Borough Council of King's Lynn & West Norfolk

Comparative District Wide CO_2 Emissions Bubble Report: 2005 to 2017

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Table of Contents

1. Introduction

1.1 Climate change is one of the most pressing and important challenges we are facing today. Unregulated climate change can severely impact life in King's Lynn and West Norfolk, as well as across the whole of the UK. It is, therefore, important that we all take responsibility at a local, regional, and national level to regulate, mitigate and adapt to climate change. Climate change is defined by the Intergovernmental Panel on Climate Change (IPCC) as a "change in the state of the climate that can be identified … by changes in the mean and/or the variability of its properties … that persists for an extended period [of time], typically decades or longer" (IPCC, 2012). Climate change can be attributed to natural processes as well as direct or indirect human activity. Due to human activity related accumulation of greenhouse gasses in the atmosphere and the IPCC conclusion that the majority of observed warming over the past 50 years is a result of this increased accumulation, the presumption is that human activity has directly contributed to climate change (Oreskes, 2004).

1.2 Carbon dioxide (CO_2) is one of the most harmful greenhouse gases, accelerating the effects of climate change through global warming. Despite a small atmospheric concentration (0.04%), CO_2 has high radiation absorbing properties, resulting in the absorption of reflected infrared radiation which gradually increases global temperatures (Pielke, 2020). Since the industrial revolution, the atmospheric concentration of CO_2 has increased by 45%, from 280 ppm in 1750 to 415 ppm in 2019 (NOAA, 2019). Thus, the more CO_2 released into the atmosphere, the greater the global warming effect and consequently the greater the effects of climate change.

1.3 With the continued 2019 rate of increase of greenhouse gases in the earth's atmosphere, it is expected that climate change will persist to the point that temperatures could exceed historical levels as early as 2047 (Mora, et.al, 2013). Average annual temperatures between 2008 and 2017 are 0.8°C warmer than the average between 1961 and 1990. In addition, the top ten warmest years have occurred since 1990 (BEIS, 2019). It is expected that there will be a shift towards warmer, wetter winters and hotter, drier summers. Natural variations will occur, but hotter general temperatures are expected to become more common. Between 1981 and 2000 the probability of seeing a summer that was as hot as 2018 was less than 10%. Now, the probability is estimated to be between 10-20% (Lowe, et.al, 2019). In 2019, the UK saw the highest recorded temperature of 38.7°C set on 25th July in Cambridge (Met Office, 2019a). Additionally, 2019 saw the 5th wettest autumn on record (348.4mm during September to November) (Met Office, 2019b), and 2020 saw the wettest February on record (Met Office, 2020).

1.4 UK coastal flood risk is expected to increase over the 21st century and beyond, under all emission scenarios considered. There will be an increase in the frequency and magnitude of extreme water events around the UK coastline. An increased future flood risk will be dominated by the effects of mean sea level rise. King's Lynn and West Norfolk is home to many high flood risk areas, which will likely be affected by unchecked warming of over 2°C. Unchecked temperature rise will consequently lead to rises in sea levels, from the melting of large ice masses. King's Lynn and West Norfolk is, therefore, vulnerable to extensive flooding.

1.5 In response to climate change pressure, the UK government legislated the Climate Change Act in 2008, which initially committed the UK to emissions reductions of 80% by 2050 from a 1990 baseline (Climate Change Act, 2019). The act also established the Committee on Climate Change to advise the government on meeting targets and setting policies. In 2016, the UK signed the Paris Agreement, committing the UK to reducing greenhouse gas emissions in order to limit global average temperature to below 2°C above pre-industrial levels; and work towards an ideal temperature increase limit of 1.5°C (UNFCCC, 2016). These efforts are recognised as leading to the substantial reduction of risks and impacts associated with climate change. Following the Paris Agreement, in 2019 the Climate Change Act was amended to commit the UK to net zero emissions from a 1990 baseline by 2050 (Climate Change Act, 2019). This amendment enshrines in law and ensures that major steps are taken to reduce the impacts and risks of climate change. This net zero pledge was the first of its kind for a major emitting country.

1.6 The government commitment to net zero emissions (from a 1990 baseline) by 2050 requires change and work to be done throughout all levels of government. The Borough Council of King's Lynn and West Norfolk (BCKLWN) is no exception. In order to adapt to and mitigate climate change, we first need to understand how much CO_2 the King's Lynn and West Norfolk district emits. This report breaks down King's Lynn and West Norfolk's CO_2 emissions, comparing them over a 13-year period (2005 – 2013) as well as against other districts in Norfolk. This will provide a comprehensive overview of King's Lynn and West Norfolk's CO_2 emissions and will highlight key areas contributing to the overall emissions figure.

2. King's Lynn & West Norfolk 2017 CO_2 District Profile

Table 1: King's Lynn & West Norfolk district CO_2 emissions sector breakdown[1].

Sector	**Sector Split**	**kt CO_2**	**% of Total Emissions**
Industrial and Commercial	Electricity	186.8	13.3
	Gas	413.3	29.4
	Large Industrial Installations	24.8	1.8
	Other Fuels	45.2	3.2
	Agriculture	27.5	2.0
	Total	**697.5**	**49.6**
Domestic	Electricity	86.7	6.2
	Gas	87.4	6.2
	Other Fuels	71.8	5.1
	Total	**245.9**	**17.5**
Transport	A Roads	217.8	15.5
	Motorways	-	-
	Minor Roads	159.9	11.4
	Diesel Railways	0.1	0.0
	Other	11.6	0.8
	Total	**389.4**	**27.7**
Land Use, Land Use Change & Forestry (LULUCF)	Net Emissions ***(Total)***	**72.5**	**5.2**
2017 Population ('000s, mid-year estimates)		**151.9**	
Per Capita Emissions (t)		**9.2**	
King's Lynn and West Norfolk Total (kt)		**1,405.3**	

Data Source: DBEIS, UK local authority and regional carbon dioxide emissions national statistics, 2005-2017.

[1] Kt = kilo tonnes; t = tonnes; CO_2 = Carbon Dioxide

2.1 The Department of Business, Energy and Industrial Strategy (BEIS) publish local authority area CO_2 emissions statistics every year. As of March 2020, the 2017 data set is the most recent published local authority area estimates. Emissions are allocated on an end-user basis (apart from goods production), which means that emissions are distributed to points of consumption. This reflects the total emissions relating to that energy consumption, rather than points of generation (such as power stations).

2.2 CO_2 emissions are split into four sectors: industrial and commercial emissions, domestic emissions, road transport and land use, land use change and forestry (LULUCF). Table 1 presents the breakdown of King's Lynn and West Norfolk emissions, showing that King's Lynn and West Norfolk emitted 1405.3 kilo tonnes (kt) of CO_2. The breakdown is as follows:

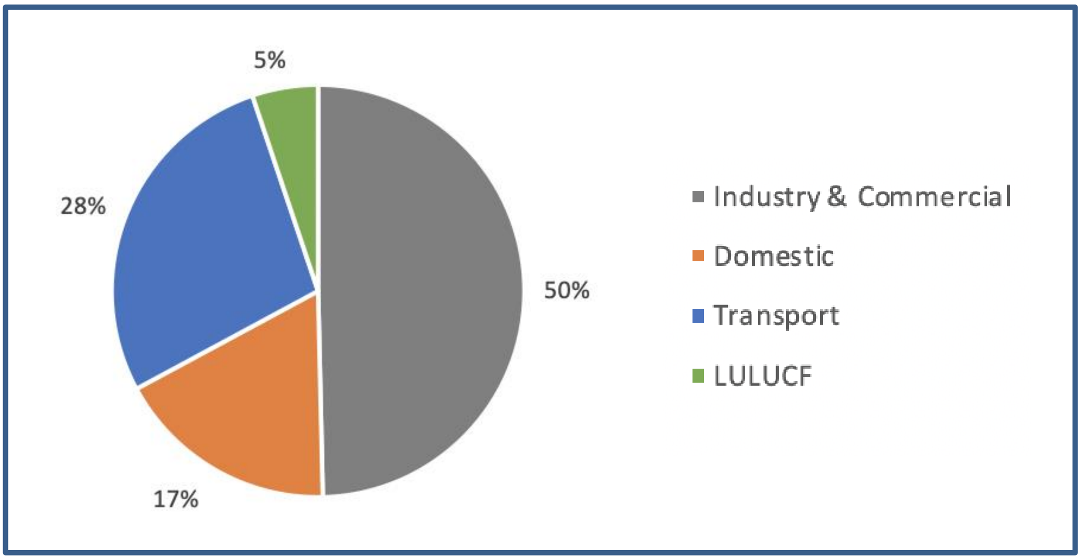
1. Industrial and commercial: 697.5 kt CO_2
2. Transport: 389.4 kt CO_2
3. Domestic: 245.9 kt CO_2
4. LULUCF: 72.5 kt CO_2

2.3 The percentage contribution of these four sectors is shown in Figure 1 below. Industrial and commercial contributes the largest share of emissions (50%); road transport contributes the second most (28%). The domestic and LULUCF sectors contribute the least to the share of emissions (17% and 5% respectively).

2.4 Within these sectors, emissions data sets are split further to provide a more in-depth view of where the emissions are coming from. As you can see from the full breakdown in Table 1 (page 5), the five highest emitting sub sectors are as follows:

1. Industrial and commercial gas: 413.3 kt CO_2
2. Transport: A roads: 217.8 kt CO_2
3. Industrial and commercial electricity: 186.8 kt CO_2
4. Transport: minor roads: 159.9 kt CO_2
5. Domestic gas: 87.4 kt CO_2

Figure 1: Percentage contribution to district CO_2 emissions.



3. Comparative Analysis in Norfolk

3.1 Comparative analysis across all districts in Norfolk shows King's Lynn and West Norfolk to be the largest contributor to Norfolk CO_2 emissions (as highlighted in table 2). King's Lynn and West Norfolk emits 566.7 kt CO_2 more than the closest emitting district (South Norfolk). King's Lynn and West Norfolk also has the highest per capita emissions in Norfolk (9.2 t CO_2). Again, the district with the closest per capita emissions is South Norfolk (6.2 t CO_2). From table 2 you can identify that King's Lynn and West Norfolk emits the highest amount of CO_2 in the industrial and commercial sector (697.5 kt CO_2), the domestic sector (245.9 kt CO_2), as well as the LULUCF sector (72.5 kt CO_2). King's Lynn and West Norfolk also has the third highest road transport emissions in Norfolk, behind Breckland and South Norfolk.

3.2 Overall, King's Lynn and West Norfolk contributes 27.3% to Norfolk emissions. This is 11% more than the closest contributor (South Norfolk). The most striking statistic is that King's Lynn and West Norfolk also contributes 37.7% of Norfolk's industrial and commercial emissions; 24.2% more than the closest contributor (Broadland). Table 3 provides a full breakdown of individual district emissions, which are shown as a percentage of overall Norfolk emissions.

3.3 Despite accounting for 27.3% of all emissions in Norfolk, King's Lynn and West Norfolk is only home to 16.9% of Norfolk's population (151,945 individuals). Despite this, King's Lynn and West Norfolk has per capita emissions on 9.2 t CO_2. The foremost explanations for this are the major emissions coming from industrial and commercial sector as well as the above average LULUCF emissions.

Table 2: Norfolk CO2 emissions sector breakdown.

2017	Industrial & Commercial (kt)	Domestic (kt)	Road Transport (kt)	LULUCF (kt)	Total (kt)	Per Capita (t)
Breckland	221.6	199.5	392.1	-113.4	699.8	5.0
Broadland	250.8	202.7	251.8	2.2	707.5	5.5
Great Yarmouth	94.0	138.3	138.7	0.8	371.7	3.7
King's Lynn & West Norfolk	697.5	245.9	389.4	72.5	1,405.3	9.2
North Norfolk	176.9	179.4	228.2	4.6	589.1	5.7
Norwich	206.3	183.5	134.3	3.0	527.2	3.8
South Norfolk	201.8	207.4	441.8	-12.5	838.6	6.2
Norfolk	***1,848.9***	***1,356.8***	***1,976.2***	***-42.7***	***5,139.2***	***5.72***

Data Source: DBEIS, UK local authority and regional carbon dioxide emissions national statistics, 2005-2017.

Table 3: Individual district emissions shown as a percentage of overall Norfolk emissions.

2017	Industrial & Commercial (kt)	Domestic (kt)	Road Transport (kt)	LULUCF (kt)	Total (kt)	Per Capita (t)
Breckland	11.9%	14.7%	19.8%	265.6%	13.6%	5.0
Broadland	13.6%	14.9%	12.7%	-5.3%	13.8%	5.5
Great Yarmouth	5.1%	10.2%	7.0%	-1.8%	7.2%	3.7
King's Lynn & West Norfolk	37.7%	18.1%	19.7%	-169.9%	27.3%	9.2
North Norfolk	9.6%	13.2%	11.6%	-10.9%	11.5%	5.7
Norwich	11.2%	13.5%	6.8%	-7.1%	10.3%	3.8
South Norfolk	10.9%	15.3%	22.7%	29.3%	16.3%	6.2
Norfolk	***1,848.9***	***1,356.8***	***1,976.2***	***-42.7***	***5,139.2***	5.7

Data Source: DBEIS, UK local authority and regional carbon dioxide emissions national statistics, 2005-2017.

Table 4: A comparison between different local authorities' per capita CO_2 emissions.

2017	Industrial & Commercial (t)	Domestic (t)	Road Transport (t)	LULUCF (t)	Total (t)
Breckland	1.6	1.4	2.8	-0.8	5.0
Fenland	3.2	1.5	1.9	0.8	7.5
King's Lynn & West Norfolk	4.6	1.6	2.6	0.8	9.2
UK	**2.1**	**1.5**	**1.9**	**-0.2**	**5.3**

Data Source: DBEIS, UK local authority and regional carbon dioxide emissions national statistics, 2005-2017.

3.4 Table 4 highlights the difference in per capita emissions between different local authorities and the UK average. Breckland and Fenland are used as comparisons due to their geographical closeness to King's Lynn and West Norfolk. King's Lynn and West Norfolk has higher than or identical per capita emissions to all four different sectors than the comparison local authorities and the UK average. Overall, King's Lynn and West Norfolk's per capita emissions are 3.9 tonnes CO_2 higher than the UK average (72.9% higher). With regards to King's Lynn and West Norfolk's industrial and commercial per capita emissions, they are 123.3% higher than the national average. Domestic stands at 7.7% higher, road transport 33.4% higher and finally LULUCF per capita emissions are -566.6%[2] higher than the national average. Industry and commercial appear to be the most significant contributor to King's Lynn and West Norfolk's high per capita emissions.

4. Sector Explanation

4.1 Industrial and Commercial:

We have established that the industrial and commercial sector contributes 697.5 kt CO_2 to the overall district emissions figure, equating to 50% of King's Lynn and West Norfolk's emissions. The industrial and commercial sector is, therefore, the largest emitter in the district. This sector is split into electricity use, gas use, large industrial installations, other fuels and agriculture. Of these sub sectors, most emissions come from electricity and gas usage (13.3% and 29.4% of total district emissions respectively).

4.2 Domestic:

With regards to domestic emissions, not all housing uses gas. Due to the rural nature of the district many domestic properties do not have access to the main gas line. Therefore, these properties use oil or solid fuel for spatial heating, with little opportunity to engage with other forms of heating. Thus, emissions are relatively high as carbon intensive fuel is often the only option for heating such properties. Electricity and gas consumption in domestic properties both contribute 6.2% of overall district emissions. The reliance on other (more carbon intensive) fuels is evident, as other fuels contribute a similar percentage of district emissions to gas and electricity, contributing 5.1% of district emissions.

Many of these domestic properties are also relatively old and are thus, energy inefficient. Consequently, heat is not properly contained in the properties, requiring more fuel to be burnt just to keep the property warm, releasing more CO_2. Emissions from this sector are also relatively weather dependent. For example, if the UK saw a mild winter, then properties may not require as much heating which has the effect of CO_2 reductions. Conversely, a colder winter will increase fuel use through heating and so CO_2 will follow that same trajectory.

4.3 Road Transport:

King's Lynn and West Norfolk is a large rural district and has a mixture of A-roads and smaller (B/C) roads. A-roads are the main roads that come in and out of larger areas like King's Lynn, contributing 15.6% to overall district emissions. Therefore, A-roads attract commuter travel, visitor travel and goods transportation. A-roads include the A10, A134, A17, A47, A149, A148, forming the main routes for heavy goods vehicles in and out of King's Lynn and West Norfolk. There is a large network of minor roads throughout the district, contributing 11.4% to the total district emissions. Minor road emissions contribution is likely due the rural feature of the district, and the consequent broad dispersal of services and population.

[2] This is a negative number because you are using the positive LULUCF King's Lynn and West Norfolk value with negative UK value within a formula.

4.4 LULUCF:

Whilst many districts have a CO_2 sink with forestry, King's Lynn and West Norfolk (like other fen districts) is a net emitter, mainly due to CO_2 (and methane) emissions from the fen peat deposits and as a major food producer. This explains the 72.5 kt CO_2 from LULUCF. This sector contributes 5.2% to total district emissions, as well as accounting for -169.9% of Norfolk LULUCF emissions. Whilst the LULUCF sector is the lowest sector emitter in the district, it is proportionally much higher than Norfolk and national averages for LULUCF.

5. Comparative Yearly CO_2 Emissions Analysis

Table 5: Yearly CO_2 emissions in King's Lynn and West Norfolk, per sector.

	Industrial & Commercial (kt)	Domestic (kt)	Road Transport (kt)	LULUCF (kt)	Total (kt)	Per Capita (t)
2005	728.5	404.1	390.6	77.2	1,600.3	11.4
2006	752.6	414.5	388.8	75.9	1,631.8	11.4
2007	777.1	400.4	393.3	72.2	1,642.7	11.4
2008	897.7	396.8	380.4	72.1	1,747.0	12.0
2009	903.9	363.0	368.5	75.7	1,711.1	11.7
2010	1,045.2	392.9	366.4	73.6	1,878.2	12.8
2011	940.5	342.9	357.8	73.2	1,714.3	11.6
2012	946.4	362.9	356.2	78.2	1,743.6	11.7
2013	939.5	349.4	356.6	73.8	1,719.2	11.5
2014	816.6	300.2	359.5	71.2	1,547.5	10.3
2015	738.4	286.1	366.5	71.7	1,462.7	9.7
2016	488.3	268.4	378.9	72.5	1,208.2	8.0
2017	697.5	245.9	389.4	72.5	1,405.3	9.2

Data Source: DBEIS, UK local authority and regional carbon dioxide emissions national statistics, 2005-2017.

5.1 Industrial and Commercial:

Industrial and commercial CO_2 emissions have seen a slight decline in start and end figures between 2005 and 2017, with large fluctuations in between. In 2005 CO_2 emissions were recorded at 728.5 kt CO_2 and as of 2017 have been recorded at 697.5 kt CO_2. This is a decrease of 31 kt CO_2, (4%) from 2005 CO_2 emissions to 2017 emissions. CO_2 emissions peaked in 2010, with 1,045.2 kt CO_2 emitted. From 2010 to 2017 CO_2 emissions dropped by 347.7 kt CO_2, which is a 33% decrease. Emissions hit their lowest level in 2016, with 488.3 kt CO_2 emitted, however, they rose again in 2017 by 209.2 kt CO_2 (a 43% increase). Whilst the overall trend shows a very small decrease, the fluctuations show the true extent to industrial and commercial emissions change, with a recent reduction from peak CO_2 emissions of 33%.

5.2 Domestic:

Domestic CO_2 emissions followed an almost year on year steady decrease from 2005 to 2017. Emissions in 2005 were recorded at 404.1 kt CO_2 reducing to 245.9 kt CO_2 in 2017. This is a reduction of 158.2 kt CO_2, which equates to a 39% decrease. CO_2 emissions peaked in 2006 at 414.5 kt CO_2, therefore, from 2006 to 2017 CO_2 decreased by 41%. CO_2 emissions in 2017 are the lowest they have been, following on from a yearly decrease since 2012. Overall, domestic CO_2 emissions have seen a strong and steady decrease from 2005 to 2017.

5.3 Road Transport:

Road transport CO_2 emissions have stayed relatively consistent from 2005 to 2017, fluctuating from a high of 393.3 kt CO_2 in 2007 to a low of 356.2 kt CO_2 in 2012. CO_2 emissions have only decreased by 1% (3.9 kt CO_2) from the peak 2007 figure to the latest 2017 figure. The 2017 CO_2 emissions figure in turn has only decreased by 0.003% from the 2005 figure (a reduction of 1.2 kt CO_2). Overall, road transport CO_2 emissions have stayed relatively stable from 2005 to 2017, seeing small fluctuations in the year's in-between.

5.4 LULUCF:

LULUCF CO_2 emissions have followed a similar trend to road transport emissions, staying relatively consistent between 2005 and 2017, but with small fluctuations in-between. In 2005 CO_2 emissions were recorded at 77.2 kt CO_2 and as of 2017 CO_2 emissions were recorded at 72.5 kt CO_2. This is a 6% decrease, which is a reduction of 4.7 kt CO_2 from the 2005 figure to the 2017 figure. LULUCF CO_2 emissions peaked in 2012 with emissions of 78.2 kt CO_2. From this figure, emissions have decreased by 7%, which is a reduction of 5.7 kt CO_2. CO_2 emissions reached their lowest point in 2014 at 71.2 kt CO_2 emitted. Comparing the 2017 figure of 72.5 kt CO_2 to this lowest point, CO_2 has increased by 1.3 kt CO_2, which is a 2% increase. The general trend shows that LULUCF CO_2 emissions have stayed constant over a 13-year period, with some small fluctuations in the years between 2005 and 2017.

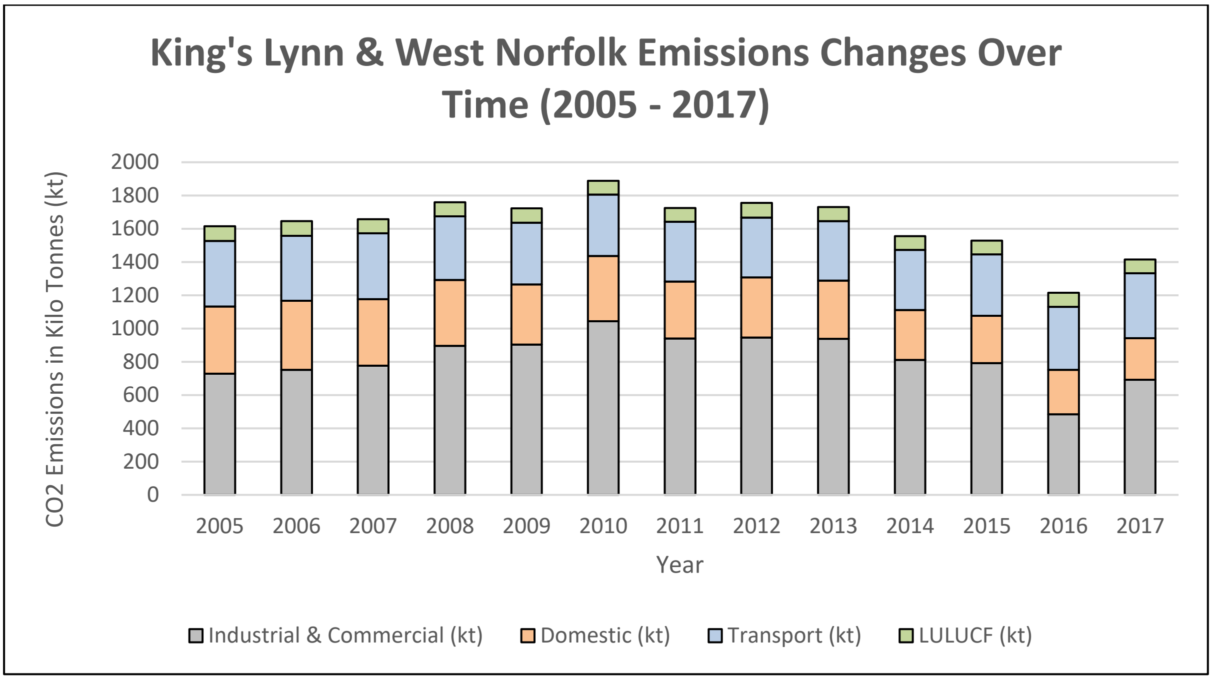
5.5 Total Emissions:

Total CO_2 emissions have seen fluctuations between 2005 and 2017. From 2005 to 2010 total CO_2 emissions saw an almost yearly increase from 1,600.3 kt CO_2 to a high of 1,878.2 kt CO_2. Over the next 3 years emissions stayed stable, with an average of 1,725.7 kt CO_2. 2013 to 2016 saw a yearly decrease in CO_2, from 1,719.2 kt CO_2 in 2013 to an all-time low of 1,208.2 kt CO_2 in 2016. However, 2017's figures show an increase from the 2016 figure to 1,405.3 kt CO_2. From the 2005 figure to the 2017 figure, CO_2 emissions decreased by 12%, which is a reduction of 195 kt CO_2. However, CO_2 emissions have decreased by 25% (472.0 kt CO_2) when you compare the peak year in 2010 to 2017 CO_2 emissions, and by 36% (670 kt CO_2) when comparing peak 2010 CO_2 levels to all-time low CO_2 emissions in 2016. Overall, the trend shows a decline in total CO_2 emissions over a 13-year period (see figure 2). However, CO_2 emissions have fluctuated over this time, and we are currently sitting 197.1 kt CO_2 above our all-time low.

5.6 Per Capita:

The mean per capita CO_2 emissions sits at 11 kt CO_2, with a range of 4.8 kt CO_2. There have been mild fluctuations in per capita CO_2 emissions over the 13-year period, with the highest value of 12.8 kt CO_2 occurring in 2010, and the lowest value of 8 kt CO_2 occurring in 2016. From 2005 to 2013, CO_2 emissions didn't drop below 11 kt CO_2, and then dropping annually 2014 to 2016, recording a low of 8 kt CO_2 in 2016. Per capita CO_2 emissions have since increased to 9.2 kt CO_2 for 2017. From the 2005 figure to the 2017 there has been a decrease of 19%, which is a decrease of 2.2 kt CO_2 per capita. Overall, the trend has shown a gradual decrease in per capita CO_2 emissions, with small fluctuations within the 13-year period.

Figure 2: Yearly CO_2 emissions trends in King's Lynn and West Norfolk.



Data Source: DBEIS, UK local authority and regional carbon dioxide emissions national statistics, 2005-2017.

6. Conclusion

6.1 Throughout the four sectors CO_2 emissions have seen a decrease from 2005 figures. The domestic sector is the only sector which has seen a large reduction in CO_2 emissions, decreasing by 39% from 2005 to 2017. The remaining three sectors have not seen large reductions over the 13-year period. Transport CO_2 emissions only decreased by 0.003%, LULUCF have only seen a 6% decrease and industrial and commercial CO_2 emissions have only seen a 4% over 13 years. However, over this timeframe each sector has seen fluctuations in their yearly CO_2 emissions, with the lowest CO_2 level falling after 2012 for each sector. Apart from domestic CO_2 emissions, 2017 CO_2 levels are sitting higher than they were in 2016, showing an increase in recent CO_2 emissions. The domestic sector is the only sector to show a steady decrease in CO_2 emissions over the 13-year period. The total CO_2 emissions figure has seen a general decrease over this period, reaching an all-time low in 2016 (see figure 2). This downwards trend is mostly attributed to a decrease in domestic CO_2 emissions. Ultimately, the increase in 2017 emissions from 2016 levels suggests that work needs to be done to ensure future reductions in district CO_2 levels.

7. Glossary of Key Terms

Term	Definition
Adapt	The process by which we adjust to new situations e.g. the adjustment to actual or expected climate change and its effects.
Atmospheric Concentration	The concentration of greenhouse gases in the earth's atmosphere, measured in parts per million (ppm).
Carbon Dioxide (CO_2)	Carbon dioxide is a gas found in our atmosphere. Its chemical formula is CO_2. It is a waste product in our bodies and is produced by burning fossil fuels.
Carbon Intensive	A process which has a high carbon footprint. This is in relation to its economic importance.
CO_2 Sink	A natural reservoir that absorbs and stores carbon dioxide from the atmosphere e.g. woodlands and oceans.
Greenhouse Gases (GHG)	A greenhouse gas is any gas found in the atmosphere which absorbs heat. By absorbing heat, it thereby keeps the planet's atmosphere warmer than it otherwise would be.
Intergovernmental Panel on Climate Change (IPCC)	The IPCC is an intergovernmental body of the United Nations that works to provide scientific information to understand the scientific basis of the risks associated with climate change.
Kilo Tonnes (Kt)	A unit of mass equivalent to 1000 tonnes.
Mitigate	To mitigate is to lessen the force of something unpleasant. In relation to climate change, mitigation refers to the measures used to limit the amount of greenhouse gases emitted into the atmosphere.
Net Zero Emissions	Net zero emissions are when human caused greenhouse gas emissions are balanced out by removing greenhouse gases from the atmosphere. These human-caused greenhouse gases should first be reduced as close to zero as possible. Any remaining greenhouse gases should then be balanced with an equivalent amount of carbon removal e.g. by restoring forests.
Per Capita Emissions	This is a measure of greenhouse gas emissions per person.
Pre-Industrial	A time before the UK's industrial revolution. In relation to climate change, that is the UK's emissions levels before the industrial revolution.
Tonnes (t)	A unit of mass equivalent to 1000 kilograms.

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