCIM	RIBA Plan of work	Guidance
Strategic Assessment	0: Strategic Definition	**CC4.1** **Strategic priorities** Consider how a development that delivers environmental security and valuable greenspace will support NHSS values and sustainability strategic investment priorities.
Action: Apply POE learning & adopt soft landings approach		
Initial Agreement Initial Design Statement	1: Preparation and Briefing	**CC4.2** **Environmental security and Green Space Factor (GSF)** Within the brief, commit to a purposeful approach to landscaping that will create valuable, high-quality green infrastructure, supporting a network of multi-functional green space and delivering aspects of environmental security that benefit the immediate and wider community. Option / site appraisal activity will consider strategies for: • Minimising geo-environmental risk; • Minimising risk from any external sources of pollution; • Optimising site layout and orientation, for buildings and people; • Integrating greenspace interventions; • Protecting and enhancing biodiversity. Within the brief, require the preparation of a baseline sustainable landscape assessment. This should demonstrate potential for realising full sustainable health and biodiversity benefits and should also consider factors such as use-ability, accessibility and health and wellbeing benefits. For larger projects, a detailed masterplan approach should be adopted. Commit to targeting a GSF of at least 0.4.
Early OBC	2: Concept Design	**CC4.3** **Option / Site appraisals** Early appraisals should include an options sustainability assessment, master-planning, landscape and environmental risk assessment and, where relevant, potential mitigation and / or remediation strategies, covering: • Topography; • Geology; • Flooding (present and future risk); • Hydrology;

CLIMATE CHANGE: CC4. Environmental security

- Ecology and green networks;
- Contamination;
- Structures;
- Existing character;
- Local Knowledge;
- Access and services (including active and public transport);
- Amenities (provision and accessibility);
- Microclimate;
- Site optimisation (layout / building location and orientation / planning / maintenance).
- Site optimisation
- The design should be developed to demonstrate that the network of green spaces, wetlands and features can be managed to deliver a range of benefits, including:
- Sustainable health and care:
- Inclusive Design
- Design that enables and encourages the active use of the NHSS estate in clinical interventions and care programmes.
- Accessible and inclusive design should encourage use of the outdoor estate by all building users and the local community. Early stakeholder engagement (promoted and facilitated as part of the Soft Landings approach) can encourage wider community ownership, management and maintenance of the estate.
- Mitigate risk of pollution:
- Flooding risk
- All current and future sources of flooding should be considered and managed in accordance with industry best practice guidance. This will include present and future predictions with allowance for climate change as per industry guidance.
- Where any flood risk is identified, a site-based Flood Risk Assessment should be commissioned.
- Responsibly manage surface water run-off
- The SUDS hierarchy should be adopted, with a requirement for a feasibility study to be prepared to consider the incorporation of a green roof. Design should demonstrate an improvement for peak rate of run-off and run-off volume, an adequate allowance should be made for climate change. Risk of pollution should be calculated and managed accordingly, with any high-risk areas identified and pollution control strategies discussed and agreed with the client and wider team. An appropriate level of pollution prevention should be provided for in accordance with industry best practice, for example in accordance with the SuDS manual.
- Zero local pollution
- Promote strategies that minimise the developments contribution to local pollution, including water, air and noise. Undertake preliminary assessments of the site to explore opportunities for use of land that could support zero GHG emission energy generation.

CLIMATE CHANGE: CC4. Environmental security		
Final OBC	3: Spatial coordination	• Optimise site layout and orientation: **Layout** Site layout design should integrate the natural site characteristics with the placement of the buildings(s) to prioritise safe, secure, accessible and inclusive routes and spaces within and out with the site boundary. **Orientation** Positioning and orientation of buildings should consider the site microclimate and optimise passive design strategies. Species selection and planting design of trees and shrubs should be carefully considered to successfully offer a level of solar protection, act as noise buffer and enhance air quality. This approach should be adequately investigated and where appropriate reflected in any detailed modelling or testing of the building and / site to consider and help quantify benefits. • Ecological resilience and enhancements to biodiversity: **Protect and enhance** Instruct a baseline survey and identify the most appropriate enhancement opportunities for the site, including tree planting. Protect and enhance the ecological value of the site. Create, enhance and improve local biodiversity and wildlife habitats. Confirm the proposed enhancement strategy and the level of biodiversity net gain (e.g. this could be as a percentage). **CC4.4** **Integrated design approach** Continued integrated approach required from specialist consultants, e.g. landscape architect, architect, civil and structural engineers, to validate the conceptual design against desired outcomes. Ensure stakeholder feedback continues to be captured and demonstrate how this is reflected in the final design. Enable staff to develop a sense of ownership over the new development and external spaces. This activity should be integrated into the soft landings approach for the project and discussed more holistically, for example also addressing the use of high-quality external space in support of the wellbeing issues that are referenced within this guide. Consider how internal and external space could be designed and used to support environmental, circular and wellbeing outcomes, identifying and exploring opportunities for wider local community interaction and benefit.
Performance review - pre-planning:		Internal approval required– This is expected to coincide with the completion of Final OBC stage. Complete evaluation matrix and report on the targeted GSF and environmental security approach and level of impact.
Final FBC	4: Technical Design	**CC4.5** **Planning for aftercare** There is a requirement for a site wide management and maintenance plan to be prepared. This should include for landscaping and all pollution control features. Any management and maintenance requirements should be clearly communicated with the client.
Performance review - pre-construction:		Internal approval required – Update evaluation matrix and report any changes. Confirm GSF and environmental security approach.

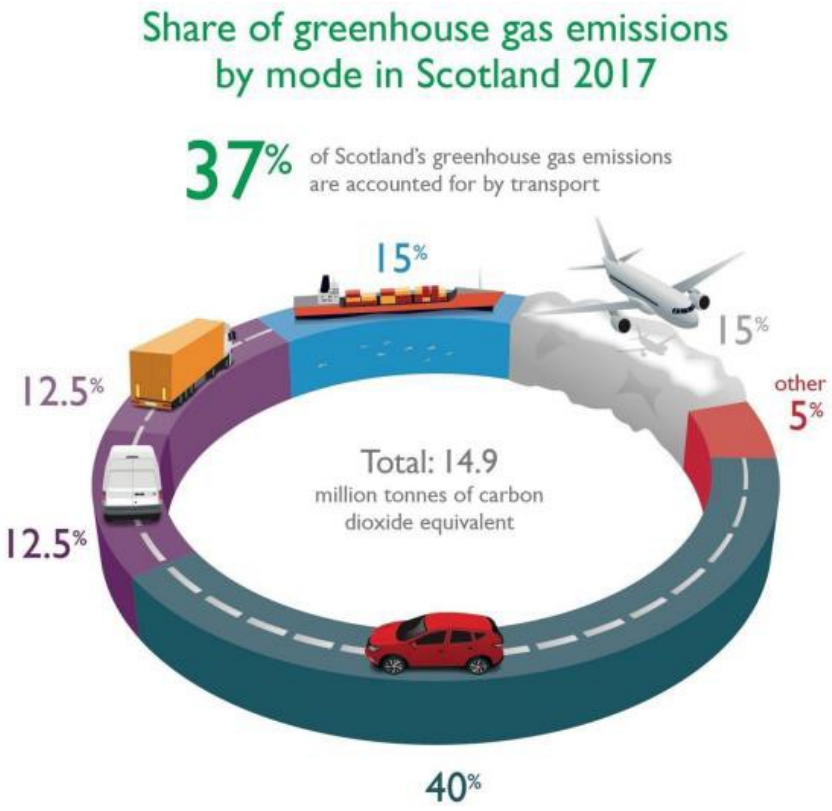
CLIMATE CHANGE: CC4. Environmental security		
Construction and Commission-ing	 5: Manufacture and Construction	**CC4.6** **Quality and change control** Ensure specification is managed through change control procedures and client approval is requested where any changes would impact quality or performance. Ensure a nominated individual from the lead contractor is appointed to monitor, manage and report on all environmental security and enhancement aspects as agreed during earlier design stages. **Responsible site management** The lead contractor is required to operate an Environmental Management System (EMS). The EMS must be certified to ISO 14001:2015 or equivalent standard. There is a requirement for the contractor to adopt responsible site management process. This should be demonstrated through the Considerate Constructors Scheme or equivalent process.
Project Monitoring and Evaluation	 6: Handover	**CC4.7** **Aftercare** Provide induction training to client's estate manager representative, referencing the environmental security approach and a detailed review of the maintenance and management strategy. A detailed training, handover and aftercare package will form part of the soft landings approach – all management and maintenance requirements should be recognised and addressed as part of the soft landings approach, ensuring adequate communication and on-going support for end users.
Performance verification – 'as built' / pre-occupation		Internal approval required – Update evaluation matrix and report any changes. Confirm GSF and environmental security approach and predicted level of impact.
Project Monitoring and Evaluation	 7: Use	**C4.8** **Structured POE programme:** Activity should monitor actual performance and compare this against predicted performance for environmental security impact (e.g. effectiveness of pollution control, level of biodiversity etc.), maintenance and management.
Performance verification – in use		Internal approval required – Completed POE reporting template.
Resources		Scotland's biodiversity: it's in your hands[50]; RIBA Sustainable Outcomes Guide[17]; SEPA Regulatory Method (WAT-RM-08) Sustainable Urban Drainage Systems (SUDS or SUD Systems)[51]; Forestry Commission – Noise Abatement[52]; Urban Green Space and Health: Intervention Impacts and Effectiveness, WHO[53].

Issue: Active travel and sustainable transport

Accessible and sustainable travel options

Transport is currently the largest contributor to Scottish GHG emissions, with single occupancy car journeys making the greatest contribution. More than a third of these car journeys in Scotland are short distance and under 1km. The transport system has a significant impact on local air quality, with road traffic contributing to recorded levels of Particulate matter (PM10) and nitrogen oxides (NOx). Exposure to poor air quality levels can have a considerable impact on health, increasing the risk of diseases such as asthma, respiratory illness and heart disease.

Figure 11: Share of greenhouse gas emissions by mode in Scotland
Source: Scottish Government, National Transoprt Strategy



One of Scotland's public health priorities is to enhance health and wellbeing by encouraging greater levels of physical activity. Physical inactivity contributes to nearly 2,500 deaths in Scotland annually, which is estimated to cost the NHS around £94 million. The Scottish Government and NHSS are both committed to working collaboratively to drive positive change in this area and put active travel at the heart of transport planning.

Changing travel behaviour, in favour of more active and more sustainable options, will have a significant impact on the environment, local air quality and contributions towards the net zero target. An active, accessible and more sustainable transport strategy will also help to enable a healthier and more inclusive society.

Option / Site appraisals

Early site transport appraisals can be used to raise awareness of existing local transport and infrastructure provision and identify where there are opportunities for

more active and sustainable improvements to be made. Designing beyond current minimum levels of compliance will ensure site strategies and infrastructure has an element of resilience and can support the longer-term transition towards net zero.

The location of a site or a number of potential development sites should be considered with regards to their proximity to existing transport infrastructure, hubs and provision and their opportunity for connecting to or establishing active travel networks. Healthcare facilities should be accessible for all.

Engagement with national bodies can provide significant contributions when shaping a brief and can also positively influencing future concept designs. Utilise resources made available through Sustrans[54], Architecture & Design Scotland[55] and Way to Work[56].

Stakeholder engagement

Stakeholder engagement will play an important part in understanding and positively influencing end user behaviour. It is important to ensure that as part of the wider stakeholder engagement exercise, relevant transport providers, national transport steering groups and end user groups (including staff, visitors, deliveries and local community groups, including representation from local mobility access committees where available) are represented and engaged on travel and transport issues and that an appropriate feedback and communication mechanism is established throughout the project.

The importance of continued stakeholder engagement should not be undervalued. Creating opportunities for end user groups to remain informed and connected to the design, will provide an opportunity to promote the benefits of active travel and public transport and encourage a modal shift.

Places for everyone

Sustrans Places for Everyone[54] scheme is funded by Scottish Government through Transport Scotland with the aim of creating safe, attractive, healthier places by increasing the number of trips made by walking, cycling and wheeling for everyday journeys. The scheme contributes to the Scottish Government's objectives laid out in the National Performance Framework by aiming to create a healthier, environmentally sustainable nation with a thriving economy and communities. The scheme has six design principles which all new build and major refurbishment healthcare projects should follow:

1. Develop ideas collaboratively and in partnership with communities.
2. Facilitate independent walking, cycling, and wheeling for everyone, including an unaccompanied 12-year old.
3. Design places that provide enjoyment, comfort and protection.
4. Ensure access for all and equality of opportunity in public space.
5. Ensure all proposals are developed in a way that is context-specific and evidence-led.
6. Reallocate road space, and restrict motor traffic permeability to prioritise people walking, cycling and wheeling over private motor vehicles.

CLIMATE CHANGE: CC5. Active travel and sustainable transport

Issue	**CC5. Active travel and sustainable transport**
Outcome	Transition towards achieving net zero GHG from transport by 2045.
Performance verification	Integrated design that prioritises high quality walking, cycling and wheeling infrastructure and accessible sustainable transport for all.

SCIM	RIBA Plan of work	Guidance
Strategic Assessment	 0: Strategic Definition	**CC5.1** **Strategic priorities** Consider how a development that integrates and prioritises active travel and more sustainable transport in a safe and inclusive way will support NHSS values and sustainability strategic investment priorities.
Note: Apply POE learning & adopt soft landings approach		
Initial Agreement Initial Design Statement	 1: Preparation and Briefing	**CC5.2** **Active travel and sustainable transport** Within the brief, commit to promoting design that integrates and prioritises active travel and more sustainable transport options for all users, in accordance with Scotland's National Transport Strategy and the Sustainable Travel Hierarchy. Consideration should be given to the following: • Removing the need to travel: During wider stakeholder engagement activities, explore opportunities for the provision of digital health offering and of shared services e.g. other complementary public sector services. • Safe movement of people and goods: Adoption of a transport user hierarchy, categorising and prioritising users based on the level of safety that they require. Prioritisation of movement of people on site should also be considered, with priority given to those who are most vulnerable and those arriving by foot or wheeling. • Design for quality: Design for high-quality active travel routes. Encourage a change in behaviour; utilise design to increase the attractiveness of active and sustainable transport to all site users. • Design for resilience: Build a resilient transport infrastructure by designing for future compliance. This will include shorter-term full Electric Vehicle Fleet targets as well as longer-term targets as laid out in the National Transport Strategy. Consider required infrastructure and capacity needs and how the development could achieve these.
Early OBC	 2: Concept Design	**CC5.3** **Option / Site appraisals** An integrated approach is required when considering this issue and the environmental security issue. Consideration of both issues should be used to inform option / site appraisal activity.

CLIMATE CHANGE: CC5. Active travel and sustainable transport

There is a requirement for a transport assessment to be delivered. Early local engagement and appraisals should include:

- Current trends, behaviours and opinions of existing building / site users (where relevant) in relation to active travel and sustainable transport. This could also involve examining and understanding any existing desire lines.
- Local environment and site accessibility for all users (including consideration of all local active travel networks e.g. traffic free routes, canal paths, forest paths etc. and required connection to these).
- All existing infrastructure and suitability / opportunity for enhancement and / or expansion.
- Accessibility and existing capacity (and suitability of future expansion) of public transport and any community transport options.
- Provision of local complementary amenities, supporting inclusive transport strategies.

Stakeholder feedback

Concept designs should demonstrate how they have considered and responded to stakeholder and consultation feedback. All users and their transport needs should be considered.

Integrated design

The design should promote an intuitive and integrated approach when considering transport infrastructure. Accessibility, inclusion and safety of all users should be fully considered and demonstrated in the design:

- An integrated design approach should be adopted, considering wayfinding and the safe movement of people in and out with the site and the use of green space and infrastructure.

There is a requirement to consider the six design principles laid out by Sustrans under their Places for Everyone initiative.

Final OBC

3: Spatial coordination

CC5.4

Safety and security

For end users and those traveling to, from and through the site, active travel and sustainable transport journeys should be viewed as safe and intuitive, if they are to be considered as viable options.

A safety and security assessment should consider all user groups. This should consider site layout, access, wayfinding, lighting provision, segregation of service vehicle and delivery routes and adequate levels of protection.

Provision of complementary services

The provision of complimentary services is also required in order to truly incentivise and support a behavioural shift.

To enable active travel to be viewed as a viable and attractive option for users, adequate provision of complementary services should also be provided. This could include:

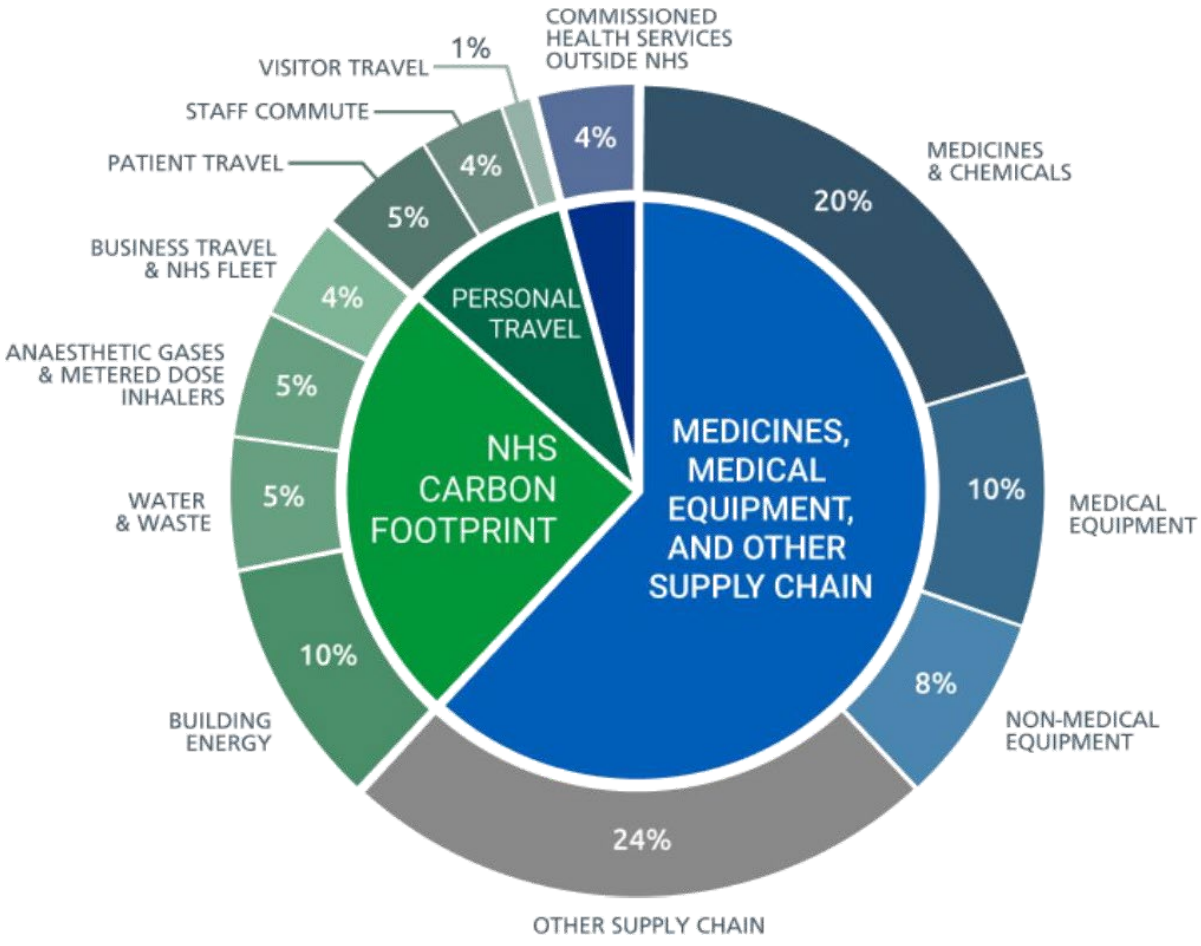
- Adequate provision of accessible lockers.
- Adequate provision of accessible showers.
- Adequate provision of secure cycle parking facilities (supporting levels of predicted user demand).
- A variety of seating and sheltered spaces along all outdoor routes.

Final Design Statement

CLIMATE CHANGE: CC5. Active travel and sustainable transport		
Performance review - pre-planning:		Internal approval required– This is expected to coincide with the completion of Final OBC stage. Complete evaluation matrix and provide an overview of the proposed active travel and sustainable transport strategy. Include levels of targeted behavioural shits.
Final FBC	 4: Technical Design	**CC5.5** **Route planning and signage** To support behavioural shifts, careful consideration should be given to effective route planning, signage and wayfinding. The design should be underpinned by a clear zoning strategy, ensuring a person-centred environment that is designed to be safe and attractive to use and also effective and efficient to operate. Communicate with and obtain feedback from end user groups on desirable and accessible tools for route planning. Obtain feedback on proposed signage for the site, entry and exit points, indoor and outdoor spaces and coordinate a consistent site wide strategy. Incorporate signage that communicates in a friendly, positive, accessible and inclusive way, assisting in an entire user journey through a space or between different spaces. Embrace the Places for Everyone design principles.
Performance review - pre-construction:		Internal approval required – Update evaluation matrix and report any changes. Summarise design response in relation to Places for Everyone principles.
Construction and Commission-ing	 5: Manufacture and Construction	**CC5.6** **Travel Plan** A site specific Travel Plan should be prepared prior to building handover. The client should have a level of input to the development of this document: • The Travel Plan should support the long-term sustainable travel aspirations of the site. • Guidance should be provided on the measures and features that are present and the safe movement of people and goods during the building's operational phase. • The Travel Plan should form part of the complete Building User Guide information. • Sections within the Travel Plan should be suitable for providing visitors with information in relation to travelling to and from the site and will promote and prioritise the most active and sustainable journeys.
Project Monitoring and Evaluation	 6: Handover	**CC5.7** **Aftercare** The transport strategy and details of the Travel Plan should be effectively communicated and promoted to end users during handover and aftercare sessions.
Performance verification – 'as built' / pre-occupation		Internal approval required – Update evaluation matrix and report any changes. Provision of site-specific Travel Plan and confirm provision of active and sustainable measures and predicted travel trends (predicted level of uptake).

CLIMATE CHANGE: CC5. Active travel and sustainable transport		
Project Monitoring and Evaluation	7: Use	**CC5.8** **Structured POE** Activity should include strategy impact and efficiency review and contribution to GHG reduction - monitoring trends and considering staff, patient, visitor, delivery and services impact.
Performance verification – in use		Internal approval required – Completed POE reporting template.
Resources		Scotland's National Transport Strategy & Transport Scotland Active Travel Framework[57]; Sustrans Places for Everyone[54]; Way to Work[56]; Architecture & Design Scotland Active Travel information & other resources[55]

Figure 12: NHS Carbon Footprint Plus proportions by key source Source: Delivering a net zero National Health Service, October 2020 www.england.nhs.uk/greenernhs/a-net-zero-nhs/



Appendix A – References

Legislation

Scottish legislation

Ref No.	Title of document / Location	Publisher	Website Link to Document
4	Climate Change (Emissions Reduction Targets) (Scotland) Act 2019	Scottish Government	www.legislation.gov.uk/asp/2019/15/contents
	Climate Change (Scotland) Act 2009	Scottish Government	www.legislation.gov.uk/asp/2009/12/contents
	The Public Contracts (Scotland) Regulations 2015	Scottish Government	www.legislation.gov.uk/ssi/2015/446/contents/made
	Procurement (Scotland) Regulations 2016	Scottish Government	www.legislation.gov.uk/sdsi/2016/9780111030868/contents
	Procurement Reform (Scotland) Act 2014	Scottish Government	www.legislation.gov.uk/asp/2014/12/contents

UK legislation

Ref No.	Title of document / Location	Publisher	Website Link to Document
	Health and Safety at Work etc. Act 1974	UK Government	www.legislation.gov.uk/ukpga/1974/37/introduction
	The Management of Health and Safety at Work Regulations 1999	UK Government	www.legislation.gov.uk/uksi/1999/3242/made
	European Union (Withdrawal) Act 2018	UK Government	www.legislation.gov.uk/ukpga/2018/16/data.pdf
	The Waste Electrical and Electronic Equipment Regulations 2013	UK Government	www.legislation.gov.uk/uksi/2013/3113/introduction/made

European legislation

Ref No.	Title of document / Location	Publisher	Website Link to Document
	Article 15 Person responsible for regulatory compliance	The European Parliament and the Council of the European Union	https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32017R0745&from=EN#d1e2842-1-1

UK & International standards

Ref No.	Title of document / Location	Publisher	Website Link to Document
	BS 7671:2018 Requirements for Electrical Installations. IET Wiring Regulations	British Standards Institution (BSI)	https://shop.bsigroup.com/ProductDetail?pid=000000000030342613
	ISO 9001 Quality Management	British Standards Institution (BSI)	www.bsigroup.com/en-GB/iso-9001-quality-management/
	ISO 55001:2014(en) Asset management	ISO (the International Organization for Standardization	www.iso.org/obp/ui/#iso:std:iso:55001:ed-1:v1:en
	BSI Home Page	British Standards Institution (BSI)	www.bsigroup.com/en-GB/
	ISO/IEC 15408-1:2009 Information technology - criteria for IT security	British Standards Institution (BSI)	www.iso.org/standard/50341.html
9	The WELL Building Standard	International WELL Building Institute	Biophilia I - qualitative | WELL Standard (wellcertified.com)

Guidance

Scottish guidance

Ref No.	Title of document / Location	Publisher	Website Link to Document
	Health Facilities Scotland - Publications page	NHSS NSS Health Facilities Scotland	www.nss.nhs.scot/health-facilities/health-facilities-publications-and-guidance/our-publications/
	Healthcare Improvement Scotland - Home page	Healthcare Improvement Scotland	www.healthcareimprovementscotland.org/
	Audit Scotland - Home page	Audit Scotland	www.audit-scotland.gov.uk/
	National Infection Prevention and Control Manual	NHS National Services Scotland	www.nipcm.hps.scot.nhs.uk/
	Health Directorate Policy	Scottish Government	www.sehd.scot.nhs.uk/index
	Key Procurement Principles	Scottish Government - Health Finance	www.sehd.scot.nhs.uk/mels/CEL2012_05.pdf
	Procurement Journey	Scottish Government	www.procurementjourney.scot/procurement-journey
	Public Sector Procurement	Scottish Government	www.gov.scot/policies/public-sector-procurement/

Ref No.	Title of document / Location	Publisher	Website Link to Document
	The Healthcare Quality Strategy for NHS Scotland	Scottish Government	www.gov.scot/publications/healthcare-quality-strategy-nhsscotland/
	Scottish Health Council Policy, Legislation and Guidance section	Scottish Health Council	scottishhealthcouncil.org/patient__public_participation/policy_and_legislation.aspx#.Xc2DHeRCfIW
	Scottish Global Health Coordination Unit	NHS Scotland	www.scottishglobalhealth.org/
	National Procurement Competency Framework	Scottish Government	www.gov.scot/publications/scottish-procurement-competency-framework/
1	A Climate Change Risk Assessment for Scotland	Scottish Government	CCRA » Devolved Administration reports » Scotland (hrwallingford.com)
3	Scotland's National Performance Framework	Scottish Government	National Performance Framework | National Performance Framework
5	Scottish Government's Net Zero Public Sector Building Standard	Scottish Government	Net Zero Public Sector Buildings Standard - Scottish Futures Trust
6	NHSS Government Soft Landings Navigator	NHS Scotland	PowerPoint Presentation (cam.ac.uk)
7	The Place Standard tool	NHS Scotland, Architecture and Design Scotland, Scottish Government	https://placestandard.scot/
8	Community Wealth Building	Scottish Government	Cities and regions: Community wealth building - gov.scot (www.gov.scot)
12	5 Steps to Mental Wellbeing	NHS Scotland	5 steps to mental wellbeing - NHS (www.nhs.uk)
13	Unlocking the potential of NHS greenspace	Nature Scotland, NHS Scotland, Scottish Forestry	www.nature.scot/sites/default/files/2020-04/NHS%20Greenspace%20Demonstration%20Project%20-%20full%20report%202020.pdf
14	Greenspace Scotland, Green Health Case Studies	Greenspace Scotland	Health | Greenspace Scotland
15	Nature Scotland, NHS Greenspace	Nature Scotland	NHS Greenspace | NatureScot
22	Circular Procurement, Zero Waste Scotland	Zero Waste Scotland	Circular Procurement | Zero Waste Scotland

Ref No.	Title of document / Location	Publisher	Website Link to Document
23	Construction Resources for a Circular Economy	Zero Waste Scotland	https://zerowastescotland.org.uk/sites/default/files/Construction%20Circular%20Economy%20Resources%20062020.pdf
28	Scottish energy data, Scottish Government	Scottish Government	Scottish energy statistics hub index - gov.scot (www.gov.scot)
30	Climate change and sustainability tools	NHS NSS	Access climate change and sustainability tools | National Services Scotland (nhs.scot)
31	SMASH Introduction, Public Health Scotland	Public Health Scotland	SMASH Introduction - ScotPHN
47	DUSTE map	Scottish Land Commission	Transforming Vacant and Derelict Land - Housing & Development - Our work - Scottish Land Commission
48	Community Impact Tool	Scottish Land Commission	5f75b8e59a1ac_VDL Community Impact Tool.pdf (landcommission.gov.scot)
50	Scotland's biodiversity: it's in your hands	Scottish Government	Scotland's biodiversity: it's in your hands - gov.scot (www.gov.scot)
51	Regulatory Method (WAT-RM-08) Sustainable Urban Drainage Systems (SUDS)	SEPA	Regulatory Method (WAT-RM-08) (sepa.org.uk)
52	Forestry Commission – Noise Abatement	Forestry Commission	Noise abatement - Forest Research
54	Places for Everyone	Sustrans	Places for Everyone - Sustrans.org.uk
55	Healthier Places: Guide to the NHSS Design Assessment Process	Architecture & Design Scotland	Healthier Places: Guide to the NHSScotland Design Assessment Process (NDAP) – A&DS (ads.org.uk)
56	Various resources	Way to Work	Home - Way To Work Scotland
57	Scotland's National Transport Strategy	Scottish Government	National Transport Strategy 2

UK guidance

Ref No.	Title of document / Location	Publisher	Website Link to Document
	Toward Net Zero and Sustainable NHS	NHS England	www.england.nhs.uk/greenernhs/

Ref No.	Title of document / Location	Publisher	Website Link to Document
	Healthcare Quality Improvement Partnership Homepage	HQIP	www.hqip.org.uk/
	HSE Safety alerts in health and social care	Health and Safety Executive	www.hse.gov.uk/healthservices/safety-alerts.htm
	Maintaining portable electric equipment in low-risk environments	Health and Safety Executive	www.hse.gov.uk/pubns/indg236.pdf
10	The Building With Nature Standards	Building With Nature	www.buildingwithnature.org.uk
11	Warwick and Edinburgh Mental Wellbeing Scale	Warwick Medical School	The Warwick-Edinburgh Mental Wellbeing Scale (WEMWBS)
17	RIBA Sustainable Outcomes Guide	RIBA	Sustainable Outcomes Guide (architecture.com)
18	CIBSE Guide L Sustainability	CIBSE	CIBSE - Building Services Knowledge
24	'Circular economy guidance for construction clients', UK Green Building Council	UKGBC	https://www.ukgbc.org/ukgbc-work/circular-economy-guidance-for-construction-clients-how-to-practically-apply-circular-economy-principles-at-the-project-brief-stage/
26	Resource suite, Building Controls Industry Association	BCIA	https://bcia.co.uk/resources/
27	GHG emissions and projections, UK Government	UK Government	https://www.gov.uk/government/collections/government-conversion-factors-for-company-reporting https://www.gov.uk/government/collections/energy-and-emissions-projections
29	Net Zero Carbon Buildings: A Framework Definition, UKGBC	UKGBC	Net Zero Carbon Buildings: A Framework Definition - UKGBC - UK Green Building Council
32	Delivering a net zero NHS	NHS England	Greener NHS » Delivering a net zero NHS (england.nhs.uk)
33	Various publications, London Energy Transformation Initiative LETI	LETI	Publications | LETI
34	A Healthcare Engineering Roadmap for Delivering Net Zero Carbon	IHEEM	A Healthcare Engineering Roadmap for Delivering Net Zero Carbon - IHEEM

Ref No.	Title of document / Location	Publisher	Website Link to Document
35	Resource suite, Climate Framework	Climate Framework	Climate Framework Resource Library
36	Net Zero Carbon Industry Initiative	Construction Leadership Council	Net Zero Carbon » Construction Leadership Council
37	Various resources	RIBA	Resources (architecture.com)
38	Embodied Carbon: Developing a client brief	UKGBC	UK-GBC-EC-Developing-Client-Brief.pdf (ukgbc.org)
39	Professional Statement, Whole life carbon assessment for the built environment	RICS	Whole Life Carbon Assessment for the Built Environment, 1st edition (rics.org)
40	Delivering a Net Zero NHS	NHS Supply Chain	Delivering a Net Zero NHS » NHS Supply Chain
42	2030 Climate Challenge	RIBA	RIBA-2030-Climate-Challenge.pdf (architecture.com)
44	National guidance for healthcare waste water discharges	Water UK	National guidance for healthcare waste water discharges | Water UK
45	Hospitals and healthcare establishments:GPP 25	NIEA, SEPA	gpp-25-hospitals-and-healthcare-establishments.pdf (netregs.org.uk)
46	Pre-commission Cleaning of Pipework Systems	BSRIA	Pre-Commission Cleaning of Pipework Systems Amended 6th edition (BG29/2021) (bsria.com)
49	The Green Space Factor and the Green Points System	GRaBS	Tools: The Green Space Factor and the Green Points System | Town and Country Planning Association (tcpa.org.uk)
	NHS Net Zero Carbon Building Standard (publ'n due Nov 2021)	NHS England	www.england.nhs.uk/estates/health-technical-memoranda/

European guidance

Ref No.	Title of document / Location	Publisher	Website Link to Document
	Conformity Assessment	European Commission	https://ec.europa.eu/growth/single-market/goods/building-blocks/conformity-assessment/
	Healthcare Professionals and Healthcare Institutions	European Commission	https://ec.europa.eu/growth/sectors/medical-devices/getting-ready-new-

Ref No.	Title of document / Location	Publisher	Website Link to Document
			regulations/healthcare-professionals-and-health_en
2	Publications & data, European Centre for Disease Prevention and Control	European Centre for Disease Prevention and Control	Homepage | European Centre for Disease Prevention and Control (europa.eu)
43	Unified Water Label Scheme	European Bathroom Forum	www.europeanwaterlabel.eu

International guidance

Ref No.	Title of document / Location	Publisher	Website Link to Document
3	Sustainable Development Goals	United Nation	https://www.un.org/sustainabledevelopment/sustainable-development-goals/
	What is global citizenship	Oxfam	https://www.oxfam.org.uk/education/who-we-are/what-is-global-citizenship
16	Indoor Environmental Quality	BSRIA	BSRIA: Indoor environmental quality (IEQ)
19	WGBC Air Quality in the Built Environment	World Green Building Council	Air Quality in the Built Environment | World Green Building Council (worldgbc.org)
20	WHO Air Quality Guidelines	World Health Organisation	Air quality guidelines global update 2005 (who.int)
21	The Circular Economy, Ellen MacArthur Foundation	Ellen MacArthur Foundation	What is a circular economy? | Ellen MacArthur Foundation
25	Cradle to Cradle Certified™	C2C Certified	https://www.c2ccertified.org/products/registry
41	GGHH agenda and its sustainability goals	Global Green and Healthy Hospitals	GGHH Agenda and its Sustainability Goals | Global Green and Healthy Hospitals (greenhospitals.net)
53	Urban Green Space and Health: Intervention Impacts and Effectiveness	WHO	WHO/Europe | Urban health - Urban green space and health: intervention impacts and effectiveness (2017)