PAS 2038:2021

Retrofitting non-domestic buildings for improved energy efficiency – Specification

Department for Business, Energy & Industrial Strategy

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Foreword

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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, guidance 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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0 Introduction

0.1 Context

National targets for the reduction of greenhouse gas emissions in response to the threat of climate change require significant improvements to the energy efficiency of the UK's building stock, including nearly all of its two million non-domestic buildings. The statutory objective set by the Climate Change Act 2008 [1] (as amended 2019) is that the UK achieves "net zero emissions" status, and this requires the reduction of not just carbon dioxide emissions, but all greenhouse gas emissions associated with energy use in buildings to the lowest possible level, in the context of a balance between energy supply and demand that results in net zero greenhouse gas emissions.

***NOTE** For clarification of the term "net zero emissions" in the context of buildings, see Net zero carbon buildings: A framework definition [2]. The framework definition covers both emissions associated with construction and emissions associated with operational energy use.*

This PAS supports work towards that objective by promoting and defining technically robust and responsible "whole-building" retrofit processes that support:

a) improved functionality, usability and durability of buildings;
b) improved comfort, well-being, health and safety (including fire safety) and productivity of building occupants and visitors;
c) enabling buildings to use low or zero carbon energy supplies;
d) improved energy efficiency, leading to reduced fuel use, fuel costs and pollution (especially greenhouse gas emissions associated with energy use);
e) reduced environmental impacts of buildings;
f) protection and enhancement of the architectural and cultural heritage as represented by the building stock;
g) avoidance of unintended consequences related to any of the above; and
h) minimization of the "performance gap" that occurs when reductions in fuel use, fuel cost and carbon dioxide emissions are not as large as intended or predicted.

The requirements and guidance presented in this PAS are intended to apply to improvement measures in the context of a holistic approach to retrofit that takes the objectives listed above into account. The holistic approach considers the building as a system of elements (building fabric and building services), interfaces and occupants that interact, and not as a set of elements that are independent of each other or of occupants' working practices and behaviour.

0.2 Non-domestic buildings

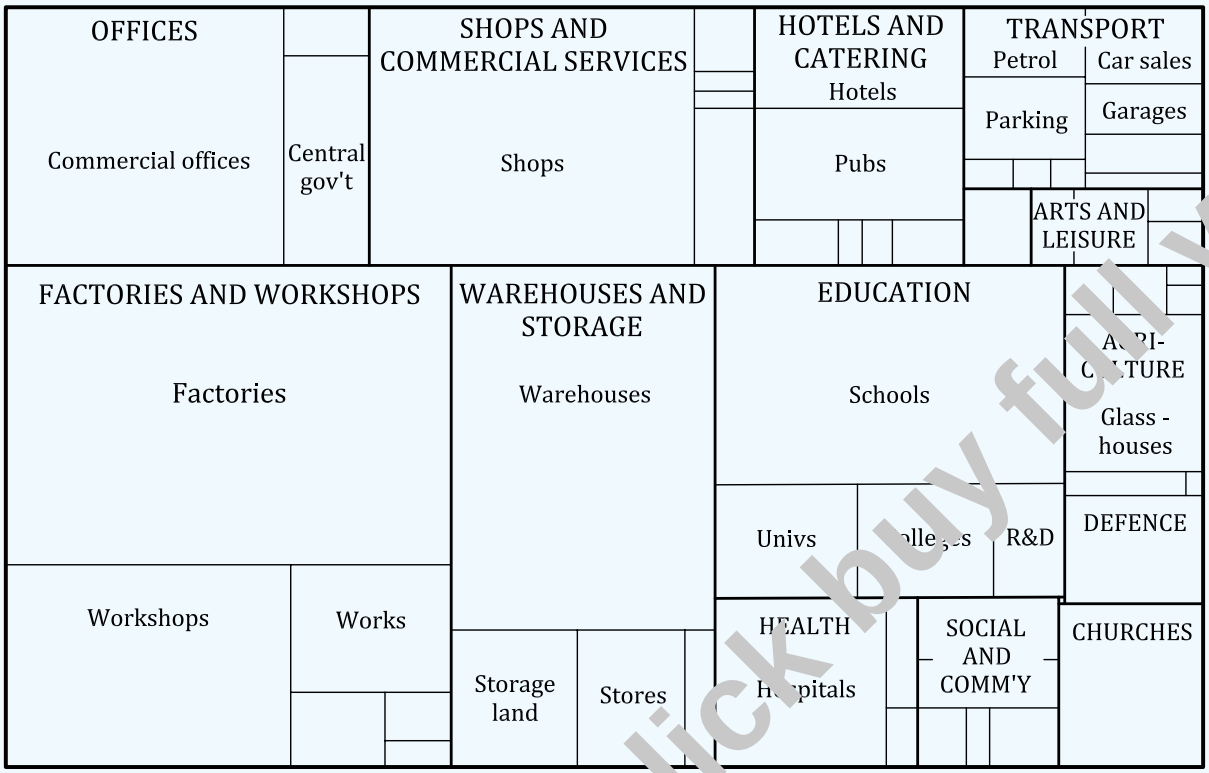
Non-domestic buildings accommodate a huge variety of activities, and range in size from simple corner shops to large multi-storey mixed-use buildings, shopping centres, hospitals and universities. Some buildings are owner-occupied, while others are let to single tenants or accommodate multiple tenants. Some buildings are managed and maintained by their occupants (who may have little knowledge of buildings, or how to improve them), but many are managed and maintained by building professionals, e.g. surveyors, commercial agents or facilities managers.

Figure 1 illustrates the breakdown of the non-domestic building stock in England and Wales by activities accommodated and by floor area. The four "bulk classes" of non-domestic buildings, which together constitute more than half the total floor area, are:

a) offices;
b) shops and commercial services;
c) factories and workshops; and
d) warehouses and storage.

The remainder of the stock is composed of buildings that have many other uses.

Figure 1 – Breakdown of the non-domestic building stock in England and Wales by activities accommodated and by floor area



NOTE *Floor areas of non-domestic premises in England and Wales: □ = 1 square kilometre.*

SOURCE: University College London Energy Institute (Non-Domestic Building Stock Project)

0.3 Retrofit projects

Non-domestic buildings undergo retrofit for a variety of reasons, and the objectives listed in **0.** are rarely the sole purpose of a project. Often retrofit is combined with repairs, maintenance, improvement, alteration, extension, change of use or change of tenancy. Sometimes the overall objective is to maintain or improve a building's commercial value by making it more attractive to potential tenants or purchasers, or to the occupants' customers.

For the purpose of this PAS, retrofit projects are divided into four broad categories:

1) retrofit of an owner-occupied building (often, but not always, including both the building fabric and the building services);
2) retrofit of a tenanted building, between tenancies, i.e. when unoccupied (again, often, but not always, including both the building fabric and the building services);
3) retrofit of a tenanted building embracing only the building envelope and/or the common parts and the building services provided by the landlord (also referred to as retrofit of the "base building"); and
4) retrofit of only the parts of a tenanted building that are occupied by a tenant, including any services (e.g. lighting) that the tenant provides (sometimes referred to as "fitting out" or "refitting").

NOTE *In the case of a tenanted building, the lease or tenancy agreement may restrict what the tenants are allowed to do without the permission or collaboration of the landlord.*

Some buildings that are traditionally constructed or are statutorily protected for architectural, cultural or historical reasons are expected to be treated with great care during retrofit in order to protect them from damage. Special requirements for such buildings are specified in this PAS.

0.4 The retrofit process

The general approach to retrofitting specified in this PAS is to reduce energy demand, improve energy efficiency, decarbonize the building services and, for larger buildings, minimize whole life emissions. The main stages of the usual process of retrofitting a building are reflected in the structure of this PAS. They are:

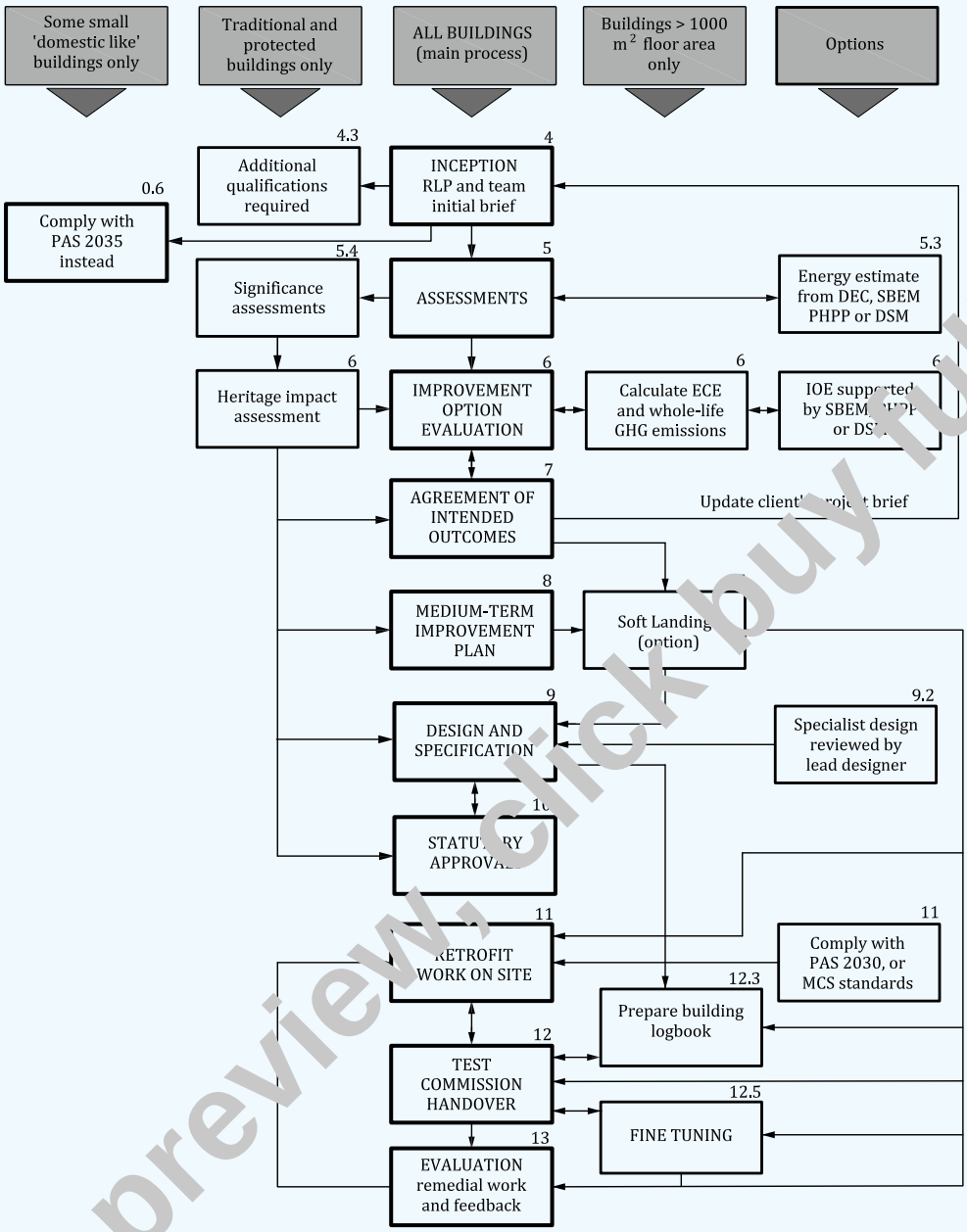
a) appointment of a project team and agreement of an initial brief;
b) assessment of the building, including its context, condition, occupancy and performance;
c) evaluation of improvement options to identify appropriate work;
d) agreement of intended outcomes, including performance targets;
e) preparation of an improvement plan, possibly to be implemented in stages;
f) design and specification of the work;
g) obtaining statutory approvals;
h) carrying out the retrofit work (installing measures);
i) testing, commissioning and handover of the retrofitted building;
j) fine-tuning of performance to meet or surpass the intended targets; and
k) evaluation of the project to confirm outcomes, identify any unintended consequences and specify any necessary remedial works.

Each of these stages is covered by a separate clause of this PAS. However, retrofit is seldom a linear process, many projects involve iteration, particularly before and during the design and specifications stage when improvement options are being evaluated and selected, and when the costs of options for achieving intended outcomes are revealed. Similarly, after the installation of improvement measures, testing, commissioning and fine-tuning of performance may involve iterative adjustment and even reconfiguration of controls.

NOTE *After the condition of the existing building has been assessed, it is appropriate to complete any outstanding repair and maintenance work prior to installation of any retrofit improvements. In some cases, repairs and maintenance can themselves improve the energy performance of the building.*

Figure 2 summarizes the PAS 2038 retrofit process for non-domestic buildings in diagrammatic form.

Figure 2 – Diagrammatic summary of the PAS 2038 retrofit process



__NOTE__ The main process defined in this PAS is shown by the bold boxes in the central column, see "ALL BUILDINGS (main process)" and runs from top to bottom of the diagram. The first column shows an alternative for some small "domestic like" buildings and the second column indicates additional requirements for traditionally constructed and protected buildings only. The fourth column shows requirements that apply only to buildings with more than 1000 m² of floor area and the fifth column shows optional processes that may be adopted. Numbers against boxes on the diagram refer to the related clauses in this PAS.

Abbreviated terms

DEC	Display Energy Certificate
DSM	Dynamic Simulation Model
ECE	Energy Cost Effectiveness
GHG	Greenhouse Gas
MCS	Microgeneration Certification Scheme
PHPP	Passive House Planning Package
RLP	Retrofit Lead Professional
SBEM	Simplified Building Energy Model

0.5 The BSI Retrofit Standards Framework

This PAS is part of the BSI Retrofit Standards Framework suite of standards, which also includes PAS 2030:2019[1)], PAS 2035:2019[2)], BS 5250, BS 7913, the Microgeneration Certification Scheme (MCS) standards and many industry standards.

PAS 2030:2019 includes annexes that specify measure-specific installation requirements that are applicable to both domestic and non-domestic buildings. Annex A of this PAS specifies measure-specific installation requirements that are applicable only to non-domestic buildings.

0.6 Alternative approach for some small buildings

If the building to be retrofitted:

a) has floor area not exceeding 500 m^2;

b) is not more than three stories in height (including any basement);

c) is constructed of load-bearing masonry walls (solid or cavity brickwork/blockwork, or stone), or is timber-framed and clad externally with brick or timber;

d) has mostly pitched roofs with timber structure, covered in tiles or slates; and

e) has building services that consist of heating, hot water, ventilation, lighting and small power only, possibly supplemented by solar photovoltaic or solar thermal systems (i.e. there is no central air handling mechanical cooling or air conditioning);

then as an alternative to this PAS, the retrofit project may adhere instead to the requirements of PAS 2035:2019, provided that:

1) the Retrofit Coordinator for the project is qualified as a Non-Domestic Energy Assessor (NDEA) in addition to holding the Level 5 Diploma in Retrofit Coordination and Risk Management;

2) the modelling software used for the PAS 2035:2019 improvement option evaluation is based on the Simplified Building Energy Method (e.g. iSBEM); and

3) compliance with PAS 2035:2019 is self-certified by the Retrofit Coordinator in accordance with PAS 2035:2019, **15.2.4**, on behalf of the client for the project.

If any of the above conditions cannot be met, then the project adheres instead to this PAS.

[1)] At the time of publication of PAS 2038, PAS 2030:2019 is undergoing review, and an amendment is expected to be published in due course.
[2)] At the time of publication of PAS 2038, PAS 2035:2019 is undergoing review, and an amendment is expected to be published in due course.

1 Scope

This PAS specifies requirements for retrofitting non-domestic buildings for improved energy efficiency. It covers all buildings except those used as private dwellings (i.e. houses, bungalows, flats or apartments). However, non-domestic buildings do include multi-residential buildings in which occupants share some communal facilities, e.g. hotels, guest houses, hostels and students' and nurses' accommodation.

The requirements specified in this PAS cover the:

a) safe management of the retrofit process, from inception to completion;
b) assessment of buildings for retrofit of energy efficiency and related measures;
c) identification and evaluation of improvement options (energy efficiency measures);
d) preparation of improvement plans;
e) design and specification of energy efficiency measures (whether individual measures or packages of multiple measures);
f) installation of measures;
g) testing, commissioning and handover of installed measures;
h) fine-tuning of the performance of retrofitted buildings; and
i) evaluation of retrofit projects.

This includes measures or packages of measures that are intended to:

1) improve the insulation of the building fabric (exposed floors, walls, roofs, windows and external doors), reduce thermal bridging and eliminate thermal by-pass;
2) improve the air tightness of the building envelope;
3) establish a safe and dynamic moisture equilibrium through each element of the building fabric;
4) improve the resistance of the building envelope to water penetration in order to maintain the thermal properties of the building fabric, and the capability of the building envelope to manage moisture in a manner suited to its construction;
5) minimize overheating;
6) replace building services systems that use fossil fuels with low or zero carbon (LZC) systems;
7) provide efficient heating and cooling systems with effective controls, including systems that use LZC technologies;
8) provide efficient ventilation systems with effective controls in order to maintain good internal air quality and to minimize the risk of condensation and mould growth;
9) minimize the risks associated with chemicals, e.g. volatile organic compounds (VOCs), released within buildings, which might be increased subsequent to air tightness being improved;
10) provide efficient water heating systems with effective controls, including systems that use LZC technologies;
11) provide efficient fixed lighting with effective controls as part of an efficient lighting strategy related to the use of the building and the activities accommodated;
12) provide efficient equipment to reduce electricity use and minimize internal heat gains;
13) provide locally generated renewable heat using LZC technologies;
14) provide locally generated renewable electric power using LZC technologies;
15) provide demand management (e.g. on-site energy storage) especially where on site generation by LZC technologies is also provided; and
16) provide metering and monitoring systems (e.g. smart meters) to promote the efficient use and management of energy throughout the building.

NOTE 1 *Effective controls are sometimes referred to as "responsive", "intelligent" or "smart" controls, although none of these terms is well defined; effective controls are useable and demand-responsive.*

This PAS applies to the retrofit of buildings, including retrofit that is undertaken at the same time as a change of use of a building, in which the types of activity accommodated are changed. This PAS also covers Type 4 (see **0.3**) retrofit projects, in which non-domestic buildings such as shops or offices are refurbished or refitted internally and the work includes any of the measures listed above.