Crawley Borough Council

Climate Emergency Support

June 2020

Anthesis

Foreword from Crawley Borough Council

In July 2019, Crawley Borough Council declared a climate emergency and made a commitment to reduce emissions from our activities by at least 45% by 2030 and to net zero by 2050, in line with the UK's national target.

In order to develop a Climate Emergency action plan, Crawley Borough Council's first task was to undertake a new baseline carbon audit to understand the current emissions from our workings and activities. The Council also sought to understand the carbon footprint of the borough as a whole to determine what proportion of emissions we are responsible for and what influence we could have more widely.

Crawley Borough Council commissioned Anthesis to help with this work and produce this 'Climate Emergency Support' evidence base. It sets out the scale of change needed to meet our own carbon reduction targets as a Council, and models possible carbon emission reduction pathways for the borough as a whole in order to help us plan our own Climate Emergency response.

Anthesis used the SCATTER tool to test different portfolios of interventions to illustrate the potential to decarbonise buildings, transport, waste and industry and generate renewable energy across the borough. SCATTER - which stands for Setting City Area Targets and Trajectories for Emissions Reduction – is an interactive tool funded by BEIS that uses a wide range of national and local public data sets to help local authorities understand and report on area-wide greenhouse gas emissions. It allows local authorities to explore different greenhouse gas reduction actions and enables the creation of carbon reduction scenarios from which to develop their climate action plans.

All the information in this report, including the carbon reduction pathways, is intended to serve as one of many information sources to help Crawley Borough Council decide on our own priority actions necessary to reduce our own carbon emissions. These will be presented in a draft action plan. It will also help support the ability for Crawley Borough Council to develop future policy to influence the reduction of carbon emissions more broadly in the borough.

Note: The data and analysis in this report is pre-COVID 19.

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Introduction & Context

Introduction

In July 2019, Crawley Borough Council declared a climate emergency and made a public commitment to aim to reduce emissions from its activities by at least 45% by 2030 and to zero by 2050, in line with UK's national target.

Crawley Borough Council … resolves to:

1. Declare a Climate Emergency
2. Pledge to aim to reduce carbon emissions generated by Crawley Borough Council activities by at least 45% by 2030 and to zero by 2050 as recommended by the Inter-governmental Panel on Climate Change (IPCC).
3. Call upon central government to provide the powers and resources to make these targets possible.
4. Work with other councils and partners to determine and implement best practice methods to reduce carbon emissions and so limit Global Heating to less than 1.5 degrees Celsius.
5. Request that the Overview and Scrutiny Commission (OSC) urgently sets up a Scrutiny Panel to look into and make recommendations focusing upon the workings and activities of Crawley Borough Council relating to carbon emissions and to report to Council as soon as is practicable. Council further requests that OSC co-opts a member or members of the Youth Council to the Scrutiny Panel.
6. Request that the Head of Corporate Finance will undertake a review of the ethical investment policy in the Treasury Management Strategy with a view to incorporating the Council's climate change declaration.
7. Encourage all Crawley residents to commit to the West Sussex County Council Climate Pledge published in May 2019.

This work is being commissioned by Crawley Borough Council in order to respond to the above motion.

This body of work seeks to provide an evidence base to support Crawley Borough Council in their response to the Climate Emergency, by outlining the current emissions profile of the council and the borough and understanding the scale of change needed to meet their 2050 net zero carbon ambition.

Objectives

To better understand:

- the borough's carbon footprint using a location-based accounting approach;
- the use of this information to determine the proportion of emissions that can be influenced locally without the action of regional or national actors;
- the current emissions profile for the council's direct and indirect operations;
- gaps in data where further work is needed; and
- possible emission reduction pathways to 2050 across the borough's energy system.

To aid Crawley Borough Council in the following areas:

- providing a more informed evidence base for future action plan development which also serves to inform and direct existing local projects;
- encourage confidence in the mandate for climate action, thus facilitating the establishment of a robust local strategy which can deliver objectives over a long term cycle.

Introduction & Context

Context

The full council resolution came about as a response to the Intergovernmental Panel on Climate Change (IPCC) special report on the impacts of global warming of 1.5 °C above pre-industrial levels, issued in October 2018. The report stated that in order to remain within a 1.5 °C increase, governments would have to cut emissions of greenhouse gases by 45% by 2030.

The UN Environment Programme then published their 2019 Emissions Gap Report, which found that the Nationally Determined Contributions (NDCs) were insufficient to ensure that global temperature rises stays below 1.5 °C, and that nations must triple their efforts in order to meet even a 2 °C target. It also found that global emissions had risen in 2018 after a period of stability between 2014 and 2016.

A key finding of the report is 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.'

Research by the Global Carbon Project issued in December 2018 reported that global carbon emissions are on course to rise by a further 2.7% in 2018, an increase on the rise seen in 2017. In November 2019, the World Meteorological Organization reported that during 2018 concentrations of CO_2 peaked at 407.8 parts per million – a level last seen 3 million years ago when average global temperatures were 2-3°C warmer.

The Climate Change Act 2008 introduced a legally binding target for the UK to reduce greenhouse gases by 80% by 2050 against a 1990 baseline. In June 2019 the UK Prime Minister announced a revised target - the UK will cut emissions to net zero by 2050 (relative to the 1990 baseline).

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

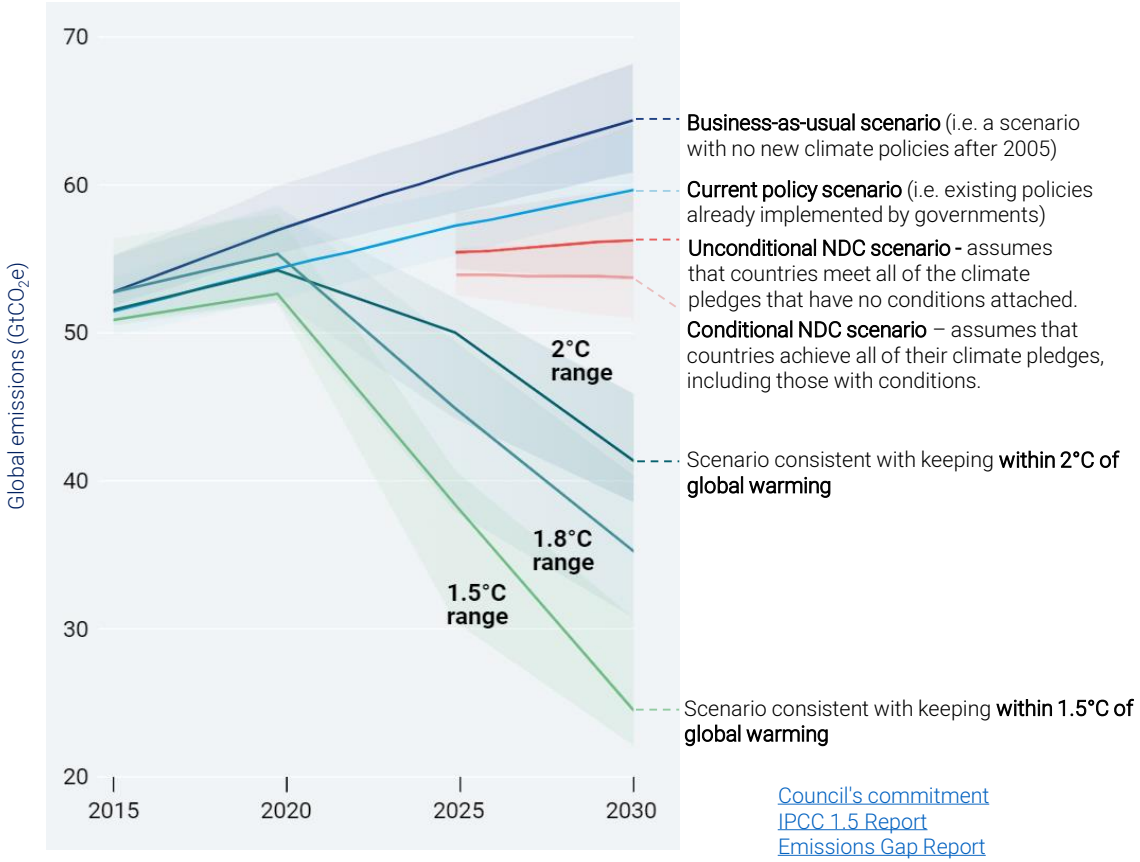


Chart showing possible global emissions scenarios for 2015-2050
Source: UN environment programme interactive Emissions Gap Report

Council's commitment
IPCC 1.5 Report
Emissions Gap Report
Global Carbon Project research
WMO publication

1 - The 2005 policies scenario projects global emissions assuming no new climate policies are put in place from around 2005 onwards, based on the Kyoto Protocol Agreement (2005).

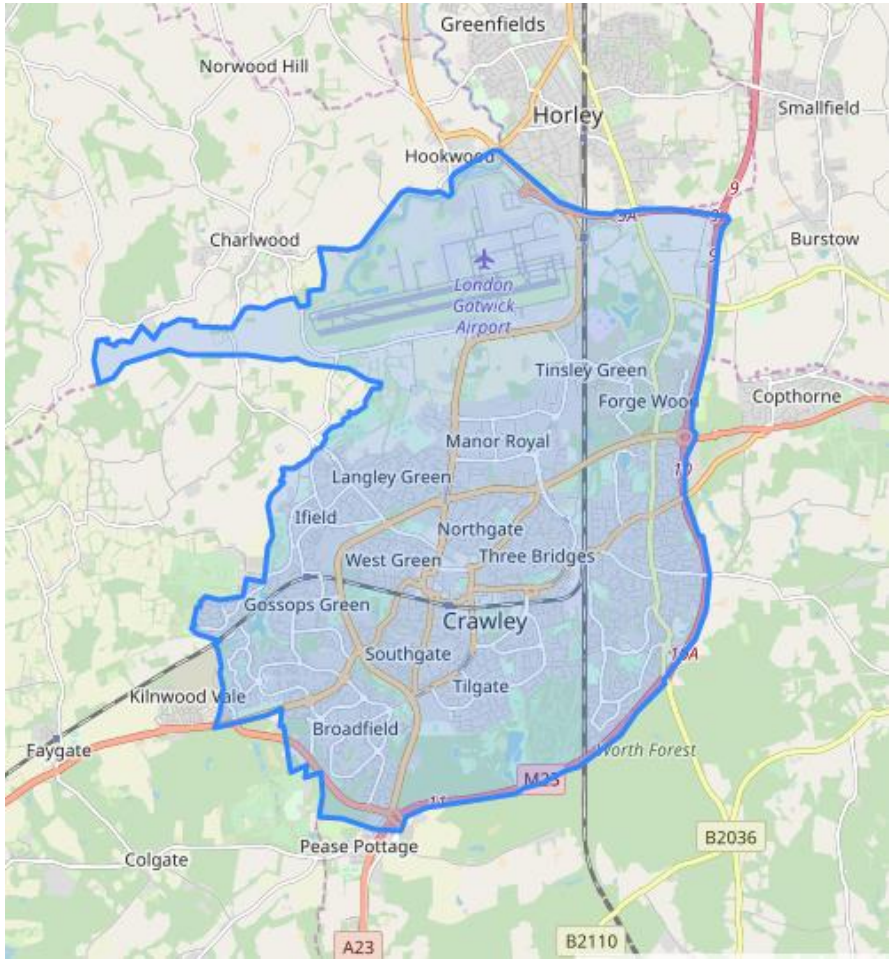
Introduction & Context

Context

Crawley is a large town and borough in the northeast corner of West Sussex, divided into 14 neighbourhoods. Crawley Borough Council delivers services across the borough with some additional services provided by West Sussex County Council. The town is home to Gatwick Airport and the Manor Royal Business District, the largest business park in the Gatwick Diamond, with a diverse range of international companies. The major industries are aviation, transport, warehousing and distribution, along with specialist sectors including aerospace, health and life sciences, medical technology and advanced manufacturing. Crawley has the highest net in commute[1] of all the West Sussex boroughs.

Metric	Description
Area	44.96 km^2
Population	112,448
Population density	2,221/km^2
Number of households[2]	40,900
Number of registered businesses	3,510
Geography	Crawley's land is mostly flat plains, and the borough lies in the Weald, an area of highly variable terrain between the North and South Downs. There are no major waterways in the borough, only a few small brooks and tributaries for the River Mole. Summer temperatures are among the highest in the UK due to Crawley's inland location.
Transport	• Major road A23 between London and Brighton • 4 railway stations (Three Bridges, Crawley, Gatwick and Ifield) • Main local bus operator is Metrobus, and the Fastbus guided bus service operates to and from Gatwick Airport • Gatwick Airport falls within the Crawley borough but is not owned by Crawley Borough Council

Table 1: Crawley Borough statistics and geography



1 – pre-COVID 19

2 - https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/families/adhocs/008604estimatednumberofhouseholdsfortheunitaryauthoritiesofengland2004to2016

Introduction & Context

Crawley Borough Council's Influence

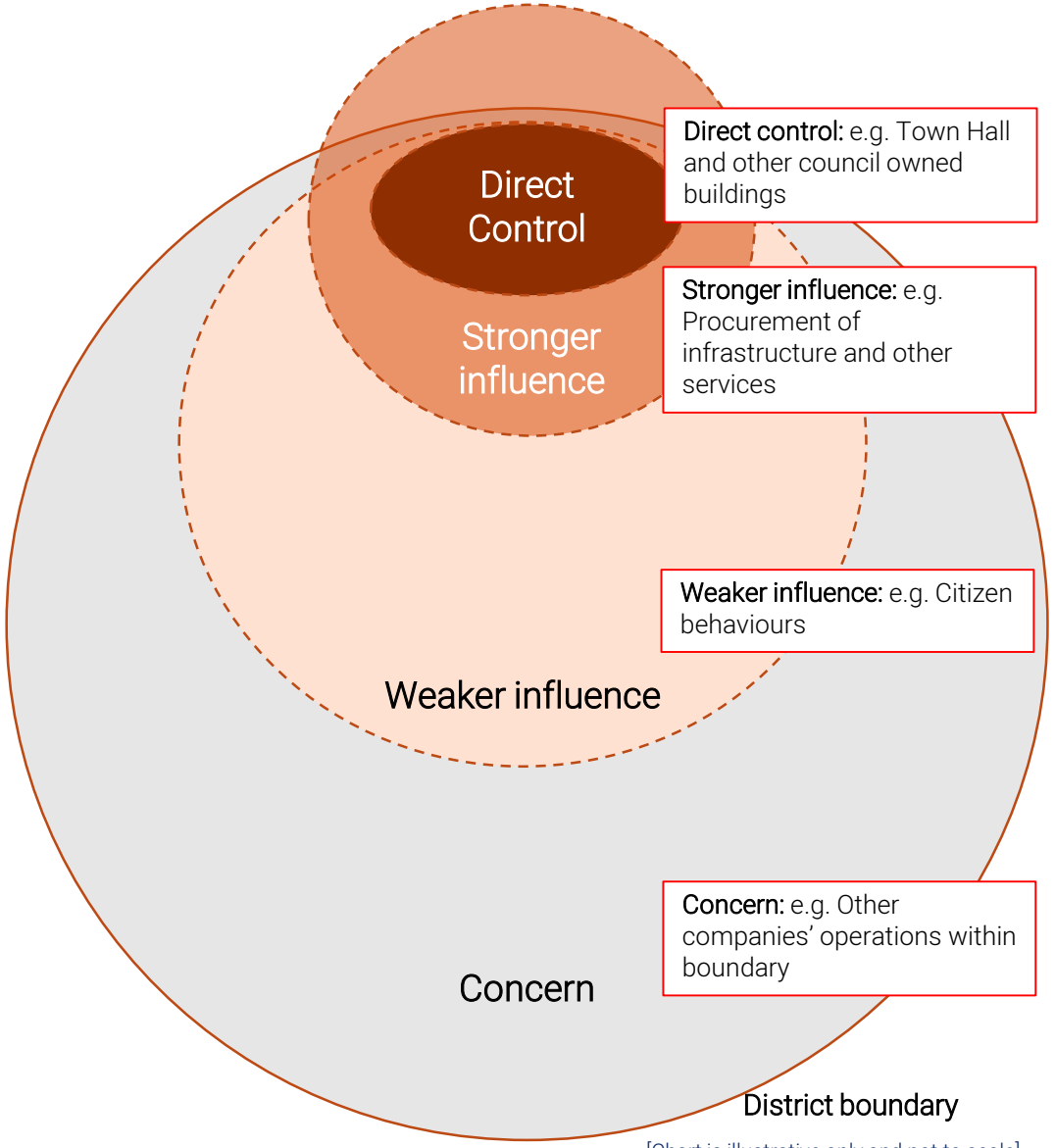
This chart illustrates that Crawley Borough Council's influence is varied and complex across the different activities that occur within their own operations and also across the borough.

Influence bandings are based on Anthesis' judgment following discussion with officers, and are by no means definitive. The examples that relate to each banding are intended to highlight opportunities for Crawley Borough Council to apply their influence in areas or ways previously not fully explored (e.g. by using 'convening power' and/or policy).

Influence extends beyond the district boundary, whereby Crawley Borough Council's demand (and supply) of goods and services drive emissions in supply chains around the world. Such emissions are referred to as consumption based emissions (relative to the UK produced emissions totals) and are not included in traditional location-based inventory calculations.[1]

Influence	Description
Direct Control	Emissions sources are directly owned or operationally controlled by the Council.
Stronger	Owners and operators of emissions sources are clearly defined but are not directly owned or operated by the Council. Emissions relate to council procurement or council led activities (some out of boundary).
Weaker	Emissions sources do not relate to council owned or operated assets, procurement or council led activities, however some convening power may exist with specific actors in the borough.
Concern	Owners and operators of emissions sources are not clearly defined, influence limited to lobbying central government or trade associations.

Table 2: Council influence bandings



[Chart is illustrative only and not to scale]

1 - https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/794557/Consumption_emissions_April19.pdf7

Anthesis

1. Crawley Borough Current Emissions Profile

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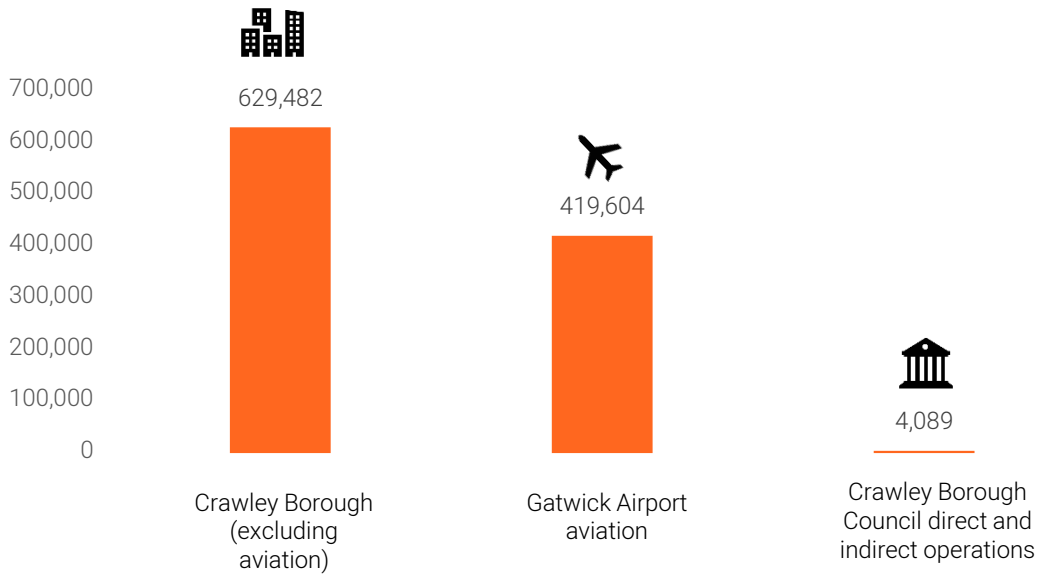
1. Crawley Borough Current Emissions Profile

Key findings

- Emissions from Crawley Borough in 2017[1] accounted for **629 $ktCO_2e$**, excluding aviation.
- To meet the emissions reduction ambitions for the borough, **reducing energy and transport demand needs to be prioritised**, as these types of measures can be undertaken now, without the need for significant advances in technology.
- The largest sector for emissions in the borough is buildings, in total responsible for **68%** of emissions. There is a significant opportunity to reduce emissions from buildings through energy efficiency, retrofit and demand reduction measures.
- Within this, industrial and commercial buildings account for the largest share of the buildings sector emissions, evidenced by the dominance of commercial and industrial organisations within the Crawley Borough area. Industrial and commercial buildings account for **31%** of overall borough-wide emissions.
- It will be vital to **engage with large and high emitting businesses** in the area to explore further action they could be taking to improve the efficiency of their operations and reduce emissions in order to match the ambitious reduction goals of the council. This should build on and continue to promote initiatives such as the **Green Business Programme and Re-Energise Manor Royal.**
- On-road transport is responsible for **25%** of emissions in the borough – tackling modal shift towards public and active transport will provide additional co-benefits to the borough.
- Residential buildings account for **151 $ktCO_2e$ – 23% of borough-wide emissions.** There is an opportunity for the council to improve energy efficiency and consider on-site renewables for social housing owned by the council, to reduce energy demand from homes.
- Crawley Borough Council is already in the process of implementing several renewable installations which will help to reduce the carbon intensity of the borough. The challenge will be to finance and implement the scaling up of renewables to the degree required to meet the net zero ambition.
- Transport emissions have recently increased in the borough, demonstrating the need for a shift towards lower carbon transport modes.
- Another major source of emissions within the borough are emissions from aviation allocated to Gatwick Airport, which account for **420 $ktCO_2e$** (landing and take off emissions only). Crawley Borough Council has limited ability to influence emissions from aviation from Gatwick Airport as the council does not operate or have decision power over the airport.



Crawley Borough emissions (tCO_2e)

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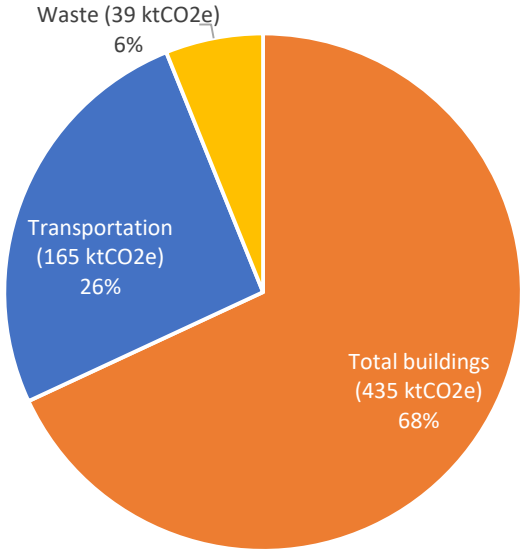
1 - based on the most up to date data available from BEIS at the time of this report

1. Crawley Borough Current Emissions Profile

Summary

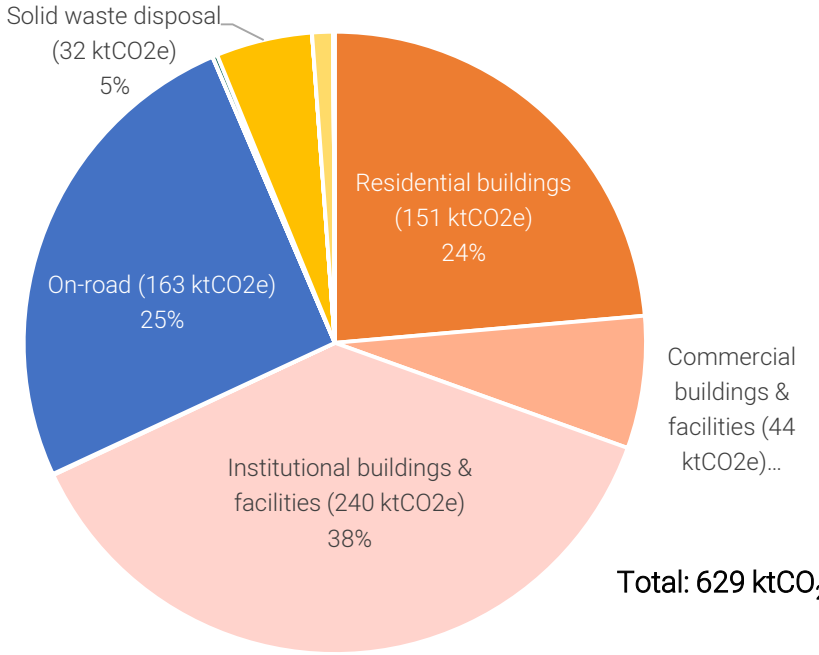
The figures and charts presented below summarise the direct and indirect emissions relating to the area administered by Crawley Borough Council. There are two methods used for this estimation; one uses the Anthesis' SCATTER tool, the other uses BEIS Local Authority Emissions data. The differences between the two are explored overleaf (see Appendix 1 for full data tables).

Figure 1: SCATTER sector inventory for direct and indirect emissions within Crawley (aviation emissions excluded), 2017



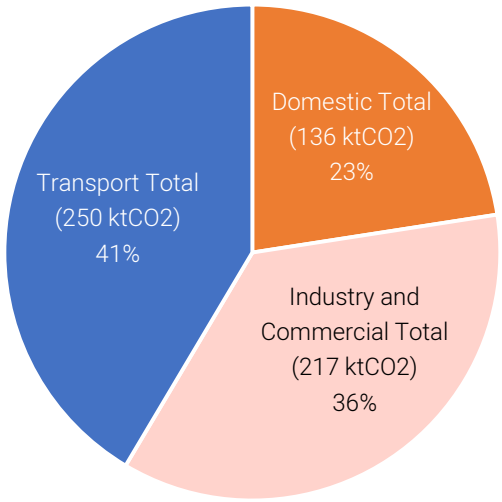
Total: 629 $ktCO_2e$

Figure 2: SCATTER sub-sector inventory for direct and indirect emissions within Crawley (aviation emissions excluded), 2017



Total: 629 $ktCO_2e$

Figure 3: BEIS sector inventory for direct and indirect emissions within Crawley (excludes aviation), 2017



Total: 594 $ktCO_2$

See page 11 for a breakdown of the difference between SCATTER and BEIS data

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Please note: The totals shown include the negative contribution from Land Use, Forestry and Agriculture but as these are negative they cannot be shown in the pie charts

1. Crawley Borough Current Emissions Profile

Summary

Below is the full inventory for Crawley Borough which details sub-sector emissions across the borough boundary, prepared in the format of the Global Protocol for City-wide Emissions (GPC). The key explains where emissions are not calculated or covered elsewhere.

Summary greenhouse gas emissions (tonnes CO2e)		Scope 1	Scope 2	
Sector	Sub-sector	Total tCO_2e	Total tCO_2e	Total tCO_2e
		DIRECT	INDIRECT	TOTAL
Stationary energy	Residential buildings	93,943.32	57,043.46	150,986.78
	Commercial buildings & facilities	25,509.86	18,361.89	43,871.75
	Institutional buildings & facilities	65,710.35	92,786.49	158,496.84
	Industrial buildings & facilities	28,013.65	53,786.62	81,800.27
	Agriculture	368.74	0.74	369.48
	Fugitive emissions	-	n/a	0.00
Transportation	On-road	162,527.96	IE	162,527.96
	Rail	135.81	IE	135.81
	Waterborne navigation	-	NO	-
	Off-road	1,625.28	IE	1,625.28
Waste	Solid waste disposal	31,925.96	n/a	31,925.96
	Biological treatment	-	n/a	-
	Incineration and open burning	-	n/a	-
	Wastewater	6,995.96	n/a	6,995.96
Industrial Process and Product Use (IPPU)	Industrial process	0.06	n/a	0.06
	Industrial product use	0.00	n/a	0.00
Agriculture, Forestry and Land Use (AFOLU)	Livestock	490.77	n/a	490.77
	Land use	- 10,216.21	n/a	- 10,216.21
	Other AFOLU	-	n/a	-
Generation of grid-supplied energy	Electricity-only generation	NO	n/a	-
	CHP generation	120.44	n/a	120.44
	Heat/cold generation	NO	n/a	-
	Local renewable generation	350.53	n/a	350.53
	TOTAL	407,031.51	221,979.20	629,481.68

Key

- Scope 1: direct emissions from eg gas used in buildings and fuel consumed
- Scope 2: indirect emissions from generation of purchased electricity
- IE (Included Elsewhere): Emissions are included under another sub-sector
- NO (Not Occurring): No emissions from this sub-sector occur within the borough boundary

Anthesis

1. Crawley Borough Current Emissions Profile

SCATTER – Frequently Asked Questions

What do the different emissions categories 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).

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.

The BEIS Local Emissions Summary does not differentiate between direct/indirect/other (or the various 'scopes').

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

- The Direct Emissions Summary and Subsector categories are aligned to the World Resource Institute's Global Protocol for Community-Scale Greenhouse Gas Emission Inventories ("GPC"), as accepted by CDP and the Global Covenant of Mayors.
- The BEIS Local Emissions Summary represents Local Authority level data published annually by the Department for Business Energy & Industrial Strategy (BEIS).
- Stationary energy includes emissions associated with industrial buildings and facilities (e.g. gas & electricity).
- Industrial Process and Product Use (IPPU) specifically relates to emissions that arise from production of products within the following industries: iron and steel, non-ferrous metals, mineral products, chemicals. These are derived from DUKES data (1.1-1.3 & 5.1).

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

Why does the BEIS summary differ from the SCATTER summary?

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

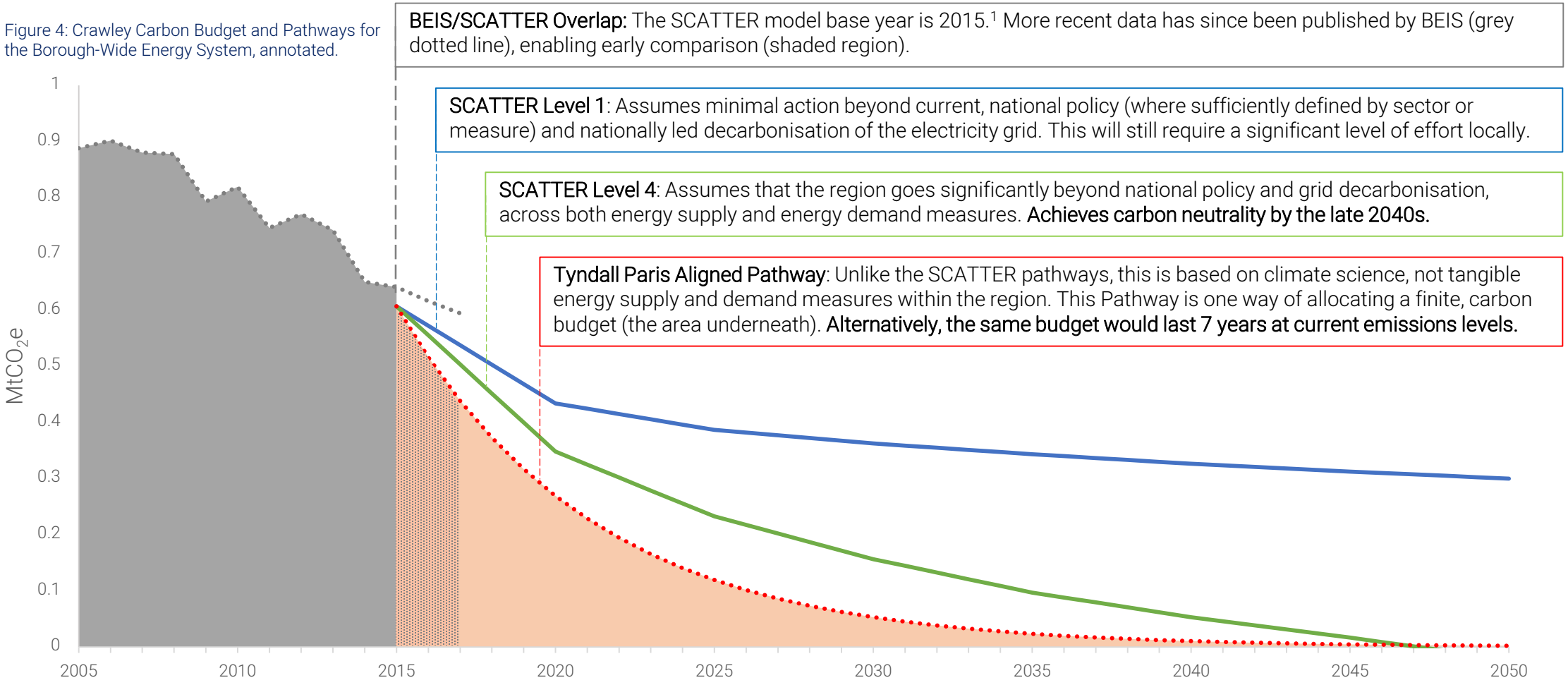
2. Borough-wide Energy System Pathways

Anthesis

2. Borough-wide Energy System Pathways

Summary

Figure 4: Crawley Carbon Budget and Pathways for the Borough-Wide Energy System, annotated.



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1 – Local Authority emissions & energy consumption data is published 2 years in arrears. SCATTER Tool operates from 2015 Base year, with adjustments made using 2016 & 2017 BEIS Local Authority Emissions data

2. Borough-wide Energy System Pathways

Crawley's Carbon Budget – Tyndall Centre Research

Introduction

The Tyndall Centre for Climate Research is a research organisation tied to the University of Manchester who have undertaken analysis to determine the contribution of each UK local authority to the national carbon budget. The defined carbon budgets are based on translating the targets set out in the Paris Agreement, informed by the latest research on climate change and defined in terms of science-based carbon accounting.

A temperature increase of 1.5°C is the result of a given concentration of atmospheric greenhouse gases. Using this principle as a starting point, it is possible to define a global emissions budget which relates to this temperature change. Subsequent allocation regimes can be applied to apportion a UK-wide energy budget before finally defining a budget for the Crawley Borough area. A more complete description of these allocation regimes can be found in Appendix 2. A key omission from this budgeting analysis is emissions from aviation and shipping and the below results define an **energy-only** budget for the region's energy supply and demand.

Results

The Tyndall Centre research analysis[1] stipulates:

- The energy-only budget for the Crawley area between 2020-2100 is **3.8 $MtCO_2$.**
- A **consistent emissions reduction rate of -13.1% per year** is needed to adhere to this budget.
- **By 2042, >95% of the recommended carbon budget will have been emitted** and low-level CO_2 emissions continue at a diminishing level to 2100.
- At current emissions levels, **only 7 years of carbon budget would remain,** from 2020.

Aviation and shipping

Aviation and shipping emissions are deducted from the budget at the UK level, **not** at the Crawley Borough level. Therefore, the carbon budget allocated to Crawley under the Tyndall Centre analysis does not include aviation emissions.

The Tyndall Centre analysis assumes the UK emissions from aviation as remaining constant up until 2030, followed by a linear reduction to full decarbonisation in the sector until 2075. The aviation assumptions are more optimistic than the Department for Transport emissions forecasts used in SCATTER.

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

Year	Required reduction in emissions against 2015 levels
2025	62.0%
2030	81.2%
2035	90.7%
2040	95.4%
2045	97.7%
2050	98.9%

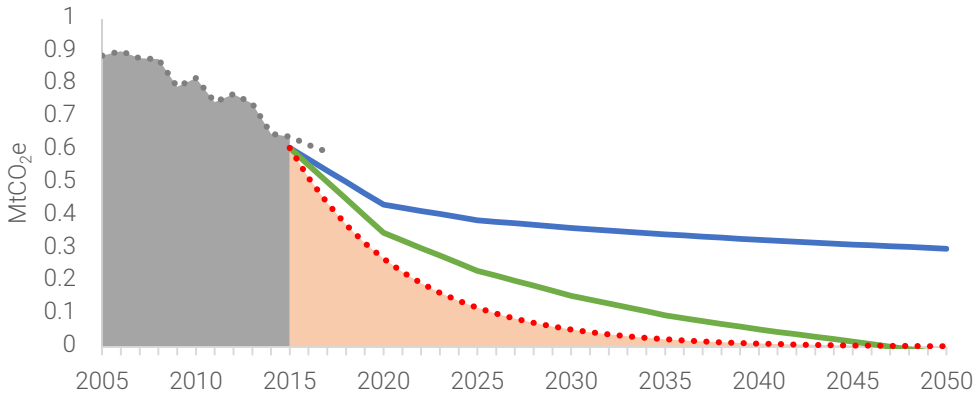
Table 3: Crawley Borough Carbon Budget, Tyndall Centre analysis[1]

1 - https://carbonbudget.manchester.ac.uk/reports/E07000226/

2. Borough-wide Energy System Pathways

SCATTER Model

Figure 5: Crawley Carbon Budget and Pathways for the borough-wide energy system



SCATTER "Level 1' Pathway – Assumes the selected region doesn't take much action beyond current, national policy and nationally led decarbonisation of the electricity grid.[1]

SCATTER "Level 4" Pathway – Assumes the selected region goes significantly beyond national policy and National Grid assumptions, across both energy supply and demand measures. Many assumptions aligned with the legacy DECC 2050 Pathways calculator 'Level 4'. See Appendix 4 for further details.

Tyndall Paris Aligned Budget – The finite, cumulative amount that the region should emit between now and 2050, based on research performed by the Tyndall Centre for Climate Change Research.[2]

Tyndall Paris Aligned Pathway – The yearly totals that must reduce 13% on average each year to keep within the budget. Note: Unlike the SCATTER Pathways, this does not specify what tangible measures could achieve this pathway, rather, it sets out what science (IPCC[3]) indicates we need to aim for.

Historic Pathway – Previous emissions totals as reported within the BEIS Local Authority Emissions data sets.[4]

This graph shows two possible future emissions pathways over time, as modelled by the SCATTER pathways tool. This tool focuses on energy system (fossil fuel consumption) emissions reductions within Crawley. The pathways do not represent reductions outside of the Crawley Borough boundary (i.e. consumption-based emissions).

Both Pathways can be compared against the Tyndall Centre for Climate Change Research's Paris Aligned Budget. This is derived from climate science[3] and applies a method for scaling down global carbon emissions budgets that are 'likely' to keep temperature change "well below 2°C and pursuing 1.5°C", to local authority regions. Unlike the SCATTER pathways, this is based on climate science, not tangible energy supply and demand measures in region. The cumulative nature of CO_2 reinforces the need to take a 'budget' approach, where any annual shortfalls accumulate over time. This Pathway is just one way of allocating a finite, carbon budget (the area underneath the curve). Alternatively, the same budget would last only 7 years if emissions remain at current levels. This highlights the need for urgent action now.

Gaps exist between the SCATTER Level 4 Pathway and the Tyndall Paris Aligned Pathway / zero carbon axis because modelling assumptions are based on present day evidence and judgment. Such assumptions are not intended to constrain the future ambition to close the gap.

1 – The BAU carbon intensity of electricity tracks the National Grid Future Energy Scenario (FES) "2 Degrees", 2017), on the basis that this was aligned with the legislated targets at the time the SCATTER tool was developed.
2 – This is based on information not yet publicly available, however the method is broadly comparable with work performed for the Greater Manchester Combined Authority and the City of Manchester. Contact c.w.jones@tyndall.ac.uk for further information.
3 – Intergovernmental Panel on Climate Change, 1.5°C Special Report, 2018
4 – Data is published 2 years in arrears, 2017 published data is represented on the graph as the SCATTER Pathways tool had not been updated at the time of writing. % Reduction figures presented do reflect the 2018 published BEIS data

2. Borough-wide Energy System Pathways

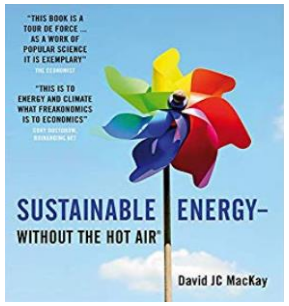
About the SCATTER model

SCATTER is intended to serve as one of many information sources to help local authority users inform their priorities for emissions reduction. Specifically with reference to the forward-looking pathways modelling element, it is intended to focus on the 'what' rather than the 'how'. It is important to note that SCATTER does not intend to prescribe certain technologies or policies, and similarly does not intend to discount other methods of arriving at the same outcome, just because they do not feature in the model. The SCATTER pathways serve as 'lines in the sand' and give users an indication of whether they are likely to be on-target or off-target for a carbon neutral trajectory through the adoption of interventions to drive the transition to a low carbon economy.

Note that the analysis undertaken for this report is based on the original SCATTER V1 (Excel-based tool) as it is the latest live version of the tool at the time of writing. Updates to the tool included in V2 (online tool) may provide different results but have not been included in this analysis, as V2 was not live at the time of writing. Naturally, technologies, assumptions and approaches to energy models are evolving all the time, and we would welcome the opportunity to receive feedback and/or collaborate on refinements of SCATTER in the future. Please share any feedback with scatter@anthesisgroup.com.

Basic principles

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



Two key modifications were made by Anthesis:

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

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

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

2. Borough-wide Energy System Pathways

Energy Supply & Demand

Reducing demand should always come first, as these are measures that can be undertaken now, without the need for significant and unknown advances in technology. Demand reduction will put less strain on the energy system supply.

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

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

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

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

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

Future demand is hard to predict. Recently published analysis within the National Grid's Future Energy Scenarios (FES) 2019 indicates that even under a scenario that meets the UK's net zero by 2050 (Two Degrees), electricity demand still increases. SCATTER's L4 Pathway on the other hand (consistent with the legacy 2050 Pathways tool), assumes that electricity demand still reduces overall. Factors such as increased electrification of heat and transport are naturally big drivers for the increase, but incentives and opportunities for demand reduction and energy efficiency measures are still significant and could slow or tip trends in the other direction.

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

Source	Change in current[1] demand	
	2030	2050
FES Two Degrees (2019)	▲ 5%	▲ 48%
SCATTER Level 4 (L4) Pathway	▼-35%	▼-55%

Anthesis

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

3. Energy System Interventions

Anthesis

3. Energy System Interventions

Domestic Buildings

The following tables provide metrics to understand the nature and extent of Crawley-specific measures. These are all assumed in order to track the green SCATTER level 4 (L4) pathway as shown on page 13. These assumptions are based on what is needed to achieve the carbon reductions to achieve the L4 pathway and do not consider feasibility, financing or skills required to deliver the measures themselves. Note that all figures provided are against a baseline year of 2015.

Measure	Current Crawley Borough Context	SCATTER L4 Pathway		
		2025	2030	2050
Improved insulation	1,836 ECO measures installed between 2013 and March 2019.[2] 56% of EPC-rated homes have a rating of D or below[3] In 2017, 6.9% of households in Crawley were in fuel poverty.[4] 233 Watts/°C average UK heat loss per house (Referred to in the legacy 2050 Pathways tool as thermal leakiness. See definition opposite)	Solid wall insulation rate of 409 households per year.[1] Loft insulation rate of 1,026 households per year. Superglazing installed at a rate of 959 households per year. New builds to PassivHaus or equivalent standard 183 Watts/°C average heat loss per house (21% reduction in thermal leakiness)	Solid wall insulation rate of 423 households per year. Loft insulation rate of 1,060 households per year. Superglazing installed at a rate of 988 households per year. New builds to PassivHaus or equivalent standard 158 Watts/°C average heat loss per house (32% reduction)	By 2050, retrofit measures have been applied to the vast majority of homes. With the exception of superglazing which is installed at a rate of 976 households per year. New builds to PassivHaus or equivalent standard 58 Watts/°C average heat loss per house (75% reduction)
Reduction of average temperature[5]	Current average UK household temperatures are approximately 17.3°C[6]	16.8°C	16.7°C	16.0°C

What is 'thermal leakiness'?

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

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

Examples of good practice:

Crawley's first PassivHaus development, Gales Place was completed in 2017 with 13 new affordable homes built to PassivHaus standard. Dobbins Place will soon see completion of 6 new PassivHaus standard homes.
Exeter's Zero Energy Building Catalyst is supporting 80 enterprises in Devon to engage with new models of retrofit.

1 – For a full list of retrofit measures see Appendix 4 for a list of EPC ratings see Appendix 5.
2 - See https://www.gov.uk/government/statistics/household-energy-efficiency-statistics-headline-release-september-2019
3 - https://www.gov.uk/government/statistical-data-sets/live-tables-on-energy-performance-of-buildings-certificates#epcs-for-existing-domestic-properties
4 - https://www.gov.uk/government/statistics/sub-regional-fuel-poverty-data-2019
5 - Reductions may be achieved through better heating controls (i.e. 'Smart thermostats') that zone the heat, as opposed to reducing comfort
6 - ECUK (2017) Table 3.16: Internal and external temperatures 1970 to 2012

3. Energy System Interventions

Domestic Buildings

Measure	Current Crawley Borough Context	SCATTER L4 Pathway		
		2025	2030	2050
Decarbonisation of heat	Renewable Heat Incentive (RHI) has accredited 14 domestic installations for renewable heat systems within Crawley since 2014[1] In the UK, Gas boilers will be banned in new homes from 2025 (See Appendix 6 for further detail on the type of heating technologies assumed within SCATTER)	35% of all households have a new heating system installed. Majority of heating systems are old gas boilers, with some heat pumps* (13%) and district heating (<1%)	62% of all households have a new heating system installed. Majority of heating systems are old gas boilers, with some heat pumps (27%) and district heating (1%)	94% of all households have a new heating system installed. Majority of heating systems are heat pumps (78%) and district heating (3%).
Appliance & lighting efficiency	Energy consumption from domestic lighting in the UK decreased 7% between 2015 and 2018[3] National average demand per household is 2.59 MWh	Average demand per household is 2.42 MWh	Average demand per household is 2.12 MWh	Average demand per household is 0.92 MWh
Electrification of cooking	47% of cooking in the UK is currently electrified[4]	69% electrified	76% electrified	100% electrified

Examples of good practice:

A new district heat network based on marine source heat pumps will be delivered as part of a smart local energy system at **Shoreham-by-Sea**, West Sussex.

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

The Rural Community Energy Fund (RCEF) has provided a grant to examine the feasibility of developing a heat network in **Firle**, East Sussex to provide energy via heat pumps and biomass.

Anthesis

1 - https://www.gov.uk/government/statistics/rhi-monthly-deployment-data-may-2019
2 - Air-source and ground-source heat pump technology
3 - https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/820753/2019_Electrical_Products_Tables.xlsx
4- based on legacy SCATTER assumptions

3. Energy System Interventions

Non-Domestic Buildings

Measure	Current Crawley Borough Context	SCATTER L4 Pathway		
		2025	2030	2050
Commercial space heating & cooling	55% of EPC-rated commercial 'lodgements' in Crawley are rated D or lower[1]	16% reduction in commercial heating and cooling demand from 2015	24% reduction in commercial heating and cooling demand from 2015	100% reduction in commercial heating and cooling demand from 2015
Electrification of heat	89% gas and oil-fired boilers.[2] (See Appendix 6 for further detail on the type of heating technologies assumed)	57% gas and oil-fired boiler	46% gas and oil-fired boiler	0% gas and oil-fired boiler
Appliances & lighting	Consumption by non-domestic lighting, computers and commercial motors in the UK fell 1.7% between 2015 and 2018[3] Total non-domestic consumption in 2017 was 50 GWh.[2]	Total commercial lighting and appliance demand is 44.2 GWh	Total commercial lighting and appliance demand is 42.6 GWh	Total commercial lighting and appliance demand is 36.2 GWh
Energy used for cooking	24% electrified[2]	46% electrified	57% electrified	100% electrified

Examples of good practice:

Cornwall Council will no longer provide gas in its new homes and piloted the use of ground source heat pumps at Tolvaddon Energy Park.

Crawley has received funding from BEIS to develop a district heat network which will connect new housing at John Brackpool Close and the Boulevard together with the new Town Hall to a combined heat and power (CHP) plant.

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

West Sussex County Council, Crawley Borough Council and EU partners through the Businesspark Integrated Sustainable Energy Packages (BISEPS) project are working to support businesses invest in renewable energy and low-carbon heat sources.

Anthesis

1 – See Appendix 5; a 'lodgement' is assumed to represent the same unit as 'household' (for domestic buildings) and allows comparison between the two different sector's properties.
2 - based on legacy SCATTER assumptions
3 - https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/820753/2019_Electrical_Products_Tables.xlsx

3. Energy System Interventions

Transport

Measure	Current Crawley Borough Context	SCATTER L4 Pathway		
		2025	2030	2050
Distance reduction	Of all West Sussex boroughs, Crawley Borough has the highest proportion of the workforce who commute 40 to less than 60kms to work (6.5%) and 60kms and over to work (5.1%).[1] Crawley has the highest number of vehicles in West Sussex entering the town each morning.[2]	Overall travel demand drops 17% relative to 2015 levels 25% reduction in passenger miles travelled by car	Overall travel demand drops 25% relative to 2015 levels 27% reduction in passenger miles travelled by car	Overall travel demand drops 25% relative to 2015 levels 38% reduction in passenger miles travelled by car
Significant passenger transport modal shifts	90% of households in Crawley are within 1.2 miles of their nearest train station. [2] 1.8% of Crawley's population regularly cycle to work. [2] 7.6% of travel to work or school is by bus. [2]	6% reduction in car transport share against 2015 levels Modal share of public transport (rail & bus) is 18% Modal share of active transport (walking & cycling) is 6%	10% reduction in car transport against 2015 levels Modal share of public transport (rail & bus) is 20% Modal share of active transport (walking & cycling) is 6%	22% reduction in car transport against 2015 levels Modal share of public transport (rail & bus) is 29% Modal share of active transport (walking & cycling) is 9%
Modal shift of freight and increase in efficiency	71% of freight emissions in the UK are from road[3]	Road freight is 99% diesel[3]	Road freight is 98% diesel	Road freight is 93% diesel

Refer to Appendix 7 for further information on assumptions on other modes of transport.

Examples of good practice:

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

Bristol Council plans to introduce a Clean Air Zone for charging non-compliant, high emissions vehicles

Nottingham City Council introduced a Workplace Parking Levy congestion charge to encourage employers to reduce the number of free workplace parking places they provide to staff and switch to alternative modes of transport. The scheme has resulted in a reduction of air pollution and has raised over £60 million which the council spends to further reduce car use.

Anthesis

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

3. Energy System Interventions

Transport

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

Measure	Current Crawley Borough Context	SCATTER L4 Pathway		
		2025	2030	2050
Shift to zero carbon cars	There are 10 EV public charging points in the borough.[1] 2% of vehicles registered in Crawley are PHEV or ULEV.[2]	51% EV, 13% PHEV/HEV, 36% petrol/diesel	75% EV, 14% PHEV/HEV, 11% petrol/diesel	100% EV
Shift to zero carbon buses	Funding has been secured from the government's Ultra-Low Emission Bus Scheme towards 20 zero-emission fuel cell buses for Gatwick, Crawley and Manor Royal Business District.[3]	51% EV, 37% PHEV/HEV, 12% petrol/diesel.	76% EV, 24% PHEV/HEV	100% EV
Rail electrification	The Brighton main line and Arun Valley line which both pass through the borough are electrified.	Rail is 100% electrified	Rail is 100% electrified	Rail is 100% electrified

Examples of good practice:

Crawley was ranked in the top 20% of boroughs EV charging locations per 1,000 EV registrants, and among the best boroughs in Sussex for the average distance to a charging point

Crawley will benefit from the introduction of 20 hydrogen buses to the Metrobus fleet.

Edinburgh's EV Charging Plan is an ambitious plan for EV charging infrastructure.

London's Ultra Low Emissions Zone has resulted in a reduction in air pollution and improved traffic flows.

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

Anthesis

1- http://www.crawley.gov.uk/pw/Streets__Roads_and_Transport/Parking/PUB294671
2 - https://www.gov.uk/government/statistical-data-sets/all-vehicles-veh01#licensed-vehicles (2018)
3- https://www.buses.co.uk/first-step-towards-zero-emission-fuel-cell-electric-buses-metrobus-gatwick-and-crawley

3. Energy System Interventions

Waste

Measure	Current Crawley Borough Context	SCATTER L4 Pathway		
		2025	2030	2050
Waste reduction[1]	Crawley Borough Council collected 32,104 tonnes of household waste and 1,675 tonnes of non-household waste in 2017/2018[2]	7% decrease in quantity of household waste	10% decrease in quantity of household waste	20% decrease in quantity of household waste
Increased recycling[3]	28% of waste collected by Crawley Borough Council is sent for recycling, composting or reuse.[2]	55% of household and commercial waste recycled	61% of household and commercial waste recycled	85% of household and commercial waste recycled

Examples of good practice:

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

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

Anthesis

1- Volume % relate to household waste only, and any reductions are defined in terms of weight. Other categories within SCATTER include Commercial and Industrial waste, Construction & Demolition waste, Sewage Sludge and Landfill Gas.
2 – DEFRA: Local authority collected waste generation from April 2000 to March 2018 (England and regions) and local authority data April 2017 to March 2018
3-Waste destinations consist of 'recycling' (one category), 'landfill', 'composting', and 'incineration or EfW'. Updates made to the original DECC Pathways Calculator in respect of EU Waste Directive 2035 Targets.

3. Energy System Interventions

Industry

Measure	Current Crawley Borough Context	SCATTER L4 Pathway		
		2025	2030	2050
Industry efficiency	Per BEIS figures, total emissions from industry and commercial sources decreased 33% between 2011-17[1]	51% reduction in emissions from industry	55% reduction in emissions from industry	76% reduction in emissions from industry[2]
Electrification of industry	35% of UK industrial energy consumption in 2018 was electric[1]	41% of UK industrial energy use is electrified	44% of UK industrial energy use is electrified	66% of UK industrial energy use is electrified
Carbon Capture and Storage (CCS) on industry	No CCS facilities or research in borough.	2% of UK industrial emissions are captured by CCS	4% of UK industrial emissions are captured by CCS	42% of UK industrial emissions are captured by CCS

Note: Oil production is treated with the minimum level of ambition and forecasts production in line with governmental projections.

Measure	Current Crawley Borough Context	SCATTER Level 1 Pathway		
		2025	2030	2050
Oil production	No significant oil or petroleum product manufacturing within the borough.	18% reduction in oil production relative to 2015 levels	36% reduction in oil production relative to 2015 levels	77% reduction in oil production relative to 2015 levels

Anthesis

1 - https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/820647/DUKES_1.1.5.xls
2 – Emissions are offset by CCS measures; these reductions describe the gross reductions of emissions through improvements in efficiency – https://www.irena.org/DigitalArticles/2019/Apr/-/media/652AE07BBAAC407ABD1D45F6BBA8494B.ashx

3. Energy System Interventions

Renewable Energy Supply

Measure	Current Crawley Borough Context	SCATTER Level 4 Pathway		
		2025	2030	2050
Solar PV	1,209 installations in Crawley with a capacity of 4.8 MW and a generation of 4,663 MWh[1]	0.28 km^2 of PV arrays across roof space (equivalent to arrays on 34% of households)[2] 0.09 GW installed capacity 70 GWh generated per year	0.39 km^2 of PV arrays across roof space (equivalent to arrays on 43% of households) 0.13 GW installed capacity 100 GWh generated per year	0.9 km^2 of PV arrays across roof space (equivalent to arrays on 60% of households, with a further 0.34km^2 of ground mounted and commercial property installations) 0.31 GW installed capacity 230 GWh generated per year
Storage	No notable energy storage projects within boundary Your Energy Sussex (YES) partnership has plans to develop a large energy storage facility in the district.	2.40 GW storage capacity in standby generators	2.51 GW storage capacity in standby generators	2.67 GW storage capacity in standby generators
Bioenergy supply (heat & electricity)	1.1 MW installed capacity with an annual output of 5.87 GWh.	20 MW installed capacity	22 MW installed capacity	33 MW installed capacity
Solar thermal	Negligible installed capacity in Crawley	0.09 km^2 solar panels for hot water 3.5 MW installed capacity.	0.14 km^2 solar panels for hot water 4.4 MW installed capacity.	0.4 km^2 solar panels for hot water 12.5 MW installed capacity.

A note on supply technologies

SCATTER estimates values for the installed capacity of each supply technology, by taking a nationally assumed capacity figure (L1 was aligned to the 2017 National Grid's Future Energy Scenario, Two Degrees) and scaling down to region based on a local authority's size proxy (e.g. population, number of households, land area). This serves as an indicator for the nature and extent of renewable supply required to future demand.

SCATTER **does not** account for the geographies and local contexts unique to a given local authority, which we acknowledge play a very important role in the viability of a given technology.

Examples of good practice:

West Sussex Virtual Power Plant combines PV and storage across groups of property to act as a localised grid.

Kent's Cleve Hill Solar Farm produces enough power for 91,000 homes and generates over £1m a year for local authorities.

Anthesis

1 - RHI data used for this estimate can be found here. Domestic and non-domestic estimates were calculated by using national averages for the share of solar thermal applications and capacities, as well as the average capacity per solar thermal installation.
2 - https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/743822/Renewable_electricity_by_Local_Authority__2014-2017.xlsx
3 – The % of households quoted is taken from a 2.2 kW installation occupying 16m^2 of roof space and household number projections (as per the Energy Savings Trust Guidance)

3. Energy System Interventions

Renewable Energy Supply

The following energy technologies operate within the SCATTER tool but have very little or no precedent within Crawley in terms of capacity or installations. Given Crawley is approaching these technologies from a 'standing start' they are treated with the minimum ambition level within the tool (L1).

Measure	Current Crawley Borough Context	SCATTER Level 1 Pathway		
		2025	2030	2050
Hydro power	No installed capacity in Crawley as of 2018.[1]	3.1 MW installed peak capacity	3.2 MW installed peak capacity	4.7 MW installed peak capacity
Wave, tidal and tidal stream	No installed capacity in Crawley as of 2018. [1]	6.9 GWh installed capacity.	22.8 GWh installed capacity.	45.1 GWh installed capacity.

Given Crawley's size, large increases in installation of onshore wind turbines within boundary may prove difficult. However, out of boundary initiatives have proven a viable option for energy supply for a number of local authorities, particularly Warrington. For this reason the ambition level was kept high within the tool:

Measure	Current Crawley Borough Context	SCATTER Level 4 Pathway		
		2025	2030	2050
Onshore wind	1 installation in Crawley with a capacity of 0.01 MW and an annual generation of 12 MWh. [1]	35 MW installed capacity (14 turbines)	51 GW installed capacity (20 turbines)	129 GW installed capacity (52 turbines)

1 – https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/743822/Renewable_electricity_by_Local_Authority__2014-2017.xlsx

3. Energy System Interventions

Renewable Energy Supply – Comparative Study

Crawley has a limited amount of existent installed capacity for renewable energy supply. Here a comparison is made with local authorities of similar size by population (households) and GVA. Often, the feasibility of given technologies can be severely limited by local geographies and contexts (hydroelectric power in a flat region, large wind farms in a geographically small area etc.). The below table is intended to serve as a reference for the variety of technologies available across a number of urban areas which face similar constraints to Crawley in terms of size, economic output and population. Solar PV, onshore wind, hydroelectric power and biomass have all been compared – note that 'biomass' incorporates a variety of specific technologies including anaerobic digesters, landfill gas and solid municipal waste. In addition, there are likely impacts on air quality as a result of burning biomass that should be considered.

Local Authority	Households[1]	Population ('000s)[2]	GVA (£m)[3]	Renewable Technology (MW)				Total installed renewable capacity (MW)[4]	Capacity per unit area of land (kW/km²)[5]
				PV	Wind	Hydro	Biomass		
Crawley	42,322	111.7	4,977	4.8	0.006	0	1.1	5.9	130
Dartford	-5%	-4%	-36%	4.5	0	0	7.4	11.9	160
Hartlepool	-2%	-17%	-70%	20.4	24.5	0	26.7	71.6	730
Mid Suffolk	-3%	-9%	-58%	31.4	12.4	0	47.4	91.2	100
South Hams	0%	-24%	-60%	122.4	0.8	1.4	0.6	125.2	140

Per unit area of land, Dartford borough generates 23% more energy than Crawley Borough– suggesting there is greater potential for capacity in Crawley even after considering land constraints.

Table 5: Comparative metrics for Crawley Borough and other UK local authorities.
All percentages listed are relative to the figures for Crawley.

Anthesis

1 – https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/families/adhocs/008604estimatednumberofhouseholdsfortheunitaryauthoritiesofengland2004to2016
2 – https://www.gov.uk/government/collections/uk-local-authority-and-regional-carbon-dioxide-emissions-national-statistics
3 – https://www.ons.gov.uk/economy/grossvalueaddedgva/datasets/regionalgrossvalueaddedbalancedbylocalauthorityintheuk
4 – https://www.gov.uk/government/statistics/regional-renewable-statistics
5 – https://ons.maps.arcgis.com/home/item.html?id=a79de233ad254a6d9f76298e666abb2b

3. Energy System Interventions

Estimated Emissions Savings Summary

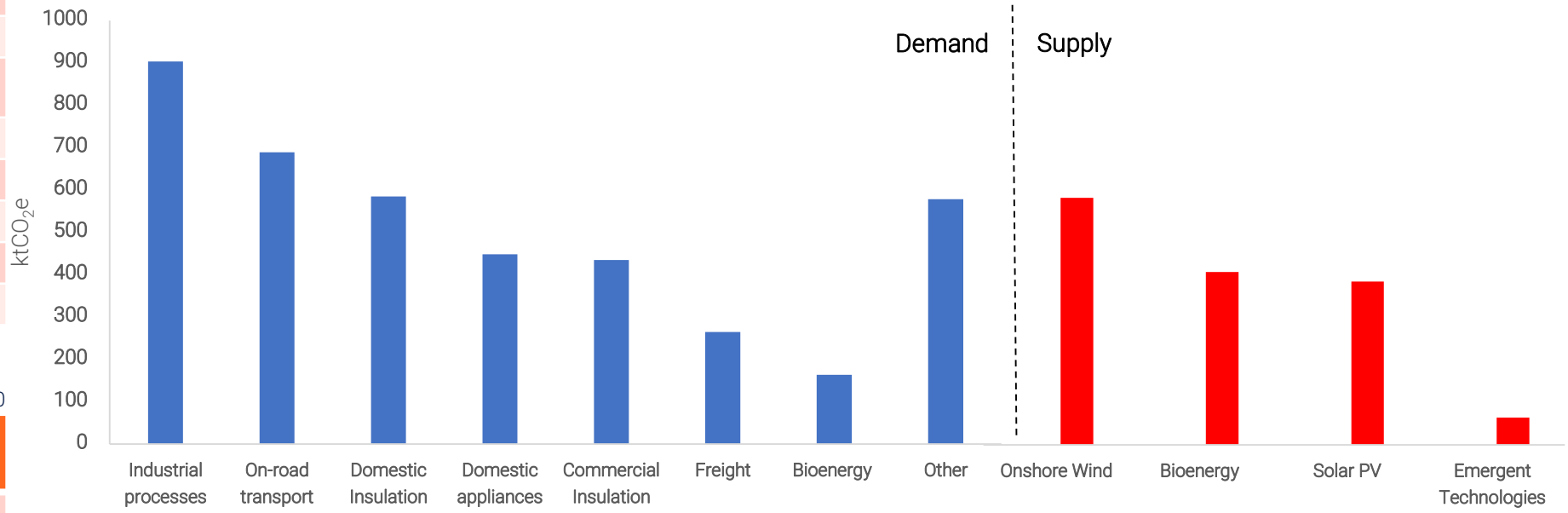
Table 6: Demand side measure cumulative savings to 2030

Demand-side measure	Cumulative saving to 2030 ($ktCO_2e$)
Industrial processes	903
On-road transport	689
Domestic space heating and hot water	585
Domestic appliances	448
Commercial Insulation	435
Freight	265
Bioenergy	164
Other	578

Table 7: Supply side measure cumulative savings to 2030

Supply-side measure	Cumulative savings to 2030 ($ktCO_2e$)
Onshore Wind	577.92
Bioenergy	404.08
Solar PV	382.00
'Emergent' Technologies	63.39

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



Notes:

- It is not appropriate to sum any savings presented from renewable supply with savings achieved on the demand side of the energy system, as this is may result in double counting.
- Intervention is critical on the demand side to realise emissions savings from renewable supply. For example, if heating systems are not electrified, then a decarbonised electricity grid will have limited impact. Similarly if the grid is not decarbonised, savings from Electric Vehicles will not be as great.
- 'Emergent' technologies are hydro, tidal and wave power.
- 'Other' constitutes the following: rail transport, petroleum and fossil fuel production, carbon capture and storage

3. Energy System Interventions

Emissions Savings Summary

Comparisons against base year

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

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

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

SCATTER sector	% reduction against 2017 by 2030
Domestic Buildings	72%
Non-domestic Buildings	68%
Transport	81%
Waste & Industry	72%
Total	**74%**

Table 8: Base year emissions goals approach to emissions tracking. Percentage reduction exceeding 100% within the waste & industry sector indicates that emissions are net-captured, either by means of CCS technologies or other means such as biomass.

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

Emissions intensity per unit of energy consumption is calculated from the ratio of projected values for net CO_2e emissions and energy demand (in TWh). The very sharp decrease in the emissions intensity per TWh accounts for changes to both the decarbonization of the energy supply as well as reduced demand.

Emissions intensity per capita is similarly calculated from the ratio of projected emissions to projected population.

Year	Emissions intensity per capita	
	tCO_2e/head	% reduction against 2017 levels
2017	5.32	N/A
2025	1.90	64%
2030	1.23	77%

Year	Emissions intensity per TWh	
	$ktCO_2e$/TWh	% reduction against 2017 levels
2017	0.28	N/A
2025	0.17	41%
2030	0.15	48%
2050	0.08	71%

Table 9: Intensity emissions reduction approach to emissions tracking.

4. Crawley Borough Council's Own Emissions

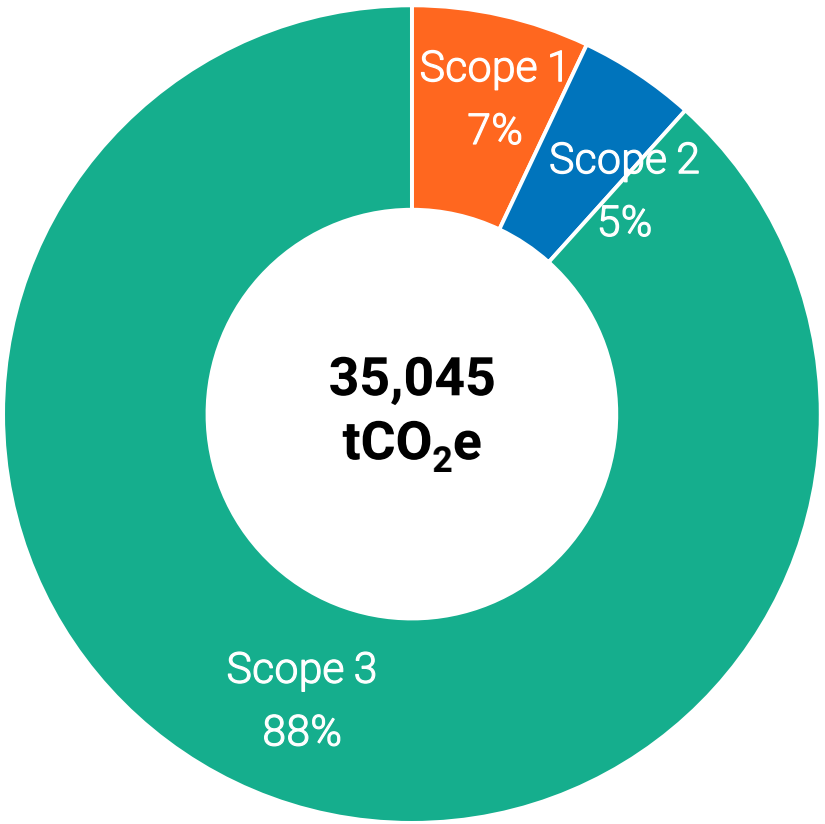
Anthesis

4. Crawley Borough Council's Own Emissions

Overview

- The analysis of Crawley Borough Council's own emissions focused on key emissions sources, including:
    - Buildings & Other Assets
    - Vehicle Fleet
    - Business Travel
    - Procurement Spend
    - Employee Commute

- Scope 3 emission sources are the largest contributor to the council's own emissions accounting for 88% of total emissions, with Scope 1 and 2 emissions sources contributing a marginal 7% & 5%, respectively.
- The largest single emissions source was consumption based emissions from the council's procurement spend, contributing to 83% of the council's total emissions.
- In addition, a substantial amount of emissions were apportioned to buildings & other assets, accounting for 4,056 tCO_2e across scope 1, 2 & 3 emissions sources.
- The council's Scope 1 & 2 emissions represent <1% of the borough's Scope 1 & 2 (Direct & Indirect emissions). It is not appropriate to directly compare the council's total footprint (i.e. Scopes 1, 2 & 3), as the proportion of Scope 3 emissions that occur inside and outside of the district boundary has not been defined.



4. Crawley Borough Council's Own Emissions

Table 10: Crawley Borough Council emissions breakdown by scope and sector 2018-2019

Table 10 details a breakdown of the emissions for Crawley Borough Council's emissions across council owned buildings, vehicle fleet and procurement spend.

An **operational control approach** to GHG accounting has been used for the analysis of emissions from owned/leased buildings and assets. In reference, the GHG Protocol defines operational control as an organisations 'authority to introduce and implement its operating policies at the operation' (GHG Protocol, 2019). This is demonstrative for commercial properties, such as parks and playing fields, community support centres, leisure centres etc., which have been encompassed under the council's Scope 1, 2 and 3 emissions.

In addition, activities under direct control but not operated by Crawley Borough Council have been included in Scope 1 emissions. For example, the Biffa waste vehicle fleet is owned but not operated by the council, however Crawley Borough Council has direct influence over vehicles purchased for this fleet.

Glossary

WTT: '*Well-to-tank (WTT) fuels conversion factors should be used to account for the upstream Scope 3 emissions associated with extraction, refining and transportation of the raw fuel sources to an organisation's site (or asset), prior to combustion.*' (DEFRA, 2019)

T&D: '*Transmission & Distribution (T&D) factors should be used to report the Scope 3 emissions associated with grid losses (the energy loss that occurs in getting the electricity from the power plant to the organisations that purchase it).*' (DEFRA, 2019)

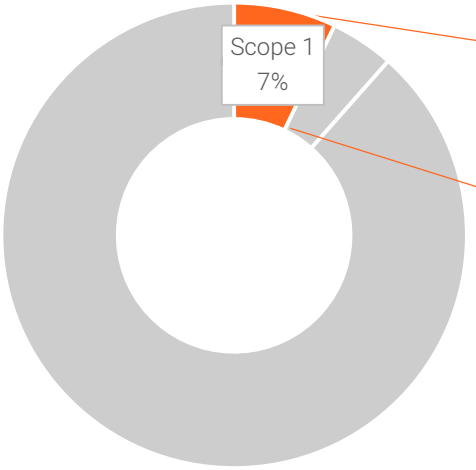
HGV: Heavy goods vehicles i.e. any truck with a gross combination mass (GCM) of over 3,500 kilograms

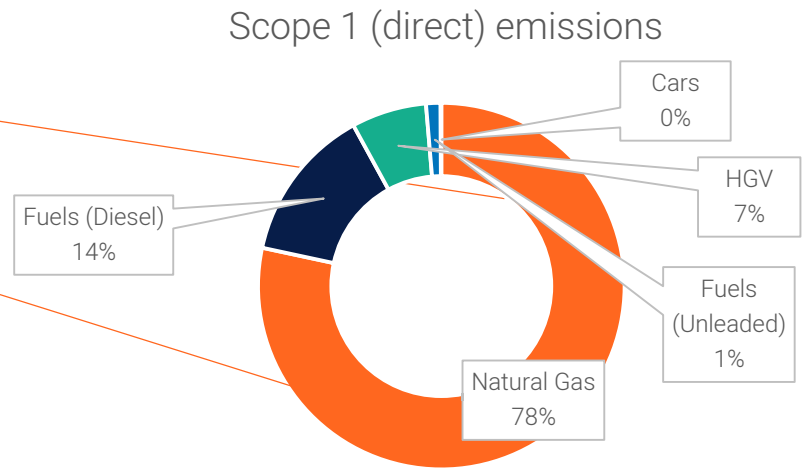
		FY1819			
Emission Source		Activity Data	Unit	tCO2e	% of total emissions
Scope 1					
Buildings & Other Assets: Council Operated	*Natural Gas*	3,030	*MWh*	557	1.59%
	Total			**557**	**1.59%**
Buildings & Other Assets: Contractor Operated (K2 & The Hawth)	*Natural Gas*	7,478	*MWh*	1,375	3.92%
	Total			**1,375**	**3.92%**
Vehicle Fleet	*HGV Rigid >3.5-7.5t*	1,000	*miles*	0.79	0.00%
	HGV Rigid >7.5-17t	9,834	*miles*	10	0.03%
	HGV Rigid >17t	99,549	*miles*	153	0.44%
	Pool Cars	5,008	*miles*	1.46	0.00%
	Fuels (Diesel)	337,148	*Litres*	337	0.96%
	Fuels (Unleaded)	13,682	*Litres*	32	0.09%
	Total			**534**	**1.52%**
Total Scope 1 Emissions				**2,466**	**7.04%**
Scope 2					
Buildings & Other Assets: Council Operated	*Purchased Electricity*	3,508	*MWh*	993	2.83%
	Total			**993**	**2.83%**
Buidlings & Other Assets: Contractor Operated (K2 & The Hawth)	*Purchased Electricity*	2,464	*MWh*	630	**1.80%**
	Total			**630**	**1.80%**
Total Scope 2 Emissions				**1,623**	**4.63%**
Scope 3					
Buildings & Other Assets: Council Operated	*Natural Gas - WTT*	3,030	*MWh*	77	0.22%
	UK Electricity - T&D	3,508	*MWh*	85	0.24%
	Water Supply	52,216	*m3*	18	0.05%
	Water Treatment	52,216	*m3*	37	0.11%
	Total			**217**	**0.62%**
Buildings & Other Assets: Contractor Operated (K2 & The Hawth)	*Natural Gas - WTT*	7,478	*MWh*	179	0.51%
	UK Electricity - T&D	2,464	*MWh*	53	0.15%
	Water Supply	49,264	*m3*	17	0.05%
	Water Treatment	49,264	*m3*	35	0.10%
	Total			**284**	**0.81%**
Contractor Vehicles	*Vans (Class II)*	52,577	*miles*	10	0.03%
	Vans (Class II)	23,199	*Litres*	62	0.18%
	Total			**73**	**0.21%**
Grey Fleet	*Average Car: Petrol*	59,867	*Miles*	27	0.08%
	Average Car: Diesel	89,801	*Miles*	17	0.05%
	Motorbikes	60	*Miles*	11	0.03%
	Total			**55**	**0.16%**
Employee Commute	*Walk / Bicycle*	980,169	*Miles*	-	0.00%
	Private On-Road Transport	3,690,966	*Miles*	1,063	3.03%
	Public On-Road Transport	357,957	*Miles*	64	0.18%
	Public Off-Road Transport	441,069	*Miles*	31	0.09%
	Total			**1,158**	**3.30%**
Procurement Spend	*Input/Output*	£64	*million GBP*	29,171	83.24%
	Total			**29,171**	**83.24%**
Total Scope 3 Emissions				**30,957**	**88.33%**
Total Emissions				**35,045**	

Anthesis

4. Crawley Borough Council's Own Emissions

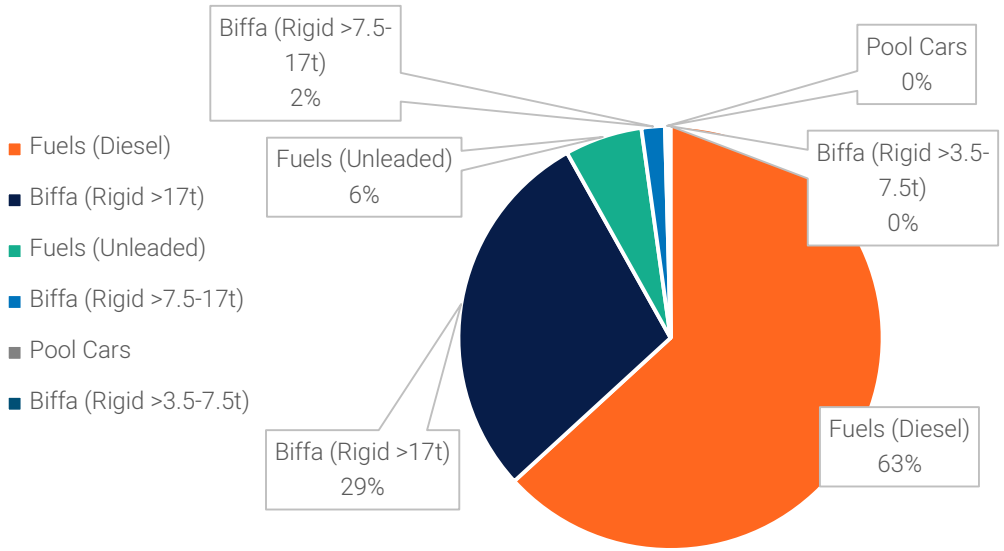
Direct Emissions (Scope 1)





Scope 1 – Further analysis

- The analysis of Crawley Council's own direct (scope 1) emissions focused on two key emissions sources:
  - Buildings & Other Assets
  - Vehicle Fleet
- Scope 1 emissions accounted for **2,466 tCO_2e**, which is **7%** of the council's own emissions for FY1819.
- The biggest source of direct emissions were buildings and other assets owned by the council, accounting for **78%** of direct emissions.
- In reference, **56%** of scope 1 emissions were from buildings & other assets operated by contractors, including the K2 & the Hawth. Whereas, **23%** of direct emissions were from council operated buildings & other assets.
- The remainder of direct emissions were apportioned to the council's own vehicle fleet including, HGV's, Cars & vehicle fuel consumption.
- Fuels (vehicles not specified) including diesel and unleaded contributed the largest amount to scope 1 emissions from the council's vehicle fleet, accounting for **337 tCO_2e** & **32 tCO_2e**, respectively.
- The remainder of direct emissions are produced from the council's own vehicle fleet (**22%**), including **163 tCO_2e** from Biffa HGV's classed as Rigid (>3.5 – 7.5t) [**0.79 tCO_2e**], Rigid (>7.5 – 17t) [**10 tCO_2e**] & Rigid (>17t) [**153 tCO_2e**], and pool cars [**1.46 tCO_2e**].

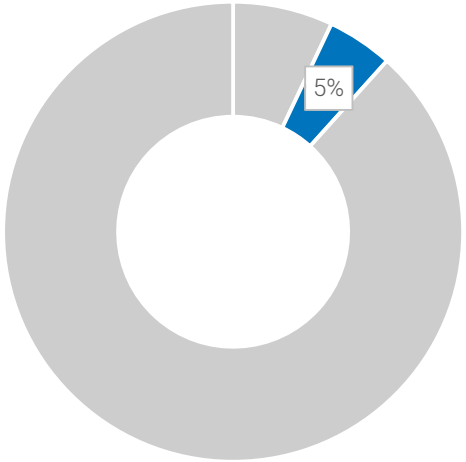


4. Crawley Borough Council's Own Emissions

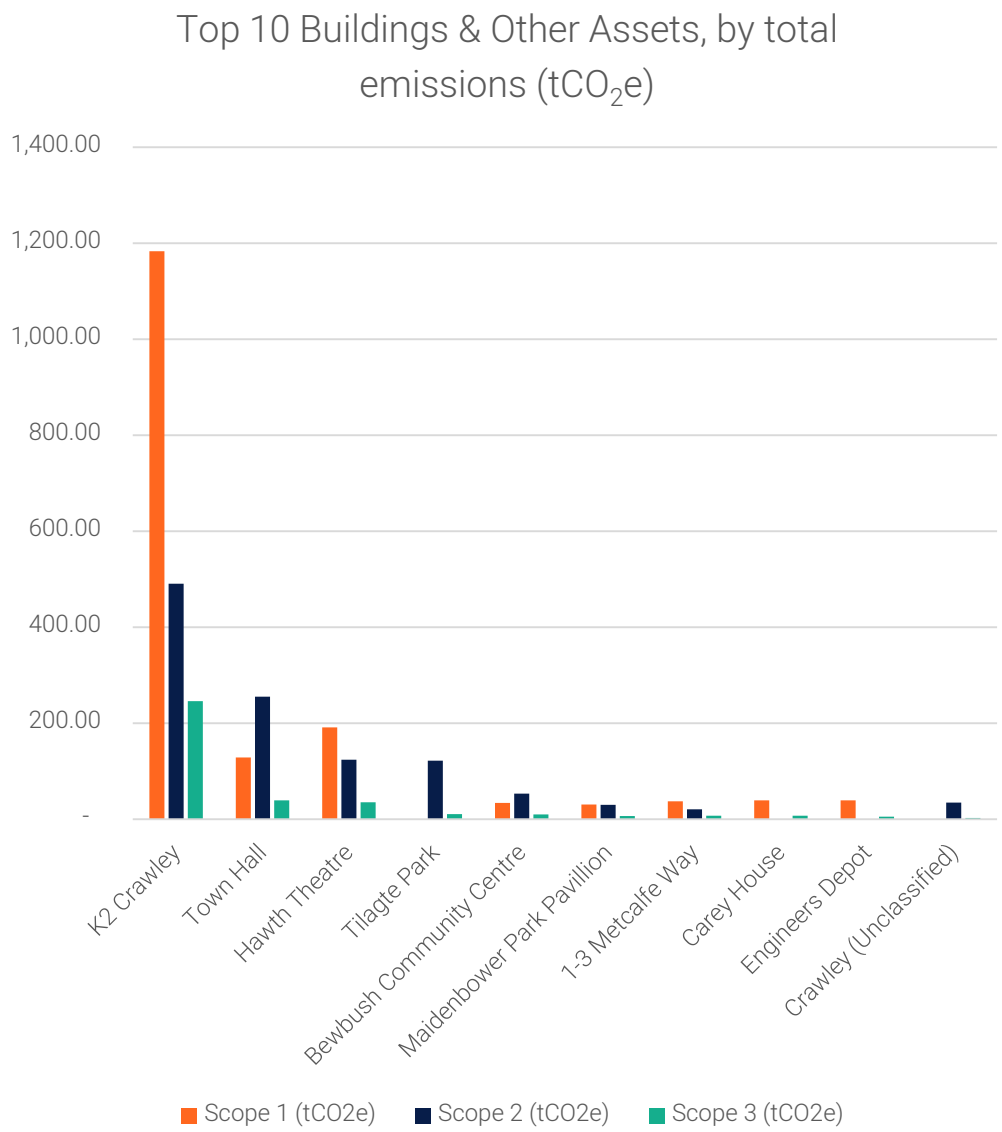
Indirect Emissions (Scope 2)

Scope 2 – Further analysis

- The analysis of Crawley Borough Council's own indirect emissions focused on one key emissions source:
    - Buildings & Other Assets
- Scope 2 emissions accounted for **1,623 tCO_2e**, and **4.6%** of the council's own emissions for 2018-2019.



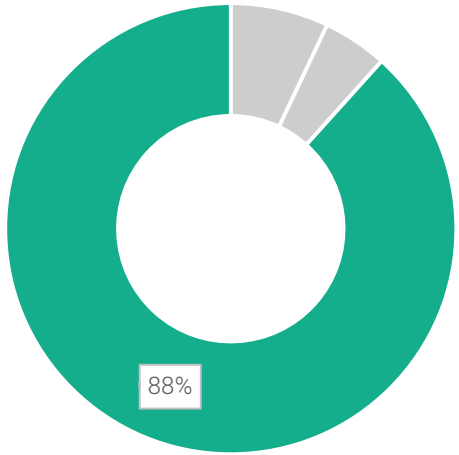
- The council's own indirect emissions are all associated with Purchased electricity from council's own buildings and other assets.
- **61%** of scope 2 emissions were from council operated buildings & other assets, and **39%** of indirect emissions were from contractor operated buildings & other assets.
- The top indirect emissions source within the council's buildings & other assets was from K2 Crawley, accounting for **490 tCO_2e (30%)** of total emissions from purchased electricity consumption within this sector.
- The Town Hall and Hawth Theatre also contributed a substantial amount to the council's own scope 2 emissions, accounting for **16% (255 tCO_2e)** & **8% (124 tCO_2e)** of total scope 2 emissions, respectively.

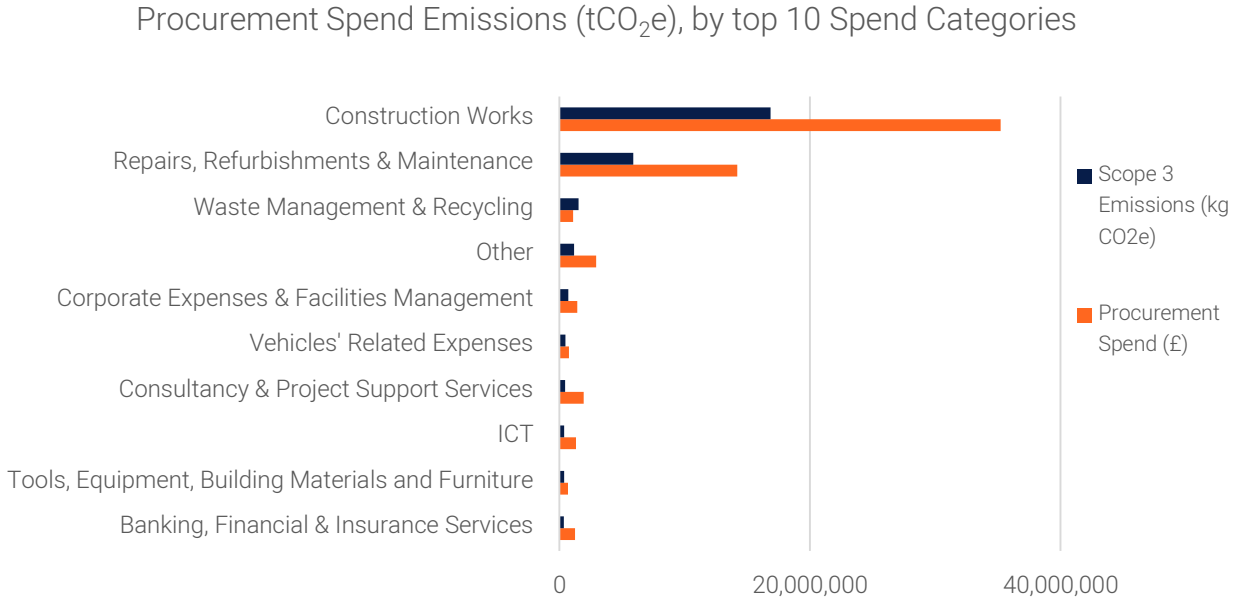


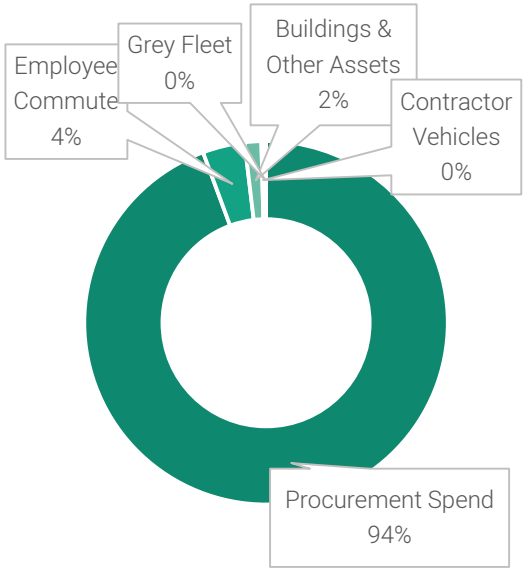
4. Crawley Borough Council's Own Emissions
Other Emissions (Scope 3)

Scope 3 – Further analysis

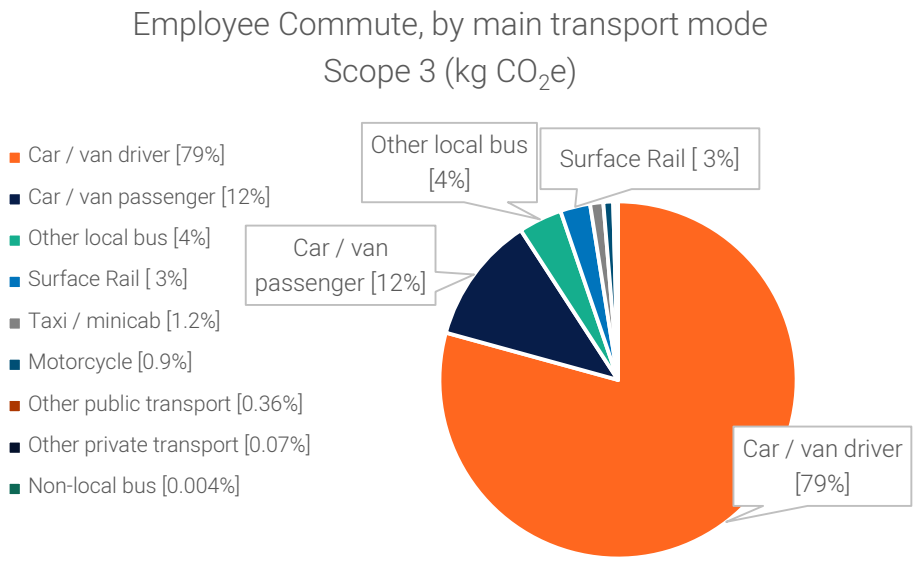
- The analysis of Crawley Council's own other emissions focused on five key emissions sources:
  - Buildings & Other Assets
  - Contractor Vehicles
  - Grey Vehicle Fleet
  - Employee Commute
  - Procurement Spend







- The council's other emissions are largely comprised of input/output emissions associated with procurement spend, accounting for **88%** of total GHG emissions, and **94%** of Scope 3 GHG emissions.
- The top emission sources under procurement spend were categorised as construction works, accounting for **16,849 tCO_2e**.
- The Scope 3 emissions from employee commute were estimated using public datasets from the Department for Transport (DfT) National Travel Survey (NTS) including, average commuter trips by employment status and main mode. This was calculated based on organisational employee size/person(s), with car/van drivers on average making up the largest proportion (**79%**) of Scope 3 emissions from employee commute.



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4. Crawley Borough Council's Own Emissions

Recommendations – Sports & Leisure Facilities (The Hawth & K2)

The following pages set out the recommendations for potential carbon reduction actions for some of the major council emissions sources, with some example case studies for how other councils in the UK have used their differing levels of influence to implement actions towards emissions reduction in each area.

7% of total emissions 2,289 tCO_2e

Sports & Leisure Facilities

Crawley Borough Council has **stronger influence** over sports and leisure facilities in the borough, as many are owned by the council, or have partnerships with the council. There is therefore an opportunity to influence low carbon activities with these buildings.

Suggested carbon reduction measures	Costs / Resources needed	Co-benefits	Examples of other councils taking action
Engage with sports & leisure facilities to switch to a renewable energy supplier	Existing staff resources.	• Cost savings through energy reduction • Increased public awareness of sustainability • Demonstrating leadership to local businesses • Increased self sufficiency through local renewables • Financial benefit from investing in renewables • Increasingly battery storage solutions at scale can reduce (per kWh) lifecycle costs through improved pay back.	• Epping Forest Council replaced the heating system in Loughton Leisure Centre[1] with a new on-site CHP unit, improving energy efficiency of the building. • Exeter Council have signed off work on the first ever PassivHaus swimming pool[2] and leisure centre, expected to reduce energy costs by 70% compared to a good practice swimming pool.
Assess the feasibility of renewable heat source potential such as ground source heat and heat networks	Costs for consultancy fee to conduct audits and analysis. Council staff resource needed to manage assessment.		
Assess the potential for battery storage for existing solar PV	No additional cost beyond council resourcing time to facilitate uptake.		
Conduct energy audits to assess suitability of retrofit options for each council-influenced leisure centre	Investment grade audits can be commissioned per building ranging £2,000-£5,000.[2]		
Implement low water use and water re-use strategies and strategies to reduce evaporation from pool water	Additional staff time to develop strategies with leisure centres.		

Crawley Borough Council actions to date

At K2 Crawley sports and leisure facility:

- CHP replaced May 2019, improving the energy efficiency of the building.
- LED replacement scheme completed to the two largest sporting areas (main sports hall and Gymnastics hall) reducing weekly wattage by over 50,000 to these two areas.
- Energy efficient pumps have been fitted to the pool filtration system.
- LED Replacement schemes are ongoing to other areas (when lights fail, they are replaced with LED replacement fittings).
- All areas were recently fitted with PIR detectors.

At The Hawth Theatre:

- The Main Theatre and Studio (two largest areas) have been upgraded to LED lighting schemes reducing consumption significantly.
- The Main Car park and all external areas were upgraded to LED lighting in 2019 and feasibility currently ongoing looking at LED replacement throughout the main circulation areas.

1- https://www.eppingforestdc.gov.uk/clean-and-green-power-goes-live-at-loughton-leisure-centre/
2 - https://www.passivhaustrust.org.uk/news/detail/?nId=557

4. Crawley Borough Council's Own Emissions

Recommendations - Council's Procurement Spend

Crawley Borough Council has **stronger influence** over its own procurement spend through the guidelines and strategy for procuring goods and services. The council has an opportunity to work with existing and future suppliers to reduce their emissions, supporting reductions in the council's indirect and borough-wide direct emissions.

83% of total emissions 29,171 tCO_2e

Suggested carbon reduction measures	Costs / Resources needed	Co-benefits	Examples of other councils taking action
Define a framework for requesting standardised carbon emissions data from suppliers.	Additional staff resource to develop and consult on the framework.	• Suppliers are engaged and will benefit from cost reductions • Demonstrates leadership to supplier organisations	• Lambeth Council have introduced mandatory carbon reporting[1] as part of their procurement process and have written to engage all current suppliers with the net zero challenge.
Work with all commissioned services and major procurements to ensure they have carbon reduction policies and procedures in place.	May require additional staff resources or training of existing staff.		• Luton Borough Council is working on a new local plan and could seek to demand that developers meet the Code for Sustainable Homes ambitious 'Code 4' standard which would require developers to go significantly in excess of building regulations.
Update responsible procurement requirements to include alignment with carbon neutral ambition, using performance indicators.	May require additional staff resources or training of existing staff.		• Stockport Borough Council are currently undertaking work on developing a mechanism for incorporating carbon pricing into financial appraisals.

Crawley Borough Council actions to date

Sustainable Procurement Charter was updated in May 2019, and asks suppliers to consider minimizing their carbon footprint.

1 - https://moderngov.lambeth.gov.uk/documents/s107089/Appendix%20A%20LBL%20carbon%20reduction%20plan.pdf#page=9

4. Crawley Borough Council's Own Emissions
Recommendations – Other buildings

Crawley Borough Council should also consider actions to manage emissions from other key buildings in the borough. There is further opportunity to manage and reduce emissions from these sources given the extent of control the council has.

5% of total emissions
1,767 tCO_2e

Source	Suggested carbon reduction measures	Costs / Resources needed	Co-benefits	Examples of other councils taking action
Town Hall	• Conduct energy audits for each building and consider retrofitting measures including insulation • Invest in on-site renewable energy generation and storage • Assess the feasibility for air source or ground source heating systems and heat networks • Introduce smart energy management systems to optimise energy use • Review Asset Management strategy and incorporate a carbon target and a way of assessing and monitoring the carbon impact of actions • Develop a sustainable community engagement strategy	Direct control	• Cost savings through energy reduction measures • Return on investment potential from renewable energy supply • Demonstrates council leadership supporting wider reductions across the borough	Waltham Forest Council has invested in 30 energy reduction projects across its building stock, including a boiler upgrade and improved insulation in the Town Hall resulting in 43% reduction in energy consumption.
Community centres		Direct control for council owned community centres. Weaker influence for others		Exeter City Council recently funded the development of Newton Community Centre[1], which was built with energy efficiency in mind, including solar panels and improved insulation and heating.

Crawley Borough Council actions to date

- The new Town Hall is designed to BREEAM 'Excellent' standards.
- Roll out of LED lighting in council owned community centres.

1 - https://news.exeter.gov.uk/newtown-community-centre-set-to-open-at-celebratory-event/

4. Crawley Borough Council's Own Emissions

Recommendations – Employee Commuting

Crawley Borough Council has **weaker influence** over its employees commuting methods, as this is heavily driven by employee behaviours and home locations. There are still a number of measures the council can take to unlock further emissions reductions in this area.

3% of total emissions
1,158 tCO_2e

Suggested carbon reduction measures	Costs / Resources needed	Co-benefits	Examples of other councils taking action
Develop a sustainable travel plan and processes for regularly monitoring and reporting on employee commuting.	Existing staff resources.	• Increased staff engagement on sustainability can help integrate low carbon action across other areas of the council operations • Incentives can help staff reduce commuting costs • Improved health and well-being from increasing more active modes of travel • Reduced congestion through reduction of private car use • Especially during the recovery from the COVID-19 crisis it is becoming increasingly important for health and well-being of staff to have increased home working flexibility	• Lancaster University implemented a travel plan in 2005, achievements include a 24% reduction in carbon emissions from staff and student commuting and the proportion of staff commuting by car alone has reduced from 58% to 43% • Leicester City Council launched a cycle scheme[1] for 8,000 staff members to encourage uptake of electric bikes by reducing the upfront cost.
Conduct a regular staff travel survey to ensure monitoring of commuting modes and distances.	Additional staff resource and fees for external development of travel survey.		
Develop a programme to incentivise staff who drive low emission vehicles.	Existing staff resources.		
Develop communications programme to encourage alternative transport.	Existing staff resources.		
Update long term HR policy to support working from home. Ensure further functionality and support on remote working technology is rolled out.	Existing staff resources. Additional budget may be needed to ensure roll-out of technology hardware to enable home working.		

Crawley Borough Council actions to date

The new Town Hall will have reduced staff car parking and improved cycle parking and other facilities to support active travel. This will be an opportunity for staff to reconsider how they travel to work and embrace new ways of working, reducing the need for car use.
Remote working technology has started to be rolled out using Microsoft Teams.

1 - https://employeebenefits.co.uk/leicester-city-council-cycle-8000/

4. Crawley Borough Council's Own Emissions

Recommendations – Council Owned Fleet

Crawley Borough Council has **stronger influence** over its council's own fleet, as this is owned by the council either directly or indirectly through supplier organisations. There are a number of ways that the council can use its influence to reduce emissions from its fleet.

2% of total emissions 662 tCO_2e

Suggested carbon reduction measures	Costs / Resources needed	Co-benefits	Examples of other councils taking action
Develop a low emissions vehicle procurement strategy	Existing staff resources.	• Reduces air pollution from council fleet, improving health and air quality of the borough • Encourages wider uptake of low emissions vehicles • Demonstrates leadership	• Nottingham City Council was part of a pilot EU funded scheme, CleanMobilEnergy[1] to roll out electric vehicle waste collection trucks powered by renewable energy.
Switch council fleet to electric or plug-in hybrid electric vehicles	The Energy Saving Trust offer a free Ultra-Low Emissions Vehicle review. Transitioning council fleet to low emissions vehicles could be funded through a zero emissions zone or workplace parking levy in key locations.		• South Yorkshire Authorities pioneered the Eco-Stars Fleet Recognition Scheme[2] to evaluate registered fleets and award stars according to their environmental performance, encouraging best practice. • Leeds City Council have electrified 16% of their total van fleet[3]. It is estimated that these vehicles will lead to fuel savings of £13,500 per year and savings of 52 tCO_2 to 2020.
Review and update fleet management plan	Additional staff costs for strategy development.		• The Royal Borough of Kensington and Chelsea developed a Green Fleet Strategy and Action Plan to define their activities towards reducing emissions from vehicles used in all of the council's operations[3].

Crawley Borough Council actions to date

The BIFFA waste fleet contribute a significant proportion of transport emissions for the council. The technology used for the waste fleet will be reviewed to coincide with the procurement of a new waste contract in 3 years.

1 - https://www.nweurope.eu/projects/project-search/cleanmobilenergy-clean-mobility-and-energy-for-cities/
2 - https://www.ecostars-uk.com/south-yorkshire/introduction/
3 - https://environmentjournal.online/articles/leeds-council-to-add-more-electric-vehicles-to-its-fleet/
4 - https://www.rbkc.gov.uk/greenerborough/sites/default/files/atoms/files/Green%20Fleet%20Strategy%20and%20Action%20Plan.pdf

4. Crawley Borough Council's Own Emissions

Recommendations – Crawley Homes

Emissions not tracked

Crawley Borough Council owns 8,158 council homes and therefore has **direct control** over activities and measures taken in Crawley Homes. Significant action has already been underway to improve the efficiency of energy use in these buildings while also increasing on-site renewable generation, which the council can continue to build on. Data is not currently collected on the energy consumption of Crawley homes, however they represent a significant asset owned by the council and therefore it will be crucial to consider relevant carbon reduction measures and aim to track energy consumption going forward.

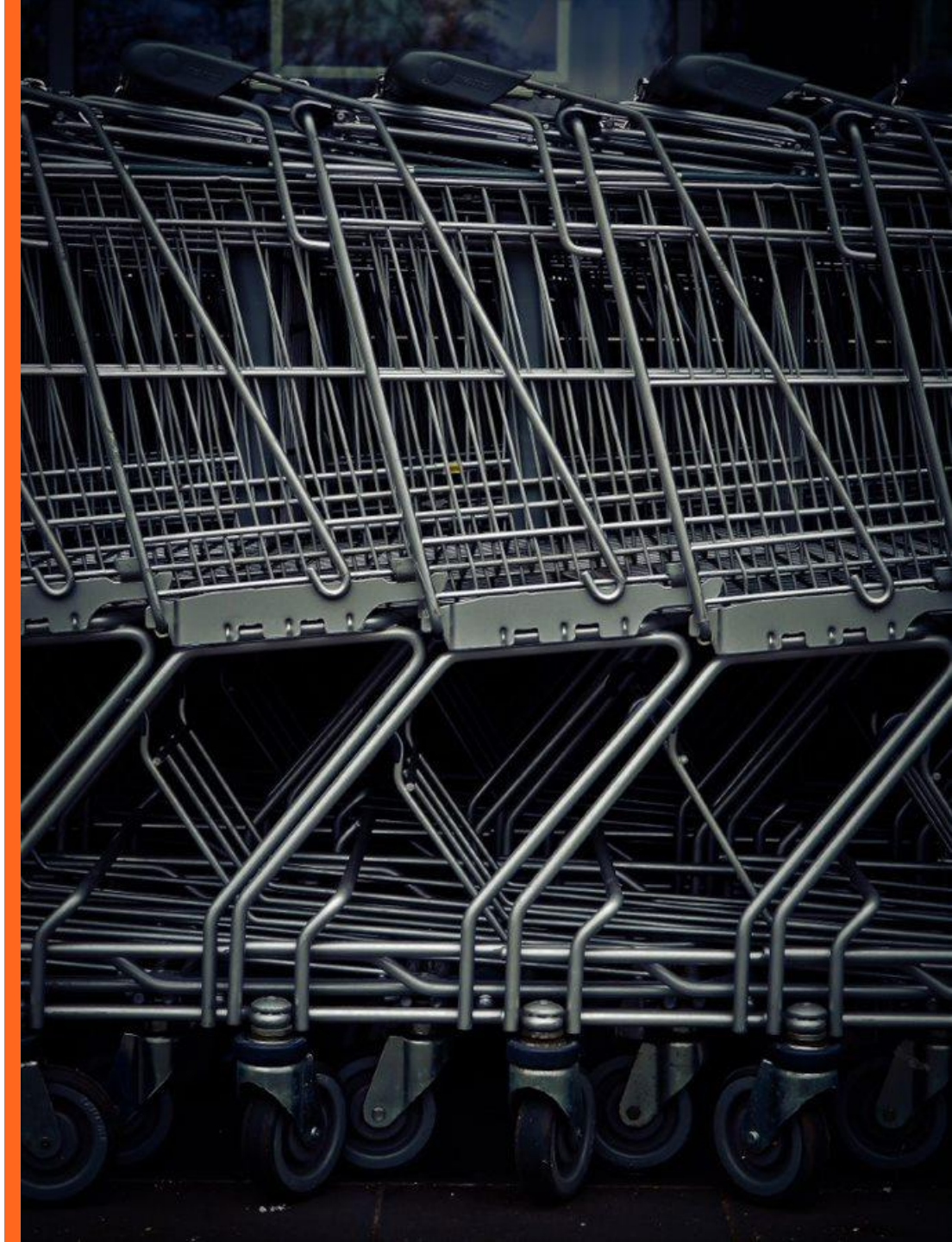
Suggested carbon reduction measures	Costs / Resources needed	Co-benefits	Examples of other councils taking action
Review investment plans for stock with below 'D' EPC rating with the aim of improving energy efficiency standards using stock modelling software such as IRT DREam	Existing staff resources.	• Energy savings will provide long term cost savings • Increased need for retrofit provides opportunities for job creation • Reducing energy costs tackles fuel poverty • Improving new build standards encourages higher standards for construction companies, showcasing leadership • Increased awareness of residents through engagement and behaviour change programs • Improved temperature conditions in homes increases health and wellbeing of residents	• Exeter Council is pioneering a retrofitting approach to its council homes to deliver net-zero energy properties in Chestnut Avenue using the Energiesprong energy efficiency solution[1]. This incorporates a ground source heat pump heating system, insulated wall and roof panels and solar PV rooftop installations with battery storage facility. • Portsmouth Council have been awarded funding to roll out the Energy Redress Scheme[2], a program targeted at reducing fuel poverty through home visits and a dedicated energy advice helpline for vulnerable and disadvantaged communities. • Anthesis worked with Sheffield City Council[3] to arrange SAP surveys of council homes to determine the eligibility for ECO funding.
Consider implementation of district heating and heat pump technology for lower carbon heat sources, such as air and water source heat pumps	Resources would be needed to manage contract and costs for procurement of services.		
Develop a strategy for decarbonising and improving the efficiency of council housing	Additional staff costs for strategy development.		
Assess the possibility of mandating higher standards for new homes	Existing staff resources.		
Develop a behaviour change programme for tenants of council housing to encourage efficient use of energy in the home	Additional staff costs for strategy development.		

Crawley Borough Council actions to date

- 222 Crawley Homes have been fitted with solar PV producing a total of 666kWh back to the grid.
- Additional installations in Forge Wood, Northgate and Three Bridges have been implemented after the removal of the Feed-in-Tarif scheme.
- 40kWh of solar PV has been installed across council owned hostels and sheltered housing.
- An additional 32kWh of solar PV has been installed on newer blocks of flats.
- Currently exploring battery storage solutions to maximise benefit from these installations.
- LED lighting upgrades to communal areas of housing blocks, 73 blocks completed with work continuing through 2020.
- In 2016 SCHAFFER HOUSE Sheltered housing was fitted with a water source heat pump in place of boilers. The council will see a carbon reduction of 50% at the site.

1 - https://news.exeter.gov.uk/plans-to-turn-exeter-s-council-house-stock-into-super-energy-efficient-home/
2 - https://environmentjournal.online/articles/portsmouth-council-receives-funding-from-charity-to-tackle-fuel-poverty/
3 - https://www.anthesisgroup.com/case_study/case-study-energy-company-obligation-eco-funding-for-sheffield-city-council/

Appendices



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Appendix 1

Data Tables for SCATTER and BEIS Emissions Summaries for entire Crawley Borough

Sectors	Scope 1 & 2 Emissions, ktCO2e
Industry and Commercial Electricity	121.4
Industry and Commercial Gas	51.1
Large Industrial Installations	0.3
Industrial and Commercial Other Fuels	43.5
Agriculture	0.5
Domestic Electricity	40.5
Domestic Gas	93.1
Domestic 'Other Fuels'	2.6
Road Transport (A roads)	63.4
Road Transport (Motorways)	86.9
Road Transport (Minor roads)	45.4
Diesel Railways	0.2
Transport Other	53.7
LULUCF Net Emissions	-8.3
Total	594.4

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

Sub-sector	Direct ktCO2e	Indirect ktCO2e
Residential buildings	93.9	57.0
Commercial buildings & facilities	25.5	18.4
Institutional buildings & facilities	65.7	92.8
Industrial buildings & facilities	28.0	53.8
Agriculture	0.4	0
Fugitive emissions	0	0
On-road	162.5	IE
Rail	0.1	IE
Waterborne navigation	0	NO
Off-road	0	IE
Solid waste disposal	31.9	0
Biological treatment	0.0	0
Incineration and open burning	0.0	0
Wastewater	7.0	0
Industrial process	0	0
Industrial product use	0	0
Livestock	2.0	0
Land use	0	0
Other AFOLU	NE	0
Electricity-only generation	0	0
CHP generation	0.1	0
Heat/cold generation	0	0
Local renewable generation	0	NE
Sub-total	417.3	222.0
Total	639.2	

Notes:
•BEIS data (above) and SCATTER data (right) are compiled using different methodologies. The SCATTER model operates on 2016 data. BEIS data is from 2017.
•Within the SCATTER model, national figures for emissions within certain sectors are scaled down to a local level.

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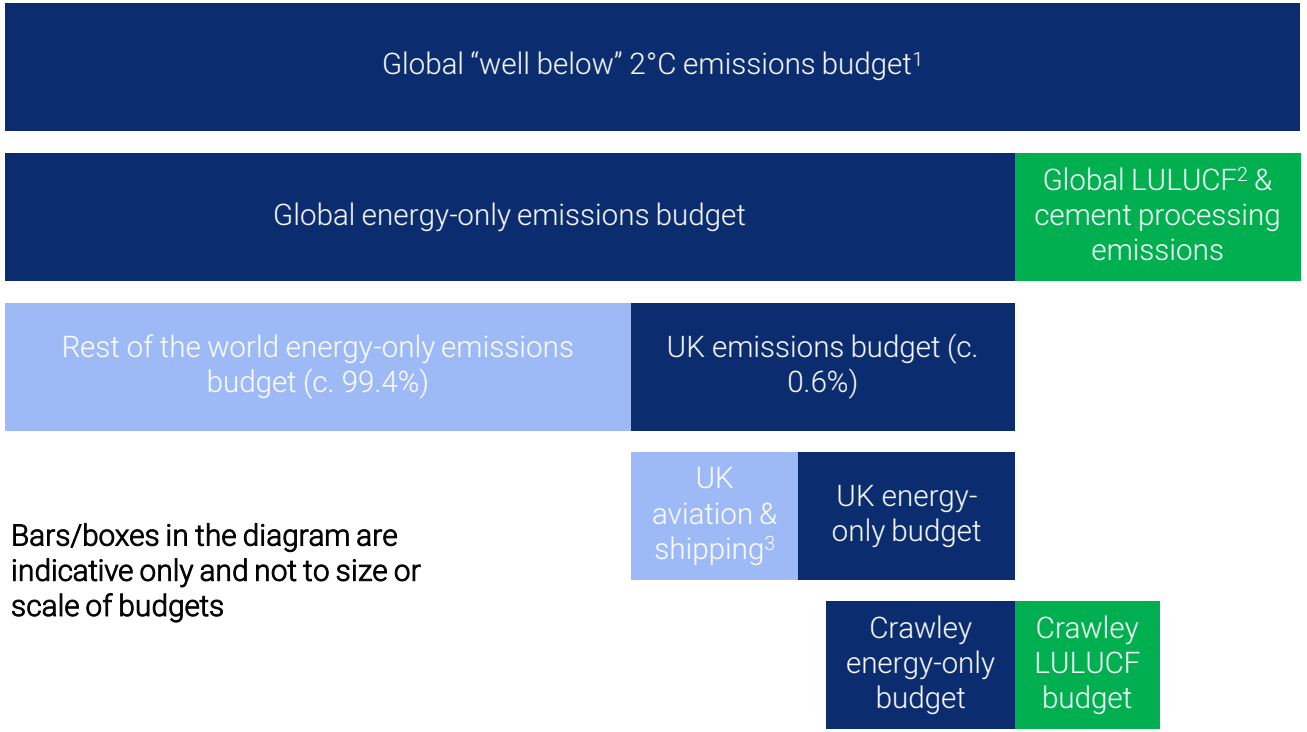
Appendix 2

Deriving the Crawley Borough Carbon Budget



Bars/boxes in the diagram are indicative only and not to size or scale of budgets

The borough's carbon budget defines a finite emissions limit that should not be exceeded in order that Crawley plays its full part in adhering to the Paris Agreement.

The global budget is taken from the IPCC Special Report on 1.5 °C and represents the latest IPCC estimate of the quantity of CO_2 that can be emitted whilst remaining consistent with keeping global temperatures below 2 °C.

The carbon budget report is available here.

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 15% emissions reduction rates for Trafford 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 3

Summary list of interventions and modification summary

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

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

Notes:

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

Appendix 4

Domestic retrofit measures assumed within SCATTER level 4 pathway (page 20 and 21)

Retrofit Measure	Number of households retrofitted per annum						
Year	2020	2025	2030	2035	2040	2045	2050
Solid wall insulation	397	409	423	436	565	5	5
Cavity wall insulation	830	48	49	49	182	-	-
Floor insulation	453	467	482	497	645	491	491
Superglazing	900	929	959	988	1,282	976	976
Lofts	995	1,026	1,060	1,092	1,450	-	-
Draughtproofing	3,162	135	139	139	506	5	5

Notes:

- This data is included within SCATTER but is not directly linked to the emissions calculation in the model (it was used to inform cost assumptions in the original legacy DECC 2050 Pathways calculator).
- The numbers shown are the minimum assumed measures for the L4 Pathway, as ambition was pushed further than the legacy DECC tool to which this table relates.
- 2050 household levels are predicted to be 106,236, derived from non-region specific growth assumptions in legacy DECC Pathways tool.
- Household is defined as per https://www.gov.uk/guidance/definitions-of-general-housing-terms#household
- The average heat loss per home includes new builds (at PassivHaus standard), which will contribute to lowering the average over time.
- For further detail, please refer to Section D of the DECC 2050 Pathways guidance:

Appendix 5
Energy Performance Certificates (EPCs)

Non-domestic EPC ratings for Crawley 2008-19	
EPC rating	Number of lodgements
A	27
A+	0
B	150
C	684
D	702
E	298
F	100
G	88
Not Recorded	0
Total number of lodgements	2,049

Domestic EPC ratings for Crawley, 2008-19	
EPC Rating	Number of lodgements
A	11
B	1,215
C	11,257
D	12,490
E	2,751
F	435
G	117
Not Recorded	0
Total number of lodgements	28,276

Notes:
- Defining in terms of 'lodgements' allows direct comparison between domestic and non-domestic property.
- Only 63% of domestic properties carry a publicly available EPC rating.
- Live reporting on the EPC ratings of all properties (both domestic and non-domestic) can be found at: https://www.gov.uk/government/statistical-data-sets/live-tables-on-energy-performance-of-buildings-certificates#epcs-for-all-properties-non-domestic-and-domestic

Appendix 6

Domestic & commercial heating and hot water systems assumed within SCATTER Level 4 pathways

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

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

Notes:

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

Appendix 7

Transport assumptions for SCATTER level 4 pathway

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

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

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*Pax ~ people/persons/occupants

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