Adur & Worthing Councils

A Carbon Neutral Study for Adur and Worthing: Exploring pathways to achieve the target

June 2020

Anthesis

ADUR & WORTHING COUNCILS

Executive Summary

Report overview

- This report was commissioned by Adur & Worthing Councils to apply the SCATTER approach to help understand greenhouse gas (GHG) emissions in Adur & Worthing and interventions needed to achieve carbon neutrality by 2050.
- Adur & Worthing Councils have committed to working towards carbon neutrality by 2030 for the councils own direct emissions, and 2050 for area-wide emissions, supporting the UK's Net Zero by 2050 commitments and the Paris Agreement.

The SCATTER approach

SCATTER is a greenhouse gas (GHG) emissions reporting tool, which stands for Setting City Area Targets & Trajectories for Emissions Reduction. It is designed to help local authorities set baselines and model trajectories in order to reduce emissions and meet their climate change objectives:

- **Underpinned by climate science:** SCATTER incorporates research from the Tyndall Centre for Climate Change Research, which has translated the Paris Agreement into local emissions targets. If Adur and Worthing continue emitting at current levels, their 2100 carbon "budget" will be used up within seven years.
- **Providing data-driven models:** Understanding the nature of current emissions gives the means by which to measure progress and identify key emissions sources in Adur and Worthing. The impact of interventions across these sources has been modelled using the SCATTER tool to understand the nature and extent of future action required.
- **Underscoring the need for urgent actions:** Both the scale and ambition of intervention is transformational. A step change in behaviour, policy, investment and collaboration is required, which brings with it both opportunity and challenge.

Key messages

In 2017, emissions were **272 $ktCO_2e$** in Adur and **407 $ktCO_2e$** in Worthing

Both profiles show the largest source of emissions are **Buildings** (57% and 67% for Adur and Worthing respectively), followed by **Transport** (30% & 23%) and **Waste** (13% & 10%)

Tyndall Centre analysis defines a fixed carbon emissions budget of **3,700 $ktCO_2$** in order that Adur and Worthing aligns with the Paris Agreement

Adur and Worthing's emissions are tracking a 'business as usual' scenario, which will exceed Adur and Worthing's carbon budget by a **factor of 3 by 2050**

The highest ambition scenario based on current technologies shows that Adur and Worthing reaches zero emissions after **2040**, still exceeding the Tyndall Carbon Budget

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Science-based carbon budgeting

The Tyndall Centre for Climate Change Research have undertaken research to translate the UK's national target as set out in the Paris Agreement into an emissions limit for local authorities in the UK, setting a "budget" for each region. The fixed budget represents a scaled-down portion of the global budget which corresponds to a "Well Below 2°C" temperature rise scenario.

The carbon budget for Adur and Worthing is **3,700 $ktCO_2$** for the period 2020-2100. Remaining within this budget is possible if Adur and Worthing achieves an annual emissions reduction rate of **12.9%.** At 2017 rates, however, the budget would be exceeded **within 6 years**.

A key aspect of this research is the consideration that emissions impacts are cumulative. Once emitted, carbon dioxide remains in the atmosphere for many years, where it contributes to the increase in average global temperatures. The carbon budget does not reset each year, so by "overspending" in early years, the remaining budget is diminished in later years. This underscores the urgent need for emissions reductions in the immediate term, rather than delaying action and making large cuts in a few years' time.

It is also important to note that the budget accounts for emissions-intensive industries such as aviation, shipping and cement manufacturing at the national level. The budget of 3,700 $ktCO_2$ relates only to the *energy system* for Adur and Worthing, so does not factor in emissions from land use, livestock and forestry.

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

Year	Recommended cumulative emissions total ($ktCO_2$)	Reduction against 2015 levels
2020	480	24.2%
2025	2,100	62.1%
2030	2,910	81.1%
2035	3,310	90.5%
2040	3,510	95.3%
2045	3,610	97.6%
2050	3,660	98.8%

Table i: Recommended cumulative emissions for Adur and Worthing under the Tyndall Centre analysis.

SCATTER Inventory tool

The SCATTER Inventory tool defines emissions profiles for Adur and Worthing for the most recently-available year, based on energy consumption datasets and locally-scaled figures. The pie charts on the next page show the 2017 emissions profiles for Adur and Worthing separately, as well as Adur and Worthing combined. Data is released 2 years in arrears, with 2017 representing most up-to-date year that can be published.

The dominant sources of emissions are energy use within buildings and fuel consumption in cars and other on-road transport. Not all subsectors of emissions have been included, such as those from land use and agriculture, which act as net "sinks" of carbon.

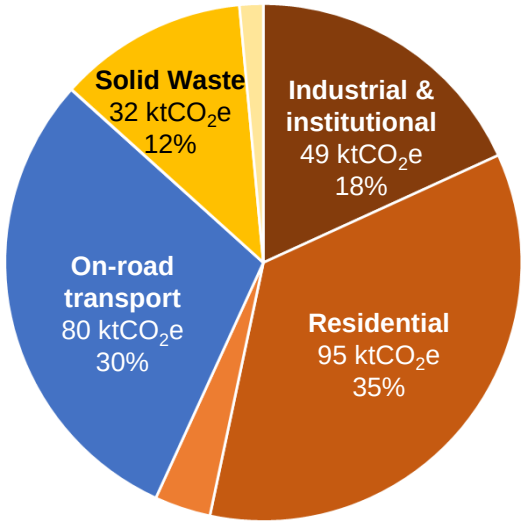
One tonne of carbon dioxide is roughly equal to one month's commuting by car between Worthing and London, or a one-way economy class flight to Las Vegas from

Current emissions inventories – comparing Adur and Worthing

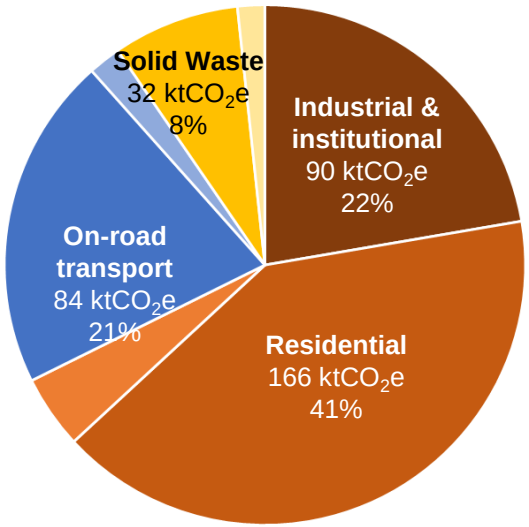
The pie charts below show the 2017 emissions profiles for Adur (left), Worthing (centre) and combined Adur and Worthing (right). Both Adur and Worthing demonstrate fairly similar figures across waste and transport emissions. The largest differences lie within the emissions associated with buildings. The data in the table opposite indicates that residential emissions are coupled very closely to the number of households i.e. the emissions per household are very similar (3.4 tCO_2e/household in Adur against 3.5 tCO_2e/household in Worthing). Worthing has a higher number of households than Adur, which explains the larger total for residential emissions.

The average business in Adur is responsible for 11.3 tCO_2e, against 14.1 tCO_2e in Worthing (roughly 25% higher). Economic metrics are a key proxy indicator for an increased emissions intensity; typically emissions scale with economic output. This is reflected in the differing GVA per capita statistics;[1] Worthing's GVA per capita is approximately 23% higher than in Adur.

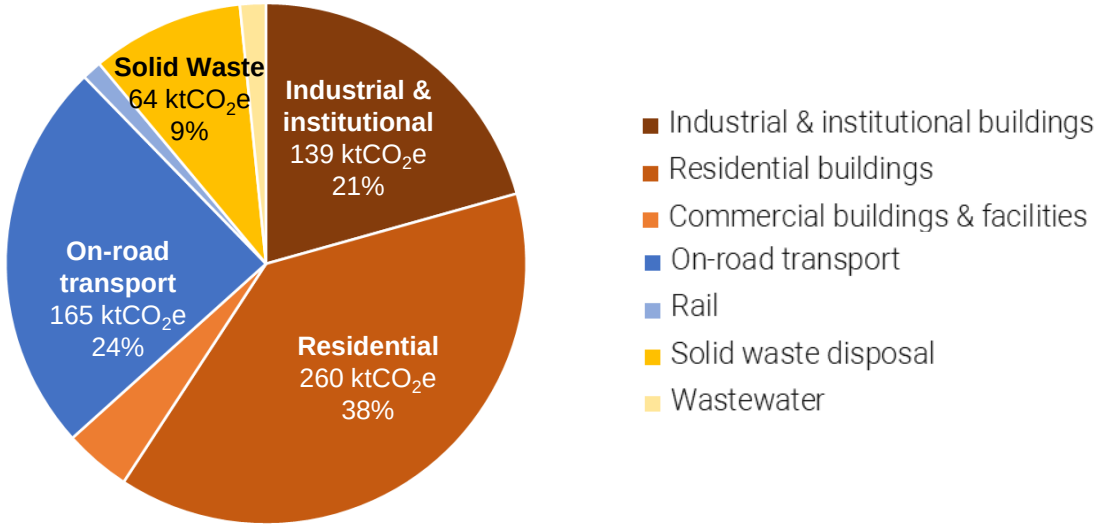
Emissions sector	Adur	Worthing
Residential	3.42 tCO_2e/household	3.49 tCO_2e/household
Commercial and industrial	11.25 tCO_2e/business	14.13 tCO_2e/business



Adur Total: 272 $ktCO_2e$



Worthing Total: 407 $ktCO_2e$



Combined Total: 679 $ktCO_2e$

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1 – Gross Value Added (GVA) per capita is a measure of a local authority's contribution to national gross domestic product (GDP) per head of resident population in that local authority.

SCATTER Pathways tool

The SCATTER Pathways tool is intended to help inform decision-making and target-setting at the local authority level. The Pathways come from the modelling of different measures and their impacts on energy system emissions. The tool focuses on energy system (fossil fuel consumption) emissions reductions within Adur and Worthing. The pathways do not represent the effects of activities outside of the A&WC administrative boundary (e.g. reducing consumption-based emissions).

SCATTER Pathways is intended to focus on the 'what' rather than the 'how', with pathways serving as 'lines in the sand' to give users an indication of whether they are likely to be on-target or off-target for a carbon neutral trajectory through the adoption of interventions to drive the transition to a low carbon economy.

Each measure carries a flexible level of ambition, on a scale of one to four (with four being the most ambitious). Only the "business-as-usual" (i.e. least ambitious) and "Level 4" (i.e. most ambitious) pathways have been discussed as part of this study. Other trajectories, based on more conservative action than suggested in Level 4, fall short of achieving carbon neutrality for Adur and Worthing and have been omitted from the analysis for simplicity.

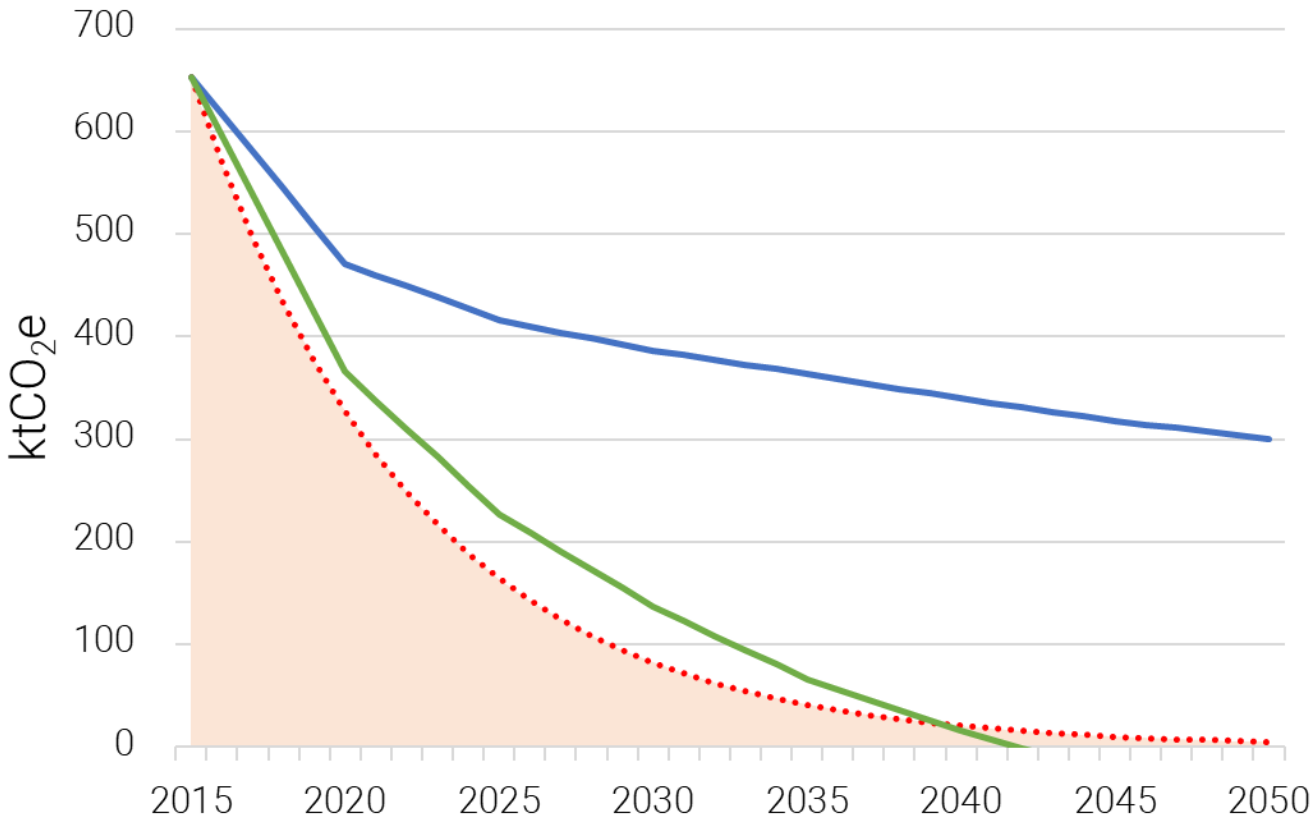
Measures vary across a broad range of activity, from improving the efficiency of lighting and appliances in people's homes, to electrifying rail networks, to increasing the number of local wind farms. Some relate to reducing the *demand* for energy, some relate to "greening" the *supply* of energy. It should be noted that future demand for energy is difficult to predict and reducing demand should always come first.

It is important to note that 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 as part of a specific measure.

The effects of these measures on the emissions within Adur and Worthing are calculated, enabling us to forecast the emissions profile up to the year 2050. This provides key indicators and targets for the local Councils and organisations to measure progress and prioritise new projects and initiatives.

The graph overleaf shows two possible future emissions pathways over time, as modelled by the SCATTER pathways tool, as well as a representation of the Tyndall Centre analysis. Gaps exist between the SCATTER Level 4 pathway and the Tyndall-aligned pathway because modelling assumptions are based on present day evidence and judgement. Such assumptions are not intended to constrain the future ambition to close the gap.

SCATTER Pathways summary for Adur and Worthing (combined)



Historic emissions reductions can be calculated from annual figures published by BEIS. Based on those datasets, Adur and Worthing reduced their combined emissions around 10% between 2015 and 2017, due largely to the decarbonisation of the electricity grid. The average annual reduction rate in emissions since 2005 has been under 4%, highlighting the ambitious action required to achieve the 13% reduction target set out by the Tyndall Centre carbon budget.

Pathways Key

Business-as-usual (BAU): Assumes actions in line with current, national policy, such as nationally led decarbonisation of the electricity grid. This will still require a significant level of effort locally.

SCATTER Level 4: **Assumes actions significantly beyond national policy** and grid decarbonisation, across both energy supply and energy demand measures. Achieves carbon neutrality by the early 2040s.

Carbon Budget pathway: Assumes action which is aligned to the climate science set out by the Tyndall Centre. This Pathway is one way of allocating a finite, carbon budget (the area underneath the line) and is not based upon tangible energy supply and demand measures within the region. The red dotted line tracks the recommended 12.9% reduction from the Tyndall Centre analysis.

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1 –SCATTER Tool operates from 2015 baseline year, with adjustments made using 2016 & 2017 BEIS Local Authority Emissions data.

SCATTER Pathways measures

The SCATTER Pathways tool features a broad range of measures, modelling action in each one, to varying degrees of ambition. The measures that are discussed within this report link directly to the “slices” of the emissions pie charts, and are summarised below. The 2050 target represents the Level 4 (i.e. most ambitious) pathway, except where stated otherwise. Measures include:

Domestic buildings

- Improved energy efficiency: Improving the heat retention within households, through retrofitting measures such as loft, wall and/or floor insulation, as well as superglazing and draughtproofing. **2050 target:** the average heat loss per house is 75% lower than currently modelled, with all new builds constructed to highest energy efficiency standards.
- Moving off gas boilers: Installing non-fossil fuel sources for home heating, such as heat pumps or district heating. **2050 target:** Majority (90%) of domestic heating systems are heat pumps, with the remaining 10% delivered by resistive heaters and district heating.
- Appliances and lighting efficiency: Reducing the energy demand from appliances (inc. white goods & electrical items) due to improvements in device and appliance efficiency. **2050 target:** 69% reduction in the average appliance and lighting energy demand against 2015 baseline (to 0.93 MWh per household per annum). Better home heating controls mean that the average household temperature across the whole house annually is 16.0ºC.
- Shifting off gas for cooking**:** Installation of electrified cooking systems, with the phasing out of gas cookers. **2050 target:** 100% of cooking systems are electrified.

Non-domestic buildings

- Improved energy efficiency: As with domestic households, improvements which reduce the demand for energy for heating and cooling. **2050 target:** 45% reduction against 2015 baseline.
- Moving off gas boilers: As with domestic buildings. **2050 target:** Heating demand met entirely by heat pumps and resistive heaters.
- Appliance and lighting efficiency: As with domestic buildings. **2050 target:** 24% in the demand for energy for appliances and lighting against 2015 baseline.
- Shifting off gas for cooking: As with domestic buildings. **2050 target:** 100% of commercial cooking systems are electrified.

Transport

- Travelling shorter distances: Reducing in the overall mileage travelled across all modes (i.e. more efficient transport infrastructure networks). **2050 target:** Overall mileage drops 25% relative to 2015. Car mileage sees a 38% reduction.
- Using cars less: Changing the mode of travel for all passengers, encouraging greater use of public transport (such as train and bus) and active transport (such as walking and cycling). **2050 target:** 29% of passenger mileage is completed by public transport, 9% by active transport.
- Using electric transport: Shifting to electric cars, buses and electrified rail networks, with the phasing out of petrol and diesel vehicles. **2050 target:** 100% of all cars, buses, private hire vehicles and trains are electric/electrified.
- Improved efficiency of freight: Changing the mode of travel for freight and commercial journeys. **2050 target:** Road freight using diesel falls below 93% of total mileage share.

Waste

- Producing less waste: Reducing in the weight of waste produced across all streams, for both commercial properties and domestic households. **2050 targets:** 20% decrease in overall quantity of waste against 2015 levels.

- Increased recycling rates: Improving the proportion of recycling as a destination for waste. **2050 targets:** 85% of commercial and household waste is sent to recycling.

Industry

- Improving industry efficiency: Improving equipment efficiency and processes that are emissions-intensive. **2050 target:** 76% reduction in emissions from industrial processes.
-
- Electrification of industry: Increasing the degree of electrification in industrial processes (including chemical, mineral and mineral processing). **2050 target:** 66% of the power supplied to industry is electricity.

- Carbon capture and storage: Increasing the usage of carbon capture and storage technology. **2050 target:** 42% of industrial process emissions are captured by CCS.

- Reducing oil production: Reducing the imported level of oil and petroleum products. **2050 target:** 77% reduction in oil production relative to 2015 baseline (Level 1).

Renewable energy supply

- Increased solar (PV & thermal): As both roof-mounted arrays or at ground level. **2050 target:** 518 MW solar PV capacity, 13.9 MW solar thermal capacity installed.

- Increased energy storage: Improving capacity for energy to be stored as the grid transitions to decentralised supply and more time-dependent supply. **2050 target:** 2.69 GW storage capacity in standby generators.

- Increased bioenergy: From both out-of-boundary sources (as both feedstock and energy supply) and from in-boundary biomass stations. **2050 target:** 38 MW installed capacity.

- Increased onshore wind: Capacity from onshore wind turbines. The added capacity of offshore turbines is treated at national level. **2050 target:** 148 MW installed capacity.

- Increased “other” sources: Capacity from hydroelectric power stations. Wave, tidal & tidal stream sources of energy are treated at the national level. **2050 target:** 5.4 MW installed hydroelectric capacity (Level 1).

Other SCATTER forecasts

Within Pathways, there are a number of other measures which were not applied within this study. This is due to their diminished feasibility since the inception of the tool. These include:

- Nuclear power & bioenergy imports
- Peatland restoration, afforestation & geosequestration
- Small-scale wind & marine algae
- CCS power stations & geothermal electricity

Other measures were treated with national forecasts and models. These include:

- International aviation and shipping
- Household and population estimates
- GDP/GVA forecasts

Local case studies and best practices

Domestic buildings

A programme to install 250 air source heat pumps in dwellings in West Sussex is planned through the Innovate UK funded Smarthubs project

LEAP free energy advice service have installed over 1,200 LED lightbulbs in homes across **Adur and Worthing**, cumulatively saving 0.75 $ktCO_2$ over the next 10 years

Non-domestic buildings

Worthing Borough Council is investigating heat network feasibility within the Worthing Civic Quarter using government funding.

BISEPS project is led by **West Sussex County Council,** developing secure, competitively-priced, low carbon energy for SMEs in the region.

Waste

Household waste in Adur & Worthing has dropped by 14% since Adur & Worthing Councils moved to alternate weekly bin collections, whilst recycling waste has increased by over 3%

Brighton & Hove Food Partnership coordinate community composting schemes to help residents reduce food waste going to incineration under the East Sussex waste contract

Transport

West Coastway line is fully electrified between Brighton and Southampton, but holds no rail freight capacity

easitADUR & WORTHING offers discounted travel options for public transport and cycling

Brighton & Hove announced 30 new hybrid buses with the capability to run in a 'zero-emissions mode' through the city's Ultra Low Emissions Zone

West Sussex Electric Vehicle Strategy estimates that the county will require 3,305 public charging points by 2025 and 7,346 by 2030 and is developing a Network Plan by the end of 2020 to work towards this

Renewable energy supply

Splashpoint Leisure Centre in Worthing had 100 kWh solar array installed as part of the first community energy scheme in the borough.

Shoreham Port is one of eleven ports to hold Eco Port status, with two 100 kW wind turbines and a 2.2 MW PV array

Solar farm at **Westhampnett** combines a 7.4 MW PV array and 4.4 MW battery unit to produce and store energy – completed as a subsidy-free project

Plans for a 20 MW grid balancing battery storage project have been planning approval at Halewick Lane, **Sompting,** to be delivered in 2021

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Introduction & Context

This work is being commissioned by Adur & Worthing Councils (A&WCs).

Aims

The aim of this study is to provide an evidence base for work relating to the Climate Emergency. This study focuses on the following areas in particular:

- Defining the current emissions profiles of both Adur and Worthing,
- Determining future emissions pathways which benchmark the necessary action required for Adur and Worthing to drastically reduce their in-boundary emissions.

Objectives

To better understand Adur and Worthing's carbon footprint using a location-based accounting approach;

- To use this information to determine the proportion of emissions that can be influenced locally; and
- Identify gaps in data where further work is needed.

To aid A&WCs by:

- Providing an informed evidence base for future action plan development which also serves to inform and direct existing local projects;
- Increasing confidence in the mandate for climate action, aiding development of a robust local strategy which can deliver objectives over a long term cycle.

Local and national policy

In 2015, the UK adopted the Paris Agreement as part of a joint pledge by members of the European Union, committing to:

- Strengthening the global response to the threat of climate change by keeping global temperature rise this century well below 2°C above pre-industrial levels.
- Encouraging efforts to limit the temperature increase even further to 1.5°C.

Tackling the climate crisis is a long-standing issue in the UK, reflected in the legally binding target in the 2008 Climate Change Act. This was updated in 2019 to reflect the updated target of 100% reduction in emissions by 2050 against a 1990 baseline.

In January 2019, A&WCs committed to 100% clean energy across Adur and Worthing under the UK100 Cities Pledge. In July 2019, A&WCs declared a Climate Emergency and committed to work towards becoming carbon neutral by 2030 for the Councils' own direct emissions.

Evidence of need

The full council resolution was issued following the Intergovernmental Panel on Climate Change (IPCC) special report on the impacts of global warming of 1.5°C above pre-industrial levels, published in October 2018. The report stated that in order to remain within a 1.5°C increase, governments would have to cut emissions of greenhouse gases by 45% by 2030 against a 2010 baseline. Since the first IPCC report was published in 1990, global emissions have increased 60%.

A key finding of the report states that if current emissions rates continue unabated, it is likely that the Paris Agreement target of limiting warming below 1.5°C will be surpassed as early as 2030.

In their 2019 Emissions Gap Report, the UN Environment Programme found that the current Nationally Determined Contributions were likely to result in a 3.2°C temperature rise by 2100. Global emissions have increased sharply since 2017 following a brief period of stagnation in the mid-2010s.

The relevance of the action at local authority level was highlighted by the Emissions Gap Report: *"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."*

The evidence from these two reports makes clear that immediate and drastic action is required to avoid global warming to dangerous levels, whilst encouraging sub-national policy measures and action as a necessary means of reducing emissions.

A growing consensus

The recognition of urgency to address the climate emergency is no longer just the message from environmental groups, but is now being reiterated across a variety of sectors both domestically and internationally:

- **UK Local Authorities**: As of February 2020, 70% of Local Authorities have made Climate Emergency Declarations.
- **UK Climate Strike action**: In 2019 schools and businesses demonstrated unprecedented levels of support for climate action. This has been mirrored in the media with enhanced scrutiny and coverage on climate related issues.
- **Global Businesses:** Increasing numbers of businesses are now involved in the Science Based Target Initiative (SBTi) and support the Task Force on Climate-related Financial Disclosures (TCFD).

Leading a sustainable recovery

The global disruption and impacts of the COVID-19 pandemic have forced governors, citizens and businesses to radically reassess their policy decisions, lifestyles and the ways in which they work.

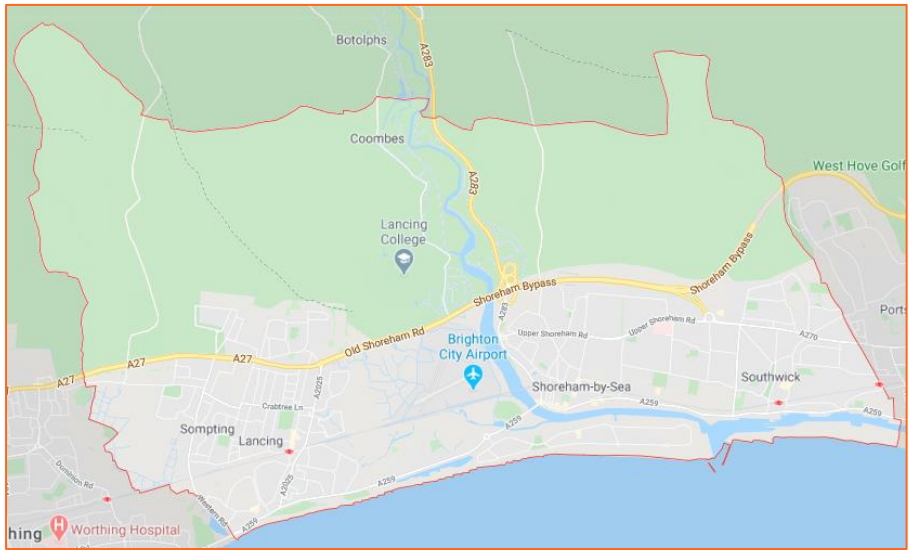
The ongoing lockdown offers the chance to reflect on the way that we operate as a society. This time also presents the opportunity to shift our collective values and review the demands of "emergency action" in a climate context. Local and national commitments to emissions reductions have not changed as a result of the COVID-19 crisis.

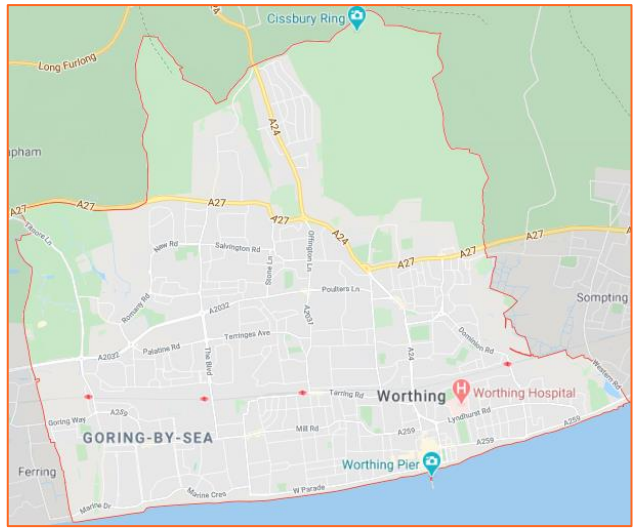
The cost of delaying action on the pandemic has been felt in many countries. Similar decisiveness will be required as we recover from this crisis, respond in a way that is centred around the resilience, health and wellbeing of local communities.
UN Secretary General Antonio Guterres acknowledged this in a statement in April 2020: *"… ensuring a future for the planet must be a core element in rebuilding society after lockdown measures are lifted".*

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.

Table 1: Adur district and Worthing borough profiles

Metric	Adur	Worthing
Area	41.80 km^2	32.48 km^2
Population (2017 est.)	63,721	109,632
Population density	1,524 /km^2	3,375 /km^2
Number of households (2018)	27,743	47,464
Number of registered businesses (2019)	2,320	3,765
Geography	Adur and Worthing are enclosed between the South Downs National Park to the north and the English Channel to the south and form part of the Sussex Coastal strip built-up area	
Transport	• Southern Rail runs through Adur and Worthing. Strong rail links across both districts to Brighton, Gatwick, Portsmouth & London • AA27 runs through Adur and Worthing, with links directly to the M23, M25 and M27 • Shoreham Airport & Shoreham Port • Bus service operators: Stagecoach, Southern Transit, Compass Bus, Brighton & Hove Bus & Metrobus • National Cycle Route 2 runs along seafront	





Figures 1a & 1b: Adur (top) and Worthing (bottom).

Adur and Worthing are situated along the West Sussex coast, west of Brighton. Adur & Worthing Councils represent two distinct local authorities, combined under a joint management structure. The borough and district operate under a single chief executive with separate political councils. Credit: Google Maps

1. Adur and Worthing Current Emissions Profiles

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1. Adur and Worthing Current Emissions Profile

Assessing emissions

Given the distinct political boundaries of the district and borough, the emissions profiles for Adur and Worthing have been presented individually and as a combined profile. There are three different ways the emissions data are presented:

- By sector, using the SCATTER Inventory tool (see figs 2a-c).
- By subsector, using the SCATTER Inventory tool (see figs 3a-c).
- By sector, using the BEIS[1] Local Authority Emissions data (see figs 4a-c).

The differences between the SCATTER and BEIS data are explored on page 20. The full data tables for each pie chart can be found in Appendix 2.

Where do Adur & Worthing's emissions come from?

Emissions from buildings

The dominant sources of emissions in both Adur and Worthing come from combustion of fuel in buildings where local people live and work (also called "stationary energy"). SCATTER is able to break these building types down into various sub-groups:

- Industrial & institutional buildings: Larger industrial facilities including factories, warehouses, workshops as well as public sector buildings including schools, health centres, hospitals, leisure centres, Council buildings etc..
- Residential buildings**:** Domestic households of all tenure types.
- Commercial buildings: Buildings from which commercial businesses operate e.g. shops, shopping centres, offices, restaurants etc..

Emissions from transport

The second largest source of emissions come from transport within the borough and district. These emissions are based upon fuel purchases within boundary:

- On-road transport: Emissions from all forms of passenger vehicle, including cars, vans, motorcycles, buses and taxis. Aviation is excluded, but freight emissions are included.
- Rail: Emissions from diesel-fuelled rail transport. Emissions from electricity consumption within the rail sector are included in the commercial and industrial sectors.

Emissions from waste

The final source of emissions shown in the emissions profiles are from waste disposal:

- Solid waste disposal: Incorporates various waste streams across commercial, industrial and municipal sources.

- Wastewater: Scaled directly from national wastewater data by population, using established emissions conversion factors.

Emissions from agriculture, forestry and land use

Not all subsectors have been included in the emissions profile summaries. Emissions from agriculture, forestry and land use (AFOLU) have been excluded from the SCATTER inventory, as well as emissions from livestock. Emissions from land use, land use change & forestry (LULUCF) have been excluded from the BEIS profiles.

Emissions from agriculture come mainly from livestock, with a smaller contribution from fuel consumption to power vehicles and buildings. These agricultural emissions are in part offset by land use emissions, which are negative; carbon is absorbed by the natural environment, such as trees and wetlands.
Since the emissions from land use are negative, they have been excluded from inclusion in the profile. The figures for AFOLU and LULUCF have been included in the data tables in Appendix 1a-c.

1 – The UK Government Department for Business, Energy & Industrial Strategy.

SCATTER sectors

Figure 2a: SCATTER sector inventory for direct and indirect emissions within Adur, excluding AFOLU, 2017

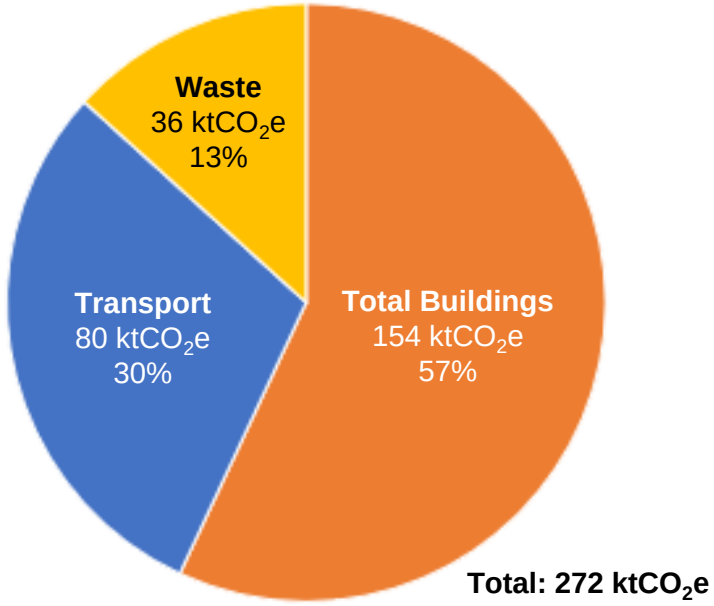


Figure 2b: SCATTER sector inventory for direct and indirect emissions within Worthing, excluding AFOLU, 2017

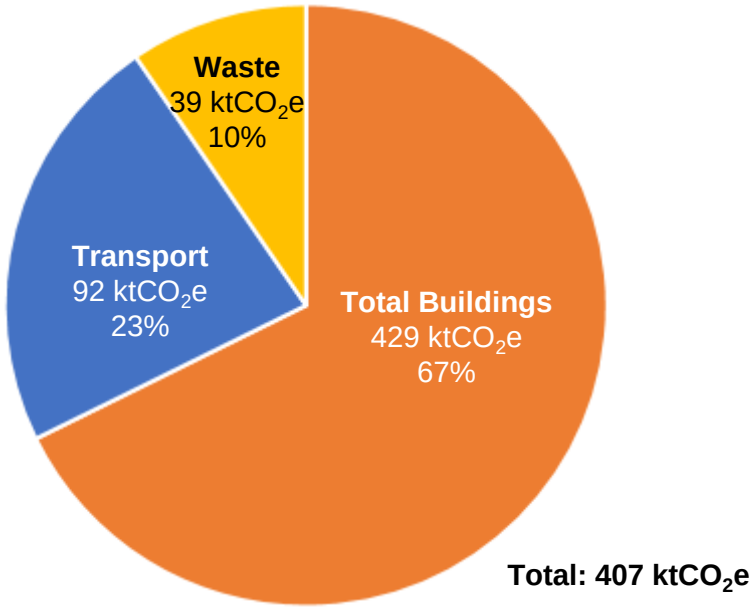
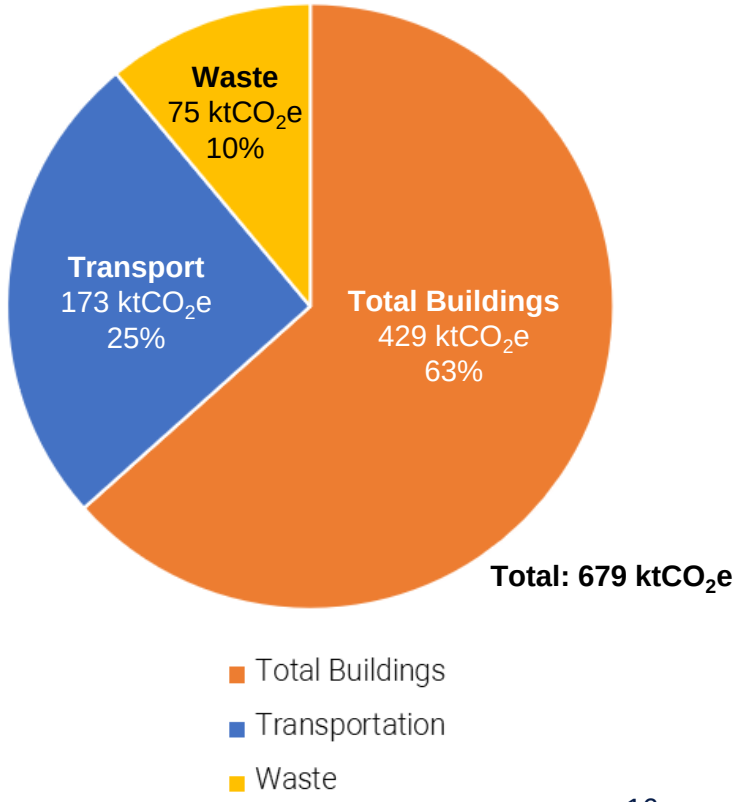


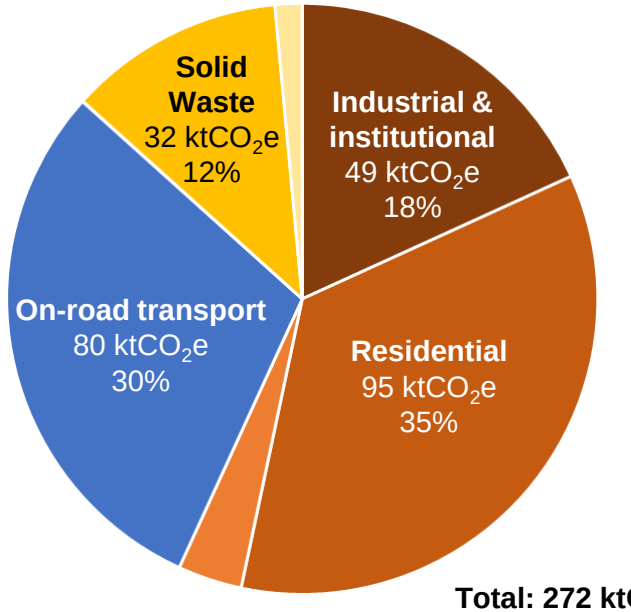
Figure 2c: SCATTER sector inventory for direct and indirect emissions within Adur and Worthing **combined**, 2017



1 – Note that **all** inventories in this report were collated in February 2020 ahead of the March 2020 update to the SCATTER inventories tool.

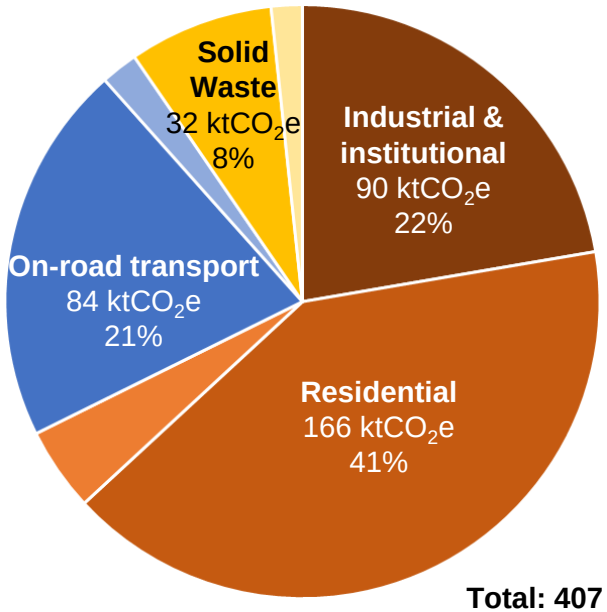
SCATTER subsectors

Figure 3a: SCATTER sub-sector inventory for direct and indirect emissions within Adur, excluding AFOLU, 2017



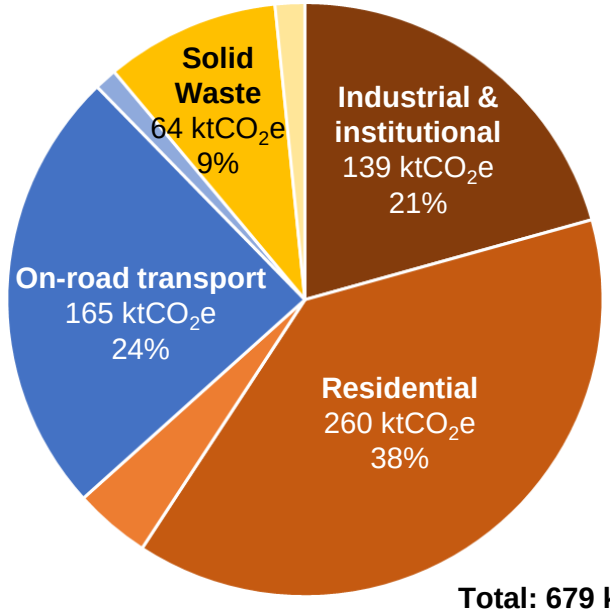
Total: 272 $ktCO_2e$

Figure 6b: SCATTER sub-sector inventory for direct and indirect emissions within Worthing, excluding AFOLU, 2017

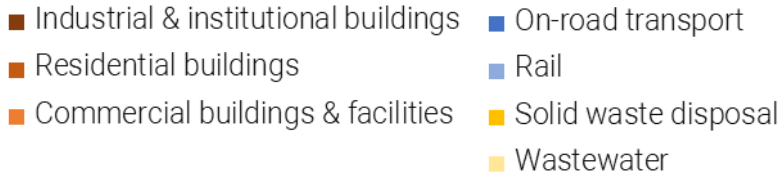


Total: 407 $ktCO_2e$

Figure 2c: SCATTER sub-sector inventory for direct and indirect emissions within Adur & Worthing **combined**, 2017



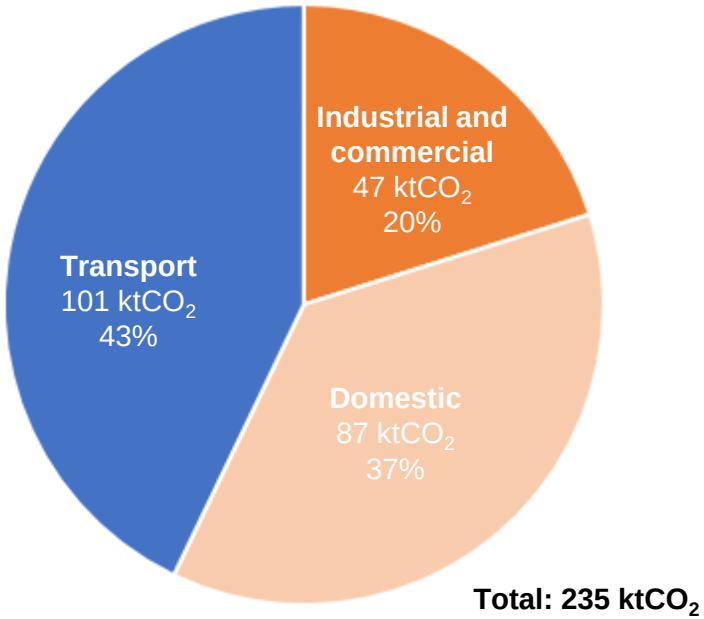
Total: 679 $ktCO_2e$



Anthesis

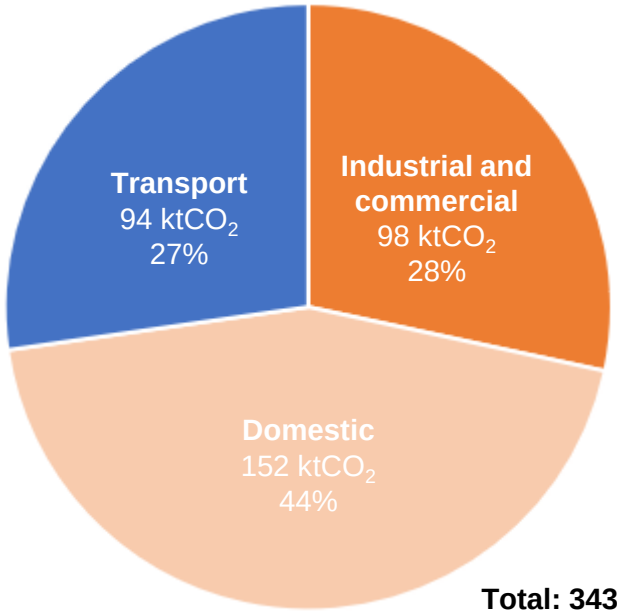
BEIS sectors

Figure 4a: BEIS sector inventory for direct and indirect emissions within Adur, excluding LULUCF, 2017



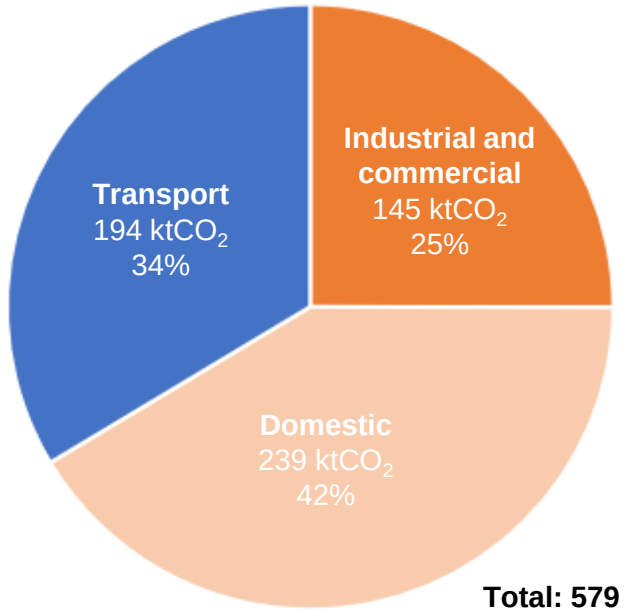
Total: 235 $ktCO_2$

Figure 4b: BEIS sector inventory for direct and indirect emissions within Worthing, excluding LULUCF, 2017



Total: 343 $ktCO_2$

Figure 4c: BEIS sector inventory for direct and indirect emissions within Adur & Worthing **combined**, excluding LULUCF, 2017



Total: 579 $ktCO_2$

Summary – Key Findings

Comparing Adur and Worthing

The largest sources of emissions for Adur & Worthing are Buildings (57% and 67% for Adur and Worthing respectively), followed by Transport (30% & 23%) and Waste (13% & 10%).

Both Adur and Worthing demonstrate fairly similar figures across waste and transport emissions. The largest differences lie within the emissions associated with buildings. Worthing's residential emissions (160 $ktCO_2e$) and industrial & institutional buildings (90 $ktCO_2e$) are both much higher than those for Adur (95 $ktCO_2e$ and 49 $ktCO_2e$ respectively).

Emissions by household and by business

Emissions sector	Adur	Worthing
Residential	3.42 tCO_2e/household	3.49 tCO_2e/household
Commercial and industrial	11.25 tCO_2e/business	14.13 tCO_2e/business

Table 2: Comparing residential and commercial emissions per "unit" of each (i.e. residential emissions per household and commercial & industrial emissions per business).

Residential: The first of these metrics measures the emissions intensity per household in Adur and Worthing. The data indicates that residential emissions are coupled very closely to the number of households i.e. the emissions per household are very similar. Worthing has a higher number of households than Adur, which explains the larger total for residential emissions.

Commercial and industrial: Emissions in this sector are less strongly coupled to the total number of businesses in Adur and Worthing. The average business in Worthing is responsible for around 20% more emissions than the average business in Adur. Economic metrics are a key proxy indicator for the emissions in a region – within more affluent local authorities, the emissions intensity is typically higher. The increased emissions intensity in Worthing is also reflected in the differing GVA per capita statistics;[1] Worthing's GVA per capita is approximately 23% higher than in Adur.

Visualising Carbon Dioxide

Throughout this analysis emissions are defined in units of tonnes of carbon dioxide (CO_2) or carbon dioxide equivalent (CO_2e). One tonne of CO_2 is roughly equivalent to one month of daily commuting by car between Worthing and London, or a one-way economy class flight between Heathrow and Las Vegas.

When the "equivalent" unit is used, this means that the effects of other greenhouse gases (GHGs) have been considered. Different GHGs trap heat in the atmosphere more effectively than carbon dioxide. Converting into common units of carbon dioxide allows for an easier comparison between greenhouse gases.

1 – Gross Value Added (GVA) per capita is a measure of a local authority's contribution to national gross domestic product (GDP) per head of resident population in that local authority.

Frequently Asked Questions

See this Tyndall Centre **blog post** on the various terms that are often used alongside carbon neutral/net zero.

What do the different emissions categories and terms 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 Carbon Disclosure Project (CDP) / Global Covenant of Mayors reporting.

Carbon Neutral/Net Zero: Throughout this report, the terms 'carbon neutral' and 'net zero' are used interchangeably. Typically, they mean the same thing: that while emissions have been reduced overall, some remain, but are offset through carbon dioxide removal from the atmosphere by some technological means or by the natural environment.

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 Adur and Worthing.
- The full methodology is available at http://SCATTERcities.com/pages/methodology

Why does the BEIS summary differ from the SCATTER summary?

- The BEIS summary **represents CO_2 only**; SCATTER also includes emissions factors for other greenhouse gases such as Nitrous Oxide (N_20) and Methane (CH_4). These are reported as a CO_2 'equivalents (e)'.
- The BEIS summary **does not provide scope split**; SCATTER reports emissions by scope 1, 2, and 3 (i.e. direct, indirect or other categories).
- **The BEIS summary categories are not directly consistent or mapped to the BEIS LA fuel data** which is available as a separate data set. SCATTER uses published fuel data and applies current-year emissions factors, whereas the BEIS data calculations scale down national emissions in each transport area. Specifically for road transport, BEIS data splits total emissions across road type; SCATTER uses fuel consumption for on-road transport per LA.
- **Different treatment of 'rural' emissions** i.e. Agriculture, Forestry and Other Land Use (AFOLU) and Land Use, Land Use Change & Forestry (LULUCF) categories are derived from different underlying data sets.

2. Science-based Carbon Budgets

Anthesis

2. Science-based Carbon Budgets

Carbon budgets developed through Tyndall Centre research

The Tyndall Centre for Climate Change Research is a research organisation based at the University of Manchester. Their research aims to translate the Paris Agreement targets of limiting temperature change below 1.5°C into a finite emissions 'budget' for each local authority. A temperature increase of 1.5°C is the result of a given concentration of atmospheric greenhouse gases.

The budget is finite: A global carbon budget represents the finite emissions that can be emitted before the 1.5°C threshold for greenhouse gas concentration is crossed. This global budget can subsequently be scaled down to a national level, and finally, a regional level. A more complete description of this approach can be found in Appendix 2.

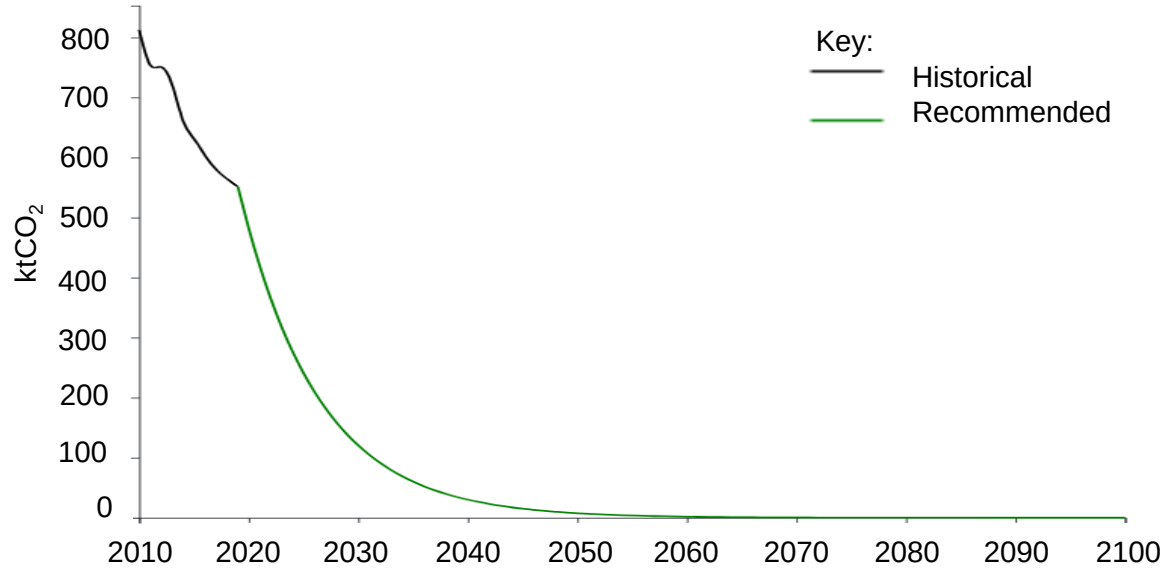
The impact is cumulative: A crucial element of this approach is understanding the importance of cumulative carbon emissions. Once emitted, carbon dioxide remains in the atmosphere for many years, contributing to increasing the average global temperature. The carbon budget does not reset each year; it represents a finite limit to emissions. If the carbon budget were a monthly payday check paid on Friday, at the current rate of emissions, it would be spent before lunchtime the following Monday.

The red dotted line defined in the SCATTER pathways graph on pages 26-28 is a representation of a 12.9% annual reduction. Since 2005, the average annual reduction in Adur and Worthing has been less than 4%.

A key omission from this budgeting analysis is emissions from aviation and shipping and the budget considers only the region's *energy system*. This type of budget is termed 'energy-only' and also excludes emissions from land use, land change and forestry, as well as cement manufacturing.

Carbon budget: A fixed amount of carbon that can be emitted before an average temperature increase of

Fig 5: Adur and Worthing carbon budget, showing a 12.9% annual reduction rate.



The carbon budget for Adur and Worthing[1] between 2020-2100 is **3,700 $ktCO_2$**

An annual emissions reduction rate of 12.9% is needed to adhere to this budget

At 2017 rates, Adur and Worthing will exceed its carbon budget **within 6 years**

1 – https://carbonbudget.manchester.ac.uk/reports/

2. Science-based Carbon Budgets

Carbon budgets developed through Tyndall Centre research

Aviation and shipping

Aviation and shipping emissions are deducted from the budget at the UK level, **not** at the borough/district level. Therefore, the carbon budget allocated to Adur and Worthing by the Tyndall Centre analysis **does not** include aviation emissions. The Tyndall Centre analysis assumes the UK emissions from aviation as remaining constant up until 2030, followed by a linear reduction to full decarbonisation in the sector until 2075.

These aviation assumptions are at odds with current market trends, which indicate that worldwide emissions from flights rose by 32% between 2013 and 2018. Similarly, Airbus recently reported they anticipate the number of commercial planes in operation to double by 2038.

With government predictions expecting significant growth in aviation and shipping emissions, the remaining UK budget available for local authorities will reduce significantly, requiring even greater reductions in emissions in order to keep within the 1.5°C budget. It is therefore recommended that governments work collaboratively to consider strategies that limit emissions growth from aviation and shipping.

Adur & Worthing budget milestones

The table below gives the cumulative emissions totals and percentage reductions against 2015 baselines for Adur and Worthing needed to achieve carbon neutrality by 2050:

Year	Reduction in emissions against 2015 levels	Cumulative emissions total ($ktCO_2$)
2020	24.2%	480
2025	62.1%	2,100
2030	81.1%	2,910
2035	90.5%	3,310
2040	95.3%	3,510
2045	97.6%	3,610
2050	98.8%	3,660

Table 3: Adur and Worthing carbon budget targets.

>95% of the recommended carbon budget is used up by 2040 under the Tyndall Centre trajectory

At current rates, 95% of the recommended budget is used up by 2025

3. Pathways to Carbon Neutrality

Anthesis

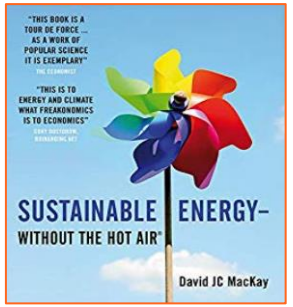
3. Pathways to Carbon Neutrality

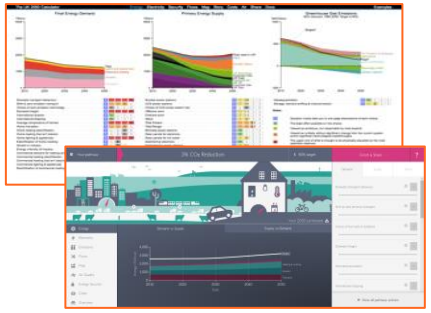
SCATTER Pathways

SCATTER is intended to serve as one of many information sources to help local authority users inform their priorities for emissions reduction. Specifically with reference to the forward-looking Pathways part of the tool, it is intended to focus on the 'what' rather than the 'how'. It is important to note that 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. The SCATTER pathways serve as 'lines in the sand' and give users an indication of whether they are likely to be on-target or off-target for a carbon neutral trajectory through the adoption of interventions to drive the transition to a low carbon economy.
The analysis undertaken for this report is based on the original SCATTER V1 (Excel-based tool) as it was the latest live version of the tool at the time of writing**. Updates to the tool included in V2 (online tool) have not been included in this analysis**. Naturally, technologies, assumptions and approaches to energy models are evolving all the time, and we would welcome the opportunity to receive feedback and/or collaborate on refinements of SCATTER in the future. Please share any feedback with scatter@anthesisgroup.com.

Basic principles

Sir David MacKay's 'Sustainable Energy - Without Hot Air (2009)" underpins the basis for the pathways modelling. As a scientific advisor to the Department for Energy & Climate Change (DECC), now BEIS, MacKay's work led to the development of the 2050 Pathways calculator. An open source, Microsoft Excel version of this tool was published by DECC which we used as the foundation for SCATTER.





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: Technology specifications changes were reviewed and updated where judged to be out of date and constraining ambition. Given that almost a decade had passed since 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. We also referenced the 2050 Wiki page during the course of the update. A summary of these changes can be found in Appendix 3.

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.

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

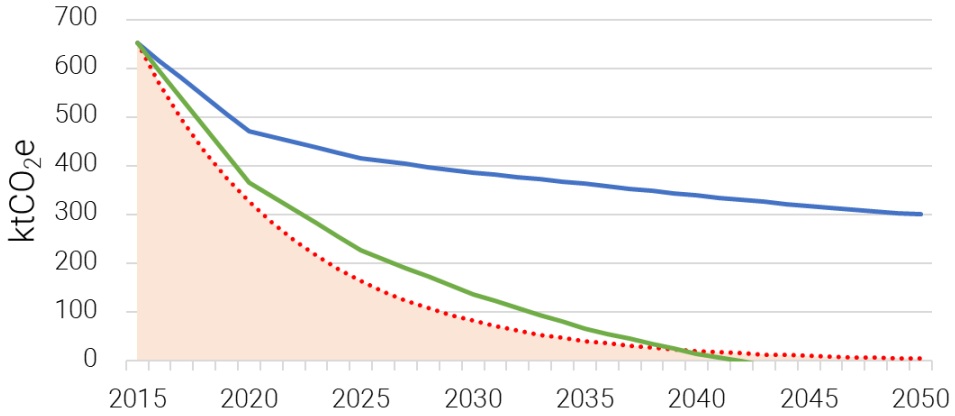


Figure 6: Adur and Worthing Pathways for area-wide carbon reduction.

SCATTER "Level 1" (BAU) Pathway – Assumes Adur and Worthing doesn't take much action beyond decarbonisation of the electricity grid and nationally led policy.[1] It is worth noting that meeting national targets still requires significant local action.

SCATTER "Level 4" Pathway – Assumes Adur and Worthing go significantly beyond national policy and National Grid assumptions, across both energy supply and demand measures.

Tyndall-aligned Pathway – A 12.9% annual reduction as defined by Tyndall research. Unlike the SCATTER Pathways, this does not specify what tangible measures could achieve this pathway, rather, it sets out what science indicates we need to aim for. The beige region is a representative area defining the finite, cumulative amount that the region should emit between now and 2050, based on research by the Tyndall Centre for Climate Change Research.

Understanding the Pathways models

This graph shows possible future emissions pathways over time, as modelled by the SCATTER pathways tool.

The tool focuses on energy system emissions reductions within Adur and Worthing. The pathways do not represent reductions outside of the A&WC administrative boundary (i.e. consumption-based emissions). The Pathways are based on the effects that different measures have on Adur and Worthing's emissions. There are varying degrees of ambition available for each measure, with the blue line representing the lowest level (termed "Level 1") and the green line representing the highest level of ambition (termed "Level 4").

Both pathways can be compared against the Tyndall Centre for Climate Change Research carbon budget. This is derived from climate science and applies a method for scaling down global carbon emissions budgets, as discussed in Chapter 2. Unlike the SCATTER pathways, this is based on climate science, not tangible energy supply and demand measures in region. The cumulative nature of CO_2 reinforces the need to take a 'budget' approach, where any annual shortfalls accumulate over time.

The red dotted line is just one way of allocating a finite, carbon budget (the area underneath the curve). Alternatively, the same budget will last only 7 years if emissions remain at current levels. This again highlights the need for urgent action **now**.

Gaps exist between the SCATTER Level 4 Pathway and the Tyndall-aligned Pathway because modelling assumptions are based on present day evidence and judgement. Such assumptions are not intended to constrain the future ambition to close the gap. A summary page similar to those on page 27 & 28, for the combined district and borough, can be found in Appendix 4.

Anthesis

1 – The BAU carbon intensity of electricity tracks the National Grid Future Energy Scenario (FES) "2 Degrees", 2017), on the basis that this was aligned with the legislated targets at the time the SCATTER tool was developed.

Carbon Reduction Pathways for Adur

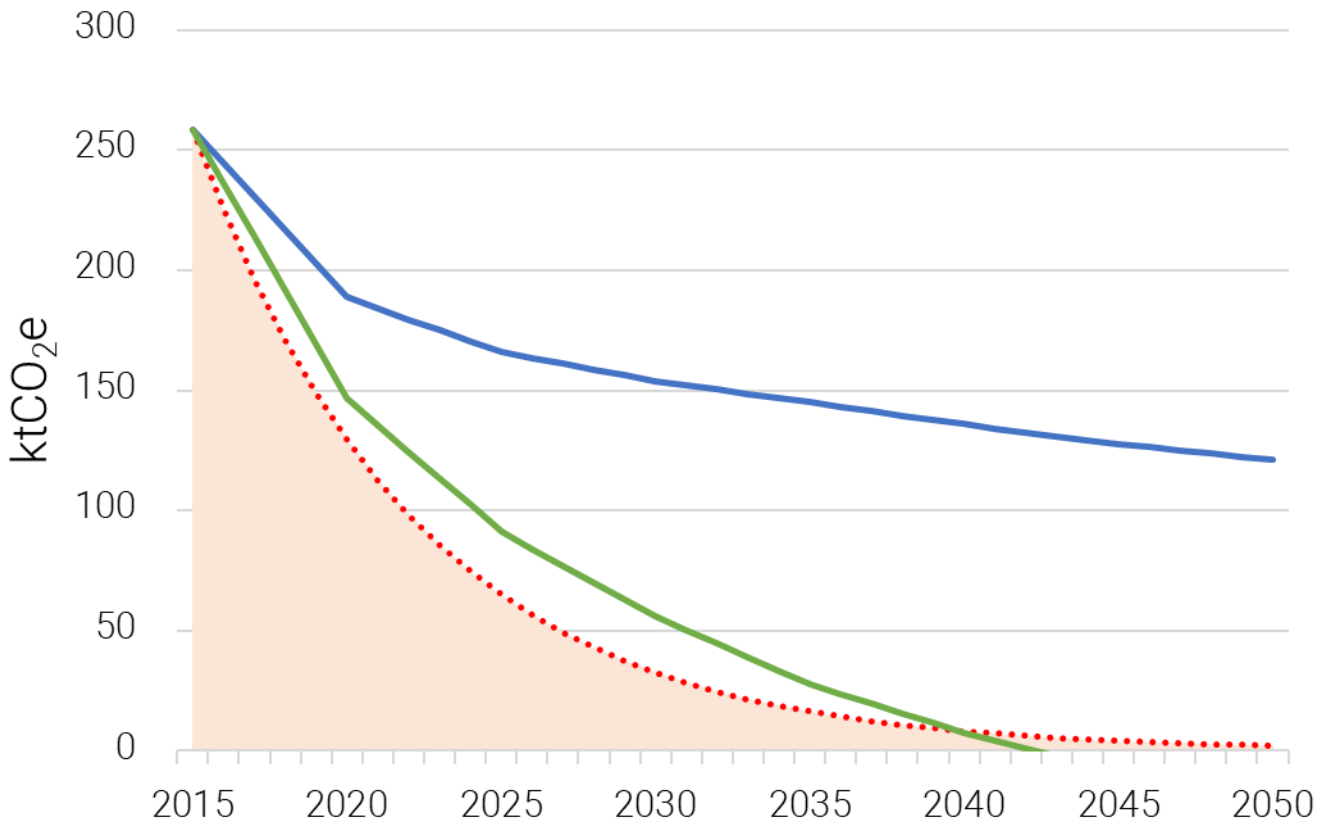


Figure 7: Adur Pathways for district-wide carbon reduction.

Historic Emissions Reductions

BEIS publishes local authority emissions data each year, with a two year lag between collection and reporting. Data is typically released in June, meaning that 2017 is the most recently available year.

Between 2015 and 2017, Adur's emissions fell by just over 7%, due mainly to the "greening" of the electricity grid. Differences in the two methodologies between SCATTER and BEIS mean that any direct comparisons must be heavily caveated.

Pathways Key

Business-as-usual (BAU): Assumes actions in line with current, national policy, such as nationally led decarbonisation of the electricity grid. This will still require a significant level of effort locally.

SCATTER Level 4: **Assumes actions significantly beyond national policy** and grid decarbonisation, across both energy supply and energy demand measures. Achieves carbon neutrality by the early 2040s.

Carbon Budget pathway: Assumes action which is aligned to the climate science set out by the Tyndall Centre. This Pathway is one way of allocating a finite, carbon budget (the area underneath the line) and is not based upon tangible energy supply and demand measures within the region. The beige area would last only seven years at current emissions levels.

Anthesis

1 – SCATTER operates from 2015 baseline year, with adjustments made using 2016 & 2017 BEIS Local Authority Emissions data.

Carbon Reduction Pathways for Worthing

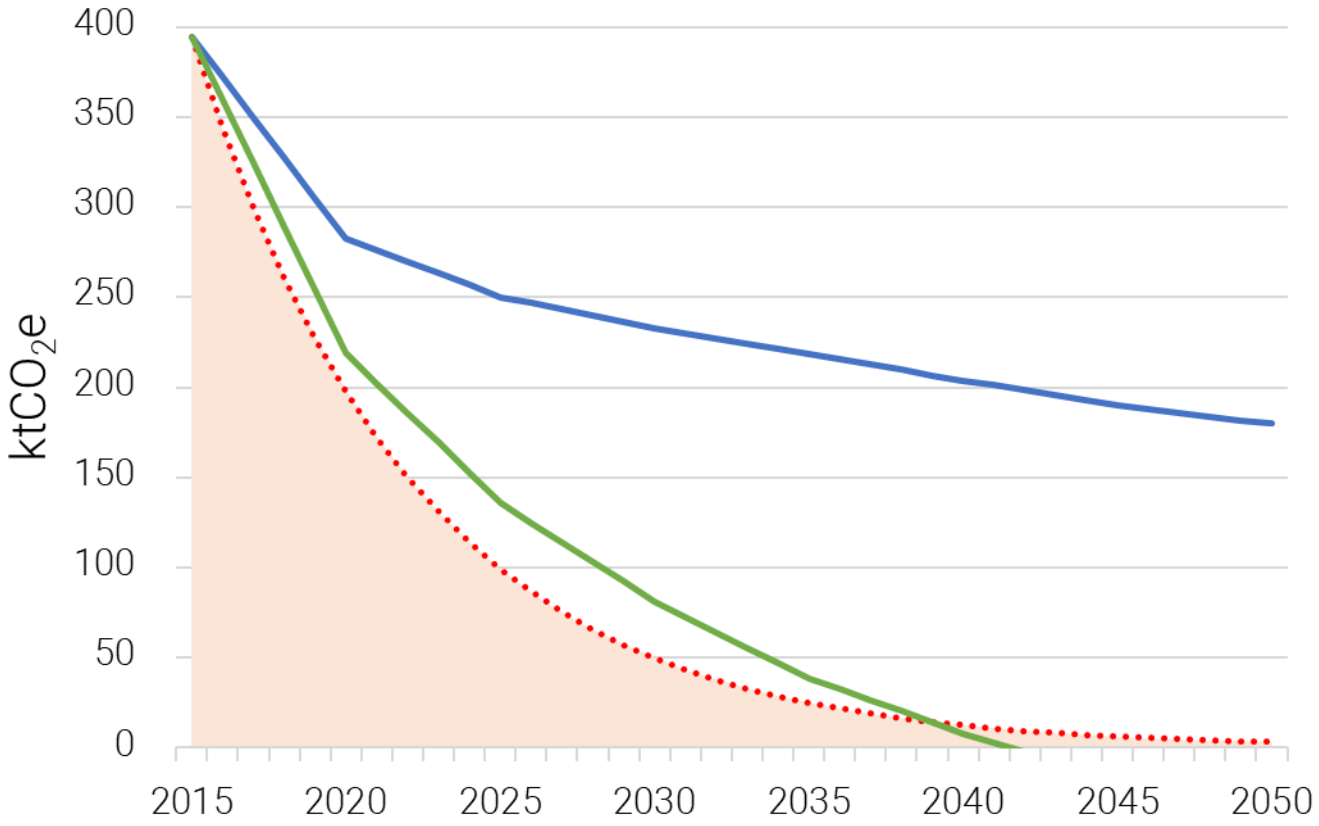


Figure 8: Worthing Pathways for borough-wide carbon reduction.

Historic Emissions Reductions

BEIS publishes local authority emissions data each year, with a two year lag between collection and reporting. Data is typically released in June, meaning that 2017 is the most recently available year.

Between 2015 and 2017, Worthing's emissions fell by just under 10%, due mainly to the "greening" of the electricity grid. Differences in the two methodologies between SCATTER and BEIS mean that any direct comparisons must be heavily caveated.

Pathways Key

Business-as-usual (BAU): Assumes actions in line with current, national policy, such as nationally led decarbonisation of the electricity grid. This will still require a significant level of effort locally.

SCATTER Level 4: **Assumes actions significantly beyond national policy** and grid decarbonisation, across both energy supply and energy demand measures. Achieves carbon neutrality by the early 2040s.

Carbon Budget pathway: Assumes action which is aligned to the climate science set out by the Tyndall Centre. This Pathway is one way of allocating a finite, carbon budget (the area underneath the line) and is not based upon tangible energy supply and demand measures within the region. The beige area would last only seven years at current emissions levels.

1 –SCATTER Tool operates from 2015 baseline year, with adjustments made using 2016 & 2017 BEIS Local Authority Emissions data.

Energy supply & demand

The energy system has two main components; energy supply, and energy demand. In this report, the term 'energy system' relates to energy in the form of solid, liquid and gaseous energy that is used to provide fuel, heat and electricity across buildings, transport and industrial sectors. Energy must be supplied to each of these sectors, in order to meet the demand for energy that the sectors require. Demand drives the amount of supply we need. Businesses, residents and public services all play a part in contributing to this demand.

Future demand is hard to predict. Recently published analysis within the National Grid's Future Energy Scenarios (FES) 2019 indicates that even under a scenario that meets the UK's net zero by 2050 (Two Degrees), electricity demand still increases. SCATTER's L4 Pathway on the other hand (consistent with the legacy 2050 Pathways tool), assumes that electricity demand still reduces overall. Factors such as increased electrification of heat 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.

Reducing demand should always come first.

Economically, this usually makes sense, whether at an individual, organizational or district level. For example, energy bills can reduce and at a district level, costs associated with installing new generation assets, new grid connections and grid reinforcement works can be minimised.

Socially, there are benefits if citizens can be better off if they shift to more active forms of transport such as walking and cycling or increase efficiency of journeys by car sharing.

Table 4: FES & SCATTER demand side assumptions at 2030 and 2050.

Source	Change in current[1] demand	
	2030	2050
FES Two Degrees (2019)	▲5%	▲48%
SCATTER Level 4 (L4) Pathway	▼-25%	▼-45%

Environmentally, emissions savings can often be achieved much quicker by implementing various demand side behaviour changes or 'quick win' efficiency measures. This can help safeguard carbon budgets and avoid placing too much reliance on slower, riskier, renewable supply infrastructure to deliver the emissions savings so critically required.

The potential for demand reduction is still huge. The International Energy Agency (IEA) estimated that efficiency measures (i.e. demand side reduction), could contribute 40% towards our emissions targets.[2]

Anthesis

1 - FES: 2018, SCATTER: 2017 levels, electricity demand only.
2 – International Energy Agency, Energy Technology Perspectives, 2017

4. Interventions to Achieve Carbon Neutrality

Brighton Energy Co-op installing 100kW Solar PV on the roof of the Worthing Borough Council owned Splashpoint Leisure Centre for South Downs Leisure, Jan 2020

Anthesis

Pathways tool and interventions

The SCATTER pathways tool models the influence of a range of measures on the emissions from the borough's energy system. This chapter of the report defines the measures which are locally influenceable, and what actions will be necessary to achieve a pathway to carbon neutrality for Adur and Worthing.

The tool operates on more measures and interventions than are listed in this chapter. Not all interventions are listed due to the region's limited local influence on their implementation. The ambition level for these national measures is set to governmental forecasts.

The defined measures are based on **what** is needed to achieve carbon reductions for the L4 pathway and do not consider **how** they can be delivered e.g. policy, feasibility, financing or skills required. Note that all figures provided are against a baseline year of 2015.

Navigating the tables

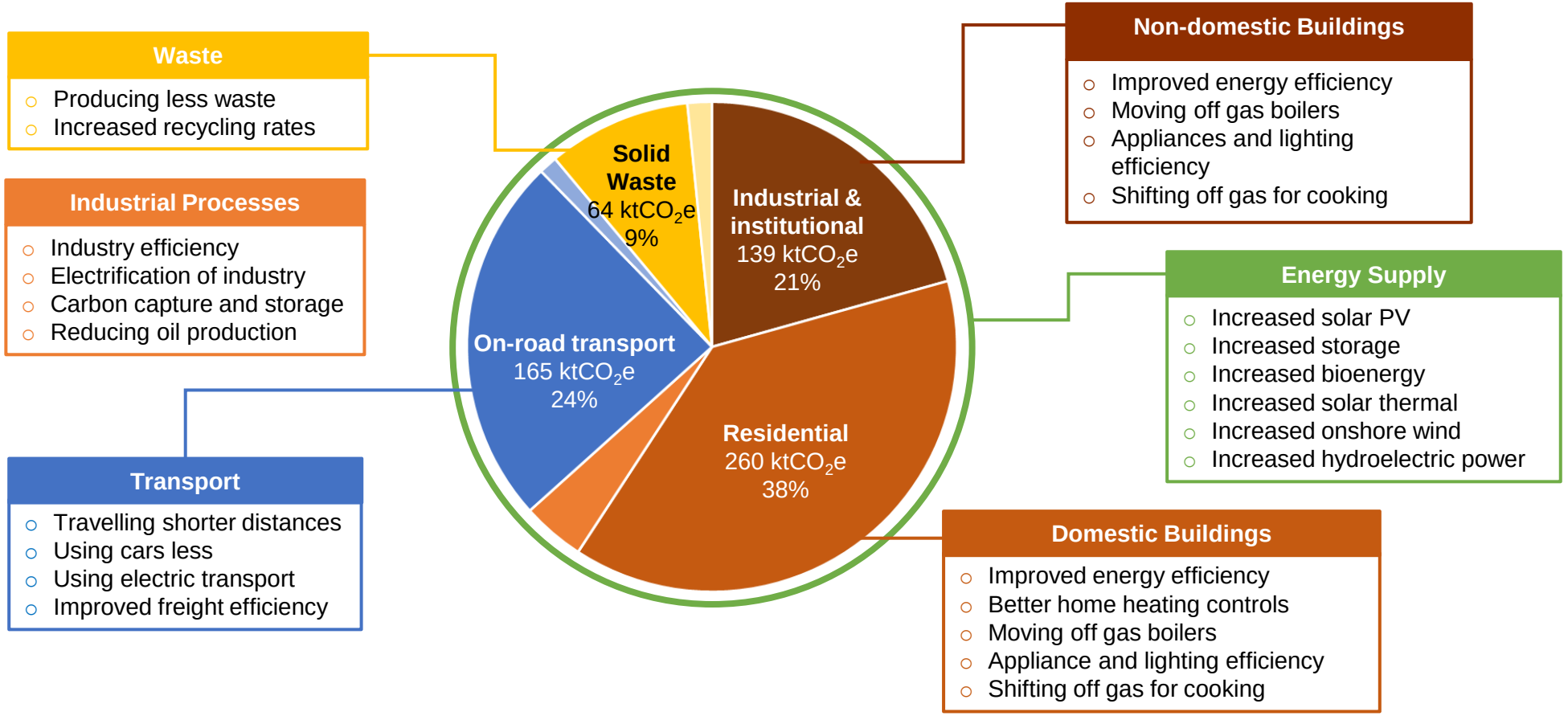
The tables in this chapter provide metrics to understand the nature and extent of measures specific to Adur and Worthing:

- **Measure:** Defines the 'action' or changing activity within a given sector.
- **Current Context:** Describes the existing 'state of play' within the regions. Note that every effort is made to define the current contexts in the same parameters as the SCATTER interventions, though this is not always possible.
- **Interventions:** These are the outputs from the SCATTER pathways tool. They are given at milestones of 2025, 2030 and 2050. The 5- and 10-year milestones give an indication of the urgency for **front-loaded actions** and underscores the need for urgent action. The 2050 milestone is included to offer an 'endpoint' evaluation for the measures that will deliver carbon neutrality for Adur and Worthing.

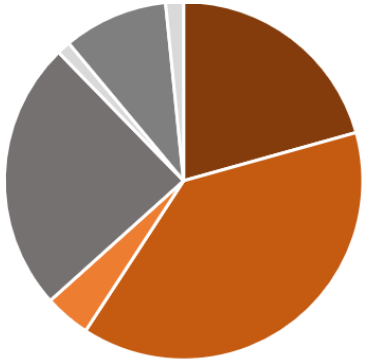
Measures are broken down into various sectors, which are matched up with the SCATTER sectors listed in Chapter 1 as part of the current emissions inventories.

Summary of measures

The range of potential carbon reduction measures considered as part of this study is summarised below. This also presents the SCATTER sectors to which the measures correspond. Explanations of each measure are given in at the head of each section.



Domestic and non-domestic buildings



Decreasing building energy demand and electrifying our heating systems

The following measures describe the modelling around reducing the energy demand for heating within domestic and non-domestic buildings:

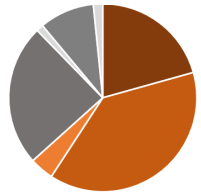
- **Improved energy efficiency:** The tool plots the effects of improving heat retention within homes, which can be improved through the rollout of deep retrofit measures within homes. Measures include: loft insulation, wall insulation (for both cavity and solid walls), floor insulation, superglazing and draughtproofing**.** Improvements to commercial practices which reduce energy demands for heating and cooling, including but not limited to improvements to building fabric.
- **Moving off gas boilers:** Considering 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).
- **Appliance and lighting efficiency:** Considers the reduction in energy demand from more efficient lighting and appliances, including white goods, electrical devices and all forms of lighting.
- **Better home heating controls:** Considers the reduction in energy demand corresponding to the reduction in average temperature of the home. ‘Average’ denotes the **annual** average across all homes and implies the use of smart control technologies rather than changes to comfort levels and/or healthy temperatures.
- **Shifting off gas for cooking:** Models the uptake of electrical cooking systems and discontinuation of gas cookers.

Improving the energy performance of the domestic property in Adur and Worthing addresses both carbon reductions and quality of living improvements.

Fuel Poverty Statistics (2017) indicated a fuel poverty rate of 8.5% in Adur (2,446 households) and 9% in Worthing (4,530 households).

Anthesis

Domestic Buildings



Measure	Current A&WC Context	SCATTER L4 Pathway		
		2025	2030	2050
Improved energy efficiency[1]	**Adur:** 1,427 ECO measures installed (c.5% of households) between 2013 and March 2019[2] 73% of EPC-rated homes have a rating of D or below[4] **Worthing:** 2,946 ECO measures installed (c.6% of households) between 2013 and March 2019[2] 76% of EPC-rated homes have a rating of D or below[4] 233 Watts/^{o}C average heat loss per house (Referred to in the legacy 2050 Pathways tool as thermal leakiness. See definition opposite)	183 Watts/^{o}C average heat loss per house (21% reduction in thermal leakiness) Indicative retrofit rates: Solid wall insulation: 1,192 households a year Loft insulation: 2,998 households per year Superglazing: 2,703 households per year New builds to PassivHaus[5] or equivalent standard	158 Watts/^{o}C average heat loss per house (32% reduction in thermal leakiness) Indicative retrofit rates Solid wall insulation: 1,235 households a year Loft insulation: 3,104 households per year Superglazing: 2,802 households per year New builds to PassivHaus or equivalent standard	58 Watts/^{o}C average heat loss per house (75% reduction in thermal leakiness) New builds to PassivHaus or equivalent standard

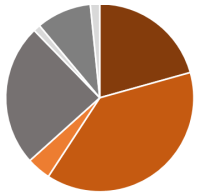
What is 'thermal leakiness'?

Thermal leakiness is a measure of how well a house **retains heat**. A house with high thermal leakiness will not retain heat very easily and will be more expensive to keep warm. Thermal leakiness varies across the ambition thresholds within SCATTER and depends on three variables, all of which will impact the Watts/^{o}C metric:

1) Thermal conductivity of the building fabric (i.e. .'U-values' of ceilings, floors, walls and windows).
2) Ventilation (i.e. effectiveness of draught-proofing).
3) Temperature difference with the outside (i.e. the average temperature of the home based on the occupant's preference or use of smart thermostats).

1 – For a full list of retrofit measures see Appendix 5, though note that these are non-prescriptive. The measures described are indicative only, and the tool operates performs calculations based on the reductions in thermal leakiness as opposed to the effects of different specific retrofit measures.
2 – See ECO measure data – the Energy Company Obligation (ECO) is a government-led scheme which seeks to improve the energy efficiency of homes across Great Britain through the installation of retrofit measures via grant funding.
3 – Sub-regional fuel poverty statistics for England 2019
4 – EPC data – only approximately 66% of domestic properties in region are listed as having an EPC (c.53,000 households). For a full list see Appendix 6.
5 – PassivHaus refers to a standard of energy efficiency, where a building uses no more than 15 kWh/m^{2} for space heating and cooling.

Domestic Buildings



Measure	Current A&WC Context	SCATTER L4 Pathway		
		2025	2030	2050
Moving off gas boilers	**Adur:** c. 26,000 properties (91%) have gas systems installed[1] **Worthing:** c. 44,000 properties (88%) have gas systems installed Renewable Heat Incentive (RHI) has accredited 16 domestic installations for renewable heat systems in **Adur** and 23 in **Worthing** since 2014[2]	**Adur:** 33% of household stock have a new heating system **Worthing:** 35% of household stock have a new heating system Majority of heating systems are gas boilers, with some heat pumps[3] (14%)	**Adur:** 48% of household stock have a new heating system **Worthing:** 49% of household stock have a new heating system Majority of heating systems are gas boilers, with an increased share of heat pumps (26%) and district heating (1%)	In both **Adur** and **Worthing**, every house has a new heating system installed Majority of heating demand is delivered by heat pumps (90%) with the remainder from resistive heaters and district heating
Appliance & lighting efficiency	Consumption by domestic lighting decreased 7% between 2015 and 2018[4] The total mean domestic electricity demand in 2018 was 3.64 MWh in **Adur** and 3.55 MWh in **Worthing**[5]	Average demand per household is 2.42 MWh (20% reduction relative to 2015)	Average demand per household is 2.12 MWh (30% reduction relative to 2015)	Average demand per household is 0.93 MWh (69% reduction relative to 2015)
Shifting off gas for cooking	47% electrified[6]	69% electrified	76% electrified	100% electrified
Better home heating controls[7]	Current average temperatures are approximately 17.3ºC[8]	16.8ºC	16.7ºC	16.0ºC

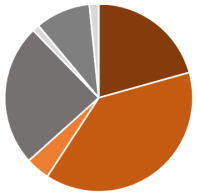
See Appendix 7 for a description of the various heating technologies assumed within SCATTER

Anthesis

1 – Assuming 1 meter per household based on 2018 data from: Gas network data
2 – https://www.gov.uk/government/statistics/rhi-monthly-deployment-data-may-2019
3 – Air-source and ground-source heat pump technology
4 – Sub-national electricity consumption statistics 2005 to 2018
5 – Electricity demand data

6 – based on legacy SCATTER assumptions
7 – Reductions may be achieved through better heating controls (i.e. 'Smart thermostats') that zone the heat, as opposed to reducing comfort
8 – ECUK (2017) Table 3.16: Internal and external temperatures 1970 to 2012

Domestic Buildings



Local examples of best practice

A programme to install 250 air source heat pumps in dwellings in West Sussex is planned through the Innovate UK funded Smarthubs project

LEAP free energy advice service have installed over 1,200 LED lightbulbs in homes across **Adur and Worthing**, cumulatively saving 750 tCO_2 over the next 10 years

National policy drivers & schemes

Gas boilers will be banned in **new** homes from 2025

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. However, it has been argued that the proposed changes are not ambitious enough.

Minimum energy efficiency standards (MEES) in the private rented sector and non-domestic property prevents landlords from letting properties if they are rated below EPC Band E.

National examples of best practice

Sunderland City Council invested in the largest gas replacement project to switch to heating provided by ground source heat pumps to a block of 364 flats.

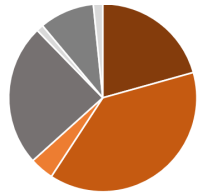
Trent and Dove Housing retrofit programme includes the installation of ground-source heat pumps for 130 residents

Exeter City Council have developed 103 certified Passivhaus homes as part of their low energy development plans.

South West England Ready for Retrofit report assessed local barriers and enablers in order to stimulate long term growth in the retrofit market

4. Interventions to Achieve Carbon Neutrality

Non-Domestic Buildings

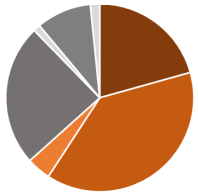


Measure	Current A&WC Context	SCATTER L4 Pathway		
		2025	2030	2050
Improved energy efficiency	**Adur:** 64% of EPC-rated commercial 'lodgements' are rated D or lower[1] **Worthing:** 67% of EPC-rated commercial 'lodgements' are rated D or lower[1]	16% reduction in commercial heating and cooling demand against 2015 levels	24% reduction in commercial heating and cooling demands against 2015 levels	45% reduction in commercial heating and cooling demands against 2015 levels
Moving off gas boilers	89% gas and oil-fired boilers (2015)[2] See Appendix 7 for further detail on the type of heating technologies assumed	Reduce gas and oil-fired boilers to 58%	Reduce gas and oil-fired boilers to 46%	All demand met entirely by heat pumps and resistive heaters
Appliances & lighting	Consumption by non-domestic lighting, computers and commercial motors fell 1.7% between 2015 and 2018[3]	7% reduction from 2015 **Adur:** Non-domestic demand is 115 GWh **Worthing:** Non-domestic demand is 217 GWh	10% reduction from 2015 **Adur:** Non-domestic demand is 111 GWh **Worthing:** Non-domestic demand is 209 GWh	24% reduction from 2015 **Adur:** Non-domestic demand is 95 GWh **Worthing:** Non-domestic demand is 178 GWh
Shifting off gas for cooking	Cooking is 24% electrified	46% electrified	57% electrified	100% electrified

Anthesis

1 – See Appendix 6; a 'lodgement' is assumed to represent the same unit as 'household' (for domestic buildings) and allows comparison between the two different sector's properties.
Energy Performance of Buildings Certificates
2 – BEIS Total sub-national final energy consumption, 2015, Total Domestic Fuel - Allocated according to ECUK proportions
3 – https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/820753/2019_Electrical_Products_Tables.xlsx

Non-Domestic Buildings



Local examples of best practice

Worthing Borough Council is investigating heat network feasibility within the Worthing Civic Quarter using government funding.

BISEPS project is led by **West Sussex County Council,** developing secure, competitively-priced, low carbon energy for SMEs in the region.

National policy drivers & schemes

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 across Great Britain 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 across all properties.

National examples of best practice

Cornwall Council have piloted the use of ground source heat pumps at Tolvaddon Energy Park as part of a £4m investment in 19 commercial units.

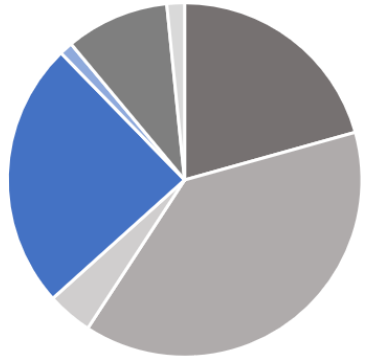
The Carbon Trust's Green Business Fund has supported hundreds of small businesses to identify energy savings and energy efficiency improvements.

Bedfordshire's sustainable warehouse was accredited in 2019 as the most sustainable building of its kind in the UK.

Welsh Government Planning Policy requires projects with a floor area greater than 1000m^2 to achieve a BREEAM Very Good rating**.**

Nottinghamshire County Council in partnership with Salix supported energy reduction projects in 78 schools. Projects included LED lighting upgrades, new Building Energy Management Systems, boiler replacements and improving building fabric insulation.

Transport



Changing the way we travel & phasing out fossil fuel vehicles

The first group of transport measures model **changes in behaviour** and culture around transport**:**

- **Travelling shorter distances:** A reduction in the overall mileage travelled by all passengers across all modes.
- **Using cars less:** Changes in the mode of travel passengers use to complete their journeys. These are broken down into car (which includes petrol, diesel, hybrid and electric vehicles) active (walking and cycling) and public (train and bus).
- **Improved freight efficiency:** A change in the mode of travel for freight and commercial journeys. Across Adur and Worthing there are approximately 600 heavy goods vehicles.

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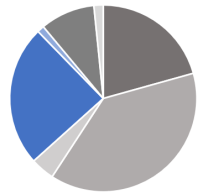
The second group of transport measures consider the **adoption of electric vehicles** and the phasing out of petrol and diesel as a means of fuelling our transport**:**

- **Shift to zero carbon cars:** Uptake of hybrid and electric passenger vehicles, including plug-in hybrids and the phasing out of petrol/diesel vehicles. The tool does **not** consider hydrogen-fuel vehicles.
- **Shift to zero carbon buses:** Uptake of hybrid and electric public transport buses and phasing out of diesel buses.
- **Rail electrification:** Considers the emissions savings resulting from electrifying rail networks

Anthesis

Transport



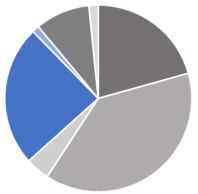
Measure	Current A&WC Context	SCATTER L4 Pathway		
		2025	2030	2050
Travelling shorter distances	**Adur:** 10.2% of residents work from home and the most common distance travelled to work is 5-10km[1] **Worthing:** 10.4% of residents work from home and the most common distance travelled to work is less than 2km[1]	Overall travel demand drops 17% relative to 2015 levels 25% reduction in car transport **mileage**	Overall travel demand drops 25% relative to 2015 levels 27% reduction in car transport **mileage**	Overall travel demand drops 25% relative to 2015 levels 38% reduction in car transport **mileage**
Using cars less	**Adur:** 2.5% of people regularly cycle to work and 99.2% of households are within two kilometres of a railway station[2] **Worthing:** 3.4% of the population regularly cycle to work and 88.2% of households are within two kilometres of a railway station[2]	6% reduction in car transport **share** against 2015 levels Modal share of public transport (rail & bus) is 18% Modal share of active transport (walking & cycling) is 6%	10% reduction in car transport **share** against 2015 levels Modal share of public transport (rail & bus) is 20% Modal share of active transport (walking & cycling) is 6%	22% reduction in car transport **share** against 2015 levels Modal share of public transport (rail & bus) is 29% Modal share of active transport (walking & cycling) is 9%
Improved freight efficiency	It is estimated that in **Adur** there are approximately 4,500 LGVs and 400 HGVs[3] It is estimated that in **Worthing** there are approximately 5,600 LGVs and 200 HGVs[3] 71% of freight emissions in the UK are from on-road transport[4]	Road freight using diesel falls below 99% of total modal share[5]	Road freight using diesel falls below 98% of total modal share	Road freight using diesel falls below 93% of total modal share

Refer to Appendix 8 for further information on assumptions on other modes of transport.

Anthesis

1 – West Sussex Census Bulletin https://www.westsussex.gov.uk/media/4622/censusbulletin_traveltowork.pdf
2 – West Sussex JSNA https://www.westsussex.gov.uk/media/3094/10_transport.pdf
3 – https://www.gov.uk/government/statistical-data-sets/all-vehicles-veh01
4 – Department for Transport Statistics - Table TRA3105 Heavy goods vehicle traffic by axle configuration and road category in Great Britain, 2015
5 – SCATTER assumptions in this area do not include hydrogen as freight fuel and are left unmodified from the legacy DECC 2050 Pathways calculator

Transport



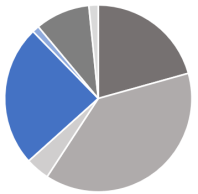
Measure	Current A&WC Context	SCATTER L4 Pathway		
		2025	2030	2050
Shift to zero carbon cars	3 public charging points listed on the council website West Sussex Electric Vehicle Strategy estimated in a high uptake scenario that the county will require 3,305 public charging points by 2025[1]	51% EV, 13% PHEV/HEV, 36% petrol/diesel	75% EV, 14% PHEV/HEV, 11% petrol/diesel	100% EV
Shift to zero carbon buses	There are 16 local bus services operating in **Adur**[2] , No evidence to suggest trialing of low emission buses in either Adur or Worthing	48% EV, 40% PHEV/HEV, 12% petrol/diesel	76% EV, 24% PHEV/HEV	100% EV
Rail electrification	As of October 2017, 34% of Great Britain's railway routes were electrified[3]	Rail is 100% electrified	Rail is 100% electrified	Rail is 100% electrified

Transport Glossary
EV – Electric Vehicle
PHEV – Plug-in Hybrid Electric Vehicle
HEV – Hybrid Electric Vehicle
ULEV – Ultra Low Emission Vehicle

Anthesis

1 – West Sussex Electric Vehicle Strategy 2019-2030
2 – Adur District Bus Review (2019)
3 – Investigation into the Department for Transport's decision to cancel three rail electrification projects

Transport



Local examples of best practice

West Coastway line is fully electrified between Brighton and Southampton, but holds no rail freight capacity

easitADUR & WORTHING offers discounted travel options for public transport and cycling

Brighton & Hove announced 30 new hybrid buses with the capability to run in a 'zero-emissions mode' through the city's Ultra Low Emissions Zone

West Sussex Electric Vehicle Strategy estimates that the county will require 3,305 public charging points by 2025 and 7,346 by 2030 and is developing a Network Plan by the end of 2020 to work towards this

National policy drivers & schemes

Go Ultra Low is a national scheme aiming to inform consumers and promote the savings associated with switching to EV

Moving Forward Together strategy commits bus operators to only purchase ultra-low or zero carbon buses from 2025. The current definition for an ultra-low emissions bus target is a 30% reduction in GHG emissions against Euro VI average performance

UK Government operating an open consultation (concluding July 2020) on ending the sale of new petrol, diesel and hybrid cars and vans by 2035, or earlier if a faster transition appears feasible

National examples of best practice

London Borough of Waltham Forest has a scheme to improve walking and cycling has developed 24km of cycle route and trained 15,000 to cycle

Nottingham City Council introduced a Workplace Parking Levy congestion charge to encourage employers to reduce the number of free workplace parking places they provide to staff and switch to alternative modes of transport

Bath's BreATHe project will roll out levies for higher emission vehicles within Bath city centre

Bristol has introduced a fleet of 10 new electric cars which are available to rent by the public

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

Waste & Industry

Improving waste streams

The following measures within the waste sector are defined within the tool:

- **Producing less waste:** An overall reduction in the weight of waste produced across all streams, for both commercial properties and domestic homes.
- **Recycling rates:** Models the different destinations for waste streams.

The in-boundary emissions impacts will largely relate to treatment (if it occurs in boundary) and transport. However, it is important to note that there are other emissions impacts associated with waste that may occur outside of the authority boundary. For example, in the production process associated with the item that has been consumed.

Where such emissions occur outside of the local authority region boundary; the associated embodied emissions are not be accounted for here - these would only be reflected using consumption-based accounting which relies on methodologies outside of the scope of SCATTER.

Improving the efficiency of industrial processes

The following industrial measures are defined within the tool:

- **Industry efficiency:** Changes in sectoral emissions through improvements to equipment efficiency and process development.
- **Electrification of industry:** Increasing the degree of electrification of industrial processes (including chemical, metal and mineral processing).
- **Carbon capture and storage:** Uptake of carbon capture and storage technology across industrial sectors and processes.
- **Reducing oil production:** Reduced demand for oil and petroleum products against baseline levels, assuming no changes to the operational processes at refineries themselves.

Waste

Measure	Current A&WC Context	SCATTER L4 Pathway		
		2025	2030	2050
Producing less waste[1]	**Adur:** 21,519 tonnes of household waste and 2,402 tonnes of non-household waste was collected in 2017-2018[2] **Worthing:** 38,913 tonnes of household waste and 5,175 tonnes of non-household waste was collected in 2017-2018[1] The volume of waste has increased steadily from 2014-15 by 3%[2]	8% decrease in overall quantity of waste against 2015 levels	11% decrease in overall quantity of waste against 2015 levels	20% decrease in overall quantity of waste against 2015 levels
Increased recycling[3]	**Adur:** 34% of household waste for recycling, composting and reuse in 2017/18[2] **Worthing:** 36% of household waste was sent for recycling, composting and reuse in 2017/18[2]	55% of commercial and household waste goes to recycling	61% of commercial and household waste goes to recycling	85% of commercial and household waste goes to recycling

1 – Percentages are defined in terms of weight, not volume. Other categories within SCATTER include Commercial and Industrial waste, Construction & Demolition waste, Sewage Sludge and Landfill Gas.
2 – Local Authority Collected and Household Waste Statistics 2014/15 - 2017/18, England
3 – Waste destinations consist of 'recycling' (one category), 'landfill', 'composting', and 'incineration or EfW'. Updates made to the original DECC Pathways Calculator in respect of EU Waste Directive 2035 Targets.

Industry

The energy intensity of industry has been set to the maximum ambition level as it includes key measures like industry electrification and energy demand. However, this intervention also incorporates the use of Carbon Capture and Storage (CCS). We recommend that no reliance is placed on such technology by A&WC given that is still in the very early stages of development and has limited precedent in the borough. **All reductions are given against a 2015 baseline:**

Measure	Current A&WC Context	SCATTER L4 Pathway		
		2025	2030	2050
Industry efficiency	Per BEIS figures, total emissions from industry and commercial sources decreased 33% between 2011-17[1]	51% reduction in emissions from industry	55% reduction in emissions from industry	76% reduction in emissions from industry
Electrification of industry	35% of UK industrial energy consumption in 2018 was electric[1]	41% of UK industrial energy use is electrified	44% of UK industrial energy use is electrified	66% of UK industrial energy use is electrified
Carbon Capture and Storage (CCS) on industry	No CCS facilities or research in district or borough Progress report into breakthrough technologies states that government cannot assume that CCS will be running at scale by 2050	2% of UK industrial process emissions are captured by CCS	4% of UK industrial process emissions are captured by CCS	42% of UK industrial process emissions are captured by CCS

Oil production is assumed to follow governmental projections, which is correspondingly set as the lowest ambition level within the tool.

Measure	Current A&WC Context	SCATTER Level 1 Pathway		
		2025	2030	2050
Oil production	No significant oil or petroleum product manufacturing within Adur and Worthing	18% reduction in oil production relative to 2015 levels	36% reduction in oil production relative to 2015 levels	77% reduction in oil production relative to 2015 levels

1 – https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/820647/DUKES_1.1.5.xls

Waste & Industry

Local examples of best practice

Household waste in Adur & Worthing has dropped by 14% since Adur & Worthing Councils moved to alternate weekly bin collections, whilst recycling waste has increased by over 3%

Brighton & Hove Food Partnership coordinate community composting schemes to help residents reduce food waste going to incineration under the East Sussex waste contract

National examples of best practice

Loughborough Food Waste Processing projects aim to improve the reliability of anaerobic digesters.

Powys Council achieved the greatest reduction in carbon associated with recycling in the UK. This partly down to shifting the collection schedule.

Bristol's 'Slim my Waste- Feed my Face' trial campaign reduced the amount of general waste by 10%.

London's Library of Things projects promote a 'borrow not buy' movement for rarely-used items.

National policy drivers & schemes

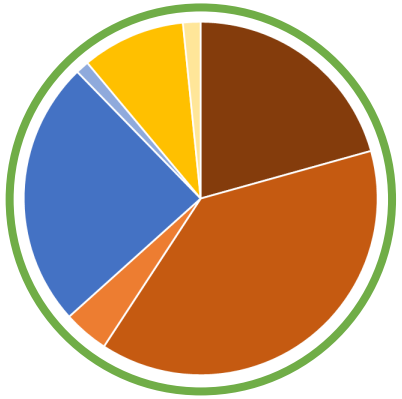
The UK has a recycling target for packaging of 70% by 2030

The Waste and Resource Strategy defines a 25-year plan for England to increase the value received from waste and promote a circular economy

A mandatory food waste collection system is expected to drive up recycling

An extended producer responsibility for packaging material is planned for introduction in 2023

Renewable Energy Supply



Meeting demand with green energy

The measures across the buildings, transport waste & industry sectors are primarily focused on the reduction of demand for energy, as well as the adoption of technologies which are powered by electricity as opposed to fossil fuels (e.g. natural gas).

A crucial factor in transforming these measures into carbon emissions reductions is the adoption of **renewable electricity supply**, which sits across all sectors.

The tool considers a wide range of renewable technologies:

- **Solar PV:** Capacity from solar photovoltaic (PV) cells, either as roof-mounted arrays or at ground-level.
- **Storage:** Storage and battery technology capacity.
- **Bioenergy supply:** Capacity from bioenergy which is both imported from out-of-boundary sources (as both feedstock and energy supply) and from in-boundary biomass stations.
- **Solar thermal:** Capacity from solar thermal technology, which differs from solar PV, but is still treated as a solar array on rooftops.
- **Onshore wind:** Capacity from onshore wind turbines. The added capacity from offshore wind turbines is treated at the national level.
- **Hydro:** Capacity from hydroelectric power stations.
- **Wave, tidal and tidal stream:** Capacity from wave, tidal & tidal stream sources. Treated at the national level.

For all of the supply technologies referenced in this section, if the technology is not feasible in the district boundary to the extent suggested, then the residual capacity is assumed to occur outside the boundary i.e. it is assumed that other regions would compensate for the lack of supply from this technology.

Anthesis

Renewable Energy Supply

Measure	Current A&WC Context	SCATTER Level 4 Pathway		
		2025	2030	2050
Solar PV	**Adur:** Up to 2018, there have been 715 installations with 2.8 MW installed capacity and an annual output of 2.69 GWh[1] **Worthing:** Up to 2018, there have been 929 installations with 3.5 MW installed capacity and an annual generation of 3.41 GWh	0.47 km^2 of PV arrays across roof space (equivalent to arrays on 43% of households) 159 MW installed capacity[2] 120 GWh generated per year	0.67 km^2 of PV arrays across roof space (equivalent to arrays on 58% of households) 226 MW installed capacity 295 GWh generated per year	1.52 km^2 of PV arrays across roof space (equivalent to arrays on all eligible households plus a further 0.25 km^2 on ground-mounted arrays)[3] 518 MW installed capacity 390 GWh generated per year
Storage	Battery storage projects are planned to be installed at multiple sites in Adur and Worthing as part of the iUK funded Smarthubs project.	2.41 GW storage capacity in standby generators[4]	2.52 GW storage capacity in standby generators	2.69 GW storage capacity in standby generators
Bioenergy supply (heat & electricity)	**Adur:** In 2018, there was 1 plant biomass installation with a capacity of 5.1 MW **Worthing**: In 2018, there was 1 sewage gas plant installed with a capacity of 0.4 MW	23 MW installed capacity	25 MW installed capacity	38 MW installed capacity
Solar thermal	No installed capacity through the government-supported Renewable Heat Incentive scheme as of September 2019[1]	5.9 MW installed capacity (equivalent to approximately 1,400 family homes)[5]	7.5 MW installed capacity (equivalent to approximately 1,800 family homes)	13.9 MW installed capacity (equivalent to around 3,300 family homes)

1 – Based on 2018 data from: BEIS renewables data
2 – The % of households quoted is taken from an installation occupying 16m^2 of roof space and household number projections, with an assumed maximum coverage rate of 80% (as per the Energy Savings Trust Guidance)
3 – "Eligible" here relates to households that have suitably sized rooves, that are pitched at a suitable angle, and are oriented in a suitable direction. This figure varies from region to region but in some cases can be as high as 90% of households. A more conservative estimation of 80% of households being eligible was made here.
4 – Standby generators are similar to batteries in that they are a source of stored energy if the primary supply fails or is insufficient i.e. generators serve to store the energy produced from PV arrays during the day which can then be used during the evening when it is dark.
5 – "family homes" relates to an occupancy of 3-5 people, with a 6m^2 solar thermal array with a total capacity of 4.2 kW.

Renewable Energy Supply

Within SCATTER, offshore wind technology is treated at the national level and models a steady increase in capacity up to 2025. Offshore wind is not treated using the same principles as land-based technologies because the number of local authorities with direct influence, control and/or ownership of a local offshore site for wind farm developments is very small.

It is worth noting that turbines used on offshore farms have, on average, a higher rating than onshore equivalents. **The number of turbines defined within the SCATTER L4 pathway assumes an average rating of 2.5 MW per turbine.** At Rampion Wind Farm off the coast of Worthing the average turbine rating is 3.45 MW.

Measure	Current A&WC Context	SCATTER Level 4 Pathway		
		2025	2030	2050
Onshore wind[1]	**Adur:** Up to 2018, 2 installations of onshore wind at Shoreham Port, with 0.2 MW of installed capacity and an annual generation of 428 MWh[2] **Worthing:** No installed on-shore capacity as of 2018, though offshore Rampion Wind Farm has 116 turbines with a combined capacity of 400 MW	40 MW installed capacity 16 onshore turbines installed (2.5 MW rating), equivalent to an additional 12 turbines at Rampion (3.45 MW rating)	59 MW installed capacity 23 onshore turbines installed, equivalent to an additional 17 turbines at Rampion	148 MW installed capacity 59 onshore turbines installed, equivalent to an additional 43 turbines at Rampion

A note on supply technologies

SCATTER estimates values for the installed capacity of each supply technology, by taking a nationally assumed capacity figure (L1 was aligned to the 2017 National Grid's Future Energy Scenario, Two Degrees) 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.

Anthesis

1 – National planning restrictions could make these targets very difficult to achieve. As with the other intervention measures, if progress with this intervention could not be achieved, intervention would need to be increased under alternative measures to compensate.
2 – BEIS renewables data

Renewable Energy Supply

The following energy technologies are included within the SCATTER tool but have lower feasibility given their limited national uptake to date. Acknowledging this, they are treated with the minimum ambition level within the tool (L1). As noted on the introduction, for these or any of the supply technologies referenced in this section, if the technology is not feasible in the district boundary to the extent suggested, then the residual capacity is assumed to occur outside the boundary i.e. it is assumed that other regions would compensate for the lack of supply from this technology.

Measure	Current A&WC Context	SCATTER Level 1 Pathway		
		2025	2030	2050
Hydro power	No installed capacity as of 2018	3.5 MW installed peak capacity	3.7 MW installed peak capacity	5.4 MW installed peak capacity
Wave, tidal and tidal stream	No installed capacity as of 2018 Total national generation from wave and tidal was 9.3 GWh in 2018	Energy generation from wave, tidal stream and tidal wave grows steadily to 2900 GWh nationally by 2050.		

Renewable Energy Supply

Local examples of best practice

Splashpoint Leisure Centre in Worthing had 100 kWh solar array installed as part of the first community energy scheme in the borough.

Shoreham Port is one of eleven ports to hold Eco Port status, with two 100 kW wind turbines and a 2.2 MW PV array

Solar farm at **Westhampnett** combines a 7.4 MW PV array and 4.4 MW battery unit to produce and store energy – completed as a subsidy-free project

Plans for a 20 MW grid balancing battery storage project have been planning approval at Halewick Lane, **Sompting** and will be delivered in 2021

National policy drivers & schemes

The UK government has set a target to achieve 15% of its energy consumption from renewable sources by 2020.

Contracts for Difference scheme is the governments principal mechanism for encouraging investment in renewables

UK National Energy and Climate Plan sets out integrated climate and energy objectives, targets, policies and measures for the period 2021-2030

National examples of best practice

Warrington Borough Council own two solar farms outside of the borough .Enough energy is generated to power a town and it is expected to generate income for the local authority

Forest Heath Council own the solar farm at Toggam Farm, Lakenheath and have used the proceeds to plug funding gaps in frontline services

Stockport Hydro was Greater Manchester's first community owned hydroelectric project. It has been operational since 2012 and generates enough clean energy to power 60 homes

Renewable Energy Supply – Comparative Study

The feasibility of given renewable technologies varies greatly from district to district, given the constraints of local geographies and land usage (e.g. hydroelectric power in a flat area, large wind farms in a geographically small area etc.). The below table is intended to serve as a reference for the variety of technologies available across a number of different landscapes and geographies. The compared authorities have been chosen on the basis that they represent similar economic output and numbers of households and allow Adur and Worthing to note its performance against peer authorities. Note that 'wind' relates to onshore wind **only** given the relative lack of influence an authority has over offshore projects.

Local Authority	Households[1]	GVA (£m)[1]	Current installed capacity, selected renewable technologies[2]				Total installed capacity (MW)[2]	Renewable energy capacity per unit area (kW/km²)
			PV	Wind	Hydro	Organic fuels*		
Adur and Worthing	74,907	3,755	6.3	-	-	5.4	12.0	161.2
Dundee City	-3%	-5%	4.1	0.1	0.2	10.6	15.0	250.1
Barking & Dagenham	-6%	+5%	5.2	0.003	-	3.6	8.7	241.6
Poole	-11%	+6%	11.4	-	-	9.3	20.7	319.3
Knowsley	-14%	+6%	10.5	0.5	-	0.3	11.3	130.4
Colchester**	-2%	+5%	90.5	0.04	0.04	11.3	101.8	309.4
West Lothian**	+0.2%	+1%	8.1	105.1	-	1.0	114.2	267.0
Telford & Wrekin**	-9%	+2%	40.9	0.1	-	7.1	48.0	165.4

Table 5: Comparative metrics for Adur and Worthing and other UK local authorities.

All percentages listed are relative to the figures for Adur and Worthing.

*includes anaerobic digestors, sewage & landfill gas, municipal solid waste, animal & plant biomass

**these local authorities represent regions of far greater area than Adur and Worthing but are nonetheless similar in terms of GVA & households.

Adur and Worthing's onshore renewable energy is split between solar PV and organic fuels. Excluding the offshore wind development at Rampion, Adur has relatively low levels of installed renewables when compared to peer authorities (even after accounting for the varying areas of each authority).

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1 – ONS GVA Statistics
2 – BEIS Renewable Energy Statistics

Intervention Emissions Savings Estimates

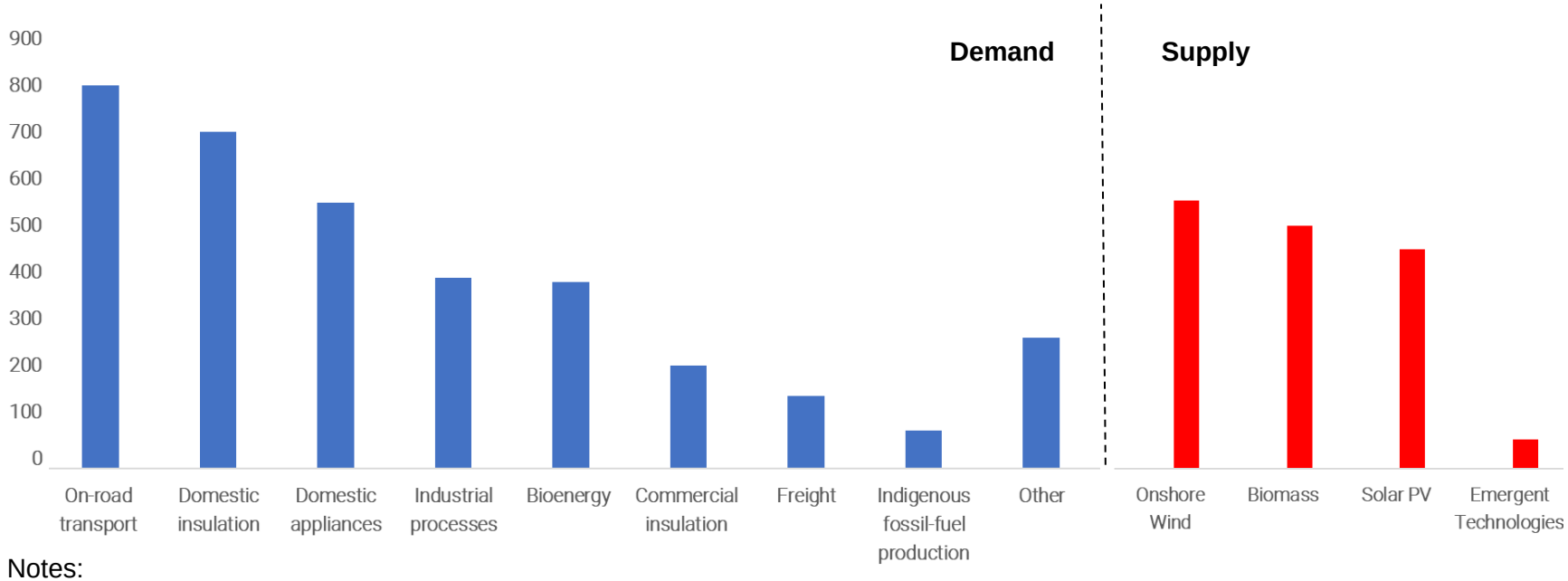
Table 6: Demand side measure cumulative savings to 2030

Demand-side measure	Cumulative saving to 2030 ($ktCO_2e$)
On-road transport	826
Domestic insulation	726
Domestic appliances	573
Industrial processes	411
Bioenergy	402
Commercial insulation	223
Freight	157
Indigenous fossil-fuel production	83
Other	283

Table 7: Supply side measure cumulative savings to 2030

Supply-side measure	Cumulative savings to 2030 ($ktCO_2e$)
Onshore Wind	591
Biomass	535
Solar PV	484
Emergent Technologies	66

The estimated cumulative savings to 2030 for demand-side measures are presented below (blue). Supply-side measures (red) have also been presented, though please note the limitations of such estimates and the importance of not summing the demand and supply.



Notes:

- It is not appropriate to sum any savings presented from renewable supply with savings achieved on the demand side of the energy system, as this is may result in double counting.
- Intervention is critical on the demand side to realise emissions savings from renewable supply. For example, if heating systems are not electrified, then a decarbonised electricity grid will have limited impact. Similarly if the grid is not decarbonised, savings from Electric Vehicles will not be as great.
- 'Emergent' technologies are hydro, tidal and wave power. 'Other' constitutes the following: rail transport, waste & recycling, commercial appliances & fossil fuel production emissions
- 'Bioenergy' relates to the consumption of hydrocarbons (solid, liquid & gaseous) as well as other organic fuels.

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Emissions Savings Summary

Comparisons against base year

This section provides an indication of relative savings by sector expressed as % reductions and intensity metrics within Adur and Worthing.

The Global Protocol for Community-Scale Greenhouse Gas Emission Inventories describes how GHG inventories such as those in SCATTER can be used as a basis for performance tracking and goal setting. Progress can be assessed in a number of ways, but here a **base year emissions goals** approach and a **base year intensity goals** approach have been used.

The base year emissions goals approach compares emissions reductions relative to an emissions level in an historical baseline year (in this case, 2017 has been chosen as the most recent dataset). These emissions reductions are typically represented in percentage terms and are shown in the table below:

SCATTER sector	% reduction against 2017 by 2030
Domestic Buildings	69.6%
Non-domestic Buildings	63.6%
Transport	82.2%
Waste & Industry	124.4%
Total	**76.0%**

Table 8: Base year emissions goals approach to emissions tracking. Percentage reduction exceeding 100% within the waste & industry sector indicates that emissions are net-captured, either by means of CCS technologies or other means of sequestration. Note that the above figures relate to emissions within Adur and Worthing.

The **base year intensity goals** approach compares changes in the emissions intensity relative to an historical baseline year. Emissions intensity can be defined as the amount of emissions per unit of a given parameter; most commonly population. In 2017, the UK average emissions intensity per capita was 5.3 tCO_2/head. Two base year intensity goals are shown in the tables below; emissions intensity per capita and emissions intensity per household.

Emissions intensity per capita is calculated from the ratio of projected emissions to projected population, and emissions intensity per household is similarly calculated from the projected growth in the number of households.

Year	Emissions intensity per capita, Adur and Worthing		Emissions intensity per household, Adur and Worthing	
	tCO_2e/head	% reduction against 2017 levels	tCO_2e/hh	% reduction against 2017 levels
2017	3.30	N/A	8.18	N/A
2025	1.21	63%	2.64	68%
2030	0.71	79%	1.51	82%

Table 9: Intensity emissions reduction approach to emissions tracking within Adur and Worthing.

Appendices

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Appendix 1a

Data Tables for SCATTER and BEIS Emissions Summaries – Adur

Sector	Scope 1 & 2 Emissions, $ktCO_2$
Industry and Commercial Electricity	23.2
Industry and Commercial Gas	13.2
Large Industrial Installations	-
Industrial and Commercial Other Fuels	10.0
Agriculture	1.0
Domestic Electricity	27.0
Domestic Gas	56.0
Domestic 'Other Fuels'	4.0
Road Transport (A roads)	62.1
Road Transport (Motorways)	-
Road Transport (Minor roads)	26.5
Diesel Railways	0.1
Transport Other	12.2
LULUCF Net Emissions	-3.6
Grand Total	**231.6**

Notes:

- BEIS data (above) and SCATTER data (right) are compiled using different methodologies.
- 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.
- Agriculture & livestock figures were omitted from the profiles given in Section 1.

IE	= Included Elsewhere
NE	= Not Estimated
NO	= Not Occurring

Sub Sector	Direct, $ktCO_2e$	Indirect, $ktCO_2e$
Residential buildings	56.6	38.1
Commercial buildings & facilities	6.1	3.4
Institutional buildings & facilities	15.3	17.1
Industrial buildings & facilities	6.7	9.9
Agriculture	0.7	0
Fugitive emissions	0	0
On-road	80.4	IE
Rail	0.1	IE
Waterborne navigation	0.002	IE
Aviation	0	NO
Off-road	0	IE
Solid waste disposal	31.9	0
Biological treatment	0	0
Incineration and open burning	0	0
Wastewater	4.0	0
Industrial process	0	0
Product use	0	0
Livestock	1.36	0
Land use	0	0
Other AFOLU	0	0
Electricity-only generation	0	0
CHP generation	0	0
Heat/cold generation	0	0
Local renewable generation	0	0
Sub-total	**203.1**	**68.4**
Grand total	**271.5**	

Appendix 1b

Data Tables for SCATTER and BEIS Emissions Summaries – Worthing

Sector	Scope 1 & 2 Emissions, $ktCO_2$
Industry and Commercial Electricity	48.8
Industry and Commercial Gas	36.3
Large Industrial Installations	0.1
Industrial and Commercial Other Fuels	11.8
Agriculture	0.5
Domestic Electricity	47.2
Domestic Gas	100.2
Domestic 'Other Fuels'	4.9
Road Transport (A roads)	44.2
Road Transport (Motorways)	-
Road Transport (Minor roads)	39.7
Diesel Railways	9.3
Transport Other	0.5
LULUCF Net Emissions	-3.0
Grand Total	**343.4**

Notes:

- BEIS data (above) and SCATTER data (right) are compiled using different methodologies.
- 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.
- Agriculture & livestock figures were omitted from the profiles given in Section 1.

IE	= Included Elsewhere
NE	= Not Estimated
NO	= Not Occurring

Sub Sector	Direct, $ktCO_2e$	Indirect, $ktCO_2e$
Residential buildings	100	65.5
Commercial buildings & facilities	11.2	7.2
Institutional buildings & facilities	19.0	36.7
Industrial buildings & facilities	13.6	21.2
Agriculture	0.42	0
Fugitive emissions	0	0
On-road	84.2	IE
Rail	8.2	IE
Waterborne navigation	0.002	IE
Aviation	0	NO
Off-road	0	IE
Solid waste disposal	31.9	0
Biological treatment	0	0
Incineration and open burning	0	0
Wastewater	6.9	0
Industrial process	0	0
Product use	0	0
Livestock	1.4	0
Land use	0	0
Other AFOLU	0	0
Electricity-only generation	0	0
CHP generation	0	0
Heat/cold generation	0	0
Local renewable generation	0	0
Sub-total	**276.7**	**130.7**
Grand total	**407.4**	

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Appendix 1c

Data Tables for SCATTER and BEIS Emissions Summaries – Adur and Worthing combined

Sector	Scope 1 & 2 Emissions, $ktCO_2$
Industry and Commercial Electricity	71.9
Industry and Commercial Gas	49.5
Large Industrial Installations	0.1
Industrial and Commercial Other Fuels	21.9
Agriculture	1.5
Domestic Electricity	74.2
Domestic Gas	156.2
Domestic 'Other Fuels'	8.9
Road Transport (A roads)	106.3
Road Transport (Motorways)	-
Road Transport (Minor roads)	66.1
Diesel Railways	9.4
Transport Other	12.6
LULUCF Net Emissions	-6.6
Grand Total	**572.0**

Notes:

- BEIS data (above) and SCATTER data (right) are compiled using different methodologies.
- 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.
- Agriculture & livestock figures were omitted from the profiles given in Section 1.

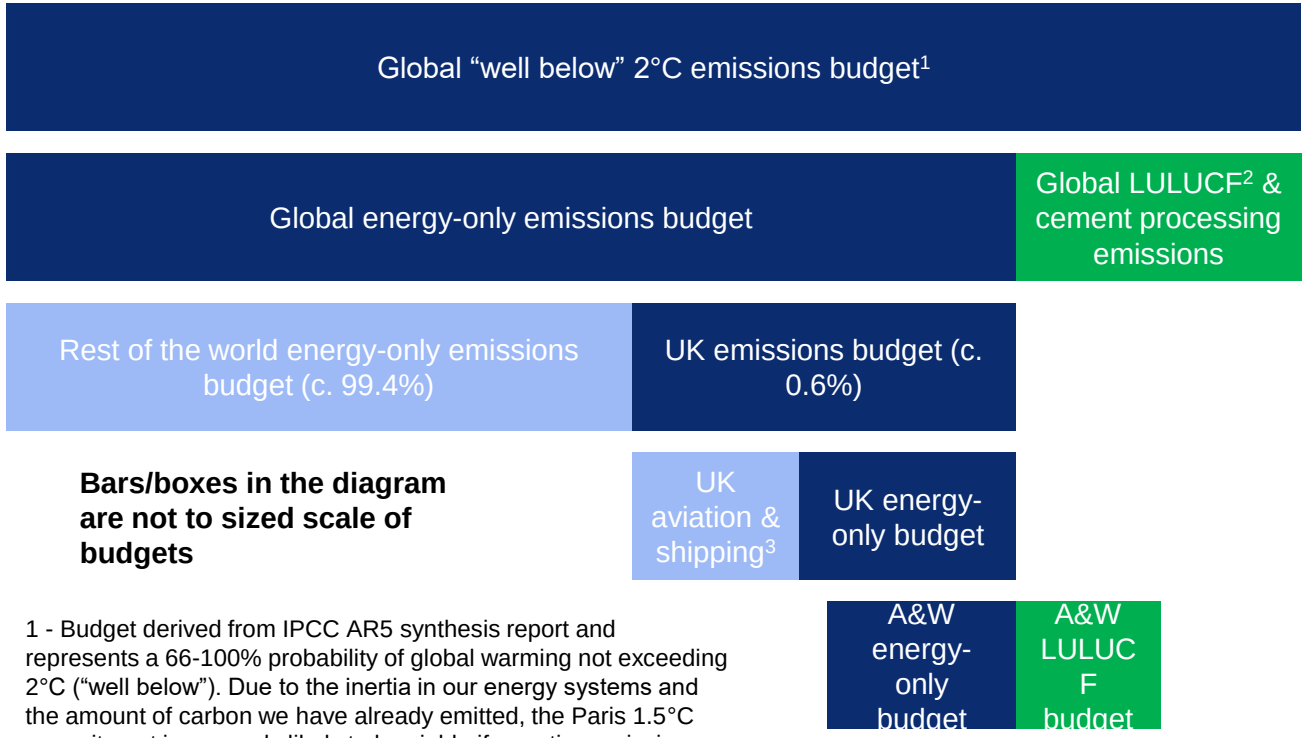
IE = Included Elsewhere
NE = Not Estimated
NO = Not Occurring

Sub Sector	Direct, $ktCO_2e$	Indirect, $ktCO_2e$
Residential buildings	156.6	103.6
Commercial buildings & facilities	17.3	10.6
Institutional buildings & facilities	34.3	53.7
Industrial buildings & facilities	20.3	31.3
Agriculture	1.09	0
Fugitive emissions	0	0
On-road	164.5	IE
Rail	8.2	IE
Waterborne navigation	0.004	IE
Aviation	0	NO
Off-road	0	IE
Solid waste disposal	63.9	0
Biological treatment	0	0
Incineration and open burning	0	0
Wastewater	10.9	0
Industrial process	0	0
Product use	0	0
Livestock	2.7	0
Land use	0	0
Other AFOLU	0	0
Electricity-only generation	0	0
CHP generation	0	0
Heat/cold generation	0	0
Local renewable generation	0	0
Sub-total	**480.0**	**199.1**
Grand total	**679.1**	

Anthesis

Appendix 2

Deriving the Adur and Worthing carbon budget



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% emissions reduction rates for Adur and Worthing 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.

Adur and Worthing’s budget

The carbon budget (3,700 $ktCO_2$ for the period 2020-2100) sets out a finite emissions limit that the should not be exceeded in order that Adur and Worthing remains in line with the Paris Agreement. The budget itself is derived from a ‘scaling-down’ approach – a full methodology is available to view in the 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 Adur & Worthing 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.

Appendix 3

Summary list of modifications between SCATTER and DECC Pathways Calculator

Measure	Updated from original Pathways Calculator?
Energy generation & storage	
Onshore wind	N
Biomass power stations	Y
Solar panels for electricity	N
Solar panels for hot water	N
Storage, demand shifting & interconnection	N
Geothermal	N
Hydro	N
CCS	N
Bioenergy sourcing	
Increase in land used to grow crops for bioenergy	Y
Reduction in quantity of waste	N
Increase the proportion of waste recycled	Y
Bioenergy imports	N
Transport	
Reducing distance travelled by individuals	N
Shift to zero emission transport	Y
Choice of fuel cell or battery powered zero emission vehicles	N
Freight: Shift to rail and water and low emission HGVs	N

Measure	Updated from original Pathways Calculator?
Domestic buildings	
Average temperature of homes	N
Home insulation	Y
Home heating electrification	Y
Home heating that isn't electric	N
Home lighting & appliances	N
Electrification of home cooking	N
Commercial buildings	
Commercial demand for heating and cooling	Y
Commercial heating electrification	Y
Commercial heating that isn't electric	N
Commercial lighting & appliances	N
Electrification of commercial cooking	N
Industrial processes	
Energy intensity of industry	Y

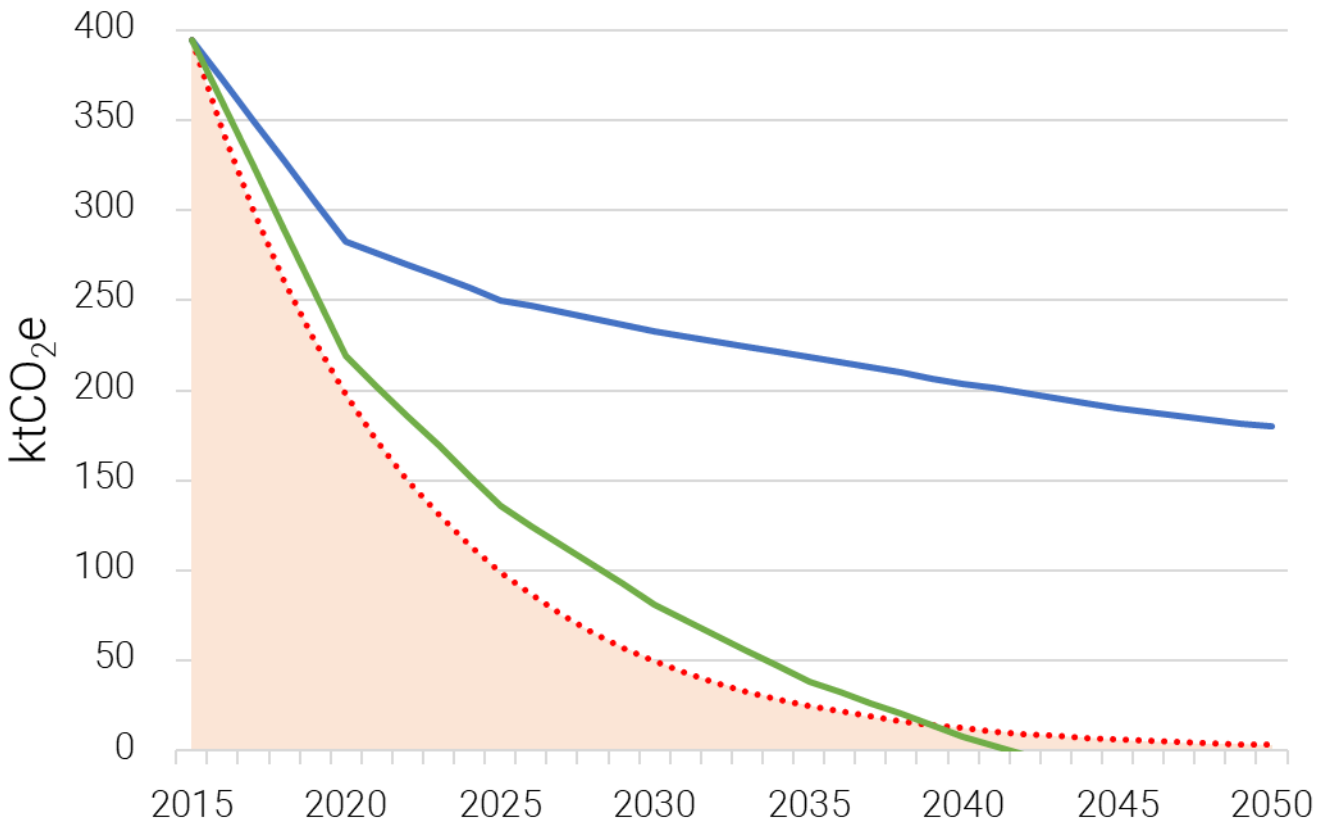
Notes:

- Updates flagged do not include scaling to local region – it is assumed that this happened for all measures. They relate to instances where the upper threshold of the ambition has been pushed further(i.e. at Level 4)
- Some updates amended forecasts and predictions of technology uptake
- Updates exclude alignment of Level 1 ambition to the National Grid FES (2017)
- Note that bioenergy source did not have material bearing on the model due to assumptions linked to bioenergy shortfalls (i.e. it is assumed that bioenergy would be sourced from outside of region, or another renewable source would be used). Waste assumptions may however drive more sustainable consumption behaviours.

Appendix 4

Pathways Summary – Adur and Worthing combined

Carbon Reduction Pathways for Adur and Worthing combined



Historic Emissions Reductions

BEIS publishes local authority emissions data each year, with a two year lag between collection and reporting. Data is typically released in June, meaning that 2017 is the most recently available year.

Between 2015 and 2017, Adur and Worthing's emissions fell just under 9%, due mainly to the "greening" of the electricity grid. Differences in the two methodologies between SCATTER and BEIS mean that any direct comparisons must be heavily caveated.

Pathways Key

Business-as-usual (BAU): Assumes actions in line with current, national policy, such as nationally led decarbonisation of the electricity grid. This will still require a significant level of effort locally.

SCATTER Level 4: **Assumes actions significantly beyond national policy** and grid decarbonisation, across both energy supply and energy demand measures. Achieves carbon neutrality by the early 2040s.

Carbon Budget pathway: Assumes action which is aligned to the climate science set out by the Tyndall Centre. This Pathway is one way of allocating a finite, carbon budget (the area underneath the line) and is not based upon tangible energy supply and demand measures within the region. The beige area would last only seven years at current emissions levels.

Anthesis

1 –SCATTER Tool operates from 2015 baseline year, with adjustments made using 2016 & 2017 BEIS Local Authority Emissions data.

Appendix 5a

Adur Domestic retrofit measures assumed within SCATTER

Retrofit Measure	Indicative number of households in Adur retrofitted per annum						
Year	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Solid wall insulation	237	245	253	262	341	3	3
Cavity wall insulation	47	16	22	26	109	-	-
Floor insulation	270	279	288	298	389	297	297
Superglazing	537	555	573	593	774	590	590
Lofts	586	610	631	655	875	-	-
Draughtproofing	1,888	47	63	75	303	3	3

Notes:

- This data is included within SCATTER but is not directly linked to the emissions calculation in the model (it was used to inform cost assumptions in the original legacy DECC 2050 Pathways calculator).
- The numbers shown are the minimum assumed measures for the L4 Pathway, as ambition was pushed further than the legacy DECC tool to which this table relates.
- 2050 household levels are predicted to be 35,377, derived from non-region specific growth assumptions in legacy DECC Pathways tool.
- Household is defined as per https://www.gov.uk/guidance/definitions-of-general-housing-terms#household
- The average heat loss per home includes new builds (at PassivHaus standard), which will contribute to lowering the average over time.
- For further detail, please refer to Section D of the DECC 2050 Pathways guidance:

Appendix 5b

Worthing Domestic retrofit measures assumed within SCATTER

Retrofit Measure	Indicative number of households in Worthing retrofitted per annum						
Year	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Solid wall insulation	427	445	462	480	619	5	5
Cavity wall insulation	891	53	59	61	202	-	-
Floor insulation	488	507	527	547	706	535	535
Superglazing	970	1,009	1,049	1,088	1,403	1,064	1,064
Lofts	1,068	1,115	1,161	1,204	1,588	-	-
Draughtproofing	3,407	151	167	173	560	5	5

Notes:

- This data is included within SCATTER but is not directly linked to the emissions calculation in the model (it was used to inform cost assumptions in the original legacy DECC 2050 Pathways calculator).
- The numbers shown are the minimum assumed measures for the L4 Pathway, as ambition was pushed further than the legacy DECC tool to which this table relates.
- 2050 household levels are predicted to be 63,802, derived from non-region specific growth assumptions in legacy DECC Pathways tool.
- Household is defined as per https://www.gov.uk/guidance/definitions-of-general-housing-terms#household
- The average heat loss per home includes new builds (at PassivHaus standard), which will contribute to lowering the average over time.
- For further detail, please refer to Section D of the DECC 2050 Pathways guidance:

Appendix 6

Energy Performance Certificates (EPCs)

Non-domestic EPC ratings for Adur and Worthing, 2008-19		
EPC rating	Number of lodgements	
	Adur	Worthing
A	6	4
A+	0	2
B	77	104
C	223	489
D	264	622
E	143	312
F	52	149
G	79	135
Not Recorded	0	2
Total number of lodgements	**844**	**1,819**

Domestic EPC ratings for Adur and Worthing, 2008-19		
EPC Rating	Number of lodgements	
	Adur	Worthing
A	4	4
B	535	817
C	4,118	7,928
D	8,349	16,598
E	3,215	7,988
F	785	2,241
G	201	600
Not Recorded	0	0
Total number of lodgements	**17,207**	**36,176**

Adur and Worthing EPCs

- Energy Performance Certificates provide an energy efficiency rating from A (most) to G (least) and are valid for 10 years. It provides information on a properties energy use and typical energy costings.
- They can provide a good indication of the level of insulation and thermal leakiness of a property.
- Defining in terms of 'lodgements' allows direct comparison between domestic and non-domestic property.
- In Adur, only 59% of domestic properties carry a publicly available EPC rating.
- In Worthing, only 70% of domestic properties carry a publicly available EPC rating.
- Live reporting on the EPC ratings of all properties (both domestic and non-domestic) can be found at: https://www.gov.uk/government/statistical-data-sets/live-tables-on-energy-performance-of-buildings-certificates#epcs-for-all-properties-non-domestic-and-domestic

Appendix 7

Domestic & commercial heating and hot water systems assumed within SCATTER

Heating and hot water systems share, as a % of households (domestic)				
Technology package	**2020**	**2025**	**2030**	**2050**
Gas boiler (old)	44%	37%	31%	6%
Gas boiler (new)	39%	34%	28%	6%
Resistive heating	7%	7%	7%	7%
Oil-fired boiler	6%	6%	5%	1%
Solid-fuel boiler	2%	2%	2%	0%
Stirling engine µCHP	-	-	-	-
Fuel-cell µCHP	-	-	-	-
Air-source heat pump	1%	9%	18%	52%
Ground-source heat pump	-	4%	9%	26%
Geothermal	-	-	-	-
Community scale gas CHP	1%	0%	0%	0%
Community scale solid-fuel CHP	-	-	-	-
District heating from power stations	-	0%	1%	3%

Heating and hot water systems share, as a % of lodgements (commercial)				
Technology package	**2020**	**2025**	**2030**	**2050**
Gas boiler (old)	45%	37%	30%	0%
Gas boiler (new)	16%	13%	11%	0%
Resistive heating	18%	16%	14%	7%
Oil-fired boiler	8%	7%	5%	0%
Solid-fuel boiler	-	-	-	0%
Stirling engine µCHP	-	-	-	0%
Fuel-cell µCHP	-	-	-	0%
Air-source heat pump	9%	17%	26%	60%
Ground-source heat pump	4%	9%	13%	30%
Geothermal	-	-	-	0%
Community scale gas CHP	-	-	-	0%
Community scale solid-fuel CHP	-	-	-	0%
District heating from power stations	0%	1%	1%	3%

Notes:

- Domestic (left) and commercial (right) share of heating technologies assumed within SCATTER
- Matrix is unchanged from original DECC Pathways Calculator. It is acknowledged newer technologies or fuel sources such as hydrogen are not reflected in this tool.

Appendix 8

Transport assumptions

Projection of modal share of all passenger transport (units: % of passenger-km)			
Mode	**2015**	**2050 BAU**	**2050 L4**
Walking	4%	4%	4%
Bicycles	1%	1%	5%
Cars, Vans and Motorcycles	80%	80%	62%
Buses	5%	5%	19%
Railways	9%	9%	10%
Travel demand relative to 2015	100%	100%	75%

Ambition level (units: Pax/ vehicle-km) @ 2050			
Mode	**2015**	**2050 BAU**	**2050 L4**
Cars, Vans and Motorcycles	1.56	1.56	1.65
Buses	11.32	11.32	18.00
Railways	0.32	0.37	0.42

Adur and Worthing's Transport Assumptions

This represents the underlying assumptions around the share of different transport modes in 2050.

- The comparison between 2050 BAU and 2050 Level 4 pathway shows the need to reduce the share of car transport and shift to modes such as buses, bicycles and railways.
- The final outlines that an overall reduction in distance travelled (regardless of method) is required to decrease by 25% in 2050
- Pax refers to any peoples, persons and occupants (i.e. passengers)

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