UNIVERSITY OF EXETER

A Review of Devon County Council's Climate Change Strategy

CENTRE FOR ENERGY AND THE ENVIRONMENT

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Management Summary

In 2004 Devon County Council (DCC) signed the Nottingham Declaration on Climate Change which commits the council to working with central government to contribute, at a local level, to deliver the UK Climate Change Programme through its relevant functions. The first important step was preparing DCC's climate change strategy in 2005. The strategy and its objectives outline a framework for DCC to act within its role as corporate entity, a service provider and a community leader. In the past 12 years DCC has changed considerably and the climate change agenda has moved on from raising awareness and taking first steps to firmly setting the world onto a trajectory for a low carbon society by the latter-half of the 21st century.

Local authorities play an important role in delivering national carbon targets. They can drive and influence emissions reductions in their wider areas through the services they deliver, their role as community leaders and major employers, and their regulatory and strategic functions. In particular, local authorities have most scope to influence emission reduction in the buildings, transport and waste sectors, as well as more directly within their own estates. DCC commissioned the Centre for Energy and the Environment (CEE) via the South West Energy and the Environment Group (SWEEG) to identify the realistic carbon savings that will arise from DCC delivering local action as well as the carbon savings arising from the delivery of national policy. The scope of the review covers the administrative area of DCC, with results broken down for each of the eight Devon districts, as well as for Dartmoor.

Nationally, carbon dioxide is responsible for 84% of total greenhouse gas (GHG) emissions in the most recent year where records are available. The remaining emissions are due to methane (mainly from agriculture and waste disposal), nitrous oxide (mainly agriculture), and F-gases (mainly refrigeration). Interrogation of carbon dioxide data reveals that in Devon 40% of emissions are associated with transport, 34% with industrial and commercial activity, and 27% are from domestic. Within individual districts, the relative importance of these sectors changes – for example in Exeter transport is responsible for 22% of emissions, whilst in Mid Devon it is 47%. Carbon dioxide emissions have fallen at a rate of 3% per annum between 2005 and 2015, which is similar to both the regional and national trend. Interrogation of data on other GHG emissions reveals that 24% of total GHG emissions in Devon are from methane, with a further 8% from nitrous oxide. This results in the agriculture sector being the most significant sector in Devon, being responsible for 28% of total GHG emissions. Whilst per capita carbon dioxide emissions in Devon are similar to those observed nationally, methane emissions are much higher resulting in total GHG emissions of 9.0 $tCO2_e$/capita in Devon compared to 7.1 $tCO2_e$/capita nationally.

Estimates have been made of the projected pathway for GHG emissions in Devon and its districts which result from national policy (as described by the Committee on Climate Change [CCC]). If there were no carbon reduction policy in place, GHG emissions would be projected to fall by 1.7% in Devon between 2015 and 2032. With savings from current "low risk" policy the reduction would be 3.4%. If all the savings through less certain government policies are realised in practice then the level of emission reduction would be 18.0%. This leaves a 23.5% policy gap to achieve the CCC's stated national trajectory for carbon reduction, which if it were met would result in emissions in Devon being 41.5% lower in 2032 than they are in 2015.

Whilst savings will need to be found across every sector, the single most important sector is Transport. When viewed across all sectors, a very small proportion of the required emission

reduction is captured by what is currently deemed to be "low risk" policy, with the majority of these reductions related to the projected uptake of large scale renewable energy schemes in the near to mid-terms which in turn reduce emissions from power consumption in the I&C and Domestic sectors. There is a significant amount of carbon reduction that is either "at risk", or for which there is currently no effective policy framework.

Local authorities have the ability to influence GHG reduction within their administrative areas. Devon operates a two-tier local governance structure, with responsibilities for various functions split between DCC and the district and National Park authorities. The CCC has published a report outlining the areas where local authorities can affect the greatest impact, which in the case of DCC is in the buildings, transport, waste and renewable energy sectors.

Within the buildings sector DCC should continue to work with the districts and National Park Authority in the development of the three new strategic plans (i.e. located around Exeter, Plymouth and North Devon) across the county. In existing dwellings DCC can assist with delivering the levels of insulation and boiler replacement required by continuing to work with the district authorities and organisations responsible for delivering the Green Deal/ECO and its successor schemes, as it has done through the Cosy Devon partnership. In addition, DCC can use its role as a trusted, impartial, and local organisation to provide information to residents. This can include both signposting to energy efficiency schemes, and information on behaviour measures. The CCC indicator target for direct emissions (i.e. non-electricity) from non-domestic buildings is a 58% reduction by 2030 from 1990 levels; this compares to a domestic target of a 24% reduction. Whilst a significant proportion of this reduction will come as a result of renewable heat, there are still opportunities to reduce energy demand from non-domestic buildings. DCC has a potential role to play by raising awareness of opportunities and delivering schemes directly. Low carbon heat will become increasingly important. In Devon, this will mean an increase in the number of heat pumps, the delivery of low carbon district heating schemes – as is already occurring at Cranbrook and in new development around Exeter – and increases in anaerobic digestion with injection of biomethane into the gas network. DCC can play an important supporting role here.

GHG reduction in the transport sector will occur through a combination of technology improvements and sustainable travel choices. Nationally the target is that in 2030 60% of all new cars and vans will be electric. Currently, uptake of EVs in Devon is similar to other county areas with uptake in Exeter similar to that in more urban parts of the country. It is likely that the trend for higher levels of EV uptake in urban areas will continue, as travel distances are typically shorter, and there is greater potential to concentrate charging infrastructure. DCC can help facilitate the uptake of EVs in the county by supporting the installation of charging infrastructure in places such as employment and retail sites and transport hubs and including rural sites (e.g. as Dartmoor National Park Authority is considering at National Park Visitor Centres on Dartmoor), and by incentivising EV use through providing priority parking spaces or free/reduced charge parking (where DCC has control, though local car parks are the responsibility of district councils), and use of dedicated lanes or bus lanes. DCC can also show leadership by increasing the uptake of EVs within its own business fleet, and by using its influence when procuring services from contractors. Regarding sustainable travel choices DCC should work with the districts and key stakeholders to promote sustainable travel choices to residents and businesses and to target national funding schemes, continue to work with bus operators and other stakeholders to improve and increase the use of bus services in the county, work with districts on car park charging and associated impacts on the road network, and work with

relevant stakeholders with the aim of developing strategies that reduce unnecessary freight journeys, shorten distances covered, and minimise empty running.

Waste emissions arise mainly due to the production of methane from landfill sites. DCC is responsible for waste disposal, whilst collection is the responsibility of the district authorities. Recycling and composting rates in Devon are already amongst the best in the country. However, there are a number of opportunities to further reduce emissions from the sector by promoting initiatives (e.g. the Don't Let Devon go to Waste campaign) that aim to reduce waste, promote further recycling/composting, divert more waste from landfill to EfW, utilising waste heat from the EfW facility at Marsh Barton, promoting anaerobic digestion with renewable heat and power capabilities within the county, promoting the flaring of methane from landfill sites in Devon where possible, and ensuring there is sufficient capacity to sustainably dispose of waste generated from proposed new developments.

The CCC state that local authorities can increase the uptake of renewable energy generation within their local areas by supporting applications through the planning process, and through encouragement of community renewable schemes. Planning applications are handled by the district authorities and so there is limited scope for DCC to support renewable energy here, but there is scope to assist with strategic-scale resource identification and collaboration on deployment issues, such as grid availability. DCC has already supported communities to develop renewable schemes through the SEACS project (which ran from 2011 – 2014 and has resulted in the development of a series of tools for community groups to use, the Devon Community Energy Accelerator Project in partnership with Regen (which ran from 2014 – 2016 and awarded seed funding to 18 organisations via small grants), thee Devon County Council Community Energy Support Service provided by DARE (which ran from 2016 – 2018 an includes the provision of a wide range of support requested by established and emerging community energy organisations in Devon) and most recently a collaboration with Regen as part of the Peer Power Project to develop a State of the Community Energy Sector Report and provide further bespoke support to established and emerging organisations to end in March 2018. DCC can also reduce GHG emissions in Devon directly by targeting emissions from its own estate, which are responsible for approximately 0.5% of all GHG emissions within Devon. Of these emissions, 42% are from transport, 40% from street lighting and 18% from buildings. Although not specifically quantified within DCC's carbon footprint, the council can influence emission arising from the services it procures both for its own operations, and for the public services for which it is responsible.

Finally, even if GHG emissions are reduced to zero tomorrow, the climate system will continue to change for another 40 years; the climate change we are experiencing now is a result of emissions in the 1970s. Therefore there is a need to ensure communities are able to adapt to the inevitable projected change. Certain local authority responsibilities are directly related to ensuring places are designed to be climate proof and so it should be ensured that climate adaptation is built-in to these services. Specifically DCC should ensure its own estate is resilient to the impacts of projected climate change, provide resilient infrastructure (including mitigating the impacts of potential flooding) and through its role in emergency planning take steps to prevent and respond to the impacts of extreme weather events, ensuring business continuity and continuity of key public services and ensuring the most vulnerable sections of population are protected. DCC should review each of its responsibilities across these areas to ensure that the strategies and procedures are adequate to meet the potential projected impacts of climate change.

CONTENTS

1. Introduction

In 2004 Devon County Council (DCC) signed the Nottingham Declaration on Climate Change which commits the council to working with central government to contribute, at a local level, to deliver the UK Climate Change Programme through its relevant functions. The first important step was preparing DCC's climate change strategy in 2005. The strategy and its objectives outline a framework for DCC to act within its role as corporate entity, a service provider and a community leader. In the past 12 years DCC has changed considerably and the climate change agenda has moved on from raising awareness and taking first steps to firmly setting the world onto a trajectory for a low carbon society by the latter-half of the 21st century.

Internationally the Paris Agreement, the latest within the United Nations Framework Convention on Climate Change, unites the world to continue global efforts to deal with greenhouse gas (GHG) emissions mitigation and adaptation to the changing climate. As of November 2017, 197 parties have signed the agreement and the great majority have ratified it. The Agreement expects each country to plan its own ambitious emissions reduction activity and report its contribution to mitigating global warming in order to keep global temperature below 2°C above pre-industrial levels and ideally 1.5°C. Nationally, the UK is committed under the Climate Change Act (2008) to an 80% emissions reduction in 2050 compared to 1990 levels, and has legislated five-year carbon budgets covering the period to 2032 that are compatible with this long-term target.

Local authorities play an important role in delivering national and international carbon targets. They can drive and influence emissions reductions in their wider areas through the services they deliver, their role as community leaders and major employers, and their regulatory and strategic functions. For county councils such as DCC this includes Education, Highways, Waste Disposal, Public Health, Passenger Transport, Flood Risk Management, Minerals and Waste Planning, Economic Development, Transport Planning, Social Care, Libraries and Trading Standards.

Clearly certain services have greater scope for contributing to GHG reduction than others. In 2012 the Committee on Climate Change, an independent statutory body established under the Climate Change Act, published a report[1] advising how local authorities can most effectively reduce emissions and manage climate risk in their areas. The report looked at GHG emissions covered by the EU Emissions Trading Scheme (traded sector) and those that are not (non-traded sector).

The non-traded sector covers direct carbon dioxide (CO_2) emissions (i.e. arising from burning fossil fuels) from buildings and non-energy intensive industry, surface transport, and most non-CO_2 emissions, including from agriculture and waste. It accounts for around 60% of total national emissions. The traded sector, including the power sector and energy-intensive industries covered by the EU ETS, accounts for 40% of total UK emissions.

Local authorities have most scope to influence emission reductions in certain areas within the non-traded sector. In particular, there are important roles for local authorities in the reduction of direct emissions through reducing emissions from buildings, promoting sustainable transport, and improving waste management. These three sectors in total account for around half of the UK's total GHG emissions in 2016, and failure of local authorities to act here would result in carbon budgets not being achieved:

[1] CCC 2012, How local authorities can reduce emissions and manage climate risk

- Buildings: There is scope for county councils to participate in programmes to improve energy efficiency and encourage behaviour change in both the residential and non-residential sectors. This activity aligns with the county council's public health and economic development roles. Furthermore, through strategic planning functions, county councils play an important role in encouraging energy efficiency standards in larger developments of new buildings.
- Sustainable transport: There is a crucial role for county councils to design and implement local sustainable transport plans to assist in behaviour change (e.g. achieving a modal shift resulting in the rationalisation of car journeys). In addition, local authorities have an important role to play in supporting investment in electric vehicle charging infrastructure, and in ensuring that new residential and office developments are designed to encourage the uptake of sustainable transport options.
- Waste: Although the landfill tax is determined nationally, county councils are key to working in partnership with the waste collection authorities to support the diversion of waste from landfill via policies and strategies for reducing overall levels of waste generated, implementing separate food waste collection systems and facilitating recycling centres and energy from waste plants.

Although policies for reducing power sector emissions are set at the national and European level, there is also potential for local authorities to contribute to power sector decarbonisation and reduced electricity consumption through involvement in low-carbon decentralised energy; local authorities can further champion renewable energy generation within their communities through direct investment in projects on their land assets or by encouraging community ownership. Finally, local authorities can demonstrate leadership and protect themselves against rising energy prices by ensuring their own operations are being delivered in a low-carbon fashion.

Even if GHG emissions are reduced to zero tomorrow, the climate system will continue to change for another 40 years; the climate change we are experiencing now is a result of emissions in the 1970s. Therefore there is a need to ensure communities are able to adapt to the inevitable projected change. Certain local authority responsibilities are directly related to ensuring places are designed to be climate proof. It should be ensured that climate adaptation is built-in to these services. In addition, a local authority needs to make sure that each of its services is resilient to current extreme weather and weather expected under a future climate to ensure that service users are not put at unnecessary risk.

The CCC recommends that local authority plans should include a high level of ambition for emissions reduction, and focus on emissions drivers and adaptation activity over which local authorities have control or influence. DCC commissioned the Centre for Energy and the Environment (CEE) via the South West Energy and the Environment Group (SWEEG) to identify the realistic carbon savings that will arise from DCC delivering local action as well as the carbon savings arising from the delivery of national policy. The focus of this review is on the non-traded sector, and within that, buildings, surface transport and waste. Additionally it will look at how DCC can assist with decarbonising the power sector and demonstrating leadership through its own estate. The scope of the review covers the administrative area of DCC, with results broken down for each of the eight Devon districts, as well as for Dartmoor.

2. Current Emissions

2.1 Scope and Approach

In order to understand the relative importance of the areas where DCC (and the district local authorities) can have an influence on GHG emissions in their respective areas, the current emissions for each area broken down by both sector and greenhouse gas was established. The performance of the UK against the carbon budgets established through the Climate Change Act is assessed by the Committee on Climate Change (CCC) who produce annual progress reports, the most recent of which was published in the summer of 2017[2]. Nationally, carbon dioxide is responsible for 84% of total GHG emissions in 2016. The remaining emissions are due to methane (mainly from agriculture and waste disposal), nitrous oxide (mainly agriculture), and F-gases (mainly refrigeration).

Carbon dioxide data was taken from the *"UK local authority and regional carbon dioxide emissions national statistics: 2005-2015"* dataset[3], which is updated annually and is available at district resolution. The data presents emissions for each of the Industrial & Commercial[4], Domestic, and Transport sectors, as well as for Land Use, Land Use Change and Forestry Emissions (LULUCF). The geographical scope of the study was taken to be the entirety of Devon which comprises 8 districts. In addition, estimates were made for emission that occurred within Dartmoor National Park, with the method used to calculate this described in Appendix 1.

Methane and nitrous oxide emissions were estimated for each district by taking emissions data from the NAEI which was available for each of these gases both as area sources at a 1 x 1 km resolution, and as point sources, across the entirety of the UK. An exercise was undertaken using GIS to allocate these emissions to each district (and to Dartmoor) by overlaying the area boundaries with the NEAI grid (a grid square was taken to be within a district if the centre of that square landed within the district) and the ratio of these obtained values were divided by total UK emissions from each gas to obtain a ratio, which was then applied to the total emissions for the UK as reported by the CCC in their progress report. In the case of nitrous oxide, the ratio between methane and nitrous oxide was obtained by using the same ratio as is observed nationally (namely 91% methane, 8% nitrous oxide; 1% carbon dioxide[5]) and was used to separate the CCC emission data from the waste sector into the relevant gas. The derived factors are shown in Table 1. It can be seen, for example, that Devon's population is only a little over 1% of the UK total, but over 5% of methane emissions from agriculture occur in the county. F-gas emissions were apportioned to Devon by taking a ratio of I&C carbon dioxide emissions from electricity consumption locally to nationally, in the absence of any other information.

[2] Meeting Carbon Budgets – 2017 Progress Report to Parliament, Committee on Climate Change, June 2017

[3] https://www.gov.uk/government/statistics/uk-local-authority-and-regional-carbon-dioxide-emissions-national-statistics-2005-2015

[4] which includes carbon dioxide emissions from the Agriculture sector, some of which are distinctly separated into agricultural processes, and some of which is hidden within the overall carbon emissions from the I&C sector e.g. in the case of electricity demand

[5] Carbon dioxide from the waste sector was ignored as it was deemed to be *de minimis*

Table 1: Factors used to apportion methane and nitrous oxide to the agriculture and waste sectors when applying nationally reported values from the CCC to Devon and its districts

	Population % relative to UK	*Agriculture % UK methane*	*Agriculture % UK nitrous oxide*	*Waste % UK methane*	*Waste % UK nitrous oxide*
East Devon	0.21%	0.83%	0.48%	0.34%	0.36%
Exeter	0.20%	0.01%	0.01%	0.01%	0.01%
Mid Devon	0.12%	0.90%	0.56%	0.14%	0.43%
North Devon	0.14%	0.90%	0.48%	0.10%	0.48%
South Hams	0.13%	0.60%	0.38%	0.17%	0.36%
Teignbridge	0.20%	0.30%	0.22%	0.22%	0.28%
Torridge	0.10%	1.06%	0.53%	0.09%	0.45%
West Devon	0.08%	0.83%	0.42%	0.12%	0.49%
Dartmoor	0.05%	0.47%	0.25%	0.09%	0.37%
Devon Total	***1.19%***	***5.43%***	***3.08%***	***1.18%***	***2.88%***

The period of analysis was taken to be 2005 to the end of the 5th carbon budget period, namely 2032.

2.2 Carbon Dioxide Emissions in Devon

2.2.1 Total Carbon Dioxide Emissions

Total carbon dioxide emissions and breakdowns between the sectors and local authority areas for the latest year where data is available (2015) are shown in Table 2 and in Figure 1 to Figure 5. Total emissions in Devon in 2015 were just over 4,500 $ktCO_2$. Transport is the most significant sector at 40% with I&C next at 34% and Domestic at 27%; however, these splits vary greatly at district level (Figure 2).

East Devon and Teignbridge are the districts that have the highest total emissions, though this is due to their having higher populations than the other districts in the county. Exeter – the only urban district – has suppressed emissions as transport emissions within the district boundary are lower (due to shorter travel distances). This is perhaps slightly misleading as there is significant travel from within the Devon districts to the major urban centres at Exeter, Torbay and Plymouth, and the majority of emissions associated with those journeys would be allocated within the rural districts as opposed to the much smaller urban areas.

Dartmoor is responsible for about 5% of all emissions in Devon of which half are from transport (the highest fraction observed within a geographical area).

Table 2: Carbon dioxide emissions ($ktCO_2$ and expressed as a % of the Devon total) in each district, Devon and Dartmoor across the three main sectors in 2015

Authority	I&C	Domestic	Transport	Total
East Devon	219 (5%)	227 (5%)	332 (7%)	778 (17%)
Exeter	225 (5%)	154 (3%)	105 (2%)	484 (11%)
Mid Devon	189 (4%)	123 (3%)	271 (6%)	584 (13%)
North Devon	211 (5%)	151 (3%)	186 (4%)	548 (12%)
South Hams	195 (4%)	152 (3%)	228 (5%)	575 (13%)
Teignbridge	231 (5%)	200 (4%)	382 (8%)	812 (18%)
Torridge	136 (3%)	109 (2%)	120 (3%)	365 (8%)
West Devon	140 (3%)	95 (2%)	181 (4%)	417 (9%)
Devon Total	1,547 (34%)	1,211 (27%)	1,805 (40%)	4,563 (100%)
Dartmoor	*59 (1%)*	*50 (1%)*	*107 (2%)*	*215 (5%)*

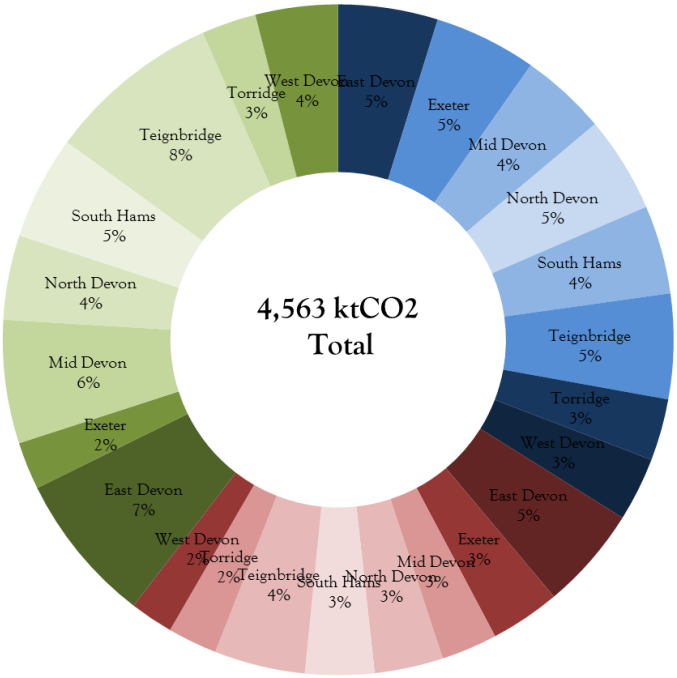


Figure 1: Carbon dioxide emissions in each district across the three main sectors (I&C blue, Domestic red, Transport green) in 2015

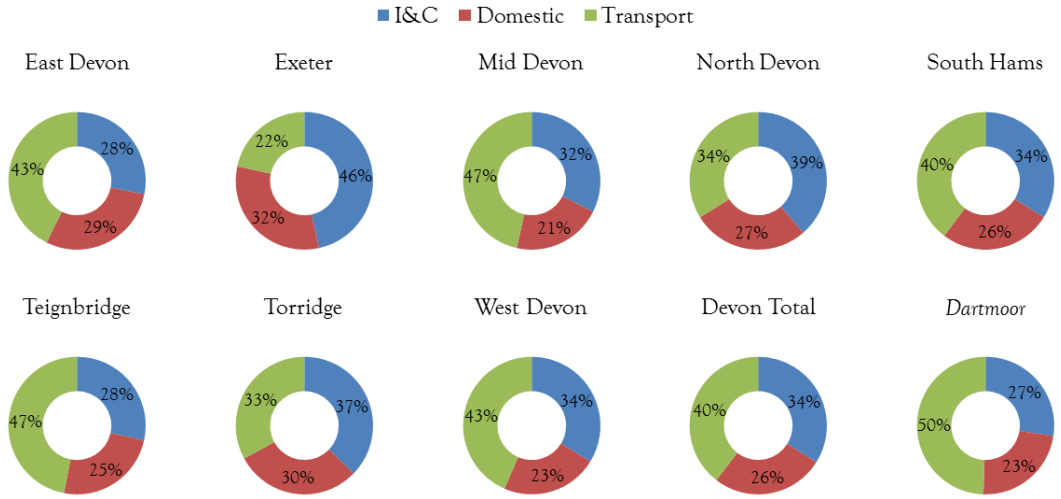


Figure 2: Split of carbon dioxide emissions across the three main sectors in 2015 by district

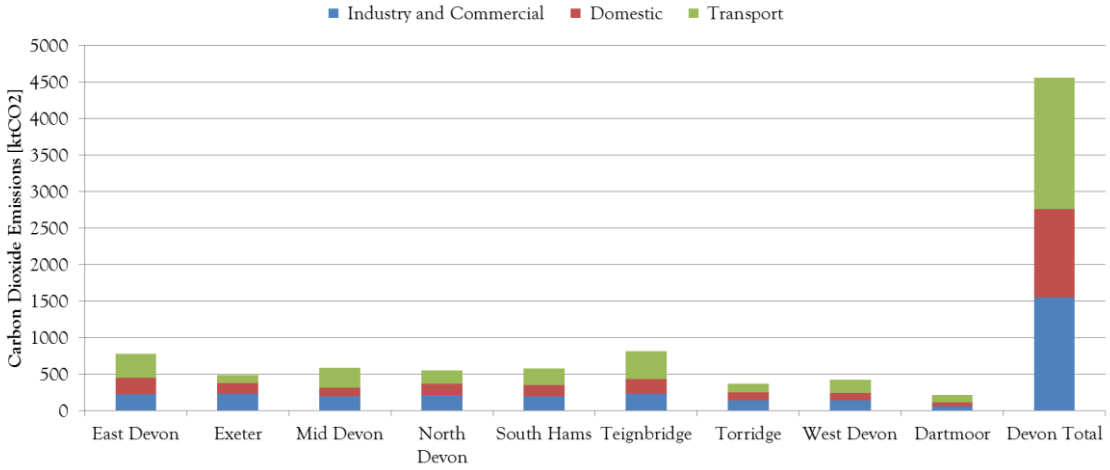


Figure 3: Absolute carbon emissions ($ktCO_2$) broken down by sector in 2015

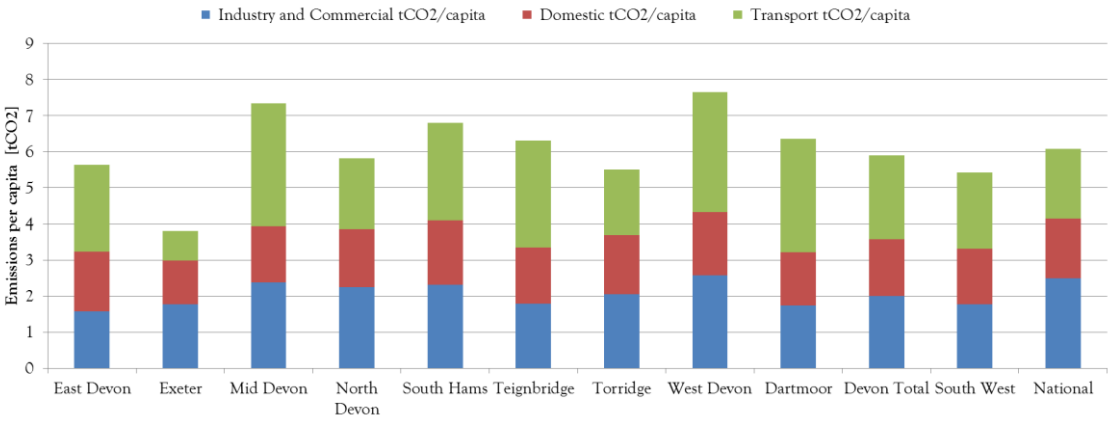


Figure 4: Carbon dioxide emissions per capita ($ktCO_2$/capita) broken down by sector in 2015 stacked

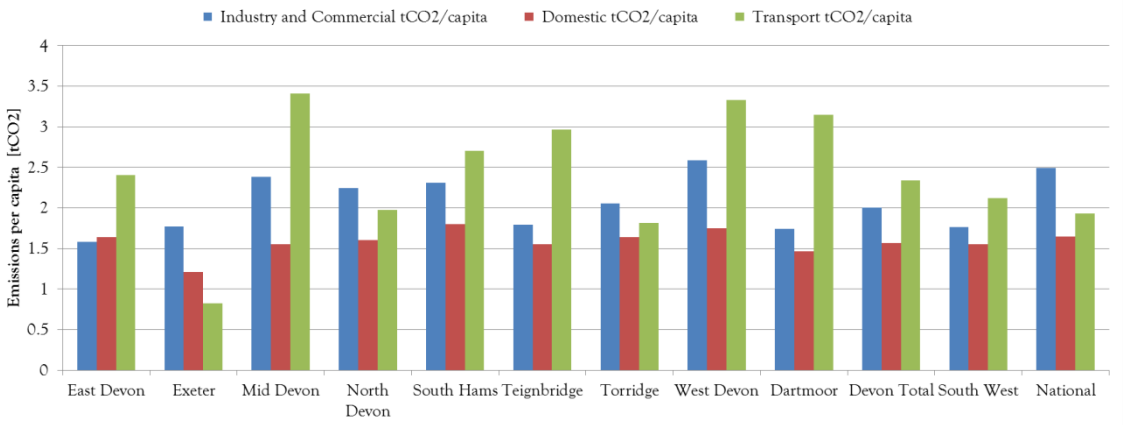


Figure 5: Carbon dioxide emissions per capita ($ktCO_2$/capita) broken down by sector in 2015 with sectors individually shown

2.2.2 Carbon Dioxide Emissions Outturn 2005 – 2015

The changes in emissions from each of the three sectors and areas between 2005 and 2015 are shown in Table 3, and the time series for absolute and per capita emissions in Figure 6 and Figure 7. Over the period, emissions have fallen by 27%, at an average of 3.1% per annum across the districts which is similar to both the regional and national changes. Emissions reductions have been more pronounced in the I&C and domestic sectors than the transport sector with there also being more variance in the reduction in I&C emissions compared to domestic emissions at district scale.

Table 3: Change in absolute emissions per sector and district between 2005 and 2015 (note: the I&C value for Exeter in 2005 in the BEIS data contains an error and so the 2006 value was used in its place)

	Industrial and Commercial	Domestic	Transport	Overall	Annualised
East Devon	-24%	-33%	-7%	-22%	-2.5%
Exeter	-27%	-34%	-8%	-26%	-3.0%
Mid Devon	-25%	-32%	-8%	-21%	-2.3%
North Devon	-30%	-33%	-4%	-25%	-2.8%
South Hams	-46%	-34%	-8%	-32%	-3.8%
Teignbridge	-22%	-33%	-9%	-21%	-2.3%
Torridge	-17%	-32%	-1%	-23%	-2.6%
West Devon	-25%	-29%	-1%	-21%	-2.4%
Devon Total	-35%	-33%	-6%	-27%	-3.0%
Dartmoor	-26%	-31%	-4%	-18%	-2.0%
South West	-40%	-32%	-7%	-28%	-3.2%
National	-34%	-30%	-8%	-27%	-3.1%

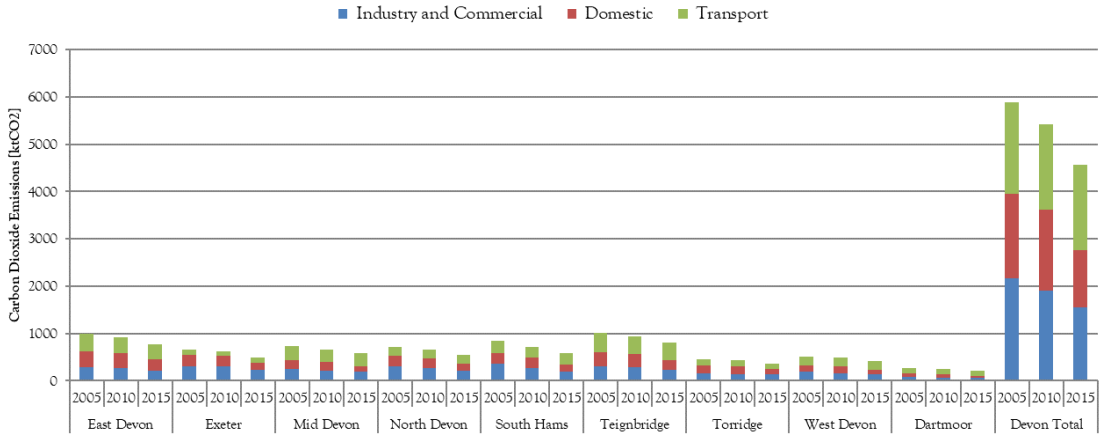


Figure 6: Carbon dioxide emissions ($ktCO_2$) broken down by sector in 2005, 2010 and 2015

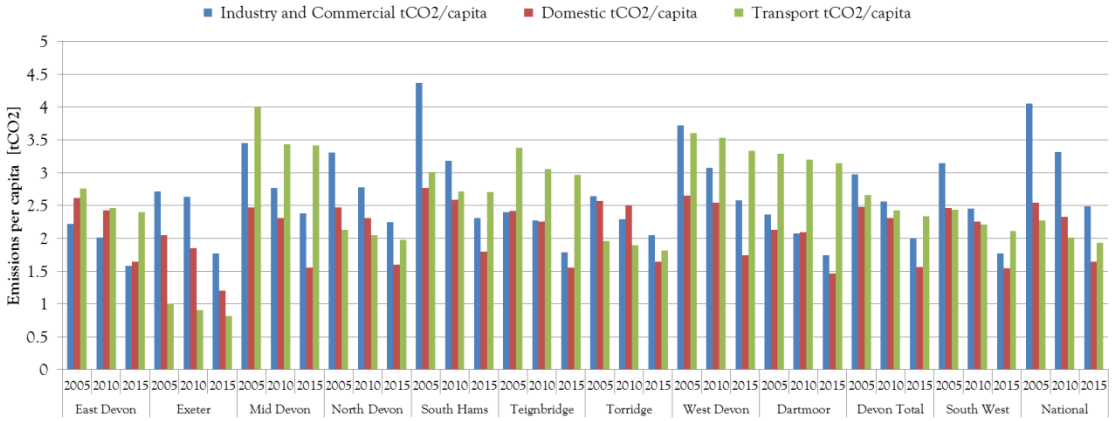


Figure 7: Carbon dioxide emissions per capita ($ktCO_2$/capita) broken down by sector in 2005, 2010 and 2015

The most recent CCC progress report on meeting carbon budgets was reviewed to understand the underlying reasons for changes in carbon dioxide emissions in the locality. The trends in change in carbon dioxide emissions for Devon, the 8 districts and Dartmoor were compared to the national trends (based on information in the CCC report) and are shown in Figure 8. Some of the main reasons for this reduction in carbon emissions are as follows:

- The most significant driver for carbon dioxide reduction has been reductions from the power sector. The carbon intensity of electricity was 531 gCO_2/kWh in 2005, and 379 gCO_2/kWh in 2015. Provisional data for 2016 indicates that this could fall to 286 gCO_2/kWh. This is being driven by the increasing capacity of, and generation from, renewable energy sources together with a reduction in the use of coal. Combined with reduced demand from buildings and industry (for example due to more efficient building services, lighting and equipment) in the UK, emissions from the power sector fell by 40% compared to 2005. The trend observed locally has been similar (37%).
- In the UK, emissions from the I&C sector have fallen by 30% between 2005 and 2015, which is slightly better than the trend observed in Devon (25%). The variance in emission change between the districts is higher for this sector than for any other, and may be driven by the opening or closing of larger industrial sites (the data does not allow specific reasons to be determined).
- In the UK, direct emissions (i.e. excluding electricity) from the domestic sector have fallen by 22% between 2005 and 2015, which is similar to the trend observed Devon. The underlying driver for this carbon reduction – even with increasing numbers of dwellings – has been

improvements to the efficiency of the stock, mainly boiler replacements, and loft and cavity wall insulation. In addition, the annual variation in temperature is visible in Figure 8 e.g. 2010 being much colder than 2011.

- In the UK, emissions from the transport sector have fallen by only 8% between 2005 and 2015, with the trend observed locally broadly following this, with the exception of North Devon, Torridge and West Devon where emissions have barely fallen over the period. In general, efficiency improvements resulting from the turnover of the vehicle fleet are being offset by greater travel distances.
- In general, the CCC observes that lately carbon reduction has levelled off across all the sectors with the exception of the power sector, where the carbon intensity of electricity generation is projected to continue falling.

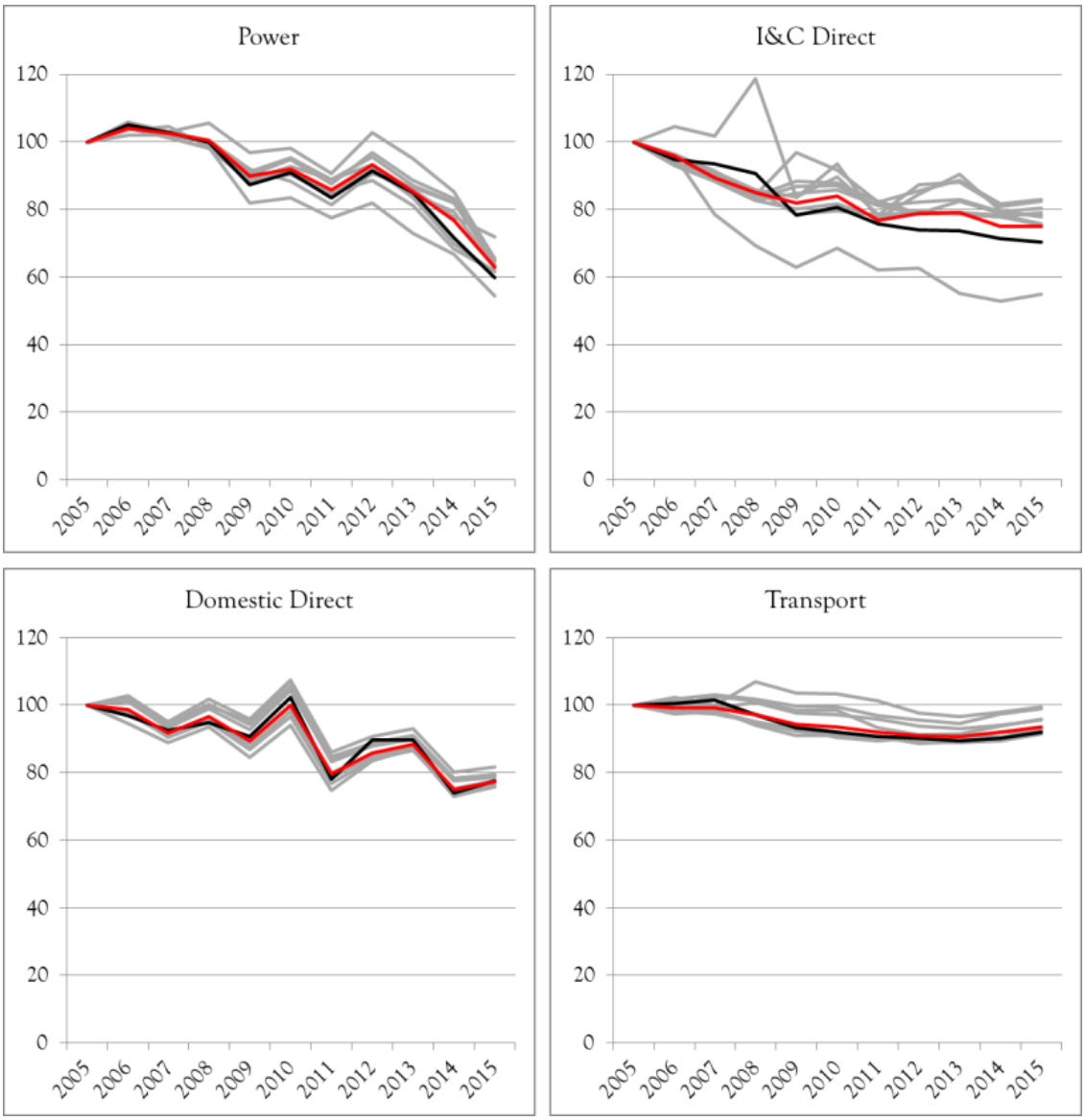


Figure 8: Trends in carbon dioxide emissions in the Power, I&C (direct), Domestic (direct) and Transport sectors for Devon (red), each district (grey) and the UK (black) indexed to 2005

2.3 Non-Carbon Dioxide Emissions in Devon

It can be seen in Figure 9 that the most significant non-carbon dioxide GHG is methane, and that Agriculture is far and away the most significant sector for non-carbon dioxide GHGs. The CCC has reported that nationally since 2005 non-carbon dioxide emissions from Agriculture and F-gases have remained broadly constant, whilst those from Waste have sharply fallen from 49 $MtCO_2e$ in 2005 to 18 $MtCO_2e$ in 2016. The results for all gases are shown in Table 4 and in Figure 10 to Figure 13. In Devon as a whole, carbon dioxide is responsible for around two-thirds of GHG emissions (as opposed to 84% nationally) with Agriculture being the single largest sector. The results vary by district, though Devon being a relatively rural county means that emissions from agriculture are significant in most districts (with the exception of Exeter and Teignbridge). Nationally, the approximate split of GHG emissions from agriculture are 50% enteric fermentation from cows and sheep, 30% from fertilisers for soil management, and 10% carbon dioxide for machinery (which would be accounted for in the previous section). When non-carbon dioxide GHGs are taken into account, per capita emissions in Devon and most of its districts are significantly higher than the national average.

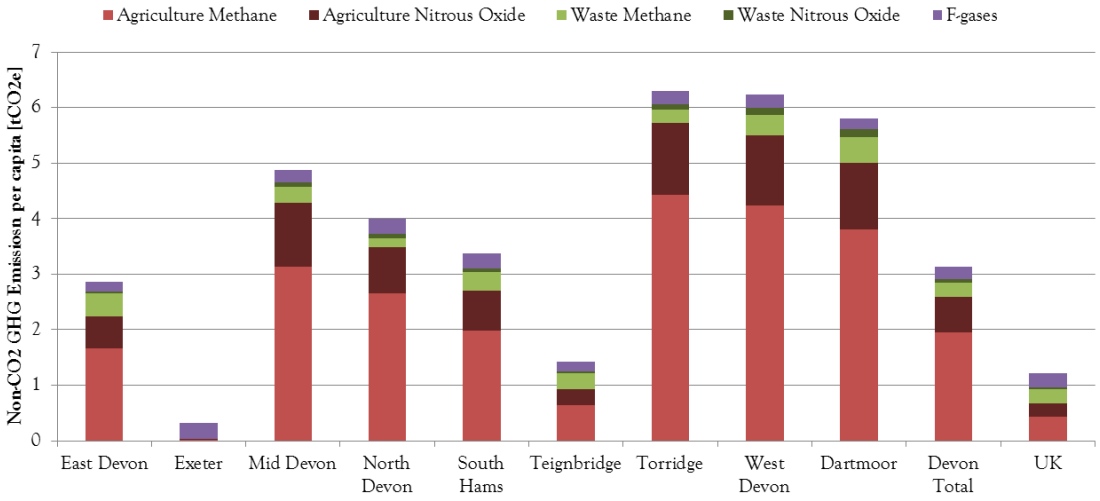


Figure 9: Per capita emissions for non-carbon dioxide GHGs for Devon and the UK in 2015

Table 4: Per capita emissions all GHGs for Devon and the UK in 2015 [tCO_2e/capita]

Local Authority	Carbon Dioxide	Methane	Nitrous Oxide	F-gases	LULUCF	Total
East Devon	5.6 (66%)	2.1 (24%)	0.6 (7%)	0.2 (2%)	0.0 (0%)	8.5 (100%)
Exeter	3.8 (93%)	0.0 (1%)	0.0 (0%)	0.3 (7%)	0.0 (-1%)	4.1 (100%)
Mid Devon	7.3 (59%)	3.4 (28%)	1.2 (10%)	0.2 (2%)	0.1 (1%)	12.4 (100%)
North Devon	5.8 (58%)	2.8 (28%)	0.9 (9%)	0.3 (3%)	0.2 (2%)	10.0 (100%)
South Hams	6.8 (66%)	2.3 (22%)	0.8 (8%)	0.3 (3%)	0.1 (1%)	10.3 (100%)
Teignbridge	6.3 (83%)	0.9 (12%)	0.3 (4%)	0.2 (2%)	-0.2 (-2%)	7.6 (100%)
Torridge	5.5 (49%)	4.7 (41%)	1.4 (12%)	0.2 (2%)	-0.6 (-5%)	11.2 (100%)
West Devon	7.7 (57%)	4.6 (35%)	1.4 (10%)	0.2 (2%)	-0.6 (-4%)	13.3 (100%)
Dartmoor	6.4 (52%)	4.3 (35%)	1.3 (11%)	0.2 (2%)	0.0 (0%)	12.2 (100%)
Devon Total	5.9 (66%)	2.2 (25%)	0.7 (8%)	0.2 (3%)	-0.1 (-1%)	9.0 (100%)
UK	6.1 (85%)	0.7 (10%)	0.3 (4%)	0.3 (4%)	-0.1 (-2%)	7.1 (100%)

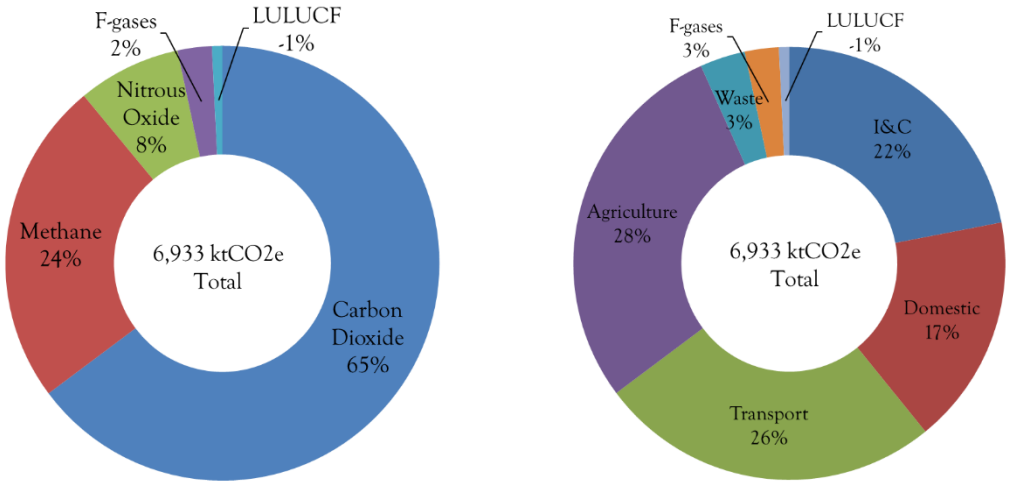


Figure 10: Split of GHG emissions by gas and sector for Devon in 2015 (note: carbon dioxide emissions from agriculture are allocated to the I&C sector, and F-gas %s differ due to rounding differences)

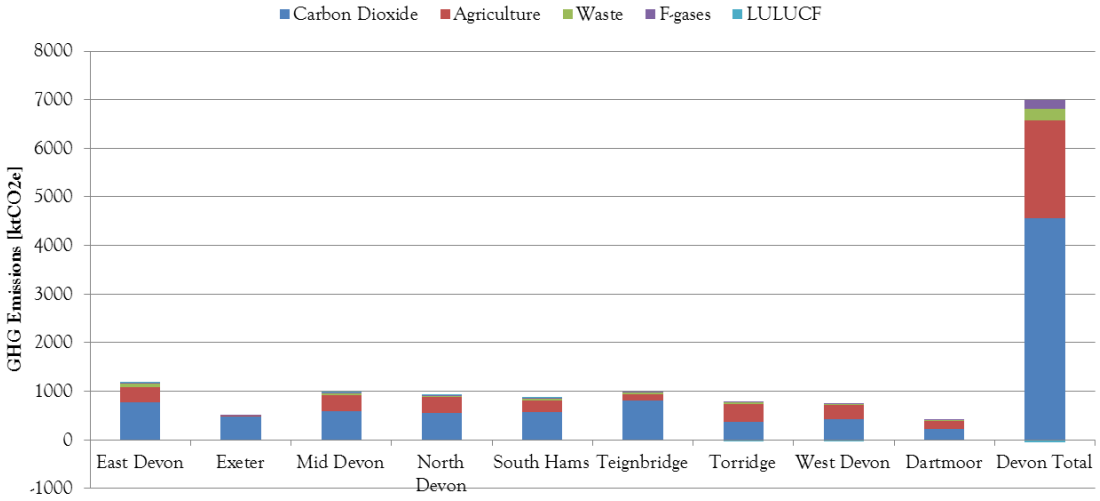


Figure 11: Split of absolute emissions from carbon dioxide together with non-carbon dioxide emissions from Agriculture (non-carbon dioxide GHG emissions), Waste, F-gases and LULUCF in Devon in 2015

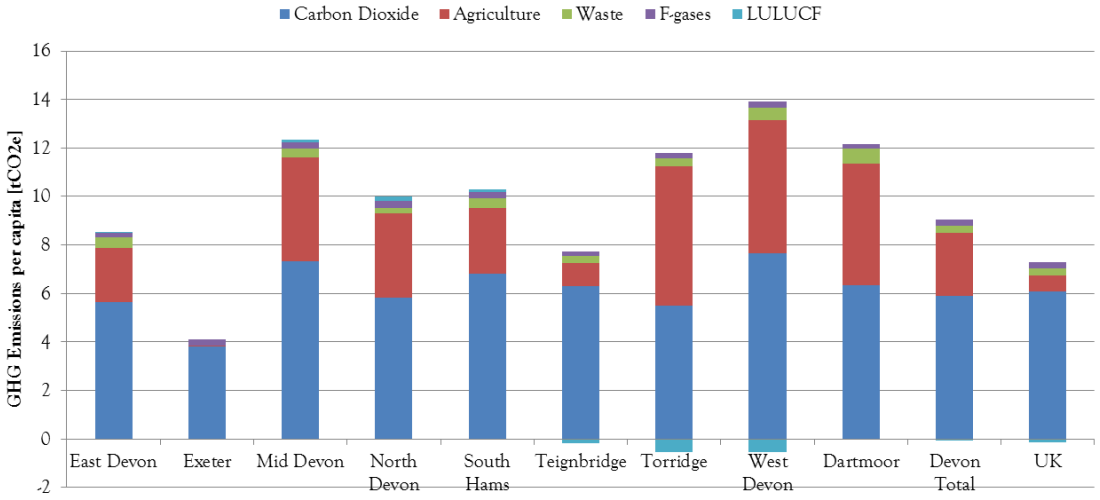


Figure 12: Split of per capita emissions from carbon dioxide together with non-carbon dioxide emissions from Agriculture (non-carbon dioxide GHG emissions), Waste, F-gases and LULUCF in Devon in 2015

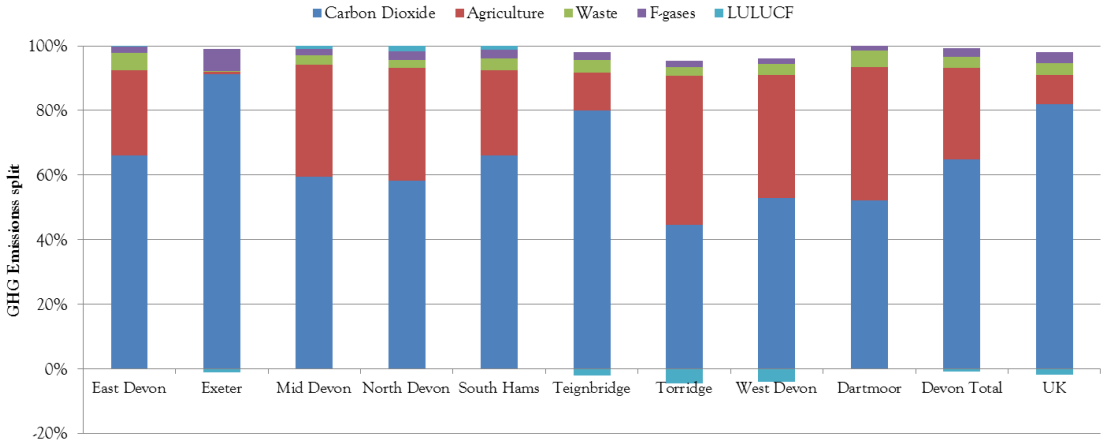


Figure 13: Relative split of absolute emissions from carbon dioxide together with non-carbon dioxide emissions from Agriculture (non-carbon dioxide GHG emissions), Waste, F-gases and LULUCF in Devon in 2015

3. Projections and National Policy

3.1 Apportioning National Policy to Devon

In order to estimate the projected change in GHG emissions across the Devon, the trajectory for emissions reported by the CCC in their progress report was analysed. This report considered the impact of a range of policy measures across the different sectors within the UK economy. The CCC present carbon dioxide trajectories resulting from a range of policies, which they classified as either "lower risk", "at-risk", and the resulting "policy gap" in order for the UK's carbon budget targets under the Climate Change Act to be met in the most cost-effective manner. These trajectories extend to 2032.

The policies reported at a national level were in general directly apportioned to emissions in the local area based on metrics such as percentage change. The CCC sectors do not directly align with the sectors for which emission data is reported locally. For example, the CCC report separates emissions into Power, Buildings and Industry sections, and so these had to be apportioned into the I&C and Domestic sectors respectively. The local carbon dioxide data aggregates the industrial and commercial sectors. These emissions were separated by apportioning using national splits of fuel use. Emissions projections for Buildings (which included domestic and non-domestic), and Industry were directly applied to the local carbon dioxide data. The projections for the Power sector were applied to each sector based on the electricity demand from each of these sectors. Emissions within the I&C sector were disaggregated by apportioning emissions based on the split of energy consumption by fuel and sector taken from DUKES[6]. The national data included final fuel consumption (thousands of tonnes of oil equivalent) for each of "Industry" and "Commercial" and "Public Administration". The last two of these were summed and referred to as emissions from the commercial sector, and were taken to imply emissions from non-domestic buildings other than in the industrial sector. To summarise, the following process was followed:

- The local BEIS data for "Industry and Commercial Electricity" carbon dioxide data emissions was apportioned based on the split at national level between Industry (50%) and Commercial + Public (50%)
- The local BEIS data for "Industry and Commercial Gas" carbon dioxide data emissions was apportioned based on the split at national level between Industry (52%) and Commercial + Public (48%)
- The local BEIS data for "Industry and Commercial Other Fuels" carbon dioxide data emissions was apportioned based on the split at national level between Industry (86%) and Commercial + Public (14%) by considering energy consumption of coal, manufacturing fuel and petroleum products and using carbon conversion factors to weight these.
- It was assumed that "Large Industrial Installations" resulted in emissions only to the industrial sector.
- "Agriculture" emissions reported locally relate to emissions from onsite combustion due to farm equipment, urea application and liming of soils. For the purposes of the projections (and unlike in the previous section), these emission were transferred to the Agriculture sector (which is dominated by methane and to a lesser extent nitrous oxide).
- Projections for carbon emissions for each of the above, and all remaining sectors, were estimated by applying the percentage change taken at a national level to occur locally.

[6] Digest of United Kingdom Energy Statistics, 2015 data, Table 1.1 Aggregate energy balance 2015 Gross Calorific Values

3.2 Projected GHG Emissions in Devon

If there were no policy in place, between 2015 and 2032 GHG emissions would be projected to fall by 1.7% in Devon. With savings from current "low risk" policy the reduction would be 3.4%. If all the savings through less certain government policies are realised in practice then the level of emission reduction would be 18.0%. This leaves a 23.5% policy gap to achieve the CCC's stated trajectory for carbon reduction, which if it were met would result in emissions being 41.5% lower in 2032 than they are in 2015.

The "no policy" baseline and "CCC target" scenarios are shown in Figure 14. Whilst savings will need to be found across every sector, the single most important sector is Transport. The GHG emission reduction across each sector in Devon can be seen separately in Figure 15. It can be seen that very little of the required emission reduction is captured by current low risk policy. The majority of these are related to the projected uptake of large scale renewable energy schemes in the near to mid-terms which in turn reduce emissions from power consumption in the I&C and Domestic sectors. There is a significant amount of carbon reduction that is either "at risk", or for which there is currently no effective policy framework. The projected trajectories for each Devon district can be seen in Figure 16 (all GHG emissions) and Figure 17 (only emissions from the three mainly carbon dioxide-dominated sectors).

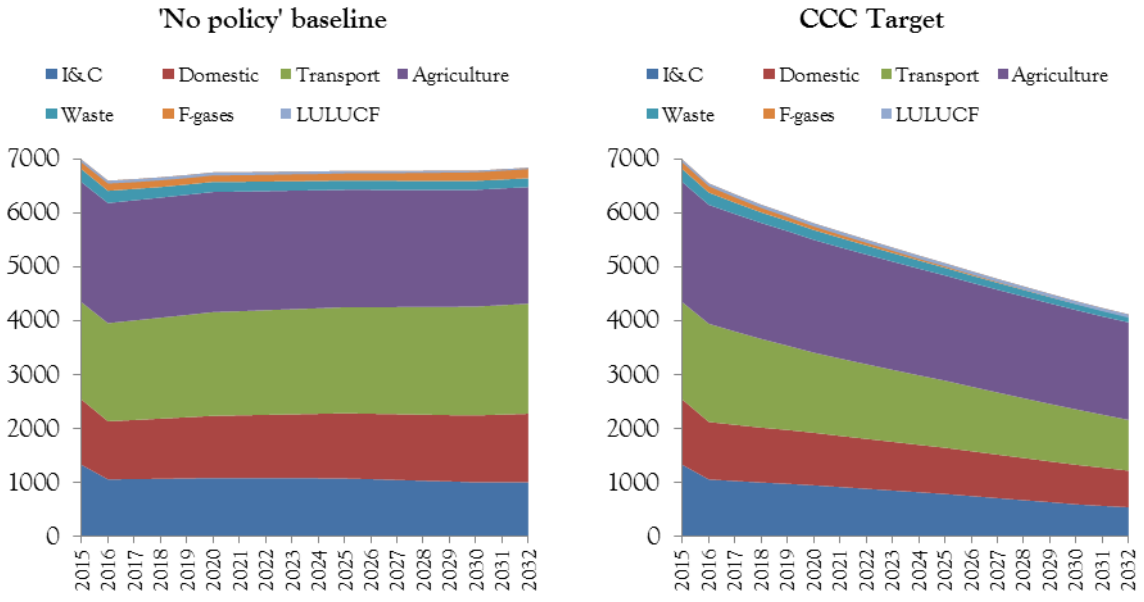


Figure 14: Projected GHG emissions ($ktCO_2e$) from each sector in Devon for "no policy baseline" and "CCC Target" i.e. including all low risk, at risk and policy gap measures.

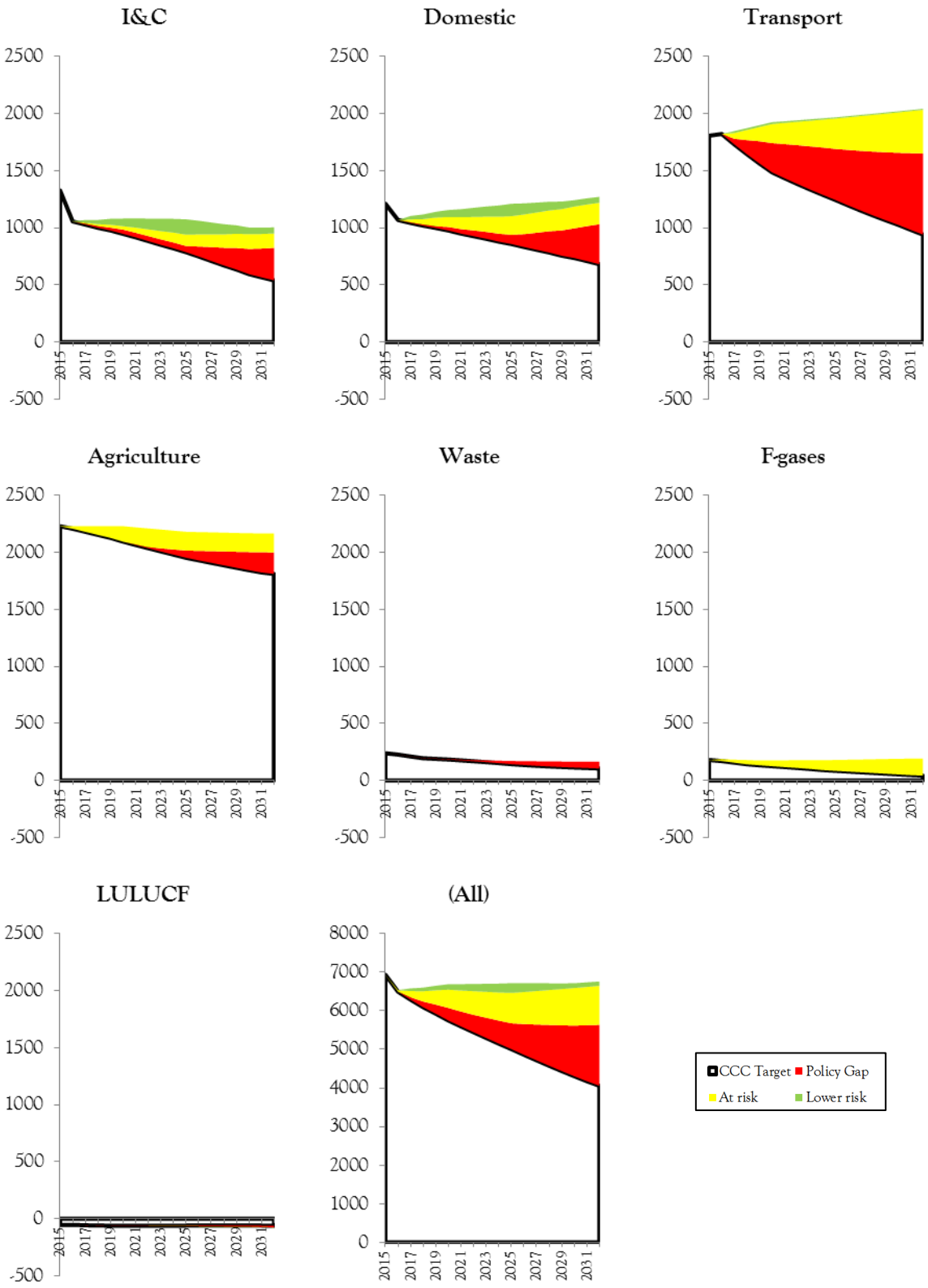


Figure 15: Projected GHG emissions ($ktCO_2e$) in Devon across 7 sectors and in total (bottom middle) resulting from national carbon reduction policy as identified by the CCC

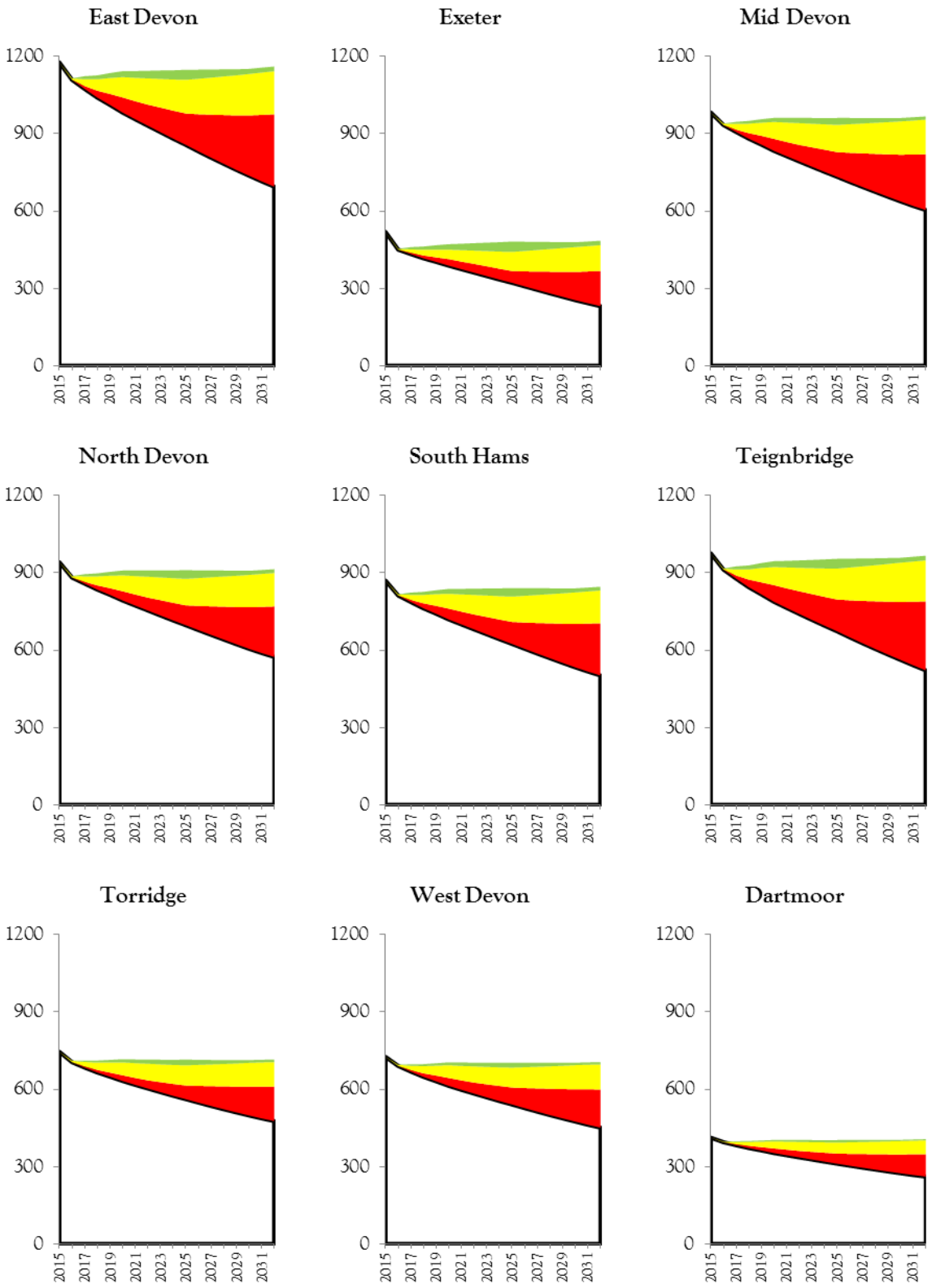


Figure 16: Projected total GHG emissions ($ktCO_2e$) for each Devon district as identified by the CCC

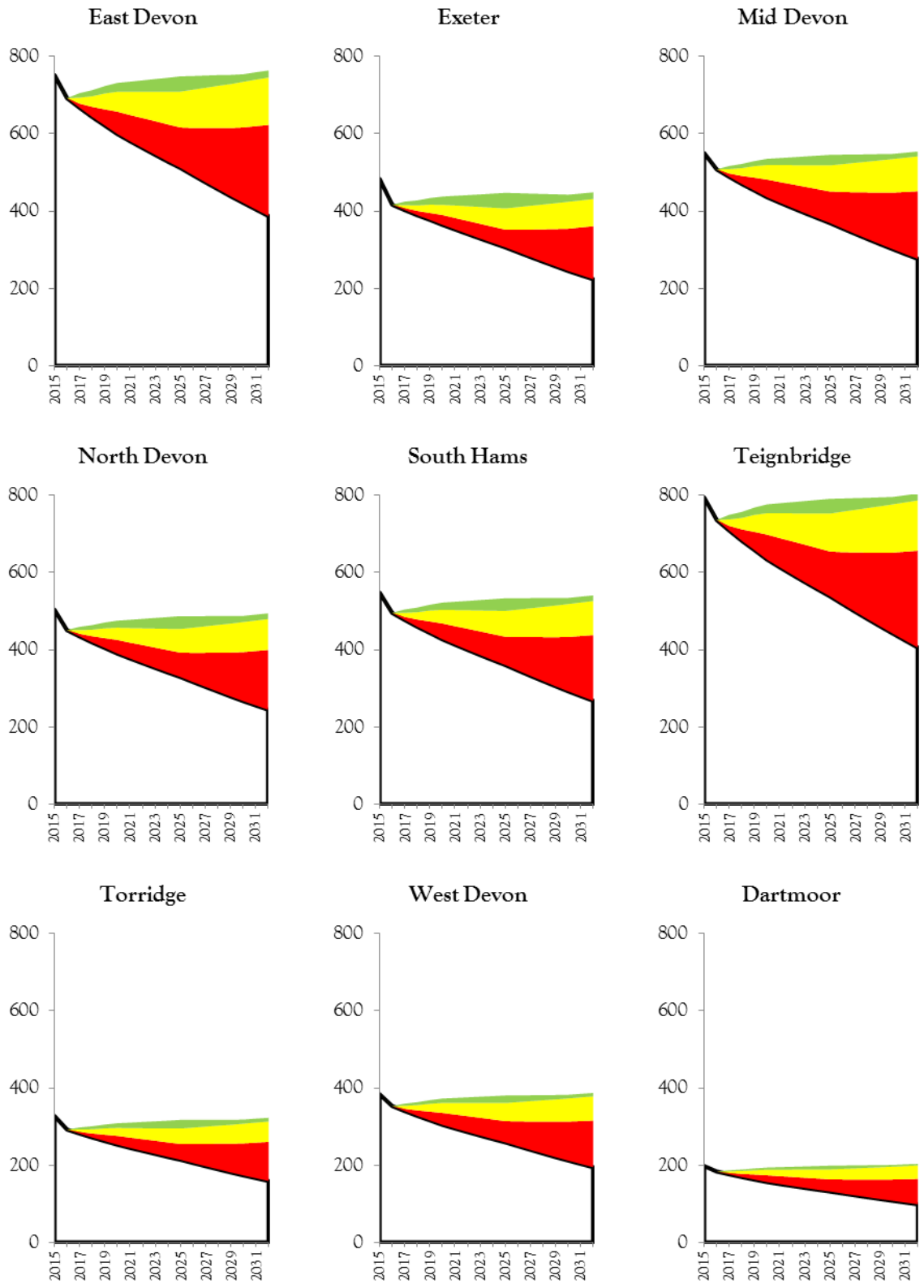


Figure 17: Projected GHG emissions ($ktCO_2e$) from the I&C (excluding "Agriculture"), Domestic and Transport sectors only for each Devon district as identified by the CCC

4. Local Action

4.1 Background

The CCC has published a report[1] advising how local authorities can most effectively reduce emissions and manage climate risk in their areas. Devon is a "shire area" which is administered by DCC as the county council, together with eight district councils. The CCC lists "shire area" responsibilities as education, highways, transport planning, passenger transport, social care, libraries, waste disposal and strategic planning. The districts are responsible for housing, leisure and recreation, environmental health, waste collection and planning services. The CCC states that local authorities are well placed to drive and influence emissions reduction due to their functions as service providers, social housing owners (though in the case of two-tier authorities housing is addressed at district level), community leader, planning authority and regeneration coordinator.

With regard to the sectors against which the CCC report's annual progress against the UK's carbon budgets, the CCC states that local authorities have influence is shown in Table 5.

Table 5: Summary of sectors and greenhouse gas emissions under the influence of local authorities in the UK, adapted from CCC[1]

Sector	Direct Role	Leadership/Facilitation role
Power	Low e.g. community renewable energy	Public support/planning approval, involvement in low carbon decentralised energy
Buildings	High (e.g. Green Deal)	Awareness raising
Surface Transport	High (for sustainable transport measures)	Encouraging low carbon vehicles
Waste	High	Waste prevention
Agriculture	Low e.g. County Farms	n/a
Other non-carbon dioxide	n/a	n/a
Industrial refineries and other energy supply carbon dioxide	n/a	Promoting CHP, heat networks and waste heat recovery

The CCC report states that local authorities should develop low-carbon plans that have a high level ambition and that focus on drivers over which they have influence. Specifically, buildings, transport, waste, power, and an authority's own estate are identified. It is recommended that the high level ambition for DCC's low-carbon plan should be to support the UK in meeting its carbon budget targets by delivering carbon reduction action at the same rate locally as implied nationally. The next sections focus on each of those sectors in turn.

4.2 Buildings

4.2.1 New Development

Strategic planning can play an important role in shaping GHG emissions in an area. Traditionally, local strategic plans are set locally by district authorities. There are currently three strategic plans covering the entire administrative area of Devon:

- The Greater Exeter Strategic Plan (GESP) which will deliver a formal statutory document to provide the overall spatial strategy and level of housing and employment land to be provided up to 2040 in East Devon, Exeter, Mid Devon and Teignbridge.
- The Plymouth Plan between Plymouth, a Joint Local Plan which will cover Plymouth, South Hams District and West Devon Borough to 2034.
- The North Devon and Torridge Local Plan, a new local plan to cover northern Devon (North Devon and Torridge) that will consider the long-term vision of objectives for the area up to 2031.

Since the Housing Standards Review, local planning authorities have not been able to set carbon standards for buildings in new developments that are in advance of the national carbon compliance mechanism, namely Part L of the Building Regulations. However, planning can still play a significant role by ensuring development is brought forward in the most favourable locations, for example to take advantage of (low carbon) heat sources or loads, or to reduce travel distances. DCC has been working in partnership with the districts in developing the GESP, and should seek to support other progressive low carbon plan making across the county.

The CCC states that local authorities also have an important role regarding enforcement of building regulations and planning policy. However, this is the responsibility of the district authorities, rather than the County Council.

4.2.2 Existing Homes

There is the potential to reduce emissions from existing homes in a number of ways, including improving insulation, replacing boilers, and using more efficient appliances within dwellings. DCC does not own any housing itself, as housing provision is a role that district authorities are responsible for. The Energy Saving Trust's (EST) Home Analytics database was used to estimate the extent of insulation and boiler type across Devon, with the results shown in Figure 18 to Figure 22. In general, local authority (and social landlord) owned homes are better insulated than private sector housing. It should be noted that the most recent national data on dwelling tenure indicates that there are no local authority owned houses in North Devon, South Hams, Teignbridge, Torridge and West Devon and so the Home Analytics data is likely out of date. Nonetheless, those dwellings will still be located within each of those districts albeit owned by non-local authority providers.

The CCC has set a target that where practicable, all lofts are insulated by 2022. Across Devon this equates to up to 2,580 lofts in local authority owned dwellings, and approximately 76,000 dwellings including all tenure types.

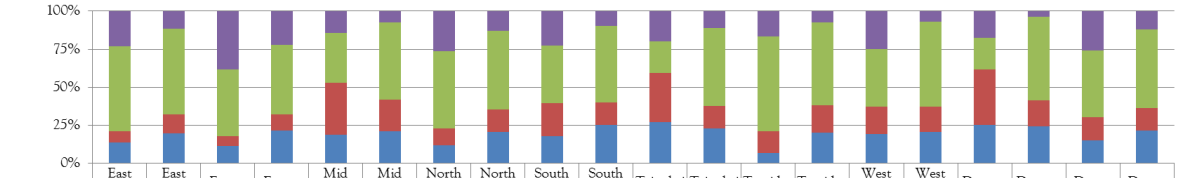
The CCC has also targeted insulating all cavity walls where practicable by 2030 which in the case of Devon is approximately 3,200 within local authority owned dwellings, and 116,000 dwellings including all tenure types.

The CCC has set a target of insulating 2 million solid walls by 2030. This would translate to insulating 23%[7] of all dwellings with solid walls. If this target is applied to Devon, this would mean that over 8,000 solid wall dwellings would need to be insulated by 2030, at a rate of almost 700 per year. It should be noted that 33% of local authority owned solid wall dwellings are already insulated.

The CCC does not set a specific target for condensing boilers and states in the most recent progress report "most boilers have now been replaced with efficient condensing models (around 70% in 2016)". This is potentially at odds with the EST Home Analytics data (Figure 22) which indicates that there is still significant potential to replace standard with condensing boilers which currently only account for 40% of boilers.

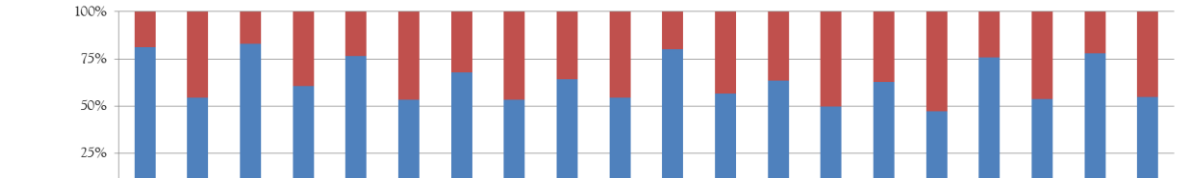
DCC can assist with delivering the levels of insulation and boiler replacement required by continuing to work with the district authorities and organisations responsible for delivering the Green Deal/ECO and its successor schemes, as it has done through the Cosy Devon partnership.

In addition, DCC can use its role as a trusted, impartial, and local organisation to provide information to residents. This can include both signposting to energy efficiency schemes, and information on behaviour measures.



	East Devon LA	East Devon All	Exeter LA	Exeter All	Mid Devon LA	Mid Devon All	North Devon LA	North Devon All	South Hams LA	South Hams All	Teignbridge LA	Teignbridge All	Torridge LA	Torridge All	West Devon LA	West Devon All	Dartmoor LA	Dartmoor All	Devon LA	Devon All
No Loft	1012	7505	2055	11780	433	2564	356	5663	169	4050	289	6704	120	2304	90	1693	70	595	4524	42263
250mm+	2454	36838	2344	24500	1011	17545	684	22890	281	21438	308	30118	453	16927	138	13991	81	8391	7673	184247
125-249mm	330	8012	330	5648	1047	7177	144	6572	162	6332	471	8941	104	5566	66	4190	143	2642	2654	52438
0-124mm	587	12895	615	11348	571	7286	160	9094	134	10637	394	13398	50	6302	69	5085	99	3675	2580	76045

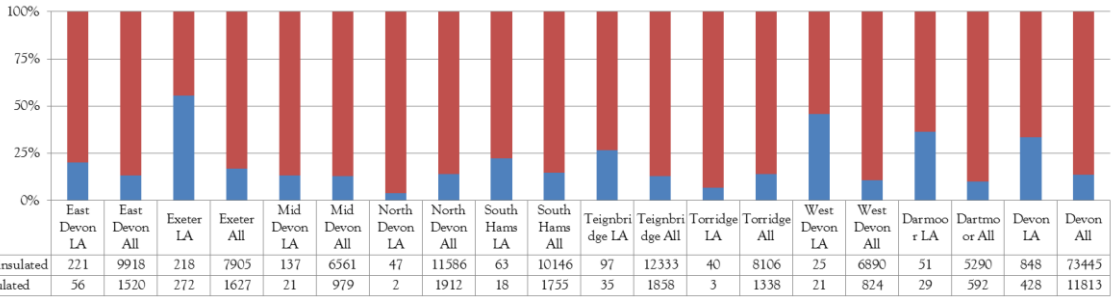
Figure 18: The extent of loft insulation across Devon for Local Authority owned, and all dwellings



	East Devon LA	East Devon All	Exeter LA	Exeter All	Mid Devon LA	Mid Devon All	North Devon LA	North Devon All	South Hams LA	South Hams All	Teignbridge LA	Teignbridge All	Torridge LA	Torridge All	West Devon LA	West Devon All	Darmoor LA	Dartmoor All	Devon LA	Devon All
CW Uninsulated	731	23637	760	16310	598	11984	386	13762	216	12893	234	18312	240	10414	112	8627	72	4053	3277	115939
CW Insulated	3158	28147	3708	25147	1965	13741	810	15724	385	15455	938	24017	417	10269	188	7743	224	4725	11569	140243

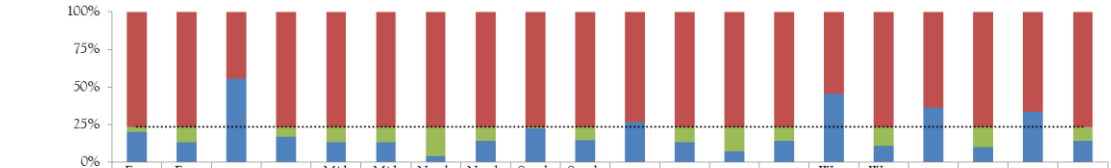
Figure 19: The extent of cavity wall insulation across Devon for Local Authority owned, and all dwellings

[7] Based on 7.1 million dwellings with solid walls in the England from English Housing Survey Energy Efficiency of English Housing 2012, and pro-rating this based on ratio of English to UK total dwellings.



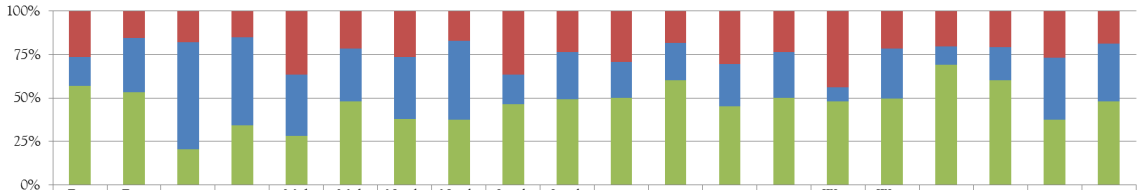
	East Devon LA	East Devon All	Exeter LA	Exeter All	Mid Devon LA	Mid Devon All	North Devon LA	North Devon All	South Hams LA	South Hams All	Teignbridge LA	Teignbridge All	Torridge LA	Torridge All	West Devon LA	West Devon All	Dartmoor LA	Dartmoor All	Devon LA	Devon All
SW Uninsulated	221	9918	218	7905	137	6561	47	11586	63	10146	97	12333	40	8106	25	6890	51	5290	848	73445
SW Insulated	56	1520	272	1627	21	979	2	1912	18	1755	35	1858	3	1338	21	824	29	592	428	11813

Figure 20: The extent of solid wall insulation across Devon for Local Authority owned, and all dwellings



	East Devon LA	East Devon All	Exeter LA	Exeter All	Mid Devon LA	Mid Devon All	North Devon LA	North Devon All	South Hams LA	South Hams All	Teignbridge LA	Teignbridge All	Torridge LA	Torridge All	West Devon LA	West Devon All	Dartmoor LA	Dartmoor All	Devon LA	Devon All
2030 Still uninsulated	212	8756	218	7297	121	5772	38	10332	62	9110	97	10863	33	7229	25	5905	51	4503	848	65263
2030 "Gap"	9	1162	0	608	16	789	9	1254	1	1036	0	1470	7	877	0	985	0	787	0	8182
Current Insulated	56	1520	272	1627	21	979	2	1912	18	1755	35	1858	3	1338	21	824	29	592	428	11813

Figure 21: Number of solid walls that would need to be insulated by 2030 to align with the national trajectory (23% by 2030)



	East Devon LA	East Devon All	Exeter LA	Exeter All	Mid Devon LA	Mid Devon All	North Devon LA	North Devon All	South Hams LA	South Hams All	Teignbridge LA	Teignbridge All	Torridge LA	Torridge All	West Devon LA	West Devon All	Dartmoor LA	Dartmoor All	Devon LA	Devon All
No Boiler	1159	10161	946	7920	1116	7414	357	7468	273	10006	430	10734	222	7288	159	5388	80	3143	4662	66379
Condensing	727	20208	3292	27128	1087	10523	478	20198	125	11518	300	12690	175	8182	30	7181	41	2921	6214	117628
Standard	2497	34881	1106	18228	859	16635	509	16553	348	20933	732	35737	330	15629	174	12390	272	9239	6555	170986

Figure 22: The extent of boilers across Devon for Local Authority owned, and all dwellings

4.2.3 Commercial and Public Buildings

Statistics from the Valuation Office Agency[8] were consulted to establish the nature of commercial buildings in Devon. Offices space is disproportionately located in Exeter (33% of Devon by floor area), with industrial and "other" business use floor area being more evenly spread across the county (Figure 23). In addition, buildings in Exeter are likely to be larger than elsewhere in Devon (Figure 24).

The CCC indicator target for direct emissions (i.e. non-electricity) from non-domestic buildings is a 58% reduction by 2030 from 1990 levels; this compares to a domestic target of a 24% reduction. Whilst a significant proportion of this reduction will come as a result of renewable heat, there are still opportunities to reduce energy demand from non-domestic buildings. DCC has a potential role to play by raising awareness of opportunities and delivering schemes directly. In addition local authorities (districts rather than county) are also responsible for enforcing building regulations both for new and existing non-residential buildings.

[8] Official Statistics, Business Floorspace (Experimental Statistics), From:Valuation Office Agency Published:17 May 2012

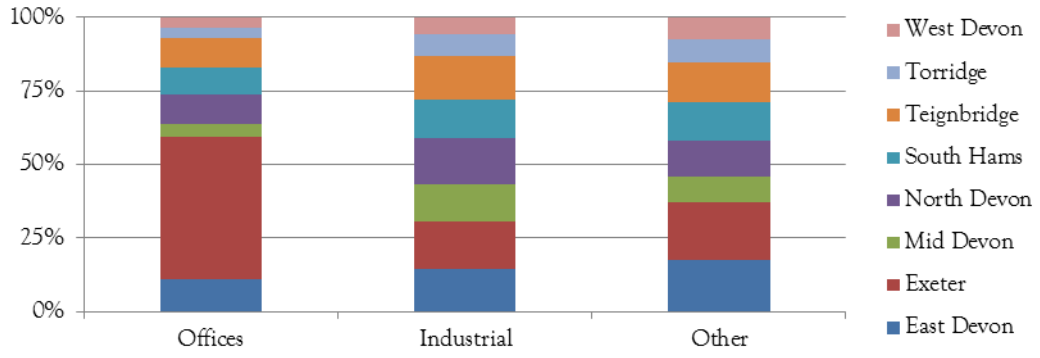


Figure 23: Split of floor area by business sector and district

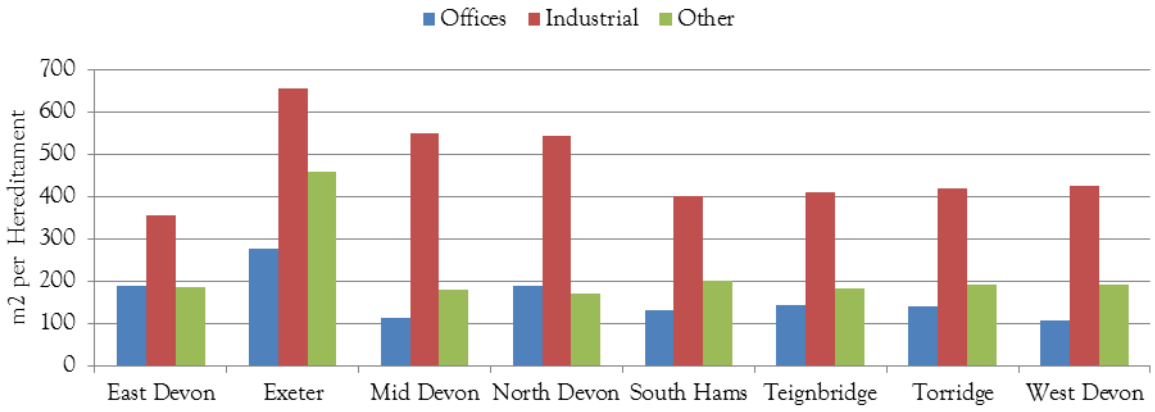


Figure 24: Average size of hereditament by sector and district

4.2.4 Low Carbon Heat

The CCC has targeted at least a quarter of buildings using heat from low-carbon sources such as heat pumps, biomethane and low-carbon heat networks by 2030.

If the 2.5 million heat pumps the CCC propose as a national target are applied to Devon proportionately this would equate to almost 33,000 heat pumps in Devon by 2030, at an installation rate of 2,700 per year. This would result in 9% of Devon's homes being heated by heat pumps, or 60% of all Devon dwellings that are currently being heated electrically (on the assumption that these represent the most likely candidate dwellings for heat pumps).

The CCC has targeted supplying 40 TWh of heat through low-carbon heat networks by 2030. Heat networks can be incorporated either into new or existing developments with the latter being more expensive and disruptive. In all cases, increased development density improves the viability of a scheme, and it is imperative that there is the potential for the heat to be generated using a low-carbon source (for example biomass or waste heat), given the falling carbon intensity of grid electricity which can be viewed as a potential alternative strategy for the provision of heat. It would not be appropriate to attempt to apportion the national target to Devon, as it is a comparatively rural county that does not benefit from the higher density of existing development that exists in more urban parts of the country. Within Devon the best potential for heat networks is therefore with new

development. This is consistent with national planning policy, and is reflected in the local plans developed by the district councils. Good progress has already been made with regard to practical delivery, with schemes having been brought forward in Cranbrook to the east of Exeter, and in developments at the outskirts of Exeter such as Monkerton. These demonstrate that low-carbon heat networks can be viable locally. In addition the energy company Dextco[9] was recently formed with the aim of generating heat from a central hub based at the Royal Devon and Exeter's (RD&E) Wonford Hospital to be distributed to consumers across the city. Future projects include distributing heat from the Marsh Barton Energy Recovery Facility. The Dextco Board of Directors will oversee the work of the company and is made up of representatives from the RD&E, University of Exeter, Devon County Council, Exeter City Council and Teignbridge District Council. DCC should continue to support the delivery of low-carbon heat networks in the county.

The CCC has targeted injecting 20 TWh of biomethane into the gas grid by 2030. Biomethane is produced through the process of Anaerobic Digestion (AD), whereby micro-organisms break down biodegradable waste or other matter in the absence of oxygen. Devon is an agricultural county, and there is a significant local resource (crops, farm waste or other waste) that could usefully produce biomethane that could be injected into the gas grid. The CEE has previously shown that it is preferable that in Devon large scale AD facilities inject methane from biomethane into the gas grid rather than burning the gas on site for two reasons. Firstly injection is as efficient as using biogas to generate electricity and heat (combined heat and power [CHP]) in a gas engine. More importantly the shortage of heat loads for CHP in the county means that these heat loads are better utilised by thermal treatment facilities which consume a more plentiful resource and have more need to produce electricity and heat on-site. Access to the gas grid for gas injection should therefore be a criterion that DCC should consider for waste recovery site selection. DCC's Waste Plan[10] already states that "the Government has explicitly stated its support for the provision of anaerobic digestion in the Waste Management Plan for England 2013 in recognition of its value in dealing with organic waste and avoiding, by more efficient capture and treatment, the greenhouse gas emissions associated with its disposal to landfill". A recent example of a facility is the 2 MW plant (of which 500 kW is converted to electricity via CHP, and the remaining 1.5 MW equivalent gas upgraded and fed directly into the national gas grid[11]) at Enfield Farm[12], Clyst St Mary which will be fed on a mix of silage (16,537 tonnes), pig slurry (6,000 tonnes), wheat (3,000 tonnes) and poultry and farmyard (1,000 tonnes) manure producing energy that will be exported to grid as well as digestate to be spread on land as biofertiliser and soil conditioner. It must be stated that biogas produced in Devon and injected into the gas grid would not directly contribute to GHG reduction in the county. Rather – and as is the case with large scale renewable electricity that is fed into the national electricity grid – the GHG savings are incorporated into the emission factor for all gas used from the grid nationally. DCC should support district authorities as appropriate to help bring forward appropriate developments that contribute to national targets.

[9] https://www.devonnewscentre.info/new-devon-public-sector-energy-company-launched/
[10] Devon Waste Plan 2011 – 2031, December 2014
[11] http://planningapps.eastdevon.gov.uk/Planning/StreamDocPage/obj.pdf?DocNo=1456002&PDF=true&content=obj.pdf
[12] http://www.e4environment.co.uk/e4environment-celebrate-planning-application-approval-at-enfield-farm/

4.3 Transport

The government's strategy for carbon reduction from the transport sector is underpinned by increasing the uptake of ultra-low emissions (e.g. electric) vehicles, improving the efficiency of conventional cars, increasing the proportion of biofuel within the fuel mix, and reducing the need for travel, in particular from private vehicles. Local authorities can influence the first and last of these measures.

4.3.1 Promoting Low-carbon Vehicles

The national target is that in 2030 60% of all new cars and vans will be electric. Currently, uptake of EVs in Devon has been lower than the national average (Figure 25). This is because Devon is a rural county. The average uptake in Devon is similar to other county areas, which often comprise an urban centre and a more rural hinterland. The uptake in Exeter is similar to that in more urban parts of the country. It is likely that the trend for higher levels of EV uptake in urban areas will continue, as travel distances are typically shorter, and there is greater potential to concentrate charging infrastructure. DCC can help facilitate the uptake of EVs in the county including supporting the installation of charging infrastructure in places such as employment and retail sites and transport hubs, and by incentivising EV use through providing priority parking spaces or free/reduced charge parking (where DCC has control, though local car parks are the responsibility of district councils), and use of dedicated lanes or bus lanes. DCC can also show leadership by increasing the uptake of EVs within its own business fleet, and by using its influence when procuring services from contractors.

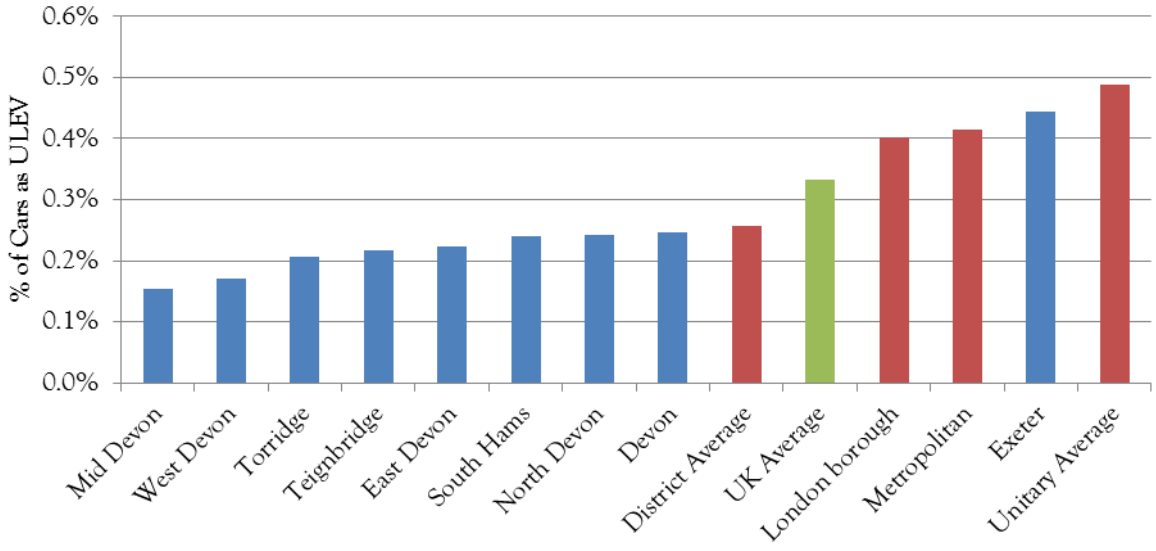


Figure 25:% of ULEV cars by Devon district (blue) and compared to national (red) benchmarks (adapted from Department for Transport data)

4.3.2 Promoting Sustainable Travel

The national strategy assumes that between 2016 and 2030 there will be a 5% modal shift from car travel to more sustainable modes of transport, and within the logistics sector a 10% operator efficiency improvement. DCC can assist with this target by supporting programmes that encourage modal shift.

Since 2005, total vehicle distance travelled in Devon has increased from approximately 7,700 to 8,300 million kilometres – an increase of around 8% (Figure 26). This broadly reflects the national

trend, which has seen travel distances rise during the start of the period before dropping to a low in 2012, which has been followed by a consistent annual increase (Figure 26). The increase in Devon in overall terms is greater than nationally and similar to the regional change; specifically in Devon, increases in non-car (i.e. van and HGV) travel distances have been significantly greater than the national and regional trends. Although the underlying reasons for this are not clear, possible explanations include a disproportionately greater increase in trends such as internet shopping (with subsequent duplication of delivery services), and/or greater increases in self-employed trades compared to the national average. The CCC projections are based on 5% modal shift for cars and 10% improvements to logistics movements limiting travel distance increases to 15% between 2016 and 2030; based on the increase in travel distance observed between 2012 and 2016, this would results in a 32% increase over the period (Figure 27). It is therefore important that policy and initiatives are put in place to slow down the current trajectory.

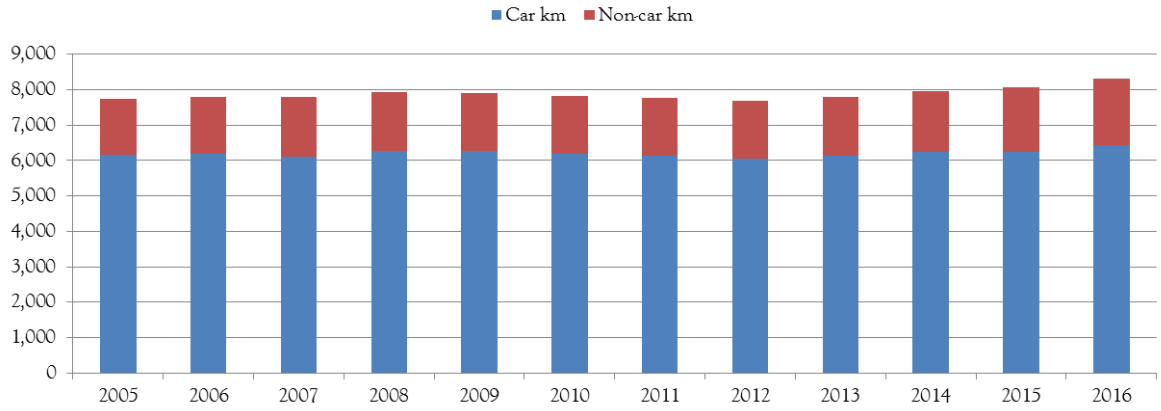


Figure 26: Motor vehicle traffic in Devon from 2005 to 2016

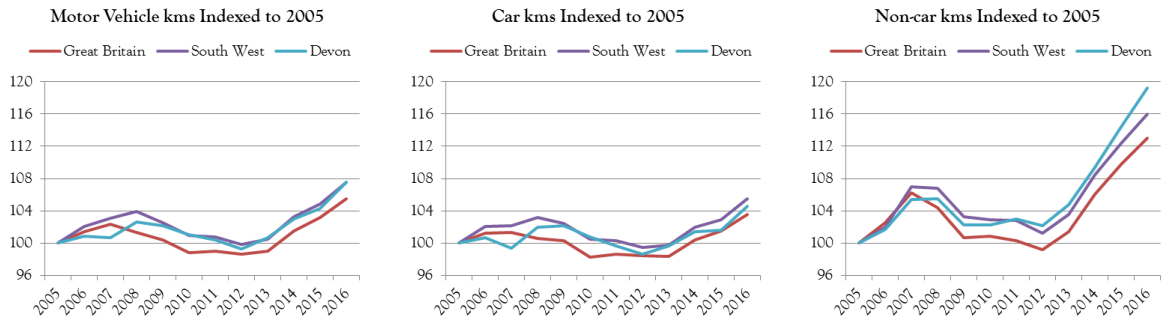


Figure 27: Motor vehicle, car, and non-car travel distances in Devon from 2005 to 2016, indexed to 2005

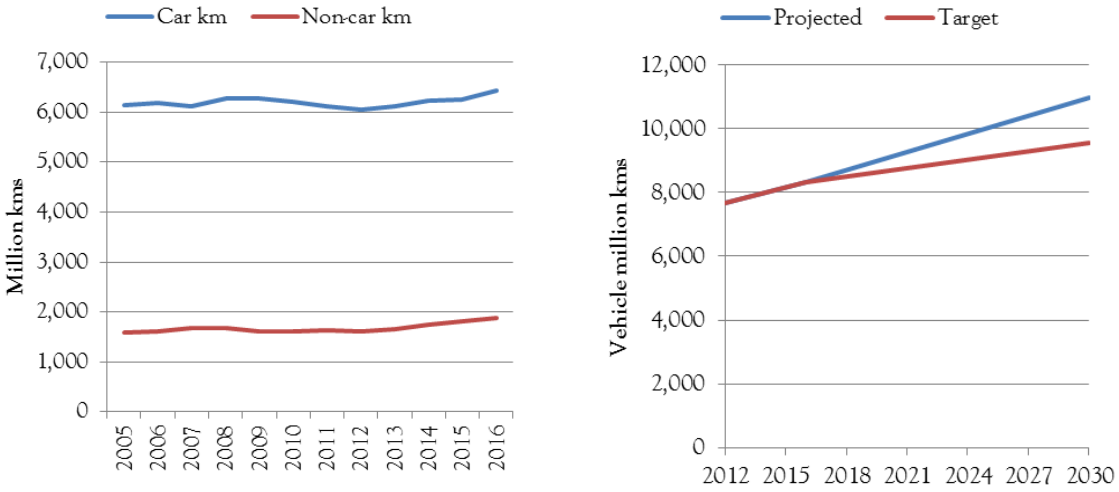


Figure 28: Split of vehicle travel distance in Devon (left) and the projected 2030 travel distances based on the 2012 – 2016 growth rate, compared to the CCC target

The CCC advises that local authorities can play an important role by supporting:

- Smarter choices: Currently there is a distinction within Devon between Exeter and the more rural districts. Whilst homeworking is lower in Exeter, the amount of people travelling to work by a sustainable mode is much higher than in the rural districts (though it may be expected that the urban areas within those districts may be more similar to Exeter than to the more rural parts of the districts). The "gap" in sustainable transport mode is in effect filled by single-occupant vehicle travel. About 7% of trips in all districts are made either as a passenger or on a motorcycle (Figure 29). DCC should continue to work with the districts and key stakeholders to promote sustainable travel choices to residents and businesses and to target schemes such as the DfT £580million Access Fund (£500million capital, £80million revenue) for projects running to 2020.
- Public transport provision: Public transport is more challenging in a rural county like Devon compared to more urban areas, and in fact poorly utilised bus services can result in higher emissions per trip than an equivalent car journey. Nonetheless strategically targeted routes can play an important role in modal shift that can reduce carbon emissions, and in addition to this there are potentially wider benefits around social inclusion. DCC should continue to work with bus operators and other stakeholders to improve and increase the use of bus services in the county.
- Parking: Public car parks are managed by the district authorities and so there is limited scope for DCC to use this as a mechanism to encourage modal switch. Nonetheless, the impact of parking pricing on the wider transport network will require the district and county councils to work strategically in partnership.
- Freight logistics: The council should work with relevant stakeholders with the aim of developing strategies that reduce unnecessary freight journeys, shorten distances covered, and minimise empty running. Such strategies could make use, for example, of Urban Consolidation Centres and could work with the Logistics Carbon Reduction Scheme[13].

Progress can be monitored by referring to published statistics for surface transport emissions, vehicle kilometres travelled, rolling out of Smarter Choices measures, evidence of planning decisions being integrated with sustainable travel strategies, and public transport messenger miles.

[13] http://www.fta.co.uk/policy_and_compliance/environment/logistics_carbon_reduction_scheme

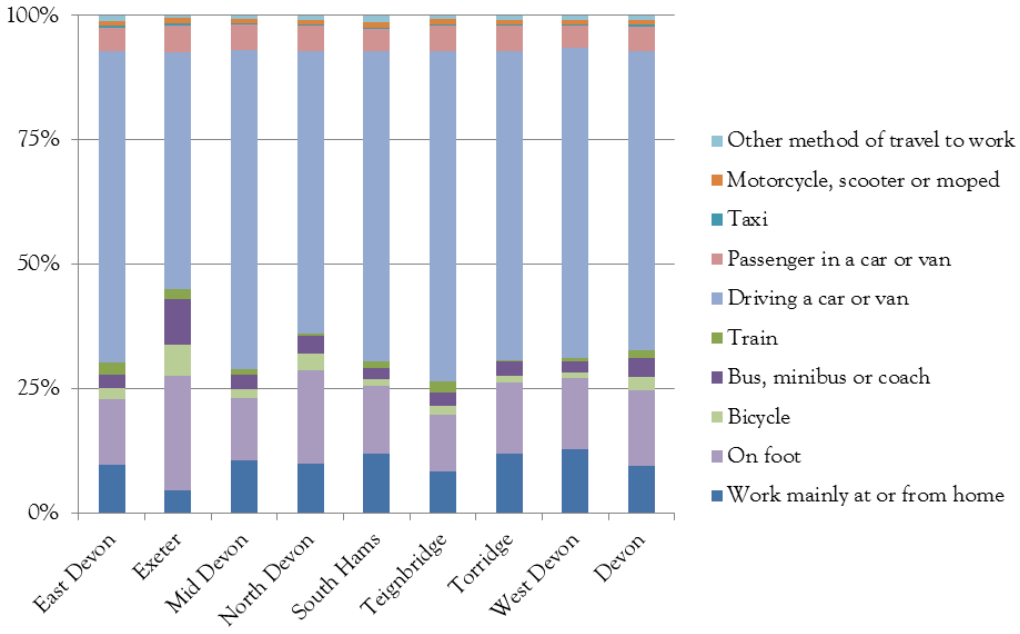


Figure 29: Proportion of those in employment travelling to work by various modes from the 2011 Census

4.3.3 Planning and Designing New Developments

A final area where local authorities can assist with reducing GHG from transport is in the planning of new development. This includes both the siting of development to minimise the need for transport i.e. located near to places of work and leisure etc., and by ensuring new development is served by attractive low-carbon alternatives to private vehicles. DCC should continue its partnership working with the three spatial plans outlined in Section 4.2.1 to ensure these outcomes are achieved as best they can in Devon.

4.4 Waste

Local authorities have statutory duties to collect residential waste and if requested, non-residential and commercial waste. GHG emissions (methane) from the waste sector have fallen drastically over the past two decades as a result of landfill gas energy recovery and waste being diverted from landfill by recycling, composting, or incineration (often with energy recovery). Nationally, the majority (67%) of GHG emissions from waste are associated with methane from landfill. Since 1990 these emissions have fallen by 80% due to reductions in biodegradable waste going to landfill, investment in methane capture technology (often with energy recovery) and improved management at landfill sites. A further 22% of waste emissions are associated with wastewater treatment. This is the responsibility of South West Water. A further 9% of emissions are from biological treatment which are a mixture of methane and N_2O from industrial and domestic composting, anaerobic digestion of non-agricultural waste and mechanical biological waste treatment (MBT). A very small amount of emissions are from incineration without energy recovery, though there are no such facilities in Devon.

The most recent data shows that Devon is performing well with 54% of local authority collected waste being recycling or composted meaning that nationally it sits 11th out of 123 (top 9%) of unitary and waste disposal authorities. A further 27% of collected waste is incinerated with energy recovery, and 19% sent to landfill (Figure 30). Whilst DCC is

responsible for the disposal of waste, the collection of waste – and therefore decisions about collection regimes – is the responsibility of the district authorities.

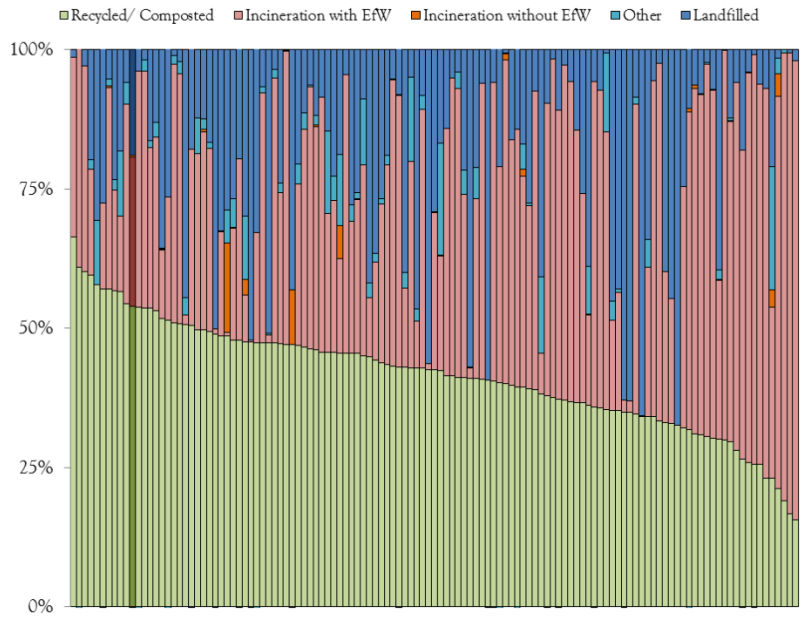


Figure 30: Destination of local authority collected waste for 123 waste disposal and unitary authorities in England in 2015/16 ranked by recycled/composted proportion. Devon is shown in a darker shade.

Whist recycling rates in Devon are encouraging the actual amounts of waste being generated in the county are higher than the national average (Figure 31). Whilst the residual household waste per household (i.e. household waste collected that is not sent for reuse, recycling or is not composted or anaerobic digestion) in Devon is amongst the best in the country (Figure 32), this is a function of not only recycling rates, but also of demographics including household size. It is likely that there is further scope to reduce the overall volumes of waste being generated in the first instance.

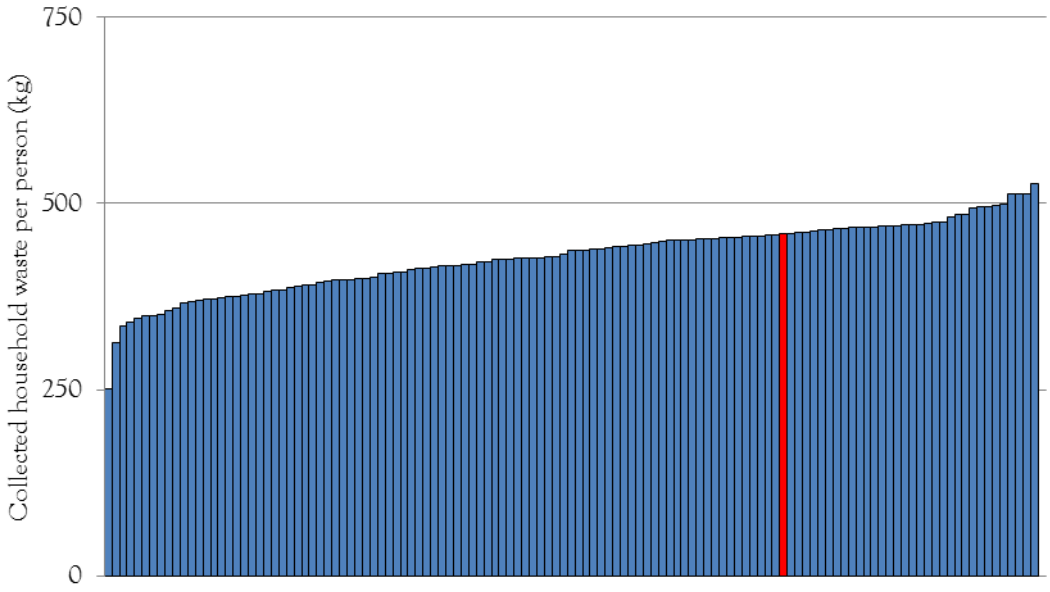


Figure 31: Collected household waste per person for all disposal authorities in England. Devon is shown in red.

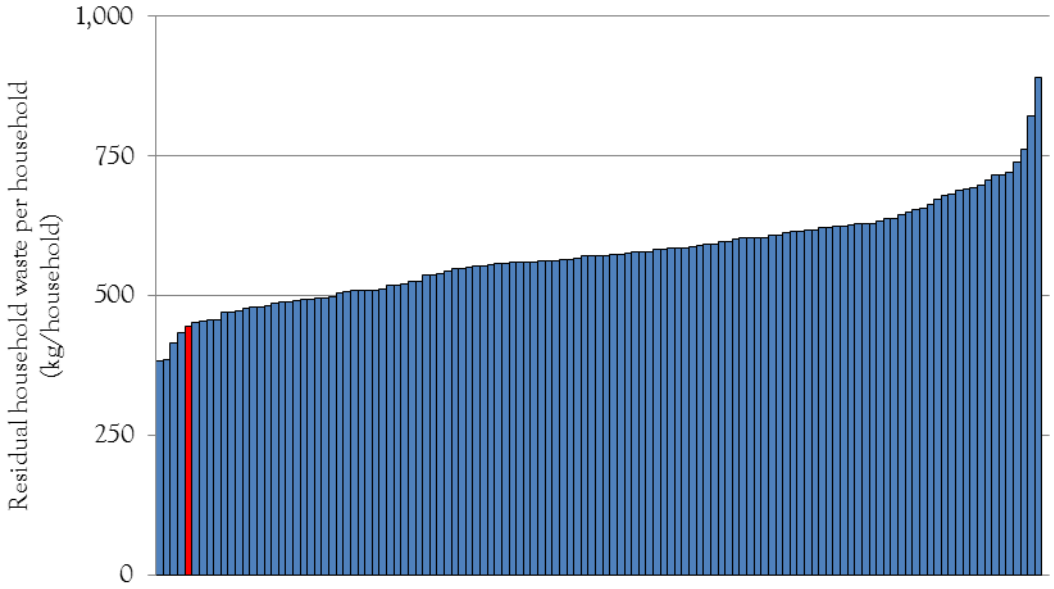


Figure 32: Residual household waste per household for all disposal authorities in England. Devon is shown in red

DCC can support emission reduction from waste in the following ways:

- Waste reduction: The most recent CCC report states that for the most recent year for which data was available, the level of avoidable household food and drink waste (i.e. that could have been consumed) increased by 5% to 4.4 million tonnes, compared to 4.2 million tonnes in 2012. This was attributed to changing economic conditions since the start of 2014 (e.g. decreasing food prices and rising wages in real terms), which weakened the incentive for people not to waste food. DCC should continue its support of the award-winning Don't Let Devon go to Waste campaign[14], which promotes the Reduce, Reuse and Recycle theme.
- Promote recycling and composting: Although Devon is already within the top 10% performing authorities regarding recycling/composting rates DCC should continue to work with the district authorities to increase the proportion of waste that is recycled.
- Energy from Waste (EfW): Although 54% of waste in Devon is recycled or composted, 27% is incinerated at the EfW plants in March Barton (Exeter) or Devonport (Plymouth) with 19% sent to landfill i.e. 42% of the non-recycled component is sent to landfill. If this waste cannot be recycled/composted, then the aim should be to increase the amount that is subject to EfW.
- Utilising waste heat from EfW: There are opportunities to utilise waste heat produced at the EfW plant for new development planned in its locality. Whilst this would not reduce GHG emissions from the waste sector specifically, it would result in emissions reductions from those new developments, and may improve the economics of the EfW scheme. DCC should continue promoting the uptake of heat from the EfW plant through Dextco.
- Anaerobic Digestion and Renewable Heat: As has been discussed in Section 4.2.4, DCC should promote the development of AD plants which have the potential to both reduce waste sent to landfill, and to generate low carbon energy.
- Landfill sites: Nationally, the majority of GHG emissions arising from the waste sector are as a result of methane production due to the decomposition of biodegradable waste. The operation of landfill sites in Devon has been contracted to private site operators, primarily Viridor Ltd. DCC should encourage high levels of methane capture and energy recovery at landfill sites, or flaring of methane where energy production is not practical.

[14] https://www.recycledevon.org/

- New development: Projected growth across the county will result in a commensurate increase in generated waste. Through the Waste Plan and in partnership working with the district authorities, DCC should ensure that this increase in generated waste is met by an increased capacity in sustainable methods of waste disposal, such as recycling, composting, and EfW.

The CCC has suggested that waste indicators that local authorities should focus on include the total waste collected, a breakdown of the composition of waste collected, the amount of waste diverted from landfill, recycling/composting rates, the amount of food and garden waste collected, and the amount of waste diverted to energy from waste production.

4.5 Renewable Energy

The CCC state that local authorities can increase the uptake of renewable energy generation within their local areas by supporting applications through the planning process, and through encouragement of community renewable schemes. Planning applications are handled by the district authorities and so there is limited scope for DCC to support renewable energy here but there is scope to assist with strategic-scale resource identification and collaboration on deployment issues, such as grid availability.

Regarding community renewable energy DCC has supported communities to develop schemes through the SEACS[15] project which has resulted in the development of a series of tools for community groups to use[16]. The Devon Community Energy Accelerator Project[17] which ran from 2014 – 2017 awarded £62,669 of seed funding to 18 organisations via small grants and for a total DCC investment of £107,000 leveraged in over £284,000 to Devon through the Rural Community Energy Fund with many more projects funded in Devon than any other part of the country (Figure 33). In addition, DARE provided the free Devon County Council Community Energy Support Service[18] for 12 months from November 2016. This includes the provision of a wide range of support requested by established and emerging community energy organisations in Devon to help them achieve their community-owned renewable energy ambitions including 'hands on' assistance in delivering communities' projects, as well as providing advice and expertise. Most recently, the Authority has collaborated with Regen as part of the Peer Power Project to develop a State of the Community Energy Sector Report in Devon and provide further bespoke support to established and emerging organisations to end in March 2018.

[15] http://en.seacs.eu/
[16] https://new.devon.gov.uk/energyandclimatechange/community-energy
[17] https://www.regensw.co.uk/community-energy-accelerator
[18] http://www.devondare.org/community-support-service.html

Figure 33: Location of Rural Community Energy Fund projects

4.6 DCC's Own Estate

Emissions from DCC[19] are responsible for approximately 0.5% of all GHG emissions within Devon (Figure 34). Of these emissions, 40% were for street lighting, 29% for school transport, 18% for corporate property (of which 55% was from electricity consumption), 8% for business travel and 6% for the business fleet. As Devon is the upper tier authority, it owns no housing. Local authority maintained schools are outside the scope of the formal reporting and targeting as the authority does not have full financial control over their operations, however their footprint is monitored and support is provided to schools wishing to reduce energy consumption. Outsourced services, such as libraries and the majority of residential care services, are also not included in DCC's footprint due to data availability.

[19] DCC emission data was supplied by DCC and was quantified in terms of emissions per financial year. These were equated to the calendar year against which the CCC charts national progress by taking the DCC year to be the earlier year of any financial year stated i.e. 2016/17 was taken to be 2016. This is because the emission calculated for that year were calculated by DCC based on emission factors for the start of the financial year i.e. using 2016 factors.

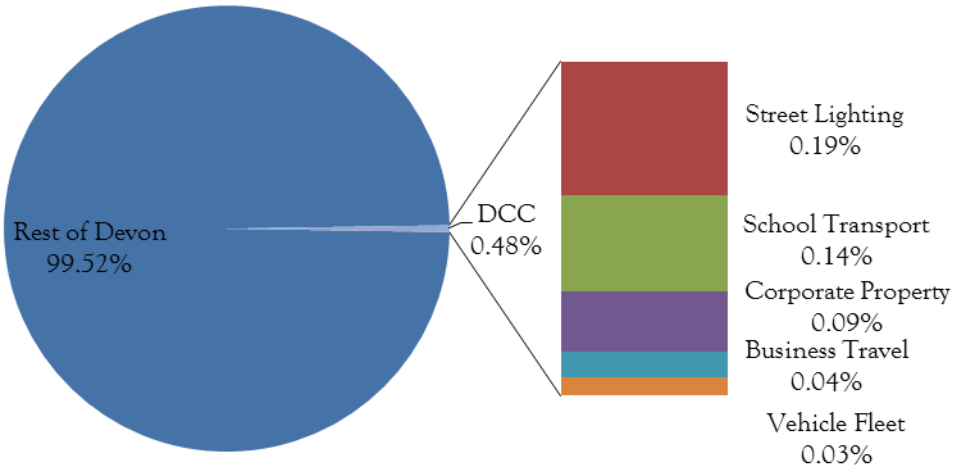


Figure 34: GHG from DCC's own operations in the context of total GHG emissions in Devon in 2016 (CCC target value)

Of DCC's emissions in 2016, 50%[20] is due to electricity consumption. If grid carbon intensity drops from 255 $kgCO_2/kWh$ in 2016 to the CCC's target value of 81 $kgCO_2/kWh$ in 2032, then DCC's emissions would drop by 37% which is a greater proportion than the projected total reduction in GHG emission in Devon across the same period. In addition to this windfall carbon reduction, DCC should set out detailed strategies to further reduce emission from its own estate in the following way:

- Buildings: DCC's estate is responsible for 18% of DCC's emissions, of which 55% was due to electricity consumption and almost all the remainder from gas consumption. DCC should continue to target its own estate with good housekeeping energy management, energy efficiency, and renewable energy (utilising FIT and RHI) projects. The CCC state that a relevant indicator for public buildings is that they should have as a minimum an EPC rating of F.
- Street Lighting: Devon County Councils has over 75,000 street lights, 8,000 illuminated traffic signs and 2,600 illuminated traffic bollards[21]. Emissions from street lighting are currently responsible for 40% of DCC's GHG emissions, though this will fall as the electricity grid carbon intensity reduces over time. DCC has already implemented[22] an extensive part-night lighting strategy and has a programme of low energy (LED) street light replacement. DCC should continue with its commitment to replacing existing lamps with lower power alternatives.
- Transport: Emissions related to transport are responsible for 42% of DCC's footprint, although proportionately this is likely to increase over time as emissions associated with electricity consumption are reduced. Of these emissions, 68% are from school transport, 18% from business travel, and 14% from DCC's own vehicle fleet. In addition, the policies that DCC develop have the potential to influence transport emissions further, for example from commuting for DCC employees (which is not included within DCC's footprint). DCC should support the reduction in emissions associated with transport by encouraging mode switching and sustainable transport choices, providing more on-site electric vehicle

[20] Including "well to tank" emissions associated with electricity consumption which increase "scope 2" electricity emissions by 9%

[21] http://www.devon.gov.uk/streetlightingpolicypartnightlighting.pdf

[22] http://www.devon.gov.uk/streetlightingconversionprogress.pdf

charging, and reducing the need for travel by making use of video-conferencing and route optimisation. The latter is likely to be important in the case of DCC's footprint, which is dominated by school transport; a sub-sector that is less likely to benefit from rapid advances in vehicle technology improvement compared to those that will be experienced with electric cars. This will require working closely with the providers of school transport, with the most effective point at which to make the greatest impact being through the commercial structuring at the point of procurement, as new contracts are tendered. For example the practise of local authorities paying school bus operator fuel bills provides a disincentive for operators to provide efficient vehicles.

- Procurement: Although not specifically quantified within DCC's carbon footprint, the council can influence emission arising from the services it procures both for its own operations, and for the public services for which it is responsible.

5. Adaptation

5.1 Climate Change Projections for Devon

Even if GHG emissions are reduced to zero tomorrow, the climate system will continue to change for another 40 years; the climate change we are experiencing now is a result of emissions in the 1970s. Therefore there is a need to ensure communities are able to adapt to the inevitable projected change.

The 2009 UK Climate Projections[23] (UKCP09) provide projections of climate change for the UK, giving greater spatial and temporal detail, and more information on uncertainty than previous UK climate scenarios. The data is also probabilistic (Figure 35) allowing the entire range of possible climate change to be estimated for different emissions scenarios. Over land, UKCP09 gives projections of changes for a number of climate variables, averaged over seven overlapping 30-year time periods, at a 25 km resolution. UKCP09 gives projections for each of three of the Intergovernmental Panel on Climate Change's (IPCC) Special Report on Emissions Scenarios (SRES) scenarios (A1FI [called "High" in UKCP09], A1B [Medium] and B1 [Low]) to show how different emissions pathways affect future climate. Each of the emissions scenarios suggests a different pathway of economic and social change over the course of the 21st Century; it is not possible to assign probabilities to each scenario. The current global emissions trajectory indicates that the "High" emissions scenario (A1FI) best represents the current status quo. The changes to key environmental parameters under the "High" emissions scenario for a range of probabilities are shown in Table 6.

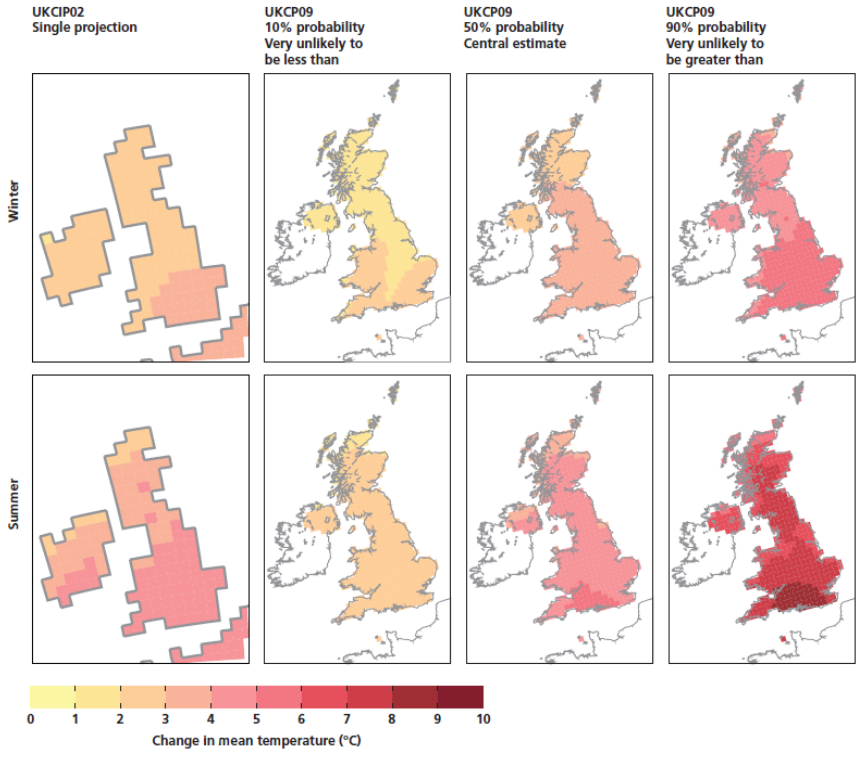


Figure 35: Indicative outputs from UKCP09 and how they differ from UKCIP02.

[23] http://ukclimateprojections.metoffice.gov.uk/21678

Table 6: Projected climate change under the High emissions projections for the 2050s and 2080s under 10%, 50% and 90% probabilities.

Parameter	Sub-Parameter	Year	Very unlikely to be less than… (10% scenario)	Central Estimate (50%)	Very unlikely to be greater than… (90% scenario)
Change in Summer Temperatures	Mean Minimum	2050s	0 to 1°C	2 to 3°C	3 to 4°C
		2080s	1 to 2°C	2 to 3°C	4 to 5°C
	Mean	2050s	0 to 1°C	2 to 3°C	2 to 3°C
		2080s	1 to 2°C	2 to 3°C	3 to 4°C
	Mean Maximum	2050s	1 to 2°C	3 to 4°C	6 to 7°C
		2080s	2 to 3°C	5 to 6°C	9 to 10°C
	Warmest Day	2050s	-2 to 0°C	2 to 4°C	8 to 10°C
		2080s	-2 to 0°C	4 to 6°C	10 to 12°C
Change in Winter Temperatures	Mean Minimum	2050s	1 to 2°C	2 to 3°C	4 to 5°C
		2080s	1 to 2°C	3 to 4°C	5 to 6°C
	Mean	2050s	1 to 2°C	2 to 3°C	3 to 4°C
		2080s	1 to 2°C	3 to 4°C	5 to 6°C
	Mean Maximum	2050s	0 to 1°C	2 to 3°C	3 to 4°C
		2080s	1 to 2°C	2 to 3°C	5 to 6°C
% Change in Precipitation	Annual Mean	2050s	-10 to 0%	-10 to 0%	0 to 10%
		2080s	-10 to 0%	0 to 10%	0 to 10%
	Winter Mean	2050s	-10 to 0%	10 to 20%	30 to 40%
		2080s	-10 to 0%	10 to 20%	60 to 70%
	Summer Mean	2050s	-40 to -50%	-20 to -30%	0 to 10%
		2080s	-60 to -70%	-30 to -40%	0 to 10%
	Wettest winter day	2050s	-10 to 0%	10 to 20%	20 to 30%
		2080s	0 to 10%	10 to 20%	40 to 50%
	Wettest summer day	2050s	-10 to -20%	0 to 10%	10 to 20%
		2080s	-20 to -30%	0 to 10%	30 to 40%
% Change in Relative Humidity	Winter mean RH	2050s	-5 to 0%	0 to 5%	0 to 5%
		2080s	0 to 5%	0 to 5%	0 to 5%
	Summer mean RH	2050s	-5 to -10%	-5 to 0%	0 to 5%
		2080s	-5 to -10%	-5 to 0%	0 to 5%
% Change in Cloud Cover	Winter cloud	2050s	-10 to 0%	0 to 10%	0 to 10%
		2080s	-10 to 0%	-10 to 0%	0 to 10%
	Summer Cloud	2050s	-20 to -30%	-10 to -20%	0 to 10%
		2080s	-30 to -40%	-10 to -20%	-10 to 0%

5.2 Impacts of Climate Change in Devon

The IUK report on designing buildings for future climate change[24] identifies risks across three broad areas:

5.2.1 Designing for comfort

- Keeping cool – building design: Of all the projected climate change impacts, hotter summers will affect the design of buildings the most. For Devon by the 2050s, central estimates are that mean summer temperatures may be 2 to 3°C higher, and the hottest summer day could be up to 4°C warmer. Buildings constructed within Devon would be expected to remain in use for decades more and by the end of the century, temperatures could be higher still. The

[24] Technology Strategy Board 2010, Design for Future Climate: Opportunities for adaptation in the built environment

increase in temperatures will increase the risk of overheating which gives rise to both discomfort and for the hottest periods, potentially heat stress. In some cases this may be addressed by retrofitting comfort cooling, which has associated cost and environmental issues. New construction can be designed to be more resilient to higher summer temperatures by careful consideration of orientation, façade design, thermal mass and ventilation strategy.

- Keeping cool – outside spaces: The projected increases in summer temperature that pose a risk to occupants within buildings also result in potential impacts outside of buildings. To address this, designers can consider additional shading on-site, incorporating trees and plants to assist with both shading and cooling from transpiration, and provision of green and blue spaces within larger developments.
- Keeping warm: As temperatures across the year are projected to increase, less energy will be required to heat buildings. However, as they must be able to provide adequate warmth under the current climate there is no material impact on how buildings need to be designed in this regard. Insulation standards should not be reduced to offset a general increase in temperature.

5.2.2 Construction

- Structural stability – below ground: Changes to rainfall patterns may increase the risk of soil shrinkage which may impact on building foundations. However, the risk of subsidence in Devon due to soil shrinkage is low and so no additional provision needs to be made with respect to adapting to climate change on this matter.
- Structural stability – above ground: Design wind loads on buildings are dependent on geographical location – whether a site is particularly sheltered (for example, in a city) or exposed (as on the coast) – and also on the shape and size of the building itself. The UKCP09 has not modelled projected changes to wind speed resulting from climate change, but the IUK report states that older buildings constructed prior to the introduction and subsequent strengthening of building codes (i.e. from prior to the 1940s) are at greater risk. It is therefore difficult to propose adaptive measures to reduce the risk of stability of a building's structure as a result of climate change with any certainty.
- Weatherproofing, detailing and materials: Under projected climate change, winter driving rain may increase, though this has not been quantified by UKCP09. Much of Devon is already in the "very severe" exposure zone (the highest classification of exposure within Building Regulations). Given the uncertainty of the data, the IUK document suggests that adapting the building to climate change with respect to weatherproofing and detailing, that construction methods are specified at one exposure rating higher, which in the case of eastern and mid Devon would be "very severe" but for the rest of Devon higher specifications do not currently exist. This may include consideration of recessed window and door reveals, projecting sills with drips, render finishes, extended eaves, greater laps and fixings to roof and cladding fixings.

5.2.3 Managing water

- Water conservation: This shift in seasonal rainfall patterns together with increasing intensity and frequency of extreme events is likely to result in periods of excess water availability on the one hand and periods of water scarcity on the other. The Environment Agency classifies[25] Devon (South West Water) as being under "Moderate" water stress, both now and under a range of future scenarios with the final stress rating stated as being "Not Serious". Changes to Part G of the Building Regulations have introduced an Optional Requirement

[25] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/244333/water-stressed-classification-2013.pdf

for new dwellings to be designed to consume not more than 110 litres/person/day of water, as opposed to the general limit of 125 litres/person/day. As the area is not under "Serious" stress, meeting the general limit of the Building Regulations would be appropriate.

- Drainage: By 2040 winter rainfall may be 10 – 20% higher both on average, and for the wettest day. This may mean that gutters, downpipes and drainage systems will require larger capacities.
- Flooding: The increase in precipitation both on average and at peak times, combined with rising sea levels, will increase the risk of flooding from rivers and sea, flash flooding, and potential changes to ground water levels. This is one of the key potential risks associated with climate change, though the extent of this risk is highly site specific. Adapting to this climate impact will require the use of Sustainable Urban Drainage Systems (SUDS), natural flood risk management techniques and new, traditionally -engineered structures. . The Environment Agency guidance with regard to adapting to climate change will need to be considered.

5.3 DCC Responsibilities and Policy

Certain local authority responsibilities are directly related to ensuring places are designed to be climate proof. It should be ensured that climate adaptation is built-in to these services. These priority areas are shown in Table 7. Whilst a number of functions are mainly the responsibility of the district authorities, it can be seen that DCC is responsible for:

- Ensuring its own estate is resilient to the impacts of projected climate change;
- Provision of resilient infrastructure, including mitigating the impacts of potential flooding;
- Being responsible for emergency planning[26], including preventing and responding to the impacts of extreme weather events, ensuring business continuity and continuity of key public services and ensuring the most vulnerable sections of population are protected.

DCC should review each of its responsibilities across these areas to ensure that the strategies and procedures that at already in place are adequate to meet the potential projected impacts of climate change.

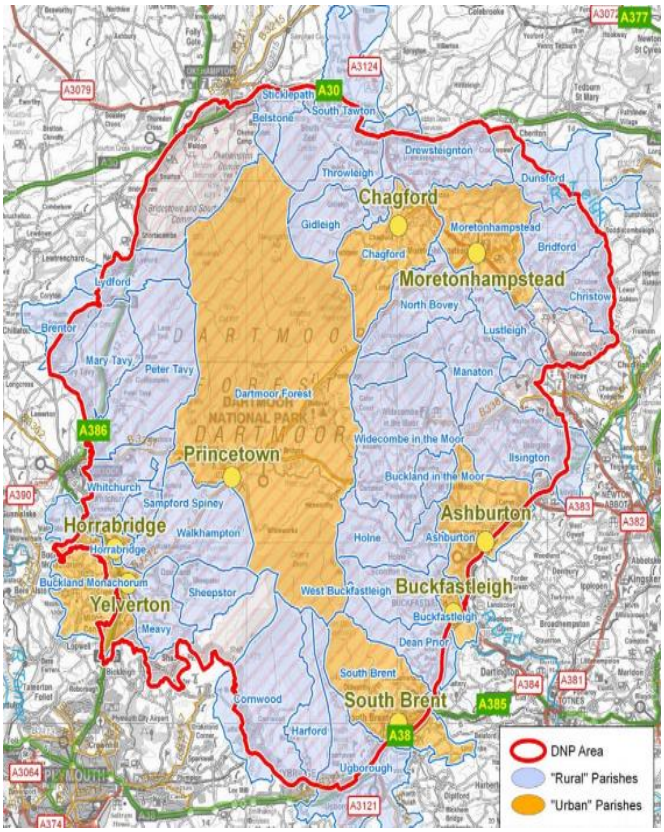
[26] https://new.devon.gov.uk/emergencies/

Table 7: Summary of how local authorities can increase climate resilience in their localities (Source: based on CCC)

Priority Area	Duties/Powers	Adaptation impact	County/District?
Land use planning	• Local Development Plans • Development management • Building control	• Steer developments to areas of lowest climate risk • Increase green infrastructure • Increase sustainable urban drainage	District and County
Designing and renovating building	• Planning functions • Strategic role in housing provision • Owners of social housing (in some cases)	• Require resilience measures in new developments • Retrofit own estates (including schools) and social housing • Encourage others (private sector housing and businesses) to retrofit	District and County (including the county's own estate)
Managing natural resources	• Manage parks, public gardens, nature reserves, allotments, commons and ponds • Duty to protect biodiversity	• Expand and improve ecological resilience of green spaces • Make space for water along rivers and coasts	District and County
Providing infrastructure	• Build and maintain non-trunk roads • Provide bus shelters street lighting, parking spaces • Carry out works to manage flood risk from surface runoff and smaller water courses	• Resilient roads and road-related infrastructure • Minimise damage to buildings and infrastructure from floods	County
Emergency planning	• Emergency planning • Flood risk management strategies • Education and awareness • Social and health care	• Prevent and respond to the impacts of extreme weather events • Ensure business continuity and continuity of key public services • Ensure most vulnerable sections of population are protected	County

APPENDIX A: DEFINING DARTMOOR

Sub-national carbon emissions are published annually by BEIS for each local authority area. This dataset is important with regards to checking progress against targets. The scope of this report covers Dartmoor National Park. The BEIS dataset does not separate out Dartmoor as a separate local authority and so it has been necessary to establish a means of doing so. Dartmoor spans four local authorities, namely Mid Devon, South Hams, Teignbridge and West Devon.



Previous work that we undertook for the South West Community Energy Partnership[27] used GIS to overlay local authority and Dartmoor boundaries in GIS together with various other datasets in order to apportion carbon emissions into each relevant area.

Initially the number of postcodes within each local authority and Dartmoor were counted. The % of Mid Devon's postcodes in Dartmoor was 0.18% (at Cheriton Cross, near Cheriton Bishop and as seen as the small wedge between the parishes of Drewsteignton and Dunsford within the national park boundary in the above map) and this was used to estimate the emissions from dwellings for Mid Devon as the number is small and the margin of error is likely to be low. Non-domestic energy use from Mid Devon occurring in Dartmoor was assumed to be zero as a visual inspection of the area using Google Earth revealed that there was no likely significant source of non-domestic energy use. Similarly, transport emissions from Mid Devon allocated to Mid Devon were assumed to be zero as the overlapping area comprised only a small length of rural roads.

For South Hams, Teignbridge and West Devon the outputs from GIS analysis undertaken for the SWDCEP study were used. These separated the geographic area into 1 x 1 km grid-squares with the proportion of either buildings or roads falling in each of the three authorities, and separately the

[27] http://www.swdcep.org.uk/strategic-energy-study-of-the-sw-devon-community-energy-partnership/

proportion falling within Dartmoor were established. From this, the proportions that were in both Dartmoor and each of the authorities could be calculated. These proportions were then applied to output from the NAEI[28] which produced outputs of carbon emissions at a 1 x 1 km resolution across the UK and broken down into various non-domestic, domestic and transport categories. From this, the proportion of each end use occurring in Dartmoor from each of the three local authorities could be calculated. The underlying assumption is that the proportion of emissions within to outside of Dartmoor has remained relatively constant since 2009. It was also assumed – in the absence of other data – that emissions associated with land use change over time in Dartmoor were zero. For context, LULUCF represented an approximate 2.5% reduction in emissions (i.e. a carbon sink) across Devon as a whole in 2015.

The population of Dartmoor was established by taking the latest ONS estimates[29] of populations in national parks and was assumed to be constant (a reasonable assumption as population only changed by 0.3% from 2002 to 2012).

The overall factors calculated from the above process that was then applied to the BEIS dataset to estimate Dartmoor emissions (and that it is proposed can be used for future years) is shown in the table below:

District	A. I&C Electricity	B. Industry and Commercial Gas	C. Large Industrial Installations	D. I&C Other Fuels	E. Agriculture	F. Domestic Electricity	G. Domestic Gas	H. Domestic 'Other Fuels'	I. Road Transport (A roads)	J. Road Transport (Motorways)	K. Road Transport (Minor roads)	L. Diesel Railways	M. Transport Other	Population Factor
Mid Devon	0.000	0.000	0.000	0.000	0.000	0.002	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.002
South Hams	0.047	0.038	0.000	0.016	0.104	0.064	0.058	0.093	0.058	0.058	0.058	0.295	0.058	0.070
Teignbridge	0.112	0.085	0.000	0.092	0.360	0.064	0.058	0.093	0.098	0.098	0.098	0.000	0.098	0.149
West Devon	0.205	0.095	0.000	0.098	0.249	0.281	0.217	0.345	0.308	0.308	0.308	0.000	0.308	0.278

[28] http://naei.defra.gov.uk/data_warehouse.php

[29] https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/bulletins/annualsmallareapopulationestimates/2014-03-20