KENT COUNTY COUNCIL

Kent & Medway Emissions Analysis and Pathways to Net Zero

December 2020

Anthesis

White Cliffs at St. Margaret's Bay

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Anthesis

01 Introduction & Context

Solar panels at Swattenden

GLOSSARY OF TERMS

ABI - Authority Based Insetting. A scheme very similar to *offsetting*, with the carbon savings occurring within the local authority boundary. See page 25 for more details.

AFOLU – Agriculture, forestry & land use.

BEIS – UK Government Department for Business, Energy and Industrial Strategy.

Carbon dioxide equivalent (CO_2e) – standard unit of measurement for greenhouse gases. One tonne of CO_2 is roughly equivalent to 2 months of commuting daily by car between Canterbury and Maidstone (just under 3,700 miles) or burning 1-2 bathtubs' worth of crude oil. "Equivalent" means that other greenhouse gases have been included in the calculations.

Carbon Neutral/ Net Zero - these two terms can be used interchangeably within this report. Whilst emissions are reduced overall, those that remain (e.g. from industrial and agricultural sectors) are then offset through carbon dioxide removal from the atmosphere. This may occur through technology such as carbon capture and storage (CCS), or naturally, by rewilding or afforestation.

Carbon sink – a process or natural feature that removes carbon from the local atmosphere (e.g. trees or wetlands). The carbon is said to be *sequestered* from the atmosphere and sinks can be thought of as a means of storing carbon.

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

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

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

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

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

Indirect emissions - greenhouse gas 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). This includes the electricity supplied to power trains.

IPCC – Intergovernmental Panel for Climate Change.

LULUCF – Land use, land use change & forestry.

SCATTER – the Anthesis-developed tool which is used to set emissions baselines and reductions targets. See the SCATTER website for more information. A list of FAQs relating to SCATTER and this report can be found in Appendix 2.

01 – INTRODUCTION & CONTEXT

Report Overview & Scope

This report has been commissioned by Kent County Council on behalf of all local authorities in Kent & Medway,[1] who together have committed to reduce greenhouse gas emissions in the area to Net Zero by 2050 at the latest. This report will be used to inform the nature and extent of actions to be delivered through the Kent and Medway Energy and Low Emissions Strategy, which sets out how Kent and Medway will work in partnership to respond to the UK climate emergency, reduce fuel poverty and eliminate poor air quality, whilst supporting clean, sustainable economic recovery and growth:

- Chapter 2 of this report defines the current emissions profile in Kent & Medway.
- Chapter 3 defines a science-based carbon budget for Kent & Medway, based on academic research at the Tyndall Centre for Climate Change Research.
- Chapter 4 shows future emissions pathways defined by a range of measures and interventions across the energy system.
- Chapter 5 explores in more detail those interventions and the scale and speed of implementation needed. This chapter also features more specific analysis for the domestic housing, transport and agricultural sectors, taking into consideration Kent's unique characteristics and contexts.

The scope of this report examines emissions resulting from solid, liquid and gaseous energy that provide fuels, heat and electricity to different sectors across Kent. Agricultural and land use analysis accounts for emissions sequestered due to the county's land use, as well as emissions from livestock and other agricultural activity.

Objectives

1. Provide a better understanding of the county's carbon footprint using a location-based accounting approach;
2. Use this information to inform the urgency and scale of action required to remain in line with the Paris Agreement;
3. Offer more detailed insights into domestic housing, transport & land use sectors; and
4. Identify gaps in data where further work is needed.

This will help councils in Kent and Medway by:

- Providing a more informed evidence base for future action plan development as the county readjusts as a result of the COVID-19 pandemic;

1 – The scope of this report includes the area administered by both Kent County Council and Medway Council. See the map on page 10 for a map defining the in-scope area.

- 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 an updated target of net zero carbon by 2050.

In May 2019, Kent County Council recognised the UK climate emergency and committed to a Net Zero target for Kent, and to investigate an accelerated target for its own services and estate. In September 2020, this accelerated target, including an element of *Authority-Based Insetting* (ABI, see page 25), was set as 2030.

All local authorities in Kent and Medway have now committed to Net Zero targets and pledged their support for the Kent and Medway Energy and Low Emissions Strategy at a meeting of Kent Leaders in October 2020.

A call to action

Kent County Council's Climate Emergency declaration 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 found that in order to remain within a 1.5°C increase, governments must cut greenhouse gas emissions by 45% by 2030 against a 2010 baseline. Since the first IPCC report was published in 1990, global emissions have increased 60%.

Another key finding of the report states that at current rates, 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.

Locally-led action has been consistently identified as a key driver for change in UN reports, finding in 2018 that "*…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.*"

COVID-19 & climate change: a Green Recovery

The global disruption and impacts of the COVID-19 pandemic have forced local councils, businesses and citizens to radically reassess their policy, operations and lifestyles. The ongoing restrictions offer the chance to reflect on how *building back better* must centre resilience and wellbeing, both of which can be met with an accelerated transition to sustainable local communities.

This time also presents the opportunity to shift our collective values and review the demands of "emergency action" in a climate context. Local and national commitments to emissions reductions have not changed as a result of the COVID-19 crisis – as of February 2020, almost 70% of local authorities had made Climate Emergency Declarations. Support for the Task Force on Climate-related Financial Disclosures has grown significantly in the past 18 months, with increasing numbers of global businesses setting science-based targets.

The next few years will be pivotal for climate change mitigation as we enter the *decisive decade* for action. Evidence from the UN reports makes clear that immediate and drastic action is required to avoid global warming to dangerous levels, delivered through sub-national policy measures as a necessary means of reducing emissions.

The recognition of urgency to address the climate emergency is no longer solely the message from environmental groups, with emissions reduction measures forming a key component of the recovery from the COVID crisis.

The response from government and businesses is growing, with UN Secretary General António Guterres declaring in April that *"ensuring a future for the planet must be a core element in rebuilding society after lockdown measures are lifted."*

In an effort to restart the economy and mobilise the transition to a low-carbon future, the UK government announced its *Ten Point Plan for a Green Industrial Revolution* in November 2020.

In the Plan's foreword, the Prime Minister observes that *"Now is the time to plan for a green recovery – with high-paid jobs that offer the extra satisfaction of helping to make our nation cleaner, greener and more beautiful."*

How much did COVID-19 curb global emissions?

According to an article in *Nature* published in May 2020, global emissions decreased around 17% this April, relative to 2019.

Emissions under lockdown were roughly equal to 2006 levels, putting into perspective the significant growth of emissions in the past 15 years and the size of the challenge we have to limit climate change in line with the Paris Agreement.

02 Current Emissions Profile

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Wind farm at Little Cheyne Court, Romney Marsh

02 – CURRENT EMISSIONS PROFILE

SCATTER inventory

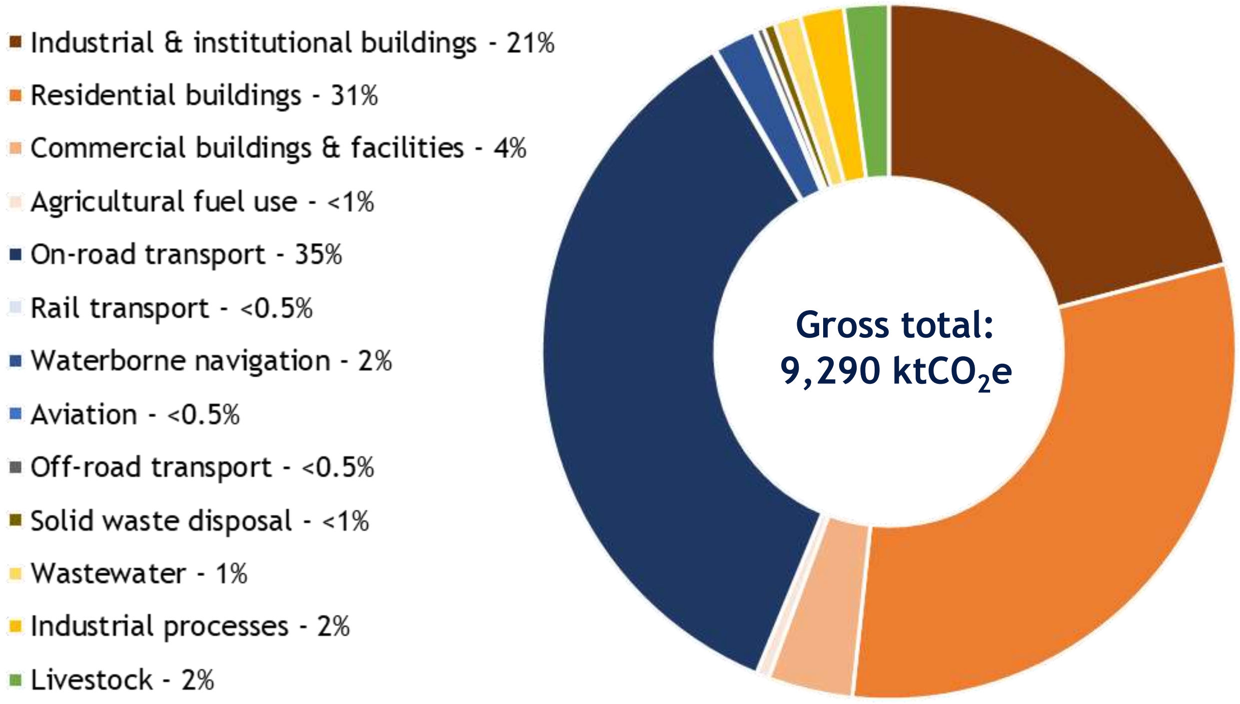
SCATTER is a local authority focussed emissions tool, providing an emissions baseline across different local activities. SCATTER allows local authorities and regions to standardise their greenhouse gas reporting and align it to international frameworks.

The current emissions profile for the area administered by Kent County Council and Medway Council is shown opposite. Emissions data is published two years in arrears, with 2017 representing the most recently available data within the tool. Emissions from forestry and land use have not been included here, as land use and forestry act as carbon *sinks* for the region. A more specific exploration of land use emissions can be found in section 5.

See Appendix 1 for a full data table of these emissions, as well as the data table from the BEIS Local Authority CO_2 inventory.

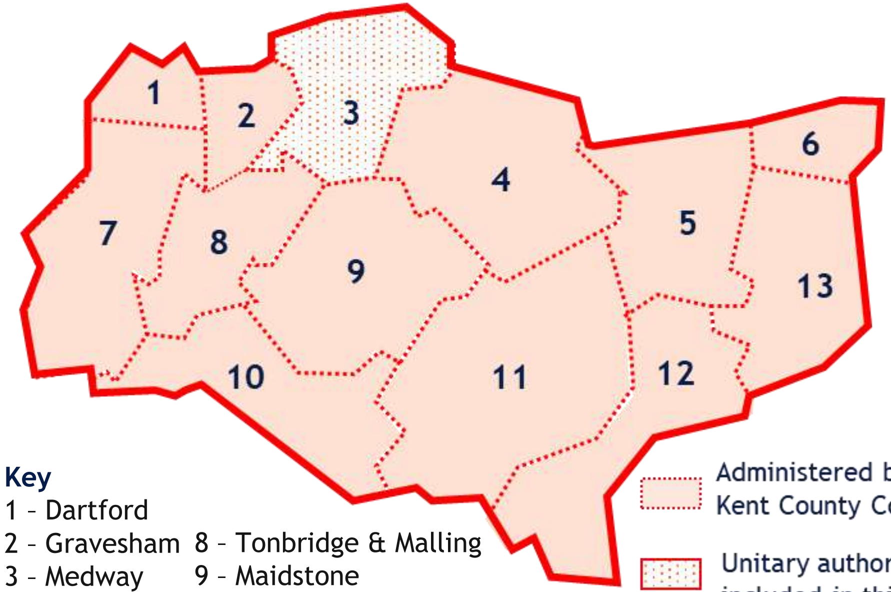
In 2017, Kent & Medway's energy system was responsible for emissions totalling 9,290 $ktCO_2e$. The majority of emissions resulted from buildings (56%) & transport (38%), with smaller contributions from waste disposal, industrial processes and livestock.

Figure 1: SCATTER emissions inventory for Kent & Medway, 2017, excluding land use.



Area assessed for emissions

Figure 2: Map of the area measured as part of this study. References to “Kent & Medway” relate to this area. A map showing the distribution of emissions amongst the different regions can be found in Appendix 2a.



Key

1 – Dartford
2 – Gravesham
3 – Medway
4 – Swale
5 – Canterbury
6 – Thanet
7 – Sevenoaks
8 – Tonbridge & Malling
9 – Maidstone
10 – Tunbridge Wells
11 – Ashford
12 – Folkestone & Hythe
13 - Dover

Administered by Kent County Council

Unitary authority included in this study

Study area boundary

Scope of assessed emissions

The emissions profile described on the previous page has been compiled using a *location-based* accounting methodology.

This approach accounts for emissions from sources within the geographical boundary of the county e.g. fuel consumption in on-road transport, in residential homes and from in-boundary waste disposal. These are termed *direct* emissions.

Also included in this analysis are emissions occurring as a consequence of the use of grid-supplied electricity, heat, steam and/or cooling that is consumed within Kent. These emissions are termed *indirect*.

All other GHG emissions that occur outside of the county boundary as a result of activities within Kent are termed *other* emissions and have been omitted from the emissions profile analysis, in accordance with Global Protocol for Community-scale (GPC) Greenhouse Gas Emission Inventories standards. They have been documented in the full data table in Appendix 1.

Please see Appendix 3 for a detailed FAQ describing SCATTER’s data sources, differences between the BEIS methodology and the SCATTER approach, and definitions for different classifications of emissions.

Exclusions from location-based accounting & transnational transport

Location-based accounting does not assess the embodied carbon emissions associated with goods and services produced **outside** of Kent and consumed within the county boundary.

An example of this would be food imported from outside of Kent but consumed within Kent. The only emissions that Kent would be attributed from this activity are the in-boundary transport of the food, the use of fuel used to store and cook the food, and any emissions associated with its disposal. Emissions associated with the production of the food itself, its packaging and its out-of-boundary transport are not included as part of the Kent total. These are known as *consumption emissions*.

Emissions attributed to Kent from trans-national activities such as waterborne freight transport and international rail services (such as Eurostar) must also be clearly defined within this approach.

Waterborne navigation emissions are derived from national datasets (see overleaf for the activities covered) before being apportioned to specific ports and their local authority. Emissions from activities off the coast (i.e. out of local authority boundaries) are therefore not considered as part of this analysis.

The extent of Kent's local authority boundaries into the English Channel define the "limit" of the study area. This is also relevant when considering energy consumption on Eurostar services. When on the UK leg of journeys, only energy consumption by trains that is recorded on meters situated within Kent's local authorities contributes to the local emissions total.

Profile subsectors – understanding the current emissions profile

56% of gross emissions in Kent & Medway come from buildings, namely:

- Residential buildings: All in-boundary households, including private and Council-operated properties, of all types.
- 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.
- Emissions attributable to electricity consumption in the rail sector are included in the commercial & industrial sectors, since the granular separation of this consumption is not possible within the respective datasets. This means that emissions from Eurostar and all other electric passenger rail in Kent are included within this sector.
- Commercial buildings: Buildings from which commercial businesses operate e.g. shops, shopping centres, offices, restaurants etc.
- Agriculture: Fuel consumption from off-road transportation in the agricultural sector. Note that this does **not** include the direct emissions from livestock or fertiliser.

A more detailed analysis of transport, residential and land use emissions can be found alongside the SCATTER Pathways analysis in Chapter 5 (pg. 41-51).

38% of gross emissions result from energy used for transport:

- On-road transport: Emissions from all forms of on-road passenger vehicle, including cars, vans, motorcycles, buses and taxis.
- Rail: Emissions from diesel-fuelled rail transport. Emissions from electricity consumption within the rail sector (including that of the trains themselves) are included as part of the commercial and industrial buildings figures.
- Waterborne navigation: Emissions from fuel consumption by waterborne transportation e.g. fishing vessels, coastal and inland shipping and for use in ports and harbours.
- Aviation: Scope 1 emissions from aviation are calculated from the proportion of aircraft movements that originate from in-boundary airports and airfields. Scope 1 emissions account only for emissions associated with landing and take-off (LTO emissions).

2% of gross emissions 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.

2% of gross emissions are from industrial processes:

- Nationally-scaled processing emissions associated with heavy industry, such as minerals, iron & steel and chemicals

2% of gross emissions are from livestock:

- Includes emissions from both dairy and non-dairy cattle as well as other farm livestock, based on livestock populations and UK Greenhouse Gas Inventory emissions factors.

Emissions omitted from the profile

Land use

SCATTER includes land use emissions, taken directly from BEIS data for various land use types. These emissions are compiled using a methodology distinct from the one used in the in-depth analysis. The SCATTER estimate indicates that the equivalent of 4% of the gross emissions total (c.333 $ktCO_2e$) were captured through Kent & Medway's land use, sequestered into soils, crops and other sinks. These are not reported within the emissions profile shown in Figure 1 as they are negative in value, but are included in the full emissions profile in Appendix 1.

Energy generation

The final significant in-boundary emissions reported by SCATTER are those from electricity generation. As per the GPC guidelines, these emissions are not reported as part of the overall emissions profile.

SCATTER allocates emissions from UK power stations according to the local authority in which the station is located. SCATTER also considers emissions associated with the operation of large-scale CHP and renewable energy installations.

The total for the county's in-boundary energy generation emissions is **2,317 $ktCO_2e$**, of which 2,301 $ktCO_2e$ are reported in the Medway profile. This figure is roughly equivalent to **25%** of the overall county-wide emissions footprint from the sources discussed above.

Kent produces significant amounts of electricity in-boundary from a broad range of generation fuels. The vast majority of the total figure for in-boundary energy generation emissions stem from the 1,365 MW gas-fired Grain Power Station (situated within Medway's boundary).

Also of note within the county are the significant offshore wind developments at Kentish Flats & Thanet wind farms. The listed capacities for offshore wind in the table opposite reflect where the associated cabling comes ashore from these offshore installations, as opposed to being within the district itself. Finally of note is the nuclear power plant at Dungeness, which remains a significant source of energy and falls within the Folkestone & Hythe boundary.

Putting energy generation into context

Kent's broad range of fuels for electricity generation form part of the national energy mix. This mix represents the overall proportion of each fuel source and gives rise to a *carbon intensity* for each unit of energy generated. As the national energy supply becomes increasingly weighted towards renewables and decreasingly influenced by carbon-intensive fuels like coal, the carbon intensity of the UK energy mix will fall.

Kent's indirect emissions (i.e. the emissions which are associated with energy production and supply) are calculated from the carbon intensity of the UK electricity grid at the national level.

Figure 3 (overleaf) describes and compares current installations of renewable technologies across Kent and Medway, including offshore wind installations.

Whilst the feasibility of given renewable technologies varies from district to district due to local factors, comparing the overall capacity per unit area can allow more direct comparison between districts. Offshore wind capacity dominates over any onshore technology, though Canterbury and Swale demonstrate strong performance even without the significant offshore contributions. These two areas, along with Thanet, demonstrate the highest proportion of technologies after accounting for their geographical size.

By contrast, Gravesham and Sevenoaks demonstrate low levels of installed renewable capacity, with Sevenoaks also having the lowest renewable energy capacity per unit area.

How much of Kent's electricity demand is met by its in-boundary renewables?

Taking the county in isolation, we can contextualise energy supply by comparing the in-boundary renewable generation as a proportion of the overall energy consumption for the county.

- SCATTER activity data for electricity consumption for heating, lighting, appliances & cooking in buildings was calculated for the county (6.8TWh in total).
- This figure was compared against the county's renewable generation figures. Kent's locally-installed renewables generated just under 4.4 TWh of energy in 2017 (BEIS renewables statistics).
- This treatment excludes all energy consumption from natural gas, coal and other fuels i.e. the electricity consumption data represents a small proportion of the overall fuel consumption for the county (c. 10% of overall direct & indirect energy consumption).

This comparison indicates that approximately 64% of Kent's electricity consumption could be met by its in-boundary renewables.

Local authority	Installed capacity, selected renewable technologies (MW)				Total renewable capacity (MW)	Onshore capacity per area (kW/km^2)
	PV	Onshore wind	Other sources*	Offshore wind		
Ashford	35.8	0.04	3.2	-	39.0	67
Canterbury	123.7	0.02	10.5	139.5	273.7	418
Dartford	4.5	-	7.4	-	11.9	156
Dover	30.8	0.03	28.3	300.0	359.1	184
Folkestone & Hythe	27.8	59.84	0.3	-	88.0	241
Gravesham	5.9	-	0.6	-	6.5	62
Maidstone	17.1	0.03	43.5	-	60.6	154
Medway	28.5	0.01	5.6	-	34.2	127
Sevenoaks	6.5	0.02	3.5	-	10.0	27
Swale	82.0	17.41	25.7	630.0	755.1	296
Thanet	45.8	-	0.2	-	46.1	410
Tonbridge and Malling	11.8	<0.01	8.4	-	20.2	84
Tunbridge Wells	45.9	-	0.6	-	46.4	140

Figure 3: Comparing different renewable technologies across Kent & Medway. Data taken from BEIS renewable statistics. Offshore wind capacity was excluded from the final column calculation.
*includes anaerobic digestors, sewage & landfill gas, municipal solid waste, animal & plant biomass, as well as a very small hydroelectric installation in Maidstone.

03 Carbon Budget

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Standford Hill Wind Farm, Isle of Sheppey

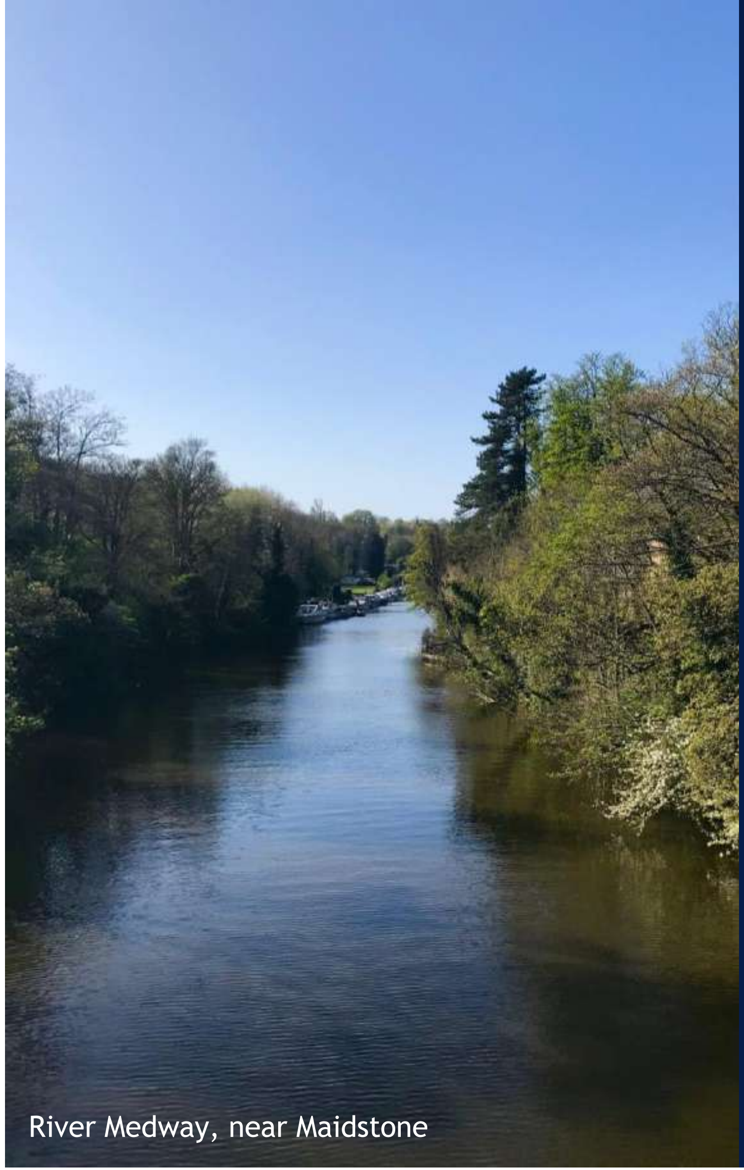
03 – INTRODUCTION

The current emissions profile offers the baseline from which to measure Kent and Medway's progress to achieving net zero carbon.

However, climate science tells us that we must also be mindful of the fact that once emitted, greenhouse gases can remain in the atmosphere for extended periods of time.

This means it is also important to consider the total *cumulative* amount of emissions within Kent & Medway. The Paris Agreement aims of remaining *"…well below 2°C"* of warming dictate an upper limit of greenhouse gas emissions that are allowed.

This chapter sets out research which joins these two concepts together in the form of a *carbon budget*.



River Medway, near Maidstone

What is a carbon budget?

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

03 – SETTING A CARBON BUDGET

The Tyndall Centre for Climate Change Research, based at the University of Manchester, have translated the Paris Agreement targets of limiting temperature change to "well below 2°C and pursuing 1.5°C" into a fixed emissions 'budget' for local authorities. There are two key ideas underpinning their research:

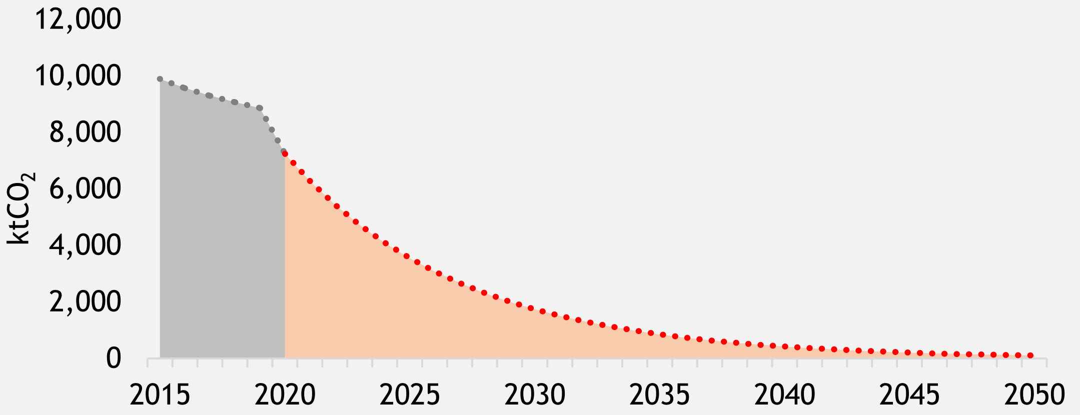
The carbon budget is a fixed amount: A global budget represents the total emissions allowed before the 1.5°C threshold for greenhouse gas concentration is crossed. This global budget can then be scaled down to a national level, and finally, a regional level.[1]

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

These two things mean that whilst the year that Kent & Medway become zero-carbon is important, the annual *rate of reduction* is also crucial.

Adding up the emissions total at each year from 2020-2050 gives a cumulative total of 57,700ktCO_2, which represents the *carbon budget* for Kent & Medway.

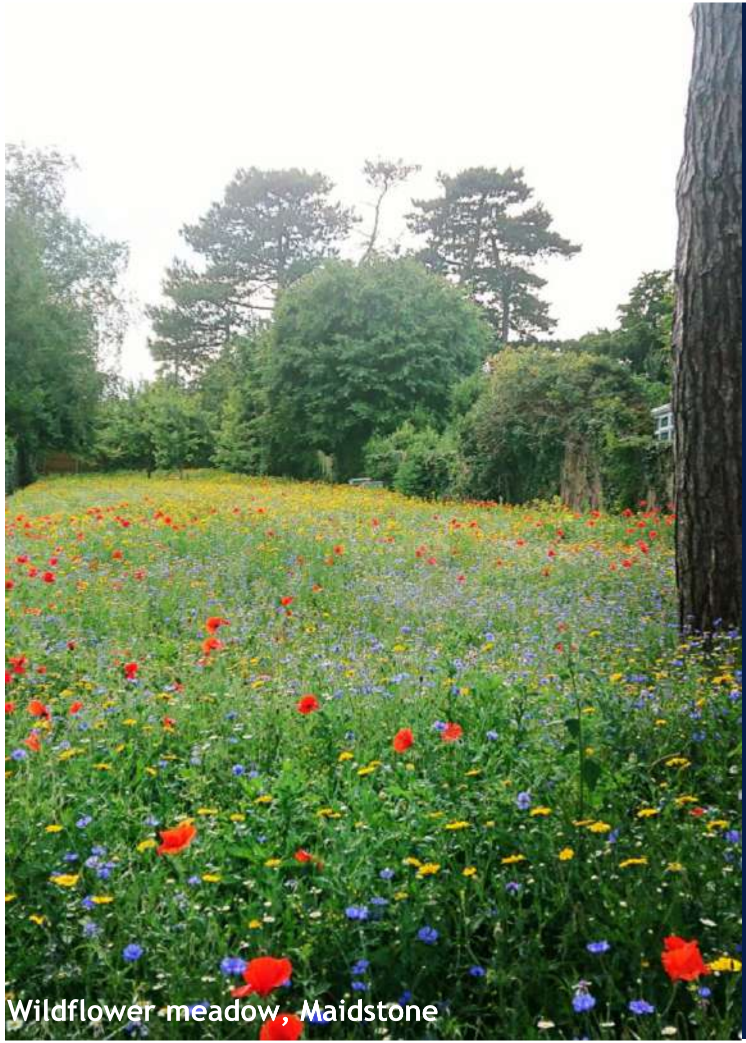
Figure 4: Graph showing historic emissions (grey dotted line), cumulative historic emissions (grey area), Tyndall Centre's recommended reduction pathway of 13.3% annual reduction (red dotted line), and the carbon budget for Kent & Medway (beige area).



How significant is a 13.3% reduction rate?

Between 2005 and 2017, the highest annual reduction rate for any year was 12%, in the aftermath of the 2008 financial crisis. The average annual reduction rate since 2005 was just over 3.5%, highlighting the scale of ambition required to achieve the average rate of 13.3% required to meet the Paris Agreement targets.

1 – See Appendix 4 for more details on how the Tyndall Centre break down the global carbon budget.



Key figures from the Tyndall Centre research

The energy system carbon budget for Kent & Medway between 2020-2100 is 57,700 $ktCO_2$

A consistent annual emissions reduction rate of 13.3% is needed to adhere to this budget

At 2017 rates, Kent & Medway will exceed its carbon budget within 7 years

Along the Tyndall Centre's pathway, Kent must achieve 80% emissions reductions by 2030

Emissions covered within the budget

The Tyndall Centre carbon budget has a different scope to the emissions profile from SCATTER, with a few key exclusions:

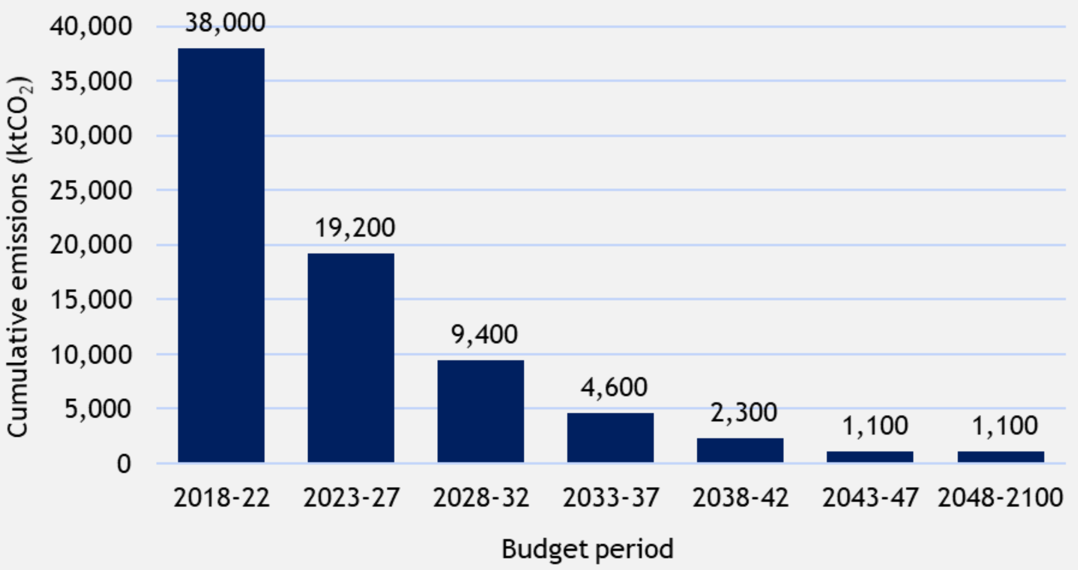
- **Land use, land use change and forestry** is not incorporated into this budget analysis.
- **Only CO_2 emissions are assessed** – contributions from all other greenhouse gases are excluded.
- **Aviation and shipping are treated differently.** Given the nature of these emissions, this research accounts for emissions in this sector at the national level, as opposed to the regional level.
- **This budget can be defined as *energy-only*,** which means that the budget accounts for emissions from energy use within Kent & Medway.
- **Figures are based on BEIS datasets** and so the same caveats apply as in Section 2 around the differences between this research and the SCATTER data.

A visual representation of how the carbon budget is derived can be found in Appendix 4.

These slight differences in scope mean that direct comparisons with the cumulative emissions from SCATTER Pathways trajectories should be taken as estimates only.

Budget milestones

Figure 5: The chart below gives the carbon budget for Kent & Medway in terms of the periods set out in government reporting frameworks.



04 SCATTER Pathways

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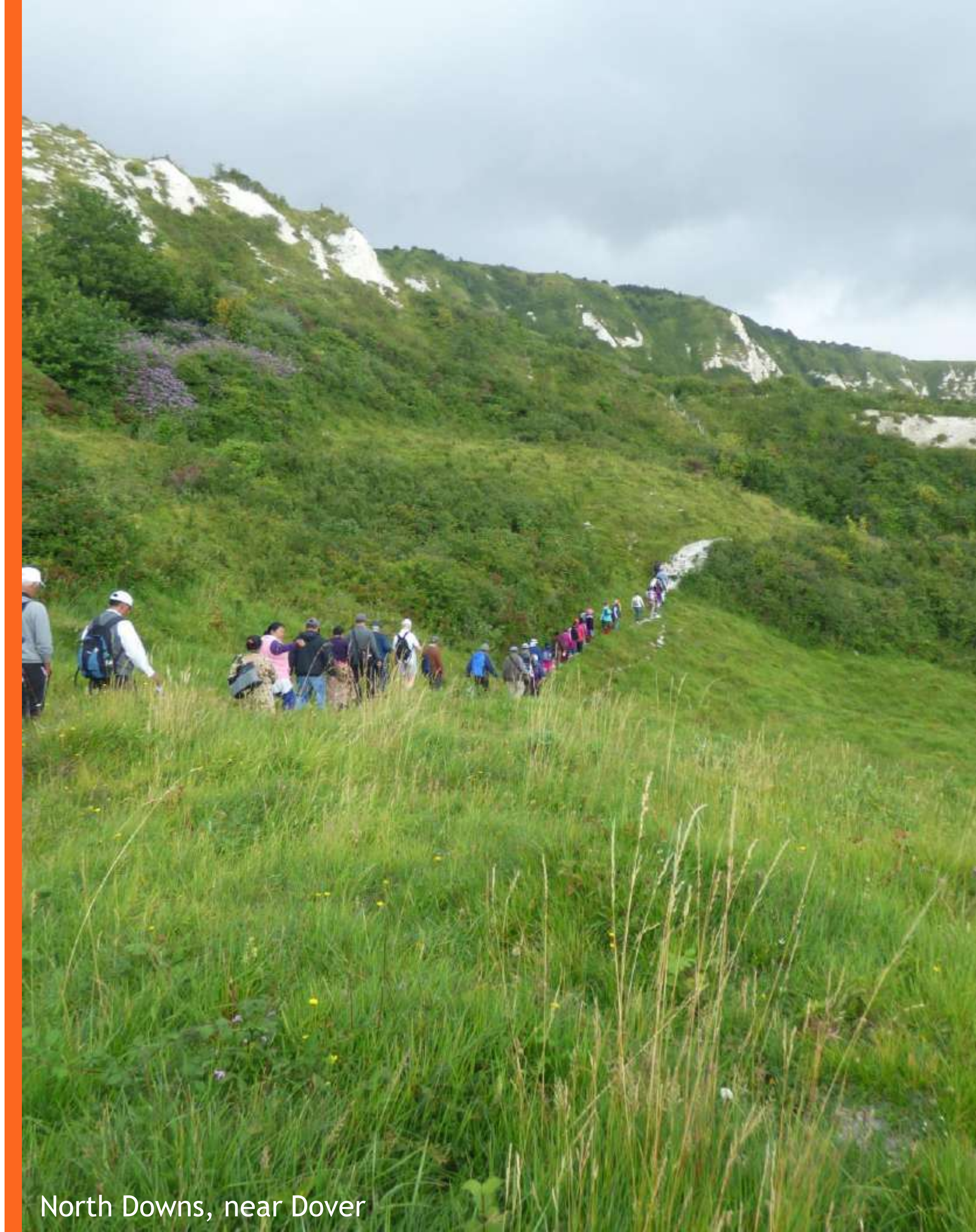


North Downs, near Dover

04 – INTRODUCTION

SCATTER is one of many information sources designed to help local authorities inform priorities for emissions reduction. It is intended to focus on the 'what' rather than the 'how'.

The SCATTER pathways are intended to act as 'lines in the sand' for Kent & Medway. They serve as an indication of whether the adoption of certain interventions can drive the transition to a low carbon economy and help to guide target-setting and key performance indicators. As with the current emissions profiles, pathways do not consider emissions from goods and services produced elsewhere and consumed within Kent & Medway.

SCATTER Pathways is now available as a free-to-use online tool for local authorities following a systems update in Spring 2020.

Basic principles

Sir David MacKay's "Sustainable Energy – Without the Hot Air (2009)" provides the basis for the pathways modelling. As a scientific advisor to the Department for Energy & Climate Change (DECC),[1] MacKay's work led to the development of the 2050 Pathways Calculator which was the foundation on which the SCATTER tool was developed. Building on the 2050 Pathways Calculator, two key modifications were made by Anthesis:

1. We scaled it down for sub-national regions: Scaling assumptions and localised data sets were built into the tool so that results were representative of cities and local authority regions, rather than the UK as a whole.
2. We pushed ambition further: Technologies within the tool were reviewed and updated where judged to be out of date and constraining ambition. Given that almost a decade had passed between MacKay's publication and the release of the 2050 Pathways tool, we sought the counsel of a technical panel to make these updates. The technical panel comprised subject matter experts from Arup, BEIS, Electricity North West, GMCA, The Business Growth Hub, The Energy Systems Catapult, The Tyndall Centre and Siemens.

The graph overleaf shows two possible future emissions pathways as modelled by the SCATTER tool, compared against a recommended annual reduction pathway based on the Tyndall Centre's research.

Observations from the Pathways

Adoption of the High Ambition Pathway does not achieve zero emissions by 2050. Gaps exist between the SCATTER High Ambition Pathway and the recommended reduction rate pathway (orange-dotted line). See Chapter 6 for a summary of these interventions at 2050 as well as discussion around *residual emissions* and what *"closing the gap"* may look like.

Positive trends in emissions reductions will eventually slow down along a business-as-usual pathway. Reductions are projected to bottom out as the electricity grid becomes fully "greened" in the future. Much stronger action is required across different areas of the energy system in order to achieve emissions reductions targets.

1 – DECC responsibilities were reformed into BEIS in 2016

04 – SCATTER PATHWAYS MODEL

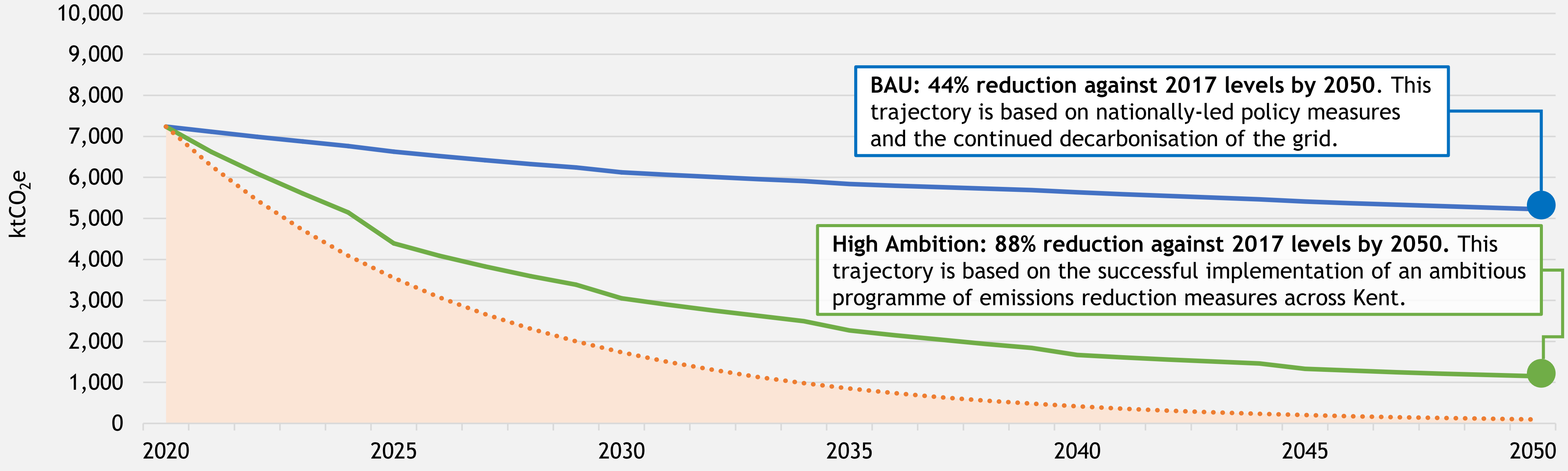
Figure 6: SCATTER Pathways for Kent & Medway.

SCATTER BAU Pathway - Assumes Kent & Medway continue along current "business-as-usual" (BAU). Reductions largely the result of continued grid decarbonisation. Between 2005 and 2017, Kent & Medway's emissions fell 36% according to BEIS datasets. [1]

SCATTER High Ambition Pathway - Assumes Kent & Medway go significantly beyond national policy and National Grid assumptions.

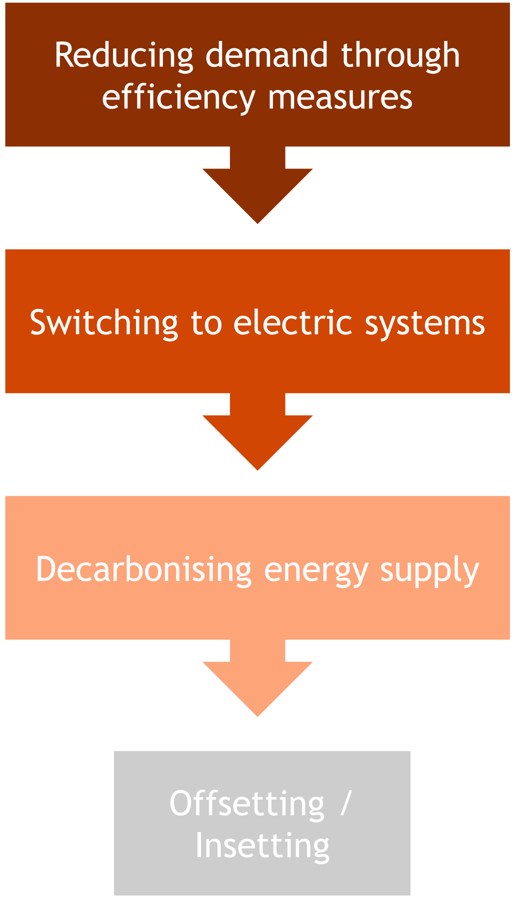
Recommended reduction rate Pathway – A 13.3% annual reduction as defined by Tyndall research. Unlike the SCATTER Pathways, this does not specify what tangible measures could achieve this pathway, but instead sets out what is recommended scientifically.

Representative Carbon Budget - A representative area equal to the cumulative emissions of the Recommended reduction rate Pathway.



1 – Please see Appendix 3 for a description of the differences between BEIS & SCATTER.

Figure 7: Hierarchy of Actions



Example interventions:

- Building retrofit
- Driving less/modal shifts
- Producing less waste

- Phasing out gas appliances
- Electrifying processes
- Switching to electric buses and

- Installing PV
- Improving storage capacity
- Installing off-shore wind

- Natural sequestration projects
- *Authority Based Insetting*

Prioritising actions

Ambitious and urgent emissions reductions interventions are demanded by the High Ambition Pathway. The scale of the actions necessary to reduce emissions significantly requires radical step changes in behaviour, across almost every area of activity within Kent.

The next chapter of this report defines these interventions. They can be thought of as falling into two main categories; interventions focused on reducing energy *demand* and interventions focused on decarbonising energy *supply*. Being able to confidently prioritise actions is important, as local governors and stakeholders begin to coordinate actions and projects. It can be helpful to refer to a defined hierarchy of actions (see opposite) when considering new initiatives.

Reducing demand should always come first.

This avoids placing too much reliance on long-term, higher risk renewable supply infrastructure to deliver the emissions savings so urgently required, whilst safeguarding carbon budgets in the process:

- Economically, consumer energy bills are reduced. At the regional level, costs associated with installing new generation assets, new grid connections and grid reinforcement works can be minimised.
- Socially, there are benefits for citizens associated with increased walking and cycling. Increasing the efficiency of traffic networks (including public transport) maximises social benefits.

- Environmentally, emissions savings can often be achieved much quicker by implementing various demand-side behaviour changes or ‘quick win’ efficiency measures.

Future demand is hard to predict accurately - but decarbonising the energy supply is the next highest priority.

The National Grid’s Future Energy Scenarios (FES) indicate that even under a scenario that meets the UK’s net zero by 2050 (Two Degrees), electricity demand still increases. Conversely, SCATTER’s High Ambition Pathway assumes that electricity demand reduces due to improvements to efficiency of operation.[1] 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 significant and could slow or tip trends in the other direction.

Stakeholder & citizen action – the role of behaviour change

The hierarchy of actions suggested here is of course idealised. Naturally, the Council’s influence and key local stakeholders may allow for some initiatives to be implemented before others.

KCC’s recent study into climate-related behavioural change offers a number of valuable and relevant messages related to this, most notably:

- Consistent, visible leadership is required from the Council;
- Clear, shared goals are key to stakeholder engagement;
- Further information and education is required to communicate to people the carbon impacts of some activities;
- The business case for action trumps the environmental case.

Tackling residual emissions and “the gap”

Despite the extensive actions described by the High Ambition Pathway, residual emissions persist at 2050. A combined approach is recommended in light of this:

- Higher ambition or more rapid implementation of measures included in the SCATTER High Ambition Pathway (i.e. bringing 2050 targets for activity forward).
- Exploration of more advanced or newer technologies not incorporated within SCATTER such as nuclear or hydrogen.
- Offsetting or ‘insetting’ as a means of addressing any residual emissions beyond this.

1 – It should be noted that this optimism for demand reduction is consistent with the legacy DECC tool.

What is carbon offsetting?

A *carbon offset* can be defined as *"…purchased credits representing a certified unit of emissions reduction or carbon removal carried out by another actor."*

Recent guidance published by Oxford University sets out a clear framework of best practice principles related to offsetting:

- Prioritise reduction over offsetting – ensuring that purchased offsets are the "last step" to reaching a carbon neutrality target.
- Ensure environmental integrity – ensuring that purchased offsets are verifiable and have low risk of negative unintended consequences.
- Maintain transparency – ensuring that current emissions, accounting practices and type of offsets employed remain well-defined and clear.

Authority Based Insetting – an alternative to traditional offsets

Authority Based Insetting (ABI) encourages business investment into project initiatives within the local boundary that contribute towards carbon reduction goals. Traditionally, carbon offsetting projects are not based locally to the investor, which poses challenges for local authorities looking to make impacts within Kent itself.

ABI provides a more appealing offsetting alternative given that:

- Investment is retained within local communities and schemes
- Low-carbon co-benefits are retained locally (e.g. health, jobs and quality of place).

ABI would need to achieve two key things:

1. **Report its carbon impact transparently**: providing a consistent framework for reporting additional local initiatives that may occur outside of a Council's organisational boundary, but within local authority boundaries.
2. **Match investment to projects:** ABI could connect into an existing funding mechanism or serve as the basis for a new low-carbon funding mechanism, matchmaking investment with low carbon projects that may offer a return on investment.

05 Emissions Reduction Interventions

Anthesis

Ground-mounted solar PV array at Swattenden Outdoor Activity Centre, near Tunbridge Wells

05 – INTRODUCTION

The SCATTER Pathways tool models the influence of a range of interventions on emissions across Kent. This chapter of the report defines the measures which are locally influenceable, and which interventions are necessary to deliver drastic reductions in emissions.

The measures do 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 defined interventions are based on what is needed to achieve carbon reductions for the High Ambition pathway and do not consider how they can be delivered e.g. policy, feasibility, financing or skills required.

The tool also operates on more forecasts and predictions than are listed in this chapter. National measures, such as those including aviation & shipping, are set to central governmental forecasts. Other forecasts, such as those for increases to household numbers and population, follow ONS models.

Navigating this chapter

The following sections provide various metrics and data designed to describe the nature and extent of measures specific to Kent & Medway:

- **Measure:** Defines the 'action' or changing activity. Measures are broken down into various sectors, which match up with the SCATTER Inventory given in Chapter 1.
- **Intervention:** Defines the target or indicative level of change required to achieve the High Ambition Pathway. Many interventions are defined in terms of changes relative to a baseline year (typically 2017).
- **Pathway Outputs:** These are given at milestones of 2025, 2030 and 2050. SCATTER pathways run up to 2050, though "checkpoint" interventions have been given for 2025 and 2030 to guide progress in the near-term. Current Contexts which describe the existing 'state of play' within Kent are also provided where relevant. Where possible, the current contexts are given in the same parameters as the SCATTER interventions for comparability, though this is not always possible.
- **Additional sectoral analysis:** Further in-depth analysis of some emissions have been included. These have been added alongside the relevant SCATTER analysis in each section. This analysis relates to: domestic buildings, transport & agriculture and land use (ALU) emissions.

05 – SUMMARY OF MEASURES

What does SCATTER consider?

The range of measures considered as part of the SCATTER Pathways tool are summarised opposite. Interventions in each of these areas underpin the forecast trajectories (i.e. the blue and green lines in Figure 6). Many of these measures are based on the DECC 2050 Calculator – a summary of the modifications can be found in Appendix 5.

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

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

Industrial processes

- More efficient processes
- Shifting from oil fuels

Agriculture, forestry & land use (AFOLU)

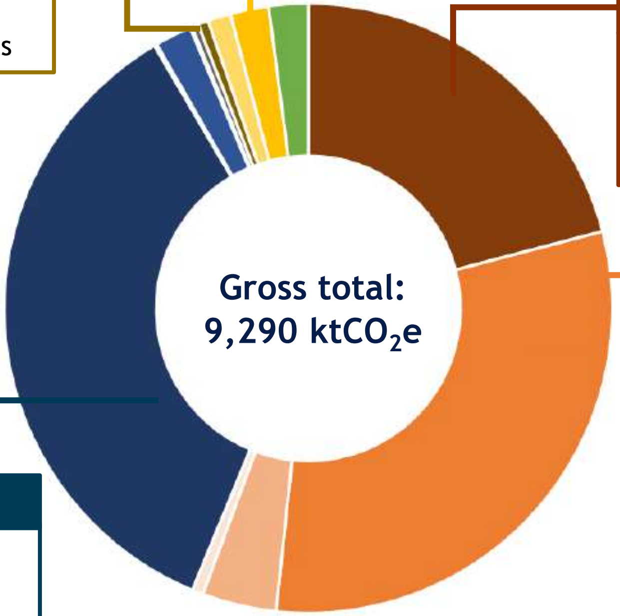
- Increased tree coverage
- Land management
- Livestock management
- Nature-based solutions

Waste

- Producing less waste
- Increased recycling rates

Non-domestic Buildings

- More energy efficient heating
- Switching from gas heaters
- Appliance and lighting efficiency
- Switching from gas cookers



Domestic Buildings

- Switching from gas heaters
- Appliance and lighting efficiency
- Switching from gas cookers
- More energy efficient homes and new-builds

Transport

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

Energy Supply

- Increased solar PV
- Increased biomass
- Increased solar thermal
- Increased wind
- Increased tidal, wave & hydro

05.1 – DOMESTIC & NON-DOMESTIC BUILDINGS

Buildings are responsible for **56%** of Kent & Medway's emissions

Decreasing the demand for energy and electrifying our heating systems & appliances

The following measures relate to energy used within domestic households, commercial properties and institutional buildings, as well as industrial property. The first two measures consider demand-side reductions, whilst the second two consider the effects of electrification.

Measures

- More energy efficient homes and buildings: For domestic property, this measure considers changes in the energy demand for heating and cooling our buildings. Different retrofit options are considered for existing households, as well as the performance of new builds. For non-domestic property, SCATTER considers improvements to practices and buildings, including improvements to building fabric. “Non-domestic” includes commercial, industrial and institutional buildings.
- Appliance and lighting efficiency: Considers the reduction in energy demand from more efficient lighting and appliances, including electrical devices, and all forms of lighting and cooking.
- Switching from gas heaters: Considers the uptake of non-fossil fuel sources for heating within homes and commercial properties, including heat pumps, district heating and combined heat and power networks (CHP). The impact of the fuel mix will be heavily influenced by the increased availability of renewable energy. No fuel mixes contain any hydrogen technology.
- Switching from gas cookers: Models the uptake of electrical cooking systems and discontinuation of gas cookers.

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

Fuel Poverty Statistics (2018) estimate a fuel poverty rate of 8.9% (just under 68,000 homes)

Traditional Kentish weatherboarded home

69% of homes in Kent & Medway have an EPC rating of D or lower, whilst just 3% are rated A or B

Interventions & Pathway Outputs

More energy efficient homes – retrofitting & new builds in Kent & Medway

The energy we use within buildings is a significant driver of emissions. Tackling the causes behind energy demand can be met in a number of ways. Chief among these is the retrofitting of homes and ensuring that new builds are built to high efficiency standards.

We can think of retrofit measures as improvements to a building's energy performance; they include things like insulation (of windows, floors & ceilings) and improved ventilation. Retrofitting serves to drive down the energy required to heat a building. Currently, household retrofitting is led largely by the government-led ECO scheme. The nature of these retrofit measures vary widely, though the majority (roughly two-thirds) are some form of insulation. SCATTER makes its estimations based on two levels of retrofit:

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

New builds must also be constructed to extremely high energy performance standards.[1] A PassivHaus standard home operates using roughly 10% of the average demand for a typical house.

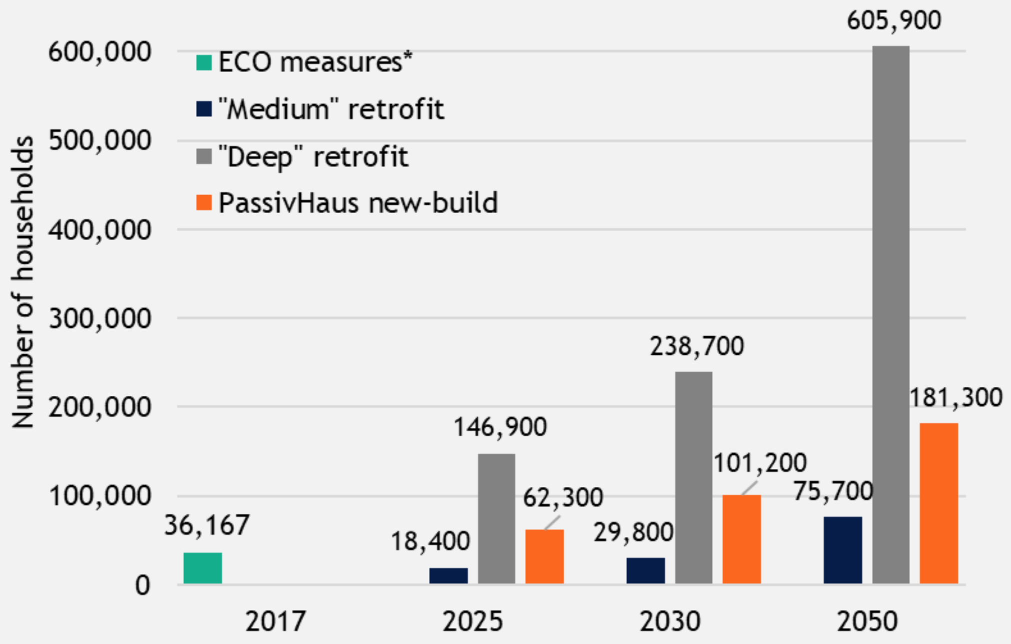


Figure 8: Indicative targets for the improvement of household energy efficiency against 2017 levels. *ECO measures are included as a comparative proxy, but resulting improvements to efficiency are typically more modest than the "medium" retrofit described within SCATTER.

SCATTER forecasts just under 80,000 additional homes will be built between 2020 and 2030 across Kent, an increase of around 10% on the existing number. The High Ambition Pathway demands these new builds are constructed to PassivHaus standard.

1 – A "high performance" building (as defined by the Association for Environment Conscious Building) operates using roughly 25% of the average energy demand for a typical house.

More energy efficient buildings - demand reduction for heating

The aim of retrofitting is to drive down the energy demand for heating and hot water in buildings. Alongside behavioural change and other efficiency improvements, SCATTER measures this demand reduction in terms of energy usage. Figures 9 & 10 describe improvements to energy demand within Kent & Medway:

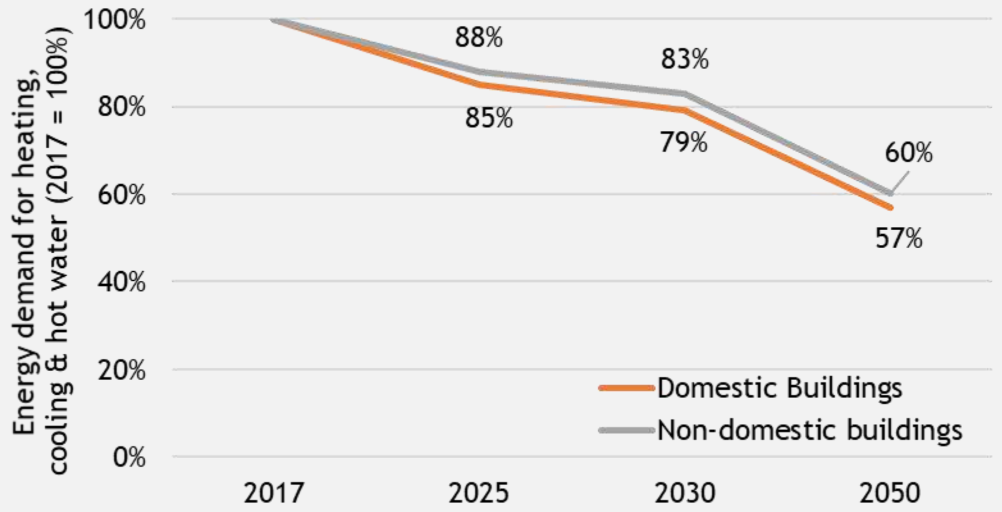


Figure 9: Energy demand reduction changes for heating, cooling and hot water, defined against a 2017 baseline. Since the number of different building types is much larger for non-domestic buildings than for households, more specific retrofit measures are not modelled within SCATTER. Instead, only the energy demand is modelled.

The reductions in demand also take into account improvements to the efficiency of new water heating systems. Domestic demand is measured in terms of energy required per household. Reductions are applied to whatever fuel the household is using i.e. accounting for more efficient gas boilers as well as electrical heating systems.

Appliance & lighting efficiency

The graph below plots a reduction in the net energy demand from lighting and appliances. Reductions are measured against a baseline of 2017 data. Both domestic and non-domestic buildings are considered.

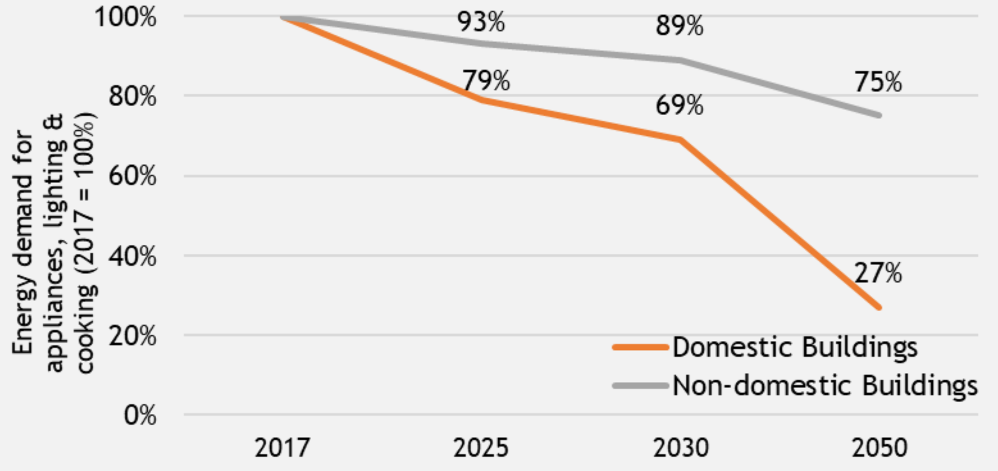


Figure 10: Energy demand reduction changes for appliances, lighting and cooking, defined against a 2017 baseline.

Making demand-side reductions underpins significant progress for reducing emissions. In order to reach zero carbon, non-fossil fuel technologies will be needed to provide our heating and cooking. Figures 11 & 12 describe this transition for Kent & Medway.

Switching from gas for heating

The rate of decarbonisation of the electricity grid will have a significant impact on the potential emissions reductions for certain technologies. The transition to electrified systems will yield higher savings if coupled with a transition to a “greened” energy supply of renewable technologies such as wind and solar.

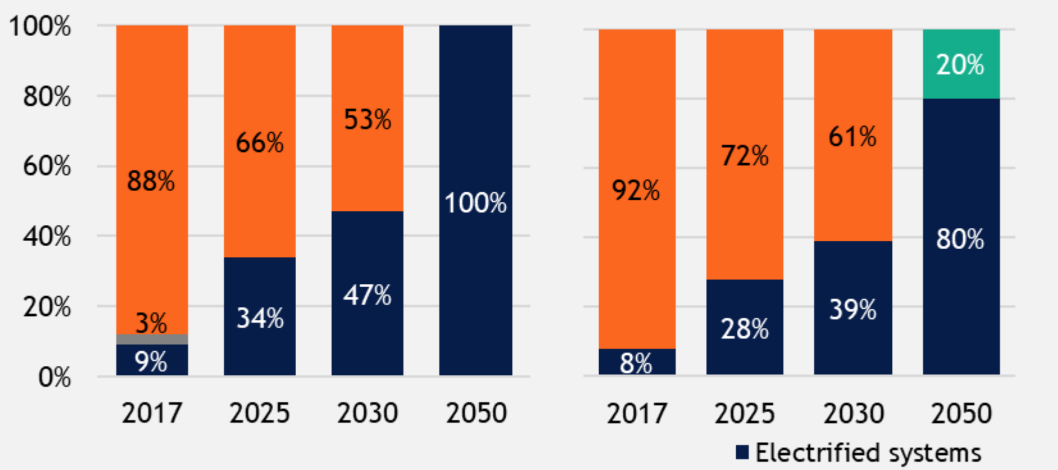


Figure 11: Domestic (left) and non-domestic (right) heating technologies. Other fuels relates to oil and solid fuel types.

Switching from gas cookers

The graph below plots the uptake of an increased number of electrified cooking systems, again for both domestic and non-domestic cookers. Consideration is also made for systems which are not necessarily electrified, but are more energy efficient than existing systems. For the most part, the uptake of electrified cooking systems directly reduces other fuel usage, though efficiency improvements also serve to reduce the fossil fuels used for cooking.

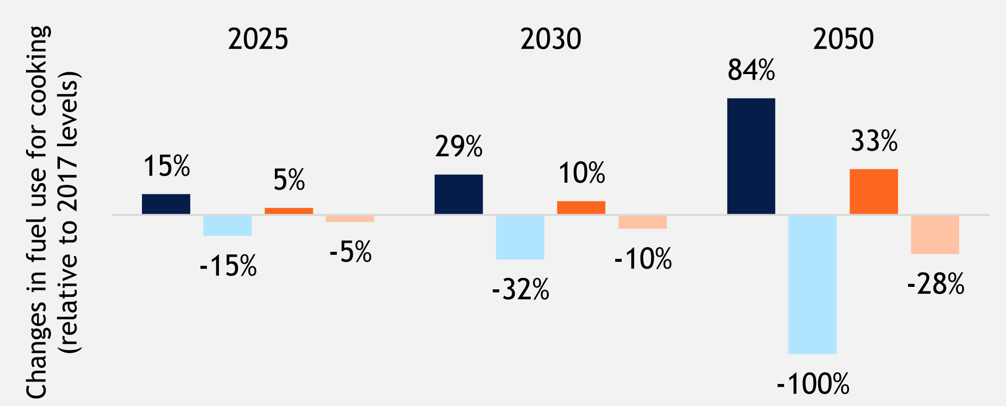


Figure 12: Changes in fuel use for cooking for domestic (blue) and non-domestic systems (orange). The transition to commercial electric cooking is predicted to be much slower than for domestic systems.

05.1 – CASE STUDIES AND POLICY DRIVERS

NON-DOMESTIC BUILDINGS

LOCAL

Best Practice

Thanet Earth is one of the largest greenhouse complexes in the UK and provides backup power to 50,000 homes through local CHP plants

LOCASE provides free support to businesses looking to become more sustainable; scheme has seen nearly £4.5m of grant funding reach over 400 SMEs in the region

All councils in Kent and Medway have committed to reduce estate emissions to net-zero by 2030, with Swale Borough Council committing to a 2025 target

NATIONAL

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

Keynsham Civic Centre aims to be one of the lowest energy-consuming public buildings in the UK, incorporating EPC A rated measures into the design process

POLICY

Drivers & Levers

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 (excludes housing)

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

05.1 – DOMESTIC HOUSING
ADDITIONAL SECTORAL ANALYSIS

Domestic housing emissions account for 31% of Kent & Medway's direct and indirect emissions.

Introduction

This section provides a more specific analysis of Kent & Medway's domestic housing emissions. This has been broken down into a few distinct areas:

- A review of the results from SCATTER, including estimates for the emissions savings associated with certain interventions and alternative pathways scenarios.
- Deeper analysis of local data and contexts within Kent and how these compare with national figures.
- Qualitative discussion of future changes to domestic housing emissions.

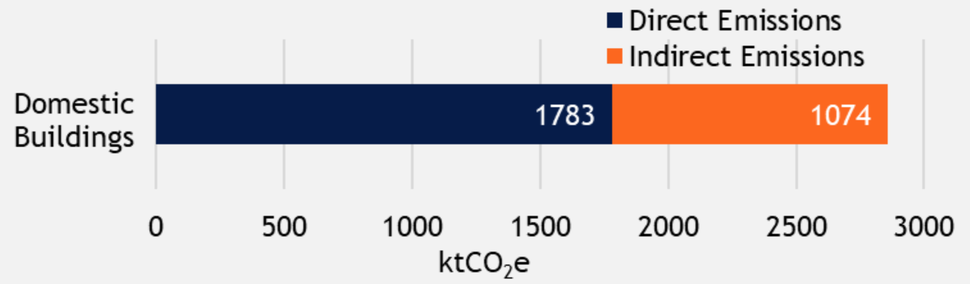


Fig 13: Domestic building emissions (2017) according to the SCATTER inventory. Direct emissions are those associated with fuel usage located within the county boundary, such as gas boilers. Indirect emissions are those associated with the use of grid-supplied electricity, steam or heating/cooling.

Alternative SCATTER scenarios

The graph below (Figure 14) shows the domestic housing breakdown of the SCATTER BAU & HA pathways. The third pathway defined describes a "low retrofit" scenario where improvements to existing buildings are less extensive, both in terms of building fabric and heating technology.
The low retrofit scenario also models the construction of new-builds to be of lower energy standards than PassivHaus/AECB High Performance.

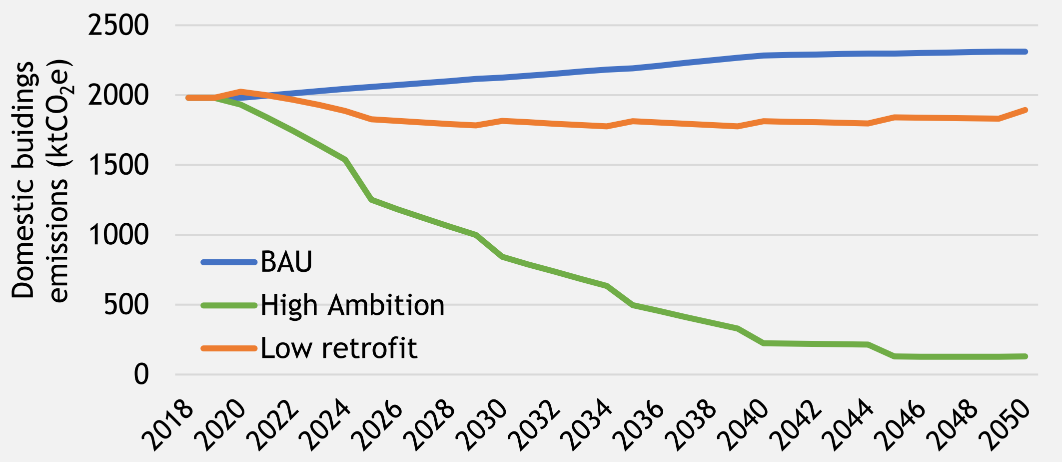


Figure 14: SCATTER Pathways for domestic buildings. Emissions increase slightly in the BAU and low retrofit cases due to the overall increase in demand for housing.

The table opposite describes the specific measures which underpin each scenario. Unless where stated, these measures relate to a 2050 endpoint against the 2017 baseline. These measures will require shifts in both technology and behaviour change in order to be implemented across the county.

The KCC Behavioural Insight Study provides a number of valuable considerations on the appetite for low-carbon improvements within domestic homes:

- Amongst residents willing to change their heating system, 20% cite lack of government support as a barrier to installing technologies such as heat pumps.
- Upfront cost (24%) and home ownership (18%) are cited as the most significant barriers for residents when considering the installation of insulation.
- Stimulus for change is financial, with most significant barriers relating to costs.
- A strong majority of residents (81%) would consider/already have switched to a renewable energy tariff.

Local government can play a key influencing role through dissemination of information to encourage resident engagement in retrofitting homes, especially where national government funding is available to support these measures.

	SCATTER measures		
SCATTER scenario	**Appliances & cooking**	**Building standards**	**Heating technologies**
BAU	20% reduction in demand, no change in cooking technologies, hot water demand per hh grows 5% p.a.	All new builds are constructed to current standards, no improvement overall to heating demand	No significant changes beyond updating existing gas boilers
HA	72% reduction in demand, cooking systems all electrified, hot water demand per hh falls 1.7% p.a.	All new-builds to PassivHaus from 2021	All heating systems powered by electricity (heat pumps or networks)
Low retrofit	As HA	As BAU	34% of heating systems electrified, 15% fuel boiler, remainder community-scale networks or CHP

Figure 15: Table defining the differences between the different pathways.

Emissions savings estimates

The low retrofit scenario varies significantly from the High Ambition pathway in both the endpoint for its heating technology mix and the standard for new-build housing.

By switching all heating systems to an electric fuel source, and combining this transition with a decarbonized grid, significantly higher savings are made along the High Ambition pathway – roughly four times the amount defined by the low retrofit case. In both scenarios the savings are maximized due to the availability of renewable energy, which was set to the highest ambition level in both cases.

The low retrofit scenario instead models the persistence of some solid-fuel boilers and solid-fuel community-scale CHP networks in the technology mix by 2050. The difference in new-build standard also has a significant impact in driving the demand for energy. Along the High Ambition pathway, PassivHaus standard new-build means that the additional demand from new households is kept to a minimum.

The opportunity for emissions reduction in addressing heating demand is significant and improving building fabric and switching to electrified technology should be prioritized as part of Kent & Medway's climate emergency response.

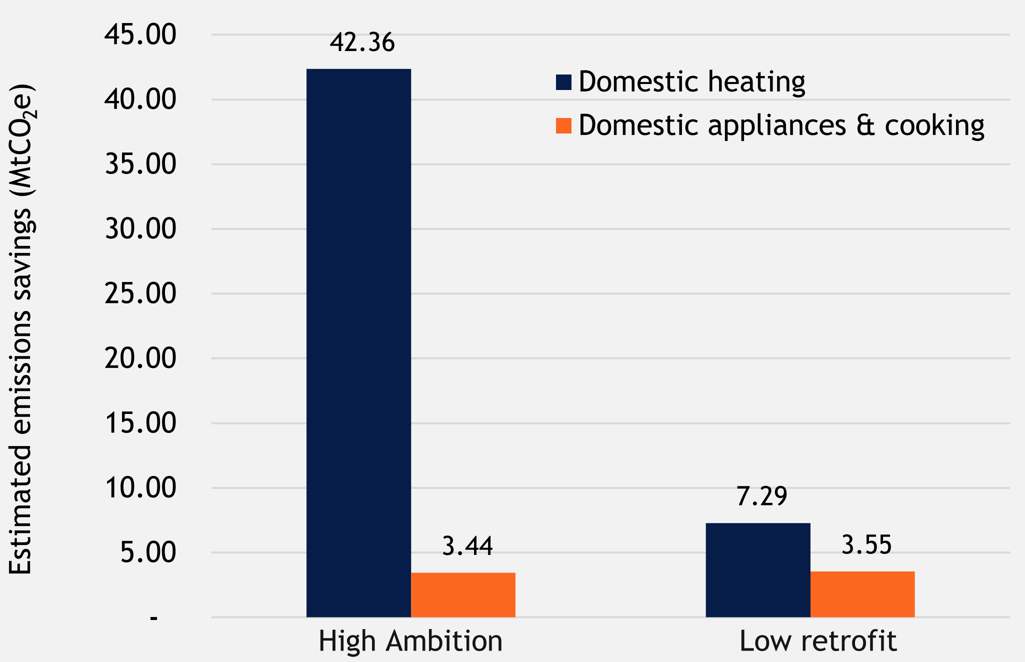


Figure 16: Estimated emissions savings relative to the BAU case for the accelerated action pathways, 2020-50.

Energy Performance Certificates within Kent

Energy Performance Certificates (EPCs) can be used to observe trends in household efficiency and benchmark progress. Ratings are awarded based on the condition and efficiency of various aspects including building fabric, heating system and ventilation on a scale of A (highest efficiency) to G (lowest efficiency). Whilst the accuracy of EPCs does vary, they can serve as a useful proxy for household energy efficiency. In particular, we can establish:

- How Kent & Medway fares against national standards;
- How the profile of EPCs has changed in the recent past and the direction/speed of travel for domestic energy efficiency;
- Which are the leading areas of the county in terms of performance.

It's important to note that not every household carries an EPC, but the proportion of households which do offers a large sample size. The true profile of energy efficiency may differ slightly due to the higher proportion of urban homes which carry an up-to-date EPC due to them being sold and rented more frequently.

From the chart opposite we can make a few observations:

- The number of AB-rated properties is small, both nationally and locally (c. 15% of the total).

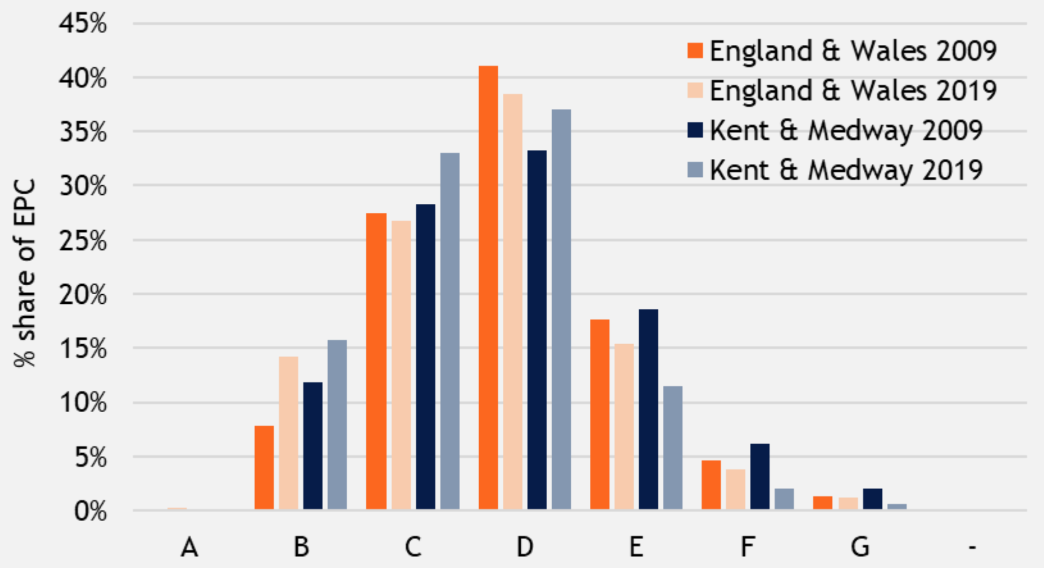


Fig 17: Comparing the distribution of EPC ratings awarded in 2009 and 2019, at the national and local level. A denotes the highest EPC rating, whilst G denotes the lowest (- denotes properties where the EPC was not recorded). Approximately 63% of households carry an EPC in Kent & Medway.

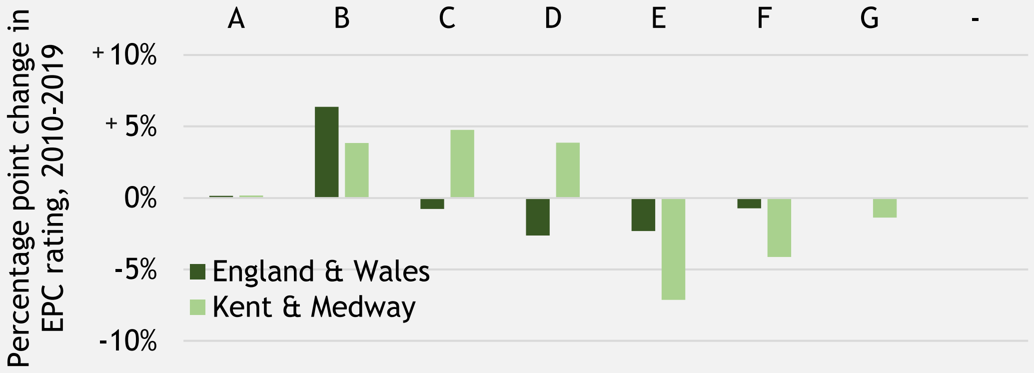
- The national trend indicates a small-scale transition towards higher standards of energy efficiency between 2009 and 2019.
- **The average EPC rating is slightly higher within Kent & Medway than nationally, reporting a higher share of ABC-rated properties.**

The *change* in the EPC ratings between 2009 and 2019 also indicate a positive trend towards more energy efficient households, with Kent & Medway again outperforming national trends and averages.

The graph below plots the change in percentage point share of different EPC ratings. An increase in AB-rated properties (coupled with a decrease in EFG-rated properties) indicates a transition to higher standards of energy efficiency.

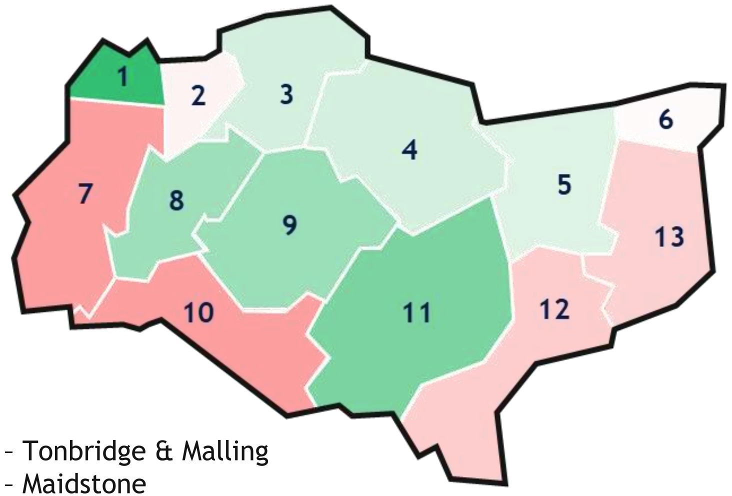
Kent & Medway has performed strongly in reducing its EFG-rated housing, though this transition has been largely to C & D ratings. Kent & Medway lags behind national averages in terms of increasing the proportion of AB-rated homes.

Figure 18: Comparison of Kent & Medway vs. England & Wales change in EPC ratings between 2009 and 2019.



EPC performance within the county

Analysing local authority level data, we can compare and rank Kent & Medway's districts according to their performance against national averages. By considering all EPCs awarded between 2010 and 2019 and comparing against national statistics for above-average or below-average numbers of high- and low-performing buildings, we can map the county according to an EPC ranking.[1]



Key

1 - Dartford
2 - Gravesham
3 - Medway
4 - Swale
5 - Canterbury
6 - Thanet
7 - Sevenoaks
8 - Tonbridge & Malling
9 - Maidstone
10 - Tunbridge Wells
11 - Ashford
12 - Folkestone & Hythe
13 - Dover

Kent average

Above average EPC

Below average EPC

1 - See Appendix 6 for a full explanation of the methodology for this analysis.

Accessing the able-to-pay retrofit market

Improving the energy efficiency of low-income households is a priority across the UK to address the issue of fuel poverty. Within Kent, fuel-poor households are the focus of work conducted by local and district councils, with KCC acting more strategically to engage “able-to-pay” (ATP) households and encourage them to improve their household energy efficiency.

ATP households are often ineligible for many efficiency improvement schemes, such as the Energy Company Obligation (ECO) which focuses on low-income, vulnerable and fuel-poor households. Encouraging the ATP market is crucial to meeting the demands of the High Ambition retrofit interventions.

Schemes such as the recent Green Homes Grant offer the means for homeowners to receive vouchers towards efficiency improvement measures for their homes. This scheme, and others like it, could play a significant role in helping significant numbers of residents to improve their energy efficiency.

In the KCC Behavioural Insights Study, the most common barrier to installing insulation was a concern of funding the upfront cost of improvements.

Heating technologies & the gas grid

The current local contexts for Kent & Medway in terms of heating technologies are a key consideration which impacts the future of decarbonized heating sources. According to BEIS research conducted in 2013, the proportion of properties in some districts that were off-gas was as high as 38%, significantly higher than the UK proportion of 14%[1]. A more complete picture of this context can be viewed at the Kiln/BEIS non-gas map. This is likely also influenced by the fact Kent contains over 18,400 listed buildings – higher than any other county in the UK.

Off-grid properties commonly rely on expensive alternatives for heating, such as oil- and coal-fired systems. These also carry a more significant carbon cost than gas boilers. Off-grid properties are also more likely to have higher rates of fuel poverty, and more likely to be single-person households.

There is an opportunity to support off-grid homes with the uptake of renewable and off-gas heating through increased financial support schemes. Working closely with local district authorities in Kent and Medway to develop a strategy to engage with off-grid properties and identify funding options to shift to electric or low-carbon hearting will support this transition. The Energy Saving Trust’s Scottish Green Homes Network seeks to inform homeowners with best practice and provide support and advice on different options available to off-grid households.

1 – Off Gas Report, Consumer Futures Unit

05.1 – CASE STUDIES AND POLICY DRIVERS

DOMESTIC BUILDINGS

LOCAL

Best Practice

Kent and Medway Warm Homes scheme has helped over 2,800 fuel poor homes since 2013, delivering lifetime bill savings of £9.68m through energy efficiency measures

A regional Kent Design Guide is being updated to encourage greater ambition in the design of net-zero new builds

ERDF-funded Innovation for Renewal project supported communities on either side of the Channel to foster resident participation and engagement with low-carbon initiatives related to household emissions

NATIONAL

Best Practice

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

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

Yorkshire's Zero Carbon cross-sector working group promotes zero carbon domestic buildings which underpins strategic planning policy

Camden's Passivhaus project is the largest residential new-build project for Passivhaus standard properties.

POLICY

Drivers & Levers

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

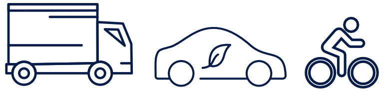
The Clean Growth Strategy set targets to upgrade as many houses to EPC band C by 2035 (2030 for all fuel-poor households)

The 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

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

05.2 – TRANSPORT



Transport is responsible for

38%

of Kent and Medway's emissions

Changing the way we travel & phasing out fossil fuel vehicles

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

Measures

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

Electrified train, Kent

Modal shift: Replacing one means of transport with another, normally to reduce congestion e.g. commuting by bus or train rather than by car.

Interventions & Pathway Outputs

Travelling shorter distances

This measure models the reduction in total travel demand – across all transport modes – per person. Travelling shorter distances can be achieved in a number of ways; the COVID-19 pandemic has facilitated a transition to remote working for large numbers of people, which reduces travel demand for commuting as well as highlighting the importance of rapid broadband connection in aiding a new working culture. Changes to transport infrastructure, public transport services and traffic management can also play a significant role in reducing journey distances and travel times.

This intervention also considers increases in population.

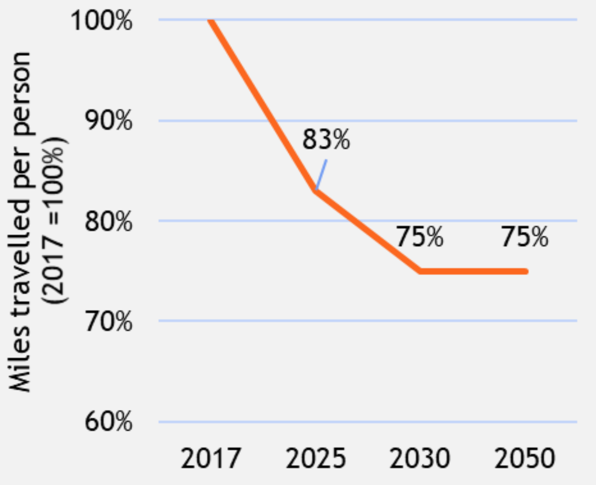


Figure 19: The shortening of the average number of miles travelled per passenger across all modes within Kent & Medway.

Between 2002 and 2018 the average distanced travelled per passenger per year in the UK dropped over 9%.

Driving less

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

Emissions savings can be made by reducing the modal share of private vehicles and increasing the proportion of people who travel by bicycle or train.

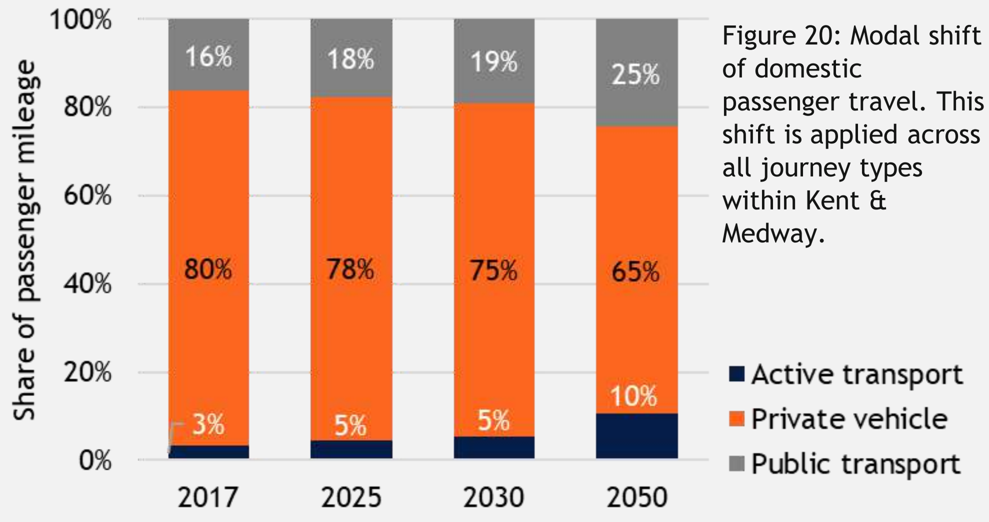


Figure 20: Modal shift of domestic passenger travel. This shift is applied across all journey types within Kent & Medway.

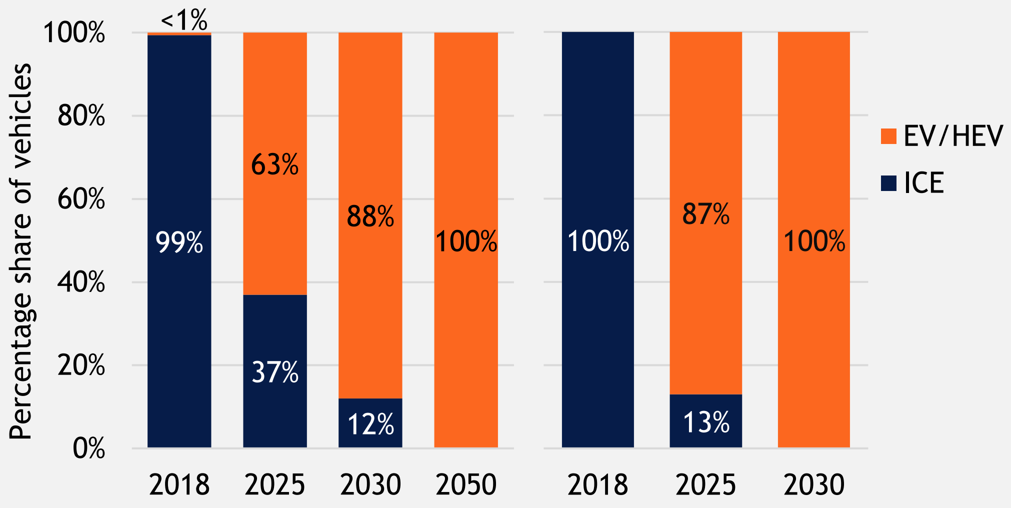
Transport glossary
EV - Electric vehicle
ICE - Internal combustion engine
HEV - Hybrid electric vehicle

Switching to electric vehicles

One of the most important steps to reducing transport emissions in Kent and Medway is the transition to electric vehicles. As with other measures around electrification, the success of the switch to EV relies heavily on grid decarbonisation and renewable electricity supply. Kent already runs a fully electrified passenger rail network.

Plans have also been approved for a hydrogen power plant at Herne Bay, with the intention of providing renewable fuel for a fleet of London buses. Hydrogen fuel is not modelled within SCATTER but may represent a viable alternative to EV deployment for heavier vehicles such as buses, refuse collection vehicles and freight. The energy for the Herne Bay site will be drawn from the offshore wind farm at Kentish Flats.

Figure 21: Private vehicles (left) and public transport (right) technology shares for EVs and ICEs. Hydrogen vehicles may be a more viable option than EV for public transport within Kent given developments at Herne Bay.



Improving freight emissions

Freight emissions are notoriously challenging to tackle. SCATTER models changes to emissions through a change to the energy intensity of freight journeys; in other words, the improved efficiency of freight journeys which can be measured through a reduction in energy used per kilometre travelled.

Limitations to existing electric battery technology for HGVs mean that within SCATTER, electric vehicles for freight are only modelled after 2040, though it is acknowledged that advances in hydrogen technology could expedite this transition away from diesel freight.

Reducing the energy intensity of freight transport could be achieved in a number of ways; more fuel-efficient vehicles, fewer empty-trailer journeys and/or modal shifts to rail or waterborne freight. The graph overleaf plots these three measures to 2050, with 2017 serving as the baseline. All percentage changes are with respect to the 2017 figure (i.e. in 2050, the energy demand per mile travelled is 25% the current figure).

Further commentary into freight emissions in Kent & Medway can be found in the specific sectoral analysis on transport on page 46.

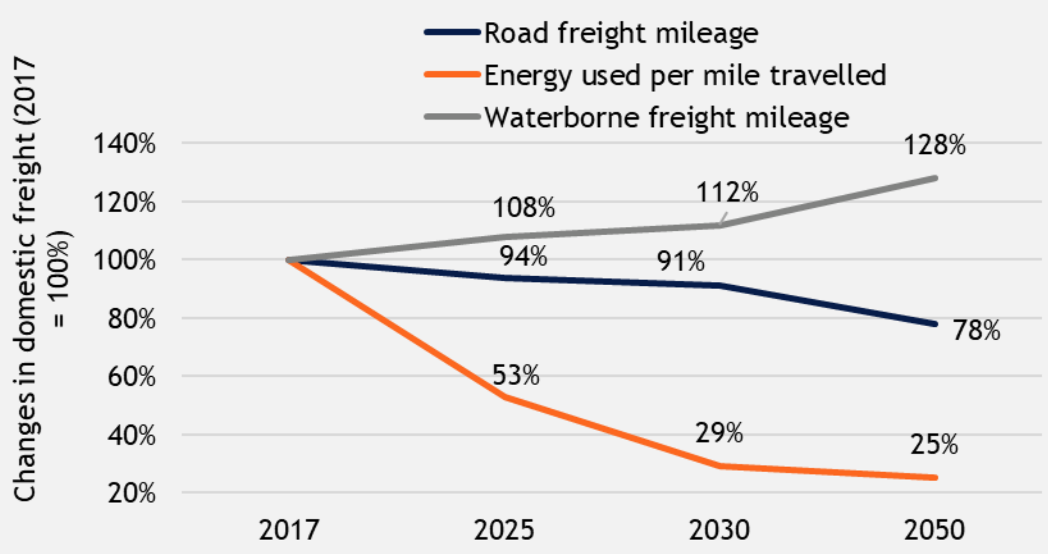


Figure 22: Improving freight emissions for Kent & Medway.

International aviation & shipping

SCATTER also includes interventions for improving emissions from international aviation and shipping. Given the nature and potential influence of these interventions, they were set to different levels of ambition which reflect central-case forecasts in each activity.

The Department for Transport (DfT) "central" forecast[1] for aviation was modelled within SCATTER, which represents the baseline trajectory for aviation emissions in the UK. The DfT scenarios model various factors related to aviation, including passenger mileage, fleet mix, fuel mix and other efficiencies.

Trajectories for **international** shipping have been modelled based on assumptions used in the DECC 2050 Pathways calculator for fuel use from marine bunkers. These are also based on a fixed fuel mix and derive from DfT scenarios, before being applied to fuel usage at UK ports. It should be noted that these fuel uses relate to different activities as those scoped by *waterborne navigation* in this report, instead referring to overall ship

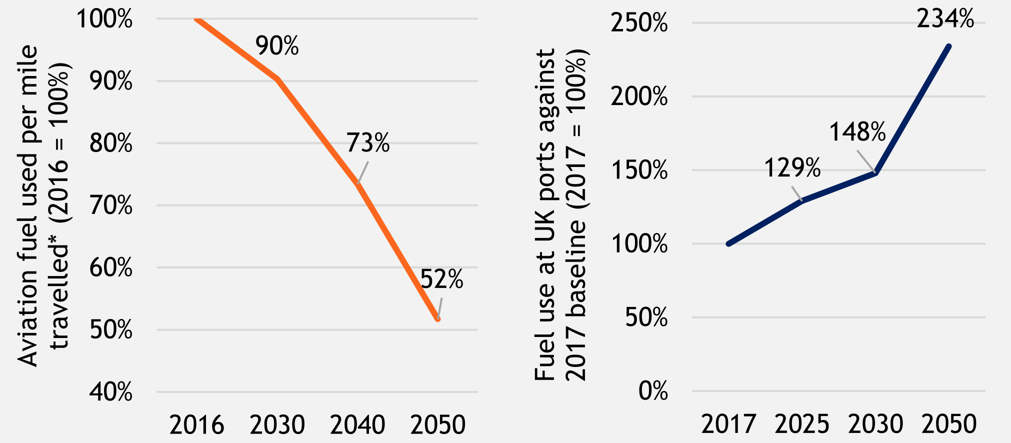


Fig 23: Left: Projected changes in fuel usage at UK ports, from DfT scenarios.
Right: Projected improvements to fuel efficiency according to DfT scenarios.
*listed as improvement to fuel efficiency in the DfT report.

1 – DfT scenarios were modelled prior to the COVID-19 pandemic.

05.2 – CASE STUDIES AND POLICY DRIVERS

TRANSPORT

LOCAL

Best Practice

Recently awarded a £180,000 OLEV grant to install 14 rapid chargers across six districts for taxis and private hire vehicles

A significant hydrogen plant has received planning permission approval at Herne Bay. Initially the fuel will supply London buses, with high future potential for usage within Kent

Notable successful public transport schemes such as the Fast Track mass transit bus scheme and an electric bus trial in Canterbury and Maidstone, as well as further trials exploring battery powered vehicles & electric minibuses

Fastrack Bus Rapid Transit (BRT) scheme in Kent Thameside developed under principles of Public Transport Orientated Development

NATIONAL

Best Practice

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

London Borough of Waltham Forest has a dedicated 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 the reduction of the number of free workplace parking places provided to staff and switch to alternative modes of transport

POLICY

Drivers & Levers

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

The UK government has the ambition to stop the sale of petrol and diesel cars by 2035 and instead switch entirely to electric vehicles

05.2 – TRANSPORT
ADDITIONAL SECTORAL ANALYSIS

Transport emissions account for 38% of Kent & Medway's direct and indirect emissions.

Introduction

This section provides a more specific analysis of Kent & Medway's transport emissions, focussing on the role of freight vehicles, including:

- A review of the results from SCATTER, including estimates for the emissions savings associated with certain interventions and alternative pathways scenarios.
- Deeper analysis of local data and contexts within Kent and how these compare with national figures.
- Qualitative discussion of future changes to transport emissions.

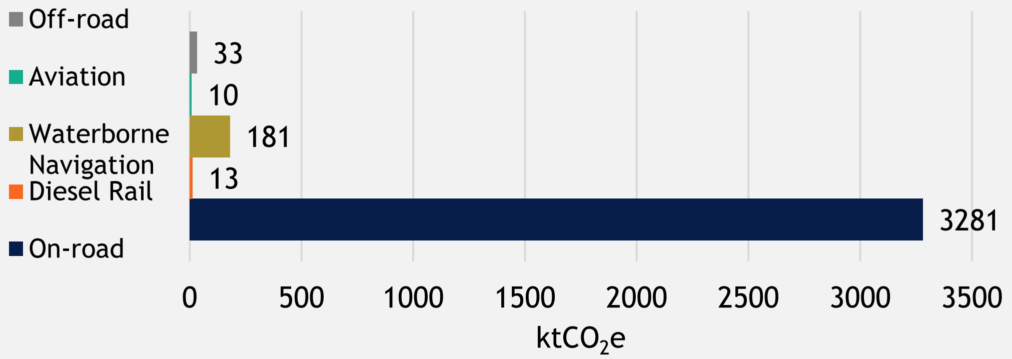


Figure 24: Transport sector direct emissions (2017) according to the SCATTER inventory. Direct emissions relate to in-boundary consumption of fuels.

Alternative SCATTER scenarios

Figure 25 shows emissions from transport along the BAU and HA pathways, along with an added pathways scenario, termed the "EV & Freight" pathway. A summary of the demands of each pathway is given in the table overleaf. Carbon savings along the HA and EV & freight pathways compared against the BAU case are influenced by the overall reduction in emissions, as well as the rate at which emissions decline. A summary of these estimates is given overleaf.

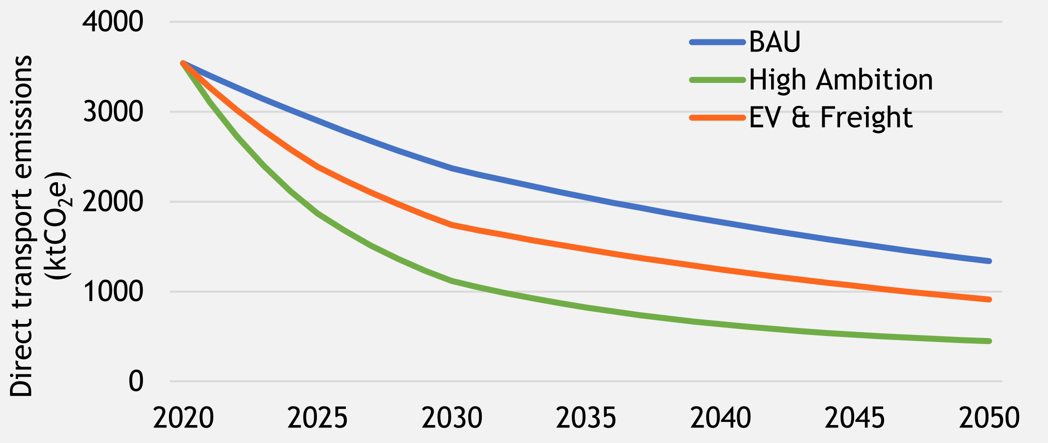


Figure 25: SCATTER Pathways for domestic buildings. Emissions increase slightly in the BAU and low retrofit cases due to the overall increase in demand for housing.

The table opposite describes the specific measures which underpin each scenario. Unless where stated, these measures relate to a 2050 endpoint against the 2017 baseline.

In both the HA and EV & freight pathways, all other non-transport related measures – including energy supply – were set to the highest ambition level. This is important to consider in the case of EV uptake for emissions savings.

Electricity consumed by the rail network is not included within these scenarios, as in the SCATTER Inventory analysis.

As before, the low-carbon transport transition will require both technological and behaviour change shifts. The KCC Behavioural Insight Study explores the appetite for this change with residents:

- Over half (52%) of surveyed Kent residents are currently willing to buy or lease an electric car, with 48% willing to transition to active transport.
- Of those unwilling or unable to make the switch to EV, just under 1 in 5 cited concerns that this would not make a tangible difference to climate change.

Rail freight can also support the shift of freight vehicles off roads, though current limitations on capacity will need to be explored further. The Draft Kent Rail Strategy (2021) is currently open for consultation and Network Rail is currently conducting a study to model future demand and capacity constraints.

SCATTER scenario	SCATTER measures		
	Domestic passenger transport	Freight	EV uptake
BAU	No changes to overall travel demand or modal share of transport modes	40% increase in freight efficiency, 47% increase in road freight, 15% decrease of waterborne transport	Cars, buses & trains are electrified by 2050
HA	25% reduction in mileage travelled per person by 2030	75% increase in freight efficiency, 22% decrease in road freight, 28% increase of waterborne transport	Cars, buses electrified by 2035, rail by 2030
EV & Freight	As HA	As BAU	As BAU

Figure 26: Table defining the differences between the different pathways.

Emissions savings estimates

The savings associated with each measure varies on the level of intervention. The speed of implementation and depth of activity drive the “saving” of carbon compared to the BAU level of intervention for each measure. Understanding the balance between the reductions impact for given measures can help define strategic decisions when action-planning; offering quantitative assessment over quick-win measures introduced rapidly against slower-to-implement, more substantive actions.

The main differences between the EV & freight pathway and the HA pathway are the speed of the transition to EV (2050 vs 2035) and the shift away from on-road freight to waterborne transport. This is borne out by comparing the emissions savings for HA vs EV & freight scenarios, where on-road savings are over twice as high in the HA case in the period 2020 and 2050. This does come at the cost of diminished savings in the waterborne navigation measures, but the payoff is significantly in favour of switching freight modes. In both scenarios, the savings are maximized due to a significant uptake in renewable energy supply, which were set to the highest ambition level in both cases.

In order to achieve the significant opportunities for on-road emissions savings under the HA scenario, action is required from business, residents and government. New regulations demanding the end of diesel and petrol-powered car sales in the UK from 2030 will play a key role in the shift to low-carbon transport and innovation in hydrogen and alternative fuels could also provide additional economic benefits.

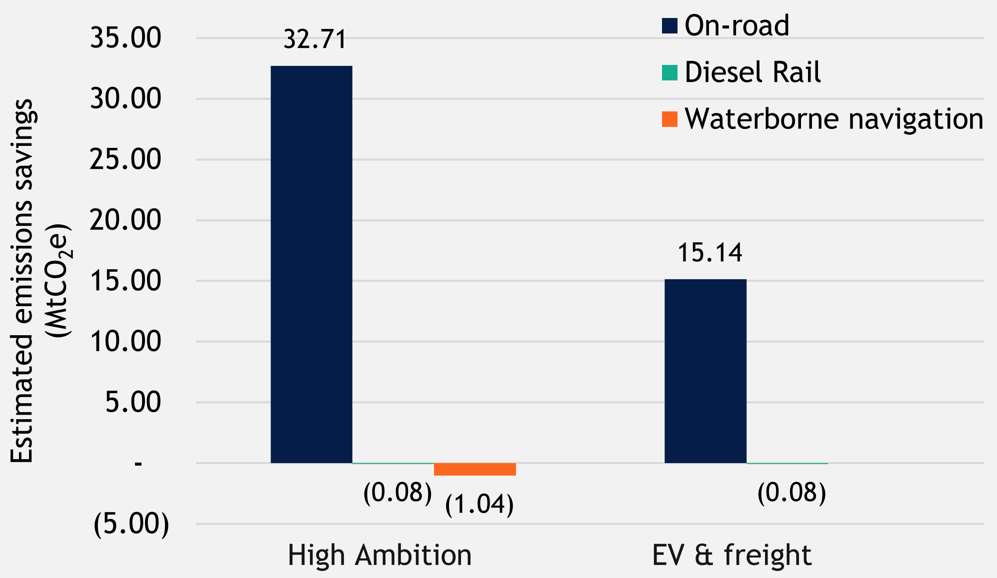


Fig 27: Emissions savings from the two accelerated action pathways when compared against the BAU case. Savings are estimated between the years 2020 and 2050 and calculated at each year-end. Waterborne navigation and diesel rail return “negative” savings, i.e. a net increase in emissions along the accelerated action pathways when compared to the BAU.

On-road emissions

Emissions from on-road vehicles are a significant portion of Kent & Medway's emissions profile. The passenger and freight traffic between Kent's port towns and mainland Europe contribute significantly to local emissions.

The analysis in this section is intended to define the significance of these traffic links in contributing to the county's emissions and how much of an outlier the county is when compared to regional and national figures.

Analysis has been performed at three levels:

- the local Kent & Medway level;
- the regional South East level (which covers Berkshire, Buckinghamshire, Sussex, Hampshire & Isle of Wight, Oxfordshire and Surrey, **with Kent excluded**) and
- the national level (England only).

Figures have been given as a proportion of the overall total within that geographical area, so as to standardize for the different sizes of assessed area.

The graph opposite compares mileage for different vehicle and road types. The mileage attributed to Heavy Goods Vehicles (HGVs) and Light Commercial Vehicles (LCVs) shows that proportionally, Kent & Medway does have higher volumes of freight/commercial traffic proportionally, though the deviation from national averages is not significant.

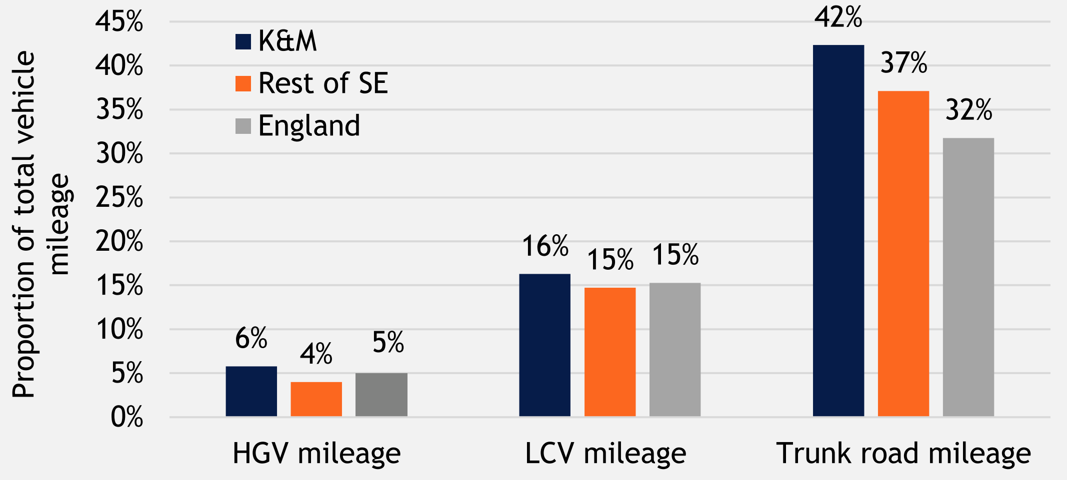


Figure 28: Mileage analysis for HGV, LCV & trunk roads. Source: DfT (TRA89).

The bars on the far right of this graph show that a significantly above-average proportion of overall mileage is completed on *trunk roads* within Kent & Medway. A trunk road is defined within the data as a motorway or an A-road, serving as a useful proxy for long-distance driving.

Supporting residents and businesses on the shift towards active and low-carbon travel will be key, as reductions in public transport use due to the pandemic has shifted a significant proportion of travel to private vehicle use, impacting congestion and local air quality. It will also be important to monitor the effect of shifts in working patterns beyond COVID-19 lockdown on transport behaviours.

The next comparisons consider carbon emissions from different road and vehicle types. BEIS local authority emissions data breaks down on-road emissions into different road types, providing data for the emissions from motorways.

Kent & Medway motorway emissions data show above average emissions figures when compared regionally and nationally. The county is also shown to have a higher proportion of HGV & LCV emissions according to an estimate based from weighted DEFRA emissions factors and mileage data.

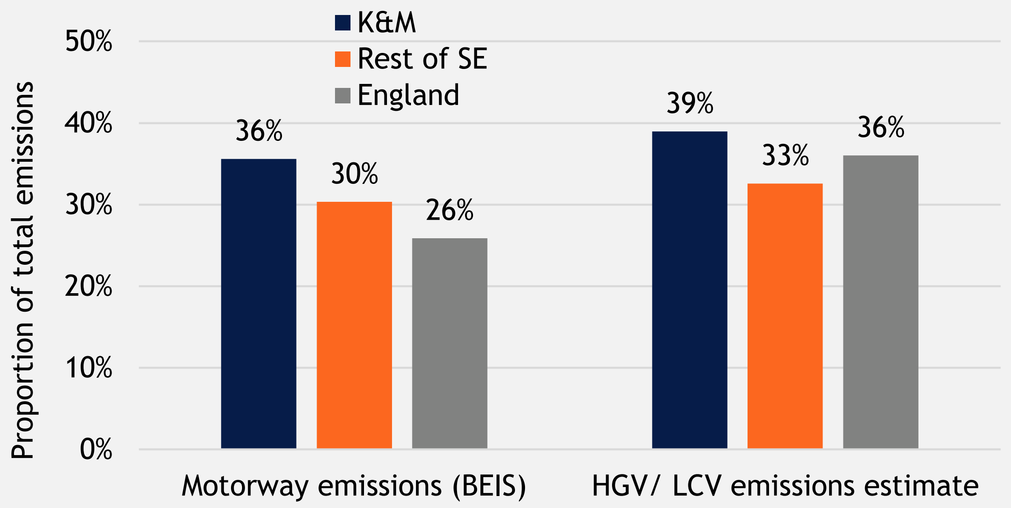


Figure 29: Emissions analysis for motorways & HGV/LCV. Source: BEIS, DEFRA, DfT (TRA89).

SCATTER on-road emissions are calculated using a slightly different methodology than BEIS figures, adopting a “top-down” approach. This means that emissions are calculated using emissions factors applied to the overall fuel consumption within the boundary as a proxy for travel behaviour. By contrast, BEIS adopts a slightly different approach, considering mileage completed by different vehicle classes and applying emissions factors on that basis.

The approach in Figure 29 is more closely aligned to the BEIS approach to emission calculation in that the vehicle class mileage was converted into emissions values by application of different emissions factors which account for fuel type, laden weight of HGVs, refrigeration and so on.

The significant proportion of transport emissions in Kent & Medway attributed to HGV & LCV highlights the importance of tackling on-road freight emissions. There is an opportunity to explore the potential for low-carbon fuels such as green hydrogen to support the transition to sustainable freight.

The UK Government will be consulting on a date for phasing out the sale of new diesel HGVs and has announced funding of £20 million in 2021 to support freight trials using hydrogen and other zero emission HGVs, as well as investing £1.3 billion to accelerate the roll out of electric charging infrastructure, targeted at installing rapid charge points on motorways and major roads.

Waterborne emissions & shipping

Within the SCATTER inventory, waterborne transportation emissions are the amalgamation of:

- **local-level water transportation:** fuel consumption for vessels used for fishing, oil exploration and coastal shipping – excluding those under international bunker contracts.
- **inland traffic:** mapped onto LA geographic boundaries using a proxy of canal length.
- **waterborne freight:** fuel consumption for inland traffic was separated from coastal using DfT statistics on waterborne freight. Port freight traffic emissions are allocated by mapping the locations of major and minor ports to local authorities.

Within Dover, this means that emissions from waterborne navigation rival that of on-road fuel consumption; 135 ktCO_2e from the port vs. 153 ktCO_2e on the district's roads. A more tailored review of the Dover/Pas de Calais strait emissions was completed in 2016 as part of an EU study.

In the UK, there has been increasing call from research institutes, NGOs and the Committee on Climate Change to include aviation and shipping emissions within national emissions targets. Global shipping company executives including BW Group and Cargill Ocean Transportation Group have been engaged in working group discussions to promote the need for a levy on carbon emissions from shipping operations.

The UK Chamber of Shipping have stated that climate change is at the top of their agenda and are considering hybrid shipping technology and setting a pathway for sustainable growth in the sector. The Clean Maritime Plan was released in July 2019 and requires all new ships trading in international and domestic UK waters must be designed with zero emission capable technologies by 2025.

Further economic analysis states that technology advances mean that "all ship types could technically achieve zero operational GHG and pollutant emissions by 2050 through full adoption of alternative fuels and associated machinery" demonstrating that these targets are achievable if financial and political levers were to enable this action.

The role of Kent County Council to support reduction in waterborne emissions will likely be one of engagement with industry networks and lobbying to national government.

There is also potential for KCC to lead innovation in this sector through investing in pioneering low-carbon fuels and technologies.

05.3 – WASTE & INDUSTRY

Waste & industrial processes are responsible for

4%

of Kent and Medway's emissions

Improving waste streams and decarbonising industry

Waste & industrial processes form a comparatively small portion of Kent & Medway's emissions, but represent activities that commonly have significant impacts outside of direct carbon emissions. Within SCATTER Pathways, waste emissions are impacted by improving the amount and final endpoint of different waste streams. Measures related to industry focus on the decarbonisation of industrial processes and practices themselves, as opposed to the energy performance of industrial buildings (which falls under the non-domestic buildings measures).

Measures

The measures which relate to waste emissions are:

- Producing less waste: Considers changes in the overall weight of waste produced across all streams from domestic, commercial and industrial activity.
- Increased recycling rates: Considers the different destinations for waste streams.

The following industrial measures are defined within the tool:

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

Interventions & Pathway Outputs

Producing less waste

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

According to annual Kent County Council waste statistics from FY16/17, the average household's waste was over 535kg. Of this, an estimated 47% was sent for reuse, recycling or composting.

In similar statistics for Medway Council, the average waste per household was higher, at just under 622kg, with an estimated 43% sent for reuse, recycling or composting.

Increased recycling rates

After reducing the amount produced outright, the second SCATTER intervention considers changes to the amount of waste that is recycled. A weighted average from 2016/17 was used for Kent & Medway.

SCATTER trajectories incorporate EU targets for a recycling rate for municipal waste of 60% by 2035, rising to 65% by 2035.[1]

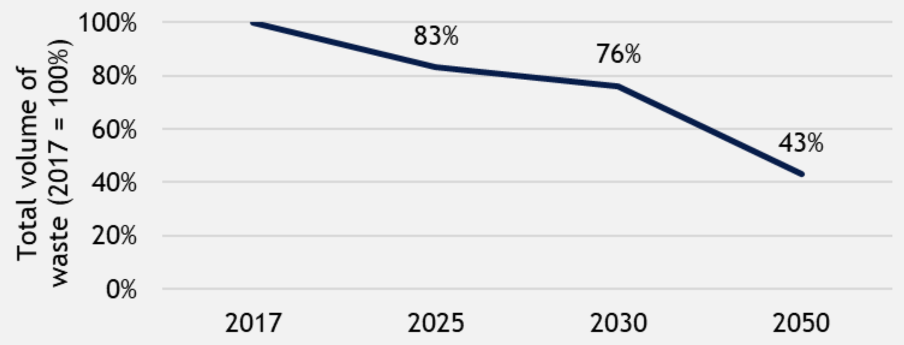


Figure 30: Reduction in overall volumes of waste modelled in SCATTER for Kent & Medway.

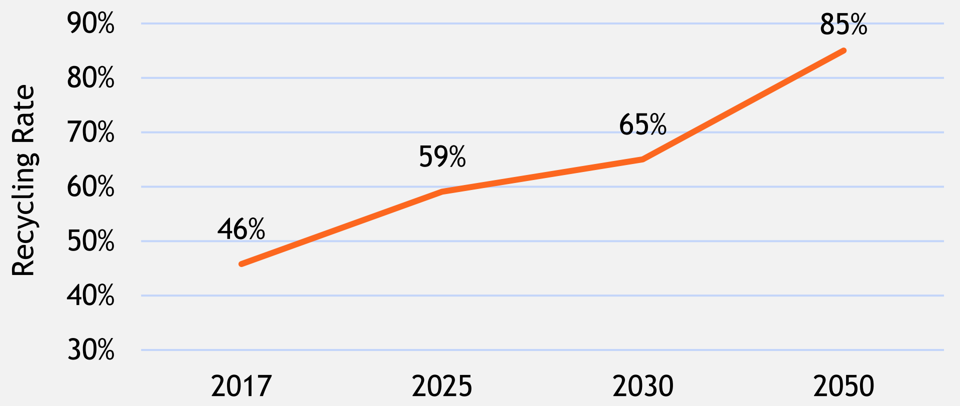


Figure 31: Increase in waste recycling rates modelled in SCATTER for Kent & Medway.

1 – These targets have since been revised to a higher level of ambition (65% by 2030), though this occurred after the development of SCATTER.

Switching from oil fuels

Tackling industrial emissions can be extremely challenging, particularly the decarbonisation of very energy-intensive processes and reducing the emissions from the processes themselves.

For the chemicals, metals and minerals industries, SCATTER models the changing use of fuels for these processes, shifting off the most carbon-intensive fuels (i.e. fuel oil) in favour of transition fuels such as natural gas.

As mentioned in other parts of this report, other nascent transition fuels such as hydrogen and/or biofuels are not included within these modelling scenarios but may form part of the solution to decarbonising industrial emissions within Kent & Medway.

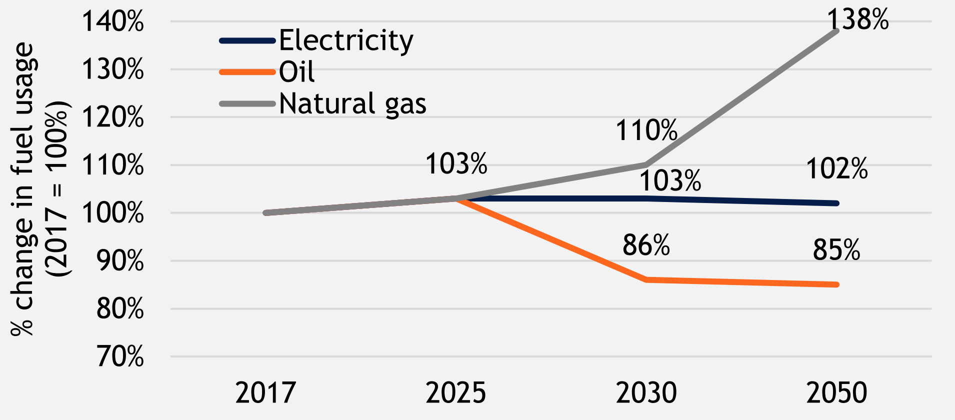


Figure 32: Changes in fuel use for industrial processing in SCATTER.

More efficient processes

This intervention considers changes to greenhouse gas emissions that result from industrial processes themselves. Process emissions arise from the manufacture and/or production of materials, chemicals and other products e.g. through combustion. Separate trajectories are measured for chemicals, metals and minerals industries. “Other” industries covers all other industrial activity.

Improvements to various efficiencies may drive these reductions:

- Energy efficiency – reducing energy intensity by upgrading to best-practice technologies or better energy recycling (such as CHP) measures.
- Material efficiency – reducing consumption of emissions-intensive materials in manufacturing processes (e.g. minimising the use of fertilizer through efficiency improvements would greatly reduce N_2O emissions).

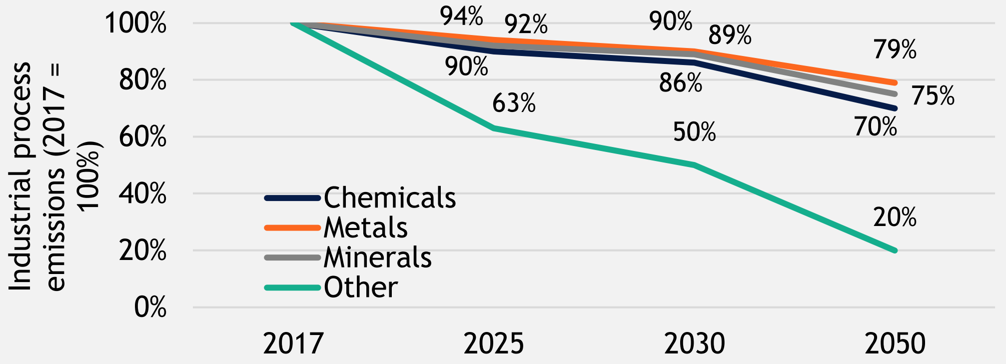


Figure 33: Reduction in industrial process emissions modelled in SCATTER.

05.3 – CASE STUDIES AND POLICY DRIVERS

WASTE & INDUSTRY

LOCAL

Best Practice

KCC's Waste Disposal Strategy and Evidence Base set out future plans for a sustainable waste management service.

In Kent & Medway, the percentage of waste to landfill has decreased compared to the national average, decreasing from just under 50% in 2008/09 to under 2% in 2018/19.

Allington Energy from Waste (EfW) Incinerator has the ability to produce 40MW of power through the processing of 500,000 tonnes of household and business waste per year.

NATIONAL

Best Practice

Powys Council achieved the greatest reduction in carbon associated with recycling in the UK, partly due to shifting of the collection schedule.

Loughborough University are leading innovation in food waste processing with industry partners.

The Industrial Strategy Challenge Fund (ISCF) has launched £149 million to invest in supporting businesses across the foundation industries to share best practice work together in support of the net zero transition.

POLICY

Drivers & Levers

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.

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

05.4 – ENERGY SUPPLY

Meeting demand with green energy

The measures described so far across the buildings, transport and industry sectors are heavily influenced by the provision of renewable electricity from zero-carbon sources.

Measures

SCATTER considers a wide range of renewable technologies:

- Wind: A variety of different wind capacities are defined; whether on- or off-shore.
- Solar PV: As with wind, installed capacity from both Major Power Producers (MPPs) and “local” sites is considered.
- Biomass/coal power stations: Switching from fossil fuels to biomass generation in power stations.
- Hydroelectric power: Scaled to the local authority level by area of inland water.

Offshore wind, as well as tidal and wave power, are applied only to local authorities with pre-existing installations. The suggested capacities are scaled to Kent and Medway by energy consumption, except where stated otherwise. For all of the supply technologies referenced in this section, if the technology is not deemed feasible within Kent to the suggested extent, the residual capacity is assumed to occur outside the boundary.

Kentish Flats Wind Farm

Interventions & Pathway Outputs

Wind

Installed wind capacity can be broken down in terms of whether or not sites are on- or off-shore or delivered by Major Power Producers:

- On-shore capacity relates to land-based installations that are delivered by MPPs.
- Off-shore capacity is assumed to be delivered by MPPs.
- Local capacity refers to on-shore installations that are **not** delivered by MPPs (e.g. community energy schemes).
- BEIS figures have been included for comparative current context. These statistics are split only between on- and off-shore capacity.

The modelled wind capacity for Kent & Medway can be seen opposite in Figure 34.

According to WindEurope, the average power rating of new onshore wind turbines in 2019 was 3.1 MW and 7.2 MW for on- and off-shore turbines respectively. Whilst Kent's current context in offshore installations is notable, the county also has high potential for further onshore development according to potential site mapping.

In the government's Ten Point Plan, released in November 2020, ambitious plans for scaling offshore wind capacity were described as part of an effort to decarbonise the UK's energy supply, encouraging up to £20bn of private investment within the next ten years. That said, onshore wind installations are often cheaper to deliver than offshore equivalents, meaning that Kent may benefit from further scoping of potential onshore sites for wind.

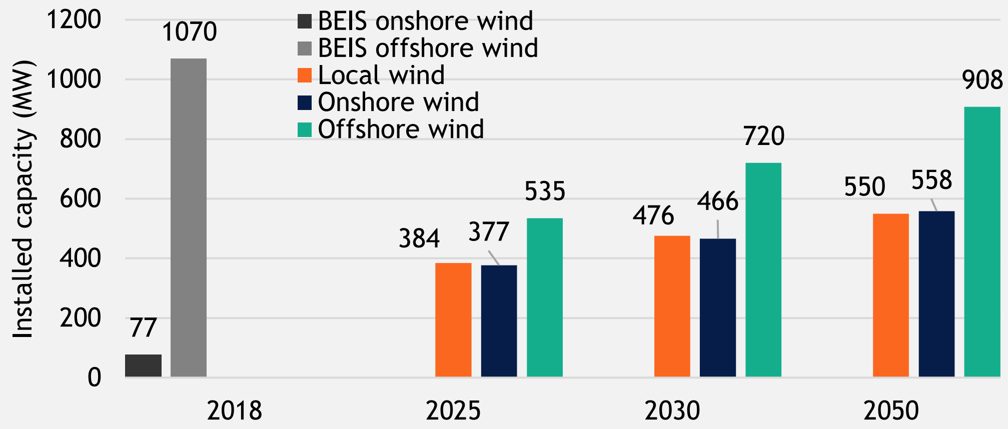


Figure 34: Modelled increase in installed wind capacity in Kent & Medway, with current installed capacity listed for 2018 (per BEIS statistics).

Solar PV

Similarly, solar PV technologies can be split out into local installations that are not delivered by an MPP, which could be domestic household installations or other relatively small-scale roof- or ground-mounted arrays (e.g. on schools or office buildings). According to the Energy Saving Trust, the typical household array capacity is between 2-4 kW. "Large-scale" solar PV capacity relates to sites with significant capacity installed, delivered by MPPs.

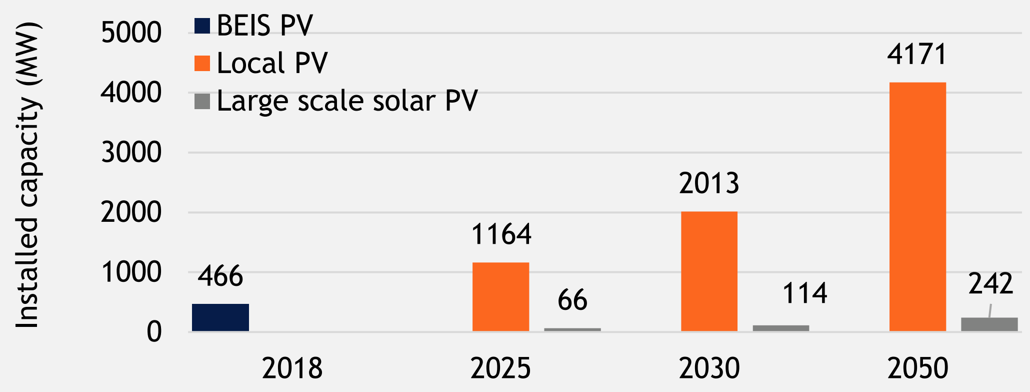


Figure 35: Modelled increase in PV capacity within Kent & Medway.

Biomass

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

The current installed capacity across Kent for all organic renewable energy supplies is 134 MW, with a significant facility at Ridham Dock. Also included in that figure is the capacity from energy from waste (EfW) installations, most notably the EfW plant at Allington.

For the High Ambition pathway, generation in power stations from solid biomass fuels is modelled to increase fourfold by 2025, before dropping off to very low levels by 2050. Without the coupling of biomass generation to carbon capture and storage technology, there will always be residual emissions associated with the consumption of solid biomass fuels. The phasing out of coal and natural gas follow trajectories in the National Grid Two Degrees scenario.

Other renewable technologies

The other technologies considered within SCATTER are wave, tidal and hydro power stations. Local wave, tidal & large scale hydro projects have not been forecast on the basis that no existing capacity exists within Kent. The tool considers only the development of existing sites for these technologies rather than novel installations. SCATTER does not consider new local nuclear energy installations, though national government's Ten Point Plan does seek to pursue investment into Small Modular Reactor and Advanced Modular Reactor technology.

Renewable technology	BEIS (MW)	SCATTER		
	2017	2025	2030	2050
Wave	0	-	-	-
Tidal	0	-	-	-
Hydro	0.004	• 43 MW local • 31 MW large scale	• 56 MW local • 40 MW large scale	• 69 MW local • 47 MW large scale

05.4 – CASE STUDIES AND POLICY DRIVERS

ENERGY SUPPLY

LOCAL

Best Practice

Wind farm projects at **Kentish Flats** and **Thanet** are major offshore installations for which KCC has promoted and expanded onshore supply chains and infrastructure.

Solar Together Kent offers a unique group-buying scheme for local residents and SMEs to install solar PV and battery storage at a reduced-price.

The UK's largest solar park has been approved to be built in Cleve Hill, Graveney with a planned 880,000 panels supported by storage technology, generating an expected 350MW to power over 91,000 homes. A dedicated Habitat Management Area of 56 hectares of open grassland and meadow areas, hedgerows and woodland isalso planned to improve biodiversity in the area.

NATIONAL

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

POLICY

Drivers & Levers

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

05.5 – AGRICULTURE & LAND USE

Kent & Medway's livestock is responsible for about **2%** of total emissions

Kent & Medway's natural environment acts as a carbon sink for approximately **4%** of total emissions

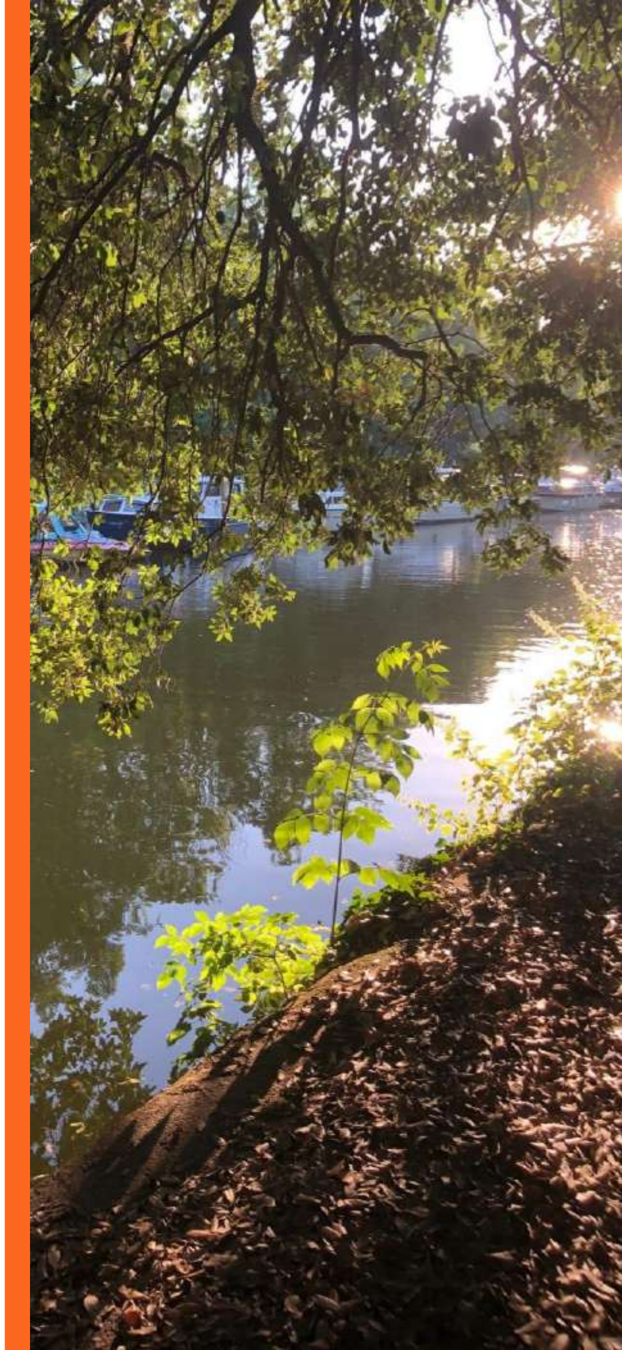
Managing natural infrastructure

The use of green spaces and the natural environment has a significant role in acting as a carbon "sink" – meaning that it removes carbon emissions from the atmosphere in the form of trees, peat and other natural features.

Measures

- Increased tree coverage: Considers the increase in the proportion of land which provides woodland coverage.
- Tree planting & other nature-based solutions: Considers changes to the coverage of trees outside of woodland, through new trees being planted and maintenance of existing trees.
- Land management: Considers changes to green belt, grassland and cropland coverage. SCATTER does not consider soil carbon stocks and their management; any changes to non-wooded nature-based solutions are contained within this measure. However, further analysis on soil carbon stocks has been added to supplement the SCATTER analysis.
- Livestock management: Considers changes in the number of livestock in the area (cattle, pigs, sheep and horses).

As the emissions estimates for agriculture and land use included in SCATTER are high-level, a more detailed and accurate analysis of agriculture and land use emissions is also included in this section. This analysis seeks to better quantify the emissions associated with livestock and land use as well as explore natural capital's sequestration potential.



Interventions & Pathways Outputs

Increased tree coverage & tree planting

Tree coverage and the associated sequestration potential has been separated out into "woodland coverage" and "lone trees". Woodland coverage relates to areas of trees which can be defined as such by a land use map.

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

Year	Woodland coverage	Tree planting outside woodlands (i.e. lone trees)
Current	An estimated 17% of Kent & Medway is covered by woodland[1]	Tree planting outside woodlands is equivalent to roughly 30 lone trees per hectare in Kent
2030	24% increase in woodland coverage	Increase in lone tree coverage to around 40 lone trees per hectare

Land & livestock management

The sequestration potential for rural areas can also be maximised by transitioning towards natural features which absorb more carbon than grass- and cropland as well as shifting land management practices to maximise carbon sequestration.

The Knepp Estate in Horsham is a pioneering local case study focused on *rewilding*, restoring land which was once intensively farmed to a wildlife conservation project.

Year	Land management	Livestock numbers decrease 0.5% annually
Current	Farmed area remained constant between 2013 and 2016, with an 8% decrease in grassland	7% reduction in the total number of livestock between 2013 and 2016
2030	N/A	12% decrease on 2017 levels
2050	7% decrease in grassland; 1% decrease in cropland	48% decrease on 2017 levels

1 – Tree canopy data is calculated using BlueSky data and i-Tree tools.

05.5 – AGRICULTURE & LAND USE

ADDITIONAL SECTORAL ANALYSIS

Introduction

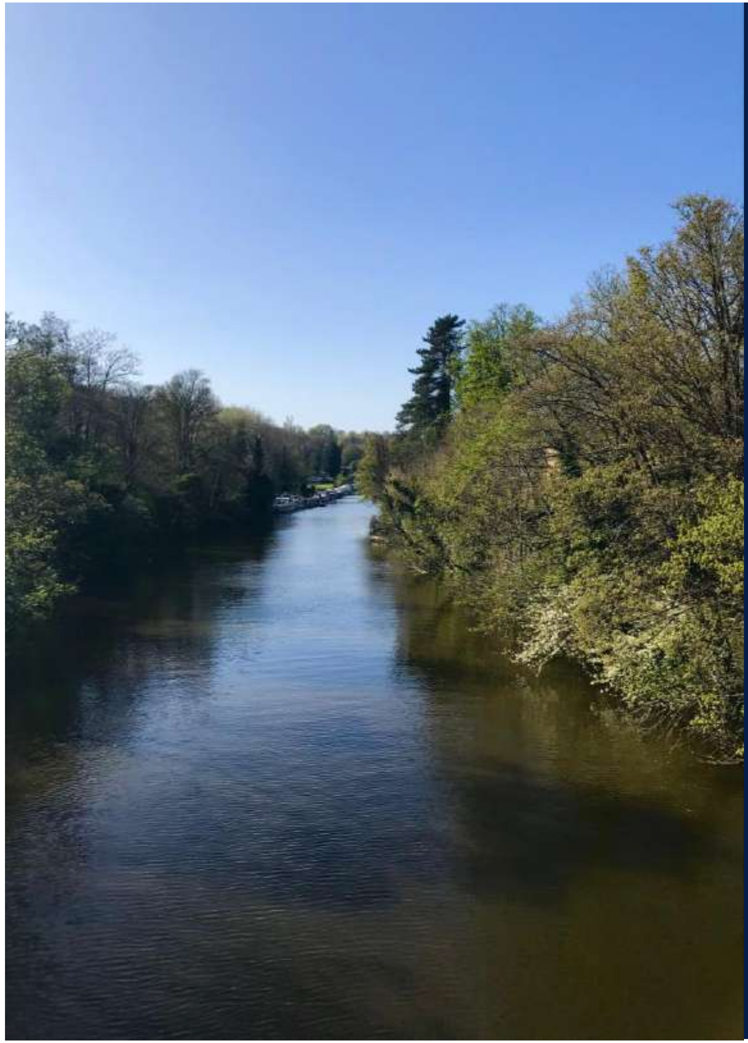
This section provide additional detailed analysis into agricultural sector emissions across Kent County. Whilst the SCATTER tool provides some estimations for agricultural emissions, a more accurate representation of current a future emissions is provided here. Agricultural emissions include those generated through livestock, land use and land use change as well as carbon sequestered in forests and soil.

Summary of key points

- Gross emissions[1] from agriculture and land use in Kent are in excess of 318 ktCO_2e, approximately 3.4% of emissions from the Kent & Medway's energy system.
- Overall, Kent's agriculture and land use emissions act as a 'net sink', sequestering more than the sector's total gross emissions.
- Emissions from livestock are the dominant source of gross emissions, responsible for approximately 61% of gross emissions. Dairy cows are responsible for 26% of gross emissions and non-dairy cows are responsible for 50%.
- The other 39% of gross emissions is the result of crop and grassland emissions, typically the result of nitrous oxide emissions from fertilisers.
- Land in Kent and Medway also acts as a carbon sink, removing approximately 5% of gross emissions from the atmosphere in the soil.
- Trees across the county also act as a carbon sink, sequestering an estimated 367 ktCO_2e from Kent and Medway's gross emissions.
- Using Committee on Climate Change forecasts, reducing consumption of beef, dairy and lamb by 50% could reduce gross emissions by as much as 83 ktCO_2e and planting woodland on land saved from grazing could reduce gross emissions by a further 86 ktCO_2e.
- Doubling the current area of planted woodland through increasing density or land coverage within Kent & Medway could reduce gross emissions in the county by approximately **7%** as compared to current gross emissions. There is significant opportunity to maximise and develop the natural capital across the county to support balancing of emissions.

The modelling included in this section is indicative and consideration will need to be made for current land and livestock management practices and biodiversity impacts which will need to be measured at a more local scale. These management practices will differ depending on the land area and owners and this will have a variety of impacts on emissions produced and sequestered.

1 - 'Gross emissions' are defined as emissions which have not been subjected to any offsetting against soil and biomass carbon.



Key figures for agriculture and land use

ALU emissions are equivalent to 3.4% of the energy system

61% of ALU emissions are from livestock

39% of ALU emissions are from fertilizer application

105% of current agricultural emissions are sequestered by land-use and forestry

Land Use Summary

The land area covered by Kent & Medway totals approximately 373,960 hectares (ha). Ashford accounts for the largest local authority area within the county, accounting for 58,062ha.

- The proportion of total land in Kent & Medway is largely made up of permanent grassland of 140,356ha (38%) and arable crop growth of 117,071ha (31%).
- This proportion is typical across the majority of local authorities in Kent & Medway, however, Dartford (33%), Medway (27%) & Thanet (26%) also attribute high proportions of urban infrastructure (non-agricultural land use).
- Sevenoaks & Tunbridge Wells show a higher proportion of Woodland with 7,041 (19%) & 6,870 (21%), respectively.

Agricultural and land emissions

The graphs opposite describe emissions from agricultural activity and associated land management practices within Kent & Medway.

Emissions from agriculture come from two main sources:

- Livestock production produces 61% of gross emissions. The majority comes from enteric fermentation in dairy cattle.
- Fertiliser applications produce the remaining 39%. The main sources are nitrous oxide from grassland (which has low fertiliser applications but a large total area) and wheat production (which has a high average fertiliser application rate and large area). These will vary each year if crops are rotated.

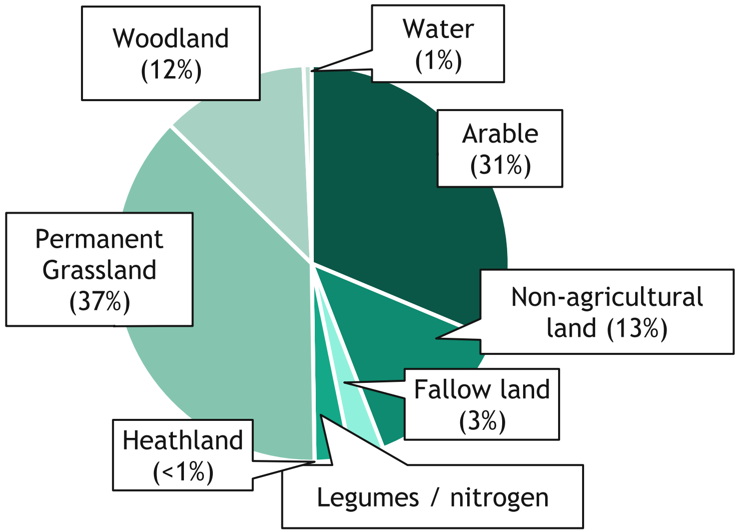
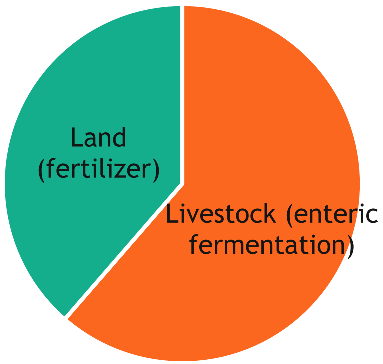


Figure 36: Land uses as a proportion of the overall Kent & Medway total.



Agricultural and land emissions by local authority

- The highest proportion of emissions are associated with Ashford local authority accounting for approximately 66,782 tCO_2e with 69% from livestock & 31% from land.
- When compared against carbon changes in soil and biomass, the total net effect is that emissions are *sequestered* and the local land acts as a carbon *sink* for around 14,000tCO_2e. The full data table for this analysis can be found in Appendix 7.
- To visualise areas of different land use types, Appendix 8 outlines data tables and maps of land use types for each local authority in Kent & Medway.

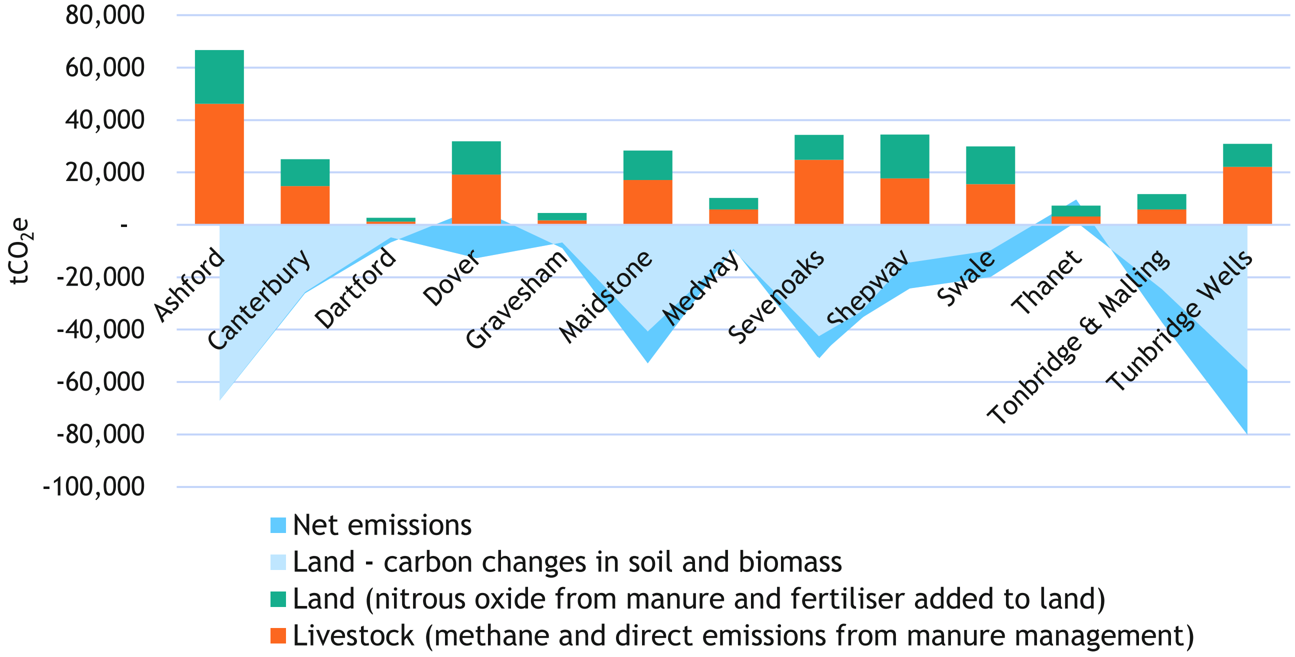


Figure 39: A breakdown of these emissions as compared to carbon sequestration from local sinks. The net emissions are negative, meaning Kent & Medway acts as a carbon sink.

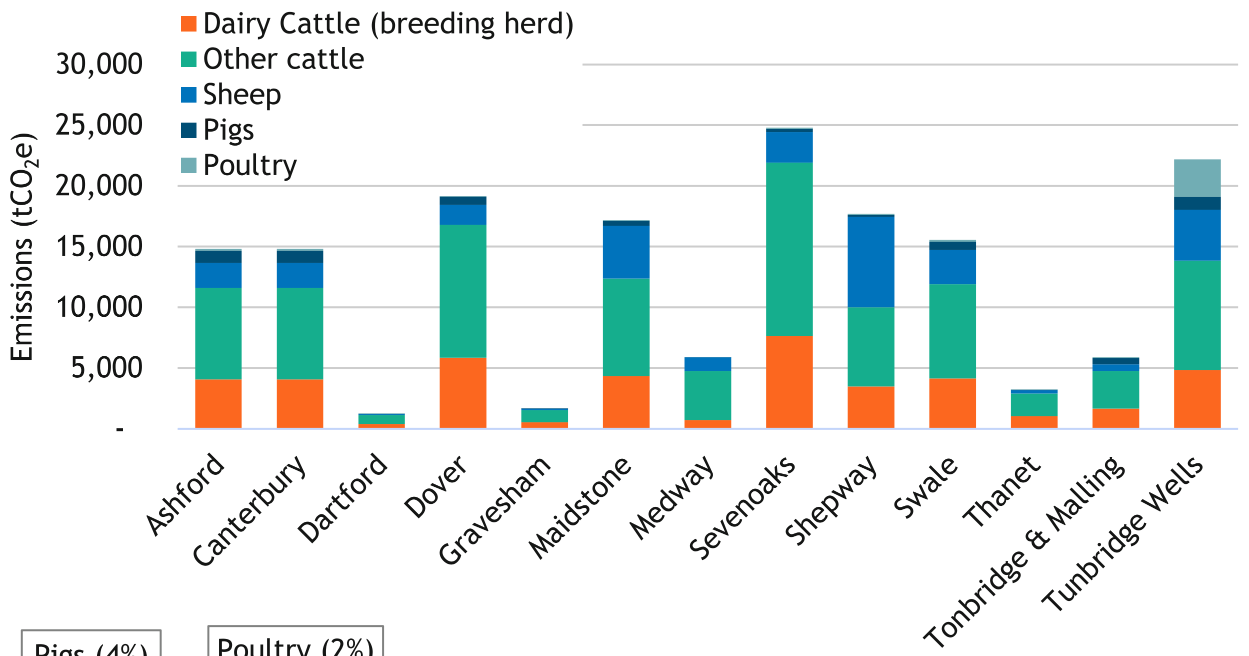
Livestock emissions

The graphs opposite provide a breakdown of emissions from different types of livestock within Kent & Medway:

- The total emissions from livestock in Kent & Medway accounts for approximately 164,120 tCO_2e
- Sevenoaks was the highest-ranking district, with an estimated 24,803 tCO_2e (15% of the overall total) from livestock
- The majority of livestock within the county are poultry, with figures exceeding 1.9 million
- Just over half of emissions stemmed from "other cattle" (82,490 tCO_2e) with each cow contributing 1.9 tCO_2e to the total figure.

The estimated figures for livestock numbers & emissions are based on DEFRA statistics which break down key crop areas and livestock numbers on agricultural holdings between 2013-2016. The figures account for:

- enteric fermentation – direct CH_4 emissions from eructation and flatulence
- CH_4 emissions from manure storage
- direct N_2O emissions from manure management when housed. Figures also include estimates on N_2O emissions from manure dropped on the land by livestock when grazing & N_2O emissions from manure collected then spread on the land.



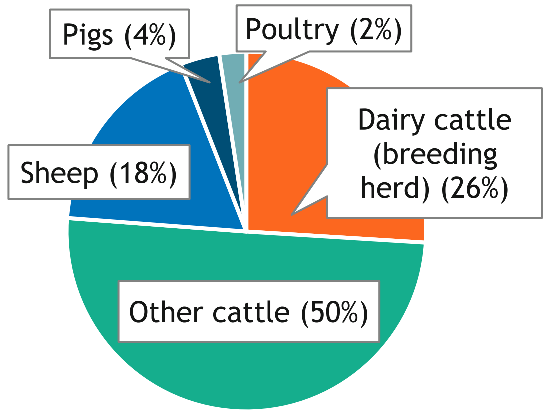


Figure 40 (top): Livestock emissions per local authority broken down by livestock type.

Figure 41 (left): Overall livestock emissions in Kent & Medway, broken down by livestock type.

Soil carbon & biomass emissions

Grassland and forests act as carbon sinks, storing a net total of 332,970 tCO_2 per year in Kent & Medway. Cropland and settlements are net sources of carbon, typically the result of land conversions in earlier years, but these can also be the result of the way soils are managed.

Forestry

Forestry in the UK as a whole is a net carbon sink, storing an average of 5.5 tCO_2 per hectare per year for existing woodland. Of this, about 1.3 tonnes are stored in the soil, 2.9 tonnes in trees, and 1.3 tonnes in dead wood and leaf litter. Applying this average to the total area of forestry in the Kent & Medway area would give net storage of about 247,599tCO_2 per year; compared to 367,374tCO_2 for Kent currently in the table to the right. Additional data on forest age and type would be needed to better estimate the actual contribution of current forestry to net emissions.

Carbon stocks by land use

Understanding existing carbon stocks can help prioritise areas for action – for conservation of existing stocks or for additions through land-use management or change. Carbon is stored in several “pools” – the key ones being soil and above-ground biomass (trees, crops and other plants). The balance of total carbon between these pools depends on the type of land – woodland stores relatively more carbon in above-ground biomass (trees) than cropland or grassland, for example.

Land type	tCO_2e
Grassland	-123,850
Forestland	-367,374
Settlements	95,003
Cropland	63,250
Total	-332,970

Figure 42 (left): Estimated soil and biomass gains and losses for Kent & Medway. Source: BEIS / CEH / Ricardo.

Figure 43 (below): Carbon stocks by land-use type. Adapted from Natural England, 2012 and Open University 2018. Carbon in soils to 100cm is extrapolated from 15cm using ratios calculated from Natural England 2012.

Habitat	tC per ha				tCO_2 per ha
	Soils (15cm)	Vegetation	Soils (100 cm)	Vegetation & Soils (100 cm)	Vegetation & Soils (100 cm)
Dwarf shrub heath	88	2	218	220	799
Coniferous woodland	90	70	185	255	935
Broadleaf, mixed woodland	73	70	150	220	808
Neutral grassland	69	1	130	170	628
Improved grasslands	67	1	116	117	431
Arable and horticulture	47	1	95	96	351

The maps opposite show an example of an estimate for soil carbon to a depth 15cm in the area in 1978 and 2007. The areas with higher carbon stocks correspond largely with areas designated within the Countryside Surveys as improved grassland (as carbon stocks are estimated using this designation).

Total soil carbon in the top 15cm for Kent & Medway (based on data from the maps opposite) is estimated to be 19.9 million tonnes of carbon (MtC), equivalent to 73.0 $MtCO_2$. Extrapolating this to a depth of 100 cm gives approximately 43.2 MtC stored, equivalent to 158.4 $MtCO_2$.

Above-ground carbon

Using the carbon stocks values and applying them to the broad land-types within the Crop Map of England gives an estimate of 332,970 tC stored in vegetation. The majority is within grassland, using an area of 140,356 ha.

Emissions reductions scenarios for agriculture & land use

The UK Committee on Climate Change (CCC) provides several scenarios for how changes in land-use and agriculture can contribute towards the UK's emissions reductions targets. These are set at low, medium and high ambitions. These represent business-as-usual, adoption of currently-available measures, and more radical and novel measures respectively. Only the medium and high ambition measures are considered here.

Dietary Change

This scenario includes a reduction in the national consumption of dairy, beef and lamb of 20% (medium) and 50% (high) by 2050. Some of this is replaced by increased consumption of pork and chicken. This is modelled here as a 20% or 50% reduction in cattle numbers, and the same reductions in grassland and associated fertiliser applications. Pig and chicken numbers increase by 20% under both ambition levels.
Grassland is reduced by 31,736ha and 79,357ha respectively in the medium and high scenarios. While more crops will be needed to replace some of the animal products, gains in productivity should mean little additional cropland is needed.

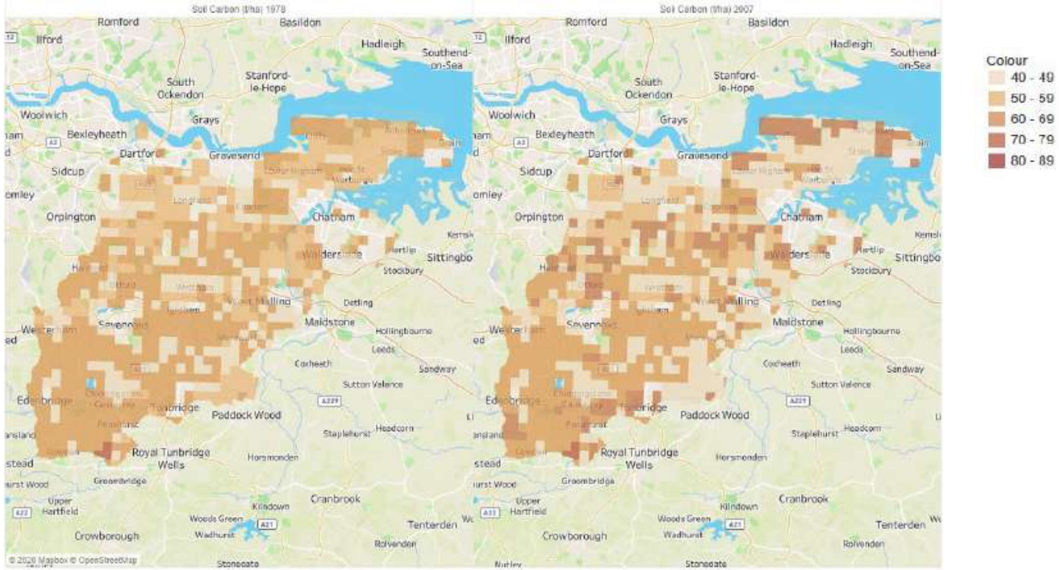


Figure 44: Estimated soil carbon stocks to 15cm based on land-cover type (land-use) and soil characteristics. Source: Countryside Surveys 2007 and 1978.

Afforestation

For this report, the equivalent area of grassland freed by dietary change is converted to woodland over the period to 2100. The forest management plan used by the CCC is followed – a mix of native broadleaved and conifer woodlands which are managed to provide some fuel and harvested wood products.
The grassland area is planted at a constant rate per year to the year 2100, equivalent to 397 hectares per year (medium) and 992 hectares per year (high). Grassland is assumed to be replaced by woodland to provide a simple scenario for the purposes of these calculations.[1]

Planting 31,736ha of woodland would significantly increase the existing area of woodland within Kent & Medway, from a current estimate of 45,018ha (an increase of around 70%).

Greenhouse gas emissions reductions

The table below shows average annual emissions reductions associated with these scenarios between now and 2100, modelled against the total emissions in Kent & Medway of 1.1 $MtCO_2e$.

With medium ambition the measures can reduce gross emissions across Kent & Medway by about 6%. With high ambition, emissions can be reduced by 15%.

	tCO2e, net emissions reductions per year		% of current gross emissions[3]	
Scenario	Medium	High	Medium	High
Dietary change (grassland) - change to 2100	-2,683	-6,708	-0.2%	-0.6%
Dietary change (livestock) - change by 2050	-29,864	-76,424	-3%	-7%
Dietary change (subtotal)	**-32,547**	**-83,131**	**-3%**	**-7%**
Planting woodland on saved land	-34,938	-85,600	-3%	-7%
Total	**-67,485**	**-168,732**	**-6%**	**-15%**

Figure 45: Emissions reductions from the two scenarios. 1. This is the average annual savings from the reductions in cattle and sheep and associated grassland use by 2050. 2. This is the average annual net carbon sequestration over the period to 2100 in biomass and soil. 3. Gross emissions are used here as the impact on current sequestration (and net emissions) is not known.

Engaging with agricultural businesses and rural land-owners could support the understanding of feasible options for maximising natural capital's carbon sequestration and emissions reduction capacity across Kent. Through industry networks, KCC could facilitate knowledge-sharing and identify opportunities for collaboration to support low carbon practices in the sector.

1 - The overall UK woodland mix is used here (using the published CCC numbers), which includes a much higher proportion of conifers than would normally be planted in England or Wales. This will likely overstate carbon storage as faster-growing conifers tend to store more carbon under the scenarios analysed. In practice, where and on what type of land woodland is planted depends on a variety of factors including the suitability of the land and the aim of providing connected habitats for biodiversity promotion.

06 2050 Summary

Anthesis

PROJECTED FUTURE PROFILE

By 2050, the emissions profile for Kent and Medway is predicted to change significantly under the high ambition pathway. Most notably, overall emissions are reduced by almost 90%, with the vast majority of residual emissions stemming from buildings.

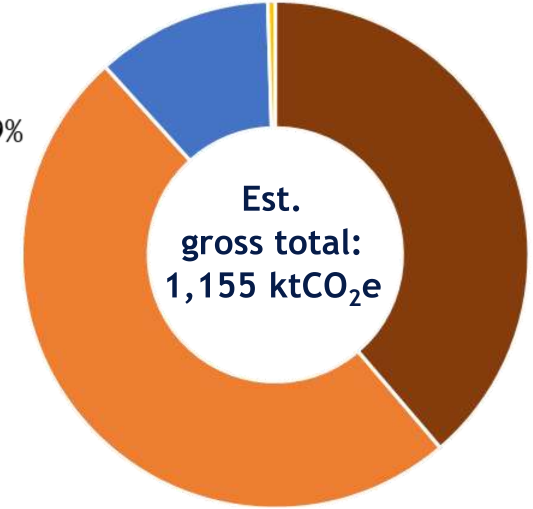
Even at the most ambitious pathway, Kent and Medway is not predicted to reach carbon neutrality by 2050.

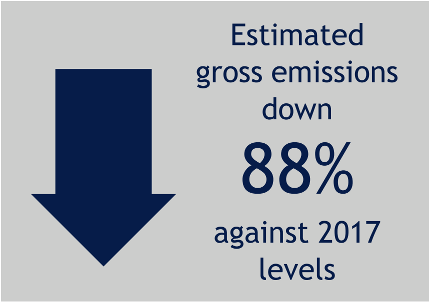
Tackling residual emissions – closing the gap to carbon neutrality

Despite the ambitious actions described, hard-to-remove emissions in industry, freight transport and domestic property persist. Whilst emissions are dramatically reduced through the High Ambition interventions, this is not enough to achieve net zero by 2050.

Further action and offsetting/insetting strategies are recommended as a means of addressing these residual emissions.

- Industry & Commercial - 39%
- Domestic - 50%
- Transport - 11%
- Waste - <0.5%





Reductions by sector at 2050:

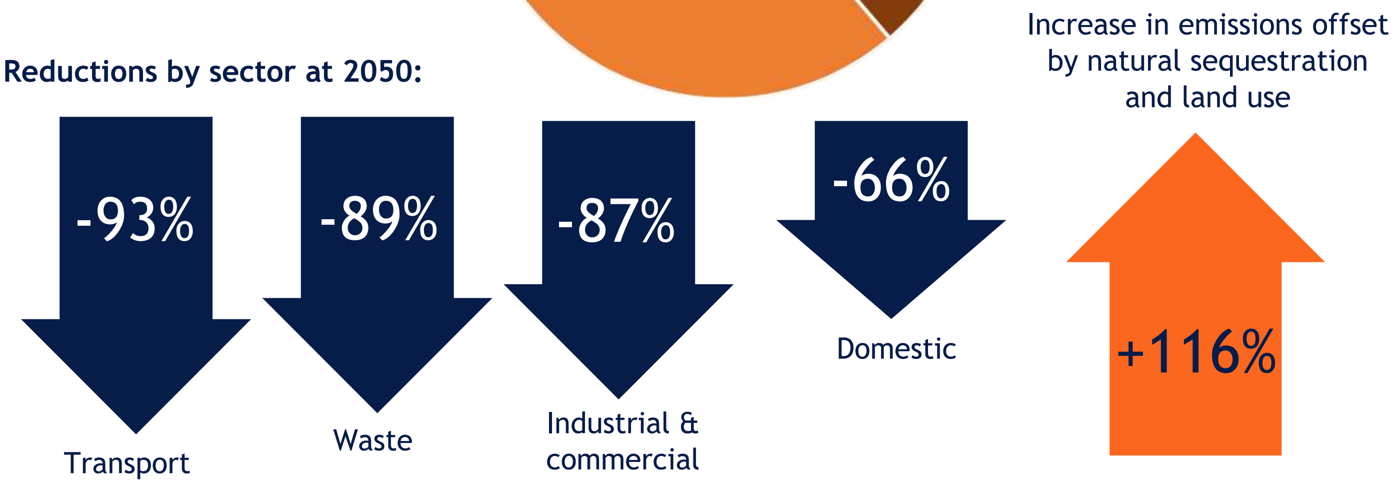


Fig 46: Estimated 2050 emissions profile (top). Emissions reductions in key sectors under the High Ambition Pathway (bottom).

SUMMARY OF INTERVENTIONS

Reaching High Ambition at 2050

The following tables describe the 2050 interventions required to adopt the High Ambition Pathway (green line) for Kent and Medway. All reductions are against a 2017 baseline except where stated otherwise:

Sector	Measure	2050 Intervention
Domestic buildings	More energy efficient homes & new builds	• 75,700 “medium” retrofit • 605,900 “deep” retrofit • 181,300 new builds to PassivHaus standard
Buildings	Reduced energy demand for heating, cooling & hot water	• Domestic: 43% reduction • Non-domestic: 40% reduction
	Reduced energy demand for appliances, lighting and cooking	• Domestic: 73% reduction • Non-domestic: 25% reduction
	Switching from gas heating systems	• Domestic: 100% of heating systems are electrified • Non-domestic: 80% of heating systems are electrified, remaining 20% supplied by CHP systems
	Shifting from gas to electric cookers	• Domestic: 84% increase in electric fuel usage for cooking • Non-domestic: 33% increase in electric fuel usage for cooking
Transport	Travelling shorter distances	• 25% reduction in the average number of passenger miles travelled per person
	Driving less	As a percentage of passenger mileage: • 10% active transport • 25% public transport • 65% private vehicle
	Switching to electric vehicles	• 100% of private vehicles, buses and trains are electric (though this transition is heavily frontloaded)
Freight transport	Improving freight emissions	• 28% increase in waterborne freight mileage • 22% decrease in road freight mileage • 75% decrease in energy used per mile travelled • 234% increase in fuel use at UK ports for *international* shipping

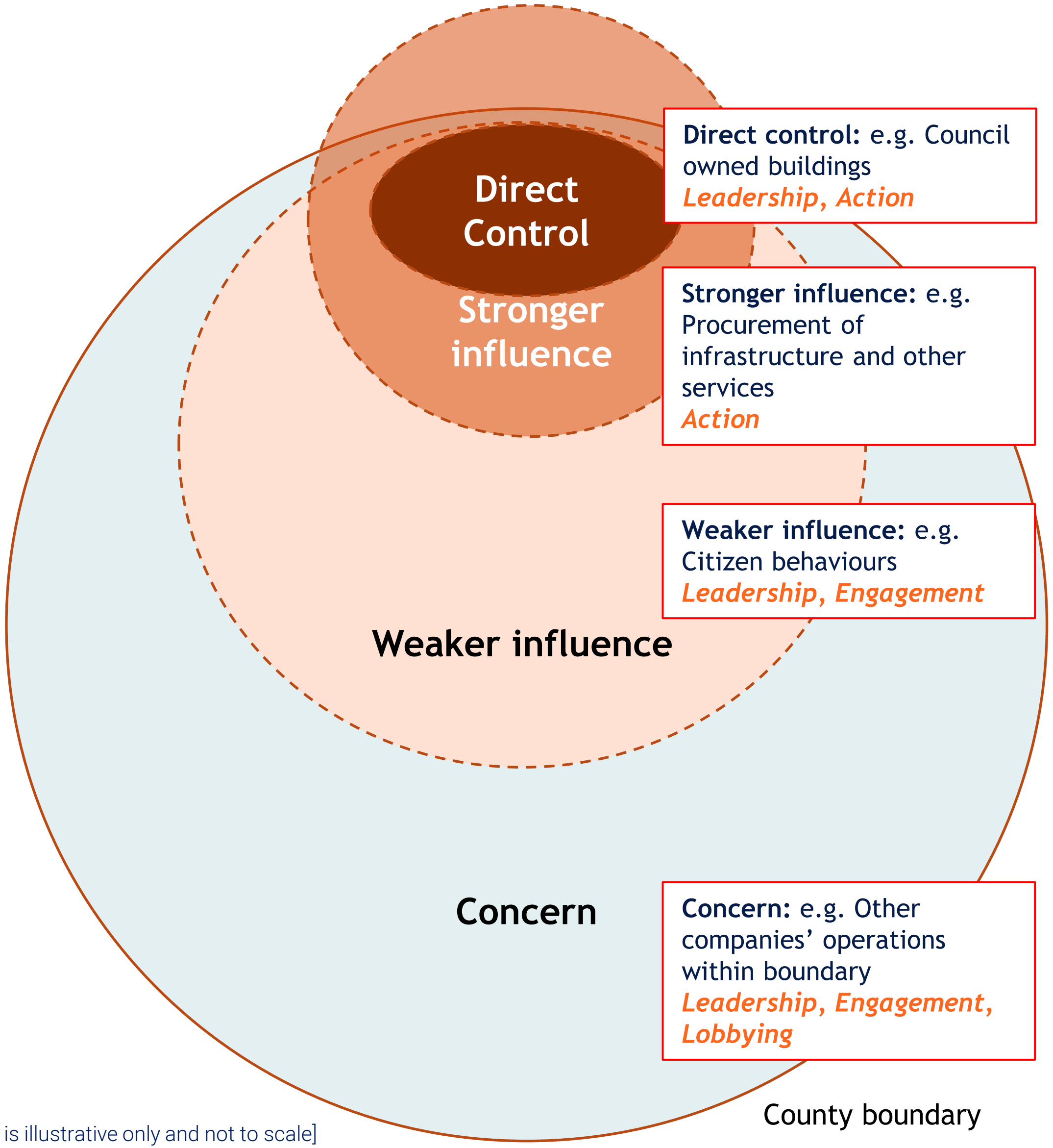
Sector	Measure	2050 Intervention
Waste	Producing less waste	• 57% reduction in the volume of waste
	Increased recycling rates	• 85% recycling rate
Industry	Switching from fossil fuels	• 15% reduction in oil fuel usage • 2% increase in electricity consumption • 38% increase in the use of natural gas
	More efficient processes	Process emissions reduced: • 30% for chemicals • 21% for metals • 25% for minerals • 80% for other industries
Renewable energy supply	Wind	• Local wind: 550 MW installed capacity • Large installations (on- and off-shore): 1,466 MW installed capacity
	Solar PV	• Local PV: 4,171 MW installed capacity • Large scale PV: 242 MW installed capacity
	Biomass	• Declining usage having displaced fossil fuel sources in power stations
	Other renewables	• Local hydro: 69 MW installed capacity • Large-scale hydro: 47 MW installed capacity
Agriculture & land use	Forest coverage & tree planting	• Increase in lone tree coverage to around 40 lone trees per hectare • 24% increase in forest coverage
	Land & livestock management	• 48% decrease in livestock numbers • 7% decrease in grassland; 1% decrease in cropland

CONCLUSIONS & NEXT STEPS

This report is intended to form the basis for deeper conversations and the development of an action plan to prioritise specific projects to implement within Kent & Medway in support of the county's net zero ambition. It is critical that key stakeholders are engaged throughout the process, as the council cannot achieve its goals without participation from these actors.

Suggested next steps

1. Define where the Council may influence different emissions sectors directly and indirectly, supported by the current emissions profile to highlight key sources of emissions.
2. Understand the council's ability to influence within each intervention area (e.g. lobbying, engagement, leadership, action) and identify and engage key external stakeholders such as businesses and the wider public.
3. Use this evidence base to enable discussion on challenges and opportunities across each sector.
4. Develop robust action plan and accountability structure to monitor progress.
5. Develop working groups and governance to share knowledge and best practice across the county.
6. Encourage collaboration within the county's districts and across other councils nationally to share best practice.



[Chart is illustrative only and not to scale]

09 Appendices

Anthesis

APPENDIX 1: DATA TABLES FOR SCATTER AND BEIS PROFILES

Sector	Scope 1 & 2 Emissions, $ktCO_2$
Industry and Commercial Electricity	1003.6
Industry and Commercial Gas	710.4
Large Industrial Installations	606.2
Industrial and Commercial Other Fuels	354.2
Agriculture	82.6
Domestic Electricity	771.0
Domestic Gas	1625.5
Domestic 'Other Fuels'	189.4
Road Transport (A roads)	1651.0
Road Transport (Motorways)	1393.3
Road Transport (Minor roads)	869.3
Diesel Railways	11.8
Transport Other	28.2
Gross Total	9296.7
LULUCF Net Emissions	-338.5
Grand Total	**8958.2**

Sub Sector	Direct, $ktCO_2e$	Indirect, $ktCO_2e$	Other, $ktCO_2e$
Residential buildings	1783.1	1074.0	494.7
Commercial buildings & facilities	218.5	148.2	63.9
Institutional buildings & facilities	408.5	748.9	182.5
Industrial buildings & facilities	353.5	434.1	133.3
Agriculture	54.8	0.0	13.1
Fugitive emissions	0.0	0.0	0.0
On-road	3281.0	IE	1042.4
Rail	13.3	IE	2.9
Waterborne navigation	181.0	IE	0.0
Aviation	9.8	NO	968.2
Off-road	32.8	IE	0.0
Solid waste disposal	50.8	0.0	0.0
Biological treatment	0.0	0.0	0.0
Incineration and open burning	0.0	0.0	0.0
Wastewater	114.2	0.0	0.0
Industrial process	189.4	0.0	0.0
Product use	0.0	0.0	0.0
Livestock	193.6	0.0	0.0
Land use	-333.0	0.0	0.0
Other AFOLU	0.0	0.0	0.0
Electricity-only generation	2300.3	0.0	351.0
CHP generation	12.7	0.0	2.3
Heat/cold generation	0.0	0.0	0.0
Local renewable generation	4.2	0.0	0.0
Sub-total	**8868.7**	**2405.2**	**3254.4**

Notes:

- BEIS data (far left) and SCATTER data (near left) 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.
- Land use emissions totals considers croplands, grasslands, forestland and settlements.
- According to GPC guidelines, emissions associated with in-boundary energy generation are not reported as part of the overall emissions profile but instead reported separately. The key justification for this is to avoid double-counting with Kent's indirect emissions, which also account for emissions associated with energy generation.

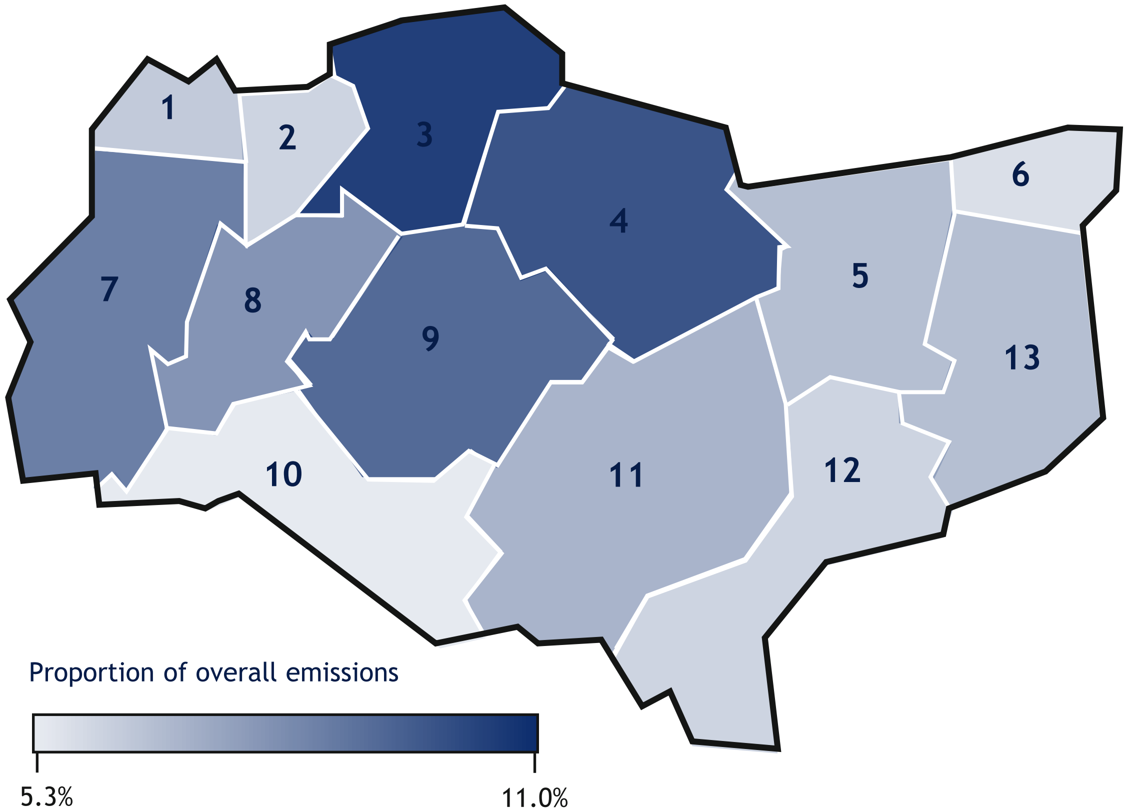
IE = Included Elsewhere
NE = Not Estimated
NO = Not Occurring
= Omitted/excluded in Figure 1
= Included in Figure 1

APPENDIX 2A: REGIONAL EMISSIONS MAP

The map opposite shows each local authority in the Kent county coloured by its percentage contribution to the **overall gross** emissions figure for the county. Darker shades of blue indicate local authorities with higher emissions. The sources of emissions included in this map are the same as described on page 9, i.e. emissions from energy generation and land use have been omitted.

Summary of key findings:

- No single local authority in Kent is responsible for more than 11.0% of total emissions excluding land use.
- The area responsible for the highest proportion is Medway, accounting for 10.94% of Kent's total gross emissions.
- The local authority responsible for the smallest contribution is Tunbridge Wells, closely followed by Gravesham (5.47% and 5.51% respectively).



Key

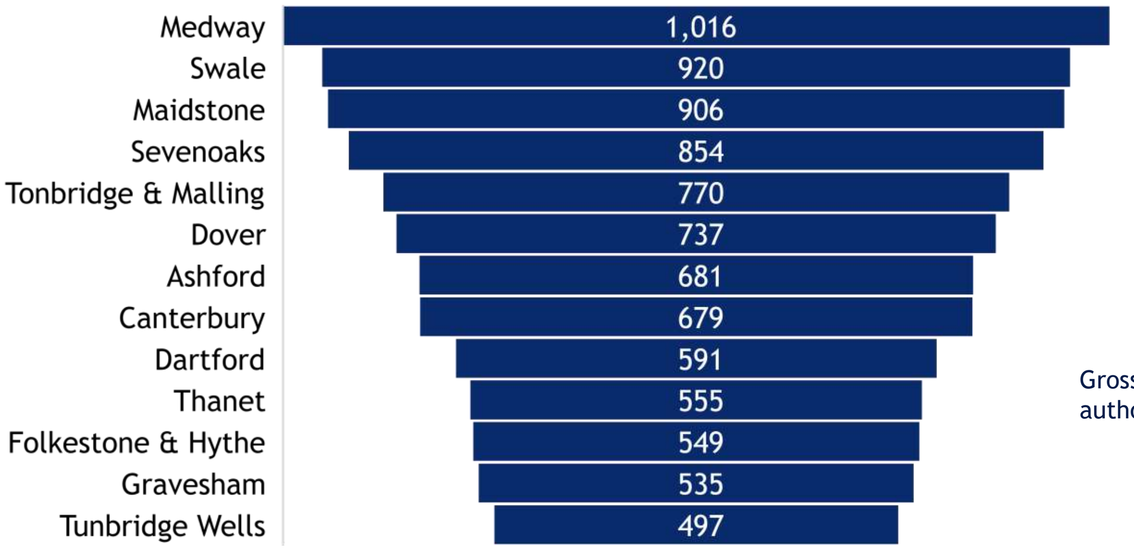
1 – Dartford
2 – Gravesham
3 – Medway
4 – Swale
5 – Canterbury
6 – Thanet
7 – Sevenoaks
8 – Tonbridge & Malling
9 – Maidstone
10 – Tunbridge Wells
11 – Ashford
12 – Folkestone & Hythe
13 - Dover

APPENDIX 2B: REGIONAL EMISSIONS DATA

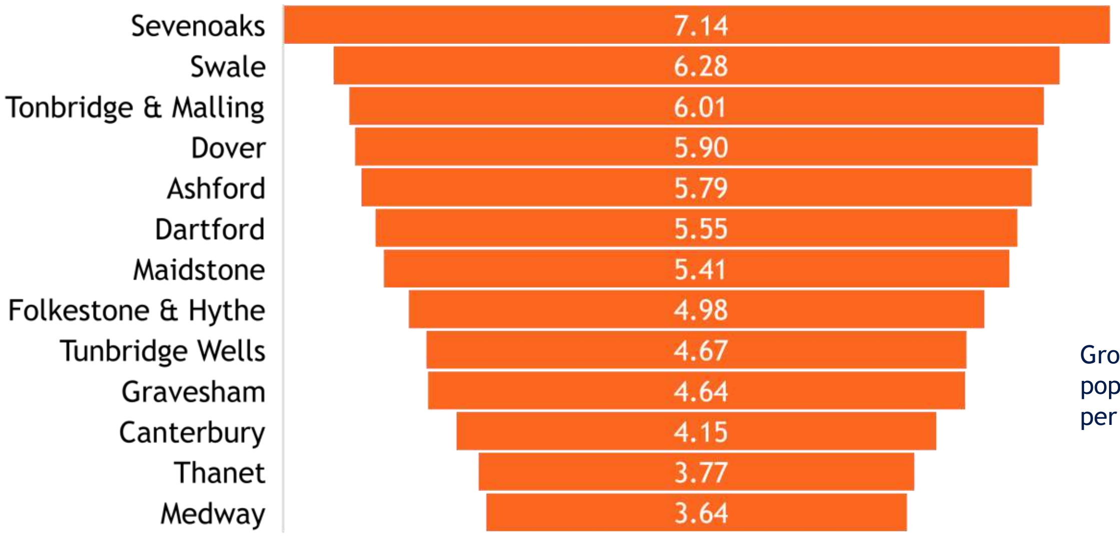
The two graphs opposite show the **gross emissions total** (top) and **emissions per capita** (bottom) for each local authority. Once again, the sources of emissions included in this map are the same as described on page 9, i.e. emissions from energy generation and land use have been omitted.

Summary of key findings:

- Medway accounts for the highest overall emissions out of all local authorities, but has the smallest per capita footprint.
- Thanet ranks 10th for overall emissions, and 12th for per capita footprint.
- Residents in Sevenoaks have a per capita footprint almost double that of Medway.
- Swale ranks 2nd in both overall emissions and per capita emissions.



Gross total emissions per local authority (in units of $ktCO_2e$).



Gross emissions per head of population (in units of tCO_2e per capita).

APPENDIX 3: SCATTER FAQ

What do the different emissions classifications mean within the SCATTER Inventory?

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). This includes the electricity supplied to power trains.

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

Note that the categories may not sum to 100% due to rounding.

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

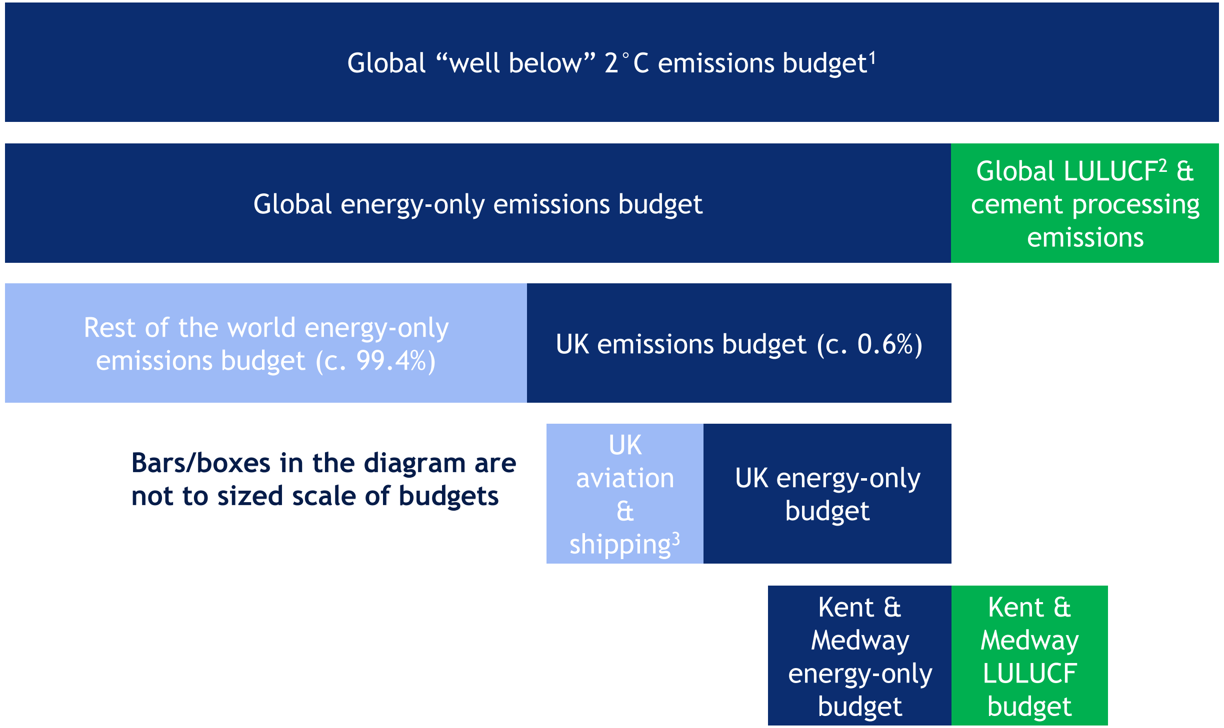
- **The Direct Emissions Summary and Subsector categories** are aligned to the the World Resource Institute's Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC), as accepted by CDP and the Global Covenant of Mayors.
- **The BEIS Local Emissions Summary** represents Local Authority level data published annually by the Department for Business Energy & Industrial Strategy (BEIS).
- **Stationary energy** emissions are derived from energy consumption statistics (specifically the ECUK Data Tables) and total fuel consumption data published by BEIS.
- **Transport** emissions are derived from BEIS datasets for energy consumption. A top-down method is adopted for these figures – more guidance is available in the GPC protocol guidelines. **Waterborne navigation & direct aviation emissions** relate to trips that occur within the region. The figures are derived based on national data (National Atmospheric Emissions Inventory (NAEI), Civil Aviation Authority & Department for Transport) and scaled to Kent.
- **Waste** emissions are sourced from DEFRA statistics for waste generation and an allocation to different waste streams. **Industrial** emissions are apportioned to each local authority from BEIS and DUKES datasets.
- **Livestock and land use** estimates within SCATTER are based from DEFRA statistics for livestock numbers and NAEI emissions factors.

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.

The full methodology is available at http://SCATTERcities.com/pages/methodology

APPENDIX 4: DERIVING THE CARBON BUDGET



Kent & Medway’s Budget

The carbon budget (57,700 ktCO_2 for the period 2020-2100) sets out a finite emissions limit that the should not be exceeded in order that Kent 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 full print version of the Tyndall Centre’s research.
The Tyndall Centre for Climate Change Research have based this budget on a 2°C global average temperature rise, on the basis that:

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

Negative Emissions Technologies (NETs)

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

1 - Budget derived from IPCC AR5 synthesis report and represents a 66-100% probability of global warming not exceeding 2°C (“well below”). Due to the inertia in our energy systems and the amount of carbon we have already emitted, the Paris 1.5°C commitment is now only likely to be viable if negative emissions technologies (NETs) prove to be successful at a global scale. If the 13.3% emissions reduction rates for Kent & Medway are achieved and NETs are deployed at the scales assumed in the global models, then the targets adopted may be considered as a 1.5°C compatible. This also expressly assumes that other carbon cycle feedbacks, such as methane released due to melting permafrost etc., do not occur, and that an overshoot of 1.5°C does not result in increased feedbacks that further accelerate warming at lower budgets than the IPCC budgets currently estimate.
2 - Land Use, Land Use Change & Forestry
3 - UK Aviation & Shipping is accounted for at the national level. If emissions due to aviation and shipping increases, then a smaller proportion of the UK-wide budget is available for the energy-only budget and vice versa.

APPENDIX 5: INTERVENTION MODIFICATIONS SUMMARY

Measure	Updated from original Pathways Calculator?
Energy generation & storage	
Onshore wind	No (N)
Biomass power stations	Yes (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
Domestic buildings	
Average temperature of homes	N
Home insulation	Y
Home heating electrification	Y

APPENDIX 6: EPC RANKING METHODOLOGY

Ranking EPCs

Kent's districts were ranked according to their EPC rating profiles using the following method:

- All EPCs between 2010 and 2019 were collated to provide a proportional value for each letter rating per local authority. This process was repeated for the EPC profile for England and Wales.
- The percentage point deviation from the national average was then calculated for each local authority.
- In the first column, higher proportions of ABC-rated properties (positive deviation) are favourable and are coloured on a green-red scale. In the second column, lower proportions of EFG-rated properties (negative deviation) are favourable and are coloured on a green-red scale. In both columns, green shades indicate positive performance and red shades indicate negative performance.
- The differential between the ABC and EFG ratings was then calculated, giving a single number from which to rank each local authority relative to one another and the national average.

	Proportion of EPCs which are rated...	
Local authority	ABC	EFG
Ashford	46.27%	18.18%
Canterbury	39.48%	20.35%
Dartford	51.01%	15.05%
Dover	35.01%	23.53%
Folkestone & Hythe	35.39%	24.74%
Gravesham	36.07%	21.72%
Maidstone	44.78%	18.58%
Medway	38.02%	18.46%
Sevenoaks	33.61%	26.51%
Swale	39.43%	19.90%
Thanet	36.63%	21.91%
Tonbridge & Malling	44.10%	18.73%
Tunbridge Wells	35.07%	27.42%
Kent total	39.55%	20.84%
England & Wales	**38.04%**	**22.10%**

	Deviation from national average		
	ABC	EFG	Differential
Ashford	8.23%	-3.93%	12.15%
Canterbury	1.44%	-1.76%	3.20%
Dartford	12.97%	-7.05%	20.02%
Dover	-3.03%	1.43%	-4.46%
Folkestone & Hythe	-2.65%	2.64%	-5.28%
Gravesham	-1.97%	-0.38%	-1.59%
Maidstone	6.74%	-3.52%	10.26%
Medway	-0.03%	-3.64%	3.61%
Sevenoaks	-4.43%	4.41%	-8.84%
Swale	1.39%	-2.20%	3.58%
Thanet	-1.41%	-0.19%	-1.22%
Tonbridge & Malling	6.06%	-3.37%	9.43%
Tunbridge Wells	-2.97%	5.32%	-8.29%
Kent total	1.51%	-1.26%	2.77%

APPENDIX 7A: ALU DATA TABLES

The tables opposite describe land uses across the different Kent & Medway local authorities. The upper table describes these in terms of hectares (ha) and the lower table describes the same data as a percentage proportion for each LA.

Land Use (ha)	Ashford	Canterbury	Dartford	Dover	Gravesham	Maidstone	Medway	Sevenoaks	Folkestone & Hythe	Swale	Thanet	Tonbridge & Malling	Tunbridge Wells	Total
Arable	18,107	10,095	1,606	13,693	2,842	12,796	3,900	8,319	14,653	12,988	4,390	6,499	7,183	**117,071**
Non-agricultural land	4,146	3,854	2,386	3,094	2,122	5,233	5,221	3,926	3,624	4,323	2,653	3,998	3,307	**47,888**
Legumes / nitrogen fixing	2,565	669	43	667	124	1,060	264	398	1,725	1,021	221	465	853	**10,075**
Fallow land	1,452	1,217	360	922	244	1,212	920	617	853	1,276	595	679	728	**11,076**
Heathland	-	-	-	2	-	0	-	1	0	-	3	1	-	**7**
Permanent Grassland	24,669	9,657	1,983	10,925	3,154	14,899	6,736	16,576	12,595	14,515	2,165	8,307	14,174	**140,356**
Woodland	7,091	5,043	871	2,176	1,390	4,113	1,691	7,041	1,973	2,545	256	3,957	6,870	**45,018**
Water	32	354	26	28	26	19	621	156	253	779	52	105	17	**2,469**
Total	58,062	30,888	7,276	31,507	9,902	39,333	19,354	37,035	35,676	37,447	10,334	24,013	33,133	373,960

Land Use (% of total, per LA)	Ashford	Canterbury	Dartford	Dover	Gravesham	Maidstone	Medway	Sevenoaks	Folkestone & Hythe	Swale	Thanet	Tonbridge & Malling	Tunbridge Wells	Total
Arable	31%	33%	22%	43%	29%	33%	20%	22%	41%	35%	42%	27%	22%	31%
Non-agricultural land	7%	12%	33%	10%	21%	13%	27%	11%	10%	12%	26%	17%	10%	13%
Legumes / nitrogen fixing	4%	2%	1%	2%	1%	3%	1%	1%	5%	3%	2%	2%	3%	3%
Fallow land	3%	4%	5%	3%	2%	3%	5%	2%	2%	3%	6%	3%	2%	3%
Heathland	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Permanent Grassland	42%	31%	27%	35%	32%	38%	35%	45%	35%	39%	21%	35%	43%	38%
Woodland	12%	16%	12%	7%	14%	10%	9%	19%	6%	7%	2%	16%	21%	12%
Water	0%	1%	0%	0%	0%	0%	3%	0%	1%	2%	1%	0%	0%	1%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

APPENDIX 7B: ALU DATA TABLES

Emissions (tCO_2e)	Ashford	Canterbury	Dartford	Dover	Gravesham	Maidstone	Medway	Sevenoaks	Folkestone & Hythe	Swale	Thanet	Tonbridge & Malling	Tunbridge Wells	Total
Livestock (methane and direct emissions from manure management)[1]	46,210	14,829	1,237	19,158	1,684	17,175	5,876	24,803	17,696	15,553	3,239	5,864	22,178	195,501
Land (nitrous oxide from manure and fertiliser added to land) [2]	20,572	10,260	1,486	12,760	2,879	11,217	4,411	9,520	16,752	14,419	4,119	5,932	8,704	123,032
Gross emissions	**66,782**	**25,089**	**2,724**	**31,919**	**4,563**	**28,392**	**10,286**	**34,323**	**34,448**	**29,972**	**7,358**	**11,796**	**30,882**	**318,533**
Land - carbon changes in soil and biomass[3]	-66,905	-25,628	-4,718	-12,716	-6,738	-40,623	-9,734	-42,613	-24,520	-19,859	1,137	-24,553	-55,501	-332,970
Net emissions	**-122**	**-539**	**-1,995**	**19,203**	**-2,175**	**-12,231**	**552**	**-8,290**	**9,927**	**10,113**	**8,495**	**-12,756**	**-24,619**	**-14,438**

Notes

Emissions from agriculture and land across Kent & Medway.

1. Methane from enteric fermentation and manure management, plus nitrous oxide from direct manure management.
2. Nitrous oxide emissions from fertiliser (including manure) application to land.
3. Net carbon sequestration, taken from “UK local authority and regional carbon dioxide emissions national statistics.” The statistics report does not provide any detail on what this is, but it may come from soil carbon returning to equilibrium following historic changes e.g. afforestation, deforestation / conversion to cropland or grassland.

The estimated figures for livestock numbers & emissions are based of the Department for Environment Food & Rural Affairs: Local Authority breakdown for key crops areas and livestock numbers on agricultural holdings for 2013-2016

APPENDIX 7C: ALU DATA TABLES

The tables opposite describe livestock numbers and the associated emissions across the different Kent & Medway local authorities. The estimate for N_2O emissions for

- Manure dropped on land by livestock was 2-6% for cattle, 60% for poultry
- Manure spread on land was 7-10% for cattle and up to >100% for poultry.

Livestock numbers	Ashford	Canterbury	Dartford	Dover	Gravesham	Maidstone	Medway	Sevenoaks	Folkestone & Hythe	Swale	Thanet	Tonbridge & Malling	Tunbridge Wells	Total
Dairy Cattle (breeding herd)	874	874	84	1,264	114	932	152	1,650	753	895	218	357	1,043	**9,209**
Other cattle	3,901	3,901	375	5,644	510	4,159	2,077	7,365	3,361	3,995	973	1,593	4,654	**42,510**
Sheep	15,618	15,618	750	12,547	1,021	33,108	8,649	18,969	56,795	21,530	2,094	4,320	31,934	**222,953**
Pigs	2,430	2,430	52	1,665	71	926	14	678	311	1,701	90	1,295	2,580	**14,244**
Poultry	86,468	86,468	495	17,408	673	33,470	908	55,515	49,792	68,657	14,423	14,112	1,491,828	**1,920,218**
Total	109,292	109,292	1,756	38,528	2,390	72,594	11,800	84,176	111,012	96,778	17,798	21,677	1,532,039	2,209,134

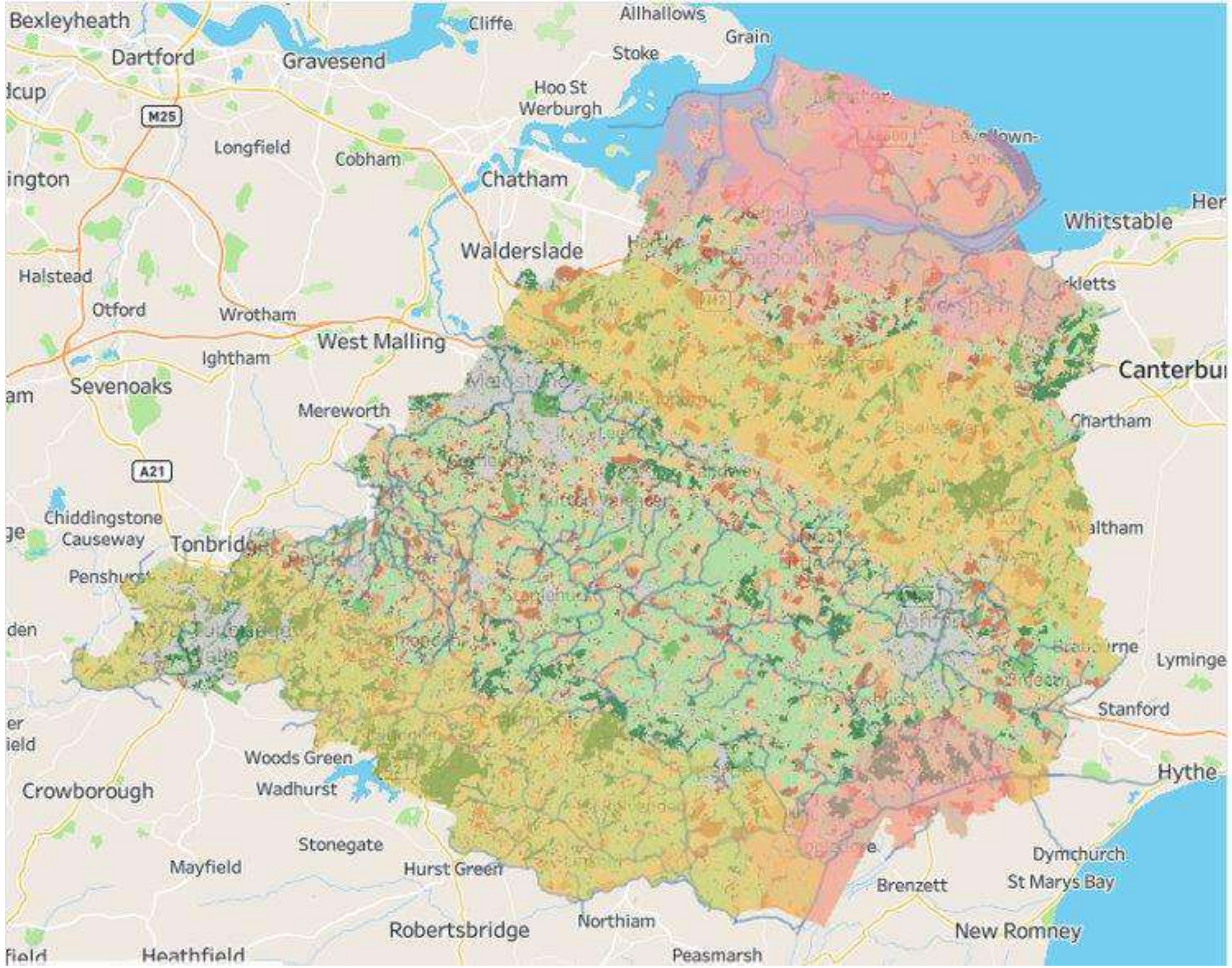
Emissions, tCO_2e														Total
Dairy Cattle (breeding herd)	4,046	4,046	389	5,854	529	4,314	705	7,639	3,486	4,144	1,010	1,652	4,828	**42,643**
Other cattle	7,564	7,564	727	10,942	990	8,064	4,027	14,280	6,516	7,746	1,887	3,089	9,024	**82,420**
Sheep	2,053	2,053	99	1,649	134	4,352	1,137	2,493	7,465	2,830	275	568	4,197	**29,304**
Pigs	988	988	21	677	29	376	6	275	126	691	37	526	1,048	**5,788**
Poultry	179	179	1	36	1	69	2	115	103	142	30	29	3,081	**3,965**
Total	14,829	14,829	1,237	19,158	1,684	17,175	5,876	24,803	17,696	15,553	3,239	5,864	22,178	164,120

Livestock type	Emissions per head of livestock (tCO_2e)
Dairy Cattle (breeding herd)	4.63
Other cattle	1.94
Sheep	0.13
Pigs	0.41
Poultry	<0.01

APPENDIX 8A: REGIONAL LAND USE

Ashford, Maidstone, Swale & Tunbridge Wells

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

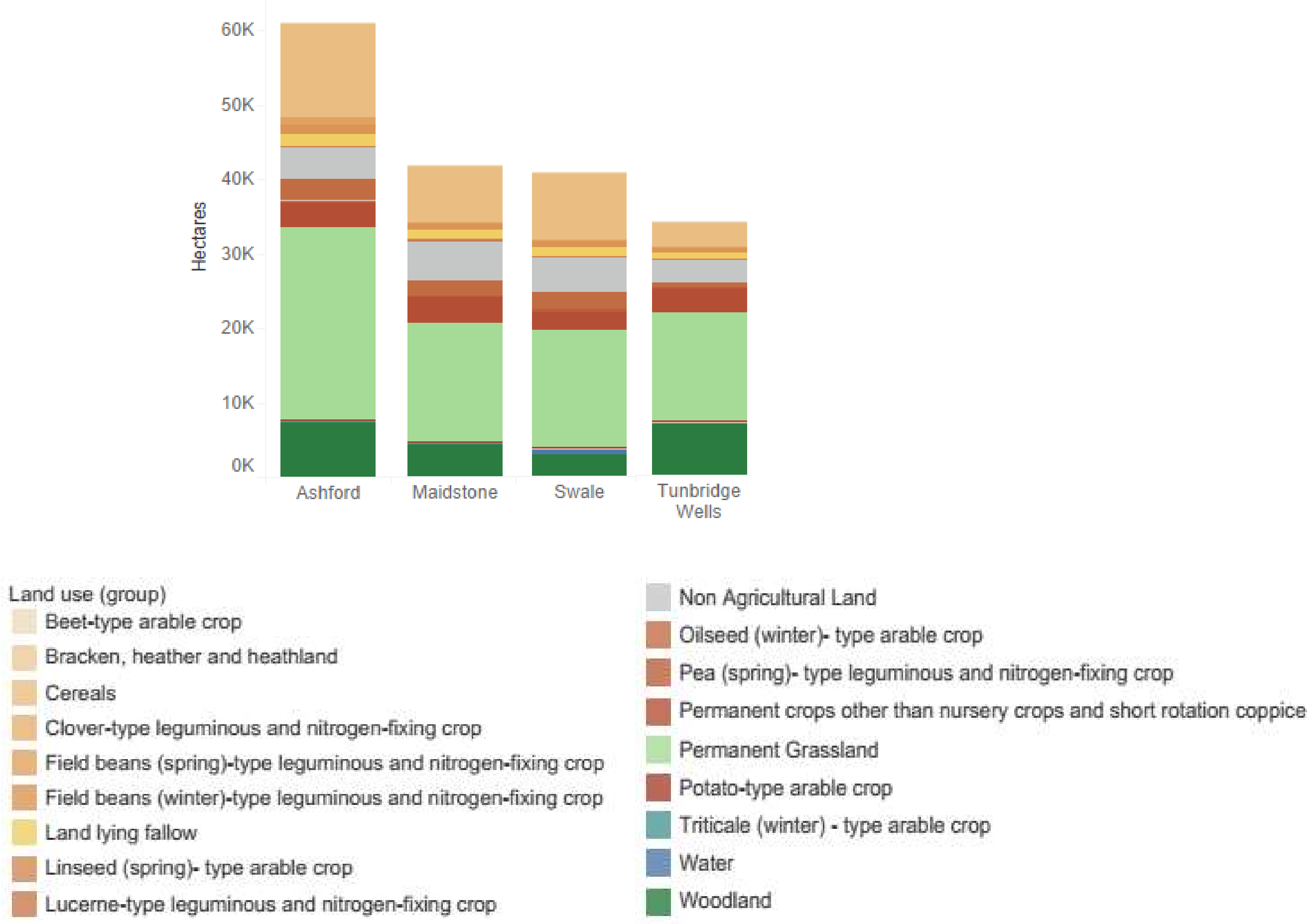


APPENDIX 8B: REGIONAL LAND USE

Ashford, Maidstone, Swale & Tunbridge Wells

The chart to the right explores land use types across Ashford, Maidstone, Swale and Tunbridge Wells.

Land Use	Ashford	Maidstone	Swale	Tunbridge Wells
Arable	18,107	12,796	12,988	7,183
Non-agricultural land	4,146	5,233	4,323	3,307
Legumes / nitrogen fixing	2,565	1,060	1,021	853
Fallow land	1,452	1,212	1,276	728
Heathland	-	0	-	-
Permanent Grassland	24,669	14,899	14,515	14,174
Woodland	7,091	4,113	2,545	6,870
Water	32	19	779	17
Total	**58,062**	**39,333**	**37,447**	**33,133**

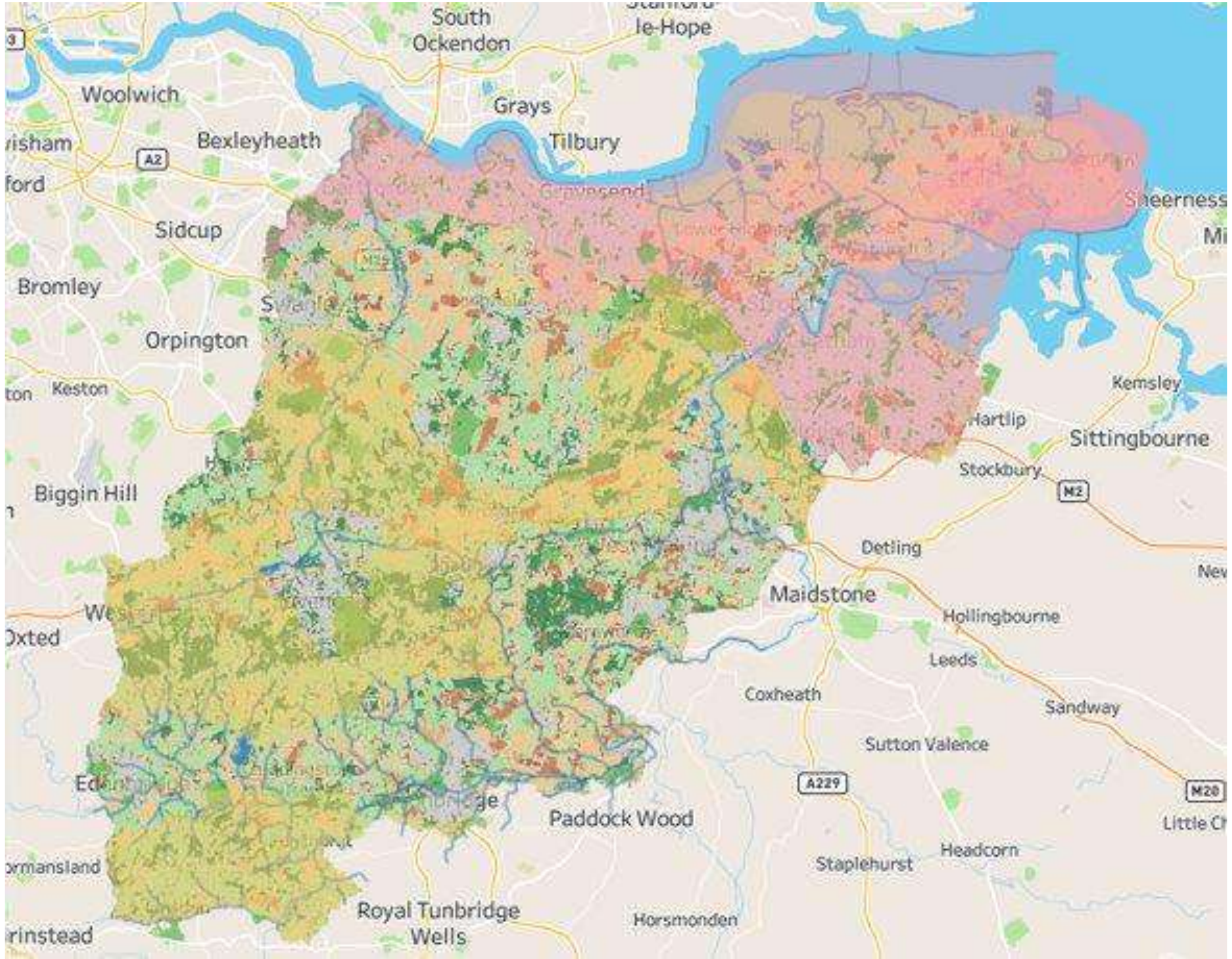


APPENDIX 8C: REGIONAL LAND USE

Dartford, Gravesham, Medway, Sevenoaks, Tonbridge & Malling

Land use (group)

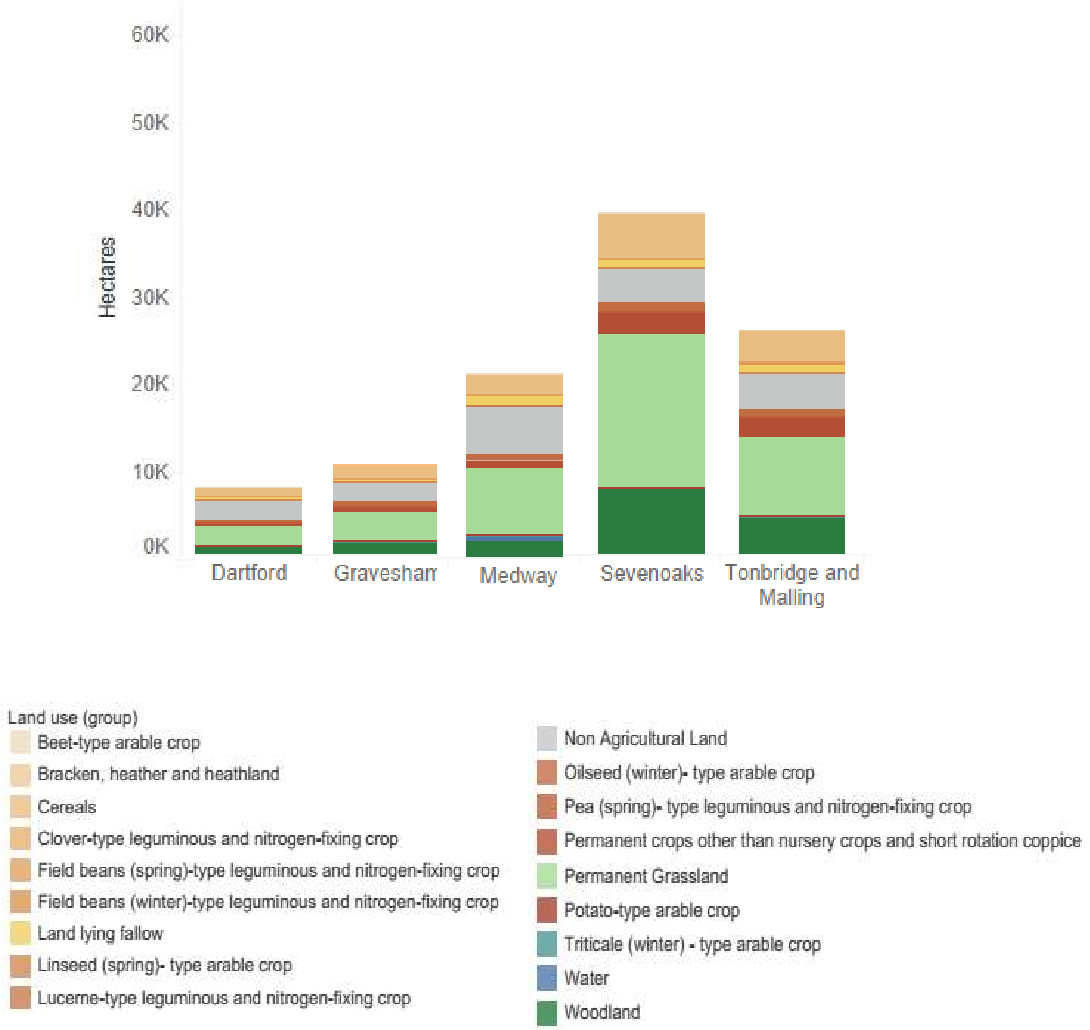
- Beet-type arable crop
- Bracken, heather and heathland
- Cereals
- Clover-type leguminous and nitrogen-fixing crop
- Field beans (spring)-type leguminous and nitrogen-fixing crop
- Field beans (winter)-type leguminous and nitrogen-fixing crop
- Land lying fallow
- Linseed (spring)- type arable crop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



APPENDIX 8D: REGIONAL LAND USE

Dartford, Gravesham, Medway, Sevenoaks, Tonbridge & Malling

Land Use	Dartford	Gravesham	Medway	Sevenoaks	Tonbridge & Malling
Arable	1,606	2,842	3,900	8,319	6,499
Non-agricultural land	2,386	2,122	5,221	3,926	3,998
Legumes / nitrogen fixing	43	124	264	398	465
Fallow land	360	244	920	617	679
Heathland	-	-	-	10	1
Permanent Grassland	1,983	3,154	6,736	16,576	8,307
Woodland	871	1,390	1,691	7,041	3,957
Water	26	26	621	156	105
Total	**7,276**	**9,902**	**19,354**	**37,035**	**24,013**



APPENDIX 8E: REGIONAL LAND USE

Canterbury, Dover, Shepway & Thanet

NB: Shepway District Council's name was changed in 2018 to Folkstone & Hythe District Council, however the old name remains as BEIS agricultural data sets used in this analysis have not reflected this name change.

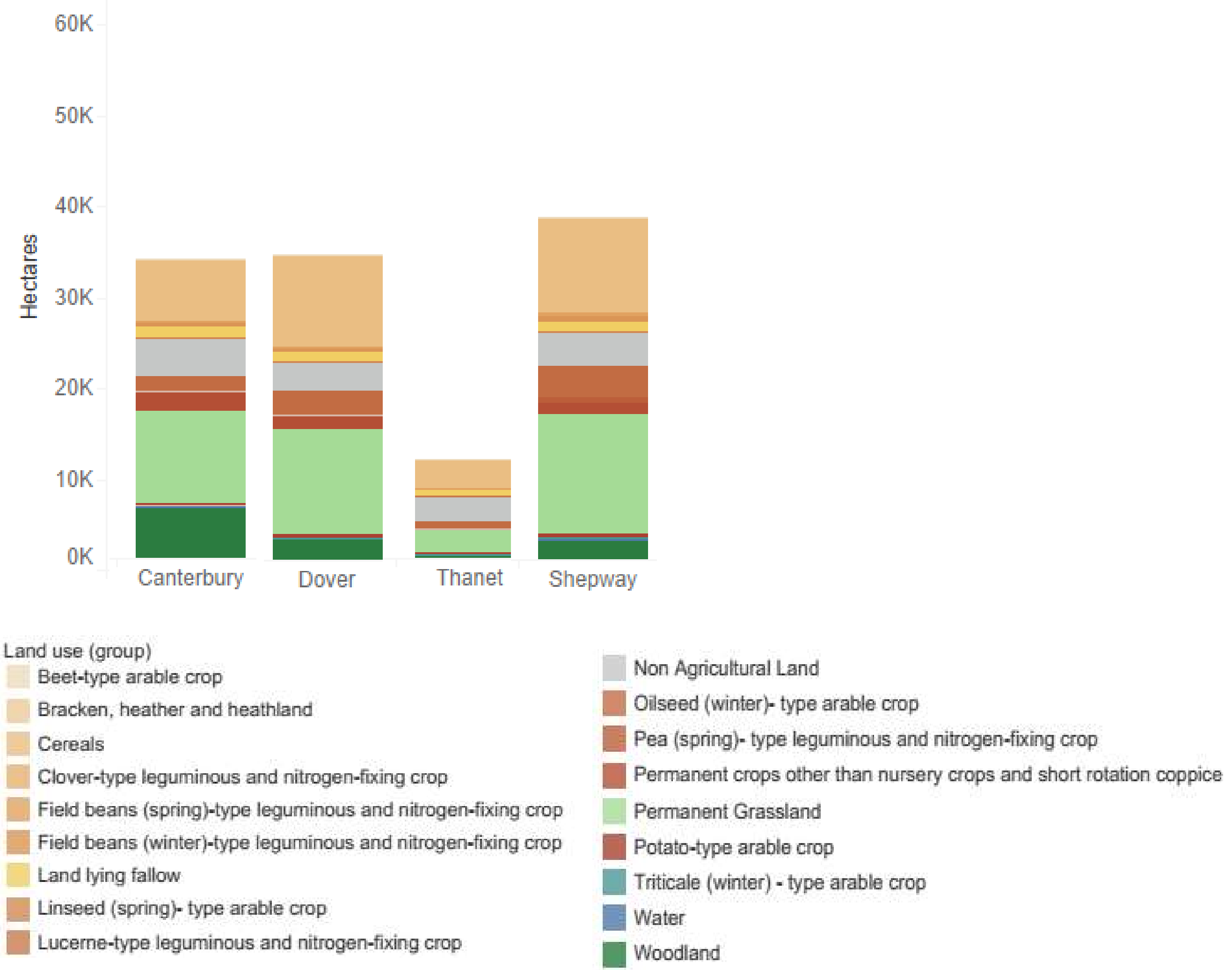
Land use (group)

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

APPENDIX 8F: REGIONAL LAND USE

Canterbury, Dover, Shepway & Thanet

Land Use	Canterbury	Dover	Shepway	Thanet
Arable	10,095	13,693	14,653	4,390
Non-agricultural land	3,854	3,094	3,624	2,653
Legumes / nitrogen fixing	669	667	1,725	221
Fallow land	1,217	922	853	595
Heathland	-	2	0.4	3
Permanent Grassland	9,657	10,925	12,595	2,165
Woodland	5,043	2,176	1,973	256
Water	354	28	253	52
Total	**30,888**	**31,507**	**35,676**	**10,334**



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