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Net Zero Public Sector Buildings Standard

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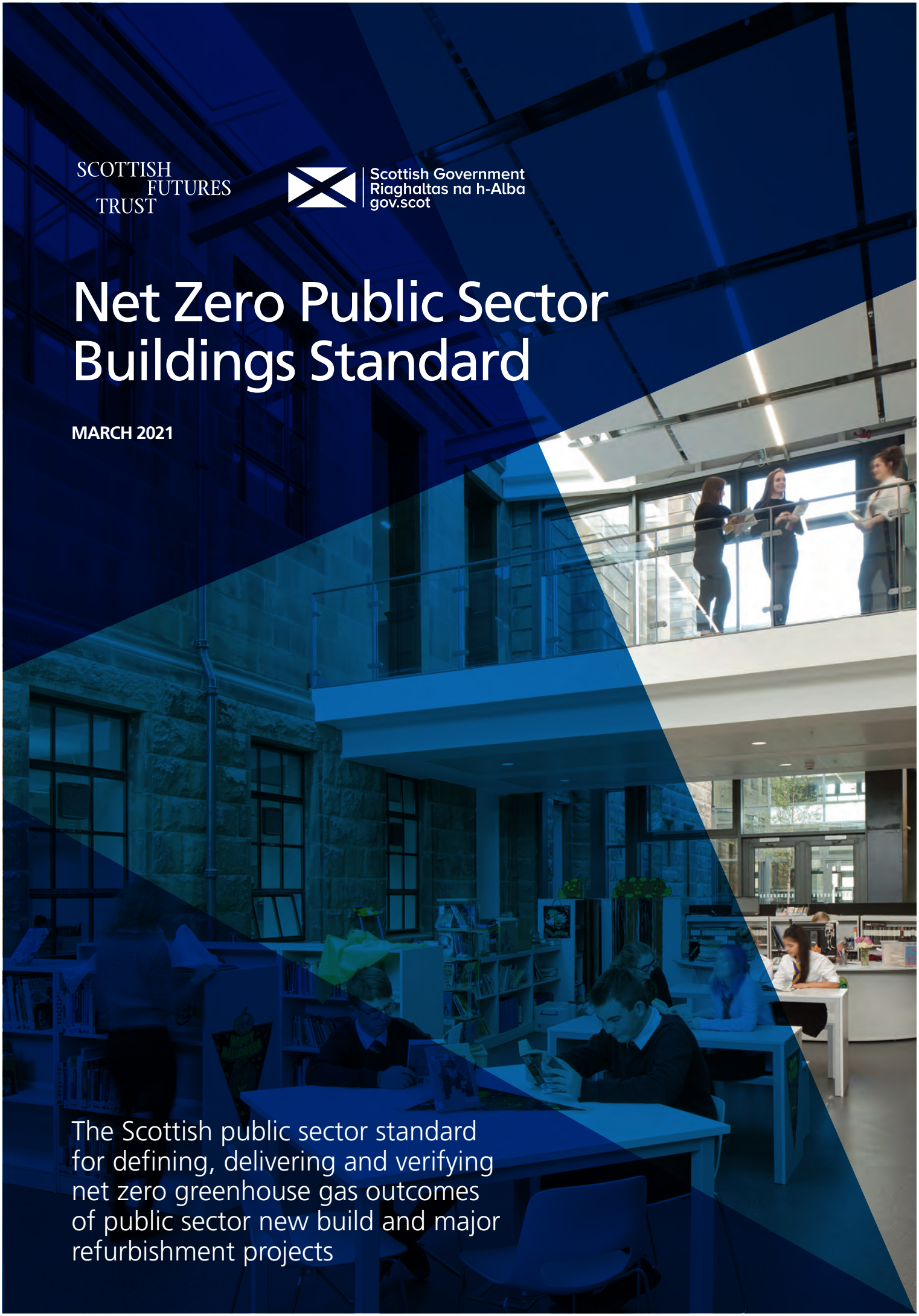

The Scottish public sector standard for defining, delivering and verifying net zero greenhouse gas outcomes of public sector new build and major refurbishment projects

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Foreword

The Net Zero Public Sector Buildings Standard is a voluntary standard, owned by the Scottish Government and applicable to public sector new build and major refurbishment projects.

1. Introduction

The Scottish Government is committed to all buildings achieving net zero emissions by 2045. A step change in attitudes to energy use in the built environment is required to achieve this.

Public bodies have demonstrated significant reductions in emissions from their built estates by working collaboratively to reshape them to better suit the needs of the people and service delivery they support. This includes refurbishing or repurposing existing buildings, co-location with partner organisations and other options that improve the efficiency of existing assets, as well as the construction of new ones.

The Net Zero Public Sector Buildings (NZPSB) standard ("the Standard") is informed by exemplary in-use energy and carbon performance from across the UK and Europe. It supports the development, delivery and operational stages of new build and major refurbishment projects to:

- Take a collaborative, evidence-based approach to identifying priorities that will improve people's lives, communities and the places they live and work in, contributing to inclusive net zero economy outcomes
- Minimise construction embodied carbon through best practice in options appraisal, life cycle assessment and the measurement, targeting & reporting of impacts
- Cut operational energy use compared to current regulatory requirements by:
    - Enhancing the client brief to set world class energy performance as a core objective
    - Rigorously checking and commissioning performance at the design & delivery stages
    - Ongoing commitment to achieving operational energy targets
- Support growth and flexibility of zero emissions energy supplies by:
    - Increasing onsite low and zero emissions generation beyond current practices
    - Establishing zero direct emissions from heating & cooling as the norm
    - Adopting opportunities arising from Local Heat and Energy Efficiency Strategies
    - Optimising self-supply from renewables with energy storage & demand response
    - Fitting electric vehicle smart charging points
- Enable an improved experience for building users through a focus on improving comfort conditions, air quality and availability of natural lighting
- Collect and share data in open, interoperable and transparent formats

The Standard supports a challenging, credible path to net zero materials and energy supplies for all non-domestic buildings. By 2045, projects that adopt the Standard will achieve zero embodied emissions during construction and subsequently the whole life of projects, including operational energy. There are many ambitious public bodies that intend to achieve these outcomes sooner and the Standard provides guidance for them to do so and encourages others to follow their lead.

2. Scope

The Standard guides organisations participating in publicly funded new build and major refurbishment projects to develop and improve buildings to achieve a step change improvement in Net Zero (NZ) Operational Energy (OE), and to take action on embodied carbon; Whole Life (WL) emissions and both indoor and other environmental aspects:

1. Inclusive NZ Economy Outcomes
2. NZ-Construction: Project Specific
3. NZ-Operational Energy (NZ-OE):
    - Operational Energy Target (OET)
    - Zero Direct Greenhouse Gas Emissions from Heating, Cooling and Hot Water (ZEH)
    - Carbon Strategy
4. NZ-Whole Life (NZ-WL): Project specific
5. Indoor Environmental Quality (IEQ):
    - Indoor Air Quality
    - Avoidance of Overheating
    - Natural Lighting
    - Other Project Specific Targets
6. Other Environmental Aspects: Project Specific

The voluntary Standard is owned by the Scottish Government, which leads on the setting of its high-level objectives and targets in consultation with sector partners and stakeholders. This includes assessment of infrastructure investment decisions on the basis of their contribution to Inclusive Net Zero Economy Outcomes, further details of which are set out in the Glossary.

A central principle of the Standard is Verified and Transparent Performance Reporting. It is critical that buildings' performance against targets is well reported upon and assessed and that the evidence and findings are made publicly available. This high quality of reporting and evidence gathering is intended to enable the Scottish Government periodically to update the definition of 'exemplar practice' in core objectives as performance improves. It allows the Scottish Government to agree objectives and targets that differentiate between building categories and sectors, encouraging those that can progress fastest to do so, and ensuring that Scotland's climate change mitigation priorities and strategic aims are met by all projects that adopt the Standard.

3. The Standard

3.1. Overview

The Standard's core objectives and governance arrangements will be integrated into existing arrangements for public sector new build and major refurbishment projects in Scotland. The Standard elevates energy, emissions and environmental objectives to core project objectives, as tangible as budget and programme. Checks are made at key stages and non-compliance rectified to ensure projects are able to proceed to subsequent stages without compromising the project's ability to meet all its core objectives.

In addition to robust governance arrangements covering project leadership, budgets and programme, applying the Standard involves the Participant designating an Inclusive Net Zero Champion. The INZ Champion should be appointed to communicate the requirements of the Standard to the Project Design & Facilities Teams and to support the analysis and reporting they will need to carry out to ensure reports are submitted to the Scottish Government at each stage in the process, to demonstrate that core objectives have been met. The competency and independence requirements for the INZ Champion are set by the Scottish Government.

The Standard comprises six stages. The stages take the Participant through the full lifecycle of a project from briefing, development and delivery to the operational stage when the core performance objectives are verified in use:

1. Application Stage
2. Concept Design Stage
3. Detailed Design Stage
4. Delivery Stage
5. Performance Verification Stage
6. Continuous Improvement Stage

The table below shows how the six stages of the Standard align with a selection of current Scottish Government Frameworks.

Frameworks for Project Governance, Briefing, Management and Verification

Scottish Capital Investment Manual (SCIM)	**Assurance Review Framework Gateways**	**RIBA Plan of Works**	**Government Soft Landings (Adjusted for Energy Focus)**	**Net Zero Public Sector Buildings Standard**
Service Change Planning				
Strategic Assessment	0 Strategic review of a programme	0 Strategic Definition	Draft Energy Management Plan	Application
Initial Agreement	1 Business Justification before IA Approval	1 Preparation & Briefing		
Outline Business Case	2 Delivery Strategy & readiness to proceed to procurement	2 Concept Design		Concept Design
Full Business Case	3 Investment decision review before contracts are placed	3 Spatial Coordination	Energy Management Plan	Detailed Design
		4 Technical Design	Draft handover and aftercare strategy plan	
Construction & Commissioning	4 Readiness of service to use the facility	5 Manufacturing and Construction	Final handover and aftercare strategy plan	Delivery
Project Monitoring & Evaluation		6 Handover		
	5 Operations review & benefits realisation	7 Use	Qualitative health check and seasonal commissioning	Verify Performance
				Continuous Improvement

NHS Design Assessment Process (NDAP)

3.2. Application Stage

Participants intending to apply the Standard to their project should contact the Scottish Government to determine the current targets applicable to its building categories and sector.

The ambitious OET applicable to the Standard is typically only achievable if it has been considered from its earliest stages, e.g. RIBA Stage 0.

A key output of the Application Stage is an Application Stage report that the Participant should produce, setting out the project's core objectives. It should state the assessments that have been carried out, evidencing the investment's contribution to Inclusive Net Zero Economy Outcomes and, where the project includes new build components, justifying this rather than repurposing existing assets. The approach to renewable energy sources should clearly differentiate between the technologies that will be installed by handover and plans for the remaining period to the target date to achieve Net Zero – Operational Energy.

3.3. Concept Design and Detailed Design Stages

Energy Modelling (or other approved approaches) should be used throughout the design process to assess the impact of design decisions upon the achievement of relevant targets, applying iterative adjustment and remodelling to optimise them and verify success. This is applicable to physical parameters with quantitative target values, e.g. OET, IEQ, peak power loads, renewable energy generation and storage and other environmental parameters.

Concept and Detailed Design Stage Reports are key outputs that should be produced by the Participant, demonstrating that the design is on track to meet the targets. The reports should include outline and detailed Measurement & Verification Plans respectively. The Detailed Design Stage Measurement & Verification Plan should specify the meters, sub-meters and other equipment needed for Transparent and Verified Performance Reporting.

3.4. Delivery Stage

Participants should demonstrate a robust approach to checking construction quality. Commissioning of equipment and controls that impact upon the achievement of core objectives should be thorough. This should include seasonal commissioning and adjustment where applicable and be accompanied by operational verification. All metering, sensors, loggers, equipment, controls and software that the design depends upon to meet the core objectives and for them to be verified should be demonstrated to have been installed, programmed and producing the required outputs in appropriate format. Bespoke and effective training and documentation should be delivered to the relevant operation teams and Participants' staff.

The Delivery Stage Report should demonstrate systems' capability of operating in accordance with the Energy Modelling to achieve the core objectives and targets. The Report should include a NZPSB Reporting Plan, setting out how the targets' requirements will be reported upon during the Verify Performance and Continuous Improvement stages. This should include finalising the Measurement & Verification Plan for third party verification of performance versus targets.

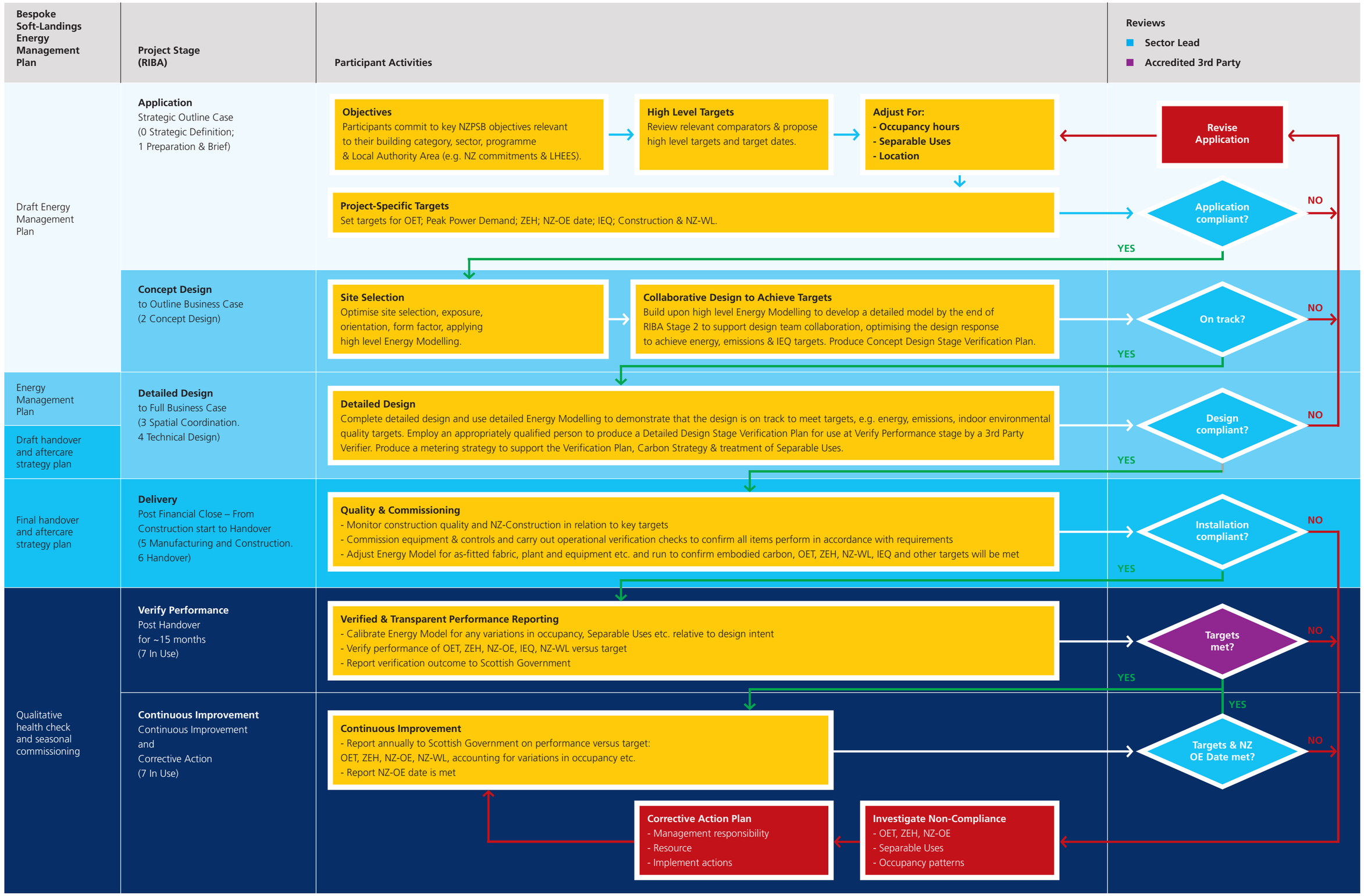
3.5. Verify Performance Stage

The Verify Performance stage is a key differentiating factor compared to current practice. It should commence on Handover and performance be monitored for at least twelve months of representative operational use to enable compliance with the OET and other quantitative targets to be verified by an independent third party. Occupancy patterns, weather data, contextual information and other drivers of energy use should be collated to determine whether the building is used as anticipated by the Energy Model. Instances of non-compliance should be rectified, taking account of changes in usage patterns. The Verify Performance Stage Report should set out the findings of the assessment and any corrective actions required.

3.6. Continuous Improvement Stage

The Participant should submit annual Continuous Improvement Stage Reports to the Scottish Government to demonstrate continued conformance with requirements. Where the operational energy use is more than 20% greater than the OET, this should be identified as a non-compliance and investigations carried out to improve performance. Non-compliances identified by the Continuous Improvement reporting process should be rectified in time to allow compliance to be evidenced in the subsequent report and should be subject to periodic third party verification at a frequency agreed with the Scottish Government.

3.7. Process Diagram



4. Objectives

On initiating the project, the Participant should set out the approach to objective and target setting, for all environmental aspects, including those specific to Inclusive Net Zero Economy Outcomes. This should include the project's governance structure and resources. An essential resource for projects following the Standard is an Inclusive Net Zero Champion to coordinate compliance with the Standard, including articulation of objectives, targets and the delivery of monitoring and reporting activities throughout the development, delivery and operational life of the building.

The Standard is intended to be sufficiently flexible to be applied under a wide range of procurement routes, delivery mechanisms, finance options and accounting treatments. As a general guide, the responsibility to meet targets is owned by the lead Participant for which the building is designed and operated.

4.1. Net Zero – Inclusive Net Zero Economy Outcomes

The development of a NZPSB new build or major refurbishment should be preceded by a consultative engagement activity to determine core objectives shared with partners and local communities that will contribute towards improving the lives of people, supporting inclusive and sustainable economic growth and creating more successful places. This process should include an assessment of the impact of a building's location on the people's need to travel and the suitability of its facilities to support active travel and wellbeing.

Consideration should be given to these Inclusive Net Zero (INZ) Economy Outcomes when setting the Standard's targets that will influence their achievement. For example, extensive community use of a new or refurbished building could require adjustment of its OET and indoor environmental quality aspects.

Where appropriate, objectives that fall outside of the scope of the other carbon, energy and environmental objectives could be met by establishing bespoke targets to be quantified and monitored under the Standard to verify the project's contribution to INZ Economy Outcomes.

4.2. Net Zero – Construction

Projects should apply best practice in options appraisal and life cycle assessment to determine whether the project's core outcomes would be optimally delivered by major refurbishment of an existing building, or by new build. The construction embodied carbon of a major refurbishment project is typically significantly lower than that of a new build. This assessment should be consistent with and take account of assessment of Inclusive Net Zero Economy Outcomes.

New build and major refurbishment projects should have no greater construction embodied carbon than required by the Scottish Government for their building category (applying the Cradle-to-Construction definition). To simplify compliance, this requirement can be met by the following approaches and associated Scottish Government guidance and requirements for the majority of sectors:

- applying waste minimisation best practice and circular economy principles at the design and delivery stages

- quantifying the project's Cradle-to-Construction embodied carbon and demonstrating that it is less than the target identified by the Scottish Government
- specifying that additional materials required to achieve the Standard's low energy objectives are of low embodied carbon (e.g. thermal insulation)

4.3. Net Zero – Operational Energy

To meet this core objective, projects should achieve exemplar practice in all energy use, including thermal performance relevant to their building category and project type (new build or major refurbishment). The Scottish Government, in collaboration with stakeholders, publishes Net Zero – Operational Energy objectives for commonly occurring building categories that adopt the Standard.

Greenhouse gas emissions from energy use can be minimised by reducing demand; meeting needs efficiently; excluding energy sources that cause direct greenhouse gas emissions within the building curtilage from heating and hot water provision; optimising onsite renewable sources and establishing a credible offset regime for residual emissions. The Standard addresses reducing demand and meeting needs efficiently with an ambitious OET and reporting regime. Renewables and offsetting are addressed by ZEH and the Participant's Carbon Strategy.

4.3.1. Operational Energy Target

The Application Stage should include a draft OET, expressed in kWh/m^2 of gross internal floor area per year that covers all energy use of the building (typically supplied through its fiscal meters), including loads currently unregulated by Building Standards. The target should be ambitious and specific to the building categories that comprise the project, taking account of the conditions of the Exemplar, or other comparator building(s) it is based upon. This should include normalisation for typical drivers of energy use, such as Heating Degree Days, exposure, altitude and occupancy patterns. For example, the Scottish Government set 67 kWh/m^2/year as the target for the core areas and core hours of new build schools under the first wave of the Learning Estate Investment Programme (LEIP) in 2019.

The OET should be based on an initial benchmarking exercise, using verified performance data from published indicative OETs; examples of existing NZPSB or exemplar case studies of similar building categories, as appropriate, provided by the Scottish Government. However, early adopters of the Standard are likely to have the burden and flexibility of identifying their own comparator buildings, subject to appropriate quality and verification checks. In the case of major refurbishment projects, consideration could also be given to deriving the OET from an improvement in the existing building's baseline energy use, subject to there being no significant changes in patterns of occupancy and other aspects of operational use.

For electrically heated buildings, the OET should be based on all-electric building comparators, taking account of the lower operational energy consumption of a heat pump compared to a fossil fuel fired heat source.

Consideration should be given to any proposed use of the building that will either increase or decrease energy demand compared to its comparator. This could include additional activities, occupancy hours and building services, such as increased ventilation provision or use. Consideration should also be given to the impacts upon energy utilisation intensity of agile and remote working and colocation of multiple organisations, as these may not be well represented in comparator buildings.

Where no relevant published OET or exemplary case study is available for the building category, an initial draft OET should be set that demonstrates a step change improvement over a relevant 'Typical' building energy benchmark (or baseline energy use for major refurbishment projects).

In summary, in order of priority, the initial draft OET should aspire to:

1. Published indicative OET
2. Exemplary case study equivalence, where available and achievable
3. Step change improvement against 'Typical' building energy benchmark
4. Step change improvement against the overall Energy Use Intensity of the original building, adjusted for changes in occupancy patterns and energy-intensity of activities (for major refurbishment)

This activity should include the context for each comparator building to explain their performance and contrast them with the proposed building. The 'Typical' benchmark may require a composite of benchmarks from building categories represented in the project or be derived from portfolio or estate data available to the project team.

A description of the context of the comparator building will be of particular importance for projects that will be open for considerably longer hours than their relevant comparator and may need a higher OET. This need should be assessed by the Participant carrying out detailed Energy Modelling work and including the outputs in the Design Stage report. The Energy Modelling should demonstrate that if the building operated for the standard number of hours for the relevant comparator, it would meet the initial draft OET and should provide details on how this target should be adjusted for the expected operating hours and activities.

Unusually high process and equipment energy loads and their associated heating, ventilation and air conditioning (HVAC) systems should be quantified and their impacts forecast by the Energy Model. Examples of such loads include extensive medical or laboratory equipment; central laundries and sterilisation services; production kitchens; major flood lighting beyond the perimeter of the building (e.g. for multiple sports fields and car parking spaces); regional data centres and electric vehicle charging. For buildings in which these needs are significantly greater than the comparator building, they may be treated as Separable Uses. Where they can be separately metered, their consumption should be assessed separately from the rest of the building's use, and flexibility built into the OET to accommodate them.

In addition to an ambitious OET, all elements of all buildings should achieve excellence in energy performance. Particular care should be taken in relation to buildings to be heated by heat pumps and other low temperature or high cost heat sources, to ensure that the thermal envelope and air tightness are of appropriately high standard to design-out both underheating and high operating costs.

The building's peak power demand should also conform to an excellent standard of performance and a target should be set for peak demand that supports the achievement of the Carbon Strategy, including management through energy storage and load shifting.

Verification Plans should be produced during the Concept and Detailed Design Stages. The Detailed Design Stage Verification Plan should set out a robust metering strategy to support calibration of the Energy Model during the Verify Performance Stage, enabling account to be taken of actual operating hours and Separable Uses, demonstrating compliance or non-compliance with the adjusted OET. Preference will be given to approaches that combine whole facility with individual systems.

4.3.2. Zero Direct Greenhouse Gas Emission Heating

All NZPSBs should achieve zero direct greenhouse gas emissions from heating (ZEH), cooling and hot water in advance of 2024 for new builds and the majority of major refurbishment projects.

Exceptions to the ZEH target date will be subject to the Participant making the case to the Scottish Government that their temporary use of fossil fuels would enable a greater emission reduction to be achieved in the locality of the building through future actions by an agreed timescale, such as connection to a planned net zero emissions heat network by its NZ-OE target date.

4.3.3. Carbon Strategy

The Application should include a Carbon Strategy that states the date by which the building will achieve Net Zero – Operational Energy. The Carbon Strategy should set out how the building's energy needs will be met by an appropriate mix of onsite and remote low and zero carbon (LZC) technologies and other energy sources on handover and throughout operation. The strategy should comply with the Participant's, Scottish Government's and Local Authority's Net Zero commitments.

The Carbon Strategy should outline how demand, generation and storage will be balanced to minimise emissions, peak power demand, the need for grid reinforcement and curtailment of onsite renewables. This should include consideration of integrating electric vehicle smart charging points. The approach should seek synergies with Local Heat and Energy Efficiency Strategies and other local delivery plans that may be developed in the vicinity of the project; optimise whole life costs and achieve an optimum route to Net Zero – Operational Energy by the target date.

The Carbon Strategy should differentiate between approaches that are to be incorporated at handover and the scope of emission reductions that will be achieved in the future, *Continuous Improvement* stages and how they will be resourced, reported upon and verified.

4.4. Net Zero – Whole Life

Participants should apply current best practice in NZ-WL relevant to their project identified by the Scottish Government. Participants are additionally encouraged to establish objectives to be achieved and reported upon in the design, delivery and in-use stages, such as water efficiency and other recurrent, non-energy emissions impacts. Circular economy principles should be applied to avoid waste and optimise materials use.

4.5. Indoor Environmental Quality

Participants should apply current best practice in IEQ relevant to their project as identified by the Scottish Government, prioritising parameters such as indoor air quality, avoidance of overheating, availability of natural light and volatile organic compounds.

The impact of material selection upon indoor air quality should be considered here, including but not limited to floor coverings, wall finishes, adhesives and insulants.

Consideration should be given to extending the design stage dynamic simulation modelling, in-use stage monitoring and verification to include other indoor environmental priorities, such as thermal comfort, acoustic comfort and water hygiene.

4.6. Other Environmental Aspects

Consideration should be given to applying the Standard's target setting, monitoring and verification regime to other environmental aspects of project-specific priority to Participants, the Local Authority area and the Scottish Government, for example green infrastructure, biodiversity, landscaping, flood risk management, climate change adaptation and resilience, health and wellbeing and active travel.

5. Glossary

Carbon

The term 'carbon' is used throughout the Standard to denote the carbon dioxide equivalent of all greenhouse gas emissions. For example, in referring to the carbon emissions of a gas-fired boiler, this would be deemed to include the carbon dioxide and nitrous oxide products of combustion and methane of any unburnt fuel.

Carbon Offsetting

This definition will be reviewed and updated to align with the Scottish Government's definition and policy commitment.

For the purposes of the Standard, Carbon Offsetting should only be used as a last resort, and should not be used for Scope 1 emissions.

Carbon Offsetting is only acceptable until 2045, or earlier, subject to the Scottish Government's definition and policy instruction. At such time, all energy sources supplied to the building should be zero emissions.

Where Carbon Offsetting is used, it should always demonstrate additionality and is subject to Scottish Government approval. The following could be considered:

- onsite zero emission energy generation technologies in excess of minimum regulatory requirements
- offsite zero emission energy supplies that comply with the Local Heat and Energy Efficiency Strategies (LHEES) relevant to the project
- strategic approach that optimises zero emission energy generation across the Participant's estate and / or the locality of the building
- nearby zero emission energy supplies procured through a power purchase agreement (or similar arrangement that demonstrates the additionality of the solution)
- distant zero emission energy generation supplied via a power purchase agreement
- third party verified supply contracts for zero emission energy generation with clear evidence of additionality
- carbon sequestration (e.g. afforestation and reforestation) solutions should only be considered when all other options have been exhausted and in all cases should include third party verification and should comply with the Scottish Government's policies and priorities for greenhouse gas emission reporting and offsetting
- All Carbon Offsetting options should achieve net zero carbon emissions well in advance of 2045 and preference should be given to solutions that achieve in-year offsetting of residual emissions as they occur

The annual amount of carbon offsets should be included in annual energy and carbon reports for the project.

Carbon Strategy

For the purposes of the Standard, a Carbon Strategy is the strategy that a Participant produces for an existing or planned new building to ensure it progresses from its current condition of emitting carbon to achieving net zero energy supplies by the NZ deadline applicable to the project, sector and Local Authority Area.

A Carbon Strategy will apply appropriate emission factors to energy used in the project, forecasting updates to them as they change overtime. For example, a Carbon Strategy will take account of plans to connect to low carbon heat and power sources that become available through LHEES and other local delivery plans relevant to a specific project. It should also take account of national and UK wide plans for decarbonisation of electricity and gas grids that could affect the project in the future.

It will take account of the building's position within the context of the Participant's estate and the locality of the building and will include the temporary application of Carbon Offsetting, where appropriate.

Carbon Strategies can include approaches that achieve a balance between onsite renewables, grid connections and other LZC technologies. As the range of technically and commercially viable approaches extends in the future, this may include demand response; continuous selection of onsite generation in response to variations in grid emission factors and price signals; deployment of battery storage; electric vehicle charging, combined with vehicle-to-grid supplies; smart technologies; the internet of things; and other innovative approaches and technologies intended to minimise constraints on onsite generators and reduce grid reinforcement requirements.

Carbon Strategies should be regularly reviewed to ensure that they are up to date, minimise reliance upon temporary Carbon Offsetting solutions and provide value for money in the transition to net zero energy supplies.

Electrical Energy

Electrical energy is the electricity used, for example, for power and lighting in buildings, including both grid-supplied and self-generated supplies.

Embodied Carbon

Goods and services require energy to produce them. This includes the energy expended in sourcing raw materials; transporting them; transforming them into finished items; delivering them to construction sites and their final adaption and installation.

Energy Modelling

Energy Modelling is a specialist software activity that forecasts the Operational Energy use of a building based upon its design and an understanding of how the building is intended to be used. It applies dynamic simulation and detailed HVAC analysis to determine the impact of both internal and external influences upon the indoor environment and the energy consumed by systems to meet control setpoints.

Exemplar Building

An exemplar building, in the context of the process of setting an Operational Energy Target for a new build project, is one that is of a similar building category to the proposed building and has proven 'best in class' energy utilisation intensity and good indoor environmental quality. Few Scottish public bodies have an exemplar building in their portfolio. Consequently, whilst identifying the top 10th percentile of building energy performance in a sector can provide useful contextual information, it is unlikely to be sufficiently ambitious to meet the requirements of the Standard. For example, in the case of schools in Scotland, for all but one Council, the top 10th percentile of schools had approximately 40-50% greater energy utilisation intensity in 2018-19 than the Exemplar schools outside of Scotland that informed the Learning Estate Investment Programme's schools' target of 67 kWh/m^2/year. The search for exemplar buildings to use as comparators for operational energy target setting should only include countries of similar climate conditions and can typically be limited to Scotland, the rest of the UK, the EU and the rest of Europe (in order of priority).

Inclusive Net Zero Champion

An Inclusive Net Zero Champion (INZ Champion) is a Participant appointee who coordinates adherence to the Standard and its reporting requirements. They act as a single point of contact on NZPSB aspects of the project for external liaison, e.g. with Third-Party Verifiers. The competences an individual requires to fulfil the INZ Champion role are set out by the Scottish Government.

Inclusive Net Zero Economy Outcomes

In its *Key Findings Report* (January 2020), the *Infrastructure Commission for Scotland* establishes Inclusive Net Zero Economy Outcomes as priorities against which infrastructure investment options should be assessed. It advises:

> "To achieve an inclusive net zero carbon economy, the Scottish Government should put "place" at the heart of coherent, infrastructure prioritisation and planning" and that it is essential that existing "assets are, most effectively and efficiently utilised, maintained and enhanced to net zero carbon readiness".

A sample of recommendations from the Key Findings Report relevant to this voluntary standard for public sector buildings, drawn from categories *Place and Making the most of existing assets*, includes:

- a place based approach to ensure delivery of an integrated and coherent outcome based approach to planning spatial land use undertaken at regional, local and community level
- presumption in favour of enhancing, re-purposing, or maintaining existing infrastructure over developing options for new infrastructure
- new build should only be considered where Participants have demonstrated this is the most appropriate response
- presumption against like-for-like replacement of existing assets with new single organisation assets in favour of shared facilities
- support the creation of a vibrant circular economy

Local Heat and Energy Efficiency Strategies (LHEES)

An approach to local energy planning being delivered through locally tailored strategies, setting out the long-term plan for decarbonising heat in buildings and improving their energy efficiency. For each local authority area the strategies set out how each segment of the building stock needs to change to achieve zero direct greenhouse gas emissions in the building sector and remove poor energy efficiency as a driver of fuel poverty. The strategies identify heat decarbonisation zones, setting out the primary measures for reducing emissions within each zone, and prioritising areas for delivery against national and local priorities.

Low and Zero Carbon (LZC) technologies

Low and zero carbon technologies generate heat, power and cooling with lower emissions than conventional, fossil fuel-based generation technologies. Technologies that input energy entirely from renewable sources, such as kinetic energy from the wind, or heat from the sun are defined as zero carbon. Where a combination of fossil fuel and renewable energy sources are input into a generating technology system, it is defined as low carbon. These definitions exclude embodied carbon. Two examples of zero carbon electricity generating technologies are wind turbines and photovoltaic (PV) panels. Heat pumps supplied with electricity from the grid to generate heat are low carbon heat generating technologies.

Major Refurbishment

The Standard applies to major refurbishment, i.e. which goes beyond cosmetic renovations (such as painting and decorating). It is intended to apply to lifecycle replacement of significant elements of a building or its services and to remodelling work and alterations intended to modernise or improve a building. It is unlikely that a minor refurbishment would transform an existing building sufficiently to meet the Standard's exemplary performance targets.

Measurement and Verification (M&V)

Measurement and Verification (M&V) is the process of quantifying avoided energy use, delivered by an Energy Conservation Measure (ECM).

It demonstrates how much energy the ECM has avoided using. The process enables the energy savings delivered by the ECM to be isolated and fairly evaluated.

Various protocols for good practice in Measurement and Verification exist, including the International Performance Measurement and Verification Protocol (IPMVP), which defines common terminology and the key steps in implementing a robust M&V process. A key part of the M&V process is the development of an 'M&V Plan', which defines how the savings analysis will be conducted before the ECM is implemented. This provides a degree of objectivity that is absent if the savings are simply evaluated after implementation.

Net Zero

Net Zero is the achievement of a balance of zero greenhouse gas emissions by taking actions to remove the same quantity of greenhouse gases from the atmosphere as all of the activities under consideration generate. For example, a house that meets all its energy needs when the sun is shining, exporting surplus generation to the grid, would be able to claim that it had Net Zero operational energy carbon impacts if the exported electricity was greater or equal to its consumption of grid electricity when the sun is not shining. Alternative routes to NZ in this scenario would include Carbon Offsetting.

Net Zero Building

In April 2019, UKGBC published *Net Zero Carbon Buildings: A Framework Definition*, which provides the property and construction sector with clarity on the outcomes required for a Net Zero building. It outlines three boundaries to consider when looking to manage carbon impacts of buildings:

- Net Zero – Construction
- Net Zero Operational – Operational Energy
- Net Zero – Whole Life

Definitions of the three boundaries as adapted for the Standard are set out below:

- Net Zero – Construction (NZ-Construction)

  UKGBC Framework Definition of NZC – Construction (April 2019): When the amount of carbon emissions associated with a building's product and construction stages up to practical completion is zero or negative, through the use of offsets or the net export of on-site renewable energy

  A building's product and construction stages are covered by the embodied carbon emissions within the Cradle to Construction boundaries, defined as the carbon emissions associated with the primary sources of materials, manufacture of products, transport of materials and products, and construction activities in the design and installation of materials and products into the new build or major refurbishment project. This definition includes the construction site energy and waste. In the standard EN 15978 these boundaries are known as Modules A1-5

- Net Zero – Operational Energy (NZ-OE)

  UKGBC Framework Definition of NZC – Operational Energy (April 2019): When the amount of carbon emissions associated with the building's operational energy on an annual basis is zero or negative. A net zero carbon building is highly energy efficient and powered from on-site and/or off-site renewable energy sources, with any remaining carbon balance offset

  The Standard extends this definition of NZ-OE to prioritise Zero Direct Greenhouse Gas Emissions from Heating (ZEH) within the NZ-OE requirement. (See ZEH definition in this Glossary of Terms.)

- Net Zero – Whole Life (NZ-WL)

  The UKGBC Framework Definition of NZ Building (April 2019) identified, but did not define NZ - Whole Life. It noted that further work would be needed to define the scope and requirements.

  Under the Standard NZ-WL emissions includes the embodied carbon of non-energy operational impacts, such as water supplies; waste disposal and maintenance activities and products for the life of the building.

Operational Energy

Operational energy is the total energy supplied to the building by grid supplies, onsite generators, private wire, district heating and other sources for all onsite energy uses, including both regulated and unregulated loads and Separable Uses.

Participants

The organisations involved in the development, delivery and use of new build and major refurbishment projects are defined in the Standard as Participants.

Scope 1 Emissions

The World Resources Institute's Greenhouse Gas (GHG) Protocol sets out the scopes of authoritative emission reporting. Scope 1 is identified as the highest priority for accurate reporting, as it includes the full basket of GHGs that are the direct responsibility of an organisation. These are: -

- Water vapour (H_2O)
- Carbon Dioxide (CO_2)
- Methane (CH_4)
- Nitrous Oxide (N_2O)
- Ozone (O_3)
- Chlorofluorocarbons (CFCs)
- Hydrofluorocarbons (HCFCs and HFCs)

In the context of reporting Scope 1 emissions from buildings, the most commonly occurring would be carbon dioxide arising from the combustion of fossil fuels such as natural gas for space heating and hot water.

Scope 2 Emissions

Scope 2 covers indirect emissions arising from energy networks, such as electricity or steam.

Scope 3 Emissions

Scope 3 covers all other sources of emissions. Common Scope 3 emission sources for public bodies to report include water, waste, recycling, staff business travel and staff commuting.

Separable Uses

Separable Uses of energy are significant process or equipment loads beyond that which would be expected to occur in the comparator building.

Thermal Energy

Heating, hot water and cooling are thermal energy needs in buildings.

Verified and Transparent Performance Reporting

The performance of projects developed in adherence to the Standard should be reported in a planned and transparent form, suitable for verification by a third party verifier. The *Detailed Design Stage Verification Plan* produced once the design of a project is complete sets out how operational performance is to be measured, verified and the verification outcome reported upon.

Zero Direct Greenhouse Gas Emissions from Heating, Cooling and Hot Water

Zero Direct Greenhouse Gas Emissions from Heating, Cooling and Hot Water (ZEH) is the provision of space and hot water heating (and cooling) to a building, without giving rise to direct greenhouse gas emissions from the building's heating system.

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