PAS 2080:2023

Carbon management in buildings and infrastructure

Construction Leadership Council

The **Green Construction Board**

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Foreword

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This PAS is not to be regarded as a British Standard. It will be withdrawn in the event it is superseded by a British Standard.

The PAS process enables a standard to be rapidly developed in order to fulfil an immediate stakeholder need. A PAS can be considered for further development as a British Standard, or constitute part of the UK input into the development of a European or International Standard.

Supersession

PAS 2080:2023 supersedes PAS 2080:2016, which is withdrawn.

Information about this document

This is a full revision of the PAS, and introduces the following principal changes.

- Expanded scope to include all the built environment (buildings and infrastructure), with a focus on behaviours and good practice principles intended to complement existing standards/guidance.
- Clarifications to the role of value chain members with control of and influence on whole life carbon in the context of a net zero transition and systems-level change.
- Increased emphasis on a whole life carbon, aligned with a 1.5 °C global warming, circular economy principles, and the urgent need to decarbonize systems, networks and assets, while balancing capital carbon investment with operational and user benefit.
- Inclusion of requirements specific to procurement and to aid decision-making in projects and programmes of work.
- Consideration of other demands and co-benefits when managing carbon, such as climate adaptation and biodiversity net gain.
- More emphasis on the importance of leadership, governance and collaboration across the value chain and beyond, including guidance for government, regulators and financiers.
- Features to encourage consistent approaches across the built environment industry to collectively manage whole life carbon and support the net zero transition, while not conflicting with other existing standards, accreditation schemes, procurement notices, or similar.

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Presentational conventions

The provisions of this PAS are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is "shall".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Where words have alternative spellings, the preferred spelling of the *Shorter Oxford English Dictionary* is used (e.g. "organization" rather than "organisation").

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Executive summary

At a time of a global climate emergency and with an international agreement to transition to a net zero carbon economy by or before 2050, PAS 2080 outlines a carbon management process that is applicable across both infrastructure and buildings, recognizing that they have key commonalities and are part of an interconnected system – the built environment. By following the PAS 2080 approach, value chain members across the built environment can work collaboratively towards the common goal of net zero carbon transition and achieve the following outcomes:

- align buildings and infrastructure projects and/or programmes of work, at the asset, network or system level, to the net zero transition by or before 2050, and therefore contribute to limiting global warming to 1.5 °C, as per Paris Climate Agreement 2015;
- reduce carbon and increase value across the whole life of buildings and infrastructure; and
- remove silos and create collaborative ways of working that promote innovation, encourage positive change for society and support economic development.

The 2013 *Infrastructure carbon review* [1] recognized the opportunity to create wider benefits through managing carbon in a consistent manner across the value chain. PAS 2080 was first published in 2016 and outlines a practical process to realize low-carbon outcomes. Its principles and claims of conformity have been adopted by several infrastructure organizations and, increasingly, developers and local authorities.

Targeted at leaders and all members of value chain organizations (asset owners/managers, designers, constructors and product/material suppliers) responsible for delivering built assets and networks, PAS 2080 provides a common process for the built environment value chain on how to manage whole life carbon in projects and programmes of work. PAS 2080 promotes reduced carbon, increased value delivery, more collaborative ways of working, and a culture of challenging convention and traditional practice for decarbonization.

PAS 2080 includes requirements for all value chain members to show leadership and establish effective governance mechanisms for reducing whole life carbon through a common management process. The individual value chain requirements are structured around:

- effective leadership;
- maximizing opportunities for whole life carbon reductions at all stages of the delivery process;
- selecting appropriate carbon emissions assessment methodologies;
- setting appropriate carbon reduction targets;
- determining baselines against which to assess carbon reductions;
- establishing metrics (e.g. key performance indicators – KPIs) for credible carbon emissions monitoring and reporting;
- integrating carbon management into procurement; and
- continual improvement of carbon management and performance.

PAS 2080 also sets out guidance for other value chain members – government, regulators and financiers – to illustrate the key roles these organizations play in the net zero transition, particularly to change behaviours. These are presented in Annex C.

The PAS is supplemented by the *Guidance document for PAS 2080*, which provides further practical guidance on how to implement the different requirements of this PAS and addresses current good practice through worked examples and case studies.

0 Introduction

0.1 The aim of PAS 2080

PAS 2080 is a specification for whole life carbon management when delivering projects and programmes in the built environment. The PAS supports the transition to a net zero carbon economy by 2050 and requires close collaboration across value chain members. It defines their contribution towards the net zero transition by developing and implementing, in a collaborative manner, the PAS 2080 carbon management process.

0.2 Buildings, infrastructure, and greenhouse gas emissions

Recently, there has been a step change in political and public perception of the impacts from climate change and environmental degradation. The urgency for action has been universally agreed with the COP21 Paris Agreement. At the time of writing (2023), national governments and the private sector are gearing up for transitioning to a net zero carbon world by or before 2050 that is also resilient to the unavoidable changing climate and enhances biodiversity net gain.

Consequently, the challenge for buildings and infrastructure (also referred to as "built environment" in this document) has shifted: work on every existing and new asset needs to contribute towards the urgent transition to net zero carbon. This requires a step-change transformation at the system level, driven collaboratively by all value chain members.

To date, carbon management in buildings and infrastructure has been largely managed separately. There are industry differences in terminology used to describe emissions sources (e.g., capital vs embodied carbon) and their materiality; there are different standards that buildings and infrastructure professionals use to assess whole life carbon; and different definitions for the stages of delivering projects and programmes work, among other differences. There has also been limited understanding of the carbon implications of land use change, circular economy principles, and the loss of ecosystems and biodiverse habitats. While PAS 2080 recognizes such differences in infrastructure and buildings, as the World Green Building Council points out, "infrastructure and buildings share key commonalities and are interdependent in use – it is important that we consider them together as part of a system" [2]. Accordingly, decarbonization should be carried out in alignment with net zero transition.

To better align the way decarbonization is managed in buildings and infrastructure, PAS 2080 sets some overarching principles to drive whole life carbon reduction, focusing on behaviours and good practices instead of specifics covered elsewhere. Some terms that are used to describe sources of emissions, for example, might more be familiar to buildings practitioners, while other terms might be more familiar to infrastructure practitioners. To provide clarity and avoid duplication, the terms and definitions use in this PAS are defined in Clause **3**.

The *Infrastructure carbon review* [1] and PAS 2080:2016 focused on the whole life carbon of all economic infrastructure and differentiated between carbon in the control and influence of asset owners/managers. Since then, the decarbonization principles have continued to mature.

The review of the UK's progress on decarbonization, published almost eight years after the *Infrastructure carbon review* [1], accentuated the need for the following actions (which have directly informed the scope of PAS 2080:2023):

- focusing on whole life carbon both within the control and influence of asset owners/managers, not just in creating assets, but also in their future operation and use;
- considering assets as part of complex, interconnected networks and systems;
- taking into account and integrating the carbon implications of climate resilience, environmental regeneration and biodiversity; and
- recognizing that most of the built environment expected to exist in 2050 is already built and has locked in high carbon behaviours, hence the need for retrofitting to decarbonize established built environment systems.

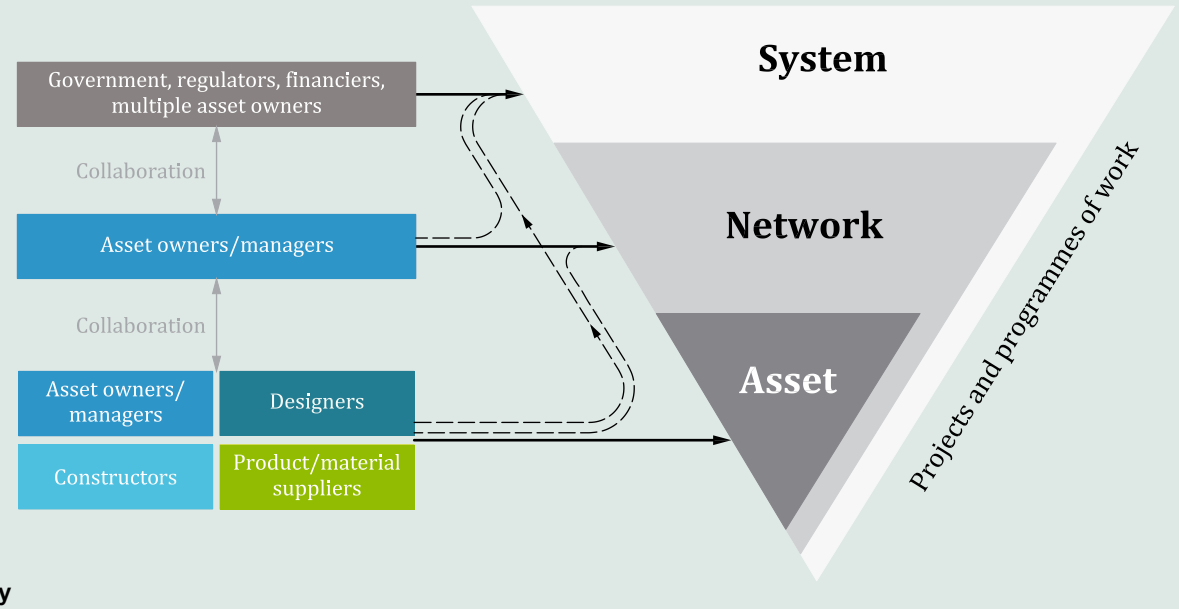
0.3 From assets to networks and systems

In the context of a net zero transition, it is essential that decarbonization is addressed from the system level downwards and through close collaboration across the value chain. PAS 2080 acknowledges this systems approach when setting out carbon management requirements and recognizes it is typically governments and regulators who have the greatest control at the system level – and, in some specific cases, major asset owners/managers.

Figure 1 graphically outlines the nested relationship of an asset within a network and a wider system, and the level of control and influence each member of the value chain has to drive whole life carbon reductions, recognizing that projects and programmes of work can be undertaken at each level.

PAS 2080 also recognizes that whole life carbon assessment is an essential part of managing to reduce carbon. Clarification is provided in Clause **4** and worked examples in the *Guidance document for PAS 2080* to drive the right behaviours and principles for decarbonization by all value chain members.

Figure 1 – Relationships between value chain members across assets, networks and systems



NOTE *A building or infrastructure asset is part of a network, which in turn is part of a system. The control of decision-making sits with different members of the value chain, but some of them often have greater ability to influence decarbonization, depending on the level at which they are operating.*

0.4 Decarbonization, resilience and environmental restoration

In striving for net zero, it is important that the value chain, especially asset owners/managers, recognize the complex interdependencies and synergies between decarbonization, other emergencies (e.g., climate adaptation, biodiversity loss), as well as the social and economic priorities in each context.

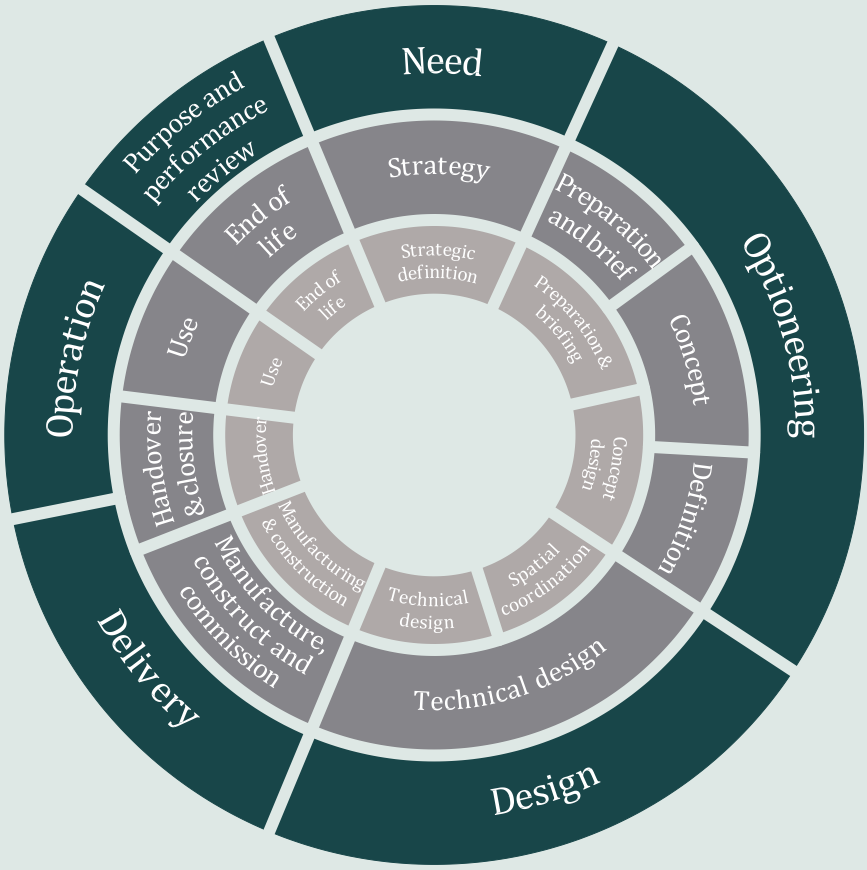
It is important that projects and programmes of work in the built environment address these challenges in a holistic way. The carbon management process outlined in PAS 2080 provides a systematic way to allow value chain members to place the relevant criteria (for the future benefit of our planet and society) at the centre of decision-making.

Further clarification on how to consider these aspects as part of the carbon management process is included in Clause **4** and Clause **6**, and in worked examples provided in *Guidance document for PAS 2080*.

0.5 Consistency in the built environment

Adopting consistent language across different sectors will help with resonating the principles of the carbon management process with all value chain members and stakeholders. Figure 2 proposes a unifying approach to compare well-established work stages in infrastructure and buildings, and indicates the terminology used in this document.

Figure 2 – Unifying work stages for projects and programmes of work



Key

- PAS 2080:2023
- BS 8536:2022
- RIBA Plan of Work

NOTE *This figure introduces work stages in PAS 2080 that are similar to those of the Value Toolkit (developed by the Construction Innovation Hub) [4]. For the purposes of this document, these stages map to the work stages of infrastructure (adapted from BS 8536:2022, with an additional "end-of-life" stage) and the work stages of the built environment (Plan of Work [5] developed by the Royal Institute of British Architects), as shown. There are other sector-specific definitions of work stages that differ from those shown in Figure 2, but this is not enough to hinder value chain members from implementing a carbon management process.*

1 Scope

This PAS specifies requirements for the management of whole life carbon in buildings and infrastructure – in the provision, operation, use and end of life of new projects and/or programmes of work, as well as the management or retrofit of existing assets and networks.

PAS 2080 is a specification to:

a) align the built environment with the transition to a net zero carbon economy by 2050;
b) encourage wider uptake of carbon management across the built environment;
c) promote close collaboration between all members of the value chain;
d) recognize the importance of systems in transitioning to net zero, clarifying the role of each value chain member to control and influence decision-making;
e) streamline consideration of influencing carbon beyond the project/programme boundaries;
f) emphasize the importance of the carbon reduction hierarchy for whole life carbon reduction;
g) take into account whole life carbon and circular economy principles when delivering/operating new or maintaining/repurposing/retrofitting existing assets/networks; and
h) integrate co-benefits and other emergencies/priorities as part of the carbon management and decision-making processes.

The scope of the PAS is summarized in Table 1.

Table 1 – PAS 2080 scope

PAS 2080 is about	PAS 2080 is not about
Managing carbon to reduce whole life emissions in the built environment, aligned with the net zero carbon transition and recognizing the importance of balancing climate adaptation and circular economy principles to bring wider co-benefits.	How to conduct a detailed appraisal of wider sustainability or environmental aspects[1)].
Consistency in the process of carbon management, including target setting, opportunities identification, assessment, use of data, procurement, continuous improvement, monitoring, reporting, leadership, governance and collaboration for decarbonization.	Prescriptive greenhouse gas (GHG) quantification/assessment methodologies and data gathering, as this is already addressed in other standards/specifications.
Consistency in framing whole life carbon reduction, both within the control and influence of the value chain.	GHG reporting against national accounts or a compliance methodology.
Decarbonization for increasing value: driving whole life carbon reduction that is compatible with the net zero carbon transition.	Whole life cost management or prescriptive guidance on how to manage decarbonization at national level.
Demonstrating capability for integrating carbon in decision-making when delivering projects and/or programmes of work, whether at asset, network or system level.	Organizational or corporate ESG (environmental, social and governance) certification.

[1)] While this standard is not about environmental or sustainability appraisals, it is important that the carbon implications of climate adaptation, biodiversity net gain and nature-based solutions are fully taken into account in the delivery, operation, use and end of life of projects and/or programmes of work. Failing to evaluate them together might risk conflict and unintended consequences across the systems.

Table 1 – PAS 2080 scope

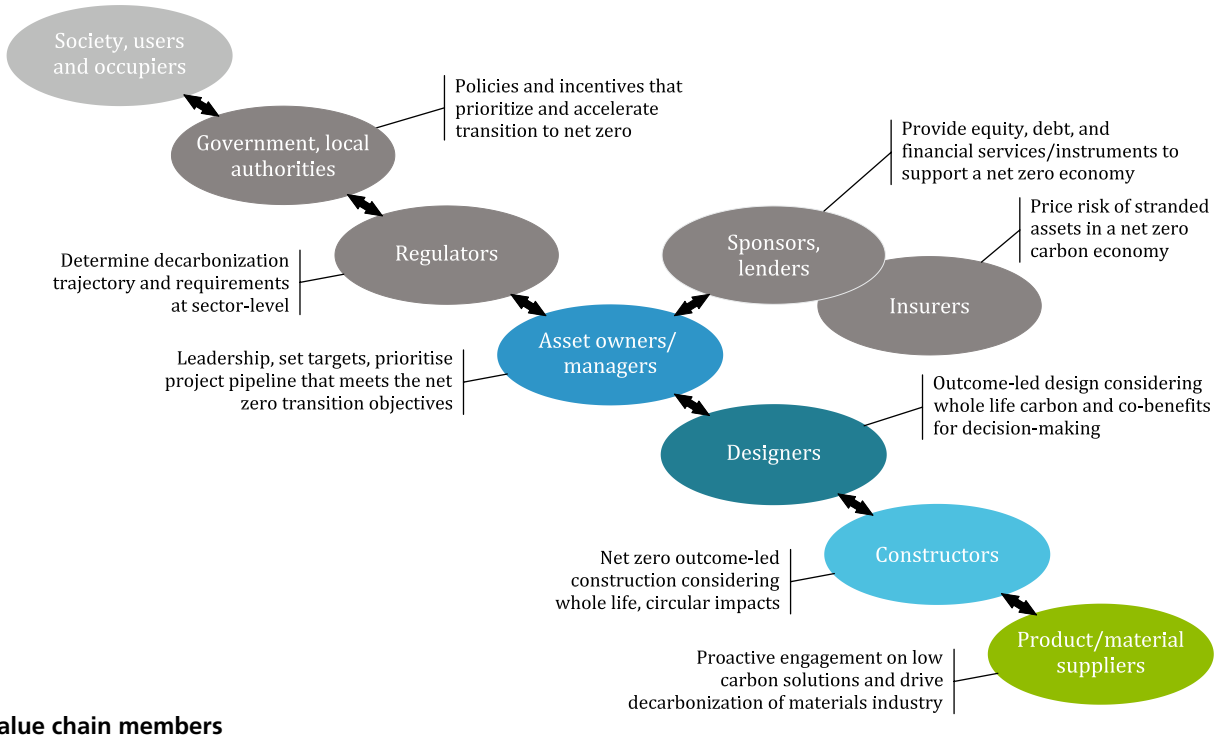
PAS 2080 is about	PAS 2080 is not about
Highlighting the importance of government, regulators and financiers in implementing decarbonization in projects and/or programmes of work.	Setting prescriptive regulatory or investor requirements and KPIs.

The concepts of systems thinking and co-benefits (e.g., climate adaptation, nature-based solutions) are being continually refined and applied. Although PAS 2080 is focused on carbon management, it recognizes the importance (for all value chain members) of addressing these concepts in the context of a project or programme of work and the associated risks or co-benefits of any intervention (see Clause **4** for further context and *Guidance document for PAS 2080* for worked examples).

Although asset owners/managers have the primary responsibility for implementing a carbon management process, all value chain members share responsibility for the management of the associated carbon emissions and removals during the delivery of projects and/or programmes of work. Asset owners/managers can only realize the intended reductions within a fully integrated value chain involving designers, constructors and product/material suppliers, together with regulators and financiers who influence climate-related policy, planning and regulation.

Figure 3 reflects the relationships across the value chain in the built environment and their roles in carbon management. While PAS 2080 does not set requirements for government, regulators and financiers, this revision acknowledges their importance in influencing decision-making in the built environment by providing additional guidance, in Annex C, on the role they can play in the net zero transition.

Figure 3 – Value chain members in the built environment and their roles in carbon management



NOTE *Other stakeholders who have influence on carbon reduction but are not subject to the requirements of the PAS include, among others, letting agencies, academia and quantity surveyors.*

To help each value chain member contribute effectively, the responsibilities set out in each clause of this PAS are arranged under the following headings.

1) Requirements for all value chain members.
2) Asset owner/manager requirements.
3) Designer requirements.
4) Constructor requirements.
5) Product/material supplier requirements.

Practitioner roles in each value chain member include strategic planning, procurement, design, construction, operation, maintenance, use and end of life.

The PAS includes requirements for developing a carbon management process built around the following components.

i) Decarbonization principles (Clause **4**).
ii) Leadership (Clause **5**).
iii) Integrating carbon management into decision-making (Clause **6**).
iv) Whole life carbon assessment principles to support decision-making (Clause **7**).
v) Target setting and baselines (Clause **8**).
vi) Monitoring and reporting (Clause **9**).
vii) Procurement (Clause **10**).
viii) Continual improvement (Clause **11**).
ix) Claims of conformity (Clause **12**).

In addition to the clauses of this PAS, the informative annexes include guidelines on the following topics.

- Categories of emissions and removals to aid decision-making for reducing whole life carbon (Annex A).
- Applying the carbon management process (Annex B).
- Guidance for government, regulators and financiers (Annex C).

To successfully claim conformity with the requirements of this PAS, each value chain member is required to declare the role(s) they undertake (from the above responsibilities list). They can then demonstrate conformity with the clauses under the "requirements for all value chain members" heading and those under other headings pertaining to their role(s) – refer to Clause **12** for further details.

To achieve conformity, value chain members are to evidence relevant organizational capability appropriate to the point(s) of delivery at which they are involved. This includes alignment with the principles outlined in Clause **4** and demonstrating their capability to deliver decarbonization in the built environment.

NOTE *Value chain members can claim conformity with PAS 2080 as:*

- *an asset owner/manager;*
- *a designer;*
- *a constructor; or*
- *a product/material supplier*

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this PAS, the following terms and definitions apply.

3.1 activity

set of actions that consume time and resources and whose performance is necessary to achieve, or contribute to, the realization of one or more outcomes

[SOURCE: PD ISO/IEC TR 24766:2009, **3.1**]

3.2 activity data

data based on a unit quantity of input or output of the studied system or a process within it

NOTE *Activity data can be a physical quantity such as mass (kg), a unit of cost (£), or a unit of energy (kWh).*

3.3 asset

physical entity forming part of a network and/or system that has potential or actual value to an organization and its stakeholders

NOTE *For the purpose of this document, buildings are regarded as assets. They are serviced by infrastructure networks, which combined form different systems as part of the built environment.*

3.4 asset owner/manager

organization that manages and is responsible for providing, operating and maintaining a buildings and infrastructure network or asset(s)

NOTE *Typically the asset owner/manager is the asset owner, but on occasion an asset owner/manager might also be the organization charged with operating buildings or infrastructure, a project sponsor, a service provider, a developer, a financier, the entity undertaking project works, or the organization charged with providing services from buildings and infrastructure.*

3.5 baseline

scenario for what carbon emissions and removals would have been in the absence of planned measures aiming to reduce emissions

NOTE *Emissions and removals are separate parts of the baseline and calculation of emissions reduction only refers to the baseline emissions.*

3.6 building

structure, usually enclosed by walls and a roof, constructed to provide support or shelter for intended occupancy

[SOURCE: BS ISO 19880-1:2020, **3.7**]

3.7 built environment

collection of human-made or induced physical objects located in a particular area or region

NOTE *When treated as a whole, the built environment typically is taken to include buildings, external works (landscaped areas), infrastructure, and the products of construction works within the area under consideration.*

[SOURCE: BS ISO 15392:2019, **3.5**]

3.8 capital carbon

GHG emissions and removals associated with the creation and end-of-life treatment of an asset, network or system, and optionally with its maintenance and refurbishment

NOTE 1 *GHG emissions associated with maintenance and refurbishment are included as "optional" under the capital carbon definition because they could also be defined as "operational carbon" emissions, depending on the chosen assessment methodology. The selected terminology is to be clarified as part of the assessment methodology process (see Clause* ***7****).*

NOTE 2 *PAS 2080 recognizes the use of the established terms "embodied carbon" and "upfront carbon" by parts of the industry (in accordance with existing life cycle assessments standards and guidance) to refer to similar stages of a whole life carbon assessment. For the purpose of PAS 2080, "capital carbon" is the selected terminology to allow comparison/alignment with the cost management/expenditure profile of projects and/or programmes of work (see Note 3). The selected terminology is to be clarified by the practitioner (as described in Clause* ***7****) and considered in the context of the PAS 2080 whole life carbon framework for decision-making in Clause* ***4****.*

NOTE 3 *As defined in the* Infrastructure carbon review *[1], capital carbon can be alternatively defined as the GHG emissions associated with the scope of capital expenditure defined in accordance with the asset owner's preference.*

3.9 carbon budget

estimated amount of whole life carbon a system can emit

NOTE *Carbon budgets are usually set at the system level and are aligned to national or international net zero targets or other decarbonization trajectories defined at the system level.*

3.10 carbon dioxide equivalent (CO_2e)

unit for comparing the radiative forcing of greenhouse gases (GHGs) to carbon dioxide

NOTE *The carbon dioxide equivalent is calculated using the mass of a given GHG multiplied by its global warming potential (see* ***3.25****).*

[SOURCE: BS ISO 14064-1:2006, **2.19** modified – note 2 deleted]

3.11 carbon management

assessment, reduction and removal of greenhouse gas emissions during the planning, optioneering, design, delivery, operation, use, end of life (and beyond) of new, or the management of existing, assets, networks and/or systems

3.12 carbon offset

discrete reduction in greenhouse gas emissions not arising from the defined subject, made available in the form of a carbon credit meeting a defined set of requirements (as per PAS 2060:2014) and used to counteract emissions from the defined subject

NOTE *Offsets can be generated via a variety of activities, including those that avoid or reduce emissions and those that remove carbon from the atmosphere. Additional information on offset categories is available in the* Oxford principles for net zero aligned carbon offsetting *(2020) [6].*

[SOURCE: PAS 2060:2014, **3.7** modified – original note removed, new note added]

3.13 carbon reduction

process of minimizing greenhouse gas emissions in the development of new, or the refurbishment of existing, assets or networks

NOTE *The outcome of carbon reduction process is a quantified reduction in existing sources of GHG emissions or the avoidance of GHG emissions.*

3.14 circular economy

economy 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

NOTE *Circular economy principles can be applied across all work stages of projects and/or programmes of work to assess materials/products in terms of reuse and recycling potential after end of life, as well as their flexibility in being repurposed or retrofitted whilst satisfying the whole life performance required from their respective assets and networks.*

[SOURCE: BS ISO 20400:2017, **3.1**]

3.15 co-benefits

added benefits of decarbonization, above and beyond the direct benefits of reducing greenhouse gas emissions

NOTE *Examples of co-benefits include, but are not limited to, reduced air pollution, increased resilience, reduced cost and risks, employment possibilities, security, social justice, nature restoration and regeneration, and biodiversity net gain.*

3.16 constructor

entity that undertakes work to construct, build, maintain, repair, replace, disassemble or demolish an asset or network

NOTE *A constructor can be an asset owner/manager or a product/material supplier.*

3.17 control

ability of value chain member to make decisions about activities that leverage carbon emissions and removals

NOTE 1 *This could include either operational decision-making power and/or financial decision-making power.*

NOTE 2 *Details of which value chain members, including regulators and financiers, have control or influence when working on an asset, network or system level are provided in Annex C.*

3.18 decarbonization

process by which organizations, sectors or other entities aim to achieve zero fossil carbon emissions, typically referring to a reduction of the carbon emissions associated with key sectors, such as electricity, industry and transport

3.19 designer

entity that creates, prepares or specifies the design of an asset or network that is to be constructed, maintained, repaired or refurbished

NOTE *A designer can be an asset owner/manager, consultant, constructor or product/material supplier.*

3.20 emissions factor

amount of greenhouse gases emitted, expressed as carbon dioxide equivalent (CO_2e) and relative to a unit of activity

[SOURCE: PAS 2060:2014, **3.7** modified – note removed]

3.21 emissions reduction

quantified decrease in greenhouse gas emissions specifically related to or arising from an activity between two points in time or relative to a baseline

3.22 end of life

stage which begins when the asset has reached the end of its design life and is ready for refurbishment, retrofit, disposal, dismantling, etc., and ends when the asset is recycled, reused, recovered or returned to nature (combustion, deterioration)

NOTE *The process for setting study boundaries and assessing end-of-life emissions follows an appropriate standard or methodology, as described in Clause* ***7****.*

3.23 financier

investor (individual or organization holding equity or debt categorized as financial assets, including but not limited to asset owners, asset managers and banks) and lender (individual or organization that loans money to a borrower to finance consumption or investment, on the expectation of repayment on contractual terms, usually within a stated period and with interest payment)

[SOURCE: ISO 14097:2021, **3.7** modified – to include separate definitions for investor and lender from same source]

3.24 functional unit

quantified performance of a product or system for use as a reference unit

NOTE *The functional unit takes into account a function, a quantity, a duration, and a quality of the asset, network or system being assessed. Refer to the* Guidance document for PAS 2080 *for further explanation and examples of functional units.*

[SOURCE: BS EN ISO 14044:2006, **3.20** modified – note added]

3.25 global warming potential (GWP)

factor describing the radiative forcing impact of one mass-based unit of a given greenhouse gas relative to an equivalent unit of CO_2 over a given period of time

[SOURCE: BS ISO 14064-1:2006, **2.18** modified – note deleted]

3.26 greenhouse gases (GHGs)

gaseous constituents of the atmosphere, natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, the atmosphere and clouds

NOTE 1 *Throughout PAS 2080, the term "carbon" is often used (e.g., capital carbon, user carbon, operational carbon). This is applied as shorthand for "GHGs" (or the equivalent CO_2e) as defined by the UNFCC Kyoto Protocol [7].*

NOTE 2 *The UNFCC Kyoto Protocol [7] (and Doha Amendment) seven main greenhouse gases include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6) and nitrogen trifluoride (NF_3).*

[SOURCE: BS ISO 14064-1:2006, **2.1** modified – original notes deleted and new notes added]

3.27 greenhouse gas (GHG) assessment

process of calculating the total amount of GHG emissions and removals due to the delivery, use, operation, maintenance, demolition and/or reuse of assets and/or networks

NOTE *The principles of quantification and reporting GHG emissions in the built environment differ from Scopes 1, 2 and 3 defined by the* Greenhouse Gas Protocol *[8], and adopted by the Science Based Targets initiative (SBTi) [9], typically used in the corporate sector (e.g. companies' sector, organizations, institutions). Although there are commonalities in certain terminologies and principles, a whole life carbon approach is used for the purpose of carbon management and driving decarbonization in the built environment (buildings and infrastructure).*

3.28 greenhouse gas (GHG) emission

total mass of GHG released to the atmosphere over a specified period of time

[SOURCE: BS ISO 14064-1:2006, **2.5**]

3.29 influence

ability of value chain member to support other value chain members to make low-carbon decisions

3.30 infrastructure

basic physical and organizational structures, facilities, equipment and services needed for the operation of a society or organization, or the services and facilities necessary for an economy to function

NOTE *Assets (infrastructure assets and buildings) are part of networks (e.g. municipal pipes and manholes are part of a water network). The combination and interaction between networks (e.g. transport, drainage, water, energy, telecommunications) form built environment "systems" (see **3.49**).*

[SOURCE: ISO/TR 19231:2014, **3.5** modified – expanded to cover equipment, note added]

3.31 leadership

ability of an individual, group or organization to lead, influence or guide other individuals, teams or entire organizations

3.32 life cycle

consecutive and interlinked stages of a product, equipment or service, from raw material acquisition or generation from natural resources to design, production, transportation/delivery, use, end-of-life treatment and final disposal

NOTE *A whole life cycle carbon assessment is only one of the components of the carbon management process. As further described in Clause **7**, existing standards for life cycle assessment do not cover all elements of the PAS 2080 whole life carbon framework for decision-making (Clause **4**), hence value chain members are to assess carbon influenced outside the direct project/programme boundary to inform decision-making (i.e. emissions/removals within the study boundary [see **3.48**]).*

[SOURCE: BS ISO 37100:2016, **3.1.12** modified – expanded to cover equipment, note added]

3.33 nature-based solutions

actions to protect, sustainably manage and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits

NOTE *Nature-based contributions to decarbonization could be by: 1) providing infrastructure services (e.g. flood protection, urban cooling) and avoiding the need for capital and operational carbon from the equivalent grey/ hard infrastructure (e.g. flood defences, air conditioning); 2) actively removing carbon from the atmosphere by enhancing natural ecosystem diversity and re-instating the natural carbon cycle, hence increasing carbon sequestration in the above ground vegetation (e.g. trees) and the soil that supports it. Worked examples are provided in the* Guidance document for PAS 2080*.*

[SOURCE: Cohen-Shachman et al. [10]]

3.34 network

combination of interconnected assets (buildings and infrastructure) that provide services (e.g. water, power, transport) to society as part of a wider system

NOTE *Asset owners/managers are typically responsible for a network and have control over its delivery, operation, use and end of life.*

3.35 net zero

reduction of anthropogenic greenhouse gas emissions to zero or to a residual level that is consistent with reaching net zero emissions in eligible 1.5 °C pathways (hence time-bound) and neutralizing the impact of residual emissions (if any) by removing an equivalent volume of carbon

NOTE 1 *A net zero target is normally set at the system level reflecting national and/or international decarbonization trajectories to align to an eligible 1.5 °C pathway.*

NOTE 2 *Net zero differs from carbon neutrality (as defined in PAS 2060:2014), as net zero is focused on reducing whole life emissions and using removals to balance out residual emissions within a certain timeframe, whereas carbon neutrality relies on carbon offsets and does not necessarily support whole life carbon reduction. PAS 2080 has been developed to bring together value chain members across the built environment to work collaboratively towards the common goal of net zero carbon transition by 2050, hence does not include carbon neutrality as part of its scope.*

3.36 operational carbon

greenhouse gas emissions and removals associated with the operation of an asset, network and/or system required to enable it to operate and deliver its service

3.37 organization

company, corporation, firm, enterprise, authority or institution, or part or combination thereof, public or private, that has its own function and administration

3.38 practitioner

member of the value chain responsible for contributing to the successful implementation of a PAS 2080-compliant carbon management process, including strategic planning, procurement, programme manager, operator, designer/technical advisor, construction manager, material/product developer, environmental or sustainability manager

3.39 product/material supplier

organization that extracts, manufactures and/or produces materials or products for incorporation into works to construct, build, maintain or operate an asset or network

3.40 programme of works

defined set of projects related to the construction, maintenance, operation and/or end of life of an asset, network or system

NOTE *A programme of works is a combination of two or more projects.*

3.41 project

unique process, consisting of a set of coordinated activities and controlled resources undertaken to achieve certain objectives that can take place at the asset, network or system level

[SOURCE: BS ISO 21931-2:2019, **3.22** modified – expanded to include resources]

3.42 project/programme boundary

physical, process, temporal and geographical limits of a project or programme of work

NOTE 1 *The "project/programme boundary" in PAS 2080 is typically referred to as "system boundary" in life cycle assessment standards. PAS 2080 does not use the same terminology, as existing standards do not address the systemic thinking required when making decisions from carbon reduction in projects and/or programmes of work in the built environment [see "system" definition (**3.49**) and Clause **4** for further details].*

NOTE 2 *For emissions beyond the project/programme boundary and its life cycle, refer to definition of "study boundary" (**3.48**).*

3.43 regulator

government or authority (e.g. country, state, city council, planning authority, highway authority, government department) which owns the regulatory applications of a specific sector or area, which serve as principles, policies or rules governing or prescribing the behaviour of users as well as the provisioning of goods, services and/or rights interchanged

NOTE *Regulators are responsible for setting targets at a system level (as per Clause **8**). Asset owners/managers are expected to engage with regulators and other relevant asset owners/managers to influence policy-making as part of the carbon management process. Refer to Clause **4** and Annex C for further information.*

3.44 removal

withdrawal of a greenhouse gas from the atmosphere and stored as a result of deliberate human activities

NOTE *Removals are arbitrarily used to refer to either natural processes or technological solutions.*

[SOURCE: IWA 42:2022, **3.3.3** modified – original notes removed and new note added]

3.45 residual level

greenhouse gas emissions from a project or programme of work that remain unabated in a specific year after carbon reduction measures have taken place

NOTE *As described in Clause **4**, it is important that carbon reduction targets (as defined in **3.50**) are consistent with the level of residual emissions in the year of national or sector-specific net zero in 1.5 °C-aligned mitigation pathways.*

3.46 resources

something that lies ready for use or that can be drawn upon (material and non-material) for aid or to take care of a need

3.47 sector

collection of organizations involved in the delivery and operation of assets for the purpose of providing a service (e.g. energy, water, telecommunications)

3.48 study boundary

physical, process, temporal and geographical limits of activities to assess GHG emissions and removals

NOTE 1 *A project or programme of works falls within the study boundary, however the study boundary can be equal to or greater than the project/programme boundary. The assessment of GHG emissions and removals at a wider study area helps with understanding the project or programme of works' impact on the wider network or system.*

NOTE 2 *Throughout PAS 2080, the term "boundary" is often used as a shorthand for "study boundary" unless specified.*

3.49 system

collection and interconnection of all physical facilities and human interactions that are operated in a coordinated way to provide a particular service

NOTE 1 *The built environment is heavily networked and interconnected, composed of "systems-of-systems", hence the importance of considering a systems-thinking approach in the context of carbon management and reduction of greenhouse gas emissions.*

NOTE 2 *Refer to definitions of asset (**3.3**), infrastructure (**3.30**) and **4.2** for further details of interdependencies and synergies between assets, networks and systems for the purpose of carbon management.*

3.50 target

desired quantity of carbon emissions (defined as an absolute value or as a reduction amount/percentage against a baseline value) that a project or programme of works is to achieve within a temporal extent

NOTE *A target is specific and appropriate to a project or programme of works. It is measurable within a specified study boundary and is time-bound. It is important that a target is referenced to a baseline. This might implicitly determine a carbon budget.*

3.51 user carbon

greenhouse gas emissions associated with users' utilization of an asset, network and/or system, and the service it provides during operation

NOTE 1 *Refer to Annex A for further definition.*

NOTE 2 *Although user carbon is not directly controlled by asset owners/managers, they might have a direct influence on user carbon emissions, particularly through collaboration with relevant stakeholders. Refer to Annex A for further guidance and examples of user carbon in different sectors.*

3.52 value chain

organizations and stakeholders involved in creating, operating and managing assets and/or networks

NOTE *These include asset owners/managers, designers, constructors and product/material suppliers, but also regulators and financiers.*

3.53 whole life carbon

sum of greenhouse gas emissions and removals from all work stages of a project and/or programme of works within the specified boundaries

NOTE 1 *This includes GHG emissions and removals within the project/programme boundary, as well as emissions/removals between the project/programme and study boundary.*

NOTE 2 *Not to be confused with "design life", which is the life expectancy of the material/product/asset, as defined by its designers within its specified parameters [see "end of life" (**3.22**)]. Typically, whole life is longer than design life.*

NOTE 3 *Whole life carbon considerations for a project and programme of works are wider than the typical life cycle (see Note 2) assessments account for, particularly when considering carbon emissions/removals in their influence at a system level (see Clause **4**).*

4 Decarbonization principles

*COMMENTARY ON CLAUSE **4***

This clause sets out the fundamental principles underpinning the carbon management process presented in this PAS. Their application allows practitioners to demonstrate that a true and fair approach has been adopted when undertaking carbon management activities.

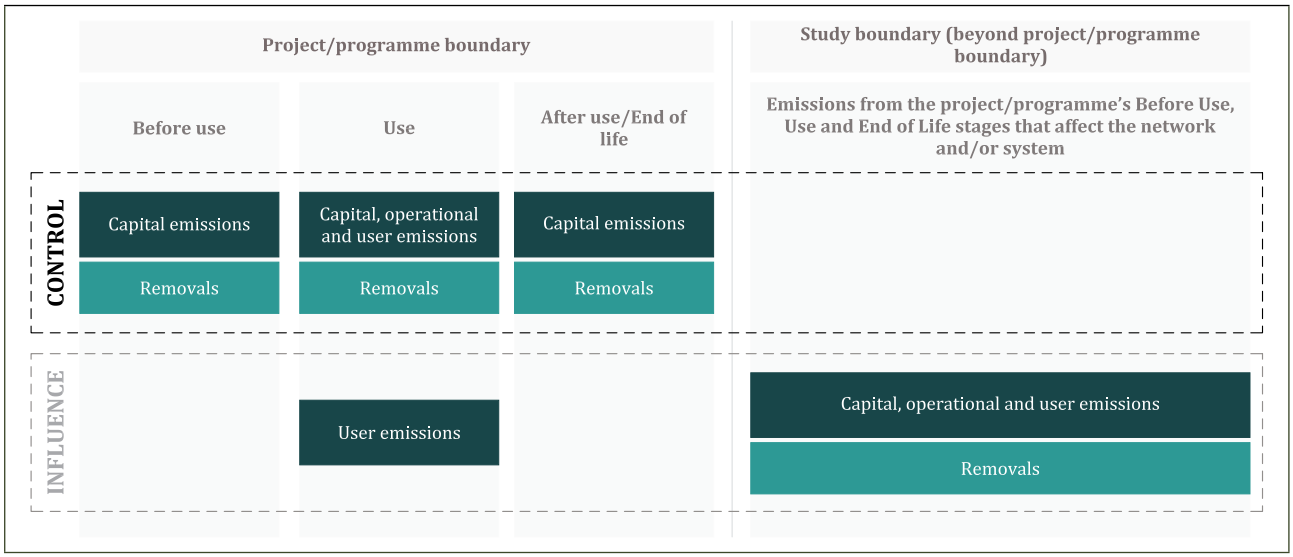
*The carbon management principles apply to projects and programmes comprising buildings and infrastructure. At the core of the principles is the fact that no asset of the built environment can function in isolation from its surrounds: its construction, operation and use impacts on and is impacted by the functions of networks and systems of which it is part. Likewise, the decarbonization principles apply to all value chain members to a greater or lesser extent. More specific details are given in Clause **5** and Clause **6**.*

4.1 Managing whole life carbon under the control and influence

All value chain members shall:

a) identify all activities that result in carbon emissions or removals they control and influence, at the asset, network and system level, as set out in Figure 4;

Figure 4 – PAS 2080 whole life carbon framework for decision-making



***NOTE 1** This framework is to identify a comprehensive list of emissions and removals to be assessed, but also to manage the reduction of those emissions. Current practices and standards typically take into account the assessment of emissions at an asset or network level, but given the complexity, scale and impact of the built environment, a holistic framework for both assessing to inform decision-making and managing whole life carbon emissions (including emissions relating to both control and influence) is required.*

***NOTE 2** This framework has been developed to provide a systematic guide to help practitioners identify all relevant emissions (examples provided in Table A.1 and Table A.2), assess their magnitude to inform decision-making for reducing those emissions at every work stage of a project or programme and, in turn, so that the decarbonization of the built environment contributes towards the regional, national and international transition to net zero carbon. The framework is not focusing on how accurate any assessments of whole life emissions need to be in different stages of the delivery process. Accuracy, data sources and detailed assessment methodologies are provided in existing standards and guidance. The framework is referenced in Clause **7**, when practitioners are assessing emissions and in Clause **6**, when practitioners follow the implementation of the PAS 2080 carbon management process to systematically manage emissions.*

b) identify interdependencies, synergies and relationships between their own project and/or programme of works and the network and system, and engage with relevant stakeholders to identify carbon reduction opportunities and risks at an asset, network and system level;

NOTE 3 *Examples of these interdependencies and synergies can be found in Annex A.*

NOTE 4 *Decision-making at the system level might mean, for example, that sacrifice/investment in capital carbon is required for operational savings or vice-versa, hence the importance of considering any project or programme of works from a whole life carbon perspective. Similarly, the selection of a low-carbon material feedstock or component in one territory might have a negative impact on emissions elsewhere. Further explanation of this decision-making process is provided in the* Guidance document for PAS 2080*.*

c) prioritize nature-based solutions for reduced whole life carbon emissions and potential for carbon removal, as well as the associated co-benefits;

NOTE 5 *Co-benefits include those that positively address other environmental emergencies (e.g., climate adaptation and biodiversity loss) as well as social and economic priorities. Although this PAS is about carbon management, it is important that decision-making in the built environment considers these other aspects to determine the optimal solution/approach for the context of each project of programme of work.*

d) engage with other value chain members or other stakeholders (such as planning authorities, financiers, government and regulators, among others) to align approaches to carbon reduction and maximize decarbonization opportunities for the project and/or programme of work and, where possible, an economic sector or geographical region;

NOTE 6 *All value chain members have a role to play in decarbonizing the built environment, but the government (including local authorities), regulators and financiers typically have the greatest opportunity to set the direction of a project and/or programme of works due to their strategic role on setting policies, objectives, requirements and outcomes. In the absence of requirements for these members in this PAS Annex C provides some context of their role and responsibility to implement carbon management at all levels.*

e) identify the work stages within which they have control or influence in terms of identifying, managing or delivering low-carbon solutions. Where opportunities or risks to influence system-wide decarbonization exist and are significant, these shall be prioritized;

f) assess emissions and removals in accordance with the whole life carbon framework for decision-making in Figure 4 and the assessment principles in Clause **7**;

g) demonstrate that the level of accuracy appropriate for informing decision-making at the stage of the project or programme has been taken into account(as per Clause **7**); and

h) integrate whole life carbon reduction in their decision-making processes in accordance with Clause **6**.

NOTE 7 Guidance document for PAS 2080 *provides further explanation of what control and influence mean for each value chain member, and includes worked examples.*

In addition, asset owners/managers and designers shall:

1) identify the carbon implications of climate resilience, or lack of, at the asset, network or system level, and integrate them in the whole life carbon framework for decision-making; and

2) collaboratively engage with other value chain members and relevant stakeholders for solutions that deliver the required level of climate change resilience for the lowest whole life carbon, including carbon avoided in recovering from future events.

4.2 Aligning to net zero carbon transition

Asset owners/managers shall prioritize target-setting and carbon reduction measures for the project and/or programme of work that align to and support the transition to net zero carbon as set out at the system, network or national level (see Clause **8** for further details).

Where national or sector carbon budgets do not exist, or where downscaling of such budgets at the project/programme level has not been set due to lack of policy or regulation, asset owners/managers shall engage with other asset owners/managers and regulators/government in their network or system to assess how the project or programme of work aligns with wider decarbonization goals.

NOTE 1 *Due to lack or inadequacy of policies and regulation, many sectors are still not regulated for net zero, hence do not have carbon targets or budgets set at a system, sector or national level. As indicated in Annex C, it is important that government and regulators act urgently to avoid unintended consequences, such as determining mechanisms of how increases in whole life carbon emissions from a project and/or programme of works are addressed in other parts of the system, sector or national level when considering limited carbon budgets.*

NOTE 2 *Further clarification is provided in* Guidance document for PAS 2080 *for asset owners/managers to interpret the relationship and differences between net zero targets for projects and/or programmes of work and science-based targets for their organizations.*

4.3 Managing whole life emissions by applying the carbon reduction hierarchy

All value chain members shall:

a) follow the carbon reduction hierarchy as presented in Figure 5 (in the order of priority shown) when identifying potential opportunities to reduce whole life carbon emissions.

   NOTE 1 *The carbon reduction hierarchy is to be applied to all emissions – capital, operational and user emissions (as defined in Clause **3**).*

   NOTE 2 *The greatest ability to influence whole life carbon reduction is at the "need" stage, where objectives and outcomes of projects/programmes are still being developed and assessed, hence the importance of value chain members following a carbon management process right from the start of the delivery process. This is also reflected in Clause **6**.*

b) in applying the carbon reduction hierarchy, demonstrate they have taken into account the following:

   1) avoid: align the outcomes of the project and/or programme of work with the net zero transition at the system level and evaluate the basic need at the asset and/or network level;

      NOTE 3 *This may include exploring alternative means for satisfying the need for whole life performance while not constructing a new asset/network or reusing/retrofitting/repurposing existing ones.*

   2) switch: assess alternative solutions and then adopt one that reduces whole life emissions through alternative scope, design approach, materials, technologies for operational carbon reduction, among others, while satisfying the whole life performance requirements;

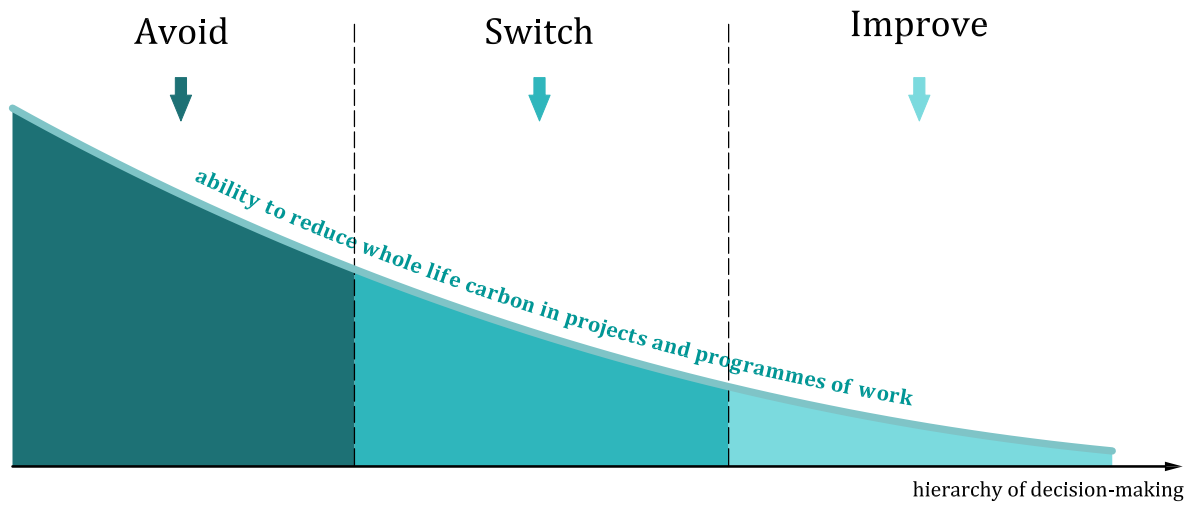
      NOTE 4 *This may also include employing innovative models that optimize the balance between capital, resource use, operational and user efficiency of an asset/network.*

   3) improve: identify and adopt solutions and techniques that improve the use of resources and design life of an asset/network, including applying circular economy principles to assess materials/products in terms of their potential for reuse or recycling after end of life.

      NOTE 5 *This includes efficiency measures for the use stage of an asset/network, and is not limited to material resources and other design and construction efficiencies.*

      NOTE 6 *In identifying appropriate low-carbon solutions, priority should be given to solutions that promote network and system decarbonization as far as possible.*

Figure 5 – Carbon reduction hierarchy



***NOTE** This figure represents a simplified and streamlined version of the carbon reduction hierarchy presented in PAS 2080:2016 and the* Infrastructure carbon review *[1]. It has been updated to clarify its applicability and relevance to a wider range of projects and programmes within the built environment (i.e. to clarify that the carbon reduction hierarchy is not solely about new builds).*

4.4 Implementing appropriate governance

All value chain members shall form and implement governance structures to:

a) align whole life carbon impacts of any decisions made with the decarbonization principles in Clauses **4.1** to **4.3**;

b) make carbon management underpin all projects and/or programmes of work (as per the requirements in Clause **6**), regardless of their scale or work stage;

c) embed whole life carbon into business and management processes, forming part of decision-making alongside cost, time and risk;

d) define and establish roles and responsibilities for carbon management to promote the outcomes and behaviours required for decarbonization;

e) put in place roles and responsibilities for engagement with other value chain members and stakeholders so that system-wide opportunities and risks are identified and managed;

f) allocate resources (human and financial) to support the delivery of carbon management processes;

g) put processes in place to assess GHG emissions, identify carbon reduction opportunities, and implement them in projects and programmes;

h) support the implementation of low-carbon solutions;

i) collaborate across the value chain, sharing expertise, knowledge and data to drive decarbonization across the industry;

j) improve business processes based on feedback from other value chain members;

k) allocate senior management support to all decision-making that has a significant effect on carbon management; and

l) keep records in support of carbon management monitoring and reporting practices (as per Clause **9**).

5 Leadership

*COMMENTARY ON CLAUSE **5***

Leadership is recognized as a key enabler of carbon management. It provides the vision to drive carbon reductions across all levels of an organization and allows the right capabilities to exist across the value chain to plan for and drive decarbonization. Leadership is expected from all levels of the value chain in implementing the requirements in this clause.

5.1 Requirements for all value chain members

All value chain members shall:

a) set an organizational policy and strategy for carbon management, with clear roles and responsibilities, and align commercial/business goals with this strategy/structure;

b) assign responsibilities to practitioners of all the disciplines within the organization that are relevant for the development and implementation of the carbon management process;

c) communicate consistently and regularly to staff at all levels within their own organization on the importance of carbon management;

d) have training programmes in place to fill gaps in knowledge and skills;

e) make adequate and competent human resources available for the development and implementation of the carbon management process;

f) demonstrate a commitment to continuous improvement through the sharing of current good practice (internally and externally);

g) promote a culture that rewards efforts to drive down carbon emissions in their own organization, as well as other organizations in the value chain;

h) make the requirements of their carbon management strategy compatible and integrated with other business processes (e.g. asset management, risks management, procurement, health and safety, cost management, quality, delivery programme, sustainability, environmental management);

i) communicate consistently with other value chain members and system stakeholders to develop collaborative relationships with the goal of reducing whole life carbon at the system level;

j) when delivering projects and/or programmes of work, where possible, involve relevant value chain members and stakeholders (e.g. government, regulators, local authorities and financiers) in strategic discussions related to the delivery process to assess how to best drive decarbonization at the asset, network and system level; and

k) proactively collaborate with members of the value chain to promote and implement decarbonization solutions within their control and influence (see Clause **4**).

5.2 Asset owner/manager requirements

In addition to **5.1**, asset owners'/managers' leadership shall:

a) clearly document and communicate the desired carbon management outcomes, roles, responsibilities and requirements (as per Clause **6** to Clause **11**) to their value chain when delivering projects and/or programmes of work at the asset, network or system level;

b) support value chain and stakeholder communication to discourage silos, develop collaborative behaviours and enable system optimization;

c) encourage value chain members to challenge current practices and solutions by having whole life carbon reduction as a key objective/outcome for delivery and applying the carbon reduction hierarchy across work stages (as per Clause **4**);

d) identify appropriate mechanisms to recognize and, where possible, reward performance in the value chain to drive low-carbon solutions (including relevant KPIs and financial incentives as set out in Clause **10**);

e) be accountable for meeting reduction targets in projects and/or programmes of work at the asset and/or network level; and

f) clearly identify the whole life carbon implications in their control and influence at the network and system level, and communicate these across the value chain.

NOTE *The importance of embedding these requirements into contracts and procurement processes should be reflected throughout all leadership activities as per Clause* ***10****.*

5.3 Designer requirements

In addition to **5.1**, designers' leadership shall:

a) support asset owners/managers in identifying and implementing whole life carbon reduction opportunities in the control and influence (see Clause **4**) of the asset owner/manager, including brokering collaborations with relevant stakeholders, where appropriate;

b) challenge existing standards, guidance and requirements, or equivalent, where relevant, to drive low-carbon solutions;

c) set clear requirements and guidance for their own suppliers working on projects and programmes to help prioritize whole life carbon reduction outcomes;

d) enable/encourage cross-discipline coordination to drive low-carbon solutions throughout design development; and

e) develop a culture to encourage design and technological innovation that drive decarbonization.

5.4 Constructor requirements

In addition to **5.1**, constructors' leadership shall:

a) promote early involvement in the delivery of projects and programmes, and put mechanisms in place to enable collaboration with asset owners/managers, designers and material/product suppliers;

b) challenge their clients, designers and suppliers to provide low-carbon solutions;

c) support supply chain partners that can demonstrate their own carbon reduction commitment; and

d) integrate resource efficiency and circular economy principles into construction business models.

5.5 Product/material suppliers

In addition to **5.1**, product/material suppliers' leadership shall:

a) communicate and promote low-carbon solutions to all value chain members during early work stages;

b) encourage carbon management processes and low-carbon technologies within their supply chain and among their industry peers;

c) proactively communicate clear, complete and transparent carbon information to other value chain members; and

d) challenge their clients, designers and constructors to provide low-carbon solutions.

6 Integrating carbon management into decision-making

*COMMENTARY ON CLAUSE **6***

Integrating whole life carbon into decision-making requires the development and implementation of a carbon management process. The intention of a carbon management process is to drive the right behaviours at each work stage (both for infrastructure and buildings) to reduce whole life carbon in a project or programme of work. This process is to be developed and implemented by asset owners/managers. All value chain members, however, are responsible for specific requirements within the carbon management process.

6.1 Requirements for all value chain members

6.1.1 Identify control and influence in whole life carbon reduction

All value chain members shall identify:

a) the level of control and influence they have during the work stages for delivering projects and/or programmes of work (as discussed in Clause **4**);

b) the necessary collaborations with other stakeholders that will enable whole life carbon reductions under their control and influence; and

c) the network(s) and system(s) with which the project or programme of work interacts, and the nature of those interactions.

***NOTE** Further guidance is given in Annex A and Annex B.*

6.1.2 Establish and implement a carbon management process

At each work stage, participating value chain members shall:

a) understand and prioritize the requirements of the carbon management process (see Figure 6) for delivering the project and/or programme of work as established by the asset owner/manager;

b) identify whole life carbon reduction opportunities over which they have control and/or influence, according to the carbon reduction hierarchy (see Clause **4**), and take early action to reduce carbon emissions where the opportunity is greatest;

c) prioritize the implementation of solutions that best support system-wide decarbonization;

d) challenge current practices to enable whole life carbon reduction, including scope, strategy and intended outcomes, standards and prescriptive specifications, design approach, programme or cost;

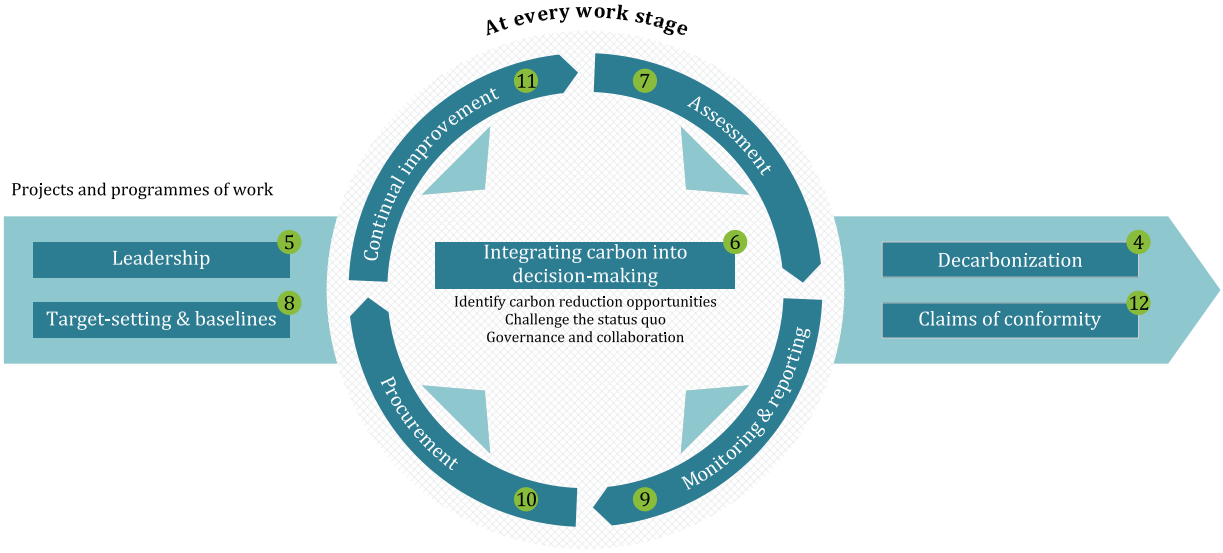
e) collaborate with other stakeholders and value chain members to implement solutions that minimize whole life carbon;

f) assess whole life carbon emissions and removals in their control and influence (as per Clause **7** and the PAS 2080 whole life carbon framework for decision-making in Clause **4**) and record reductions (as per Clause **9**) with reference to the baseline(s) and target(s) set (as per Clause **8**);

g) identify low-carbon alternatives appropriate at each stage of the carbon reduction hierarchy (as per Clause **4**), including nature-based solutions and circular economy opportunities in the project or programme, where appropriate; and

h) where carbon removal activities are planned or undertaken, report them separately from carbon emissions and emissions reductions.

Figure 6 – The PAS 2080 carbon management process



Key

X PAS 2080 clause number

NOTE *The circled numbers are cross-references to the relevant clauses in this PAS.*

6.2 Asset owner/manager requirements

6.2.1 Requirements for all work stages

In addition to meeting the requirements of **6.1**, asset owners/managers shall:

a) develop and implement a carbon management process (see Figure 6) when suited to their project(s) and/or programme(s) of work at the asset, network or system level;

b) allocate and communicate unambiguous responsibilities for each aspect of the carbon management process to value chain members involved in the delivery of project(s) and/or programme(s) of work for each work stage;

c) make decarbonization and alignment with the net zero carbon transition central to the scope and requirements of the project(s) and/or programme(s) of works;

d) align with and support sector, regional or national decarbonization ambition, or clearly explain why such alignment has not been achieved;

e) align in-house asset standards and guidance with the decarbonization principles (see Clause **4**);

f) set appropriate governance structures as per the governance principles in **4.4**;

NOTE 1 *This involves setting clear roles and responsibilities in the organization to manage whole life carbon when delivering projects and programmes of work, as well as setting up key decision-making milestones in each work stage to challenge every project on the basis of whole life carbon reduction.*

g) define and communicate to the rest of the value chain the assessment requirements for the project(s) and/or programme(s) of work (including impacts to the network and system as per Clause **7**) for achieving consistency when developing and sharing tools or data;

h) set out the objective and frequency of GHG emissions assessments (as per Clause **7**) and reporting (as per Clause **9**) during the delivery of projects and programmes, so that assessments sufficiently inform decision-making;

i) set out procurement mechanisms that enable the delivery of low-carbon solutions (as per Clause **10**); and

j) develop a collaborative environment for all value chain members involved in the implementation of the carbon management process during the delivery of systems/networks/assets and the project(s) and/or programme(s) of work.

NOTE 2 *Standards such as BS ISO 37000, BS ISO 44001 and BS 11000 provide further detail on how to develop and implement appropriate governance structures and collaborative environments that benefit all aspects of built environment delivery. Asset owners/managers can use these to define roles, responsibilities and processes that include all value chain members (see also Clause **10**).*

6.2.2 Requirements for the need and optioneering stages

In addition to meeting the requirements of **6.1** and **6.2.1**, asset owners/managers shall:

a) demonstrate that the ability of a project or programme to enable and support the net zero carbon transition of its network and/or system has been taken into account when assessing the need for a new project or programme;

   NOTE *Collaboration with other members of the value chain might be required to define this compatibility.*

b) identify the required projects and/or programmes that constitute the organization's contribution to the net zero carbon transition (of the network and system of which their assets are a part) and define a clear implementation strategy that is time-bound and in line with or beyond the set targets;

c) identify the carbon impacts associated with meeting the climate resilience needs for asset, network and/or system climate resilience;

d) review opportunities for the project(s) and/or programme(s) to alter land use or deploy nature-based solutions, and prioritize opportunities for these to help decarbonize the network and/or system;

e) identify activities that fall within the study boundary in line with the requirements of Clause **4** and Clause **7**, including impacts on the network and system;

f) assess carbon impacts in accordance with Clause **7**, prioritizing assessment of emissions and removals that might help identify the lowest carbon outcome;

g) compare the whole life carbon of all options considered using a time horizon that reflects the life of the outcome rather than the life of an asset;

h) clearly define baselines and time-bound targets at project or programme level (as per Clause **8**);

i) demonstrate that they have taken into account alternative approaches that minimize whole life carbon; and

j) demonstrate that they have taken into account options that maximize the use of existing assets where this delivers the lowest whole life carbon outcome.

6.2.3 Requirements for the design and delivery stages

In addition to meeting the requirements of **6.1** and **6.2.1**, asset owners/managers shall:

a) set clear design requirements for the project or programme of work to align with the net zero transition;

b) procure design and delivery services based on whole life decarbonization (as per Clause **10**);

   NOTE 1 *This includes not just capital or operational carbon, but also user carbon.*

   NOTE 2 *Decarbonization requirements are complemented by the commercial and programme requirements and are not in conflict with them.*

c) select a study boundary that covers all relevant sources of whole life carbon for the project or programme, including user carbon where relevant, noting that the study boundary might be wider than the project/programme boundary;

d) align standards and guidance with whole life decarbonization requirements;

e) use appropriate assessment methodologies for whole life carbon emissions and removals within both the control and the influence of the organization, in accordance with the requirements of Clause **7**;

f) demonstrate that they have assessed options that maximize the use of existing assets where this delivers the lowest whole life carbon outcome; and

g) put in place a system to implement circular economy principles within the planning, design, construction, and operational and end-of-life management, of assets, including collaboration with stakeholders for the useful exchange of resources.

   NOTE 3 *It might be necessary to revisit decisions made in previous stages to check whether carbon at system and/or network level is still being reduced, and whether opportunities/alternatives to reduce carbon at system and/or network level are being considered and implemented.*

6.2.4 Operational and end-of-life requirements

In addition to meeting the requirements of **6.1** and **6.2.1**, asset owners/managers shall:

a) optimize the operational performance of assets, networks and/or systems, identify any need for retrofitting and/or operational efficiency, and specify the timescales over which they shall be addressed;

b) procure asset management services based on the whole life carbon that the project(s) and/or programme(s) influence, as well as that which they control (as per Clause **10**);

c) capture operational data and feedback to improve baselines; and

d) assess and report actual emissions and performance against targets, in accordance with reporting principles.

6.3 Designer requirements

In addition to meeting the requirements of **6.1**, designers shall:

a) challenge the standards and prescriptive requirements that have an impact on whole life carbon;

b) integrate whole life carbon reduction opportunities in the design of the project or programme;

c) have governance structures in place, as per Clause **4**, that promote whole life carbon reduction opportunities;

d) comply with targets defined by the asset owner/manager for the project or programme of work and challenge targets where there is potential for improvement;

e) set targets that are aligned with net zero at the network or system level, to the extent that this is possible, where the asset owner/manager has not set any targets;

f) assess whole life carbon emissions of design options using an approach that is consistent with the requirements of Clause **7**;

g) demonstrate that they have followed the carbon reduction hierarchy as per Clause **4**, including, among other things, how they have assessed how to reuse materials, specified low-carbon materials, specified energy efficient and/or renewable energy generation, and otherwise minimized resource use;

h) demonstrate that they have assessed future adaptability and material recovery; and

i) submit carbon reduction proposals to the asset owner/manager or other value chain members, if appropriate, supported by the anticipated benefits and outcomes of the carbon management process.

6.4 Constructor requirements

In addition to meeting the requirements of **6.1**, constructors shall:

a) have governance structures in place, as per Clause **4**;

b) comply with targets defined by the asset owner/manager and challenge targets where there is potential for improvement;

c) set targets that are aligned with net zero at the network or system level, to the extent that this is possible, where the asset owner/manager has not set any targets;

d) assess whole life emissions of construction works using an approach that is consistent with the requirements of Clause **7**;

NOTE *For complex construction works (particularly major infrastructure projects), where data and/or tools are not available to fully assess carbon during construction, assess as a minimum the carbon impact of the most significant activities/practices and have a plan on capturing data to improve future benchmarks (see also continual improvement principles in Clause **11**).*

e) minimize use of resources (e.g. materials, water, energy), transport to site and construction waste, and maximize opportunities for reuse/recycling/recovery;

f) capture data and share knowledge on innovative construction techniques, materials and product use; and

g) submit carbon reduction proposals to other value chain members as appropriate, supported by the anticipated benefits and outcomes of the carbon management process.

6.5 Product/material supplier requirements

In addition to meeting the requirements of **6.1**, product/material suppliers shall:

a) have governance structures in place, as per Clause **4**;

b) develop and deploy low-carbon solutions, technologies, materials, products and/or methods;

c) make carbon data of existing and developing products easily accessible, allowing other members of the value chain to identify products that produce the best low-carbon outcomes;

d) assess and report to all members of the value chain the whole life carbon emissions of materials/products supplied (including direct operations and those of their supply chain) in a transparent manner;

e) demonstrate efforts towards achieving compliance with an appropriate product level life cycle assessment standard; and

NOTE *This PAS recognizes that smaller organizations might not have environmental product declarations (EPDs) for new and innovative products/materials, e.g. in cases where there may be a backlog of EPD certification. EPD certification could include BS EN 15804 and ISO 21930, among others. PAS 2080 intends to encourage progress for product/material suppliers to become verified under PAS 2080. This PAS, therefore, focuses on product/material suppliers sharing relevant whole life carbon emissions information using appropriate methodologies in a transparent manner.*

f) submit carbon reduction proposals to other value chain members as appropriate, supported by the anticipated benefits and outcomes of the carbon management process.

7 Whole life carbon assessment principles to support decision-making

*COMMENTARY ON CLAUSE **7***

*The purpose of Clause **7** is to ensure that whole life carbon assessment is fit for integrating carbon reduction into decision-making in projects and programmes, in accordance with Clause **6**.*

This clause establishes key principles for consistency in the assessment approach throughout the value chain, encourages a level of detail commensurate with the decision-making at the stage considered, recognizes that the accuracy of assessment improves as the project/programme develops, and emphasizes the importance of assessing whole life carbon, even in the absence of detailed data during the early optioneering stage of the delivery process to drive low-carbon behaviours and decisions.

*This clause references the whole life carbon framework (introduced in Clause **4**) that for the assessment of emissions and removals within and beyond a project/programme boundary. The framework can be applied to projects and/or programmes of work at the asset, network or system level. The framework builds on life cycle assessment principles of existing standards and does not intend to replace those, while enabling a common carbon management language across different asset/network/system typologies.*

The framework allows carbon hotspots both in the control and influence of the value chain to be identified and, in turn, support whole life carbon reductions. Central to the PAS 2080 whole life carbon framework is the importance of systems thinking for achieving decarbonization.

7.1 Requirements for all value chain members

7.1.1 Assessing GHG emissions over the whole life to inform decision-making at the asset, network and system level

All value chain members shall:

a) establish a comprehensive study boundary that takes into account all emission sources and removals included in the whole life carbon framework for decision-making (see Clause **4**). The study boundary shall be greater than the project/programme boundary to account for impacts on the wider network and system;

***NOTE 1** Examples of relevant emission sources and removals are provided in Table A.1 and Table A.2.*

b) assess emissions and removals for all sources within the control and influence of the value chain member (as per the whole life carbon framework for decision-making in Clause **4**) during all stages of the delivery process;

c) assess the impact of all emissions or removals to a level of detail that supports decision-making at each work stage, such that:

1) at the need and optioneering stages, an appropriate methodology (see **7.1.3**) is used to prioritize assessment of emissions and removals that might affect which option is identified as the lowest carbon outcome (including impacts to the network and system, even when outside the project boundary), working with benchmarks or initial quantities where needed; and

***NOTE 2** An option may involve the creation of new assets and/or the repurposing of existing assets.*

2) at the design, delivery and operation stages, an appropriate methodology (see **7.1.3**) is used to assess to an appropriate degree of detail all relevant sources of emissions and removals attributable to the project or programme.

***NOTE 3** This should include impacts on the network and system, except in cases where it can be demonstrated that this is no longer relevant for decision-making.*

***NOTE 4** Refer to Figure 7 for the level of detail that supports decision-making at different stages of the delivery process.*

d) assess and record emissions and removals associated with land use change (including nature-based and climate resilience solutions) as part of the decision-making process; and

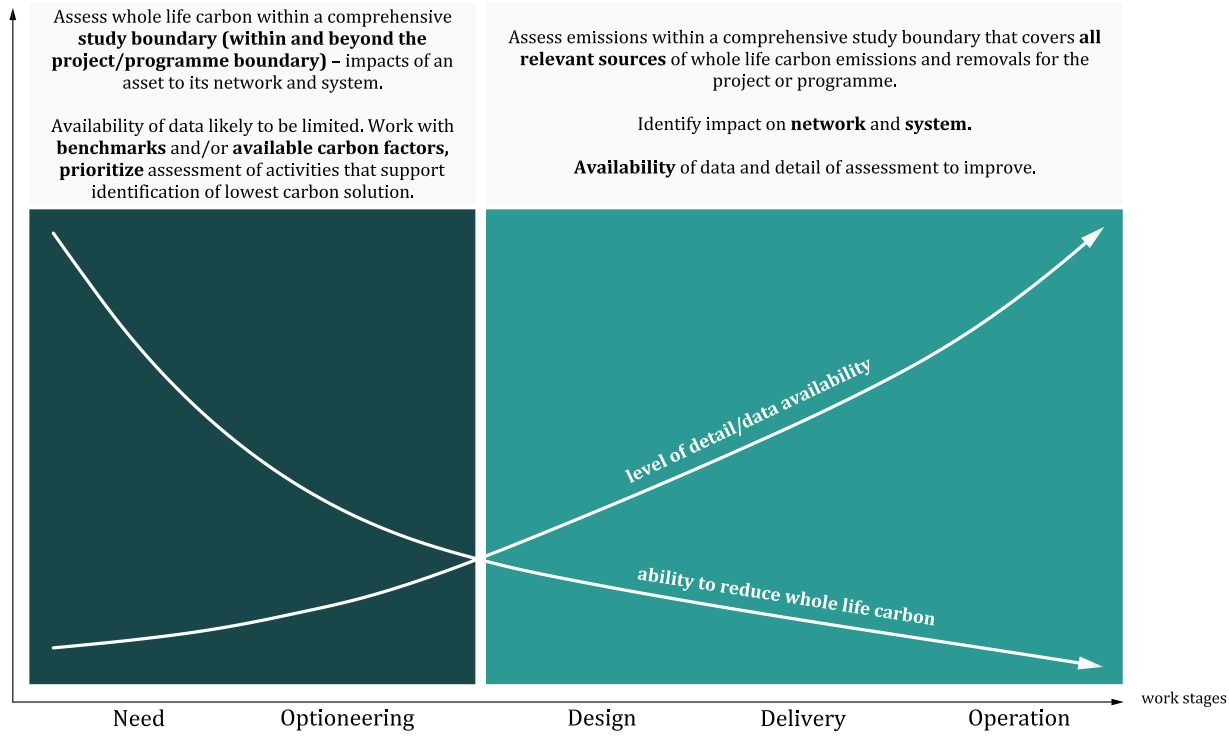
e) not include market-based offsets within the assessment boundary.

7.1.2 Selecting an appropriate level of accuracy and detail

Value chain members shall adopt the whole life carbon framework for decision-making, introduced in Clause **4**, to support and inform the decision-making process (see also Clause **6**) for meeting any carbon reduction targets (as per Clause **8**).

NOTE 1 *Value chain members should recognize that the accuracy of any GHG assessment, particularly the availability of carbon and/or asset data, improves over the delivery process, and accept that the accuracy of any assessment might be lower at the initial option selection stages. See Figure 7 for an illustration of this.*

Figure 7 – Degree of accuracy and data availability in whole life carbon assessments across work stages



NOTE *This figure illustrates how the assessment approach changes across project stages to support the decision-making process most effectively.*

Value chain members shall seek to improve the accuracy of their assessment(s), to neither overestimate nor underestimate actual emissions, and to reduce uncertainty as much as practicable.

NOTE 2 *Text on accuracy has been adapted from the* Greenhouse Gas Protocol *[8].*

7.1.3 Selecting a GHG assessment methodology

All value chain members shall:

a) assess whole life GHG emissions using appropriate GHG assessment methodologies from existing lifecycle analysis standards and/or other recognized sources;

b) identify the limitations in existing methods and address these to meet the assessment requirements in **7.1.1** and **7.1.2** that focus on assessing whole life carbon to inform decision-making at the asset, network or system level; and

c) compare the whole life carbon impact of options using the same GHG assessment methodology for consistency.

NOTE *This PAS recognizes that there are existing national and international lifecycle standards for assessment of GHGs in buildings and other civil works (such as BS EN 15978, BS EN 17472 and BS EN 15804) that could be used to assess GHG emission sources.*

8 Target setting and baselines

*COMMENTARY ON CLAUSE **8***

Setting carbon reduction targets provides clear direction and communicates intent for carbon reduction. It is important that targets are set against clear baselines so that performance against them can be determined. This clause focuses on target setting and baselines throughout the whole life of projects and/or programmes of work at the asset or network level. This PAS recognizes that net zero targets should be set at the system level and ideally all networks and assets should have targets that are aligned with the system net zero target. This PAS also recognizes the importance of asset owners/managers setting carbon targets against clear baselines at project and programme level so that the value chain can focus their efforts in delivering those targets.

*The purpose of asset-level targets is to deliver the required pace and scale of carbon reduction to support and enable a system-level net zero target. An isolated "net zero" target at asset level might cause unintended consequences of increased carbon elsewhere in the system and shift focus to offsetting carbon rather than whole life carbon reductions or activities that could result in significant carbon reductions at the network or system level. Asset-level targets should be ambitious and align to a system-level net zero target. Further context is provided in **4.1** and **4.2**.*

At the need stage through to construction, a whole life carbon target should be met which might then evolve to an operational emissions target from handover.

8.1 Requirements for all value chain members

8.1.1 Carbon reduction targets

All value chain members shall:

a) adopt the carbon reduction targets set by the asset owner/manager as a minimum (see **8.2.1**); and

b) communicate and share carbon targets with other value chain members.

8.1.2 Baselines

All value chain members shall:

a) collect and report asset and whole life carbon data relevant to their activities when delivering projects and/or programmes of work to inform future baselines; and

b) identify limitations in the accuracy of setting baselines when making comparisons against their activities during the delivery of projects and/or programmes of work, and transparently report any uncertainties at appropriate stages of infrastructure and buildings delivery.

***NOTE** This is similar to cost assessments.*

8.2 Asset owner/manager requirements

8.2.1 Carbon reduction targets

In addition to meeting the requirements of **8.1**, the asset owner/manager shall develop whole life carbon reduction targets that:

a) are set for projects and programmes at the asset or network level and align with the relevant system-level net zero carbon targets;

***NOTE 1** Where system-level target is not set, engage with their peers and/or other value chain members not covered under the scope of this PAS (e.g., regulators/government) to influence the setting of the net zero carbon target at the system level.*

b) relate to a defined outcome based on the functional unit set for the project or programme of works at the asset or network level (in line with Clause **7**);

c) are appropriate in scope to the work stage to which they are relevant; and

d) are time-bound.

NOTE 2 *An asset owner/manager could set a net zero target at the network level, where appropriate. For example, in the absence of system-level net zero target in an infrastructure or buildings sector, an asset owner/manager might choose to set a net zero target at the network level covering their entire portfolio.*

8.2.2 Baselines

In addition to meeting the requirements of **8.1**, asset owners/managers shall set baselines that:

a) are set for projects and programmes at the asset or network level;

b) follow the assessment principles presented in Clause **7**, and which align to the boundary used for setting whole life carbon targets;

c) create a reference level against which future performance can be compared relative to targets set;

d) reflect good industry practice;

NOTE 1 *Baselines should, across the industry, improve over time to mirror improvements in practices. They should reflect the latest good practices for design and activity data (such as for materials and design choices) and reputable sources of emissions factors. Therefore, the practitioner is expected to take into account these aspects when developing a baseline so it becomes a mutually agreed starting point from which all value chain members should work to improve.*

e) provide sufficient detail to assist with identifying carbon emissions hotspots, on which to focus efforts to reduce emissions;

f) state any assumptions used to fill data gaps and the limitations this might have on the relevance of the baseline;

g) describe inclusions and exclusions;

h) set out the circumstances in which the baseline might be updated;

i) where gaps exist within the baseline, identify any uncertainty in the assessment; and

j) follow a continual improvement process to make good practices in current GHG assessments contribute to future baselines.

NOTE 2 *There might be limitations when setting baselines for the first time where there is not enough existing data within an organization, or relevant secondary data to produce baselines which follow the principles for GHG emissions assessment (Clause **7**). In such instances, the best available data is chosen to allow the most valid comparisons against a design. It is critical, however, that mechanisms are put in place that require the collection of relevant data from the value chain during delivery so improved baselines can be created for future projects and/or programmes of works.*

8.3 Designer requirements

8.3.1 Carbon reduction targets

In addition to meeting the requirements of **8.1**, designers shall:

a) work towards meeting the asset owner's/manager's carbon reduction targets;

b) challenge the asset owner/manager to mutually agree a target where the asset owner/manager has not set a whole life carbon reduction target; and

c) recommend and record improvements to the asset owner's/manager's approach to target setting, where appropriate.

8.3.2 Baselines

In addition to meeting the requirements of **8.1** and **8.3.1**, designers shall:

a) support asset owners/managers to set baselines, where requested by the asset owner/manager, by providing relevant activity data;

b) recommend and record improvements to the asset owner's/manager's approach to setting baselines, where appropriate; and

c) collect and share relevant data for improving future baselines and communicate to the asset owner/manager.

8.4 Constructor requirements

8.4.1 Carbon reduction targets

In addition to meeting the requirements of **8.1**, constructors shall:

a) work towards meeting the asset owner's/manager's carbon reduction targets;

b) challenge the asset owner/manager to mutually agree a target where the asset owner/manager has not set a whole life carbon reduction target; and

c) recommend and record improvements to the asset owner's/manager's approach to target setting, where appropriate.

8.4.2 Baselines

In addition to meeting the requirements of **8.1** and **8.4.1**, constructors shall:

a) support asset owners/managers to set baselines, where requested by the asset owner/manager, by providing relevant activity data to support their development;

b) recommend and record improvements to the asset owner's/manager's approach to setting baselines; and

c) collect relevant data for improving future baselines and communicate to the asset owner/manager.

8.5 Product/material supplier requirements

8.5.1 Carbon reduction targets

In addition to meeting the requirements of **8.1**, product/material suppliers shall recommend and record improvements to the asset owner's/manager's approach to target setting.

NOTE *This can be, for example, the availability of a sector target for specific materials (such as concrete), which could inform the target-setting approach of the asset owner.*

8.5.2 Baselines

In addition to meeting the requirements of **8.1** and **8.5.1**, product/material suppliers shall:

a) support asset owners/managers to set baselines, where requested by the asset owner/manager, by providing relevant environmental impact information of the product or material (as per Clause **6** and Clause **7**) to support their development;

b) recommend and record improvements to the asset owner's/manager's approach to setting baselines; and

c) when making claims that a product or material reduces carbon compared to another product or material (as per Clause **6** and Clause **7**), align these claims with the baseline assumptions specified by the asset owner/manager.

NOTE *This is to avoid product/material suppliers making further claims of carbon reductions already captured in the target-setting and baseline process.*

9 Monitoring and reporting

*COMMENTARY ON CLAUSE **9***

A carbon management process should have robust monitoring and transparent reporting at frequent intervals during the delivery of projects and/or programmes of work to highlight the progress of carbon reductions against targets. Reports should inform decision-making in managing whole life carbon, as well as provide information for future continuous improvement.

9.1 Requirements for all value chain members

All value chain members shall:

a) identify roles and responsibilities at each work stage for monitoring and reporting, and for submitting monitoring reports to the relevant stakeholders;

b) report whole life carbon emissions at each work stage defined in Clause **6**, in line with the assessment principles detailed in Clause **7**;

c) report progress made against targets set at an asset or network level, as appropriate;

d) keep records on low-carbon options and the extent to which they can improve performance over a baseline; and

e) share good practice outcomes, including non-carbon impacts and benefits of opportunities, where relevant, with other value chain members to drive low-carbon solutions in similar projects and/or programmes of work.

9.2 Asset owner/manager requirements

In addition to meeting the requirements of **9.1**, asset owners/managers shall:

a) report whole life carbon emissions during the delivery work stages, in line with the assessment principles (Clause **7**);

b) develop KPIs to monitor and report carbon emissions, which are:

   1) developed with the same functional unit as used in baseline and target setting;

   2) incorporated into a governance system which makes the collection and reporting of KPI data a proactive process; and

   3) not overly burdensome to particular value chain members, with data gathering and reporting requirements shared across the value chain.

c) as a minimum, monitor and report carbon emissions during all work stages or at key points where decisions are made that influence whole life carbon reduction;

d) follow relevant requirements for reporting to government and other system-level stakeholders; in the absence of such requirements, identify how reporting practices can support system-level stakeholders in facilitating decarbonization;

e) review KPIs and project/programme carbon risks regularly to identify any further actions required to meet targets; and

f) publish summary information on the performance of assets, networks and/or systems against carbon targets.

***NOTE** Asset owners/managers can decide the frequency of monitoring of GHG emissions against the baseline. This will depend on the nature of the project or programme of work being delivered.*

9.3 Designer requirements

In addition to meeting the requirements of **9.1**, designers shall:

a) monitor and report the predicted carbon emissions of the elements of design for which they are responsible at appropriate and agreed delivery work stages, and report these against the asset owner's/manager's carbon reduction targets at the required frequency;

b) where an opportunity for improvement to the asset owner's/manager's approach to monitoring and reporting is identified, recommend and, where accepted, assist in its implementation in the delivery of projects and/or programmes of work; and

c) identify carbon hotspots in the design of the project or programme of work, and report these to the asset owner/manager and other value chain members at regular intervals.

9.4 Constructor requirements

In addition to meeting the requirements of **9.1**, constructors shall:

a) monitor and report carbon emissions in construction and, where appropriate, commissioning and decommissioning activities, during the relevant delivery stages;

b) where an opportunity for improvement to the asset owner's/manager's approach to monitoring is identified, recommend and, where accepted, assist in its implementation in the delivery of assets and programmes of work; and

c) identify and report where the greatest carbon emissions are expected to occur or have occurred, and where future reductions can be made.

9.5 Product/material supplier requirements

In addition to meeting the requirements of **9.1**, product/material suppliers shall put systems in place in their own organization to monitor and share carbon emissions of their own product/material carbon data so that such data is made available to other users.

10 Procurement

*COMMENTARY ON CLAUSE **10***

The procurement process is critical to accelerate whole life carbon reductions in the value chain when delivering projects and/or programmes of work. This PAS recognizes that procurement is not solely the development of a contract; it's a mechanism that will incentivize the right behaviours.

Organizations might want to consider the guidance of ISO 20400 and include carbon as part of a holistic approach to the integration of sustainability in all aspects of procurement activity.

10.1 Asset owner/manager requirements

10.1.1 Contracts

Asset owner/managers shall:

a) assess how requirements in contracts for designers, constructors or product/material suppliers or within the delivery model could support the asset owner's/manager's alignment with the decarbonization principles (Clause **4**) and the requirements in the carbon management process;

b) prioritize whole life carbon as a performance drive, avoiding prescriptive specification;

c) make requirements proportionate and relevant to each work stage;

d) provide regular updates of the contract's performance against the agreed carbon reduction targets and other requirements to the contracted entity, and review and/or re-incentivize performance against these targets on par with performance against cost and programme;

e) where appropriate, include data management/information exchange requirements in contracts to support monitoring and reporting (see Clause **9** and Clause **11**);

f) where appropriate, identify incentive mechanisms that reward whole life carbon performance;

g) where appropriate, allow for challenges to asset standards that enable low-carbon performance;

h) support appropriate risk allocation mechanisms that promote the inclusion of low whole life carbon solutions which might be novel and not proven in previous projects and/or programmes of work; and

i) incentivize collaborative contractual arrangements across the value chain that maximize carbon reduction opportunities.

***NOTE** To support the inclusion of numerical carbon targets in contracts, the asset owner/manager might also need to specify a baseline performance level with reference to **8.2.2**.*

10.1.2 Sourcing

Asset owner/managers shall:

a) periodically review the procurement categories that support the delivery of their projects and/or programme of works and identify those with a material carbon impact;

b) develop proportionate criteria for inclusion in tenders that support the selection of suppliers who can efficiently enable delivery of low-carbon outcomes;

c) review and update asset standards and specifications to promote the integration of low whole life carbon solutions; and

d) provide timely and actionable feedback to suppliers on how they performed in tenders, including carbon-focused selection criteria.

***NOTE** The importance of carbon should be explicit and aligned with other procurement priorities, such as commercial outcomes, programme and risk. ISO 20400 also provides guidance on approaches to considering a range of sustainability aspects within a broader procurement framework.*

10.1.3 Engagement

Asset owner/managers shall:

a) communicate project and/or programme and carbon targets to the contracted entity;

b) communicate the role the value chain has in achieving the asset owner's/manager's carbon targets;

c) periodically engage with their value chain to identify potential low-carbon techniques or products that can support their projects and/or programmes of work, following the requirements of Clause **6**; and

d) identify opportunities to collaborate with the value chain to develop low-carbon skills and capability.

10.2 Designer requirements

10.2.1 Contracts

Designers shall:

a) support appropriate risk allocation approaches set in contracts by the asset owner/manager that promote low-carbon solutions;

b) engage with the asset owner and/or other value chain members involved in the contract to agree on a solution that is acceptable to all relevant parties, where the risk allocation approach needs to be challenged;

c) in responding to tenders for projects and/or programmes of work, demonstrate the approach they will take to identify low-carbon options of relevance to the specific objectives for the project;

d) provide regular updates to the asset owner/manager of the contract's performance against the agreed carbon reduction targets, and review performance against these targets on par with performance against cost and programme; and

e) demonstrate how they will meet the requirements of the asset owner's/manager's carbon management process.

10.2.2 Engagement

Designers shall:

a) promote their low-carbon solutions within the value chain;

b) engage with the value chain to identify ways in which incentives within their design contracts encourage the implementation of low-carbon solutions;

c) identify opportunities to collaborate with the value chain to develop low-carbon skills and capability; and

d) where opportunities exist, actively collaborate with the value chain to develop and integrate capability.

NOTE *As set out in Clause **5**, designers should collaborate with other members of the value chain in order to understand the low-carbon solutions they are able to offer.*

10.3 Constructor requirements

10.3.1 Contracts

Constructors shall:

a) support appropriate risk allocation approaches set in contracts that promote low-carbon solutions;

b) engage with the asset owner and/or other value chain members involved in the contract to agree on a solution that is acceptable to all relevant parties, where the asset owner's/manager's risk allocation approach needs to be challenged;

c) in responding to tenders for projects and/or programmes of work, demonstrate the approach they will take to identify low-carbon options of relevance to the specific objectives for the project or programme of work;

d) where appropriate, identify any carbon reduction measures included within their tender response;

e) assess how requirements in sub-contracts could support the constructor's project/programme carbon targets and/or support the identification of low-carbon solutions, in line with the asset owner's/manager's carbon management process;

f) provide regular updates to the asset owner/manager of the contract's performance against the agreed carbon reduction targets, and review performance against these targets on par with performance against cost and programme; and

g) demonstrate how they will meet the requirements of the asset owner's/manager's carbon management process.

10.3.2 Sourcing

Constructors shall:

a) periodically review the procurement categories that support the delivery of their activities and identify those with a material carbon impact;

b) develop proportionate criteria for inclusion in tenders that support the selection of suppliers who can deliver low-carbon solutions; and

c) where required, identify and integrate low-carbon solutions within their proposed responses to tenders.

10.3.3 Engagement

Constructors shall:

a) promote their low-carbon solutions across the value chain;

b) communicate carbon targets to the value chain;

c) communicate the role the value chain has in achieving their carbon targets;

d) periodically engage with their value chain to identify potential low-carbon techniques or products that can support their projects and/or programmes of work; and

e) identify opportunities to collaborate with the value chain to develop low-carbon skills and capability.

NOTE *As set out in Clause* ***5****, constructors should collaborate with other members of the value chain in order to understand the low-carbon solutions they are able to offer.*

10.4 Product/material supplier requirements

Product/material suppliers shall:

a) engage with other members of the value chain to identify commercial models that can support the uptake of low-carbon solutions;

b) identify opportunities to collaborate with the value chain to develop low-carbon skills and capability; and

c) regularly communicate innovative, low-carbon solutions to other value chain members.

11 Continual improvement

*COMMENTARY ON CLAUSE **11***

Continual improvement is a core part of the carbon management process that allows lessons learned to improve the delivery of current and future projects and/or programmes of work; this should be targeted towards the end goal of decarbonization. Continual improvement also allows organizations to mature their carbon management experience and learn from each other about effective decarbonization approaches, including innovations.

11.1 Requirements for all value chain members

All value chain members shall:

a) establish a process of continual improvement and innovation that targets the development of low-carbon solutions, organizational capability to deliver low-carbon, and improvements in procurement processes and the relevant carbon management process components (Clause **6**);

b) capture carbon emissions information and share it with other value chain members in order to facilitate continual improvement in future carbon management between organizations within the infrastructure and building sectors;

c) capture carbon reduction solutions and share learning with other value chain members to inform good practice; and

d) maintain ongoing engagement across the value chain – asset owners/managers, designers, constructors and product/material suppliers – to build learning on industry innovations to further drive whole life carbon reductions at the asset, network and system level.

***NOTE** Organizations within the infrastructure and building value chains might already use approaches to continual improvement at a project or programme level (e.g. BS ISO 14001 or BS EN ISO 9001).*

11.2 Asset owner/manager requirements

Asset owners/managers shall:

a) annually review the effectiveness of their carbon management process and governance structures in place and make improvements where they do not result in low-carbon solutions;

b) regularly review their procurement process and, where necessary, make improvements to put appropriate incentives and/or requirements in place to help value chain members deliver whole life carbon reduction in projects and/or programmes of work;

c) adapt their GHG assessment methodology, as data availability improves, to minimize uncertainty and produce accurate, consistent and reproducible results (Clause **7**);

d) build up an inventory of the most relevant data to use when developing baselines and assessing carbon emissions at different infrastructure and building work stages; and

e) assess the need to update the project or programme of work baselines in delivery work stages to prevent carbon reductions from being claimed that are based on outdated and/or inappropriate baselines.

11.3 Designer requirements

Designers shall:

a) provide input to asset owner/manager continual improvement requirements and share improved carbon data to inform future delivery of projects and/or programmes of work; and

b) put in place a process to assess the skills and capability within their organizations and, where necessary, provide further training and/or guidance in relation to GHG assessment, baselines, targets, identifying and promoting whole life carbon reduction, and delivering low-carbon solutions.

11.4 Constructor requirements

Constructors shall:

a) provide input to asset owner/manager continual improvement requirements and share improved carbon data to inform future delivery of projects and/or programmes of work;

b) put in place a process to assess their procurement process, establishing appropriate incentives and/or requirements for value chain members to deliver whole life carbon reduction in projects and/or programmes of work;

c) capture as-built data and feedback to help improve baselines; and

d) evaluate the skills and capability within their organizations and, where necessary, provide further training and/or guidance in relation to GHG assessment, baselines, targets, low-carbon solutions, low-carbon procurement, monitoring and reporting.

11.5 Product/material supplier requirements

Product/material suppliers shall:

a) engage with other value chain members to share the latest low-carbon innovations and assess their applicability to projects and/or programmes of work; and

b) evaluate the skills and capability within their organizations and, where necessary, provide further training and/or guidance in relation to GHG assessment, baselines, targets, low-carbon solutions and low-carbon procurement.

12 Claims of conformity

12.1 General

Where claims of conformity to PAS 2080 are made, the provisions in **12.2** and **12.3** shall apply. These provisions include identification of the type of certification or verification undertaken (see **12.2**) and requirements for how the claim shall be expressed (see **12.3**).

12.2 Basis of claim

12.2.1 General

The claim shall identify the type of conformity assessment undertaken as one of the following:

a) independent third-party certification in accordance with **12.2.2**;

b) other-party validation in accordance with **12.2.3**; or

c) self-validation in accordance with **12.2.4**.

The claim shall be explicit in terms of the scope of the conformity (organization, programme or project) and the specific clauses to which conformity is claimed.

12.2.2 Independent third-party certification

Buildings and infrastructure asset owners/managers seeking to demonstrate that their carbon management process has been independently verified as being in accordance with this PAS shall undergo an assessment by an independent third-party certification body accredited to provide assessment and certification to this PAS.

12.2.3 Other-party validation

Organizations using an alternative method of validation involving parties other than those qualifying as accredited independent third parties shall satisfy themselves that any such party is able to demonstrate compliance with recognized standards setting out requirements for bodies providing certification services.

NOTE 1 *Other-party validation bodies are those undertaking assessment services without having achieved accreditation from the authorized accreditation service (e.g. UKAS in the UK). Such bodies could include those which, although independent of the organization undertaking the assessment of GHG emissions, cannot demonstrate complete independence, e.g. a trade body providing assessment services for its members or a consultant employed for such a purpose.*

NOTE 2 *Examples of such recognized standards include BS EN ISO/IEC 17065.*

12.2.4 Self-validation

Organizations shall be able to demonstrate that their carbon management process has been established in accordance with this PAS and publish supporting documentation on a website and make information available upon request. The supporting document shall detail:

a) the scope of the claim, in terms of the organizational entity, programme or project which is claiming conformity;

b) summary evidence for each clause which demonstrates that the relevant requirements have been met;

c) any limitations of the claim due to data quality or data gaps;

d) the key stakeholders/roles involved in the carbon management process; and

e) summary of actions for the further improvement of the carbon management process.

NOTE 1 *The appropriate method for self-validation and presentation of the results can be determined by reference to BS EN ISO 14064-3 and BS EN ISO 14021.*

NOTE 2 *Organizations for whom neither independent third-party certification nor other-party verification is a realistic option may rely on self-verification. In so doing, organizations should be aware that independent verification could be required in the event of a challenge and that stakeholders might have less confidence in this option.*

NOTE 3 *Guidance on what represents suitable evidence is set out in the* Guidance document to PAS 2080.

12.3 Permitted forms of disclosure

12.3.1 Asset owners/managers

Claims of conformity shall use the appropriate form of disclosure, as follows.

a) For claims of conformity based on independent third-party certification in accordance with **12.2.2**: "Carbon management process for [insert unambiguous identification of asset or programme of work] implemented as asset owner/manager by [insert unambiguous identification of the claimant] in accordance with PAS 2080, [insert unambiguous identification of the certification body] certified."

b) For claims of conformity based on other-party validation in accordance with **12.2.3**: "Carbon management process for [insert unambiguous identification of asset or programme of work] implemented as asset owner/manager by [insert unambiguous identification of the claimant] in accordance with PAS 2080, [insert unambiguous identification of the validation body] validated."

c) For claims of conformity based on self-validation in accordance with **12.2.4**: "Carbon management process for [insert unambiguous identification of asset or programme of work] implemented as asset owner/manager by [insert unambiguous identification of the claimant] in accordance with PAS 2080, self-validated."

12.3.2 Designers

Claims of conformity shall use the appropriate form of disclosure.

a) For claims of conformity based on independent third-party certification in accordance with **12.2.2**: "Carbon management process for work undertaken on [insert unambiguous identification of asset or programme of work] implemented as designer by [insert unambiguous identification of the claimant] in accordance with PAS 2080, [insert unambiguous identification of the certification body] certified."

b) For claims of conformity based on other-party validation in accordance with **12.2.3**: "Carbon management process for work undertaken on [insert unambiguous identification of asset or programme of work] implemented as designer by [insert unambiguous identification of the claimant] in accordance with PAS 2080, [insert unambiguous identification of the validation body] validated."

c) For claims of conformity based on self-validation in accordance with **12.2.4**: "Carbon management process for work undertaken on [insert unambiguous identification of asset or programme of work] implemented as designer by [insert unambiguous identification of the claimant] in accordance with PAS 2080, self-validated."

12.3.3 Constructors

Claims of conformity shall use the appropriate form of disclosure.

a) For claims of conformity based on independent third-party certification in accordance with **12.2.2**: "Carbon management process for work undertaken on [insert unambiguous identification of asset or programme of work] implemented as constructor by [insert unambiguous identification of the claimant] in accordance with PAS 2080, [insert unambiguous identification of the certification body] certified."

b) For claims of conformity based on other-party validation in accordance with **12.2.3**: "Carbon management process for work undertaken on [insert unambiguous identification of asset or programme of work] implemented as constructor by [insert unambiguous identification of the claimant] in accordance with PAS 2080, [insert unambiguous identification of the validation body] validated."

c) For claims of conformity based on self-validation in accordance with **12.2.4**: "Carbon management process for work undertaken on [insert unambiguous identification of asset or programme of work] implemented as constructor by [insert unambiguous identification of the claimant] in accordance with PAS 2080, self-validated."

12.3.4 Product/material suppliers

Claims of conformity shall use the appropriate form of disclosure, as follows:

a) For claims of conformity based on independent third-party certification in accordance with **12.2.2**: "Carbon management process for work undertaken on [insert unambiguous identification of asset or programme of work] implemented as product/material supplier by [insert unambiguous identification of the claimant] in accordance with PAS 2080, [insert unambiguous identification of the certification body] certified."

b) For claims of conformity based on other-party validation in accordance with **12.2.3**: "Carbon management process for work undertaken on [insert unambiguous identification of asset or programme of work] implemented as product/material supplier by [insert unambiguous identification of the claimant] in accordance with PAS 2080, [insert unambiguous identification of the validation body] validated."

c) For claims of conformity based on self-validation in accordance with **12.2.4**: "Carbon management process for work undertaken on [insert unambiguous identification of asset or programme of work] implemented as product/material supplier by [insert unambiguous identification of the claimant] in accordance with PAS 2080, self-validated."

Annex A (informative)
Categories of emissions and removals to aid decision-making for reducing whole life carbon

A.1 Whole life carbon emission sources and removals

Table A.1 sets out a list of emissions sources and removals for different sectors of the built environment at various stages: before use, during operation and use, and end-of-life. The emissions sources and removals are categorized as per the whole life carbon framework for decision-making introduced in Clause **4**. This framework should be used for identifying relevant sources of carbon emissions and removals to aid in decision-making for reducing whole life carbon at the asset, network and system level. Once identified, all emission sources and removals should be assessed as per Clause **7**, and action taken to reduce them as per all relevant clauses of PAS 2080.

Because decision-making should be geared towards reducing carbon across the whole system, value chain members should consider how to reduce all carbon over which they have control and influence, including capital (or embodied/upfront), operational and user carbon, as well as impacts on natural systems. While the scope of PAS 2080 relates to reducing carbon, value chain members should also take into account how the decisions made in built environment delivery cause other impacts (both benefits and dis-benefits) on the environment and/or wider sustainability goals.

Table A.1 is not exhaustive and can be used as a starting point. Each value chain member should identify all the relevant sources of emissions and removals for their particular circumstance and/or the standard they are using.

Beyond the project/programme boundary assessments should reflect the potential benefits or dis-benefits conferred from one network or system in the built environment to another. Table A.2 sets out a non-exhaustive set of examples of potential benefits or dis-benefits that may result from activity in different networks or systems. Value chain members need to consider which benefits or dis-benefits are material (i.e. non-marginal) to the decisions being made and therefore worthy of assessment. This will avoid time-consuming effort on trivial beyond-the-boundary components.

Table A.1 – Typical emissions and removal sources in buildings and infrastructure to take into account when managing whole life carbon at the asset, network and system level

	Before use	Use	End-of-life
Buildings	Site preparation. Planning, design and construction or substantial retrofit/ refurbishment of existing buildings, including substructure, superstructure, facades and fit out.	Energy and materials involved in the maintenance and upkeep of buildings. Use of energy and water by the building, including both regulated and unregulated energy sources.	Reuse, repurposing or removal of buildings.

Table A.1 – Typical emissions and removal sources in buildings and infrastructure to take into account when managing whole life carbon at the asset, network and system level *(continued)*

	Before use	Use	End-of-life
Energy infrastructure	Site preparation. Planning, design and construction or substantial retrofit/ refurbishment of infrastructure that generates, transmits, distributes or stores energy.	Energy (including fuel user for transport) and materials involved in maintenance and upkeep of energy infrastructure. Energy consumption of the infrastructure itself (auxiliary loads). All energy sector conversion, transmission and distribution losses. Any emissions from chemicals used in processes, including refrigerants, SF_6 or similar insulating gases. Emissions associated with the use of energy at the point of energy consumption.	Reuse, repurposing or removal of energy infrastructure.
Water infrastructure	Site preparation. Planning, design and construction or substantial retrofit/ refurbishment of infrastructure: • water resources assets – boreholes, reservoirs and dams • potable water supply – distribution systems, pumping stations and treatment works • collection and treatment of sewage – sewers, pumping stations and treatment works • distribution – pipelines and pumping stations; and • flood and coastal defences.	Energy (including fuels used for transport) and materials involved in maintenance of water infrastructure. Energy used in conveyance of water. Direct treatment process emissions. Energy use (including fuel used for transport) for the operation of water assets. Chemicals for treatment of water. Energy use for the heating of water and conveyance of water at the point of use.	Reuse, repurposing or removal of waste infrastructure.

Table A.1 – Typical emissions and removal sources in buildings and infrastructure to take into account when managing whole life carbon at the asset, network and system level *(continued)*

	Before use	Use	End-of-life
Transport infrastructure	Site preparation. Planning, design and construction or substantial retrofit/ refurbishment of infrastructure covering all road, rail, aviation and marine/inland water modes.	Energy (including fuel used for transport) and materials involved in the maintenance and upkeep of transport infrastructure. Energy for street and public realm lighting. Energy for pumps, control and automation systems, signage, signalling etc. Other energy-related emissions and operational processes necessary for the operation and management of transport assets. Energy and fuel use by vehicles (road, aviation, water and rail) that are owned and operated by asset owners/managers and/or operators providing transport services on the infrastructure. Energy and fuel use by user-owned vehicles (road, aviation, rail, maritime).	Reuse, repurposing or removal of transport infrastructure.
Waste infrastructure	Site preparation. Planning, design and construction or substantial retrofit/ refurbishment of infrastructure used for processing, treatment, reuse, recycling and final disposal of waste.	Energy and materials involved in the maintenance and upkeep of waste infrastructure. Energy used to power waste handling, processing and treatment equipment (to end-of-waste point). Emissions arising from any chemicals or other agents used to process and treat waste. Biogenic fugitive emissions from the storage or processing of waste. Transport of waste from point arising to point of recycling/reuse (i.e. to end-of-waste point) and final disposal. Direct emissions arising from any process to treat and dispose of waste at point of final disposal.	Reuse, repurposing or removal of waste infrastructure.

Table A.1 – Typical emissions and removal sources in buildings and infrastructure to take into account when managing whole life carbon at the asset, network and system level *(continued)*

	Before use	Use	End-of-life
Communications infrastructure	Site preparation. Planning, design and construction or substantial retrofit/ refurbishment of infrastructure for: • voice and data networks (fixed and mobile); • satellite networks; and • TV and radio broadcast networks.	Energy and materials involved in the maintenance and upkeep of communications infrastructure. Electricity consumption of networks and data centres. Energy and fuel use by vehicles that are owned and operated by asset owners/managers and/or operators providing services on the infrastructure. End-user device electricity consumption and any end-user data centres.	Reuse, repurposing or removal of communications infrastructure.
All sectors	Land use change as part of the project or programme. Either: • degradation/net carbon emissions from, for example, conversion from a green field to a building/infrastructure grey asset; or • regeneration/net carbon removal from, for example, an upgrade to a biodiverse natural habitat within the project boundary. Planning, design and construction or substantial retrofit/ refurbishment of protection from increased flooding and/or heat induced from climate change. Planning design and construction or retrofit of carbon capture, utilization and storage (CCUS) plant as part of the project or programme.	Land use change as part of the project or programme. Either: • degradation/net carbon emissions; or • regeneration/net carbon removal from, for example, an upgrade to a biodiverse natural habitat within the project boundary. Additional operational energy to protect from extreme flood and/or heat events induced from climate change. Repair and/or replacement of assets and systems following damage from extreme weather events. Energy for the operation of CCUS on the project or programme (leading to abated emissions).	Land use change as part of the project or programme. Either: • degradation/net carbon emissions from the project or programme, for example, reuse, repurposing or removal of assets; or • regeneration/net carbon removal from, for example, an upgrade to a biodiverse natural habitat within the project boundary.

Table A.2 – Typical emissions and removal categories to support decision-making for managing whole life carbon beyond the project/programme boundary at the network or system level

	Consequence for energy	Consequence for water	Consequence for transport	Consequence for waste	Consequence for communications	Consequence for buildings
Activity in all sectors	Reuse and redeployment potential					
Activity in buildings	Changes in types of energy and energy infrastructure needed for building heat, e.g. electricity networks, hydrogen, district heat networks. Excess energy generated and exported to the grid.	Reduced need for clean water and drainage infrastructure through efficiency and reduced demand.	New transport infrastructure requirements to support sustainable urban developments. Reduced need for transport infrastructure through mixed-use, digitally enabled buildings and neighbourhoods.	Changes to waste streams and waste processing requirements from use of different building materials, e.g. timber, recycled concrete.	Integration of communications infrastructure when delivering new buildings, reducing the need for additional construction.	Alleviation of pressure for new supply from other less sustainable locations.
Activity in energy	Displacement of higher carbon electricity, heat or fuels. Impacts on power transmission and distribution infrastructure and grid system requirements. Risk of locking-in carbon-emitting infrastructure and supply chains.	Water consumption, e.g. for hydrogen production and thermal power plants.	Provision of low-carbon energy for vehicles/vessels, e.g. electricity for electric vehicles (EVs), trains.	Demand for waste as energy from waste (EfW) feedstock. Decommissioning of energy waste, e.g. radioactive waste. Increased replacement and end-of-life waste, e.g. photovoltaic panels and wind power blades, which have a defined design life.	Integration of communications infrastructure when delivering energy infrastructure. Provision of energy for energy- intensive infrastructure, e.g. data centres.	Provision of power for electrification of heat and transport. Provision of hydrogen and other low-carbon fuels for heat in buildings (including via district heat networks).

Table A.2 – Typical emissions and removal categories to support decision-making for managing whole life carbon beyond the project/programme boundary at the network or system level *(continued)*

	Consequence for energy	Consequence for water	Consequence for transport	Consequence for waste	Consequence for communications	Consequence for buildings
Activity in water	Demand for energy, e.g. extraction of potable water, wastewater treatment, desalination. Excess energy generated and exported to power and gas grids. Provision of water for cooling. Risk of flooding disruption to generation, transmission and distribution plants.	Wastewater to potable water recycling. Risk of flooding/ contamination of potable water supplies.	Facilitates production of low-carbon fuels, e.g. hydrogen, biofuels Risk of disruption/ impact from flood damage.	Changes in amount of waste to be treated.	Provision of water for cooling.	Integration of water efficiency measures in buildings and cities. Risk of flood damage.
Activity in transport	Increased demand for low-carbon energy from vehicles/vessels, such as electricity for EVs and electric heating, resulting in need for more electricity generation, transmission and distribution networks, and the associated capital and operational carbon implications. Supports distribution of low-carbon fuels, e.g. biomass, waste	Impact (reduction or increase) track and road surface water runoff into wastewater and associated capital and operation carbon water implications. Increased demand for water from production of batteries and low-carbon fuels.	Modal shift between different transport networks. Alleviation of congestion on other parts of network.	Increased demand for battery waste processing and recycling. Capacity to process and recycle waste from low-carbon transport systems, e.g., EVs.	Integration of communications infrastructure when delivering transport infrastructure reducing the need for additional construction.	Support for high- density, low car- use sustainable urban development.

Table A.2 – Typical emissions and removal categories to support decision-making for managing whole life carbon beyond the project/programme boundary at the network or system level *(continued)*

	Consequence for energy	Consequence for water	Consequence for transport	Consequence for waste	Consequence for communications	Consequence for buildings
Activity in waste	Supply of feedstock for EfW plants. Excess energy generated and exported to power and gas grids. Capacity to process operational and end-of-life waste from low-carbon energy assets.	Reduced pollution of water bodies. Impacting need for water treatment.	Freight user carbon generated from traffic to and from waste treatment plants.	Waste reduction from demand-side measures or increased circularity. Changes in waste composition, e.g. to biogenic content, calorific values.	Capacity to process and recycle waste from communications infrastructure.	Integration of waste processing measures into buildings and cities. Recovery or recycling of building materials for reuse.
Activity in communications	Enabling smart, flexible energy systems that are more efficient and have higher levels of low-carbon energy supply. Increased energy demand, e.g. data centres.	Efficiency in processing through digital connectivity and automation.	Reduced need to travel through better digital connectivity. Facilitating shared mobility systems, e.g. e-scooters More efficient asset utilization and operation. Better integrated multi-model transport systems.	Efficiency in processing through digital connectivity, logistics and automation.	—	Enabling smarter, more efficient building (with impacts for energy and water use). Efficiency in construction processes through digital connectivity, logistics and automation.

Annex B (informative)
Applying the carbon management process

Table B.1 summarizes the different carbon management process requirements in each work stage when delivering projects and/or programmes of work.

The purpose of this annex is to summarize at a high level how the PAS 2080 carbon management process can be implemented (by all value chain members) during the different work delivery stages. Table B.1 provides this summary; however, it does not specify which value chain member needs to implement the relevant requirements. Value chain members should refer to the individual clauses in this PAS for the specific value chain responsibilities and requirements.

Further guidance on the roles and responsibilities value chain members have for each work stage, as well as a number of practical examples and case studies, are provided in the *Guidance document for PAS 2080*.

The guidance outlined in Table B.1 is applicable to all value chain members unless stated otherwise.

Table B.1 – Carbon management process applied to a project or programme of work across work stages

<table>
<tr><th></th><th>Need</th><th>Optioneering</th><th>Design</th><th>Delivery</th><th>Operation</th><th>Purpose/performance review</th></tr>
<tr><td>Opportunity to reduce whole life carbon</td><td colspan="6">Highest ◄ ► Lowest</td></tr>
<tr><td>Leadership
(Clause 5)</td><td colspan="2">Asset owners/managers set objectives, targets and outcomes for the project/programme of works aligned with the decarbonization principles (Clause 4).
Map key collaborators/stakeholders for enabling whole life carbon management. Set governance structure and principles.</td><td colspan="4">Make competent resources available. Align carbon management with other business processes (e.g. risk/cost management). Communicate and collaborate consistently with the relevant value chain members and stakeholders. Shape the incentives and culture. Recognize and reward innovation. Support development of skills and capability.
Challenge the status quo and drive continual improvement through the assets, networks and systems. Support other value chain members to perform their role in decarbonization. Share current good practice with other value chain members.</td></tr>
<tr><td rowspan="3">Integration into decision-making
(Clause 6)</td><td colspan="6">Asset owners/managers make alignment with net zero transition central to the scope and requirements of work.
Identify activities and associated emissions/removals within control and influence across all work stages (as per Clause 4), and the necessary collaborations with value chain members and stakeholders that will enable whole life carbon reductions, and the network(s) and system(s) with which the project or programme of works interfaces.
Integrate carbon management into the delivery processes to support system-level low-carbon outcomes. Prioritize implementation of carbon reduction opportunities within control and influence.
Integrate the carbon implications of climate resilience (or lack of) in the carbon management at all levels. Prioritize nature-based solutions for reduced carbon and increased sequestration.
Follow the carbon reduction hierarchy (Clause 4) across all work stages to identify potential opportunities to reduce whole life carbon emissions: Avoid – Switch – Improve.</td></tr>
<tr><td colspan="2">Asset owners/managers consider the life of the solution, addressing the need for the asset to determine the lowest carbon outcome.
Consider options that maximize the use of existing assets, future adaptability and material recovery.</td><td colspan="2">Align standards and guidance with whole life decarbonization requirements.
Demonstrate that proposed solutions are supportive of a net zero transition and whole life performance.
Manage resources following circular economy principles.</td><td colspan="2">Operate and maintain assets/networks in a way which supports the envisaged whole life carbon performance as a minimum, following circular economy principles.</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td rowspan="3">Assessment
(Clause 7)</td><td colspan="2">Establish a comprehensive study boundary to understand emissions impacts and reduction opportunities of the project in the wider system.
Map emissions and removals using the PAS 2080 whole life carbon framework for decision-making (Clause 4).
Select an appropriate assessment methodology using existing standards or other recognized sources.
Select data sets to be used and understand data quality and uncertainties involved.
Work with benchmarks and available carbon factors if detailed information is not available.</td><td colspan="2">Follow an assessment methodology using recognized sources and/or existing standards so that all relevant sources of emissions and removals attributable to the project or programme of works are assessed and uncertainty is acknowledged.
Include impacts to the network and system relevant for decision-making.
Improve degree of accuracy in any assessment undertaken to provide the right insights to help decision-making.
The primary focus of any assessment is to help decisions that promote low-carbon solutions.
Assess whole life carbon emissions during design and construction to monitor progress against any targets set.</td><td>Capture assessment data in suitable format (i.e. by selecting appropriate functional units) and record for the development of future benchmarks and GHG assessments.</td><td>Select an appropriate methodology for assessing end-of-life emissions, particularly to consider and prioritize circular economy principles.</td></tr>
<tr><td colspan="6">Assess GHG emissions and removals associated with land use change, including nature-based solutions and climate resilience solutions.
Report removal activities separately to prioritize GHG reduction efforts.</td></tr>
<tr><td colspan="6">Select an appropriate level of accuracy and detail.
Collaborate with the value chain and share data that supports the GHG assessment process.
Adopt tools and data that increase consistency and accuracy of any assessment.</td></tr>
</table>

Table B.1 – Carbon management process applied to a project or programme of work across work stages *(continued)*

	Need	Optioneering	Design	Delivery	Operation	Purpose/performance review
Opportunity to reduce whole life carbon	**Highest** ◄ ► **Lowest**					
Baselines and targets (Clause **8**)	Set whole life carbon reduction targets that are aligned with targets set in the network or system. Any targets set need to demonstrate, as far as possible, that they are aligned to a net zero transition. Where network or system level targets do not exist, further engagement and challenge needs to take place with different stakeholders to identify ways of closing any gaps, if possible. Work towards consistent targets set for the project and/or programme of works. Develop the project/programme baseline and transparently describe assumptions, limitations and uncertainties. Use existing benchmarks where available. Where not, use first principles to develop a baseline and record uncertainties for improvement over time. Select appropriate functional units to develop the baseline.		Capture and communicate uncertainties in baselines as the project progresses. Challenge carbon targets where there is the potential for improvement. Set appropriate targets for different stages of delivery to drive the right behaviours. A project level whole life carbon target may need to be broken down into capital, operational targets for selective work packages that different value chain members may be leading. Capture design and construction GHG data using appropriate functional units to improve future baselines.		Capture operational data to inform future baselines and targets. Communicate and share improvements in benchmarks/ factors based on project/programme operation, use and end of life.	
Monitoring and reporting (Clause **9**)	Asset owners/managers to define monitoring and reporting requirements and communicate.	Report to government and system-level stakeholders. Repeatedly review performance against targets throughout development. Use captured data to improve performance over the baseline. Share good practice outcomes, including non-carbon impacts and co-benefits.			Report actual emissions and performance against targets.	
	Identify roles and responsibilities and stakeholders to report to. Report carbon progress against the set targets and record identified carbon reduction opportunities throughout all stages of development. Share good practice outcomes and carbon data regularly with the value chain to enable wider decarbonization.					
Procurement (Clause **10**)	Include carbon management process requirements (including objectives, targets and project outcomes) in contracts. Avoid prescriptive specifications and focus on outcomes. Consider types of incentives to include in contracts. Cascade requirements in sub-contracts. Identify and implement delivery models that support low-carbon outcomes and that promote collaboration.	Review performance against the agreed targets as well as cost and programme. Promote risk allocation approaches that support innovation and low-carbon outcomes. Where appropriate, include data management/information exchange requirements in contracts. Incentivize collaborative contractual arrangements that allow and encourage the successful implementation of the carbon management process.				
		Promote, engage and communicate low-carbon solutions through the value chain. Identify areas of innovation when responding to tenders. Allow for challenge to asset standards and identify incentive mechanisms to reward whole life carbon reduction.	Establish procurement processes that reward suppliers at lower tiers of the value chain that deliver low-carbon solutions. Establish procurement mechanisms that promote innovation that follow the carbon reduction hierarchy of avoid, switch, improve, promoting repurposing and reusing existing assets.			

Annex C (informative)
Guidance for government, regulators and financiers

C.1 Their role of control and influence in the value chain

The *Infrastructure carbon review* [1] set out the whole value chain comprising of multiple stakeholders who have varying levels of control and influence of carbon reduction, at different stages of the lifecycle of a project or programme of works. These stakeholders and their potential roles are shown in Figure 2. At the top of the value chain are government, regulators and financiers (sponsors, lenders, insurers), who arguably have the greatest influence across networks and systems of the built environment.

Although asset owners/managers have the primary responsibility for delivering and managing buildings and infrastructure assets and have the ability to integrate the work under a common carbon management process, all value chain members should share responsibility for the management of the associated carbon emissions and can greatly influence projects and/or programmes of work to be compatible with a net zero carbon transition. Asset owners/managers can only realize carbon reductions within a fully integrated value chain involving not only designers, constructors and product/material suppliers, but also regulators and financiers that determine climate-related policy, planning and KPIs.

Although recognized to be at the top of the value chain, government, regulators and financiers were beyond the scope of the *Infrastructure carbon review* [1] and, as such, there are no normative clauses in PAS 2080 for their role in driving carbon reduction. This informative annex sets out guidance for government, regulators and financiers in enabling decarbonization of the built environment by following PAS 2080 principles.

C.2 Government and regulators

Government, through legislation and regulation, can shape the policy agenda within which the built environment operates. Policy establishes the direction of development in line with social and economic drivers; net zero carbon transition is part of national and regional policy, which includes built environment systems across buildings and infrastructure. Currently, many governments, whether national, regional or local, make decisions for the development of projects and/or programmes of work. However, alignment with net zero transition is typically not taken into account.

Ideally, whole life carbon management principles should be applied at the start of the decision-making process, when policy responses are being decided, with decarbonization measures forming a key part of the decision-making process, and with PAS 2080 helping to inform that. This is not yet the case. In the meantime, some local governments are early adopters of a hybrid approach that combines PAS 2080 considerations within national appraisal and evaluation processes, which includes the value of whole life decarbonization in the selection of projects and programmes. Further explanation and worked examples are provided in the *Guidance document for PAS 2080*.

Not all regulators currently have a mandate focused on ensuring the economic sectors they regulate transition to net zero carbon. The guidance in Table C.1 sets out how, in line with the PAS 2080 principles, government and regulators can support the economic sectors they oversee to deliver on net zero.

Table C.1 – Key areas for support from government and regulators

PAS 2080 clauses	Actions aligned with carbon management principles
Leadership	• Be clear on targets and actions required from asset owners/managers for net zero carbon to be achieved and provide support accordingly. • Support the development of collaborative forums focused on facilitating cross-sector problem solving and knowledge sharing. • Encourage training and skills development across their sectors for the delivery of net zero.
Integrating carbon into decision-making	• Set specific requirements for asset owners/managers that promote decarbonization when delivering projects and/or programmes of work. • Require information on the carbon associated with a project or programme of work when considering regulatory submissions or business cases.
Assessment	• Encourage the adoption of robust and validated methodologies for the reporting of carbon emissions in their control and influence. • Develop robust methodologies tailored to the government or regulator, where required. • Incentivize greater data sharing and collaboration within the value chain, allowing improvements in maturity of their sector.
Target setting and baselines	• Be clear on the system-level targets/budgets that can be adopted by the value chain. • Encourage the sharing of information on the baseline position of networks (or information that could be used to develop baselines), including future trends that should be taken into account.
Procurement	• Develop and promote delivery models that share risk and reward for low-carbon solutions.
Monitoring and reporting	• Require asset owners/managers to publish carbon information associated with the whole life of their assets and networks. • Be clear on the decarbonization targets for key sectors to allow timely progress in reaching net zero. • Require asset owners/managers to follow accountability, transparency, inclusion and verifiable reporting principles as part of the management process.
Continual improvement	• Identify key areas of innovation for networks and systems to tackle. • Invite challenge on the approaches to carbon management taken by the sector.

C.3 Financiers

Financiers are a highly diverse community and include those who provide equity and debt to built environment companies and assets, or provide other financial services, such as insurance, that support those activities. In some cases, financiers could also be the asset owner/manager.

Aside from compliance, the finance community can use its influence both in terms of the types of projects and/or programmes of work they choose to support, and for those they already are involved in, provide leadership and guidance on how to respond to net zero. This might require a longer-term view on investment, and recognition of the role assets play in wider decarbonization across built environment systems.

Emerging guidance and standards will promote better decision-making and transparency for the finance community. Some of these include regulatory requirements and provide more consistency on net zero, target setting, reporting, etc. for large organizations, such as global investment funds focused on infrastructure and real estate. The main difference between such standards and PAS 2080 is that the former are focused on net zero at the organizational level for large global investment organizations, whereas PAS 2080 focuses on building capability to deliver low-carbon buildings and infrastructure.

The guidance in Table C.2 sets out how, in line with the clauses of PAS 2080, financiers can act and support the value chain in achieving net zero by following carbon management principles.

Table C.2 – Key areas for support from financiers

PAS 2080 clauses	Actions aligned with carbon management principles
Leadership	• Set the ambition for their (the financier's) investments and projects in achieving net zero carbon. • Influence the assets they are involved with (existing and new) to develop plans to contribute to the net zero transition. • Share lessons and insights on investment profile and asset management/performance to promote investment in low-carbon projects across the industry. • Engage with government and regulators to align decarbonization plans at a network and system level, with appropriate financial and funding mechanisms to execute/deliver them. • Develop finance instruments and packages for accelerating retrofit, refurbishment and alternative solutions.
Integrating carbon into decision-making	• Support government and regulators in the identification of risks and opportunities in relation to low-carbon delivery and operation. • Require information on the carbon associated with a project or programme of work when assessing business cases, project finance and funding/insurance agreements. • Take a whole life carbon view when considering payback for any low-carbon investments. • Take into account physical/transition risks, as well as co-benefits, when making decisions on providing investment/insurance to low-carbon projects and/or programmes of work.
Assessment	• Contribute to methodologies tailored to their sector and/or provide input data where useful. • Align carbon performance across the project life cycle with the set targets.
Target setting and baselines	• Define portfolio targets for investments/insurance and communicate these to the value chain (particularly asset owners/managers) to meet the ambition. • Encourage sharing of information that supports the definition of baselines, including future trends that should be taken into account. • Include performance requirements and targets that encourage decarbonization in funding criteria of projects and/or programmes of work.
Procurement	• Promote delivery models that share risk and reward for low-carbon solutions. • Take into the account the inclusion of carbon metrics and performance requirements in financial and project contracts. • Establish project finance structures (or similar) that support collaboration in the value chain.
Monitoring and reporting	• Require asset owner/managers to report information on carbon for their assets and networks in alignment with carbon management principles and/or other relevant frameworks (e.g. sustainability disclosure requirements). • Be clear on the decarbonization targets for projects so that timely progress in reaching net zero forms part of asset valuations and investment decisions.
Continual improvement	• Identify key areas of innovation for networks and systems to tackle.

C.4 Local and regional government

Local and regional government actors (e.g., local authorities) might have control and influence in any or both of the areas set out in **C.2** and **C.3**, either through policy-making, planning or investment activity. In some cases, local and regional government could be asset owners/managers, too.

Given the diversity of roles of local and regional government actors, it is not possible to provide specific guidance. Rather, local and regional government actors should identify the relevant requirements in this PAS and annex and undertake to follow such requirements/guidance to support decarbonization of the built environment within their control and influence.

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