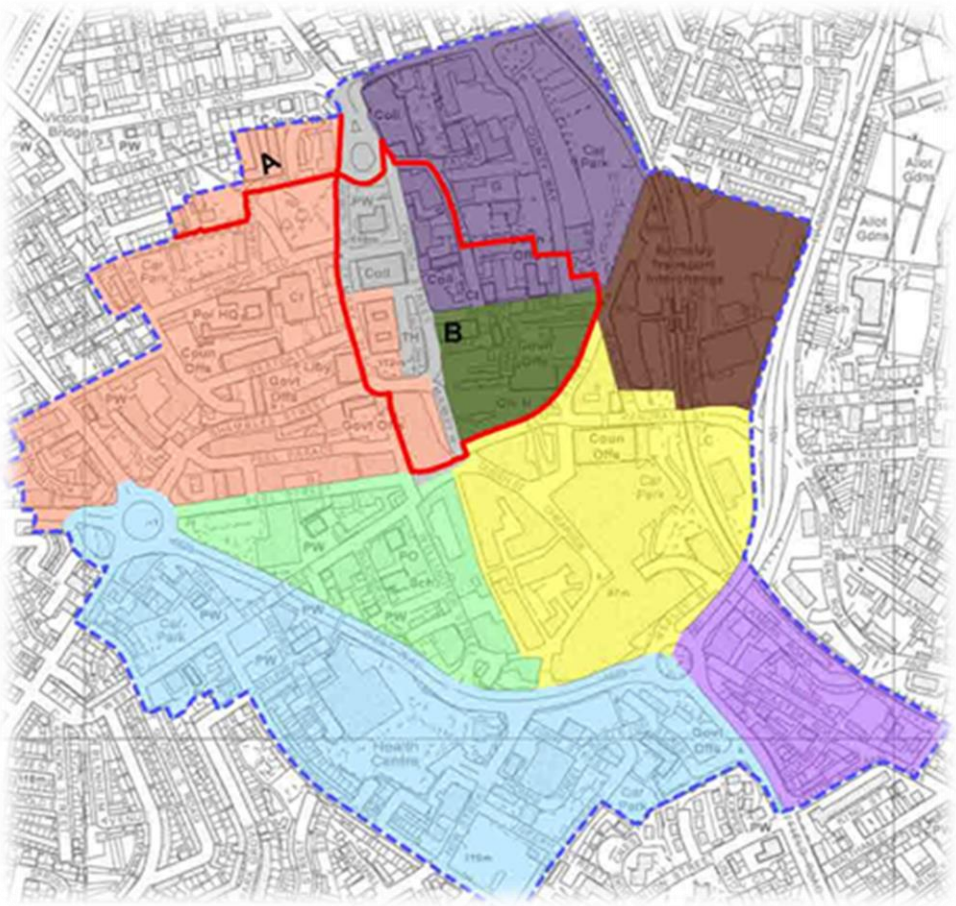
Barnsley Zero Carbon Town Centre

Built Environment Zero Carbon Transition Strategy



LEDA

BARNSLEY ZERO CARBON TOWN CENTRE

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1 Summary

Barnsley Metropolitan Borough Council (BMBC) aims to; develop the town centre to recover from the pandemic; meet the needs of inhabitants and visitors; improve health and wellbeing; and meet the council's commitments to greenhouse gas emissions reductions. The council is targeting being carbon neutral in its own operations by 2040, and for the town centre to be carbon neutral by 2045.

The town centre is predominantly non-residential buildings, and so most of the greenhouse gas emissions will involve working with the businesses in the town centre. The residential buildings in the town centre are predominantly large blocks of apartments, and these will require large projects to improve their performance along the same lines as the larger non-residential buildings. A small number of terraced houses are present, and some smaller business premises, and these would share similar fabric retrofit issues and could be tackled as part of a broader borough wide retrofit programme for domestic scale buildings.

2 Introduction

Achieving the net zero targets agreed by the council requires the reduction of energy demand and meeting that demand from renewable resources.

Retrofit of the buildings in the town centre will be an important step in meeting net zero and involves the improvement in performance of the buildings through energy efficiency measures, low carbon heating (using heat pumps), electrification of cooking, improving efficiency of electrical equipment and lighting, and electricity generation from renewable resources.

The focus of retrofit is in reducing the operational greenhouse gas emissions associated with the buildings in the town centre over the lifetime of the retrofit measures. Ultimately, all combustion must be eliminated, and all energy provided by electrical means. This will enable the town centre to reach net zero as electricity generation becomes zero greenhouse gas emission over time. Eliminating combustion will also give benefits in internal and external air quality and hence improve the health of the population using the town centre.

Achieving retrofit of the buildings within the town centre is a combination of technical, financial, and organisational issues that together are complex and challenging to solve.

At a national and international level, deep fabric first retrofit to enable net zero carbon emissions is expected to pay back, but for an individual household or business there may not be a viable business case for many of the measures that make up a package for deep retrofit.

This reflects the fact that there is a regional level tradeoff between energy demand reduction and the need to construct energy generation, transmission, storage, and distribution infrastructure. Reducing demand is often less expensive than building more infrastructure and therefore reducing demand is where investment should be placed (although this is not currently well supported by the policies implemented nationally, despite the ambitions described in the governments heat and buildings strategy[1]).

Some of the benefits from deep retrofit measures (as part of a whole building plan which deals holistically with improving the building performance) are seen in other sectors of the economy. For

[1] Heat and Buildings Strategy https://www.gov.uk/government/publications/heat-and-buildings-strategy

example, improvements in comfort and internal air quality give rise to reduced costs in the health care system both in terms of physical and mental illness. The same can be said of improvements in external air quality due to elimination of combustion in transport and buildings and in promoting active travel modes. The individual household or business making the improvements does not directly receive the benefits in financial terms, and it is therefore necessary to provide funding to businesses to make implementation of retrofit measures have a viable business case.

The scope and scale of retrofit required is substantially beyond what is currently carried out, and building a pipeline of work and a supply chain to support it is necessary. This will involve investment in training and activities to develop capacity in relevant professions and trades that are required alongside developing demand.

2.1 Scope

This report is a subset of the works undertaken by URBED to complete the Barnsley Town Centre Urban Design and Sustainability Study.

The scope of this report is:

- the built environment within the Town Centre area defined by the local plan[2]
- to estimate the greenhouse gas emissions associated with the buildings within the town centre based on the best data available
- to provide strategies to reduce the emissions from buildings to help achieve zero carbon

The scope[3] of emissions considered includes scope 1 (direct emissions from owned or controlled sources – for buildings, this is primarily the combustion of fossil gas for heating and hot water generation) and scope 2 (indirect emissions from the generation of purchased electricity, steam, heating, and cooling consumed by the reporting entity – for buildings, this is all electricity uses). The emissions scopes considered relate to energy delivered at the meter for gas and electricity in all the buildings within the town centre boundary.

The following are excluded from the analysis:

- increases in the number of residents, properties, buildings/floor space
- carbon dioxide equivalent of other gas emissions such as hydrogen distribution losses and refrigerant leaks
- emissions from transport, waste, and industrial processes
- scope 3 emissions (all other indirect emissions that occur in an entities value chain)

[2] Barnsley Local Plan. Policies Map; January 2019. P.5
[3] Green House Protocol (GHG); Scopes and definitions, P.11

2.2 Methodology

The study behind this report consists of the parts shown in Figure 2.1.

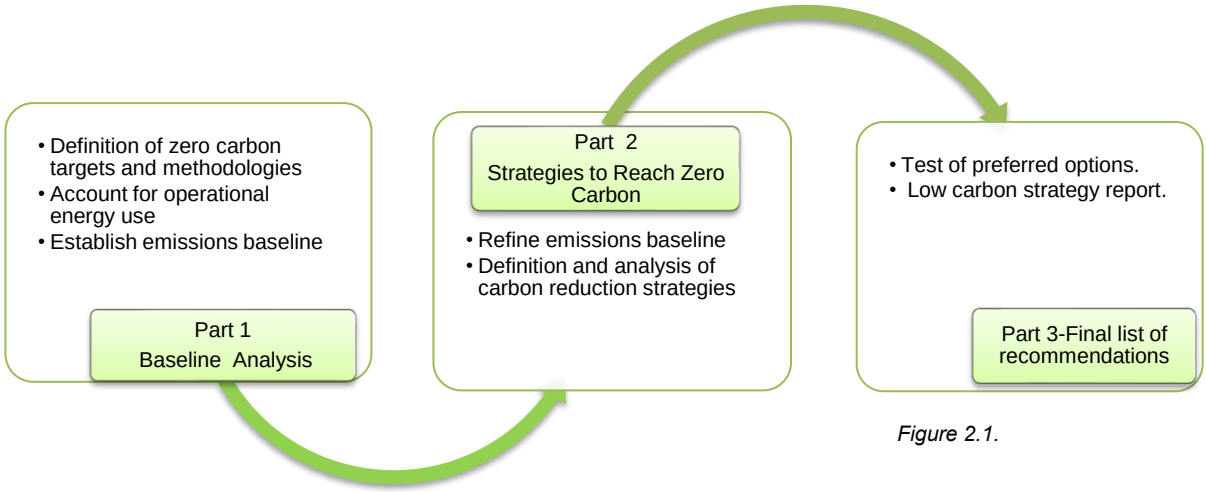

Figure 2.1.

Part 1 provides a definition of Zero Carbon and relates this to the existing BMBC targets to align proposed strategies and timeframes. A Carbon Emissions baseline is established for 2018 using EPC data and other sources. This supersedes the earlier baseline based on Office for National Statistics (ONS) data[4] and BEIS statistics[5] for electricity and gas consumption presented in the Medium and Lower Super Output Areas (MSOA, LSOA) data, since that could not be related to specific buildings within the town centre.

In Part 2, a series of different building typologies are defined, and more specific CO_2 emissions are associated with these typologies. Strategies to achieve Zero Carbon are presented for several case studies to demonstrate possible solutions.

In Part 3, the final recommendations are presented giving a timeline for the implementation to achieve zero carbon for the town centre.

2.3 Baseline

In recent UK studies several different models and methodologies have been applied to calculate baselines of carbon emissions and develop carbon savings pathways. These studies include Greater Manchester, Sheffield, Bristol, and Brighton, among others.

Greater Manchester and Sheffield studies have conducted their research by applying the SCATTER TOOL method in collaboration with Tyndall Centre for Climate Research. The tool recommends an overall Carbon budget and defines pathway projections with annual mitigation rates to reduce carbon emissions year by year.

Other reports developed for Bristol City Council and Brighton & Hove, have used Department for Business, Energy & Industrial Strategy (BEIS) and ONS National data sets on energy and carbon emissions statistics for local authority administrative areas. This more granular data enables more informed measures for carbon savings to be formulated.

The revised baseline for 2018 within this report is calculated based upon publicly available EPC data for domestic and non-domestic buildings, augmented with data from BMBC's own building

[4] Office of National Statistics (ONS), April 2018
[5] BEIS energy consumption statistics; Lower and Middle super output areas statistics (www.gov.uk)

operations (2019) and calculated values from business tax data and energy benchmarks. The previous BEIS/ONS data approach was found to be difficult to split the LSOA data between that within the town centre and that outside the town centre as several LSOA overlap the town centre area and building types are not evenly distributed across the LSOA.

The data has been used to calculate estimates of energy use for each fuel and then BEIS carbon reporting conversion factors have been used to convert this data to greenhouse gas emissions on a consistent basis for the baseline.

The carbon reduction trajectory considers grid decarbonisation based on government published Energy and emissions projections[6] using UK Government Green Book assumptions[7].

2.4 Barnsley Town Centre Overview

The area defined as Barnsley town centre covers 74.6 hectares[8], which represents just below 1% of the Borough's total area[9]. The BMBC area has an overall population of 245,199 inhabitants, where the town centre serves over 70,000 people[10] as a mixed-use destination of retail, civic and cultural services.

2.5 Town Centre Boundary

The town centre is characterized by a distinct hierarchy of streets and primary routes which are open to traffic and offer access to the different areas and key sites, as seen in figure 2.2[11].

The main gateways, which limit the town centre boundaries are The West Way (A628), Shambles Street and Townend roundabout at the West side; Barnsley main Interchange and Eldon Street at the East side; Huddersfield Road, Old Mill Lane (A635) and Church Lane gateway to the North; and The West Way (A628), Harlborough Hill Road and Alhambra Roundabout to the South. Secondary routes offer pedestrian access to the core retail, shopping areas and public spaces such as Cheapside and Market Street.

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[6] https://www.gov.uk/government/collections/energy-and-emissions-projections
[7] https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal Table 1 in data tables
[8] URBED QGis Maps. Local Plan- Town Centre Boundary
[9] Office of National Statistics (ONS). Sourced from 2011 Census key statistics
[10] Barnsley Town Centre prospectus and feasibility study, P.6
[11] Barnsley Town Centre Regeneration Plan; Arup, 2016. P.15.

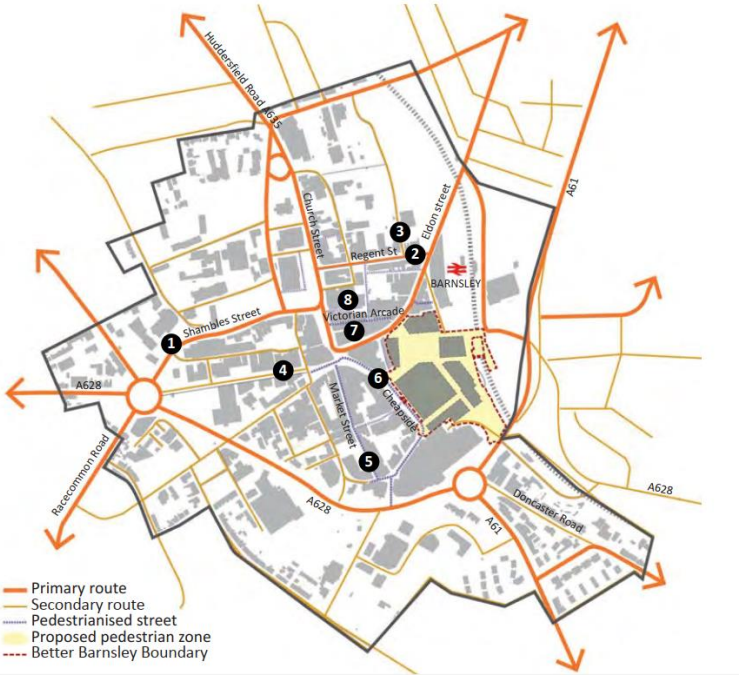


Figure 2.1 - Main primary and secondary routes. Regeneration study, 2016

2.6 Town centre neighbourhoods

The Barnsley local plan[12] identifies nine major areas within the town centre as seen in figure 2.3.

The northern part of the town centre - the courthouse campus – contains a large proportion of the educational and office buildings, with the Digital Media Centre, Barnsley College, and the University Campus Barnsley, combined with car parks and open areas. The eastern side of the town centre contains - The Lanes - and - The Markets – areas, where several buildings owned by the council are concentrated, with small and large retail spaces and public leisure buildings. Transport Facilities - Barnsley Interchange and big retail outlets and complexes define the main uses around the Eastern Gateway. Looking to the West of the centre – Westgate and Market Hill – contain some conservation buildings built prior to 1919, which can be found together with gardens and green public spaces. The conservation area lies principally within The Lanes and Market Hill areas with parts also in The Courtyard Campus and Churchfields areas.

Residential is generally located within peripheral areas of the town centre: The Southern Fringe area at the West side of the town centre; The Yards towards the southern boundary of the town centre; and along Old Mill Lane towards the northern boundary of the town centre. The residential areas are close to the boundaries of the town centre and generally are linked to the residential areas outside the town centre boundary. The Yards and Southern Fringe areas are separated from the rest of the town centre by major roads.

[12] Barnsley Local Plan - Policies Map; January 2019. P.5 https://www.barnsley.gov.uk/services/planning-and-buildings/local-planning-and-development/our-local-plan/barnsleys-local-plan/.

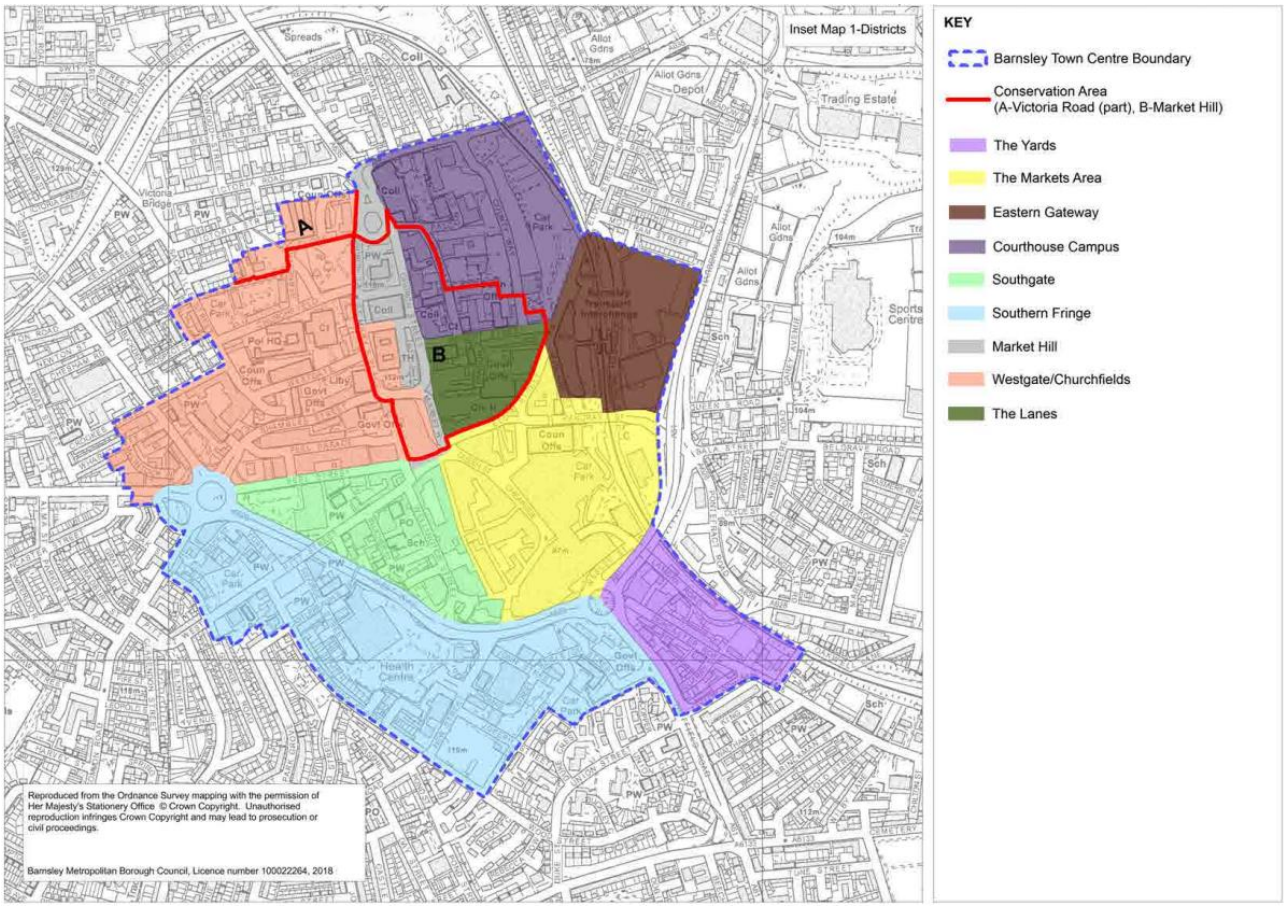


Figure 2.2 - Barnsley town centre boundary with areas as identified in the Barnsley local plan, January 2019.

2.7 Domestic sector

Within the Borough there are 110,590 households[13] and 25,000 new homes are planned to be built by 2033[14]. Council's Housing accounts for 18,500 of the properties[15] , with an averaged Energy Performance Certificate (EPC) rating C - which is equivalent to 51-75 kWh/m^2 per year.

From the private sector, it is estimated that 22,500 household (28% of the total) are built pre-1919, which were constructed with solid walls or cavity walls with a lack of insulation.

The averaged SAP rating[16] for private homes in Barnsley is 57, corresponding to a yearly energy use of 101-135 kWh/m^2. 31% of private homes scored 35 points (171-200 kWh/m^2 per yr.) and therefore have much greater risk of being in fuel poverty.

The pattern within the town centre is somewhat different from the borough with several larger apartment buildings making up the larger proportion of the dwellings and a smaller number of terraced houses around the edges of the town centre.

[13] Office of National Statistics (ONS), April 2018.
[14] Housing strategy 2014-2033. P.11
[15] Barnsley Energy Strategy 2015-2025; Total number of household's properties P.28
[16] LSM, Research Centre; Barnsley Metropolitan Borough Council Green Deal Pioneer Places. P.11

2.8 Non-Domestic Sector

Within the town centre, the main building sub-sectors consist of retail (small shops and large commercial), the refurbished market spaces, public buildings, and educational institutions.

The council's properties[17] include a range of non-domestic buildings both within and close to the town centre. These are public institutions and facilities with primary schools, development centres, the Town Hall, and the New Library. The Civic and leisure centres play a major role in the council's operational energy use, with big spaces such as the Barnsley Markets, the Cooper Gallery and the Metrodome also making a large contribution.

The council's non-domestic buildings had a total energy consumption[18] of 1,671 GWh in the reference year. The energy performance varies hugely according to year of construction, volume, characteristics, and tenure. Only some of these buildings lie within the town centre boundary and the more detailed analysis considers these.

3 Targets and Policies

3.1 International and UK national targets

In November 2008, The Climate Change Act 2008[19] (CCA) came into force in which the UK government set the target to reduce greenhouse gas emissions by at least 80% of 1990 levels by 2050.

In December 2015, the UK government were signatories to the Paris Agreement to limit the increase in global average temperature to well below 2°C above pre-industrial levels; and to pursue efforts to limit the increase to 1.5°C, to substantially reduce the risks and impacts of climate change.

The Intergovernmental Panel on Climate Change Special Report (October 2018) on Global Warming of 1.5°C[20] called for the global community to act and establish targets to limit cumulative CO_2 emissions.

The Committee on Climate change (CCC) set up by the CCA provides the UK and devolved governments with independent advice on setting and meeting carbon budgets and preparing for climate change. It also monitors progress in reducing emissions and achieving carbon budgets and targets. In May 2019 it produced a report[21] outlining how the governments of Great Britain could achieve Net Zero by 2050 and meet the commitments of the Paris Agreement.

In June 2019, The Climate Change Act 2008 (2050 Target Amendment) Order 2019[22] was signed into force by the UK government committing by law to achieve 100% (net zero carbon) emissions by 2050.

Despite the legal commitment to achieve net zero nationally by 2050, there is currently a gap in UK government policy commitments towards meeting this target and the latest report[23] (2021) from the CCC indicates that:

[17] Council local energy data sets, March 2020
[18] BEIS energy consumption statistics. Sub-national gas consumption statistics 2005-2018
[19] Climate Change Act 2008. www.legislation.gov.uk
[20] IPCC's Special Report on Global Warming of 1.5ºC: https://www.ipcc.ch/sr15/
[21] Net Zero Technical Report. Committee on Climate Change, May 2019
[22] The Climate Change ACT 2008 (2050 Target amendment). Order 2019
[23] Progress-in-reducing-emissions-2021-Report-to-Parliament https://www.theccc.org.uk/

> "There has been little of the necessary progress in upgrading the building stock. Insulation rates remain well below the peak market delivery achieved up to 2012 before key policies were scrapped, demonstrating clear potential for growth if an effective policy package is put in place. Despite a small improvement in the rates of heat pump installation, these remain far below the levels that are necessary."
>
> "Progress on setting out policies is significantly behind that on ambition, with only one-fifth of the emissions savings for the Sixth Carbon Budget having policies that are 'potentially on track' for full delivery (e.g. renewable electricity generation)."
>
> "In many other areas, some policy plans have been set out but these lack detail and/or do not comprehensively cover the necessary set of issues. Together, areas in which policy is in danger of falling behind cover around three-fifths of the emissions reduction required to 2035."

3.2 Barnsley Council's targets

BMBC declared a Climate Emergency[24] on the 18th of September 2019, and to support the national transition to a net zero carbon approved two programmes:

- Zero 40: Achieving net zero carbon emissions on Council's own operations by 2040.
- Zero 45: Achieving net zero carbon emissions for the whole of Barnsley by 2045.

Both programmes are held within the BMBC key strategy plan[25] titled "Energy Strategy 2015 – 2025", which is part of the current corporate plan for 2021-2024.

Additionally, an internal report "Developing A Zero Carbon Strategy For The Council And The Borough And Declaration Of Climate Emergency", was delivered to BMBC cabinet to support the decision with the same title. This internal report outlines the figures and targets for achieving the two programmes.

BMBC is also developing detailed Sustainable Energy Action Plans (SEAP)[26] for every five years running up to 2040 with the first such plan for 2020-2025 approved and published.

The SEAP for 2020-2025 recommends an ambitious first borough-wide target for 2025 to reduce emissions by 65% (against a 2017 baseline) and that as part of this, an ambition to reduce the council's own emissions by 60% (against a 2019 baseline). It is stated that this will provide BMBC with the best opportunity to be zero-carbon by 2035.

3.3 Net Zero Carbon definition

The CCC May 2019 report[27] includes information about the effects of greenhouse gases and provides a definition of what is meant by Carbon Emissions:

> "Long-lived greenhouse gases like carbon dioxide accumulate in the atmosphere. Therefore, their emissions must be reduced to zero in order to stop their cumulative warming effect from increasing and to stabilise global temperatures. Some activities, such as afforestation,

[24] Developing a Zero Carbon Strategy for the Council and the Borough and Declaration of Climate Emergency (Zero40). Appendix 1: Climate Change Declaration.
[25] BMBC website. Key Strategies; Corporate Plan for 2021-2024. https://www.barnsley.gov.uk/services/our-council/key-strategies
[26] BMBC website. Reducing Carbon emissions. https://www.barnsley.gov.uk/services/our-council/reducing-carbon-emissions
[27] Net Zero Technical Report. Committee on Climate Change, May 2019. P.45

actively remove CO2 from the atmosphere.

'Net-zero' emissions means that the total of active removals from the atmosphere offsets any remaining emissions from the rest of the economy. The removals are expected to be important given the difficulty in eliminating emissions from some sectors.

Sometimes 'net-zero' is used to refer to CO_2 only, and sometimes it refers to all GHGs. Our recommendation is that the UK should set a net-zero target to cover all GHGs and all sectors, including international aviation and shipping."

Based on the BMBC declaration of Climate Emergency approved programmes to achieve net zero, the definition of Net -Zero carbon in relation to the scope of this report corresponds to:

"'Net-zero' emissions means that the total of active removals from the atmosphere offsets any remaining emissions from the operation of buildings within the town centre."

CIBSE have recently adopted the definition of Net Zero Carbon for the built environment developed by LETI and this is an appropriate definition of Net Zero Carbon for the town centre strategy to adopt particularly in regard to any new construction as it makes clear the need to minimise energy use as part of achieving net zero.

"A 'Net Zero Carbon – Operational Energy' asset is one where no fossil fuels are used, all energy use has been minimized, meets the local energy use target (e.g. kWh/m^2/yr) and all energy use is generated on- or off- site using renewables that demonstrate additionality. Direct emissions from renewables and any upstream emissions are 'offset'."

Strategies to reach net zero carbon (or carbon neutrality) can imply a whole raft of options from energy efficiency and changing processes, switching energy sources, generating renewable energy on buildings or larger scale inside or outside the boundary, and implementation of carbon removal schemes or purchase of offsets. Purchased offsets in the form of energy emissions reductions or energy efficiency are not deemed suitable as they do not actively remove additional carbon dioxide from the atmosphere.

4 Baseline Analysis - Borough and Council's Carbon emissions

4.1 Whole borough carbon emissions

The borough baseline (2018) emissions are 1,199,000 tonnes CO2/yr.[28]

The council have set a goal of reaching net zero greenhouse gas emissions for the borough by 2045 with an initial 45% reduction by 2030 followed by further targets at the end of each 5-year period.

	2018 baseline	45% reduction to 2030		To zero carbon		
SEAP period		2020-25	2025-30	2030-35	2035-40	2040-45
Emissions tonnes	1,199,000	850,000	503,000	378,000	253,000	0

Table 4.1 - Barnsley Borough. Carbon emissions plan, 2018. Developing a Zero Carbon Strategy for the Council and the Borough and Declaration of Climate Emergency (Zero40)

The 2018 baseline covers direct and indirect emissions within the whole Borough for stationary energy (domestic and non-domestic buildings) and transportation. Stationary energy represents 72.8% of the total, where transport is responsible for 27.2% of the overall carbon emissions. The baseline does not include Scope 3 emissions (associated with goods purchased, business travel and waste for example) that occur outside the borough.

2018 Sectoral Emissions of Carbon within Barnsley	Tonnes of Carbon
Industry and Commercial	436,000
Domestic Housing	438,000
Transport	324,000
Total	1,199,000

Table 4.2 - Barnsley sectoral carbon emissions, 2018. Developing a Zero Carbon Strategy for the Council and the Borough and Declaration of Climate Emergency (Zero40)

4.2 Council's Own Carbon Emissions

The council's own operational emissions for 2018 were 28,000 tonnes CO_2/year.[29]

This is equivalent to 2.3% of the overall Borough wide carbon baseline. This total shown in table 4.3 is the sum of direct (gas) and indirect (electricity related) emissions associated with the operational energy demand from the buildings owned by the council, but also includes some Scope 3 emissions associated with business travel by car and train.

The council has set a goal of reaching net zero greenhouse gas emissions for its own operations by 2040 with an initial 60% reduction by 2030 followed by further targets at the end of each 5-year period.

[28] Developing a Zero Carbon Strategy for the Council and the Borough and Declaration of Climate Emergency (Zero40). P.5 https://barnsleymbc.moderngov.co.uk/documents/s57611/ZERO%2040.pdf
[29] Developing a Zero Carbon Strategy for the Council and the Borough and Declaration of Climate Emergency (Zero40). P.4

	2018 baseline	60 % reduction by 2030		To zero carbon by 2040	
SEAP period		2020-25	2025-30	2030-35	2035-40
Emissions (tonnes)	28,000	19,600	11,200	5,600	zero

Table 4.3 - Council baseline emissions, 2018. Developing a Zero Carbon Strategy for the Council and the Borough and Declaration of Climate Emergency (Zero40)

4.3 Town Centre Carbon Emissions

Defining the baseline for the Town Centre is less straightforward than for the whole borough or the council's own operations as data for actual usage within the Town Centre boundary is not directly available.

Data is available for domestic usage down to Lower Super Output Areas (LSOAs), but several LSOAs overlap the town centre, with most of the domestic usage in those LSOAs outside the town centre boundary.

A refined baseline analysis has been carried out to account for properties in the Town Centre using data sets available including domestic and non-domestic EPC data, council building operational data and business rates data.

The council energy data sets can be used directly once those buildings in the town centre boundary have been extracted.

The other datasets are used to infer estimates of energy use and then calculate associated CO_2 emissions.

For the domestic sector, energy performance certificates have been selected based on the post codes in the town centre and used to calculate the annual energy baseline (GWh/year) and consequent space heating and power carbon emissions. Data was taken both from EPC data provided by the council and that available on the public EPC register.

For the non-domestic sector, we have used two different data sets and separate methodologies to try and cover the full range of properties.

Firstly, Energy Performance Certificates were selected based on post code. Non-domestic certificates generally provide data only as predicted carbon emissions, so this has been converted to energy use and then converted back to carbon emissions using a standard emissions factor consistent with the other data.

Secondly, business rates data selected based on post code was used to determine use type and floor area and Energy Benchmarks applied to generate predicted energy use and hence carbon emissions (using CIBSE Energy Benchmarks for Gas and Electricity)

Due to the use of different data sets, there is a risk of duplication and some checks have been carried out to try to avoid double counting, however the information in the data sets is different and duplications and omissions may still exist.

As part of final review a few properties have been identified that do not appear in either the EPC

data or the business rate data. These properties potentially represent an underestimate in the predicted energy use and CO_2 emissions of the town centre. Most of the buildings are however thought to be included.

The baseline developed indicates that the Town Centre comprises 687 dwellings, 42 BMBC Buildings and 1372 non-domestic premises. In many cases dwellings are grouped into larger buildings and similarly smaller non-domestic premises are within larger buildings, so the numbers of dwellings and premises will be greater than the number of buildings that will need to be retrofitted.

4.4 Domestic buildings baseline

When analysing the domestic energy performance certificates, some manipulation of the data is necessary to estimate the energy use and split this into gas and electricity use. Some EPCs do not disclose the energy used for space heating and water heating and approximations have been applied to estimate the proportions of energy from gas and electricity in these cases. There are also some properties for which EPCs do not exist in the register, so estimates have been included for energy use in these cases. As domestic buildings make up a small proportion of the total energy used in the town centre, these approximations will not affect the overall conclusions drawn.

The analysis indicates that 66% of domestic heating demand is supplied by mains gas, 30% by electricity and 4% by communal heating system (for which the fuel is assumed to be gas).

For properties heated by gas, the average gas use is estimated to be 14092 kWh/y and average electricity use is estimated to be 2256 kWh/y.

For properties heated by electricity, the average electricity use is estimated to be 4182 kWh/y.

Total consumption for domestic properties is 3.3 GWh/y gas and 2.2 GWh/y electricity with resulting emissions of 0.7 kte CO_2e/y and 0.6 kte CO_2e/y respectively on 2018 factors, giving total emissions of 1.3 kte CO_2e/y for the baseline.

4.5 Non-Domestic buildings baseline

According to the energy data set based on the data gathered from the official Energy Performance Certificates (EPC) records, there are 534 business properties broken down by retail & professional business, offices, and restaurants. The breakdown (figure 4.1 below) of the properties with EPC records by fuel type shows around a third of emissions associated with gas and two-thirds with electricity.

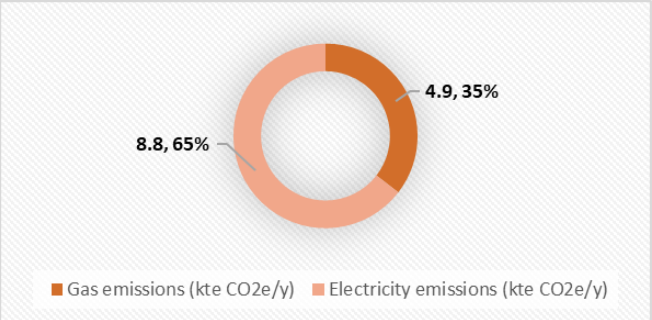


Figure 4.1 - Carbon emissions breakdown from non-Domestic buildings based on EPC data.

For energy estimates derived from business rates data, using energy benchmarks, figure 4.2 below shows how the 836 properties are divided by sub-sectors. Retail and offices account for the largest number of properties. The council buildings represent 5% of the total number.

The council buildings have a substantial energy consumption and consequently have a significant impact on the total carbon emissions with a sub-total of 2.6 kte CO_2e/y.

The overall split of consumption for the 1372 business properties is estimated as 59.8 GWh/y for gas and 58.7 GWh/y for electricity, with resulting direct emissions of 12.2 kte CO_2e/y.and indirect emissions of 16.6 kte CO_2e/y respectively, as shown in table 4.4.

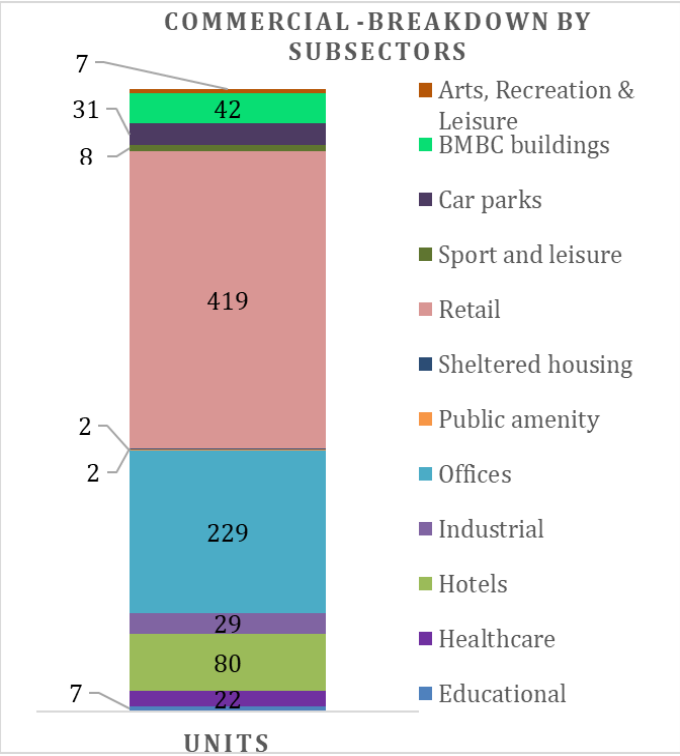


Figure 4.2 - Non-domestic emissions estimated from business rates floor area and CIBSE energy benchmarks

4.6 Combined Domestic and Non-Domestic buildings

Combining the data, the total carbon emissions baseline for domestic and non-domestic buildings is calculated to be 30.2 kte CO_2e/y. The results of the analysis are shown in table 4.4 below.

	Consumption		Emissions		
	Gas GWh/y	Electricity GWh/y	Gas kte CO_2e/y	Electricity kte CO_2e/y	Total kte CO_2e/y
Domestic Gas	3.3	2.2	0.7	0.6	1.3
Non-domestic (EPC)	23.8	31.2	4.9	8.8	13.7
Non-domestic (Council)	6.1	4.9	1.2	1.4	2.6
Non-domestic (Bus.rates)	30.0	22.6	6.1	6.4	12.5
Total	63.2	61.0	12.9	17.2	30.2

Table 4.4 - Barnsley Town Centre – Refined carbon emissions Baseline

Non-domestic buildings represent over 95% of the total carbon emissions and the non-domestic sector is where the primary focus should be to meet the emission reduction targets for the town centre.

Domestic buildings will feature more highly in other parts of the borough and approaches to address smaller domestic buildings in the town centre should be developed alongside a borough wide approach. Large domestic buildings (containing apartments) in the town centre are best addressed as specific whole building retrofit projects rather than apartment by apartment.

In comparison to the earlier benchmark derived from meter data across LSOAs, this data indicates lower gas related CO_2 emissions for the domestic sector, since the number of properties heated by gas represent 34% of the total. A large proportion of the domestic properties in the town centre are apartments in larger blocks where a direct electric heated strategy has been adopted.

Non-domestic buildings include nearly double the number estimated in the original baseline (based on an area weighted proportion of gas and electricity meters in the LSOAs that overlap the town centre area). This relates both to the much higher proportion of non-domestic buildings in the town centre compared to the rest of the area in each LSOA and some sub-metering of gas or heat in the larger buildings. Where energy use has been inferred from business rates data, there is an assumption of gas being used for heating, which may be incorrect in some cases. This is a conservative assumption with respect to the number of buildings that will need to switch to electric heating.

Non-domestic properties heated by means of electricity account for 60%. Electricity consumption for retail is higher-than-average where the energy benchmarks estimate higher electricity consumption for other uses than for gas used for space heating. Retail may have high electricity use for lighting and refrigeration of goods, although efficiency gains in both these areas are possible and economically viable.

5 Pathways to meet carbon emission reduction targets

Emissions need to be reduced along a suitable trajectory aligned with the 5-year SEAPs.

Ideally, emissions reductions will be implemented as early and as deeply as possible. Realistically, there will be a need to develop plans, supply chain capability and financing to carry out measures to reduce emissions and this will introduce delays to implementation. Early periods within the trajectory therefore need to implement measures that are easier to access while planning and developing capacity for the later more challenging measures.

Future trajectories and pathways to meet Barnsley emission targets are represented in Table 2. Projections are based on a 5-year plan following the internal report "Developing A Zero Carbon Strategy For The Council And The Borough And Declaration Of Climate Emergency", and the two programmes developed for:

- Achieving Net zero carbon emissions on Council's operations by 2040.
- Achieving Net zero carbon emissions for the Borough and Barnsley operations by 2045.

Each 5-year period corresponds to one of the four Sustainable Energy Action Plans (SEAP)[30] running up to 2040 and extended up to 2045 to offset remaining carbon emissions and achieve carbon neutrality for Barnsley Town Centre operations.

Period	2018	2020-2025		2025-2030	45%	2030-2035		2035-2040		2040-2045	87%
Net GHG emissions (kte CO_2e/year) residual to offset	30	23%	23	29%	17	51%	8	27%	6	34%	4
0 - Remove demand		Study of removal opportunities						Implementation		Implementation	
1 - Reduce demand											
1.1 Residential											
1.1.1 Existing stock		Prepare and pilot retrofit plans		Retrofit all easier properties		Retrofit all easier properties		Retrofit harder properties		Retrofit harder properties	
1.1.2 New stock		Propose standards, train and develop contractors		Implement new energy in use standards		Require lower embodied energy		Require lower embodied energy			
1.2 Non-residential											
1.2.1 Existing stock		Prepare and pilot retrofit plans		Retrofit all easier properties		Retrofit all easier properties		Retrofit harder properties		Retrofit harder properties	
1.2.2 New stock		Propose standards, train & develop contractors		Implement new energy in use standards		Require lower embodied energy		Require lower embodied energy			
2 - Decarbonise supply											
2.1 Local PV arrays		Identify PV opportunities in town centre		Implement PV		Implement PV		Implement PV		Implement PV	
2.2 Power purchase		Study opportunities and legal issues		Implement CPPA as businesses switch to all electric		Implement CPPA as businesses switch to all electric		Implement CPPA as businesses switch to all electric		Implement CPPA as businesses switch to all electric	
2.3 Low temperature heat network		Study viability of and pilot for any LT heat networks		Implement LT heat networks		Implement LT heat networks		Implement LT heat networks		Implement LT heat networks	
3 - Offset residual emissions											
3.1 Woodland creation		Identify tree planting locations and start planting for 2045 emissions		Woodland creation/tree planting		Woodland creation/tree planting		Woodland creation/tree planting		Woodland creation/tree planting	

Table 5.1 – Required trajectory of greenhouse emission reduction to meet targets

[30] BMBC official website. Reducing Carbon emissions. https://www.barnsley.gov.uk/services/our-council/reducing-carbon-emissions

5.1 Key Pathways

The key elements of the greenhouse gas emissions reduction programme are:

- Removing uses that generate energy demand
- Reducing demand of existing and new buildings
- Decarbonising energy supply
- Offsetting unavoidable residual emissions

For each element the steps are identified for each of the 5-year periods to gradually reduce emissions. These elements interlock to provide an effective route to net zero emissions.

5.1.1 Remove demand

Removal of demand may occur during the timeframe of the Zero Carbon Strategy for the town centre. Changes to activity/uses in the town centre including businesses ceasing to trade and relocating out of the area will have an impact on energy use and emissions. Some changes may be planned, such as moving a high energy use business into a location where it can be connected to a low carbon energy source such as a heat network. Urban and masterplan changes can be a source of demand removals, for example creating a car park in a location previously occupied by an office building, or re-converting surface car parks into green spaces. Some use changes (for example businesses using commercial kitchens associated with the nighttime economy) may however result in increases in demand and these will need to be considered carefully to determine if the use change along with associated changes to other areas of emissions (for example transport) justify the change.

5.1.2 Reduce demand

Strategies to minimize the energy demand in buildings are a key element of the plan to reduce carbon emissions. Generally, buildings and construction represent about one third of total energy consumption[31] and around 40% of the total carbon emissions and therefore the built environment has a large contribution to make in reducing emissions.

Existing buildings

Energy use in the domestic and non-domestic sector must be reduced through energy efficiency measures. For the existing building stock, retrofit plans must be prepared and piloted during the first 5-year period ready for large scale roll out in the second and third 5-year periods. Plans must adjust to the building typology to ensure appropriate choices are made. Issues such as tenancy will also affect how retrofit can be incentivised and paid for.

The second and third 5-year periods (2025-2035) are where the greatest proportion of domestic and non-domestic retrofits take place. Better insulation and energy efficient systems can reduce the heating consumption up to 80% and replacement equipment can reduce the electricity consumption for electric appliances and lighting up to 50%. Buildings with historical features will be more limited in what fabric improvements are possible, and therefore other buildings should have the deepest retrofit possible to balance this and enable the overall reductions in emissions required to be achieved.

[31] International Energy Agency. https://www.iea.org/topics/buildings

Table 5.2 shows measures to reduce heating and electricity demand, which can be applied in both domestic and non-domestic buildings. Some measures such as increasing insulation and replacing gas boilers with heat pumps can provide great energy demand reductions for the housing and non-domestic buildings. Other measures, such as using efficient appliances and lighting systems in combination with smart controls, will have a bigger impact on the non-domestic stock, where the overall electricity usage is higher than on the housing stock.

Reduction of Energy needs
External building envelope insulation
Improved Air tightness
Improved windows with better insulation & solar gain control
Efficient ventilation with heat recovery
Replacement of gas boilers with:
Individual heat pump systems
Local heat networks based on heat pumps
Improvements to Heating controls
Efficient lighting system
High efficiency appliances
Efficient cooling system

Table 5.2 - Measures to reduce energy demand

Domestic retrofits will also have broader benefits such as the reduction of risk of fuel poverty, improved health (reduction of radon exposure, under / overheating, better internal air quality) and increased wellbeing (increased comfort, reduced noise).

The last 10-year window (2035-2045) shows a reduced rate of carbon savings being achieved. In these periods harder retrofits on properties which require special attention are carried out, as well as building upgrades to improve the energy efficiency of those buildings already at around EPC band C. The potential improvements in these cases are smaller and harder to achieve.

New stock

New build for domestic and non-domestic are expected to be built with much higher energy efficiency criteria than the existing stock, although buildings being constructed to meet minimum building regulations may still require retrofit prior to 2045. Within the town centre the increase of new residential is expected to be gradual up to 2033, with proposed development on the Courthouse Campus[32] with 138 dwellings and Southern Fringe with 88 dwellings expected to progress.

To reduce the energy demand from new build will require the council to propose and set energy efficiency standards beyond current minimum requirements, and train contractors to achieve them. Increasing the skills available to deliver energy efficient, comfortable, and healthy buildings should be a priority during the first 5-year period (2020-2025), as this will benefit both new build and retrofit projects.

According to Barnsley's Energy Strategy 2015-2025, there are ongoing plans to encourage new build compliance with the Code for Sustainable Homes. The Code for Sustainable Homes is no longer widely used, and we recommend adoption of an energy standard focused on construction of high-

[32] Barnsley Town Centre Regeneration Plan; Arup, 2016. P.37

quality building fabric and that delivers high winter and summer comfort levels for people using the buildings, and ensures good internal air quality with reduced condensation and mould growth risks. LETI[33] and other organisations have proposed targets that are appropriate for new buildings within areas aiming for net zero carbon. Adopting higher standards now will ensure that buildings do not need to be retrofitted to be fit for purpose in 2045. Adopting a standard for new build in Barnsley town centre based on sound building physics principles and measured against a clear target should be a priority. Passive House or AECB building standard would form a solid basis for this.

The implementation of new energy in use standards should occur by the second 5-year window (2025-2030) such that buildings being designed for construction after 2030 are required to comply with them.

New build should also reduce embodied carbon associated with the materials of construction to contribute to lower scope 1, 2 and 3 emissions associated with the buildings. Together with reducing operational emissions, this would reduce overall building carbon emissions progressively over the periods 2025-2030 and 2035-2040.

5.1.3 Decarbonize supply

Strategies to remove fossil fuels from heat generation should be developed in the 2020-2025 period and implemented in the 2025-2030 period. No gas boilers should be installed in new build properties from 2025, in line with UK targets, and where possible, boiler replacements should be heat pump installations.

As the town centre transitions from burning gas for heating and hot water generation to electricity, renewable electricity supplies must be secured to match the electricity demand.

Some local renewable electricity may be possible by installing Solar PV panels on buildings with appropriate roof orientations and which are not shaded.

Much of the electricity required by the town centre will need to be imported and to ensure that sufficient renewable generation is constructed to meet the town centre demand, power purchase agreements may need to be used. Power purchase agreements provide certainty of demand for the organisations constructing the renewable generation projects. For the purchasers, there would potentially be opportunities to negotiate favourable pricing and to have certainty over energy bills for the long term.

Local PV arrays

Opportunities to increase the amount of local renewable electricity generation within the town centre with the deployment of rooftop, building integrated or ground mounted PV installations should be investigated in the first 5-year period (2020-2025) and incorporated into whole building plans for buildings where schemes are feasible. While opportunities may be limited for successful PV installations, those that exist should be exploited.

The council has created the Energise Barnsley programme[34] to install solar PV panels on council houses in the borough. The programme also includes the installation of solar PV panels for some non-domestic buildings owned by the council and some of the large industrial unit roofs. Although most of this PV capacity lies outside the town centre, some investment in PV within the town centre is already proposed under this programme.

[33] https://www.leti.london/cedg
[34] http://www.energisebarnsley.co.uk/

Implementation of PV installations within the town centre should take place in the following ten-year window 2025-2035 alongside building fabric improvements.

Additional PV capacity to help the town centre become net zero (particularly to help balance the large domestic and non-domestic buildings consumption) could be implemented by direct investment in medium-scale solar farms outside Barnsley. An alternative to direct investment would be the use of Power Purchase agreements as described below.

Power Purchase

Since the opportunities to develop renewable energy generation facilities within the town centre boundary will be limited, the purchase of renewable energy from external sources is highly likely to form part of a zero-carbon town centre strategy.

Power purchased as part of the zero-carbon transition for the town centre should be additional capacity. Investment in additional capacity can be achieved either directly by investing in a facility or via a long-term supply contract that enables a facility to be built by providing certainty of demand and power purchase price. These long term supply contracts are often referred to as Corporate Power Purchase Agreements (CPPAs). Smaller businesses may struggle to individually access CPPAs, so there is a role for an organisation to aggregate demand, and enable them to access zero carbon power to match their requirements.

Low temperature heat networks

Although large scale heat networks have been ruled out for the town centre, some localised networks to connect heat producers and users, and to utilise shared heat pumps, should be considered where appropriate. These systems will utilise low temperature or ambient loops to enable a variety of sources of low temperature heat to be integrated.
Preparing for the implementation of any local heat networks should be carried out in the first period 2020-2025 as the necessary infrastructure to share heat will be a longer-term investment and may involve significantly disruptive works.

Where heat is provided by combined heat and power plants, these can be converted from gas to large heat pumps to reduce the carbon intensity. However, some additional electricity supply will need to be provided to make up for the lost power export, as well as the additional electricity demand.

Electricity Distribution and Transmission

The physical infrastructure to enable electrification of heat and transport in the town centre will need to be provided. The current infrastructure in the town centre is fed from Barugh, Barnsley and Elmhirst Lane 2 primary (11kV) sub-stations.

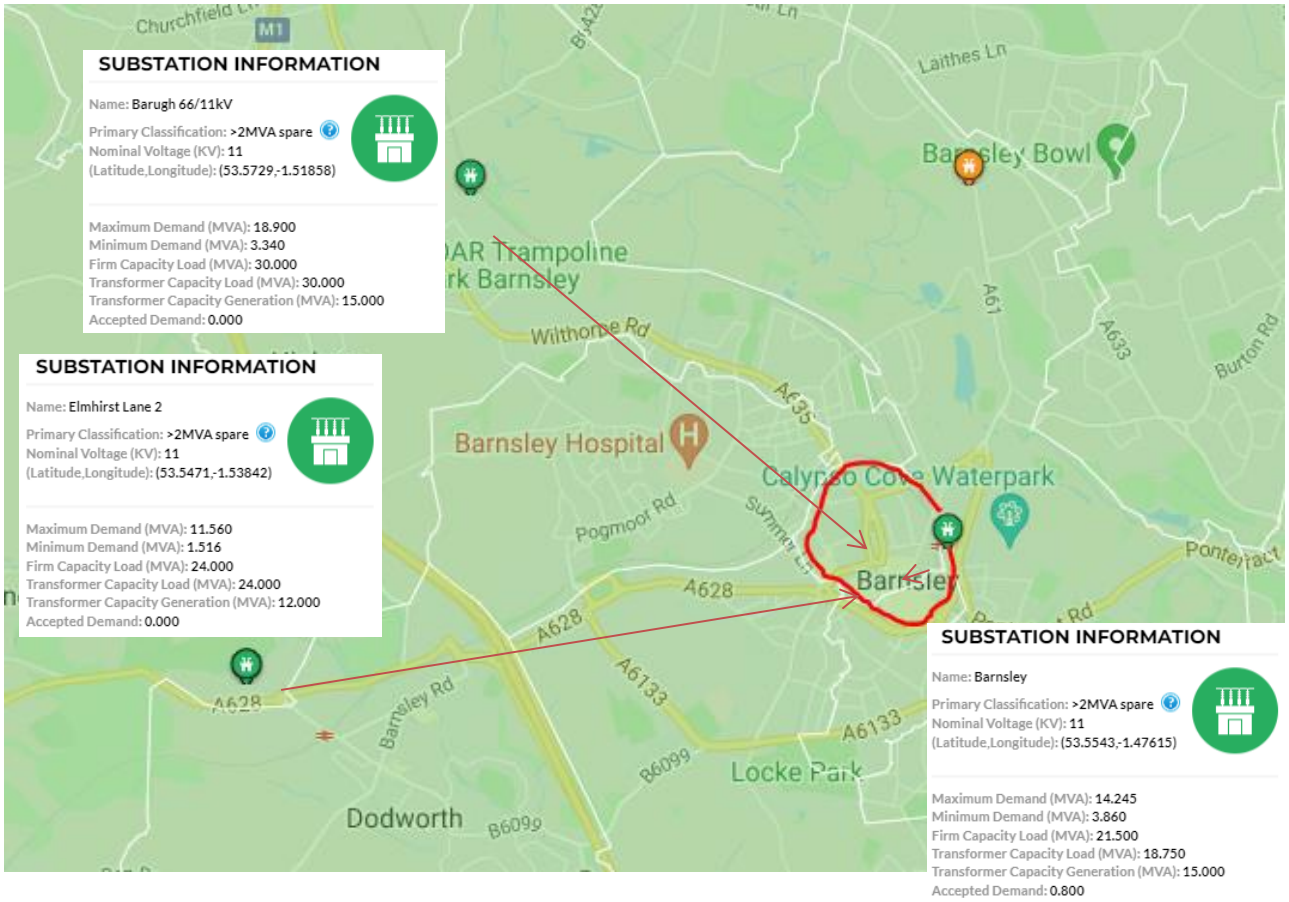


Figure 5.1 – Primary substations for Barnsley town centre

The primary substations are generally showing a healthy level of spare capacity (NPg heat map May 2022)[35], so there is not an immediate need for upgrades, but delivery of the zero-carbon strategy may require additional capacity to support both electrification of heat and transport. The peak capacity required will be highly dependent on how much demand reduction can be achieved and demand flexibility. It should be noted that well insulated buildings will tend to have more flexibility in when they are heated than poorly insulated buildings.

The latest predictions for grid planning are included in the Northern Powergrid Planning Scenario (2021)[36], which is a hybrid of the scenarios from National Grid. This scenario meets net zero in the mid-2040s and is NPg's best view, based on a hybrid pathway with an accelerated uptake of electric vehicles and heat pumps in the early years where these are the main technologies available, and in later years making some use of hydrogen via hybrid heat pumps.

In setting the town centre strategy for zero carbon we have considered that full electrification of heat is the most important pathway to consider. It is questionable how much hydrogen will be used for heat in buildings, even though national government is still trialling hydrogen for domestic heating

[35] https://www.northernpowergrid.com/demand-availability-map
[36] NPG predicted demand https://odileeds.github.io/northern-powergrid/2021-DFES/index.html

through to 2026. There is growing evidence that hydrogen will be a more expensive way to reduce emissions associated with heating buildings than electrification[37] and zero carbon hydrogen will be a limited and expensive resource and best deployed in situations where electrification is more difficult, such as certain industrial and heavy transport uses.

Year	Required capacity of Barnsley Primary Substation (covering most of the town centre but also some area outside the town centre)
2020	13.34 MW
2025	13.80 MW
2030	14.37 MW
2035	15.47 MW
2040	16.82 MW
2045	17.84 MW
2050	18.58 MW

Table 5.3 - Barnsley Primary Substation required capacity in NPg Planning Scenario — net zero in mid-2040s

The world described by the NPg planning scenario is ambitious, but broadly aligned with the Zero40/Zero45 targets set by BMBC, achieving net zero in the mid-2040s. The scenario relies on intensive investment in low carbon technologies, as well as early action from government and a high level of engagement from consumers, to achieve aggressive rollout rates, especially of EVs and heat pumps.

Electricity demand - Appliance efficiency assumptions meet current EU targets for 2030. Industrial and commercial (I&C) energy efficiency is aligned to EU energy efficiency targets.

Heat demand - For building level heat, new build properties are required to install low carbon heating technologies from 2025. Off-gas grid properties are required to renew their heating systems with low carbon systems from 2025 onwards, and on-gas properties are no longer able to replace heating systems with natural gas boilers from 2030 onwards. This scenario promotes rollout of hybrid heat pumps at an early stage, allowing the heat pump market to build gradually through the mid to late 2020s ahead of the steep increase in rollout rate required from 2030. By the mid-2040s, all high carbon heating systems are replaced with low carbon alternatives.

Transport - This scenario sees deep electrification at an accelerated rate. A ban on pure internal combustion engine (ICE) vehicles takes effect in 2030, followed by hybrid vehicles in 2035, resulting in the phase out of fossil fuel powered vehicles in the mid-2040s. The electrification of transport extends to commercial fleets with electric buses and heavy goods vehicles (HGVs) growing significantly from the late 2020s and transitioning to electric power trains before 2050.

Natural gas and hydrogen supply – The scenario assumes that the gas grid still exists but at reduced capacity relative to current levels. By the mid-2040s, within the Northern Powergrid region, it is entirely converted to delivering low carbon hydrogen serving customers on hydrogen hybrid heat pumps.

Generation - The incentivization of renewable generation continues and offshore wind generation grows rapidly. The rollout of carbon capture and storage (CCS) technologies is also successful. From

[37] Delivering net-zero carbon heat: Technoeconomic and whole-system comparisons of domestic electricity- and hydrogen-driven technologies in the UKhttps://doi.org/10.1016/j.enconman.2022.115649

the early 2030s and onwards, both gas CCS and bioenergy with CCS (BECCS) play a significant role in the generation mix. With an engaged society, there is a high uptake of consumer driven technologies such as domestic solar PV and batteries.

Flexibility - For Northern Powergrid, the key purpose for using flexibility in the network is to reduce peak demand. NPg planning scenario considers customer flexibility from time of use tariffs (ToUT), active network management (ANM) schemes, contracted customer flexibility (Distribution System Operation) and the application of smart grid solutions to the electricity network. It is assumed that customer price-driven flexibility will reduce demand by around 6% and 5% at EHV and HV/LV respectively during peak hours from 2025.

Support mechanisms - Substantial encouragement for the roll-out of heat pumps. Ban on sale of internal combustion engine (ICE) vehicles. Supportive environment for the adoption of distributed generation and flexibility markets.

5.1.4 Offset residual emissions

Following the projected carbon emissions trajectories, some of the total carbon emissions will be left over the last 5-year period (2040-2045). These will need to be offset by planting trees or alternative carbon removal measures. Given the quantity of trees required, this tree planting will need to be outside the town centre and suitable locations will need to be identified along with plans for ongoing management of these areas.

Other alternatives for carbon offsetting should be evaluated. Gold Standard or similar robust offsets should be prioritised. These will cost more than some offsets available, but are more readily verified as being effective and monitored to ensure they are maintained for the long term.

Carbon offsets are done by buying carbon credits in carbon reduction projects (for example reforestation or REED - reducing emissions from deforestation and forest degradation) among others.

Carbon savings are accounted by credits equivalent to a carbon reduction of 1 tonne of CO_2. If tree planting is used to provide the carbon offset, then each tree is equivalent to around 10kg CO_2e/y over the first 20 years from planting (based on typical planting density).

5.2 Carbon emission reduction programme

The estimated emissions due to domestic and non-domestic building energy use are shown in table 4 for each of the 5-year periods, along with the quantity of offsets required to ensure net zero in 2045.

The trajectory considers the complete electrification of heat using heat pumps and significant efficiency measures, reducing heat demand as far as possible for each type of building. Together with the reduction in grid carbon intensity, this enables emissions to be reduced to a level where offsets match the residual emissions.

Actual savings achieved should be reviewed regularly (ideally each year with full reviews each 5-year period). If expected reductions are not achieved, then further interventions should be made. Any opportunities to reduce emissions earlier should be taken.

Emissions kte CO_2e/y	2020	2025	2030	2035	2040	2045
Domestic Gas	0.7	0.6	0.4	0.2	0.1	0.0
Domestic Electricity	0.3	0.2	0.2	0.1	0.1	0.1
Non-domestic Gas	12.2	11.6	9.2	5.5	1.8	0.0
Non-domestic electricity	15.0	11.2	8.9	4.5	4.6	3.9
Total	28.2	23.7	18.7	10.3	6.6	4.0
Cumulative offsets	0.0	0.8	1.6	2.4	3.2	4.0
Net emissions	28.2	22.9	17.1	7.9	3.4	0.0

Table 5.4 - Carbon emission reductions programme

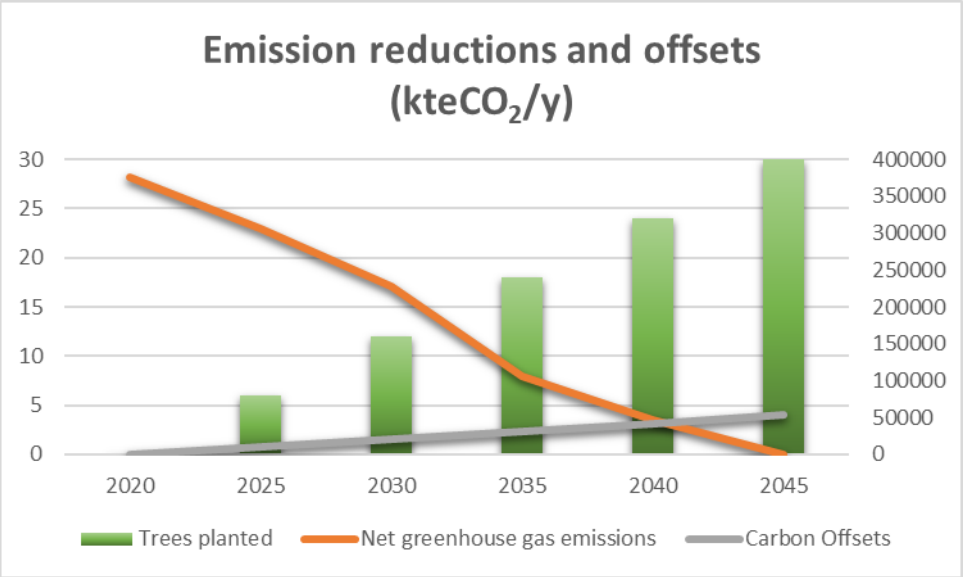


Figure 5.2 – Emission reductions and offsets required along with approximate tree planting rate to provide the required offset for 2045.

5.3 Key findings and recommendations

Key findings and recommendations:

- Prioritise retrofits from high energy use buildings. This will achieve maximum potential savings during the first 10-year period, 2020-2030.
- Identify any spatial changes that might allow for energy demand removals (such as green and blue interventions and building demolitions).
- Monitor carbon savings by the end of each 5-year period to plan future areas of intervention such as:
    - Increase of PV deployments
    - Potential buildings connected to local heat networks
    - Power purchases
- Consider a Power Purchase Agreement (CPPA) strategy to support investment in renewable power generation.
- Offset residual emissions by the end of each period.

6 High emitters and case studies

6.1 Highest emitting buildings

A visualisation map was developed to summarize and represent the main results.

This helps to:

- Spatially identify high energy consumers and properties with high carbon emissions density.
- Visualise and establish which areas could be prioritised when developing retrofit plans
- Visualise current and future scenarios.
- Test preferred options.

Three large apartment buildings and a street of terraced houses when considered as a block were identified as large emitters.

The Plaza quarter apartment building has the highest carbon emission rate of 0.23 kte CO_2e/year. A case study for how the retrofit of this building might be approached is provided below.
Princess Street when the houses are considered together is an area of high potential emissions due to the age of the houses and a case study for these buildings is provided below.
The Skyline Flats and Regent House are also high carbon emitters at baseline due to use of direct electric heating, of course over time carbon emissions would reduce, but the energy demand is high and should also be reduced.

Looking at the non-domestic sector table 3 shows the postcodes with the highest carbon emission rates and which buildings have the most impact as big energy consumers. These include the Alhambra shopping centre and buildings on Cheapside and Market Street.
In the council's properties the Glassworks and Westgate Plaza One are identified as big consumer buildings followed by the Town Hall.

As each building has its own specific requirements and characteristics, four case studies were developed to illustrate the approaches that might be followed for different building typologies, and to develop the best approach to reduce demand to a level from where residual carbon emissions can be directly offset or by a CPPA (Corporate Power purchase agreement) to meet the greenhouse gas emission targets.

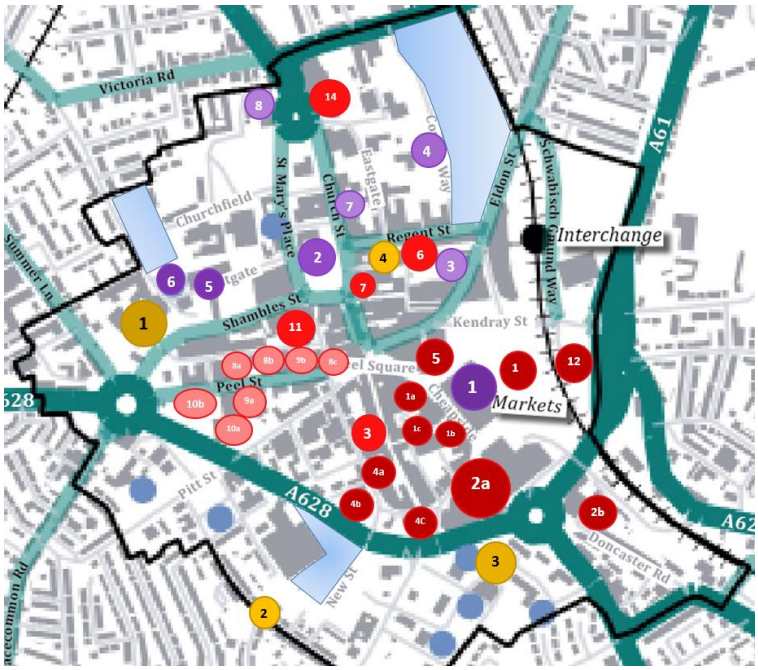


Figure 6.1 - *Location of high carbon emitters at baseline*

Table 6.1 – High greenhouse gas emitters from the domestic sector baseline

Indicative number	Buildings / Areas	Postcode	Emissions Gas + Electricity (kte CO_2e/year)
1	Plaza Quarter	S70 2RF, 2RH, 2RP, 2RQ	0.23
2	Princess Street	S70 1PJ, 1PF	0.21
3	Skyline Flats	S70 1LD, 1LW	0.11
4	Regent House	S70 2AT	0.05

Table 6.2 – High greenhouse gas emitters from the council buildings

Indicative number	Buildings / Areas	Postcode	Emissions Gas + Electricity (kte CO_2e/year)
1	Markets-part of Glassworks	S70 1GW	0.76
2	Town Hall	S70 2TA	0.32
3	Civic Hall	S70 2JL	0.08
4	Digital media centre	S70 2JW	0.19
5	Westgate plaza one	S70 2DR	0.37
6	Gateway plaza, floor 4-9	S70 2RD	0.34
7	Cooper Gallery	S70 2AH	0.04
8	Buckley house	S70 HX	0.23

Table 6.3 – High greenhouse gas emitters from the non-domestic sector baseline

Indicative number	Buildings / Areas	Postcode	Emissions Gas + Electricity (kte CO_2e/year)
1	1.a- Boots the Chemists 1.b- Unit 1-4 Cheapside 1.c-12, Albert Street East	S70 1RR	2.01
2	2.a-Alhambra shopping centre 2.b-Zero Ice	S70 1SB	2.48
3	23 Market Street	S70 1SL	1.16
4	4.a -Arcadia house 4.b-Buka Night club 4.c-Rock café	S70 1SW	2.31
5	Metropolitan Shopping Centre	S70 1SX	1.39
6	Regent house	S70 2EG	0.78
7	1-3, Church Street, Walkabout	S70 2AB	1.22
8	8.a-23-29, Peel Street 8.b-Iceland Foods-13-17, Peel street 8.b-YMCA- 23-27, Peel Street 8.c-2-8, Peel Street	S70 2RA	0.73
9	9.a-Coco night club 9.b-Stereo	S70 2RE	0.87
10	10.a-47-51 Peel Street 10.b-Cooper house	S70 2RL	0.78
11	8, Shambles Street	S70 2SW	0.99
12	Gala bingo	S70 1AY	0.97
13	Market Parade Shopping Centre	S70 1DE	0.50
14	Barnsley college	S70 1SX	0.00

6.2 Case studies

6.2.1 Domestic case study 1- Terraced Housing

Case study - Princess Street (S70 1 PF, PL, PJ, PZ)

Terraced houses from the early 1900s, which are likely to be a mixture of private rented housing and owner occupied. Typical solid brick/stone façade with two storeys and pitched roof. Heating and hot water with conventional or combi gas boiler. EPC scores for un-retrofitted buildings in E-G range and high risk of fuel poverty and poor living conditions. High energy use if heated to comfortable temperatures (so often underheated and poorly ventilated)

Main Characteristics
Early 1900s construction
Solid brick/stone with no insulation and poor roof insulation (<150mm) with uninsulated suspended ground floors
uPVC double glazed windows (may be low quality)
Timber or uPVC doors
Main heating with gas boiler, supplementary gas fire or electric fire
Natural ventilation (may have intermittent extract from bathroom)
Lighting mix. of fluorescent, halogen, and LED fittings, maybe still some incandescent
Cooking with gas or resistance electric hob
Appliances close to end of life/cheapest new models.

Strategy

Subject to finding a way to get agreement for mass retrofit, these could economically be upgraded to high performance using a serial prefabricated renovation method like the Dutch Energiesprong concept for at least some of the building's elements. This approach can lead to a quick and cost-effective solution for the domestic sector for large scale refurbishments on buildings of the same design.

Reduce Energy demand

- Internal insulation of solid wall at front to preserve appearance and avoid narrowing street. This would likely need to be site applied.
- External insulation of solid walls at the rear and of end terrace gable walls. This could be a prefabricated modular system and might incorporate factory installed windows and doors.
- High performance windows and doors installed on site at the front and in the factory for the rear.
- Pitched roof insulation with integrated photovoltaic panels (prefabricated roof module)
- Improved airtightness

- Efficient ventilation using mechanical ventilation with heat recovery to provide energy efficiency and improved internal air quality and comfort (greater than 80% heat recovery and continuous supply and extract ventilation)

Low carbon renewable heating

- Replace gas boiler with individual house air source heat pump system with low temperature radiators for space heating and a highly insulated cylinder for hot water – achieving SCOP over 3.0

Decarbonize energy supply

- Renewable power – potentially offer an incentive to use an agile tariff or "Barnsley" tariff with an agreement (Power purchase) with a renewable energy supplier to supply power to make houses net zero.
- Roof integrated PV panels where orientation is suitable (will offset heat pump running costs). PV arrangements to offset HP system running costs.

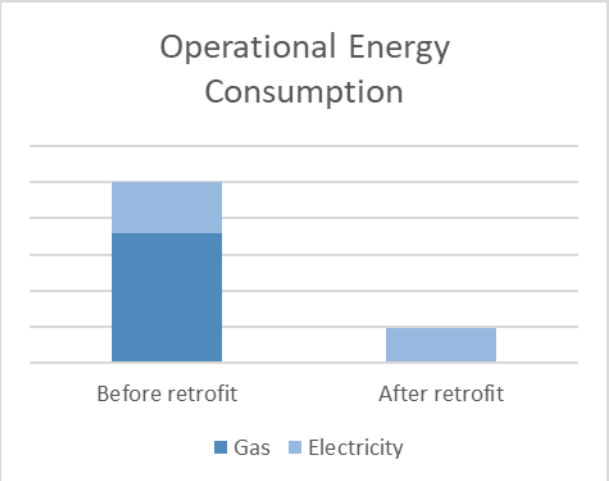
The retrofit would contribute to Barnsley's Zero45 targets, and at the same time reduce fuel poverty, improve health outcomes, and improve the look of the neighbourhood which will have broader benefits in terms of community etc.

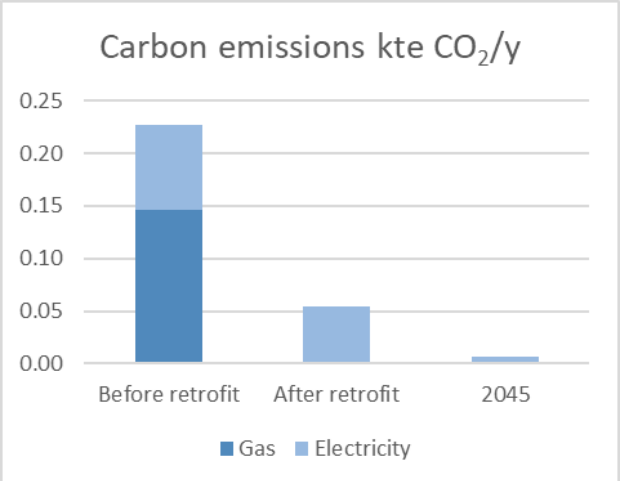
A partially offsite fabricated approach would help to minimise impact on occupiers and tenants and provide cost efficiencies to benefit owners and landlords.

Key enablers to this type of retrofit would be:

- Streamlined Planning Permission and Building Control approval process
- Finance support package
- Contractual arrangements to suit owner/occupier, landlord and tenants

This approach only works if the whole terrace can be upgraded at the same time using a standardised approach. The approach must be appealing to all the stakeholders.

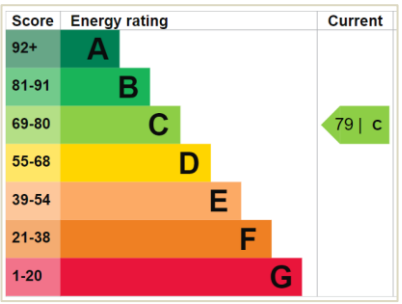




6.2.2 Domestic case study 2- Apartment Block

Case study - Plaza Quarter (S70 2RP)

Modern block apartment building build in 2003-2006 with a highly glazed façade, terraces, and balconies with a flat roof. Form factor is poor with lots of potential thermal bridges due to balconies and projections. Heating is provided typically with direct electric panel heaters, hot water with electric cylinders. Ventilation strategy is basic and overheating in summer may be a problem.



Main Characteristics
Modern construction - build in 2003-2006
Wall and Floor estimated U-value 0.25-0.35 W/m2K based on age
High glazed façade with double glazing installed (estimated U=2.8 W/m2K)
Flat roof estimated U-value 0.25 W/m2K based on age
Main heating with electricity - panel heaters, hot water by immersion heaters
Natural ventilation with limited opening windows
Lighting is likely to be fluorescent/halogen with some LED as replacements
Cooking is assumed to be electric

Strategy

Due to the construction type, it may be challenging to install additional insulation or reduce thermal bridging without stripping the building back to underlying structure and re-cladding it (a very major project). Despite the modern construction and EPC C rating, direct electric heating results in high carbon emissions at baseline year. This will reduce as the grid carbon factor reduces over time, but the demand will still be high and can be reduced by providing heating and hot water via a heat pump-based system.

Reduce Energy demand

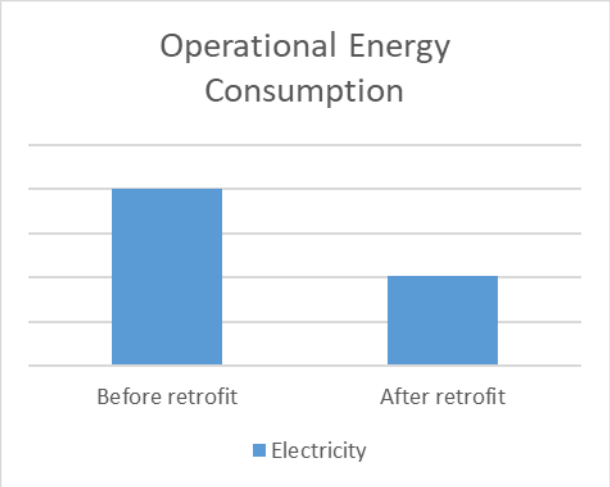
- Some fabric interventions could be considered but would likely be major projects. Focus would be on reducing thermal bridges, improving glazing performance (improving U-value while reducing g-value to control overheating) and replacing glazed surface with insulated panels.
- Ensure adequate ventilation. If possible, implement efficient continuous ventilation with heat recovery.

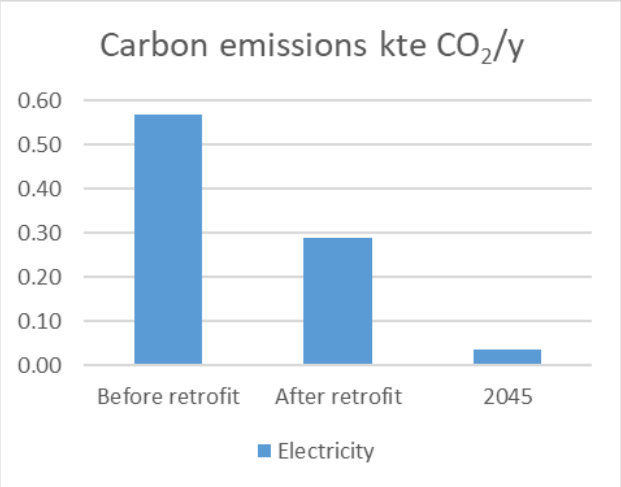
Low carbon renewable heating

- Communal air source heat pump for space heating and DHW with well insulating pipe work to avoid overheating issues.

Decarbonize energy supply

- Power purchase agreement to provide electricity to reach net zero - alternatives for private renters and community scheme
- Possible roof top PV to reduce emissions associated with communal areas and lifts.

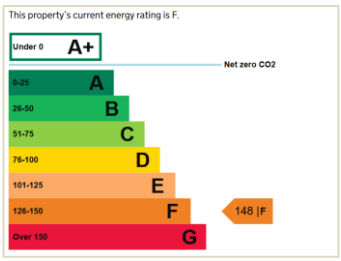




6.2.3 Non-Domestic case study 1 - Small retail

Case Study – Business units in Pitt Street (10,14,16 Pitt street)

Small private businesses with limited floor area located on the ground floor of a two-storey building with housing or small office space on the first floor. Typical business of retail and restaurant establishments with a high electricity consumption of regulated and unregulated electricity. Limited sense of community where the accommodations and housing have separated entrance on the rear side of the building.



Main Characteristics	
	Solid brick or unfilled cavity walls with no or limited insulation and flat roof also with poor insulation (0.25-0.55 W/m2K)
	Suspended or solid floor without insulation (0.35 W/m2K)
	Single or double glazing (3.1-2.8 W/m2K)
	Main heating with direct electric panels
	Business may have inefficient appliances (for example refrigerators and cooking equipment) and lighting.

Strategy

As with the terraced houses, the block would likely best be upgraded as one for the business and residential or office accommodation with a fabric first approach and highly efficient systems, using prefabricated elements where possible applied externally. It may be possible to add an additional storey to create new residential space with larger dwellings more suited to families (if the structure allows) and a more attractive communal access could potentially be provided above the rear of the shops. If retail contraction makes this set of units unsuitable then the whole building could be converted to residential or other uses alongside a full retrofit.

Reduce Energy demand

- Fabric first approach for walls and roof insulation
- Replacement improved windows
- Potential for PV on the roof
- Improved airtightness
- Efficient ventilation MVHR with heat recovery efficiency above 80%

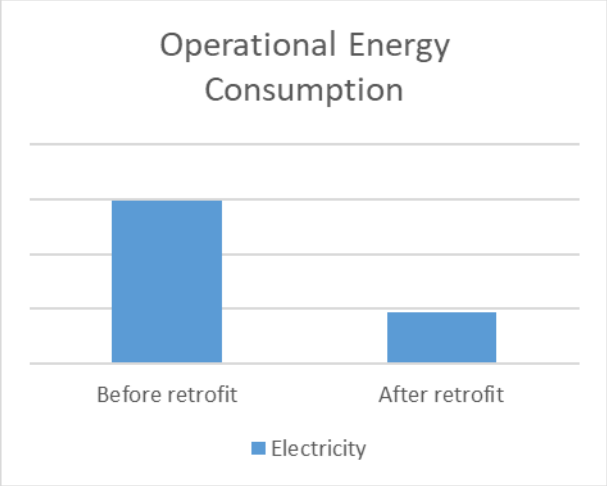
Low carbon renewable heating

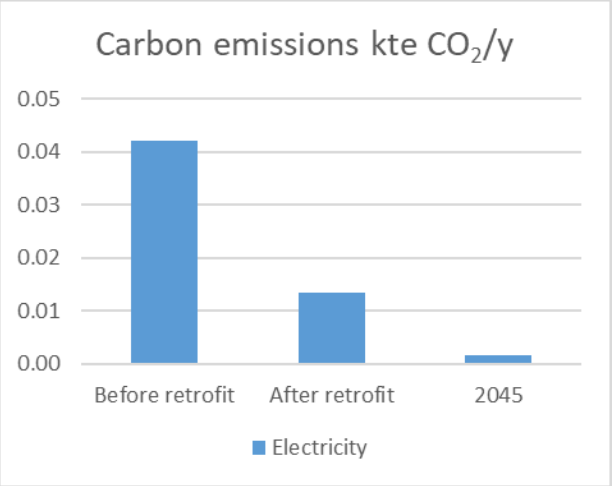
- Individual or communal air source heat pump systems mounted on the roof for space heating and DHW for the retail and accommodation above.

Decarbonize energy supply

- Renewable power – potentially offer an incentive to use an agile tariff or “Barnsley” tariff with an agreement (Power purchase) with a renewable energy supplier to supply power to make premises net zero.
- Attractive leasing arrangements for new “green businesses” that meets certain standards + support for existing businesses to transition.
- Reduced billing costs helps to reduce fuel poverty

A combination of office plus small retail space might suit developing businesses that sell both locally and on the internet. The retrofit plan will need to consider the intended use and potential changes to use of the units and space above.





6.2.4 Non-Domestic case study 2 – Public building

Case Study – BMBC - Digital media Centre (DMC 01)

The Digital Media Centre is a modern office building built in 2007. The building has significant areas of glazed façade and a form that is less compact than it might have been, which increases heating energy use and overheating frequency. Heating was provided originally with a biomass boiler which was subsequently replaced with a 200kW gas boiler. Due to the mixed office and events spaces, a large proportion of total demand is expected to come from lighting and unregulated electricity from equipment loads. The high internal heat loads can also lead to cooling demand (or overheating).

- Funding for Implementing LED Lighting and solar PV and air source heat pumps for space and water heating is approved. This will provide significant energy and carbon savings.

(a) (b)

Figure 20: Digital media centre, (a) gas boiler, (b) thermal store, valves and plant room space

Main Characteristics
Modern construction - build in 2007
U-values as per year construction convention (≥0.35 W/m2K)
Terraced flat roof (≥0.25 W/m2K)
High glazed façade which leads to overheating issues (≥ 2.8 W/m2K)
Significant equipment density (networks system) and therefore large internal heat gains
Main heating with 200kW gas boiler

Strategy

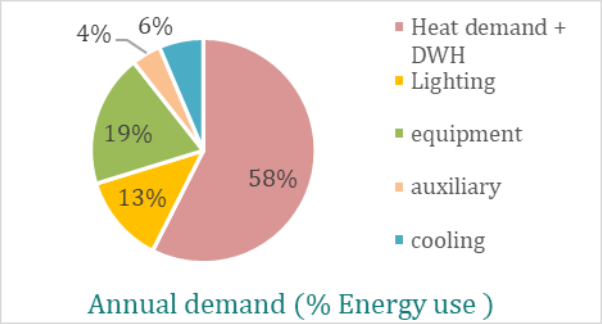
Significant energy and carbon savings can be achieved by implementing efficient lighting and upgrading equipment to more efficient types. This will also reduce cooling loads and/or overheating frequency. A communal HVAC system to provide heating and cooling with advanced building management controls could lead to a significant reduction in both demands. In combination with envelope improvements to improve glazing properties, and implement a shading system, this could both improve comfort and reduce energy consumption.

Reduce Energy demand

- Upgrade glazing to reduce solar gain and install window shading
- Upgrade lighting and equipment to energy efficient newer technologies (LED lighting, laptop computers, lifts with energy recovery braking)
- Implement intelligent controls for lighting and ventilation to optimise for occupancy of spaces
- Implement energy efficient continuous ventilation with heat recovery and improve airtightness of the building

Low carbon renewable heating

- Upgrade heating with an air source heat pump



Decarbonize energy supply

- Install PV on the roof to provide part of required renewable power, balancing some of the fixed equipment loads
- Purchase remainder of required renewable power through a power purchase agreement

7 Interventions and Opportunities

Energy efficiency, low carbon heating and renewable energy generation can all be implemented in the town centre buildings. It will be most effective from a financial and implementation perspective to coordinate these measures as part of, or alongside, intentional interventions in the buildings and infrastructure or when opportunities arise (strategic or opportunistic implementation).

Different building types within the town centre will have different opportunity points due to: different types and ages of construction; different tenant-landlord relationships; different use patterns. It is therefore important to think in terms of a whole building plan for each building, considering the businesses located within each building and their various ownership and tenancy arrangements.

Opportunity points may arise due to reasons such as:

- Change of tenant
- Change of use
- Change of owner
- Required maintenance
- Refurbishment/rebranding/refit

Some of these opportunity points may be initiated by council interventions, for example:

- Supported change of use to fill vacant units
- Strategic changes to areas of the town centre

Refitting and refurbishment of buildings that may occur with change of tenant or use may result in stripping back the building to the basic fabric, and there may be substantial changes to building services to accommodate new requirements. In a typical refit, little improvement to the building fabric would be made and services would be specified to meet only the minimum standards required, and so an opportunity may be lost to achieve substantial improvements. For most buildings there will only be a few opportunities within the 20 years during which greenhouse gas emission reductions must be achieved. Refit projects are often programme driven, so there is pressure to not include additional works.

Several things are therefore key to seizing the opportunity when it arises for a building:

- Readily available funding for the energy efficiency, low carbon heating and renewable generation implementation (as a pre-approved package using grants, loans, and other financial instruments)
- Mandatory requirements and strong incentives to include retrofit measures in the building refit.
- Support for tenant businesses while the additional works are carried out, be it temporary premises, pop up shops or similar offers to enable their businesses to be generating money while the works are carried out.
- A plan for the building retrofit developed ahead of the refit works to ensure there are minimal delays due to addition of the retrofit to the works.

With larger projects, such as with a change of use, the incorporation of retrofit works should be less of a change to the works, but again the same support mechanisms are required to make the cost and time impacts of the additional work acceptable to the owner and tenants.

Change of owner may offer a variety of opportunities, but ownership of buildings will also be a particular barrier to retrofit works in some cases. Where ownership is through agents, trusts, offshore companies, or overseas owners, there may be little interest in the buildings other than income. In some cases, this may even preclude proper maintenance and they may be falling into disrepair and have significant issues existing or developing. A retrofit plan for these buildings would need to consider how the building can be brought to and maintained in a state to be retrofit ready. The process of engaging with the owners of these buildings is likely to take a substantial amount of time and these may be some of the most difficult buildings in the town centre to get retrofitted, not due to technical issues, but due to getting the owners to engage with the need to retrofit.

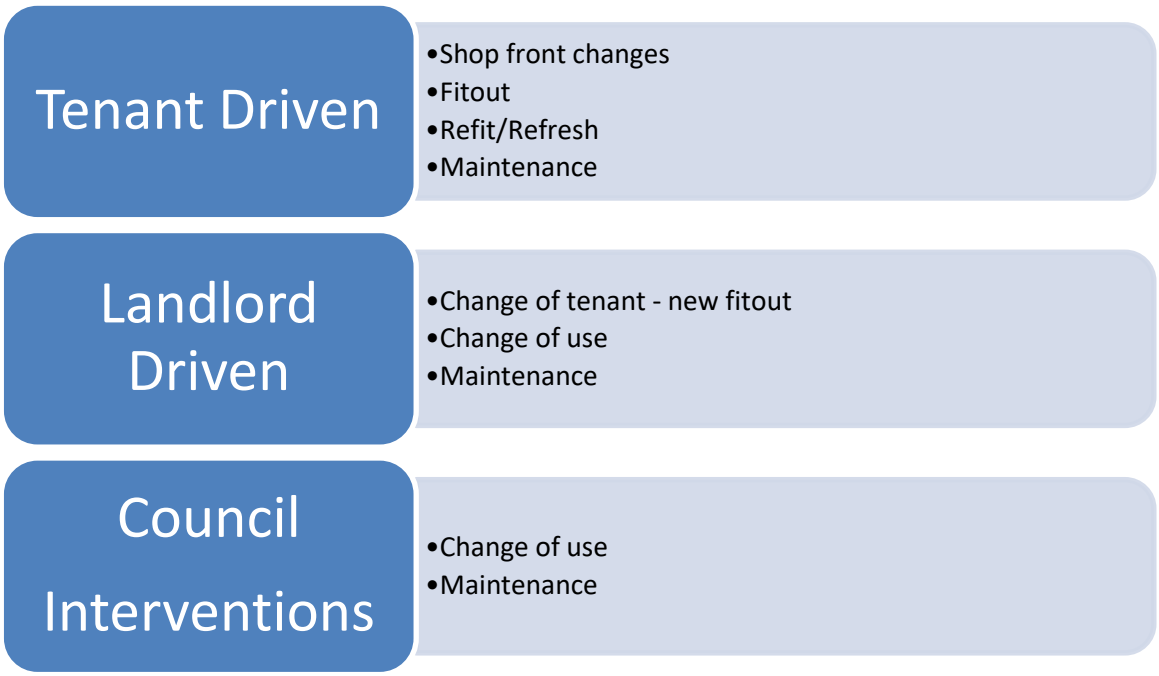
Some buildings may be owned and occupied by the same business. This group can be further divided into owned and occupied by a small-medium business, and owned by a national/international business, and occupied by a local branch of that business. The approaches in these cases will likely be different.

It is vital for the long-term sustainability of the town centre that businesses see Barnsley Town Centre as a supportive, profitable, necessary, and desirable place to operate their business. Businesses will have different drivers for location, relating to customer base; employees/skills; special features of premises (access or equipment).

The drivers for and requirements of retrofit are very different for non-domestic buildings than for domestic buildings. Imposing too great a burden in cost, time or complexity may disengage a business from the process, or worse lead to them considering whether alternative premises outside the town centre are better suited to their (perceived) needs.

When maintenance is required to the building, this is either something that the owner has planned for or something that is raised as an urgent problem for the owner to address by their tenant. Timing to implement retrofit measures may be critical and with emergency maintenance may not be possible.

Most tenants (particularly after the effects of the last few years with supply chain disruptions and price increases) will be focused on the day-to-day operations of their businesses and not as much on the longer-term issues such as the premises in which they operate.



Some of the interventions identified within the town centre spatial strategy will change building uses, and it should therefore be considered where those uses may increase energy requirements. New building uses should be implemented as fully electrified with no new combustion. Mechanisms need to be found to achieve this through regulation and incentives. Planning policy may be able to go beyond minimum building regulations and incentivise appropriate all electric solutions ahead of an expected ban on combustion of fossil fuels in buildings (examples include Bristol's energy hierarchy[38] or the GLA requirements "Be Lean, Be Clean, Be Green"[39]). Where new or relocated restaurants and cafes are created, this should be with a fully electric commercial kitchen so that they can decarbonise as the electricity grid decarbonises. This may require support for businesses to invest in new equipment and potentially change the way that they cook.

Infrastructure in the town centre will need to be considered alongside the plan to reduce greenhouse gas emissions of buildings, and opportunities to address this strategically rather than piecemeal would help to minimise disruption.

- Gas infrastructure for buildings in the town centre will become redundant, but infrastructure may pass through to serve other areas.
- Electricity infrastructure in the town centre is expected to require re-enforcement, and this may involve additional cables in the streets and new/upgraded sub-stations to enable the electrification of heat and other uses
    - EV charging in public car parks and at businesses with parking
    - Electrification of rail and bus infrastructure
    - Electrification of commercial kitchens

Studies will be needed with Northern Powergrid and Northern Gas Networks to understand the implications for their networks of the proposed changes to the town centre and whether changes are

[38] Policy BCS14 in Bristol Core Strategy
https://www.bristol.gov.uk/documents/20182/34540/Core+Strategy+WEB+PDF+%28low+res+with+links%29_0.pdf
[39] GLA Energy Assessment Guidance April 2020
https://www.london.gov.uk/sites/default/files/gla_energy_assessment_guidance_april_2020.pdf

required within and beyond the town centre to support these changes.

Making it happen

Making the town centre attractive to businesses committed to greenhouse gas emission reduction will require a strong support network to be built. Organisations to promote collaboration between businesses to achieve economies of scale for finance, materials, and contractor procurement; and a critical mass for developing the skilled supply chain required will help to make the task feasible.

There are many opportunities that could be realised for businesses that choose to be more sustainable. There is a growing awareness amongst the public (particularly those what are 'able to pay') of the need to be more sustainable and that is increasing demand for and support of businesses that are more sustainable. There is therefore a marketing value in implementing retrofit measures to a business's premises in terms of achieving accreditations, awards, and recognition of the business's sustainability. Accreditations such as B Corp and Science Based Targets should be promoted, as widely recognised third party accreditations of sustainability commitments and attainment. Businesses holding or committing to gaining these should be encouraged to locate in the town centre. Other broader sustainability measures such as local sourcing, fairtrade and organic should be recognised as supporting the larger sustainability picture although they will not contribute directly to lowering scope 1 & 2 emissions in the town centre.

For new businesses, empty buildings and units can be redeveloped to provide incubator & temporary spaces. The opportunity should be taken to both make these spaces energy efficient and low carbon, but also to build the understanding of this into the businesses using these spaces through data collection, information display, and engagement with employees. These businesses will then expect their next premises to be energy efficient and low carbon as well and will be far more likely to seek the resources and expertise to make this happen than businesses that have 'grown up' in less efficient premises.

The support for businesses could be presented as a Zero Carbon Business Hub, whether this is a single organisation or group of organisations working together to deliver the necessary services. The hub would need to provide resources to help businesses as well as advice and would need sufficient funding to develop some of the missing pieces to enable an ongoing retrofit programme for the town centre.

The Zero Carbon Business Hub would need to provide a range of services free of charge or low cost at point of use. The hub would also carry out enabling work such as developing connections and raising confidence across the supply chain, aggregating demand to enable capacity to be built in local contractors, designers and other retrofit professionals and trades people. Capacity building and enabling the supply chain will require a long-term commitment and certainty of direction over the 20-year timeframe for greenhouse gas emission reduction.

As shown in figure 7.2, zero carbon business hub services would range from training to financial services, and the hub team would need a diverse range of skills to provide the full package of support to businesses. The hub team would need to work with a wide range of service providers to meet the needs of Barnsley's businesses.

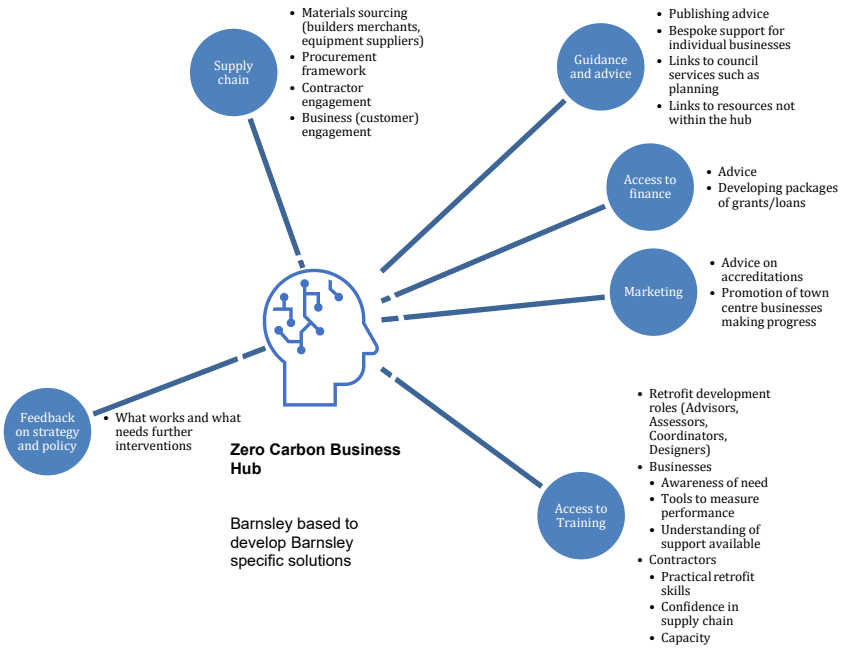


Figure 7.2 – Zero Carbon Business Hub

Financial services might include advice, but also access to innovative products developed by the hub which might combine grant funding from public, private and third sector organisations with public and private loans to produce funding packages to support whole building deep retrofit. Aggregating the needs of several businesses together may also open other ways of bringing investment into retrofit. The service should make it easier for businesses to form viable business cases for deep retrofit.

Zero Carbon specific marketing would enable businesses to be supported in gaining and promoting sustainability accreditations, awards, and initiatives.

Training might be provided locally or nationally, but the hub would provide a route of access to funding and support for individuals and businesses in Barnsley to upskill and work in making the transition to zero carbon. The hub would help engage businesses with local training providers and where necessary (for example for retrofit assessors and coordinators) with national providers.

The supply chain around retrofit will need to be strengthened from a supply and demand side, and engagement across the supply chain will help to increase capacity and confidence in delivering retrofit work.

The hub could act as a means of linking suppliers of design and installation services with businesses needing retrofit services within the Barnsley area. Supporting the market for retrofit, identifying barriers, and working to reduce them will help to accelerate the retrofit to the pace needed to meet the targets set.

Planning and building regulations can affect retrofit projects, and building refurbishments are governed by the planning and building regulations currently in force. These processes are sometimes a barrier to achieving deep retrofit, and ensuring that the businesses in the town centre have access to appropriate advice and support to allow planning and building regulations processes to act as enablers to retrofit, rather than barriers, should also be an aim for the hub. Current regulations do not align with national or BMBC targets for greenhouse gas emission reduction targets and reaching net zero. It will therefore be helpful to (where possible) augment the current regulations

with requirements that are consistent with the trajectory that needs to be achieved. This, together with the support and resources suggested above, will give the best chance of the stated goals being achieved.

The hub should also have a role in monitoring the pace of retrofit and the energy savings being achieved and feeding back to the council the effectiveness of current strategy and policies in place, so that these can be adjusted when required.

Conclusions

Every building within the town centre will need a whole building medium term retrofit plan, and the implementation of some combination of fabric energy efficiency improvements, low carbon heating and renewable electricity generation. Suitable locations for renewable electricity generation are limited and most of the investment within the town centre will be in fabric improvements and low carbon heating, along with improvements to electrical distribution infrastructure. There will need to be some investment outside the town centre (possibly through power purchase agreements) to enable additional renewable electricity generation to be built elsewhere, to match the requirements of the town centre. Results of retrofit should be evaluated and fed back to provide assurance that the town centre is on track to meet the net zero targets. Where there is a shortfall in emissions reductions, high quality carbon offsets can be purchased alongside additional measures to bring emissions reductions to the levels that are needed.

Strategy for development of capabilities and supply chain

For non-domestic buildings, PAS 2038:2021 “Retrofitting non-domestic buildings for improved energy efficiency” provides a framework for developing retrofit plans for non-domestic buildings. The process is led from end-to-end by a retrofit lead professional, a role like the retrofit coordinator of PAS2035 (which applies to domestic buildings). PAS2038 allows those smaller non-domestic buildings (<500m^2) to follow the PAS2035 process and therefore the PAS2035 roles are also relevant within the town centre for non-domestic as well as domestic buildings.

Access to enough people with the skills to provide retrofit advice, assessment, coordination, design, installation, and evaluation of retrofits as defined in PAS2035/2038 should be an early objective of capability development. Achieving a suitable environment for retrofit will also need there to be supply chain, finance, and planning advisors available who can work on developing the supply chain, finance packages and supporting projects through planning. Broad skilled individuals will be needed to engage with businesses to understand how to get them on board with the retrofit process and progress the many projects that will be required. Access to skilled people will likely need to be a combination of recruiting people who already have some or all of the necessary skills, and building a training pipeline through local and national training organisations to provide the growing capacity to support projects as they become available.

Strategy for finance

The finance strategy will need to work with funding available from central government and other parties as well as any local loan or grant funding. Opportunities to put together packages of work that may be investable by the private sector should also be explored. This will link to key strategic decisions around areas of the town centre and how these might be developed. Certain types of finance (for example heritage funding) will only be applicable to certain buildings, and therefore different routes for financing need to be supported simultaneously. Businesses will need support to understand and access financing and packaging of financial support will be needed to make the decision to retrofit as easy as possible.

Strategy for business support

To engage businesses with the process of retrofit and the road to net zero, ideally, they would work with a single point of contact, who would be able to provide them with the clarity and confidence they need to move forward with a retrofit project. Training as retrofit advisors may be suitable to enable single point of contacts to work with businesses, with enough knowledge to help them access the more specialist support they need to develop their projects. Training around the specific way that the processes for retrofit in Barnsley are working, and in other areas such as finance and supply chain support, will also be important to provide a seamless service to businesses. Removing as many barriers as possible to retrofitting their buildings should be a key aim in developing the zero-carbon town centre strategy.

8 Appendices

8.1 Supporting information

8.1.1 Do everything else first and only then offset

How can the town centre procure renewable energy and carbon offsets with certainty that they are having the positive impact intended?

https://www.ukgbc.org/news/ukgbc-consults-on-renewable-energy-procurement-and-carbon-offsetting-guidelines/

Where carbon offsetting must be used, high quality offsets such as Gold Standard https://www.goldstandard.org/ should be used to ensure that carbon reductions are verified and persistent.

8.1.2 Corporate Power Purchase Agreements (CPPA)

For many of the organisations that operate premises within Barnsley Town Centre, a Corporate Power Purchase Agreement (CPPA) may be a significant part of their strategy to demonstrate compliance with their corporate social responsibility strategy and carbon targets.

A CPPA is a long-term contract where a business agrees to buy electricity directly from a renewable energy generator rather than the traditional approach of simply buying electricity from licensed electricity suppliers.

As the UK moves towards decarbonisation, there is a constant need to build the next generation of renewable assets to meet demand and these long-term agreements help to finance renewable energy projects, giving generators a guaranteed buyer and revenue stream for the energy they produce.

Power Purchase Agreements give organisations budget certainty (including potential to negotiate discounts) and help with transparency and accountability in demonstrating that net zero goals will be met and showing corporate social responsibility. They allow organisations to demonstrate where their power is generated and prove that it is from renewable resources.

For smaller businesses, an intermediary organization to aggregate the needs of the businesses and engage a suitable scale generator in a CPPA may be needed.

A generator in this context may be local to Barnsley town centre where a direct CPPA may be possible or remote in which case an indirect CPPA would be used with the licensed electricity supplier ‘sleeving’ the power between the generator and the consumers.

8.1.3 Woodland Carbon Code

Estimating the carbon that can be removed by planting trees is not straightforward as the CO_2e/year reduction varies through the life of the trees, peaking at around 25 years and then reducing again.

The Woodland Carbon Code https://woodlandcarboncode.org.uk/ is a voluntary standard for when claims are being made for carbon sequestered by woodlands.

One aspect that the Code highlights is that the land the trees will be planted on will already be storing carbon and planting the trees will change that land. It must be certain that the benefit of the trees is achieved when considering the change to the land as well.

8.2 Additional information

8.2.1 Connecting with other areas to share best practice.

Carbon Neutral cities Alliance

Achieving deep decarbonisation is a daunting task with few clear roadmaps, and leading global cities have pursued this in relative isolation from each other. That is why the Carbon Neutral Cities Alliance was created. By sharing resources and ideas and collaborating on strategic approaches, CNCA cities can accelerate progress in meeting their aggressive goals; develop more rigor and consistency with which these plans are developed; garner support among key stakeholders critical to their success; and inspire other cities to reach for similarly aggressive goals by providing them with tested, “leading edge” know-how.

This report on the CNCA Framework identifies strategies for driving change.

https://carbonneutralcities.org/wp-content/uploads/2018/04/CNCA-Framework-for-Long-Term-Deep-Carbon-Reduction-Planning.pdf

Place-Based Climate Action Network

The Place-based Climate Action Network (PCAN) is about translating climate policy into action ‘on the ground’ to bring about transformative change

https://www.pcancities.org.uk/

Leeds is one of the PCAN cities and recently published its Pathway to Net-Zero Carbon Roadmap

https://leedsclimate.org.uk/news/climate-commission-shows-moving-net-zero-emissions-can-help-leeds%E2%80%99-post-covid-recovery.

PCAN has also been developing work on Yorkshire and Humber wide carbon reduction.

https://leedsclimate.org.uk/news/yorkshire-wide-approach-carbon-reduction-needed

8.2.2 Aim to promote and attract sustainable businesses.

B Corp

Certified B Corps are a new kind of business that balance purpose and profit. They are legally required to consider the impact of their decisions on their workers, customers, suppliers, community, and the environment. This is a community of leaders, driving a global movement of people using businesses as a force for good. Example: The Body Shop at 42 Cheapside S70 1RU

https://bcorporation.uk/

Science Based Targets

Businesses that set Science Based Targets https://sciencebasedtargets.org/ take a lead on the way to a zero-carbon economy, boost innovation and drive sustainable growth by setting ambitious, science-based emissions reduction targets. Examples: Vodafone at Cheapside S70 1SB, Sainsbury’s (although not in the town centre) and M&S at 7 Queen Street S70 1RL.

Workers and Members Co-operatives

While not directly linked to emissions reductions, co-operatives are socially engaged organisations and are likely to align to the values required for businesses working in a zero-carbon town centre.

8.2.3 Levers and strategies for reducing Carbon in Building Systems

The following table indicates some strategies that can be used to develop the zero-carbon town centre.

LEVERS	STRATEGIES	ACTIONS
Voluntary Action	Encourage Improved Energy Efficiency Performance of Existing Buildings	• Conduct building energy performance challenges • Promote building energy rating systems (commercial and residential) • Promote voluntary energy use benchmarking programs • Promote voluntary "stretch" building energy conservation codes and green-building principles by providing information, technical assistance • Promote "cool roofs"—coating of rooftops white to reduce building energy use—and other low-cost approaches • Support best practice information sharing among building owners
	Promote Energy Conservation Behaviors by Building Occupants/Tenants	• Work with utilities to improve customer access to energy-use data • Conduct public education programs and campaigns that promote energy-saving measures • Promote green leasing for commercial buildings, which enable a fair proportion of costs/benefits to be allocated to both tenants and landlords
Price Signals	Increase Access to Financing	• Improve access to specialized financing to pay for efficiency improvements
	Support/Provide Rewards for Performance	• Provide regulatory and zoning relief for projects meeting certifiable high standards (e.g., LEED) • Promote supportive market mechanisms such as building appraisal and mortgage underwriting that capture the value of investments in energy efficiency
	Subsidize Capacity Improvements for Building Management	• Support efforts to train building operators in energy efficiency best practices

Public Investment	Expand capacity of efficient heating and cooling Invest in Technology Development and Deployment	• Develop and expand low- to no-carbon district heating and cooling systems • City piloting of new building technologies • Support Municipal Strategic Energy Management programs
	Model the Behavior-Invest in Energy Retrofitting of Government Buildings	• Conduct deep retrofitting combined with installation of on-site renewable energy supply • Improve building operations and preventative maintenance • Improve energy efficiency of public/government-owned housing • Require all rehabilitation projects financed by city to include "green" capital needs assessment
Mandates	Mandate Reporting	• Adopt Building Energy and Reporting Disclosure ordinances • Require energy audits and disclosure • Require sub-metering • Require building rating system
	Mandate No- to Low-Carbon Standards for New Construction	• Adopt/phase-in building and energy conservation codes based on carbon neutral, zero net energy, Passive House, Living Buildings, and other cost-effective high-efficiency approaches
	Mandate Performance Improvement of Existing Buildings	• Require targeted buildings (e.g., commercial above certain amount of floor area) to benchmark (measure and disclose) energy performance, and/or conduct energy audits, and/or install energy sub-meters for large tenants • Require "deep" retrofitting of buildings at designated intervention points: time of sale/purchase, financing, major renovation of building or space, and rebuilding • Require upgrades to commercial/industrial buildings' lighting systems • Require higher standards for energy efficiency of appliances • Require certification of building operators

8.2.4 Reasons to retrofit

Helping businesses to justify retrofit is one of the key priorities. There are many aims for retrofit and different aims will have different levels of priority for different businesses. The following may provide some ideas of reasons to retrofit (based upon a report from the Passivhaus Trust[40] and the processes of PAS2035/2038).

[40] Passivhaus retrofit in the UK, January 2022
https://passivhaustrust.org.uk/UserFiles/File/Policy%20papers/2022.01.12%20PHT%20Retrofit%20Position%20Paper%20v2.3.pdf

Why retrofit this building?

Retrofit refers to measures to improve a building with the following general aims:

	Higher levels of comfort (ability to maintain higher air temperatures and warmer and more even surface temperatures). Better internal air quality (reduction in risks of condensation and mould growth; reduction in external pollutants entering via ventilation; and removal of internal air pollutants).
	Reducing greenhouse gas (GHG) emissions (reducing energy use and switching to low carbon renewable heat sources). 18% of UK greenhouse gas emissions come from our homes and homes must play their part in reducing emissions. Government GHG emission targets are 68% reduction by 2030, 78% by 2035 and 100% by 2050 and many councils are committed to 100% reduction by 2030 compared to 1990 baseline.
	Reducing local air pollution (reduced NOx and particulates due to using low carbon heat sources rather than burning fossil fuels or biomass)
	Reducing the impact of rising energy costs (through using less energy) and reducing fuel bills to lessen fuel poverty. Protecting the building from degradation (reduction in risks such as rotting timbers, salt damage to plaster and paint).
	Reducing the impact on utilities infrastructure, reducing demand for renewable energy, and reducing peak load. Well insulated buildings enable better demand management, which helps to maximise use of renewable energy generation.

Retrofit works hand in hand with behaviour changes to enable buildings that support a high quality of living and that will be fit for purpose in the future.

The benefits of delivering retrofit are significant, but individual buildings come with their own unique set of challenges and building owners have limited budgets. It is unlikely that all UK homes and non-residential buildings will be retrofitted by 2050, so those buildings that are retrofitted should aspire to reach the deepest levels of retrofit practical to compensate. Where building retrofits are constrained and cannot for example meet the EnerPHit (LETI exemplar) level of performance, it is important to not lock in poor performance that will cause difficulties as we seek to move to a fully decarbonised electricity grid and as deep a retrofit as possible should be planned, even if this must be delivered in multiple steps.

To gain the maximum benefit from retrofit work, it is important that a holistic whole house approach is taken, and processes are put in place to ensure quality control during design and construction to minimise the risk of an energy performance gap and any unintended consequences as far as possible.