APPENDIX 7

South Gloucestershire

CO_2 emissions baseline and net zero gap analysis

Report to accompany dataset and presentation of results

November 2019

This report was produced for	South Gloucestershire Council
Issue date	6 November 2019
Version	Final
Written by:	Frankie Mayo
Approved by:	Hazel Williams

Regen, Bradninch Court. Exeter, EX4 3PL

T +44 (0)1392 494399 E admin@regen.co.uk www.regen.co.uk

Registered in England No: 04554636

All rights reserved. No part of this document may be reproduced or published in any way (including online) without the prior permission of Regen

1. Introduction

1.1 Introduction

South Gloucestershire Council commissioned Regen to produce a carbon emissions baseline study. The aim of the study is to provide an initial evidence base to inform the Council's planning in response to its July 2019 climate emergency declaration. The analysis covers emissions from energy consumption for heat, power, and transport in the area, as well as a high-level analysis of agricultural CO_2 emissions from energy and potential carbon sequestration opportunities. Total CO_2e emissions from agriculture were not included in the scope of this study, for example emissions from fertiliser use or cattle rearing.

This report is an accompaniment to the slide-pack and data produced. It is structured to match the slide-pack delivered to South Gloucestershire Council as part of the carbon baseline and gap analysis study. The report provides additional context, data sources, methodology, and narrative, as an aid in understanding and presenting the dataset and slides. Please note that not all the slides are replicated in the report.

1.2 Structure of the report

Section 2 of this report sets out a scope 1 and 2 CO_2 emissions baseline for 2017 for the South Gloucestershire area. This comprises emissions from:

- Domestic heat by fuel source
- Non-domestic heat by fuel source
- Residual power consumption in domestic and non-domestic properties
- Emissions from transport by vehicle type and fuel type
- Emissions from agricultural energy use.

The baseline year across the entire analysis is 2017. However, where noted, the most up to date data is used, for example, for the renewable energy capacity totals in the area.

As well as the baseline, Section 2 includes statistics on energy efficiency, high emitting sectors, the financial value of energy purchased in the region, and reasons for historic changes in the emissions.

Section 3 presents analysis of South Gloucestershire Council's own scope 1 and 2 emissions was completed, alongside historic trends and an initial assessment of the scope 3 emissions from council procurement expenditure.

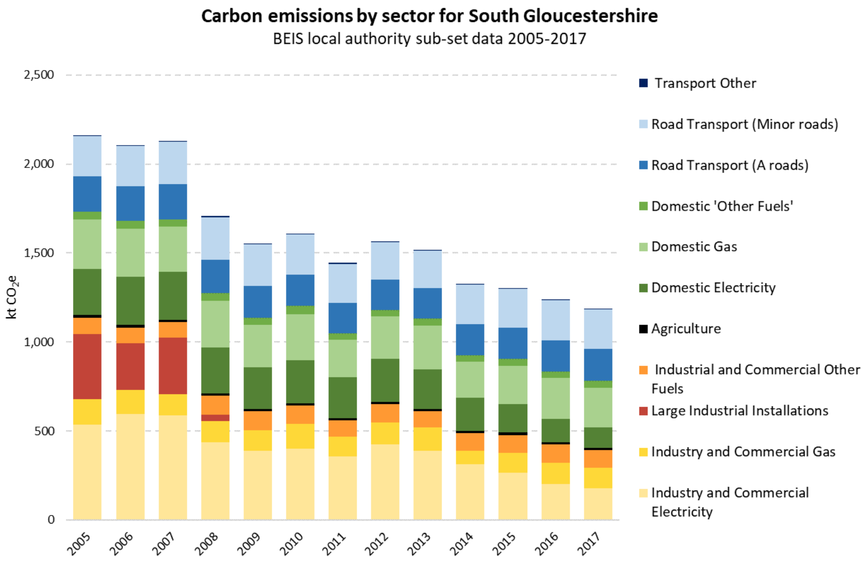
Section 4 models two pathways for South Gloucestershire. The first models what needs to happen in order to achieve the target of net zero carbon by 2030. This is called the 'net zero pathway'. The second models a highly ambitious approach to reducing carbon towards net zero but does not quite achieve net zero in 2030. This is called the 'highly ambitious pathway'. In addition, a series of essential 'need to do' actions have been identified which are common to both pathways. The purpose of this is to evidence the scale of interventions necessary, such as the scale of deployment of electric vehicles and reduction in miles needed to reduce transport emissions in line with a net zero pathway.

As part of the pathways analysis, the role of local, regional, and national action is highlighted. Some interventions are more easily impacted or influenced by council action; however, others are more dependent on regional or national government action, such as the carbon intensity of electricity on the national grid.

Section 5 summarises the scale of change that is needed for each of the key sectors and gives headline national and local/regional actions that could facilitate the change. Section 6 details gaps where further follow-up work is recommended. Finally, section 7 gives details of and weblinks to the data sources referred to through the report and used in the analysis.

2. South Gloucestershire baseline emissions

Slide 4: South Gloucestershire emissions over time



Slides 4 and 5 show the historic trends in emissions for South Gloucestershire from 2005 to 2017. The total emissions each year are broken down into sectors by fuel use.

Key points

- Since 2005, there has been a 45% reduction in total emissions, while population rose 9%.
- The significant reduction in large industrial installations is a major contributor to the reduction in emissions, alongside reduced domestic electricity consumption and falling electricity carbon intensity.
- There has been only a very limited reduction in transport emissions.

Methodology of note

- This data is sourced from the BEIS local authority emissions data.

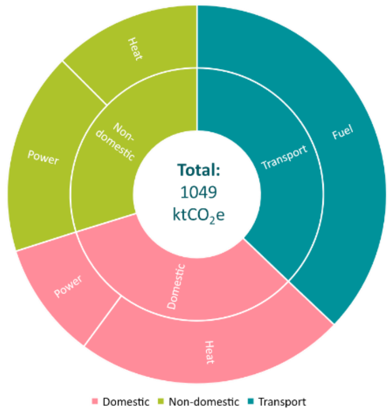
Assumptions and limitations

- The BEIS local authority emissions data presents a subset of the baseline carbon emissions for the area. Its scope is restricted to the emissions that can be apportioned to the local authority. This means large power stations, aviation, shipping and motorway traffic is removed.
- Transport emissions within the BEIS local authority emissions data are taken from the total GB transport emissions and apportioned by road type to local authority areas, based on the results of the Road Traffic Survey. Since the BEIS data relies on a methodology which does not easily differentiate between vehicle types and fuel use, it is hard to use this data to estimate the impact of initiatives to increase the uptake of low-emission vehicles.

Data sources

- BEIS local authority emissions data

Slide 6: 2017 South Gloucestershire baseline emissions



Slides 6 shows the results of the Regen baseline analysis for 2017. The total CO_2 emissions from energy consumption are made up of three categories: 'domestic', 'non-domestic' and 'transport'.

Key points

- The BEIS local authority emissions data shown in slide 4 may be considered 'top down'. Slide 6 shows the results of Regen's 'bottom up' emissions baseline analysis, created using benchmarks and local data, such as the number of domestic and non-domestic properties. The energy efficiency of buildings, their heating technology types, the power demand and road-transport vehicle types and miles driven have all been analysed.
- By creating this 'bottom up' total emissions baseline for 2017, the subsequent analysis can isolate the impacts of certain interventions, such as energy efficiency improvements or the decarbonisation of heat.
- Other than emissions from agricultural energy consumption, the total South Gloucestershire area CO_2 emissions are roughly split into thirds.
- As transport is electrified, the transport 'third' will reduce as some of these emissions are picked up by either home-charging and the domestic electricity bill, or through private 'non-domestic' charging service stations.

Methodology of note

- Domestic and non-domestic heat emissions: The number of properties with each heating-fuel type was extrapolated from Energy Performance Certificate (EPC) data. These results were combined with the local average heat demand by fuel type, incorporating energy efficiency statistics for the area and then multiplied by efficiency factors to produce fuel demand and carbon factors to produce emissions from that fuel demand.
- Power emissions: Electricity consumption by sector from the BEIS local authority total energy consumption statistics were combined with national grid carbon intensity factors. In the final representation here, 'power' represents all electricity use apart from heat. Electricity demand for heat is included in the 'heat' segment.

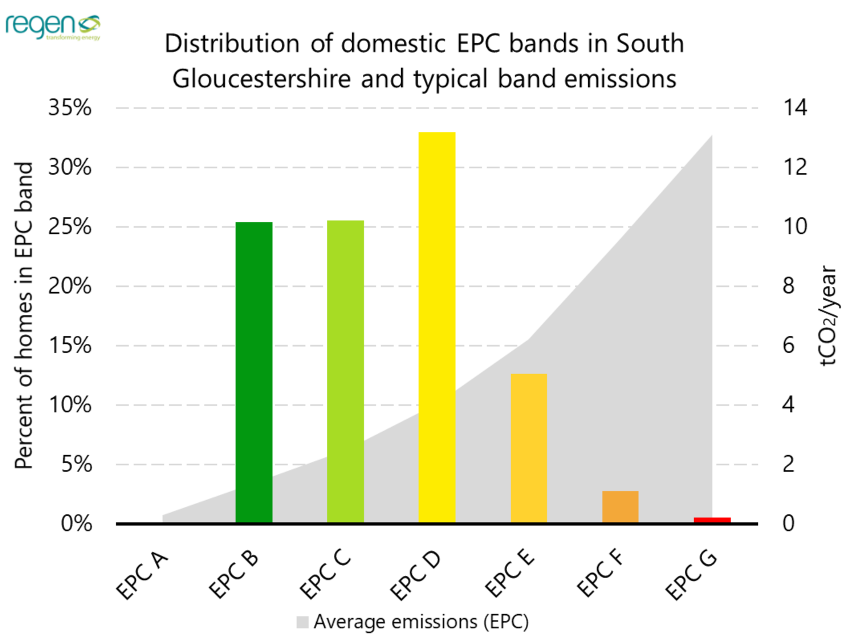
Assumptions and limitations

- These results differ slightly from the BEIS total local authority emissions data. This is due to slightly different methodologies used. For example, a more accurate measure of transport emissions has been used, based upon the average mileage driven by the known vehicle-type mix registered in the area, rather than the proportion of national mileage in the area.

Data sources

- EPC data, Department for Transport vehicle registration statistics, census data, BEIS sub-national energy consumption.

Slide 8: Domestic EPCs and baseline emissions summary



Slide 7 gives some details of domestic baseline demand and slide 8 introduces the domestic energy efficiency baseline data. The EPC data shown here is used throughout the study to assess the domestic fuel demand and associated emissions.

Key points

- Over half of all those properties with an EPC in 2017/18 were an EPC B or C. There were zero homes with an A rating.
- Energy efficiency is a key component of reaching net zero carbon emissions. Reducing energy consumption reduces emissions, as well as helping to tackle fuel poverty and associated deprivations relating to health and wellbeing. By reducing energy consumption to as low as practicable, the more challenging task of decarbonising residual energy consumption is made easier.

Methodology of note

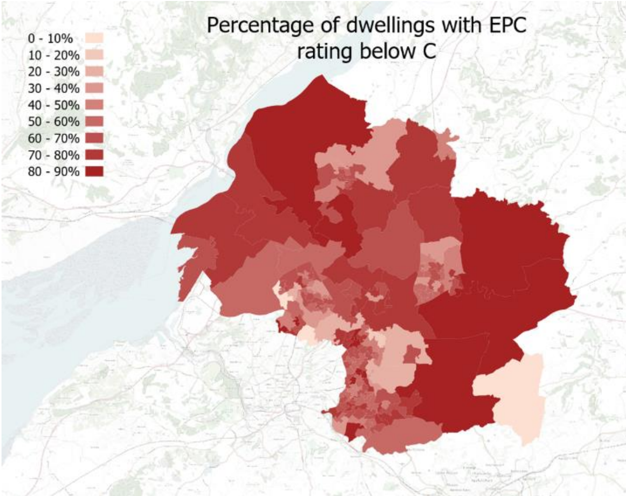
- Every home which transfers ownership or is newly built is registered with an EPC. The most recent EPC data is published up to midway through 2019.
- Aggregated at a local authority level, this data provides an indication of the average energy performance of properties in the area, as well as main heating type, and associated recommendations for energy efficiency and reduction in CO_2 emissions.
- Recent EPCs with entries from 2018/19 years have been used as a snapshot and duplicates have been removed wherever possible.

Assumptions and limitations

- There are some important limitations to the EPC data:
  a. Not every home has an EPC, so the data has been extrapolated to cover the 115,000 homes in South Gloucestershire.
  b. Older EPC data is less reliable as changes may have been made to a property's efficiency level without a new EPC being issued. The most recent years of 2018/19 are used as a 'snapshot'.
  c. The energy use and carbon emissions are estimates, and the 'main heating fuel' does not account for secondary sources of heat, or if only a single room in a house is heated for instance.

Data sources

Slide 9: Data reported by small geographies



Slides 9 and 10 present the work done to represent baseline emissions data by smaller geographies within the South Gloucestershire area. These are typically Lower Layer Super Output Areas, or outward postcodes. These slides may be used to show a local picture for energy efficiency or homes without gas heating.

Key points

- In the database, data has been presented by LSOA or outgoing postcode for: Number of households, average CO_2 emissions, number of heat pumps, number of homes with heating technologies (coal, oil, gas, electricity, etc.), number of homes in each EPC band, domestic solar PV installations, off-gas homes, and number of vehicles.
- Areas of correlation can be observed between estimated emissions and off-gas homes for instance, or in some areas, a correlation is noticeable between the higher than average number of cars per person, and the installation of rooftop solar PV – both potential indicators of affluence.

Methodology of note

- Much of this data was compiled for other areas of analysis, such as transport vehicle numbers from Census 2011 and 2019 Department for Transport. The EPC data for heating fuels and for EPC bands was compiled as part of the domestic heating emissions analysis.
- Other demographic information is available through the ONS and Census data and have been reported to 2017. These and other statistics have been represented in a series of thematic maps included in the slide and database outputs of this study, showing the distribution of different factors within the local authority area.

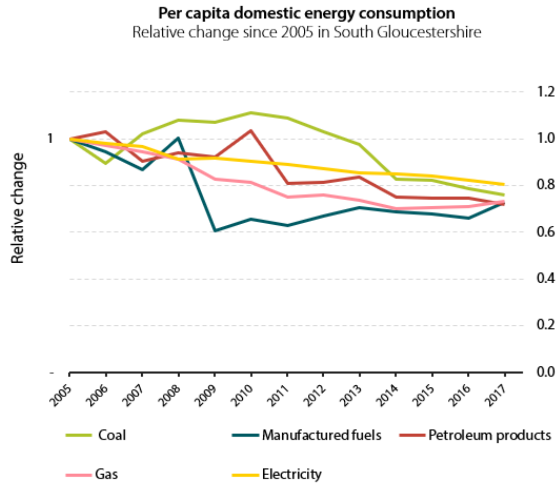
Assumptions and limitations

- Feed-in Tariff data has been used to assess the total number and capacity of domestic rooftop solar PV in the area. However, some solar PV may have been installed without registering under the subsidy scheme, especially as the scheme ended to new entries in March 2019.
- Limitations for EPCs have been listed elsewhere: in short they are only a ‘snapshot’ of energy efficiency statistics and are extrapolated out to all homes to give an indication of the entire housing stock.

Data sources

- EPC data, BEIS energy consumption data, Office for National Statistics population estimates, Ofgem Feed-in Tariff data.

Slide 13: Historic trends in domestic emissions



Slides 12, 13 and 14 describe the changes to CO_2 emissions from domestic energy consumption since 2005. They are broken down by fuel type and show absolute and relative change.

Key points

- Each individual fuel component of domestic energy consumption has reduced to around 80% of their 2005 value.
- In real terms, the largest reduction is in domestic per-capita gas consumption – down by around 1.6 MWh per person. There have been some limited improvements in domestic fabric efficiency across the area, but the reduction in domestic gas consumption is largely attributable to the increased efficiency of gas boilers. Non-condensing boilers can have efficiency of around 75-80%, whereas modern condensing boilers have a higher 85-90% efficiency.
- However, though the overall consumption trend is downwards, domestic per-capita gas usage rose slowly each year from 2014 to 2017, so that 2017 consumption levels were similar to 2013.
- Domestic electricity consumption has reduced in line with improving average appliance efficiency, which has more than offset increased appliance usage.

Methodology of note

- The results have been calculated from BEIS sub-national energy consumption by fuel, paired with population estimates to calculate per-capita consumption.

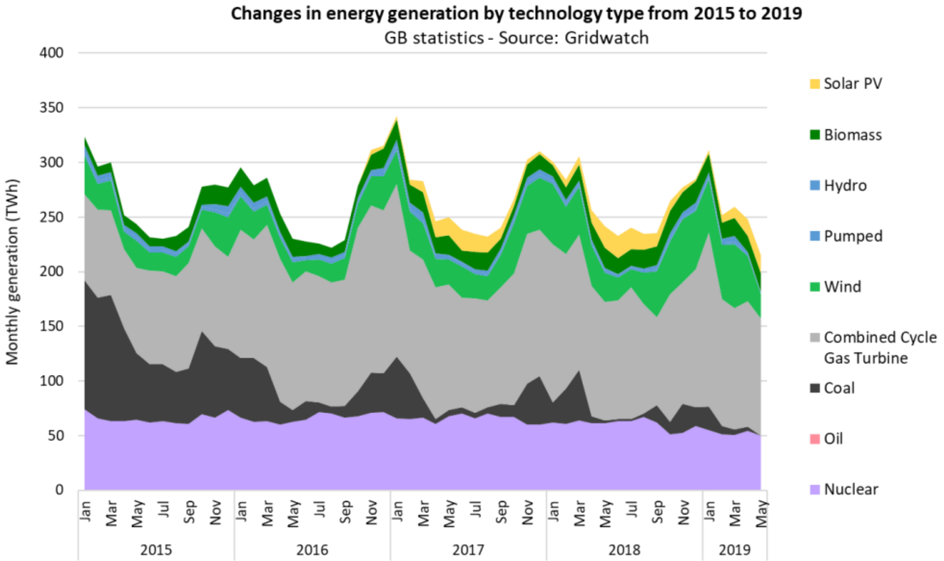
Assumptions and limitations

- There are competing factors to assess in the domestic trends for gas and electricity consumption. Changing customer behaviour, partially in response to increasing costs of energy, is not as easy to model as boiler efficiency and domestic energy efficiency.

Data sources

- BEIS sub-national energy consumption, ONS population estimates.

Slide 15: Historic trends in emissions from electricity



Slide 15 shows the changing generator fuel mix in the national electricity supply from 2015 to 2019. It can be used to demonstrate the importance of national electricity decarbonisation measures.

Key points

- The carbon intensity of electricity at a national level has reduced significantly in the last 5 years. As shown in slide 15, high-emitting coal has reduced from a major component to marginal supply. In 2019, there were significant number of days without any coal powered generation at all. It has been replaced with renewables such as offshore and onshore wind, as well as natural-gas-fired power.
- This reduction has meant that emissions from power consumption from the domestic and non-domestic sectors have significantly reduced, as the generation source has been decarbonised.
- The other factor contributing to reducing emissions from electricity consumption is reduced demand, through the replacement of appliances with more efficient models and behaviour change.
- Decarbonisation of the electricity supply is a national action point, as the fuel mix is directly impacted by government policy and support for particular technologies. However, it is also influenced by local delivery of projects and local planning, for example on the 3rd September 2019, East Devon District Council rejected an application for a gas-powered power plant on environmental grounds.

Methodology of note

This analysis was based on daily energy generation statistics from Gridwatch UK. It shows both the yearly trends, and the seasonal trends, showing, for example, that coal now only operates in winter periods of peak demand.

Assumptions and limitations

- In this study, a yearly average carbon intensity of electricity has been used. However, slide 15 shows how yearly average carbon intensities can obscure the true emissions from electrical components with highly seasonal demand. For instance, electric heaters are used more in winter, when the carbon intensity of electricity is higher.

Data sources

- Gridwatch data, BEIS carbon intensity statistics.

Slide 17: Energy consumption from non-domestic properties

Heat demand by technology for non domestic properties in South Gloucestershire	
Heat technology	Consumption (GWh)
Biomass	6
District heat	2
Electricity	82
Heat pumps	34
LPG	8
Gas	429
Oil	42
Hybrid heat pumps	-
Other	21

EPC rating	
EPC A	2%
EPC B	12%
EPC C	31%
EPC D	31%
EPC E	15%
EPC F	5%
EPC G	5%

Slide 17 shows some key results of the non-domestic emissions baseline analysis. It shows non-domestic energy consumption for heat by fuel type, demonstrating the prominent role of gas in providing non-domestic heat.

Key points

- Non-domestic emissions account for around 310 kt CO_2 e, from around 5,800 properties.
- Estimates from the EPC data indicate that around 45% of non-domestic properties use gas as their primary heating fuel, and around 35% of properties use electricity. The technology mix is more evenly weighted than for domestic properties, where around 84% of homes use gas as central heating.
- The analysis shows that both domestic and non-domestic properties with electric heating tend to use far less energy for heat. This is partly explained by the smaller average size of these properties and different usage patterns may also contribute to this trend. The result is that gas used for heat is the vast majority of heat energy demand in the area, making up over two-thirds of consumption.
- Estimates from the EPC data indicate that around 45% of non-domestic properties have an EPC rating of a C or above.

Methodology of note

- Non-domestic EPCs and Display Energy Certificates data was accessed and extrapolated for the total number of non-domestic properties in the area.
- A total figure of 5,800 non-domestic properties was used for the South Gloucestershire area. Properties with no energy consumption were excluded from the analysis.

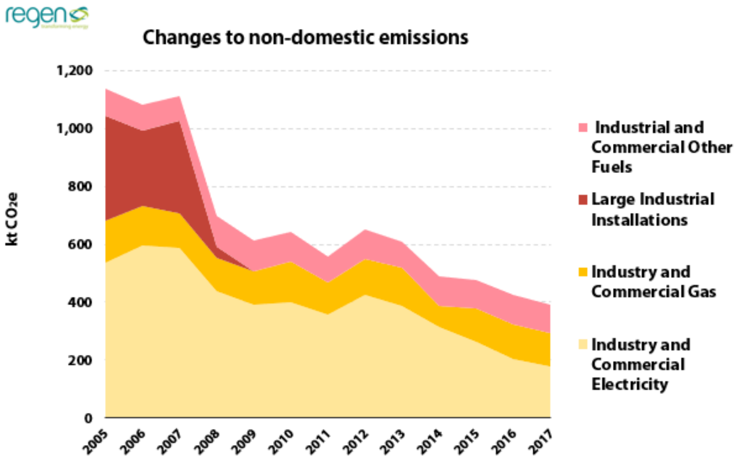
Assumptions and limitations

- The numbers of non-domestic properties with recent EPCs is low, so the extrapolation is only an indication of the whole picture.
- Improved analysis of typical heat demand by building type present in the region would allow for targeted interventions in energy efficiency of heat technology by specific building type. In this study all non-domestic property types were included in one category.

Data sources

- EPC data, Display Energy Certificate data, BEIS sub-national energy consumption

Slide 19: Historic trends in non-domestic emissions



Slides 18 and 19 discuss the changes in emissions from non-domestic energy consumption from 2005 to 2017. The graphs can be used to introduce the changes in large industrial installations, as well as reducing emissions from electricity consumption.

Key points

- Non-domestic emissions have reduced significantly since 2005. Reduced energy consumption, the decarbonisation of grid electricity, and the closure of large industrial installations are all key factors.
- Reductions in non-domestic gas emissions are directly proportional to reductions in gas consumption, as the fuel itself has not been decarbonised in the period. This contrasts with electricity where the changing carbon intensity of grid electricity has combined with efficiency improvements to reduce emissions.
- Slide 19 reflects how the use of 'other fuels' has remained relatively constant since around 2008. In contrast, gas use has fallen to 80% of its 2005 value.

Methodology of note

- This analysis was based upon ONS statistics on local authority estimates of Gross Value Added by sector by year, used to assess the potential correlation between economic output and energy consumption or emissions. For this, the BEIS sub-national total final energy consumption statistics were used.

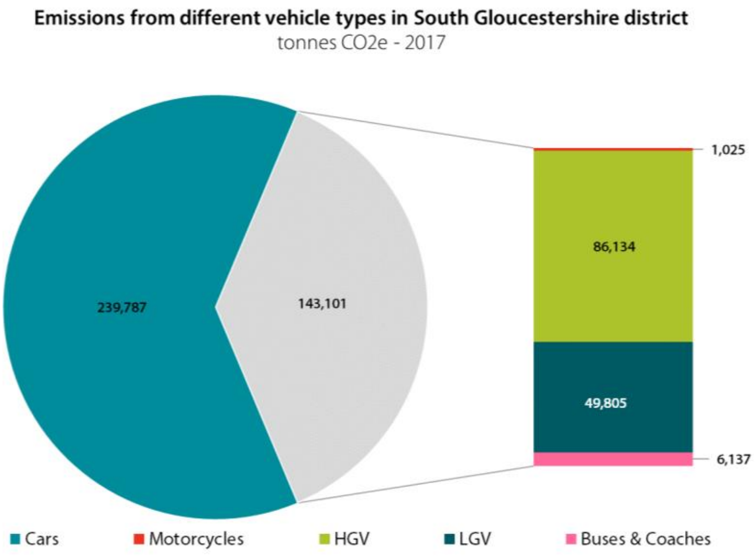
Assumptions and limitations

- Further analysis is needed to more fully understand the factors that have resulted in an 80% reduction in non-domestic gas consumption. For example, factors might include changes in economic activity in specific sub-sectors or the changing stock of non-domestic properties, for instance a relative increase in retail premises. However, increased fabric efficiency and gas boiler efficiency improvements are likely to be key factors.

Data sources

- ONS regional GVA, BEIS total final energy consumption

Slide 20: Road transport baseline emissions summary



Slide 20 shows the vehicle-type split for total road-transport emissions in the South Gloucestershire area.

Key points

- As is typical across the UK, cars make up a significant proportion of total road-vehicle numbers within South Gloucestershire.
- Though there are comparatively fewer HGVs and LGVs, they make up a large proportion of emissions due to their lower fuel efficiency and high mileage.
- Many usage trends are national or even international. For example, consumer vehicle preference and national public infrastructure are not directly influenced at a local level. However, the availability of public transport, car miles driven at shorter journey lengths and charges related to the use of polluting vehicles can be influenced locally.

Methodology of note

- The emissions totals are based upon the number of each vehicle type registered in the area, and the average mileage for those vehicles in the area. In the BEIS local authority emissions data, motorway traffic is excluded from local authority totals as not under their influence, and so motorway mileage is excluded in this analysis too.
- Emissions from electric vehicles are technically included within the analysis; however, electric vehicle deployment is currently so low as to have a negligible impact on the split of emissions by vehicle type.

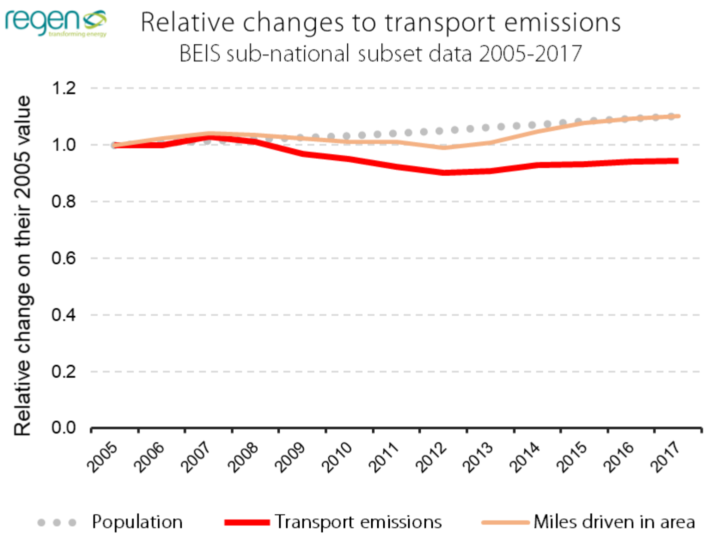
Assumptions and limitations

- Any methodology to apportion emissions from vehicles to a particular geographic area is limited in some way. However, slide 20 is a good indication of the scale and split of transport emissions associated with the area.
- This analysis has only looked at road transport. The impacts of aviation, shipping and rail are not considered at this local level.

Data sources

- Department for Transport vehicle data

Slide 21: Historic trends in road transport emissions



Slide 21 shows the changes in road transport emissions trends, compared to population and mileage trends. The correlation between population and miles driven in the area is clear to 2017, whereas the uncoupling of emissions from mileage is shown from 2009 onwards.

Key points

- Key factors which have historically influenced national road travel include GDP growth, relative cost of learning to drive, the employment rate, urbanisation, and changes to company-car taxation. These are examined further in the Government publication 'Understanding the drivers of road travel', linked in Section 7.
- The total road vehicle mileage in South Gloucestershire is closely linked to population growth, as shown in slide 20. There was a partial deviation following the economic recession in 2008/09; however, mileage has since returned to a growth rate that is proportional to the growth level of the population.
- EU legislation on new vehicle efficiency improvements previously meant that the average vehicle efficiency was slowly, but consistently improving. However, consumer preferences for higher polluting cars such as SUVs, and fewer new diesel vehicles, mean that this average efficiency improvement has stalled in recent years. As can be seen in the chart on slide 20, transport emissions have remained relatively stable since around 2013.

Methodology of note

- The analysis uses BEIS subset local authority emissions data.

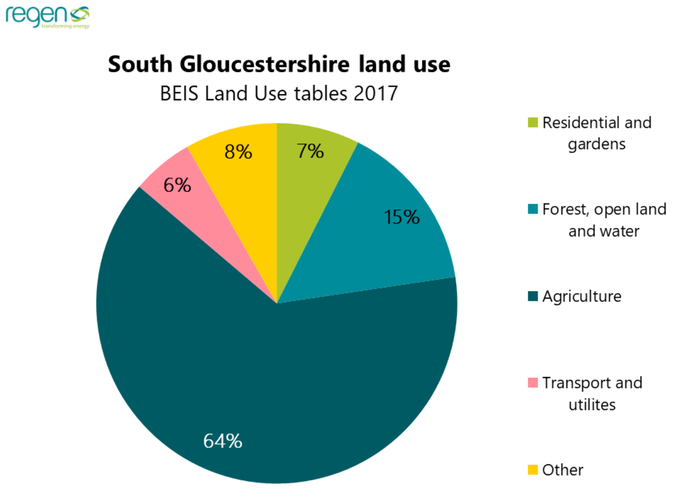
Assumptions and limitations

- Analysis of road traffic behaviour and vehicle trends is complex and to understand fully the local changes in South Gloucestershire would require a further detailed study. However, many of the factors identified in the analysis are driven by national and international trends, which are more easily influenced at a national government level. National trends and research will highlight many answers relevant to a local level too.

Data sources

- BEIS local emissions data, ONS population statistics, and the DfT 'Understanding the drivers of road travel' report.

Slide 22: Land-use data



Slide 22 shows the breakdown of land-use types in the South Gloucestershire area and some of the sequestration potential from land-use change.

Key points

- The South Gloucestershire district consists of 64% agricultural land and 15% natural or semi-natural land. The remaining 20% consists of urban spaces.
- Land in South Gloucestershire is estimated to currently sequester around 10 kt CO_2 per year.
- DEFRA data for land-use change suggests that the most significant carbon sequestering is achieved through a change of farmland into natural land, which may increase the soil carbon content by 286 t CO_2e per hectare. Changing four hectares of farmland to forest would increase the carbon sequestration by one kt CO_2, 10% of the current estimated carbon sequestration of the district.

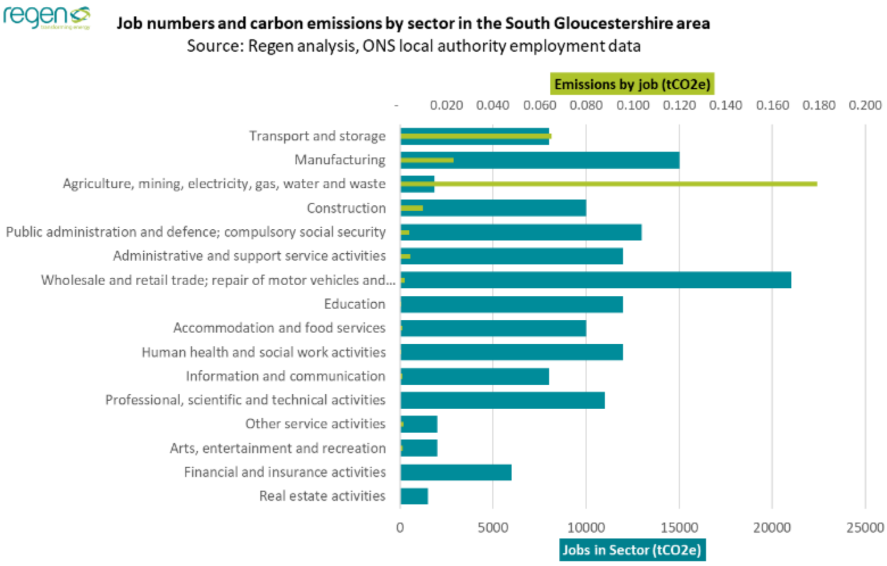
Assumptions and limitations

- BEIS use a model which splits the country into 20 km squares, each with particular land use and carbon sequestration potential. These are divided up and assigned to local authorities to give a total for land use, land use change and forestry emissions.
- This BEIS methodology states an uncertainty of around 40-50% with additional uncertainty of around 20-30% due to the disaggregation process.
- The land use changes only account for the soil carbon content and not other aspects such as biomass carbon content and indirect impacts of these changes.
- There is a lot more work that can be done in this area due to the complexity and significant number of factors to be accounted for. Models with more accurate land use data and information regarding forest management and farming practices could highlight potential areas for improvement.

Data sources

- BEIS local and regional greenhouse gas emissions 2005-2017, BEIS Land use tables 2017, DEFRA UK Emissions by Sources and Removals by Sinks due to Land Use, Land Use Change and Forestry activities, University of Exeter Natural Environment Valuation Online Tool (NEVO).

Slide 23: Employment and emissions by sector



Slide 23 shows data on the typical emissions per job in the area, alongside the number of jobs per sector in the area.

Key points

- Transport and storage, manufacturing, and construction are all sectors with both relatively high employment, and high emissions per job.
- There are relatively few employees in the 'agriculture (etc.)' category; however, the sector has relatively high emissions.

Methodology of note

- The number of local jobs by sector is combined with each sector's typical emissions-per-job to provide an estimate of the higher polluting sectors. It highlights areas of intersection, such as manufacturing and construction which have relatively high emissions-per-job and relatively high number of jobs in the area.
- ONS statistics of carbon emissions per GVA per sector by local authority are available, as are energy consumption per job, employment per sector, and GVA per local authority. These are combined to give an estimated carbon emissions per job and emissions per sector in South Gloucestershire.

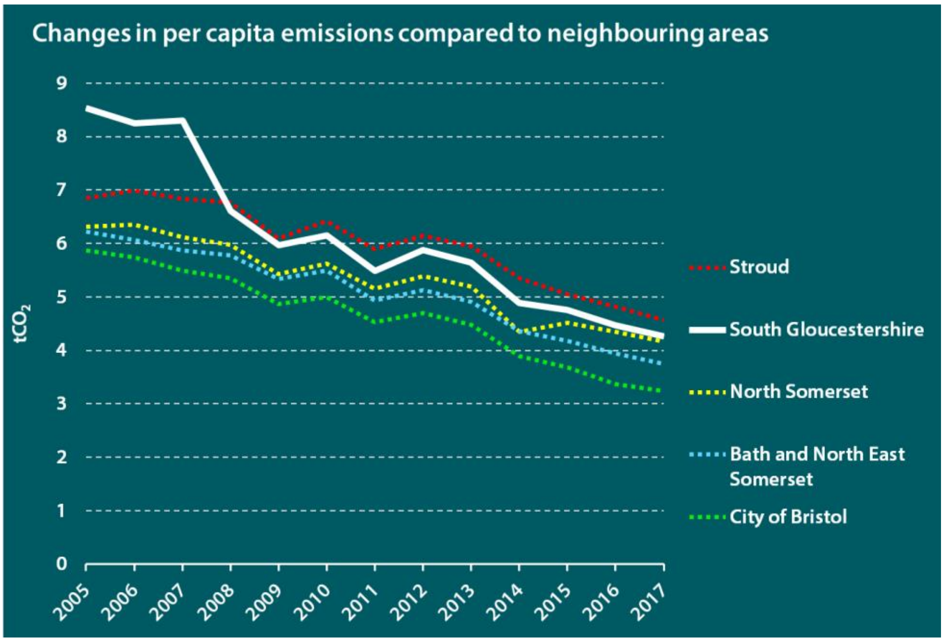
Assumptions and limitations

- There are operational differences between some large employers which are grouped in the same high-level sector, such as South Gloucestershire Council and the Ministry of Defence, which would benefit from further analysis. The Royal Mail are attributed to the high emitting sector 'transportation and storage', whereas in South Gloucestershire they may also have significant administrative employees.

Data sources

- ONS employment and GVA statistics by sector, and publicly available data on large employers in the region.

Slide 26: Emissions per person and regional comparison



Slides 24 to 26 discuss per capita emissions in South Gloucestershire. Slide 26 shows the relative emissions per person for South Gloucestershire and surrounding local authorities. The slide shows how all local authorities may be impacted by national actions, such as the decarbonisation of the national electricity grid.

Key points

- There are many regional or national factors which impact the area's per capita emissions. Whilst there are many local actions which may be taken to transition to net zero, national actions and regional collaboration are also critically important.
- Slide 26 highlights that all neighbouring local authority areas are following similar decarbonisation trends. The per capita reduction in emissions follows national trends for improved efficiency of appliances, vehicles and gas boilers, which have contributed to reduced fuel consumption, and the recent decarbonisation of the national electricity grid as coal plants have come offline.
- The 2007/8 drop in South Gloucestershire's emissions per capita is due to a significant reduction in emissions from large industrial installations in the area that year.

Methodology of note

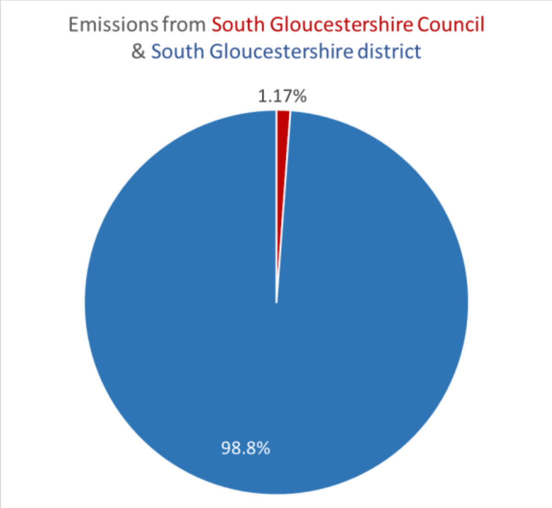
- This is a representation of the BEIS sub-set local authority emissions data graphed on a per-capita basis. It includes all emissions, not just those related to domestic usage.

Data sources

- BEIS local authority emissions data

3. South Gloucestershire Council baseline emissions

Slide 29: Scope 1 and 2 and comparison to the wider region



Slide 29 shows the comparison between the scope 1 and 2 CO_2 emissions for the South Gloucestershire Council as compared to emissions for the area as a whole. Slide 30 and 31 break these emissions down by fuel type.

Key points

- South Gloucestershire Council scope 1 and 2 emissions comprise around 1.2% of the total scope 1 and 2 emissions for the South Gloucestershire area.
- These emissions arise from the fuel usage of council vehicles, the heat and power to council buildings such as schools and offices, and the power used for street lighting.
- Changing ownership has a significant impact on the Council's emissions but not necessarily the area's total emissions. For example, the Council has acquired Bristol and Bath science park, increasing the Council's total electricity consumption. Meanwhile, some schools have become academies, meaning that they are no longer accounted for in the council's consumption statistics.
- Council-owned renewable electricity and heat produced over 1 GWh in 2018/19. There has been a reduction in renewable heat production, whereas renewable electricity generation has remained relatively stable since 2016/17.
- As a policy maker and convener, there are also emissions that are under the sphere of influence of the council, which are not included in scope 1, 2 or 3 emissions.
- The council can also lead by example, and through its prominent position in the local area impact changes in emissions through sustainability leadership.

Methodology of note

- Council emissions were calculated from council-provided consumption data, combined with DEFRA carbon factors.

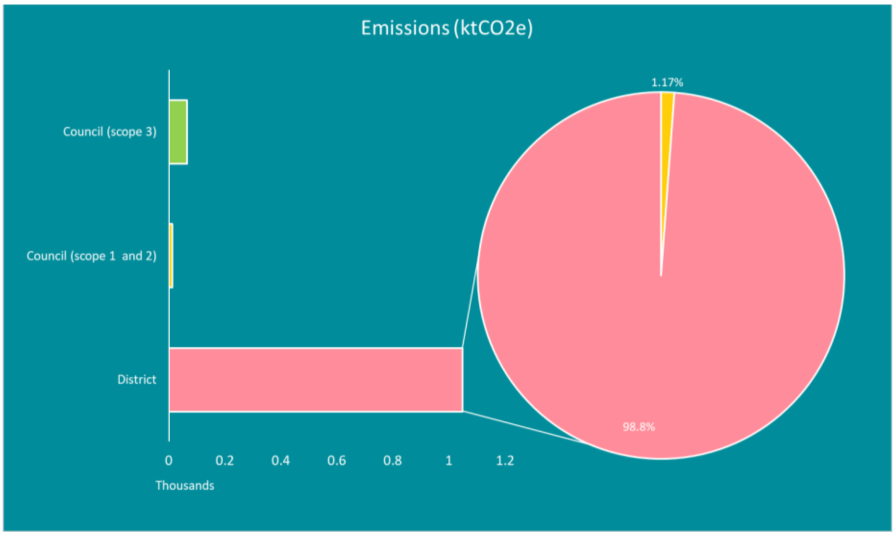
Assumptions and limitations

- Without more detailed information on the renewable heat installations under Council control, the factors influencing the Council's reduced renewable heat generation are unclear.

Data sources

- Council-provided data on consumption and renewable energy generation.

Slide 35: Scope 3 council emissions



Slide 35 compares the South Gloucestershire Council scope 3 emissions from procurement to the Council's scope 1 and 2 emissions.

Key points

- Scope 3 council emissions incorporate all of the upstream and downstream emissions which result from the activities of the Council, but which are not directly emitted by the Council itself. For example, fuel consumption in Council vehicles is included in scope 1, whereas fuel consumption in employee vehicles traveling to work is scope 3.
- Energy consumption has associated scope 3 emissions, from the processes used to create the power infrastructure and fuels; however, the actual emissions from burning fuels for energy is accounted for in scope 2.

Methodology of note

- Only the scope 3 emissions from Council procurement of goods and services are presented here. There are other emissions associated with the generation of waste, staff commuting, pensions and investments and office management.
- Government data tables which provide indicative kg CO_2 / £ by sub-sector have been used to estimate the emissions from the categories of expenditure. However, these data tables were last updated in 2011, and therefore have been extrapolated to give an indicative picture.
- The treatment of waste produced in the South Gloucestershire area is a scope 3 category source, and therefore not included in the baseline analysis for the area. However, it can have high emissions and is important to consider as it can also be influenced by council decision-making. Therefore, it is recognised as a gap, with further analysis recommended.

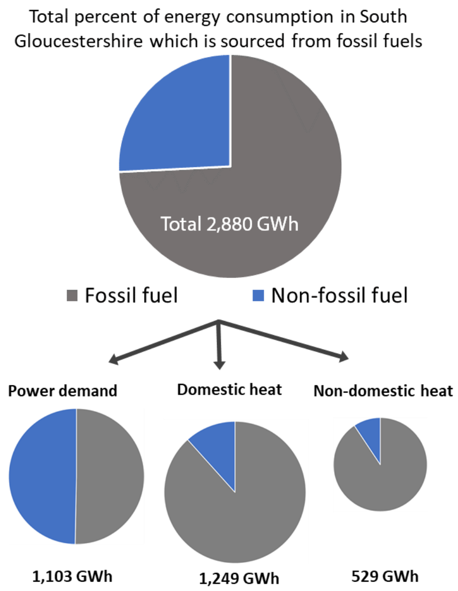
Assumptions and limitations

- This assessment is very limited and is intended only as a first-pass scoping of the potential areas of importance. As a next step, a full scope 3 analysis should take the activities with the highest emissions – including areas not in this analysis such as waste and commuting – and complete a fuller analysis to hone the data, in order to allow targeted decision-making.

Data sources

- Council-provided procurement data.

Slide 36: Fossil fuel usage and value of electricity spend



Slide 36 shows the proportion of energy which is fossil fuel based, split by power and heat. Slide 38 shows the same calculation if transport fuel spend is included.

Key points

- Three key energy components were considered in this analysis: heat, power, and transport. Taken together, the total fossil fuel component is 86%.
- The fossil fuel component of power is around 50%. This is the national figure and was taken for 2017. The remaining 50% of power generation is sourced from nuclear power, renewable energy, and interconnectors to other countries.
- Heat delivered in domestic and non-domestic properties is mainly sourced from natural gas. The remainder is from electricity or other fossil fuel sources such as LPG. In South Gloucestershire, 84% of homes are heated with gas.
- Taking heat and power together, around 74% of energy was sourced from fossil fuels in 2017.
- Transport is almost entirely fossil fuelled, with the deployment of alternatively fuelled vehicles such as electric vehicles still in its early stages.

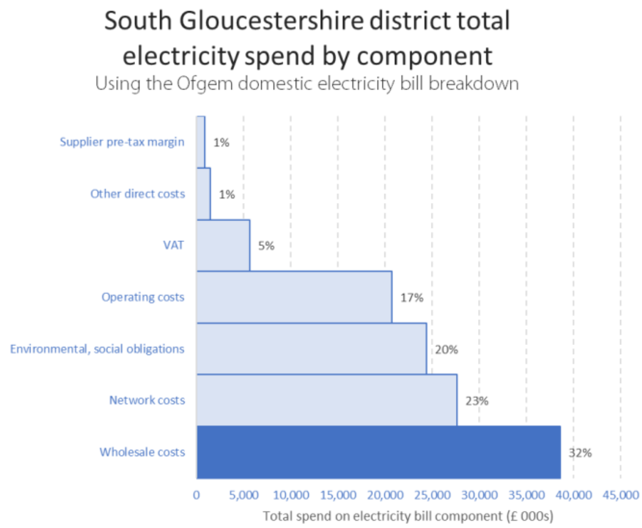
Assumptions and limitations

- As elsewhere in the analysis, the 'heat' category includes electricity consumption for heating, and the 'power' category refers to all non-heating uses. This method allows changes to heat demand from efficiency or heating technologies to be modelled more easily.

Data sources

- BEIS sub-national energy consumption dataset and Regen analysis.

Slide 40: Local value of energy purchased



Slides 39 and 40 show the assessment of energy spend, by fuel type. An illustrative breakdown of the amount of value retained locally from electricity expenditure is shown on slide 40.

Key points

Millions of pounds are spent on energy in the South Gloucestershire area, especially if transport fuel is included. The amount that customers spend on energy intersects with key energy challenges and questions around how to secure a just transition to net zero. For example, how to support those in fuel poverty whilst improving energy efficiency.

An estimated 312 GWh of renewable electricity was generated in the area in 2018. If it is assumed that this electricity is used locally, it is estimated that this helps to retain approximately £17m from total electricity bills in the area each year. Whether the owners of these generators are local organisations and therefore whether that proportion is in reality retained locally, would require further analysis.

Methodology of note

- Analysis using the Ofgem component breakdown of domestic electricity bills has attempted to estimate the total maximum value of electricity which is retained in the area. Of the components of an electricity bill, realistically only the wholesale costs of energy have the potential to be retained within the area.
- No analysis on the local value retained from transport fuel costs has been attempted, due to the lack of production infrastructure in the region. However, as transport is electrified, this energy component is transferred to the electricity networks and onto domestic and non-domestic electricity bills.

Assumptions and limitations

- Due to the limited data on non-domestic electric bills, the typical domestic electricity bill components have been used to establish the breakdown for both domestic and non-domestic electricity bills.

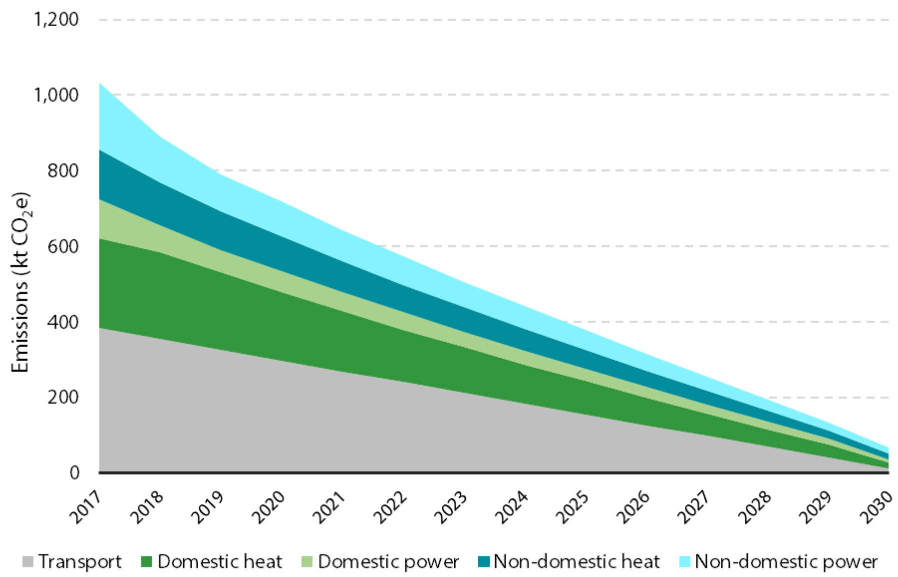
Data sources

- Ofgem domestic electricity bill breakdown, government tables on typical fuel unit costs, Energy Savings Trust typical unit cost data

4. Pathways to Success - 'Net Zero' and 'Highly Ambitious'

Two pathways have been modelled. The first models what needs to happen in order to achieve the target of net zero carbon by 2030. This is called the 'net zero pathway'. The second models a highly ambitious approach to reducing carbon towards net zero but does not quite achieve net zero in 2030. This is called the 'highly ambitious pathway'. In addition, a series of essential 'need to do' actions have been identified which are common to both pathways.

Slide 42: Scale of the Challenge – 'Net Zero Pathway': to reach net zero by 2030

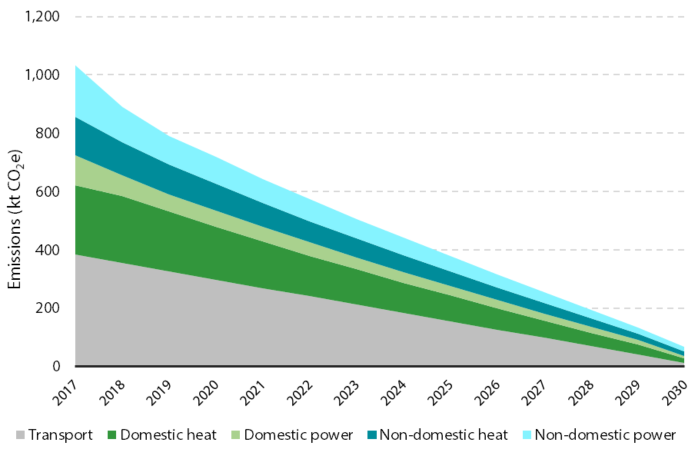


Slide 42 shows a pathway to net zero emissions in the area, moving from the 2017 baseline to net zero in 2030. Some residual emissions remain, which would need to be minimised. Carbon positive actions would need to be taken to offset these residual emissions.

Key points – including 'need to do' actions

- Achieving net zero means the complete transition of our energy systems, through activities we already know are needed, but also through additional as yet unknown actions.
- Power consumption decarbonises rapidly and drops to almost zero by 2030. This requires action at the national scale, but is also facilitated by local projects and decision-making to support renewable energy and limit the deployment of new fossil fuel infrastructure.
- The scale of challenge to decarbonise heat and transport is clear. Rather than centralised wholesale changes, decarbonisation will require changes to almost every home and vehicle. For example, an estimated 97,000 gas-boilers in the area need replacing with low-carbon alternatives, alongside LPG and other fossil fuel heat technologies.
- Approximately 45% of non-domestic properties are heated by gas. As with domestic boilers, these need replacing with low-carbon alternatives wherever possible.
- All journeys will need to be made through active travel or using low carbon vehicles. The lowest emitting vehicles would be mass transit such as trains or buses; however, electric cars are recognised as a key route to decarbonisation.
- The roll out of energy efficiency measures need to be maximised under the net zero pathway, with 75% of homes retrofitted to EPC C.
- Every home built between now and 2030 which isn't a zero-carbon home will need to be retrofitted within the period to achieve a zero carbon standard. The same is true for non-domestic properties.

Slide 42: Scale of the Challenge – 'Net Zero Pathway': to reach net zero by 2030 (continued)



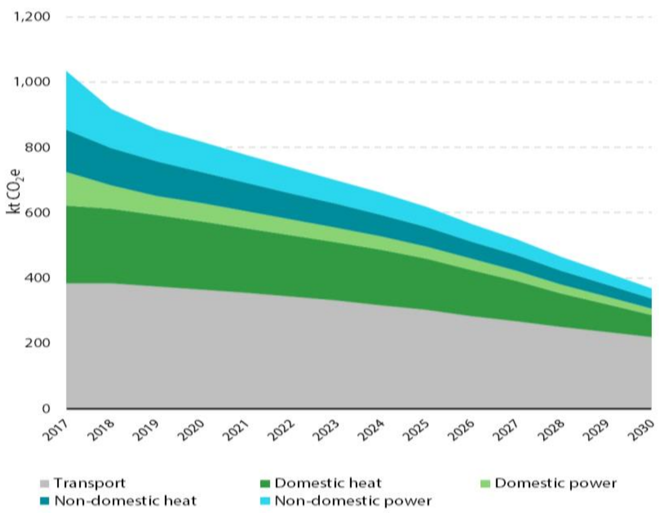
Methodology of note

- Each component has been individually modelled based upon the number and efficiency of heating technologies, changing heat demand from energy efficiency improvements, the number of electric vehicles, and the decarbonisation of the national electricity supply.
- The analysis has taken into account population growth in line with ONS projections, which has an impact on domestic energy consumption and the number of vehicles.

Assumptions and limitations

- Any future projection is limited by a series of necessary assumptions. Large, unforeseeable changes are not modelled, though radical interventions and rapid acceleration of existing trends are both used to project out to 2030. Assumptions are made about the level of decarbonisation needed without a route to deliver it – for example, it is assumed that business and industry will fully decarbonise without setting out a known pathway for this. Similarly, it is assumed that nearly all homes will move to low carbon heating without considering the technology pathway to achieve this.
- Energy is currently a largely invisible utility which often shows up only as an annual bill. Making significant changes to the way people interact with energy is likely to illicit strong responses, meaning that projecting changes in individual behaviour is precarious. However, there is wide scope for very positive interventions and significant changes across all sectors.

Slide 43: 'Highly Ambitious Pathway' – towards net zero



Slide 43 shows a highly ambitious emissions reductions pathway. Each sector shows significant reductions far beyond the precedent of decarbonisation rates achieved so far. The purpose is to illustrate the scale of impact of potential decarbonisation interventions and the gap that still remains between this highly ambitious emissions reduction pathway and net zero in 2030. The aim is to offer some calibration of the unknown elements of the challenge of meeting the area's net zero ambitions.

Key points – including 'need to do' actions

- The highly ambitious pathway towards net zero sees significant and rapid reductions in emissions from both heat and power by 2030.
- Emissions from transport do not approach zero under this pathway; however, there is still very high uptake of electric vehicles and a reduction of mileage, leading to a 40% reduction in emissions.
- Both the domestic and non-domestic sectors are reduced to below 50 kt CO_2e each. Almost all domestic properties are insulated to at least an EPC band of C reducing emissions up to 44%, and non-domestic properties reduce their energy consumption by 10%.
- There are very high reductions in road transport emissions from around 380 to around 220 kt CO_2e. This is made up from fuel type changes as well as from mileage reduction.
- Electricity supply is decarbonised at a national level much faster than the current BEIS trajectory, to 50g CO_2/kWh by 2030.

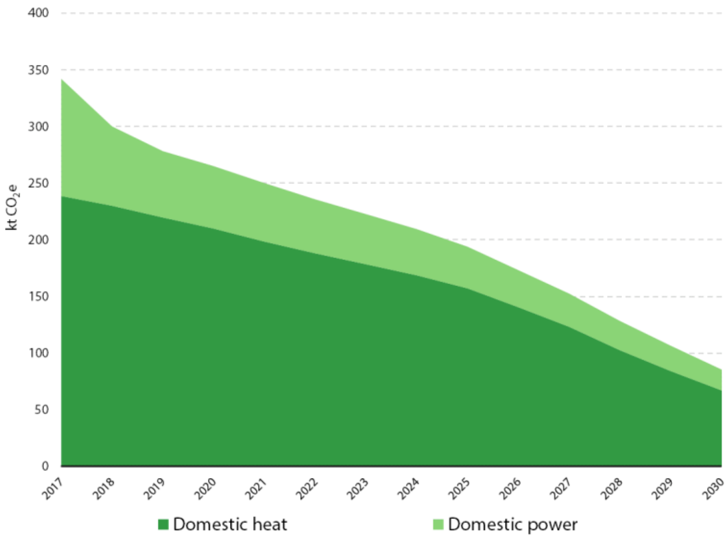
Methodology of note

- The pathway have been constructed through the modelling of current and future technology deployment trends and carbon reduction impacts.

Assumptions and limitations

- Although the highly ambitious pathway does not meet net zero, it does rely on assumptions that the national decarbonisation trajectory is rapid and effective, e.g. that national electricity supply decarbonises at a rate that is faster than current estimates.

Slide 44: Domestic 'need to do' actions



Slide 44 shows for the domestic sector, a highly ambitious pathway for decarbonising energy use in South Gloucestershire. It shows the level of decarbonisation that could be achieved through a wide-reaching domestic energy efficiency programme and low carbon heating roll-out.

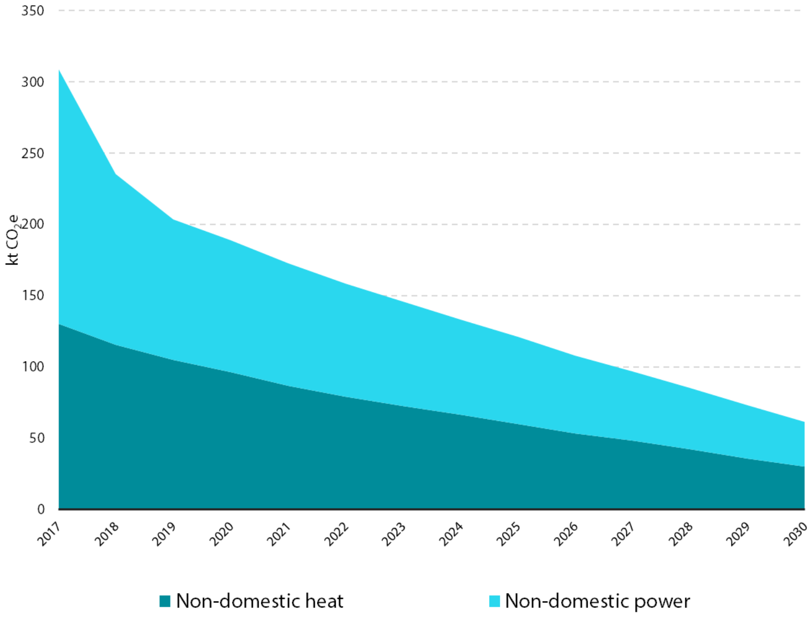
Key points – including 'need to do' actions

- This highly ambitious pathway represents replacing half of all current boilers with low-carbon alternatives, which represents around 50,000 homes. If these were replaced at a steady rate, this implies around 5,000 gas boilers replaced with low-carbon heating each and every year.
- This pathway also incorporates all of the EPC recommendations for energy efficiency, implying that 98% of homes are an EPC band of A-C, reducing emissions by 44%. The combination of reduced heat demand and partial electrification are key contributors to the reduction in emissions shown in the chart.
- The residual appliance power demand in homes represents relatively few emissions compared to heat. These emissions are reduced in line with the decarbonisation of the national grid. Electricity demand from domestic charging of electrical vehicles is included in the transport section, not here in the domestic section.
- The government has announced that after 2025 no gas boilers will be installed in newly built homes; however, there is currently no legislation which attempts to do the same for existing homes or properties. This would likely be necessary to implement the scale of change needed.
- Reductions in emissions due to the improved efficiency of modern condensing gas boilers are not expected to be a significant contributor to net zero pathway emissions reductions; only widespread changes to low carbon heat technologies will have the required impact.

Methodology and limitations of note

- The rate of change of heating technologies has been modelled in a linear fashion out to 2030. In reality, the change will not be linear, and slow heat pump deployment is expected in the next few years, with this ramping up over time.
- Analysis suggests that homes heated by electricity currently have a much lower average heat demand than those heated by natural gas. This is expected to be partly due to the lower average size of homes with electric heating, as well as the high unit cost and the higher than average proportion of electrically heated homes which are lived in by people in fuel poverty.

Slide 45: Non-domestic 'need to do' actions



Slide 45 shows for the non-domestic sector, a highly ambitious pathway for decarbonising energy use in South Gloucestershire, based on the key factors of electricity grid decarbonisation, shifting away from gas heating and energy efficiency improvements.

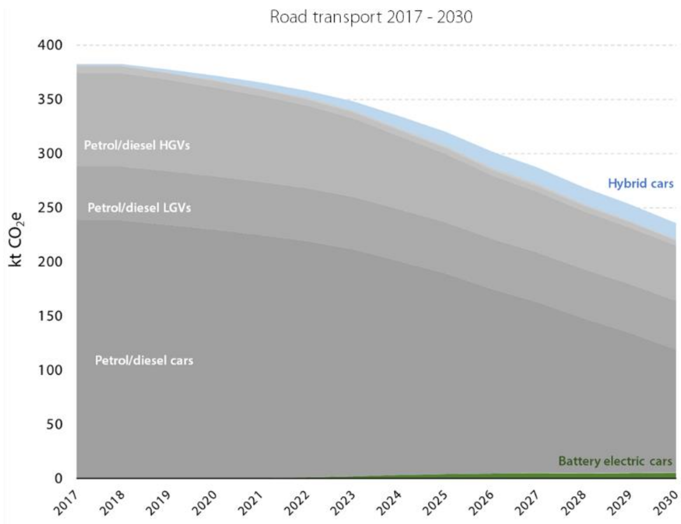
Key points – including 'need to do' actions

- In this highly ambitious pathway the percent of non-domestic properties heated by gas reduces from 45% to 10% at the end of 2030.
- Due to limitations in the non-domestic EPC data, exact band shifts haven't been modelled in the projections; however, a 10% reduction in overall energy consumption as a result of improved energy efficiency is included.
- This projected pathway produces a 77% reduction in heating emissions. The significant contributors to this are the reduction in fossil fuel heating (gas, oil, LPG), and the decarbonisation of electricity. Improvements in energy efficiency also reduce the heat required across the sector.
- An assumption about the maximum uptake rate of new heating technologies has been applied to both domestic and non-domestic properties. However, due to the relatively low penetration of gas heating in non-domestic properties there is the potential for these boilers to be replaced at a relatively rapid rate.
- The high proportion of electric heating means that the non-domestic sector is more sensitive to changes in the carbon factor of electricity. The rapid reduction in grid carbon intensity in the next 5 years as coal fired generation comes offline reduces non-domestic emissions significantly.

Methodology and limitations of note

- A more in-depth analysis of sub-sectors and property types would yield more specific trajectories.
- Economic factors such as factory closures or relocations can have a significant impact on non-domestic emissions, as shown in the baseline data. The pathway does not consider this factor.

Slide 46: Transport 'need to do' actions



Slide 46 shows a pathway for emissions from road transport vehicles to 2030 in South Gloucestershire. The modelled pathway considers the rate of uptake of electric and hybrid vehicles, as well as a shift towards active travel and electrified public transport.

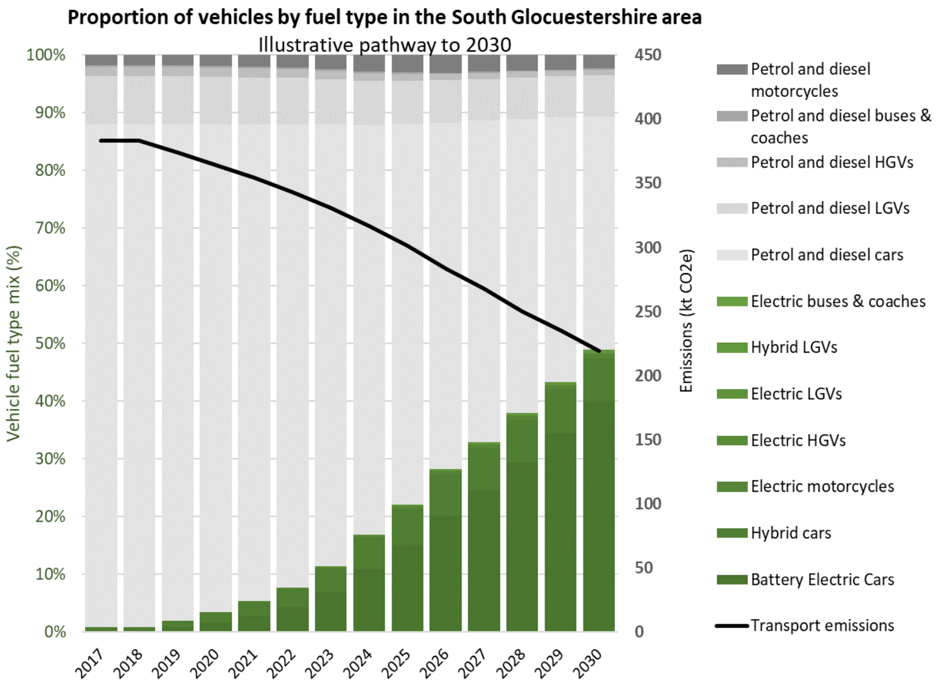
Key points

- The current target for a national ban on new diesel and petrol vehicles is set for 2040. Since that announcement though, the net zero by 2050 target was brought forward and the Committee on Climate Change is now recommending an earlier target of at least 2035.
- To match the ambition in this study, the fossil fuel car ban would likely need to be brought forward to at least 2030. This projection has modelled electric vehicles making up around 100% of new vehicle sales in the area before 2030. The rate at which this trend occurs changes the total emissions across the period, for example whether it is a linear increase in electric vehicle sales or explosive take-up towards the end of the period.
- Several other national factors will influence the uptake of electric vehicles; these include the customer perception of choice and performance, cost of new vehicles, and the strength of the second-hand market. There is scope for local influence over charger provision, as customers without off-road parking are likely to seek to charge in publicly available alternatives.
- The use of low-carbon public transport, cycling and walking are all very low-carbon alternatives, even when compared to an electric car. This is an area where there can be significant local influence.
- There are also non-electric alternatively fuelled vehicles, such as those that use hydrogen fuel cell technology. For high-mileage heavy goods vehicles, it may be that this alternative technology is better suited and may be introduced before 2030. The impact has not been assessed in this analysis.
- This methodology has also modelled a high reduction in annual mileage, so that even with population growth, the total mileage reduces. As previously mentioned, total mileage has historically increased proportionally with population increase. Large reductions will be influenced by local factors like public transport provision and encouraging modal shift, as well as behavioural factors such as trip-sharing and remote-working.

Data sources

- Committee on Climate Change - Net zero report

Slide 53: Transport emissions to 2030



Slide 53 shows the uptake rate of electric and hybrid vehicles under the highly ambitious pathway to 2030.

Key points

- Electric vehicles, the majority of which are battery electric cars and plug-in hybrid cars, make up 48% of vehicles in this 'need to do' pathway. The rate of uptake will be impacted by customer perceptions of electric vehicles, upfront cost and, importantly, the government ban on new petrol and diesel vehicle sales.
- Though there is a lot of interest in electric vehicles, it is starting from a very low base, and needs rapid acceleration in the next 5 years to meet the ambition of this study. Total emissions from transport are reduced by up to 43% by 2030.
- Where these electric vehicles charge is an important question for encouraging uptake and ensuring an equitable transition. For example, it may be much cheaper to charge at home, but many homes do not have off-street parking, and therefore interest in on-street parking or public charging stations may be particularly high in certain areas, but not in others.
- This reduction in transport emissions is also dependent on the decarbonisation of the electricity grid, as these new vehicles will create a large increase in electricity consumption.

Methodology of note

- This analysis has modelled the rapid uptake of electric vehicles using example scenarios from the Committee on Climate Change and the National Grid Future Energy Scenarios report. Further to these, it has also incorporated reduction in total mileage and the accelerated electricity decarbonisation rate.

Data sources

- Committee on Climate Change, National Grid Future Energy Scenarios

Slide 48: Estimated domestic interventions

Recommendation	Extrapolated numbers (indicative)
Floor insulation	77,000
Cavity wall insulation	39,350
Roof or loft insulation	39,050
Wall insulation	27,000
Heating control	28,600
Hot water insulation	17,200
Storage heater	10,750
Boiler thermostat	9,000
Draughtproofing	8,200

Slide 48 shows the estimated numbers of domestic energy efficiency measures needed to maximise the delivery of energy efficiency measures in South Gloucestershire and deliver the highly ambitious pathway.

Key points – including 'need to do' actions

- Currently, around 48% of dwellings are below a rated EPC band C.
- The vast majority of homes in the South Gloucestershire area would benefit from some energy efficiency improvements.
- Energy efficiency measures are usually the most cost effective in the worst insulated homes, which are also on expensive heating systems.
- Energy efficiency measures are an important first step in installing efficient heat pumps, as they run at lower temperatures than gas boilers.

Methodology of note

- If all the listed measures were delivered, the result would be that 98% of properties achieve bands A-C. In a strategic approach, the homes with the worst energy efficiency ratings would be treated earlier on, and some of these recommendations for homes already in the A-C band may be deprioritised. A single installation of floor insulation may have different impacts on a home depending on the other measures in place and the fuel that they use, though almost all homes will need to transition to low-carbon heating by 2030.

Assumptions and limitations

- This analysis of the EPC data is meant as illustrative of the scale of measures necessary only, and emissions reductions are also dependent on other factors, such as low-carbon heating deployment and the decarbonisation of the national electricity grid.
- Although the analysis sets out the potential for energy efficiency measures to be delivered in the area, how to achieve this extremely high level of take up is unknown.

Data sources

- EPC analysis for South Gloucestershire

Slide 52: Estimated non-domestic efficiency interventions

Recommendation	Percentage	Extrapolated numbers
local temp heating controls	63%	3610
Solar thermal	61%	3506
Fitting double glazing	52%	3008
ASHP	29%	1648
Cavity wall insulation	29%	1644
Loft insulation	11%	610
roof insulation	10%	566
Boiler efficiency	9%	528
solid wall insulation	4%	246

Slide 52 estimates the numbers of interventions that are needed to maximise energy efficiency in the non-domestic sector in South Gloucestershire.

Key points – including 'need to do' actions

- Heating controls are recommended in over half of all non-domestic properties, as is double-glazing. This shows the contrast in building stock to domestic properties where the most recommended interventions relate to wall, roof and floor insulation.
- As in the domestic interventions, emissions reductions from energy efficiency are key, but to achieve significant decarbonisation also need to take place alongside low-carbon heat deployment and the decarbonisation of the national electricity grid.

Methodology of note

- The methodology is similar to the domestic EPC analysis, where the recommended measures from properties with an EPC are extrapolated to give an indication of the scale of interventions required.

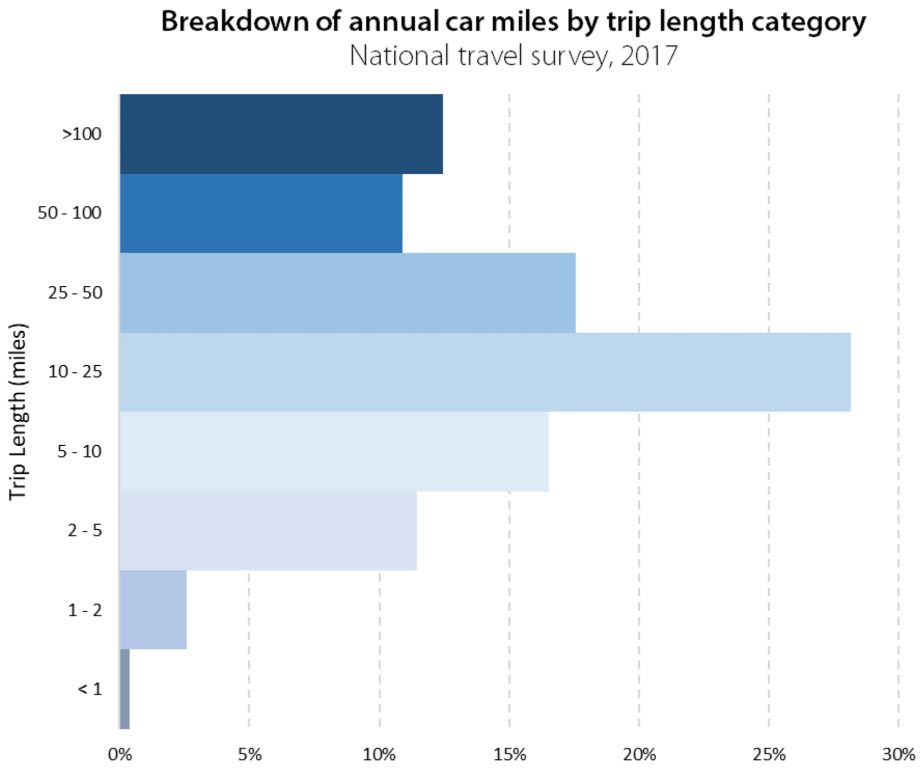
Assumptions and limitations

- The limited number of non-domestic EPCs reduces the level of confidence in the extrapolated results. Non-domestic properties, their energy use and energy efficiency measures are less standardised than domestic properties.
- Further analysis on the sectoral split or average energy consumption by different non-domestic property types would provide further detail on the specific recommendations relevant to different property types.

Data sources

- Analysis of non-domestic EPC data in South Gloucestershire

Slide 55: Local journeys



Slide 55 shows the proportion of total UK mileage that falls into different trip length categories. Applying this data to South Gloucestershire mileage, it emphasises the role of modal shift in moving users away from their cars for shorter journeys.

Key points

- The analysis within each pathway considered local modal shift, particularly the implications of changes to journeys under 10 miles, as well as in part those under 25 miles.
- Modal shift away from cars has multiple benefits, alongside reduced carbon emissions, there are also air quality issues, public health, and road safety benefits. Though there are limited miles and thus emissions from the shortest journeys, these journeys are also relatively worse for air quality as engines typical emit the most pollutants in the first few miles of a journey, as the catalytic converter is less efficient at lower temperatures.
- There is also large scope for reductions in longer journeys, though reduced scope for local action to support this. National infrastructure improvements, such as to rail services rather than airport expansion and the relative costs of different travel modes are key factors to encouraging modal shift at scale.

Assumptions and limitations

- This analysis serves only to provide an indication of the scale of emission reductions from modal shift at the local level. Critical infrastructure and interventions are needed to encourage these shifts and the impacts of any specific interventions that have not been modelled.
- However, reducing journey miles is a key step, alongside the decarbonisation of the fuel source, in reducing emissions from road traffic.

Slide 56: Renewable energy installations

Technology type	Electric capacity (MW)	Thermal capacity (MW)	Total number of installations
Biomass	9.3	4.9	80
Energy from Waste	32.0	-	1
Heat Pump	-	3.1	320
Landfill Gas	7.6	-	4
Onshore Wind	8.3	-	12
Solar PV - ground mount	91.2	-	10
Solar PV - rooftop	22.6	-	4,042
Solar Thermal	-	0.3	100
Hydropower	0.0	-	1
Grand Total	**171.0**	**8.3**	**4,570**

Slide 56 gives details of currently installed renewable energy projects in South Gloucestershire.

Key points

- This data is an update to the report on local renewable energy produced by Regen for the South Gloucestershire Council. Relatively little renewable energy has been deployed in the area in 2019, though there has been some rooftop PV installed under the Feed-in Tariff, which officially closed in March 2019.
- Renewable electricity generates the equivalent of 27% of total electricity consumption in the South Gloucestershire area.
- The deployment of renewable energy generation is a key local action which can contribute to the pathway to net zero. Though it is assumed in the analysis that national grid decarbonisation occurs, it is critical that renewable energy is deployed at the scale needed to support that decarbonisation. The democratisation of energy, through local ownership and community energy groups, can also be facilitated at a local level, and will support a just transition.
- National policies such as planning guidance and price support schemes are key to renewable energy deployment.

Methodology of note

- This database is an update to the previous progress report and has been updated through analysis of the Feed-in Tariff, and other renewable energy registers such as the RO and RHI.

Assumptions and limitations

- With the closure of subsidy schemes such as the Feed-in Tariff, some data visibility of new renewable energy projects installed has been lost. Therefore, it is possible that some renewable energy generators have been installed in the area which are not captured in this data. However, it is currently expected to be at a low level, as any large sites would be picked up under other sources, and small-scale renewables are not as economically attractive as they once were.

Data sources

- Feed-in Tariff data, RO, RHI data.

THE UK100 PLEDGE

Key points

- The UK100 is a pledge to shift to 100% clean energy by 2050. This has been interpreted to include all energy for heat, power, and transport. The ambition of this pledge has now been matched in adoption of a net zero target in UK law for 2050, though substantive actions are yet to be announced or implemented.
- South Gloucestershire can contribute to this in a variety of ways, many of which are sketched out in this analysis. The analysis shows how heat and transport may be decarbonised through electrification, and the necessary simultaneous decarbonisation of the national electricity grid. Generating the clean energy required for this new electricity consumption will required an increased rate of deployment of renewable energy.
- South Gloucestershire currently generates around a quarter of its electricity consumption from local renewable energy, implying a fourfold increase necessary to meet current demand. As heat and transport are also electrified, this figure increases.
- However, it is not at all necessary for South Gloucestershire to act as an ‘energy island’ and be completely self-sufficient, as it is much more efficient for those areas which have more renewable energy resource than others to export their generation to other areas through the national electricity grid.
- If the new electricity generation capacity needed to meet the UK 100 pledge is made up from new onshore wind and solar farms, split 50:50 by generation contribution, then this increase could be made up from 71 3 MW wind turbines, and 963 hectares of ground mounted solar farms – though these numbers are indicative only. There is currently 8.3 MW of onshore wind in South Gloucestershire. This comprises 3 turbines over 1 MW, and 11 rated at 500 kW or under.

Methodology of note

- The analysis has estimated the required annual renewable electricity generation in the area to meet estimated electricity demand by 2030. The analysis focuses on the key renewable technologies that are deployable at scale in South Gloucestershire, solar PV and onshore wind.

Assumptions and limitations

- There is not a methodology to apportion responsibility for decarbonising the national electricity grid to local authorities, further South Gloucestershire Council has limited control over which technologies are deployed.

Data sources

- Analysis of renewable energy sources, UK100

5. National, regional and local action

Achieving net zero emissions in South Gloucestershire by 2030 requires systematic change in the energy system (and beyond). The Council has committed to providing "the leadership to enable South Gloucestershire to become carbon neutral by 2030."

The Council's spheres of influence are:

- Leading by example on its own estate and procurement
- Working in partnership with the private sector to deliver local projects
- Offering investment, grants, and low-cost financing for energy measures and levering in government funding
- Setting robust and ambitious planning policy and guidance
- Communicating issues to the local community, building meaningful consent for the energy transition and inspiring local action
- Influencing national government

Actions under each of these spheres should be explored, drawing on the baseline data and potential pathways to understand what action is needed and has the biggest potential impact.

This baseline analysis has identified the key areas of activity and the scale of the challenge in that area. In each of these key areas of activity, the baseline analysis has identified the scale of the challenge to decarbonise South Gloucestershire, in its approach to net zero by 2030. Table 5-1 sets out potential national and regional/local actions that could support delivery of the necessary activity in South Gloucestershire.

Table 5-1 Scale of the challenge and example actions

Area of activity identified through baseline analysis	**What is the scale of the challenge in South Gloucestershire?**	**Example national actions**	**Example regional/local actions**
Decarbonisation of electricity supply	Target of 0-50g CO_2/kWh Fourfold increase in local renewable electricity generation to achieve UK100 pledge for current electricity consumption.	Commitment and support for significant new renewable generation capacity. Removal of planning barriers to onshore wind. Enabling of strategic investment in the electricity network to support renewables.	Local/West of England supportive planning policy for renewables. Whole energy system plan for the area, developed with Western Power Distribution, landowners and developers, to facilitate renewable energy deployment and the development of a smart electricity network.
Widespread rollout of domestic energy efficiency measures	49% of homes are under an EPC C, representing at least 56,000 properties needing an upgrade. 74% of homes are EPC C and under.	National whole house retrofit investment programme.	Development of whole house retrofit programmes (e.g. Energiesprong programme in Exeter). Review other local incentivisation options (e.g. Worcestershire Council scheme to link council tax

			incentives to energy efficiency) and loan options Work with social landlords to roll out energy efficiency measures in social homes as a step towards a wider private sector programme.
Zero carbon new buildings	An estimated 15,000 new homes are due to be built by 2030. All new homes built in the area should be zero carbon.	National zero carbon homes policy to be implemented as soon as possible. In the interim, the government to clarify that local authorities can include zero carbon standards in their local plans.	Strong local/West of England planning policy on zero carbon homes and buildings. Low-carbon lifestyle facilitation through mass-transit intersection with zero carbon buildings
Non-domestic energy efficiency improvements	55% of non-domestic properties are under an EPC C, representing at least 3,000 properties needing an upgrade.	Financial incentives, funding and taxes to focus businesses on decarbonising their operations.	Raising awareness with local businesses and facilitating partnership decarbonisation projects. Support and incentives for organisations to reduce their energy use.
Decarbonisation of heat	96,000 homes and 2,800 businesses need to be switched from fossil fuels to low carbon alternative.	Set out a zero carbon heat roadmap for the UK including the balance of electrification and decarbonising the gas grid. Funding for low carbon heat options made available post-RHI in March 2021.	Production of a local net zero heat plan (incorporating energy efficiency) that goes as far as possible to understand local building stock, heat demand and low carbon heat opportunities on a spatial basis. Local funding and incentives for low carbon heat installations
Reduction in road transport emissions	15% reduction in mileage through active travel and public transport. Almost all vehicles to be electric by 2030 – there are projected to be around 310,000 vehicles in the area by 2030.	Bringing forward the date of fossil fuel car ban to 2030. Other national incentive options such as scrappage schemes. Funding for fit for purpose decarbonised public transport made available to local authorities and for national infrastructure.	Production of a net zero local transport plan Coordinated investment in electric vehicle charging and public transport infrastructure.
Carbon sequestration	Maximise sequestration from land-use change, and management of continued use of agricultural land.	Further research and incentivisation for sequestration e.g. through agricultural policy.	More analysis to fully understand the sequestration potential of specific actions.

"National" emissions

Some national sources of carbon emissions such as aviation, shipping, rail, motorway routes and some large industrial processes are excluded from the analysis for South Gloucestershire. The UK government will need to take urgent action to address the emissions from these hard to tackle, large scale carbon emitters.

6. Data gaps and areas where further work is needed

Waste treatment
The analysis did not include waste treatment emissions, as the scope extended to the energy system alone. Waste treatment emissions constitute some of the area's scope 3 emissions. These emissions can be significant. Waste treatment emissions can be considered either as the emissions from treatment plants within the area or as resulting from waste that is generated within the area (wherever it is treated). Further analysis could consider emissions from waste arising from South Gloucestershire and how to achieve net zero emissions. As the waste management authority, South Gloucestershire Council has significant potential to influence emissions from waste.

Agriculture
Only the carbon emissions from agricultural energy use have been included in the analysis. There are significant greenhouse gas emissions from agriculture, particularly beef farming. These emissions may be a significant gap in the total emissions presented from this analysis and are in need of further assessment.

LULUCF
Land-use, land-use change and forestry has only been assessed at a high-level, and an in-depth study is recommended to refine the figures on the potential for carbon sequestration in the area. Various factors are also relevant which may limit the deployment of carbon sequestration through land use change, specifically the interplay between sequestration potential, employment, land ownership, and cost.

South Gloucestershire Council scope 3 emissions
A very preliminary assessment of the scope 3 emissions of the Council has been conducted, focussed on the impacts of procurement expenditure by category. The next step is to widen this preliminary assessment to incorporate all other potentially important scope 3 components, such as Council pensions and investment. As a next step, it is recommended to develop more in depth data sources or data collection methods to more gather more precise and up to date data. Actions to reduce the scope 3 emissions can then be prioritised.

Road transport behaviour
Previous studies and research have been used to analyse the recent trends in local road traffic and associated emissions. However, for a more targeted approach further data analysis and collection may be necessary. For example, this analysis has not included assessment of key routes for where public transport could supplant car journeys most easily, or the impact of new road and building infrastructure on walking and cycling journeys.

Industry and commercial
Further analysis of stock and businesses in the area would be useful to enable more targeted interventions, as the non-domestic EPC data is limited in its coverage of property type split and recommendations.

7. Data sources

1. BEIS – Local authority CO_2 emissions data:
   https://www.gov.uk/government/statistics/uk-local-authority-and-regional-carbon-dioxide-emissions-national-statistics-2005-to-2017
2. EPC data (domestic and non-domestic by local authority)
   https://epc.opendatacommunities.org/
3. Department for Transport – Vehicle registration statistics
   https://www.gov.uk/government/statistical-data-sets/all-vehicles-veh01
4. BEIS – Sub-national energy consumption statistics
   https://www.gov.uk/government/collections/total-final-energy-consumption-at-sub-national-level
5. Office for National Statistics – Populations estimates
   https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/datasets/populationestimatesforukenglandandwalesscotlandandnorthernireland
6. Ofgem – Feed-in Tariff data
   https://www.ofgem.gov.uk/environmental-programmes/fit/contacts-guidance-and-resources/public-reports-and-data-fit
7. Gridwatch – Electricity system data
   https://www.gridwatch.templar.co.uk/
8. ONS – Gross Value Added 1998 to 2017
   https://www.ons.gov.uk/economy/grossvalueaddedgva/bulletins/regionalgrossvalueaddedbalanceduk/1998to2017
9. Department for Transport – Understanding the drivers for road travel
   https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/703080/understanding-the-drivers-road_travel.pdf
10. Ofgem domestic electricity bill breakdown
    https://www.ofgem.gov.uk/data-portal/breakdown-electricity-bill
11. BEIS – Annual domestic energy bills
    https://www.gov.uk/government/statistical-data-sets/annual-domestic-energy-price-statistics
12. Committee on Climate Change – Net zero
    https://www.theccc.org.uk/wp-content/uploads/2019/05/Net-Zero-The-UKs-contribution-to-stopping-global-warming.pdf
13. National Grid – Future Energy Scenarios
    http://fes.nationalgrid.com/fes-document/
14. Ofgem – Renewables Obligation data
    https://www.ofgem.gov.uk/environmental-programmes/ro/contacts-publications-and-data/public-reports-and-data-ro
15. BEIS - Renewable Heat Incentive statistics
    https://www.gov.uk/government/collections/renewable-heat-incentive-statistics
16. UK100 website
    https://www.uk100.org/