WARWICK & STRATFORD-ON-AVON DISTRICT COUNCILS

South Warwickshire Climate Action Support

June 2021

Stratford-on-Avon District Council

WARWICK DISTRICT COUNCIL

Anthesis

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INTRODUCTION

Overview & Scope

This report was jointly commissioned by Warwick District Council and Stratford-on-Avon District Council in response to their climate emergency declarations and ambitions to become carbon neutral Districts by 2030.

Both District Councils will use this report to help inform the nature and extent of interventions needed to quickly and effectively achieve emissions reduction within South Warwickshire.

- **Chapter 1** of this report defines the current context for climate change action, the work to date across both Districts and the impacts of COVID-19.
- **Chapter 2** outlines the emissions baseline for both Districts utilising the SCATTER Inventory Tool and offers a comparison to Warwick's existing SCATTER baseline detailed in the CEAP main report.
- **Chapter 3** explores land & rural emissions profiling and modelling for Stratford-on-Avon District.
- **Chapters 4 & 5** outline the "carbon budget" for both Districts based on academic research at the Tyndall Centre for Climate Change Research and present future emissions pathways defined by a range of measures within the SCATTER Pathways Tool.
- **Chapter 6** identifies a series of emission reduction interventions as well as intervention milestones to aid delivery of the 2030 target.

The data provided in this report is indicative and highlights the scale and speed of change needed across both Districts in order to meet their 2030 ambitions.

Objectives:

1. Provide a better understanding of South Warwickshire's carbon footprint using a location-based accounting approach and build on existing work to date;
2. Explore the science-based carbon budget and emissions reduction pathways for both Districts;
3. Analyse the land use and agricultural footprint as well as carbon sequestration potential for Stratford-on-Avon District, given its rural nature; and
4. Reaffirm and Identify a number of emission reduction interventions and milestones for both Districts.

This will help both District Councils to:

- Provide a more informed evidence base for a shared climate emergency strategy or action programme across South Warwickshire;
- Prioritise decarbonisation projects which have an impact across the whole of South Warwickshire; both Council's working jointly allows the potential for improvements in economies of scale and funding opportunities;
- Increase confidence in the mandate for climate action and aid development of a robust joint local strategy, which can deliver objectives over a long-term cycle.

01 Background & Context

1. BACKGROUND & CONTEXT
A CALL TO ACTION

A Growing Consensus

It is now widely agreed that climate change poses an unprecedented threat, and that action is required across all aspects of society. The recognition of urgency is no longer just a message from environmental groups, but is now being reiterated across a variety of sectors:

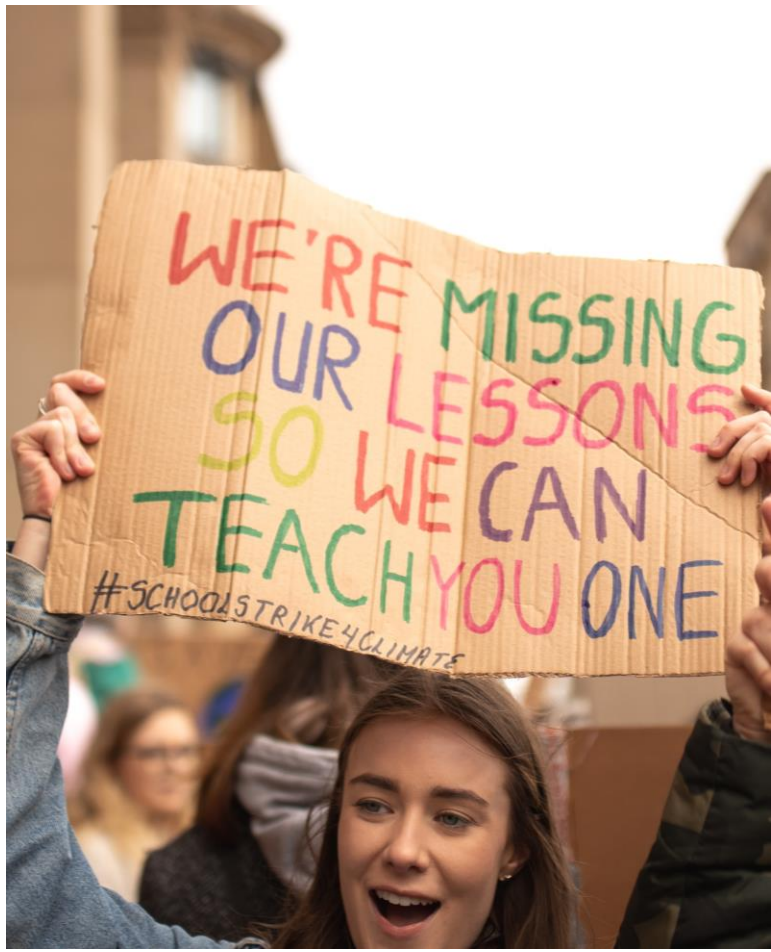
- **UK Local Authorities:** The majority of Local Authorities in the UK have now declared a climate emergency, including all five districts within Warwickshire. Climate Emergency Declarations were first issued following the IPCC's special report, published in October 2018.
- **UK Climate Strike Action:** Several climate strikes have occurred across both Districts in recent years, and these have been driven by Youth Strike 4 Climate groups in Leamington Spa and Stratford-on-Avon.
- **Global Businesses:** Nearly 800 companies globally are setting Science Based Targets. As part of the lead up to COP26, the campaign 'Race to Zero' was launched across businesses, cities and nations.

Dangerous Impacts

The UK Climate Projections Report is the latest generation of national climate projections in the UK which helps to predict the changes that will occur with future climate change. The main trends from the projections are increasing warmer, wetter winters and hotter, drier summers along with an increase in the frequency and intensity of extreme weather events.

Communities across Warwick and Stratford-on-Avon are already seeing more extremes in weather events, with flooding being a particular issue. In January 2021, Storm Christoph brought significant rain and led to Warwickshire's rivers Leam, Blythe and Dene all breaking their banks. Riverside villages such as Offchurch, Long Itchington and Walton all suffered from extreme flooding.

In the 2018 Emissions Gap Report, the UN identified local action as a key driver for change: *"…non-state and subnational action plays an important role in delivering national pledges. Emission reduction potential from non-state and subnational action could ultimately be significant, allowing countries to raise ambition."*



1. BACKGROUND & CONTEXT

OVERVIEW OF POLICY CONTEXT

Commitments have been made and targets have been set at all levels of government in response to the growing consensus and evidence around climate change. Below is a recap of the commitments that have been made on a global scale down to a local scale.

The Paris Agreement set the international target to limit global temperature rise to well below 2°C with the aim of 1.5°C above pre-industrial levels. The IPCC's follow up report stated that this requires a reduction in GHG emissions of 45% by 2030.

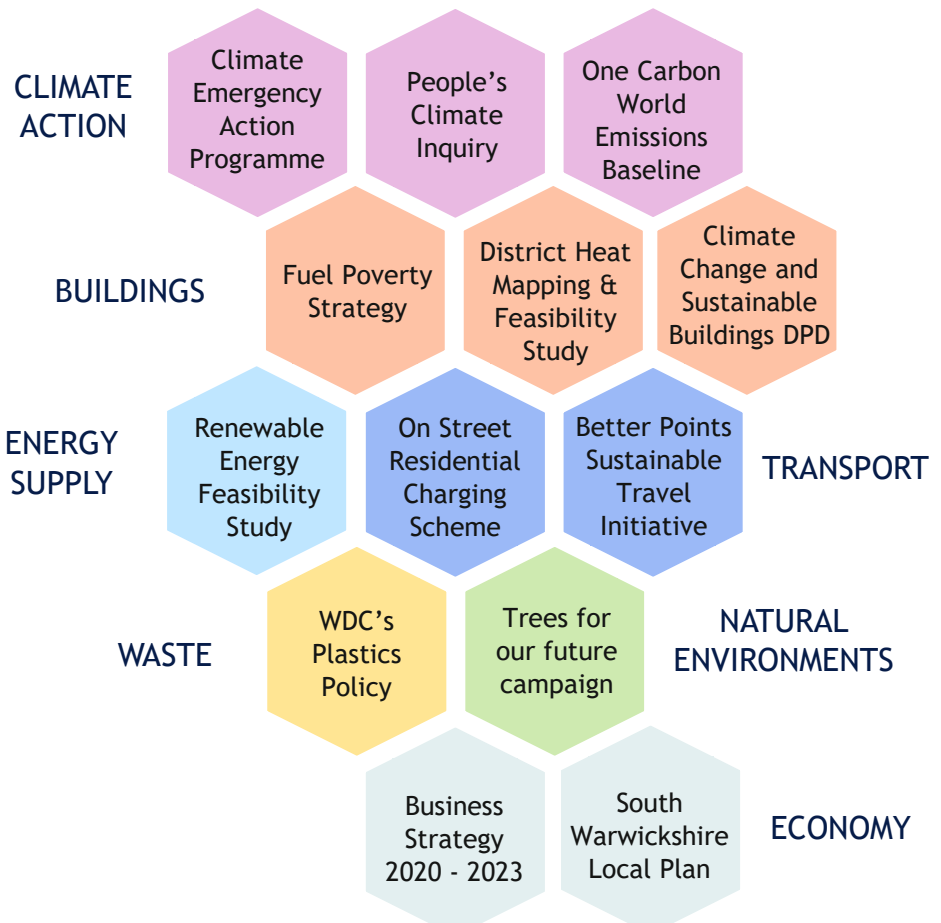
As part of the Paris Agreement, the EU and its member states committed to a minimum of 40% reduction in emissions by 2030. In December 2019, the EU agreed to set a target of becoming carbon neutral by 2050. As the UK exits the EU, it is anticipated a new Nationally-Determined Contribution for the UK, separate from the EU commitment, to be announced ahead of COP26 in late 2021.

The Climate Change Act 2008 introduced a legally binding target for the UK to reduce GHG emissions by 80% by 2050 against a 1990 baseline. In June 2019, the target was updated to reach net zero by 2050. In April 2021, the government committed to further reductions, aiming to reduce emissions by 78% by 2035 compared to 1990 levels.

At a meeting of the full Council in July 2019, Warwickshire County Council unanimously declared a climate emergency and committed to becoming carbon neutral as an organisation by 2030 or sooner. All five of Warwickshire's District's have declared a climate emergency with all, apart from North Warwickshire, setting a district-wide net zero target date of 2030.

In July 2019, both Warwick District Council and Stratford-on-Avon District Council declared a climate emergency, with both Council's setting a 2030 district-wide net zero ambition. Both District Council's recognise that climate issues do not stop at the District boundary and there is considerable value in working together to tackle key climate change issues across South Warwickshire.

1. BACKGROUND & CONTEXT
WARWICK DISTRICT COUNCIL WORK TO DATE



Climate Emergency Action Programme
Following the Climate Emergency Declaration in 2019, the Council unanimously supported a Climate Emergency Action Programme (CEAP), and a top-level Climate Emergency Action Plan was formalised for the period December 2020 – June 2021. The plan details actions focusing on governance, CEAP set up and monitoring, reducing WDC's Carbon Footprint and reducing the District's Carbon Footprint.

People's Climate Inquiry
The People's Climate Inquiry began in November 2020 and facilitated a group of 30 independent members of the public to come together and address the issues of climate change within the District. The Inquiry has been an important way to involve members of the public in making recommendations to inform the Climate Change Plan, to be adopted in May 2021. The top three recommendations from the Inquiry included: promoting and encouraging cycling, ensuring that newly built homes are carbon neutral and developing a coordinated communications campaign to encourage everyone in the District to act and make lifestyle changes.

One Carbon World Emissions Baseline
A One Carbon World emissions baseline was undertaken for the Council's own buildings and transport emissions, and this is verified as part of the UN Climate Neutral Now Scheme. The report meets the reporting requirements of the GHG Protocol Corporate Standard and is compatible with ISO 14064 and PAS 2060.

South Warwickshire Local Plan
Warwick District Council and Stratford-on-Avon District Council began working together in January 2021 to prepare a new Local Plan for South Warwickshire, which will set out a long-term spatial strategy for housing, jobs, infrastructure and climate change across both Districts. The new South Warwickshire Local Plan will replace Warwick's 2011-2029 Local Plan.

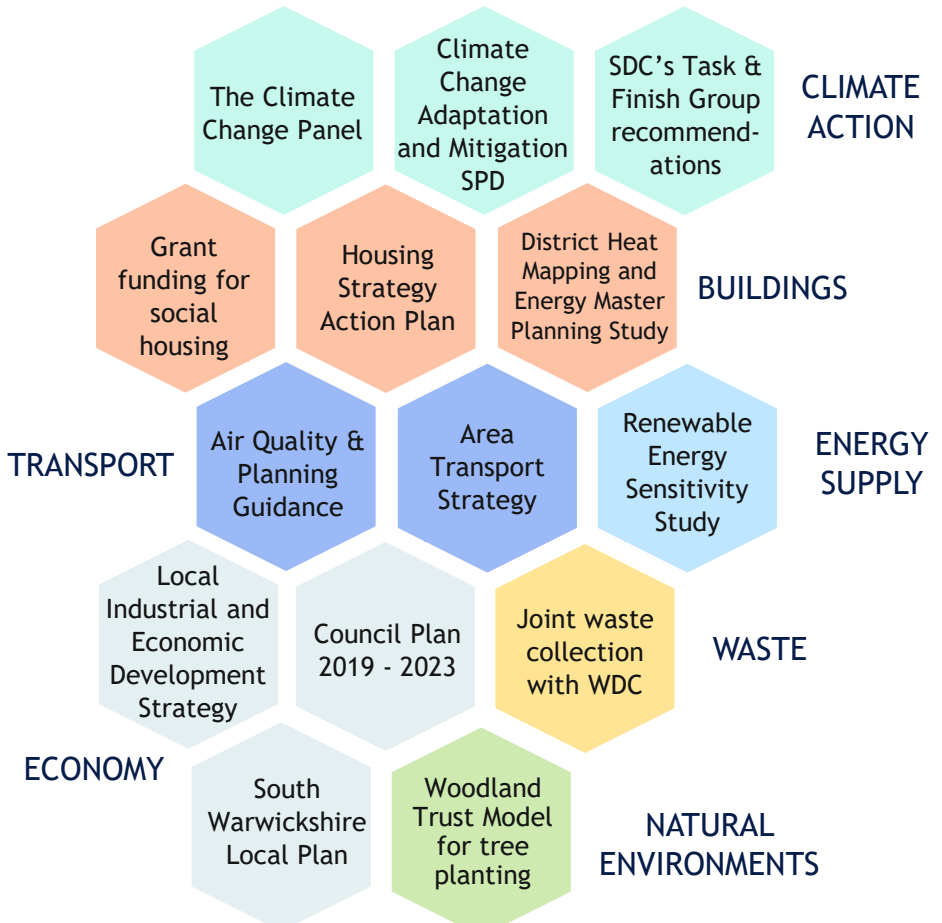
1. BACKGROUND & CONTEXT
STRATFORD-ON-AVON DISTRICT COUNCIL WORK TO DATE

The Climate Change Panel
Stratford-on-Avon's inaugural Climate Change Panel took place in January 2021 and will meet on a monthly basis. The Panel is an advisory group, designed to bring together identified members of the Council to support the development of strategic policies and action plans in response to the climate emergency declaration.

Climate Change Adaptation and Mitigation Supplementary Planning Document
The newly adopted Part V of Stratford-on-Avon's Supplementary Planning Document focuses on adaptation and mitigation measures relating to climate change and is a material consideration that will be used by the Council to help reach decisions on whether to approve or refuse planning applications.

Stratford-on-Avon District Council Plan
The Council Plan 2019 – 2023 sets out a vision for Stratford-on-Avon District as a place and for local government in 2030. The core of the plan is a set of ambitions and actions under five key objectives: working on regional, national and international stages, responding to the climate emergency, enhancing the quality of Stratford-on-Avon, nurturing a thriving and inclusive economy and putting residents and communities centre stage.

South Warwickshire Local Plan
In January 2021, the Council commenced a review of its 2011-2031 Core Strategy and are working together with Warwick District Council to prepare a new Local Plan for South Warwickshire. The South Warwickshire Local Plan will set out a long-term spatial strategy for housing, jobs, infrastructure and climate change for both Districts and it is expected that a first Scoping and Initial Options public consultation will be held in April – May 2021.



1. BACKGROUND & CONTEXT
COVID-19 AND A GREEN RECOVERY

COVID-19 & Climate Change

The global disruption and impacts of the COVID-19 pandemic have forced governments, businesses and citizens to radically reassess their policy decisions, operations and lifestyles.

The ongoing restrictions offer the chance to reflect on what is important to local communities. This time also presents the opportunity to shift our collective values and review the demands of "emergency action" in a climate context. Local and national commitments to emissions reductions have not changed as a result of the COVID-19 crisis and the cost of delaying action has been felt in many countries during the pandemic. Decisiveness will be required in the wake of this crisis, to lead a recovery which revolves around the resilience, health and sustainability of local communities.

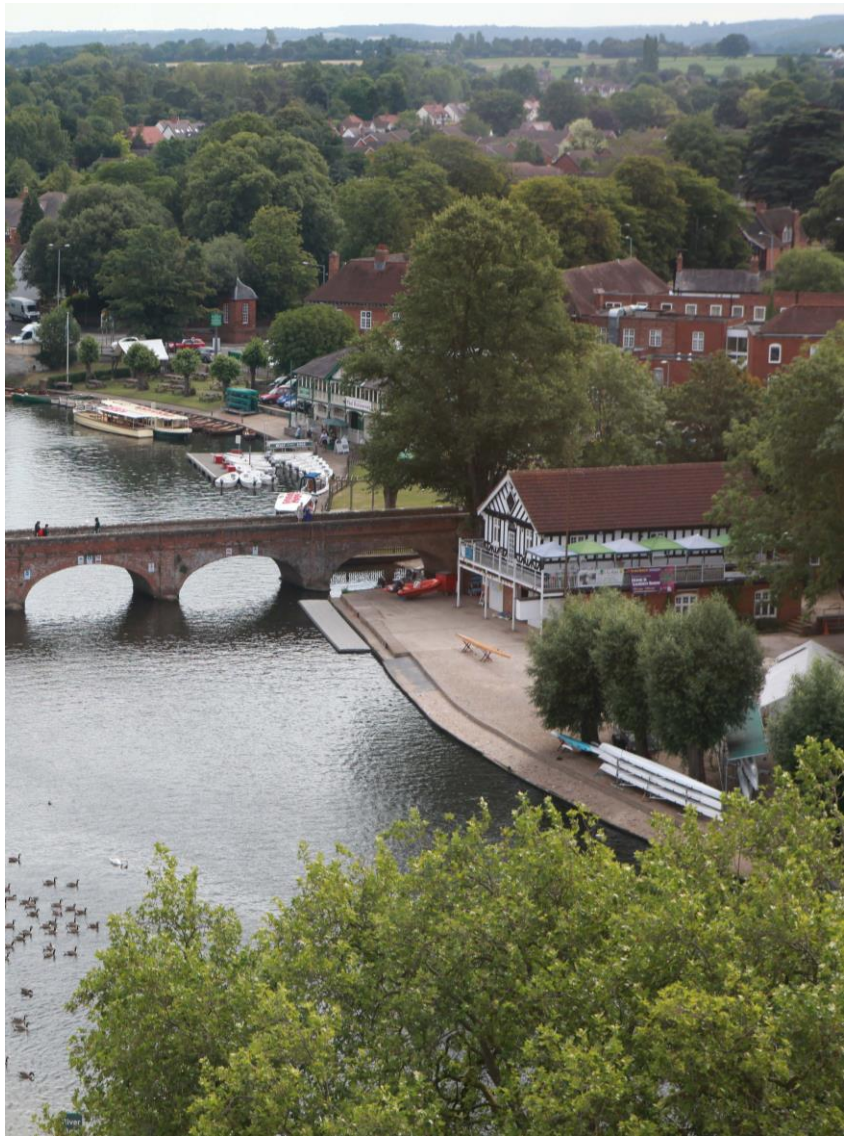
The next few years will be pivotal for climate change mitigation as we enter the decisive decade for action. The urgency of the situation is growing as we approach planetary tipping points and are held to account as a nation against international climate targets.

A Green Recovery

To maintain the prospect of meeting the commitments set out in the Paris Agreement, it is essential that government policies in response to the economic crisis avoid locking nations into carbon intensive pathways, and instead steer economies towards a resilient *Green Recovery*. In May 2020, the Committee on Climate Change called for government to use the economic recovery as an opportunity to accelerate the shift towards a low-carbon economy. This would stimulate jobs, stabilise future economic resilience, and mitigate climate related risks. Business and health professionals are also making similar calls.

The C40 Cities group has published an overview of principles which it recommends should inform this Green Recovery. Decisiveness will be required as we recover from this crisis, responding with policy that is centred around the resilience, health and wellbeing of local communities.

Warwickshire County Council has outlined the need to address climate change and investment into a sustainable future as two key COVID-19 recovery priorities in the WCC COVID-19 Recovery Plan.



02 Emissions Baseline Review

2. EMISSIONS BASELINE REVIEW
DISTRICT-LEVEL SCATTER INVENTORY

The current emissions profiles for the areas administered by Warwick and Stratford-on-Avon District Councils are shown below, based on the SCATTER Inventory Tool. This covers three greenhouse gases: carbon dioxide, nitrous oxide and methane in the 2017 reporting year. The emissions profiles cover emissions generated within the District boundary (scopes 1 & 2) as well as emissions that occur outside of the District as a result of activities taking place within the District (scope 3). Not all subsectors can be neatly summarised as a "slice" within these charts, as emissions from land use sequester carbon from the atmosphere. A breakdown of what is included within each emissions sector is detailed on pages 12 & 13.

Warwick District

In 2017, Warwick's energy system was responsible for net emissions totalling **1259.6 ktCO₂e**. The majority resulted from buildings & facilities (42.2%) and transport (53.7%). A detailed comparison of the SCATTER emissions baseline in the CEAP main report and the baseline below can be found on page 15.

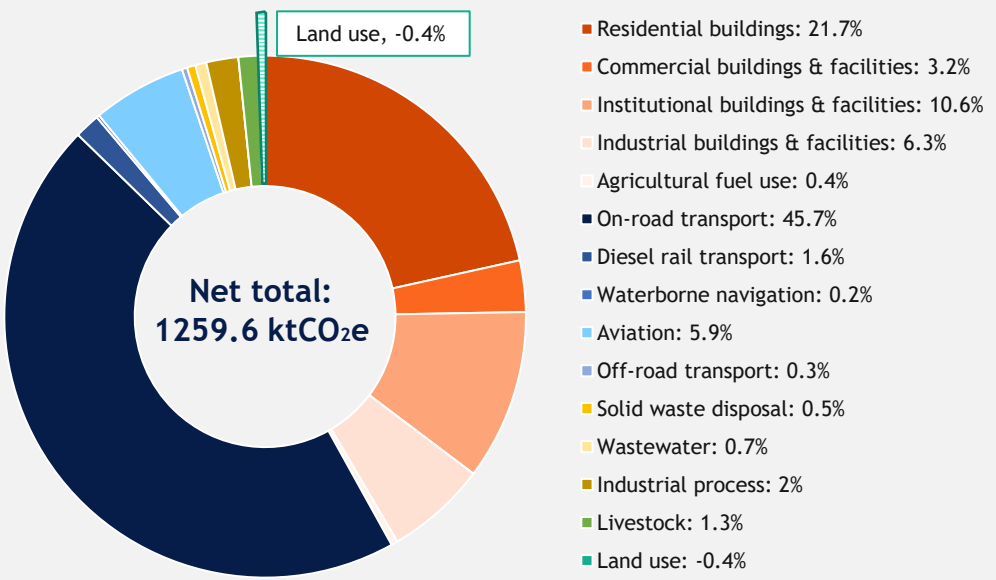


Figure 1: SCATTER emissions inventory for Warwick District, 2017. Appendix 3 details the full SCATTER inventory dataset for Warwick District.

Stratford-on-Avon District

In 2017, Stratford-on-Avon's energy system was responsible for net emissions totalling **1484.9 ktCO₂e**. Like Warwick, the majority resulted from buildings & facilities (39.3%) and transport (51.3%), however Stratford-on-Avon also have considerably larger livestock emissions (6%), which are detailed in Chapter 3.

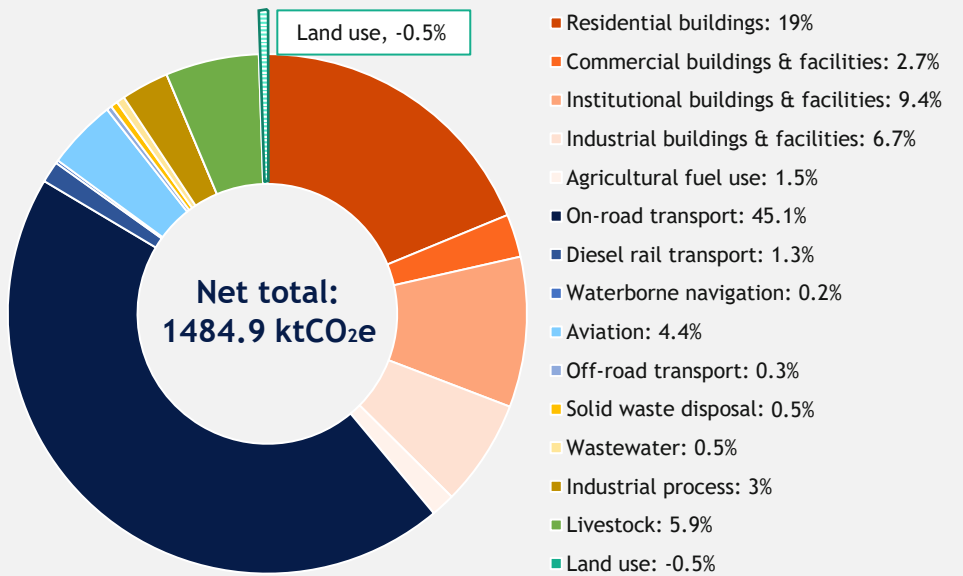


Figure 2: SCATTER emissions inventory for Stratford-on-Avon District, 2017. Appendix 4 details the full SCATTER inventory dataset for Stratford-on-Avon District.

2. EMISSIONS BASELINE REVIEW
WARWICK SCATTER EMISSIONS SUBSECTORS

The following tables demonstrate the profile of each emissions sector and explain the sources of emissions included in each:

42.2% of emissions in Warwick come from buildings

- Residential buildings (21.7%): Domestic households of all tenure types.
- Institutional buildings & facilities (10.6%): Public sector buildings including schools, collages and educational buildings, health centres, hospitals, leisure centres, Council buildings etc.
- Industrial buildings & facilities (6.3%): Larger industrial facilities, including factories, warehouses and workshops associated with manufacturing and engineering.
- Commercial buildings & facilities (3.2%): Buildings from which commercial businesses operate e.g. shops, shopping centres, offices, restaurants etc.
- Agricultural fuel use (0.4%): Fuel consumption from off-road transportation in the agricultural sector. This does not include direct emissions from livestock or fertiliser.

1.3% of emissions in Warwick come from livestock and land use acts as a net carbon 'sink' of 0.4%

- Livestock (1.3%): Including emissions from both dairy and non-dairy cattle as well as other farm livestock.
- Land use (-0.4%): These emissions estimations rely heavily on DEFRA estimations on land use types and include emissions produced as well as sequestration. Only CO_2 is considered for land use, so the figure quoted for sequestration is likely to be an underestimate.

53.7% of emissions in Warwick come from transport

- On-road transport (45.7%): Emissions from total fuel consumption of all on-road vehicles
- Diesel rail (1.6%): Emissions from diesel-fuelled rail transport. Emissions from electricity consumption within the rail sector are included in the commercial and industrial sectors as it is not possible to separate these emissions.
- Waterborne navigation (0.2%): Inland waterborne transport is allocated to local authorities based on the km of canal length.
- Aviation (5.9%): Cruise impact emissions are allocated to local authorities based on the percentage of the population, assuming that flying is uniformly distributed.
- Off-road (0.3%): A base assumption of 1% of total on-road emissions

1.2% of emissions in Warwick come from waste disposal

- Solid waste disposal (0.5%): Incorporates various waste streams across commercial, industrial and municipal sources.
- Wastewater (0.7%): Scaled directly from national wastewater data by population.

2% of emissions in Warwick come from industry

- Industrial processes (2%): National industrial processing emissions associated with heavy industry, such as iron & steel and chemicals, have been scaled down for Warwick.

2. EMISSIONS BASELINE REVIEW
STRATFORD-ON-AVON SCATTER EMISSIONS SUBSECTORS

The following tables demonstrate the profile of each emissions sector and explain the sources of emissions included in each:

39.3% of emissions in Stratford-on-Avon come from buildings

- Residential buildings (19%): Domestic households of all tenure types.
- Institutional buildings & facilities (9.4%): Public sector buildings including schools, collages and educational buildings, health centres, hospitals, leisure centres, Council buildings etc.
- Industrial buildings & facilities (6.7%): Larger industrial facilities, including factories, warehouses and workshops associated with manufacturing and engineering.
- Commercial buildings & facilities (2.7%): Buildings from which commercial businesses operate e.g. shops, shopping centres, offices, restaurants etc.
- Agricultural fuel use (1.5%): Fuel consumption from off-road transportation in the agricultural sector. This does not include direct emissions from livestock or fertiliser.

5.9% of emissions in Stratford-on-Avon come from livestock and land use acts as a net carbon 'sink' of 0.5%

- Livestock (5.9%): Including emissions from both dairy and non-dairy cattle as well as other farm livestock.
- Land use (-0.5%): These emissions estimations rely heavily on DEFRA estimations on land use types and include emissions produced as well as sequestration. Only CO_2 is considered for land use, so the figure quoted for sequestration is likely to be an underestimate.

51.3% of emissions in Stratford-on-Avon come from transport

- On-road transport (45.1%): Emissions from total fuel consumption of all on-road vehicles
- Diesel rail (1.3%): Emissions from diesel-fuelled rail transport. Emissions from electricity consumption within the rail sector are included in the commercial and industrial sectors as it is not possible to separate these emissions.
- Waterborne navigation (0.2%): Inland waterborne transport is allocated to local authorities based on the km of canal length.
- Aviation (4.4%): Cruise impact emissions are allocated to local authorities based on the percentage of the population, assuming that flying is uniformly distributed.
- Off-road (0.3%): A base assumption of 1% of total on-road emissions

1% of emissions in Stratford-on-Avon come from waste disposal

- Solid waste disposal (0.5%): Incorporates various waste streams across commercial, industrial and municipal sources.
- Wastewater (0.5%): Scaled directly from national wastewater data by population.

3% of emissions in Stratford-on-Avon come from industry

- Industrial processes (3%): National industrial processing emissions associated with heavy industry, such as iron & steel and chemicals, have been scaled down for Stratford-on-Avon.

2. EMISSIONS BASELINE REVIEW
SOUTH WARWICKSHIRE SCATTER INVENTORY

A combined net total emissions baseline for South Warwickshire has been calculated to align with both Council's ambitions to collaborate on climate action.

In 2017, South Warwickshire's energy system was responsible for net emissions totaling **2744.5 ktCO₂e**. This is composed of 1259.6 ktCO₂e from Warwick District and 1484.9 ktCO₂e from Stratford-on-Avon. The majority of emissions across South Warwickshire resulted from buildings & facilities (40.6%) and transport (52.4%). Emissions from waste (1.1%) and industry (2.6%) contributed a small amount to South Warwickshire's overall profile. Emissions from livestock were much higher in Stratford-on-Avon (5.9%) compared to Warwick District (1.3%), and land use sequestration was approximately the same across both Districts. See Appendix 5 for the full emissions data table for South Warwickshire.

The profile shown opposite relates to a territorial profile from emissions generated within the two District boundaries (scope 1 & 2) as well as outside both boundaries (scope 3) but excludes emissions from goods and services produced outside of the Districts (consumption emissions).

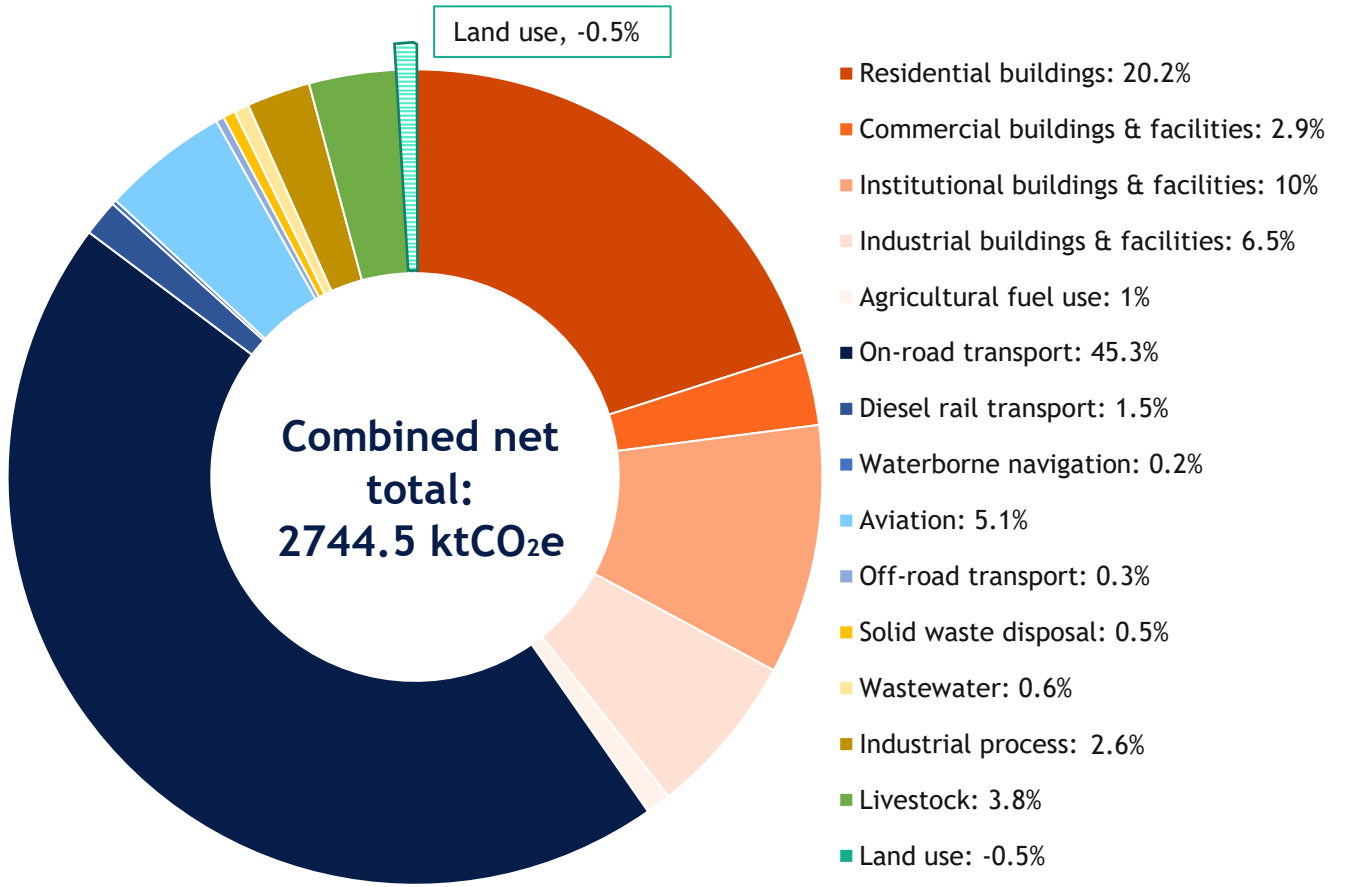


Figure 3: SCATTER 2017 inventory for South Warwickshire, shown by sub-sector.

2. EMISSIONS BASELINE REVIEW
COMPARISON TO WARWICK'S CEAP REPORTING BASELINE

Warwick District's emissions baseline detailed in the CEAP main report differs from the current SCATTER baseline shown on page 11. The previously reported SCATTER baseline calculated a net emissions total of 1060.1 $ktCO_2e$ (shown in figure 4), whereas the current baseline calculates a net emissions total of 1259.6 $ktCO_2e$. This difference is due to changes within the SCATTER methodology since October 2019, when the CEAP Report SCATTER Inventory was downloaded. Detailed changes to the SCATTER methodology are highlighted in Table 1.

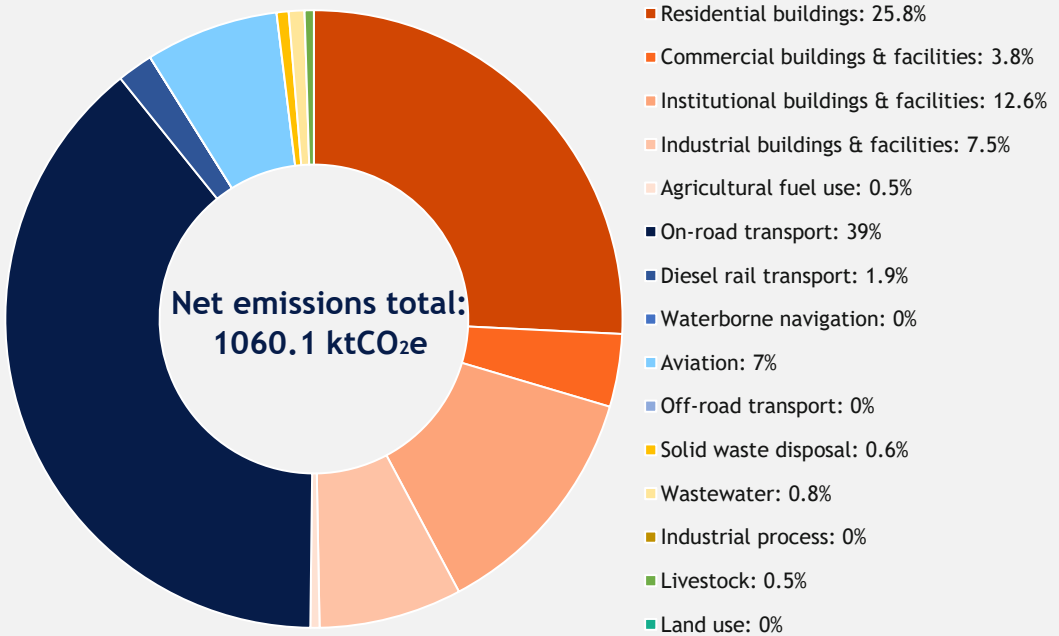


Figure 4: SCATTER inventory detailed in Warwick's CEAP main report, utilising the SCATTER inventory downloaded in October 2019.

Table 1: Changes in the SCATTER methodology since October 2019.

Sub Sector	CEAP Report Baseline	Current SCATTER Baseline	Explanation of difference
On-road transport	413.74 $ktCO_2e$	574.96 $ktCO_2e$	Correction of error to include scope 3 on-road transport emissions (161 $ktCO_2e$).
Waterborne navigation	0.01 $ktCO_2e$	2.26 $ktCO_2e$	Waterborne navigation reference data updated.
Off-road transport	0 $ktCO_2e$	4.14 $ktCO_2e$	Correction for missing off-road transport data, assumed to be 1% of on-road emissions.
Industrial processes	0 $ktCO_2e$	25.2 $ktCO_2e$	Emissions factors for Industrial Process emissions were updated to correct an error in the previous release of SCATTER.
Livestock	5.14 $ktCO_2e$	16.1 $ktCO_2e$	Update to livestock emissions factors.
Land use	0 $ktCO_2e$	-4.72 $ktCO_2e$	Land use data has been updated to reflect more recent data releases, greater granularity and different land uses. Uncertainties remain within land use emissions estimates.

03 Land & Rural Emissions Profiling Stratford-on-Avon

3. LAND & RURAL EMISSIONS
AGRICULTURE & LAND USE EMISSIONS ANALYSIS

This section of the report provides further analysis into emissions from the natural environment and agriculture, namely:

- Emissions arising from agricultural activity within Stratford-on-Avon, including emissions from livestock, farming activities and fertiliser usage;
- An estimate for the land use profile within the District and discussion of how this relates to carbon sequestration potential in the case of soil carbon and organic matter;
- Some high-level scenario analysis for land use change into the future, based on research from the Committee on Climate Change.

Emissions in summary

Total gross emissions[1] from agriculture and land use (ALU) have been estimated at **155ktCO$_2$e** according to the most recent data. A breakdown of these emissions can be seen opposite in Figure 5. This analysis contains further sources not covered in SCATTER estimations of agricultural emissions within Stratford. Of the gross emissions, livestock is the dominant source, responsible for approximately 94ktCO$_2$e (64% of the gross total for ALU emissions). Emissions from fertiliser are responsible for approximately 32ktCO$_2$e (22% of the total).

The net figure for emissions is lower, at just under 146ktCO$_2$e, owing to land use changes within the district acting as a net sink of carbon. Land use, land use change & forestry (LULUCF) is responsible for net sequestration of 8ktCO$_2$, giving the net total of 146ktCO$_2$e.

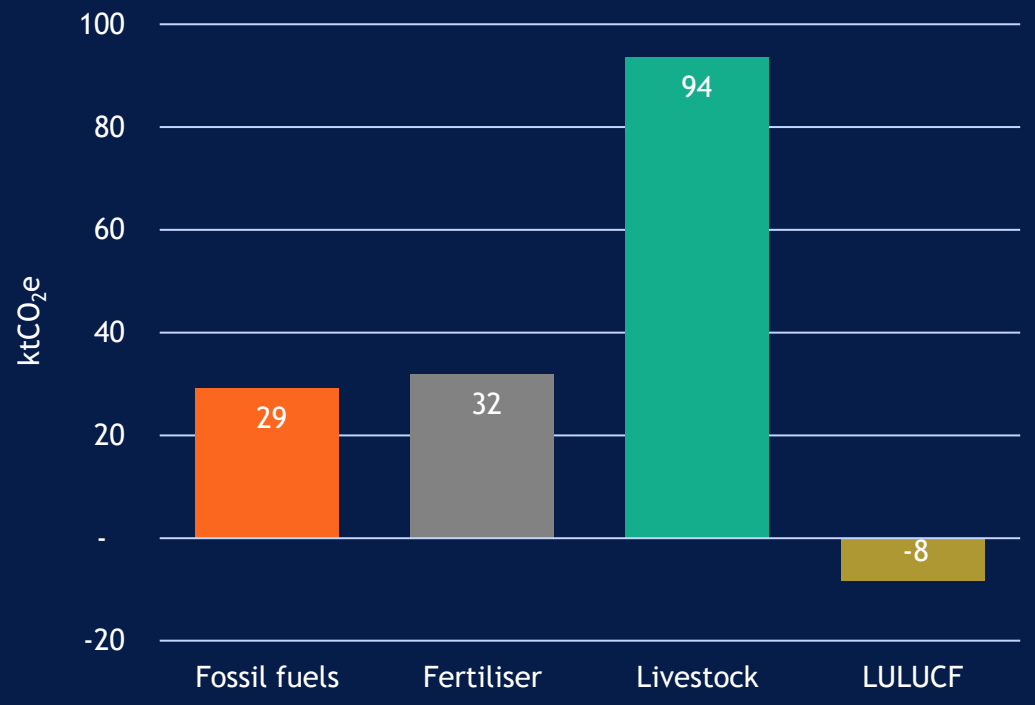


Figure 5: A summary of agricultural & land use emissions in Stratford. For a breakdown of data sources and reporting years, please see Appendix 7.

[1] Please see Appendix 7 for further details on the methodology for this analysis, including a definition of terms, data sources and overlap with the SCATTER tool.

3. LAND & RURAL EMISSIONS
ALU EMISSIONS SOURCES

Stratford's ALU emissions (155ktCO_2e when excluding the sequestration from LULUCF) come from a number of sources and activities. Some of these are the direct result of fossil fuel consumption, in things like agricultural machinery, whilst others come from livestock or are the result of land use changes. Emissions have been categorised into four main groups.

Fossil fuel usage

This category of emissions covers any fuel consumption by agricultural vehicles, machinery and buildings. In Stratford, a total of 29ktCO_2 was recorded in 2018 BEIS data.

Livestock

This category includes methane emissions associated with enteric fermentation (i.e. eructation and flatulence) as well as some nitrous oxide emissions from direct manure management. A total of 94ktCO_2e was emitted by the District's livestock according to the most recently available data (2016).
According to 2016 data from DEFRA, Stratford is home to significant numbers of sheep, as well as a large cattle population. These data are the most recently available reported figures for local authority livestock numbers:

Table 2: Livestock numbers for Stratford-on-Avon, taken from DEFRA statistics. Emissions factors for livestock taken from NAEI Inventory.

Livestock type	Number	Emissions per head (tCO_2e)
Dairy cattle	3,500	4.63
Other cattle	24,000	1.94
Sheep	168,700	0.13
Pigs	20,000	0.41
Poultry	281,600	<0.01
Total	**497,800**	**0.18**

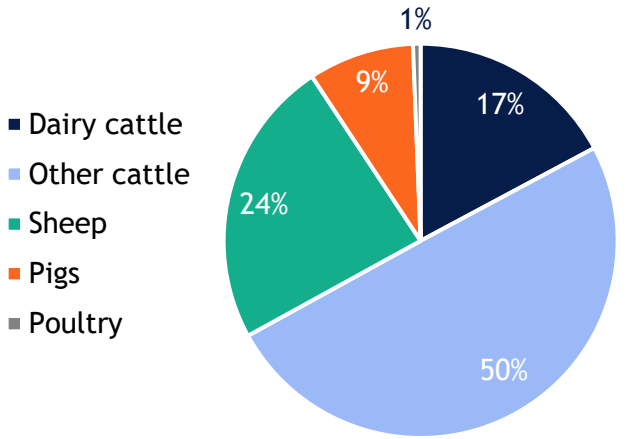


Figure 6: Emissions from livestock broken down by livestock type.

Despite the significant numbers of poultry & sheep in Stratford, their carbon impact is much lower relative to other types of livestock, such as dairy cattle. A breakdown of the emissions from livestock is shown in Figure 6, detailing the contribution from each livestock type.

The dominant contributions towards the 94ktCO_2e figure come from cattle, specifically non-dairy cattle, which are responsible for just over half of all livestock emissions. The contribution from sheep is much smaller – just under one quarter of the total – with the remainder made up by a small contribution from pigs and poultry.

Despite much lower numbers of dairy cattle than other livestock, their per-head emissions intensity means that their contribution remains significant.

Fertiliser

This category of emissions includes nitrous oxide emissions from fertiliser application to land. An estimated 58ktCO_2e was emitted through fertiliser application within Stratford (2016).

3. LAND & RURAL EMISSIONS
ALU EMISSIONS SOURCES

Fertiliser releases nitrous oxides into the atmosphere when microbes break down synthetic fertilisers (such as anhydrous ammonia) or organic fertilisers (such as animal manure). Nitrous oxides persist in the atmosphere for a long time (>100 years) and are significantly more effective than carbon dioxide at trapping heat in the atmosphere. This means that even a small concentration of nitrous oxide emissions can impact the climate in a significant way.

In Stratford, nitrous oxides come from grassland (which has low fertiliser applications but a large total area) and wheat production (which has higher fertiliser applications and a large area). Emissions from fertiliser are heavily dependent on crop rotations and will vary each year that crops are rotated.

Land-use, land-use change & forestry (LULUCF)

This category of emissions considers the different natural carbon sources and sinks within Stratford. Land use change can release carbon dioxide into the atmosphere and act as a carbon source, through processes such as the decomposition of organic matter and deforestation. Forests and woodlands act in the opposite way, absorbing carbon dioxide through the growth of trees and plants.

Land type	tCO_2e
Grassland	-34,793
Forestland	-26,683
Settlements	22,558
Cropland	30,608
Net Total	**-8,310**

Table 3 (left) shows that grass- and forestland act as carbon "sinks", storing a total of about 61$ktCO_2$ in Stratford-on-Avon. These sinks are balanced against emissions arising from settlements and cropland changes, meaning that the net sequestration is around 8$ktCO_2$. See Appendix 7 for definitions.

Table 3: Estimated soil and biomass gains and losses for Stratford (2018).

The impact of different greenhouse gases

Results in this chapter are shown as *kilotonnes of carbon dioxide equivalent* (written as $ktCO_2e$). This unit of measurement allows us to express different greenhouse gas emissions in common terms in order to directly compare their impact.
Methane is a very potent greenhouse gas, which in the short term (~20 years) has 84 times the warming effect of carbon dioxide and, in the long term (~100 years) has 28 times the effect. Nitrous oxide has 265 times the warming impact of carbon dioxide.
While carbon dioxide emissions are the primary cause of climate change, cuts to the emissions of other greenhouse gases such as methane and nitrous oxides have a much more immediate climate impact, helping to limit short- and long-term temperature increases.

Differences with BEIS data

The significant disparity in the emissions reported by BEIS and analysis presented here stems from the different greenhouse gases assessed in each case.

BEIS data considers only CO_2 emissions and neglects other greenhouse gases such as methane and nitrous oxide. These gases are emitted in significant volumes within the agricultural sector, chiefly through the rearing of livestock and use of fertilisers.

Anthesis' analysis considers these gases and provides a figure for the equivalent weight of CO_2 after accounting for methane and nitrous oxide emissions that are common in the agricultural sector.

3. LAND & RURAL EMISSIONS
LAND USE IN STRATFORD-ON-AVON

The map and chart opposite break down the various land use types within Stratford. The single largest land use is permanent grassland, which forms about 48,300 hectares (ha, 49% of the total). The next major land-type is arable of 34,300ha (35%) followed by woodland of 5,100ha (5%) and non-agricultural land of 4,800ha (5%). The smaller land use types are legume land and fallow land, contributing 2,900ha (3%) and 2,300ha (2%) respectively.

The land use map is taken from the Crop Map of England (CROME), which mainly uses satellite data to identify land-uses and crop types. The data for this profile was taken in summer 2018 and should be considered as a snapshot in time rather than a fully definitive current picture.

Table 4: Land use in Stratford-on-Avon

Land use type	Hectares	% of total
Arable	34,300	35%
Permanent grassland	48,300	49%
Legumes	2,900	3%
Fallow land	2,300	2%
Non-agricultural land	4,800	5%
Woodland	5,100	5%
Total	**97,900**	**100%**

Land use (group)
- Null
- Beet-type arable crop
- Bracken, heather and heathland
- Cabbage (spring)-type arable crop
- Cabbage (winter)-type arable crop
- Cereals
- Field beans (spring)-type leguminous and nitrogen-fixing crop
- Field beans (winter)-type leguminous and nitrogen-fixing crop
- Land lying fallow
- Linseed (spring)- type arable crop
- Lucerne-type leguminous and nitrogen-fixing crop
- Non Agricultural Land
- Oilseed (winter)- type arable crop
- Onion-type arable crop
- Pea (spring)- type leguminous and nitrogen-fixing crop
- Permanent crops other than nursery crops and short rotation coppice
- Permanent Grassland
- Potato-type arable crop
- Soya-type leguminous and nitrogen-fixing crop
- Triticale (winter) - type arable crop
- Water
- Woodland

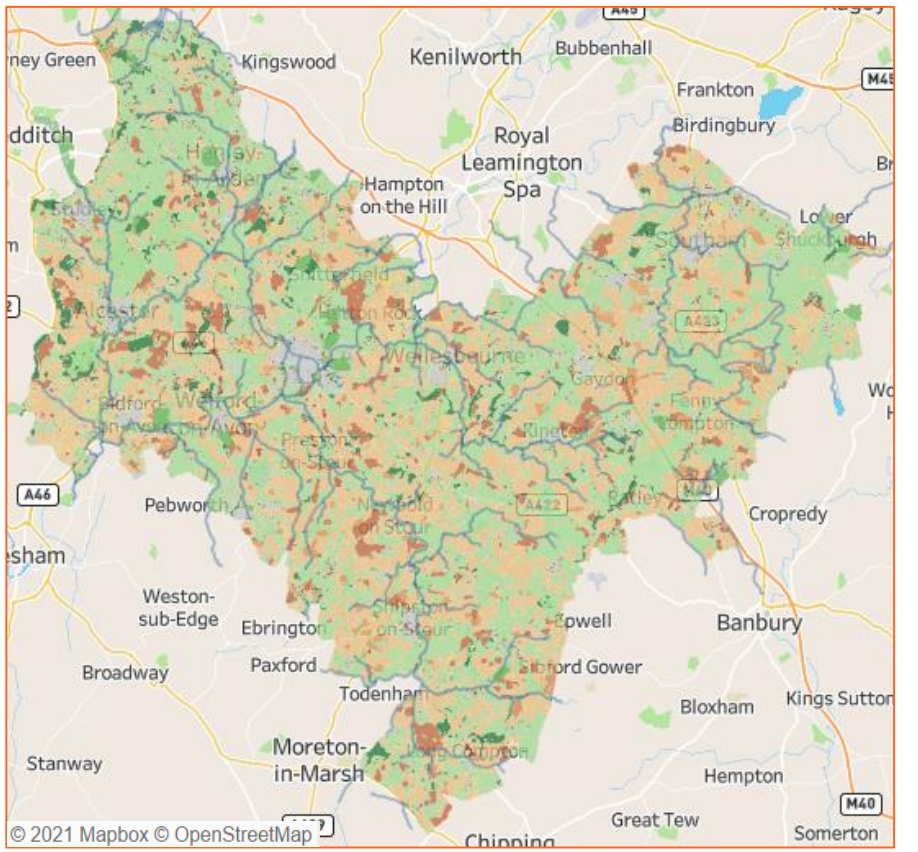


Figure 7: Land use in Stratford, based on data from summer 2018.

3. LAND & RURAL EMISSIONS

LAND USE AT PARISH LEVEL

The land area covered by Stratford District Council totals approximately 97,700ha. Stratford-upon-Avon accounts for the largest parish area within the district at just over 3,800ha. Lighthorne Heath is the smallest parish in the district, at 145ha. The largest wooded areas are in Tanworth-in-Arden (421ha) & Arrow-with-Weethley (284ha), with the largest area of non-agricultural land in Stratford-upon-Avon (730ha).

Watergall, Dorsington & Tidmington are the parishes with the highest proportional area of permanent grassland – over 90% of the land in Watergall's case. Permanent grassland makes up over 60% of the land in 21 of the district's 113 parishes. The bar charts below plot some of the parish land use profiles; a full dataset with all parish land use profiles is available upon request with Tableau Reader.

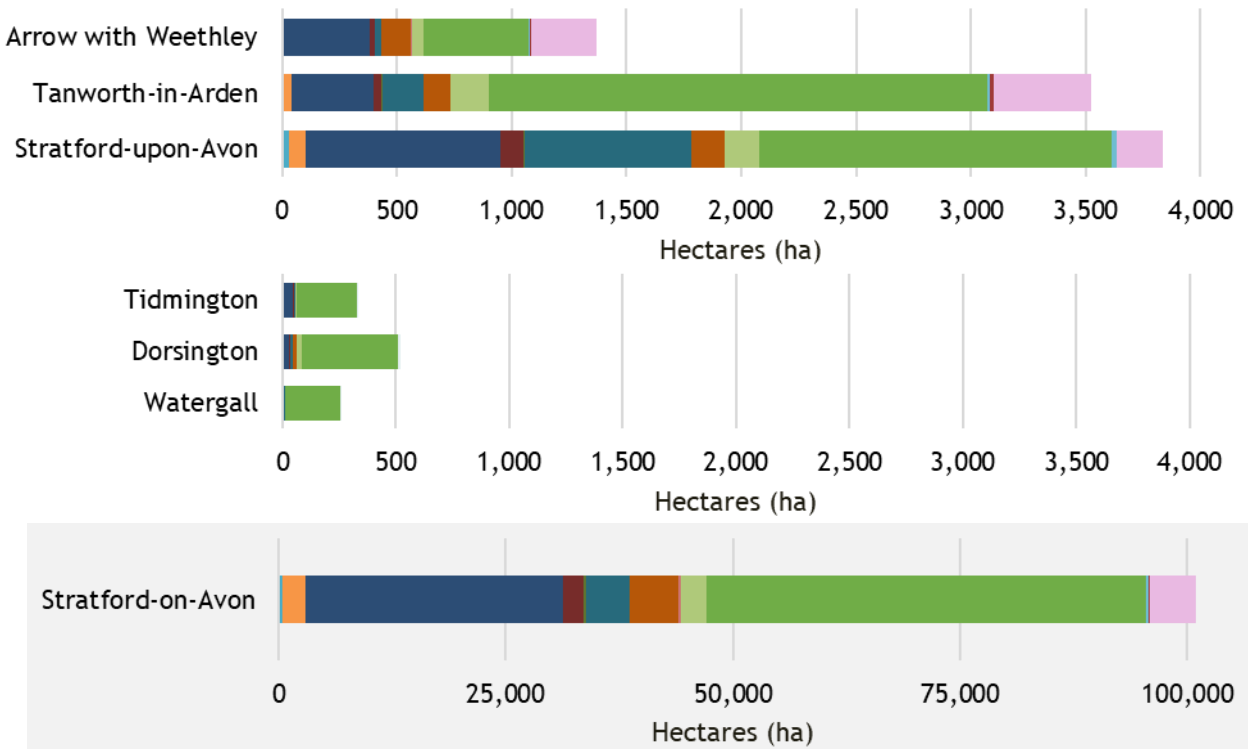


Figure 8: The first two stacked bar charts opposite show land use profiles from some of the district's 113 parishes.

The third stacked bar chart represents the land use profile for the whole of the Stratford-on-Avon district – scales have been aligned such that a rough comparison with the above parishes can be made.

3. LAND & RURAL EMISSIONS
CARBON STOCKS

Carbon is stored in several "pools" – systems that can absorb carbon for long periods of time. The key carbon pools on land are soil and above-ground biomass (trees, crops and other plants). The balance of total carbon between these pools depends on the type of land – woodland stores relatively more carbon in above-ground biomass (trees) than cropland or grassland, for example.

Quantifying carbon stocks

We can estimate the proportion of carbon stored within the natural environment in Stratford based on the land use analysis carried out on page 20. Understanding existing carbon stocks is important information when informing priority areas for action. The conservation of existing natural features significantly impacts the security of carbon stocks being kept within the natural environment, as opposed to the local atmosphere. Higher carbon stocks can be encouraged with transitions towards habitats with higher potential for carbon sequestration. Table 5 identifies the current carbon stocks within Stratford, however in order to support offsetting these carbon stocks need to increase.

How much carbon is sequestered into Stratford's trees?

UK woodlands act as a whole as a net carbon sink, storing an average of 5.5 tCO_2 per hectare per year for existing woodland. Around 1.3 tonnes are stored in the soil, 2.9 tonnes in trees, and 1.3 tonnes in dead wood and leaf litter. Applying this national average to the total area of forestry in Stratford would give an estimated net storage of 27,900tCO_2 per year, compared to the reported figure of 26,683tCO_2. Further data on local tree stocks is needed to better estimate the contribution of current forestry to net emissions, though these figures do indicate the range and scale of the sequestration potential of current tree stocks.

Table 5: Carbon stocks by land-use type. Adapted from Natural England, 2012 and Open University 2018. Carbon in soils to 100cm is extrapolated from 15cm using ratios calculated from Natural England 2012.

Habitat	Carbon stocks (tC/ha)				tCO_2 /ha
	Soils (15cm)	Vegetation	Soils (100 cm)	Vegetation & Soils (100 cm)	Vegetation & Soils (100 cm)
Coniferous woodland	90	70	185	255	935
Broad leaf, mixed woodland	73	70	150	220	808
Neutral grassland	69	1	170	171	628
Improved grasslands	67	1	116	117	431
Arable & horticulture	47	1	95	96	351

The table above describes different quantities of carbon that are stored in various habitats and natural features, including soil to a depth of 15cm and 100cm. These figures are given in units of *tonnes of carbon per hectare* (tC/ha). Habitats with more trees and vegetation lend themselves to having higher carbon storage potential, as can be seen in the cases of coniferous woodland & broadleaf woodland. The final column of this table describes the equivalent weight of *carbon dioxide* that is held within the natural environment, highlighting the significant sequestration potential for wooded areas.

3. LAND & RURAL EMISSIONS
SOIL CARBON

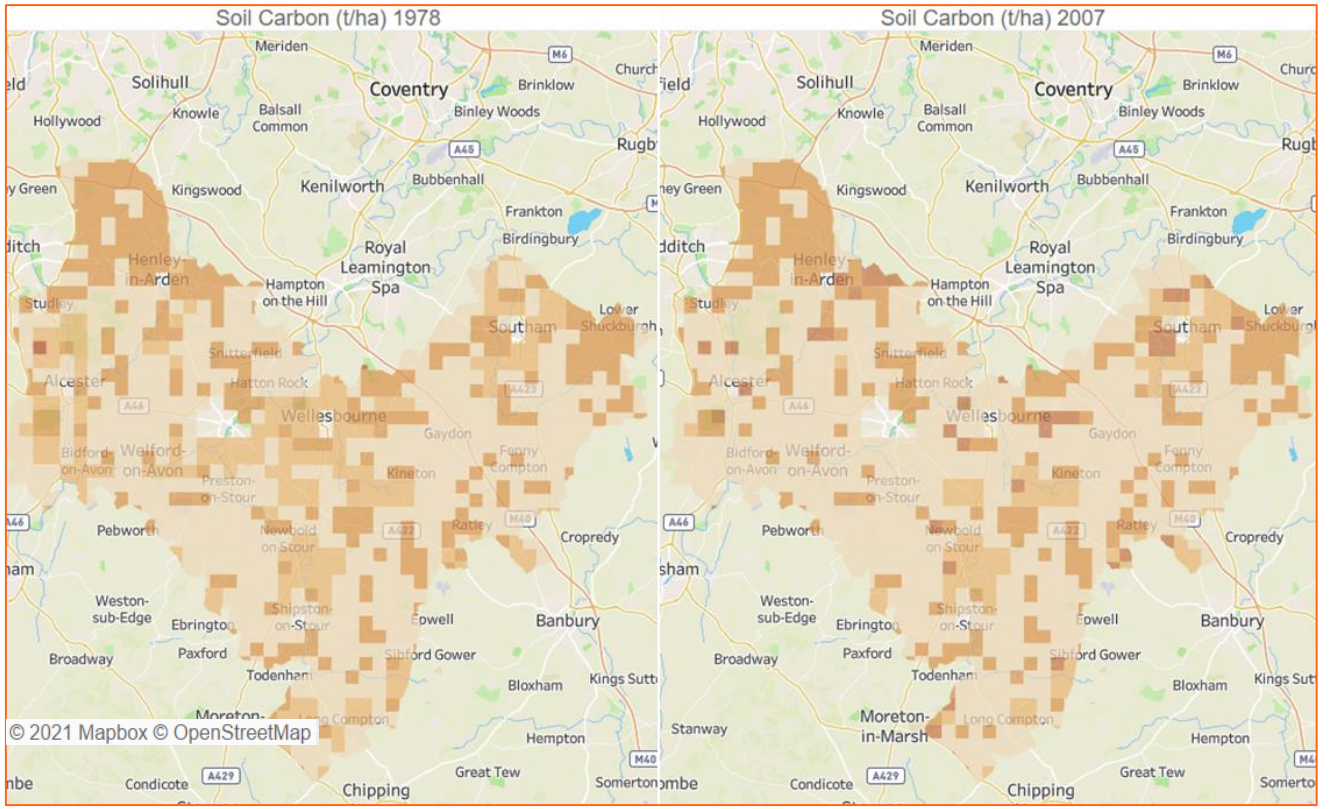


Figure 9: Estimated soil carbon stocks to 15cm based on land-cover type (land-use) and soil characteristics. Source: Countryside Surveys 2007 and 1978. The map is lower-resolution than the CROME and the underlying land-uses in this map do not correspond to those in CROME in all cases.

Carbon stocks above ground

Using the values for vegetation in Table 5 and applying them to the broad land-types within the Crop Map of England gives an estimated 186 kilotonnes of carbon (681 $ktCO_2$) stored in vegetation and natural features above ground.

Just under half of all stored carbon is within the district's woodland (49%), with smaller contributions from arable land (38%) & grassland (13%).

Carbon stocks within soil

Figure 9 (opposite) describes estimates for stored carbon within soils to a depth of 15cm, based on 1978 and 2007 datasets. Differences between the two maps demonstrate how changes to land use can impact the quantity of carbon stored in the natural environment. Areas with higher carbon stocks typically correspond with areas designated within the Countryside Surveys as improved grassland (as carbon stocks are estimated using this designation). Values for the carbon storage potential for different land use types and soils are broadly aligned with the figures given in Table 5.

A total of 5,100 kilotonnes of carbon is estimated to be held within Stratford's soils to a depth of 15cm. This is equivalent to 11,100$ktCO_2$ stored within Stratford's soils. Extrapolating these data to a depth of 100cm, estimates for stored carbon grow to 18,700 kilotonnes of carbon, equivalent to 40,600 $ktCO_2$.

3. LAND & RURAL EMISSIONS
EMISSIONS REDUCTION SCENARIOS

The UK Committee on Climate Change (CCC) provides several scenarios for how changes in land use and agriculture can contribute towards the UK's emissions reductions targets. A version of these scenarios has been considered for Stratford in order to estimate the impact of given changes on the district's agricultural and land use emissions. The model presents a business-as-usual, medium (adoption of currently-available measures) and high (more radical and novel measures). Medium- and high-ambition scenarios have been modelled here.

The CCC's report on land use provides further details on suggested policies for a net-zero UK.

Dietary change

The first scenario considers changes to public diet, specifically a reduction in the consumption of red meat in favour of white meat and vegetable protein alternatives. This is modelled as an outright reduction in the size of local numbers of cows and sheep (20% under medium ambition, 50% under high). The reduced consumption of red meat is coupled to an increase in the numbers of pigs and chickens (20% increase under both scenarios) as well as a slight increase in the land used for crops. Reductions in grassland coverage and associated fertiliser applications due to the change in livestock profile are also applied.

This scenario has significant implications for Stratford's livestock emissions, given that currently 90% of these are made up of contributions from sheep and cattle. Reduced demand for grazing grassland is projected to free up around 10,900 and 27,300 hectares under the medium and high scenarios.

Transitioning from grassland to woodland

The second part of the scenario modelling makes use of the vacated grassland freed up by changes to livestock farming practices i.e. the dietary change measure. In this scenario, 50% of the vacated grassland is assumed to be replaced by woodland up to 2050. A mixture of native broadleaved and conifer woodlands is modelled in line with the CCC's forest management plan.

The carbon storage potential of woodland is variable on many specific local factors, including the underlying soil type and suitability of the land for providing connected habitats for biodiversity promotion. Grassland is assumed to be planted with trees at a constant rate to the year 2050, equivalent to an additional woodland area of 5,400 hectares (medium) and 13,600 hectares (high). This transition from grassland to woodland would more than double the existing area of woodland within Stratford under the medium scenario.

Greenhouse gas emissions

Figure 10 (overleaf) shows the impact on ALU emissions as a result of the modelled changes to Stratford's livestock profile and land use.

The reduction in carbon-intensive livestock numbers brings with it significant changes locally to livestock emissions; a 17% drop along the medium scenario, climbing to 44% along the high ambition scenario. The percentage drop here represents a reduction in emissions from livestock & fertiliser usage. However, the transition from grassland to woodland brings the most significant potential for emissions mitigation through increased levels of carbon sequestration.

3. LAND & RURAL EMISSIONS
EMISSIONS REDUCTION SCENARIOS

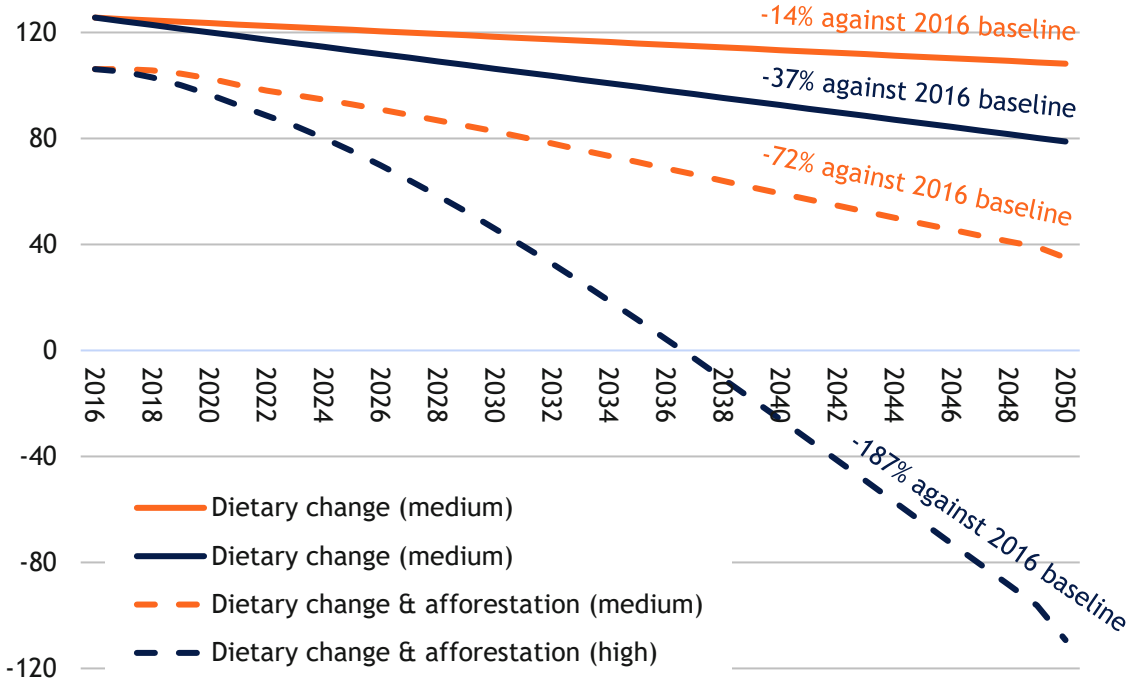


Figure 10: Emissions reductions according to CCC scenarios for dietary change and afforestation. Orange lines relate to the medium ambition scenario, whilst navy lines indicate high ambition. The dashed lines represent the additional impact on emissions of afforestation on 50% of vacated grassland. For a full methodology note describing this graph, please see Appendix 7.

"2016 baseline" refers to emissions from livestock and grassland/cropland land use. The dashed and solid lines have slightly different starting points since dashed lines consider the effects of the sequestration from existing forest.

Additional co-benefits

Reducing carbon emissions to avoid the worst impacts of climate change is complementary to many other objectives, with a number of co-benefits associated with reducing emissions in the natural environment specifically. Stratford-on-Avon's landowners and local agricultural economy have high potential to drive a transition towards low-carbon farming practices.

Deciding where and how to make emissions reductions is a challenging process. Action which cuts emissions from the agricultural sector and the natural environment can deliver significant co-benefits locally within the district.

Natural co-benefits

- Flood management
- Improved animal welfare
- Maintained landscape, especially for protected land and nature reserves
- Enhanced biodiversity

Socio-economic co-benefits

- Future land stewardship offers by government
- Better collaboration as a community across the district

3. LAND & RURAL EMISSIONS
CONCLUSIONS

Case studies

Protecting soil carbon

- Construction Code of Practice for the Sustainable Use of Soils on Construction Sites (2009)
- Safeguarding our Soils – A Strategy for England (2009)

Land use strategies

Land Quality Strategy for Oxford (Oxford City Council, 2014)
Key aims:

- Address land contamination/ remediation planning & control;
- Promote sustainable land remediation practices;
- Promote landowner compliance;
- Develop a land quality database in the Oxford area.

Southampton Land Quality Strategy (Southampton City Council, 2018-2023)
Key aims:

- Ensure legal compliance of government guidance on land contamination;
- Provide support for council land acquisitions and/or development sites;
- Provide information to the public and developers;
- Promote redevelopment of local brownfield sites.

Recommendations for next steps

This analysis has provided an estimate for the scale and nature of emissions from agricultural activities and the natural environment within Stratford. The high-level analysis for emissions reductions scenarios also provides some indication of the potential for encouraging agricultural activities towards lower-carbon alternatives.

Following this research, Stratford are encouraged to consider the following next steps:

1. Identify key partners in the agricultural sector within Stratford with a view to improving their understanding of agriculture within the local net zero targets.
2. Ensure that any adoption of low-carbon farming practices also protects the livelihood of local agricultural workers i.e. ensure the transition to a low-carbon sector protects jobs and livelihoods.
3. Develop natural environment considerations into the South Warwickshire Local Plan, in terms of afforestation or protection of soil carbon.
4. Prioritise the conservation of existing trees and natural features, as well as identifying potential sites for afforestation.
5. Build understanding of the importance of soils and the natural environment in mitigating carbon emissions (see suggestions from the Soil Association in this area).

04 Carbon Budgets

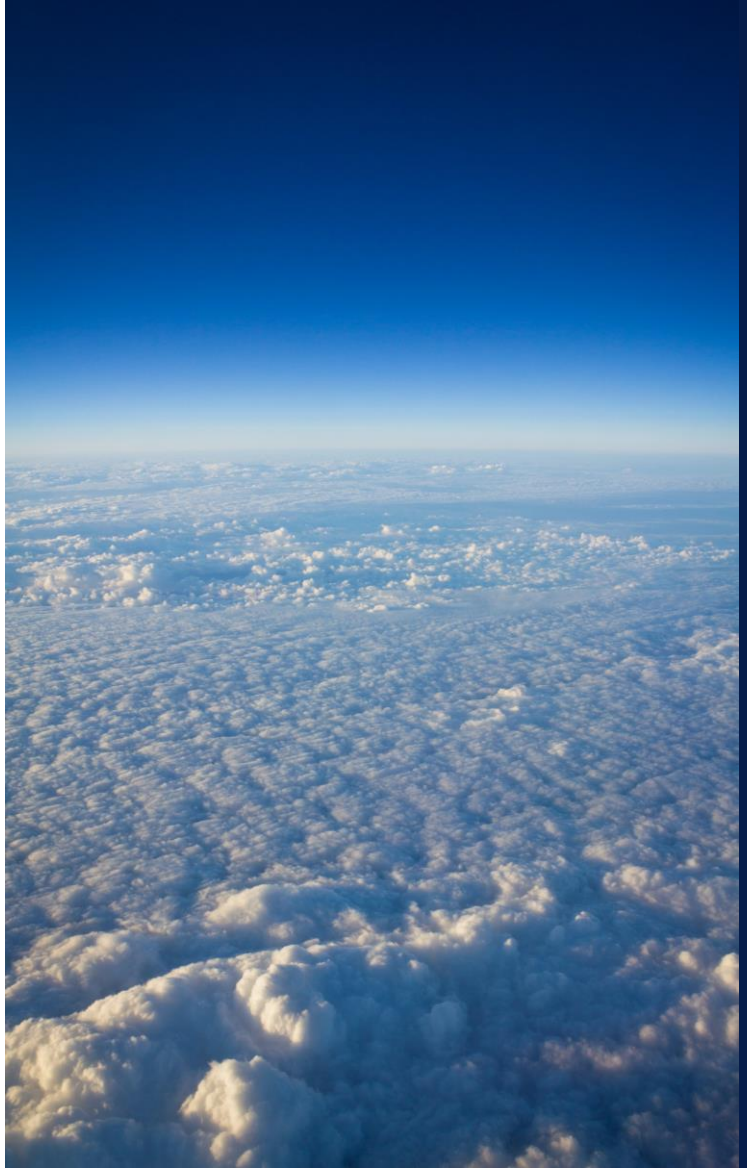
4. CARBON BUDGETS
INTRODUCTION

The current emissions profile offers the baseline from which to measure progress towards carbon neutrality by 2030.

Also important is the fact that once emitted, greenhouse gases such as CO_2 and N_2O can remain in the atmosphere for extended periods of time – up to hundreds of years. This means it is crucial to consider Warwick and Stratford-on-Avon's *cumulative* year-on-year emissions.

The Paris Agreement aims of remaining *"…well below 2°C"* of warming dictate an upper limit of greenhouse gas emissions that are allowed.

We can join these ideas together in the form of a *carbon budget* which guides a trajectory for emissions reduction.



What is a carbon budget?

A carbon budget is a fixed limit of cumulative emissions that are allowed over a given time in order to keep global temperatures within a certain threshold.

4. CARBON BUDGETS
CARBON BUDGET SCOPE

The Tyndall Centre for Climate Change Research, based at the University of Manchester, have translated the Paris Agreement targets of limiting temperature change below 2°C into a fixed emissions 'carbon budget' for each local authority. There are two key ideas underpinning their research:

The carbon budget is a fixed amount: A global emissions limit represents the total emissions allowed before the 1.5°C threshold for greenhouse gas concentration is crossed. This global "budget" can then be scaled down to a national level, and finally, a regional level. See Appendix 6 for more details on how the Tyndall Centre break down the global carbon budget.

Emissions now mean impacts later: The most crucial element of this approach is understanding the importance of cumulative carbon emissions. Once emitted, carbon dioxide remains in the atmosphere for many years, contributing to increasing the average global temperature. The carbon budget does not reset; it represents a fixed upper limit to emissions.

These two principles mean that the annual reduction rate of emissions becomes very important. Cumulative emissions and the scale & speed of action in the short-term are crucial in meeting the targets of the Paris Agreement.

Emissions covered by the carbon budget

The Tyndall Centre carbon budget has a different scope to the emission profiles within SCATTER. The Tyndall carbon budget does not include scope 3 emissions, given the complicated nature in calculating these emissions, whereas scope 3 emissions are included in Warwick and Stratford-on-Avon's pathway. The recommended Tyndall reduction rate can therefore be seen as indicative and highlights the scale and speed of change necessary to meet the Paris Agreement. For further information on the exclusions and reasoning behind these, see South Warwickshire's full Tyndall report.

- **This budget can be defined as energy-only** which means that the budget accounts for emissions from within Warwick and Stratford-on-Avon's energy system.
- **Land use, land use change and forestry** is held at a national level and is not scaled down to a regional level.
- **Only CO_2 emissions are assessed** and contributions from all other greenhouse gases, such as methane and nitrous oxide, are excluded.
- **Aviation and shipping emissions** are not attributed to individual authorities but instead accounted for at the UK level as a "national overhead". The Tyndall Centre analysis assumes that UK emissions from aviation remain constant up until 2030, followed by a steady reduction towards net zero carbon by 2075. Whilst emissions from aviation in 2020 have been significantly reduced, the extent of a potential "emissions rebound" post-COVID remains uncertain.

4. CARBON BUDGETS
DISTRICT-LEVEL CARBON BUDGET

Warwick's Carbon Budget

To demonstrate a carbon budget for Warwick District, the Tyndall Centre recommends an emissions reduction rate of 13.8% per year. This provides a pathway which keeps Warwick aligned with the Paris Agreement. Warwick's recommended carbon budget for the period 2020 to 2100 is 5,700 $ktCO_2$.

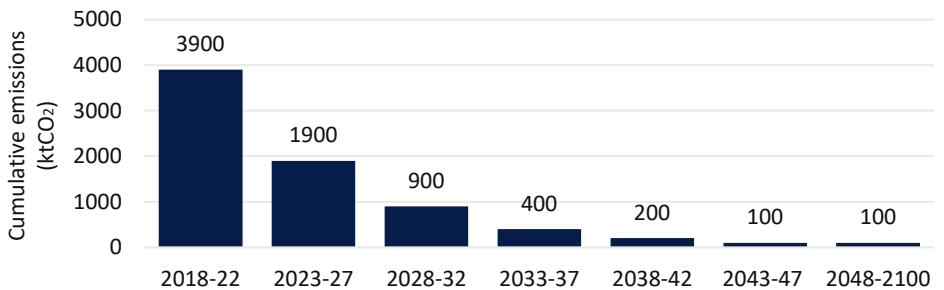


Figure 11: Warwick's carbon budget targets based on the recommended annual reduction rate. These have been broken down into the periods set out in government reporting frameworks.

Key Statistics for Warwick

Between 2005 and 2017, the average annual reduction rate was 2.4%. The challenge of achieving average annual reductions of 13.8% highlights the ambitious action required to meet the Paris Agreement targets.

At 2017 CO_2 emission levels, the entire carbon budget will be used up within 6 years from 2020.

By 2041, 5% of the budget remains provided Warwick achieves the recommended annual reduction rate.

Slight differences in scope mean that direct comparisons of the Tyndall carbon budget with the cumulative emissions from the SCATTER Pathways trajectories (detailed in Chapter 5) should be taken as estimate only.

Stratford-on-Avon's Carbon Budget

The Tyndall Centre recommend a 13.9% average annual reduction in emissions to keep Stratford-on-Avon within Paris Agreement targets. Stratford-on-Avon's recommended energy only CO_2 carbon budget for the period 2020 to 2100 is 6,200 $ktCO_2$.

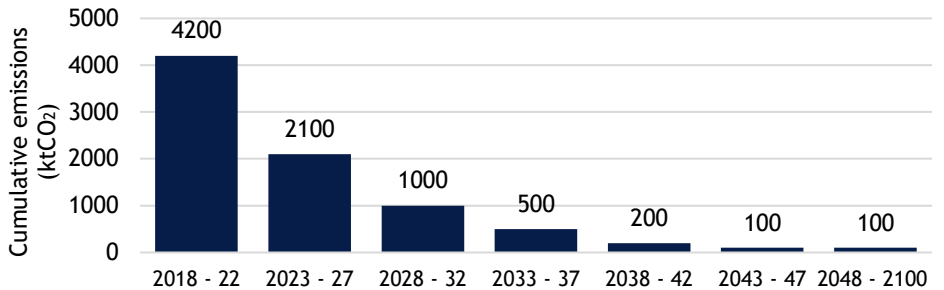


Figure 12: Warwick's carbon budget targets based on the recommended annual reduction rate. These have been broken down into the periods set out in government reporting frameworks.

Key Statistics for Stratford-on-Avon

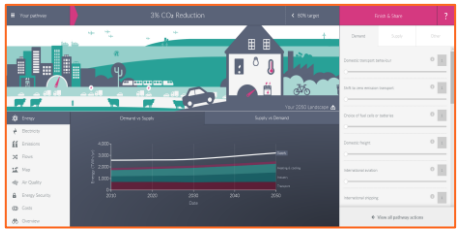
Between 2005 and 2017, the average annual reduction rate was 1.7%. The challenge of achieving average annual reductions of 13.9% highlights the ambitious action required to meet the Paris Agreement targets.

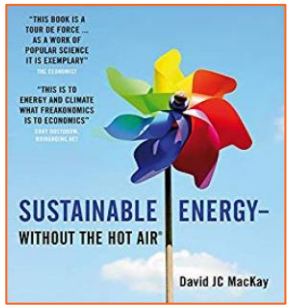
At 2017 CO_2 emission levels, the entire carbon budget will be used up within 6 years from 2020.

By 2040, 5% of the budget remains provided Stratford-on-Avon achieves the recommended annual reduction rate.

05 Emission Reduction Pathways

5. EMISSIONS REDUCTION PATHWAYS
SCATTER PATHWAYS INTRODUCTION





Above: the 2050 DECC calculator;
Right: MacKay's book

Whilst the Tyndall Centre's Paris-aligned pathway covers what the science says must be achieved, it is also useful to look at other tangible intervention-based pathways. Reviewing these pathways helps us to understand the impact of differing levels of action, or inaction, in relation to goals set, and in the context of macro-factors such as grid-decarbonisation and policy.

SCATTER Overview

As well as the inventory presented in Chapter 2, SCATTER also includes a Pathways model designed to help local authorities inform priorities for emissions reduction. It is intended to focus on the 'what' rather than the 'how'.

The pathways are based on a combination of 30+ interventions or carbon reduction measures which can be implemented to various extents. These modelled pathways are intended to act as 'lines in the sand' for Warwick and Stratford-on-Avon. They serve as an indication of whether the adoption of certain interventions can drive the transition to a low carbon economy and help to guide target-setting and key performance indicators. SCATTER pathways run up to 2050, though "checkpoint" interventions have been given for 2025 and 2030 to guide progress towards Warwick and Stratford-on-Avon's 2030 net-zero ambition.

SCATTER does not intend to prescribe certain technologies or policies, and similarly does not intend to discount other methods of arriving at the same outcome, just because they do not feature in the model.

Basic principles of SCATTER

Sir David MacKay's "Sustainable Energy - Without Hot Air (2009)" provides the basis for the pathways modelling. As a scientific advisor to the Department for Energy & Climate Change (DECC),[1] MacKay's work led to the development of the 2050 Pathways Calculator.

Two key modifications were made by Anthesis:

1) We scaled it down for sub-national regions: Scaling assumptions and localised data sets were built into the tool so that results were representative of cities and local authority regions, rather than the UK as a whole.

2) We pushed ambition further: Technologies within the tool were reviewed and updated where judged to be out of date and constraining ambition. Given that almost a decade had passed between MacKay's publication and the release of the 2050 Pathways tool, we sought the counsel of a technical panel to make these updates. The technical panel comprised subject matter experts from Arup, BEIS, Electricity North West, GMCA, The Business Growth Hub, The Energy Systems Catapult, The Tyndall Centre and Siemens.

Many other sector specific aspects of modelling treatment and assumptions have required consideration and interpretation as we have applied the model to various cities and local authorities.

Please be aware that SCATTER Pathways applies a calculated electricity factor based on renewable energy generated within the local boundary, which is not applied in the calculation of your area's inventory. This results in a slightly different starting point for SCATTER pathways compared to the baseline inventory.

[1] DECC responsibilities were reformed into BEIS in 2016

5. EMISSIONS REDUCTION PATHWAYS
WARWICK DISTRICT SCATTER PATHWAY

Key

SCATTER BAU Pathway: Assumes Warwick continues along current "business-as-usual" (BAU) trajectory in terms of nationally-led policy and behavior change. Reductions largely the result of continued grid decarbonisation.

SCATTER High Ambition Pathway: Assumes Warwick goes significantly beyond national policy and National Grid assumptions. It is the result of all interventions modelled by SCATTER at maximum ambition levels.

Paris-aligned Pathway: Based on the Tyndall Centre's recommended annual reduction rate of 13.8%. This is not based on tangible policy or implementation, but informs the action required to meet Paris Agreement targets.

Paris-aligned Reduction Rate: A representative annual reduction rate for Warwick based on research by the Tyndall Centre for Climate Change Research.

The graph below shows two possible future emissions pathways for Warwick as modelled by the SCATTER tool, compared against the Tyndall Centre's Paris-aligned recommended 13.8% annual reduction pathway.

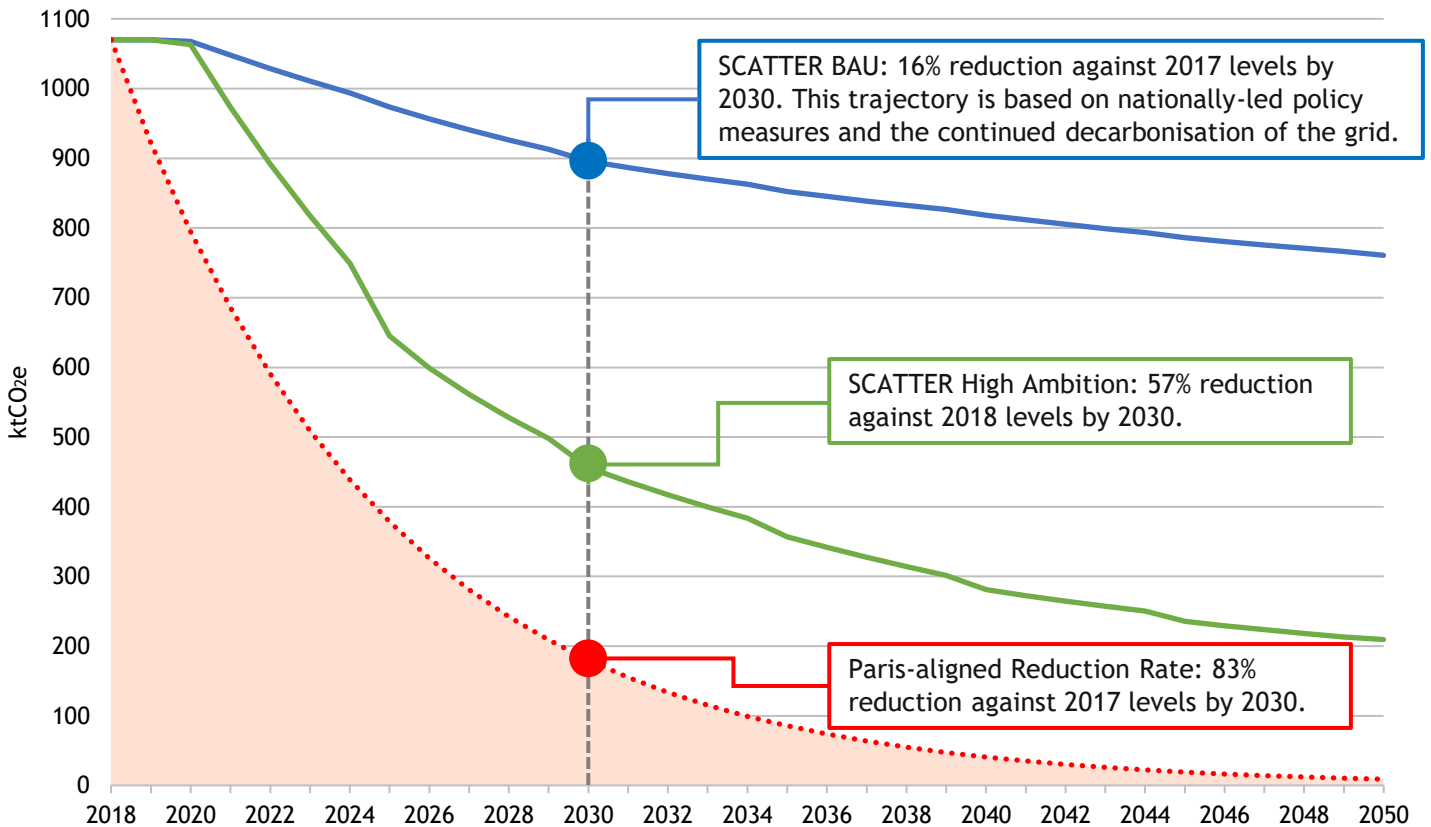


Figure 13: Future emissions pathways for Warwick District (2018-2050), with Warwick's 2030 net zero target highlighted.

5. EMISSIONS REDUCTION PATHWAYS
STRATFORD-ON-AVON DISTRICT SCATTER PATHWAY

Key

SCATTER BAU Pathway: Assumes Stratford-on-Avon continues along current "business-as-usual" (BAU) trajectory in terms of nationally-led policy and behavior change. Reductions largely the result of continued grid decarbonisation.

SCATTER High Ambition Pathway: Assumes Stratford-on-Avon goes significantly beyond national policy and National Grid assumptions. It is the result of all interventions modelled by SCATTER at maximum ambition levels.

Paris-aligned Pathway: Based on the Tyndall Centre's recommended annual reduction rate of 13.9%. This is not based on tangible policy or implementation, but informs the action required to meet Paris Agreement targets.

Paris-aligned Reduction Rate: A representative annual reduction rate for Stratford-on-Avon based on research by the Tyndall Centre for Climate Change Research.

The graph below shows two possible future emissions pathways for Stratford-on-Avon as modelled by the SCATTER tool, compared against the Tyndall Centre's Paris-aligned 13.9% annual reduction pathway.

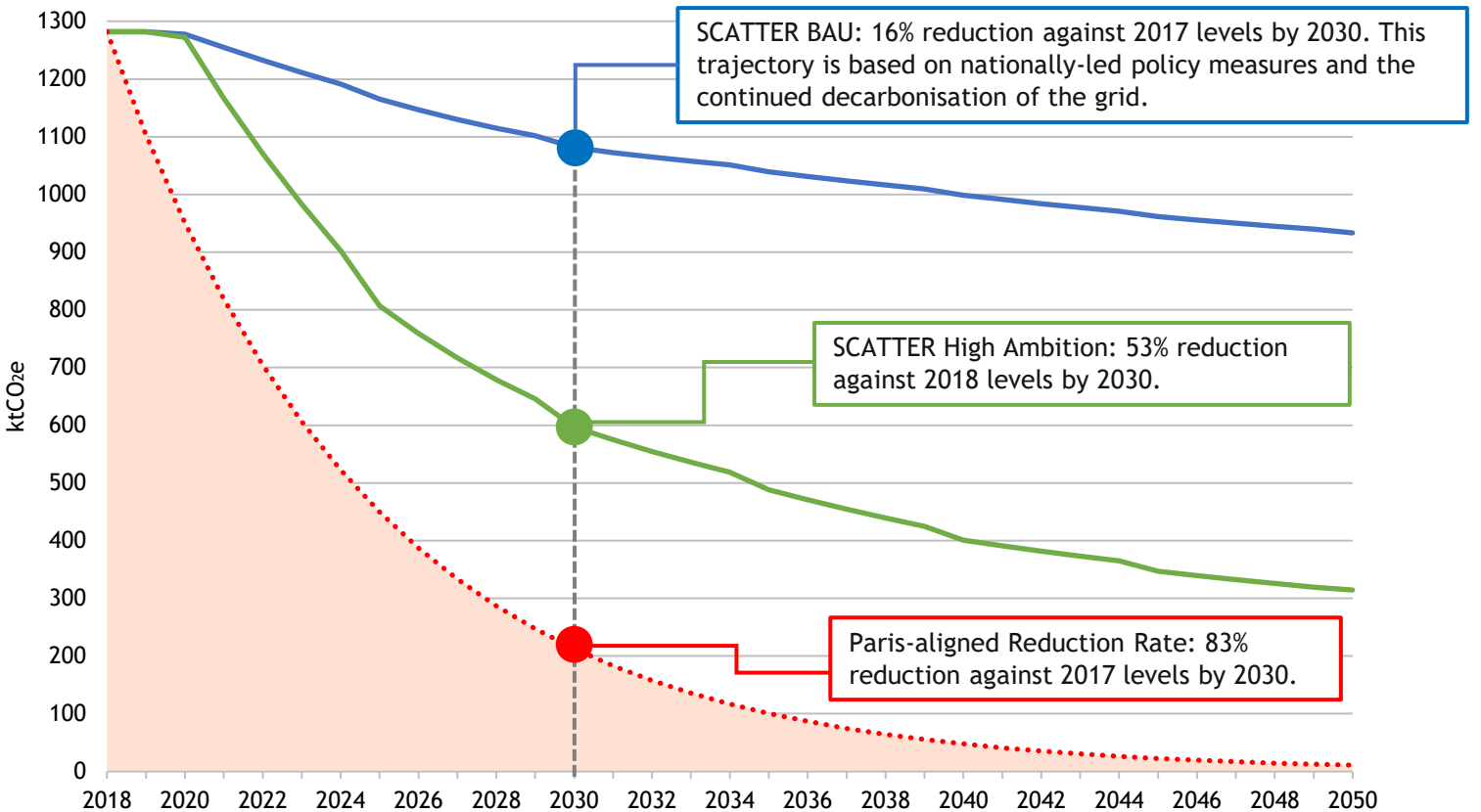


Figure 14: Future emissions pathways for Stratford-on-Avon District (2018-2050), with Stratford-on-Avon's 2030 net zero target highlighted.

5. EMISSIONS REDUCTION PATHWAYS
SOUTH WARWICKSHIRE SCATTER PATHWAY

Combining the SCATTER pathways for Warwick District and Stratford-on-Avon District result in a BAU, High Ambition and Tyndall Paris-aligned pathway for South Warwickshire shown in figure 15.

Adoption of the High Ambition Pathway interventions across both Districts delivers emissions reductions of 55% by 2030.

There is an emissions "gap" to zero at 2030 which persists even at the trajectory endpoint of 2050. This is due to residual emissions. More radical measures beyond the High Ambition Pathway for South Warwickshire will be needed to close this "gap". This is further detailed on page 39.

Key

- South Warwickshire BAU Pathway
- South Warwickshire High Ambition Pathway
- SCATTER Warwick High Ambition Pathway
- SCATTER Stratford-on-Avon High Ambition Pathway
- Paris-aligned Reduction Rate

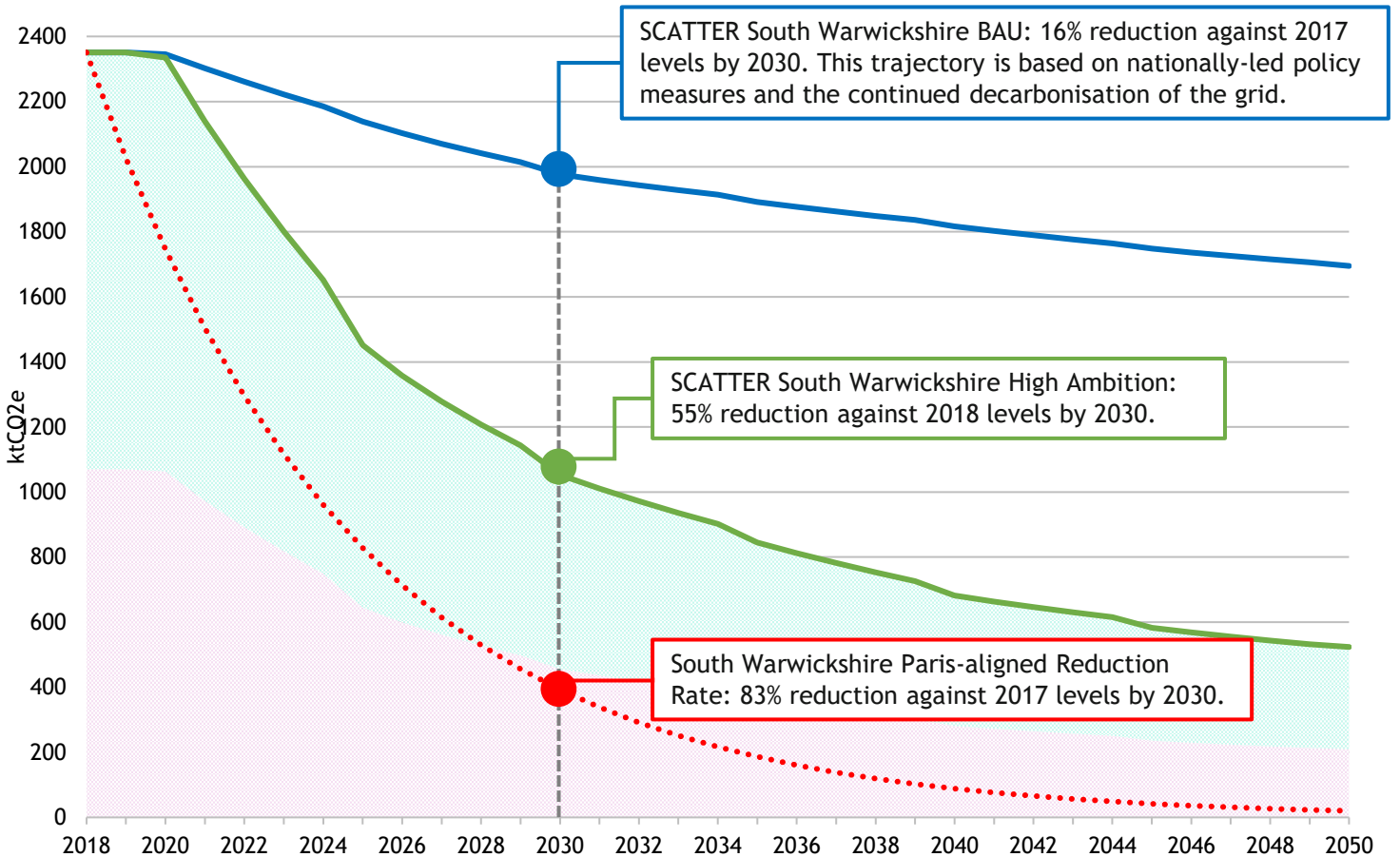


Figure 15: Future emissions pathways for South Warwickshire (2018-2050), with Stratford-on-Avon's high ambition pathway highlighted in teal and Warwick's high ambition pathway highlighted in purple.

5. EMISSIONS REDUCTION PATHWAYS
SOUTH WARWICKSHIRE HIGH AMBITION PATHWAY

Despite applying the most ambitious interventions in the SCATTER tool for South Warwickshire, emissions remain in the energy system. Along South Warwickshire's High Ambition Pathway, **1052.8 ktCO$_2$e** remain in the energy system in 2030 and **524 ktCO$_2$e** remain in the energy system in 2050.

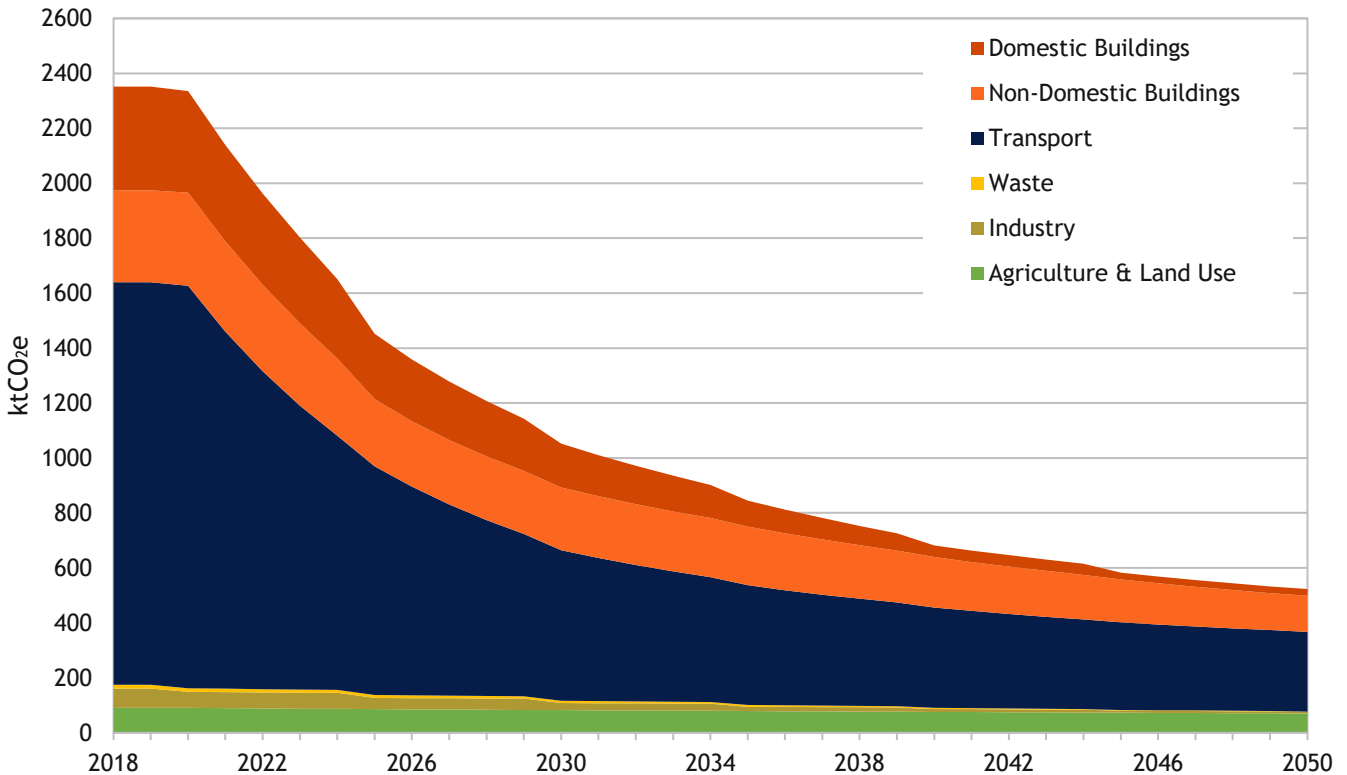


Figure 16: SCATTER High Ambition Pathway for South Warwickshire, broken down by sector. Shaded areas correspond to residual emissions.

Aggressive and urgent emissions reduction interventions are demanded by the High Ambition Pathway.
The scale of the actions necessary to reduce emissions by 55% in 2030 requires radical step changes across almost every area of activity across South Warwickshire. Chapter 6 of this report defines these interventions. They can be thought of as falling into two groups; interventions focused on reducing energy *demand*, and interventions focused on decarbonising energy *supply*. However, with increased electrification of cars, and building systems etc., future electricity demand is likely to rise. This modelling follows electrification assumptions from the UK's Future Energy Scenarios.

Adoption of the High Ambition Pathway still does not achieve South Warwickshire's target of carbon neutrality by 2030. Despite applying the most ambitious interventions in the SCATTER tool, 524 ktCO$_2$e emissions still remain in the energy system in 2050. Discussions around closing this "gap to target" can be found on page 39.

5. EMISSIONS REDUCTION PATHWAYS
DISTRICT-LEVEL HIGH AMBITION PATHWAY

By 2030, the emissions profiles for both District's are predicted to look quite different from the baseline profiles. If both Districts follow the High Ambition Pathway, at 2030 it is estimated that Warwick District will have **456.1 ktCO$_2$e** of emissions remaining in the energy system and Stratford-on-Avon will have **596.7 ktCO$_2$e** emissions remaining in the energy system.

Warwick District

Along the High Ambition Pathway, by 2030 Warwick's net total emissions are estimated to have fallen by **57%.** By sector, it is estimated that emissions from industry will fall by 63%, transport will fall by 62%, domestic buildings 58%, waste 41%, non-domestic buildings 38% and agriculture & land use 17%.

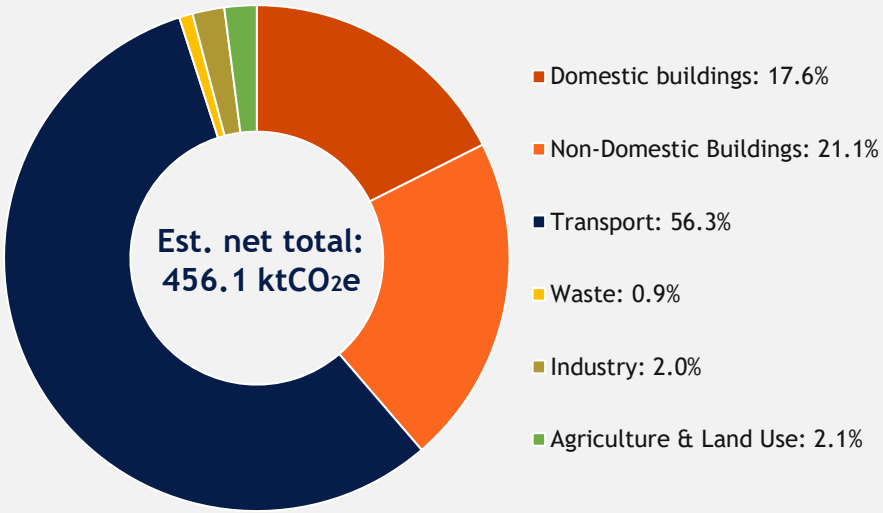


Figure 17: The estimated 2030 emissions profile for Warwick District following the High Ambition Pathway.

Stratford-on-Avon District

Along the High Ambition Pathway, total net emissions in Stratford-on-Avon are estimated to fall by **53%.** By sector, emissions from industry and transport are estimated to have reduced by 63%, domestic buildings 57%, waste 41%, non-domestic buildings 27% and agriculture & land use 8%.

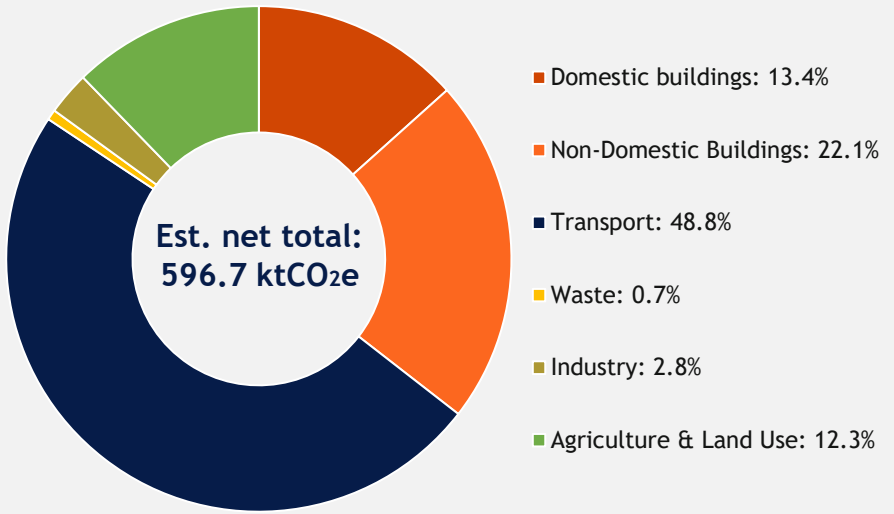


Figure 18: The estimated 2030 emissions profile for Stratford-on-Avon District following the High Ambition Pathway.

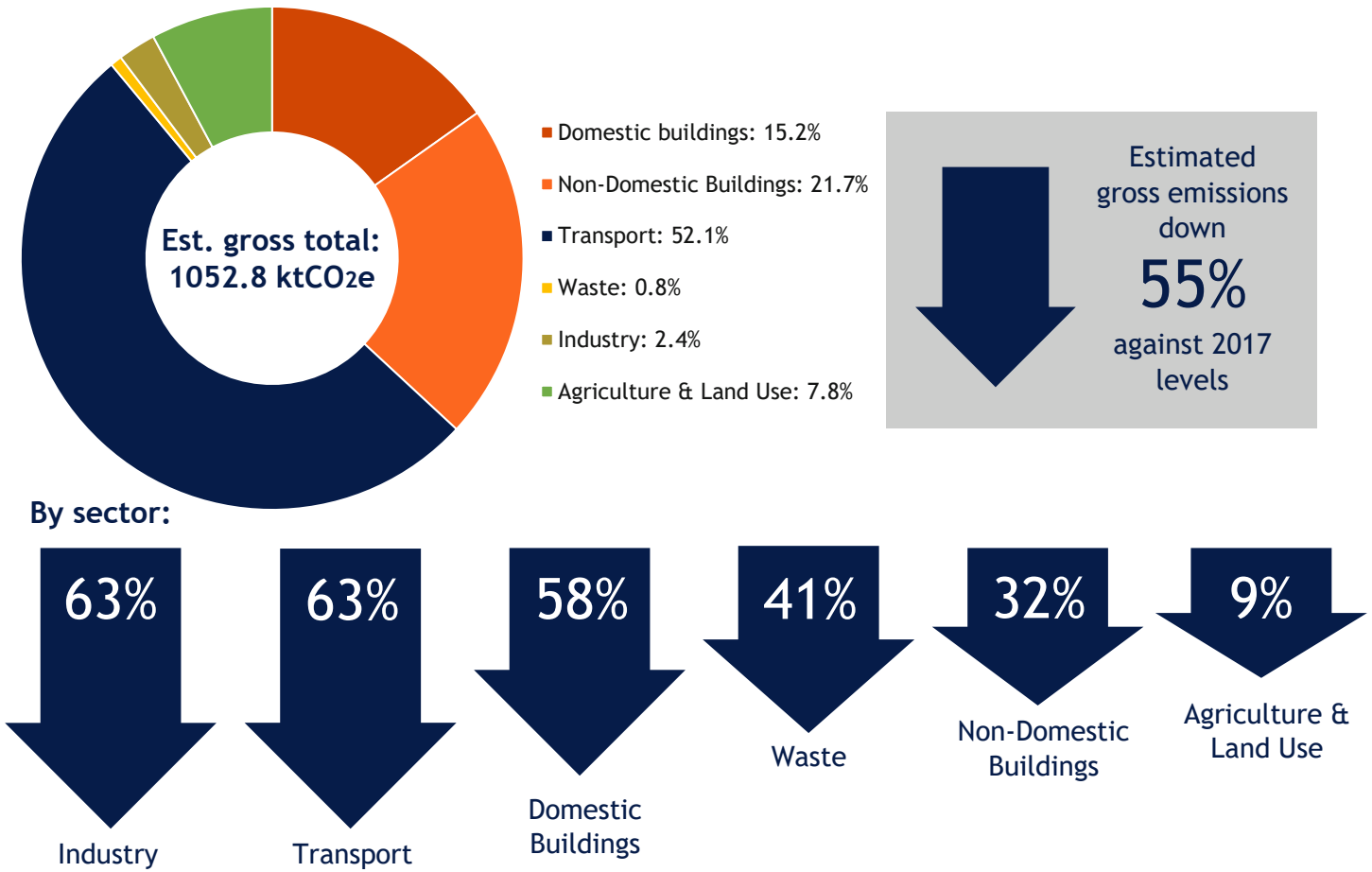
5. EMISSIONS REDUCTION PATHWAYS
SOUTH WARWICKSHIRE HIGH AMBITION PATHWAY 2030 SUMMARY

By 2030, the emissions profile for South Warwickshire is predicted to look very different from today.

Concerted local actions can have a significant effect on district emissions, resulting in reductions from the 2017 baseline of around **55%.** Transport emissions dominate the 2030 profile whilst reductions in building energy consumption have shown significant decreases in the sector's emissions.

Despite the aggressive actions described in the next chapter, hard-to-remove emissions in industry and freight transport persist. Whilst emissions from the domestic buildings and waste sectors are substantially reduced, the scale of improvement is not enough to reach net zero by 2030. Further ambition and a variety of additional technological and nature-based solutions will need to be considered to close this gap. These are explored on the next page.

Figure 19: Estimated 2030 emissions profile (top). Emissions reductions in key sectors under the High Ambition Pathway (bottom).



5. EMISSIONS REDUCTION PATHWAYS
GAP TO TARGET

How can we go beyond High Ambition?

Despite the successful implementation of the Chapter 6 interventions, some emissions remain. Defining the scale and nature of the gap to target is an important process to meeting reduction targets and goals. Even along the High Ambition Pathway, South Warwickshire is left with an emissions gap of **1052.8 ktCO2e** to meet the net zero 2030 target and a gap of **659.8 ktCO2e** to meet the Paris Agreement-aligned target.

Tackling these residual emissions can be challenging and requires South Warwickshire to embrace more radical measures in some areas.

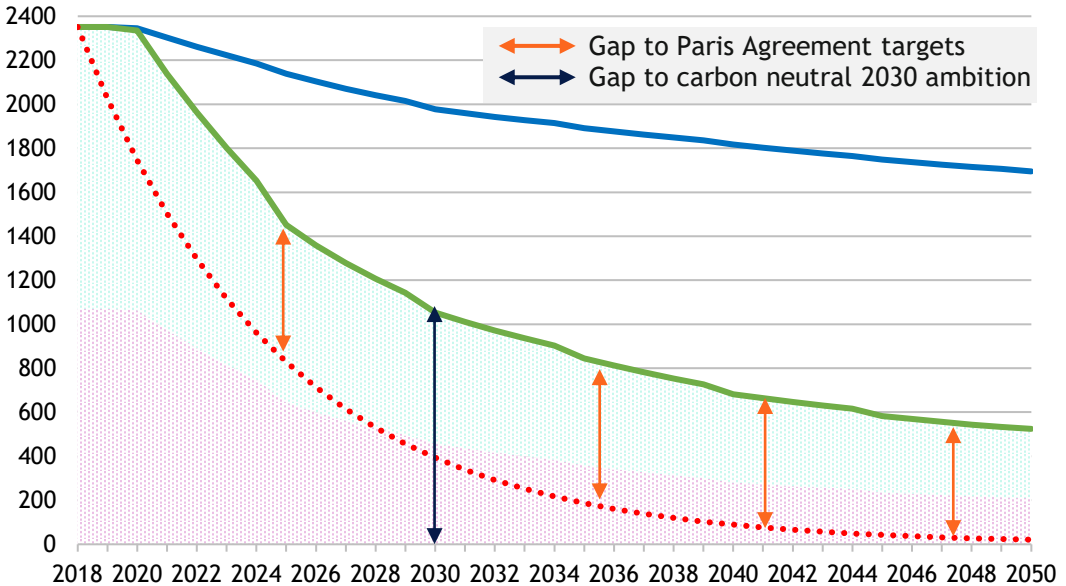


Figure 20: SCATTER Pathways, with indicators given for the gap to target.

Closing the gap

Technological innovation & marginal improvements: Improvements to technology such as solar PV has moved forward at an unpredictably rapid rate in the past twenty years. Technological efficiency improvements in different areas may dramatically improve the feasibility for emissions reduction in different sectors. However, no "silver bullet" transformational technology should be relied upon or anticipated.

Accelerated & increased deployment: Both Districts may consider action 'above and beyond' SCATTER interventions outlined in this report. For example, rather than a deep retrofit of 80% of homes as per SCATTER, stakeholders may aim for a deep retrofit of 90% of homes. Both District's may also seek to meet 2030 ambitions for implementation at an earlier date in order to accelerate emissions reductions. It is important to approach this with an understanding of the challenge associated with reaching the maximum ambition level presented in SCATTER, and the dependency on such developments.

Offsetting & insetting: This approach would emphasise nature-based solutions such as tree planting and the restoration of other ecosystems. Other nascent technologies such as carbon capture and storage (CCS) and negative emissions technologies (NETs) may also be considered.

06 Emission Reduction Interventions

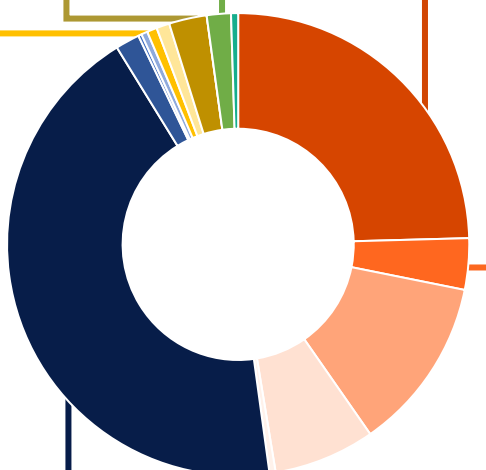
6. EMISSIONS REDUCTION INTERVENTIONS
SCATTER INTERVENTIONS

The interventions that will be assessed will initially be taken from the measures considered in the SCATTER pathways tool (summarised opposite). Activity in each of these areas underpins the pathways' trajectories.

Measures have been grouped into different sectors, which also link directly to the sectors described within the annual emissions profile.

Each group of measures has some sort of activity focused on *demand-side* reductions, switching to electrified systems, or greening energy *supply*.

The SCATTER measures are not exhaustive, but help to define "*what needs to happen*" rather than answering the question of "*how will Warwick and Stratford-on-Avon get there?*".



Natural Environment
- Increased tree coverage
- Land management
- Livestock management

Industrial Processes
- More efficient processes
- Shifting off oil fuels

Domestic Buildings
- Shifting off gas heating systems
- Appliance and lighting efficiency
- Shifting from gas to electric for cooking
- More energy efficient homes and new-builds

Waste
- Producing less waste
- Increased recycling rates

Non-domestic Buildings
- More energy efficient heating
- Shifting off gas heating systems
- Appliance and lighting efficiency
- Shifting from gas to electric for cooking

Transport
- Travelling shorter distances
- Driving less
- Switching to electric vehicles
- Improving freight emissions
- International aviation

Energy Supply
- Increase in wind
- Increased solar photovoltaics
- Increase in other renewables, including wave, tidal, hydro etc

6. EMISSIONS REDUCTION INTERVENTIONS
SUMMARY OF INTERVENTIONS

The following tables describe the scale of each interventions required to realise the emissions reductions shown in the High Ambition Pathway (green line, figure 14) for Warwick and Stratford-on-Avon. The purpose of this analysis is to understand the scale and speed of change needed to meet the High Ambition Pathway.

Sector	Measure	By 2025	By 2030	By 2050
Domestic Buildings	More energy efficient homes & new builds	Warwick: • 1,400 households "medium" retrofit • 11,500 households "deep" retrofit • 2,000 new houses built to Passivhaus standards Stratford-on-Avon: • 1,300 households "medium" retrofit • 2,100 households "deep" retrofit • 2,500 new houses built to Passivhaus standards	Warwick: • 2,300 households "medium" retrofit • 18,000 households "deep" retrofit • 3,500 new houses built to Passivhaus standards Stratford-on-Avon: • 2,100 households "medium" retrofit • 17,000 households "deep" retrofit • 3,900 new houses built to Passivhaus standards	Warwick: • 6,000 households "medium" retrofit • 47,600 households "deep" retrofit • 6,800 new houses built to Passivhaus standards Stratford-on-Avon: • 5,400 households "medium" retrofit • 43,200 households "deep" retrofit • 6,500 new houses built to Passivhaus standards
Domestic & Non-Domestic Buildings	Improved energy efficiency	• 15% domestic reduction • 12% non-domestic reduction	• 21% domestic reduction • 17% non-domestic reduction	• 43% domestic reduction • 40% non-domestic reduction
Domestic & Non-Domestic Buildings	Shifting from high carbon gas heating systems	• 34% of domestic heating systems are low-carbon or electric • 28% of non-domestic heating systems are low-carbon or electric	• 47% of domestic heating systems are low-carbon or electric • 39% of non-domestic heating systems are low-carbon or electric	• 100% of domestic heating systems are low-carbon or electric • 80% of non-domestic heating systems are low-carbon or electric

6. EMISSIONS REDUCTION INTERVENTIONS
SUMMARY OF INTERVENTIONS CONTINUED

Sector	Measure	By 2025	By 2030	By 2050
Domestic & Non-Domestic Buildings	Shifting to low carbon and energy efficient cooking and lighting systems	• 21% reduction in domestic energy demand for appliances, lighting and cooking • 15% increase in domestic electric fuel use for cooking • 7% reduction in non-domestic energy demand for appliances, lighting and cooking • 5% increase in non-domestic electric fuel use for cooking	• 31% reduction in domestic energy demand for appliances, lighting and cooking • 29% increase in domestic electric fuel use for cooking • 11% reduction in non-domestic energy demand for appliances, lighting and cooking • 10% increase in non-domestic electric fuel use for cooking	• 73% reduction in domestic energy demand for appliances, lighting and cooking • 84% increase in domestic electric fuel use for cooking • 25% reduction in non-domestic energy demand for appliances, lighting and cooking • 33% increase in non-domestic electric fuel use for cooking
Transport	Travelling shorter distances	• 17% reduction in total distance travelled per person	• 25% reduction in total distance travelled per person	• 25% reduction in total distance travelled per person
Transport	Driving less	• 3% reduction in road transport use • 9% increase in rail transport	• 6% reduction in road transport use • 17% increase in rail transport	• 19% reduction in road transport use • 50% increase in rail transport
Transport	Switching to electric vehicles	• 63% of cars are EV or HEV • 87% of buses and trains are electric	• 89% of cars are EV or HEV • 100 of buses and trains are electric	• 100% of cars are EV or HEV • 100% of buses and trains are electric
Transport	Improving freight emissions	• 6% reduction in road freight mileage • 47% reduction in energy used per mile travelled	• 9% reduction in road freight mileage • 71% reduction in energy used per mile travelled	• 22% reduction in road freight mileage • 75% reduction in energy used per mile travelled

6. EMISSIONS REDUCTION INTERVENTIONS
SUMMARY OF INTERVENTIONS CONTINUED

Sector	Measure	By 2025	By 2030	By 2050
Waste	Producing less waste	• 17% reduction in the volume of waste	• 24% reduction in the volume of waste	• 57% reduction in the volume of waste
Waste	Increased recycling rates	• 29% increase in recycling rates	• 50% increase in recycling rates	• 137% increase in recycling rates
Industry	Shifting from fossil fuels	• 3% increase in oil fuel usage • 3% increase in electricity consumption • 3% increase in natural gas usage	• 14% reduction in oil fuel usage • 3% increase in electricity consumption • 10% increase in natural gas usage	• 15% reduction in oil fuel usage • 2% increase in electricity consumption • 38% increase in natural gas usage
Industry	More efficient processes	Process emissions reduced: • 10% for chemicals • 6% for metals • 8% for minerals • 37% other industries	Process emissions reduced: • 14% for chemicals • 10% for metals • 11% for minerals • 50% other industries	Process emissions reduced: • 30% for chemicals • 21% for metals • 25% for minerals • 80% other industries

6. EMISSIONS REDUCTION INTERVENTIONS
SUMMARY OF INTERVENTIONS CONTINUED

Sector	Measure	By 2025	By 2030	By 2050
Renewable energy supply	Solar PV	Warwick: • Local PV: 95.9 MW installed capacity • Large-scale PV: 6 MW installed capacity Stratford-on-Avon: • Local PV: 86.4MW installed capacity • Large-scale PV: 6.1MW installed capacity	Warwick: • Local PV: 165.9 MW installed capacity • Large-scale PV: 10.5 MW installed capacity Stratford-on-Avon: • Local PV: 149.5MW installed capacity • Large-scale PV: 10.5MW installed capacity	Warwick: • Local PV: 343.7 MW installed capacity • Large-scale PV: 22.3 MW installed capacity Stratford-on-Avon: • Local PV: 309.7MW installed capacity • Large-scale PV: 22.3MW installed capacity
Renewable energy supply	Wind	Warwick: • Local: 29MW installed capacity • Large offshore: 49.3MW installed capacity • Large onshore: 34.7MW installed capacity Stratford-on-Avon: • Local : 100.3MW installed capacity • Large-scale offshore: 49.4MW installed capacity • Large-scale onshore: 34.8MW installed capacity	Warwick: • Local: 35.9 MW installed capacity • Large offshore: 66.4 MW installed capacity • Large onshore: 43 MW installed capacity Stratford-on-Avon: • Local: 124.2MW installed capacity • Large-scale offshore: 66.5MW installed capacity • Large-scale onshore : 43MW installed capacity	Warwick: • Local: 41.5 MW installed capacity • Large offshore: 83.8 MW installed capacity • Large onshore: 51.5 MW installed capacity Stratford-on-Avon: • Local: 143.6MW installed capacity • Large offshore: 83.9MW installed capacity • Large onshore: 51.6MW installed capacity
Renewable energy supply	Other renewable technologies (solar thermal, anaerobic digestors etc.)	Warwick: • Local hydro: 3.1MW Stratford-on-Avon: • Local hydro: 11.2MW	Warwick: • Local hydro: 4.1MW Stratford-on-Avon: • Local hydro: 14.7MW	Warwick: • Local hydro: 5MW Stratford-on-Avon: • Local hydro: 17.9MW

6. EMISSIONS REDUCTION INTERVENTIONS
SUMMARY OF INTERVENTIONS CONTINUED

Sector	Measure	By 2025	By 2030	By 2050
Natural Environment	Forest coverage & tree planting	Warwick: • Tree planting outside of woodlands increases by 30% from 2017, equivalent to 2,600 hectares Stratford-on-Avon: • Tree planting outside of woodlands increases by 31% from 2017, equivalent to 6,700 hectares	Warwick: • 24% increase in forest coverage • Tree planting outside of woodlands increases by 30% from 2017, equivalent to 2,600 hectares Stratford-on-Avon: • 24% increase in forest coverage • Tree planting outside of woodlands increases by 31% from 2017, equivalent to 6,700 hectares	Warwick: • Tree planting outside of woodlands increases by 20% from 2017, equivalent to 2,400 hectares Stratford-on-Avon: • Tree planting outside of woodlands increases by 20% from 2017, equivalent to 6,100 hectares
Natural Environment	Land use management	• Maintaining existing green spaces	• 2% decrease in grassland and 5% increase in cropland to increase forestland and carbon sequestration potential • Maintaining existing green spaces	• Maintaining existing green spaces
Natural Environment	Livestock management	• 6% reduction in livestock numbers	• 12% reduction in livestock numbers	• 48% reduction in livestock numbers

6. EMISSIONS REDUCTION INTERVENTIONS
CUMULATIVE CARBON SAVINGS

The estimated cumulative carbon savings related to the interventions on pages 44-48 are listed below for the periods 2020-2030 and 2020-2050. In summary:

- Emissions savings are calculated relative to the BAU scenario within SCATTER.
- Carbon savings are underpinned by the provision of low-carbon electricity.
- The most significant measures for Warwick and Stratford for both time periods relate to improving building efficiency to reduce energy demand.
- Energy demand and supply savings should not be aggregated to avoid double counting, energy supply carbon savings are presented separately at the end of this table

Sector	SCATTER Intervention	Subsector	Cumulative Savings from 2020 ($ktCO_2e$)			
			Warwick Savings		Stratford-on-Avon Savings	
			2030	2050	2030	2050
Domestic	Improved building efficiency	Domestic space heating and hot water	526	3,919	518	3,848
Domestic	Improved lighting and appliance efficiency	Domestic lighting, appliances, and cooking	90	402	79	326
Non- Domestic	Improved building efficiency	Industrial buildings & facilities	103	754	91	860
Non- Domestic	Improved heating efficiency	Commercial space heating, cooling, and hot water	195	1,390	231	1,631
Non- Domestic	Shifting off gas heaters					
Non- Domestic	Improved lighting and appliance efficiency	Commercial lighting, appliances, equipment, and catering	95	497	81	443

Table 8: Cumulative carbon savings for Warwick and Stratford.

6. EMISSIONS REDUCTION INTERVENTIONS
CUMULATIVE CARBON SAVINGS

Sector	SCATTER Intervention	Subsector	Cumulative Savings from 2020 ($ktCO_2e$)			
			Warwick Savings		Stratford-on-Avon Savings	
			2030	2050	2030	2050
Waste	Reducing the quantity of waste	Solid waste disposal	4	55	4	55
Waste	Increased recycling rates					
Transport	Switching to electric vehicles	On-road	1,464	5,564	1,705	6,478
Transport	Travelling shorter distances					
Transport	Driving less					
Transport	Improving freight emissions					
Transport	International aviation and shipping	Aviation	12	58	11	51
Green Space	Other technologies	Agriculture	0	0	0	0
Green Space	Land Management	Land use and Livestock	14	118	52	436
Green Space	Increase woodland cover	Land use	7	65	17	146
Green Space	Tree planting outside woodlands					
Please note carbon savings for energy supply and demand interventions should not be aggregated						
Energy Supply	Local technologies	Renewable energy generation	1,037	7,082	1,051	7,319
Energy Supply	Large scale technologies					

See Appendix 8 for a detailed breakdown of the methodology used to calculate these cumulative carbon savings.

6.1 Non-Domestic Buildings

6.1 NON-DOMESTIC BUILDINGS
CURRENT CONTEXT

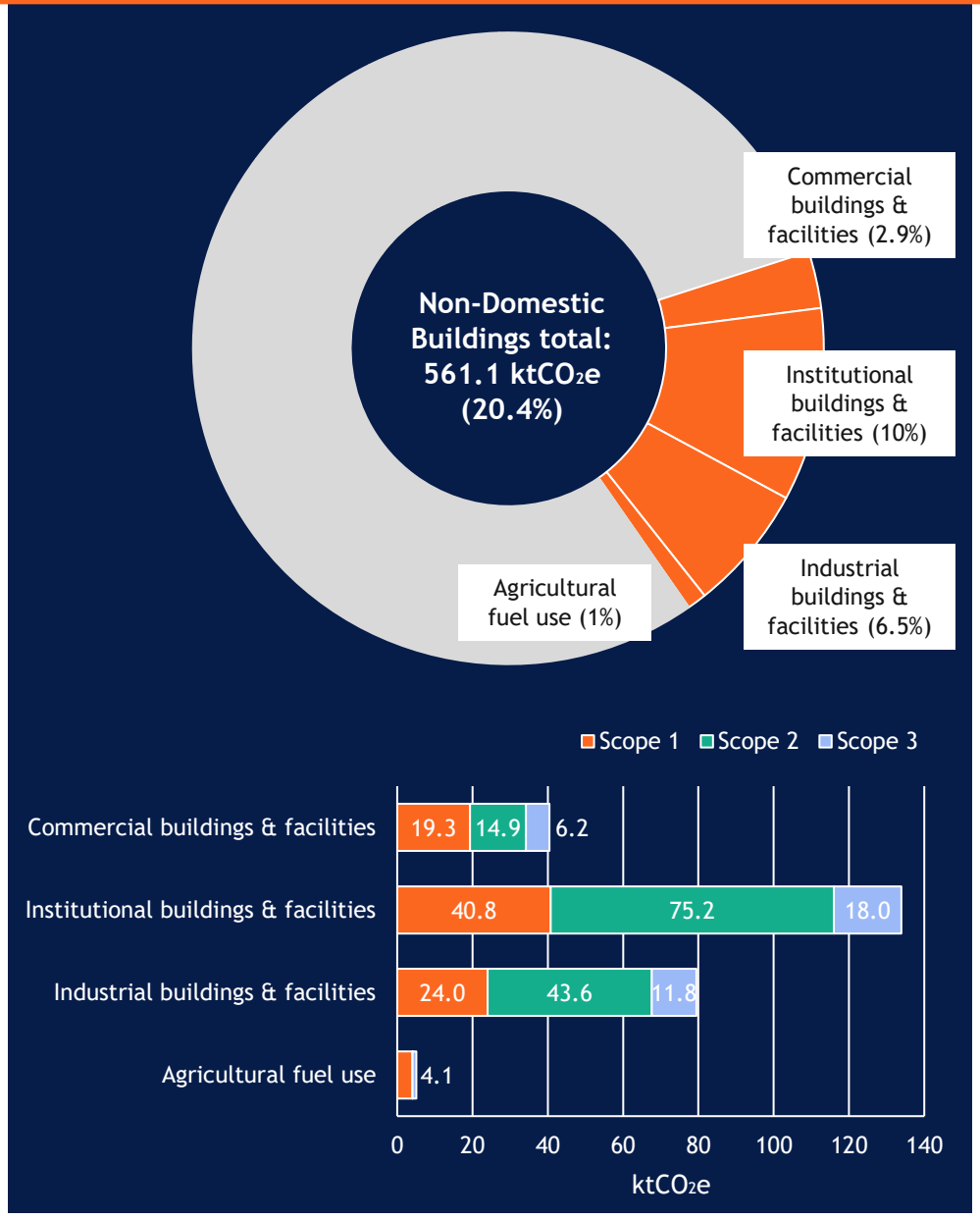
Scope of section

The non-domestic buildings sector, comprising of stationary energy use from commercial, institutional and industrial buildings & facilities and agricultural fuel use, represents 20% of South Warwickshire's total emissions. Non-domestic building emissions cover emissions produced within the building during use (scope 1), emissions associated with the grid-supplied electricity (scope 2) as well as transmission and distribution losses from the use of grid-supplied energy and embodied carbon (scope 3).

This chapter assesses SCATTER high ambition targets for a range of subsectors, including space heating, cooling and hot water as well as commercial lighting, appliances and cooking. Warwick District Council and Stratford-on-Avon District Council's properties (excluding those used for residential purposes) are included in this part of the pie chart, so interventions are aimed at both Council's and across Warwick and Stratford-on-Avon District.

Green recovery considerations

- Point 2 of The 10 Point Plan for a Green Revolution launched by the Government prioritises low carbon heating and scaling up the electrical heat pump market.
- The UK's Buildings and Heat Strategy is expected by the end of 2020.
- Small non-domestic buildings will be eligible for the UK Clean Heat Grant, which is proposed to replace the Domestic Renewable Heat Incentive (RHI) from April 2022 to March 2024, providing funding for heat pump and biomass installations.



6.1 NON-DOMESTIC BUILDINGS
KEY PLANS AND POLICY

National

- The UK Green Building Council was set up in 2013 to investigate and recommend new ways forward to reach zero-carbon buildings.
- Salix Finance offers 100% interest-free capital to deliver energy-saving measures across public sector organisations.
- MEES consultation for privately-rented non-domestic buildings closed in January 2020.
- The Government's preferred target is that non-domestic property owners in the private sector achieve EPC band B ratings by 2030.
- The Public Sector Decarbonisation Scheme provides funding for energy efficiency and heat decarbonisation. It combines the Capital Grant Scheme and the Public Sector Low Carbon Skills Fund.

Regional

- Each year, Warwickshire County Council publish a Building Energy Consumption and Emissions Review to report every operational property within their portfolio.
- The Warwickshire Energy Plan 2015 outlines the Council's aim to achieve at least an average annual 2.5% reduction in total carbon dioxide emissions from the corporate property estate per total £million gross revenue expenditure.

Warwick District

- The Warwick Local Plan 2011-2029 requires all non-residential development over 1000 sqm. to achieve the 'Very Good' BREEAM Standard as a minimum (Policy CC3) and requires all development to be resilient to the future effects of a warming climate.
- The Taking Action on Climate Change Carbon Management Plan 2020 outlines the Council's energy hierarchy for non-domestic buildings as:
  1. Reduce on-site energy use (e.g. behaviour change)
  2. Reduce energy losses by retro-fit and use of more energy efficient building fabric
  3. Source / generate energy from renewable resources and use within host building

Stratford-on-Avon District

- Policy CS.2 of the Stratford-on-Avon District Core Strategy 2011-2031 requires all non-residential development to achieve the 'Good' BREEAM standard as a minimum. Additionally, extensions or major refurbishment should improve the overall energy performance of the building.
- The Climate Change Adaptation and Mitigation Supplementary Planning Document details the measures expected from development in line with the Core Strategy.
- The Stratford-on-Avon District Core Strategy 2011-2031 highlights that the Council supports the energy hierarchy of; using less energy, supplying energy efficiently and using low carbon and renewable energy technologies.

6.1 NON-DOMESTIC BUILDINGS INTERVENTIONS

Implementing the SCATTER interventions for non-domestic buildings at the highest ambition across both District's leads to:

32% reduction in emissions from non-domestic buildings by 2030

228 $ktCO_2e$ of non-domestic building emissions remaining in 2030

The following interventions relate to commercial properties and institutional buildings, as well as industrial property. The first two interventions consider decreasing the demand for energy, whilst the second two consider the effects of electrifying heating systems and appliances.

1. **More energy efficient buildings:** For non-domestic property, SCATTER considers improvements to energy use practices and buildings, including improvements to building fabric.
2. **Appliance and lighting efficiency:** Considers the reduction in energy demand from more efficient lighting and appliances, including electrical devices, and all forms of lighting and cooking.
3. **Shifting off gas heating systems:** Considers the uptake of non-fossil fuel sources for heating within commercial properties, including heat pumps, district heating and combined heat and power networks (CHP). The impact of the fuel mix will be heavily influenced by the increased availability of renewable energy. Hydrogen technology is not modelled in the tool due to the limited availability of large-scale data.
4. **Shifting from gas cooking facilities:** Models the uptake of electrical cooking systems and discontinuation of gas cookers.

Warwick People's Inquiry on Climate Change recommendations highlighted the importance of retrofit of public buildings.

The levels of activity described correspond with the High Ambition Pathway described on page 36. These targets represent the most ambitious within SCATTER. We can see the effects of these activities on overall emissions by looking at a sector-by-sector breakdown of the High Ambition Pathway (see below).

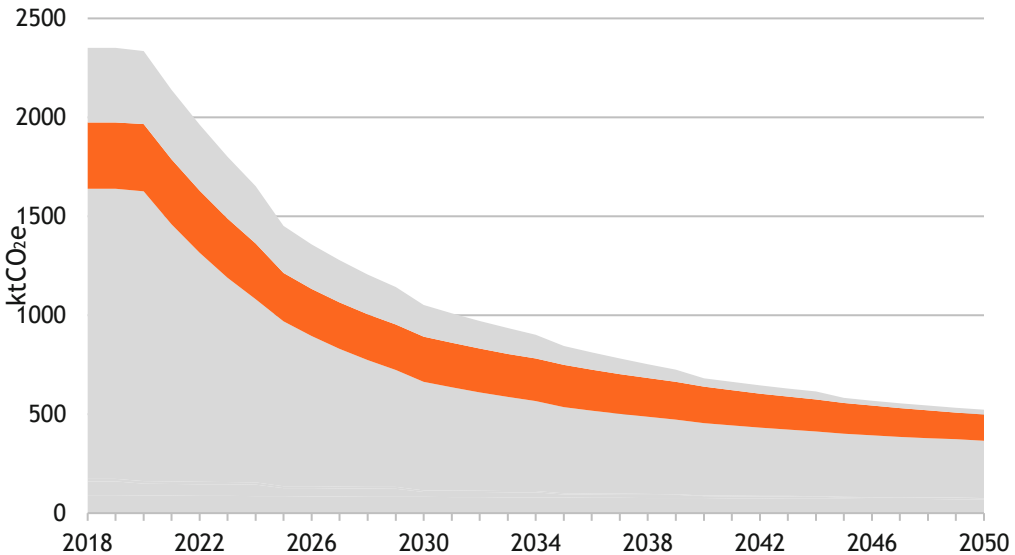


Figure 21: SCATTER High Ambition Pathway with the non-domestic building's emissions pathway highlighted in orange.

6.1 NON-DOMESTIC BUILDINGS
INTERVENTIONS SUMMARY

Table 9: Current context, intervention milestone at 2030 and associated cumulative emissions savings to 2030.

Intervention	Current Context 2020	By 2030	Cumulative emissions savings (2020 - 2030)	
			Warwick	Stratford-on-Avon
Reduced energy demand for heating, cooling & hot water	Warwick: There were 30 Renewable Heat Incentive installations between 2011 and 2021.[1] As of 2018, there were estimated to be 33 heat networks in Warwick.[2] 48% EPC-rated non-domestic properties are rated D or below.[3] Stratford-on-Avon: There were 89 Renewable Heat Incentive installations between 2011 and 2021.[1] As of 2018, there were estimated to be 12 heat networks in Stratford.[2] 42% EPC-rated non-domestic properties are rated D or below[3]	• 17% reduction	Non-domestic space heating, cooling and hot water: **195 $ktCO_2e$**	Non-domestic space heating, cooling and hot water: **231 $ktCO_2e$**
Shifting off gas heating systems		• 39% heating systems are low-carbon or electric		
Shifting from gas to electric for cooking		• 10% increase in electric fuel usage for cooking	Non-domestic lighting, appliances, equipment & cooking: **95 $ktCO_2e$**	Non-domestic lighting, appliances, equipment & cooking: **81 $ktCO_2e$**
Reduced energy demand for appliances, lighting and cooking		• 11% reduction		

[2] Heat networks can be considered as either district or communal heating as defined by BEIS. Most current heat networks are in the form of communal heating, which distributes thermal energy from a central source within a building occupied by more than one final customer. A district heat network on the other hand, distributes thermal energy through a network to multiple buildings or sites.

6.1 NON-DOMESTIC BUILDINGS INTERVENTION MILESTONES

1. More energy efficient buildings

This measure describes energy demand reduction for space heating and hot water heating as a result of improvements to building fabric and positive behaviour changes. "Retrofit" in this context refers to insulation, draughtproofing, double glazing etc., as opposed to the installation of renewable energy technologies. The demand-side reductions are focused on changes to the building fabric, which are considered separately to any changes to electrified systems.

These forecast reductions in demand consider improvements to the efficiency of new water heating systems. Reductions are applied to whatever fuel the building is using i.e., accounting for more efficient gas boilers or electrical heating systems. Emissions reductions are calculated in terms of an overall reduction in net energy demand, without prescribing specific targets for numbers of buildings to be retrofit.

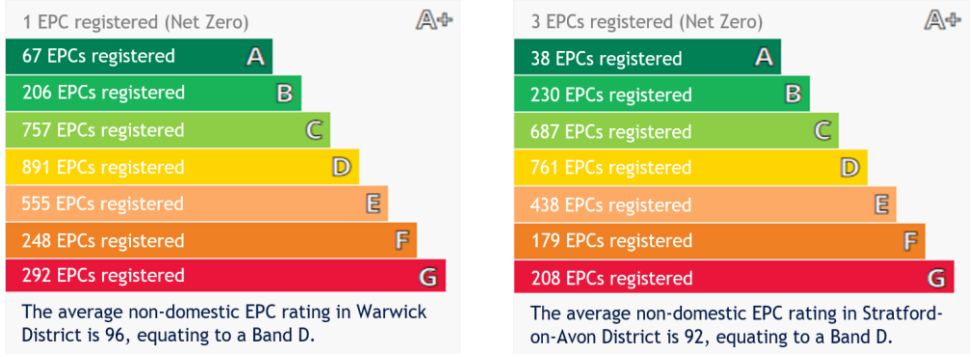


Figure 22: Non-Domestic EPCs issued up to and including September 2020 across Warwick District (left) and Stratford-on-Avon District (right). Data provided by EPC Open Data Communities.

Key Milestones

South Warwickshire

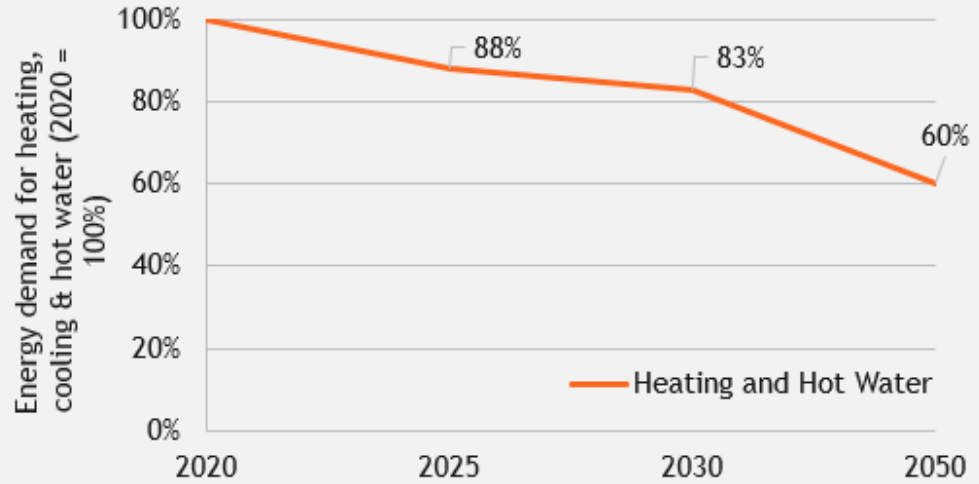


Figure 23 (above): Modelled changes in energy demand for space heating and hot water relative to a 2020 baseline of 100%.

Table 10: Intervention milestones for improving energy efficiency in non-domestic buildings

Year	Milestone required to achieve High Ambition Pathway
2025	12% reduction in overall energy demand for space heating and hot water
2030	17% reduction in overall energy demand for space heating and hot water
2050	40% reduction in overall energy demand for space heating and hot water

6.1 NON-DOMESTIC BUILDINGS
INTERVENTION MILESTONES

2. Appliance and lighting efficiency

This intervention considers the reduction in energy demand due to the installation of more efficient lighting and appliances, including electrical devices. It also considers all types of cookers and catering equipment, regardless of their source fuel. The transition towards electric systems for cooking is considered separately to the reduction in demand (e.g., through improved efficiency of gas systems).

Energy demand reductions are applied to whatever fuel the building is using, such as mains electricity or gas-fired CHP. Lighting, cooling and appliances use approximately 45% of the total building's day to day use energy, heating and hot water use approximately 46% of the total building's day to day use of energy.[1] Modelled changes in MWh energy demand for lighting and appliances uses the 2017 SCATTER inventory as a baseline value.

Table 11: Modelled changes in energy demand (MWh) for appliance and lighting efficiency along the High Ambition Pathway, utilising the 2017 SCATTER inventory baseline.

Year	Warwick Appliance & Lighting (MWh)	Stratford-on-Avon Appliance & Lighting (MWh)	South Warwickshire Appliance & Lighting (MWh)
2017	93,507	86,063	179,570
2025	86,962	80,039	167,001
2030	83,221	76,596	159,817
2050	70,130	64,547	134,677

Key Milestones

South Warwickshire

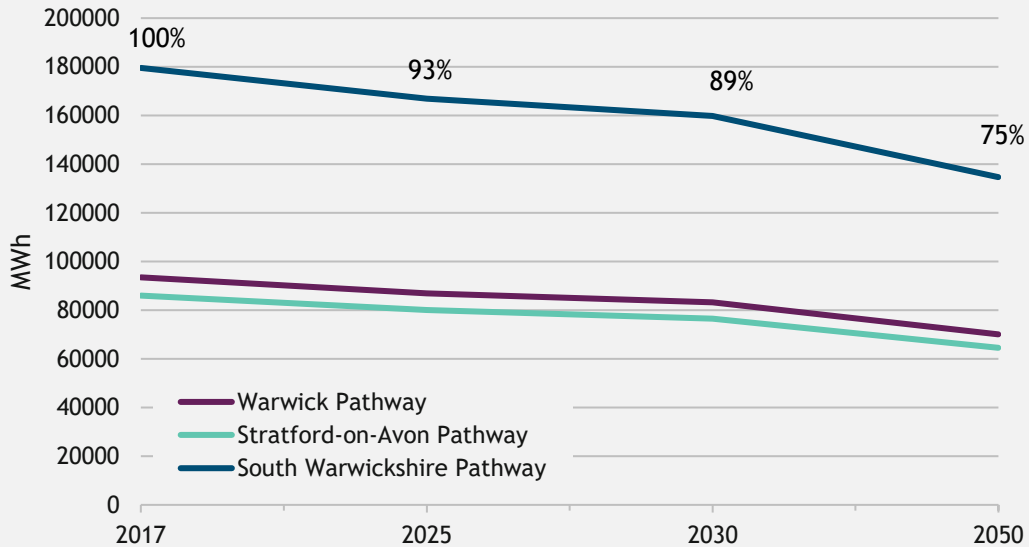


Figure 24 (above): Modelled changes in MWh energy demand for lighting and appliances in non-domestic buildings.

Table 12: Intervention milestones for improving appliance and lighting efficiency

Year	Milestone required to achieve High Ambition Pathway
2025	By 2025, commercial lighting & appliance energy demand decreases 7%
2030	By 2030, commercial lighting & appliance energy demand decreases 11%
2050	By 2050, commercial lighting & appliance energy demand decreases 25%

[1] Per BEIS analysis

6.1 NON-DOMESTIC BUILDINGS
INTERVENTION MILESTONES

3. Shifting off gas heating systems

This measure describes the transition away from fossil fuel-source heating technologies in favour of less carbon-intensive systems. In particular, the High Ambition Pathway fuel mix represents a transition to heat pumps and combined heat and power networks (CHP).

This endpoint fuel mix offers the most significant emissions reductions, though it should be noted that the impact of this measure on emissions is heavily influenced by the availability of renewable energy. CHP systems can be fed by fully renewable technologies (e.g., solar thermal) but still offer significant carbon savings when compared against other heating systems.

The more rapidly the electricity grid can decarbonise, the greater the impact on emissions from transitioning to electrified heating systems. If the grid is slow to decarbonise the emissions factor for electricity will remain high and emissions savings will be diminished. Switching to an electrified heating system can also provide incentive to property owners to install on-site electricity generation technologies (such as solar PV).

Key Milestones

South Warwickshire

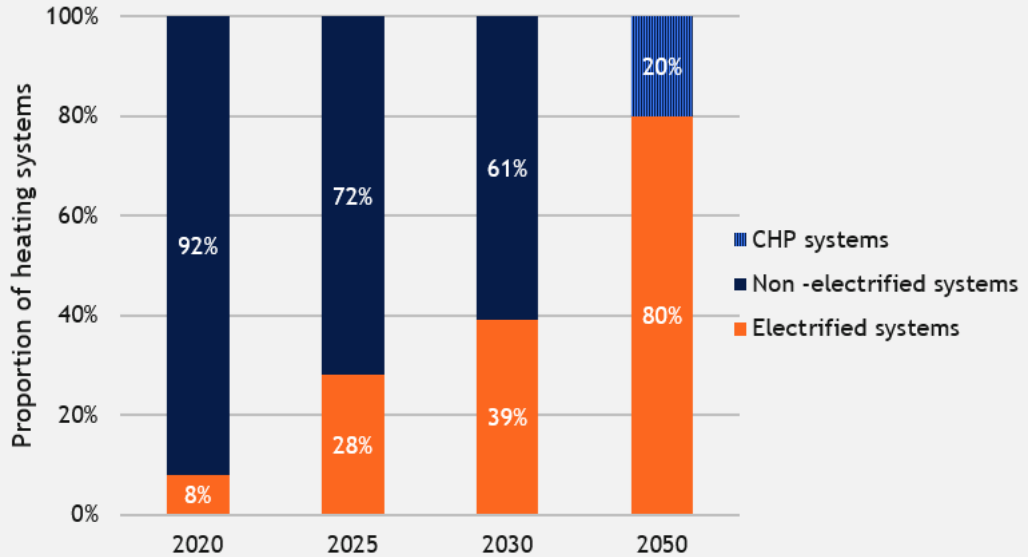


Figure 25 (above): Modelled changes in the technology mix for non-domestic heating technologies.

Table 13: Intervention milestones for shifting off gas heating systems for non-domestic buildings.

Year	Milestone required to achieve High Ambition Pathway
2020	In the Building Energy Efficiency Survey, BEIS model that 92% of space heating and hot water provision came from natural gas usage.
2025	By 2025, 28% of non-domestic buildings have electrified heating systems.
2030	By 2030, 39% of non-domestic buildings have electrified heating systems.
2050	By 2050, 80% of non-domestic buildings have electrified heating systems.

6.1 NON-DOMESTIC BUILDINGS
INTERVENTION MILESTONES

4. Shifting from gas cooking facilities

This measure describes the uptake of electrical cooking systems and discontinuation of gas cookers. It accounts for a transition to fully electrified systems by 2050. For the most part, the uptake of electrified cooking systems directly reduces other fossil fuel usage, though this does constitute an overall increase in electricity consumption.

As with the heating systems measure, the projected change towards electric systems delivers emissions savings in tandem with decarbonisation from the grid.

Key Milestones

South Warwickshire

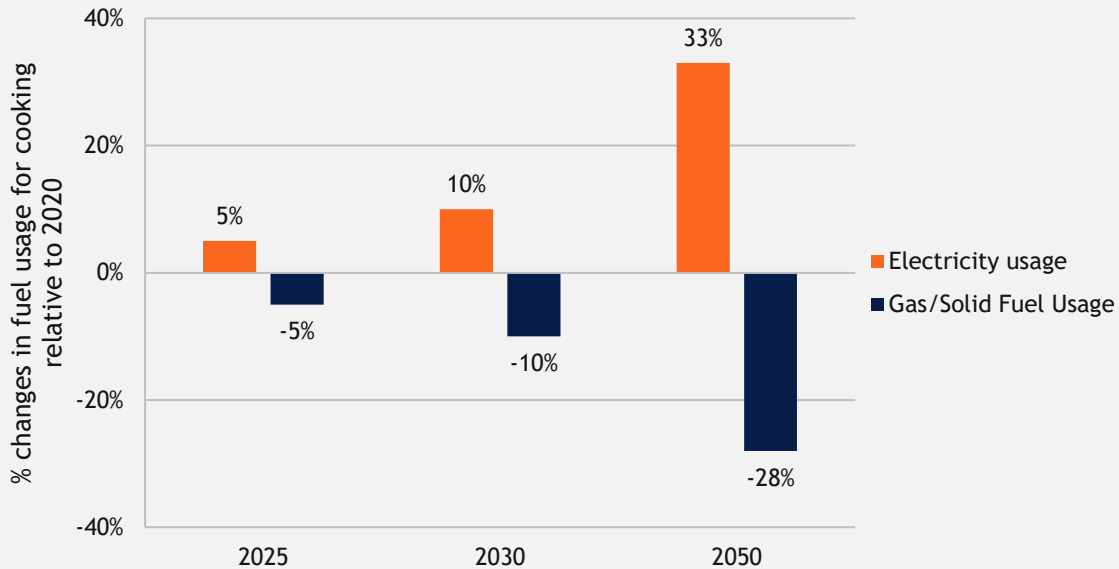


Figure 26 (above): Modelled changes in non-domestic cooking energy demand. The transition can be thought of as a direct swap between gas/solid fuel systems and electrified systems.

Table 14: Intervention milestones for shifting from gas cooking facilities for non-domestic buildings.

Year	Milestone required to achieve High Ambition Pathway
2025	By 2025, there is a 5% increase in electricity usage for commercial catering and a 5% decrease in gas & soil fuel usage.
2030	By 2030, there is a 10% increase in electricity usage for commercial catering and a 10% decrease in gas & solid fuel usage.
2050	By 2050, there is a 33% increase in electricity usage for commercial catering and a 28% decrease in gas & soil fuel usage.

6.1 NON-DOMESTIC BUILDINGS
LOCAL AND NATIONAL CASE STUDIES

Local Case Studies

A new **Community Stadium** is being built in Warwick District to the south of Royal Leamington Spa.[1] Along with the creation of a community hub for sport, leisure and other health related provisions, the stadium will also be the home ground for Leamington Football Club. Warwick District Council have proposed that the stadium design will need to be at the lowest possible levels of carbon emissions, and ideally be a net zero project.

Figure 27: Image of the new Community Stadium Scheme which is part of a wider multi-faceted project, involving developments to Myton School and the potential inclusion of a residential development and 60-bed care home[1]. See Community Stadium Report and the Community Stadium Plan for more detail.

Warwick District Council have undertaken **energy efficiency audits** on 12 key non-domestic buildings and have applied to the Public Sector Decarbonisation Scheme to make energy efficiency improvements to 3 buildings.[2]

The new combined Leisure Centre and Scout and Guides Centre at **Castle Farm, Kenilworth** will incorporate low energy design into the project as well as cost-effective energy strategies. It is hoped that Kenilworth Leisure Centre will achieve low carbon status.[3]

National Case Studies

Exeter Passivhaus Leisure Centre is part of Exeter City Council's city centre master plan and is set to be a world first Passivhaus Leisure Centre. It is the first commercial Passivhaus development from the council who have delivered several domestic schemes. The design includes 70% saving on energy costs when compared to a current good practice pool and a 50% reduction in water use. Local news reports suggest that the leisure centre will cost c.£44 million.[4]

Figure 28: Image of the St Sidwell's Point Passivhaus Leisure Centre expected to open at the end of 2021.[1]

Southampton District Energy Scheme delivers energy to over 45 energy users, both residential and commercial. The scheme is currently saving around 10,000 tonnes of CO2 emissions per annum, using heat from a large-scale combined heat and power (CHP) plant, supplemented by geothermal energy and conventional boilers.[5]

Oxford City Council upgraded their internal air conditioning systems which was estimated to save 161 tCO2/year and repaid its £45,000 spend in 1.2 years through reduced energy costs.[6]

6.2 Domestic Buildings

Anthesis

6.2 DOMESTIC BUILDINGS
CURRENT CONTEXT

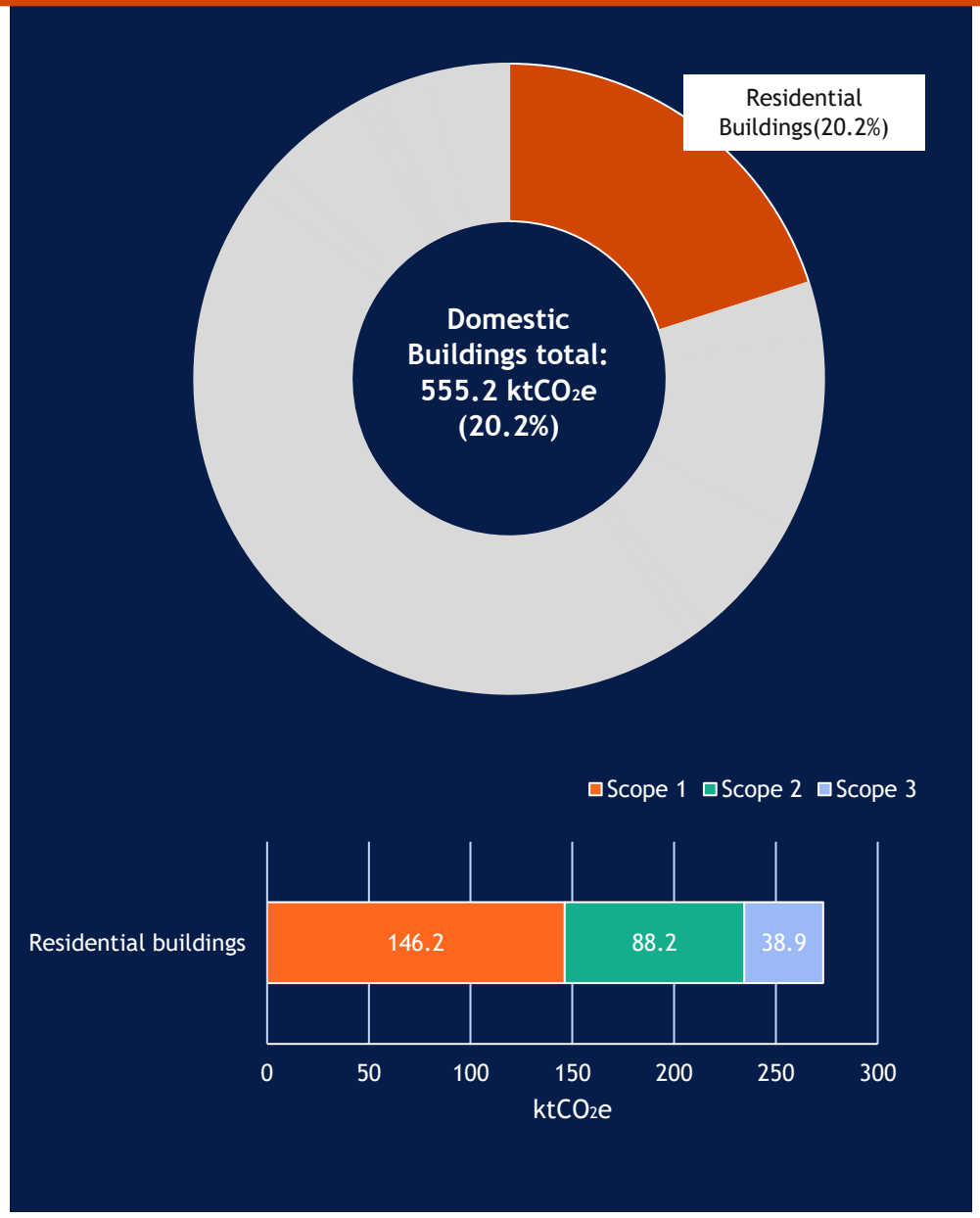
Scope of section

Domestic households within Warwick and Stratford-on-Avon are the second type of building described within this report. Similar to non-domestic buildings, they represent 20% of total emissions across South Warwickshire making domestic buildings a significant source to target action.

This section covers interventions related to all domestic dwelling types, covering private households, social housing and all rented dwellings. As with non-domestic buildings, the emissions analysed here are those associated with direct emissions from energy use within both District's households (scope 1), indirect emissions associated with the consumption of grid-supplied energy in homes (scope 2) and indirect transmission and distribution losses from the use of grid-supplied energy (scope 3).

Green recovery considerations

- Point 2 and 7 of The 10 Point Plan for a Green Revolution launched by the UK Government prioritise low carbon heating, aiming for 600,000 heat pump installations nationally per year by 2028.
- The Green Homes Grant launched in September 2020 will help homeowners upgrade their homes.
- Due to COVID-19 restrictions, as of June 2020, domestic energy consumption increased, with households where people are staying home estimated to pay up to £16 extra per month on energy, which is likely to be higher in properties with lower levels of energy efficiency.
- The Future Homes Standard will require new builds to be future proofed with low carbon heating and gas boilers will be banned in new homes from 2025.



6.2 DOMESTIC BUILDINGS
KEY PLANS AND POLICY

National

- Clean Growth Strategy set targets to upgrade as many houses to EPC band C by 2035 (2030 for all fuel-poor households)
- Third phase of the Energy Company Obligation (ECO3) will conclude in 2022.
- The Future Homes Standard provides an update to Part L of the building regulations and will include the future ban on new gas boilers by 2025
- Minimum energy efficiency standards (MEES) in the private rented sector and non-domestic property prevents landlords from letting properties rated below EPC Band E.
- The UK Green Building Council was set up in 2013 to investigate and recommend new ways forward to reach zero-carbon buildings.

Regional

- The West Midlands Combined Authority has collaborated with five of the region's leading housing associations to accelerate and increase the number of affordable homes.
- The Coventry and Warwickshire Local Enterprise Partnership Strategic Reset Framework states Planning and Housing as one of the Economic Reset Taskforce and Business Groups aiming to minimise the negative economic impacts of COVID-19.

Warwick District

- Warwick District Council's Fuel Poverty Strategy 2021-2026 outlines that funding will be provided to bring the Council's housing stock to EPC level C by 2030 and a net zero-carbon specification is being developed for new affordable homes.
- The Warwick Local Plan 2011-2029 requires all development to be resilient to the future effects of a warming climate.
- Warwick District Council's Business Strategy 2020-23 outlines the Council's aim to acquire land to build affordable social housing to high environmental standards.

Stratford-on-Avon District

- Policy CS.2 of the Stratford-on-Avon District Core Strategy 2011-2031 states that extensions or major refurbishment should improve the overall energy performance of the building and that all residential development should encourage sustainable living.
- The Stratford-on-Avon District Housing Strategy 2015-2021 details how the Council aims to improve existing housing's energy efficiency to tackle fuel poverty.
- The Stratford-on-Avon District Core Strategy 2011-2031 highlights that the Council supports the energy hierarchy of; using less energy, supplying energy efficiently, using low carbon and renewable energy technologies.

6.2 DOMESTIC BUILDINGS INTERVENTIONS

Implementing the SCATTER interventions for domestic buildings at the highest ambition across both District's leads to:

58% reduction in emissions from domestic buildings by 2030

160 $ktCO_2e$ of domestic building emissions remaining in 2030

The following interventions relate to domestic households. The interventions consider both decreasing the demand for energy, as well as the effects of electrifying heating systems and appliances.

1. **More energy efficient homes & new builds:** For domestic property, this measure considers changes in the energy demand for heating and cooling our buildings. Different retrofit options are considered for existing households, as well as the performance of new builds.
2. **Appliance and lighting efficiency:** Considers the reduction in energy demand from more efficient lighting and appliances, including electrical devices, and all forms of lighting and cooking.
3. **Shifting off gas heating systems:** Considers the uptake of non-fossil fuel sources for heating within homes and commercial properties, including heat pumps, district heating and combined heat and power networks (CHP). The impact of the fuel mix will be heavily influenced by the increased availability of renewable energy. Hydrogen technology is not modelled in the tool due to the limited availability of large-scale data.
4. **Shifting from gas cooking facilities:** Models the uptake of electrical cooking systems and discontinuation of gas cookers.

The levels of activity described correspond with the High Ambition Pathway described on page 36. These targets represent the most ambitious within SCATTER. We can see the effects of these activities on overall emissions by looking at a sector-by-sector breakdown of the High Ambition Pathway (see below).

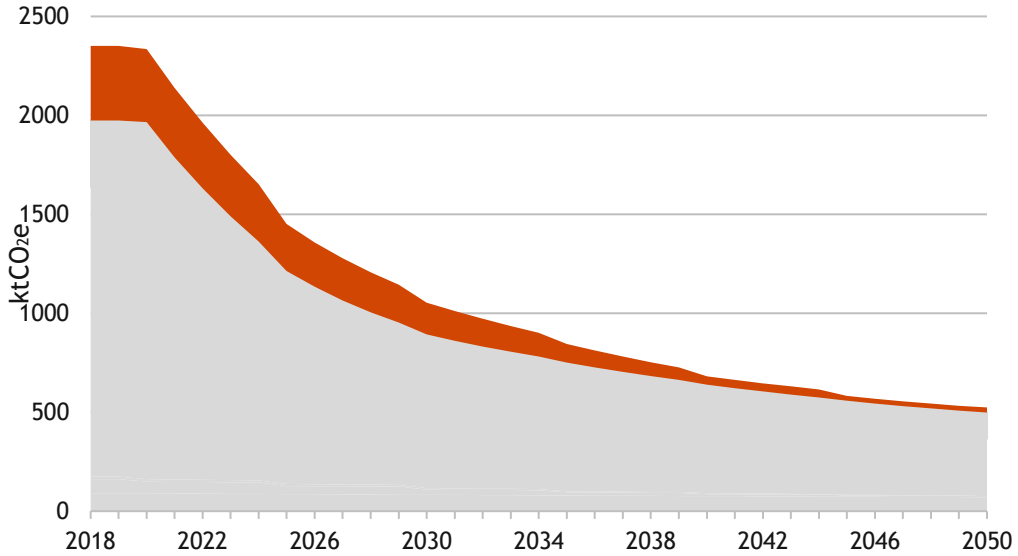


Figure 29: SCATTER High Ambition Pathway with the domestic building's emissions pathway highlighted in dark orange.

6.2 DOMESTIC BUILDINGS
INTERVENTIONS SUMMARY

Table 15: Current context, intervention milestone at 2030 and associated cumulative emissions savings to 2030.

Intervention	Current Context 2020	By 2030	Cumulative emissions savings (2020-30)	
			Warwick	Stratford-on-Avon
More energy efficient homes & new builds	Warwick: 2,848 households in Warwick have received ECO measures.[1] 62,116 households in Warwick classed as fuel poor.[2] Stratford-on-Avon: 2,720 households in Stratford have received ECO measures.[1] 55,030 households in Stratford are classed as fuel poor.[2]	Warwick: • 2,300 households "medium" retrofit • 18,000 households "deep" retrofit • 3,500 new houses built to Passivhaus standards Stratford-on-Avon: • 2,100 households "medium" retrofit • 17,000 households "deep" retrofit • 3,900 new houses built to Passivhaus standards	Domestic space heating, cooling and hot water: **526 $ktCO_2e$**	Domestic space heating, cooling and hot water: **518 $ktCO_2e$**
Reduced energy demand for heating, cooling & hot water	Warwick: 55% of EPC-rated domestic properties are rated D or below. [3] Stratford-on-Avon: 50% of EPC-rated domestic properties are rated D or below.[3]	• 21% reduction		
Shifting off gas heating systems	Warwick: It is estimated that 15% of properties in Warwick are not connected to the gas network.[4] Stratford-on-Avon: It is estimated that 31% of properties in Stratford are not connected to the gas network.[4]	• 47% of heating systems are electrified		

6.2 DOMESTIC BUILDINGS
INTERVENTIONS SUMMARY

Intervention	Current Context 2020	By 2030	Cumulative emissions savings (2020-30)	
			Warwick	Stratford-on-Avon
Shifting from gas to electric for cooking	Nationally in 2016, it was estimated that around 45-50% of domestic cooking was electrified.[5]	• 29% increase in domestic electric fuel use for cooking	Domestic lighting, appliances, equipment & cooking: **90 $ktCO_2e$**	Domestic lighting, appliances, equipment & cooking: **79 $ktCO_2e$**
Reduced energy demand for appliances, lighting and cooking	In the UK, consumption by domestic lighting decreased 25% between 2010 and 2019.[6]	• 31% reduction		

6.2 DOMESTIC BUILDINGS
INTERVENTION MILESTONES

1. More energy efficient homes & new builds

This measure considers changes to the energy demand for heating homes, in both existing properties and newly built homes. Different retrofit options are considered for existing households, as well as the performance of new builds.

The aim of retrofit is to drive down the energy demand for heating and hot water in buildings; typical measures include things like insulation for floors, windows and ceilings as well as improved ventilation. Currently household retrofit is led largely by government-supported schemes, such as ECO (and more recently the Green Homes Grant). ECO retrofit measures vary, though around two thirds involve some form of insulation. SCATTER models future energy demand based on the uptake of two "modes" of retrofit:

- Medium – a 66% reduction in annual average energy demand through inner wall insulation.
- Deep – an 83% reduction in annual average energy demand, through inner & external wall insulation.

New builds must also be constructed to extremely high energy performance standards.[1] SCATTER forecasts an increase in the number of households of around 13% on the existing number by 2040. The High Ambition Pathway demands these new builds meet Passivhaus standard. Warwick People's Inquiry on Climate Change recommended all new homes be carbon neutral in both construction and future use, supported by planning guidelines and that all housing should be assessed for retrofitting needs.

Key Milestones

Warwick District

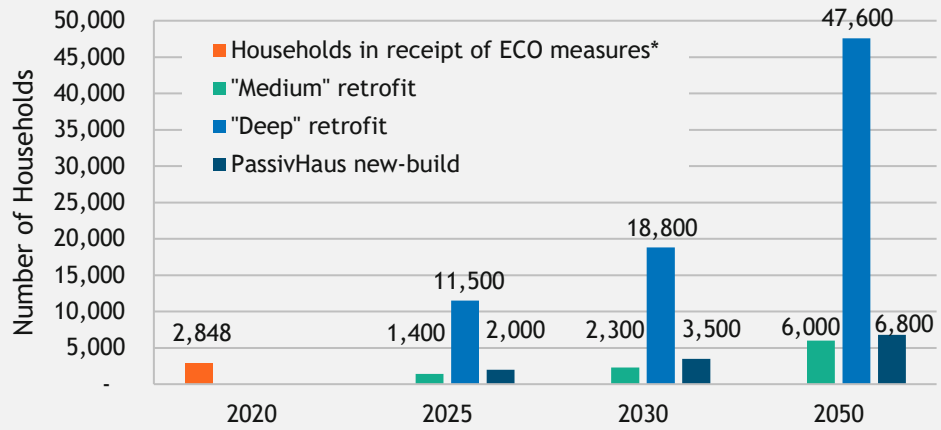
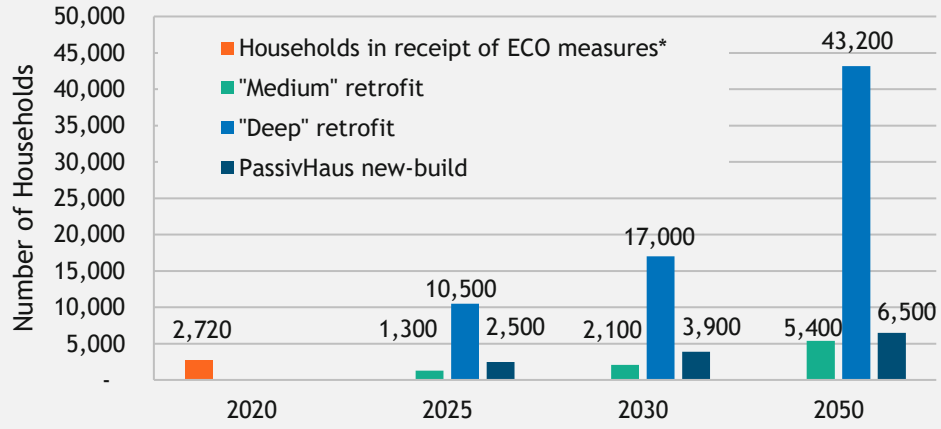


Figure 30: Retrofit rates and new build standards for Warwick (above) and Stratford-on-Avon (below). *ECO measures are included as a proxy for comparison, though the average improvements to energy demand fall well short of medium retrofit in practice.

Stratford-on-Avon District



[1] The Association for Environmentally Conscious Buildings deems a "high performance" building as requiring 25% of the average energy demand for heating. Passivhaus standards are typically 10% of the average demand.

6.2 DOMESTIC BUILDINGS
INTERVENTION MILESTONES

2. Appliance and lighting efficiency

This measure considers the reduction in energy demand due to the installation of more efficient lighting and appliances, including electrical devices. This also covers all types of cookers and catering equipment, regardless of their source fuel.

As in the non-domestic measures, the transition towards electric systems is considered separately – demand reductions are applied to whatever fuel the building is using.

Reductions in this area are anticipated through the uptake of newer, more efficient devices (e.g., smart-controlled technology) as well as positive changes in behaviour. Modelled changes in MWh energy demand for lighting and appliances uses the 2017 SCATTER inventory as a baseline value.

Table 16: Modelled changes in MWh appliance and lighting efficiency in domestic buildings, utilising the 2017 SCATTER inventory baseline.

Year	Warwick District Appliance & Lighting (MWh)	Stratford-on-Avon District Appliance & Lighting (MWh)	South Warwickshire Appliance & Lighting (MWh)
2017	429,583	454,317	883,900
2025	339,370	358,911	698,281
2030	296,412	313,479	609,891
2050	115,987	122,666	238,653

Key Milestones

South Warwickshire

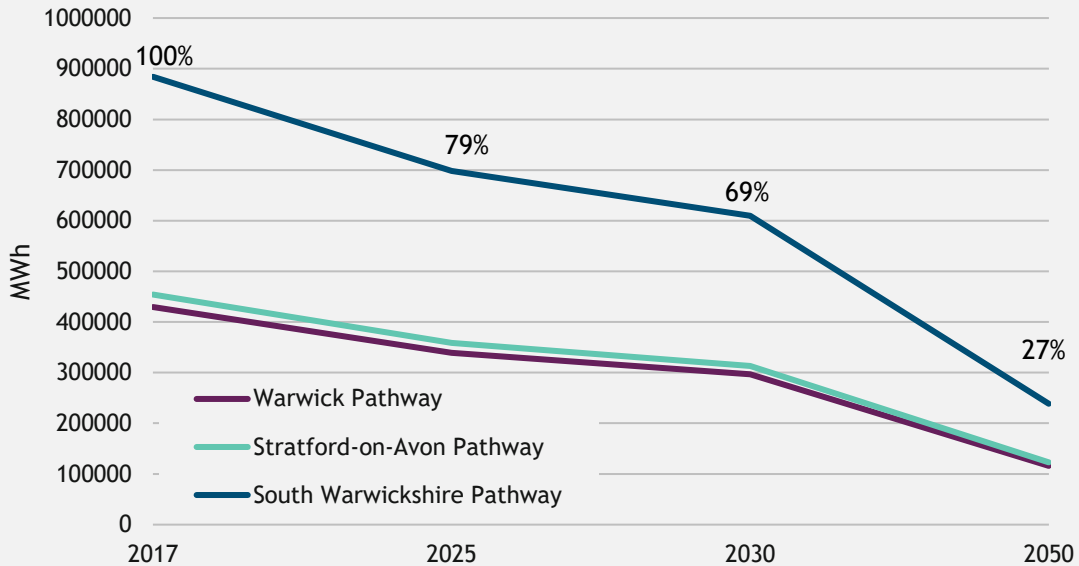


Figure 31 (above): Modelled changes in the energy demand for lighting, appliances and cooking in domestic buildings relative to a 2017 baseline.

Table 17: Intervention milestones for shifting off gas heating systems for domestic buildings.

Year	Milestone required to achieve High Ambition Pathway
2025	By 2025, there is a 21% reduction in energy demand for domestic lighting and appliances.
2030	By 2030, there is a 31% reduction in energy demand for domestic lighting and appliances.
2050	By 2050, there is a 73% reduction in energy demand for domestic lighting and appliances.

6.2 DOMESTIC BUILDINGS
INTERVENTION MILESTONES

3. Shifting off gas heating systems

This measure models the emissions savings resulting from the increased uptake of non-fossil fuel sources for heating.

For domestic properties, the High Ambition Pathway fuel mix is projected to adopt a transition to fully electric-sourced technologies. These are split for the most part between air- and ground-source heat pumps, with a smaller contribution from resistive heaters and electric-sourced CHP.

The impact of this transition on emissions savings is heavily influenced by the increased availability of renewable energy. The same principles apply to domestic heating as in the non-domestic case around reducing the carbon factor of the energy supply through rapid growth of renewable energy technologies.

Key Milestones

South Warwickshire

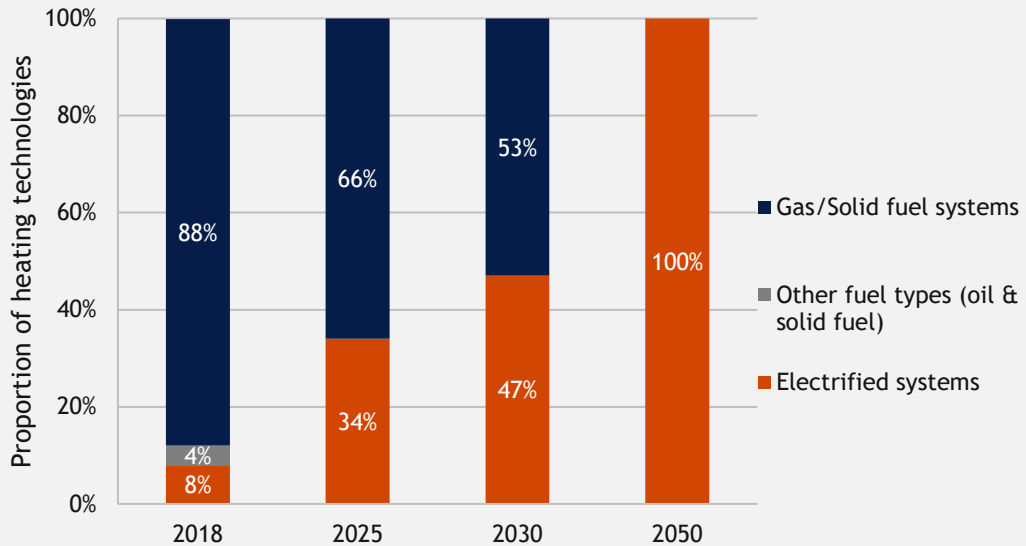


Figure 32: Modelled increase in the proportion of domestic heating systems that are electrified.

Table 18: Intervention milestones for shifting off gas heating systems for domestic buildings.

Year	Milestone required to achieve High Ambition Pathway
2018	The latest English Housing Survey data indicates that 88% of all dwelling heating systems across the UK are gas fired, 3.7% oil fired, and 0.6% solid fuel fired, whereas only 8% of homes are heated by electricity.
2025	By 2025, 34% of households across both Districts must have electrified heating systems.
2030	By 2030, 47% of households across both Districts must have electrified heating systems.
2050	By 2050. 100% of households must have electrified heating systems.

6.2 DOMESTIC BUILDINGS
INTERVENTION MILESTONES

4. Shifting from gas cooking facilities

This measure models the uptake of electrical cooking systems and discontinuation of gas cookers within domestic homes.

Similarly, to the non-domestic intervention, the uptake of electrified cooking systems directly reduces other fuel usage, with some efficiency improvements also reducing the fossil fuels used for cooking. The decoupling between the direct transition in energy demand from gas- and solid-fuel systems to electric can also be attributed to efficiency gains and improvements.

As with the heating systems measure, the projected change towards electric systems delivers emissions savings in tandem with decarbonisation from the grid.

Key Milestones

South Warwickshire

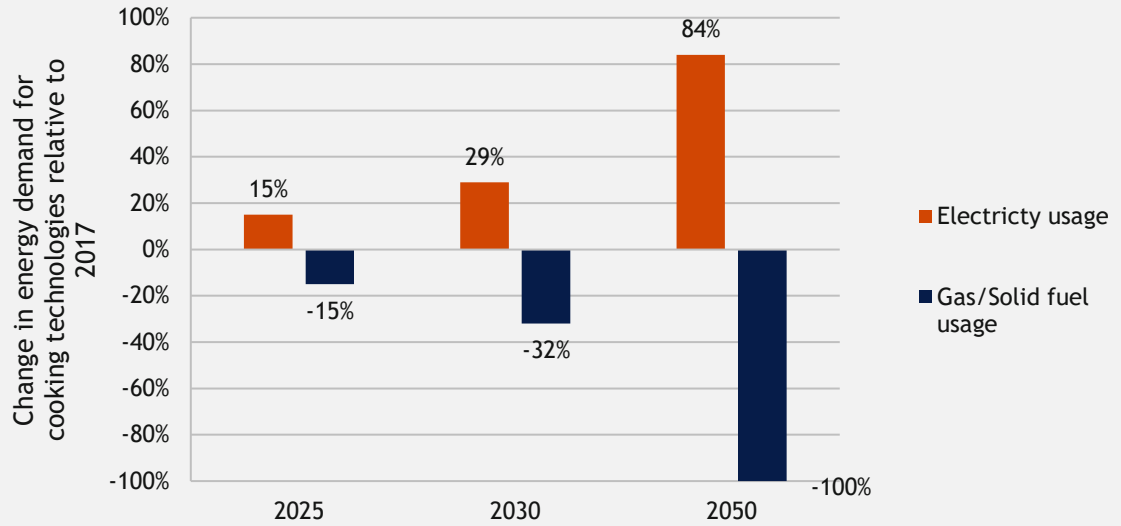


Figure 33 (above): Modelled changes in the fuel usage for domestic cookers. By 2050, all cookers will be electrified under this scenario.

Table 19: Intervention milestones for shifting from gas cooking facilities for domestic buildings.

Year	Milestone required to achieve High Ambition Pathway
2025	By 2025, there is a 15% increase in electricity usage for domestic cooking and a 15% reduction in use of gas/soil fuels.
2030	By 2030, there is a 29% increase in electricity usage for domestic cooking and a 32% reduction in use of gas/solid fuels.
2050	By 2050, there is an 84% increase in electricity usage for domestic cooking and 100% reduction in use of gas/solid fuels.

6.2 DOMESTIC BUILDINGS
LOCAL AND NATIONAL CASE STUDIES

Local Case Studies

Warwick District Council's Home Improvement Plan has a budget of £23m over 10 years in place to retrofit Council housing stock to make these properties low carbon. Housing Repair (HRA) has set aside funds to build zero carbon social housing.[1]

54 new homes are being constructed by Vistry Partnership to in a new development north of Gallows Hill. These new homes meet high energy efficient standards and include air source heat pumps, cavity walls and PV solar panels delivering a 77-80% reduction in carbon emissions.[2]

Warwickshire Warm & Well is a partnership with Act of Energy which in which several energy efficiency drop-in events undertaken aimed at supporting private landlords were run.[3]

National Case Studies

The Nottingham housing association was the first in the UK to pilot net zero retrofit of social housing using Energiesprong. They undertook a pilot project to improve 10 inefficient homes and deliver a more comfortable indoor climate for residents.[4]

Figure 34: Image of Energiesprong retrofit of housing in Nottingham.

Manchester Housing Providers Partnership are a collective of over a dozen social landlords that have pledged to support the City's net zero target. Various members have embarked on the development of zero carbon strategies and asset management plans as a result (with further actions planned).[5]

Southampton City Council's energy provider CitizEn Energy has been providing free low energy LED light bulbs for installation in vacant council homes. The Council plans to install them in 100 homes overall.[6]

6.3 Transport

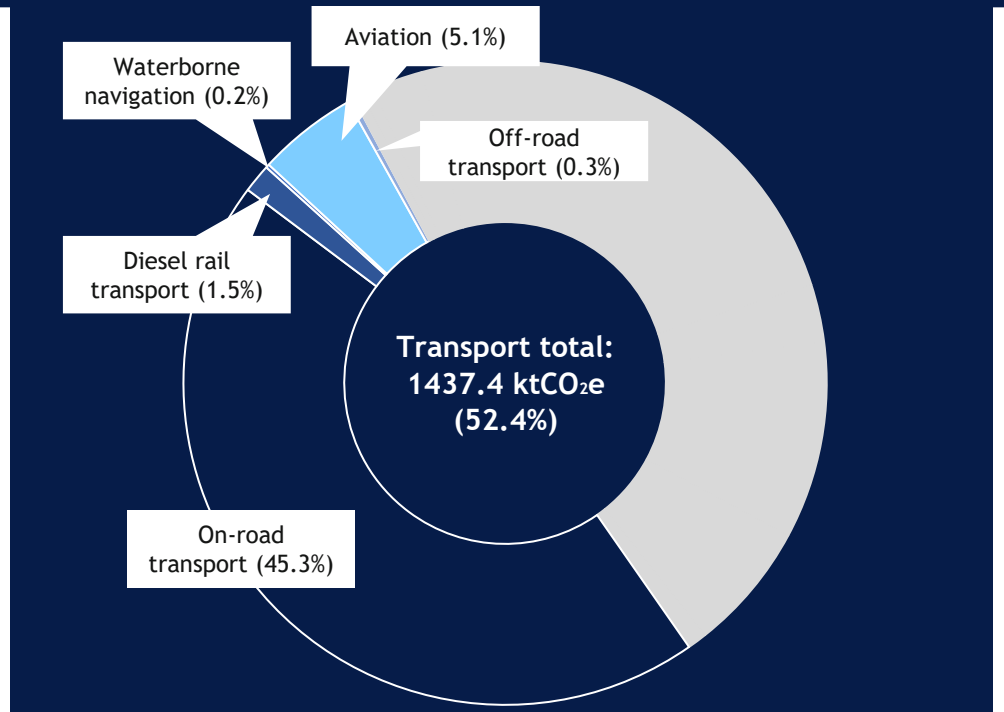
6.3 TRANSPORT
CURRENT CONTEXT

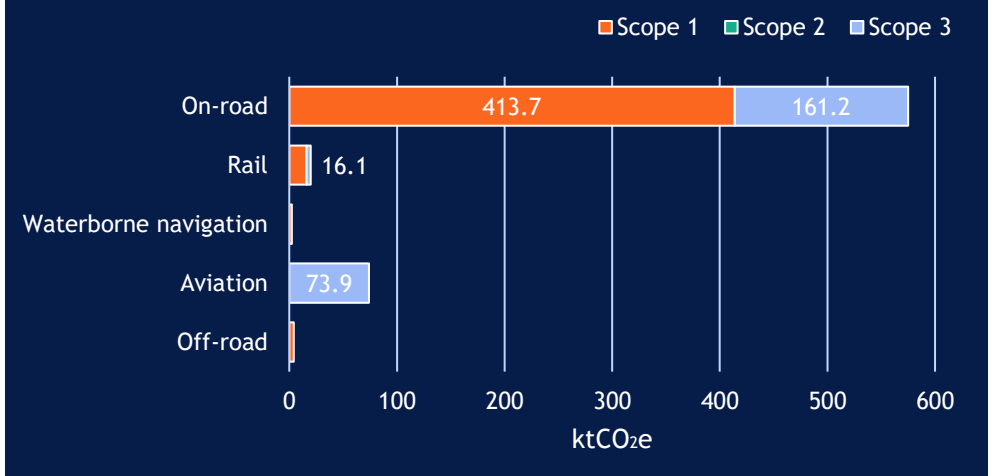
Scope of section

This next section on transport assesses SCATTER high ambition targets for a range of activities including modal share, travelling shorter distances, uptake of EV and domestic freight transport. Emissions from transport represent over half of South Warwickshire's emissions profile, making them a fundamental source to target action. Although no major airports exist inside either local authority boundary, aviation emissions do occur, and these are an apportion of national aviation emissions allocated to each District. These scope 3 aviation emissions account for emissions associated with individuals from within both District's utilising air travel.

Green recovery considerations

- The Gear Change – A bold vision for cycling and walking strategy provides a £2 billion investment for increasing the number of people walking and cycling for travel.
- The Local Transport Note 1/20 provides new cycling infrastructure standards.
- Points 4 & 5 of The Ten Point Plan for a Green Industrial Revolution include investments for charging infrastructure; enhancements of the rail networks; segregated cycle lanes and more low-traffic neighbourhoods. Point 6 outlines the Government's ambition for Sustainable Aviation Fuels and the establishment of the Jet Zero Council to accelerate net zero aviation.
- The UK Climate Change Committee's (CCC) Sixth Carbon Budget states that significant charging infrastructure, with over 300 public charging points, need to be rolled out by 2030 and 100 hydrogen refueling stations by 2035 to support HGVs. Almost half of the UK's rail network should be electrified by 2035 and the UK must build supply chains and new markets for low-carbon vehicles.





6.3 TRANSPORT
KEY PLANS AND POLICY

National

- The Road to Zero Strategy 2018 sets out new measures to establish the UK as a world leader in development, manufacture and use of zero emission road vehicles.
- Ten Point Plan for a Green Industrial Revolution includes ending the sale of new petrol and diesel cars and vans by 2030.
- Moving Forward Together strategy commits bus operators to only purchase ultra-low or zero carbon buses from 2025.
- Well Managed Highway Infrastructure: A Code of Practice advocates sustainability through sustainable consumption and production; climate change and energy; natural resource protection and environmental enhancement; and sustainable communities.

Regional

- The Warwickshire Local Transport Plan sets out the transport strategy and policies for the County from 2011 to 2026.
- Warwickshire County Council's EV Charging Infrastructure Strategy 2017 – 2026 addresses air quality issues within the County and delivers an action plan to improve EV infrastructure
- WCC's Safe and Active Travel (SAfER) in Schools has been developed to promote and support road safety and active travel activities in schools across Warwickshire.
- Transport for West Midlands (TfWM), with support from Coventry City Council and Warwickshire County Council, successfully bid for Coventry to become one of the UK's only two all-electric bus cities.

Warwick District

- The Warwick Local Plan 2011-2029 requires significant housing sites to provide for cycling and walking infrastructure and supports development which contributes to the cycling and walking network.
- Warwick and Leamington Spa's 2015 Transport Strategy identifies local transport issues in Warwick and Leamington Spa and addresses these issues in parallel with local growth scenarios for the area up to 2028.
- Warwick District Council now have a pool of eight low emissions vehicles utilised by Lifeline, Housing, Planning and Neighbourhood Services teams.

Stratford-on-Avon District

- Stratford-on-Avon District Council developed new Air Quality and Planning Guidance in December 2018 to assist in reducing air quality impacts of new developments, promoting the inclusion of EV charging points at new development sites.
- The Stratford-upon-Avon Area Transport Strategy 2018 identifies principles that underlie future development of the town's transport network to meet the needs of local people and as a popular visitor destination.
- Stratford-on-Avon District's Core Strategy 2011- 2031 identifies the need for cycle links, secure bike storage and walking routes within each of its area strategies.

6.3 TRANSPORT INTERVENTIONS

Implementing the SCATTER interventions for transport at the highest ambition across both Districts leads to:

63% reduction in emissions from transport by 2030

548 $ktCO_2e$ of transport emissions remaining in 2030

The transport measures in SCATTER consider changes in behaviour around transport, as well as the adoption of more electric vehicles for our journeys.

1. **Travelling shorter distances:** A change in the overall mileage travelled per passenger across all forms of transport. Increases in population are also considered in this measure.
2. **Driving less:** Changes to the mode by which passengers travel, defined by miles travelled. These are broken down into car transport (which includes petrol, diesel, hybrid and electric vehicles), active transport (walking and cycling) and public transport (train and bus).
3. **Switching to electric vehicles:** Considers the speed of the uptake of electric cars, trains and buses and phasing out of petrol and diesel vehicles. The impact of this measure is influenced by both the demand-side reductions and grid supply from renewable energy supply. The tool does **not** consider hydrogen-fuel vehicles.
4. **Improving freight emissions:** Considers changes to both the fuel efficiency and mode of travel for freight and commercial journeys.
5. **Reducing aviation emissions:** Considers the reduction of cruise impact Scope 3 aviation emissions.

The levels of activity described correspond with the High Ambition Pathway described on page 36. These targets represent the most ambitious within SCATTER. We can see the effects of these activities on overall emissions by looking at a sector-by-sector breakdown of the High Ambition Pathway (see below).

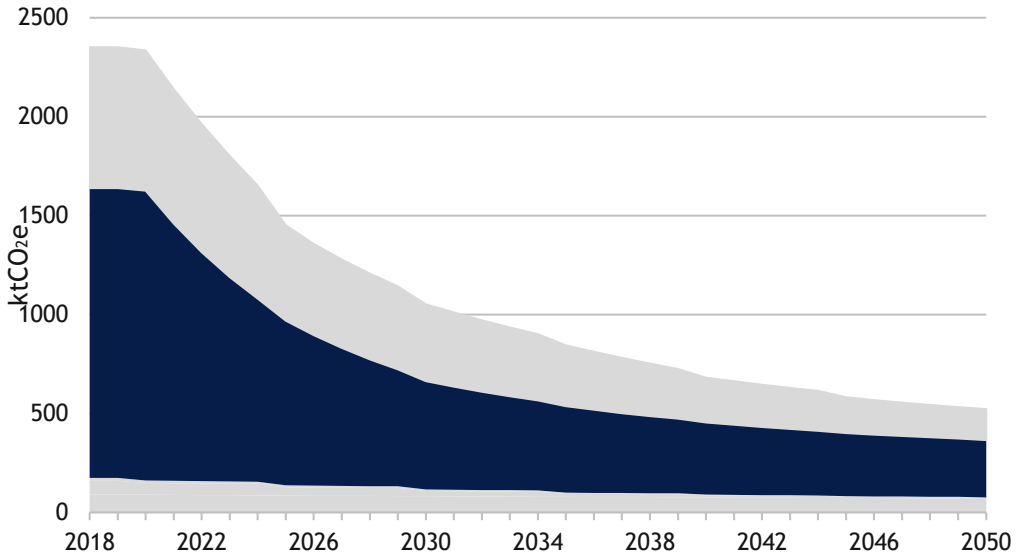


Figure 35: SCATTER High Ambition Pathway with the transport emissions pathway highlighted in blue.

6.3 TRANSPORT
INTERVENTIONS SUMMARY

Table 20: Current context, intervention milestone at 2030 and associated cumulative emissions savings to 2030.

Intervention	Current Context 2020	By 2030	Cumulative emissions savings (2020-30)	
			Warwick	Stratford-on-Avon
Travelling shorter distances	• The average distance travelled to work has increased in all regions of England and Wales. • During the 2011 census, it was estimated that the average distance travelled to work within Warwick District was 15.7km.[1] • In 2018, 15% of journeys in Stratford were less than 2km (1.2 miles).[2]	• 25% reduction in the average number of passenger miles travelled per person	On-road transport: **1,464 $ktCO_2e$** Rail transport: **-15 $ktCO_2e$***	On-road transport: **1,705 $ktCO_2e$** Rail transport: **-15 $ktCO_2e$***
Driving less	• In Warwick, 87% of journeys in 2011 were by car.[3] • In 2018, 19% of commutes in Stratford were on foot or by bicycle. [2]	• 6% reduction in road transport use • 17% increase in rail transport		
Switching to electric vehicles	• In Warwick, there are currently 41 charging points.[4] • In Stratford, there are 62 charging points.[4]	• 89% of cars are EV or HEV • 100% of buses and trains are electric		
Improving freight emissions	• Warwick: There are approximately 10,900 LGVs and 5,600 HGVs registered.[5] • Stratford-on-Avon: There are approximately 10,300 LGVs and 1,200 HGVs registered. [5]	• 9% reduction in road freight mileage • 71% increase in efficiency		
Reducing aviation emissions	637 air freight transport movements were recorded at Coventry airport in 2016 and no passenger movement was recorded.[6]	• Department for Transport "low" scenario - covering 'lower economic growth worldwide with restricted trade, coupled with higher oil prices and failure to agree a global carbon emissions trading scheme'	Aviation: **12 $ktCO_2e$**	Aviation: **11 $ktCO_2e$**

* Emissions increase slightly due to modal shift of freight

6.3 TRANSPORT
INTERVENTION MILESTONES

1. Travelling shorter distances

This measure models the reduction in total travel demand per person, across all transport modes. Travelling shorter distances can be achieved in a number of ways. The COVID-19 pandemic has certainly encouraged large numbers of people to find remote home working solutions. The future of office working remains uncertain, as many businesses become receptive to future working patterns which incorporate home-working. Following the introduction of lockdown measures in March 2020, road traffic fell to around one third of pre-pandemic levels on weekdays, however following the re-opening of office spaces and schools in September, this number recovered to approximately 90% of typical levels.[1]

Changes to transport infrastructure, public transport services and traffic management can also drive reductions in the average distance travelled per person. This intervention also considers increases in population between 2030 & 2050.

Warwickshire County Council's Sustainable Modes of Travel Strategy identifies that the south of the county is predominantly rural and survey data suggests that children in these areas tend to be driven longer distances to schools within their catchment areas. Longer distances between where people live and the places that they need to get to is one of the most important barriers to promoting sustainable travel modes. Warwick People's Inquiry on Climate Change recommendations also highlighted the importance of reducing commuting to work and improving availability of housing closer to key areas of work.

Key Milestones

South Warwickshire

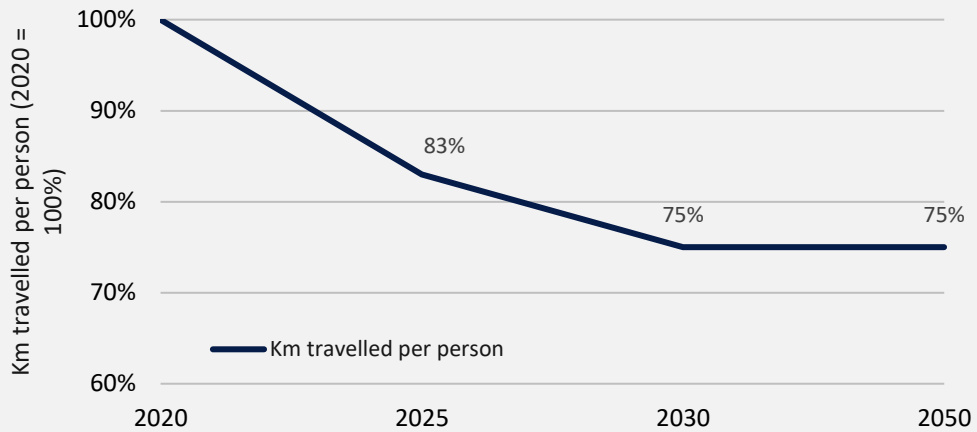


Figure 36: The shortening of the average number of km travelled per passenger across all modes within South Warwickshire.

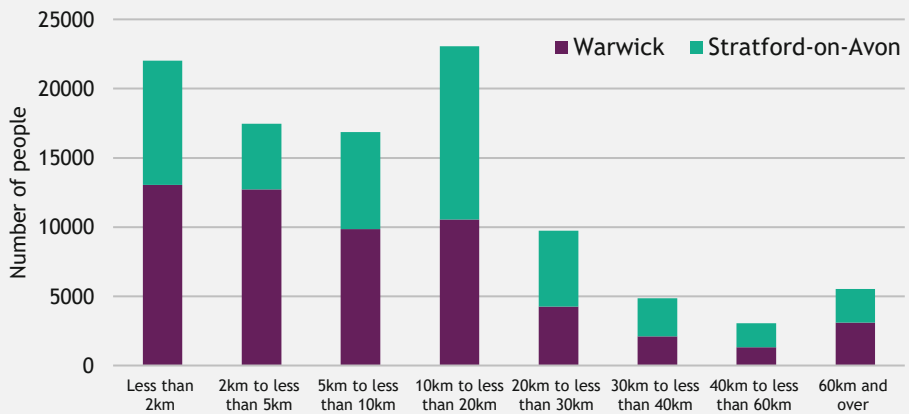


Figure 37: Distance travelled to work according to the last 2011 census for Warwick and Stratford-on-Avon. The census detailed that the average distance travelled to work in Warwick District was 15.7km and Stratford-on-Avon District 18.8km (Source: 2011 Census - Distance travelled to work)

[1] DfT statistics on transport during the COVID-19 pandemic

6.3 TRANSPORT
INTERVENTION MILESTONES

2. Driving less

As well as reducing the average distance travelled per passenger, SCATTER also considers changes to the mode of travel i.e., the means by which the journey was completed. SCATTER breaks these modes of transport into private vehicles (i.e., cars), public transport (which includes buses and trains) and active transport (i.e., walking and cycling). This intervention focuses on reducing the demand for road transport.

Warwickshire County Council's Local Transport Plan identifies that of the 53,678 households in Stratford-on-Avon District almost half own two or more cars, which is among the highest levels in the UK. However, over 6,400 households (12%) do not have access to a car in Stratford-on-Avon District and the predominantly rural nature of Stratford-on-Avon makes it difficult to serve by public transport.

Warwick People's Inquiry on Climate Change recommendations also highlighted the importance of encouraging further uptake of cycling and improving accessibility of public transport. According to 2011 census data, over 7% of people in Warwick District utilise public transport to get to work and 13% people walk to work. Both these percentage modal shares are much higher than Warwickshire's average and this may be a reflection of the more urban nature of Warwick District.

Warwick District has five declared Air Quality Management Areas (AQMAs) and Stratford-on-Avon has two declared AQMAs. These AQMA's identify areas that are unlikely to met the National Air Quality objectives and act as a locality for targeted air quality action.

Key Milestones

South Warwickshire

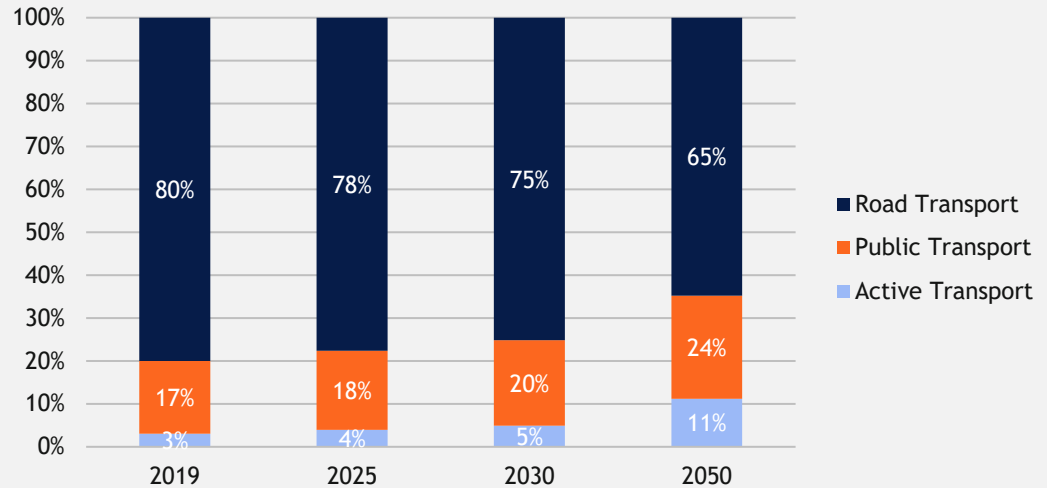


Figure 38 (above): Changes in mileage share for different modes of transport along the high ambition pathway. The data for 2019 is the national average mileage completed per person by each modal type (Source: Modal comparisons DfT).

Table 21:The modal split for journeys to work in Warwick District, Stratford-on-Avon District and the average across Warwickshire (Source: 2011 Census - Method of travel to work)

	Road Transport	Public Transport	Bicycle	On foot	Other method of travel
Warwick District	75.5%	7.7%	3.4%	12.9%	0.5%
Stratford-on-Avon District	81.3%	4.2%	2.4%	11.5%	0.6%
Warwickshire Average	80.9%	5.6%	2.5%	10.5%	0.5%

6.3 TRANSPORT
INTERVENTION MILESTONES

3. Switching to electric vehicles

One of the most important steps to reducing transport emissions in Warwick & Stratford-on-Avon District's is the transition to electric vehicles. As with other measures around electrification, the success of a borough-wide switch to EV relies heavily on grid decarbonisation and renewable electricity supply. Owing to the rural nature of both District's and the difficulties in serving public transport, this intervention can be suggested as a priority action.

Data from the DfT and the DVLA indicates that in 2019, 2.9% of newly licensed cars across Stratford-on-Avon were ULEVs and 3.2% of newly licensed cars across Warwick were ULEVs. The steady increase in ULEV uptake across both Districts is detailed in figure 40.

Warwick People's Inquiry on Climate Change recommendations support increased uptake of electric vehicles and highlights the need for charging infrastructure for households with no access to off road parking.

Transport glossary
ICE - Internal combustion engine (petrol and diesel vehicles)
HEV - Hybrid electric vehicle
ULEV - Ultra-low emission vehicle (currently defined as a vehicle which emits <75 gCO_2/km travelled).

Key Milestones

South Warwickshire

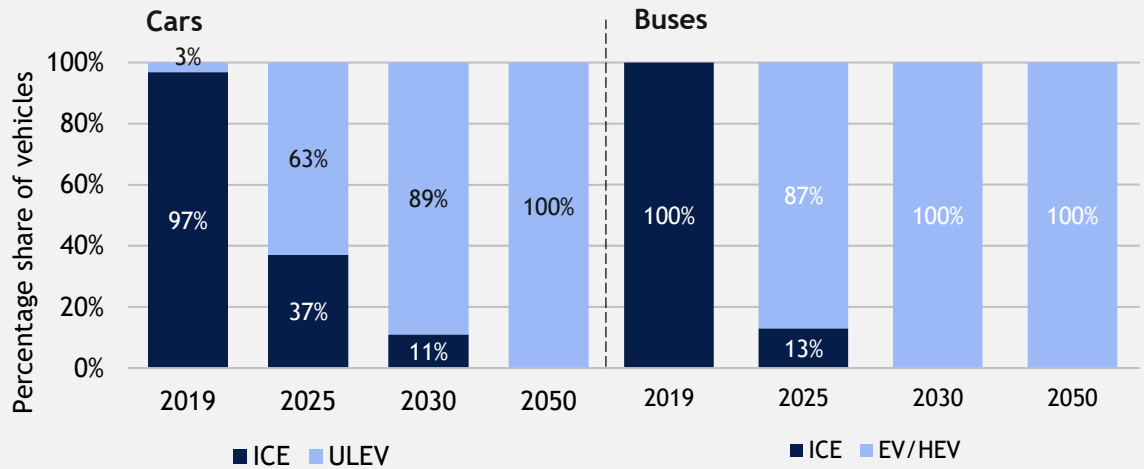


Figure 39 (above): Transitioning away from fossil-fuel powered road vehicles. All rail networks (not shown here) are electrified by 2025.

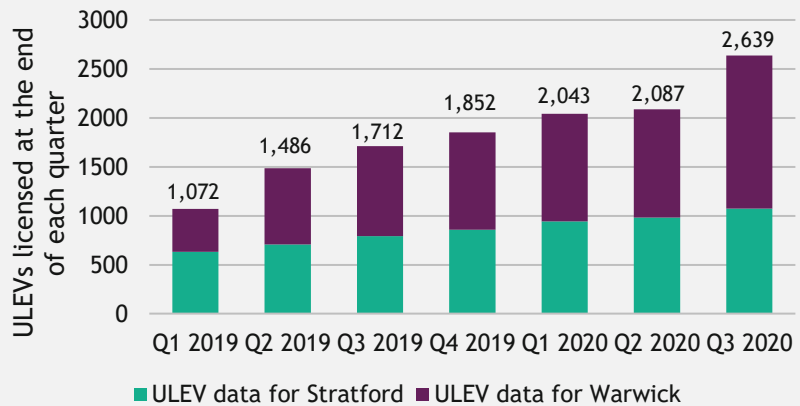


Figure 40: Number of ULEVs licensed at the end of each quarter across South Warwickshire (Source: DfT Licensed ultra low emissions vehicles by local authority VEH0132).

6.3 TRANSPORT
INTERVENTION MILESTONES

4. Improving freight emissions

Freight emissions are notoriously difficult to tackle, posing challenges both in terms of operational technology and emissions accounting. SCATTER operates on three metrics which reduce freight emissions:

1. Improved journey efficiency: reducing the mileage travelled by HGVs through more efficient infrastructure and fewer "empty-trailer" journeys.
2. Improved efficiency of freight vehicles themselves i.e., reduction in energy used per mile travelled as more fuel-efficient (and eventually electric) vehicles are used
3. A modal shift from road freight to waterborne transport

Warwickshire's central location within the country makes the area an attractive place for businesses and distribution hubs to locate, given the excellent road and rail links that exist. Warwickshire's Sustainable Freight Distribution Strategy also highlights that the West Midlands has a significant element of manufacturing, particularly in terms of exports, which generates large numbers of freight movements.

The West Midlands Freight Strategy identifies that freight transport is a major contributor to national carbon emissions and that local action at the major town or city level is likely to have the most impact. The Freight Strategy identifies involvement of the Local Enterprise Partnership's (LEPs) across the West Midlands to be particularly valuable.

Key Milestones

South Warwickshire

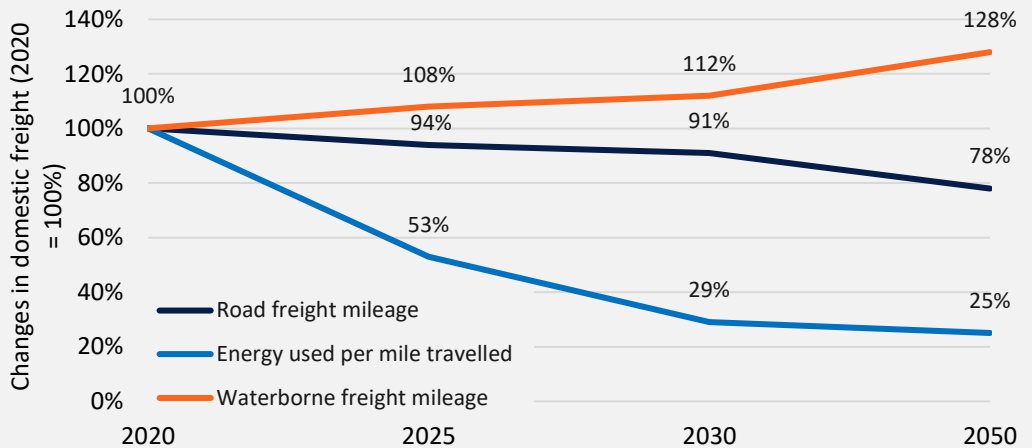


Figure 41: Improving freight emissions across three areas of activity. Percentage changes are relative to a 2020 baseline at 100%.

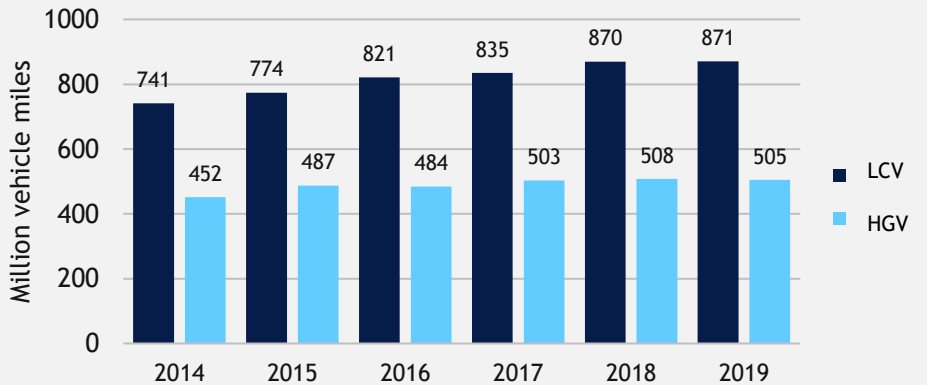


Figure 42: Light Commercial Vehicle (LCV) and Heavy Goods Vehicle (HGV) annual traffic across Warwickshire from 2014 - 2019, in million miles (Source: DfT Traffic by local authority TRA8903)

6.3 TRANSPORT
INTERVENTION MILESTONES

5. Reducing aviation emissions

Emissions from aviation account for 5.1% of South Warwickshire's emissions profile. These are composed of an estimated value of just under 400 tCO_2e scope 1 emissions from cargo aircraft at Coventry airport[1], and scope 3 cruise impact emissions which are allocated to all local authorities to account for passenger air travel. These scope 3 cruise impact emissions are based on the percentage of the population, assuming that flying is uniformly distributed across the whole UK population. Cruise tonnes of fuel consumed are calculated from the total impact of UK aviation using the BEIS fuel emission factors.

To model aviation emissions scenarios, SCATTER pathways uses the Department for Transport's UK Aviation Forecasts which are detailed in table 22. Figure 43 models the impact of these different aviation forecasts on South Warwickshire's emission pathway.

Whilst WDC and SDC may not have direct control over these emissions, combining the councils have a role in engaging with the public and key businesses to reduce emissions from these sources. Given that Birmingham Airport is the principal aviation facility for the West Midlands and serves a wide catchment area, both Council's can continue to work with Birmingham Airport to reduce emissions and support the airport's Sustainability Strategy to 2030.

Key Milestones

South Warwickshire

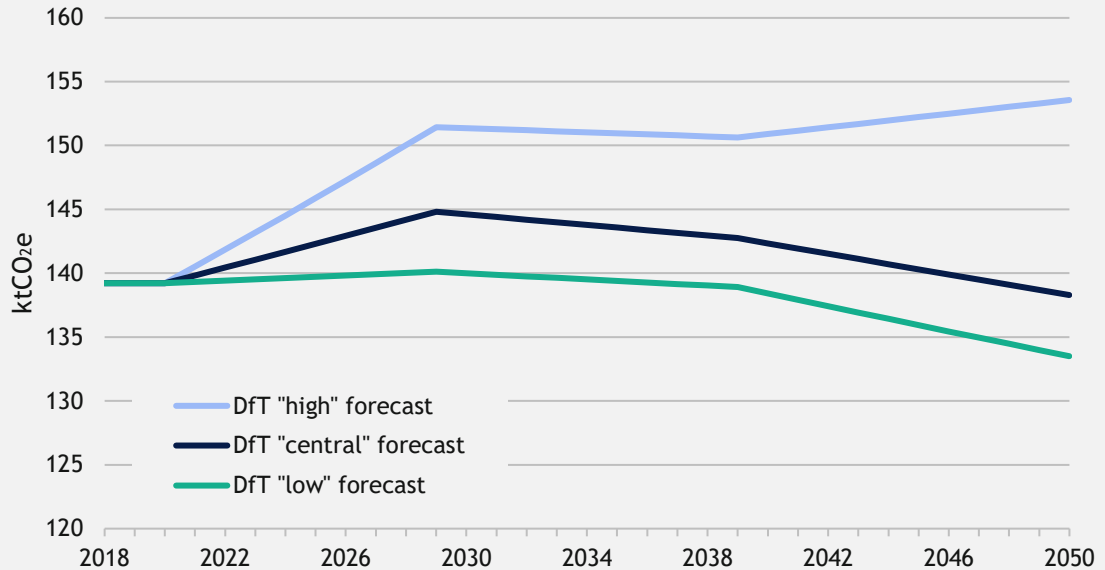


Figure 43: Modelled changes in South Warwickshire's High Ambition SCATTER pathway emissions under the DfT's low, central and high aviation emissions forecasts.

Table 22: DfT's growth forecasts for international aviation (Source: DfT UK Aviation Forecasts 2017)

DfT forecast	Scenario explanation
DfT "high" forecast	The "high" scenario projects higher passenger demand from all world regions, lower operating costs and a global emissions trading scheme.
DfT "central" forecast	The "central" forecast represents the DfT base-case.
DfT "low" forecast	The "low" forecast encapsulates lower economic growth worldwide with restricted trade, coupled with higher oil prices and failure to agree a global carbon emissions trading scheme.

[1] Air transport movements figure from Civil Aviation Authority (CAA) Air Transport Movement dataset for 2016 was used as no data was recorded for Coventry Airport in 2017.

6.3 TRANSPORT
LOCAL AND NATIONAL CASE STUDIES

Local Case Studies

In Warwick, 30 dual 'fast' electric charge points are being installed across the District in WDC car parks, funded as part of a county-wide bid under the On Street Residential Charging Scheme, expecting to be installed by Spring '21. In addition, 4 dual 'fast' on-street chargers will be installed.

South Warwickshire County Council have connected to the Switch and Save scheme through iChoosr which offers lowest price Electric Vehicle options for householders to help increase uptake of electric vehicles in the region. A county-wide Electric Vehicle Strategy will soon be released.

The Betterpoints reward scheme pilot is now operating again across Warwick, to encourage people to travel using sustainable transport with incentives such as high street vouchers.[1]

National Case Studies

Poundbury in Dorset is a development designed around people rather than cars. The key to its success is having a layout of connected streets coupled with offices, small shops, cafes and pubs integrated within homes. The effect is that Poundbury has an authentic small town feel rather than a car dependent suburb.[2]

Edinburgh City Council's Electric Vehicle Framework outlines that in residential developments where there are 10+ parking spaces, every 6 spaces should include an electric vehicle charging point. The policy also calls for provisions to be made for infrastructure to allow all new individual dwellings with a driveway or garage to have vehicle chargers in the future.[3]

Waltham Forest Council launched their 'mini-Holland' project after winning TfL funding in 2014, a bold initiative to improve air quality and reducing congestion. Over five years, Waltham Forest delivered substantial infrastructure changes throughout the borough, including the introduction of mod.[4]

6.4 Waste

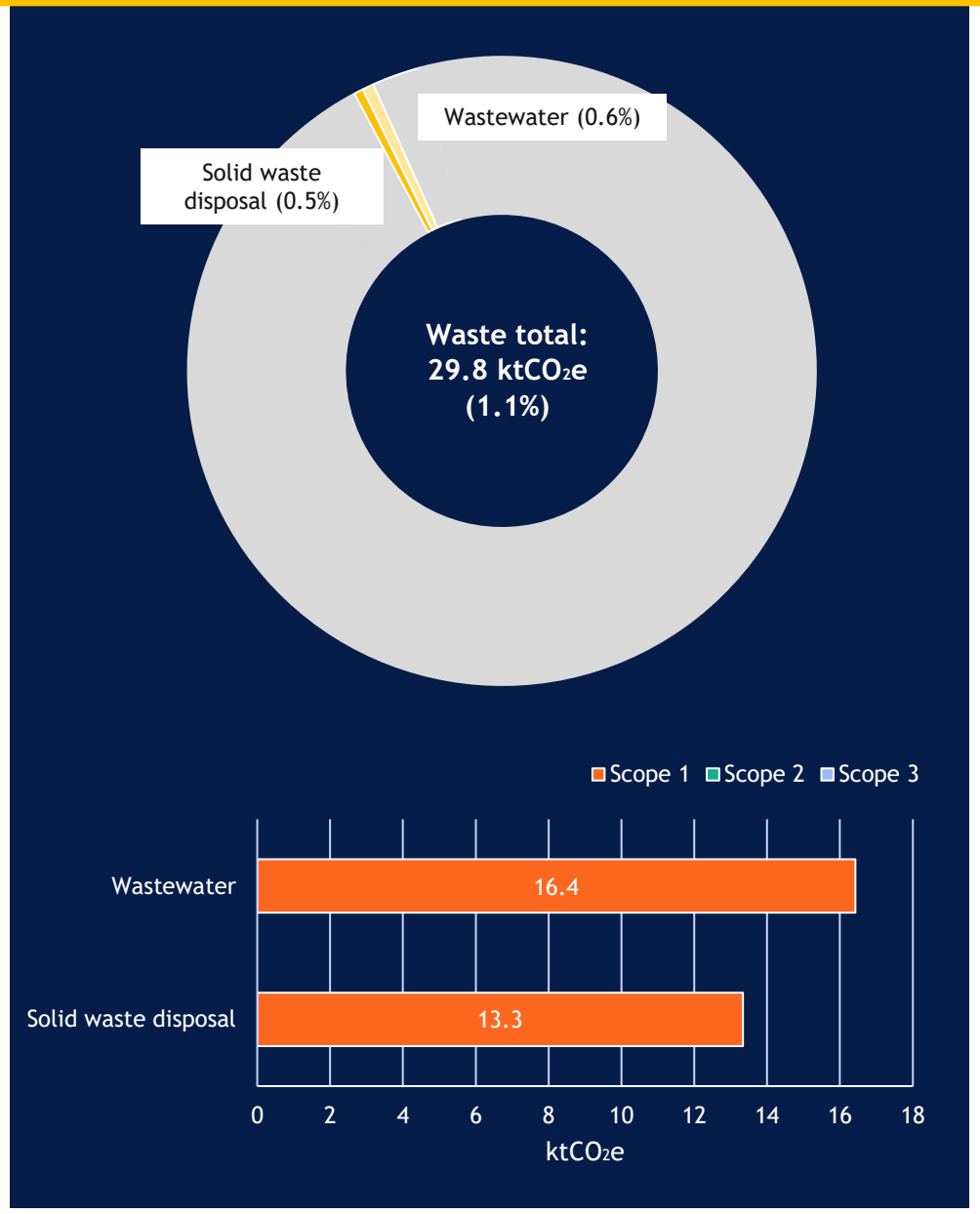
6.4 WASTE
CURRENT CONTEXT

Scope of section

Waste management represents a much smaller proportion of Warwick and Stratford-on-Avon's emissions than the sectors previously discussed, representing approximately 1% of South Warwickshire's total emissions. The waste measures described here relate to all waste streams; reuse, open and closed-loop recycling, combustion and composting & landfill. We can think of reducing the quantity of waste as a demand-side reduction, linking it to more efficient waste collections and saved costs associated with waste processing.

Green recovery considerations

- Research by WRAP indicated that 4 out of 5 individuals in the UK undertook additional food management behaviours during lockdown, which have endured to post-lockdown. Levels of food waste are higher among those returning to 'normal'.
- With the closing of household waste recycling centres, charity shops and the reduction or stoppage of local authority recycling services during lockdown, there has been a reported 300% increase in fly-tipping, with much recyclable waste a risk of ending up in landfill if people did not store recyclable waste at home.
- In the UK's first lockdown, commercial and industrial workplace waste reduced by 50% and municipal waste has increased by 20%. Recycling reportedly increased by 30%, likened to quantities in post-Christmas peak. Municipal waste's composition also experienced a change, with more glass, metal cans, carboard and plastic. As the UK transitions back to 'normal', municipal waste is expected to be 10% up on pre-COVID levels.



6.4 WASTE
KEY PLANS AND POLICY

National

- Our Waste, Our Resources: A Strategy for England (2018) sets out how the country will preserve resources by minimising waste, promoting resource efficiency and moving to a circular economy.
- Waste and Recycling: Making Recycling Collections Consistent in England (2019) The government are working with local authorities and waste management businesses to implement a more consistent recycling system in England. The measures are expected to come into effect in 2023.
- Waste Prevention Programme for England aims to supporting a resource efficient economy, reducing the quantity and impact of waste produced whilst promoting sustainable economic growth

Regional

- Warwickshire's Municipal Waste Management Strategy has objectives to reduce the amount of waste generated, to meet and exceed national re-use, recycling and composting targets and develop integrated, sustainable solutions for managing waste.
- The Warwickshire Waste Core Strategy 2013 – 2028 is a Development Plan Document which sets out the spatial strategy, vision, objectives and policies for managing waste across the County up to 2028.

Warwick and Stratford-on-Avon Districts

- Warwick District Council's Plastics Policy aims to reduce the use of plastics in its own operations and support the District to achieve plastic-free status.
- The Warwick Local Plan 2011-2029 aims for waste organisations to improve their infrastructure to meet current and future needs and for new development to provide for and encourage sustainable waste management.
- Both District Council's are in the procurement stages of a joint waste and recycling contract. Part of the new contract proposal includes the introduction of a joint 123+ service, moving to a 3-weekly collection of residual waste to encourage further recycling.

6.4 WASTE
INTERVENTIONS

Implementing the SCATTER interventions for waste at the highest ambition leads to:

41% reduction in emissions from waste by 2030

8 $ktCO_2e$ of waste emissions remaining in 2030

The following measures relate to emissions arising from in-boundary waste disposal. We can think of reducing the quantity of waste as a demand-side reduction, linking it to more efficient waste collections and saved costs associated with waste processing. Increasing the proportion of waste sent for recycling represents the second step in the process for mitigating emissions from waste disposal.

1. **Reducing the quantity of waste:** Considers changes in the overall weight of waste produced across all streams from domestic, commercial and industrial activity. Reducing the quantity of waste is a priority when examining the waste hierarchy: reduce, reuse, recycle.
2. **Increasing the recycling rate:** Considers the different destinations for waste streams, with the aim of less waste going to landfill.

The levels of activity described correspond with the High Ambition Pathway described on page 36. These targets represent the most ambitious within SCATTER. We can see the effects of these activities on overall emissions by looking at a sector-by-sector breakdown of the High Ambition Pathway (see below).

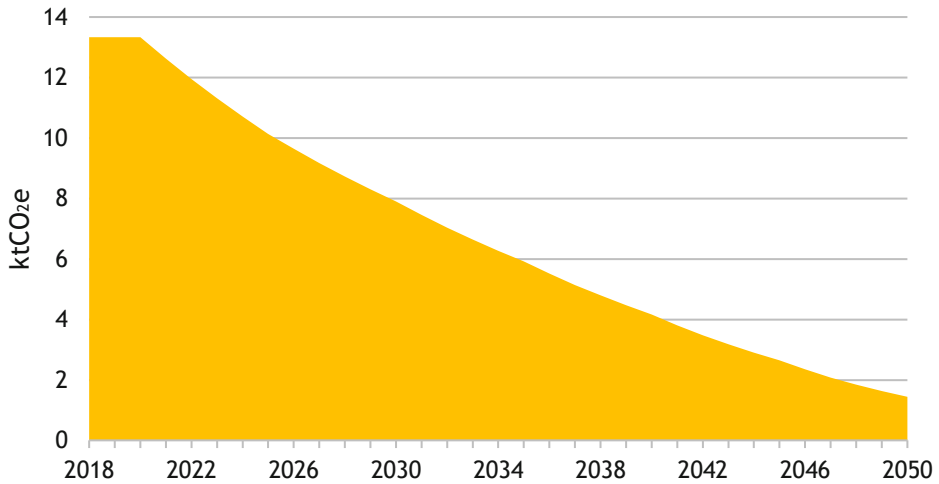


Figure 44: South Warwickshire's SCATTER High Ambition Pathway for waste.

6.4 WASTE
INTERVENTIONS SUMMARY

Table 23: Current context, intervention milestone at 2030 and associated cumulative emissions savings to 2030.

Intervention	Current Context 2020	By 2030	Cumulative emissions savings (2020-30)	
			Warwick	Stratford-on-Avon
Reducing the quantity of waste	Warwick: • 50,916 tonnes of household and 95 tonnes of non-household waste was collected by the District Council in 2018/19.[1] • The volume of household waste collected by the District Council started to decrease in 2017-18, falling by 3% from 2016-17 to 2018-19.[1] Stratford-on-Avon: • 55,905 tonnes of household and 156 tonnes of non-household waste was collected by the District Council in 2018/19.[1] • The volume of household waste collected by the District Council started to decrease in 2017-18, falling by 1% from 2016-17 to 2018-19.[1]	• 24% reduction in the volume of waste	Solid waste disposal: **4 $ktCO_2e$**	Solid waste disposal: **4 $ktCO_2e$**
Increasing the recycling rate	Warwick: • 1670 fly tipping incidents recorded in Warwick in 2018-19.[2] • The household recycling rate in 2018-19, based on Local Authority collected waste was 53.7%.[1] Stratford-on-Avon: • 364 fly tipping incidents recorded in Stratford-on-Avon in 2018-19.[2] • The household recycling rate in 2018-19, based on Local Authority collected waste was 59.6%.[1]	• 50% increase in recycling rate		

6.4 WASTE
INTERVENTION MILESTONES

1. Reducing the quantity of waste

The first step in improving emissions from waste is a reduction in the total volume of waste produced. This reduction covers waste from households, commercial & industrial usage, construction & demolition.

The DEFRA dataset on local authority collected waste identified that in Warwick District, each household generated an estimated 377kg of waste from April 2019 to March 2020. In Stratford-on-Avon, the average household generated 381kg of waste across the same period. In Warwick District, 53.8% of this household waste was sent for reuse, recycling or composting and this figure rose to 60.5% in Stratford-on-Avon District. Waste generation figures from 2017 – 2020 for both Districts are detailed in figure 46.

Local authorities have reported large increases in household waste arisings during the COVID-19 outbreak and huge falls in commercial waste arisings, according to the results of the ADEPT COVID-19 Waste Impacts Survey.

Warwick People's Inquiry on Climate Change recommendations highlighted the need for centralised systems to encourage reuse as a means to reducing waste to landfill. The High Ambition Pathway for reducing the quantity of waste is illustrated in figure 45.

Key Milestones

South Warwickshire

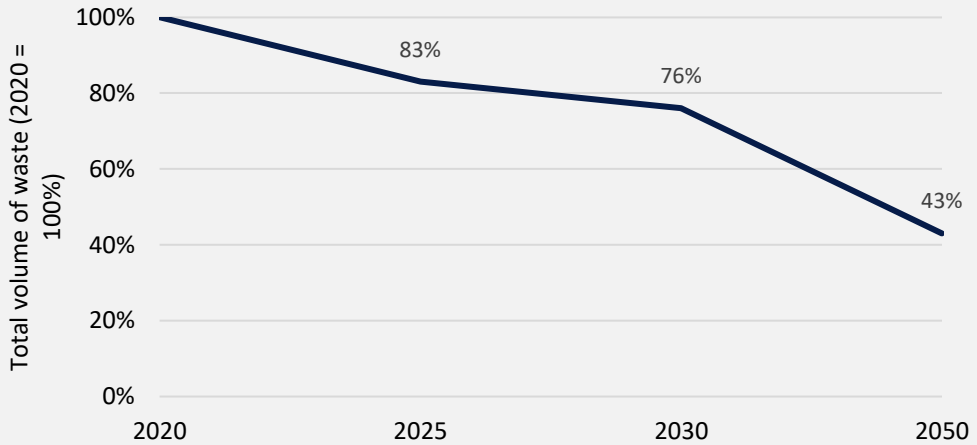


Figure 45: Reductions in the overall volume of waste produced across both Districts to align with the High Ambition Pathway.

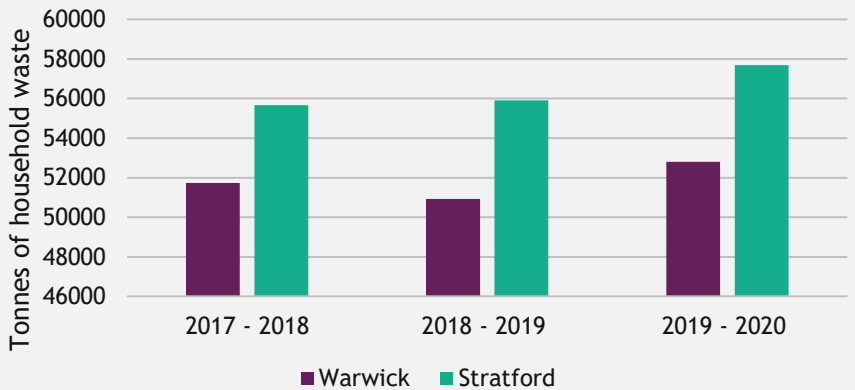


Figure 46: Local authority household collected waste generation from 2017 – 2020 (Source: Local authority collected waste: annual results tables).

6.4 WASTE
INTERVENTION MILESTONES

2. Increasing the recycling rate

After reducing the volume of waste outright, the second SCATTER intervention considers changes to the amount of waste that is recycled. SCATTER trajectories incorporate EU targets for recycling rates, with High Ambition projecting a more rapid transition to increased rates of recycling. The growth in recycling rate across South Warwickshire needed to follow the High Ambition Pathway is illustrated in figure 47.

Warwick People's Inquiry on Climate Change recommendations also highlighted the need for targeted recycling initiatives for high-rise residential buildings and other premises with central waste points, with access to community composting where possible. In addition, they recommended further support to businesses on sustainable packaging and waste management recommendations.

Key Milestones
South Warwickshire

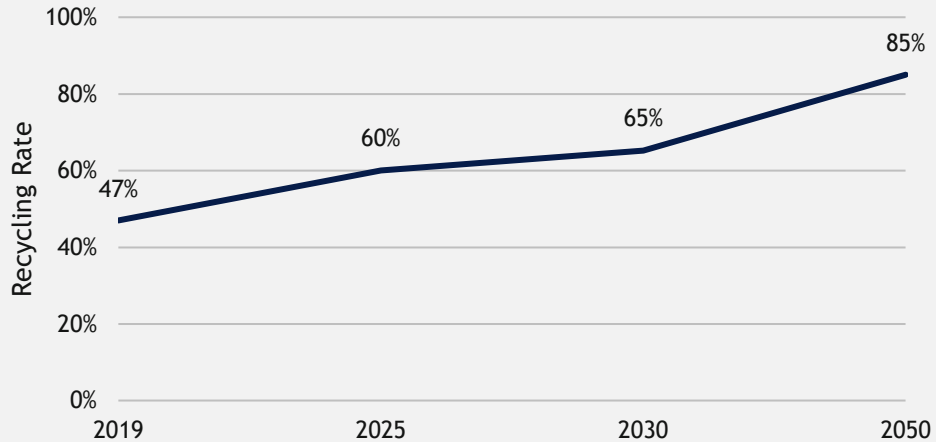


Figure 47: Growth in recycling rate across South Warwickshire utilising a baseline recycling figure of 47% for domestic and commercial waste in 2019/20.

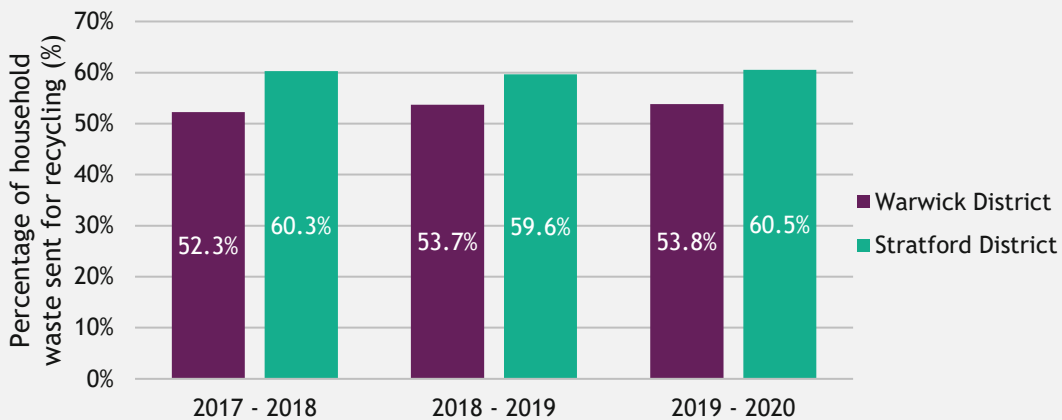


Figure 48: Local authority household waste sent for recycling, compositing or reuse from 2017 – 2020 (Source: Local authority collected waste: annual results tables).

6.4 WASTE
LOCAL AND NATIONAL CASE STUDIES

Local Case Studies

Warwick District Council is supporting local communities to mirror its Plastics Policy, which sets out how the Council is reducing single-use plastics.[1]

Warwickshire's first Repair café was launched in 2018 at the at the Sydni Centre in Sydenham. Volunteers ran repair stations with tools and kit available for visitors to fix broken items.[2]

Leamington and Warwick achieved plastic free community status through the SAS Plastic Free Communities movement in 2020. A five-point plan to reduce single-use plastic was put in place through collaboration between 30 businesses, organisations and community groups. Objectives included setting up a community-led steering group and developing a Plastic Free Schools education programme.[3]

National Case Studies

Cheshire West & Chester Council has finished top of the Eunomia Recycling Carbon Index 2020, making it the highest scoring council in England, Wales and Northern Island in terms of avoided carbon emissions in 2018/19. Cheshire West & Chester Council saved 120kg CO2e per capita and improved performance was largely due to a 3% increase in curbside collected recycling tonnage.[4]

London's Library of Things project promote a 'borrow not buy' movement for rarely-used items to discourage waste. 80% of household items are used less than once per month and 90% of borrowers say they now have more money to spend on things important to them. The most popular items to borrow at the London Library of Things are sewing machines, bread makers, steam cleaners and cordless hedge trimmers.[5]

6.5 Industry

6.5 INDUSTRY
CURRENT CONTEXT

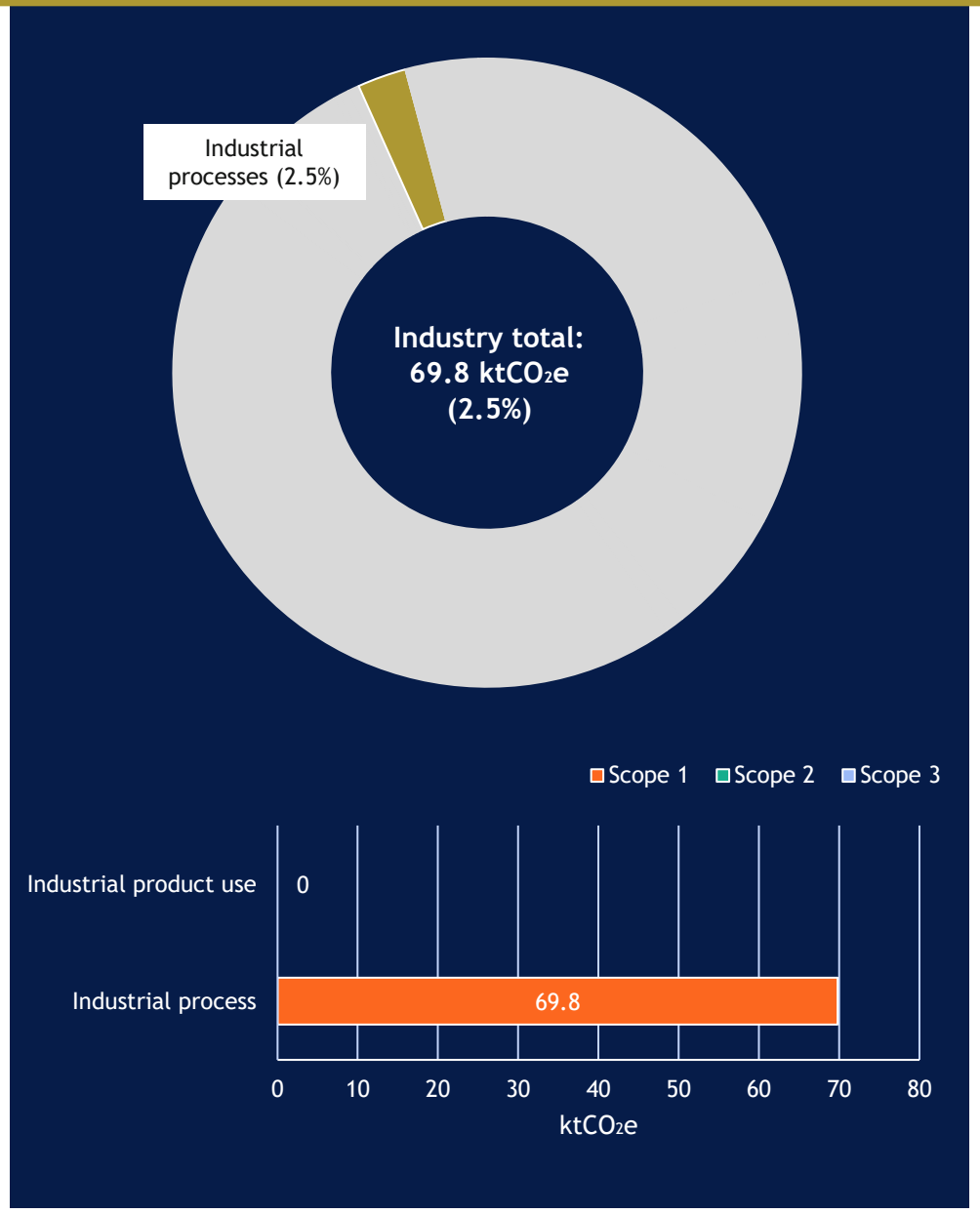
Scope of section

Industrial process emissions, like those arising from waste, represent a much smaller proportion of South Warwickshire's baseline inventory, with around 2.5% of emissions as a result of industrial processes. Tackling industrial emissions can be extremely challenging, particularly the decarbonisation of very energy-intensive processes and reducing the emissions from the processes themselves.

The emissions associated with industrial buildings are considered as part of the non-domestic buildings sector as a form of stationary energy. Therefore, this section relates to emissions arising directly from industrial processes where materials are chemically or physically transformed. Examples of industrial processes include production and use of mineral products; production and use of chemicals and production of metals. Further information on the emission sources included under these sectors can be viewed in the GHG Protocol for Cities.

Green recovery considerations

- Point 8 of The 10 Point Plan for a Green Industrial Revolution outlines the Government's ambition to capture 10Mt of carbon dioxide a year by 2030 using Carbon Capture, Usage and Storage (CCUS) technologies. The Government aims to establish CCUS in two industrial clusters by mid 2020s and will aim for four of these sites by 2030.
- The UK Climate Change Committee's (CCC) Sixth Carbon Budget states that Carbon Capture and Storage should be applied to the manufacturing & construction sector at scale in the 2030s. The Budget also states that front-loaded investment in the 2020s will be required to realise a biodegradable waste landfill ban by 2025. There are no noted current plans to achieve this.



6.5 INDUSTRY
KEY PLANS AND POLICY

National

- The UK's Industrial Strategy one of the grand challenges set is clean growth and maximising the advantages for UK industry.
- The Clean Growth Strategy includes improving business and industry efficiency. Alongside the strategy, BEIS published joint industrial decarbonisation and energy efficiency action plans with seven of the most energy intensive industrial sectors, including the food and drink sector.
- Ten Point Plan for a Green Industrial Revolution includes plans to invest in carbon capture for industries that are particularly difficult to decarbonise.

Regional

- The West Midlands Local Industrial Strategy outlines low carbon technology as a sector strength of the area and commits to demand side management and to deliver new approaches to clean energy generation.
- The Coventry & Warwickshire Local Enterprise Partnership (CWLEP) outlined in its Annual Review 2020 that 61 businesses in the area had joined the Green Business Network, providing opportunities for energy efficiency and low carbon innovation.
- Warwickshire County Council's Economic Growth Strategy 2020-25 has a green and sustainable economy and helping businesses to transition to the low-carbon economy as one of its priorities.

Warwick and Stratford-on-Avon Districts

- The Stratford-on-Avon District Council Local Industrial and Economic Development Strategy 2018-2031 outlines the increasing demand for electricity due to the digitalisation of the economy as a challenge.
- The Stratford-on-Avon District Council Local Industrial and Economic Development Strategy 2018-2031 also outlines how it aims to improve energy supply through encouraging the growth of low-carbon technologies and the efficient use of resources.

6.5 INDUSTRY INTERVENTIONS

Implementing the SCATTER interventions for industry at the highest ambition leads to:

63% reduction in emissions from industry by 2030

26 $ktCO_2e$ of industry emissions remaining in 2030

The industrial sector represents a relatively small proportion of emissions in Warwick and Stratford, and most of the action in this area will be delivered though the Coventry & Warwickshire LEP (CWLEP) and West Midlands Combined Authority (WMCA). The following industrial measures are defined within the SCATTER tool:

1. **Shifting from fossil fuels:** Considers change to the energy consumption in industrial processes and activity. Trajectories measures the changing fuel used – and what proportion of processes can be powered with electricity and natural gas rather than heavier oil fuels.
2. **More efficient processes:** Considers annual reductions in process emissions via a reduction in the production index of various industries. Separate trajectories are included for chemical, metal, and mineral sectors, with all other industrial activity grouped together (labelled as "other industry").

The levels of activity described correspond with the High Ambition Pathway described on page 36. These targets represent the most ambitious within SCATTER. We can see the effects of these activities on overall emissions by looking at a sector-by-sector breakdown of the High Ambition Pathway (see below).

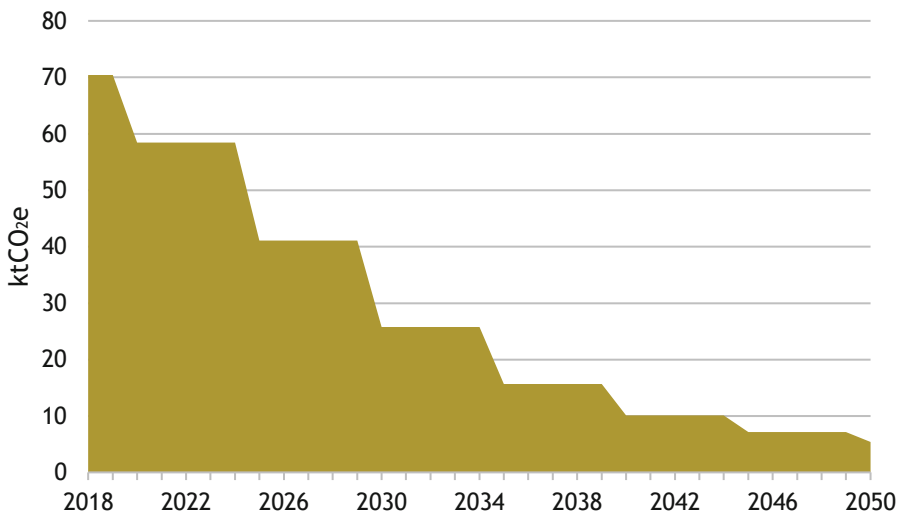


Figure 49: SCATTER High Ambition Pathway, broken down by sector. Domestic building emissions are highlighted in dark orange and Non-Domestic building emissions are highlighted in light orange.

6.5 INDUSTRY
INTERVENTIONS SUMMARY

Table 24: Current context, intervention milestone at 2030 and associated cumulative emissions savings to 2030.

Intervention	Current Context 2020	By 2030	Emissions savings per subsector (2020-30)	
			Warwick	Stratford-on-Avon
Shifting off fossil fuels	• In the UK, 35% of energy consumed by the industrial sector in 2019 was electric.[1]	• 14% reduction in oil fuel usage • 3% increase in electricity consumption • 10% increase in the use of natural gas	• Industrial buildings & facilities (also includes savings from building fabric improvements): **103 $ktCO_2e$** • Industrial processes: **29 $ktCO_2e$**	• Industrial buildings & facilities (also includes savings from building fabric improvements): **91 $ktCO_2e$** • Industrial processes: **51 $ktCO_2e$**
More efficient processes	• Industrial carbon emissions in the UK including those from energy-intensive industries have halved since 1990, which has mainly been due to efficiency gains, fuel switching, a change to industrial structure of the UK and re-location of production overseas.[2] • Since 1990 the chemical sector has improved its energy efficiency by 35%.[3]	Process emissions reduced: • 14% for chemicals • 10% for metals • 11% for minerals • 50% for other industries		

6.5 INDUSTRY
INTERVENTION MILESTONES

1. Shifting from fossil fuels

This intervention considers changes to the energy consumption in industrial processes, with the trajectories focused on the electrification of industry. For the chemicals, metals and minerals industries, SCATTER models the changing use of fuels for these processes, shifting off the most carbon-intensive fuels (i.e., fuel oil) in favour of transition fuels such as natural gas and electricity. Progress to date indicates that in the UK, 35% of energy consumed by the industrial sector in 2019 was electric.[1]

The West Midlands Local Industrial Strategy outlines the development of low carbon technology and clean energy generation as a priority for industry across the West Midlands. Working collectively with the CWLEP, WDC and SDC can support businesses with accessing regional and national funding for low to zero carbon product and process development for small-scale industry.

Key Milestones

South Warwickshire

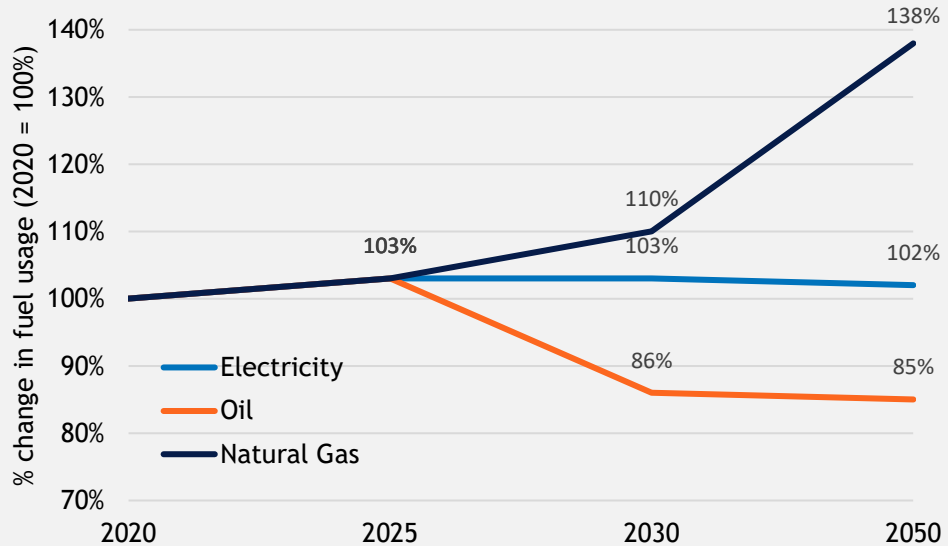


Figure 50: Modelled changes in fuel consumption for industrial processes and activities

Table 25: Intervention milestones for shifting from fossil fuels within industry

Year	Milestone required to achieve High Ambition Pathway
2025	Electricity consumption increased by 3%; oil consumption increased by 3%; natural gas consumption increased by 3%
2030	Electricity consumption increased by 3%; oil consumption reduced by 14%; natural gas consumption increased by 10%
2050	Electricity consumption increased by 2%; oil consumption reduced by 15%; natural gas consumption increased by 38%

[1] DUKES Energy Consumption by final user

6.5 INDUSTRY
INTERVENTION MILESTONES

2. More efficient processes

This intervention considers the growth of different industries' greenhouse gas emissions that result from the industrial processes themselves. Process emissions arise form the manufacture and/or production of materials, chemicals and other products e.g. through combustion. As with some freight emissions, the direct impact of certain industries within both Districts is limited but are given here to illustrate the necessary actions in the industrial sector.

Separate trajectories are included for chemical, metal and mineral sectors, with all other industrial activity grouped together (labelled as "other" industry).

WDC and SDC can ensure that the Council has a programme in place for supporting efficiency improvements within local industry. Across both Districts, businesses need to review procurement policies and ensure products and services are sourced with a view of reducing overall supply chain emissions. Following this, businesses can identify areas where efficiencies in production can be improved, such as the adoption of a circular economy model.

Key Milestones

South Warwickshire

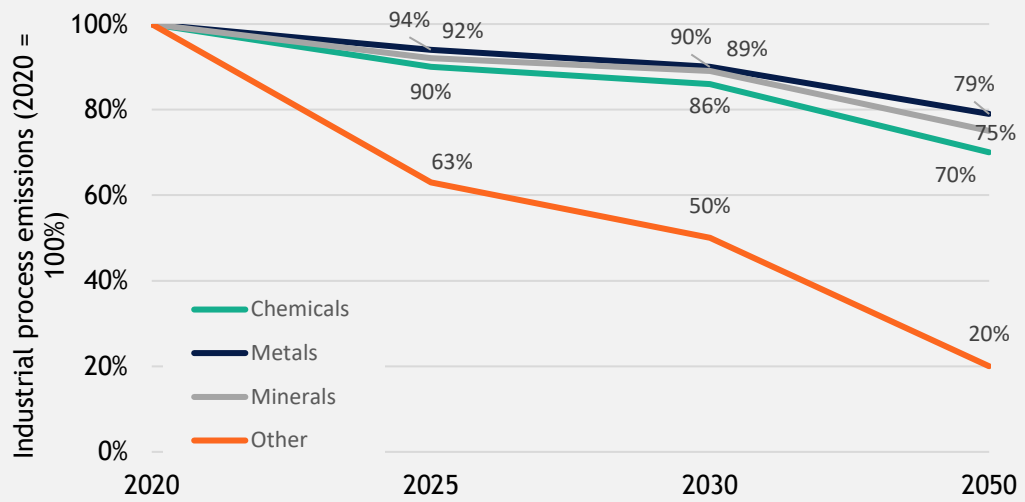


Figure 51: Modelled changes in fuel consumption for industrial processes and activities

Table 26: Intervention milestones for shifting from fossil fuels within industry

Year	Milestone required to achieve High Ambition Pathway
2025	Process emissions from chemical industries reduced by 10%, metals industries reduced by 6%, minerals industries reduced by 8% and other industries reduced by 37%
2030	Process emissions from chemical industries reduced by 14%, metals industries reduced by 10%, minerals industries reduced by 11% and other industries reduced by 50%
2050	Process emissions from chemical industries reduced by 30%, metals industries reduced by 21%, minerals industries reduced by 25% and other industries reduced by 80%

6.5 INDUSTRY
LOCAL AND NATIONAL CASE STUDIES

Local Case Studies

Balfour Beatty are using EcoNet, a system which autonomously manages power demand on construction sites traditionally powered by the National Grid and diesel generators, at its Long Itchington site in Warwickshire. The system is expected to reduce the emissions of individual sites by up to 80%.[1]

Figure 52: Image of HS2's extensive Long Itchington Wood Tunnel construction site.

National Case Studies

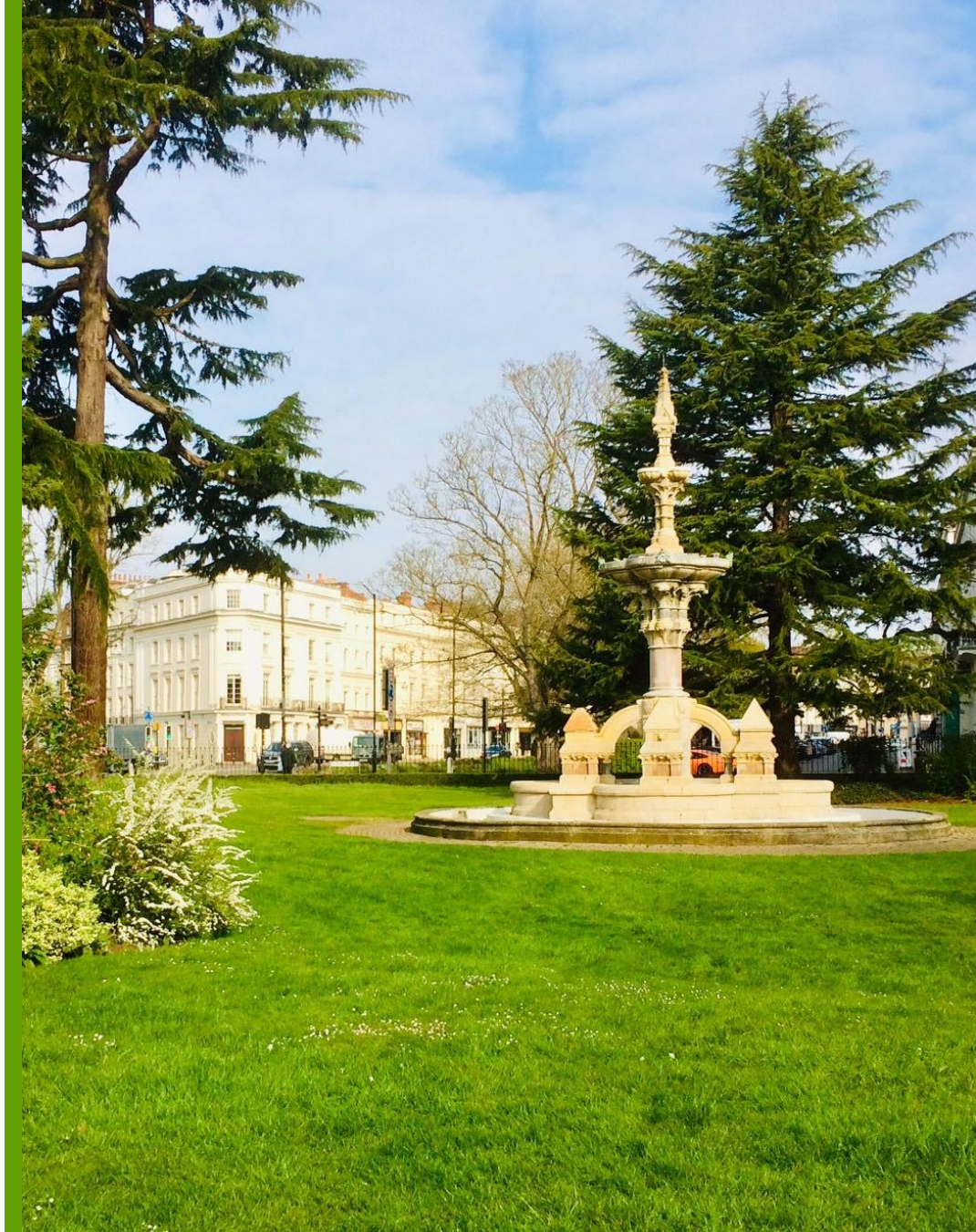
Teesside Collective is a collective project aimed to create one of Europe's first clean industrial zones. The area has one of the highest concentrations of industry in the country and the cluster of industries are working together to develop carbon capture and storage. The group is made up of five large industrial companies in the region and has the potential to help to retain the UK's industrial base, attract new investments and jobs as well as meet the UK's climate change targets.[2]

The City of Manchester have used their borough-wide target as a short-hand way of indicating the scale of change needed for a variety of suppliers, businesses and organisations within the city. Some businesses have subsequently sought a SBTi certified target aligned with the city's ambition.[3]

The Zero Carbon Humber Partnership aims to build a net-zero industrial cluster whilst delivering economic growth. The partnership hopes to develop carbon capture usage and storage, low carbon hydrogen technology and shared regional pipelines and infrastructure.[4]

6.6 Natural Environments

Anthesis



6.6 NATURAL ENVIRONMENTS
CURRENT CONTEXT

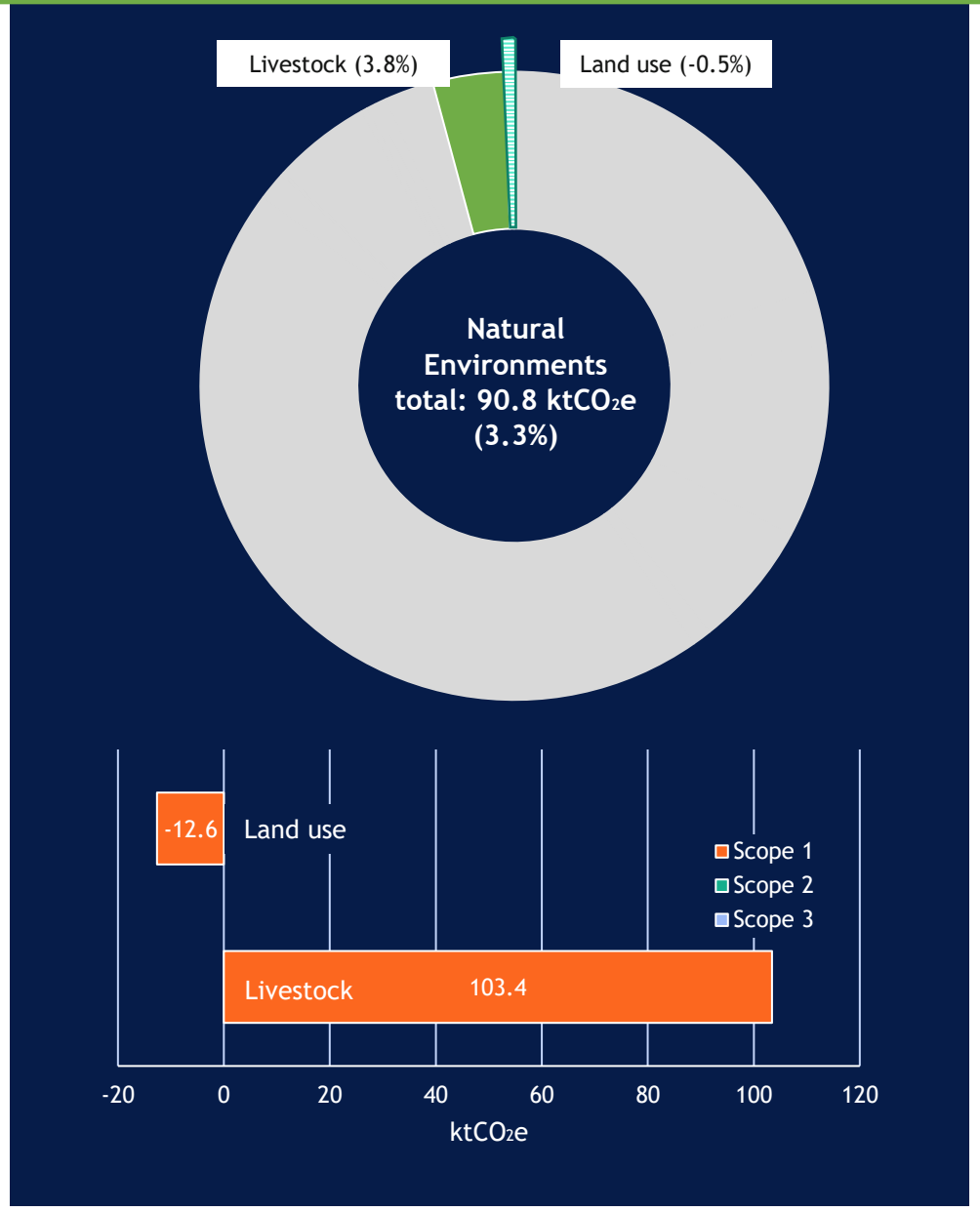
Scope of section

The use of green spaces and the natural environment has a significant role in acting as a carbon "sink" – meaning that it removes carbon emissions from the atmosphere in the form of trees and other natural features. Management of natural infrastructure also forms an important part of achieving significant co-benefits across South Warwickshire, in terms of net biodiversity gain, improved air quality and improving quality of place.

The net contribution of natural environment emissions to South Warwickshire's overall emissions total is relatively small at 3%. As highlighted in Chapter 3, most of these emissions originate from livestock within Stratford's district boundary. Both Districts have committed to increasing tree coverage, with SDC looking to the Woodland Trust model for a tree planting scheme and WDC committing to planting 160,000 trees, one for every citizen in Warwick District, by 2030.

Green recovery considerations

- Point 9 of the UK's 10 Point Plan for a Green Industrial Revolution details the establishment of 10 long-term Landscape Recovery projects over the next four years and a New Environmental Land Management scheme which will incentivise land management actions such as tree planting and peatland restoration.
- £40 million Green Recovery Challenge Fund available for environmental charities to work on projects which contribute to nature conservation and restoration; nature-based solutions; or connecting people with nature.
- UK Government pledge in 2020 to re-forest Britain and plant 75,000 acres of trees per year by 2025.



6.6 NATURAL ENVIRONMENTS
KEY PLANS AND POLICY

National

- The 25 Year Environment Plan includes commitments to create new forests/woodlands, incentivise tree planting, explore innovative finance; and increase protection of existing trees
- Land use: Policies for a Net Zero UK (2020) includes converting 22% of agricultural land (mostly from livestock) to forestry
- Woodland Trust Emergency Tree Plan recommends Local Authorities write an Emergency Tree Plan and set targets for tree planting.

Regional

- The Warwickshire, Coventry and Solihull Green Infrastructure Strategy provides an evidence base to assist plans, policies and strategies to achieve a diverse and well-managed green infrastructure network across the region.
- The Warwickshire, Coventry and Solihull Green Infrastructure Strategy also identifies green infrastructure assets and provides recommendations for their protection and enhancement.

Warwick District

- The Warwick Local Plan 2011-2029 requires new development to provide green infrastructure, such as parks and open spaces, and allocates land for a Country Park as a multifunctional green infrastructure asset.
- The Warwick Local Plan 2011-2029 also states the Council's intention to protect, enhance and restore the district's green infrastructure.
- Warwick District Council's Tree and Woodland Strategy aims to provide a sustainable, high quality tree population which is protected and maintained to a high standard.
- The Trees for our Future planting project is in development.

Stratford-on-Avon District

- The Stratford-on-Avon District Core Strategy 2011-2031 states that development should maximise opportunities for green infrastructure to assist in climate adaptation.
- The Stratford-on-Avon District Core Strategy 2011-2031 also states that the existing green infrastructure network will be promoted and enhanced to contribute to climate adaptation measures such as carbon sinks.
- The Climate Change Adaptation and Mitigation Supplementary Planning Document details the measures expected from development in line with the Core Strategy, such as community food growing and hedgerow restoration.

6.6 NATURAL ENVIRONMENTS INTERVENTIONS

Implementing the SCATTER interventions for natural environments at the highest ambition leads to:

9% reduction in emissions from natural environments by 2030

83 $ktCO_2e$ of natural environment emissions remaining in 2030

As discussed in Chapter 3, the use of green spaces and the natural environment has a significant role in acting as a carbon "sink". SCATTER's modelling in this area is distinct from the CCC scenarios. The interventions modelled by SCATTER include:

1. **Increased tree coverage & tree planting:** Increasing tree coverage considers the increase in the proportion of land which is forest cover. Tree planting considers the changes to the coverage of trees outside of woodland, through new trees being planted and maintenance of existing trees.
2. **Land use management:** Considers changes to the green belt, grassland and cropland coverage.
3. **Livestock management:** Considers changes in the number of livestock in the area (cattle, pigs, sheep and horses). Changes to farming practices, health & fertility of stock, feed conversion rations etc are not considered.

Warwick People's Inquiry on Climate Change recommendations also highlighted the need for increased green spaces, native trees and shrubs in council-owned green and currently unused areas, which will aid natural carbon capture and improve local biodiversity.

The levels of activity described correspond with the High Ambition Pathway described on page 36. These targets represent the most ambitious within SCATTER. We can see the effects of these activities on overall emissions by looking at a sector-by-sector breakdown of the High Ambition Pathway (see below).

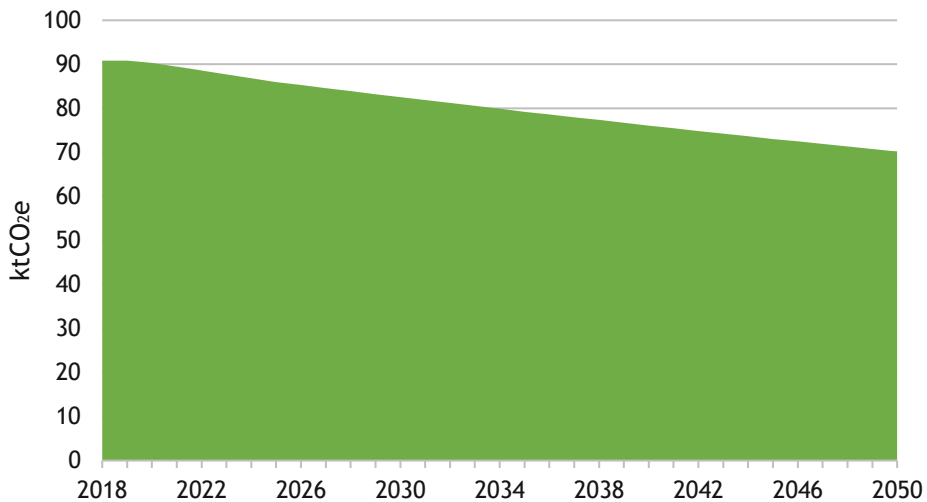


Figure 53: SCATTER High Ambition Pathway, broken down by sector. Emissions from the natural environment are shown in green.

6.6 NATURAL ENVIRONMENTS
INTERVENTIONS SUMMARY

Table 27: Current context, intervention milestone at 2030 and associated cumulative emissions savings to 2030.

Intervention	Current Context 2020	By 2030	Emissions savings per subsector (2020-30)	
			Warwick	Stratford-on-Avon
Forest coverage & tree planting	Warwick: • Warwick (parliamentary constituency) is estimated to have over 19,000 individual trees in parks and open spaces. [1] • Warwick has committed to planting 160,000 trees over the coming years. [1] Stratford-on-Avon: • Stratford-on-Avon (parliamentary constituency) is estimated to have 5.9% woodland cover[2]	• 24% increase in forest coverage	• Land use: **7 $ktCO_2e$**	• Land use: **17 $ktCO_2e$**
Land management	• In 2018, there was approximately 176.1 ha of rough grassland in Warwick.[3] • In 2018, there was approximately 478 ha of rough grassland in Stratford-on-Avon.[3]	• Maintaining existing green spaces		
Livestock management	• 67.5% of land in Warwick is classed as agricultural.[3] • 80% of land in Stratford-on-Avon is classed as agricultural.[3]	• 12% decrease in livestock numbers	• Livestock: **6 $ktCO_2e$**	• Livestock: **35 $ktCO_2e$**

6.6 NATURAL ENVIRONMENTS
INTERVENTION MILESTONES

1. Increased tree coverage & tree planting

Tree coverage and the associated sequestration potential has been separated out into “forest coverage” and “lone trees”. Forest coverage relates to areas of trees which can be defined as such by a land use map. The ability of existing forest stocks to continually sequester carbon is expected to weaken in the future due to the aging profile of trees.

Lone trees instead relate to smaller wooded areas, hedgerows, trees contained within gardens and so on.

The sequestration potential of carbon dioxide per hectare of trees is estimated from a typical tree whose canopy coverage extends to 25m^2, for which the lifetime uptake of carbon is around 750kgCO_2.

Table 28: Forest coverage and tree planting outside of woodlands at present and 2030.

Year	Forest coverage	Tree planting outside woodlands (including lone trees, hedges, and small woodlands)
Current	The 2019 Woodland Trust Survey, which is broken down by parliamentary constituency, indicates a woodland coverage of 7.7% in Kenilworth & Southam, 3.6% in Warwick & Leamington and 5.9% in Stratford-on-Avon.	Tree planting outside woodlands is currently reported at around 7,100 hectares across South Warwickshire.
2030	The SCATTER high ambition pathway suggest a 24% increase in forest cover by 2030.	Tree planting outside woodlands increases by 30% from 2020 coverage to 9,230 hectares.

South Warwickshire Forest Coverage

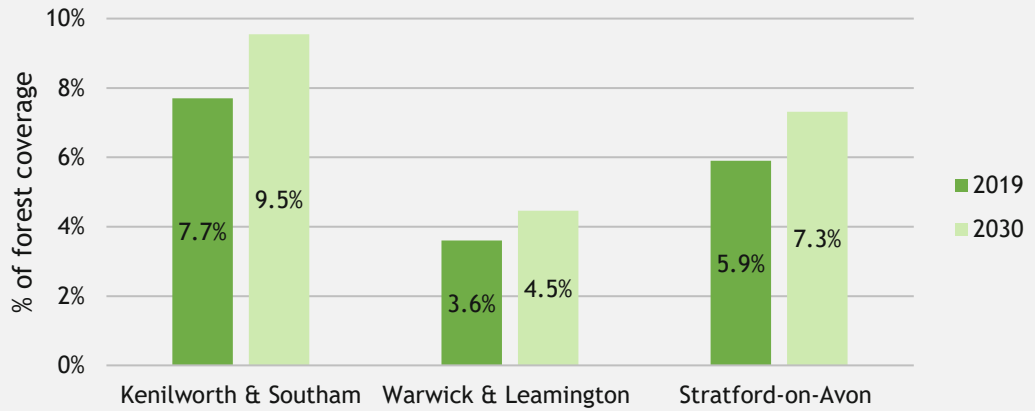


Figure 54: SCATTER High Ambition Pathway milestones for 2030 forest coverage based on a 2019 baseline of woodland coverage by parliamentary constituency (Source: 2019 Woodland Trust Survey).

South Warwickshire Lone Tree Coverage

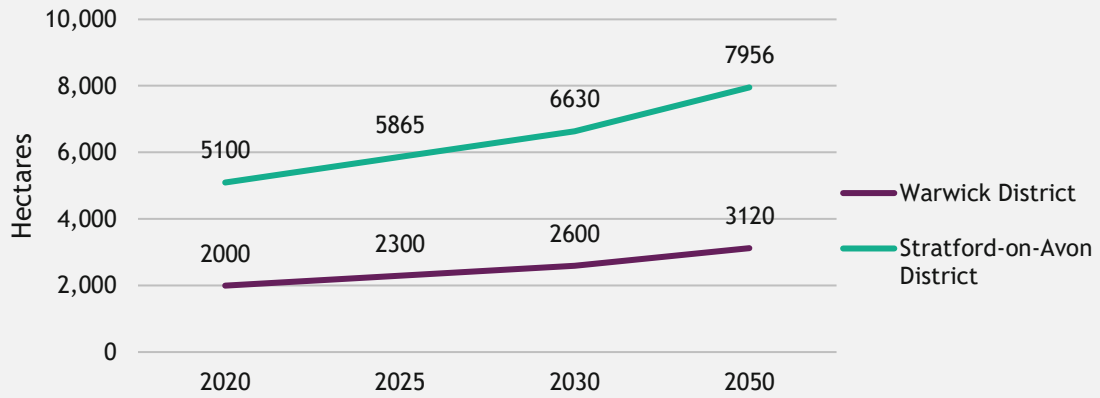


Figure 55: SCATTER High Ambition Pathway milestones for tree planting outside of woodlands (including lone trees, hedges and small woodlands).

6.6 NATURAL ENVIRONMENTS
INTERVENTION MILESTONES

2. Land use management

Land use change is modelled as a transition from open grassland and cropland to land which can be used to sequester greater levels of carbon. The land use trajectories from DECC 2050 emissions calculator have been mapped to Warwick District.

A more detailed breakdown of Stratford-on-Avon's emissions reduction scenarios can be found in Chapter 3 on page 25 and 26.

Key Milestones
Warwick District

Table 29: Intervention milestones for land use management for Warwick District.

Year	Milestone required to achieve High Ambition Pathway
2025	Maintaining existing green spaces
2030	By 2030, there is a 2% decrease in grassland and 5% increase in cropland to increase forestland and carbon sequestration potential
2050	Maintain existing green spaces

Other research on land-use

The Committee on Climate Change (CCC) report on land use highlights the fundamental role of land as a natural asset and its provision of our food, clean water and natural regulation of the environment.

The report also recognises that the current approach to land use is not sustainable once the growth of the UK population and the associated per capita food production is considered. These concerns, coupled with the need to respond to climate change, have encouraged a future land strategy for the UK which is mindful of the current contexts around agriculture whilst securing long-term sustainability and meeting climate goals.

CCC analysis balances the need to reduce land-based emissions with other essential functions of maintaining food production and the agricultural industry. Their key actions are based around transitioning to low-carbon farming practices, restoring carbon-sequestering natural habitats such as peatlands and afforestation and agro-forestry.

Specific recommendations call for coordination between landowners and land managers in terms of investment, innovation and farming practices. By adopting more ambitious land use strategies, the proportion of carbon sequestered by the natural environment can grow significantly and enable Warwick & Stratford to meet their carbon reduction goals. Further discussion of land use within Stratford can be found in Chapter 3.

6.6 NATURAL ENVIRONMENTS
INTERVENTION MILESTONES

3. Livestock management

SCATTER models livestock numbers based on scenarios from the DECC 2050 emissions calculator. These scenarios assume different priorities for the future of agriculture, with the High Ambition pathway forecasting a shift away from livestock. This shift could be underpinned by behavioral changes to diet or a switch to less land-intensive meats such as chicken.

SCATTER plots these emissions in terms of outright livestock numbers and does not explicitly consider changes to specific farming practices such as nitrogen usage, or feed conversion ratios.

The intervention milestones for livestock needed to progress along the High Ambition Pathway for Warwick are identified in figure 56. Chapter 3, page 25, details livestock emissions scenario reductions for Stratford-on-Avon.

Table 30: Current livestock emissions figures across Warwick District.

Livestock type	Current emissions contribution across Warwick District ($ktCO_2e$) [1]
Dairy Cattle	5.02
Non-Dairy Cattle	7.56
Sheep	3.15
Pigs	0.31
Poultry	0.03

Key Milestones

Warwick District

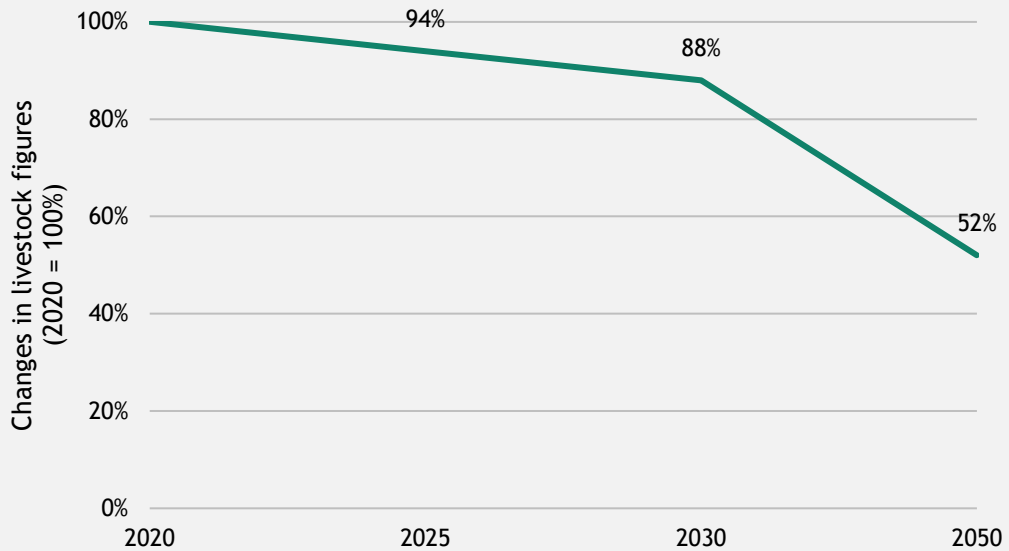


Figure 56 (above): Reduction in livestock figures following a High Ambition emissions reduction pathway for Warwick District.

Table 31: Intervention milestones for livestock management for Warwick District.

Year	Milestone required to achieve High Ambition Pathway
2025	By 2025, there is a 6% reduction of dairy cow and other livestock
2030	By 2030, there is a 12% reduction of dairy cows and other livestock
2050	By 2050, there is a 48% reduction of dairy cows and other livestock

[1] Livestock emissions data taken from Warwick's SCATTER Inventory baseline

6.6 NATURAL ENVIRONMENTS
LOCAL AND NATIONAL CASE STUDIES

Local Case Studies

Warwickshire County Council is offering schools, colleges and community groups free tree-planting kits from the Woodland Trust to create a variety of new wooded areas and extensive habitats for animals.[1]

Wildlife Ways is increasing the amount of green infrastructure in Solihull through tree and hedgerow planting, the creation of wildflower areas and ornamental planting.[2]

Coventry City Council is planting 3,000 new trees between Park Wood and Ten Shilling Wood, connecting the Local Nature Reserves across land which is currently grassland. The project will contribute to the Council's target to plant a tree for every citizen. [3]

National Case Studies

Greater Manchester City of Trees is a leading example of how a tree planting project can address climate change objectives whilst engaging the local community and providing numerous co-benefits. So far, the initiative has planted 459,929 trees and involved 12,538 people. It is aiming to plant 3 million trees and bring 2,000 hectares of unmanaged woodland back into community use.[4]

Nottingham's Good Food Partnership, which was part funded by Nottingham City Council, work to promote the sustainability of Nottingham's local food system and work towards a circular food economy, reducing the ecological footprint of the food system and aim for zero edible food waste.[5]

Hinckley and Bosworth Borough Council is seeking Government support for its ambitions to extend the National Forest across Leicestershire, in line with the region's carbon neutrality goals. The council will be working to find grants to buy land and engage with local landowners to provide tree planting space.[6]

6.7 Energy Supply

Anthesis

6.7 ENERGY SUPPLY
CURRENT CONTEXT

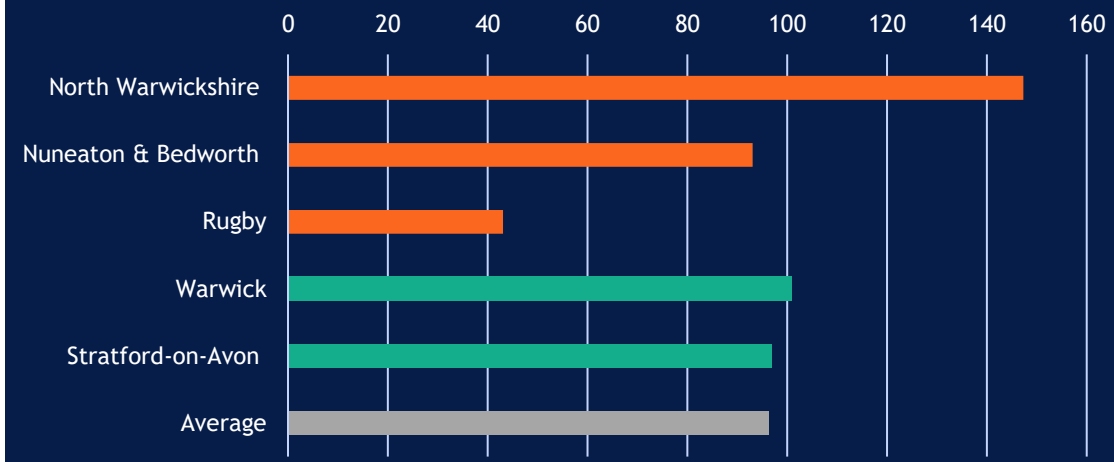
Scope of section

Throughout the sections of this chapter on buildings, transport and industry, reference has been made of the importance of providing decarbonised electricity to South Warwickshire. The following analysis provides details for the scale and ambition required to meet Warwick and Stratford-on-Avon District's energy consumption with renewable sources.

The method by which SCATTER apportions local renewable capacity is based upon the scaling up of installed capacity in a given local authority. These are based on the National Grid's Two Degrees Scenario and weighted according to current installed capacity.

Green recovery considerations

- Point 2 of The 10 Point Plan for a Green Industrial Recovery launched by the UK Government indicates work with industry to complete testing necessary to allow up to 20% blending of hydrogen into the gas distribution grid for all homes on the gas grid and to begin hydrogen heating trials in a local neighbourhood by 2023.
- The UK Climate Change Committee's (CCC) Sixth Carbon Budget states that in the 2020s, the UK should be deploying low-cost renewables at scale and developing the markets for gas carbon capture storage and hydrogen and its electricity generation should be entirely low-carbon by 2035 with wind, particularly offshore, as the backbone of the system.
- An overall decrease in electricity demand during the COVID-19 lockdown allowed higher penetration of renewables in the energy network, presenting a rehearsal for the UK's 2025 coal-free target.



Warwickshire Local Authorities	Installed renewable capacity (kW)					Renewable capacity per unit land area (kW/km²)
	Solar PV	Local wind	Hydro	Organic Fuels*	Total	
North Warwickshire	27,102	80	6,076	8,630	41,888	147
Nuneaton & Bedworth	5,050	0	0	2,300	7,350	93
Rugby	7,269	18	0	7,946	15,233	43
Warwick	23,014	6	15	5,510	28,545	101
Stratford-on-Avon	91,182	69	0	3,492	94,743	97
Average	**30,723**	**35**	**1218**	**5,576**	**37,552**	**96**

Figure 57: Comparison of renewable energy capacity within Warwick and Stratford-on-Avon compared to other Warwickshire Local Authorities (Source: BEIS Regional Renewable Statistics).

*encompasses anaerobic digestors, sewage & landfill gas, municipal solid waste generation and plant biomass

6.7 ENERGY SUPPLY
KEY PLANS AND POLICY

National

- The UK's National Planning Policy Framework (2019) states as a core planning principle that planning should support the transition to a low carbon future.
- UK National Energy and Climate Plan sets out integrated climate and energy objectives, targets, policies and measures for the period 2021-2030.
- The Renewable Heat Incentive and Smart Export Guarantee reward the use of community and domestic scale renewable energy technologies.
- Energy White Paper outlines the latest plans on decarbonising the UK's energy system consistent with the 2050 net zero target.

Regional

- As an organisation, Warwickshire County Council only buy 100% green energy to power office locations, buildings and the county's streetlighting
- The Warwickshire Energy Plan 2015 has policies to increase the use of and public support for low and zero-carbon technologies.

Warwick District

- The Warwick Local Plan 2011-2029 supports proposals for new low carbon and renewable energy technologies.
- Warwick District Council's Business Strategy 2020-23 outlines the Council's aim to explore solar, battery and other energy opportunities.
- WDC conducted a Feasibility Study for Low Carbon Energy in Warwick District which involved identifying and appraising investment in four potential projects within the District; the development of a Solar Farm, a Hydrogen Farm, a District Heating Scheme and Micro-energy Generation.

Stratford-on-Avon District

- The Stratford-on-Avon District Core Strategy 2011-2031 promotes decentralised low carbon and renewable energy schemes in development and all new developments in district heating priority areas will be required to incorporate infrastructure for district heating.
- The Climate Change Adaptation and Mitigation Supplementary Planning Document details the options which can be used in development in line with the Core Strategy, such as photovoltaics, solar water heating and air source heat pumps.

6.7 ENERGY SUPPLY INTERVENTIONS

The interventions described so far across the buildings, transport and industry sectors are heavily influenced by the provision of renewable electricity from zero-carbon sources. SCATTER considers a wide range of renewable technologies:

1. **Wind:** Both onshore and "local" wind are considered for Warwick and Stratford-on-Avon. Local capacity is defined as power generated from sources that are not Major Power Producers.
2. **Solar photovoltaics:** As with wind, installed capacity from both Major Power Producers and local, more small-scale sites are considered.
3. **Other renewable technologies:** This covers other potential renewable technologies, beyond solar and wind, that could be explored within Warwick and Stratford-on-Avon. Some key technologies to consider are: solar thermal, anaerobic digestion, sewage & landfill gas, municipal soil waste generation and plant biomass.

The modelled capacities are scaled to Warwick and Stratford-on-Avon by the District's energy consumption. For all of the supply technologies referenced in this section, if the technology is not deemed feasible within Warwick or Stratford-on-Avon's boundary to the suggested extent, the residual capacity is assumed to occur outside the boundary. This is pertinent to the offshore wind capacity, as well as some of the potentially larger scale installations of wind and solar.

Local vs Large scale technology

SCATTER considers a wide range of renewable technologies, some can be implemented locally, whilst others require an out-of-boundary delivery (e.g. offshore wind). Local installation refers to solar and other renewable capacity within Warwick or Stratford-on-Avon's boundary. SCATTER also considers the installation of large-scale renewable energy projects, they are theoretically based on out-of-boundary installations delivered, managed or directly owned by Warwick or Stratford-on-Avon-based stakeholders or major power producers.

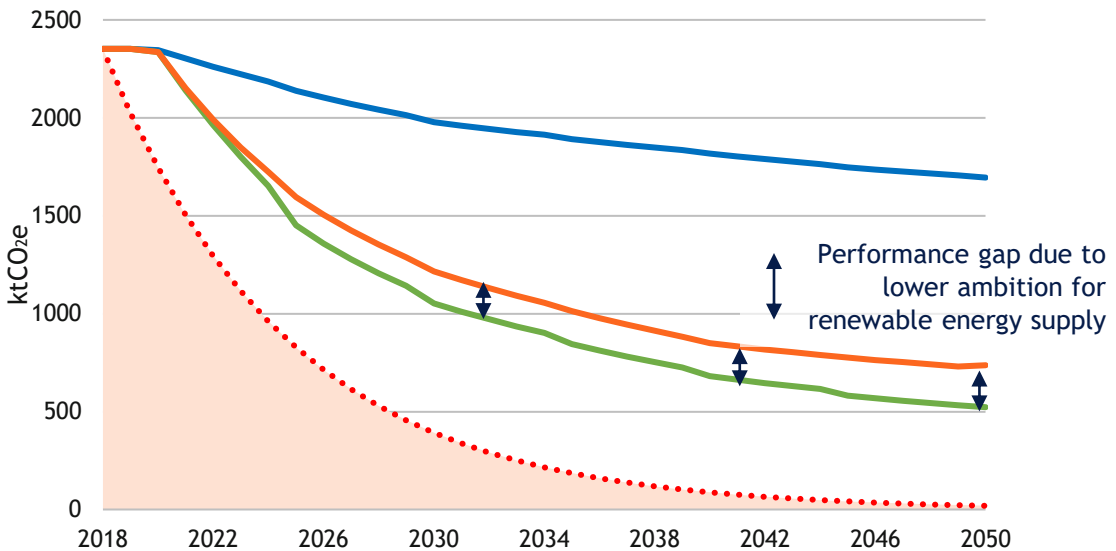


Figure 58: The energy supply sector has been presented differently to other sectors to avoid double counting. It is not possible to separate out the savings specifically from renewable energy supply as it is interdependent with demand-side measures. This chart only serves to demonstrate the importance of energy supply measures. The green line tracks the High Ambition Pathway and the blue line the BAU. The orange line tracks a High Ambition scenario for all measures **except** those which relate to renewable energy sources (termed a Low-Capacity scenario).

6.7 ACTION PLANNING
INTERVENTIONS SUMMARY

Table 32: Current context, intervention milestone at 2030 and associated cumulative emissions savings to 2030.

Intervention	Current Context 2020	By 2030	Emissions savings per subsector (2020-30)	
			Warwick	Stratford-on-Avon
Wind	• In 2019, Warwick had 1 onshore wind site, with a capacity of 0 MW and 13MWh generation.[1] • In 2019, Stratford-on-Avon had 7 onshore wind sites, with a capacity of 0.1MW and 146MWh generation.[1]	Warwick: • Local wind: 35.9 MW • Large offshore: 66.4 MW • Large onshore: 43 MW Stratford-on-Avon: • Local wind: 124.2MW • Large-scale offshore: 66.5MW • Large-scale onshore: 43MW Recognising that offshore technology is not feasible within the districts' boundaries, the installed capacity shown here will need to be replaced by other technologies or funding such installations outside of the districts (see page 112 for further explanation).	Energy supply*: **1,037 $ktCO_2e$**	Energy supply*: **1,051 $ktCO_2e$**
Solar PV	• In 2019, Warwick had 1,921 solar PV sites, with a capacity of 23 MW and 22,352MWh generation.[1] • In 2019, Stratford-on-Avon had 2,515 solar PV sites, with a capacity of 91.2MW and 89,065MWh generation.[1]	Warwick: • Local PV: 165.9 MW installed capacity. This equates to approximately 37,700 homes installing solar PV • Large-scale PV: 10.5 MW installed capacity Stratford-on-Avon: • Local PV: 149.5MW installed capacity. This equates to approximately 34,000 homes installing solar PV • Large-scale PV: 10.5MW installed capacity		

*Not to be aggregated to savings presented in other sectors to avoid double counting i.e., where heat or transport is electrified

6.7 ACTION PLANNING
INTERVENTIONS SUMMARY

Intervention	Current Context 2020	By 2030	Emissions savings per subsector (2020-30)	
			Warwick	Stratford-on-Avon
Other renewables	• In 2019, Warwick had 1 sewage gas site and 3 landfill gas sites, with a combined capacity of 5.4MW and 24,867MWh generation. [1] • In 2019, Stratford-on-Avon had 1 sewage gas site and 1 landfill gas site, with a combined capacity of 1.9MW and 12,284MWh generation.[1]	• Declining usage having displaced fossil fuel sources in power stations	Included in savings above	Included in savings above
	• In 2019, Warwick had 1 hydro site, with a capacity of 0MW and 45MWh generation. [1] • Stratford-on-Avon had no installed hydro capacity. [1]	Warwick: • Local hydro: 4.1MW Stratford-on-Avon: • Local hydro: 14.7MW		

6.7 ENERGY SUPPLY
INTERVENTION MILESTONES

1. Wind

The capacity of wind power technologies vary between local, on- or off-shore installations. Small-scale wind turbines which contribute to domestic household power typically have very small capacities, in the region of 15 kW. A typical on-shore wind turbine has a capacity of 2.5 MW, with off-shore turbines typically higher.

This modelling estimates values for the installed capacity of each supply technology, by taking a nationally assumed capacity figure and scaling down to region based on a local authority's size proxy (e.g. population number of households, land area). This serves as an indicator for the nature and extent of renewable supply required to future demand.

SCATTER does not account for the geographies and local contexts unique to a given local authority, which we acknowledge play a very important role in the viability of a given technology. Such assessment lies outside of the scope of the SCATTER tool and feasibility of local implementation will need to be weighed up with other technology types, or investment opportunities for wind technology outside of the districts.

Key Milestones

Warwick District

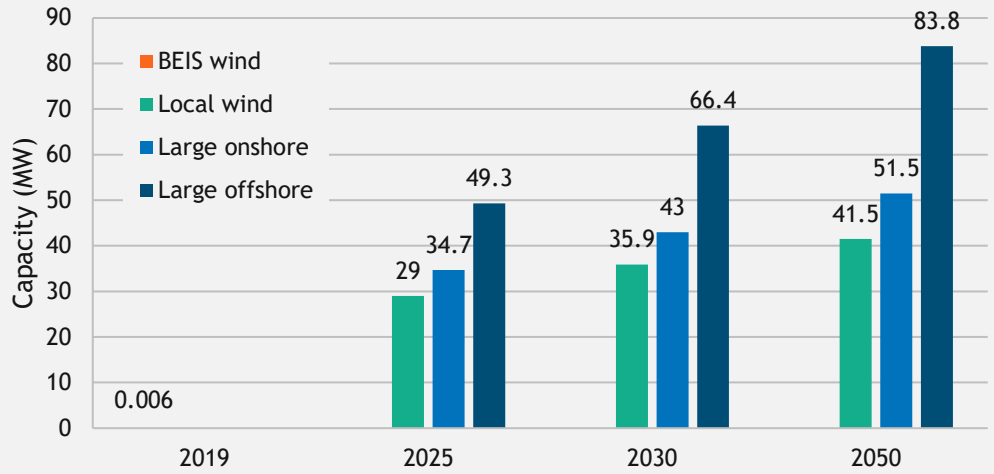
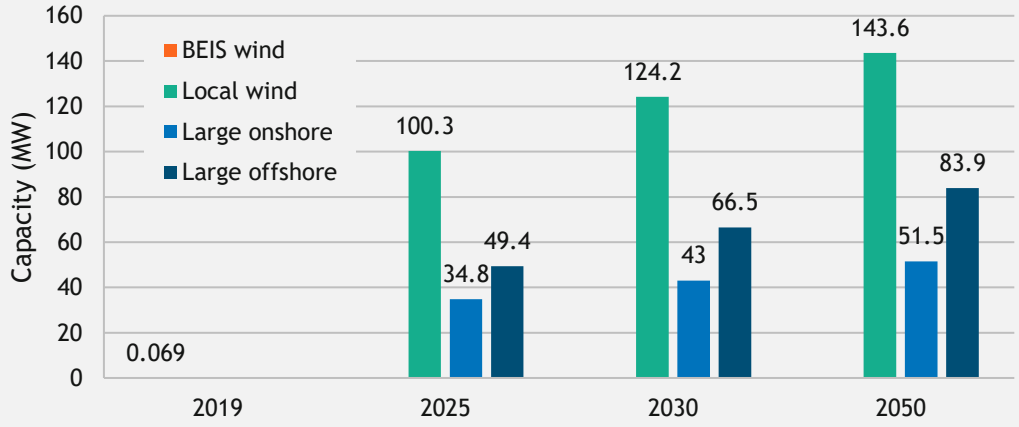


Figure 59: Comparing the SCATTER outputs against the recorded installed capacity from BEIS renewable energy statistics for energy generated from wind for Warwick (above) and Stratford (below).

Stratford-on-Avon District



6.7 ENERGY SUPPLY
INTERVENTION MILESTONES

2. Solar photovoltaics

Similarly, solar PV technologies can be split out into local installations, and larger sites for ground- or roof-mounted arrays. According to the Energy Saving Trust, the typical household array capacity is between 2-4 kW. The current average square meter of solar PV panel provides a capacity in the region of 0.15-0.20 kW of energy.

Warwick District Council have previously explored the potential for solar farms within the District. In 2020, a study was conducted by BP Lightsource to explore the viability of investing in a 6MW solar farm. The study suggested that the Bishops Tachbrook site under consideration was unlikely to be feasible due to likely easement costs associated with the M40. WDC have made it clear that the Council are very much interested in the potential to invest in large scale solar energy generation should a viable location come about. A study by Rena Technologies is currently being conducted to investigate the feasibility for solar at certain sites across Warwick.

Stratford-on-Avon has a comparatively high capacity of installed solar PV, with 91 MW of installed capacity in 2019 compared to the 30 MW average across Warwickshire. The 60,000 solar panel Heart of England Community Energy solar farm, built by Anesco in 2016, plays a substantial role in the District's renewable energy generation.

Key Milestones

Warwick District

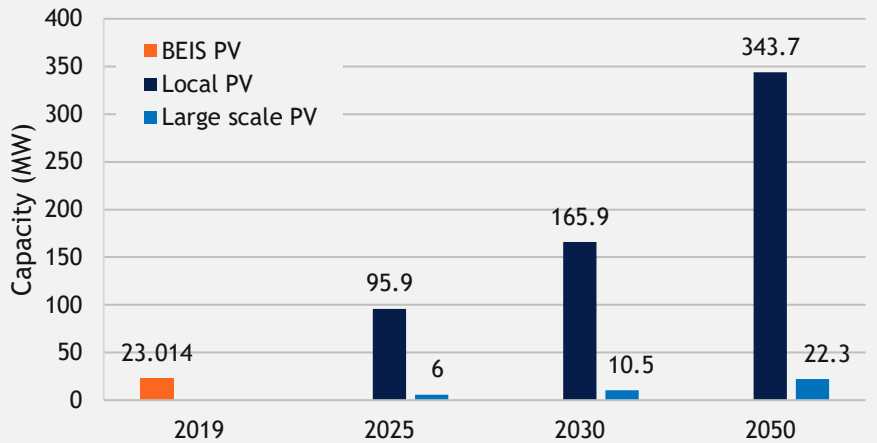
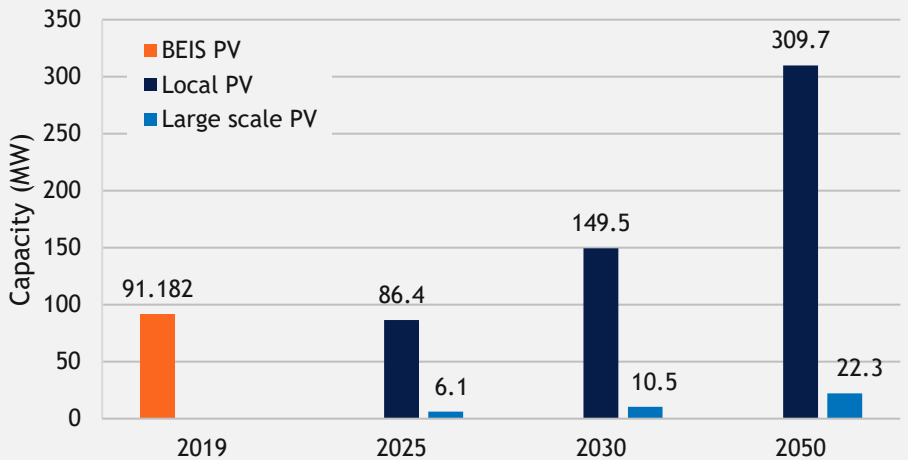


Figure 60: Comparing the SCATTER outputs against the recorded installed capacity from BEIS renewable energy statistics for energy generated from solar PV for Warwick (above) and Stratford (below).

Stratford-on-Avon District



6.7 ENERGY SUPPLY
INTERVENTION MILESTONES

3. Other renewable technologies

SCATTER also considers other renewable technologies, including wave, tidal and hydroelectric power. Only Local Authorities with existing installed capacity or significant inland water area are included in the scope of those technologies. To this end, very small amounts of small-scale hydroelectric projects have been identified as suitable across Warwick and Stratford-on-Avon.

Biomass within SCATTER is assumed to displace fossil fuels as an energy source for generation in power stations. The combustion of solid biomass fuels (such as woodchips or chicken litter) still releases greenhouse gases into the atmosphere, albeit with a much smaller impact than that of coal or natural gas.

For the High Ambition pathway, generation in power stations from solid biomass fuels is modelled to increase fourfold by 2025, before dropping off to very low levels by 2050. Without the coupling of biomass generation to carbon capture and storage technology, there will always be residual emissions associated with the consumption of solid biomass fuels.

The phasing out of coal and natural gas follow trajectories in the National Grid Two Degrees scenario.

Key Milestones

Warwick District

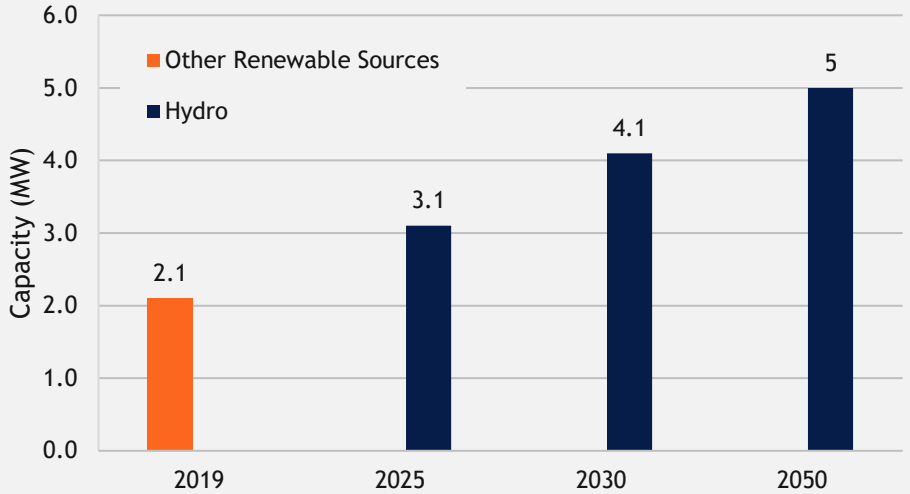
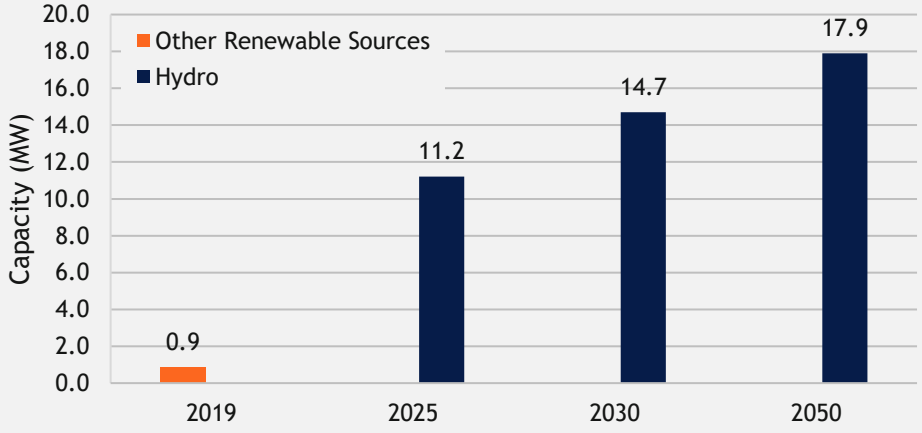


Figure 61: Comparing the SCATTER outputs against the recorded installed capacity from BEIS renewable energy statistics for other renewable technologies for Warwick (above) and Stratford (below).

Stratford-on-Avon District



6.7 ENERGY SUPPLY
LOCAL AND NATIONAL CASE STUDIES

Local Case Studies

Community Energy Warwickshire has installed solar PV panels at Stratford upon Avon Hospital, Leamington Spa Hospital and Warwick Hospital. The group has also run energy savings fairs and workshops with Act on Energy and has set up a charitable fund to support educational activities.[1]

Hive Energy's new 60-acre, subsidy-free School Farm Solar Park near Churchover, Rugby will generate enough renewable energy to power 4,000 homes (13MW). The Park will contribute to Rugby Borough Council in business rates whilst supporting the Council's commitment to become carbon neutral by 2030. [2]

Vital Energi are developing a new energy-from-waste facility in Burton Upon Trent that is set to generate 18MWe of electricity from non-recyclable Refuse Derived Fuel. The facility is being built on the site of the demolished Drakelow C Power Station.[3]

National Case Studies

Portsmouth City Council now has 738 solar PV panels installed alongside a ten-unit battery system. Batteries are a key component of the new solar installation on one of the city council's industrial estate. It can store 135kWh of electricity enough to power the average house for 2 weeks) and can be used at time of the day when electricity costs are higher.[4]

Figure 62: Image of the solar installation on Portsmouth City Council industrial units.

Northumberland County Council have approved the development of an energy-producing anaerobic digester at North East Grains, a cooperative of about 80 farming businesses. The facility will have an overall capacity of generating 500KW and surplus generation will be fed back to the National Grid. Additionally, the site will allow for 3 new jobs to be created in the area, while supporting the region's environmental goals.[5]

07 Recommendations

7. RECOMMENDATIONS
THE COUNCIL'S INFLUENCE

The chart opposite illustrates that both Council's influence is varied and complex across the different activities that occur within their own operations and also across the Districts. Influence bandings are based on Anthesis' judgment and are by no means definitive. Following the analysis provided in this report, we recommend that WDC and SDC consider developing a joint action plan to identify and agree specific actions the councils can take with their varying degrees of influence to support the net zero transition.

Note that influence also extends beyond the district boundary, whereby both District's demand (and supply) of goods and services drive emissions in supply chains around the world. Such emissions are referred to as consumption based emissions (relative to the UK produced emissions totals).

Table 33: Influence bandings descriptions.

Influence	Description
Direct Control	Emissions sources that are directly owned or operationally controlled by the Council, e.g. Council buildings and fleet.
Stronger	Owners and operators of emissions sources are clearly defined but are not directly owned or operated by the Council, e.g. emissions relating to procurement or council-led activities.
Medium	Emissions sources do not relate to council owned or operated assets, procurement or council led activities, however some convening power may exist with specific actors in the district, e.g. emissions from local stakeholders across sectoral networks and partnerships.
Weaker	Owners and operators of emissions sources are not clearly defined, influence limited to lobbying central government or trade associations, e.g. National Grid decarbonisation, vehicle levies.

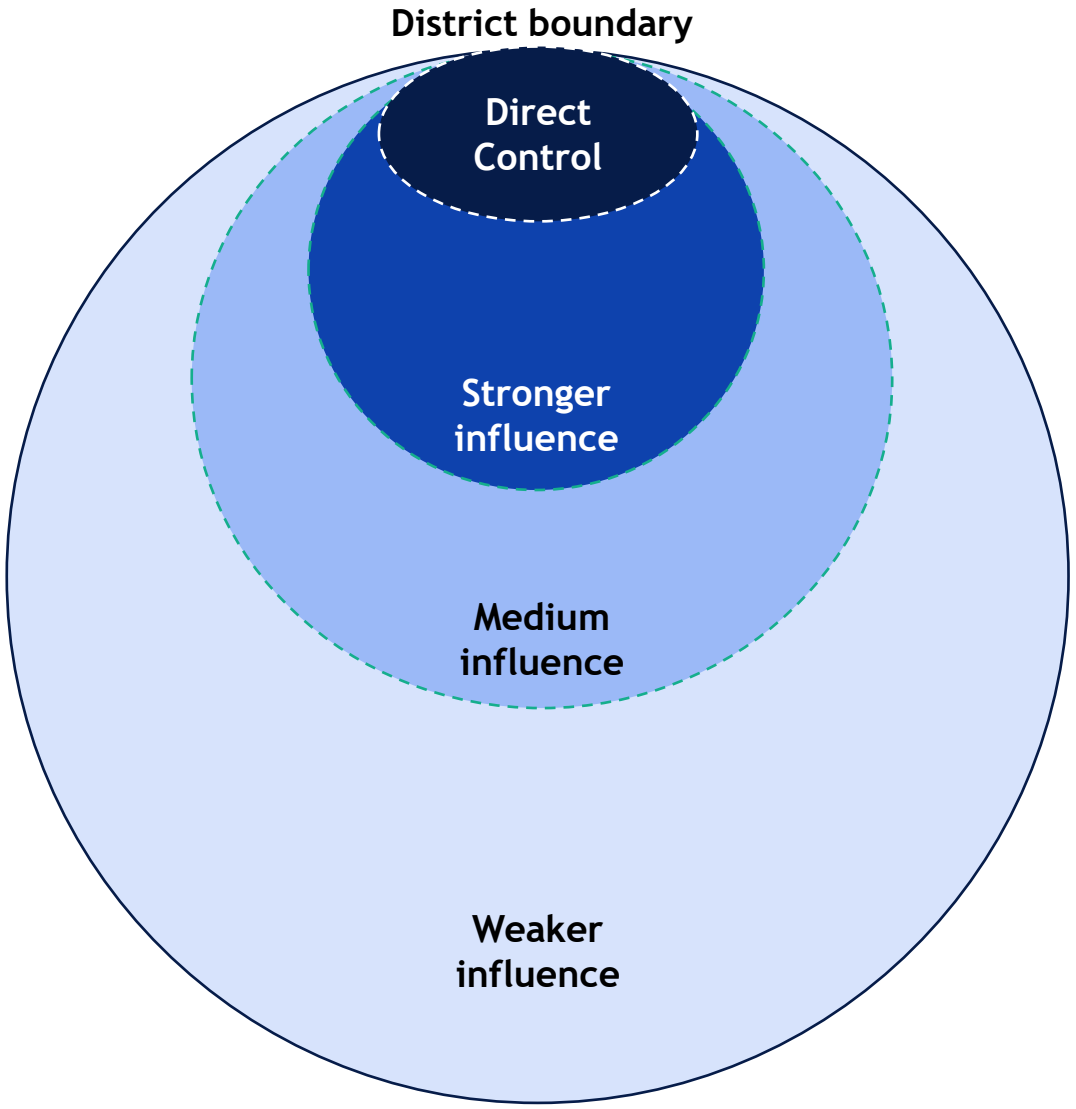


Figure 63: Influence bandings. Note that the diagram above is illustrative only and not to scale.

7. RECOMMENDATIONS
NEXT STEPS

As outlined in this report, both Warwick and Stratford districts have fairly similar emissions profiles, with the majority of emissions across South Warwickshire resulted from buildings & facilities (40.7%) and transport (52.4%). It will be vital to tackle emissions in these areas to achieve decarbonisation.

The scale and speed of the interventions outlined here are significant and yet still don't enable the districts to reach net zero by 2030. **Additional shifts in behaviour and technology will be needed to meet the 2030 timeline.** As with all councils, local influence over the feasibility of certain measures is limited and many of these measures require national and regional policy support.

Further discussions to understand the council's potential to influence each measure and the degree to which this is possible will now be needed to determine the feasibility of these scenarios.

As a priority, WDC and SDC should convene key internal stakeholders to:

1. Understand the findings from the analysis combined with the recommendations from Warwick People's Inquiry on Climate Change;
2. Decide on the feasibility of measures and priority areas; and
3. Identify the council's ability to influence in more detail across all intervention areas.

By implementing the interventions described in this report, South Warwickshire could see reductions in total emissions of **55% by 2030.** In order to achieve this, Warwick and Stratford-on-Avon District Councils should consider the following recommendations:

- **Working together to develop a joint Climate Action Plan** which specifies the actions that the councils agree to take forward and identifies owners to lead implementation. This action plan should scope out estimated costs and will highlight the areas where investment should be prioritised.
- Continuing to **engage with key external stakeholders** such as businesses, citizens, faith and third-sector organisations to help them play their part in taking climate action forward. Communication and education was highlighted as a key recommendation from Warwick People's Inquiry on Climate.
- **Considering a variety of funding streams** to support financing local carbon reduction initiatives including community investment schemes, government grants and Authority Based Insetting. Warwick People's Inquiry on Climate Change also highlighted the importance of financing in delivering their recommendations.
- Engaging with key local agricultural stakeholders to understand the challenges and opportunities with increasing natural capital and nature-based carbon capture based on our analysis. We would recommend inviting key organisations such as **local landowners, agribusinesses and farmers to develop a shared understanding of local land management practices** and what is needed by the sector to support net zero and improve biodiversity in the districts.
- Combining efforts to maximise available government funding to decarbonise buildings and other assets that the councils collectively own, enabling **Warwick and Stratford-on-Avon District Councils to take a leadership role** and demonstrate best practice to encourage other businesses and public sector organisations to reduce their carbon impacts.

08 Appendices & References

APPENDICES CONTENTS

APPENDIX 1: GLOSSARY OF TERMS

AFOLU – Agriculture, forestry & land use.

BEIS – UK Government Department for Business, Energy and Industrial Strategy, the successor to the Department for Energy & Climate Change (DECC).

Carbon budget - a carbon budget is a fixed limit of cumulative emissions that are allowed over a given time in order to keep global temperatures within a certain threshold.

Carbon dioxide equivalent (CO_2e) – the standard unit of measurement for greenhouse gases. One tonne of CO_2 is roughly equivalent to six months of commuting daily by car or burning 1-2 bathtubs' worth of crude oil. "Equivalent" means that other greenhouse gases have been included in the calculations.

Carbon Neutral/ Net Zero - these two terms typically mean the same thing in the context of CO_2-only emissions. Whilst emissions are reduced overall, those that remain (e.g. from industrial and agricultural sectors) are then *offset* through carbon dioxide removal from the atmosphere. This removal may occur through technology such as carbon capture and storage (CCS) technologies, or through natural sequestration by rewilding or afforestation.

Carbon offset - defined by the IPCC as a reduction in emissions of carbon dioxide or other GHGs made in order to compensate emissions made elsewhere.

Carbon sink – a process or natural feature that removes carbon from the local atmosphere (e.g. trees or wetlands). The carbon is said to be *sequestered* from the atmosphere.

Climate Emergency – a situation in which urgent action is required to reduce or halt climate change and avoid potentially irreversible environmental damage resulting from it.

Cruise Impact Emissions – Scope 3 emissions which account for national fuel usage within the aviation sector after take-off and landing. Emissions are apportioned to each local authority based on population size and assume that flying is equal across the population.

Decarbonisation – the process of changing our activities and industry practices to create an economy that sustainably reduces emissions of carbon dioxide.

Deep/Medium Retrofit – the aim of retrofit is to drive down the energy demand for heating and hot water in buildings; typical measures include things like insulation for floors, windows and ceilings and improved ventilation. Medium retrofit represents a 66% reduction in energy demand and a deep retrofit represents an 83% reduction.

Energy system - the consumption of fuel, heat and electricity across buildings, transport and industrial sectors, from solid, liquid and gaseous sources.

Gross emissions – the emissions total before accounting for local carbon sinks.

IPCC – Intergovernmental Panel for Climate Change.

Indirect emissions – GHG emissions occurring as a consequence of the use of grid-supplied electricity, heat and/or cooling within the city boundary.

Insetting/Offsetting – the action of compensating for carbon emissions by utilising an equivalent or unrelated carbon dioxide saving elsewhere. Insetting refers to more local activity within a 'sphere of influence'.

LULUCF – Land use, land use change & forestry.

SCATTER – Anthesis-developed tool which is used to set emissions baselines and reductions targets. See the SCATTER website for more information.

APPENDIX 2: SCATTER FAQS

What do the different emissions categories mean within SCATTER?

Direct = GHG emissions from sources located within the local authority boundary (also referred to as Scope 1). For example petrol, diesel or natural gas.

Indirect = GHG emissions occurring as a consequence of the use of grid-supplied electricity, heat, steam and/or cooling within the local authority boundary (also referred to as Scope 2).

Other = All other GHG emissions that occur outside the local authority boundary as a result of activities taking place within the boundary (also referred to as Scope 3). This category is not complete and only shows sub-categories required for CDP / Global Covenant of Mayors reporting.

What do the different sectors and subsectors represent within the SCATTER Inventory?

- **The Direct Emissions Summary and Subsector categories** are aligned to the the World Resource Institute's Global Protocol for Community-Scale Greenhouse Gas Emission Inventories ("GPC"), as accepted by CDP and the Global Covenant of Mayors.
- **The BEIS Local Emissions Summary** represents Local Authority level data published annually by the Department for Business Energy & Industrial Strategy (BEIS).
- **Stationary energy** includes emissions associated with industrial buildings and facilities (e.g. gas & electricity).
- **IPPU** specifically relates to emissions that arise from production of products within the following industries: iron and steel, non-ferrous metals, mineral products, chemicals. These are derived from DUKES data (1.1-1.3 & 5.1).
- **Waterborne Navigation and Aviation** relate to trips that occur within the region. The figures are derived based on national data (Civil Aviation Authority & Department for Transport) and scaled to Warwick & Stratford.
- The full methodology is available at http://SCATTERcities.com/pages/methodology

How does SCATTER treat future energy demand?

Future demand is hard to predict accurately. The National Grid's Future Energy Scenarios (FES) indicates that under all scenarios that meet the UK's net zero by 2050 target (including "Leading the Way", which illustrates the fastest credible rate of decarbonisation) electricity demand still increases. On the other hand, SCATTER's High Ambition Pathway assumes that electricity demand reduces due to improvements to efficiency of operation.[1] Factors such as increased electrification of heating technologies and transport are naturally big drivers for the increase, but incentives and opportunities for demand reduction and energy efficiency measures are still significant and could slow or tip trends in the other direction.

1 - It should be noted that this optimism for demand reduction is consistent with the legacy 2050 Pathways tool.

APPENDIX 3:

2017 WARWICK SCATTER INVENTORY DATA TABLE

Note that SCATTER calculates a territorial emissions profile and therefore excludes emissions from goods and services generated outside the district (also referred to as consumption emissions).

Sub Sector	Direct (Scope 1) $ktCO_2e$	Indirect (Scope 2) $ktCO_2e$	Other (Scope 3) $ktCO_2e$
Residential buildings	146.19	88.19	38.85
Commercial buildings & facilities	19.34	14.88	6.19
Institutional buildings & facilities	40.78	75.18	17.96
Industrial buildings & facilities	24.02	43.58	11.85
Agricultural fuel use	4.10	0.00	0.98
Fugitive emissions	NO	0.00	0.00
On-road	413.74	IE	161.22
Rail	16.08	IE	3.83
Waterborne navigation	2.26	IE	0.00
Aviation	0.39	IE	73.89
Off-road	4.14	0.00	NE
Solid waste disposal	6.67	0.00	IE
Biological treatment	NO	0.00	IE
Incineration and open burning	NO	0.00	IE
Wastewater	8.72	0.00	NO
Industrial process	25.21	0.00	0.00
Industrial product use	0.00	0.00	NE
Livestock	16.07	0.00	0.00
Land use	-4.72	0.00	0.00
Other AFOLU	NE	0.00	0.00
Electricity-only generation	NO	0.00	0.00
CHP generation	NO	0.00	0.00
Heat/cold generation	NE	0.00	0.00
Local renewable generation	0.01	NO	0.00
Sub-total	722.98	221.82	314.77
Net total	**1259.57**		

Notes:

- Within the SCATTER model, national figures for emissions within certain sectors are scaled down to a local authority level based upon a series of assumptions and factors.

IE	= Included Elsewhere
NE	= Not Estimated
NO	= Not Occurring
	= included as part of profile
	= excluded as part of profile

APPENDIX 4: 2017 STRATFORD-ON-AVON SCATTER INVENTORY DATA TABLE

Note that SCATTER calculates a territorial emissions profile and therefore excludes emissions from goods and services generated outside the district (also referred to as consumption emissions).

Sub Sector	Direct (Scope 1) $ktCO_2e$	Indirect (Scope 2) $ktCO_2e$	Other (Scope 3) $ktCO_2e$
Residential buildings	142.26	96.16	43.54
Commercial buildings & facilities	19.54	14.03	6.58
Institutional buildings & facilities	51.59	70.89	17.84
Industrial buildings & facilities	43.48	41.09	14.73
Agricultural fuel use	18.12	0.01	4.33
Fugitive emissions	NO	0.00	0.00
On-road	473.46	IE	195.97
Rail	16.12	IE	3.84
Waterborne navigation	2.80	IE	0.00
Aviation	NO	IE	63.33
Off-road	4.73	0.00	NE
Solid waste disposal	6.67	0.00	IE
Biological treatment	NO	0.00	IE
Incineration and open burning	NO	0.00	IE
Wastewater	7.71	0.00	NO
Industrial process	44.62	0.00	0.00
Industrial product use	0.00	0.00	NE
Livestock	87.35	0.00	0.00
Land use	-7.87	0.00	0.00
Other AFOLU	NE	0.00	0.00
Electricity-only generation	NO	0.00	0.00
CHP generation	NO	0.00	0.00
Heat/cold generation	NE	0.00	0.00
Local renewable generation	0.14	NO	0.00
Sub-total	910.55	222.18	352.15
Net total	**1484.88**		

Notes:

- Within the SCATTER model, national figures for emissions within certain sectors are scaled down to a local authority level based upon a series of assumptions and factors.

IE	= Included Elsewhere
NE	= Not Estimated
NO	= Not Occurring
	= included as part of profile
	= excluded as part of profile

APPENDIX 5: 2017 SOUTH WARWICKSHIRE SCATTER INVENTORY DATA TABLE

Note that SCATTER calculates a territorial emissions profile and therefore excludes emissions from goods and services generated outside the district (also referred to as consumption emissions).

Sub Sector	Direct (Scope 1) $ktCO_2e$	Indirect (Scope 2) $ktCO_2e$	Other (Scope 3) $ktCO_2e$
Residential buildings	288.45	184.35	82.39
Commercial buildings & facilities	38.88	28.91	12.77
Institutional buildings & facilities	92.37	146.07	35.8
Industrial buildings & facilities	67.5	84.67	26.58
Agricultural fuel use	22.22	0.01	5.31
Fugitive emissions	NO	0	0.00
On-road	887.2	IE	357.19
Rail	32.2	IE	7.67
Waterborne navigation	5.06	IE	0
Aviation	0.39	IE	137.22
Off-road	8.87	0	NE
Solid waste disposal	13.34	0	IE
Biological treatment	NO	0	IE
Incineration and open burning	NO	0	IE
Wastewater	16.43	0	NO
Industrial process	69.83	0	0.00
Industrial product use	0	0	NE
Livestock	103.42	0	0.00
Land use	-12.59	0	0.00
Other AFOLU	NE	0	0.00
Electricity-only generation	NO	0	0.00
CHP generation	NO	0	0.00
Heat/cold generation	NE	0	0.00
Local renewable generation	0.15	NO	0.00
Sub-total	1633.57	444.01	666.92
Net total	**2744.5**		

Notes:

- Within the SCATTER model, national figures for emissions within certain sectors are scaled down to a local authority level based upon a series of assumptions and factors.

IE	= Included Elsewhere
NE	= Not Estimated
NO	= Not Occurring
	= included as part of profile
	= excluded as part of profile

APPENDIX 6: DERIVING THE CARBON BUDGET

Warwick & Stratford-on-Avon's carbon budget

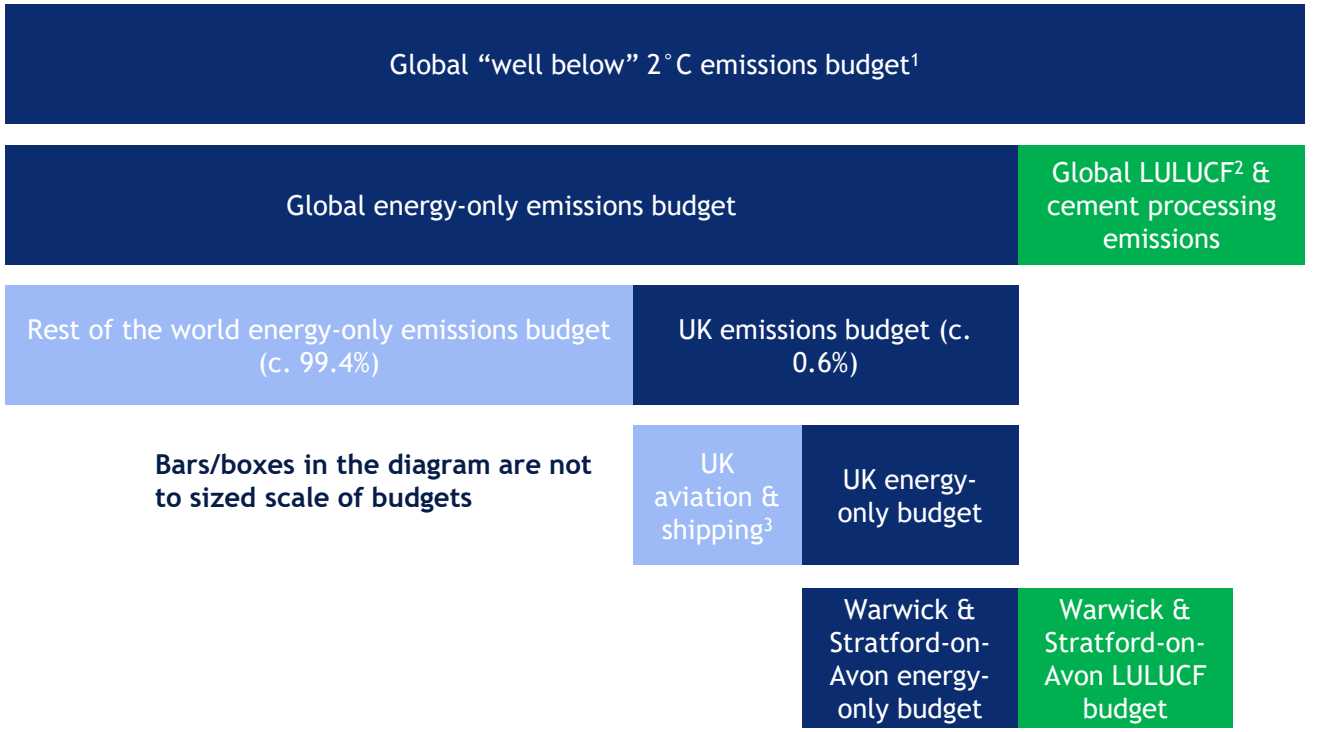
The carbon budgets sets out a finite emissions limit that the should not be exceeded in order that Warwick and Stratford remain in line with the Paris Agreement. The budget itself is derived from a 'scaling-down' approach – a full methodology is available to view for Warwick and Stratford-on-Avon in the full print version of the Tyndall Centre's research.

The Tyndall Centre for Climate Change Research have based this budget on a 2˚C global average temperature rise, on the basis that:

1. The Paris Agreement commits us to limiting warming to this level.
2. Global modelling for both 1.5˚C and 2˚C assume planetary scale negative emissions.

Negative Emissions Technologies (NETs)

NETs remain a highly speculative and uncertain development and are leaned upon heavily in IPCC models. Large-scale NETs are not likely to be viable within the boundary of South Warwickshire due to the profile of emissions. If research, development and demonstration of NETs shows that they may work at scale, and then they are rolled out globally at unprecedented rates, 1.5˚C may theoretically be achievable. However this is only made possible if rapid, deep 2˚C mitigation begins now and additional feedbacks do not occur.



1 - Budget derived from IPCC AR5 synthesis report and represents a 66-100% probability of global warming not exceeding 2˚C ("well below"). Due to the inertia in our energy systems and the amount of carbon we have already emitted, the Paris 1.5˚C commitment is now only likely to be viable if negative emissions technologies (NETs) prove to be successful at a global scale. If the 13.8% emissions reduction rates for Warwick (13.9% for Stratford) are achieved and NETs are deployed at the scales assumed in the global models, then the targets adopted may be considered as a 1.5˚C compatible. This also expressly assumes that other carbon cycle feedbacks, such as methane released due to melting permafrost etc., do not occur, and that an overshoot of 1.5˚C does not result in increased feedbacks that further accelerate warming at lower budgets than the IPCC budgets currently estimate.

2 - Land Use, Land Use Change & Forestry

3 - UK Aviation & Shipping is accounted for at the national level. If emissions due to aviation and shipping increases, then a smaller proportion of the UK-wide budget is available for the energy-only budget and vice versa.

APPENDIX 7: AGRICULTURE & LAND USE ANALYSIS

Data	Source	Year published
Fossil fuel, LULUCF emissions	BEIS	2018
Livestock numbers	DEFRA	2016
Emissions factors	Livestock: NAEI Inventory	2017
	Fertiliser: British Survey of Fertiliser Practice	2017
Land use map	Crop Map of England	2018
Carbon stocks by habitat	Natural England, Open University	2012, 2018
Soil carbon map	Countryside Surveys	2007
Emissions reduction scenarios	CCC	2015

Definitions of different emissions for this section

- **Gross emissions:** In this context, gross emissions refers to emissions from agricultural fossil fuel usage, emissions from fertiliser and emissions from livestock. It does **not** include emissions (be they positive or negative) from LULUCF sources.
- **Net emissions:** This term here refers to the emissions total having accounted for emissions from LULUCF sources.

Note on reporting years

- Statistics for livestock numbers at the local authority level were last published by DEFRA in 2016.
- BEIS sources for data are published two years in arrears.

Note on land use change

- BEIS categorises land use into the following categories: Forest Land, Cropland, Grassland, Wetland, Settlements. Emissions under land use change relate to changing land use types which results in release of emissions to the atmosphere. Emissions under Settlements relate to changing land use type from agricultural land to settled land such as housing, but do not include emissions associated with energy, transport or other activity on the land.

Emissions reduction scenarios - dietary change

- Medium scenario is defined as a 20% reduction in red meat and dairy consumption, replaced by pork, chicken & human-edible crops (50% under high scenario). The production of beef, lamb and milk was reduced by 20% (by 2050) from BAU. All grassland areas were reduced in proportion with the reduction in total cattle & sheep numbers – i.e. 20% by 2050.
- This assumes no specific changes to practices i.e. the same proportion of livestock is reared in uplands/lowlands as under BAU.
- Total arable area is changed by the net difference in reduction due to less ruminant cereal-based feed required and the increase due to more pig & poultry cereal feed and human-edible crops.
- Cropping area requirements for animal feed and relative replacement values of red meat with white meat were taken from Audsley et al. .

APPENDIX 7: AGRICULTURE & LAND USE ANALYSIS (CONT.)

Emissions reduction scenarios - woodland coverage

- These data have been taken from the Committee on Climate Change (CCC) report on quantifying the impact of future land use scenarios carried out by the Centre for Ecology & Hydrology.
- The second scenario (focused on *afforestation*) considers the boost to sequestered emissions as a result of planting trees on 50% of the vacated grassland from the dietary change scenario.
- All of the primary data used in this analysis is taken from the CCC report.
- Our analysis converted national projections for estimated sequestration from the UK's woodlands and coupled this to the increased coverage of woodlands.
- Discussion of the parameters of the underlying model for the projected sequestration potential of planted woodland can be found in the CCC report linked above. These parameters consider tree species, soil type, growth among other factors.
- These data were then used to derive a time-varying factor which defines the sequestered emissions per hectare of woodland (tCO_2/ha) in a given year in the future.
- A separate factor was derived for new (post-2016) and existing forest.
- The emissions factors were then applied to the Stratford-specific values for existing woodland coverage and projected new woodland coverage up to 2050.
- This approach enabled us to consider the changing sequestration potential of planted woodland, since the growth and decay of trees is a non-linear, time dependent process i.e. a hectare of newly-planted young trees will not sequester as much carbon in 2023 as the same hectare of mature trees in 25 years time.
- This time sensitivity with respect to the potential sequestration as a result of tree planting should not be ignored, since the "sequestration payback" of afforestation can often only be felt after a period of years.

APPENDIX 8: CARBON SAVINGS METHODOLOGY

Why are carbon savings important to estimate?

Understanding the activities which offer the highest potential carbon savings is another way Warwick and Stratford-on-Avon can prioritise action towards carbon neutrality. Understanding which activities contribute most to reducing both District's emissions also links into the hierarchy of actions for project development and sets out the "heavy hitting" interventions defined by SCATTER.

Estimating emissions savings

Using the SCATTER "High Ambition" and "Business as Usual" scenarios we can estimate emissions savings, broken down into different categories. This is done by comparing the projected emissions along each pathway from different subsectors (e.g. domestic lighting or commercial heating) for each year, and defining the difference between them.

A visual representation of this method is given opposite in figure 63.

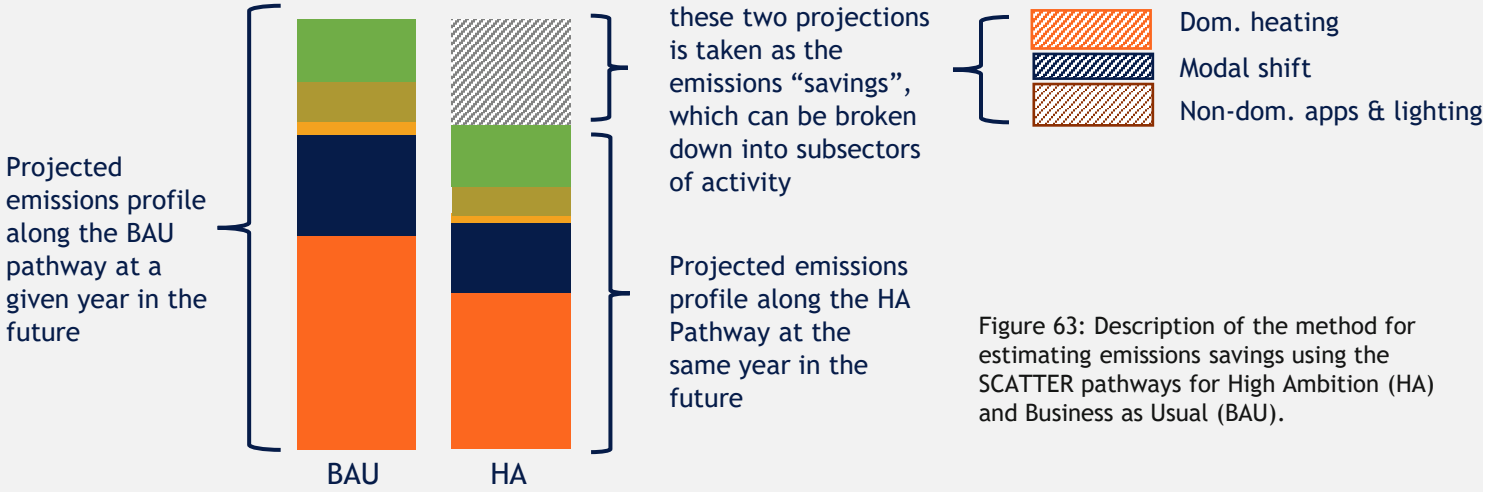


Figure 63: Description of the method for estimating emissions savings using the SCATTER pathways for High Ambition (HA) and Business as Usual (BAU).

Which areas of activity have been estimated?

The categories of emissions savings are broken down slightly differently to the SCATTER interventions, meaning that the savings are grouped slightly differently. This is because of the interdependency of the SCATTER interventions, where more than one intervention contributes to the same savings subcategory.

Since one action can contribute to more than one SCATTER intervention target, the savings from multiple separate interventions may be combined into one subcategory. This is illustrated below:

Interdependent SCATTER interventions	Common savings subcategory	Example activity that meets both interventions
1. Domestic heating technologies 2. Hot water demand	Domestic space heating & hot water	Installation of an efficient household heat pump

Energy supply

In order to isolate the impact of supply-side measures, a pathway of business-as-usual installation of renewables was created within SCATTER, with all demand-side measures kept at high ambition levels. The emissions were then compared along this hybrid pathway to the High Ambition Pathway, with the difference taken as savings directly from energy supply measures.

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