UNIVERSITY OF EXETER | CENTRE FOR ENERGY AND THE ENVIRONMENT

Exeter's 2019 greenhouse gas inventory and sector emissions monitoring

Author(s):	TA Mitchell, ADS Norton, A Rowson
Report Number:	ID 1007
Publication Date:	February 2022

Revision number	Initial	Date
0 First draft	ADSN/TAM	24/02/2022
1 minor changes	ADSN	11/07/2022

CENTRE FOR ENERGY AND THE ENVIRONMENT
University of Exeter
Hope Hall
Prince of Wales Road
Exeter, EX4 4PL
+44(0)1392 724143/4/5
www.exeter.ac.uk/cee

Cover image:
Exeter quay

Management Summary

Exeter City Council (ECC) declared a Climate Emergency in 2019 and pledged to work towards creating a carbon neutral city by 2030. The target year is 20 years in advance of the 2050 national net zero target required under the Climate Change Act and reported on in the Sixth Carbon Budget.

In 2020 the Council announced a series of initiatives to drive forward the city's net zero ambitions. The Centre for Energy and the Environment at the University of Exeter was commissioned to establish a baseline greenhouse gas (GHG) inventory for the city, quantify the reductions required to achieve net zero in 2030 and identify more specific and timely metrics for monitoring progress towards carbon neutrality in each emissions sector.

The GHG inventory reports emissions for eight sectors: power, buildings, industry, transport, agriculture, land use, waste and fluorinated gasses (F gases). The inventory is for territorial emissions. Territorial emissions are those arising from within the boundaries of the city and are therefore more in the control of people living, working and visiting the city.

Greenhouse gas emissions in Exeter have generally been on a downward trajectory since 2008. Estimated GHG emissions of 717 thousand tonnes of carbon dioxide equivalent (kt CO_2e) in 2008 have declined by a third to 476 kt CO_2e in 2019. Buildings is the sector with the highest emissions (35%) followed by power (24%) and transport (22%). Emissions from each of the remaining sectors are 7% or less.

Analysis for ECC's 2007 Climate Change Strategy identified a 2020 emissions target of 516 kt CO_2. With 2019 emissions below 500 kt CO_2e, this looks achievable (subject to Covid 19 bounceback). However, the sector detail shows that the reduction is the result of grid decarbonisation, which has taken place outside Exeter, and has delivered three times the change estimated in 2007. Local sector reduction in buildings and transport has failed to meet the objectives set in 2007 by factors of 6 and 4 respectively.

Extrapolating from the "current trend" since 2016 suggests that emissions in 2022 will be 448 kt CO_2e.The continuation of the current trend to 2030 would give residual emissions of 291 kt CO_2e, nowhere near net zero. Importantly, the current trend will not continue because of grid decarbonisation; for the decline in emissions to continue at the same rate, a 28% reduction from non-power sectors will be required to deliver the extrapolated trend in 2030.

Delivering net zero in 2030 requires a much greater reduction in emissions. A linear decline in emissions from 2021 to zero in 2030 requires a decline of 50 kt CO_2e (11%) per year and gives cumulative emissions over the period of 2.2 Mt CO_2e. Under the extrapolated current trend these cumulative emissions would be exceeded in 2026. Lack of progress in the buildings and transport sectors is particularly concerning. Growth in the city is leading to increases in emissions and the decarbonisation of electricity cannot continue to make up for the shortfalls in these sectors. The city needs to make significant progress in buildings and transport to deliver net zero.

In the sector analysis, net zero 2050 targets from the Sixth Carbon Budget set the 2030 values for measures in Exeter. The default assumption is that progress from the current position to net zero will occur in a linear manner, i.e. with the same annual increment in the nine years between 2021 and 2030. The danger with other assumptions (for example an exponential change which starts at a low level) is that the short term challenge is minimised only for the measure to then be impossible to deliver in the late 2020s.

Power

Local renewable energy contributes to grid decarbonisation and to the local economy. In the power sector, the majority of Exeter's future additional renewable energy will come from solar photovoltaic (PV) panels on roofs. The Sixth Carbon Budget does not set targets for roof mounted PV so it has been assumed that by 2030 25% of Exeter's existing domestic roofs have PV installed and that 50% of new homes built between 2020 and 2030 have PV with each installation assumed to have the historic average peak capacity (3 kW). Hitting this target would mean that in 2030, 14,000 of Exeter's domestic roofs (28%) would have PV (currently 2,300). The target for larger non-domestic arrays is 890 installations (currently 128). Recent PV installation rates have been low (36 in 2020) with a long run average of 220 installations per year. Hitting the 2030 monitoring target of 14,900 installations in total requires a rate of some 1,240 installations per year, every year to 2030. This installation rate is twice the peak historic rate achieved in 2012.

Buildings

Emissions from Exeter's buildings have hardly changed since 2008. Buildings were responsible for 35% of GHG emissions in 2019. 25,400 of Exeter's 56,400 homes (45%) are estimated to still need more loft insulation. Installing this basic energy efficiency measure by 2030 requires 2,800 installations in every year until 2030. The city needs cavity or solid wall insulation in 10,200 homes. Insulating all cavities and half the solid walls by 2030 requires 1,500 wall insulation measures each year.

Net zero requires moving away from natural gas for heating. While Exeter has more homes connected to heat networks than many UK cities its size (3,100), another 11,200 will need to be connected by 2030 (1,200 each year). While some homes will be on heat networks, the majority will need to install heat pumps with a target of 42,200 homes having heat pumps by 2030 (currently 449 homes are estimated to have heat pumps). This requires the installation of 4,600 heat pumps every year to 2030.

Non-domestic buildings also need improving. 3,100 non-domestic buildings in Exeter have energy efficiency ratings of C or below. Achieving a targeted 27% improvement in energy efficiency means upgrading most of these buildings to band B with 260 buildings upgraded every year to 2030. The need to switch to low carbon heating in non-domestic buildings implies heating system replacement in 270 non-domestic buildings every year to 2030.

Industry

The industrial sector covers emissions from manufacturing and construction businesses excluding those arising from the consumption of electricity and from buildings (covered above). Typically, the sector includes energy intensive industrial activities such as refineries, chemicals, iron and steel, and cement, which together are responsible for nearly two thirds of UK industrial sector emissions. These industries are not present in Exeter. Emissions in the area are more likely to occur from food and drink manufacture, printing, water, waste management and a variety of other smaller manufacturing businesses.

Industrial emissions in Exeter are relatively small (6% in 2019) and are less than one-half of the 2008 value. Only 2% of Exeter's 2019 industrial emissions came from industrial processes with the remainder arising from fuel consumption (mostly gas) indicating that cutting fuel consumption is the priority. The absence of identified point source emissions in Exeter makes it difficult to identify specific measures that target significant industrial emissions in the city. Improving industrial energy efficiency and switching away from fossil fuels to electricity are likely to be the most effective ways of reducing emissions. However, there is currently insufficient granularity in the data to measure or target specific measures in the sector. Reducing 2019 emissions of 27 kt CO_2e will require annual emission reduction of 2.4 kt CO_2e per year over 11 years to 2030.

Transport/Mobility

Emissions from transport, Exeter's third largest emissions sector (22%), have remained stubbornly high with little change since 2008. Pre Covid rises in vehicle miles in Exeter need to be reversed to hit the 2030 target of a 17% decline in the 542 million kilometres driven in 2019. This change requires a 10 million kilometre per year reduction to 2030, a large change from the 6 million average annual increase from 2000 to 2019.

Electric vehicle (car and van) ownership in Exeter has grown exponentially over recent years. At the end of 2020 there were 590 battery electric vehicles registered in Exeter. For all 50,400 vehicles in Exeter to be electric requires 317 to be registered in 2021 with exponential growth continued thereafter. However, this rate of growth means that beyond 2027 the required replacement rate exceeds the pre Covid new vehicle registration rate. Adequate charging points will also be needed; as of October 2021 Exeter had 49 charging points for electric vehicles. The 2030 charging point target is 778, which if it is to be met, needs the installation of 81 new charging points per year to 2030.

Larger commercial vehicles and HGVs will also need to be zero emissions. In 2020 there were 2,500 HGVs, buses and other vehicles registered in Exeter. These are likely to be a fraction of those categories of vehicle driving on the city's roads. Although relatively few in number, larger vehicles have a greater per vehicle impact on emissions, so transitioning them away from fossil fuels is important. Targets and monitoring for larger vehicles need to be developed as data becomes available.

Exeter has recorded steady increases in cycling over the past decade. However, to reach the target of 11% of car and taxi journeys requires current cycling (5 million kilometres) to increase to 46 million kilometres in 2030, an annual increase of 4 million kilometres each year every year. Similar numbers of journeys will need to be walked.

<u>Waste</u>
Exeter's waste emissions (7% of the 2019 total) have been similar over the past 4 years following the commissioning of the energy recovery facility (ERF) in Marsh Barton. Emissions prior to 2014 were lower as Exeter's waste was disposed of outside the city (mostly to landfill).

Exeter City Council and Devon County Council, the respective waste collection and disposal authorities, only have information on, and collection and disposal responsibilities for, domestic waste. Local authorities have little knowledge of or influence over commercial waste in their locality. It is important for Exeter to obtain reliable and up to date information on volume and composition of non-domestic waste streams to enable assessment of emissions from non –domestic waste.

The Sixth Carbon Budget foresees a range of measures including reducing waste generation by 33% by 2037, increasing the UK wide recycling rate to 70% by 2030 and fitting carbon capture and storage (CCS) to all energy from waste (EfW) plants by 2050.

Exeter generated 39,000 tonnes of household waste in 2020/21. A 33% reduction would require this to fall to 26,000 tonnes in 2030, equivalent to an annual reduction of 1,300 tonnes each year. Although Exeter's households each generate moderately less waste than those in other parts of county, the city has a relatively low recycling rate (28% versus 55% for Devon as a whole). Improving recycling to 70% requires a 4.2% annual increase each year to 2030.

Measures for lowering emissions from the ERF include reducing fossil inputs to the ERF (e.g. by increasing plastic recycling) and exporting heat. The use of heat increases the efficiency of energy recovery from the waste and reduces CO_2 emissions; the more heat used, the lower the emissions. Promoting heat use in the Liveable Exeter schemes in Water Lane and Marsh Barton will be important in this respect. Ultimately, the installation of CCS is required. The Sixth Carbon Budget requires the installation of CCS on all UK energy from waste plants between 2040 and 2045. Net zero in Exeter requires this in 2030.

<u>F-gases</u>
Although emissions from F-gases in Exeter are a minor part of Exeter's footprint (6%), under a net-zero scenario, the decarbonisation of other sectors means that left unchanged, the F-gas contribution will play an increasing role.

Emissions reduction in the F-gas sector is driven by national and international legislation and there is therefore relatively limited scope for Exeter to accelerate emission reduction from F-gases. Local trading standards bodies enforce air conditioning inspections and more proactive enforcement may be a route to lower emissions.

Further work is required to develop specific targets for F-gas emissions. Reducing 2019 emissions of 29 kt CO_2e will require annual emission reduction of 2.6 kt CO_2e per year over 11 years to 2030.

The monitoring targets show the scale of the changes needed in Exeter to meet the 2050 targets set out in the Sixth Carbon Budget by 2030. In summary, these include:

- Over 1,200 PV installations each year every year to 2030, compared to 36 in 2020, a six-fold increase in the long run average installation rate.
- Installing loft insulation in 25,400 homes by 2030 or 2,800 homes each year every year to 2030.
- Insulating the walls of 13,500 homes by 2030 at the rate of 1,500 every year.
- Putting 4,600 heat pumps in homes every year to 2030, there are currently 449 heat pumps in Exeter's homes.
- Connecting an extra 11,200 homes to heat networks by 2030 (over 1,200 each year).
- Improving the energy efficiency of 260 non-domestic buildings every year to 2030 and switching 270 every year to low carbon heating.
- Reducing driving in Exeter by 10 million kilometres each year, every year to 2030.
- Continuing the exponential growth in electric vehicles ownership (aiming for 317 in 2021) and putting in an additional 81 charging points in every year to 2030.
- Increasing cycling rates by 4 million kilometres annually (equivalent to 70% of the current total level) with matching increases in walking.
- Achieving a 1,300 tonne annual reduction in household waste generation each year, every year and a 4.2% annual increase in recycling rates each year, every year to 2030.
- Capturing and storing CO_2 emission from the Exeter energy recovery facility by 2030.

It has not been possible to identify data sources or specific proxy measures for the industry and f-gas sectors and some more specific targets have yet to be determined and therefore do not currently have data sources or incremental targets. These shortcomings should be addressed as part of the ongoing monitoring process.

Contents

1 Introduction

The 2007 Energy White Paper[1] set a goal of reducing carbon dioxide (CO_2) emissions by between 26% and 32% from 1990 levels by 2020. In its 2007 Climate Change Strategy, Exeter City Council (ECC) set a 30% CO_2 emission reduction target over the same timescale. The Centre for Energy and the Environment (CEE) at the University of Exeter to undertook an analysis[2] as input to the strategy. The analysis identified emissions reduction potential in buildings and transport offset by growth to give net emission reduction of 92 kt CO_2 and 16 kt CO_2 respectively with progresses towards the target being assisted by a 68 ktCO_2 reduction in the carbon intensity of electricity sourced from the National Grid. These reductions, totalling 175 kt CO_2, would achieve 2020 emissions of 530 kt CO_2 versus estimated 1990 emissions of 736 ktCO_2, a 28% reduction. This study provides an updated greenhouse gas (GHG) inventory for the city and reports on progress towards the 2020 emissions reduction potentials identified in 2007.

The 2008 Climate Change Act, with subsequent amendments, radically changed the UK's climate change ambition and now sets a legal obligation for net zero emissions in UK by 2050. The Act established the Climate Change Committee (CCC). The CCC sets five-year carbon budgets for the UK, the most recent of which is the Sixth Carbon Budget[3, i] covering the period from 2033 to 2037.

In 2019, increasing urgency to address climate change led ECC to declare a Climate Emergency and pledge to work towards net zero by 2030[4]. In 2020 the Council announced a series of initiatives to drive forward the city's net zero ambitions[5] and, in addition, to establishing a baseline GHG inventory for the city. The CEE was commissioned to quantify the reductions required to achieve net zero in 2030 and identify more specific and timely metrics for monitoring progress towards carbon neutrality.

[i] This study makes extensive use of material from The Sixth Carbon Budget. References to the CCC refer to the Sixth Carbon Budget unless stated otherwise.

2 GHG inventory

This GHG inventory is for territorial emissions. Territorial emissions are those arising from within the boundaries of the city and are more within the control of people living, working and visiting the city[ii]. The publication of territorial GHG emissions for local authority areas is 2 years in arrears, so the most recent data available is for 2019[6].

2.1 Methodology

This inventory reports emissions under the following categories:

- **power**: emissions resulting from electricity consumption;
- **buildings**: emissions resulting from fuel combustion in the domestic, commercial and public administration sectors;
- **industry**: emissions categorised as from industry (other than from electricity consumption and in buildings), including large industrial installations, in the government local authority CO_2 dataset ;
- **transport**: emissions from road and rail vehicles (emissions from electric vehicles are reported under power; emissions from aviation and shipping have not been included);
- **agriculture**: emissions from fuel use in the sector, as reported in the government local authority CO_2 dataset (emissions from livestock and fertiliser use was assumed to be negligible in Exeter in the absence of data for recent years);
- **land use and land use change**: as reported in the government local authority CO_2 dataset;
- **waste:** emissions from the disposal of solid waste and wastewater, and
- **f-gases**: emissions from the consumption of fluorinated gases (in the absence of data for Exeter, national emissions have been apportioned on the basis of non-domestic electricity consumption since the majority of such gases are used in refrigeration systems, air conditioning and heat pumps).

An accompanying report[7] describes the inventory methodology in more detail.

2.2 Results

Estimated total greenhouse gas emissions in Exeter in 2019 are 476,221 tonnes of carbon dioxide equivalent (t CO_2e). Figure 1 and Table 1 give the breakdown of emissions.

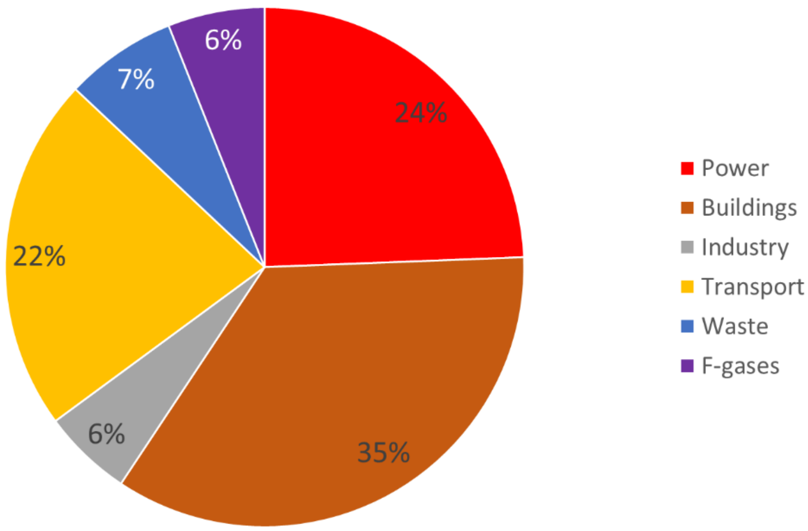

Figure 1. Sources of Exeter's greenhouse gas emission in 2019 (excluding agriculture and land use)

[ii] The territorial emissions method is consistent with the approach taken in UK national reporting. A complementary method, consumption-based carbon footprinting, considers upstream and downstream emissions arising outside an area.

Table 1. Exeter's greenhouse gas emission by sector in 2019

Sector	GHG emissions t CO_2e
Power	117,077
Buildings	167,684
Industry	26,795
Transport	106,023
Waste	33,449
F-gases	28,914
Agriculture	948
Land use	-4,669
Total	476,221

Figure 2 shows the breakdown of emissions for each year since 2008. GHG emissions in Exeter have generally been on a downward trajectory with estimated GHG emissions of 717 kt CO_2e in 2008 declining by a third by 2019.

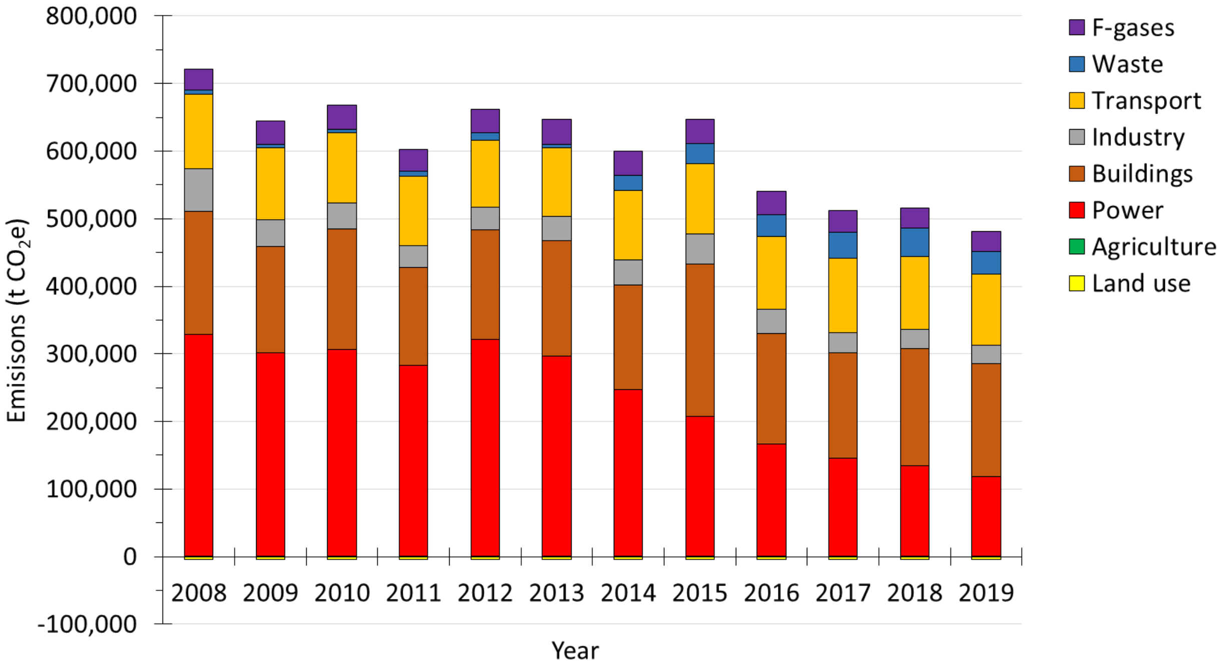

Figure 2. Sources of greenhouse gas emission in Exeter from 2008 to 2019.

2.2.1 Progress in reducing emissions

In 2007, a 30% reduction, based on a 1990 emissions estimate of 736 kt CO_2, required 2020 emissions of 516 kt CO_2. With 2019 emissions below 500 kt CO_2e, this looks achievable (subject to Covid 19 bounceback). However, the sector detail shows that the reduction is the result of grid decarbonisation, which has delivered three times the change estimated in 2007 (210 kt CO_2e versus 68 kt CO_2). Locally, sectoral reduction in buildings (15 ktCO_2e versus 93 kt CO_2) and transport (4 kt CO_2e versus 16 kt CO_2) has failed to meet the objectives set in 2007 by factors of 6 and 4 respectively.

Looking ahead, the changes achieved in each sector, based on the latest emissions trends, are summarised in Table 2 and Table 3, and Figure 3 and Figure 4. Only the power, industry and land use change sectors are on trend to achieve net zero carbon by 2030. Changes in grid carbon intensity will largely take place outside the city, the mix of industry in the city affects industrial emission trends, and land use change will not have a material impact on future emission reduction. Increases in waste sector emissions are a result of the development of the Marsh Barton energy recovery facility (ERF) . Prior to 2014 the city's waste emissions were artificially low as Exeter's waste was landfilled outside the city. Since 2014 the situation is partially reversed as the ERF treats some waste that originates outside Exeter.

As emphasised above, lack of progress in the buildings and transport sectors is particularly concerning, with growth in the city leading to significant increases in emissions in recent years. The city needs to make significant progress in these two key sectors to deliver net zero.

Table 2. Changes achieved from a 2008 and 2016 baseline in t CO_2e. Negative values indicate a reduction. Values in green exceed the annual reduction required for zero carbon by 2030 on a linear trajectory; those in red do not.

Sectr	Change achieved (t CO_2e)		Average annual change achieved (t CO_2e)		Annual change required to achieve zero carbon by 2030 (t CO_2e)	
	2008 to 2019	2016 to 2019	2008 to 2019	2016 to 2019	2008 to 2030	2016 to 2030
Power	-210,379	-49,151	-19,125	-16,384	-14,884	-11,873
Buildings	-15,321	+4,327	-1,393	+1,442	-8,318	-11,668
Industry	-35,917	-9,049	-3,265	-3,016	-2,851	-2,560
Transport	-3,661	-1,586	-333	-529	-4,986	-7,686
Agriculture	+71	+8	+6	+3	-40	-67
Land use	-442	-187	-40	-62	+192	+320
Waste	+27,377	+1,363	+2,489	+454	-276	-2,292
F-gases	-2,105	-5,589	-191	-1,863	-1,410	-2,465
Total	-240,378	-59,864	-21,853	-19,955	-32,573	-38,292

Table 3. Changes achieved from a 2008 and 2016 in percentage terms. Negative values indicate a reduction. Values in green exceed the annual reduction required for zero carbon by 2030 on a linear trajectory; those in red do not.

Sector	Change achieved (%)		Average annual change achieved (%)		Annual change required to achieve zero carbon by 2030 (%) [iii]	
	2008 to 2019	2016 to 2019	2008 to 2019	2016 to 2019	2008 to 2030	2016 to 2030
Power	-64.2%	-29.6%	-5.8%	-9.9%	-4.5%	-7.1%
Buildings	-8.4%	+2.6%	-0.8%	+0.9%		
Industry	-57.3%	-25.2%	-5.2%	-8.4%		
Transport	-3.3%	-1.5%	-0.3%	-0.5%		
Agriculture	+8.1%	+0.9%	+0.7%	+0.3%		
Land use	-10.4%	-4.2%	-0.9%	-1.4%		
Waste	+450.9%	+4.2%	+41.0%	+1.4%		
F-gases	-6.8%	-16.2%	-0.6%	-5.4%		
Total	-33.5%	-11.2%	-3.0%	-3.7%		

[iii] Except for land use, which starts with negative emissions (carbon uptake), so an increase in emissions would technically be allowable in this sector, although the number is small relative to other sectors.

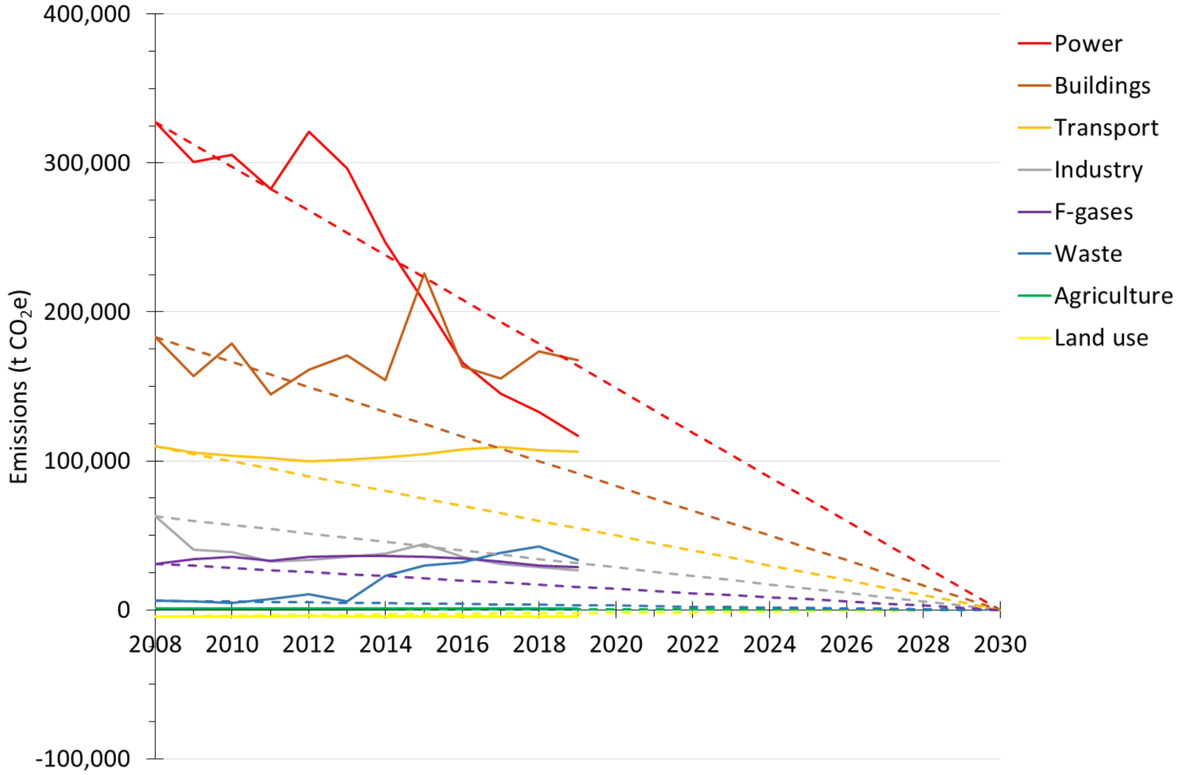

Figure 3. Emissions reductions against a linear trajectory to net zero by 2030 (dotted), 2008 base, by sector.

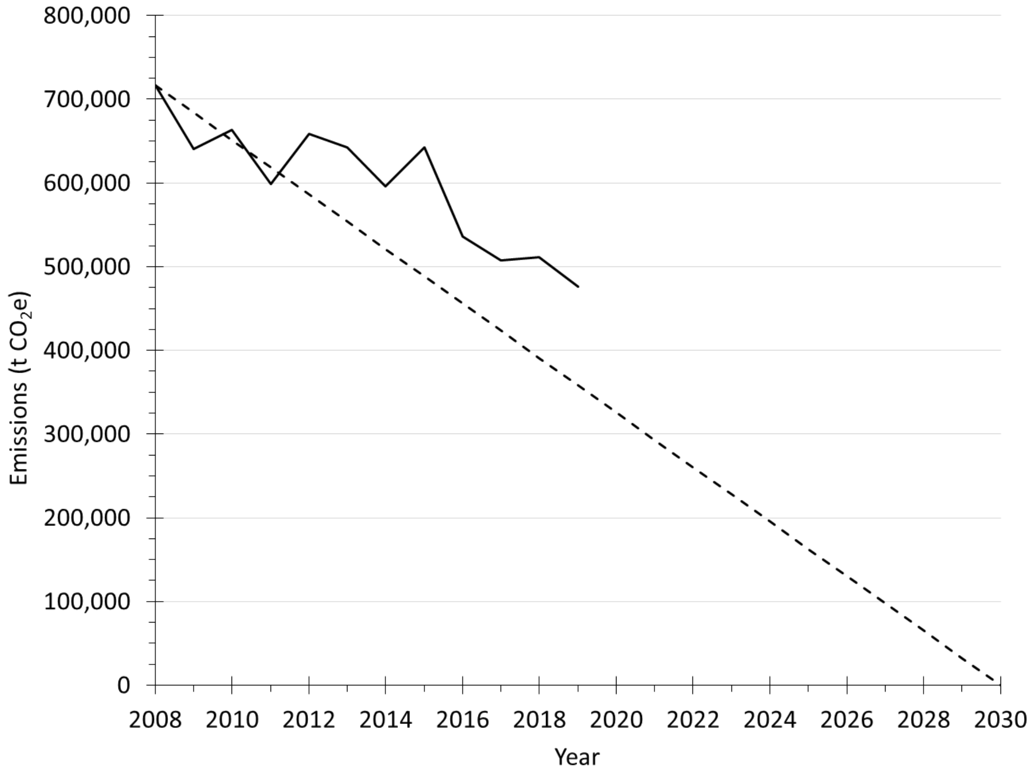

Figure 4. Emissions reductions against a linear trajectory to net zero by 2030 (dotted), 2008 base, total emissions.

Progress in the power sector is attributable to rapid decarbonisation of grid electricity. Locally, emissions from the transport and buildings sectors in particular are not falling at the rate required.

2.2.2 Future emissions trajectories

Figure 5 extrapolates Exeter's total emissions between 2016 and 2019 to represent the "current trend". To cover the two year data lag it is assumed that emissions follow this trajectory in 2020 and 2021 giving estimated emissions in 2021 of 448 kt CO_2e. Following the current trend would result in 2030 emissions of 290.5 kt CO_2e and give an ongoing decline of 17.5 kt CO_2e (3.9% of 2021 emissions) per year and cumulative emissions from 2021 to 2030 of 3.7 Mt CO_2e. However, the continuation of the current trend without local GHG reduction relies on unrealistic grid decarbonisation that would imply zero carbon grid electricity in 2026[iv]. Using the CCC's Balanced Pathway UK grid carbon intensity projections suggests that, while it may be realistic to assume current trend estimates for 2021 may be achieved with grid decarbonisation, by 2030 a 28% reduction from non-power sectors will be required to continue to follow the current trend.

Emissions reductions from 448 kt CO_2e in 2021 to net zero in 2030 could take many alternative trajectories. For example, a possible but unlikely trajectory would be to follow the current trend until 2029 with net zero occurring in one step the following year. This would create cumulative emissions from 2021 to 2030 of 3.4 Mt CO_2e. Alternatively, a linear decline to net zero in 2030 (shown in Figure 5) would give a decline of 49.8 kt CO_2e (11.1%) per year and give rise to cumulative emissions of 2.2 Mt CO_2e. Achieving the linear decline requires an additional 32.3 kt CO_2e (7.2%) per year over the current trend.

An alternative decline (also illustrated in Figure 5) shows how a delay to the start of emissions reduction can achieve the same cumulative emissions as the linear decline by assuming a more accelerated descent in the middle years of the decade.

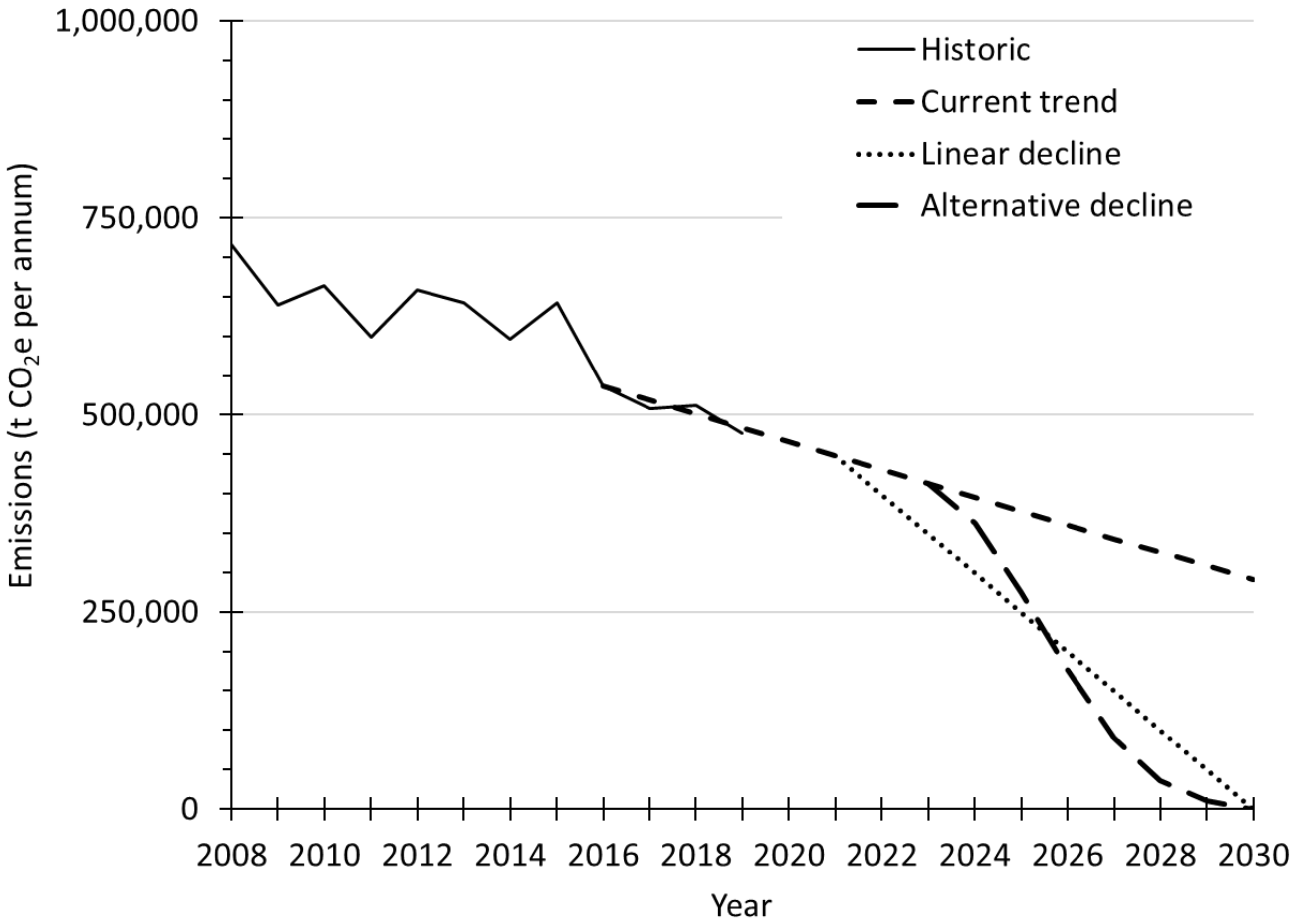

Figure 5. Current trend emissions with alterative trajectories to net zero by 2030.

[iv] The Climate Change Committee's assessment in the Sixth Carbon Budget is that electricity grid carbon intensity will approach zero (10gCO_2/kWh, a reduction of 95% on 2019) in 2035.

Figure 6 shows the cumulative emissions from the current trend, linear and alternative declines in Figure 5. By 2026, cumulative emissions from the current trend case exceed the 2.2 Mt CO_2e cumulative emissions to 2030 from the linear decline case.

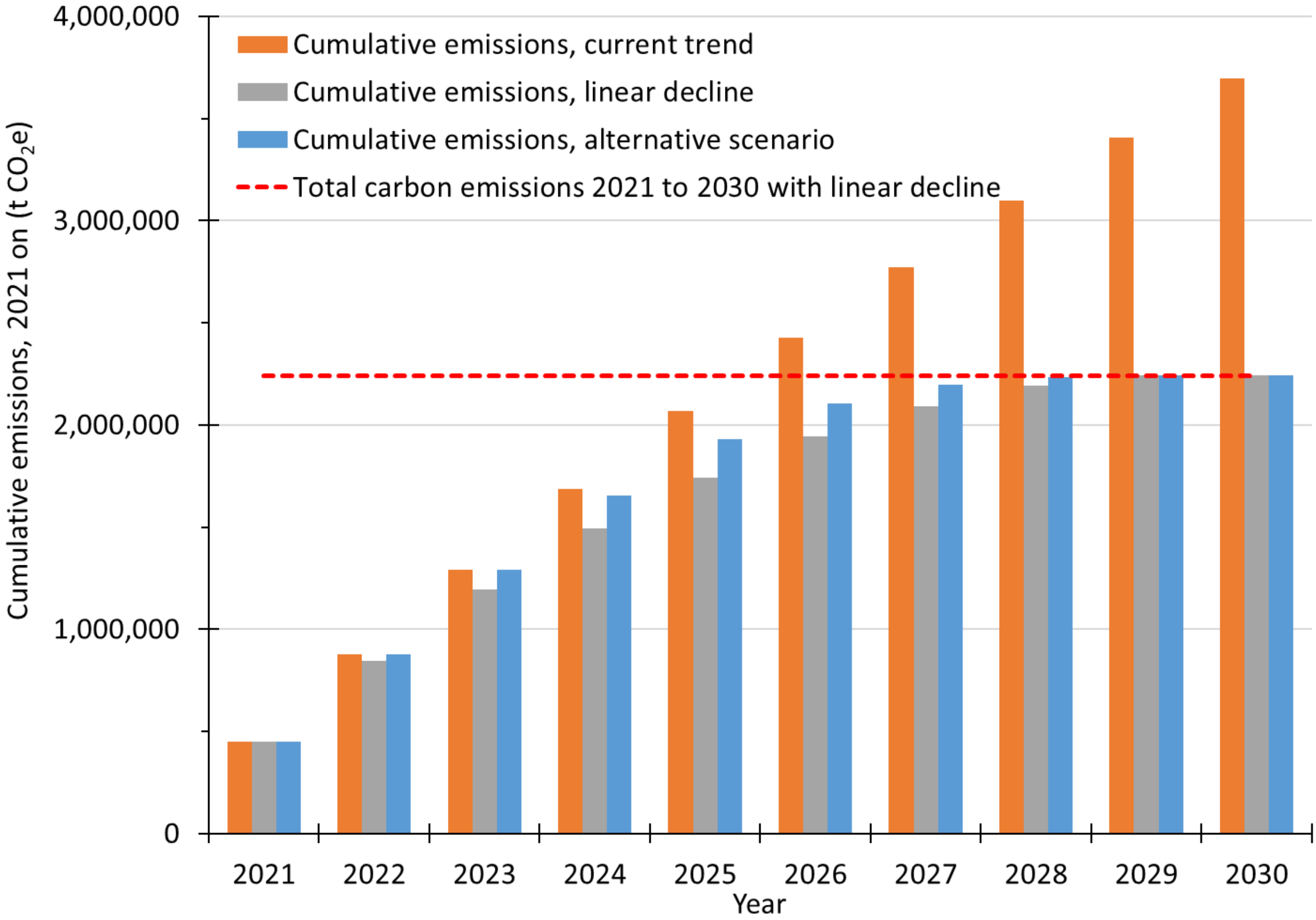

Figure 6. Emissions reductions against a linear trajectory.

3 Sector emissions monitoring

While there may be a broad public understanding of what Net Zero means (i.e. minimal fossil fuel use), the two year lag in the publication of GHG emissions statistics together with the difficulty of relating the reduction in quantities of CO_2 to everyday actions presents challenges for setting and achieving easily understood interim CO_2 targets.

Exeter has pledged to work towards net zero by 2030. This target is 20 years in advance of the 2050 national net zero target required under the Climate Change Act and reported on in the Sixth Carbon Budget.

The approach taken in the sub sections below is to use the 2050 data from the Sixth Carbon Budget to establish 2030 net zero target values for measures in Exeter. The change required between the current status and the 2030 target is then used to calculate a measurable target for the end of 2022 which can be reported on in 2023 and subsequently annually thereafter.

The default assumption, unless there is evidence to the contrary, is that progress will occur in a linear manner, i.e. with the same increment in each of the nine years between 2021 and 2030. This is consistent with the linear GHG reduction profile shown in the graphs above. The danger with other assumptions (for example an exponential change which starts at a low level) is that the short term challenge is minimised only for the measure to then be impossible to deliver in the late 2020s.

3.1 Power

Power, distributed through the national and regional electricity networks is the sector of the UK economy that has decarbonised most rapidly. The resulting national grid emission factor has fallen by 60%, from 477 g CO_2/kWh in 2010 to 193 g CO_2/kWh in 2019. The use of a national emissions factor for local electricity CO_2 emissions calculations precludes considering carbon emissions from power at a local level by, for example, considering renewable electricity generation in Exeter as Exeter's CO_2 reduction. All renewable energy generation in the UK contributes to national emissions reduction, so while Exeter should do everything possible to deliver local renewable electricity generation, the emission reduction benefits contribute to national grid decarbonisation.

The Sixth Carbon Budget estimates that demand for electricity will more than double by 2050. At the same time the CCC projects that grid carbon intensity will have reduced by 76% in 2030, 96% in 2040 and 99% in 2050. Zero carbon electricity generation is therefore essential for the national net zero target to be met. Projections for the Balanced Pathway show that variable renewables such as solar photovoltaic (PV) and wind generation make up 58% of generation in 2030 and 66% in 2040 and 2050. Given these projections, it is clearly important to maximise Exeter's contribution to zero carbon electricity generation and, to be consistent with a 2030 net zero target, Exeter could therefore target full deployment of its renewable electricity potential by 2030.

The urban nature of Exeter limits the potential for renewable electricity generation in the city and, while there may be discrete opportunities for technologies such as run of river hydro[v] and small-scale wind turbines[vi]; these do not have the potential to generate material amounts of power. A review of a long list of potential renewable energy technologies is included as part of the evidence base for the Greater Exeter Strategic Plan[8] . The review led to an assessment of large-scale wind and ground mounted PV across the region. The assessment identified one 0.5 MW wind site in Exeter with the potential to generate 1 GWh annually and 24 ground mounted PV sites with total capacity of 64 MW and the potential to generate 64 GWh anually. In practice, the number of ground mouthed PV sites in the city that are realistically likely to receive planning permission and gain grid access will be significantly fewer. Roof mounted PV arrays, although individually small, have the potential to make a material contribution if widely adopted across the rooftops of Exeter's homes and businesses.

3.1.1 Current renewable electricity generation

Data on renewable electricity (RE) installations is available from the Department of Business Energy and Industrial Strategy's (BEIS) regional renewable energy statistics[9] and also from OFGEM's feed-in tariff installation report[10,vii]. The BEIS data shows total RE generation in Exeter of 16 GWh in 2020, 3% of Exeter's 511 GWh electricity consumption. PV generated 78% (12 GWh), sewage gas[viii] 17% (3 GWh) and hydro 5% (1 GWh).

3.1.2 PV on homes

In 2020 there were a total of about 2,295 PV installations (amounting to 4% of Exeter's homes), with a total capacity of 7 MW generating 7 GWh. 2012 saw the largest annual installation rate (663). Recently installation rates have been significantly less, averaging 82 annually over four years since 2016. Figure 7 shows the trends in domestic PV generation and installations as a percentage of Exeter's domestic roofs.

[v] Exeter has two run of river hydro sites with total capacity of 273 kW. The availability of civil infrastructure, e.g. weirs, mill leats, etc., limits the development of new sites.

[vi] There have been some trials of small-scale wind turbines in the city but these have generally been unsuccessful.

[vii] The discontinuation of the feed–in tariff for PV means that OFGEM data is not representative after 2018.

[viii] Generated from combined heat and power at the Countess Weir sewage treatment facility.

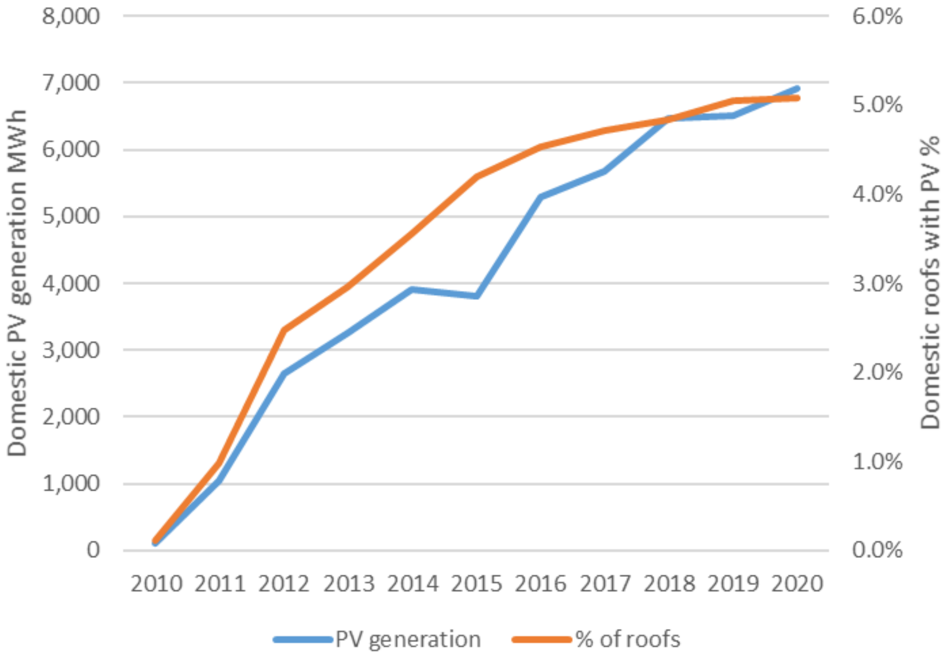

Figure 7: Historic domestic PV in Exeter from 2010 to 2020

Target setting for PV assumes that by 2030 25% of Exeter's existing domestic roofs[ix] have PV installed and that 50% of new homes built between 2020 and 2030[x] have PV with each installation assumed to have the historic average peak capacity (3 kW). Hitting this target would mean that in 2030 13,971 domestic roofs (28%) in Exeter would have PV. Figure 8 shows the projected increase in domestic solar PV which would generate 42 GWh in 2030.

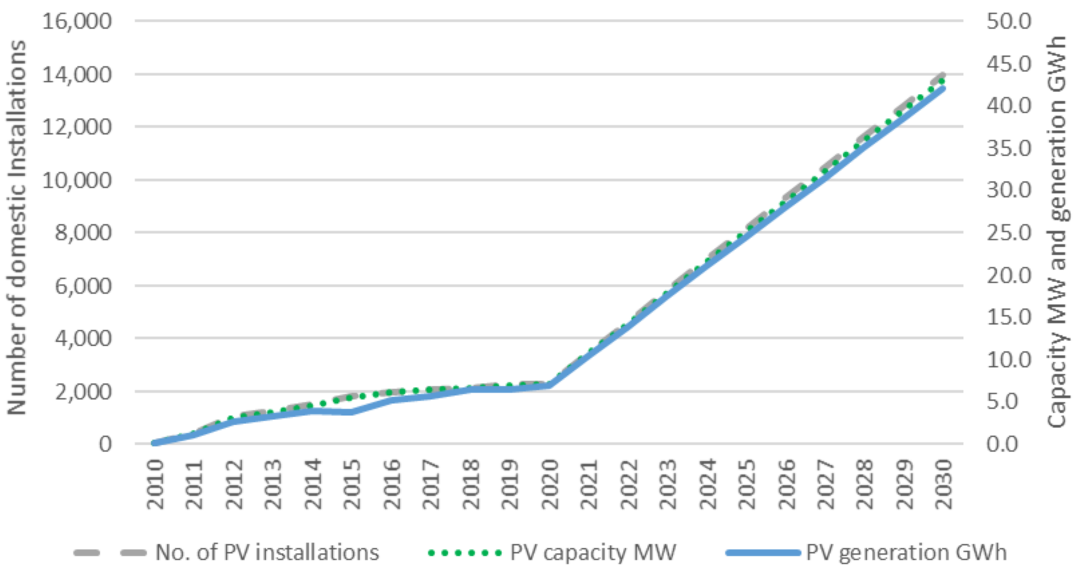

Figure 8: Historic and projected domestic PV in Exeter

The projected domestic installation rate is 1,200 per year, some 6 times the historic average and twice the peak rate achieved in 2012.

[ix] Number of roofs from 2011 census housing mix (41,160) assumes that 3 purpose built flats or 2 conversions share one roof and does not count flats in commercial buildings or mobile/temporary homes. New roofs added annually (data from ECC's "Authority Monitoring Report 2020/21" https://exeter.gov.uk/media/5861/amr-2020-2021.pdf) to 2020 gives 45,179 existing roofs.

[x] Based on ECC 2021 housing supply statement (see https://exeter.gov.uk/planning-services/planning-policy/monitoring/five-year-housing-supply-statement/) which gives 5,353 new roofs in 10 years.

3.1.3 Non-domestic PV

Non-domestic PV installations generated 5 GWh in 2020 from 128 sites with a total capacity of 5MW. Exeter City Council PV sites provide about 40% of the non-domestic generation. New non-domestic PV will be a combination of a larger number of roof mounted PV arrays together with a smaller number of ground mounted sites. The relatively high historic average array size (42 kW) accounts for the current ratio of site sizes. Exeter has 3568 non-domestic buildings[11]. It is assumed that 25% are suitable sites (mostly roofs) and install PV with the average historic installation capacity per site. On this basis projected 2030 generation is 42 GWh. Figure 9 shows historic and projected non-domestic PV installations, capacity and generation.

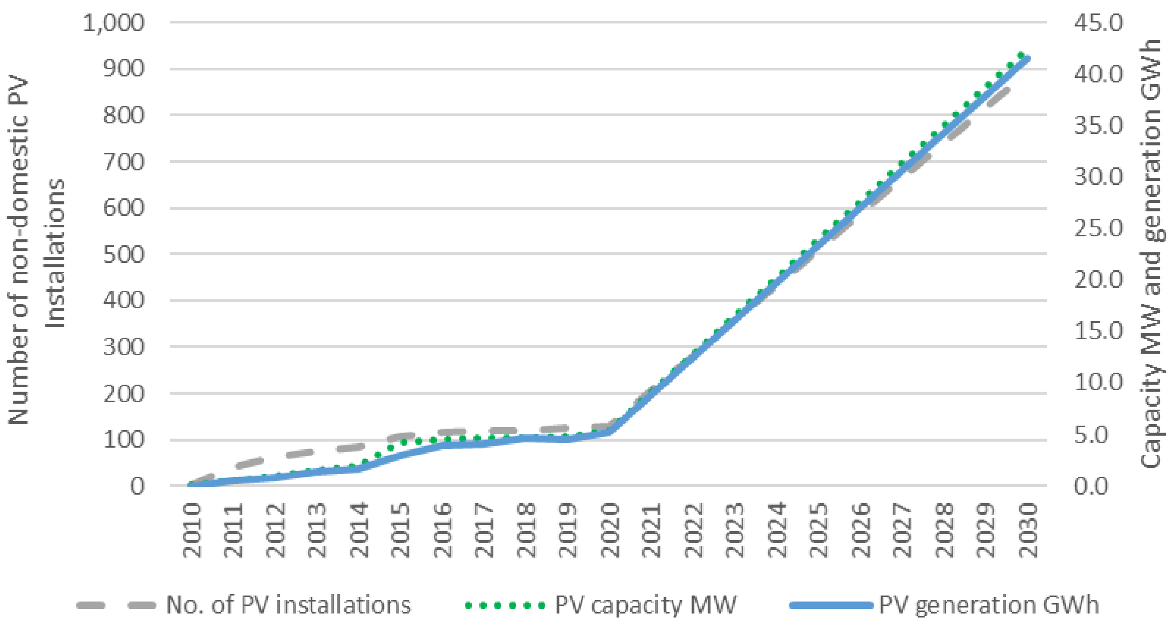

Figure 9: Historic and projected non-domestic PV in Exeter

The projected non-domestic installation rate is 76 per year, nearly 7 times the historic average and twice the peak rate achieved in 2011.

3.1.4 All PV

Table 4 and Figure 10 show historic and projected domestic and non-domestic PV installations in Exeter over the period 2010 to 2030.

Table 4. Historic and projected domestic and non-domestic PV installations in Exeter

Year	No. of PV installations	PV capacity MW	PV generation GWh
2010	51	0.1	0.1
2011	450	1.8	1.5
2012	1,104	4.1	3.5
2013	1,328	5.4	4.6
2014	1,599	6.5	5.6
2015	1,910	9.9	6.7
2016	2,082	10.7	9.2
2017	2,185	11.1	9.8
2018	2,259	11.3	11.1
2019	2,387	11.8	11.0
2020	2,423	12.4	12.1
2021	3,667	19.7	19.3
2022	4,911	27.0	26.4
2023	6,155	34.3	33.6
2024	7,399	41.7	40.7
2025	8,643	49.0	47.9
2026	9,887	56.3	55.0
2027	11,131	63.6	62.2
2028	12,375	70.9	69.3
2029	13,619	78.2	76.4
2030	14,863	85.5	83.6

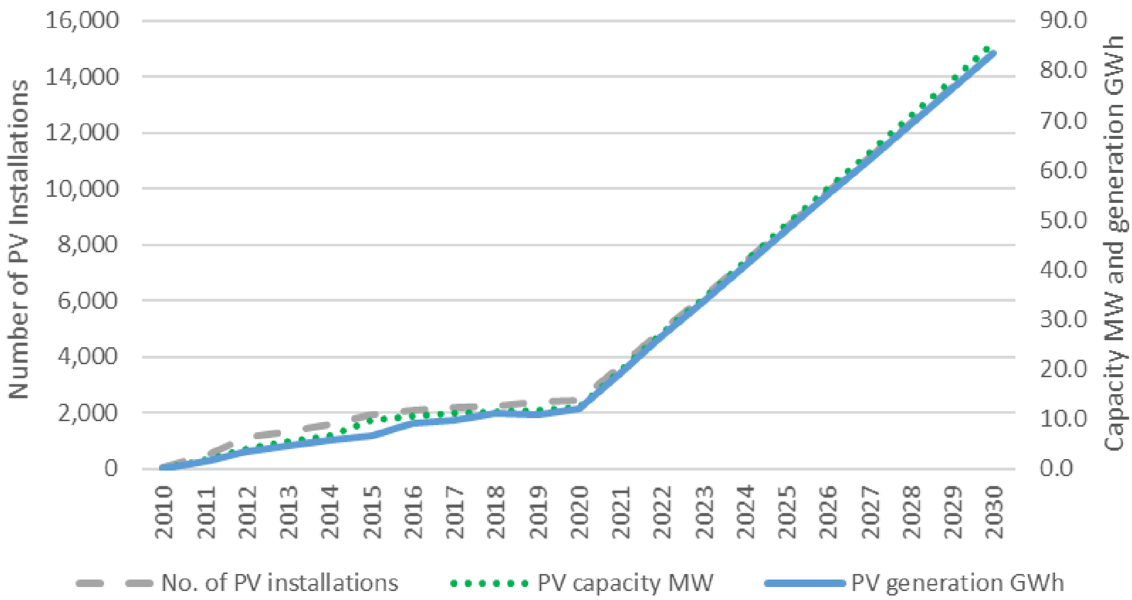

Figure 10: Historic and projected total (domestic and non-domestic) PV in Exeter

The projected overall installation rate is 1,240 per year, some 6 times the historic average and twice the peak rate achieved in 2012. The 2030 PV generation of 84 GWh represents 16% of Exeter's current electricity consumption. However, by 2030 the CCC projects national electricity demand will rise by 17%. Over the period 2020 to 2030, grid electricity CO_2 emissions offset (using the grid emission factors in the Sixth Carbon Budget) peak at 6.0 ktCO_2e in 2025 falling to 3.9kt CO_2e in 2030, 1% of Exeter's current CO_2 emissions.

3.1.5 PV monitoring and reporting

SECTOR: POWER

CURRENT LEVEL: 2,423 PV INSTALLATIONS, 12 MW CAPACITY & 12 GWh GENERATION (2020)

MONITORING TARGET: 14,863PV INSTALLATIONS, 88 MW CAPACITY & 86 GWh GENERATION IN 2030

NEXT YEAR INCREMENT: 1,244 PV INSTALLATIONS, 20 MW CAPACITY & 20 GWh GENERATION

DATA SOURCE: RENEWABLE ENERGY BY LOCAL AUTHORITY STATISTICS, BEIS

DATA AVAILABLE: ANNUALLY

3.2 Buildings

Emissions from Exeter's buildings have hardly changed since 2008. Buildings were responsible for GHG emissions of 167.7 kt CO_2e in 2019, 35% of the city's GHG emissions. The majority of emissions associated with the buildings sector are due to the requirements for space heating and hot water. Emissions from the consumption of electricity are included under the power sector. Reducing emissions arising from space heating and hot water relies on both reducing demand through efficiency measures, and supplying any heat required using low-carbon technologies.

3.2.1 Energy efficiency in homes

The Sixth Carbon Budget calls for insulation of all lofts and cavities and solid wall insulation on 50% of solid wall homes by 2033. The target in Exeter is 2030.

Data from Energy Performance Certificates[12] (EPC) provides information on some 37,278 homes or two thirds of the 56,350[xi] homes in Exeter (duplicate EPCs on the same home excluded). The dates of the EPCs go back to 2008, which means that many will be out of date with the potential for changes to the properties since the EPC. This caveat should be borne in mind when using EPC data. Table 5 shows the roof insulation data in Exeter EPCs with the percentage for each type applied to the total number of homes.

Table 5: Loft insulation recorded in Exeter EPCs

Roof / insulation type	EPCs	% of roofs	Exeter
Dwelling/premises above	6,785	18.20%	10,254
U values given (new homes)	5,352	14.35%	8,088
Pitched uninsulated	2,633	7.06%	3,979
Pitched 100mm or less	7,407	19.86%	11,194
Pitched 101mm to 200mm	6,762	18.14%	10,219
Pitched 201mm to 300mm	5,184	13.90%	7,834
Pitched 300mm plus	1,033	2.77%	1,561
Pitched unknown	26	0.07%	39
Flat roofs	1,043	2.80%	1,576
Roof rooms & thatched	1,037	2.78%	1,567
Unknown	25	0.07%	38
Total	**37,287**		**56,350**

About 24% of Exeter's homes either do not need roof insulation (e.g. non-top floor flats) or are difficult to insulate. Of the remaining 42,876 homes 17,484 (41%) are insulated (new build, where U values are given, and pitched roofs with more than 200mm). However, 3,979 pitched roof homes in Exeter have no loft insulation and 21,413 homes require top up insulation[xii] giving a total 25,392 homes, or 45% of the housing stock, in need of some loft insulation. Installation over 9 years requires 2,821 loft insulation measures per year to 2030.

[xi] Estimate of number of homes in Exeter in 2020 based on 2009 census (51,020) plus new dwellings completed since.
[xii] The recommended depth for loft insulation is between 220mm and 270mm depending on the insulation, material uses (National Insulation Association see: https://www.nia-uk.org/understanding-insulation/loft-insulation/)

SECTOR: BUILDINGS

CURRENT LEVEL: 17,484 INSULATED LOFTS

MONITORING TARGET: 42,876 HOMES WITH LOFT INSULATION (200mm OR MORE)

NEXT YEAR INCREMENT: 2,821 FULL AND TOP UP LOFT INSULATION INSTALLS

DATA SOURCE: EPCS

DATA AVAILABLE: QUARTERLY, BUT INCLUDES HISTORICAL DATA

Table 6 shows a summary of the EPC data for wall insulation in Exeter.

Table 6: Wall insulation recorded in Exeter EPCs

Wall type	EPCs	% of walls	Exeter
Insulated cavity walls	21,741	58.31%	32,856
Insulated other walls	1,237	3.32%	1,869
Insulated solid walls	1,172	3.14%	1,771
Partly insulated cavity walls	946	2.54%	1,430
Partly insulated other walls	196	0.53%	296
Partly insulated solid walls	30	0.08%	45
Uninsulated cavity	6,453	17.31%	9,752
Uninsulated other walls	549	1.47%	830
Uninsulated solid walls	4,944	13.26%	7,472
Unknown	19	0.05%	29
Total	**37,287**	**100.00%**	**56,350**

The data suggests that 32% of the homes in Exeter (18,053) do not have wall insulation of which 54% (9,752) are cavity walls and 41% (7,472) are solid walls.

Assuming linear installation of cavity wall insulation over 9 years, 1,084 cavity wall insulation installations are required per year to 2030.

SECTOR: BUILDINGS

CURRENT LEVEL: 32,856 INSULATED CAVITY WALLS; 9,752 UNINSULATED

MONITORING TARGET: 9,752 CAVITY WALL INSULATION INSTALLS BY 2030

NEXT YEAR INCREMENT : 1,084 CAVITY WALL INSULATION INSTALLS

DATA SOURCE: EPCs

DATA AVAILABLE: QUARTERLY BUT INCLUDES HISTORICAL DATA

Assuming linear insulation of half of the 7,472 uninsulated solid walls in Exeter over 9 years gives 415 solid wall insulation installations per year.

SECTOR:	BUILDINGS
CURRENT LEVEL:	1,711 INSULATED SOLID WALLS; 7,472 UNINSULATED
MONITORING TARGET:	3,736 SOLID WALL INSULATION INSTALLS BY 2030
NEXT YEAR INCREMENT:	415 SOLID WALL INSULATION INSTALLS
DATA SOURCE:	EPCS
DATA AVAILABLE:	QUARTERLY BUT INCLUDES HISTORICAL DATA

3.2.2 Low carbon heat in homes

The Sixth Carbon Budget foresees the decarbonisation of home heating in urban areas via heat pumps and heat networks. By 2050 the uptake of heat pumps in UK homes with gas is forecast to reach 17.8 million representing 76% of the 23.6 million UK homes on the gas grid[13]. Around 20% of heat to homes and 42% to public and commercial customers will be through heat networks by 2050. Table 7 shows EPC data on heating in Exeter's homes.

Table 7: Heating types recorded in Exeter EPCs

Heating type	EPC no.	% of heat type	Exeter
Mains gas central heating	28,846	77.36%	43,594
Electric storage heaters	3,744	10.04%	5,658
Community schemes	2,074	5.56%	3,134
Electric room heaters	1,469	3.94%	2,220
Room heaters mains gas	474	1.27%	716
Heat pumps	297	0.80%	449
Electric central heating	159	0.43%	240
Oil central heating	83	0.22%	125
LPG central heating	70	0.19%	106
Unknown	27	0.07%	41
Room heaters coal	21	0.06%	32
Solid fuel central heating	10	0.03%	15
Room heaters biomass	8	0.02%	12
Biomass central heating	5	0.01%	8
Room heaters bottled gas	0	0.00%	0
Room heaters oil	0	0.00%	0
Total	**37,287**	**100.00%**	**56,350**

BEIS Renewable Heat Incentive (RHI) statistics[14] shows 57 heat pumps in Exeter. This is significantly fewer than the pro-rata 449 calculated from the EPC data (presumably due to the majority of installations not taking up the RHI). The pro rata EPC data gives 3,134 homes in Exeter connected to community heating schemes (heat networks)[xiii]. On this basis an estimated 55,819 homes in Exeter will require low or zero carbon-heating retrofit by 2030[xiv].

Installation of heat pumps in 76% of homes that do not have heat pumps, or are not connected to heat networks,[xv] requires 41,714 extra installations over 9 years, a rate of 4,635 each year.

[xiii] A BEIS FOI request gives 1,261 homes, 54 commercial buildings and 939 educational customers (total 2,255) connected to DH in Exeter with total capacity of 12.1 MW supplying 9 GWh in 2015. The more up to date EPC data is used.
[xiv] Assuming that new homes built after 2025 have low or zero carbon heating.
[xv] Assuming all homes in Exeter are on the gas grid.

SECTOR: BUILDINGS

CURRENT LEVEL: 449 HEAT PUMPS IN HOMES

MONITORING TARGET: 42,163 HEAT PUMP IN HOMES BY 2030

NEXT YEAR INCREMENT: 4,635 HEAT PUMP INSTALLS

DATA SOURCE: EPCs

DATA AVAILABLE: QUARTERLY BUT INCLUDES HISTORICAL DATA

Heat networks will play a role in the balance of Exeter's homes currently without low or zero carbon heating that are not retrofitted with heat pumps (24% or 13,657). Heat networks connecting 20% homes that need retrofit low or zero carbon heating total 11,164. Over nine years to 2030 this requires the connection of 1,240 buildings each year.

SECTOR: POWER AND HEAT

CURRENT LEVEL: 3,134 HEAT CUSTOMERS CONNECTED TO HEAT NETWORKS

MONITORING TARGET: 14,298 HEAT CUSTOMERS CONNECTED TO LOW CARBON HEAT NETWORKS IN 2030

NEXT YEAR INCREMENT: 1,240 HEAT CUSTOMERS CONNECTED TO LOW CARBON HEAT NETWORKS

DATA SOURCE: EPCs

DATA AVAILABLE: QUARTERLY BUT INCLUDES HISTORICAL DATA

Table 8 summarises the current and target 2030 net zero heating mix in Exeter's homes.

Table 8: Current and target 2030 net zero heating mix in Exeter's homes

Heating type	Current	2030	Change
Gas	43,594	0	-43,594
Heat pump	449	42,163	41,714
Heat network	3,134	14,298	11,164
Other	9,173	5,815	-3,358
Total	**56,350**	**62,276**	**5,926**

Currently the majority of heat networks are fuelled by natural gas. Fossil fuel based heat networks will need to decarbonise to achieve Net Zero.

SECTOR: POWER AND HEAT

CURRENT LEVEL: NO LOW CARBON HEAT NETWORKS

MONITORING TARGET: ALL HEAT NETWORKS DECARBONISED BY 2030

NEXT YEAR INCREMENT: DECARBONISATION PLAN FOR ALL HEAT NETWORKS IN EXETER

DATA SOURCE: UNKNOWN

DATA AVAILABLE: UNKNOWN

3.2.3 Energy efficiency and low carbon heat in non-domestic buildings

The Sixth Carbon Budget assumes a 27% reduction in energy consumption compared to the CCC's 2018 baseline. However, in its Balanced Pathway, the CCC assumes that commercial energy efficiency measures are fully deployed by 2030 and public sector measures are fully deployed by 2032. Nationally the CCC projects that by 2030 37% of public and commercial heat demand is met by low-carbon sources. Of this low-carbon heat demand, 65% is supplied via heat pumps, 32% via district heating and 3% by biomass. By 2050 all heat demand is met by low-carbon sources of which 52% is heat pumps, 42% is district heat, 5% is hydrogen boilers and around 1% is new direct electric heating.

In practical terms, this requires organisations (or in many cases, their landlords), to invest in efficiency measures such as insulation and low and zero carbon building services.

Display energy Certificate (DEC) and non-domestic Energy Performance Certificate (EPC) data provide an insight into Exeter's non-domestic buildings. DECs are required annually on buildings accessed by the public which are over 1000 m^2, and less frequently (every 10 years) on smaller buildings (over 250 m^2). There are some 275 premises with DECs in Exeter[xvi]. Non-domestic EPCs have been required since 2008 on the sale, rental or construction of non-domestic premises. As EPCs are not required regularly some will be out of date with the potential for changes having been made since the EPC was performed. There are 2,282 non-domestic EPCs in Exeter[xvii]. DECs and EPCs provide an operational/asset rating from A (good) to G (poor) for each building based on the building's estimated CO_2 emissions. Most buildings with DECs will also have an EPC.

The CO_2 estimates in DECs and EPCs are calculated using electricity CO_2 emissions factors that are not consistent with those used for Exeter's 2019 GHG emission estimate. Building electricity consumption figures in the DECs have therefore been use to estimate CO_2 emissions using the 2019 grid electricity emission factors for each rating band resulting in total CO_2 emissions from buildings with DECs of 33 kt CO_2 (a 38% reduction compared to 87 ktCO_2 reported in the DECs). Figure 11 shows the distribution of buildings, floor areas and CO_2 emissions for each DEC band. The graph suggests the poor performing buildings in band E and, to a lesser extent, band G account for a disproportionate share of the building stock's CO_2 emissions.

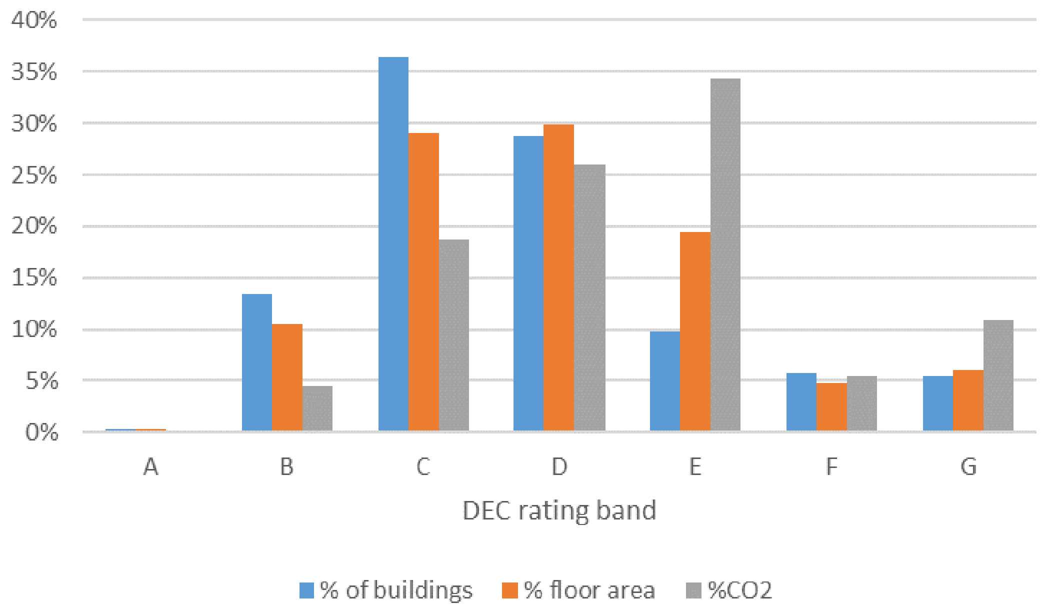

Figure 11: Percentage of non-domestic buildings, floor area and CO_2 emissions for each DEC band in Exeter.

[xvi] DECs with missing energy data excluded.
[xvii] EPCs with missing energy data excluded.

Average CO_2/m^2 figures for each rating band have been used to estimate how improvements in building performance to a better performing band is likely to impact CO_2 emissions[xviii]. Improving buildings with DEC ratings of D, E, F and G (137 buildings) to a C rating achieves a 38% reduction in CO_2 emissions, while improving only E, F and G rated buildings (58 buildings) to a D rating achieves a 25% reduction.

EPCs do not provide energy consumption data so the methodology applied to DECs cannot be repeated. Total CO_2 emissions recorded in the 2,282 EPCs are 113 kt CO_2. As with DECs, this figure will be inconsistent with Exeter's 2019 GHG inventory. If the 38% reduction applied to the DECs is applied, total emission fall to 43 kt CO_2 (much of which will duplicate savings from buildings that also have DECs). Figure 12 shows the distribution of buildings, floor areas and CO_2 emissions for each EPC band which suggest a more proportionate profile of CO_2 emissions compared with the number of buildings and floor space than is found from DECs.

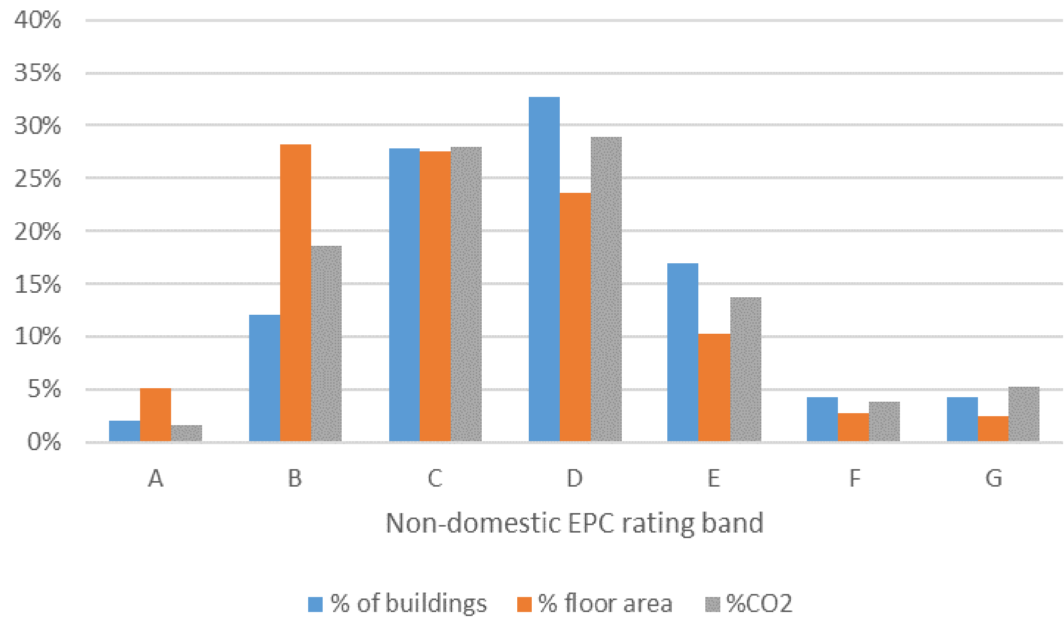

Figure 12: Percentage of non-domestic buildings, floor area and CO_2 emissions for each EPC band in Exeter.

The 43 kt CO_2 adjusted total emissions from EPCs compares with the non-domestic GHG assessment of 127 kt CO_2 (34%). This indicates that EPCs have not been undertaken on all non-domestic properties. This is confirmed by comparing the number of EPCs (2,282) with the 3,568 non-domestic buildings recorded in the non-domestic national energy efficiency data-framework[15] (64%). .

As with DECs, average CO_2/m^2 figures for each rating band in the EPCs have been used to estimate how improvements in building performance to a better performing band is likely to impact CO_2 emissions. Improving buildings with EPC ratings of D, E F and G rated buildings (1,326 or 58% of the buildings with EPCs) to a C rating achieves a 12% reduction well short of the 27% required by the CCC. Improving C, D, E, F and G (1,960 or 86% of the buildings with EPCs) to a B rating achieves a 36% reduction in CO_2 emissions. This implies that achieving a 27% CO_2 emission reduction will require significant energy efficiency upgrades to some 2,312[xix] non-domestic buildings in Exeter. Assuming that the same number are upgraded in each of the nine years to 2030 gives 257 buildings requiring upgrading per year.

[xviii] Note that no specific allowance is made for electricity grid decarbonisation.
[xix] 86% of the 3,568 non-domestic buildings in Exeter (3,065 pro rated (27/36)).

SECTOR: BUILDINGS

CURRENT LEVEL: 3,065 NON-DOMESTIC BUILDINGS WITH EPC BAND C, D, E, F, AND G RATINGS

MONITORING TARGET: 2,312 NON-DOMESTIC BUILDINGS BAND C, D, E, F & G IMPROVED TO BAND B BY 2030

NEXT YEAR INCREMENT: 257 NON-DOMESTIC BUILDINGS IMPROVED FROM BANDS C, D, E, F & G TO BAND B

DATA SOURCE: EPCS/DECS

DATA AVAILABLE: ANNUALLY BUT INCLUDES HISTORICAL DATA

Table 9 shows the numbers of low carbon heating (LCH) measures implied by the CCC's non-domestic heating projections.

Table 9: Projected low carbon heat sources for non-domestic buildings.

Area CCC timeframe	National 2030	National 2050	Exeter	Exeter
Total low carbon heat provision	37%	100%	37%	100%
from:				
Heat pumps	65%	52%	858	1,855
Heat networks	32%	42%	422	1,499
Biomass	3%		40	
Hydrogen		5%		178
Direct electric		1%		36
Total	**100%**	**100%**	**1,320**	**3,568**

Net Zero by 2030 requires Exeter to meet the CCC's 2050 target. EPC data shows that 4 non-domestic buildings in Exeter are heated with biomass and 8 are supplied from heat networks. Grid electricity is the main heating fuel for 1,097 premises[xx]. Assuming that 2,459 buildings require LCH upgrades and that the same number are upgraded in each of the nine years to 2030 gives 273 buildings per year.

SECTOR: BUILDINGS

CURRENT LEVEL: UNKNOWN

MONITORING TARGET: 3,568 NON-DOMESTIC BUILDINGS WITH LOW CARBON HEATING (LCH) BY 2030

NEXT YEAR INCREMENT: 273 NON-DOMESTIC BUILDINGS INSTALL LCH MEASURES

DATA SOURCE: EPCS/DECS

DATA AVAILABLE: ANNUALLY BUT INCLUDES HISTORICAL DATA

[xx] EPCs do not specify how many of these have heat pumps.

3.3 Industry

The industrial sector covers emissions from manufacturing and construction businesses excluding those arising from the consumption of electricity (included under the power sector) and from space heating and hot water provision in buildings (covered above). Typically, the sector includes energy intensive industrial activities such as refineries, chemicals, iron and steel and cement, which together are responsible for nearly two thirds[16] of UK industrial sector emissions. These industries are not present in Exeter. Emissions in the area are more likely to occur from activities such as food and drink manufacture, printing, water treatment and waste management and a variety of other smaller manufacturing businesses.

Industrial emissions in Exeter are relatively small (26.8 kt CO_2e or 6% of total emissions in 2019) and have more than halved since 2008. Figure 13 shows the historic trajectory of industrial emissions in Exeter. There is a general trend of falling emissions, albeit with an increase in the period 2011 to 2015. The graph shows a linear extrapolation forward from the periods 2015 to 2019 and 2017 to 2019. Were the average reduction of 4.1 kt per annum achieved from 2015 onwards maintained, the sector would be decarbonised by 2025. This is likely to be over-optimistic: firstly, the annual rate of reduction is halved from 2017 onwards to 2.0 kt; at this rate of decline decarbonisation would not be achieved until 2033. Secondly, further examination of the data , discussed below, suggests that the 2015 value may be anomalous. To achieve zero carbon by 2030 would require a reduction in emissions of 2.4 kt per annum from 2020 onwards.

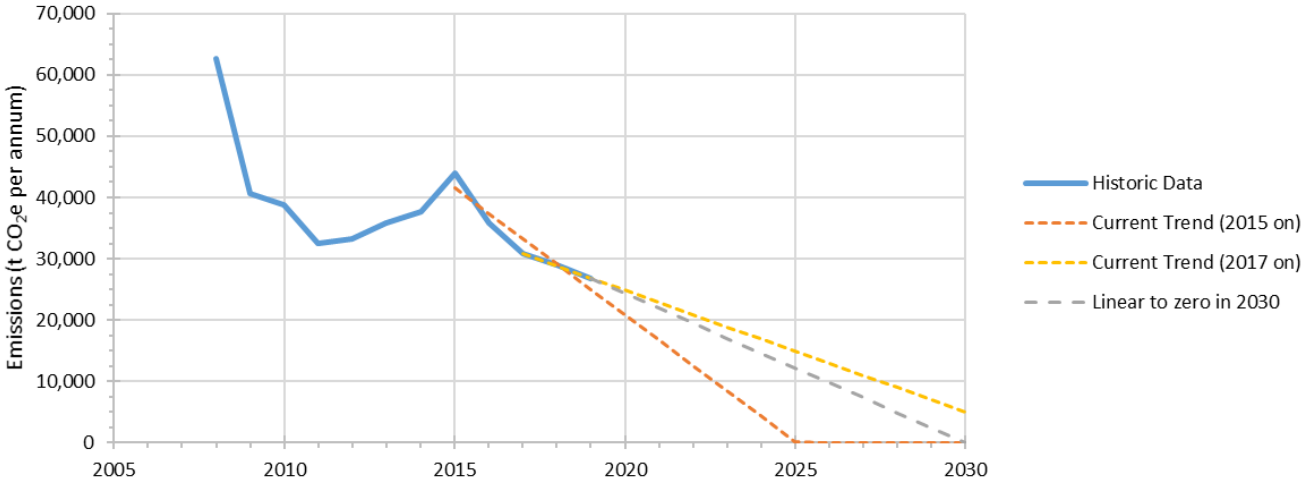

Figure 13: Historic and projected industrial emissions for Exeter.

The BEIS Local Authority CO_2 data[6] reports emissions from large industry separately. The data includes emission sources identified in the National Atmospheric Emissions Inventory or by the Environment Agency as large industrial point sources. Figure 14 shows the contribution from large industry and other industry; a rapid decline in emissions from large industry is evident in the first reported year, from 2008 to 2009. Emissions from large industry have generally reduced at a faster rate than other industry, accounting for 49% of total industrial emissions in 2008, 36% in 2009, 26% in 2017 and 13% in 2019. The graph also reveals a large spike in emissions from other industry for a single year in 2015. The data show this to be attributable to natural gas consumption[xxi].

[xxi] The anomalously high consumption is present in both the BEIS local authority CO_2 and gas consumption datasets.

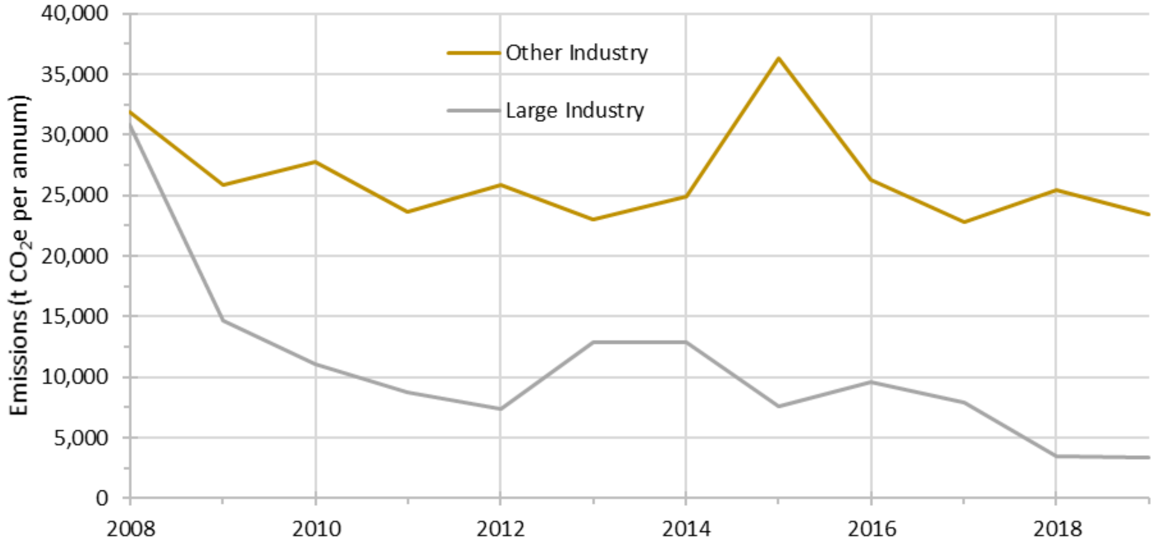

Figure 14: Industrial emissions in Exeter categorised as being from large industry or other industry.

Industrial emissions in the BEIS Local Authority data are significantly higher than those in the National Atmospheric Emission Inventory point and area source data (which lists no industrial point sources within Exeter). This suggests that the BEIS Local Authority data might erroneously include emissions from some non-industrial point sources, such as power generation, commercial and public sector operations.

The National Atmospheric Emission Inventory reports industrial emissions from fuel combustion separately from industrial processes. Data from recent years indicate that only a very small proportion (1 to 2.5%) of industrial emissions in the city originate from industrial processes. Cutting industrial fuel consumption (mostly gas) is therefore a priority for industrial emissions reduction In Exeter.

The Committee on Climate Change envisions fuel switching (to electricity and hydrogen), carbon capture and storage, and improving energy efficiency as key to decarbonisation of the sector. The absence of identified point source emissions in Exeter makes it difficult to identify specific measures that target significant industrial emissions in the city. Improving industrial energy efficiency and switching away from fossil fuels to electricity are likely to be the most effective ways of reducing emissions. However, there is currently insufficient granularity in the data to measure or target progress. The monitoring target is therefore based on the BEIS Local Authority CO_2 emission dataset (excluding non-CO_2 emissions[xxii]).

SECTOR:	INDUSTRY
CURRENT LEVEL:	26.8 THOUSAND TONNES CO_2 EMISSIONS (2019)
MONITORING TARGET:	ZERO CO_2 EMISSIONS BY 2030
NEXT YEAR INCREMENT:	2.4 THOUSAND TONNES CO_2 EMISSIONS REDUCTION
DATA SOURCE:	BEIS LOCAL AUTHORITY CO_2 STATISTICS
DATA AVAILABLE:	ANNUALLY

[xxii] Methane and nitrous oxide emission estimates are added to the figures presented elsewhere in this report. In recent years, CO_2 accounted for over 99% of industrial CO_2e emissions in Exeter.

3.4 Transport / Mobility

Emissions from transport, Exeter's third largest emissions sector (22%), have remained stubbornly high with little change since 2008.

While lower emission vehicles will be key to the decarbonisation of the transport sector, reduction in vehicle use is also an important factor. In Exeter, vehicle-kilometres increased at an average of 6 million per annum between 2000 and 2019. Reversing this trend through lower use and modal shift is potentially the most effective way of reducing CO_2 emissions. The Balanced Pathway in the Sixth Carbon Budget assumes a 17% reduction in vehicle miles in 2050. Figure 15 shows the trend in vehicle miles in Exeter from 2000 to 2019 and a projected linear reduction to 83% of 2019 levels by 2030[xxiii].

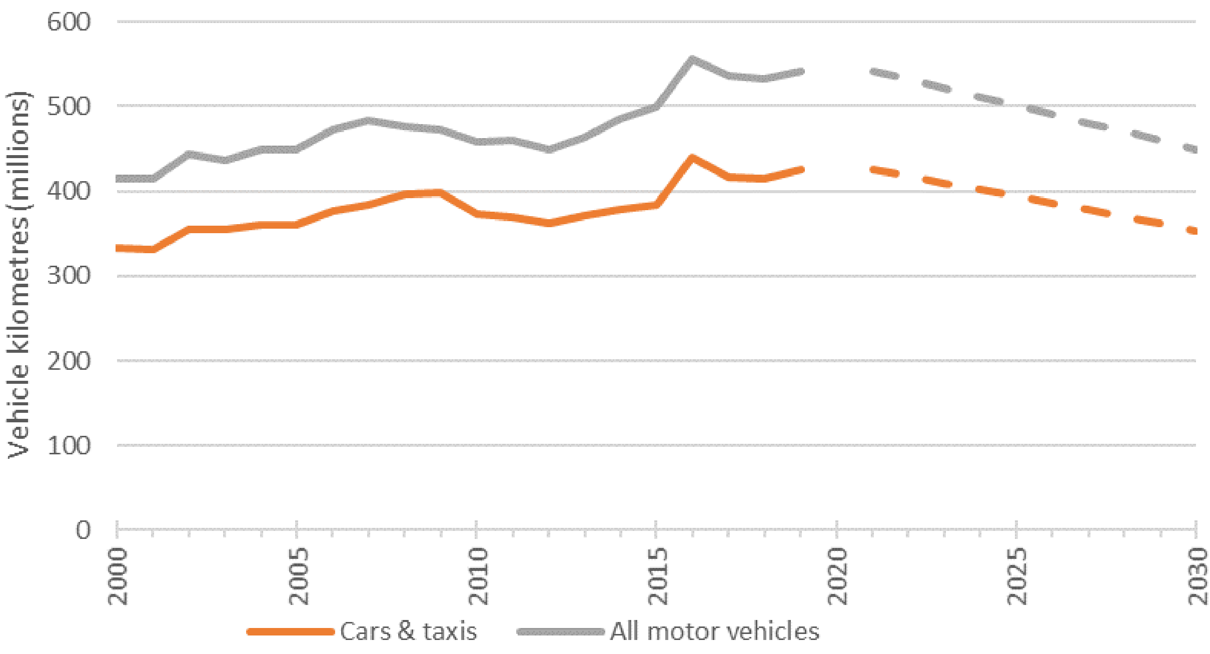

Figure 15: Vehicle kilometres on roads in Exeter [17].

The annual reduction in activity by all vehicles required to achieve a 17% reduction by 2030 is 10 million kilometres or 2% per annum. This is a large change from the 6 million average annual increase from 2000 to 2019. Investment in alternatives to the private car will help towards achieving this target; investment in capacity for general traffic will have the opposite effect.

SECTOR:	TRANSPORT/MOBILITY
CURRENT LEVEL:	542 MILLION VEHICLE KILOMETRES (2019)
MONITORING TARGET:	17% REDUCTION (FROM 2019) BY 2030 TO 450 MILLION VEHICLE KILOMETRES
NEXT YEAR INCREMENT:	10 MILLION VEHICLE KILOMETRE REDUCTION
DATA SOURCE:	LOCAL AUTHORITY ROAD TRAFFIC STATISTICS, DfT
DATA AVAILABLE:	ANNUALLY

[xxiii] Data for 2020 is not available and, if it were, would be atypical due to the impact of Covid-19 lockdowns.

3.4.1 Electric and zero carbon vehicles

Electric vehicles and charging points hold the key to the transformation of mobility. Net zero essentially requires all cars and vans driving in Exeter to be electric and the provision of the corresponding charging infrastructure. The provision of infrastructure for larger commercial vehicles and HGVs is also required to enable emissions reduction from these vehicle classes.

The number of battery electric vehicles (BEVs) registered in the Exeter[xxiv] area has been accelerating with 590 registered in2021 (1.2% of Exeter's 50,430 licensed vehicles[xxv]). Figure 16 shows the exponential rate of increase to date.

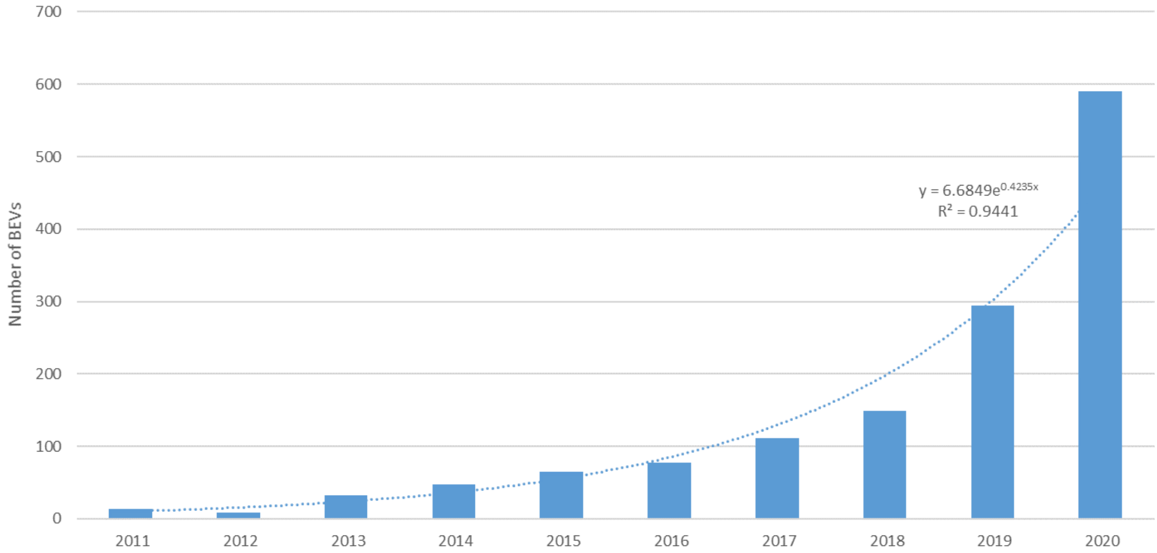

Figure 16: Battery electric vehicles in Exeter, 2011 to 2020 [18].

Figure 17 includes projections at the current growth rate and suggests that some 63% of vehicles may be BEVs by 2030. Continuing at this rate could potentially see all vehicles registered in the city electrified by 2032.

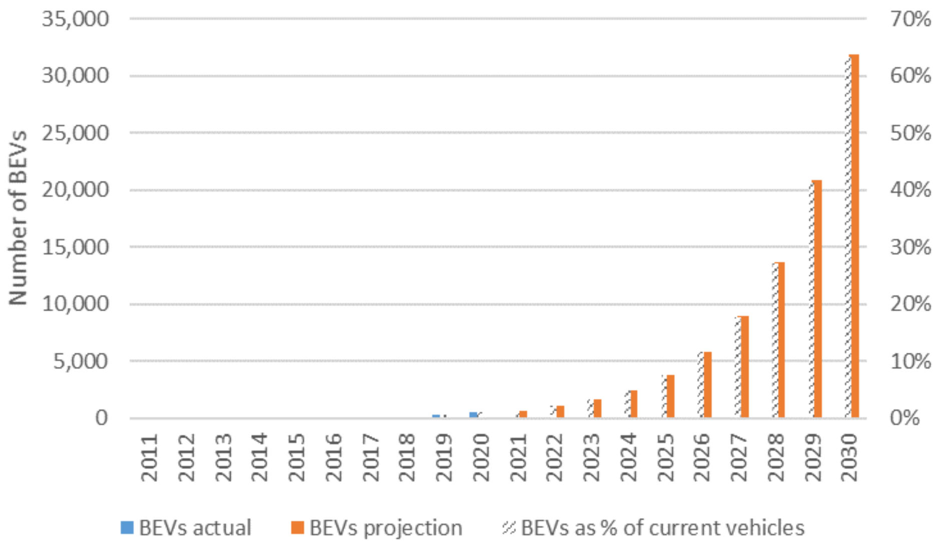

Figure 17: Projected battery electric vehicles in Exeter to 2030 at current growth rate.

[xxiv] Considering vehicle registrations in Exeter is a consumption-based approach (as against territorial). Vehicles registered in Exeter drive outside the city boundaries. The target is that all vehicle mileage within Exeter is undertaken in EVs, which requires all those driving in the city using vehicles registered elsewhere to also be BEVs. Measures to achieve this might include a strict clean air zone, for example. Nonetheless, BEV registrations in the city are a relevant indicator of progress towards eliminating fossil fuel mobility.

[xxv] Excluding motorcycles

Delivering 100% electric vehicles by 2030 requires a slightly higher growth rate. The figures and the targets for electrifying all vehicles by 2030 are set out in Table 10.

Table 10. Battery electric vehicle targets to achieve 100% of current vehicle numbers by 2030 (shaded parts of the table are unlikely to be achievable through the normal vehicle replacement cycle - see below).

Year	Current BEV projection		Accelerated Projection to meet 100% by 2030	
	Number	**%**	**Number**	**%**
2020	590	1.2%	590	1.2%
2021	705	1.4%	907	1.8%
2022	1,077	2.1%	1,418	2.8%
2023	1,645	3.3%	2,216	4.4%
2024	2,512	5.0%	3,463	6.9%
2025	3,837	7.6%	5,411	10.7%
2026	5,860	11.6%	8,456	16.8%
2027	8,949	17.7%	13,214	26.2%
2028	13,669	27.1%	20,650	40.9%
2029	20,876	41.4%	32,270	64.0%
2030	31,884	63.2%	50,430	100.0%

In 2019 (pre Covid-19), first time registrations of cars represented 8.4% of the South West fleet which, if applied to Exeter's vehicles, implies that about 4,200 new vehicles are registered annually. Cells that are shaded in Table 10 exceed this number of annual new registration and occur if either the exponential function from Figure 16 or an accelerated exponential function is applied.

The shading implies that from 2028 (following the current exponential trajectory), or from 2027 (for the accelerated trajectory), all vehicles replacements from then on will be BEVs. If replacement is limited to the current 8.4% per year, the percentage BEVs in 2030 will be limited to 43% of the fleet if the current exponential trajectory is followed, or 50% of the fleet if the accelerated exponential trajectory is followed.

This limitation shows the potential pitfalls of relying of accelerated uptake of measures in the latter part of the decade.

Replacing 4,200 vehicles with BEVs each year to 2030 achieves 43,000 vehicles, 7,000 short (85%) of the target.

Incentives to increase the rate of fleet replacement or further accelerate the uptake of BEVs in earlier years will be required to achieve 100% BEV by 2030. Measures could include the promotion of car clubs or additional regulation of petrol and diesel vehicles.

SECTOR: TRANSPORT/MOBILITY

CURRENT LEVEL: 590 BEVs REGISTERED IN EXETER (1.2%)

MONITORING TARGET: 50,430 BATTERY ELECTRIC VEHICLES (100%) IN EXETER IN 2030

NEXT YEAR INCREMENT: 317 EXTRA BEVS REGISTERED (FOLLOWING ACCELERATED TRAJECTORY)

DATA SOURCE: ULEV STATISTICS, DfT

DATA AVAILABLE: QUARTERLY

Larger commercial vehicles will need to be zero emissions along with cars and light goods vehicles. Whilst the analysis above considers the vehicle fleet as a whole, the strategy for the replacement of large vehicles (which are operated commercially) is likely to differ significantly from the replacement of cars (and to an extent light goods vehicles) which are largely privately owned. In 2020 there were 2,470 HGVs, buses and other vehicles[xxvi] registered in Exeter. Again, these only represent a fraction of the vehicles driving on the city's roads. Although relatively few in number, larger vehicles have greater emissions per vehicle, so transitioning them away from fossil fuels is important.

SECTOR: TRANSPORT/MOBILITY

CURRENT LEVEL: NEAR ZERO NON-FOSSIL LARGER COMMERCIAL VEHICLES

MONITORING TARGET: 100% NON ZERO CARBON LARGER COMMERCIAL VEHICLES AND HGVS BY 2030

NEXT YEAR INCREMENT: TO BE DETERMINED

DATA SOURCE: TO BE DETERMINED

DATA AVAILABLE: TO BE DETERMINED

3.4.2 Vehicle charging points

The Sixth Carbon Budget provides estimates of the public vehicle charging point infrastructure required nationally in 2035. These figures have been prorated by population to estimate the number of charge points required in Exeter in 2030 (see Table 11).

Table 11. The estimated number of public vehicle charging points required in Exeter in 2030.

Charger size	Quantity
3 to 7 kW	127
22 kW	264
50 kW	375
150+ kW	12
Total	778

In October 2021 Exeter had 49 charging points, an increase of 10 since October 2020, and itself an increase of 11 from October 2019. To achieve 779 charging points by 2030, assuming an even number of installations over 9 years will require the addition of 81 new charging points per year. This is approximately eight times the installation rate achieved over the past two years.

SECTOR: TRANSPORT/MOBILITY

CURRENT LEVEL (2021): 49 PUBLIC CHARGING POINTS

MONITORING TARGET: 778 PUBLIC ELECTRIC VEHICLE PUBLIC CHARGING POINTS IN 2030

NEXT YEAR INCREMENT: 81 ADDITIONAL PUBLIC CHARGING POINTS

DATA SOURCE: PUBLICLY AVAILABLE EV CHARGING DEVICES BY LA, DfT

DATA AVAILABLE: QUARTERLY

[xxvi] Other vehicles include rear diggers, lift trucks, rollers, ambulances, Hackney Carriages, three wheelers and agricultural vehicles, and account for about one-half of the number of vehicles stated.

3.4.3 Walking and cycling

Figure 18 shows cycling activity on Exeter's major roads. Count data are also available for a small number of minor roads but distance data are not publically available. Activity on major roads is therefore assumed as a proxy for cycling activity as a whole. Growth has been sporadic, with large year-on-year increases in some years, and to a lesser extent year-on-year decline in others. Calculating a three-year rolling average from historic data clarifies the general trend. This averaged data shows a more consistent increase from 2008 onwards. The increase since 2007 averages 12% per annum.

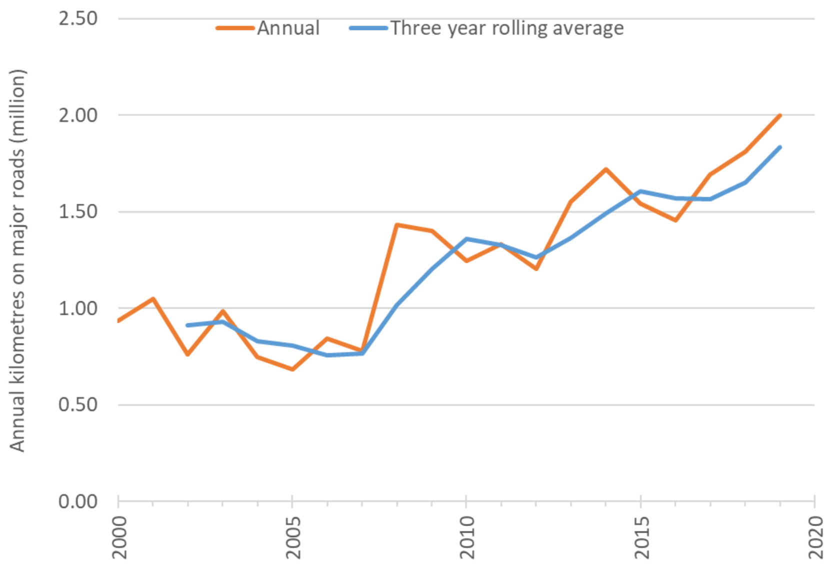

Figure 18: Cycling count in Exeter from 2007 to 2019 [17].

Additional data from Devon County Council[xxvii], which operates a network of traffic counters on off-road cycle paths, facilitates the estimation of the kilometres cycled in Exeter on off-road cycle paths (see Figure 19). From 2007 to 2015, there is an approximately linear increase in cycling averaging about 13% per annum (similar to the on-road figure). Since 2015, activity has been more variable, with the figure for 2021 being similar to 2015.

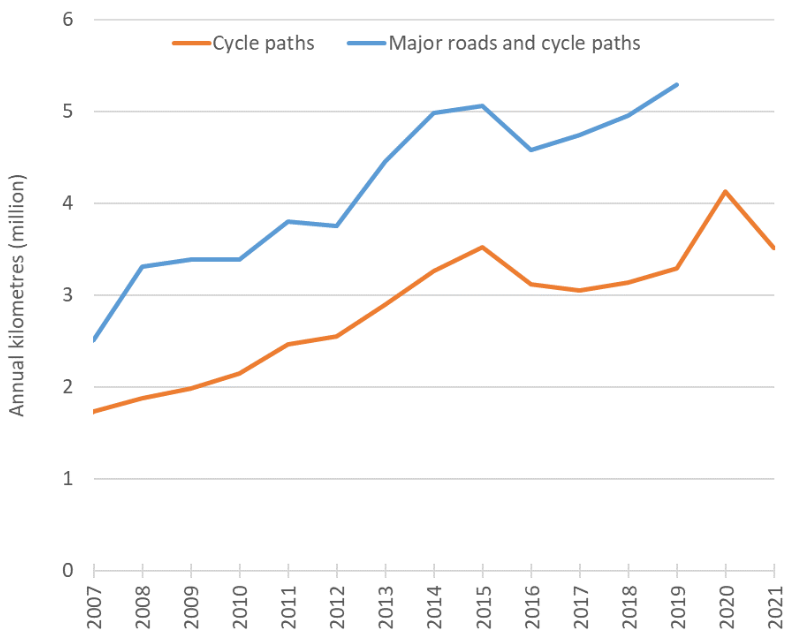

Figure 19: On and off-road cycling counts in Exeter from 2007 to 2021.

[xxvii] Personal communication with William Pratt, Transportation Planning Team Leader, Devon County Council, 7th Feb 2022.

The DfT publishes statistics on walking and cycling based on the National Travel Survey and the Active Lives Survey[19]. These include the proportion of adults who do any walking or cycling, for any purpose, by frequency and local authority. Figure 20 shows the 2018/19 statistics for Exeter compared to the South West and England.

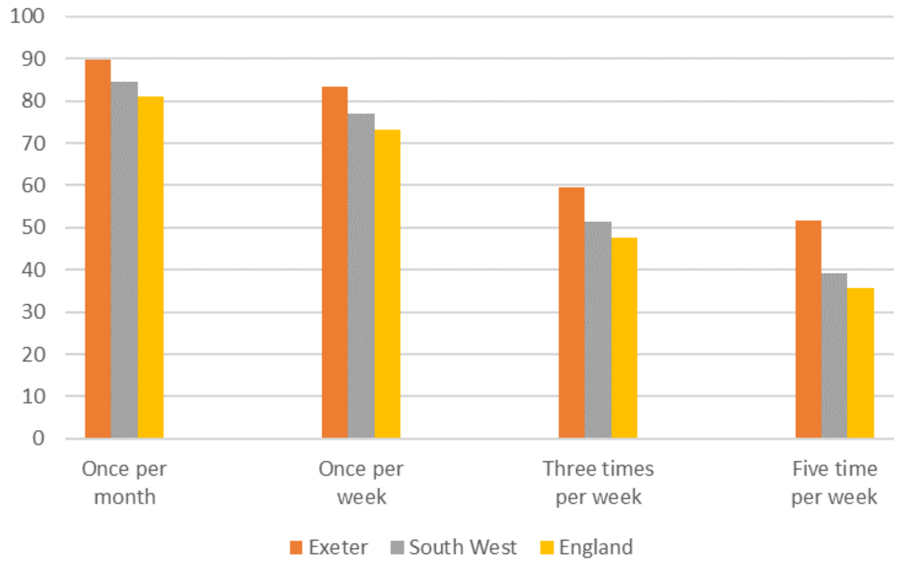

Figure 20: The percentage of adults who did any walking or cycling, for any purpose in 2018/19 [19].

The figures suggest that people in Exeter walk and cycle more frequently than average regionally and nationally which, given Exeter's largely urban nature, is perhaps unsurprising.

In the Sixth Carbon Budget the CCC assumes that 5-7% of car journeys could be shifted to walking and cycling (including e-bikes) by 2030, rising to 9-14% by 2050. Urban areas such as Exeter should exceed this national figure. England's Cycling and Walking Investment Strategy[20] aims to double cycling from 2013 to 2025. The Government's recent transport decarbonisation plan[21] identifies that 43% of urban journeys are under 2 miles and aims for 50% of all journeys in towns and cities to be cycled or walked by 2050 (assumed here to be 22% of journeys split evenly between cycling and walking, a target of 11% for each).

Figure 21 takes the historic cycling counts from Figure 18 and projects these to 2050.

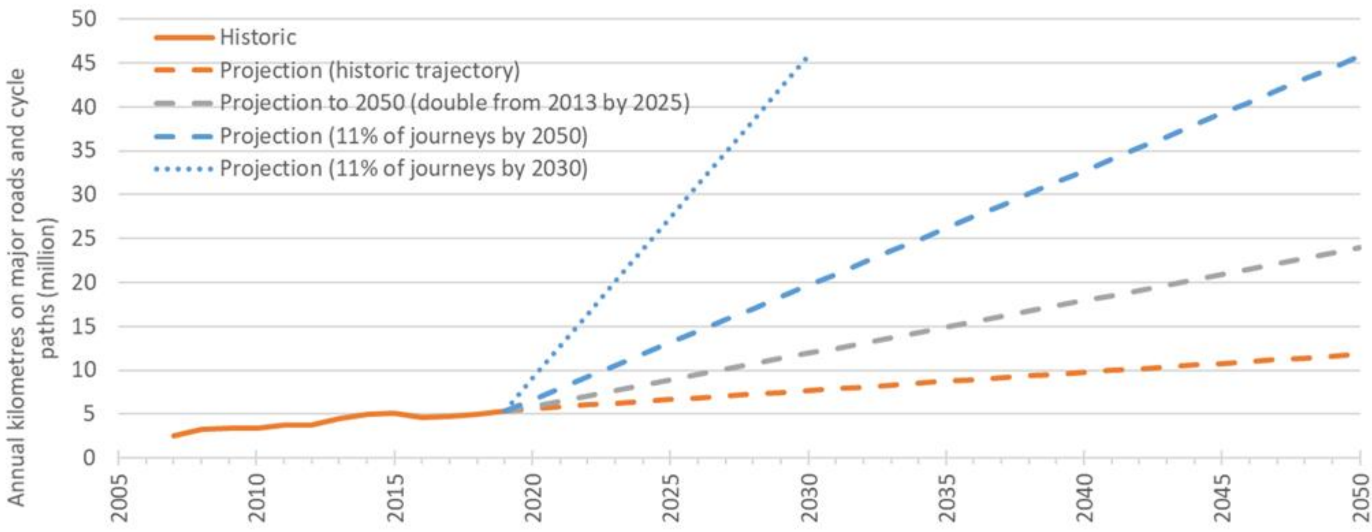

Figure 21: Cycling count projections in Exeter.

Assuming linear growth of the historic trend leads to a 49% increase from 2013 to 2025, well short of the doubling in the Cycling and Walking Investment Strategy. Doubling by 2025 would (if linearly extrapolated) lead to 24 million kilometres cycled on major roads and cycle paths by 2050. This would therefore appear to fall short of the 46 million required for cycling of 11% of all car and taxi journeys (although the cycling projection does exclude unquantified cycling activity on minor roads). To meet the 11% target by 2050 (assuming linear growth) requires an annual increase of 1.3 million kilometres (25% of 2019 levels). Meeting the target by 2030 requires an increase of 3.7 million kilometres (70% of 2019 levels).

SECTOR:	TRANSPORT/MOBILITY
CURRENT LEVEL:	2.0 MILLION km CYCLED (ON MAJOR ROADS) (2019) 3.3 MILLION km CYCLED (ON CYCLE PATHS) (2019)
MONITORING TARGET:	46 MILLION km CYCLED
NEXT YEAR INCREMENT:	3.7 MILLION km CYCLED
DATA SOURCE:	DfT LOCAL AUTHORITY ROAD TRAFFIC STATS (MAJOR ROADS) DCC MONITORING DATA (CYCLE PATHS)
DATA AVAILABLE:	ANNUALLY

To meet the overall walking and cycling target, the amount of walking activity would need to be similar to cycling.

SECTOR:	TRANSPORT/MOBILITY
CURRENT LEVEL:	UNKNOWN
MONITORING TARGET:	UNKNOWN
NEXT YEAR INCREMENT:	3.7 MILLION km WALKED
DATA SOURCE:	UNKNOWN
DATA AVAILABLE:	UNKNOWN

3.5 Waste

The Sixth Carbon Budget suggests that 80% of the UK's CO_2 abatement in the waste sector to 2035 is from waste prevention, increased recycling and banning biodegradable waste from landfill. By 2050 30% of the abatement comes from fitting carbon capture and storage to energy from waste (EfW) plants. The additional 10% of emissions reductions comes from capturing more methane at landfills, reducing wastewater treatment emissions and improving composting. The CCC foresee a range of measures including reducing waste generation by 33% by 2037, increasing the UK wide recycling rate to 70% by 2030 and fitting carbon capture and storage (CCS) to all EfW plants by 2050.

It is important to recognise that locally Exeter City Council and Devon County Council (the respective waste collection and disposal authorities) only have information on, and collection and disposal responsibilities for, domestic waste. Local authorities have little knowledge of or influence over commercial waste in their locality. It is important for Exeter to obtain reliable and up to date information on volume and composition of non-domestic waste streams to enable assessment of emissions from non –domestic waste.

SECTOR:	WASTE
CURRENT LEVEL:	UNKNOWN NON-DOMESTIC WASTE ARISINGS AND COMPOSITION
MONITORING TARGET:	TO BE DETERMINED
NEXT YEAR INCREMENT:	OBTAIN DATA ON NON-DOMESTIC WASTE IN EXETER
DATA SOURCE:	TO BE DETERMINED
DATA AVAILABLE:	TO BE DETERMINED

This remainder of this section therefore considers collection and disposal of domestic waste only.

Exeter's waste emissions (34.4 kt CO_2e) are about 7% of the total and have been similar over the past 4 years following the commissioning of the energy recovery facility (ERF) in Marsh Barton. Emissions prior to 2014 were lower as Exeter's waste was disposed of outside the City (mostly to landfill).

3.5.1 Waste collection and recycling

The Devon Authorities Strategic Waste Committee provides data on waste across the county[22]. The data shows that the amount of domestic waste generated by Exeter's residents is lower than that in the rest of Devon (see Figure 22)

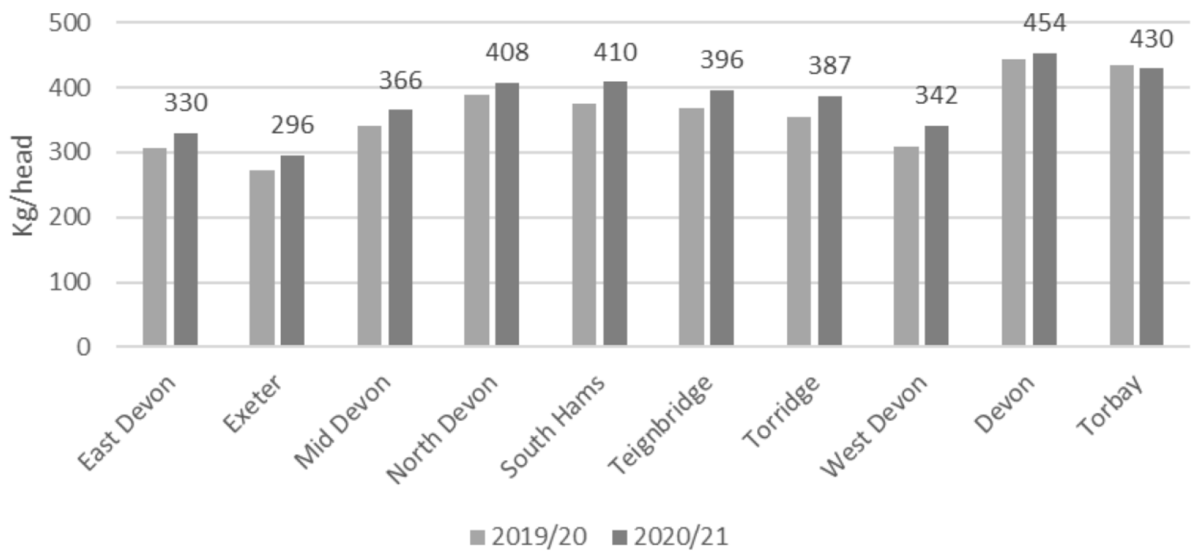

Figure 22: Domestic waste per head in Devon in 2019/21 and 2020/21 (courtesy of DCC)

However, Figure 23 shows that recycling rates are significantly lower in Exeter than in the rest of the county.

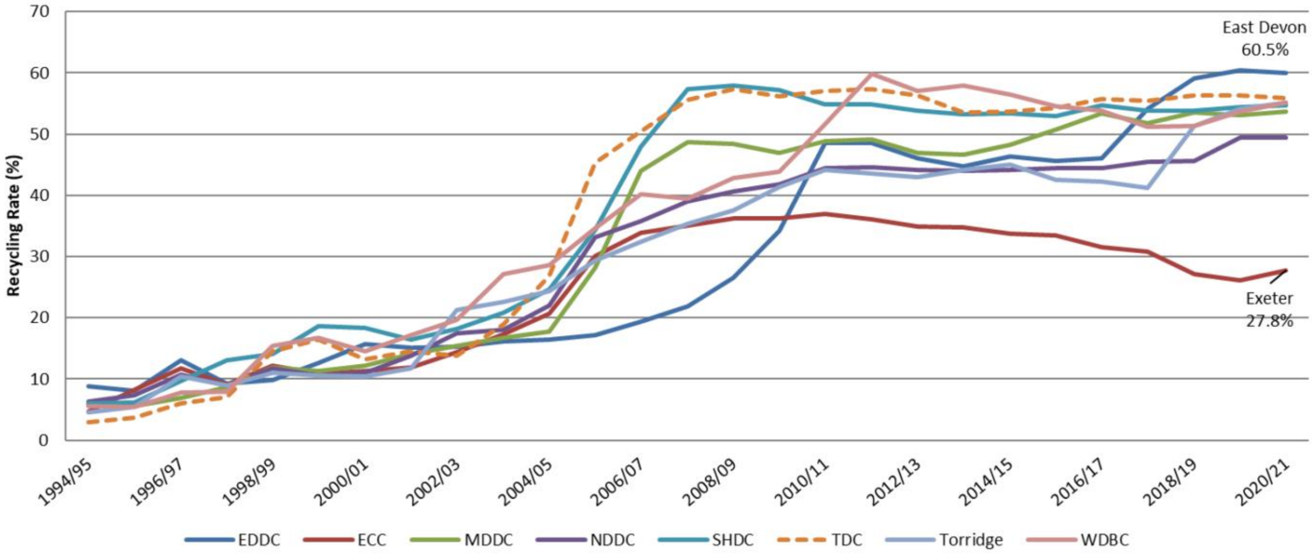

Figure 23: Domestic waste recycling rates in Devon 1994/95 to 2020/21 (courtesy of DCC)

Low recycling rates mean that in 2020/21 Exeter had higher residual waste per head (485 kg/household) that any other Devon district (16% higher than South Hams, the next highest district in Devon). Exeter's residual waste per head is also 11% higher than comparably urban Torbay. Exeter is currently in the process of introducing food waste collection, which is likely to increase the recycling rate. Figure 24 illustrates the 4.2% annual increase in recycling rate that Exeter needs to achieve the CCC's target of 70% recycling by 2030.

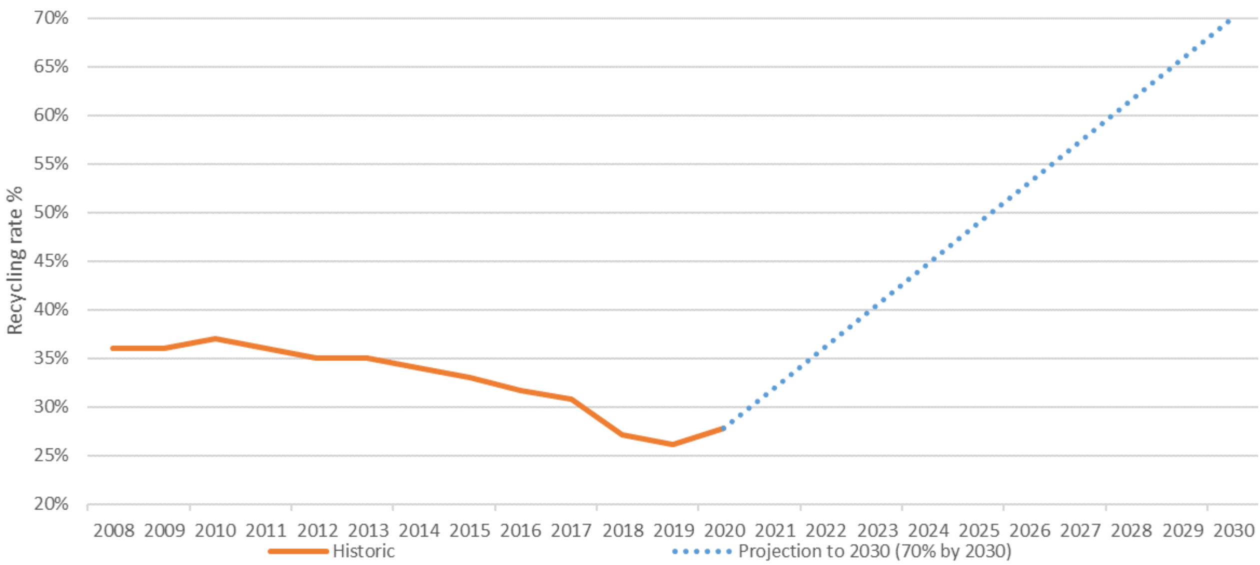

Figure 24: Domestic waste recycling projection for Exeter to meet 70% in 2030

Waste prevention is a vital component of emissions reduction from the sector. In its 2050 trajectory to net zero the CCC targets a 33% reduction in waste arisings by 2037. In light of Exeter's 2030 target, this is brought forward to 2030.

Figure 25 shows the combination of achieving a 33% reduction in waste arisings and a 70% recycling rate in 2030.

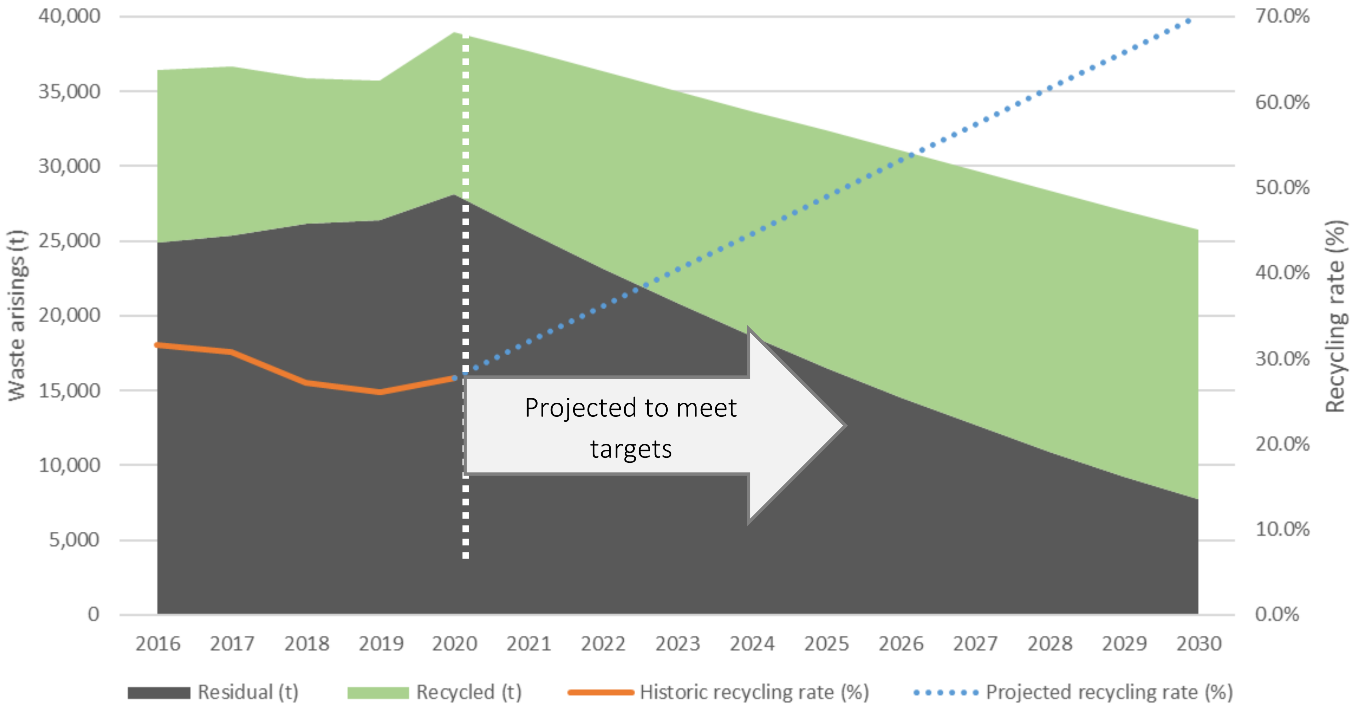

Figure 25: Domestic waste arisings and recycling rates including targets to 2030

This shows that while total waste arisings would fall 33% from 38,998 t in 2020/21 to 25,732 t in 2030/31, residual waste would fall from 28,164 t in 2020/21 to 7,720 t in 2030/31: a 73% reduction. These projections lead to the following waste collection and recycling monitoring targets.

SECTOR:	WASTE
CURRENT LEVEL:	39.0 kt TOTAL WASTE ARISINGS IN 2020/21
MONITORING TARGET:	25.7 kt TOTAL WASTE ARISINGS IN 2030/31
NEXT YEAR INCREMENT:	1.3 kt TOTAL WASTE ARISNG REDUCTION
DATA SOURCE:	DCC
DATA AVAILABLE:	ANNUALLY

SECTOR:	WASTE
CURRENT LEVEL:	27.8% RECYCLING RATE IN 2020/21
MONITORING TARGET:	70% RECYCLING RATE IN 2030/31
NEXT YEAR INCREMENT:	4.2% RECYCLING RATE INCREASE
DATA SOURCE:	DCC
DATA AVAILABLE:	ANNUALLY

Devon's waste targets[23] include reducing waste collected per head to 416 kg per head per year by 2030 and recycling at least 60% of household waste by 2025 and 65% by 2035. Exeter's waste per head (296 kg per head in 2020/21) is already lower than the Devon wide 2030 target. Meeting the CCC's trajectory gives a projected 183 kg per head in 2030.

The CCC recycling rate trajectory for Exeter is below the Devon wide target of 60% recycling in 2025 (49%), but reaches 65% in 2029: well before the 2035 Devon wide target.

In practice, changes to recycling are driven by changes to local authority collection regimes, which in turn, will be dictated by the Environment Act 2021. The Act requires mandatory changes to local authority waste collection. However, the extent and timing of these changes is still uncertain and, if implemented by central government, is out of the control of local authorities.

3.5.2 Waste disposal

Exeter disposed of its residual waste in landfills up to 2014. The city now sends its residual waste for disposal at the Exeter ERF. The plant uses waste to generate electricity for the national grid. Reduced fossil inputs to the ERF reduces emissions so increasing plastic recycling rates will be an important factor in cutting the plant's emissions. The plant has the ability to export heat. The use of heat increases the efficiency of energy recovery from the waste and reduces CO_2 emissions: the more heat used, the lower the emissions. Promoting heat use in the Liveable Exeter schemes in Water Lane and Marsh Barton will be important in this respect.

SECTOR:	WASTE
CURRENT LEVEL:	NO HEAT EXPORT
MONITORING TARGET:	HEAT EXPORT TO THE LIVEABLE EXETER DEVELOPMENTS IN THE VICINITY OF THE ERF
NEXT YEAR INCREMENT:	UNKNOWN
DATA SOURCE:	DCC
DATA AVAILABLE:	ANNUALLY

Ultimately, the installation of CCS is required. The Sixth Carbon Budget requires the installation of CCS on all UK energy from waste plants between 2040 and 2045.

SECTOR:	WASTE
CURRENT LEVEL:	NO CARBON CAPTURE AND STORAGE
MONITORING TARGET:	INSTALLATION OF CCS ON MARSH BARTON ERF BY 2030
NEXT YEAR INCREMENT:	UNKNOWN
DATA SOURCE:	DCC
DATA AVAILABLE:	UNKNOWN

3.6 F-gases

Fluorinated gasses (F-gases) account for a small percentage of UK GHG emissions (3% in 2018) and, although released in small volumes, they can have a global warming potential (GWP) up to 23,000 times greater than CO_2. The four F-gases included in the UK emissions inventory are hydrofluorocarbons (HFCs) (accounting for 94% of GHG emissions in 2017), sulphur hexafluoride (SF_6) (4% in 2017), perfluorocarbons (PFCs) (2% in 2017) and nitrogen trifluoride (NF_3) (less than 1% in 2017).

The largest source of emissions of HFCs (77%) is the refrigeration, air conditioning and heat pump sector (RACHP). Emission release is due to refrigerant leakage from appliances during use and at disposal. Current regulation outlaws refrigerants of various types, mandates inspection regimes and testing and sets a cap on the amount of HFCs that can go on the market. Cuts to the cap every 3 years give a 79% reduction from 2015 levels in 2030. Beyond this, the CCC identifies F gas replacement with lower GWP F gases as the main emission reduction measure. The Balanced Pathway reduces F gas emissions by 81% in 2050. Achieving this 81% reduction in a linear decrease by 2030 requires a reduction of 9% of current emissions each year, every year.

The National Atmospheric Emissions Inventory (NAEI) [24] provides estimates of HFC emissions. NAEI emissions are apportioned to Exeter based on non-domestic electricity consumption[25]. Given the range of uses (RACHP, fire-fighting, blowing agents/propellants, electrical switchgear, metal production, etc), local usage will vary and the apportioned value is therefore subject to significant uncertainty.

Although the estimated 28.9 kt CO_2e emissions from F-gases in Exeter are a minor part of Exeter's footprint (6%), under a net-zero scenario, the decarbonisation of other sectors means that, left unchanged, the F-gas contribution will play an increasing a role. In addition, the future deployment of tens of thousands of heat pumps across the city has the potential to increase F gas emissions. Ensuring that the release of F gases are as near to zero as practical will be important in ensuring that the city achieves the emissions reductions that the deployment of heat pumps should secure.

Emissions reduction in the F-gas sector is driven by national and international legislation and there is therefore relatively limited scope for Exeter to accelerate emission reduction from F-gases. Local trading standards bodies enforce air conditioning inspections (which are required for any system with a rated output of over 12 kW). More proactive enforcement of these air conditioning inspections may be a route to lower emissions.

Display Energy Certificates (DEC) and Energy Performance Certificates (EPC)[xxviii] record air conditioning equipment with capacity of over 12kW. These suggest that 85% of Exeter's above 12 kW air conditioning capacity is in 6 organisations/buildings as shown in Table 12. More detailed information on each system can be found in individual building air conditioning inspection certificates and reports.

Table 12. Air conditioning capacity in Exeter listed in DECs and EPCs

Source	Organisation	Location	System rating kW	%
DEC	RD&E	Wonford	3,067	49.1%
DEC	Crown & County Court	Southernhay Gardens	613	9.8%
DEC	Royal Mail	Osprey Road	525	8.4%
DEC	ECC	RAMM & Civic Centre	459	7.3%
EPC	Various	Exebridge Centre	318	5.1%
DEC	SWAS	Eagle Way	316	5.1%
DEC & EPC	Others		951	15.2%
		Total	**6,249**	**100.0%**

[xxviii] For references see Buildings section

Identifying these organisations/buildings enables a targeted approach to a year on year reduction in HFC leakage rates by encouraging a reduction in the requirements for air conditioning through improved building performance, minimising refrigerant leakage from existing equipment through good maintenance and encouraging the use of very low GWP refrigerants when replacing refrigerant or installing new equipment. However, there are likely to be thousands of other air conditioning units across the city with capacity less than 12 kW.

With most F-gas emissions coming from RACHP equipment the number, size and refrigerant type of units probably represents the best proxy measure for local emissions. However, air conditioning certification is only required every five years, giving a long time lag. In addition, reducing these measures locally will not necessarily lead to a reduction in the apportioned NAEI emissions if non-domestic electricity consumption remains the basis for apportionment.

SECTOR:	F-GASES
CURRENT LEVEL:	28.9 THOUSAND TONNES CO_2 EMISSIONS (2019)
MONITORING TARGET:	ZERO CO_2 EMISSIONS BY 2030
NEXT YEAR INCREMENT:	2.6 THOUSAND TONNES CO_2 EMISSIONS REDUCTION
DATA SOURCE:	BEIS LOCAL AUTHORITY CO_2 STATISTICS
DATA AVAILABLE:	ANNUALLY

4 Conclusions

Greenhouse gas emissions in Exeter are on a downward trajectory. Emissions of 717 kt CO_2e in 2008 declined by a third to 476 kt CO_2e in 2019 and it is likely that the city will meet a 2020 target of a 30% reduction from 1990 levels (516 kt CO_2). Changes to date are due largely to the reduction in the carbon intensity of the national electricity grid, which gives a 64% reduction in emission from the power sector (with most generation plant located outside Exeter). The city is missing 2020 sector targets for emission reduction from buildings and transport by factors of 6 and 4 respectively. Looking ahead lack of progress in these sectors is particularly concerning, with growth in the city leading to increases in emissions in recent years. The city needs to make significant progress in reducing emission from buildings and transport to deliver net zero.

Extrapolating the current trend from 2016 suggests emissions in 2021 will be 448 kt CO_2e. Continuation of the current trend without local GHG reduction relies on unrealistic grid decarbonisation (implying a zero carbon grid electricity in 2026). While it may be realistic to assume current trend estimates for 2021 can be achieved with grid decarbonisation, by 2030 a 28% reduction from non-power sectors would be required to continue the current trend to 2030 while still leaving residual emissions of 291 kt CO_2e in 2030 and cumulative emissions of 3.7 Mt CO_2e over the decade. A linear decline in emissions from 2021 to zero in 2030 would yield cumulative emissions of 2.2 Mt CO_2e. The current trend, which itself requires significant non-electricity emissions reduction, exceeds this amount in 2026.

The monitoring targets show the scale of the changes needed to meet the 2050 targets set out in the Sixth Carbon Budget by 2030. These include:

- Over 1,200 PV installations each year every year to 2030, compared to 36 in 2020, a six-fold increase in the long-run average installation rate.
- Installing loft insulation in 25,400 homes by 2030 or 2,800 homes each year every year to 2030.
- Insulating the walls of 13,500 homes by 2030 at the rate of 1,500 every year.
- Putting 4,600 heat pumps in homes every year to 2030, there are currently 449 heat pumps in Exeter's homes.
- Connecting an extra 11,200 homes to heat networks by 2030; over 1,200 each year.
- Improving the energy efficiency of 260 non-domestic buildings every year to 2030 and switching 270 every year to low carbon heating.
- Reducing driving in Exeter by 10 million kilometres each year, every year to 2030.
- Continuing the exponential growth in electric vehicles ownership (aiming for 317 in 2021) and putting in an additional 81 charging points in every year to 2030.
- Increasing cycling rates 3.7 million kilometres annually (equivalent to 70% of the current total level) with matching increases in walking.
- Achieving a 1.3 kt (3.3%) annual reduction in household waste generation each year, every year and a 4.2% annual increase in recycling rates each year, every year to 2030.
- Capturing and storing CO_2 emission from the Exeter energy recovery facility by 2030.

It has not been possible to identify data sources or specific proxy measures for the industry and f-gas sectors and some more specific targets have yet to be determined and therefore do not currently have data sources or incremental targets. The monitoring process needs to address these shortcomings.

References

1 BEER, 2007. **Meeting the Energy Challenge**, A White Paper on Energy

2 University of Exeter, 2008. **Exeter climate change strategy analysis**

3 Climate Change Committee, 2020. **The sixth carbon budget. The UK's path to net zero.** Available from https://www.theccc.org.uk/publication/sixth-carbon-budget/ [Accessed 26/1/2022]

4 Exeter City Council, 2020. **Council adopts Exeter's roadmap to a carbon neutral future**. From https://news.exeter.gov.uk/council-adopts-exeter-s-roadmap-to-a-carbon-neutral-future/ (accessed 26/1/2022)

5 Exeter City Council, 2021. **New role to drive forward city's net zero ambitions.** From https://news.exeter.gov.uk/new-role-to-drive-forward-city-s-net-zero-ambitions/ [accessed 26/1/2022]

6 Department for Business, Energy & Industrial Strategy, 2021. **UK local authority and regional carbon dioxide emissions national statistics: 2005 to 2019.** Available from: https://www.gov.uk/government/statistics/uk-local-authority-and-regional-carbon-dioxide-emissions-national-statistics-2005-to-2019 [Accessed 9/10/2020].

7 University of Exeter, 2019, **Greenhouse Gas Inventories for SWEEG: Methodology Paper**

8 University of Exeter, 2018. **Low Carbon and Climate Change Evidence Base for the Greater Exeter Strategic Plan**

9 BEIS, 2021. **Renewable electricity by local authority 2014 to 2020**. Available from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1030065/Renewable_electricity_by_local_authority_2014_to_2020_rev.xlsx [accessed 17/1/2022]

10 ofgem, 2021. **Feed-in Tariff Installation Report 30 September 2021**. Available from https://www.ofgem.gov.uk/publications/feed-tariff-installation-report-30-september-2021 [accessed 17/1/2022]

11 BEIS, 2021, Non-domestic national energy efficiency data framework. Available from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/974175/nd-need-2020-geographical-annex.pdf [Accessed 9/2/2022]

12 DLUHC, 2021. **Energy performance of buildings data: England and Wales**. Available from https://epc.opendatacommunities.org/

13 BRE Trust, 2020. **The Housing stock of the UK**. Available from https://files.bregroup.com/bretrust/The-Housing-Stock-of-the-United-Kingdom_Report_BRE-Trust.pdf

14 BEIS, 2021. **RHI monthly deployment data**. Available from https://www.gov.uk/government/statistics/rhi-monthly-deployment-data-may-2021

15 BEIS, 2021, Non-domestic national energy efficiency data framework. Available from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/974175/nd-need-2020-geographical-annex.pdf [Accessed 9/2/2022]

16 Climate Change Committee, 2019. **Net zero technical report**

17 Department for Transport, 2021. **Road traffic statistics. Local Authority Devon.** Available from https://roadtraffic.dft.gov.uk/local-authorities/71 [Accessed 28/1/2022]

18 Department for Transport, 2021. **VEH0134: Licensed ultra low emission vehicles by postcode district: United Kingdom** Available from https://www.gov.uk/government/statistical-data-sets/all-vehicles-veh01#ultra-low-emissions-vehicles-ulevs [Accessed 31/1/2022]

19 Department for Transport, 2021. **Walking and cycling statistics (CW).** Available from https://www.gov.uk/government/statistical-data-sets/walking-and-cycling-statistics-cw [Accessed 31/1/2022]

20 Department for Transport, 2017. **Cycling and walking investment strategy.** Available from https://www.gov.uk/government/publications/cycling-and-walking-investment-strategy [Accessed 31/1/2022]

21 Department for Transport, 2021. **Decarbonising transport: A Better greener Britain.** Available from https://www.gov.uk/government/publications/transport-decarbonisation-plan [Accessed 31/1/2022]

[22] Devon Authorities Strategic Waste Committee, 2021. **Waste performance statistics 2020/21**. Available from https://democracy.devon.gov.uk/documents/s38269/Waste%20Performance%20Statistics%202020%2021.pdf [Accessed 7/2/2021]

[23] Devon Authorities Strategic Waste Committee, 2020. **Resource and waste management strategy fro Devon and Torbay 2020 – 2030**. Available from https://www.devon.gov.uk/wasteandrecycling/document/resource-and-waste-management-strategy-for-devon-and-torbay/

[24] National Atmospheric Emissions Inventory, 2019 **UK emissions data selector.** Available from http://naei.beis.gov.uk/data/data-selector?q=118879,

[25] Department for Business, Energy & Industrial Strategy, 2019 **Sub-national electricity sales and numbers of customers, 2005 – 2019** , https://www.gov.uk/government/statistical-data-sets/regional-and-local-authority-electricity-consumption-statistics,