BP65: Buildings and Energy

Replacement Local Development Plan 2018-2033

Background Paper: Deposit

January 2026

CONWY

Mae’r ddogfen hon ar gael yn Gymraeg hefyd.

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Contents

Table of Figures

Net zero carbon new buildings in Conwy

1. Policy Context

1.1. Welsh Government Greenhouse Gas Emissions Policy

In March 2021, the Welsh Government approved a net zero target for 2050. Net zero means balancing the greenhouse gas emissions to the atmosphere with the same amount removed from the atmosphere. Wales also has interim targets for 2030 and 2040, and a series of 5-year carbon budgets. The first carbon budget ran from 2016 to 2020. A carbon budget is set at least five years before the budgetary period begins. The targets and carbon budgets form Wales' statutory framework. They include Wales' share of emissions from international aviation and international shipping.

For each carbon budget, the Welsh Government has to set a limit on how many international offsets Wales can use. A 0% limit means we must achieve the carbon budget by action taken in Wales.

Table 1-1 - Targets and carbon budgets approved by the Welsh Government

Budget/target	Amount
Carbon budget 2 (2021-2025)	Average 37% reduction
Carbon budget 2 offset limit	0%
Carbon budget 3 (2026-2030)	Average 58% reduction
2030 target	63% reduction
2040 target	89% reduction
2050 target	At least 100% reduction (net zero)

1.2. Net Zero Wales Carbon Budget 2

The Net Zero Wales Carbon Budget 2 focuses on Wales' second carbon budget (2021–2025), and beyond to start building the foundations for Carbon Budget 3 and the 2030 target, as well as net zero by 2050. The Budget contains 123 policies and proposals across all ministerial. It aims to build on the previous plan (Prosperity for All: A Low Carbon Wales with targets that have increasing ambition – 54% reduction for 2026-2030 compared to 37% for 2020-2025.

Carbon Budget 2 (CB 2) will be the period to plan and innovate for the future energy system for Wales. A major objective is to deliver the smart energy system needed using a regionally planned approach, rather than a top down, market driven approach. This approach is seen to be more likely to enable delivery at the speed demanded by the climate emergency, at optimal cost to the system, and in a way that leaves no people or places behind.

1.2.1. Residential buildings

The residential buildings sector covers emissions from energy usage in homes, as well as working to reduce embodied carbon in constructing and retrofitting residential properties.

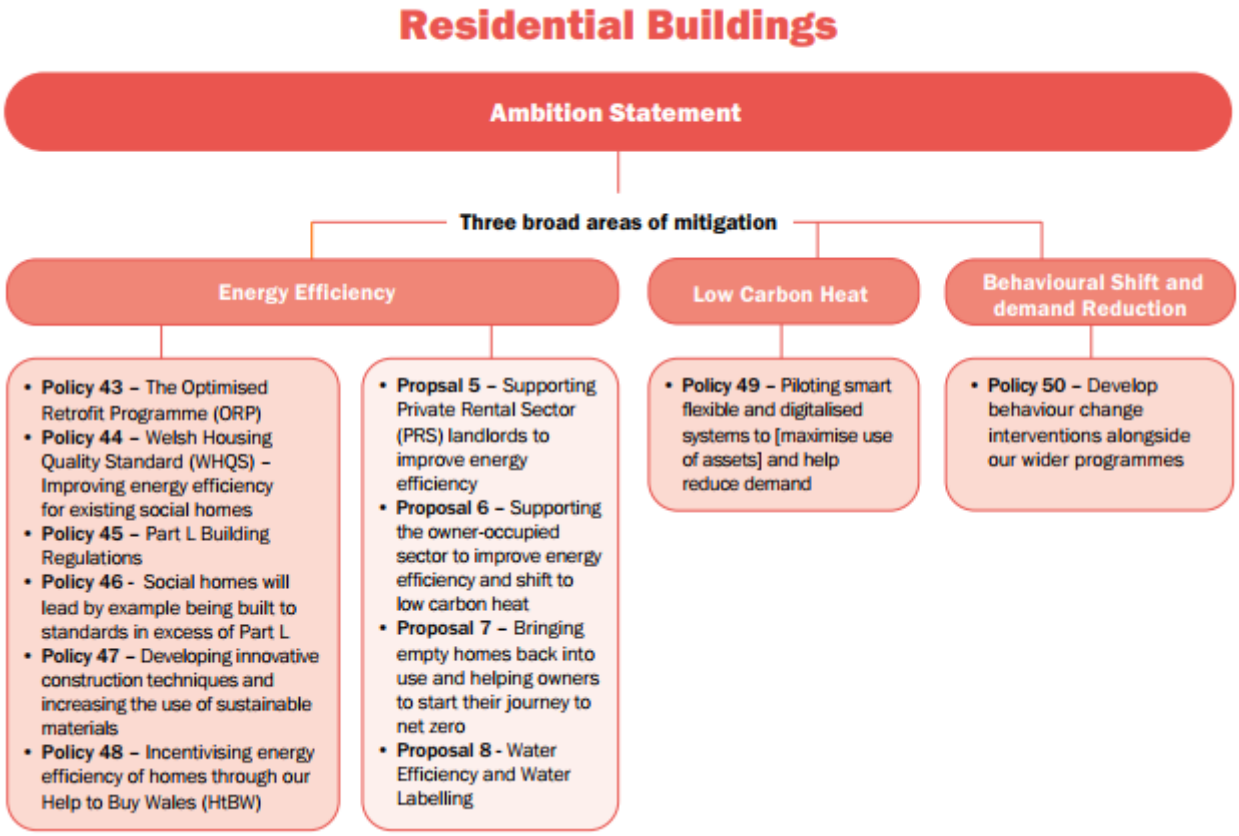
Residential buildings are responsible for 3.7 $MtCO_2e$ or 10% of Welsh emissions in 2019. The dominant source of emissions is from combustion (for heating and cooking) in residential buildings, which make up 97% of the sector emissions and 9.3% of total Welsh emissions.

The Welsh Government ambitions in this sector are that by 2025:

- They expect around 148,000 houses across Wales to receive retrofit measures to reduce heat loss.
- Aim to move from fossil fuels through increasing the proportion of heat that is electrified by 3%.
- All new affordable homes in Wales will be built to net zero carbon, and our ambition is that our net zero standards are adopted by developers of all new homes regardless of tenure by this date i.e. 2025.

There are three broad areas of mitigation and along with the policies and proposals to deliver are shown in Figure 1-1. Delivery vehicles such as the planning regulations, building regulations, and building codes will be discussed later in the report.

Figure 1-1 - Policies and proposals to mitigate residential buildings emissions



1.2.1. Industry and business

The industry and business sector includes manufacturing, construction, operation of machinery, food processing and the extraction and production of fossil fuels. The Sector also covers emissions arising from industrial and commercial buildings.

At 14.83 $MtCO_2e$ the industry and business sector accounted for 38% of Welsh emissions in 2019. Industrial emissions in Wales are dominated by iron and steel production and petroleum refining. Total emissions from the industry and business sector in Wales have decreased by 36% between the base year (1990) and 2019, driven largely by operational changes, fuel-switching to less carbon intensive fuels and improvements in efficiency of production.

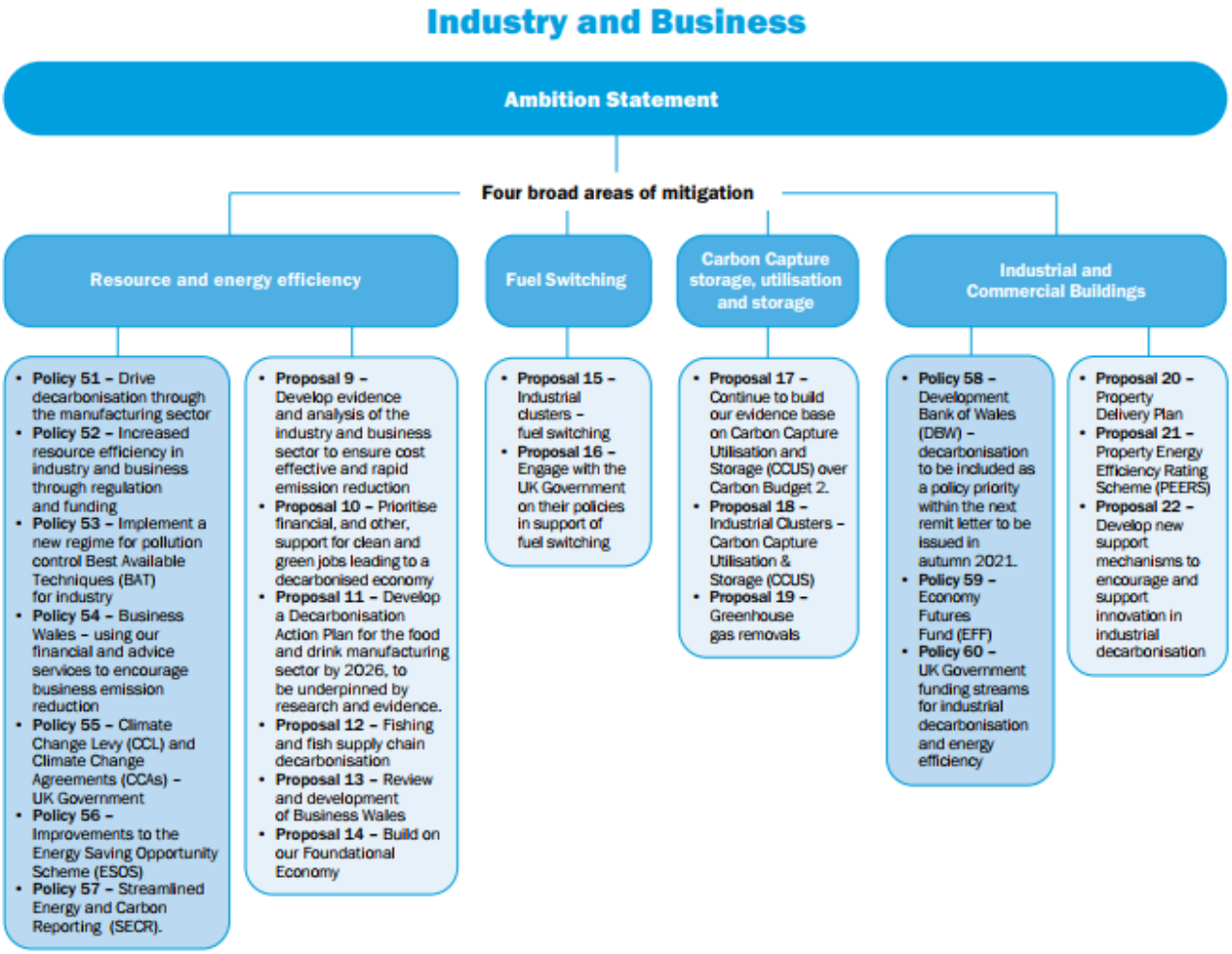
For greater context, there are 1.6m commercial and industrial buildings in England and Wales, of these 7% are larger than 1,000m² and these buildings account for 53% of energy demand across the stock. Much of this energy used is produced from fossil fuels. Providing landlords and businesses with information on the performance of their buildings is a vital step in enabling improvements to reduce emissions. It will also assist the Welsh Government in tracking progress and targeting interventions. The Welsh Government intend to collaborate with the UK Government to develop an England and Wales scheme, allowing businesses to compare their performance with a greater number of their peers.

The ambitions for this sector are by 2025:

- a decrease in energy usage in industry of 4% as a result of energy efficiencies.
- an increase in electrification in industrial processes by an average of 3%.
- grow hydrogen as a fuel by an average of 3%.

There are four broad areas of mitigation and along with the policies and proposals to deliver are shown in Figure 1-2 below.

Figure 1-2 - Policies and proposals to mitigate Industry and business emissions



Industrial and commercial buildings have largely been ignored but could be captured under:

- Improvements to the Energy Saving Opportunity Scheme (ESOS) ; and
- Streamlined Energy and Carbon Reporting (SECR).

The remit letter issued to the Development Bank of Wales (DBW), 3rd November 2021, has decarbonisation included as a policy priority. DBW is currently identifying pilot projects such as (in 2022-23) housing retrofit solutions and energy generation support aimed at building capacity and capability.

The Welsh Government are going to prioritise the decarbonisation call to action for the Economy Futures Fund (EFF), where they will be looking for applications that enable more of the business base to become carbon light or free.

None of these are building specific but CB 2 states that the amount of heating, cooling and hot water used in both industrial and commercial buildings and the materials used to construct them should be considered. This includes industrial premises and well as shops, hotels and offices in the private sector.

There are two proposals to deal with this issue:

- Property Delivery Plan, and
- Property Energy Efficiency Rating Scheme (PEERS).

In the Property Delivery Plan, all projects in receipt of Welsh Government funding under the plan will be required to comply with the Welsh Government's Sustainable Buildings Standards. Most new buildings promoted or supported by the Welsh Government, or sponsored bodies, must currently meet Welsh Government sustainable building standards (November 2019) (see section 1.2.4.1). This includes projects procured directly and indirectly; and is based on the Building Research Establishment Environmental Assessment Methodology (BREEAM).

However, in this carbon budget period, all Welsh Government direct build commercial projects undertaken as part of the Welsh Government's Property Delivery Plan will aim to achieve a net zero carbon in use standard, with the approach currently being piloted.

In March 2021, the UK Government published a strategy paper "Introducing a Performance-Based Policy Framework in large Commercial and Industrial Buildings in England and Wales". The Consultation finished in June 2021 and the proposed outcome is "The Property Energy Efficiency Rating Scheme (PEERS)".

CB 2 proposes:

- Launch a year-long pilot within the office sector in early 2022 to operationalise and test the scheme.
- Work with the UK Government on provisions in the UK Energy Bill 2022.
- Launch the mandatory scheme for the office sector in 2023.
- Expand the scheme to other commercial buildings from 2024.

The UK Government is also leading a research project aimed at developing and piloting a methodology to make use of the existing datasets to remotely evaluate the condition of existing non-domestic buildings. The aim is to develop a methodology which will enable targeted policy interventions. Welsh Government are supportive of the project and are assisting the UK Government to guide the project.

1.3. National Plan – Future Wales 2040

Future Wales–the National Plan 2040' ("FWNP") fulfils the Welsh Ministers obligations to adopt a National Development Framework within the Planning and Compulsory Purchase Act 2004, as amended by the Planning (Wales) Act 2015 and was published in February 2021.

FWNP sets out the Welsh Government's strategies for the direction and development of Wales and addressing key national priorities through the planning system. FWNP was published on 24th February 2021 and replaces the Wales Spatial Plan (WSP). The FWNP is a step forward from the WSP and forms part of the statutory development plan, meaning its contents carry weight in the planning process. FWNP will therefore play a significant role in planning decision making and will provide an important foundation for regional and local planning in the future.

Planning Policy Wales, which provides planning policy on an all-Wales basis, has been updated to align with the FWNP.

The key themes of the FWNP are health, sustainability, and prosperity for Wales; in which there is an emphasis on support for renewable energy, decarbonisation, delivery of affordable housing, a commitment to metros, and creating places with a thriving Welsh language. Examples of FWNP key features include:

- A housing policy focus on delivering new affordable homes, with local authorities setting overall housing requirements with an intention to achieve,114,000 new homes by 2038 potentially leading to an increase of 4% in the population of Wales, a 10% target increase in Welsh-speakers and 70% of power consumed to be generated by renewables by 2030.
- Expanding the national and regional growth areas and adopting a four region (North, Mid, South-West and South-East Wales) approach.
- A criteria-based policy for renewable and low carbon energy generation of all types, with reference to a small number of broadly identified pre-assessed areas where there will be a presumption in favour or large scale on-shore wind energy.

- A requirement to identify Green Belts in the South-East Wales and North Wales regions, with consideration to be given to a further Green Belt in the South-West. (This will not relate to Conwy).

The National Plan aligns with and maximises its contribution to the well-being goals, objectives, and ways of working, as required by the Well-being of Future Generations (Wales) Act 2015. It sets out land use framework to support the delivery of the Welsh Government's national strategy, Prosperity for All: the national strategy. In addition, several other Welsh Government strategies and policies have informed and helped shape the National Plan, Including the Welsh National Marine Plan, the Transport Strategy, Prosperity for All: Economic Action Plan, Natural Resources Policy and the Low Carbon Wales plan. The intention is that there will be a two-way relationship with any reviews of these documents taking account of the National Plan.

The National Plan does not replace Planning Policy Wales (PPW), a new edition 11 was issued on the same day as the National Plan which will complement PPW and the supplementary Technical Advice Notes. The National Plan will therefore affect the shape and direction of future planning policy in Wales including SDPs and LDPs.

The following deal specifically with North Wales:

- Policy 20 – National growth area - Wrexham and Deeside.
- Policy 21 – Regional Growth Area – North Wales Coastal Settlements.
- Policy 22 – Green Belts in the North.
- Policy 23 – North Wales Metro.
- Policy 24 – North-West Wales and Energy.

Targets include:

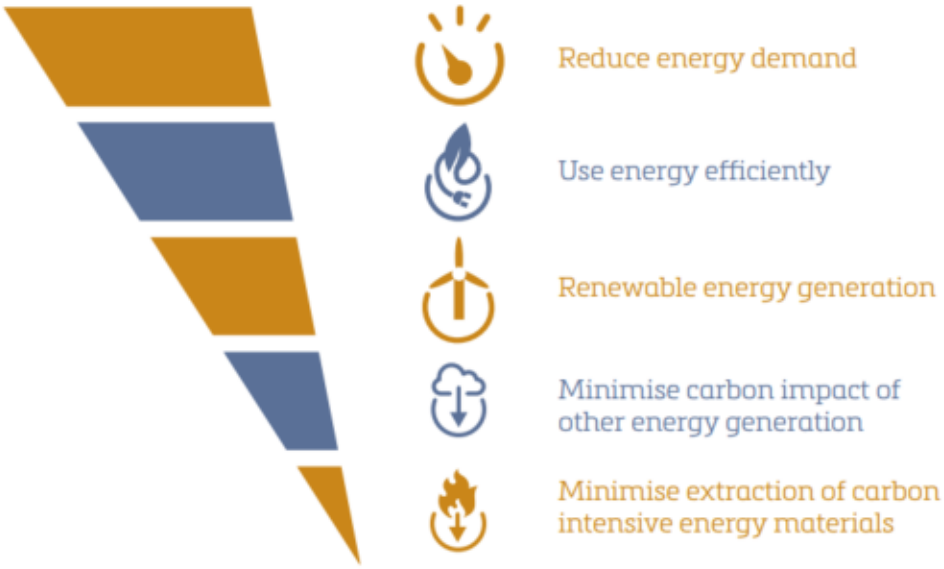
- 16,200 new homes to be delivered over the plan period including affordable housing (53%). Growth mainly in Wrexham and Deeside.
- Sustainable growth and regeneration in regionally important towns along the northern coast. Holyhead, Caernarfon, Bangor, Llandudno, Colwyn. Rhyl and Prestatyn will be a focus for manged growth to complement the National growth area of Wrexham and Deeside.
- Strategic Development Plan to identify a green belt around Wrexham and Deeside.
- New Metro for the region.
- New energy related projects supporting economic benefits and low carbon energy generation.
- Wylfa Newydd and Trawsfynydd supported in principle.

1.3.1. The Sustainable Energy Hierarchy

The Welsh Government planning policy recognises an energy hierarchy (see Figure 6).

The Welsh Government PPW expects all new development to mitigate the causes of climate change in accordance with the energy hierarchy for planning, as set out in the following energy policies. Reducing energy demand and increasing energy efficiency, through the location and design of new development, will assist in meeting energy demand with renewable and low carbon sources. This is particularly important in supporting the electrification of energy use, such as the growing use of electric vehicles and heat pumps. All aspects of the energy hierarchy have their part to play, simultaneously, in helping meet decarbonisation and renewable energy Targets.

Figure 1-3 - The Energy Hierarchy for planning



The planning system has an active role to help ensure the delivery of these targets, in terms of new renewable energy generating capacity and the promotion of energy efficiency measures in buildings. It should also support new development that has very high energy performance, supports decarbonisation, tackles the causes of the climate emergency, and adapts to the current and future effects of climate change through the incorporation of effective mitigation and adaptation measures.

1.3.2. Zero carbon buildings

Welsh Government's policy is to secure zero carbon buildings and promote a range of Low and Zero Carbon (LZC) technologies as a way of achieving this. Consequently, sustainable building design principles should be integral to the design of new development and proposals should:

- mitigate the causes of climate change by minimising carbon and other greenhouse gas emissions associated with the development's location, design, construction, use and eventual demolition; and
- include features that provide effective adaptation to, and resilience against, the current and predicted future effects of climate change.

In order, to achieve this planning authorities should:

- consider development plan policies requiring applications for developments to be accompanied by an independent Energy Report. This report shall include recommendations to the developer relating to energy efficiency and appropriate renewable energy technologies that could be incorporated into the development. A response to that report from the developer should also accompany the application and if planning authorities feel that insufficient consideration has been given to energy issues in project design, they may refuse planning permission.
- Strategic sites should be assessed to identify opportunities to require higher sustainable building standards, including zero carbon, in their development plan. In bringing forward standards higher than the national minimum, which is set out in Building Regulations, planning authorities should ensure the proposed approach is based on robust evidence and has taken into account the economic viability of the scheme.
- Design and Access Statements should show how sustainable building design principles have been considered in the design process.
- Developers should consider future requirements for carbon reduction in new buildings when designing their schemes. Because of changes and proposed changes to Building Regulations in Wales they need to be mindful of any future changes to ensure design aspects of requirements are considered as early as possible.

- Facilitate all forms of renewable and low carbon energy development and seek to ensure their area's full potential for renewable and low carbon energy generation is maximised and renewable energy targets are achieved.
- Seek to maximise the potential of renewable energy by linking the development plan with other local authority strategies, including Local Well-being plans and Economic/Regeneration strategies.

1.4. Building regulations

Those involved with the construction of new build dwellings or commercial buildings in Wales need to comply with Part L of the Building Regulations. Part L sets the national minimum standards for the energy performance of new buildings and refurbishments of existing buildings. Enhanced energy efficiency or carbon requirements required by planning policy, or accreditation with schemes such as BREEAM tend to be layered on top of the Part L target, using this target as a baseline; i.e. x% improvement on the Target Emission Rating (TER) of Part L.

For new buildings Part L of the Building Regulations is split into two documents:

- Approved document part L: 2014 L1A (new dwellings)
- Approved document part L: 2014 L2A (new buildings other than dwellings)

These building regulations do not give a single carbon target as such, but are supported by the National Calculation Methodology, which is used to calculate building energy performance for compliance checking purposes. For homes this is the Standard Assessment Procedure (SAP). It is noted that Building Regulations only cover regulated energy; i.e. heating, cooling, ventilation and lighting. Household appliances / consumer goods and charging of electric vehicles are unregulated energy and have not traditionally been covered by Building Regulations.

1.4.1. English Building Regulations

In order to understand the current trajectory of the Welsh Building Regulations, we can usefully look at the earlier changes to English Building Regulations, by the UK Department for Levelling Up, Homes and Communities (DLUHC), which came into effect on 15th June 2022. The update has resulted in an uplift in performance in energy efficiency for residential and non-residential buildings.

The updated regulations include:

- Consider amendments to Approved Documents Part F (Ventilation) and Part L (Conservation of fuel and power) ; and
- new Approved Documents for Overheating (Part O) and Infrastructure for charging electric vehicles (Part S).

These changes are aimed at improving the energy efficiency of domestic and non-domestic buildings in the UK (see Table 1-2), with the aim of helping meet the 2050 Net Zero Carbon targets and mitigate the effects of climate change. The updated regulations are interim changes, for domestic buildings, before the implementation of the Future Homes Standards planned for 2025.

Table 1-2 - Changes in the English Building Regulations

Building Regulation	What are the changes?	What key impacts will this have?
Approved Document L CONSERVATION OF FUEL AND POWER	Updated documents to replace previous versions: Volume 1: Dwellings Volume 2: Buildings other than Dwellings.	A new metric; 'Primary Energy Rate' has been introduced measured in kWhPE/ (m^2 per year). This will be influenced by fabric and fuel type. New build homes will need to produce at least 31% less carbon emissions when compared to the previous regulations (2013 Part L standards). New non-domestic builds will need to produce at least 27% less carbon emissions. In line with the National

		Calculation Methodology (NCM) using the Simplified building Energy Modelling (SBEM). Adoption of the Fabric Energy Efficiency Standard (FEES), a proposed maximum space heating and cooling energy demand for zero carbon homes. This considers fabric U-values, thermal bridging and external heat gain.
Approved Document F VENTILATION	Updated documents replace previous versions: Volume 1: Dwellings and Volume 2: Buildings other than Dwellings.	Improvements in whole house dwelling ventilation rates, Recirculating systems must meet certain new criteria and air quality sensors are required in a range of spaces. Introduction of minimum fresh air rate per m², and requirement to ventilate common parts such as corridors and lobbies in commercial buildings.
Approved Document O OVERHEATING	New Approved Document O provides statutory guidance on overheating.	The primary objectives are to limit unwanted solar gains in summertime and provide a way of removing excess heat from the building (cross-ventilation). The majority of developments will be subject to the dynamic thermal modelling (TM) approach using CIBSE's TM59 for regulatory compliance. Blinds should no longer be relied upon for compliance.
Approved Document S INFRASTRUCTURE FOR ELECTRIC VEHICLE CHARGING	New approved Document S which provides statutory guidance on infrastructure for electrical vehicle charging.	For residential schemes, provision should be made for all car parking spaces to have Electric Vehicle charge points. For non-residential schemes, a minimum of 10% active provision with a further 20% passive provision for future installation must be included.

1.4.2. Welsh Building Regulations

In Wales, the consultation for the Welsh Building Regulations ended on 17th January 2022 and the updates to the Approved Documents for Dwellings (domestic buildings only) were subsequently published on 24th May 2022.

The amendments cover:

- Energy efficiency (Approved Document Part L).
- Ventilation (Part F).
- Overheating (Part O).

These approved documents for Dwellings took effect on 23rd November 2022 for use in Wales. They do not apply to work subject to a building notice, full plans application or initial notice submitted before that date, provided the work for each building is started before 23rd November 2023.

The release of these documents marks the first significant change to Welsh Building Regulations in over a decade. These new standards will ensure that building work moving forward will deliver a better standard of living when it comes to health, safety, and energy efficiency. For energy efficiency and ventilation in new build

homes these set ambitious new targets going beyond those proposed for England. The uplift compared to England is in the region of 11-13%.

1.4.2.1. Domestic buildings

Significant changes have been introduced in November 2022 for domestic buildings:

- There will be a 37% reduction in carbon emissions in new homes compared with Part L 2014 standards.
- A Primary Energy compliance metric has been introduced alongside the existing carbon emissions standard.
- A new minimum energy efficiency standard has been introduced for new builds set at a minimum Energy Performance Certificate (EPC) rating of 81 (B).
- Tightened limiting fabric standards for thermal elements.
- Mandatory airtightness testing will be introduced for all new homes.
- Overheating risk has been addressed in its own approved document (Part O) and is no longer featured in Part L and Standard Assessment Procedure (SAP).
- The SAP 10 methodology will be adopted.
- A requirement for any properties not space-heated by Low and Zero Carbon (LZC) Technologies to have a maximum system temperature of 55°C.

The last point is a way of future proofing the building for the new generation of heat pumps which are expected to have a better Coefficient of Performance (COP). Therefore, they will be able to operate efficiently at this higher temperature than the current generation of heat pumps but still lower than that for gas or oil boilers.

Section 1 of the consultation for these changes gave an indication of the direction of travel. Therefore, the 2024 consultation will likely include a requirement for **no fossil fuel fired boilers** to provide domestic hot water and space heating by 2025.

This change in regulation marks a positive step forward in providing a greener future. However, there is still a lot more to be done and some of the potential market impacts are summarised below:

- **Upskilling**
  All involved in the construction process will need to be actively following these new regulations and presenting evidence. It will take the industry time to become familiar with the new regulations and this could impact short term programmes. Wider education and clear guidance are needed in order to help clients, design teams and builders understand what is expected from them. This stopgap will allow the industry to build up skills and capacity before the more stringent regulations come into force in 2025.
- **Cost**
  Customers will need to include the cost of these required changes. There is a lack of clarity on future costs where inflation is complicating this benchmarking exercise. In addition, there is likely to be an increase in the cost of manufacturing certain products, such as windows and doors with lower u-values. However, a focus on improving the performance of current buildings will reduce the cost of retrofit in the future.
- **Improved building stock**
  Improved insulation levels will increase energy efficiency resulting in more comfortable buildings, reduced energy use, and lower energy bills. The increased focus on air leakage and thermal bridging should result in higher quality housing stock.
  An increase in ventilation standards should help increase indoor air quality and thus the health of the occupants by reducing indoor air pollutants, condensation, and mould.
- **Product availability**
  The uplift in regulations will encourage the installation of products such as heat pumps, photovoltaics and triple glazing but is likely to increase demand and price in the short term.
  There may be potential delays in the supply chain and getting materials on site due to demand and this will need to be factored in.
  The increase in electric vehicle (EV) charging points and/or cable routes for future connection should unlock one of the biggest barriers in the uptake of electric vehicles. With consumer confidence increasing a subsequent increase in demand should follow.
- **Certifications**
  The change in building regulations provides a focus on energy and carbon impact. Alongside energy

efficiency it is important that projects are considering sustainability holistically and this is likely to drive an uptake in certification standards such as BREEAM (sustainability), WELL (wellbeing), TRUE (waste), and WiredScore (connectivity).

1.4.2.2. Non-domestic buildings

The changes to the Welsh non-domestic building regulations (buildings other than dwellings) were published on 29th September 2022 but will only take effect on 29 March 2023 for use in Wales. They include the following significant changes:

- There will be a 28% reduction in carbon emissions in new buildings compared with Part L 2014 standards
- A Primary Energy compliance metric has been introduced alongside the existing carbon emissions standard
- Incentivise new heat networks to be low carbon
- Tightened limiting fabric standards for thermal elements (i.e. walls, floors, roofs, windows)
- Uplift to minimum standards for building services for new and existing non-domestic buildings, and including them within the approved document rather than having the non-domestic building services compliance guide (NDBSCG)
- Adoption of CIBSE TM 23 which allows for either Pulse or blower door testing as methods to determine airtightness.
- Overheating risk has been addressed in its own approved document (Part O) and is no longer featured in Part L
- The SBEM v6 methodology will be adopted as with England and Scotland – currently waiting on the new version to be released by BRE, expected to be December 2022.

The changes do not apply to work on a particular building where a building notice, full plans application or initial notice have been submitted before that date, provided the work for each building is started before 29 March 2024 and do not apply to sites where a building notice, initial notice or full plans application were submitted before 31st July 2014 and building work commenced before 31st July 2015.

1.4.2.3. Electric vehicle charging

In addition, CB 2 states the intention to amend Building Regulations to mandate electric vehicle charging provision at all new and refurbished buildings. There is a proposed consultation on the adoption of Part S planned by the beginning of 2023 latest, with implementation by end of 2023.

1.5. Building standards in Wales

1.5.1. Welsh Sustainable Building Standards (2019)

Most new buildings promoted or supported by the Welsh Government or its sponsored bodies must currently meet the Welsh sustainable building standards. This includes projects procured directly and indirectly.

The current standards for residential development state that residential ‘extra care’ schemes must meet the criteria for BREEAM accreditation. While for all non-residential development, a BREEAM rating may be required based on building floor area as follows:

Table 1-3 - Welsh Sustainable Building Standards

Building floor area	Policy requirement
<=250m²	Exempt
251 to 1,000m²	No BREEAM required Part L+10%* required (10% improvement over the Target Emission Rate (TER) for current Part L of the Building Regulations)
1001 to 2000m²	BREEAM ‘Very Good’ with ‘Excellent’ for Energy Credits (ENE01)
2001+m²	BREEAM ‘Excellent’

1.5.2. Creating Beautiful Homes and Places" (Welsh Development Quality Requirements (WDQR) 2021

The "Creating Beautiful Homes and Places" (Welsh Development Quality Requirements (WDQR) [2021]) sets out revised requirements for Welsh housing associations and councils from October 2021. This concerns the minimum functional quality standards for new and rehabilitated general needs affordable homes. The performance criteria are in excess of the building regulations, for example:

- Achieving EPC rating, Band A (SAP92 or greater) through:
  - the minimum fabric standard set out in "Appendix E" – Elemental specification for the DER/TER, within the Building Regulations Approved Document Part L Wales 2020; and
  - by not using fossil fuel fired boilers to provide domestic hot water and space heating.
- An assessment of overheating risk based on the CIBSE TM59 methodology (for 'Category 1 buildings'), which demonstrates compliance criteria, for the following dwelling types:
  - Apartments/Flats.
  - Houses.

The intention is for private developers to adopt this standard by 2025. This move underpins the Welsh Government's commitment to build 20,000 high quality, low carbon homes for rent over the next five years. Social housing built with Welsh Government funding is intended to 'trailblaze' the new standards.

1.5.3. Welsh Housing Quality Standard 2023

The Welsh Housing Quality Standard 2023 (WG 44691) was put out for consultation which ended on 3rd August 2022. The purpose of this standard is to improve the quality of social homes in Wales. All social homes in Wales are required to meet and maintain the standard. Under the proposed standard, the Welsh social housing sector would be required to achieve Energy Performance Certificate (EPC) Band A rating or a Standard Assessment Procedure of 92 by 2033. There has been push back from the Welsh social housing sector as no long-term funding is currently available. Retrofitting every property in the social housing sector in Wales has been conservatively estimated at costing between £4-£5bn over a 10-year period. Achieving EPC Band A rating by 2033 has been modelled by the industry and has been estimated to cost housing associations at least £2.05bn. The industry has called for long-term government investment through a dedicated funding mechanism.

1.5.4. Property Energy Efficiency Rating Scheme (PEERS)

With respect to non-domestic buildings, the direction of travel from CB 2 is that all Welsh Government direct build commercial projects undertaken as part of the Welsh Government's Property Delivery Plan will aim to achieve a net zero carbon in use standard, with the approach currently being piloted.

In March 2021, the UK Government published a strategy paper "Introducing a Performance-Based Policy Framework in large Commercial and Industrial Buildings in England and Wales". The Consultation finished in June 2021 and the proposed outcome is "The Property Energy Efficiency Rating Scheme (PEERS)".
As a first step, the Government proposes that owners and single tenants of buildings above 1,000m² will be required to obtain a rating for their building on an annual basis, and have that rating disclosed publicly online. This will ensure that large businesses and building owners will be aware of, and accountable for, how effectively they are using energy. It sends a clear signal to businesses and buildings owners that, having legislated for net-zero by 2050, the Government is ready to recognise businesses and landlords who have a low annual carbon footprint, and drive those who consistently emit more carbon than their peers to improve. These proposals have been developed with industry experts and are based on international best practice, building on the approach that has made the National Australian Built Environment Rating Scheme (NABERS) in Australia world leading.

1.5.5. Minimum Energy Efficiency Standards (MEES)

Current UK regulations mean that Private Rental Sector (PRS) property owners/landlords are required to meet Minimum Energy Efficiency Standards (MEES), including a minimum EPC E, before they are legally allowed to let or sell a property (unless a property exemption applies). The UK Government has completed a consultation on proposals to increase the minimum standard required for any property to be rented in the PRS to EPC C or above. Current indications are that a formal response, followed by revised regulations will be published toward

the end of 2022. According to data from Rent Smart Wales there are currently around 109,000 PRS homes in Wales with an EPC rating below C, and a further 60,000 without any EPC at all.

Pending publication of the UK Government's response and intentions regarding future MEES Regulations, the Welsh government intend to review the support package available to landlords joining their PRS Leasing Scheme to ensure it also supports fabric first improvements. In order, to decarbonise PRS stock it is seen as essential to avoid losing stock, which could risk reducing housing options and choice.

The current thought process is that the UK government have proposed an EPC above a C but may follow the London plan which sets the Minimum Energy Efficiency Standards (MEES) at Energy Performance Certificate (EPC) band B by 2030 (currently an E). In addition, they are considering introducing mandatory in-use energy performance ratings for commercial buildings.

1.5.6. Omissions from standards

There is nothing explicitly within these standards to support the use of EVs in Wales, so the adoption of Part S as in England is essential.

Part S in England requires, for residential schemes, that provision should be made for all car parking spaces to have Electric Vehicle charge points. For non-residential schemes, a minimum of 10% active provision with a further 20% passive provision for future installation must be included. The same direction of travel should be expected in Wales, noting that the inclusion of EV charging in any proposal for Welsh government funding is viewed favourably.

There is also not a Welsh standard specially covering embodied energy, except for credits contained in BREEAM, and this will be discussed later in the report.

1.6. Guidance context

1.6.1. UK Green Building Council

The UK Green Building Council (UKGBC) framework definition for net zero carbon buildings was developed in 2019. The primary focus of the framework is to set in place a path to achieve net zero carbon buildings in both construction and operation (in-use energy consumption) while also beginning to provide direction for addressing whole life carbon in the industry. The framework sets out definitions and principles around two approaches to net zero carbon which are of equal importance:

Net zero carbon for construction - "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."

Net zero carbon for operational energy - "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 framework outlines where the principles should be followed to demonstrate alignment with net zero carbon for both construction and operational energy across five key steps. All new buildings should target net zero carbon for both construction and operational energy by considering these principles and following the steps to achieve a net zero carbon building.

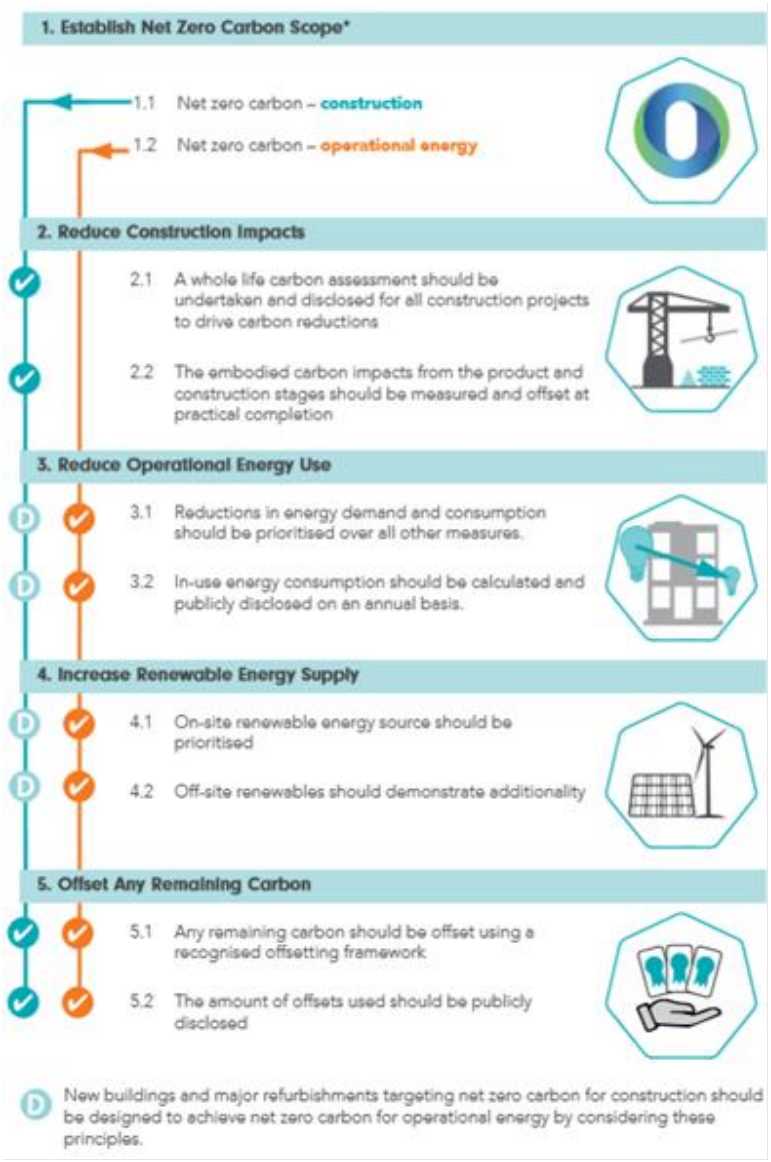


Figure 1-4 - Principles and steps to achieve net zero buildings[1]

1.6.2. Low Energy Transformation Initiative

The Low Energy Transformation Initiative (LETI) Climate Emergency Design Guide & LETI Embodied Carbon Primer 2019 sets out that Net Zero carbon in buildings needs to be considered in the context of whole life carbon. Whole life carbon includes operational and embodied carbon. The UKGBC is expected to publish further guidance related to whole life carbon to define the scope and requirements for this approach.

Operational carbon is directly linked to the energy consumed by a building associated with heating, hot water, cooling, ventilation, and lighting systems, as well as equipment such as fridges, washing machines, TVs, computers, lifts, and cooking.

A new building with zero operational carbon does not use energy from fossil fuels, is 100% powered by renewable energy and achieves a level of energy performance in-use in line with our national climate change targets. This means that an operational carbon balance is met without the need for carbon offsets.

Embodied carbon refers to the 'upfront' emissions associated with building construction, including the extraction and processing of materials and the energy and water consumption in the production, assembly, and construction of the building. It also includes the 'in-use' stage (the maintenance, replacement, and emissions associated with refrigerant leakage) and the 'end of life' stage (demolition, disassembly, and disposal of any parts of product or building) and any transportation relating to the above.

[1] https://www.ukgbc.org/ukgbc-work/net-zero-carbon-buildings-a-framework-definition/

Embodied carbon can represent 30-70% of the total CO2 emissions, as illustrated in Figure 1-5 below, from the UK Green Building Council report[2].

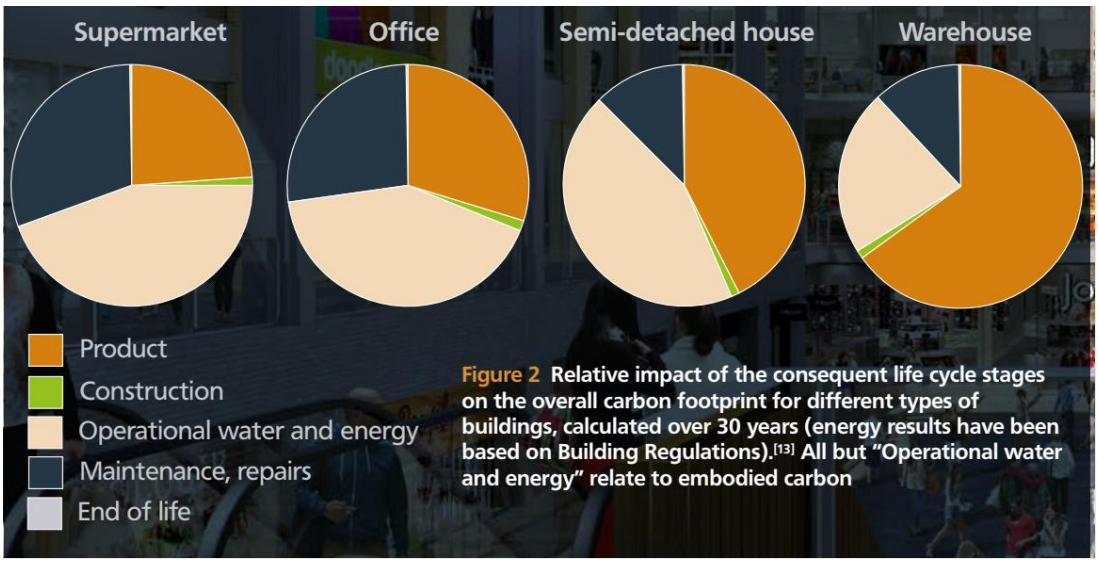


Figure 1-5 - Operational and embodied emissions for different building types

Embodied carbon is a topic that is becoming more relevant and important as operational carbon is reduced, and offsetting may be used to achieve net zero embodied carbon. A building that is whole life net zero carbon meets the operational zero carbon balance and is 100% circular, this means that 100% of its materials and products are made up of re-used materials and the building is designed for disassembly such that 100% of its materials and products can be re-used in future buildings. When construction, transport and disassembly is carried out with renewable energy there will be zero carbon emissions associated with the embodied carbon. This should be the ultimate objective for any building.

Reaching Net Zero targets will require setting out and following a zero-carbon trajectory. A Zero Carbon Trajectory is set out in the LETI Design Guide[3] to illustrate the key milestones that must be achieved in order to ensure that the UK will have a zero-carbon built environment by 2050. Key milestones along such a trajectory would include consideration of elements such as:

Table 1-2 - Key milestones for a net zero carbon trajectory

	2020-2025	2030
Operational energy	Update UK Building Regulations to signpost transition to mandatory verification of in-use energy consumption and adoption of targets. Introduction of regulatory performance framework All new buildings designed to be net zero operational carbon	All new buildings to operate at net zero operational carbon
Embodied carbon	All buildings to conduct whole life carbon calculation and aim to achieve 40% CO_2 reductions Benchmarks and methodology are established, and regulations are introduced	All new buildings achieve a 65% reduction in embodied carbon emissions
Future of heat	All new buildings are fossil fuel free	
Demand Response	Metrics established Policy to mandate minimum requirements for metrics	
Data Disclosure	All new buildings to disclose energy use data	

[2] https://www.ukgbc.org/ukgbc-work/embodied-carbon-practical-guidance/
[3] https://www.leti.london/cedg

The table above shows the urgency to act within the next five years to ensure that the 2030 targets for operational energy and embodied carbon are achieved.

The LETI Climate Emergency Design Guide[4] focuses on four building archetypes of small scale housing; medium and large scale housing; commercial offices and schools. Indicative design measures and targets are set out for each type, as set out in the Figures below.

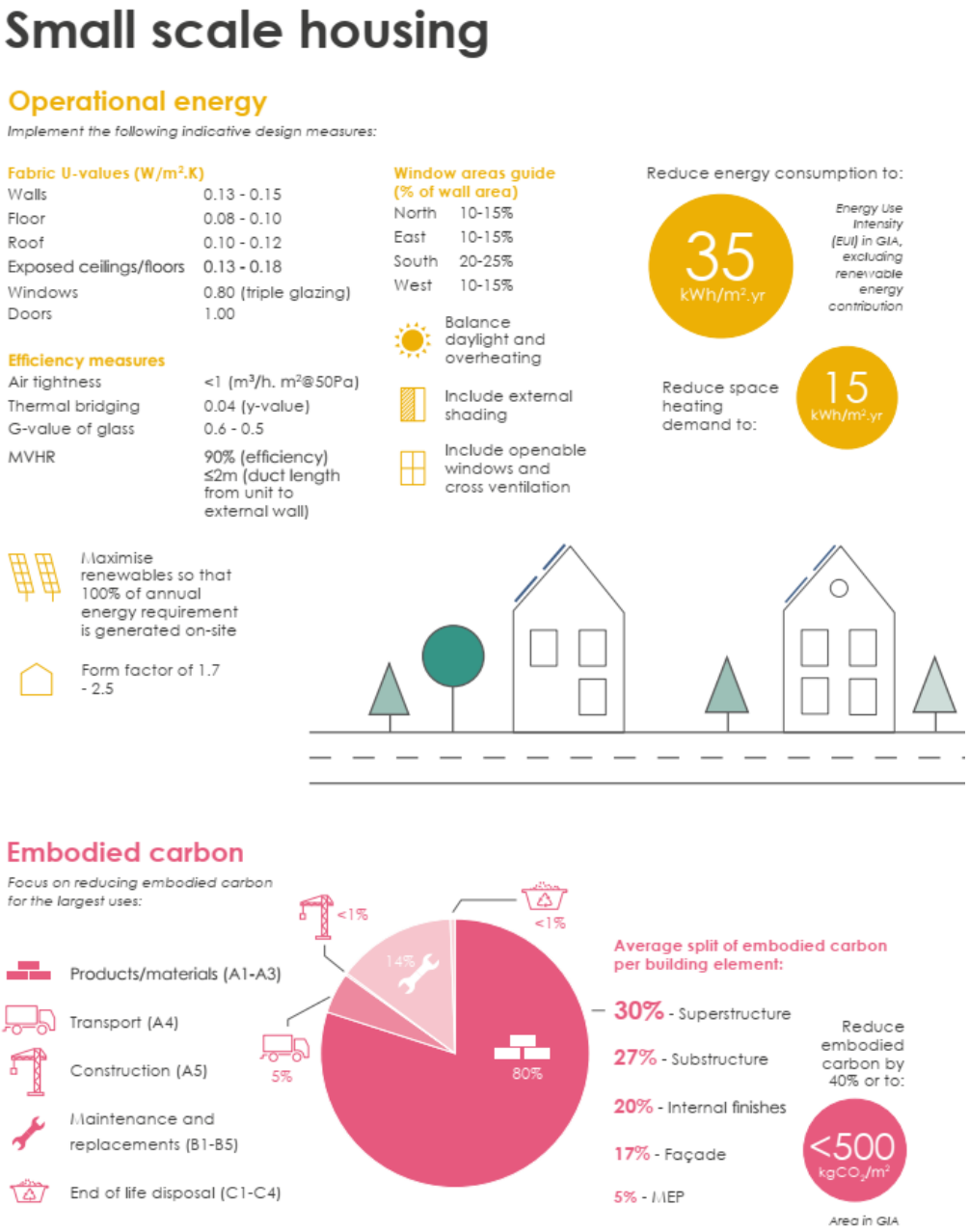


Figure 1-6 - Operational and embodied emissions targets for small scale housing

[4] https://www.leti.london/cedg

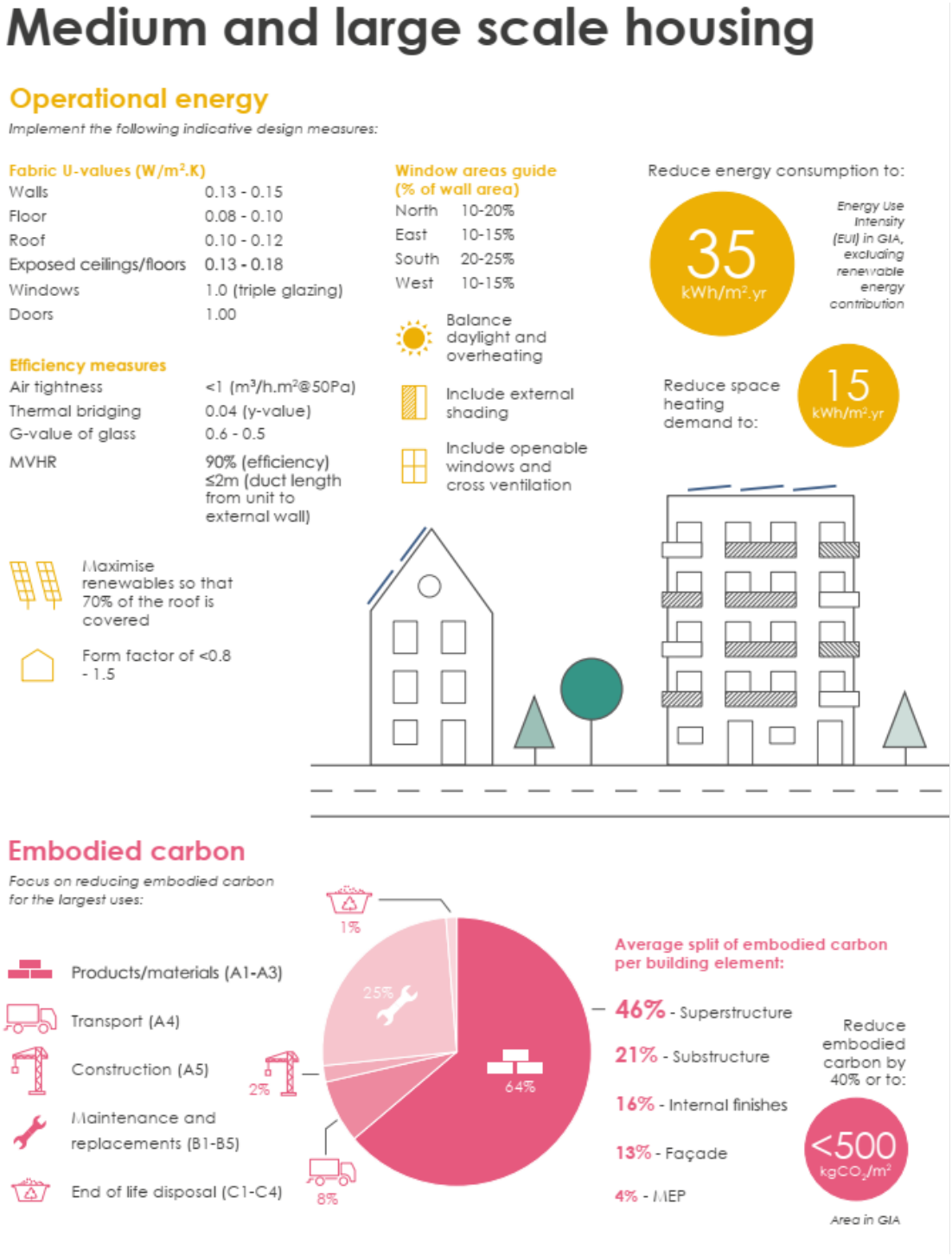


Figure 1-7 - Operational and embodied emissions targets for medium and large scale housing

Commercial offices

Operational energy

Implement the following indicative design measures:

Fabric U-values (W/m².K)

Walls	0.12 - 0.15
Floor	0.10 - 0.12
Roof	0.10 - 0.12
Windows	1.0 (triple glazing) - 1.2 (double glazing)
Doors	1.2

Fabric efficiency measures

Air tightness	<1 (m³/h. m²@50Pa)
Thermal bridging	0.04 (y-value)
G-value of glass	0.4 - 0.3

Power efficiency measures

Lighting power density	4.5 (W/m² peak NIA)
Lighting out of hours	0.5 (W/m² peak NIA)
Tenant power density	8 (W/m² peak NIA)
ICT loads	0.5 (W/m² peak NIA)
Small power out of hours	2 (W/m² peak NIA)

System efficiency measures

MVHR	90% (efficiency)
Heat pump SCoP	≥ 2.8
Chiller SEER	≥ 5.5
Central AHU SFP	1.5 - 1.2 W/l.s
A/C set points	20-26°C

Window areas guide (% of wall area)

North	25-40%
East	25-40%
South	25-40%
West	25-40%

Balance daylight and overheating

Include external shading

Include openable windows and cross ventilation

Maximise renewables to generate the annual energy requirement for at least two floors of the development on-site

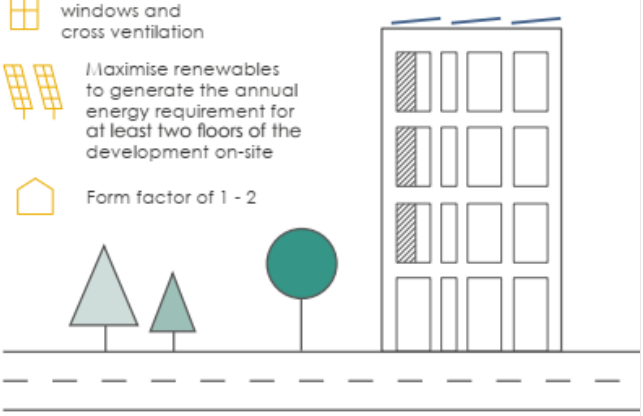
Form factor of 1 - 2

Reduce energy consumption to:

55 kWh/m².yr

Energy Use Intensity (EUI) in GIA, excluding renewable energy contribution

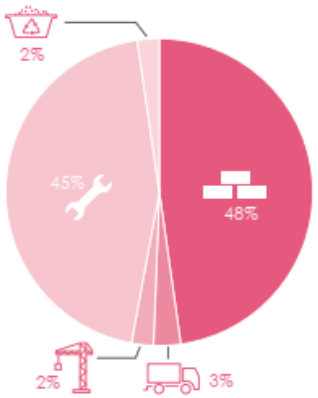
Reduce space heating demand to: 15 kWh/m².yr



Embodied carbon

Focus on reducing embodied carbon for the largest uses:

- Products/materials (A1-A3)
- Transport (A4)
- Construction (A5)
- Maintenance and replacements (B1-B5)
- End of life disposal (C1-C4)



Average split of embodied carbon per building element:

- **48%** - Superstructure
- **17%** - Substructure
- **16%** - Façade
- **15%** - MEP
- **4%** - Internal finishes

Reduce embodied carbon by 40% or to: <600 kgCO₂/m²

Area in GIA

Figure 1-8 - Operational and embodied emissions targets for offices

Schools

Operational energy

Implement the following indicative design measures:

Fabric U-values (W/m².K)

Walls	0.13 - 0.15
Floor	0.09 - 0.12
Roof	0.10 - 0.12
Windows	1.0 (triple glazing)
Doors	1.2

Fabric efficiency measures

Air tightness	<1 (m³/h. m²@50Pa)
Thermal bridging	0.04 (y-value)
G-value of glass	0.5 - 0.4

Power efficiency measures

Lighting power density	4.5 (W/m² peak NIA)
Lighting out of hours	0.5 (W/m² peak NIA)
Small power out of hours	2 (W/m² peak NIA)

System efficiency measures

MVHR	90% (efficiency)
Heat pump SCoP	≥ 2.8
Central AHU SFP	1.5 - 1.2 W/l.s

Maximise renewables so that 70% of the roof is covered

Window areas guide (% of wall area)

North	15-25%
East	15-25%
South	15-25%
West	15-25%

Balance daylight and overheating

Include external shading

Include openable windows and cross ventilation

Form factor of 1 - 3

Reduce energy consumption to:

65 kWh/m².yr

Energy Use Intensity (EUI) in GIA, excluding renewable energy contribution

Reduce space heating demand to: 15 kWh/m².yr

Embodied carbon

Focus on reducing embodied carbon for the largest uses:

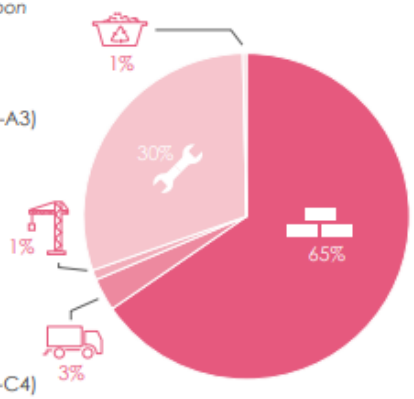
Products/materials (A1-A3)

Transport (A4)

Construction (A5)

Maintenance and replacements (B1-B5)

End of life disposal (C1-C4)



Average split of embodied carbon per building element:

- **30%** - Superstructure
- **21%** - Internal finishes
- **16%** - Substructure
- **16%** - Façade
- **13%** - MEP

Reduce embodied carbon by 40% or to: <600 kgCO₂/m²

Area in GIA

Figure 1-9 - Operational and embodied emissions targets for schools

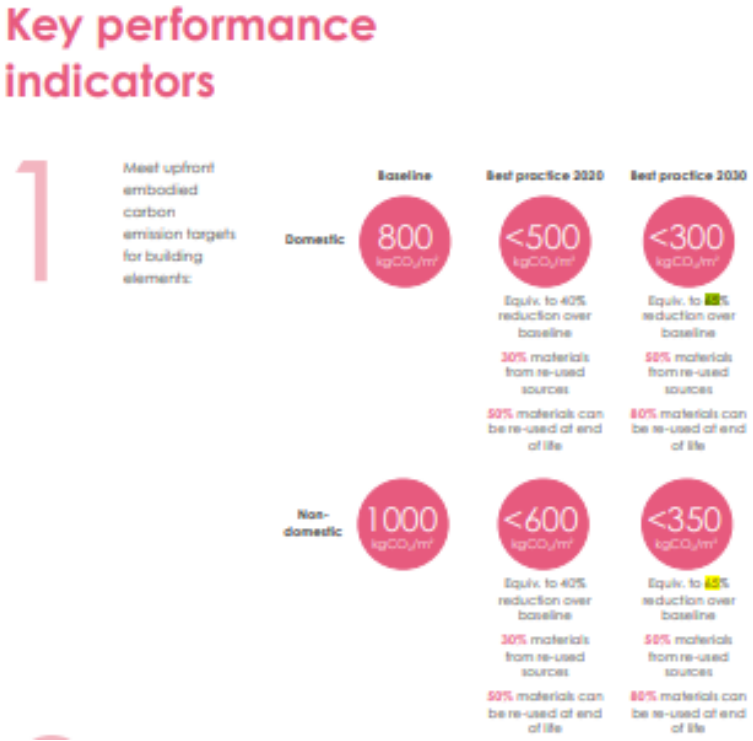


Figure 1-10- Embodied emissions targets for 2030

1.7. Existing Building Standards and Net Zero

1.7.1. Regulated, unregulated and embodied carbon emissions

Mandatory building energy performance standards are set in Part L of the Welsh Government Building Regulations as discussed in section 1.2.3. There are various voluntary UK and international standards that set higher targets. Table 1-6 presents a brief overview and comparison of these standards, focusing on those that are most commonly in use in the UK and in Wales in particular, alongside the recently revised requirements for domestic and non-domestic buildings.

An analysis of Table 1-6 shows that not all emissions associated with buildings are captured by the Building Regulations nor by most of the voluntary schemes. Revised Welsh Building Regulations, BREEAM and HQM only address CO_2 emissions resulting from the use of fixed services and appliances, i.e., heating, cooling, ventilation, hot water, and lighting. These are referred to as 'regulated' CO_2 emissions. 'Unregulated' CO_2 emissions are those that result from the use of other (typically electrical) appliances (such as fridges, home entertainment systems, etc.) and these will need be addressed in any NZ building as discussed above. Only the Passivhaus standard addresses both regulated and unregulated emissions.

In addition, embodied emissions associated with the production, manufacture, construction, maintenance, repair and demolition of buildings aren't captured by current regulations nor current standards.

1.7.2. Gap analysis between Welsh Building Regulations and Net Zero

Although the revised 2022 Welsh Building Regulations represent a marked improvement, they are still not aligned with Net Zero buildings requirements. Table 1-7 below identifies the main gaps between Regulation compliant buildings and Net Zero compliant buildings in the short term (up to 2025) and medium term (2025-30), assuming an ambitious target of Net Zero compliant buildings by 2030.

Table 1-7 - Gap analysis between Buildings Regulations and Net Zero compliant new buildings

	Regulations compliant	Net Zero compliant gap analysis
Short term (up to 2025)	**Domestic** 37% reduction in carbon emissions in new homes compared with Part L 2014. Existing flexible design approach retained, but Welsh Government example design will result in: **Heating System** Gas boilers. A heating system that has been designed to partially facilitate heat pump retrofit. **Other** Typically, a photovoltaic array and wastewater heat recovery. **Building Fabric** A building fabric that will be close to that required for net-zero, other than poorer air tightness and double glazed windows rather than triple. **Non-Domestic**	**Use of natural gas** To meet net zero in 2030, the use of natural gas would require significant offsetting. Replacing boilers of age 5-9 years in 2030 is possible, but significant perception challenges. The regulations require the heating system to be designed suitable for heat pumps, but make no mention of spatial, power, acoustic and domestic hot water considerations that are also important to allow changeover. This replacement ultimately will not make sense economically, especially when costs are likely to fall on the private owners of the building. **Building Fabric** The revised regulations look to balance carbon target with supply chain ability / confidence and with consideration of minimising to added on-cost (although this is still estimated at £5,900 to £8,300 for a typical dwelling). This fabric performance does not meet that which is envisaged for net-zero and replacing fabric elements after 5-9 years is unthinkable. **Unregulated Energy** The building regulations do not cover these energy users (household appliances / consumer goods and charging of electric vehicles are unregulated energy users), each of which will be a key component to a net zero strategy for a development.

	28% reduction in carbon emissions in new buildings compared with Part L 2014 standards.	Unregulated energy is covered in EUI targets and whole building evaluation. **Reduction in embodied carbon in new buildings** Building regulations do not consider embodied carbon. Achieving a reduction here will have to be tackled with the framework of the building regulations. **Transport** Needs to be considered in the context of how transport accessible developments can be less car reliant, but also on a micro level how buildings support EV **Other Gaps** As with individual dwelling performance, any development will have to consider its energy flows in totality to establish if it can be net zero by 2030. All new builds will require a clear pathway to zero carbon designed-in, allowing future interventions to achieve zero carbon by 2030 which can be undertaken in a cost-effective manner. This may be at a building-by-building level, but more likely to be at a neighbourhood / business estate level.
Medium term (2025 - 2030)	**Domestic** Existing flexible design approach retained, but Welsh Government example design will result in: **Building fabric**: A building fabric that should be able to deliver net-zero (not necessarily optimised to do so admittedly, given the framework of legislation). **Heating system:** No gas boilers. Heat pumps and heat networks will dominate. Other technologies, such as hydrogen, may have a role to play in heating systems of the future. However, for new homes, heat pumps and heat networks (and to a lesser extent direct electric heating) will be the principal means. **Other:** Residual systems to bring performance of the regulated services to 75-80% carbon dioxide emissions less than current regulations.	**Unregulated Energy** The building regulations do not cover these energy uses, each of which will be a key component to a net zero strategy for a development. Particularly post 2025 will see significant EV uptake. **Reduction in embodied carbon in new buildings** Building regulations do not consider embodied carbon. Achieving a reduction here will have to be tackled with the framework of the building regulations. **Transport** Needs to be considered in the context of how transport accessible developments can reduce car reliance, but also on a micro level how buildings can support EV. **Other Gaps** As with individual dwelling performance, any development will have to consider its energy flows in totality to establish if it can be net zero by 2030. All new builds will require a clear pathway to zero carbon designed-in, allowing future interventions to achieve zero carbon by 2030 which can be undertaken in a cost-effective manner. This may be at a building-by-building level, but more likely to be at a neighbourhood / business estate level. As more buildings look to be net-zero, balancing the grid energy flows becomes more and more important. Again, the Building Regulations do not address the idea of multiple buildings forming an energy system.

Non-Domestic Limited details on vision. Working assumption is that the scope of change will be similar to domestic.	This will include: • Planning new grid infrastructure based on optimised demands, not maximum projected demand, in partnership with Distribution Network Operators. • Delivery of energy via smart grids with energy storage. • Aggregation of local generation from new development in a shared Virtual Power Plant (VPP). This aggregates the smaller generators in a way that can enhance its market standing, and hence profitability.

Furthermore, it should be noted that most compliance calculations rely on modelled estimates of the building's energy demands and CO_2 emissions, but that, in real-world operation, these tend to be significantly higher than design estimates suggest. For example, research undertaken by Innovate UK, which examined the in-use performance of a selection of low carbon development schemes, found that, even though CO_2 emissions were significantly lower than in typical buildings, in-use CO_2 emissions from domestic buildings were typically 2-3 times higher than predicted, and those from non-domestic buildings were nearly 4 times higher.

In addition to setting higher building design standards, therefore, CCBC should consider requiring developers to undertake post-construction monitoring. This will be crucial to help bridge the 'performance gap' described above (between predicted or modelled emissions and those in-use emissions observed in the real world) and ensure that CO_2 reduction as indicated prior to construction are actually achieved.

Table 1-6 - Comparison between Buildings Regulations and existing voluntary standards

	WG Buildings Regs Part L 2014	WG Buildings Regs Part L revised 2022 – domestic buildings	WG Buildings Regs Part L revised 2022 – non-domestic buildings	Welsh Sustainable Buildings Standards 2019	BREEAM 'Outstanding'	Home Quality Mark	Passivhaus	Passivhaus Plus
Description	Minimum standard	Latest regulations for domestic buildings due to come into force November 2022	Latest regulations for non-domestic buildings due to come into force March 2023	Most new buildings promoted or supported by the Welsh Government or its sponsored bodies must meet these standards.	Requires a reduction in regulated CO_2 emissions, compared with Part L 2014 standards. Additional credits for achieving up to a 100% reduction (i.e., Net Zero) regulated emissions.	HQM was developed by the BRE as a rating system that can signal to householders how well the building performs based on various sustainability indicators, including energy use and CO_2 emissions.	The core focus of this standard is to dramatically reduce the requirement for space heating and cooling while also optimising comfort conditions internally.	Similar to the Passivhaus Standard, this scheme also requires renewable energy generation on-site or nearby, resulting in Net Zero emissions
Building types	Domestic and non-domestic	Domestic only	Non-domestic only	Domestic and non-domestic	Non-domestic only	Domestic only	Domestic and non-domestic	Domestic and non-domestic
Scope	Regulated energy only	Regulated energy only	Regulated energy only	Regulated energy only	Core requirements relate to regulated energy use, but additional credits can be achieved for reducing or offsetting unregulated energy use.	As for BREEAM	Regulated and unregulated energy	Regulated and unregulated energy
Target values	Based on a Target CO_2 Emission Rating (TER). The TER is calculated by determining the CO_2 emissions from a building of the same size and shape as the actual building and which is constructed according to the elemental specification set out in the 2013	37% improvement on 2014 Part L TER	28% improvement on 2014 Part L TER	Domestic buildings must meet the criteria for BREEAM accreditation. Non-domestic buildings: **Building floor area** / **Policy requirement** **<=250m²** – Exempt **251 to 1,000m²** – No BREEAM required Part L+10%* required (10% improvement	A bespoke metric is used which accounts for operational energy demand, primary energy consumption and regulated CO_2 emissions An Outstanding' rating requires at least 40% improvement on Part L 2014	As for BREEAM	Space heating demand <15 kWh/m2/year Primary energy demand <60 kWh/m2/year	Space heating demand <15 kWh/m2/year Primary [renewable] energy demand <45 kWh/m2/year

	Wales NCM Modelling Guide using one of the approved software tools.			over the TER for current Part L of the Building Regulations) **1001 to 2000m²** BREEAM 'Very Good' with 'Excellent' for Energy Credits (ENE01) **2001+m²** BREEAM 'Excellent'				
Renewable energy requirement	No	Yes, heat pumps and PVs	Yes, heat pumps and PVs	No	No	No	No, but this would typically be required to meet the targets	Yes, renewable energy generation >60 kWh/m2/year of building footprint
Embodied carbon	No	No	No	No	No	No	No	No

1.8. Net Zero new buildings

Having established that there is still a gap between the Welsh Building Regulations and Net Zero in the previous section, this section identifies the carbon reduction targets and strategy actions that would be necessary for Net Zero new domestic and non-domestic buildings in Conwy considering 2030 as the target date to achieve Net Zero. Later dates to achieve Net Zero and how transition development could look are explored in the sections that follow.

1.8.1.1. Targets

The building targets have been set based on the council's overall target of achieving Net Zero carbon and the energy hierarchy. The energy hierarchy prioritises reducing the demand as much as possible before further interventions.

Targets have been generated by an identification of what post 2030 zero carbon buildings may look like and working backwards from there to provide a clear trajectory. Critically, the targets acknowledge that it will be inconceivable that dwellings and businesses constructed over the next decade will receive major interventions in time period 2030-2035, particularly for long life-cycle elements such as building fabric.

Table 1-3 - Proposed targets for new buildings in Conwy

Timescale	Proposed targets & Justification
Prior to 2030	**No natural gas connection for space heating to any new buildings (both domestic and non-domestic)** The use of gas for heating is a large contributor to the carbon emissions for the built environment with no convincing route to grid de-carbonisation. To continue to install any heat generation technology, be it domestic boilers or non-domestic gas-fired combined heat & power would result in this plant needing to be upgraded or changed before it reaches the end of its natural lifecycle. This does not make sense economically, especially when the costs are likely to fall on the private owners of the building. The 2024 Welsh Building Regulations consultation is expected to include a requirement for no fossil fuel fired boilers to provide domestic hot water and space heating by 2025. **All new buildings pre 2030 to be operational zero carbon either through application of energy hierarchy or using onsite or offsite carbon offsets as last resort** The application of the energy hierarchy requires an approach which first reduces a building energy demands, second maximises zero or low carbon energy sources to provide for the identified demand, and finally any residual operational carbon emissions having incorporated stage 1 and stage 2, will be subject to carbon offsetting (see separate Technical Note on Carbon Offsetting). **Reduction in embodied carbon in new buildings** All new buildings achieve a 65% reduction in embodied carbon emissions[5].

[5] https://www.leti.london/cedg

Long term (2030+)	**All new domestic buildings to be operational zero carbon** Culmination of domestic strategy by 2035 at the latest. **The average impact of new non-domestic buildings to be Net Positive Carbon[6]** The net effect of new non-domestic buildings built from 2035 onwards should be an excess thermal or electrical power generation from renewables over and above that what the building consumes, so it can be used to offset Wider Conwy where it will be technically infeasible to achieve similar targets. **All new builds to be on a smart energy network** Post-2030 new buildings can start to significantly impact on energy balancing in Conwy. **Further gradual reduction in embodied carbon to achieve 100% by 2050 in new buildings** All new buildings achieve an increased reduction in embodied carbon emissions over time to achieve 100% reduction by 2050. Any residual emissions will need to be offset tying to a broader carbon offsetting strategy for this period (see Technical Note on Sequestration and Offsetting).

1.8.1.2. Outline Strategy

The following outline strategy is based on achieving the targets which have been outlined above for buildings. This strategy overlaps with the grid energy strategy (see Technical Note on Renewable Energy for further detail).

Table 1-4 - Objectives and actions for new building development in Conwy

Objectives	Actions

Energy efficient performance of buildings	• Working within the framework of Part L, identify minimum legislative standards for regulated and unregulated emissions that will apply to building types and assess whether stretch targets can be implement. Implement findings through Planning Policy. Develop in conjunction with key developers to ensure buy-in.
	  ○ Energy efficiency measures should be specified to prioritise passive design measures, using a range of carefully selected and tested options which are relevant for usage of the building/development in question.
	  ○ Passivhaus standards could be applied to certain new developments. Developments to this standard have the potential to have a 90% reduction in heat demand in comparison to new builds that are built to current regulations.
	  ○ Consideration of support that can be provided for developers to address 'unregulated' electrical loads, such as IT and office equipment, to focus on reducing overall power demand.

No natural gas usage for new build heating & hot water	• Building Regulations is currently proposing this for 2025. Mandating this earlier will achieve certain infrastructure gains that will assist in funding other measures.

[6] Carbon positive buildings go beyond zero carbon and produce more energy than they need, with carbon emissions from the building's operational energy consumption being less than the carbon emissions off-set by renewable energy generation.

	• New development should be designed to use new, innovative on site zero carbon energy technologies for hearing and hot water. This should include looking to run heating systems at lower temperatures (45°C).
New buildings to be operational Zero Carbon by 2030 and where possible to be operational Net Positive Carbon	• While this measure will require the use of the framework of Part L, this level of performance will require unregulated usage to be included within the mean figures. • Representative loads will be required from the Local Council to inform developers, recognising that such loads change regularly. • Not all homes in isolation will be able to meet these demands; this will require the Planning Authority to be able to aggregate loads from different developments / housing types. • Pre-2030, new domestic and non-domestic buildings will require a handover strategy, describing how a future transition to zero-carbon can be achieved for that building, and what future-proofing has been built in to allow this. • Setting targets for net positive carbon developments will require a developed understanding of the performance gap that exists at Conwy and whether a building-lead approach (versus grid scale intervention) can deliver best value. • Implement carbon offsetting to bridge the gap between minimum legislative standards and stretched targets for carbon emissions reduction.
Reduction of embodied carbon in new buildings	• Calculation of Life Cycle embodied carbon to be undertaken and identification of building elements that generate the most carbon emissions, allowing the designer to focus attention on areas where greater carbon mitigation interventions are possible.

1.8.2. Futureproofing buildings to facilitate retrofitting to Net Zero

As discussed above, before buildings regulations deliver Net Zero buildings, it will be important to ensure that new developments maximise opportunities to install Low or Zero Carbon (LZC) technologies – if not at the outset, then at a future date.

Key opportunities are likely to include:

• Ensuring that buildings meet a high standard of fabric efficiency, including insulation and airtightness – Reaching Net Zero will rely on reducing energy demands and switching towards the use of technologies that are powered by renewable electricity, including heat pumps and heat recovery systems. A high standard of fabric efficiency is necessary to ensure that these technologies operate at maximum efficiency. Furthermore, given that electricity is a more expensive fuel than natural gas, demand reduction is necessary to ensure that this transition minimises the increase in energy bills where possible.

• Use of low temperature heating systems that can be more easily replaced with ASHPs –In the future, the most carbon efficient form of heating is likely to involve heat pumps, which operate most efficiently when used with low-temperature heating systems. Installing radiators and pipework that are compatible with low-temperature heating systems can both reduce the cost of retrofitting a heat pump (because the pipework and radiators can be retained), and in the meantime can potentially improve the performance of a gas boiler. For example, this would likely involve underfloor heating or specifying larger radiators than would be typically used for a traditional gas boiler system.

• Maximising opportunities for renewable energy generation – The amount of electricity generated by PV depends on multiple factors, including annual solar irradiation, panel orientation, tilt and efficiency. Therefore, the design and geometry of a building, and the overall layout and solar orientation of the development, are important factors that determine how much PV can be installed.

• Allowing space for ASHPs and battery storage – ASHPs must be placed in an accessible outdoor location adjacent to the property, ideally in the open air (i.e., not within a shed or similar structure). Similarly, the design of new buildings should include space to accommodate battery systems, inverters, and other associated hardware (although it is acknowledged that the spatial requirements are likely to change over time due to technological improvements). Note that the increasing use of electric heating systems, EVs, battery storage and onsite renewable electricity generation would place significant demands on existing power infrastructure

which may require upstream reinforcements of the local grid (e.g., increasing the capacity of upstream substations and cabling). This is discussed further in the Energy Technical Note.

• Allowing access for maintenance and replacement of heating / cooling systems and other building services – This issue is more likely to arise in non-domestic buildings with designated plant rooms and ventilation systems. It is important to ensure that the design allows for easy access to all building services (e.g., door dimensions and lift facilities allowing access to plant rooms in the basement or on the roof). Designing to facilitate maintenance can also help to reduce the amount of material needed to maintain a building over its lifespan and facilitate deconstruction, aligning with Circular Economy design principles.

1.8.3. Monitoring

Developers must be required to monitor and report on operational energy use and / or CO_2 emissions, in order to confirm that the required level of improvement has been achieved, and to provide important information that will help designers to close the 'performance gap'.

2. Setting standards higher than Building Regulations

2.1. General considerations of achieving higher standards

2.1.1. New domestic buildings

An impact report produced as part of the Part L Wales Consultation in 2021 looked at the increase in build costs for new domestic buildings due to proposed new standards by contrasting two options designed to achieve improvement in energy efficiency standards in new domestic buildings. These options are:

- Option 1:
  i. High fabric standards to minimise heat loss from windows, walls, floors and roofs
  ii. Natural ventilation system
  iii. A gas boiler
  iv. A waste water heat recovery system
  v. Photovoltaic panels

- Option 2:
  i. High fabric standards to minimise heat loss from windows, walls, floors and roofs
  ii. Mechanical ventilation with heat recovery
  iii. A gas boiler
  iv. A waste water heat recovery system.
  v. Photovoltaic panels

Option 1 (less ambitious reduction, now adopted in the revised Building Regulations 2022) achieves a 37% reduction in CO_2 from new domestic buildings, compared to Part L 2014 standards. The revised regulations are expected to add £5900 to the build-cost of a new home and save households £180 a year on energy bills. This option represents the Baseline scenario in the modelling exercise described in section 2.2.

Option 2 (more ambitious reduction) achieves a 56% reduction in CO_2 from new domestic buildings, compared to Part L 2014 standards. Meeting this specification would add £8300 to the build-cost of a new home and would save households £190 a year on energy bills.[7] In addition, there is evidence that more sustainable homes and buildings may result in a higher sale or rental value, which means that some of the additional cost could be recovered in enhanced values. This more ambitious option has been tested and is referred to as the

[7] https://gov.wales/sites/default/files/consultations/2019-12/consultation-document-building-regulations-part-l-review.pdf

Domestic Buildings 'Further Consultation Option (2019)' in Scenario A of the modelling exercise described in section 2.2.

2.1.2. New non-domestic buildings

An impact report produced as part of the Part L Wales Consultation in 2021[8] looked at the increase in build costs for new non-domestic buildings due to proposed new standards by contrasting two policy options designed to achieve improvement in energy efficiency standards in new non-domestic buildings. These options are:

- Option 1 (less ambitious reduction) achieves an average 18% improvement in CO2 emissions per building, compared to the current Part L standard, across the build-mix of non-domestic buildings, compared to Part L 2014 standards. This would typically be achieved through an increase in the efficiency of building services such as lighting, and through on-site low carbon technology such as heat pumps or photovoltaic panels.
- Option 2 (more ambitious, now adopted in the revised Building Regulations 2022) achieves an average 28% improvement in CO2 emissions per building, compared to the current Part L standard, across the build-mix of non-domestic buildings., compared to Part L 2014 standards. This would typically be delivered by further adoption of low carbon technologies (e.g. larger array of photovoltaic panels) compared to Option 1.

Option 2 representing the revised Welsh building regulations for non-domestic buildings constitutes the Baseline scenario for non-domestic buildings in the modelling exercise described in section 2.2.

The estimated additional costs for each building type are set out in the table below which shows that both options will only marginally impact the viability of a limited range of proposed non-domestic new buildings.

Table 2-1 - Additional Capital Costs for non-domestic buildings

Building Type	Option 1 % cost increase	Option 2 % cost increase
Air-Conditioned Office	0.60	1.00
Primary School	0.60	1.20
Naturally Ventilated Office	0.50	1.10
Hotel	0.60	1.10
Large Warehouse	2.80	**4.60**
Medium Warehouse	3.20	4.80
Small Warehouse	2.90	4.40
Health Centre	0.80	**1.40**
Retail	3.60	4.70
Multi Residential	0.60	1.30

2.1.3. Retrofitting new buildings for Net Zero

Consideration should also be given to the opportunity costs that may occur if new buildings are not capable of meeting these requirements. The costs of retrofitting buildings to an equivalent standard are significantly higher than those for new buildings - costs of achieving higher standards via retrofit are three to five times higher than for new buildings. The cost of installing low carbon heat as a retrofit to an existing gas heated semi-detached home is around £9,000, over three times the cost than if the technology were installed in a new build. To improve fabric standards in addition to installing low carbon heat via retrofit costs range from over £16,000 to more than £25,000 per home - up to five times the costs of achieving the same standards in when first

[8] https://www.gov.wales/sites/default/files/consultations/2021-10/consultation-stage-2B-impact-assessment-part-l-wales-standards-for-non-domestic-buildings.pdf

constructing the home. For non-domestic buildings, achieving higher standards via retrofit is between approximately 3 and 10 times the costs of delivering them in a new building.

For domestic buildings, the cost of installing energy efficiency measures and low carbon heating systems can be three to five times higher if they are retrofitted, compared with installing them in new homes. The cost depends on which measures are installed but can range from around £16,000 per home[9] to upwards of £75,000 per home, as in the case of Energiesprong deep energy retrofitting projects.

Non-domestic buildings exhibit a wider range of outcomes, but as a rough estimate, the costs of installing energy saving measures and technologies may be 3 to 10 times higher when they are retrofitted than when they are installed in a new building.[9]

It is important to note that the additional costs associated with introducing higher standards can also change rapidly over time. For instance, research conducted by Element Energy on behalf of a group of Local Authorities found that, from 2011 to 2013, the cost of building to meet the (now withdrawn) Code for Sustainable Homes standard decreased by around 55%[10]. This was attributed in significant part to the rapid decrease in the cost of PV. It is possible that a similar transformation could occur if, for instance, heat pumps were to become widely adopted. The government aims to reduce the costs of low-carbon heat working with industry to reduce the costs of heat pumps by at least 25-50% by 2025 and towards parity with boilers by 2030. For example, the £60 million Net Zero Innovation Portfolio 'Heat Pump Ready' Programme is aimed at supporting the development of innovation the heat pump sector, including to improve the consumer experience in installing and using a heat pump.[11]

3. Achieving higher standards in Conwy

3.1. Policy options tested

The discussion in section 1.5 showed that to reach Net Zero new buildings in Conwy, it will be necessary to implement a range of local policies that not only require higher than current regulations CO_2 emissions reductions for regulated operational emissions, but also address unregulated operational emissions and embodied carbon emissions. It is noted that the latter two types of emissions aren't currently covered by legislative standards.

Alongside this, implementation of carbon offsetting to bridge the gap between minimum legislative standards and stretch targets for carbon emissions reduction will also be required.

Therefore, CCBC must consider introducing CO_2 emissions reductions that go beyond current Buildings Regulations, decide which emissions to cover with such reductions, define the timeframe for their introduction and application together with arrangements for offsetting carbon (for further details see Carbon Offset Fund Technical Note).

This section explores the following policy options for meeting higher standards than current regulations (with increased level of requirements with regards the type of emissions that are covered):

- Policy Option 1: New buildings (domestic and non-domestic) to achieve Net Zero operational regulated emissions, in conjunction with carbon offset fund;
- Policy Option 2: New buildings (domestic and non-domestic) to achieve Net Zero operational regulated and unregulated emissions, in conjunction with carbon offset fund;
- Policy Option 3: New buildings (domestic and non-domestic) to achieve Net Zero operational regulated, unregulated and embodied carbon emissions, in conjunction with carbon offset fund.

3.2. Testing Policy Option 1- regulated emissions

Policy Option 1: New buildings (domestic and non-domestic) to achieve Net Zero operational regulated emissions, in conjunction with carbon offset fund.

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[9] https://www.theccc.org.uk/wp-content/uploads/2019/07/The-costs-and-benefits-of-tighter-standards-for-new-buildings-Currie-Brown-and-AECOM.pdf -

[10] EP059 Costs of building to the Code for Sustainable Homes (Sept 2013) (draft).pdf (brighton-hove.gov.uk)

[11] HM Government (2021), Heat and Buildings Strategy, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1044598/6.7408_BEIS_Clean_Heat_Heat___Buildings_Strategy_Stage_2_v5_WEB.pdf

3.2.1. Emissions reductions and capital cost uplifts

To test the first policy option set out above, three scenarios with packages of measures have been analysed to establish their implications on emissions reductions and costs associated with such reductions against the baseline scenario (current regulations) for the proposed Conwy strategic allocations.

These packages of measures aim to meet higher standards than current Building Regulations (for regulated emissions) in line with the net zero targets and strategy outlined in Section 1.4 and build on more ambitious options for scenario A directly linked to Further Consultation Options 2019 (see section 2) and LETI standards for scenario B (see section 1.6.2). A third scenario C has also been tested (representing a more stringent scenario than scenario A) where gas boilers for heating are replaced by heat pumps to align with the expected direction of travel of future regulations. The three scenarios are illustrated below.

Table 3-1 - Scenarios and modelled packages of measures

<table>
<tr><th>Scenario</th><th>Measures</th></tr>
<tr><td>Baseline</td><td>Current regulations - Part L 2022 for domestic and non-domestic buildings

Energy consumption level assumptions[12] for the baseline:
<table>
<tr><th>Building type</th><th>Thermal EUI (kWh/m^2/year)</th><th>Electricity EUI (kWh/m^2/year)</th></tr>
<tr><td>Residential (average)</td><td>98</td><td>5</td></tr>
<tr><td>Office</td><td>97</td><td>43</td></tr>
<tr><td>Retail</td><td>80</td><td>50</td></tr>
<tr><td>School</td><td>123</td><td>14</td></tr>
</table>
Building cost assumptions[13]:
<table>
<tr><th>Building type</th><th>Capital cost (£/m^2)</th></tr>
<tr><td>Flat</td><td>1667</td></tr>
<tr><td>House</td><td>1450</td></tr>
<tr><td>Office</td><td>1990</td></tr>
<tr><td>Retail</td><td>1670</td></tr>
<tr><td>School</td><td>2621</td></tr>
</table>
Annual operational costs (energy bills)[14]:
<table>
<tr><th>Building type</th><th>Gas per building/ unit</th><th>Electricity per building/ unit</th><th>Gas per m^2</th><th>Electricity per m^2</th></tr>
<tr><td>Home (average)</td><td>£450</td><td>£550</td><td>£5</td><td>£6</td></tr>
<tr><td>Office building (average)</td><td>£52k</td><td>£280k</td><td>£4</td><td>£22</td></tr>
<tr><td>Retail building (average)</td><td>£8k</td><td>£170k</td><td>£3</td><td>£67</td></tr>
<tr><td>School building (average)</td><td>£13k</td><td>£12k</td><td>£5</td><td>£6</td></tr>
</table></td></tr>
</table>

[12] Data sources include: Energy consumption in new domestic buildings 2015 to 2017 (England and Wales), https://www.gov.uk/government/statistics/energy-consumption-in-new-domestic-buildings-2015-to-2017-england-and-wales, CIBSE Energy Benchmarking Tool, https://www.cibse.org/Knowledge/Benchmarking, 2019 Real Estate Environmental Benchmarks, https://www.betterbuildingspartnership.co.uk/sites/default/files/media/attachment/BBP_REEB%20Benchmarks%202019_0.pdf

[13] https://costmodelling.com/building-costs

[14] 2022 prices calculated using Green Book supplementary guidance: https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

Scenario A: Energy efficiency as per more ambitious options Renewable energy in line with regulations	Fabric improvements as per Domestic Buildings 'Further Consultation Option (2019)' (as described in section 2.1.1) Fabric improvements up to 45% above the Baseline for non-domestic buildings regulated emissions (depending on the building type; as described in section 2.1.2). *Note that this tests a more ambitious option than those tabled for the 2019 Further Consultation options for non-domestic buildings as the most ambitious option was adopted in the revised regulations.* Mechanical ventilation with heat recovery for non-domestic buildings Wastewater heat recovery Gas boilers permitted for heating Onsite renewable energy Carbon offset
Scenario B: Stretch energy efficiency targets and no fossil fuel Maximum renewable energy	Improved fabric and efficiency standards as per LETI for domestic and non-domestic buildings No gas connection (heat pumps) - coefficient of performance (COP) of 2.8 Onsite renewable energy (maximum potential and export of surplus energy) Carbon offset
Scenario C:	Fabric improvements as with Scenario A. Wastewater heat recovery. Onsite renewable energy as with Scenario A. No gas connection (heat pumps); COP 2.8 as with Scenario B. Carbon offset

Note: All figures are indicative estimates only.

Whereas for domestic buildings there is a clear point of reference for our Scenario A – which corresponds with the Further Consultation Option in 2019 ahead of the latest building regulations updates – no such point of reference was available for non-domestic buildings. This is because the 2022 regulations for Part L adopted the more ambitious of the two options set out in consultation. In setting out a new step beyond this, our approach was to incrementally improve the fabric of the building, one step beyond what was required in the updated regulations (now forming our Baseline), where cost-data could support this.

The measures (and associated elements costs) that were modelled under each scenario in relation to the baseline are presented in Tables 3-1, 3-2 and 3-3 below. The packages of measures under scenarios A, B and C address the following building elements:

- Tighter fabric standards for walls, roof, window, door and floor in terms of their u-values as well as lower air permeability and thermal bridging.
- Introduction of mechanical ventilation with heat recovery instead of natural ventilation or with better efficiency in term of heat recovery
- Introduction of wastewater heat recovery to recover heat from wastewater in bathrooms
- Introduction of rooftop PV systems
- Installation of heat pumps instead of gas boilers
- For non-residential buildings, more efficient lighting, decreased parasitic power from automatic lighting controls, cooling systems with higher efficiency, air handling units with less energy consumption

Table 3-2 - Domestic building interventions

	Baseline	Scenario A	Scenario B	Scenario C
External wall (U-value (W/m²K))	0.21	0.13	0.13	0.13
Roof (U-value (W/m²K))	0.13	0.11	0.1	0.11
Window (U-value (W/m²K))	1.4	1.3	0.8-1.0	1.3
Door (U-value (W/m²K))	1.4	1	1	1

Floor (U-value (W/m²K))	0.15	0.11	0.08	0.11
Air permeability (m³/h·m² at 50 Pa)	5	3	1	3
Ventilation	Intermittent extract fans with trickle vents	Mechanical Ventilation with Heat Recovery (MVHR)	MVHR	Mechanical Ventilation with Heat Recovery (MVHR)
Thermal bridging (W/m²K)	0.05	0.05	0.04	0.05
Wastewater heat recovery	Yes	Yes	Yes	Yes
Photovoltaics (PV)	None	40% of roof area	40% roof area for houses and 70% roof area for flats	40% of roof area
Heating system	Gas boiler	Gas boiler	Air-source heat pump (COP3.0)	Air-source heat pump (COP3.0)

Table 3-3 - Non-domestic building interventions

	Baseline	**Scenario A**	**Scenario B**	**Scenario C**
External wall (U-value (W/m²K))	0.26	0.25	0.12	0.25
Roof (U-value (W/m²K))	0.18	0.15	0.1	0.15
Window (U-value (W/m²K))	1.6	1.4	1.0	1.4
Door (U-value (W/m2K))	1.8	1.8	1.2	1.8
Floor (U-value (W/m²K))	0.22	0.15	0.09	0.15
Air permeability (m³/h·m² at 50 Pa)	5	4	1	4
Ventilation type and efficiency	Natural or MVHR 70%	MVHR 76%	MVHR 90%	MVHR 76%
Thermal bridging (W/m²K)	0.05	0.05	0.04	0.05
Lighting luminaire (llm/cW)	95	95	111	95
Parasitic power of automatic lighting controls	0.3	0.1	0.1	0.1
Cooling Seasonal Energy Efficiency Ratio (SEER)	4.5	4.5	5.5	4.5
Air handling unit (AHU) Specific fan power (SFP)	2.0	1.5	1.2	1.5
PV	20% of roof area	20% of roof area	70% roof area	20% of roof area
Heating system	Gas boiler	Gas boiler	Air-source heat pump (COP2.8)	Air-source heat pump (COP2.8)

Elemental specification costs for each of the scenarios are presented in Tables 3-5 and 3-6, for domestic and non-domestic buildings respectively.

Table 3-4 - Elemental specification costs – domestic buildings

	Baseline	**Scenario A**	**Scenario B**	**Scenario C**
External wall (£/m²)	£179	£207	£207	£207
Roof (£/m²)	£166	£170	£172	£170
Window (£/m²)	£216	£243	£297	£243
Door (£/m²)	£240	£330	£330	£330
Floor (£/m²)	£145	£170	£206	£170
Air permeability (£/m² GIFA)	£0	£5	£8	£5
Ventilation (£/unit)	£597	£2,210 semi-detached £2,360 detached	£2,210 semi-detached £2,360 detached	£2,210 semi-detached £2,360 detached
Thermal bridging	£0	£0	£0	£0
Wastewater heat recovery (£/unit)	£1,150	£1,150	£1,150	£1,150
Photovoltaics (price per system)	£1,200	£1,200	£1,200	£1,200

Heating system	£5,500 semi-detached £6,310 detached	£5,500 semi-detached £6,310 detached	£7987 semi-detached £9,275 detached	£7987 semi-detached £9,275 detached

Table 3-5 - Elemental specification costs - non-domestic buildings

	Baseline	Scenario A	Scenario B	Scenario C
External wall (£/m²)	£232	£233	£244	£233
Roof (£/m²)	£214	£216	£218	£216
Window (£/m²)	£495	£525	£585	£525
Door (£/unit)	~£600	~£600	~£600	~£600
Floor (£/m²)	£66	£71	£76	£71
Air permeability (£/m² GIFA)	£0	£4	£8	£4
Ventilation (£/unit)	£7,200 (mechanical)	£8,200	£10,533	£8,200
Thermal bridging	£0	£0	£0	£0
Lighting luminaire (£/m² GIFA)	£69	£69	£72	£69
Parasitic power of automatic lighting controls	£0	£0	£0	£0
Cooling Seasonal Energy Efficiency Ratio (£/kW)	£182	£182	£202	£182
Air handling unit (AHU) Specific fan power (£/m²GIFA)	£11	£14	£15	£14
Photovoltaics (£/kWp) *(assumes system >179kWp)*	£900	£900	£900	£900
Heating system (£/kW-th) *(assumes boiler system >150kW; or heating requirement >400kW for ASHP)*	£62	£62	£619	£619

The packages of measures identified for each scenario have been applied to each strategic site to derive energy savings, emissions reduction, uplift in capital cost and reduction in operation cost compared to the Baseline scenario considering regulated and unregulated emissions (see Appendix A for results for each site). The CAPEX uplifts for each building type vary slightly between sites; for this analysis the highest uplifts have been adopted as they represent the worst case for the universe of strategic sites considered. Note that the uplifts in capital do not include carbon offset costs in this analysis.

The business case and emissions reduction potential of scenarios A, B and C compared to the 2022 revised regulations and associated improvements in buildings standards are demonstrated in Table 3-6.

Table 3-6 - Financial implications of achieving reductions (compared to 2022 Welsh regulations costs)

Scenario	Building type	Reduction in regulated emissions	CAPEX uplift (excl. offsets; %)
A	Domestic	45%	4.6%
	Non-domestic	16% (office) 44% (school) 37% (retail)	2.0% (office) 3.1% (school) 6.1% (retail)
B	Domestic	109%	8.8%
	Non-domestic	104% (office) 137% (school) 150% (retail)	7.6% (office) 10.3% (school) 18.4% (retail)
C	Domestic	97%	5.6%

	Non-domestic	63% (office) 94% (school) 68% (retail)	3.5% (office) 5.5% (school) 9.2% (retail)

Note: All figures are indicative estimates only.

Scenarios A, B and C deliver varying reductions all of which surpassing the Welsh regulations requirements, with the more ambitious Scenario B achieving more than 100% reduction (ie. producing surplus renewable energy) for all building types and Scenario C delivering a significant improvement on Scenario A. This means that if heat pumps (instead of gas boilers) and the maximum onsite renewable energy potential are utilised, net negative carbon emissions, beyond Net Zero, can easily be achieved for regulated emissions as demonstrated in Scenario B. Scenario C, on the other hand, delivers significant reductions (although less than Scenario B) across all building types when comparing with Scenario A, as a result of heating electrification replacing gas boilers. In the case of homes and schools, regulated carbon emissions are almost eliminated through the measures implemented in Scenario C.

In terms of % uplift CAPEX costs, Scenario A uplifts range between 4.6% for domestic buildings and 2-6% for non-domestic buildings, whereas the more ambitious Scenario B (which delivers beyond Net Zero i.e. carbon negative buildings) uplifts are around 4% and 5-12% more expensive than Scenario A for domestic buildings and non-domestic buildings respectively. On the other hand, Scenario C cost uplifts are marginally more expensive than Scenario A: 1% more expensive for domestic buildings; and 1.5-3% more expensive for non-domestic buildings.

This demonstrates that further reductions, compared with current regulations for regulated emissions, are achievable, with Scenario A presenting much lower % uplift costs for all building types compared to Scenario B. A minimum policy requirement for regulated emissions reductions beyond the regulations for new developments in Conwy could therefore be aligned with Scenario A – delivering 45% reduction in emissions for domestic buildings and between 16 and 44% reduction for non-domestic buildings.

However, moving away from gas boilers for heating and instead installing air source heat pumps in Scenario C (better aligned with Net Zero ambitions) shows that % uplift costs which are only marginally higher when compared to Scenario A. Thus, if CCBC wishes to stretch policy requirements further, then Scenario C represents a more stringent policy which would deliver more significant emissions reductions (more than double for domestic and non-domestic buildings compared to scenario A) - 97% reduction in emissions for domestic buildings and between 63 and 94% reduction for non-domestic buildings.

3.2.2. Introducing carbon offset costs

The analysis above has shown that regulated emissions reductions achieved under Scenario A are short of 100% which means that, to achieve Net Zero emissions, offsets for the residual emissions would be needed. Under Scenario C, the regulated emissions reductions are higher but still short of 100%, so offsets for residual emissions would also be needed.

It is noted that no offsets would be required for Scenario B for regulated emissions as it results in carbon negative emissions (where the buildings would all be net producers of zero emissions energy). Therefore, in this section, the carbon offsetting cost analysis is focussed on scenarios A and C which require the use of offsets to achieve Net Zero.

Calculations of % uplift CAPEX costs have been undertaken for Scenarios A and C considering an offset cost of £95/tCO_2 (aligned with Greater London; see Carbon Offset Fund Technical Note for further details) and these are shown in Tables 3-7 and 3-8.

Table 3-7 – Scenario A: Financial implications of reaching Net Zero regulated emissions through carbon offsetting (compared to 2022 Welsh regulations)

Scenario	Building type	Reduction in regulated emissions (%)	Residual emissions requiring offset (%)	CAPEX uplift (excl. offsets; %)	CAPEX uplift (incl. offsets @ £95/tCO_2; %)
A	Domestic	45%	55%	4.7%	7.8%
	Non-domestic	16% (office) 44% (school)	84% (office) 56% (school)	2.0% (office) 3.1% (school)	4.9% (office) 5.1% (school)

		37% (retail)	63% (retail)	6.1% (retail)	8.5% (retail)

Table 3-8 – Scenario C: Financial implications of reaching Net Zero regulated emissions through carbon offsetting (compared to 2022 Welsh regulations)

Scenario	Building type	Reduction in regulated emissions (%)	Residual emissions requiring offset (%)	CAPEX uplift (excl. offsets; %)	CAPEX uplift (incl. offsets @ £95/tCO_2; %)
C	Domestic	97%	3%	5.6%	6.8%
	Non-domestic	63% (office) 94% (school) 68% (retail)	37% (office) 8% (school) 32% (retail)	3.5% (office) 5.5% (school) 9.2% (retail)	7.2% (office) 6.3% (school) 10.4% (retail)

For domestic buildings, the analysis shows that the introduction of carbon offset costs together with the measures under Scenario A leads to an increase of 3.1 % (from 4.7% to 7.8%) in the cost. For scenario C, the introduction of carbon offset costs leads to a smaller increase of 1.2% (from 5.6% to 6.8%) and the cost uplift works out lower than that of scenario A (6.8% comparing to 7.8%).

For non-domestic buildings, % increases in cost uplift associated with the carbon offset costs are also noted for both scenarios. Under Scenario A, for offices the increase is 2.9% (from 2% to 4.9%), for schools 2% (from 3.1% to 5.1%) and for retail 2.4% (from 6.1% to 8.5%). For scenario C, the introduction of carbon offset costs leads to an increase in the cost uplift of 4.2% (from 3.5% to 7.2%) for offices, 0.8% (from 5.5% to 6.3%) for schools and 1.2% (from 9.2% to 10.4%). Scenario A cost uplifts are therefore lower than those for Scenario B.

Thus from a capital cost uplift perspective, it can be concluded that the application of a carbon offset cost of £95/tCO_2 together with Scenario B measures would work out cheaper than with Scenario A for domestic buildings. The situation for non-domestic buildings works in the opposite way with Scenario A measures working out cheaper after the application of carbon offsets at £95/tCO_2.

3.2.3. Additional capital costs for strategic sites

This section further considers the additional costs of reducing regulated emissions at the five strategic sites looking at two different offset costs (£95/tCO_2 and £260/tCO_2) to further inform the development of RLDP policy.

Based on the gross internal area information provided for each strategic site proposed to be allocated in the RLDP, additional costs were estimated. The sites included in the analysis are:

- Abergele: commercial office, retail (food), primary school
- Llanfairfechan: 250 homes, primary school
- Llanrhos: 200 homes, primary school
- Llanrwst: 200 homes
- Old Colwyn (Ty Mawr and Peulwys): 530 homes, retail (food)

The gross internal area of the sites per building type is provided below:

Table 3-9 - Gross internal area (m^2) of buildings in strategic sites

Building type	Abergele	Llanfairfechan	Llanrhos	Llanrwst	Old Colwyn
Total	**21,088**	**24,396**	**19,940**	**17,940**	**45,094**
Residential	N/A	22,396	17,940	17,940	44,794
Non-residential (total)	21,088	2,000	2,000	N/A	300
Office	12950	N/A	N/A	N/A	N/A
School	3,400	2,000	2,000	N/A	N/A

Retail	4,738	N/A	N/A	N/A	300

Note: All figures are based on data provided by CCBC.

Utilising the additional cost per square metre of achieving higher standards presented in the tables above and gross internal areas presented, additional capital costs have been calculated for each strategic site, first without carbon offsets (see Table 3-10) and after considering the two possible costs of offsets, as illustrated in Tables 3-11 and 3-12 respectively. Note that adoption of Scenario B would not require the use of offsets as concluded in the section above so the additional cost for strategic sites under this scenario remains the same throughout the analysis.

Table 3-10 – Additional cost of policy options for strategic sites (regulated emissions; before offsets)

Option	Building type	Additional capital cost per strategic site (£)				
		Abergele	Llanfairfechan	Llanrhos	Llanrwst	Old Colwyn
Scenario A	**Total**	**£513k**	**£1,486k**	**£1,204k**	**£1,133k**	**£2,850k**
	Residential	**N/A**	**£ 1,415k**	**£1,133k**	**£1,133k**	**£2,842k**
	Non-residential (total)	**£513k**	**£71k**	**£71k**	**N/A**	**£8k**
	Office	£271k	N/A	N/A	N/A	N/A
	School	£122k	£71k	£71k	N/A	N/A
	Retail	£120k	N/A	N/A	N/A	£8k
Scenario B	**Total**	**£2,496k** *(+387%)**	**£3,044k** *(+105%)**	**£2,507k** *(+108%)**	**£2,157k** *(+90%)**	**£5,508k** *(+93%)**
	Residential	**N/A**	**£2,694k**	**£2,157k**	**£2,157k**	**£5,452k**
	Non-residential	**£2,496k**	**£350k**	**£350k**	**N/A**	**£56k**
	Office	£1,723k	N/A	N/A	N/A	N/A
	School	£596k	£350k	£350k	N/A	N/A
	Retail	£883k	N/A	N/A	N/A	£56k
Scenario C	**Total**	**£1,385k** *(+169%)**	**£1,869k** *(+26%)**	**£1,529k** *(27%)**	**£1,364k** *(20%)**	**£3,529k** *(24%)**
	Residential	**N/A**	**£1,704k**	**£1,364k**	**£1,364k**	**£3,506k**
	Non-residential	**£1,385k**	**£165k**	**£165k**	**N/A**	**£23**
	Office	£734k	N/A	N/A	N/A	N/A
	School	£280k	£165k	£165k	N/A	N/A
	Retail	£371k	N/A	N/A	N/A	£23

**Cost difference is given as a percentage change from Scenario A.*

The results in Table 3-11 for the five strategic allocations reflect the preliminary conclusions in section 3.2.1 that capital costs for Scenario A and C are cheaper than Scenario B with figures varying depending on strategic allocation:

- scenario B results in an increase in capital costs between £2.5m and £5.5m;
- scenario C results in an increase in capital costs between £1.4m and £3.5m; and
- scenario A results in an increase in capital costs between £0.9m and £2.9m.

Table 3-11 – Additional cost of policy options for strategic sites, including the price of offsets at £95/tonne

Option	Building type	Additional capital cost per strategic site – *incl. offsets at £95/tonne*				
		Abergele	Llanfairfechan	Llanrhos	Llanrwst	Old Colwyn
Scenario A plus offsets	**Total**	**£1,577k**	**£2,414k**	**£2,027k**	**£1,814k**	**£4,575k**
	Residential	**N/A**	**£2,265k**	**£1,878k**	**£1,814k**	**£4,556k**
	Non-residential (total)	**£1,577k**	**£149k**	**£149k**	**N/A**	**£19k**
	Office	£1,017k	N/A	N/A	N/A	N/A
	School	£254k	£149k	£149k	N/A	N/A
	Retail	£306k	N/A	N/A	N/A	£19k
Scenario B (no need for offsets)	**Total**	**£2,496k** *(+59%)**	**£3,044k** *(+26%)**	**£2,507k** *(+24%)**	**£2,157k** *(+19%)**	**£5,508k** *(+20%)**
	Residential	**N/A**	**£2,694k**	**£2,157k**	**£2,157k**	**£5,452k**
	Non-residential	**£2,496k**	**£350k**	**£350k**	**N/A**	**£56k**
	Office	£1,723k	N/A	N/A	N/A	N/A
	School	£596k	£350k	£350k	N/A	N/A
	Retail	£883k	N/A	N/A	N/A	£56k
Scenario C plus offsets	**Total**	**£1,933k** *(+23%)**	**£2,194k** *(-9%)**	**£1,840k** *(-9%)**	**£1,580k** *(-13%)**	**£4,127k** *(-10%)**
	Residential	**N/A**	**£1,973k**	**£1,580k**	**£1,580k**	**£4,049k**
	Non-residential	**£1,933k**	**£196k**	**£196k**	**N/A**	**£29k**
	Office	£1,135k	N/A	N/A	N/A	N/A
	School	£333k	£196k	£196k	N/A	N/A
	Retail	£465k	N/A	N/A	N/A	£29k

**Cost difference is given as a percentage change from Scenario A.*

When considering offsets at a cost of £95/tonne (Table 3-11), Scenario C has become the cheapest option across all strategic sites, at a cost of £11.7m compared with £12.4m for Scenario A. This is reflected in the percentage changes, where all sites besides Abergele are cheaper by 9-13% than their Scenario A equivalent, varying between £1.58m and £4.58m. Abergele is 23% more expensive, reflecting the high proportion of office buildings for this site.

In addition, and despite the introduction of carbon offsets to cover residual emissions and reach net zero (which is required for the other two scenarios), Scenario B remains the most expensive option across sites, even though it needs no offsets.

Table 3-12 – Additional cost of policy options for strategic sites, including the price of offsets at £260/tonne

Option	Building type	Additional capital cost per strategic site – *incl. offsets at £260/tonne*[15]				
		Abergele	Llanfairfechan	Llanrhos	Llanrwst	Old Colwyn
Scenario A plus offsets	**Total**	**£3,422k**	**£4,026k**	**£3,281k**	**£2,997k**	**£7,572k**
	Residential	**N/A**	**£3,742k**	**£2,997k**	**£2,997k**	**£7,532k**
	Non-residential (total)	**£3,422k**	**£284k**	**£284k**	**N/A**	**£40k**
	Office	£2,309k	N/A	N/A	N/A	N/A
	School	£484k	£284k	£284k	N/A	N/A
	Retail	£629k	N/A	N/A	N/A	£40k
Scenario B (no need for offsets)	**Total**	**£2,496k** *(-27%)**	**£3,044k** *(-24%)**	**£2,507k** *(-24%)**	**£2,157k** *(-28%)**	**£5,508k** *(-27%)**
	Residential	**N/A**	**£2,694k**	**£2,157k**	**£2,157k**	**£5,452k**
	Non-residential	**£2,496k**	**£350k**	**£350k**	**N/A**	**£56k**
	Office	£1,723k	N/A	N/A	N/A	N/A
	School	£596k	£350k	£350k	N/A	N/A
	Retail	£883k	N/A	N/A	N/A	£56k
Scenario C plus offsets	**Total**	**£2,888k** *(-16%)**	**£2,690k** *(-33%)**	**£2,204k** *(-28%)**	**£1,954k** *(-35%)**	**£5,029k** *(-34%)**
	Residential	**N/A**	**£2,440k**	**£1,954k**	**£1,954k**	**£4,991k**
	Non-residential	**£2,888k**	**£250k**	**£250k**	**N/A**	**£38k**
	Office	£1,833k	N/A	N/A	N/A	N/A
	School	£425k	£250k	£250k	N/A	N/A
	Retail	£630k	N/A	N/A	N/A	£38k

**Cost difference is given as a percentage change from Scenario A.*

However, when considering a carbon offset cost aligned with HM Treasury Green Book (£260/tonne expected by 2025), the results in Table 3-11 show that Scenario C plus offsets, and to a lesser extent Scenario B, would work out cheaper than Scenario A plus offsets across all strategic sites:

- Scenario C plus offsets would result in a decrease in total capital costs of 16-35% across sites when compared to Scenario A plus offsets with total additional costs per site ranging from £1.9m to £5m.
- The most ambitious Scenario B (which does not require offsets) would result in a decrease in total capital costs of 24-28% across sites when compared to Scenario A plus offsets. The total additional costs per site would range between £2.5m and £5.5m.

The results indicate that a higher carbon offset cost (better aligned with the true cost of carbon emissions to society) makes Scenario B a more cost-effective approach for non-domestic emissions but that overall Scenario C plus offsets delivers the necessary reductions at the least cost across all sites bar Abergele.

The results also highlight the importance of setting a carbon offset fund with a carbon price that provides adequate incentive for sufficient carbon reduction measures to be put into place without placing an excessive cost 'burden' on the different types of development.

In conclusion:

- a price of £95/tCO2 will unlikely provide the necessary incentive for the use of heat pumps instead of gas boilers as in Scenario C. This would mean CCBC policy lacking in ambition by not being able to

[15] HM Treasury Green Book valuation for traded CO_2e emissions for 2025. Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal - GOV.UK (www.gov.uk)

align with the expected direction of travel in terms of heating national policy, as signalled by the future price point of each tonne of CO_2 set out by HM Treasury.

- a price of £260/tCO_2 will likely result in the adoption of Scenario B for some (if not all) types of development potentially leading to lesser need for a Carbon Offsetting Fund, although one such fund would need to be set up to provide the necessary flexibility to developers in case Scenario C plus offsets makes for a better economic case. It is therefore recommended that CCBC aligns itself with Green Book offset costs when setting up a Carbon Offset Fund (for more detail see Carbon Offset Technical Note).

3.3. Payback of carbon reduction measures

The term payback period refers to the amount of time it takes to recover the cost of an investment. Simply put, it is the length of time an investment reaches a breakeven point.

Fabric measures are known to have long payback periods (normally 25 years for non-domestic buildings and over 50 years for domestic buildings) and high capital cost per lifetime carbon savings. While they are less cost-efficient than other measures, it is not possible to move towards and achieve zero carbon development without applying fabric measures first. Fabric measures also help decrease capital costs of other measures by reducing energy demand hence reducing the heat pump and PV size needed.

Energy efficiency measures in non-residential buildings such as improving efficiency of lighting, cooling and air handling unit can provide short payback periods (5-10 years) and positive financial return but for domestic buildings the payback periods for equivalent measures can also be well over 25 years.

While onsite PV has a higher capital cost per carbon saved over its lifetime, it provides a shorter payback period compared to other measures. New data from the Carbon Brief[16] shows that the solar panel payback period is now just over four years through the savings on energy bills. These statistics are based on the payback period for a £4,300 rooftop solar system, with a power capacity of 3kW. In October 2020, the payback period was 16.7 years, but under the current price cap, this reduces to 11.1 years. By April 2023, when the predicted average energy bill could hit £5,277, the payback time is set to drop to just 4.1 years.

Until recently, heat pumps did not payback over the lifetime of a building due to the much cheaper price of gas compared to the price of electricity, but the situation has changed substantially due to the difference between the unit rates of electricity and gas becoming much closer in the UK as a result of global events linked to the war in Ukraine. An analysis has been undertaken in this Technical Note to establish the payback time of heat pumps at the five strategic sites to take account of recent events (see Appendix B). It has been found that heat pumps pay back after 8-9 years in the case of domestic, and 12-19 years in the case of non-domestic buildings, across the five sites.

It is thus concluded that all carbon reduction measures considered in this Technical Note for regulated emissions will pay back during the lifetime of the equipment and will result in lower energy bills and lower operational costs for the buildings occupants.

3.4. Testing Policy Option 2 – adding unregulated emissions

Policy Option 2 adds operational unregulated emissions to Policy 1 and would require new buildings (domestic and non-domestic) to achieve Net Zero operational regulated and unregulated emissions, in conjunction with carbon offset fund.

As already discussed in this Technical Note, regulated emissions arise from building energy consumption resulting from the specification of controlled, fixed building services and fittings, including space heating and cooling, hot water, ventilation, fans, pumps and lighting. Such energy uses are inherent in the design of a building and although designers may not be able to predict how the services and fittings will be used, such services and fittings can be designed to more energy efficient specifications. This is what Policy Option 1 does.

Unregulated emissions, on the other hand, arise from building energy consumption resulting from a system or process that is not ‘controlled’, i.e. energy consumption from systems in the building on which the Building Regulations do not impose a requirement. This may include energy consumption from systems integral to the building and its operation, e.g. IT equipment, lifts, escalators, refrigeration systems, external lighting, ducted-fume cupboards, servers, printers, photocopiers, laptops, cooking, audio-visual equipment and other appliances.

[16] https://www.carbonbrief.org/

Unregulated emissions can represent a significant percentage of emissions depending on building typology. Drawing from known quantities produced by our models, for domestic buildings, unregulated emissions can amount to 15% of the total emissions and percentages do vary for non-domestic buildings: 33.5% (office); 12% (school); and 70% (retail) – see Appendix A.

Unlike regulated energy use, unregulated energy consumption is usually only determined very late in the design process and it can also vary throughout the building lifecycle. This is because buildings may have different occupants or uses over their lifetime and predicting user behaviour becomes difficult. This means that making developers accountable for total operational energy usage is problematic as it is something they can only partly influence as part of the development process. This also makes any meaningful analysis of reduction measures for such emissions problematic as part of this study.

Currently, there is only one Local Authority in the UK that includes unregulated emissions as well as regulated emissions as part of its offsetting requirement - Islington in London (see Carbon Offset Technical Note) - and the Council has been challenged multiple times for including unregulated emissions as part of its policy requirement. The Council's response is that special circumstances and opportunities for decentralised energy networks, provide Islington with the incentive and opportunity to set ambitious, locally-specific sustainability standards which build on national policy. It is understood that such special circumstances and opportunities are not present for Conwy's new development.

A possible way forward for CCBC to include unregulated emissions as part of the offsetting requirement could be to provide flexibility if a developer is faced with a shortfall in regulated emissions reductions required by CCBC but can demonstrate a good method of decreasing unregulated emissions on-site. Unregulated emissions from any part of the development would need to be minimised and reported separately to regulated emissions within the energy assessment. In this instance CCBC would calculate the net on-site savings due to the reduction in unregulated emissions prior to the S106 payment.

3.5. Testing Policy Option 3 – adding embodied carbon

Policy Option 3 adds embodied carbon emissions to Policy 2 and would require new buildings (domestic and non-domestic) to achieve Net Zero operational regulated and unregulated emissions and embodied carbon emissions, in conjunction with carbon offset fund.

As already highlighted in this Technical Note, embodied carbon emissions, or the carbon emissions associated with building materials and construction, can represent as much as 50% of total operational emissions across building types and the trend is for that percentage to continue to increase as both the electricity grid decarbonises and operational emissions decrease due to increased efficiency. So, it is important that these emissions are considered in any development and they are indeed being increasingly recognised in infrastructure with regulation in specific sectors. For example, in the rail industry, the High Level Output Specification (HLOS) requires consideration of traction and no-traction carbon emissions from railway activities. Similarly, Ofwat required all water companies to produce a capital and operational carbon footprint of their proposed asset investment and management programme. However, as already discussed in this Technical Note, no regulatory targets for embodied carbon emissions exist in Wales nor in the whole of the UK.

If CCBC were to include embodied carbon emissions as part of its offsetting requirements, developers would need to potentially address an additional 50% emissions and failure to achieve any meaningful reductions could result in potentially very high offset payments.

An alternative net on-site savings approach for embodied carbon, such as that described above for unregulated emissions, could result in regulated emissions reductions not being sufficiently pursued given the significant amount of embodied carbon emissions that could potentially be reduced in a cheaper way and that would go against the energy hierarchy approach for building design.

It is therefore recommended that CCBC doesn't include embodied carbon in its offsetting requirement but instead sets policy requirements for quantification of such emissions and adopts a guiding target of 65% reduction aligning with LETI.

4. Policy Recommendations

4.1. 2019 RLDP Preferred Strategy

Conwy's Replacement Local Development Plan (RLDP) Preferred Strategy published in 2019 sets out two strategic policies that touch upon the need to maximise energy efficiency and encourage decarbonisation in buildings:

Strategic Policy 5 (SP/5): Placemaking and Good Design

To contribute to Sustainable Placemaking and address the 5 key aspects of Good Design, development proposals should address 'Environmental Sustainability' by seeking to maximise energy efficiency and the efficient use of other resources (including land), maximise sustainable movement, minimise the use of non-renewable resources, encourage decarbonisation and prevent the generation of waste and pollution.

Strategic Policy 32 (SP/32): Energy
To promote a mix of energy generation sources, energy storage and building design which deliver clean growth and contribute to decarbonisation of energy as well as being resilient to the impacts of climate change.

The previous sections of this Technical Note set out the measures available to deliver buildings decarbonisation, recommended a strategy and targets and provided an indication of costs of additional carbon reduction measures if they were to be implemented in new buildings under three different scenarios of varying carbon performance alongside the use of offsets for residual emissions.

Below policies are proposed for the RLDP together with a justification.

4.2. Proposed RLDP policies

4.2.1. Buildings operational emissions

In preparing buildings policy in support of site allocations, CCBC should consider adopting the following approach for operational emissions:

Developers are required to address carbon emissions by applying the energy hierarchy sequentially to achieve operational net zero emissions as follows:

1: **Reduce energy demands**. Developments should be designed to minimise demand for energy (heating, cooling, hot water, lighting and power in operation), thereby minimising carbon emissions. This involves:

a) Considering the potential for technology that enables occupants to live in ways that minimise energy demands.

b) Maximising energy efficiency.

2: **Electrify remaining demand for space heating**. For homes, heating remains the greatest source of carbon emissions. Removing the use of gas for heating is the single measure with the largest impact on emissions.

a) Prohibit the use of gas, oil or any similar fuel in space heating ('fossil fuel-free heating').

b) Recommend the use of heat pumps that are suitable for the site. These will typically be air-source heat pumps (ASHP), but in some select cases, other forms of electrified heat may be suitable.

c) Require designers/developers to show how they have sufficiently sized the heat pumps or other fossil fuel-free heating provision for the expected space heating requirement, *and* that they have met any ground-level space requirements for the necessary equipment (on the interior and exterior of the buildings).

3: **Zero or low-carbon power generation**. To meet remaining energy demands in operation, including the increased electrical demand created by step (2), developments should incorporate or utilise zero or low carbon energy sources. This involves:

a) Maximising renewable energy sources within the development (especially solar PV).

b) Mandating the use of a minimum 40% of rooftop space for solar PV for homes, and 20% for non-residential buildings[17].

c) Considering the potential to utilise offsite large scale offsite renewable or low carbon energy sources such as heat networks or local large-scale renewable energy generation sources, through a direct connection to the development.

4: **Carbon Offsetting**. Developments that result in residual operational carbon emissions having incorporated stages 1, 2 and 3, will be subject to carbon offsetting requirements to bring the total operational carbon emissions to net zero in accordance with carbon offsetting Technical Note policy recommendations.

5: **Monitoring:** Developments must monitor and report on operational energy use and / or CO2 emissions, in order to confirm that the required level of improvement has been achieved, and to provide important information that will help designers to close the 'performance gap'.

It has been demonstrated in the worked examples in Section 3 that through a combination of energy efficiency measures, decarbonised heat supply and onsite renewable energy generation, it is possible to further reduce buildings carbon emissions for the proposed strategic allocations for regulated emissions.

The achievement of Net Zero operational buildings, however, is either reliant on carbon offsets for the less ambitious scenario A and to a less extent for scenario C or the application of the measures that form the more ambitious Scenario B without the need for offsets.

Note that some flexibility may need to be offered to developers as they size the solar PV panels to provide electricity for lighting and other needs. Heat pumps are an evolving product and range of performance levels are offered to the market. These will affect the energy required to operate them. There may be trade-offs between the performance of the heat pumps and the quantity of peak capacity PV designed onto the roofs – so both should be specified.

However, there are some limitations to the current study as the calculations to estimate the recommended reduction targets have been carried out based on certain assumptions for building form, density, gross internal area and building element areas, hence the actual emissions reduction that can be achieved will vary from one development to the other. Also, the results are based on three intervention scenarios with selected measures, and there are many other solutions and routes the developers can follow to achieve net zero buildings. It may not always be feasible to achieve these results depending on the building type or site limitations, especially reductions that can be achieved may differ greatly across different non-residential building types. Similarly, depending on the site conditions and possible interventions, it may be possible to achieve even higher reduction levels for some sites.

Therefore, it is recommended that, for new building development, CCBC set policy for higher reduction than the 2022 revised building regulations alongside carbon offsetting and that regulated emissions only are included in such policy.

CCBC will need to decide if the policy applies to all building development or just major development. The recommendation from this work is that it should apply to all building development.

Development Management Policy B1: Achieving Net Zero Carbon Buildings

All new domestic and non-domestic build development should achieve net zero operational regulated carbon emissions in buildings by implementing the energy hierarchy.

Proposals should demonstrate application of the energy hierarchy through submission of an Energy Statement which identifies:

- For new domestic buildings, a minimum 45% reduction for regulated emissions is achieved by on-site measures, as compared to the baseline emission rate set by Building Regulations Part L 2022
- For new non-domestic buildings, a minimum 16% reduction in regulated emissions is achieved by on-site measures, as compared to the baseline emission rate set by Building Regulations Part L 2022

All new buildings must:

- demonstrate use of the energy hierarchy through compliance with the policy provisions on energy efficiency (Management Policy B2) and renewable energy (Management Policy B3)
- provide electric vehicle charging as per RLDP policy on EVs

[17] Within the Building Regulations 2022, 40% (adjusted for number of storeys) forms part of the elemental specification in Appendix E. It is technically possible to deviate from this and meet the target primary energy rate required, by making up the energy gap through some other measure.

- offset all remaining carbon emissions (over the course of 30 years) to zero in accordance with RLDP carbon offset policy provisions

Where full compliance is not feasible/viable, proposals must pursue carbon reductions to the greatest extent feasible and viable and must still submit an energy statement demonstrating this. Where there are such constraints, proposals are expected to implement fabric energy efficiency and low carbon heating (not gas) before moving on to renewable electricity generation or carbon offsetting.

Proposals could also voluntarily reduce some or all unregulated carbon emissions to the greatest extent feasible and viable and present such information as part of an Energy Statement which will show how a development (domestic and non-domestic) has been designed to reduce energy use considering:

- Baseline annual CO_2 emissions and energy costs
- CO_2 improvements due to energy efficiency of the building fabric
- CO_2 improvements due heating, ventilation and lighting factors
- CO2 improvements from low and renewable energy technologies
- The contribution and cost breakdown of each proposed improvement measure
- Costs to occupants during operation
- Value of the offset payment which will be paid into Carbon Offset Fund to make up any shortfall to achieve net zero-carbon, where required.

Development Management Policy B2: Energy efficient buildings

All new build development is expected to demonstrate that achievement of the targets set in Management Policy B1 results from first minimizing energy consumption and second improving building energy performance through energy efficiency measures (fabric efficiency, efficient services and efficient energy supply, before considering electrification of heating (Management Policy B3) and production of renewable energy (Management Policy B4).

Where full compliance is not feasible or viable having regard to the type of development involved and its design, proposals must demonstrate through the energy statement that carbon reductions to the greatest extent feasible through energy efficiency measures have been considered and incorporated.

Proposals must demonstrate the extent to which compliance with this policy is achievable through the Energy Statement.

Development Management Policy B3: Electrification of Heat

No new build development will be heated by fossil fuels.

Development proposals must show:

- the use electric heating that that is suitable for the site. These will typically be air-source heat pumps (ASHP), but in some select cases, other forms of electrified heat may be suitable.
- sufficiently sized heat pumps or other fossil fuel-free heating provision for the expected space heating requirement, and sufficient ground-level space for the necessary equipment.

Proposals must demonstrate the extent to which compliance with this policy is achievable through the Energy Statement.

Development Management Policy B4: Zero or Low Carbon Energy Sources and Zero Carbon Ready Technology

All new build development must demonstrate:

- How the layout, orientation and massing have been designed to maximise opportunities for onsite renewable and low carbon technologies.
- Provision of additional renewable and low carbon energy technologies onsite, including battery storage if necessary, sufficient to match the remainder of the building's annual regulated energy needs, subsequent to the achievement of the required reduction in regulated emissions as set out in RLDP policy provision.

Where there is a direct off-grid connection to the development which has capacity to serve the development, the additional renewable energy can be provided by off site existing or planned low carbon or renewable energy generation or heat network provision.

If full compliance is not feasible or viable, proposals must demonstrate through the energy statement that:

- additional renewable, zero and low carbon energy technologies have been provided to the greatest extent feasible and viable; and
- 'zero carbon ready' (as opposed to immediately providing 'low/zero carbon') technologies have been incorporated.

Proposals incorporating onsite heat technologies claimed to be 'zero carbon ready' (as opposed to immediately 'low/zero carbon' technologies) will only be accepted where that technology is already available and its transition to zero carbon is based on realistic current projections of the time period in which its carbon will be eliminated. 'Zero carbon ready' heat technologies that rely on speculative future technological advances and use onsite fossil fuels meanwhile, will not be accepted.

Proposals must demonstrate the extent to which compliance with this policy is achievable through the Energy Statement.

Development Management Policy B5: Monitoring carbon emissions post-construction

Proposals must show how post-construction monitoring will take place to ensure that operational regulated CO_2 emissions reduction calculated as part of the planning application is achieved once the buildings are occupied (post-construction).

4.2.2. Buildings unregulated carbon emissions

As discussed, CCBC could include unregulated emissions as part of the offsetting requirement to provide flexibility if a developer is faced with a shortfall in regulated emissions reductions required by CCBC.

Development Management Policy B6: Unregulated carbon emissions in buildings

Proposals must calculate unregulated carbon emissions for new buildings separately and show that a reduction has been achieved in such emissions in comparison to best practice design specifications at the time of preparation of the proposals.

If a developer is faced with a shortfall in the regulated emissions reductions required in Policy B1 but can demonstrate a good method of decreasing unregulated emissions on-site, these reductions maybe considered by CCBC in substitution for reduction in regulated emissions through a calculation of net on-site savings prior to the S106 payment.

Proposals must demonstrate the extent to which compliance with this policy is achievable through the carbon reduction statement as set out in Policy GHG emissions assessment for new development.

4.2.3. Buildings embodied carbon emissions

As discussed, CCBC could introduce policy that aims to reduce emissions related to buildings embodied carbon. As embodied emissions are not proposed to be covered by offsets there would be no formal mechanism to provide for any shortfalls. LETI embodied carbon targets could be adopted as a guide.

Development Management Policy B6: Embodied carbon emissions in buildings

Proposals must calculate embodied carbon emissions for new buildings and show that a reduction has been achieved in such emissions in comparison to best practice design specifications at the time of preparation of the proposals. There is an expectation that emissions reductions achieved will be informed by the following targets: 65% reduction by 2030 and 100% reduction 2050.

Proposals must demonstrate the extent to which compliance with this policy is achievable through the carbon reduction statement as set out in Policy GHG emissions assessment for new development.

4.2.4. Provision of electric vehicle charging in buildings

In anticipation of regulations in Wales requiring infrastructure for charging electric vehicles to be provided at all new buildings, CCBC should introduce such policy requirement in the RLDP from the outset.

Development Management Policy B6: EV infrastructure in new buildings

All new developments must provide appropriate charging points for each individual building and consider the impact of such measures on the local electricity grid.

Proposals must demonstrate the extent to which compliance with this policy is achievable as part of the wider appraisals undertaken as part of Development Management Policy T2: EV infrastructure in new development.

4.2.5. Whole life GHG assessment

NOTE THAT THE POLICY BELOW CUTS ACROSS POLICY RECOMMENDATIONS FROM TECHNICAL NOTES ON BUILDINGS, TRANSPORT, SEQUESTRATION AND CARBON OFFSET FUND

Development Management Policy EN/6: GHG emissions assessment for new development

Developers will need to prepare a whole life carbon assessment to drive down all identified Greenhouse Gas (GHG) emissions at every stage of the proposed development. The assessment must include buildings (including relevant information from the Energy Statement required under Policy B1), transport and land use emissions and ensure that emissions are minimised as per relevant RLDP policy provisions.

Developers will be required to calculate whole life embodied, construction and operational carbon emissions associated with their development proposals through nationally recognised methodologies, and actions taken to reduce lifecycle carbon shall be demonstrated.

Alongside GHG emissions reductions, developers should look for opportunities within the proposed development to embed nature -based or technological solutions to capture or offset any residual emissions in accordance with separate RLDP Policies on Carbon Offsetting and Carbon Sequestration.

All information should be presented in a Carbon Reduction Statement accompanying the planning application.

4.2.6. Revision to policies

Applicable policies for new buildings will be those set out in the RLDP until further revisions of the Building Regulations or any other legislation place stricter requirements at which point the latter will need to be adhered to as part of planning applications, until such time RLDP policies are revised.

Appendices

Appendix A. Analysis for strategic sites

A.1. Baseline emissions for strategic sites

Under current Welsh Building Regulations requirements, the buildings planned in the five strategic sites are estimated to produce at total of 3,230 tCO_2 per annum. The split between the sites for domestic and non-domestic, regulated and unregulated emissions is presented in Table A-1.

Table A-1 - Carbon emissions baseline for each site, based on annual energy consumption of typical buildings, measured between 2015-17[18]

	Abergele	Llanfairfechan	Llanrhos	Llanrwst	Old Colwyn
Total emissions (tCO2)	**900.4**	**534.0**	**438.9**	**382.9**	**974.1**
Domestic total	**0**	**478.0**	**382.9**	**382.9**	**952.7**
Regulated	*0*	*404.1*	*323.7*	*323.7*	*804.7*
Unregulated	*0*	*73.9*	*59.2*	*59.2*	*148.0*
Non-domestic total	**900.4**	**56**	**56**	**0**	**21.4**
Office	466.3	0	0	0	0
Regulated	*310.0*	*0*	*0*	*0*	*0*
Unregulated	*156.3*	*0*	*0*	*0*	*0*
School	95.2	56.0	56.0	0	0
Regulated	*83.7*	*49.2*	*49.2*	*0*	*0*
Unregulated	*11.5*	*6.8*	*6.8*	*0*	*0*
Retail	338.8	0	0	0	21.4
Regulated	*103.3*	*0*	*0*	*0*	*6.5*
Unregulated	*235.5*	*0*	*0*	*0*	*14.9*

A.2. Emissions reduction profiles for strategic sites

For each site, calculations have been performed of the reductions in regulated emissions achieved for the selected package of measures for each building type, the annual operational cost savings associated with those measures and the capital cost uplift in relation to the current regulations (2022) baseline scenario. Capital cost calculations were also made considering the offset cost for the residual emissions if payments were to be made to a Carbon Offset Fund.

The summary tables are presented below, a first view just considering regulated emissions and a second view covering regulated and unregulated emissions for each site.

In the tables that follow, the data in the columns refer to the following:

- **Scenario**: See Section 3.2 above for a description of each scenario A-C.
- **Building type**: Refers to the aggregate of the buildings planned for each site, with the typology listed, according to the plan data provided. These will be different for each site.
- **Reduction in regulated emissions**: This shows the absolute reduction in carbon emissions achieved by the measures in the scenario for these buildings, compared with the quantum of emissions for the same in the baseline. These are not to be interpreted as a relative reduction.
- **Annual operational savings**: This identifies the potential reduction in operational costs that might be expected from running the buildings with the measures outlined in each scenario, based on an assessment of the energy saved through these interventions and the unit cost of each unit (in terms of

[18] See footnote 16 in section 3.2.

gas and electricity). It is an average taken over the expected operational lifetime of the buildings, which accounts for projected changes in energy unit prices.

- **Total CAPEX uplift (£)**: This shows the total capital cost associated with implementing the scenario in question to the buildings in that typology, and to achieve the emissions reduction shown. These are always relative capital costs, net of any measures that would have to be achieved to fulfil regulations.
- **Unit CAPEX impact**: This shows the relative capital costs to achieve the measures, normalised by the site footprint of each building typology planned (in square metres).
- **Total CAPEX uplift (%)**: This shows the proportion of extra capital costs that will be required to fulfil the measures required for each scenario, relative to the base of costs required to meet building regulations (the 'baseline costs').

Where an amount of carbon offsetting might be needed in relation to the buildings in order to reach net zero emissions, further values are shown in the final three columns. These have been calculated by adding the sum required to offset each remaining tonne of carbon dioxide to the total after all interventions on the building, where each tonne of residual carbon is priced at £95. Where the sum of interventions on the building already reaches 100% or more reductions, no offsetting is required and only one value will appear in the relevant cells.

A.2.1. Abergele

Table A-2 - Summary regulated emissions reduction profile for Abergele

Scenario	Building type	Reduction in regulated emissions (%)	Annual operational cost savings (%)	Total CAPEX Uplift (£; nett)	Unit CAPEX impact (£/m^2 ;nett)	Total CAPEX uplift (%; nett)
A	Residential	N/a	N/a	N/a	N/a	N/a
	Office	16%	5%	£271k (£1,016k*)	£21 (£78*)	2.0% (4.9%*)
	School	44%	24%	£122k (£254k*)	£36 (£75*)	3.1% (5.1%*)
	Retail	37%	8%	£120k (£306k*)	£24 (£63*)	6.1% (8.5%*)
B	Residential	N/a	N/a	N/a	N/a	N/a
	Office	104%	37%	£1,723k	£133	7.6%
	School	137%	131%	£596k	£173	10.3%
	Retail	150%	33%	£883k	£178	15.4%
C	Residential	N/a	N/a	N/a	N/a	N/a
	Office	63%	5%	£734k (£1,135k*)	£57 (£88*)	3.5% (5.4%*)
	School	94%	24%	£280k (£336k)	£83 (£98*)	5.5% (6.3%*)
	Retail	86%	8%	371k (£465k*)	£78 (£98*)	9.2% (10.4%*)

**incl. carbon offsets priced at £95/tonne*

A.2.2. Llanfairfechan

Table A-3 - Summary regulated emissions reduction profile for Llanfairfechan

Scenario	Building type	Reduction in regulated emissions	Annual operational cost savings (%)	Total CAPEX Uplift (£)	Unit CAPEX impact (£/m$^{2;}$ nett)	Total CAPEX uplift (%; nett)
A	Residential	46%	60%	£1,415k (£2,265k*)	£63 (£101*)	4.6% (7.4%*)
	Office	N/a	N/a	N/a	N/a	N/a
	School	44%	24%	£71k (£149k*)	£36 (£75*)	3.1% (5.1%*)
	Retail	N/a	N/a	N/a	N/a	N/a
B	Residential	109%	68%	£2,694k	£120	8.8%
	Office	N/a	N/a	N/a	N/a	N/a
	School	137%	131%	£350k	£173	10.3%
	Retail	N/a	N/a	N/a	N/a	N/a
C	Residential	97%	59%	£1,704 (£1,998k*)	£76 (£89*)	5.6% (6.5%*)
	Office	N/a	N/a	N/a	N/a	N/a
	School	94%	24%	£165k (£196k*)	£82 (£98*)	5.5% (6.3%*)
	Retail	N/a	N/a	N/a	N/a	N/a

**incl. carbon offsets priced at £95/tonne*

A.2.3. Llanrhos

Table A-6 - Summary regulated emissions reduction profile for Llanrhos

Scenario	Building type	Reduction in regulated emissions	Annual operational cost savings (%)	Total CAPEX Uplift (£)	Unit CAPEX impact (£/m$^{2;}$ nett)	Total CAPEX uplift (%; nett)
A	Residential	46%	60%	£1,133k (£1,814k*)	£63 (£101*)	4.6% (7.4%*)
	Office	N/a	N/a	N/a	N/a	N/a
	School	44%	24%	£71k (£149k*)	£36 (£75*)	3.1% (5.1%*)
	Retail	N/a	N/a	N/a	N/a	N/a
B	Residential	108%	68%	£2,157k	£120	8.8%
	Office	N/a	N/a	N/a	N/a	N/a
	School	137%	131%	£350k	£173	10.3%
	Retail	N/a	N/a	N/a	N/a	N/a
C	Residential	97%	60%	£1,364k (£1,644k*)	£76 (£88*)	5.6% (6.5%*)
	Office	N/a	N/a	N/a	N/a	N/a
	School	94%	24%	£165k	£82	5.5%

				(£196k*)	(£98*)	(6.3%*)
	Retail	N/a	N/a	N/a	N/a	N/a

**incl. carbon offsets priced at £95/tonne*

A.2.4. Llanrwst

Note that the values in the table below are gross values unless otherwise stated. In the case of emissions reductions, this is an important distinction: the reductions are shown against typical building energy consumption from 2015-17. When values are compared with the likely savings over and above the BR2022 baseline (i.e. net values), they will be substantially different to the below.

Table A-8 - Summary of regulated emissions reduction profile for Llanrwst

Scenario	Building type	Reduction in regulated emissions	Annual operational cost savings (%)	Total CAPEX Uplift (£)	Unit CAPEX impact (£/m²; nett)	Total CAPEX uplift (%; nett)
A	Residential	46%	60%	£1,133k (£1,878k*)	£63 (£105*)	4.6% (7.7%*)
	Office	N/a	N/a	N/a	N/a	N/a
	School	N/a	N/a	N/a	N/a	N/a
	Retail	N/a	N/a	N/a	N/a	N/a
B	Residential	108%	68%	£2,157k	£120	8.8%
	Office	N/a	N/a	N/a	N/a	N/a
	School	N/a	N/a	N/a	N/a	N/a
	Retail	N/a	N/a	N/a	N/a	N/a
C	Residential	97%	60%	£1,364k (£1,644k*)	£76 (£88*)	5.6% (6.5%*)
	Office	N/a	N/a	N/a	N/a	N/a
	School	N/a	N/a	N/a	N/a	N/a
	Retail	N/a	N/a	N/a	N/a	N/a

**incl. carbon offsets priced at £95/tonne*

A.2.5. Old Colwyn

Table A-10 - Summary regulated emissions reduction profile for Old Colwyn

Scenario	Building type	Reduction in regulated emissions	Annual operational cost savings (%)	Total CAPEX Uplift (£)	Unit CAPEX impact (£/m²; nett)	Total CAPEX uplift (%; nett)
A	Residential	46%	60%	£2,842k (£4,556k*)	£63 (£102*)	4.7% (7.5%*)
	Office	N/a	N/a	N/a	N/a	N/a
	School	N/a	N/a	N/a	N/a	N/a
	Retail	37%	8%	£8k (£19k*)	£25 (£64*)	6.1% (8.5%*)
B	Residential	108%	68%	£5,452k	£122	9.0%
	Office	N/a	N/a	N/a	N/a	N/a
	School	N/a	N/a	N/a	N/a	N/a

	Retail	150%	33%	£56k	£178	15.4%
C	Residential	97%	60%	£3,506k (4,098k*)	£78 (£91*)	5.8% (6.8%*)
	Office	N/a	N/a	N/a	N/a	N/a
	School	N/a	N/a	N/a	N/a	N/a
	Retail	89%	14%	£23k (£29K*)	£78 (£93)	9.2% (10.3%*)

**incl. carbon offsets priced at £95/tonne*

A.3. Cost breakdown for renewable energy solutions

Building-level interventions have been modelled for new developments including onsite building-scale renewable energy solutions with a focus on solar PV and heat pumps. Their impact on emissions and cost has been tested on the 5 strategic site allocations in the section above. The details of energy-related interventions considered are provided in this section for each of the two scenarios that have been modelled.

The renewable energy interventions considered for each scenario are presented in Table below alongside the baseline (Business as usual) scenario.

Table A-12 - Modelled renewable energy interventions in new developments

	Electricity	Thermal energy
Baseline	Solar PV installation on 40% of roof area	No heat pumps (gas boilers)
Scenario A	Solar PV installation on 40% of roof area as per Further Consultation Option (2019) in Wales Buildings Regulations Part L review consultation (residential) Solar PV installation on 20% of roof area (non-residential)	No heat pumps (gas boilers)
Scenario B	Solar PV installation on 40% of roof area of residential buildings Solar PV installation on 70% of roof area of non-residential buildings	Air source heat pumps for residential and non-residential buildings

Based on the intervention levels illustrated above, the potential rooftop PV capacity has been calculated for each of the 5 strategic sites (see Table A- below), showing that Old Colwyn is the site with the most potential and Llanrwst is the site with least, proportional to the number of residential and non-residential buildings.

Table A-13 - Potential rooftop PV capacity across 5 strategic sites

Building type	Potential rooftop PV capacity (kWp) (ranges relate to Scenario A and Scenario B)				
	Abergele	Llanfairfechan	Llanrhos	Llanrwst	Old Colwyn
Total	**335 - 1176**	**749 - 951**	**612 - 804**	**551 - 589**	**1914 - 2400**
Residential	**N/A**	**688 - 736**	**551 - 589**	**551 - 89**	**1905 - 2368**
Non-residential (total)	**335 - 1176**	**61 - 215**	**61 - 215**	**N/A**	**9 - 32**
Office	199 - 697	N/A	N/A	N/A	N/A
School	104 - 366	61 - 215	61 - 215	N/A	N/A
Retail	510 - 945	N/A	N/A	N/A	9 - 32

It has been observed that onsite rooftop PV on its own is not able to meet total electricity demand for some building typologies such as retail due to their high electricity consumption levels (See Buildings Technical note).

Other onsite and offsite renewable energy opportunities will need to be explored to meet the remaining electricity demand or as a last resort through a payment to the Carbon Offset Fund (see separate TN).

The additional capital costs associated with the levels of PV adoption under scenarios A and B have been calculated.

Table A-14 - Additional capital cost associated with two different levels of PV adoption (Scenario A and B**)**

Option	Building type	Additional capital cost per strategic site (£)				
		Abergele	Llanfairfechan	Llanrhos	Llanrwst	Old Colwyn
Scenario A	**Total**	**£330k**	**£832k**	**£695k**	**£630k**	**£1.59m**
	Residential	**N/A**	**£787k**	**£630k**	**£630k**	**£1.58m**
	Non-residential (total)	**£330k**	**£45k**	**£45k**	**N/A**	**£7k**
	Office	£146k	N/A	N/A	N/A	N/A
	School	£77k	£45k	£45k	N/A	N/A
	Retail	£107k	N/A	N/A	N/A	£7k
Scenario B	**Total**	**£1.15m**	**£995k**	**£828k**	**£670k**	**£1.68m**
	Residential	**N/A**	**£837k**	**£670k**	**£670k**	**£1.66m**
	Non-residential	**£1.15m**	**£193k**	**£158k**	**N/A**	**£24k**
	Office	£512k	N/A	N/A	N/A	N/A
	School	£269k	£158k	£158k	N/A	N/A
	Retail	£374k	N/A	N/A	N/A	£24k

The additional capital costs associated with the levels of heat pump adoption under B compared to baseline have been calculated and illustrated below.

Table A-15 - Additional capital cost associated with heat pump adoption (Scenarios A and B)

Option	Building type	Additional capital cost per strategic site (£)				
		Abergele	Llanfairfechan	Llanrhos	Llanrwst	Old Colwyn
Scenario B	**Total**	**£854k**	**£381k**	**£323k**	**£231k**	**£1.59m**
	Residential	**N/A**	**£289k**	**£231k**	**£231k**	**£1.58m**
	Non-residential (total)	**£854k**	**£92k**	**£92k**	**N/A**	**£15k**
	Office	£458k	N/A	N/A	N/A	N/A
	School	£157k	£92k	£92k	N/A	N/A
	Retail	£239k	N/A	N/A	N/A	£15k

Appendix B. Heat pump payback analysis

As outlined in Section 3.2.1, Scenario A identifies an incremental improvement over the baseline requirements set out in the Building Regulations (Wales) 2022. Scenario C is identical to Scenario A, with the exception that electrified heat, in the form of air-source heat pumps (ASHP). An analysis has been undertaken to establish the payback time of heat pumps at the five strategic sites to take account of recent global events that have impacted energy prices. The method that has been adopted is as follows:

- Take the difference between the unit rates of electricity and gas in each year of operation over the heating system's lifetime. These rates are based on price projections provided in January 2023 by BEIS, which account for recent global events and explicitly reference the Net Zero agenda in considering its projections[19].
- Adjust the differential rate to allow for the efficiency and performance of both types of system being compared.
- For each site, assess the total cost to fulfil the aggregated space heating demand each year. This is achieved by multiplying the (adjusted) difference in unit rates by the total heating energy required units across all the buildings for each typology.
- Create a running cost that adds up the savings or additional annual costs cumulatively. Finally, the cumulative cost differences are set against the difference in capital costs between the gas boiler and the ASHP, to identify the year when these capital cost differentials are paid back through the relative savings.

It has been found that heat pumps pay back after **8-9 years in the case of domestic, and 12-19 years in the case of non-domestic buildings**, across the five sites. In the figures below, the differential 'cashflow'[20] is projected out to 2050 to offer a sense of scale, assuming a construction year of 2025.

The payback period referenced is particularly sensitive to the coefficient of performance (COP) of the heat pumps. The COP defines the quantity of electrical energy that would be required to deliver the amount of space heating that would have been delivered by fossil fuels through traditional heating systems. A lower-performance ASHP will have a substantial impact on the energy requirement. For residential buildings, the COP must in the order of 2.55-2.57 in order to pay back within 25 years. The payback analysis here is based on COP of 2.8 for residential and 2.5 for non-residential, set against boiler efficiencies of 93% and 92%, respectively.

B.1. Abergele

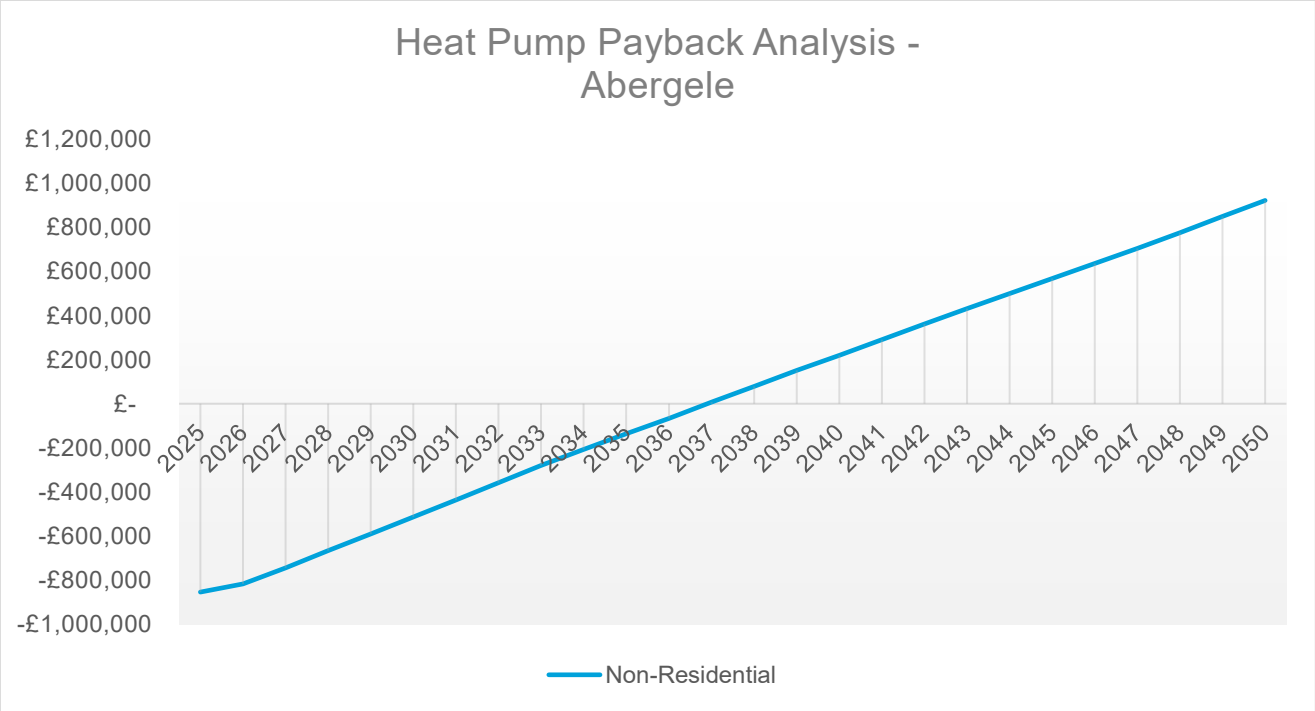
Residential payback: N/a

Non-residential payback: 12 years

[19] Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal - GOV.UK (www.gov.uk) – updated 17th January 2023. In the case of each fuel, the highest cost scenario has been selected.

[20] Note that this is not a true cashflow, since it is only capturing the difference in capital costs between the gas boiler and the ASHP; and the difference in operational costs year-over-year to fuel each of these systems.

Figure 4-1 - Whole life cost differential between Scenarios A and C - Abergele

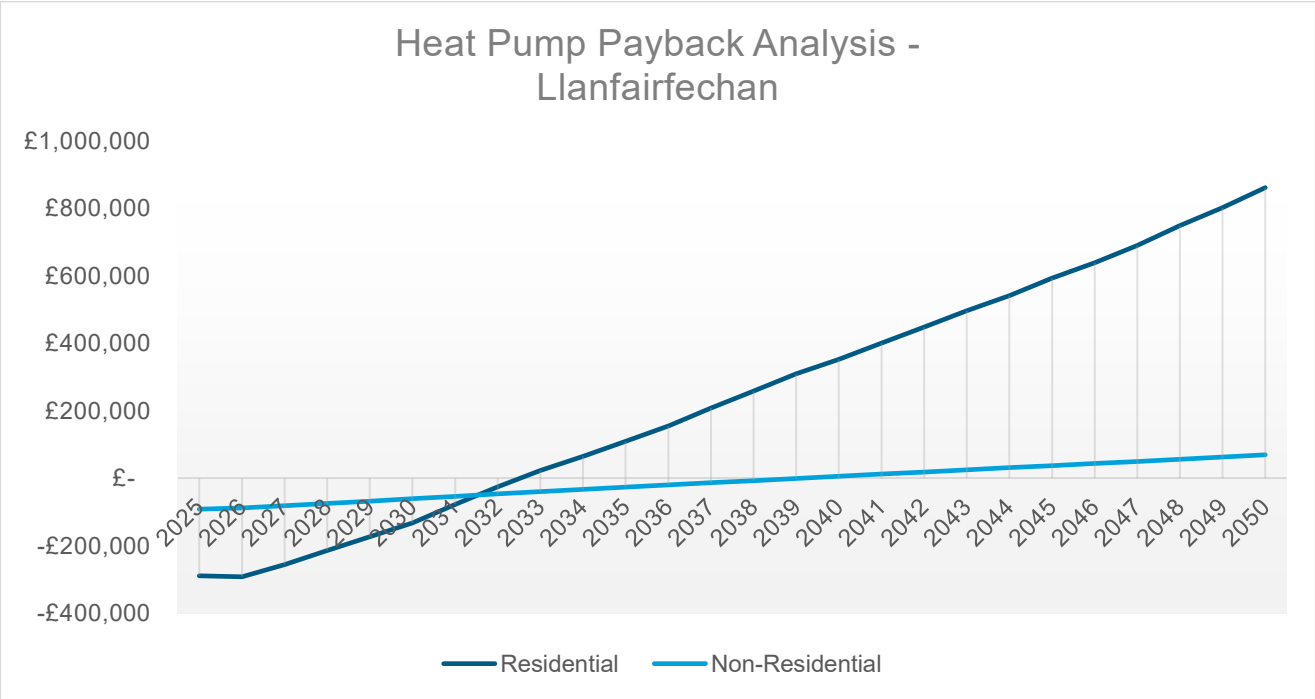


B.2. Llanfairfechan

Residential payback: 8 years

Non-residential payback: 15 years

Figure 4-2 - Whole life cost differential between Scenarios A and C - Llanfairfechan

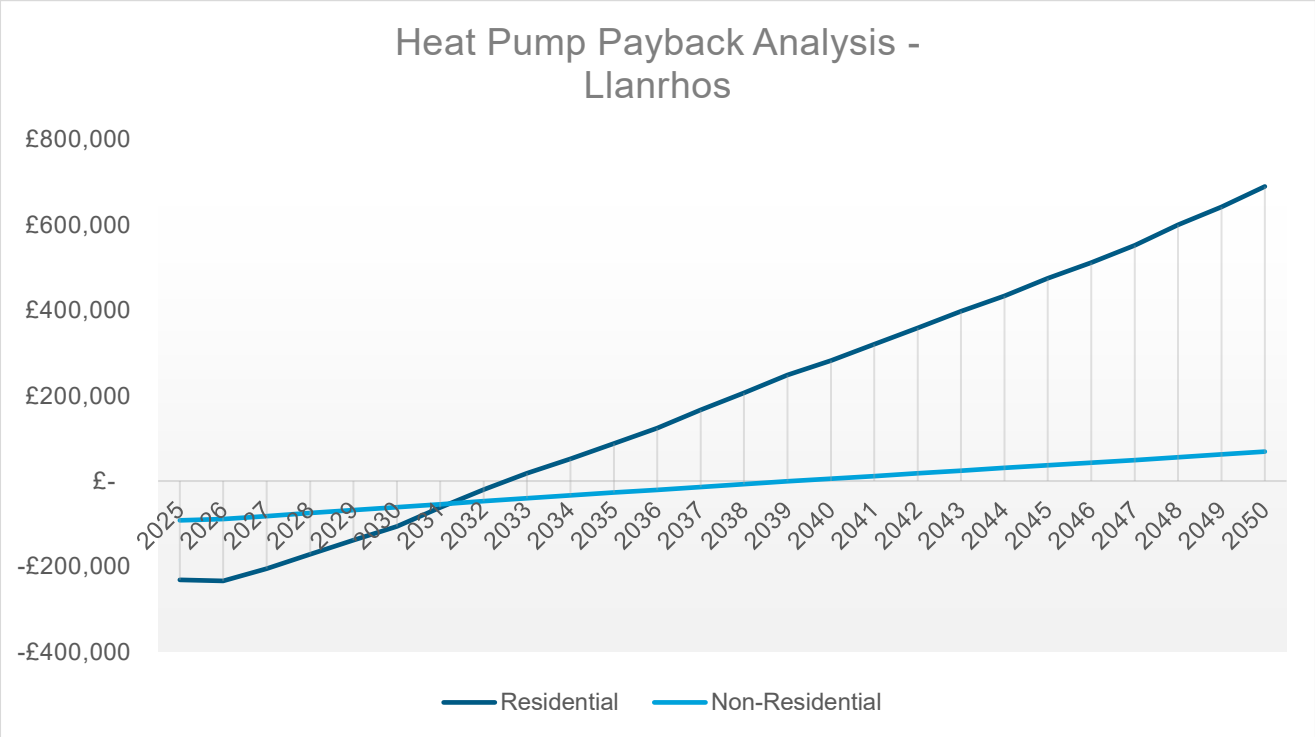


B.3. Llanrhos

Residential payback: 8 years

Non-residential payback: 15 years

Figure 4-3 - Whole life cost differential between Scenarios A and C - Llanrhos

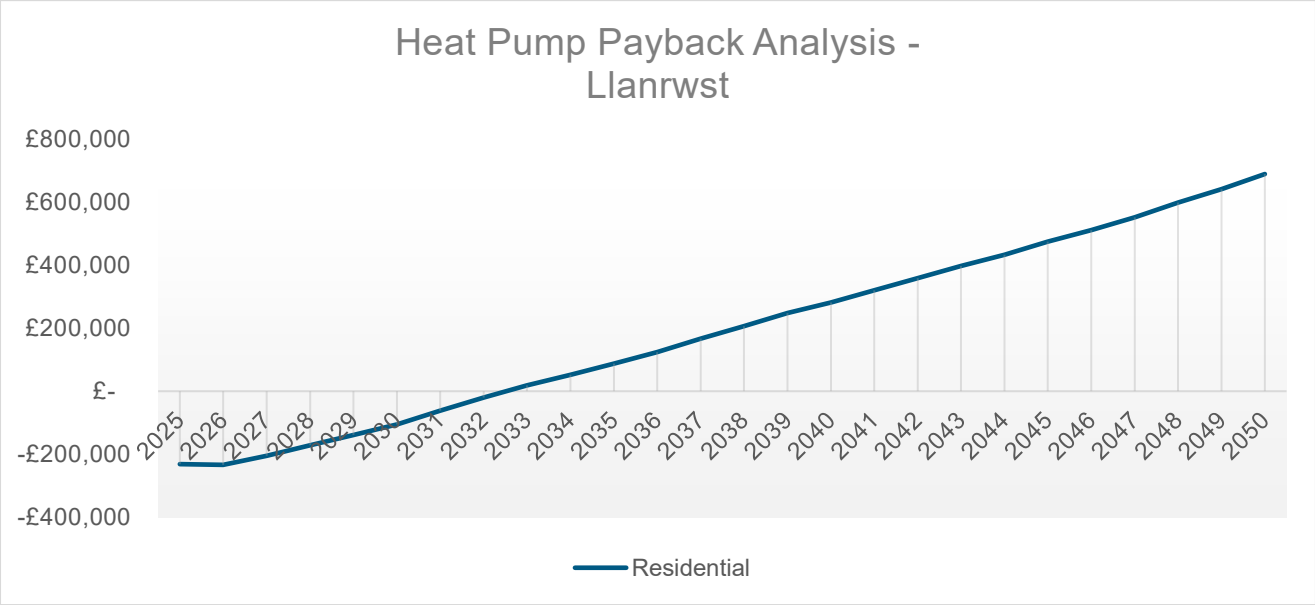


B.4. Llanrwst

Residential payback: 8 years

Non-residential payback: N/a

Figure 4-4 - Whole life cost differential between Scenarios A and C - Llanrwst

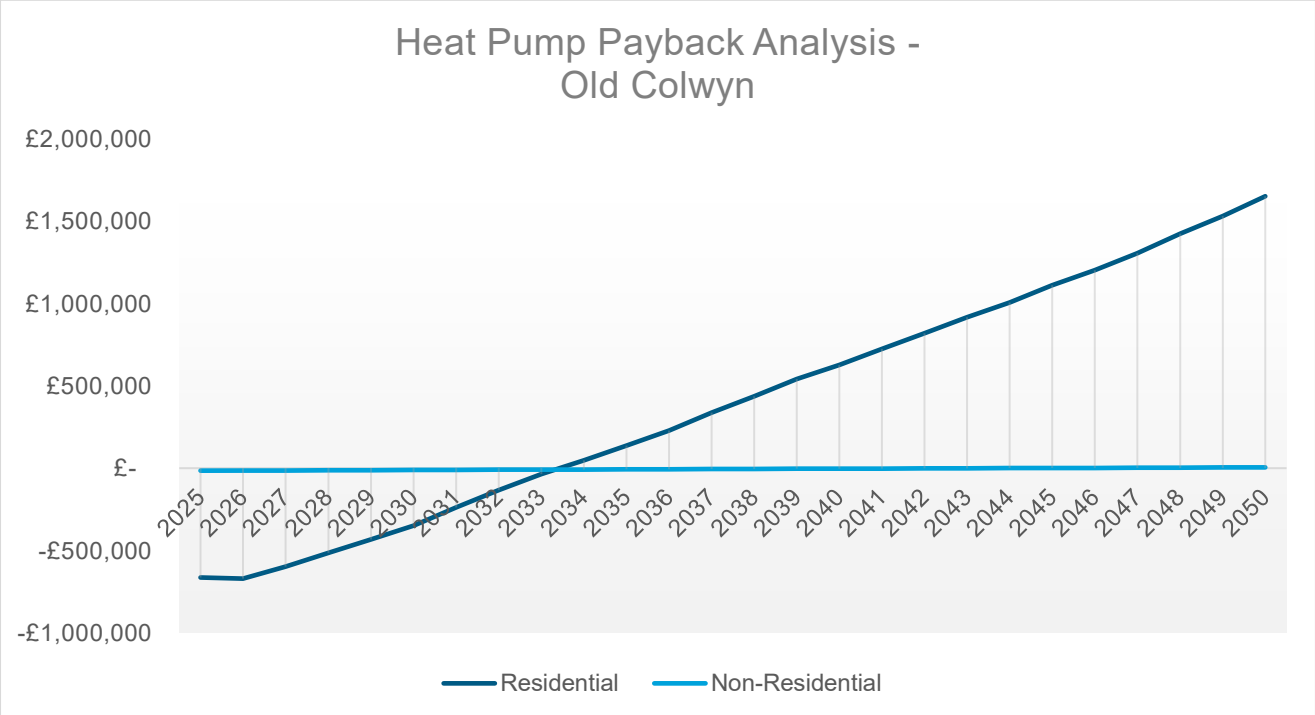


B.5. Old Colwyn

Residential payback: 9 years

Non-residential payback: 19 years

Figure 4-5 - Whole life cost differential between Scenarios A and C - Old Colwyn



Note: The capital costs of £15k for non-residential, corresponding with a small retail footprint, are paid back by 2044 (19 years) and reach £5k positive by 2050.

Appendix C. References for assumptions

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