Rutland Local Plan Review: Zero Carbon Policy Options for Net Zero Carbon Developments

B(i). Carbon Reduction

26 July 2023

Rev 01.2

QA: 26 July 2023

Bioregional

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Introduction

Bioregional has been appointed to provide Rutland County Council with an assessment of policy options available to achieve net zero carbon developments in Rutland, to inform the emerging Rutland Local Plan review.

Our suite of reports for the RCC Local Plan Review consists of four key parts:

A. Climate Change Legislation

- LPA duties to address carbon, as per the NPPF and Climate Change Act
- LPA powers, alongside their limitations, to address carbon and energy granted or not by key piece of national legislation, policy and official guidance
- Existing and emerging precedents of local plan policies
- Existing and emerging examples of how planning duties in carbon and climate have been weighed against other duties
- Defining 'net zero carbon'
- Appendices: additional guidance and advice

B. Carbon Reduction and Policy Risks

i. Carbon footprint of Rutland

- Review any existing carbon footprint work relevant to the area
- Undertake regional specific analysis of each sector
- Assessment of future desirable carbon and energy targets
- Appendix: feasibility and viability

ii. Risk matrix

- Assessing various climate and planning risks against policy approaches

C. Policy Recommendations

- Recommending ways forward to pursue net zero carbon in the RCC Local Plan Review, in ways that are consistent with national government policy and powers, and demonstrably effective.

This document is Task B(i).

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Glossary of terms and acronyms

BREDEM	Building Regulations Domestic Energy Model. A methodology for (estimating) calculating the energy use and fuel requirements of dwellings based on their characteristics. BREDEM was the basis from which SAP was developed.
Carbon, or carbon emissions	Short for 'carbon dioxide' but can also include several other gases with a climate-changing effect (nitrous oxide, methane, refrigerants) that are emitted to the atmosphere from human activities.
Carbon budget	Amount of greenhouse gas that can be emitted before reaching a level of atmospheric carbon that causes severely harmful climate change
CO_2	Carbon dioxide. Often shortened to 'carbon'.
CO_2e	Carbon dioxide equivalent. The sum of a mixture of gases, in terms of their climate-changing impact in a 100-year period expressed as the amount of CO_2 that would have the same effect. Often shortened to 'carbon'.
Embodied carbon	Carbon that was emitted during the production, transport and assembly of a building, infrastructure, vehicle or other product, before the product is in use. As opposed to 'operational carbon' which is emitted due to energy use when operating the building / infrastructure / vehicle / other product.
EUI	Energy use intensity, a measure of how much energy a building uses per square metre of floor.
GHG	Greenhouse gas (CO_2 and several other gases: nitrous oxide, methane, refrigerants). Often collectively referred to as 'carbon'.
Part L	Building regulations section that sets basic legal requirements regarding buildings' energy and CO_2.
Performance gap	The 'energy performance gap' is the difference between the amount of energy a building is predicted to use during design, versus the actual amount of energy it uses. The gap is due to poor prediction methodologies, errors in construction, and unexpected building user behaviour.
PV	Photovoltaics: solar panels that generate electricity.
PHPP	Passivhaus Planning Package – a tool to accurately calculate a building's energy use. It is used to design buildings that seek Passivhaus certification, but can be used without pursuing certification.
Regulated energy	The uses of energy within a building that are regulated by Part L of building regulations. This covers fixed energy uses in the building – mainly space heating, space cooling, hot water, permanent lighting, fans/ventilation and pumps.
SAP	Standard Assessment Procedure – the national calculation method for homes' energy and carbon, used to satisfy building regulations Part L.
SBEM	Simplified Buildings Energy Model – the national calculation method for non-residential buildings' energy and carbon, used to satisfy building regulations Part L.
TER	Target Emission Rate – limit set by Part L of building regulations on CO_2 emissions per square metre of floor.
TPER	Target Primary Energy Rate – limit set by Part L of building regulations on 'primary energy' use per square metre of floor. A new metric being introduced to building regulations from June 2022. Unlike metered energy, 'primary energy' takes into account energy lost to conversion inefficiencies during power generation and distribution, or gas combustion.
TFEE	Target Fabric Energy Efficiency – limit on space heat energy demand per square metre of floor, set by Part L of building regulations. Based only on fabric; not affected by building services like heating system, lighting, ventilation.
TM54	Method to accurately calculate buildings' energy use. Devised by Chartered Institution of Building Services Engineers (CIBSE).
Unregulated energy	Energy uses within a building or its curtilage but that are not regulated by Part L of building regulations. Examples: plug-in appliances, catering, external lighting among other uses. This can represent 50% of the total energy used at a property, depending on the type and use of the building.

Executive Summary

Defining net zero carbon

On a global level, 'net zero carbon' means a balance between emissions and removals of carbon to/from the atmosphere. 'Carbon' can mean 'carbon dioxide' (CO_2) or it can mean the sum of all gases that have a global warming effect: CO_2 (~80% of UK emissions), methane, nitrous oxide, and 'F-gases'.

Carbon emissions are mostly caused by burning of fossil fuels, but also to a lesser extent also by some industrial processes (e.g. the chemical reaction in cement production) and agricultural processes (e.g. the digestive systems of livestock, and breakdown of soil fertilisers). Currently, removals are only achieved by natural features like plants, soils, and water bodies. There are also ongoing research efforts to develop technology to capture and store carbon, but not yet successful in terms of efficiency and scale.

At smaller scales, we need 'carbon accounting methodologies' to define which emissions or removals 'belong' to a person, organisation, building, or area. This is because activities in one place (e.g. using grid electricity, or buying materials to build with) often cause carbon emissions elsewhere (e.g. burning fuel in a power station, or producing cement). The same is true for carbon removals.

Organisations and buildings that cannot achieve net zero carbon within their own direct activities are sometimes permitted to use 'carbon offsetting' (paying for carbon-reducing actions elsewhere). These are sometimes removals (e.g. tree planting) – or sometimes 'avoided' emissions (paying for measures that reduce the amount of carbon that 'would have been emitted'). Most local-scale carbon accounting methodologies agree that 'net zero carbon' should not include 'carbon offsets' from another area. See full report for detail on the carbon accounting methodologies available.

Most UK local and regional authorities track their area's emissions using official centralised figures from DESNZ (formerly BEIS) each year. DESNZ uses data on each area's buildings, energy use, industrial activity, traffic/transport activity, and types of land area, to estimate the amount of emissions and removals in each local area (carbon dioxide only; no other gases). See Figure 2.

Rutland also has used another carbon accounting method to give a more refined understanding, including the full range of greenhouse gases. Please see full report below for more detail.

Every part of the UK, including Rutland, will need to play its role in achieving the overall UK Net Zero Carbon goal by 2050 as per the Climate Change Act. Therefore, efforts to reduce emissions in each local area should be designed to assign a share of responsibility for all emissions caused in the UK by activities in that area, and refrain from double-counting any removals or 'avoided' emissions. The risk of double-counting arises if carbon offsetting is used instead of reducing emissions at source – e.g. if one area buys carbon offset credits generated by another area's woodland or insulation schemes, but those carbon savings were already counted towards the other area's carbon account in the official national figures or local carbon accounting.

The local plan therefore needs to consider several different scales of 'net zero carbon':

- 'Net zero carbon new buildings' – this always includes energy use of the building's operation, and can also include 'embodied carbon' (see glossary)
- 'Net zero carbon Rutland' – new and existing buildings, transport, industry, agriculture, land use
- 'Net zero carbon UK' – all sectors above, plus aviation and shipping. No international 'offsetting'.

Development and use of land in Rutland can affect emissions in all sectors – but new buildings, grid energy and transport are the main issues that the local plan can influence.

'Net zero carbon' has different meanings at different scales

- **At global level,** it means greenhouse gas emissions from human activity are balanced by greenhouse gas removals
- **At local scale or building scale,** we need 'carbon accounting methodologies' to decide whose carbon is whose (emissions and removals)
- **'Offsetting' is treated differently** depending on accounting method or planning policy precedent – most local authorities use DESNZ/BEIS data to track the local area's carbon account; this DESNZ/BEIS data does not count offsets from outside the area or embodied emissions of goods brought into the area
- **The local plan can mainly influence emissions from new buildings, energy & transport** – policies should reduce Rutland's total emissions, and

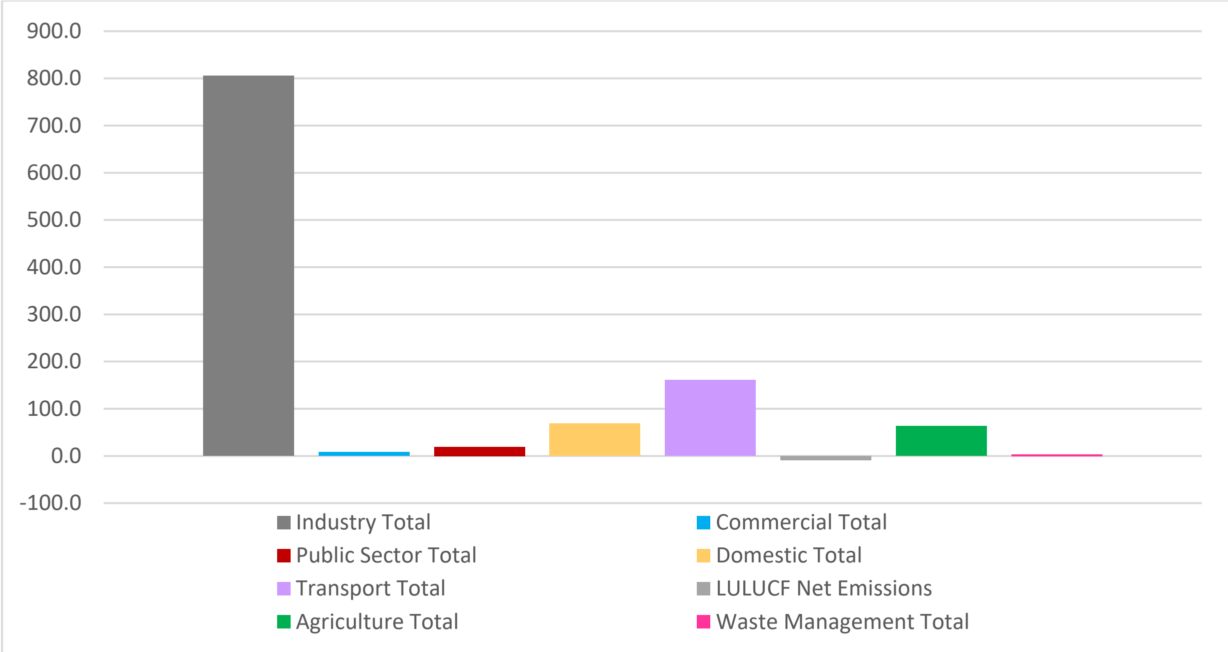


Figure 1: 2021 CO2e per sector in Rutland from BEIS/DESNZ subnational data (2023 release).

Industry is by the largest source of carbon emissions from activity within Rutland (Figure 2), accounting for 76% of CO_2 emissions (most likely due to the presence of the cement works), and transport contributes the second largest amount of 14%. Local plan policies have some powers to influence future industry development, but these are minimal when compared to influence over transport emissions. Transport that runs on grid electricity emits less, but not zero. There is currently no way for transport to actively remove carbon emissions (other than purchasing offset credits). Transport carbon will therefore only hit zero when its energy is 100% renewable, but a shift to electric transport and less car use is vital for interim carbon budgets. Embodied carbon of vehicles or infrastructure would appear in the 'industry' sector, if produced locally.

There are several ways define a 'net zero carbon building'. These definitions rely on calculations that variously take into account the following, on an annual basis:

- Use of different types of fuels and grid energy at the building: These cause carbon emissions.
- Renewable energy use at the building: Usually generated on-site but may include off-site sources.
- Amount of renewable energy that the building *exports to the grid* at times when the building produces more than it is using): This counts as a *negative* amount of carbon emissions, because it actively reduces the amount of fuel burned in power stations to supply grid energy to others.
- Embodied carbon: Carbon emitted to produce/transport and use the construction materials.

The official 'National Calculation Methodology' for buildings' energy use and carbon emissions is called SAP (for homes) or SBEM (for other buildings). These are used in the Building Regulations Part L, which sets limits per square metre per year for carbon, heat demand, and 'primary energy' use. However:

- They only cover operational carbon (energy use), not embodied carbon (materials/construction)
- They do not include 'unregulated' energy uses like plug-in appliances, which can be 50% of total
- They are predictive-only, not verified in reality, and their predictions are not accurate – buildings typically use two or three times the amount of energy predicted by SAP or SBEM (see Figure 3).

Thus a 'net zero carbon' building defined by the Building Regulations is not actually net zero carbon. Updates to Building Regulations Part L, SAP and SBEM are due in 2025 (the 'Future Homes Standard' and 'Future Buildings Standard'). However, even the 2025 update will not deliver[i] the very low space heat demand that the UK needs for its legislated carbon budgets. This is partly because SAP and SBEM underestimate energy demand and are not verified in operation, and partly because Part L sets energy and carbon targets that vary by the shape and size of the building, not the absolute targets that are needed for UK carbon budgets.

Other calculation methods and definitions are available. The two leading alternatives are:

- LETI operational net zero carbon: A building that (each year) generates as much renewable energy as it uses, sometimes using grid electricity and other times sending renewable energy to the grid. The building must also be gas-free, and meet specific energy efficiency targets that match the performance needed for national carbon budgets.
- UKGBC Framework Definition of Net Zero Carbon: This has two parts:
  - Operational: When the carbon associated with a building's energy use is zero, by use of renewable energy (from onsite or offsite sources) or purchasing verified carbon offsets.
  - Embodied: When the carbon associated with a building's construction up to the point of completion is zero or negative, through the purchase of verified carbon offsets.

Because the LETI and UKGBC definitions are for actual operational performance not just modelling, they require the use of *accurate* energy calculation methods in the design process, specifically PHPP or TM54 (see glossary). PHPP and TM54 both account for total energy, not just the share that is 'regulated'.

Net zero carbon in different sectors relevant to local plan

- **Transport is the most carbon-intensive sector in Rutland** and can only reach 'net zero' via renewable energy and offsetting, but electrification and reduced car use are vital steps
- **Green landscapes remove only a small fraction of emissions** – overall emissions must fall dramatically at source
- **Building Regulations calculation methods for energy and carbon are insufficient to define net zero carbon buildings:** these methods dramatically underestimate buildings' energy use and do not include embodied carbon or energy use of plug-in appliances
- **The industry has created improved approaches to define net zero carbon buildings** – in particular the LETI and UKGBC definitions, which use more accurate calculation methods.

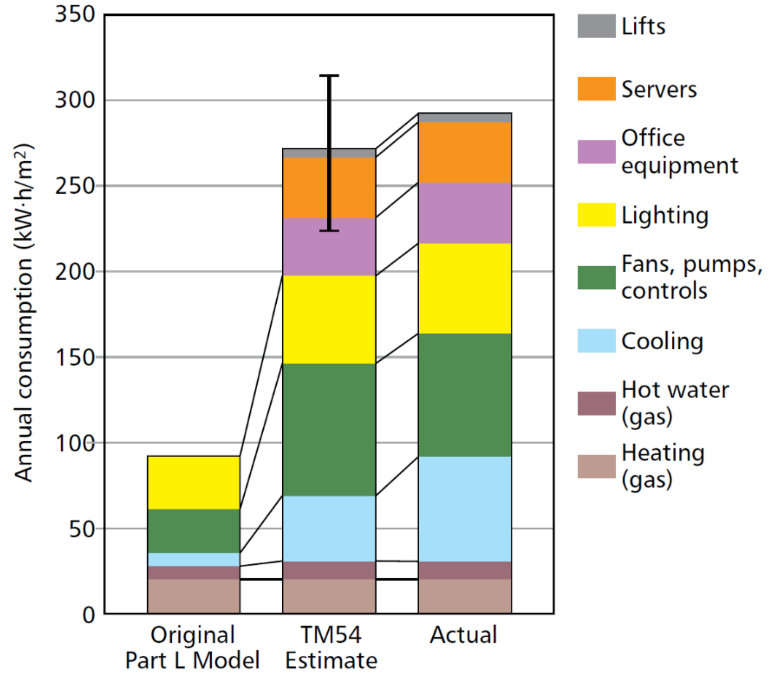


Figure 2: CIBSE graph that reveals the inaccuracies of Part L SBEM prediction of energy use, compared to a prediction using the CIBSE TM54 method, and the building's actual measured energy use in operation. This is for an office building.

Full report

Defining 'net zero carbon'

Overview

Because climate and carbon emissions are global challenges, consistency of effort is key. If carbon emissions are not consistently accounted for, there will be a risk of not reducing emissions but simply displacing them – or failing to account for the full emissions of new development.

When devising local plan policies for Rutland, it will be vital to make sure those policies use a definition of 'net zero carbon development' that fully contributes to the achievement of a net zero carbon Rutland and net zero carbon UK.

Having separately explored precedents of how local plans have defined and pursued net zero carbon (see our separate 'Task A' report), we here look at the global, national, area-wide and building-level definitions of net zero carbon that are generally accepted.

This context is important because most of the identified fully adopted precedent local plans use a definition of 'net zero carbon development' that is significantly different to how a fully-fledged carbon accounting methodology would define it.

The reason for this difference is that the local plan adopted precedents have almost always set their 'carbon reduction' requirements based on energy and carbon metrics set by national building regulations. These building regulations metrics do not account for the building's full energy use, let alone the embodied carbon of the building's materials and construction, or the transport carbon that will be induced in the lifestyles of the building's users. The use of building regulations metrics in local plan policy has been due to the way in which planning legislation defines the local planning authority's powers, and the ways in which other pieces of national government policy may constrain how those powers are exercised.

However, as set out in Task A (separate report), some pioneering local planning policies have begun to move beyond these constraints arising from planning legislation and associated national policy.

This report (Task B.i.) firstly looks at the global, national, and county-level definitions of net zero carbon. This makes it possible to understand the relative merits of different definitions of net zero carbon buildings in existing and emerging precedent local plans.

This report also helps contextualise the levels of performance or change that would be necessary to achieve those definitions of net zero carbon – in terms of changes to new buildings, existing buildings, transport, the energy system, and land use.

Net Zero Carbon at global level

At global level, "net zero carbon" means that emissions of greenhouse gases (GHGs) are balanced out by removals of GHGs from the atmosphere.

'Greenhouse gas' encompasses a bundle of different gases that have a climate-changing effect. The most common greenhouse gas is carbon dioxide (CO_2) which represents 80% of the UK's climate impact[ii]. Six other GHGs are also relevant: methane (12%), nitrous oxide (5%), and four types of fluorinated gas (refrigerants, 3%). Some of these have a weaker global warming effect, and some have a stronger effect but stay in the atmosphere for longer and therefore cause more change over time.

As CO_2 stays in the atmosphere for a long time, there is a fixed amount – a 'carbon budget' – that we can emit between now and 2100 if the world is to avoid the worst impacts of climate change (limiting global warming to less than 2˚C above pre-industrial climate). The other greenhouse gases are not subject to the 'budget' approach, because they stay in the atmosphere for a different amount of time, but should still be reduced as far as possible.

Together, the bundle of greenhouse gases is referred to as 'carbon dioxide equivalent' or 'CO_2e'. This refers to the global warming effect that the gas would have in a 100-year timeframe, compared to that of carbon dioxide. 'Carbon emissions' can refer to carbon dioxide, or the whole collection of greenhouse gases.

'Net carbon' or 'net emissions' refers to the amount of CO_2 or greenhouse gas that remains after deducting the amount that was removed from the atmosphere, usually over the course of a year.

'Net zero carbon' is sometimes used interchangeably with the term 'carbon neutrality'. These are overlapping concepts which essentially mean the same thing at global level, but at sub-global levels they are used slightly differently[iii], to reflect whether the emissions and removals are achieved *directly by* or purely *on behalf of* a particular country or organisation. This becomes a question of 'carbon accounting', discussed next.

Where do the carbon emissions come from and how can carbon be removed from the atmosphere?

The main *source of rising GHG levels* in Earth's atmosphere is the burning of fossil fuels (as this is an emission of carbon that had been locked up underground for many thousands of years until recently). Greenhouse gas is also emitted by many other human activities including fertiliser use (nitrogen fertilisers are often made from fossil fuel), ruminant livestock's digestive systems, breakdown of organic waste, and the chemical reaction during the production of cement.

Greenhouse gas *removals* are achieved by plants and soils such as forests, grassland and wetland. These are currently the only reliable and scalable means to remove greenhouse gases, as no appropriate and efficient technology for carbon capture has yet been developed. Still, research is underway to develop such technologies, and future carbon removal technology is a significant part of many countries' long-term strategy to limit the total amount of carbon emitted this century.

Carbon accounting methodologies: whose carbon is whose?

Human activities and economies are highly interconnected across local, organisational and international lines. Activity by a person in one location (such as using electricity) can cause carbon emissions by another entity elsewhere (such as burning coal to generate energy in power stations).

Therefore we need 'carbon accounting' methodologies to work out what share of carbon emissions 'belong' to each entity. That entity could be a person, organisation, building, local area, or country.

Returning to the question of 'net zero carbon' compared to 'carbon neutral', the Intergovernmental Panel on Climate Change[iv] essentially explains that:

- 'Net zero carbon' typically means a balance of emissions and removals under direct control or territorial responsibility of the entity reporting them (such as a country, district or sector)
- 'Carbon neutral' can also apply to a firm or commodity, and typically also includes emissions and removals beyond the entity's direct control or territorial responsibility.

Following this logic, 'net zero carbon' would be the appropriate term if the district or country achieves enough carbon removals within its own area to balance out its own carbon emissions, while 'carbon neutral' is a less appropriate term for a country/district but would be the term to use if the emission/removal balance is achieved by buying carbon offset credits from outside that location.

For the purposes of a local plan, we should consider the carbon account of two key entities: firstly Rutland, and secondly each new building. We must consider how the building's carbon emissions fit into the county's carbon account, and how the county's emissions fits within the wider UK's carbon account which is legally bound to achieve net zero carbon emissions by 2050 and steep carbon reductions in the preceding years. If we use inconsistent definitions or accounting methods, then our 'net zero carbon' buildings might not help Rutland to achieve its goal to be net zero as soon as viable by 2050, and Rutland in turn might not help the UK meet its 2050 goal nor its interim carbon budgets.

Several carbon accounting approaches are available to determine how much carbon a geographical area is responsible for:

- Global Greenhouse Gas Protocol for Cities (GPC) – which has three 'scopes'
- PAS2070
- Local area CO_2e inventories, released annually by the UK government BEIS/DESNZ
- Tyndall Centre local carbon budgets / SCATTER local carbon emissions accounts

Each of these methodologies is designed to define the area's 'carbon account' based on the degree of direct or financial control the area has over activities that emit or absorb carbon.

Although each methodology differs slightly from the others, a local area would usually achieve 'net zero carbon' status when the GHG removals achieved within the local area are equal to greenhouse gas emissions from directly within the local area plus the greenhouse gases due to production of grid energy the local area consumes. If an area exports grid energy to other locations, any emissions associated with the production of that energy would not count towards the area's carbon account.

The methodologies generally agree that the local area's carbon account should not include offsets purchased from outside the area. These should be reported separately, if at all. However, such offsets may still help towards the overall UK net zero carbon goal so long as they are within the UK.

The Global Greenhouse Gas Reporting Protocol for Cities (GPC)

The Greenhouse Gas Reporting Protocol is the most widely used and accepted methodology to account for any entity's carbon emissions. The GPC is a version of that methodology that has been adapted for the use of cities or any other local area. Its aim is to enable local area carbon accounts to be tracked consistently enough to be aggregated to the regional or national level.

The GPC covers several gases (along with CO_2) and splits the account into three 'scopes' which reflect the degree of responsibility and control the local area has:

- Scope 1: emissions directly from within the area – such as through burning fuel, or through methane emissions from livestock kept within that area. Ditto, carbon removals achieved directly within the area, such as by trees growing in the area.
- Scope 2: emissions associated with that area's use of grid electricity which may have been produced inside the area or outside the area.
- Scope 3: emissions that happen outside the area but caused by activity or spending by entities inside the area – such as production and transport of goods imported from elsewhere.

The GPC states that if an area purchases carbon offsets from outside the area in order to mitigate some of its emissions, these should be reported separately and not deducted from the total.

If Rutland chooses to use any external 'offsets' in its quest for emissions reduction (as a last resort), these should be from within the UK so that they fall within the UK's Scope 1 account and thus contribute to the UK's overall net zero carbon goal (which should not include overseas offsets).

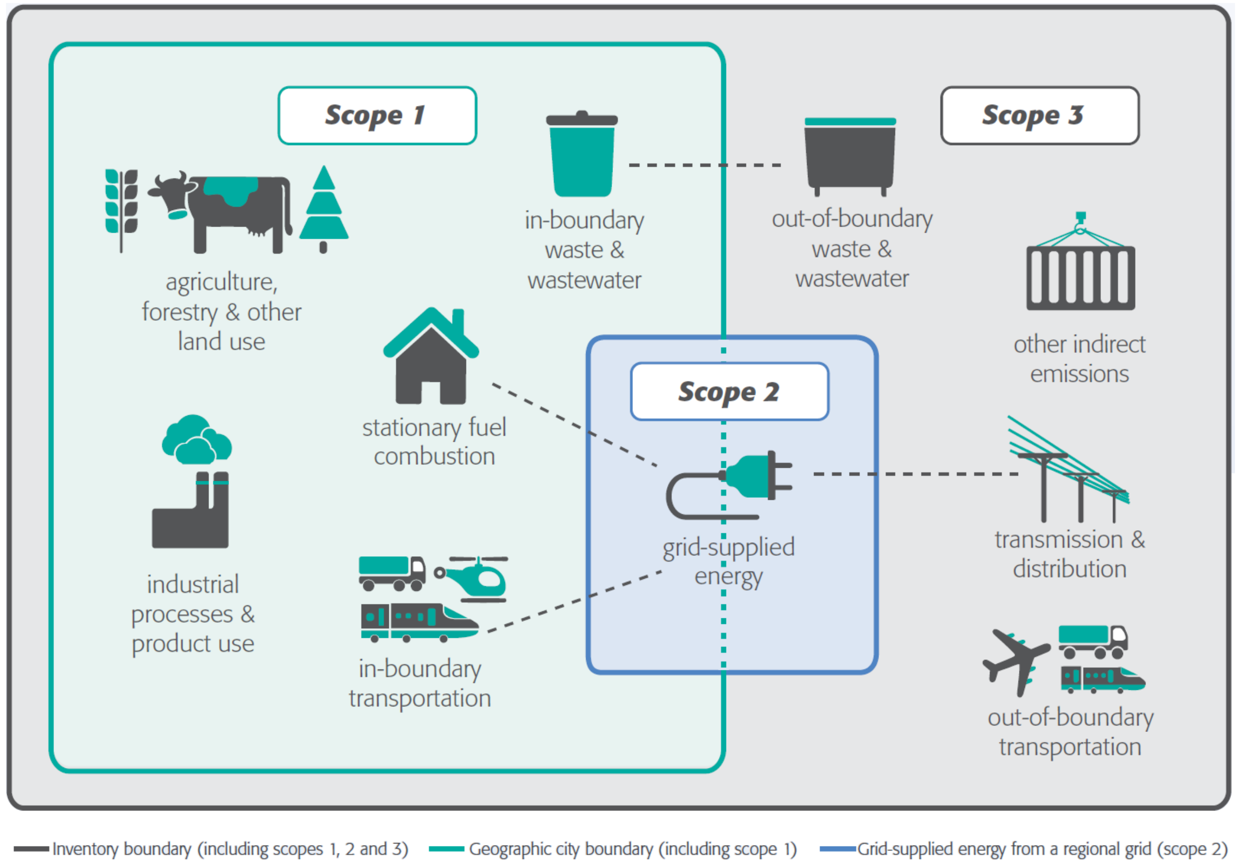


Figure 3: Various emissions sources according to Scopes 1, 2 and 3.

PAS 2070

A PAS is a Publicly Available Specification, which is essentially the precursor to a British Standard or European EN standard. A PAS defines good practice standards for a product, service or process.

PAS 2070 aims to define good practice for the assessment of the greenhouse gas emissions of a city. It builds on the GHG Protocol for Cities (GPC) to include a wider range of emissions sources and a slightly wider bundle of gases. It also offers two ways of accounting, one of which is equivalent to the GPC's three scopes ("direct plus supply chain"), and the other of which allows exclusion of of emissions from goods produced in the area that are then exported ("consumption-based emissions").

Just like the GPC, PAS2070 notes that if out-of-boundary offsets have been bought (whether by the municipality, businesses, organisations or residents) these should not form part of the total of a city's GHG account by deducting them from the total. Instead, such offsets should be accounted separately.

UK DESNZ/BEIS official subnational emissions inventories

The Department of Energy Security and Net Zero (DESNZ, formerly BEIS) releases annual figures that break the UK's carbon emissions down to a local level[v] to help local authorities make decisions. Until recently this counted CO_2 only, but now includes CO_2, methane and nitrogen dioxide (although not F-gases). It uses data from the National Atmospheric Emissions Inventory and national statistics on local area's energy consumption. It excludes aviation, international shipping and military transport because there is no clear basis for how these would be allocated to local areas.

These DESNZ/BEIS figures include only local direct emissions (including from land use and chemical use as well as fuel use) and grid energy use. They are not broken down into 'scopes', but would mostly equate to Scope 1 + Scope 2 as they do not include emissions from the local area's consumption of goods produced elsewhere (except electricity).

The DESNZ/BEIS figures are broken down into several sectors: industry, homes, commercial buildings, public buildings, transport, and land use/forestry ('LULUCF'). Transport emissions are calculated based on traffic flow data on local roads, plus fuel use on inland waterways and trains. Electrical trains are accounted for separately in the 'industry' sector.

The DESNZ/BEIS figures show how much carbon is removed by the area's grassland and woodland. This is positive, but also shows the scale of the challenge: The woodland/ grassland is nowhere near enough to zero-out the area's emissions even if the green areas were expanded many times over.

The figures also reveal how important it is to plan for reduced car use and enable low-emissions deliveries – as transport is responsible for more than half the area's emissions.

Tyndall Centre local area carbon dioxide budgets (and SCATTER trajectories)

The Tyndall Centre is a climate change research organisation made up of several UK universities working to get climate science evidence into policy. It created a tool[vi] that produces municipal-level carbon budgets towards a 2°C global climate pathway that are necessary and fair, taking into account each location's sectoral base by looking at its historical portion of the country's emissions.

These trajectories show the UK's **total CO_2 budget to 2100** if the UK is to pull its weight towards fulfilling the **Paris Agreement** (to **limit global warming to 2°C**, with **carbon cuts equitably distributed to each country** in proportion to its technological and financial capability, its needs, and its responsibility for historic emissions). This starts with the middle-range global carbon budget likely to limit global climate change to "well below" 2˚C, determined by the IPCC. Tyndall derives the CO_2 budget for the UK from this global budget, based on equity principles that account for our existing level of development and sectoral base, and the local budget is derived from the UK one. The resulting totals are split into five-yearly budgets. The Paris-compliant carbon budgets for Rutland are shown here (Figure 5), and would be used up by the end of 2026 if emissions continue at the 2017 level.

This methodology **only covers CO_2 occurring due to energy use** (whether in transport, buildings, agriculture or other industries). It does not cover the other six greenhouse gases, or releases of CO_2 from activities other than energy use. The reasons are as follows:

- Other gases are left out because "a cumulative emission budget approach is not appropriate for all non-CO_2 greenhouse gases, as [they have] … differing atmospheric lifetimes and warming effects", with more uncertainties around them.
  - There is a parallel methodology named SCATTER[1] that builds on Tyndall carbon budgets to estimate these other gases.
- Other activities are excluded because energy use is the main source of CO_2 emissions and therefore the main activity that needs to be addressed.
  - Emissions from cement production (except fuel use) are excluded because cement production is assumed to be unavoidable to some extent, therefore a deduction for cement is made from the global budget before the UK's budget is allocated.
  - Aviation and shipping are excluded from the local budget, because it is considered that those cannot be fairly allocated to local areas – so a deduction is made from the UK budget to make room for aviation and shipping, before the local budget is allocated.

Tyndall Centre assumes that global forest levels do not change between 2020-2100, assuming afforestation in certain areas to counteract deforestation in others. It recommends that GHG removals achieved by further afforestation are monitored separately from this budget and used instead to compensate for unavoidable non-CO_2 emissions, such as agricultural methane.

Unlike the Committee on Climate Change national carbon budgets, Tyndall does not assume that carbon capture technologies appear in future, as this would risk over-estimating the budget. If these technologies were to be developed in future, they could expand the size of the available budget.

Offsetting is not part of the budget, because the budget is designed to reveal the actual CO_2 reductions needed locally.

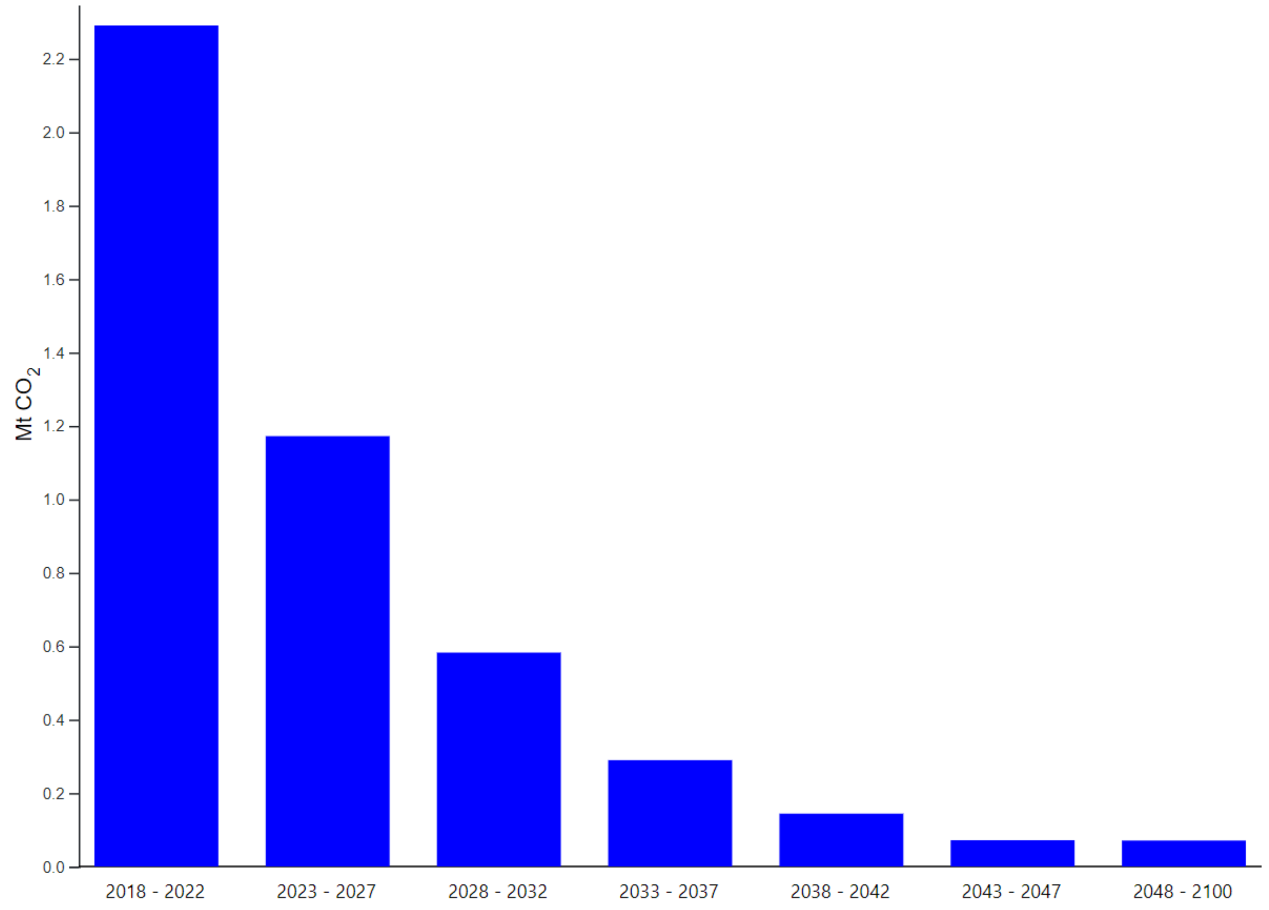


Figure 4: Rutland's carbon budgets to 2100 (energy-only, CO_2 only) compliant with the UK's commitment to the Paris Agreement. Calculated by the Tyndall Centre.[vii]

[1] Setting City Area Targets and Trajectories for Emissions Reduction. https://scattercities.com/

Rutland's existing carbon commitments and carbon accounting approach

'Future Rutland' shared vision

The 'Future Rutland' shared vision document, produced by the Council through a process of deep engagement and consultation with its community, expresses the community's shared overarching vision and main long-term aspirations for the County. This includes four themes, the second of which is 'Sustainable Lives' which contains the following goals that are directly or indirectly relevant to climate:

- "Rutland will strive to become a carbon neutral county by 2050 – a place where environmental sustainability and responsibility complement rural living."
  This is explained to mean that:
  - "New homes and developments will have sufficient infrastructure and be built in sustainable locations. Their construction will raise environmental standards, as well as having a positive impact on wildlife and the local ecology."
  - "Homes will be designed with the latest zero-carbon and green technologies in mind"
  - "Homes will be designed … in a way that makes sure communities can stay connected to nature."
  - "People in Rutland will have access to the information and support they need to decarbonise and make sustainable choices"
- "Rutland will also be a place that seizes opportunities to create and develop wild areas which support greater biodiversity"
  This is explained to mean:
  - "adding to the immense ecological value of Rutland Water and its world-renowned nature reserve"
  - "Local agricultural, planning and development practices will contribute towards a biodiversity net gain for the county"
- "Communities, organisations and businesses in Rutland will embrace their environmental responsibilities."
- This is explained to mean:
  - "Awareness and education will be at the heart of the county's climate response, so that everyone is armed with the knowledge they need about recycling, biodiversity, protecting wildlife, growing food and reducing their carbon footprint"
  - "The county of Rutland will fundamentally redefine its relationship with waste – embracing the principles of a circular economy and reducing the amount that is consumed and then thrown away".

Rutland Council Corporate Strategy 2022-27

Climate and carbon also appears in Rutland Council's Corporate Strategy 2022-27[viii] under the theme on 'Sustainable Lives'. In this document, the Council:

- Recognises the 'Future Rutland' ambition to ensure that this will be a "carbon neutral county by 2050"
- Makes a formal commitment to "support the reduction of Rutland's carbon footprint and impact on the local environment"
- In pursuit of this formal commitment, the attached initial 2-year delivery programme expresses the Council's intent to:
  - Work with the Carbon Trust to develop a carbon measure and baseline,
  - Develop and implement a carbon reduction action plan for the Council, and
  - Promote the Sustainable Warmth Project Fund to enable private sector to improve insulation.

This Corporate Strategy also contains several other commitments or actions that are indirectly related to carbon and climate, including:

- Minimise waste [noting that the actions attached to this do not appear to cover construction waste, but rather household waste]
- Encourage creation of natural habitats (which includes actions to encourage developers to increase biodiversity in new developments, and produce a water and green space infrastructure study)
- Support sustainable methods of transport through cycle routes, bridleways, public footpaths and community transport (which includes actions to review the Local Transport Plan, devise an approach for electric vehicle charging, and develop a Local Walking and Cycling Plan).
- Facilitate the increase of superfast capable broadband coverage [relevant to climate in that it could reduce the need to travel].

Current lack of a formalised county-wide carbon accounting methodology

Based on the above and on conversations with Rutland Council representatives, there is currently not a county-wide or council-wide carbon accounting methodology already in place, although the collaboration with the Carbon Trust on the Council-only carbon footprint has begun (using the industry best practice methodology for organisational carbon footprinting, the GHG Protocol). This is expected to be published in the near future, with a view to eventually developing science-based carbon targets for the organisation (carbon reduction targets that would be compatible with the globally limited carbon budget for a safe climate future).

This means there is an opportunity to now select a suitable method. It is crucial that the level of action required to reach net zero carbon is understood so that suitable programs and policies can be devised, in turn so that emissions reductions are delivered in practice. At a local level, sectors and specific measures should be identified to set out clear pathways that work towards achieving a net zero carbon future. Monitoring emissions reductions is a key element of this and should occur annually to track progress.

Local area carbon emissions estimations from central government

To illustrate general progress to date, annual sectoral emissions from the national government Department of Energy Security and Net Zero (DESNZ) are set out below. This is the data set most commonly used by local authority areas to understand their emissions as it is reliably released annually and no further calculations or analysis are needed by the local authority.

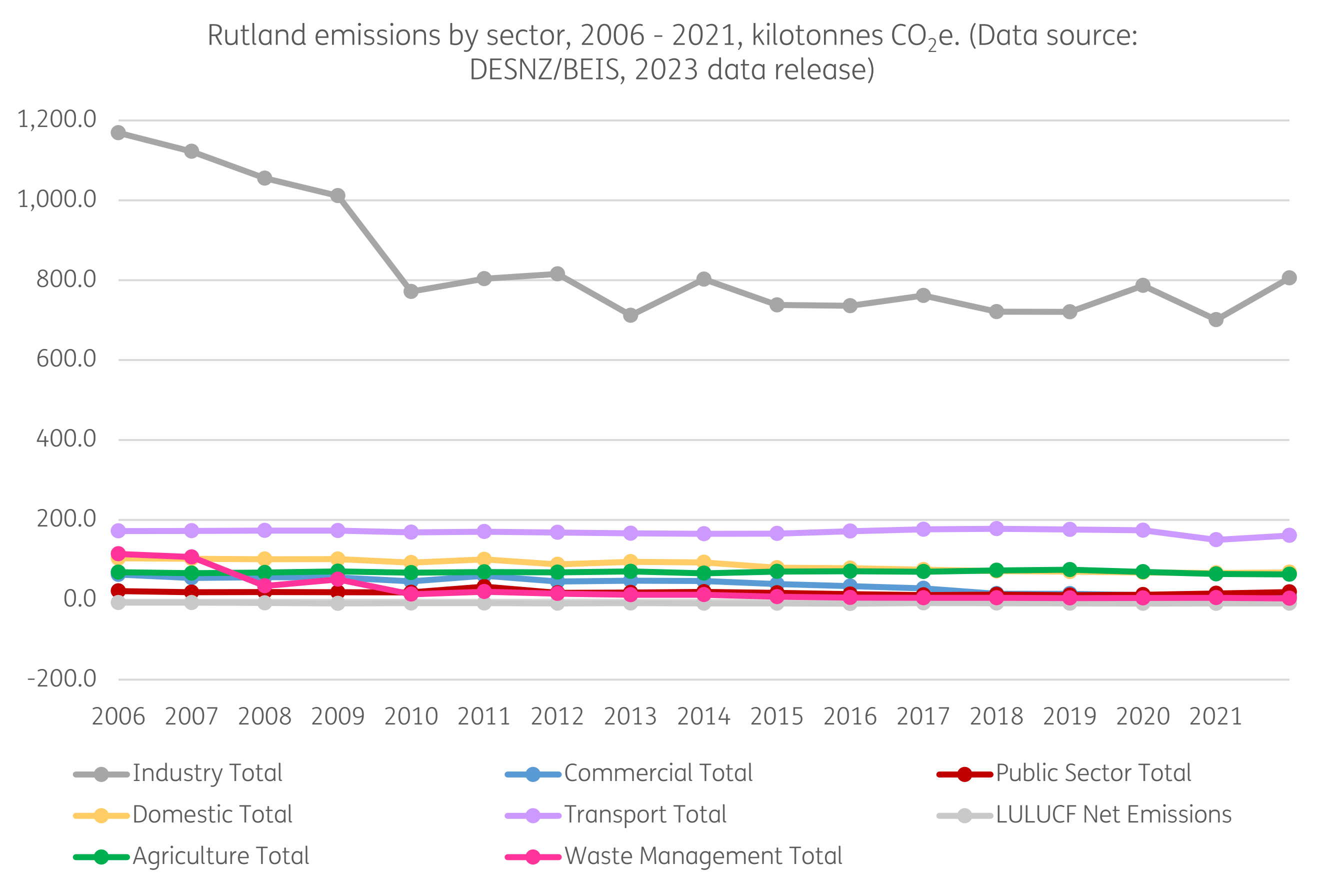


Figure 5: Sector emissions change over time from 2005 – 2021. BEIS/DESNZ subnational CO_2e data (CO_2 + methane + nitrous oxide).

Alternative carbon accounting methodology to better understand necessary interventions

Although the DESNZ/BEIS data is useful as an overview, an alternative tool – the Setting City Area Targets and Trajectories for Emissions Reduction (SCATTER) tool – improves our knowledge of what *interventions* will most effectively push Rutland towards becoming a net zero carbon geographical area. Various degrees of ambition can be set and tested in the SCATTER tool, allowing the user to adjust the desired level of emissions reductions for activities in the following sectors:

- Domestic
- Industry and commercial
- Transport
- Agriculture and land use
- Waste.

Two different scenarios (scopes 1, 2 and 3) are explored here for Rutland: a high-ambition scenario that significantly exceeds national policy and a business-as-usual scenario.

The table set out below compares the level of intervention between the opposing scenarios of 'High Ambition' and 'Business-As-Usual'. Instead of listing out the whole collection of possible interventions from the SCATTER tool, only the most relevant interventions to Rutland and local plan powers have been selected. Although some of the interventions below are not directly related to policies that could be set in the local plan, they will all be impacted by outcomes of the local plan directly or indirectly. The local plan has the most control over implementing interventions set out under 'Domestic Buildings' and 'Energy Supply'.

		High Ambition	Business-As-Usual
Agriculture and Land Use	*Forestry*	24% increase in forest cover by 2030	5% increase in forest cover by 2030
Domestic Buildings	*New build*	From 2021, 100% new-build properties are built to Passivhaus standard	All new houses are built to 2013 Building Regulations (no change)
	Heating technology	By 2050, 7% resistive heating; 60% air-source heat pumps and 30% ground-source heat pumps; 3% district heating	No change to current technology mix for home heating
	Retrofit	By 2050, 10% of current stock is retrofitted to a medium level; 80% deep retrofit	All current households remain at weighted average heat loss
	Lighting and appliances demand	By 2050, domestic lighting and appliance total energy demand has dropped to 27% of current levels.	By 2050, domestic lighting and appliance total energy demand has dropped to 80% of current levels
	Water demand	Hot water demand per household reduces by 8% every 5 years	Hot water demand per household grows 5% every 5 years
Energy Supply	*Biomass/coal power stations*	Solid biomass generation quadruples in 2025, dropping off after that. Coal phase-out follows trajectories from the National Grid's Two Degrees scenario.	No change in solid fuel power generation

	Small-scale solar PV	Local solar capacity grows, generating equivalent to 2500 kWh per household in 2030; 5200 in 2050 (from a baseline of 400 kWh per household.)	Local solar capacity grows to allow generation equivalent to 750 kWh per household in 2030; 1350 in 2050 (from a baseline of 400 kWh per household.)
	Large-scale solar PV	Large-scale solar generation grows to 200 kWh per hectare in 2030; 400 in 2050 (from a baseline of 50 kWh per hectare.)	No change in large-scale solar generation to 2030; growing to 100 kWh per hectare in 2050 (from a baseline of 50 kWh per hectare.)
	Small-scale wind	Small-scale wind grows to 2.8 MWh per hectare in 2030; 3.3 in 2050 (from a baseline of 1.2 MWh per hectare.)	No change to small-scale onshore wind
	Onshore wind	Large-scale onshore wind generation grows to 1.9 MWh per hectare in 2030; 2.2 MWh in 2050	Large-scale onshore wind generation grows to 1.26 MWh per hectare in 2030; 1.46 MWh in 2050
Industry and Commercial	*Commercial heating and cooling demand*	In 2050, commercial heating, cooling and hot water demand is 60% of today's levels	In 2050, commercial heating, cooling and hot water demand is 103% of today's levels
	Commercial heating and cooling technology	By 2050, 7% resistive heating; 60% air-source heat pumps and 30% ground-source heat pumps; 3% district heating	No change to current technology mix for commercial heating
	Lighting and appliances	Commercial lighting & appliance energy demand decreases 25% by 2050	Commercial lighting & appliance energy demand increases 28% by 2050
	Industrial processes efficiency	Industrial electricity consumption is 50% of total energy consumption by 2035; 65% by 2050. Output falls by 2% every year for non-heavy industry	Industry moves to higher natural gas consumption, with electricity consumption falling before 2035 then remaining constant
Transport	*Domestic passenger transport modal shift*	Average modal share of cars, vans and motorbikes decreases from current national average 74% total miles to 38% in 2050	No change to current national average modal split by total miles: 74% transportation by cars, vans and motorcycles
	Domestic passenger transport demand	25% reduction in total distance travelled per individual per year by 2030	No change to total travel demand per person
Waste	*Recycling*	65% recycling, 10% landfill, 25% incineration achieved by 2035, recycling rates increasing to 85% by 2050	65% recycling, 10% landfill, 25% incineration by 2040; remaining constant to 2050
	Waste reduction	Total volume of waste is 61% of 2017 levels by 2040	Total volume of waste is 124% of 2017 levels by 2040

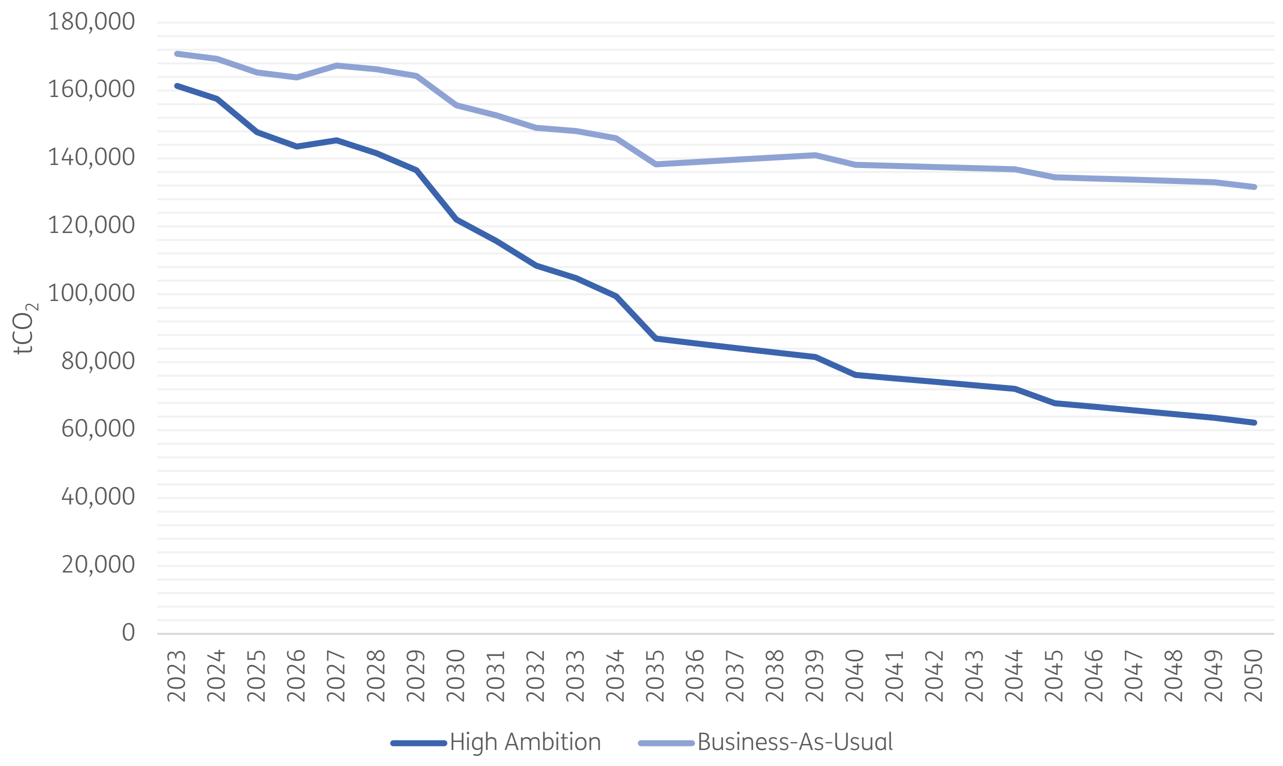


Figure 6: Two SCATTER tool scenarios for Rutland.

Figure 7 shows that although the High Ambition scenario expectedly makes progress towards a net zero Rutland, it does not achieve this by 2050, despite setting all interventions to a maximum in the SCATTER tool. This illustrates the magnitude of action required across all sectors to reach net zero by the 2050 net zero target for the UK and Rutland.

Figure 8 (below) sets out a specific sectoral breakdown of emissions reductions under the High Ambition scenario. This shows that 'Industry and Commercial' and 'Domestic' sectors result in the most significant emissions reductions and in 2023 contribute the most out of all sectors. These emissions reductions to the 'Domestic' sector represent the major impact the local plan can help to deliver to the sector through the implementation of policies that achieve new net zero carbon homes and promote widespread retrofitting of existing buildings. Although the 'Waste' sector represents a negligible proportion of overall emissions in Rutland according to the SCATTER methodology, the High Ambition scenario shows that this sector is able to get to near zero emissions by 2050. The local plan can influence this pathway to near-zero for this sector through the delivery of policies that aim to reduce waste in new buildings, which could include focusing on embodied carbon, circular economy, and material reuse and retention.

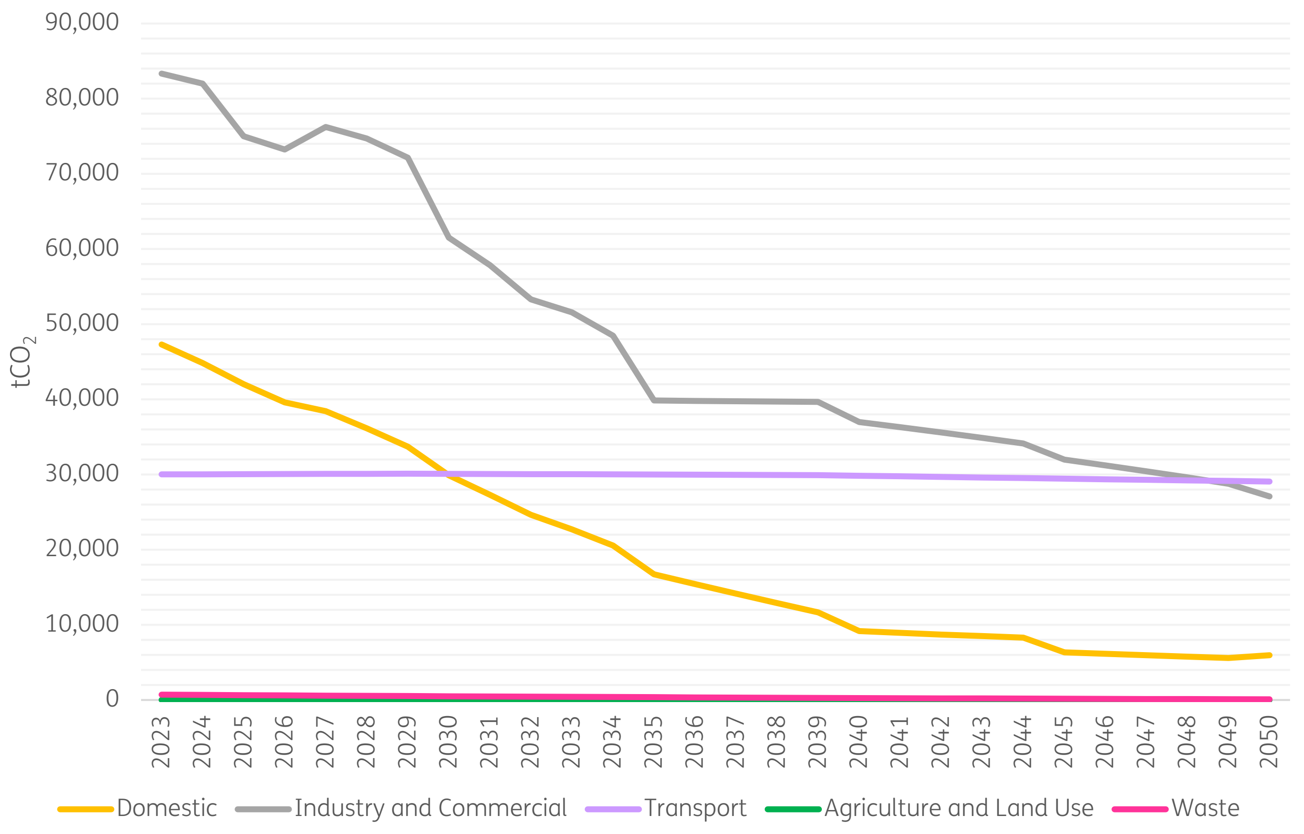


Figure 7: Sectoral breakdown of emissions reductions for the SCATTER High Ambition scenario.

In *Figure 9 ('Business as Usual')*, the 'Domestic' sector achieves no emissions reductions to 2050 and in fact shows an increase in emissions, even though it is expected that the electricity grid will significantly decarbonise. This failure to achieve reductions is primarily because the existing UK housing stock is reliant on gas for heating and therefore will not significantly benefit from reduced carbon intensity of electricity generation, unless widespread retrofitting occurs to transition existing buildings from gas to electrical heating. Contrarily, the 'Industry and Commercial' sector experiences notable emissions reductions even in this Business-As-Usual scenario, due to grid decarbonisation. However, this SCATTER projection may not account for the fact that a major proportion of Rutland's industrial emissions are from a cement works. Cement plants are generally fossil fuel driven by current necessity; their carbon reduction trajectory in reality will depend on transition to low-carbon fuels, and/or carbon capture (albeit Ketton plant has reportedly[2] recently taken part in a carbon capture technology pilot).

The results from *Fig. 8* and *Fig. 9* show the significant impact that local authority action and policy can have on the 'Domestic' sector. Whilst the ambitious scenario results in monumental emissions reductions, the Business-As-Usual scenario reveals that lack of policy action will leave the 'Domestic' sector highly carbon intensive in Rutland. Therefore, for Rutland to become a net zero carbon region as soon as viable before 2050, and to contribute its share towards a net zero carbon UK, ambitious local plan policy must be implemented to deliver truly net zero new buildings, ensure retrofitting of existing buildings and provide an attractive policy landscape for renewable energy development. Since SCATTER only refers to CO_2 from energy use, the 'Transport' sector does not result in any notable emissions reductions under both SCATTER scenarios. However, as shown in *Fig. 6*, transport is the second largest emitting sector in Rutland and should therefore be simultaneously addressed in the local plan by allocate sites primarily by their scope for reduced car use, and setting development management policies that promote walking, cycling, support public transport and electric vehicle use.

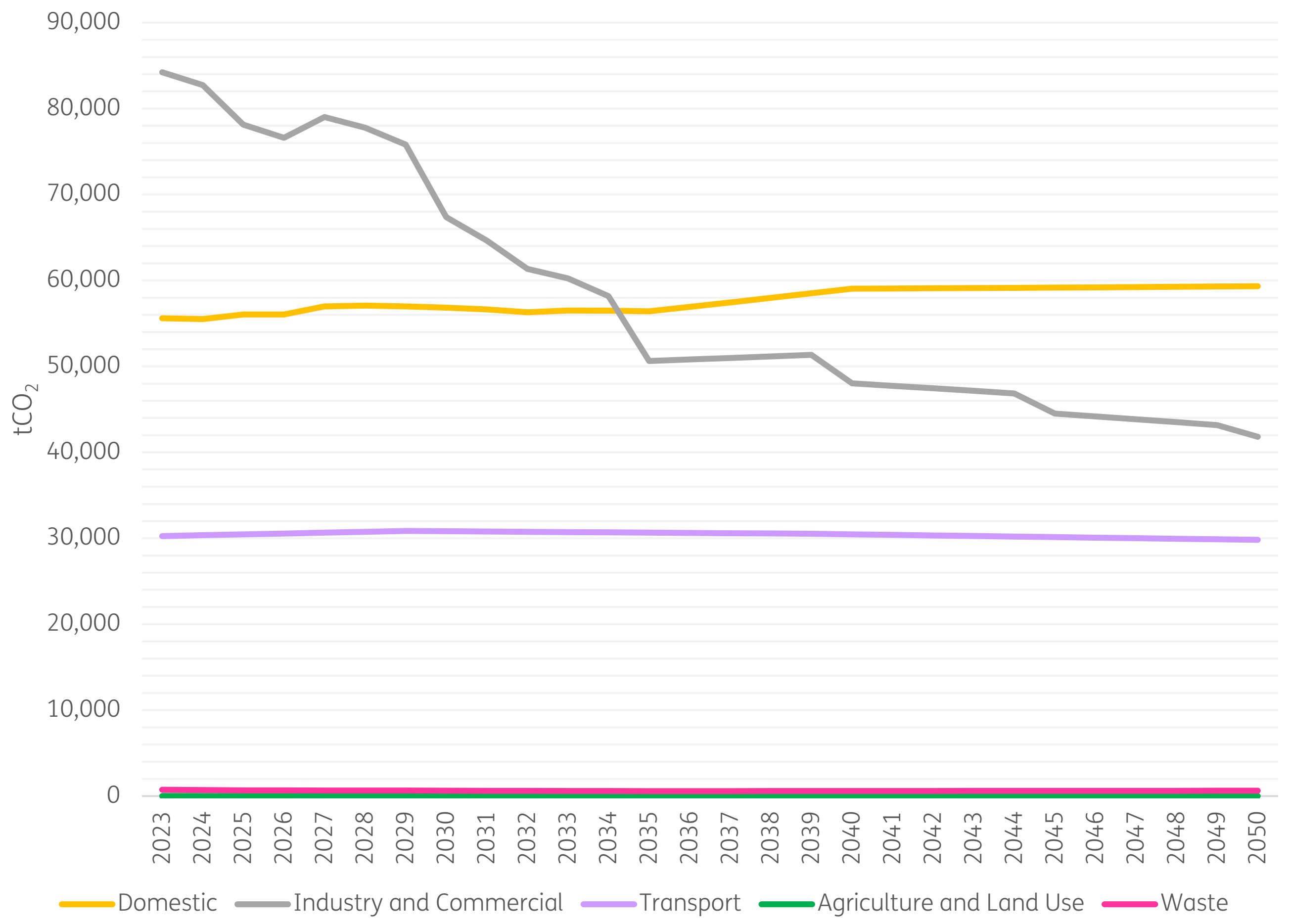


Figure 8: Sectoral breakdown of emissions reductions for the SCATTER Business-As-Usual scenario.

[2] https://www.cemnet.com/News/story/172811/c-capture-on-trial-at-ketton-plant.html and https://www.carbon8.co.uk/news/innovateuk-grant-successfully-completed

It is paramount that the Rutland local plan maximises emissions reductions for all sectors, yet it is clear from the combination of DESNZ/BEIS and SCATTER data that there is most scope for reductions to domestic buildings, transport, and industry and commercial sectors.

How could carbon accounting methodologies be logically applied to an individual building and how would this impact the carbon footprint of the local area and UK?

There are two ways in which a new building is responsible for carbon emissions:

- Operational carbon: the emissions caused by running of the building, mostly due to energy use.
- Embodied carbon: the emissions that were caused in the production and transport of the materials and their assembly into the finished building. This can also include further embodied carbon emissions as parts of the building are maintained, replaced or eventually demolished.

The Global Greenhouse Gas Protocol ‘three scopes’ is helpful to conceptualise how the individual building would contribute to Rutland’s overall emissions.

Operational carbon emissions of a building appear almost entirely within Scope 1 (burning of fuel for energy in the building itself, such as a gas boiler) and Scope 2 (use of electricity from the grid, and use of any energy from a heat network if there is one present).

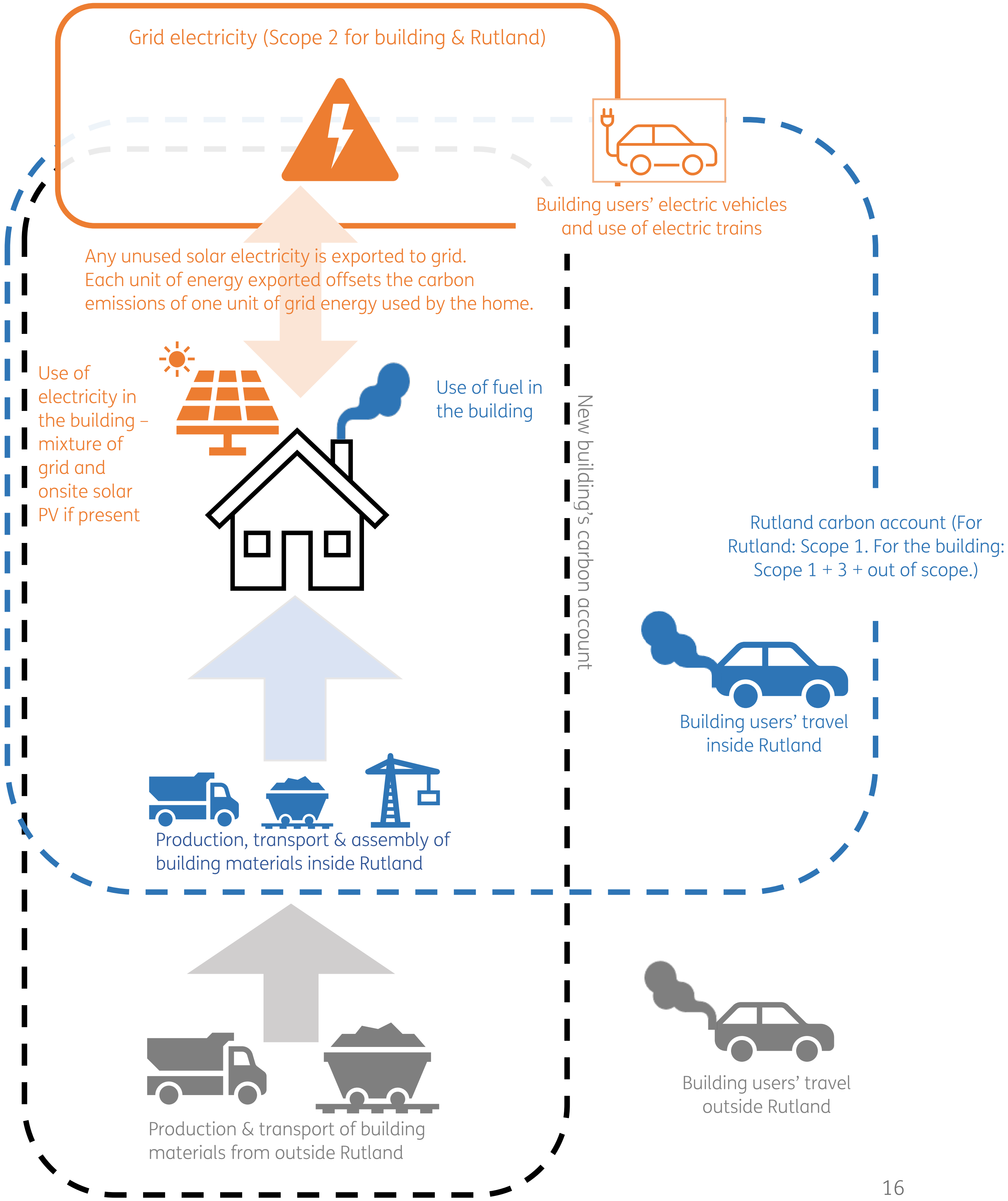
Embodied carbon would be entirely Scope 3 for the building. However, that embodied carbon will contribute to the Scope 1 and 2 emissions of Rutland and the UK, because it includes the transport of materials to site, the use of energy to assemble the building, and potentially the production of the material itself if it is sourced from within Rutland (not unlikely, given the presence of a major cement works) or the UK. It may also include some Scope 3 if the material was produced overseas.

New development could also cause increased ongoing transport emissions by causing occupants or visitors to drive. This would be part of Rutland’s carbon account (scope 1). However, any increased transport carbon is not counted within the *building’s* carbon account, by any existing methodology to account for a building’s carbon emissions. Thus a ‘net zero carbon building’ does not have to have ensure that no transport carbon is emitted by its occupants or visitors. The same is generally true for the use of the term ‘net zero carbon development’ in planning policy and the built environment sector.

Aside from industrial emissions, transport is the largest source of carbon emissions in Rutland and should be a priority for the local plan to address via the spatial strategy and separate policies.

To follow the carbon budgets for Rutland – and to ensure Rutland plays its role in following the carbon budgets for the UK as a whole – emissions from transport and from buildings’ energy use are the key areas that should be targeted by local plan policy. This is because these are the main ways that a new building’s carbon emissions would affect Rutland’s carbon account.

Embodied carbon of new buildings’ materials and construction will less strongly affect a district’s overall carbon account if using the DESNZ/BEIS methodology or the GHG Protocol for Cities methodology. The main exception to this is if new buildings in Rutland source cement from the major cementworks that exists; if this happens there will be a more direct link between embodied carbon and Rutland’s direct emissions (Scope 1). However, even if not sourcing from within Rutland, a significant portion of the embodied carbon will appear in the UK’s carbon account. Planning policy should therefore still encourage reductions in this.



'Net zero carbon building' definition in national building regulations and planning

Building Regulations Part L is the legal tool that controls buildings' energy and carbon emissions. Most definitions of 'net zero carbon buildings' in local and government policy are based on Part L and the associated calculation methods.

Building Regulations Part L looks only at *operational* energy and carbon (and does not even address the entirety of this, as explained below). There is currently no regulatory method to consider *embodied* carbon, nor to hold new development responsible for carbon emitted by new occupants' transport.

Part L only controls the 'fixed' energy uses of a building: space heating/ cooling, hot water, fixed lighting, ventilation, fans, pumps. It ignores plugin appliances, lifts, escalators, and so on ('unregulated energy'). This means a 'zero carbon' building using Part L is not truly zero carbon.

To legally comply with Part L, a proposed development must use an energy and carbon calculation named the Standard Assessment Procedure (SAP, for homes) or the Simplified Buildings Energy Model (SBEM, for non-residential buildings). These calculations are submitted to building control.

SAP and SBEM set limits on the amount of energy a building uses per square metre per year, and the amount of carbon emissions that associated with the building's energy use. These are the Target Emission Rate (TER) and Target Fabric Energy Efficiency (TFEE). The TFEE relates only to energy used for heating and cooling. The TER is the carbon emissions associated with all 'regulated' energy uses.

These limits are set by modelling a 'notional building' of the same size and shape as the proposed building, with a range of basic energy saving measures applied (insulation, glazing, air tightness, lighting efficiency, heating system efficiency and so on). Part L defines what these measures are. The proposed building must be designed so that it uses no more energy nor emits more carbon than the 'notional building' would. This means the targets vary between buildings, as heat losses are affected not only by the fabric but also the size and shape (more external surface and joins = more heat loss).

Part L is updated periodically, but not often: the previous version was been in place from 2013 to 2022. A new version "Part L 2021" was implemented from June 2022, and a further version is expected to arrive in 2025 (the Future Homes Standard). These uplifts come with changes to the 'notional building'[ix]. For Part L 2021, this has some small improvements to fabric (insulation/glazing) and solar panels applied to the roof, but it still has a gas boiler. Together these make the target emission rate about 31% lower than it was in Part L 2013. In Part L 2025 the notional building has a heat pump and much better fabric, but no solar panels. Together these measures will make the target emission rate about 75% lower in 2025 than in 2013 (or about 64% lower than it is with Part L 2022).

SAP and SBEM methods are also periodically updated to reflect changes in the carbon emissions of grid electricity, and the efficiency of various appliances or fittings such as boilers and hot water taps. Nevertheless, it is widely acknowledged that these methods are poor at predicting actual energy use (discussed overleaf) and their periodic updates tend to lag far behind the real-world changes to electricity grid carbon or changes to the efficiency of different heating technologies.

The Government's consultation on the Future Homes Standard noted that their intent is that the Part L 2025 target emission rate will be low enough that new homes would not use a gas boiler. The 75% reduction on Part L 2013 would be essentially impossible to achieve in a home that has a gas boiler, which is likely to prompt the use of heat pumps in most homes, although some may be able to reach that emissions target using direct electric heating combined with extensive solar panels.

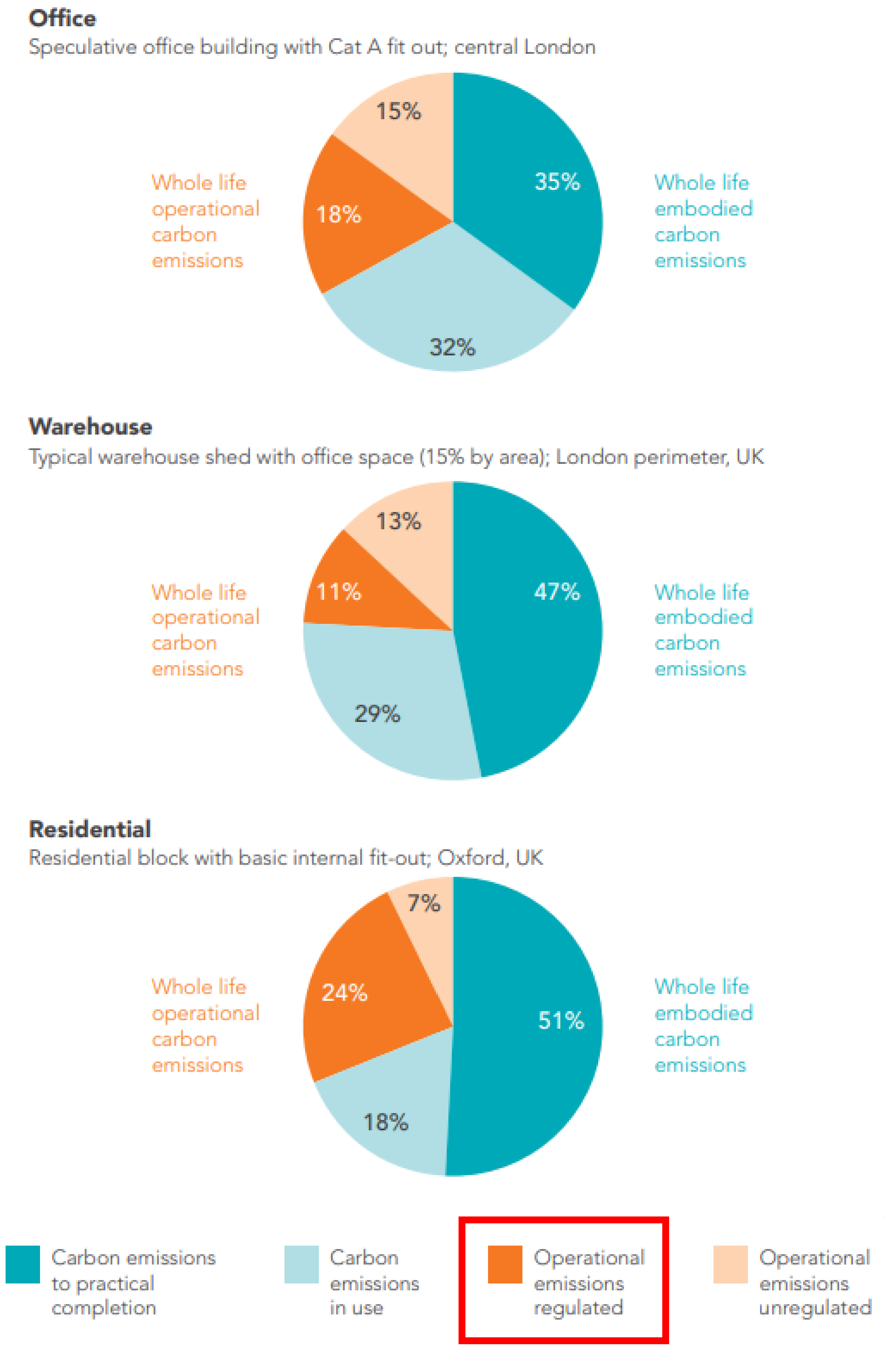


Figure 9: Diagram showing a breakdown of whole-life carbon emissions for four typical building types. Part L of building regulations only looks at the bright orange segments - and even then quite inaccurately. Source: UKGBC.

‘Net zero carbon building’ – alternative definitions in the construction sector

Green construction experts have recently been developing new approaches to remedy the shortcomings of the national building regulations, SAP and SBEM in defining and delivering net zero carbon buildings. The main weaknesses in Building Regulations identified by the sector are:

- Failure to account for ‘unregulated energy’ – that is, plugin appliances, lifts, escalators, and any other uses not covered by building regulations – which can be 50% of total operational energy use[x]
- Poor accuracy at predicting buildings’ actual energy use using SAP and SBEM methods (the ‘energy performance gap’), often incorrect by a factor of 200-300%
- Frequently outdated carbon emissions factors for energy, especially electricity
- Failure to sufficiently incentivise energy-efficient building design, due to relatively weak standards for airtightness and not setting absolute targets in kWh/m^2 that all buildings of a certain type must achieve.
- Failure to address embodied carbon (the carbon that was emitted to produce building materials, transport them to site, and assemble them into a finished building).

For all of the reasons above, a ‘net zero carbon building’ calculated by Part L SAP or SBEM will in fact be very far from being carbon-free in operation[xi], before even considering its embodied carbon impacts.

The industry has therefore begun to collaboratively develop new definitions that address not only the end result of net zero carbon, but also inform the design and energy procurement measures that should sensibly be used to achieve it, such as energy efficiency targets and embodied carbon targets.

UK Green Building Council (UKGBC) Framework Definition of Net Zero Carbon, 2019

The UKGBC definition[xii] of net zero carbon buildings includes twin tracks: operational and embodied. These twin tracks for net zero carbon buildings can be treated separately. However, buildings seeking ‘net zero carbon construction’ should also aim to fulfil the operational track too.

- Net zero carbon in construction is: “When the amount of carbon emission 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 in operation is: “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.”

UKGBC does not require the building to hit any specific targets for space heating, operational energy use, or embodied carbon , although it encourages reductions to be prioritised before offsetting.

UKGBC’s separate energy procurement guidance[xiii] confirms that off-site renewable energy supply does not have to be via a long-term power purchase agreement, but can be a green tariff so long as that it meets certain criteria on ‘additionality’ (so the purchase of the energy brings forward additional renewable energy generation capacity, not just buying up existing renewables present in the grid).The guidance notes that at the time of writing (2021) only three such tariffs existed in the UK. It also notes:

- Fossil fuel must not be the primary energy source for heating, hot water and cooking
- All new build energy systems should be compatible with being renewably powered.

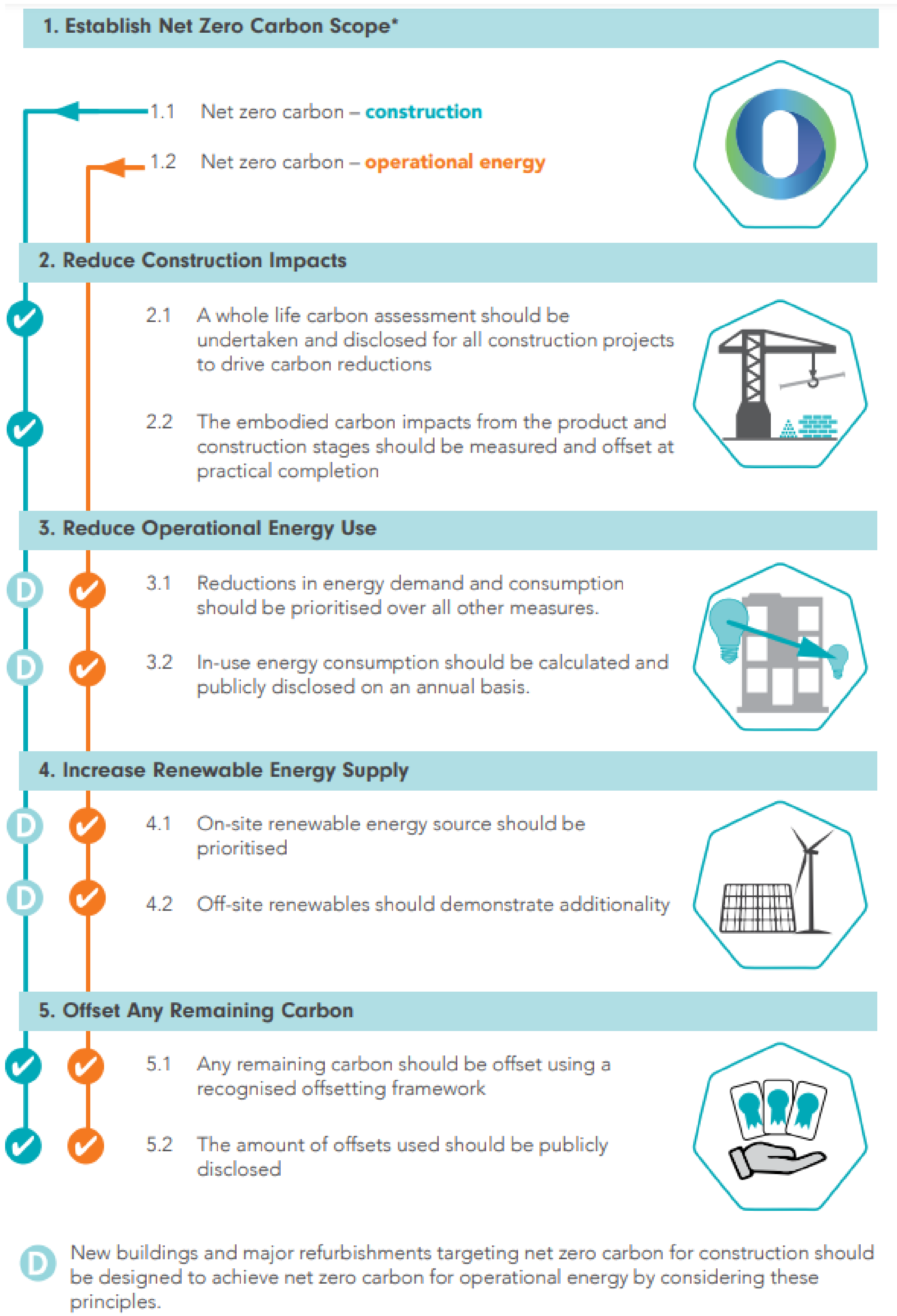


Figure 10: UKGBC Net Zero Carbon Buildings Framework Definition - twin track diagram.

London Energy Transformation Initiative (LETI) Net Zero Operational Carbon

LETI is a coalition of industry-leading green building experts, architects and surveyors.

Its definition[xiv] is that the building achieves a zero carbon 'balance' in its energy use across each year. That means that for each unit of energy that the building consumes from the grid, it exports at least one unit of zero-carbon energy produced by the building itself (generally assumed to be through solar panels). Alternatively, the building's energy demands can be entirely met by additional renewable energy supply from off-site.

LETI's definition also requires that the building fulfil the following targets:

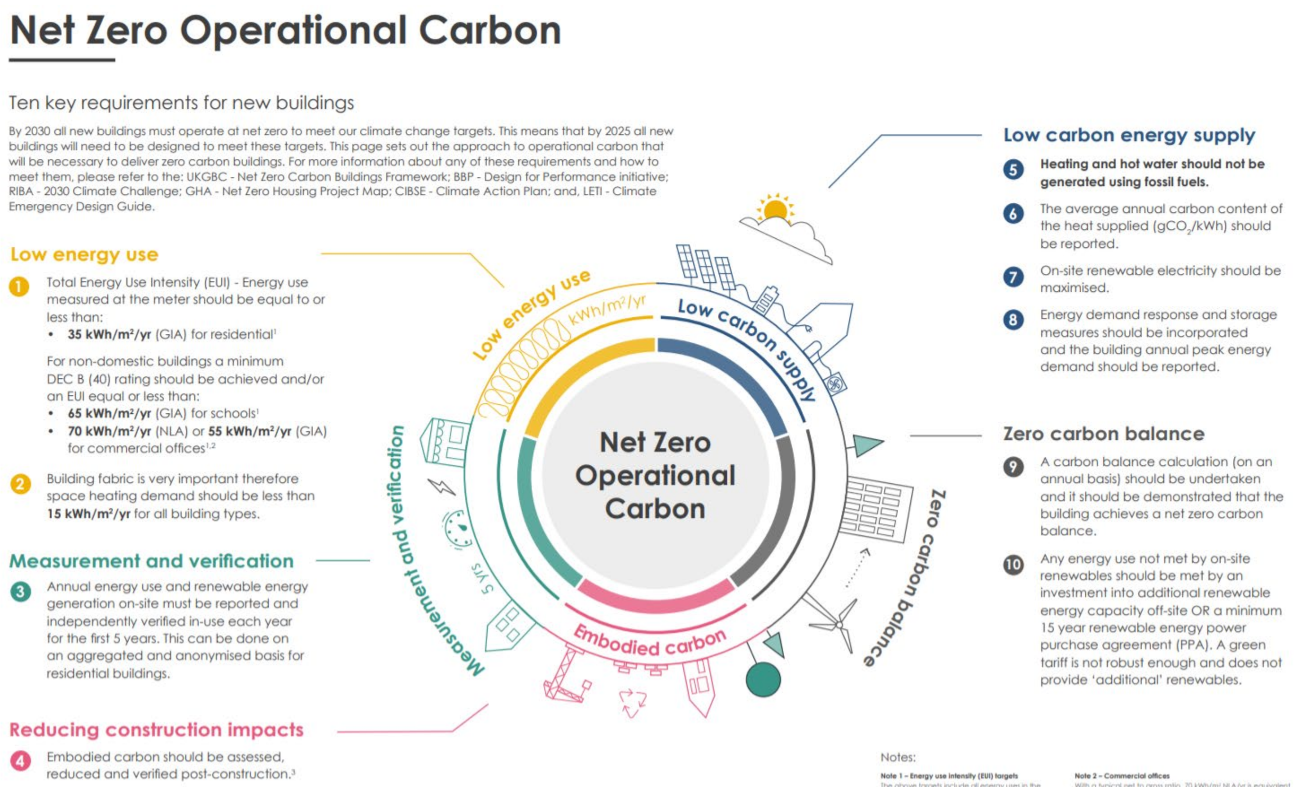
- Space heat demand: 15kWh/m_2/year for all building types.
- Total energy use intensity, including unregulated as well as regulated: 35kWh/m_2/year in homes, 65kWh/m_2/year in schools, or 70kWh/m2/year in commercial offices
  - These targets are designed to ensure the use of heat pumps, as these have a ~300% efficiency which translates a 15kWh space heat demand to a 5kWh energy use.
- All space heat and energy demand targets must be fulfilled at the design stage using an accurate predictive energy modelling methodology (not the building regulations methods SAP or SBEM[xv]), such as Passivhaus Planning Package (PHPP)[3]
- Heating and hot water not to be generated using fossil fuels
- Onsite renewable energy should be maximised.

These targets – specifically the space heat demand target and fossil-free heating – are in line with the similar targets that apply to the industry certification 'Passivhaus' (although Passivhaus basic certification does not require any level of renewable energy provision or full 'net zero carbon' status). This means the LETI targets are well-aligned to the recommended SCATTER 'high ambition scenario' interventions for the new build sector for Rutland, outlined previously for Rutland.

Other sustainable construction frameworks such as the RIBA Climate Challenge[xvi] have adopted similar targets for energy use intensity at similar levels, although not for space heating.

LETI also recommends annual reporting of energy use and renewable energy generation on site for 5 years to verify the net zero carbon status, and that embodied carbon should be separately assessed and reported. It offers separate targets[xvii] for embodied carbon, but does not expect the embodied carbon to be offset – rather, reduced at source as far as possible.

We note that although UKGBC has not updated its 'framework definition' (discussed in the previous section), it has now endorsed the LETI definition of net zero carbon[xviii].



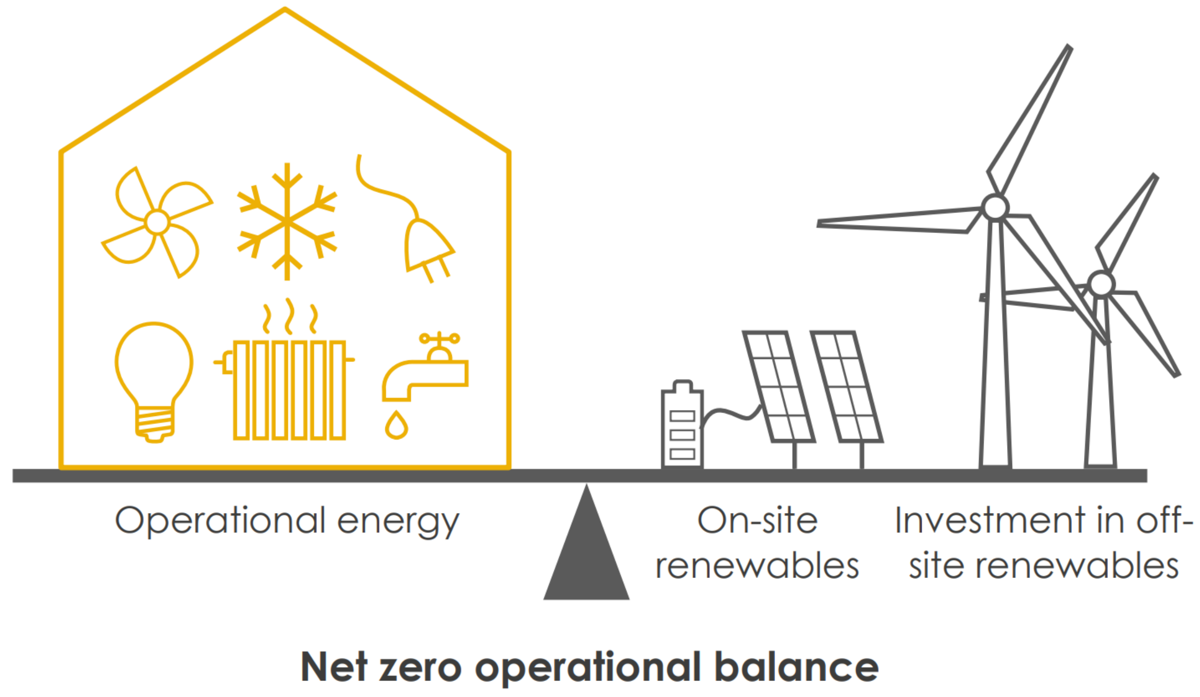


Figure 11: Diagram of LETI net zero operational balance. From LETI Climate Emergency Design Guide.

[3] Please note the Passivhaus Planning Package (PHPP) is a method to model and predict building's energy use. Although it was developed for use in the Passivhaus certification process, there is no obligation to undergo Passivhaus certification – the PHPP tool can be used in any project without pursuing certification.

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