Appendix 3. Climate Emergency Action Plan – Carbon Assessment Methodology and Assumptions

Carbon emissions trajectories for the future are best estimates as it is impossible to make exact predictions. They are therefore based on the best available data from past emissions figures[1] and government projections. While it is impossible to be exact, these figures provide the best, most accurate reference for carbon accounting going forward. As explained in full in the CEAP methodology, these figures are all based on scope 1 and 2 emissions, while national statistics cover all aspects, including what would fall under scope 3 for us as a borough, such as motorways, diesel rail, aviation, industrial shipping and consumer purchases, amongst others. Therefore, national BEIS figures and their projections[2] may be slightly different to the expectations listed here.

Specifically, the business as usual (BAU) projection is based on the BEIS data covering the period between 2012 and 2017, as this is the most relevant and consistent data to represent potential future outcomes. In this period there was an average decline of 5.6% per year, which is the figure which has been used for extrapolation for future years. With the UK government's pledge to become net zero by 2050, alongside the introduction of multiple new commitments during 2020 (as outlined in full in the CEAP) that will significantly impact the future carbon emissions trajectory, this estimate remains realistic.

The government is continually reviewing policies and is likely to make additional changes, which will also be incorporated into our carbon accounting methodology and projections once they are realised. The carbon emissions BAU trajectory is expected to change year by year, as it will be impacted by new government policies, and national and global events (e.g. COVID-19 pandemic), therefore this should be used as a reference rather than an absolute figure.

For example, the proven effectiveness of working from for many companies during the pandemic in 2020 is expected to continue and provide a large decrease in emissions from commuting. However, this remains a live document which we review and will update as required, alongside BEIS updates which are released annually but backdated 2 years.

Meanwhile, the target emissions projection is based on experimental statistics because of inherent uncertainties in the estimation of CO2 emissions. We used available tools to local authorities such as the Scatter Tool to build scenarios that help to understand the uncertainties and key elements that will affect emissions in the future. These scenarios demonstrate the level/type of changes which would be required in order to reach net zero, showing the estimated trajectories based on different parameters such as varying car use, electricity generation etc. Therefore, it has been calculated in reverse, finding out what level of reductions are needed to

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[1] 2005 – 2019 UK Local & Regional CO2 Emissions, BEIS June 2021

[2] Energy and Emissions Projections 2019, BEIS October 2020

reach our 2030 goal, again being more front-loaded in terms of total reductions, to match government expectations. The differences here are then used to inform the targets, demonstrating their importance in reaching the overall 2030 goal.

Transport

Within this section, it is impossible to attribute the overall carbon savings directly to each action as many actions overlap or combine, therefore the total savings shown in the table may be different to the sum of the individual parts because of this. Each of these are best estimates based on the data available at this time. Target 7.9 has been removed after being explored and deemed unviable, however there were no carbon savings associated with this yet so there is no effect on the total.

Target 1. - Deliver a greenway network of over 37 Km across the Borough by 2030 with the ambition to deliver 60 Km by 2036

Action 1.1 - Deliver a comprehensive and connective network of greenway routes to encourage active and sustainable transport modes

- On average, people in the UK cycle 3.3 miles per trip cycled.[3]
- One fifth of the UK's population are thought to cycle at least once a month.[3]
- On average this 20% of the population (33,000 of Wokingham Borough's populations) cycle 17 trips a year. The table below shows the breakdown of purpose of these 17 trips.[4]
- Assuming a 2% increase in those cycling once a month or more from the resulting improved greenways network (660 people) the carbon calculations can be seen below assuming there has been a switch from driving to cycling.
- The 11 trips made for utility (not for leisure in grey) were each assumed to be the nationally average cycled mileage of 3.3 miles.
- This figure was then multiplied by the carbon emissions per mile of average petrol car (0.29103x3.3) accounting for 0.960399 $KgCO_2e$.[4]
- This figure was then multiplied by a 1% (330) and a 2% (660) increase in residents cycling in the borough due to the planned green ways network to result in 3.5tCO_2e and 7tCO_2e saved per year respectively. This would occur at the completion of the network in 2036.
- By 2030 we are expecting 62% completion of the total 60km of greenways. Therefore we will expect to be saving 62% of the 7 tCO_2e expected in 2036. **This equate to 4.34 tCO_2e savings annually.**

Trips taken per person per year

Purpose	Bicycle
Commuting	6
Business	1
Education / escort education	1
Shopping	2

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[3] Cycling UK Cycle Statistics
[4] Department for Transport National Travel Survey (2018)

Personal business	1
Leisure[5]	6
Other including just walk	0
All purposes	17

Target 2. - Double public transport use by 2030 from 2019 baseline

Double Bus Usage
- There were 2,800,000 bus passengers recorded for 2019 in Wokingham. The kilometres travel on local bus services accounted for 2,200,000 km/year. The average km per passenger per year is 0.79 km.
- Buses emit 103.0 gCO2 per passenger per km, multiplying this by the average km per passenger per year calculated 0.79km equates to 81 gCO2 emissions per passenger per year.
- The average petrol car emits 180.8 gCO2 per km. multiplying this by the average km per bus passenger per year calculated to 0.79km equates to 142.9 gCO2 emissions per passenger per year.
- We are assuming residents are replacing a car journey with a bus journey. Increasing the number of bus passengers will reduce the number of residents using vehicles to do the same journeys. Therefore, the new 2,800,000 bus passengers will have reduce their carbons emissions from a private vehicle (2,800,000 x 142.9 gCO2), this equates to 400.01tCO2 per year.
- Multiplying the emissions per bus passenger per year (81 gCO2) by the number of bus passengers recorded for 2019 (2,800,000) equates to 226.8 tCO2 per year.
- Therefore, the difference from switching from cars to bus for this many people would save (400.01-226.8)= **173.3 tCO2** per year.

Double Train Usage
- Currently 18% of Wokingham Borough residents use the train once a week. This amounts to 29,700. A 100% increase, would therefore be 59,400 residents.
- We are assuming residents are replacing a car journey with a train journey once a week. The average distance driven in a car journey is 8.2miles (or 13.2km) according to Government statistics.
- An averaged sized petrol car emits $2.4kgCO_2$ in one journey (8.2 x 0.29103). Multiply this by the number of residents calculate to $71.28tCO_2$ avoided per week (2.4 x 29700).
- Multiplying this by 52 weeks equates to the annual emissions from this car travel (71.28 x 52) = **$3706.56 tCO_2$**.
- Next the emissions from the train travel were taken away from the potential car travel emissions.
- National rail trains emit $0.04kgCO_2$ per passenger per km. For the purposes of this calculation an assumption has been made that the train journey would be the same distance as average journey driven, although in reality this is unlikely. (0.04 x 13.2km) This gives the sum of $0.54kgCO_2$ per passenger.
- This figure has then been multiplied by the number of residents involved in the 100% target increase which equate to $16.04 tCO_2$ ((0.54 x 29700)/1000).

- This was then multiplied by 52 to give annual emissions of 834.08 tCO$_2$ (16.04 x 52).
- Finally this figure was taken away from potential driving emissions to give potential annual carbon emission savings of 2872.48 tCO$_2$ (3706.56 – 834.08).
- However, emissions from national rail are out of scope when considering the borough's carbon footprint. So potential carbon savings are the initial figure of **3706.56 tCO$_2$ per year**.
- These calculations assumes all the car journeys are undertaken within the borough.

The total savings in carbon emissions from doubling public transport use by 2030 will account to **3879.86 tCO$_2$e** (173.3+3706.56).

Action 2.10 Part A - Deliver the Winnersh Triangle Parkway parking projects. This will increase the amount of parking capacity at Winnersh parkway station to achieve a 10% increase in the number of Wokingham Borough residents who use a train from Winnersh station at least once a week by March 2026.

- Currently 513,392 of Wokingham Borough residents use the station at Winnersh per year. This amounts to 9,873 people per week. A 10% increase, would therefore be a further 988 residents.
- We are assuming residents are replacing a car journey with a train journey. The average distance driven in a car journey is 8.2miles (or 13.2km) according to Government statistics.
- An averaged sized petrol car emits 2.4 kgCO$_2$e in one journey. Multiply this by the number of residents calculate to 2.37 tCO$_2$e avoided per week (2.4 x 988).
- Multiplying this by 52 equates to the annual emissions from this car travel (2.37x52) **123.24 tCO$_2$.**
- Next the emissions from the train travel were taken away from the potential car travel emissions.
- National rail trains emit 0.04kgCO$_2$e per passenger per km. For the purposes of this calculation an assumption has been made that the train journey would be the same distance as average journey driven, although in reality this is unlikely. (0.04 x 13.2km) This gives the sum of 0.54kgCO$_2$e per passenger.
- This figure has then been multiplied by the number of residents involved in the 10% target increase which equate to 0.53 tCO$_2$e ((0.54 x 988)/1000).
- This was then multiplied by 52 to give annual emissions of 27.6 tCO$_2$e (1.6 x 52).
- Finally this figure was taken away from potential driving emissions to give potential annual carbon emission savings of 94.9 tCO$_2$e (122.52 – 27.63).
- Emissions from national rail are out of scope when considering the borough's carbon footprint. So potential carbon savings are the initial figure of **123.24 tCO$_2$e per year**.
- These calculations assumes all the car journeys are undertaken within the borough.

Action 2.10 Part B - Deliver transport infrastructure enhancement in Coppid Beach, includes the creation of more parking spaces to achieve a 10% increase in the

number of Wokingham Borough residents who use a park & ride at least once a week by March 2026.

- Coppid Beech Park & Ride (P&R) will run users out to Wokingham and Bracknell both an average of 2 miles (or 3.2km) journey.
- An average size petrol car will emit 0.29103$KgCO_2$ per mile.
- In 2019 8% of Wokingham Borough's residents used P&R at least once a week, this is 13,200 people (165,000 current total population).
- The targeted 10% increase of this is a further 1320 people using park and ride at least once a week.
- This is 135280 miles saved a year ((1320 x 2 miles)x 52 weeks), which would have emitted 40tCO_2e annually ((0.29103 x 135380)/1000).
- There are of course still emissions associated with the bus journey itself. An average local bus emits 0.33$KgCO_2e$ on this journey (0.10391*3.2km).
- Based on the bus timetable for the Winnersh Triangle P&R were buses go on average 4 times an hour 6 days a week for 12 hours a day equating to 568 bus journeys running to and from the P&R emitting 9.8tCO_2e a year.
- Subtracting this figure from the earlier 40tCO_2e emission saving from shorter car journeys leaves us with an **annual saving of 30.1tCO_2e** from the creation of the Coppid Beech P&R by 2026 to be sustained into 2030.

Target 3 (Demand) - 20% reduction in total distance travelled in private vehicles per individual per year by 2030

- This targets aims to reduce demand by encouraging working from home, sharing journeys to work and to local amenities, and reducing the level of freight through better management of the network. National figures are used, as there are no local figures relating to journey length for business, local trips or freight within the borough.
- The average miles travelled by car in the South East region and Rural-Urban Classification for 2017/2018 were 5,101 for rural Town and Fringe.
- There are 66,100 petrol cars registered in Wokingham as of December 2019. The average miles per year driven for these vehicles is approximately 337,148,028.4 (66,100 x 5,101).
- Therefore a 20% reduction would save 67,429,605.68 (337,148,028.4*0.2) miles
- The average petrol car emits 0.29103 $kgCO_2e$ per mile.
- Therefore, a 20% reduction in total distance travel will result in savings of **19,624.04 tCO_2e** (67,429,605.68 x 0.29103/1000)

- There are 33,900 diesel cars registered in Wokingham as of December 2019. The average miles per year driven for these vehicles is approximately 172923900 (33900 x 5,101).
- Therefore a 20% reduction would save 34584780 (172923900*0.2) miles
- The average diesel car emits 0.27901 $kgCO_2e$ per mile. Therefore, a 20% reduction in total distance travel will result in **9649.50 tCO_2e** savings (34584780* 0.27901/1000)

- There are 38000 motorbikes registered in Wokingham as of December 2019.
- The average miles travelled by motorbike in the South East region and Rural-Urban Classification for 2017/2018 were 23 for rural Town and Fringe.
- The average miles per year driven for these vehicles is approximately 874000 (38000 x 23).
- Therefore a 20% reduction would save 174800 (874000*0.2) miles
- The average motorbike emits 0.16559 $kgCO_2e$ per mile. Therefore, a 20% reduction in total distance travel will result in **28.95 tCO_2e** savings (174800* 0.16559/1000)

Total savings across all 3 are **29,302.50 tCO_2e** (19624.04+9649.5+28.95)

Action 3.1 - Engage businesses to promote homeworking and remote working when possible to achieve 30% reductions of CO_2 emissions travelled from employees of local businesses by 2022

- There are a total of 60,800 Wokingham Borough residents employed in the following roles which are office based and therefore could sustain remote working behaviours which have been enforced through the COVID-19 lockdown measures in 2020.

	Wokingham (Numbers)
Managers, Directors And Senior Officials	12,600
Professional Occupations	27,100
Associate Professional & Technical	14,100
Administrative & Secretarial	7,000
Total	**60,800**

- Assuming 30% (18,240 people) of the office-based workforce can maintain remote working or active travel to and from work this could lead to huge annual reductions in local car travel and associated emissions.
- In England in 2018, the average person travelled 788 miles per year for commuting purposes by driving a car or van. 14.4 million miles are therefore travelled each year by 30% of this sector of the workforce (788 x 18,240).
- Multiplying this mileage by 0.29103$KgCO_2$ of emissions per mile by an average petrol car ((0.29103 x 14.4)/1,000) means that **4,200 tCO_2e could be saved annually** if sustained.

Action 3.2 - Promote the Liftshare scheme through My Journey to help individuals and businesses develop bespoke travel policies

- The target is to achieve a 10% reduction in the number of car/bike trips to and from businesses within the borough by March 2025 by implementing a lift share scheme.
- The average miles travelled by car in the South East region and Rural-Urban Classification for 2017/2018 were 5,101 for rural Town and Fringe.
- There are 66,100 petrol cars registered in Wokingham as of December 2019. The average miles per year driven for these vehicles is approximately 337,148,028.4 (66,100*5,101).

- The average petrol car emits 0.29103 kgCO2e per mile. Therefore, the carbon emissions for the 66.100 vehicles in the Borough will account for 98,120.19 tCO2e (66,100*0.29103/1000)
- A 10% reduction in total distance travel will result in **9,812.02 tCO2e** carbon savings (98,120.19*0.10).
- There are 33,900 diesel cars registered in Wokingham as of December 2019. The average miles per year driven for these vehicles is approximately 172923900 (33900 x 5,101).
- Therefore a 10% reduction would save 17292390 (172923900*0.1) miles
- This translates to **4824.75 tCO2e** carbon savings (17292390*0.27901).

- There are 38000 motorbikes registered in Wokingham as of December 2019.
- The average miles travelled by motorbike in the South East region and Rural-Urban Classification for 2017/2018 were 23 for rural Town and Fringe.
- The average miles per year driven for these vehicles is approximately 874000 (38000 x 23).
- Therefore a 10% reduction would save 87400 (874000*0.1) miles
- The average motorbike emits 0.16559 kgCO$_2$e per mile. Therefore, a 10% reduction in total distance travel will result in **14.47 tCO$_2$e** savings (87400* 0.16559/1000)

Therefore total savings for this target are **14651.24 tCO$_2$e**

Target 4 The use of all cars, vans and motorbikes as a mode of transport decreases from 74% (current national/borough average) total miles to 56% in 2030

- There are 138000 cars, vans and motorbikes registered in the Borough.
- Assuming that the council target is to achieve a further 18% reduction from the current national average of 74%, the carbon savings will result in **26372.56 tCO2e** per year.

	Car / van driver	Car / van passenger	Motorcycle	Total
Average miles total	5,101	5,101	23	7,782
No vehicles	66,100	33,900	38,000	112,100
Total miles	337,148,028.44	172,923,900	885,125.55	359,298,046
18%	60,686,645.12	31,126,302	159,322.60	**64,673,648**
CO2 t	17,661.63	8,684.55	26.38	**26372.56**

Action 4.1 - To provide more primary school children with the opportunity to develop practical skills and an understanding of how to cycle safely and achieve a 5% reduction in the number of children being driven to Wokingham Borough schools by March 2022.

- Currently there are1737 trained in all level of bikeability at the boroughs primary schools[5]. A 5% increase would mean 87 more children will be trained to cycle to school.
- On average, children travel 1.6 miles to primary school[6]. Multiplying these figures together means 278 miles are travelled per day to and from school by these 87 children ((1.6 x 87)x 2).
- There are 190 days in an academic year meaning this small group of children will be travelling 52,805 miles per year (278 miles x 190 days). We are assuming these children will all transition from being driven to and from school to cycling to and from school.
- Finally we multiply this figure by the carbon emissions produced per mile driven in an average sized petrol car ((52,805 x 0.29103KgCO$_2$e)/1000) to find that **15.4tCO$_2$e emissions could be saved per academic year** from this 5% in cycling to and from primary school every day.
- As this action contributes to the overall target in action 4.2, the total saving from these combined activities has been included here, so as not to double count.

Action 4.2 - Encourage and support local schools to join Modeshift Awards scheme for active and sustainable travel to achieve a 10% reduction in the number of children being driven to school by March 2026.

- There are 21,757 children in the borough who attend a state primary or secondary school in the borough. 35.79% are driven to school equating to 7,786.8 pupils.
- A 10% reduction of those being driven is therefore 778.7 less pupils being driven to school.
- Children travel on average 3.2 miles a day to and from primary school in England. Multiplying this figure by the 10% reduction aimed for is 2491.8 miles travelled per day (778.7 x 3.2).
- This is then multiplied by 190 (school days) to calculate annual mileage by this cohort 473439.3 miles per academic year (2491.8 x 190).
- Finally this figure if then multiplied by the emissions per mile produced from and average sized petrol car to show that **137.7tCO$_2$ emissions could be saved each year** ((473439.3 x 0.29103)/1000).

Action 4.3 - Role out the Healthy School Streets programme to help achieve a 10% reduction in the number of children being driven to school by March 2026.

- See the calculations for Action 4.2 as this will help towards achieving these **137.7tCO$_2$e** a year.

Action 4.4 - Increase the uptake of cycling from local business by promoting the Love to Ride programme to reduce the CO2 emissions from a driven commute by 10% by 2025.

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[5] My Journey Monitoring Spreadsheet M62
[6] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/476635/travel-to-school.pdf

- There are 85,900 economically active residents in Wokingham Borough. We are assume they all currently commute to work.
- 63% of residents in Wokingham Borough usually drive to work equating to 54,117 residents.
- A 10% reduction and shift to active transport for work would be 5,411.7 people who usually drive to work.
- The average annual mileage for commuting is 788 miles. Multiply these figures together equates to 4,264,420 miles a year (5411.7 x 788).
- Multiplying this figure by the emissions per mile of an average petrol car shows that **1,240 tCO_2e** who be saved a year from this amount of people shifting their annual commute to zero emission modes ((4,264,420 x 0.29103)/1,000).

Action 4.5 - Develop the Local Cycling and Walking Infrastructure Plan (LCWIP) to be borough wide and implement 50% LCWIP by 2030 to increase cycle modal share by 4% and increase walking modal share by 5%

- Applying national modal share percentages[7] to Wokingham Borough means that annual mileage driven, which is 337,148,028.44, accounts for 78% of the boroughs total annual mileage. The total mileage in the borough by all modes is therefore 432,241,062.10 (337,148,028.44/0.78).

Cycling
- National Modal Share by distance travelled for cycling is 1%. This equates to 4322410.6 miles in Wokingham Borough (432,241,062.10*0.01).
- The target increase to 5% share would mean a rise to 21612053.105 miles being cycled rather than driven (432,241,062.10*0.05)
- This is a difference of 17289642.505 miles (21612053.105-4322410.6)
- Multiplying this figure by the emissions per mile of an average sized petrol car means up to **5031.80 tCO_2 of emissions** could be saved annually ((17289642.505 x 0.29103)/1,000)

Walking
- National modal share by distance travelled for walking is 3%. This equates to 10,114,441 miles a year in Wokingham Borough.
- An increase to 8% of modal share would be a further 24464843.968 miles a year walked instead of driven (34579284.968 - 10,114,441)
- This would mean **7120 tCO2** could be saved annually ((24464843.968*0.29103)/1000)

Action 4.6 - Deliver engagement and cycle training events across the Borough to achieve a 2% increase in the number of Wokingham Borough residents regularly walking and cycling for leisure and utility by March 2022 (excluding over 60s).

Cycle
- In 2019 it is thought that 38% of Wokingham Borough residents cycle at least once a week. We have clarified this target by using only the working age

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[7] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/661933/tsgb-2017-report-summaries.pdf

- population of the borough 103,000 as children and over 60s are covered in other targets. 38% of this figure is 39,140 residents cycling at least once a week (103000 x 0.38).
- A 2% increase will be 2,060 more residents cycling regularly.
- The average length of a cycle ride in the UK is 3.3 miles. Therefore weekly mileage from this 2,060 residents is 6,798 miles a week cycled (3.3 x 2060), assuming this is instead of driving.
- Multiplying this figure by the emissions per mile of an average petrol car and further multiplying this by 52 weeks in a year equates to annual emissions of these journeys if driven to be **102.88 tCO$_2$ a year** (((6798 x 0.29103)x 52)/1000).

Walking
- 92% of Wokingham Borough residents walk at least once a week which is 94,760 people.
- A 2% increase is 2,060 residents, together these will total 94% of residents walking once a week or more.
- Annually, the average walking miles for people living in 'rural towns and fringe' regions is 184 miles or 3.5 miles per week.
- Therefore this 2% increase in residents walking will save 379,040 miles (184 x 2060) which would have otherwise been driven (assumption).
- These miles, if driven, would emit a total of **110.3 tCO$_2$ a year** ((379040 x 0.29103)/1000).

Action 4.7 - More residents over 60 riding bikes for travel to achieve a 3% reduction in car use by residents over 60.

- 39,468 residents who are 60 or over according to the mid-2019 population estimates. 3% of this cohort is 1,184.
- Assuming an average annual mileage driven is 5,101 miles. Total miles for this 3% is 6,039,788 a year.
- Emissions for this amount of mileage is **1,757.8tCO2e** that would be saved through 3% of previously driving over 60s changing their main mode of transport to cycling ((6039788 x 0.29103)/1000).

Action 4.12 – 22% decrease in road freight

- Currently 8400 LGVs and 700 HGVs
- Average van mileage is 13,000 per year[8]
- At 0.41028kg per mile for average diesel vans
- Therefore (0.41028*8400*13000/1000) = 44802.576 tCO$_2$e
- Average lorry mileage is 62751per year[9]
- At 1.38502kg per mile with average load
- Therefore (1.38502*700*62751/1000) = 60837.97 tCO$_2$e

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[8]
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/611304/annual-road-traffic-estimates-2016.pdf
[9] https://afdc.energy.gov/data/10309

- In total then a reduction by 22% would save **23240.92 tCO₂e** (60837.97+44802.576)*0.22)

Target 5. Leading by example – Reduce by 70% CO2 emissions produced by council related travel by 2030

At this time only commuting is included here due to the availability of such figures, although in future emissions from travel during work will also be incorporated.

- A staff travel survey carried out in 2020 to WBC staff in 2020 showed that approximately 3482615 miles are driven to WBC workplaces annually (pre-covid)
- These journeys cause the emission of 971.68 tCO2e each year ((3482615* 0.27901)/1000).
- Reducing this amount by 70% would save **680.18 tCO2e** emissions annually (971.68 x 0.7).

Action 5.1 - Deliver a strategy to reduce grey fleet miles from work related trips by 30% and reduce the equivalent CO_2e emissions that would have been produced.

- Grey Fleet is a term used to describe the business miles travelled by an employee in their own vehicle. This 'fleet' of employee-owned cars is deemed 'grey' as the vehicles in use are in somewhat of a grey area of responsibility for the employer.
- A 30% reduction is as above but only 291.5 tCO2e of the total saving (971.68*0.3)

Action 5.2 - Promote homeworking and remote working practices amongst council staff to reduce by 40% the CO2 emissions travelled from council staff to work by 2022.

- A 40% reduction is as above but only 388.672 tCO2e of the total saving (971.68*0.4)

Action 5.3 - Incentivise council staff to mode shift to active and sustainable transport to reduce by 10% the CO2 emissions from staff travelling to work by 2025.

- A 10% reduction would be as above but **97.17 tCO₂e** (971.68*0.1).

Target 6. Continue research and innovation programmes for the reduction of CO_2

Action 6.1 - Continue to research and use innovative techniques to manage traffic and encourage uptake of sustainable modes and ultra-low emission options

- 10% of total miles baseline year = 51007192.84 (510071928.44*0.1)
- 66% petrol = 51007192.84*0.29103*0.66/1000 = 9797.45 tCO₂e
- 33% diesel = 51007192.84*0.27901*0.33/1000 = 4696.40 tCO₂e
- Therefore a 10% reduction would be **1449.39 tCO₂e** (9797.45+4696.40)*0.1)
- Again this is just for cars so overall figure will be slightly larger

- This is in addition to below as it is achieved by improvements in engine efficiency and traffic solutions rather than a switch to active/sustainable methods.

Action 6.2 - Mobility as a service (MaaS) and future proofing the network.

- 10% of total miles baseline year = 51007192.84 (510071928.44*0.1)
- 66% petrol = 51007192.84*0.29103*0.66/1000 = 9797.45 tCO_2e
- 33% diesel = 51007192.84*0.27901*0.33/1000 = 4696.40 tCO_2e
- Therefore a 10% reduction would be **1449.39 tCO_2e** (9797.45+4696.40)*0.1)
- Again this is just for cars so overall figure will be slightly larger

Savings this year

- Due to the significant impacts of covid on public transport, homeworking and travel restrictions, it is nearly impossible to base savings on these usual annual figures.
- However, according to government statistics, from the 16th of March 2020 when non-essential travel was stopped until the 12th of April 2021 when restrictions began to ease, car use dropped by an average 31%.[10]
- Therefore, finding 31% of the previous overall miles driven in cars shows that 158122297.816 miles were saved during a 1-year period (510071928.44*0.31).
- 66% of this is petrol and 33% of this is diesel
- This relates to savings of 14558.84 tCO_2e for diesel (158122297.816*0.33*0.27901/1000)
- And savings of 30372.01 tCO_2e for petrol (158122297.816*0.66*0.29103/1000)
- Therefore, total savings of at least **44930.85 tCO_2e** were achieved within the borough, demonstrating the significance of these measures were this to continue in future. This is just for cars so the actual figure will likely be greater.

Consumption Emissions

- Total miles were 510071928.44-158122297.816 = 351949630.624
- 66% petrol = 351949630.624*0.66*0.27901/1000 = 64810.33 tCO_2e
- 33% diesel = 351949630.624*0.66*0.29103/1000 = 67602.41 tCO_2e
- For a total of 132412.74 tCO_2e
- Divided by total households gives **1.89 tCO_2e** per household (132412.74 /70000)
- Again this is just for cars so overall figure will be slightly larger

Electric Vehicles

Target 7 - 50% Electric Vehicles (EVs) registered in the Borough by 2030.

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[10] https://www.gov.uk/government/statistics/transport-use-during-the-coronavirus-covid-19-pandemic

There 148,300 vehicles register in Wokingham at the end of 2019. Of these, 808 are ultra-low or electric vehicles.

Wokingham registered vehicles	Q3 2019	%
ULEVs [1]	808	0.54
Cars [2]	100,000	
Diesel cars	33,900	22.86
Petrol cars	66,100	44.57
Motorcycles [2]	38,000	25.62
Light Good vehicles (LGVs) [2]	8,400	
Diesel LGVs	8,000	5.39
Petrol LGVs	400	0.27
Heavy Good Vehicles (HGVs) [2]	700	0.47
Buses & coaches [2]	300	0.20
Other [2]	900	0.61
	148,300	

- The government predictions estimate that by 2030 there will be a national average uptake of EVs by 25%.
- A battery electric vehicle carbon emissions accounts to 0g CO2 per kilometre.
- Carbon emissions by transport account for 182 $ktCO_2e$; these are projected to decrease to 143.57 $ktCO_2e$ by 2030 following government predictions on transport electrification. A further 25% of EV uptake will result in an additional **45,625 tCO_2e** reduction by 2030.
- It is projected that by implementing a Borough wide EV strategy, adding charge points in strategic locations, giving residents the opportunity to charge easily, reduce range anxiety for EV users, the uptake to electric vehicle is accelerated by a further 25%.
- The 50% switch to EV refers to personal transport (cars and motorcycles) and light vans only, as electrification of larger goods vehicles is not currently mainstream, however as technology develops this can be reviewed.
- Therefore, the total annual saving for switching to 50% EV's will be 91,250 tCO_2e reduction by 2030.

Action 7.3 - Review the residential charge point infrastructure for those who have communal parking facilities such as flat developments through an initial pilot of 18 new charging point for residents generating associated carbon emission savings.

- The initial pilot will be accessible to approximately 27% of households equating to 12,000 households.
- Currently EVs account for 0.54% of the total vehicle ownership share in the borough.
- 94% of households in the borough own a car. This is 10,800 households in this pilot (12000 x 0.9).
- Currently 58.3 EVs would be owned in this cohort (10800 x 0.0054).
- There are currently around 20 charging locations around the borough. An increase of 18 new charge points in a 90% increase.

- Therefore there is capacity for a 90% increase in the 58.3 EVs owned. This equates to 52.5 new EVs on the road in the borough.
- Driving an average annual mileage for a rural town or friend region this would save 267,741.3 miles a year driven by internal combustion engine cars (52.2 x 5101 miles).
- This mileage would emit **77.6 tCO₂e annually** ((267,741.3 x 0.29103)/1000).

Action 7.5 - Support local businesses, including commercial property owners, to transition their commercial fleets to EV and encourage their employees to switch to EV for private use to achieve a 20% transition to EVs.

- In 2017 it was found that 40% of all vehicles in the UK can be considered as grey fleet. In Wokingham Borough that would mean that 40,000 cars are used predominantly for commuting and business travel (100000 x 0.4).
- The target aims to support the transition of 20% of this fleet 8,000 cars to EV (40000 x 0.2).
- Average commuting miles in the UK is 788 miles annually. Therefore this 20% travels 6,304,000 miles every year (8000 x 788).
- Assuming the majority of these cars are petrol the emissions produced from this travel is **1,834.6 tCO₂e** each year ((6,304,000 x 0.29103)/1000). This is the amount that could be saved by transitioning 20% of commuting vehicles to EVs.
- More information will be available at a later stage as we identify the number of taxis businesses operating in in the borough and the feasibility of these transitioning to EV.

Target 8. Council's car fleet becomes entirely ultra-low emission by 2028.

The council has currently 21 vehicles, of which 17 are owned and four are leased as showed below:

Council's fleet	KgCO2e/ mile	Av Mileage	Annual KgCO2 emissions
EJ12 SKV - Hyundai 1800 2.5 CRDi 5 dr MPV (medium diesel)	0.27459	5000	1372.95
RV05 YDA - Ford Fiesta Van (small diesel)	0.22868	8000	1829.44
RO16 EHL - Ford Connect 210 LWB 1.6 95ps Van (small diesel)	0.22868	12000	2744.16
RV54 OAO - Ford Ranger Pick-Up (large diesel)	0.33713	7000	2359.91
AD54 WMM - Ford Ranger Pick-Up (54 reg.) (large diesel)	0.33713	10000	3371.30
FJ59 DNN - Rodeo Denver Max D/C Pick-Up (2009) (large diesel)	0.33713	7000	2359.91
RJ67 ELO - Ranger XL 4x4 TDCI (large diesel)	0.33713	10000	3371.30
RX10 FXG* - Landini Agricultural Tractor (diesel)	0.27901	7675	2141.40
RJ64 HXU - Peugeot Expert Professional (small diesel)	0.22868	7675	1755.12
RE04 ZFK - Ford Transit Connect Van (unknown diesel)	0.27901	7675	2141.40
RJ08 SXE - Ford Tourneo Connect 8-Seat Minibus (medium diesel)	0.27459	2400	659.02

RY55 LTK - Ford Transit Connect Van (unknown diesel)	0.27901	7675	2141.40
VU62 OVN - Vauxhall Vivaro 9 seat Minibus (2012) (small diesel)	0.22868	7675	1755.12
HJ11 UAF - Ford Transit Tourneo 9-Seat Minibus (2009) (large diesel)	0.33713	7675	2587.47
YP09 DHZ - Ford Transit 17-Seat Minibus (large diesel)	0.33713	7675	2587.47
YS09 LJU - Ford Tourneo Connect Trend 8-Seat Van (medium diesel)	0.27459	7675	2107.48
GY12 BHO** - Ford Transit 17-Seat Minibus (2012) (large diesel)	0.33713	7675	2587.47
RK17 CWM - Peugeot Expert Van (small diesel)	0.22868	7675	1755.12
NX65 KWA - Vauxhall Vivaro Combi (small diesel)	0.22868	7675	1755.12
AX68 OSN - Ford Transit Connect 1.8 (medium diesel)	0.27459	7675	2107.48
LC67 ODR - Citroen Berlingo Van 1.6 (small diesel)	0.22868	7675	1755.12
Total annual emissions and potential savings to be made (tCO2e)			**45.2**

- For vehicles with currently unknown mileage and average of known mileage was used = 7675. Please note the true value may be significantly lower
- Total annual emissions are 45.2 tCO2e.
- To actual potential savings are calculated through the addition of emissions from vehicles with above average mileage (above 7,675 mileage). Currently this means **11.3 tCO2e.** Please note that this will become more accurate after further investigation into the mileage and lifespan of WBC vehicle assets.

Savings this year

- Individual county statistics are not yet available on EVs, but overall UK sales rose by 39%.
- Using this figure, total EVs in the borough will have risen to 1123 (808*1.39)
- This is a rise of 315, meaning carbon savings of **467.63 tCO2e** by taking petrol cars off the road (315*5101*0.29103/1000)

Renewable Energy Generation in Council's owned assets

Target 12. Increase the generation of renewable energy through investment in solar farms to power the equivalent of 25,000 homes within the Borough by 2030

- Renewable electricity for Wokingham as 2018 accounted for 41033.502 MWh (BEIS Sept 2019).
- Emissions associated with the generation of electricity at a power station. Electricity generation factors do not include transmission and distribution.
- The overall objective for the council is to generate 40,000,000 KWh of electricity by 2026 and have an aspiration to generate 100,000,000 KWh (for possible excess commercial retail) within the Borough by 2030.
- Based on a 4000 kWh per annum average usage / per average domestic property. Therefore, 40,000,000 MWh of electricity generation has the

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potential to feed 10,000 homes, and 100,000 MWh of electricity generation has the potential to feed 25,000 homes.

- Using the UK Government GHG Conversion Factors for electricity generated 0.2556, 100,000 MWhs of electricity have a potential to produce carbon savings of **25,560 tCO$_2$e**.

Year	Target	Unit	No. residential properties electricity equivalent	kg CO$_2$e	tCO$_2$e
2023	20,000,000	KWh	5,000	5112000	**5,112**
2026	40,000,000	kWh	10,000	10224000	**10,224**
2030	100,000,000	kWh	25,000	25560000	**25,560**

- It is estimated that each solar farm installed will have the capacity to generate in excess of 20 MWh of energy, this depending on land size availability. Estimated carbon savings for a solar farm under this conditions account for 5,112 tCO$_2$eand potential to feed 5,000 homes

Target 13. Increased renewable energy generation to generate equivalent to 1550 kWh per household in 2030

- There are approximately 1,932 installation of renewable energy in Wokingham, which generates 28,451.45 MWh renewable electricity (BEIS Sept 2019). Of this, 1,926 are photovoltaics.
- The inventory data used for this exercise is the current reported generation per annum for Wokingham.
- Baseline data for small-scale photovoltaics generation (26,984.53 MWh) as reported by SCATTER is currently 26,984.5. This data is not based on any detailed technical feasibility; rather the national generation is scaled by number of households, land area, etc.
- The projected pathway data provided by SCATTER, refers to the anticipated generation calculated in 2030. Total small-scale solar PV is calculated in TWh generated, based on defined rates of total installed capacity (GW). The TWh/GW capacity generation efficiencies from 2017 - 2030 are taken from the National Grid's Two Degrees scenario (2019) for large scale solar PV, but the year on year rates of change are applied to the domestic / small scale solar PV recorded.
- Carbon savings from the increase in small-scale renewable generation can be obtain using the UK Government GHG Conversion Factors for electricity generated 0.2556kgCO2e. This will account **for 27,333.46 tCO$_2$e**

Small-scale PV generation	MWh	KWh	kg CO$_2$ e	tCO$_2$e
Baseline	26,984.53	26,984,530.85	6897246.086	
2030 pathway	106,938.43	106,938,426.76	27,333,461.88	**27,333.46**

Action 13.1 Set up a Community Energy Fund for Wokingham, and through this generate an average of 27,000 kWh/year of renewable energy from the installation of small-scale PV systems funded through this scheme.

Estimated carbon savings per year 6.90 tCO2e. Accumulated carbon savings for ten years **69.01 tCO$_2$e**

KWh	kg CO$_2$ e	tCO$_2$e
27,000 per year	6,901.20	6.90
270,000 for 10 years	69,012.00	**69.01**

Action 13.2 Support residents and local businesses to reduce their energy usage and carbon emissions and increase the uptake of renewable energy installations through the green bank scheme

- It is estimated that 15,000 households apply for funding for the installation of PV through the Green Bank scheme over the next ten years.
- Typical small-scale UK installations are around 15 to 25 square metres. A 3kWp system could comprise 15 panels taking up an area of 20 square meters and will generate roughly 2,500kWh per annum[11]
- Estimated carbon savings **9,585 tCO$_2$e**

	kWh/annum	kgCO$_2$e	tCO$_2$e
1 SCPV generates 2,5000	2,500	639	0.639
15,000 households	37,500,000.00	9,585,000.00	9,585.00

Retrofitting Council and Commercial Property

Target 14. By 2028 All council buildings to be retrofitted to carbon neutral standards

- The council estates / corporate property portfolio (CCS contract) energy usage figures are for electricity 5,855,473.6 kWh per annum and for gas 9,088,705 kWh per annum as per 2018 baseline. This data does not include energy figures for schools, which account for electricity 9,284,409.4 kWh per annum and gas 13,026,155 kWh per annum as these are been addressed in target 16. Therefore, electricity related emissions for the council estate are 1,496.66 tCO$_2$e per annum.
- An additional 3,259 tCO$_2$e per annum to the total carbon emissions for the council estate have been added to equate for transmission and distribution factors.
- Gas emissions for the council estate accounts for 4,058 tCO$_2$e per annum (2018 baseline year).

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[11] Renewable Energy Sources, Carbon Trust 2018

- The total carbon dioxide emissions council estates / corporate property portfolio excluding schools for 2018 baseline are **6,612.30 tCO$_2$e.**

Council Baseline (2018)	Electricity kWh	Electricity tCO$_2$e	Gas kWh	Gas tCO$_2$e
Council Property	5,855,473.60	1,496.66	9,088,705.00	1,856.64
Transmission and distribution factors		3,259.00		
Corrected emissions for electricity		4,755.66		
			Total CO2 emissions	6,612.30

Action 14.2 Improve energy performance of council housing stock

- There are approximately 2,600 council owned houses. Assuming these were retrofitted to carbon-neutral standards and domestic gas were to be removed.
- The Borough's carbon footprint for domestic gas is 177.23 ktCO$_2$e and for domestic electricity is 71.47 ktCO$_2$e (BEIS 2017), generating a total of 248.63 ktCO$_2$e.
- As of December 2017, there were 65,285 houses registered in the Borough. It is assumed that the carbon footprint per house is 3.80 tCO$_2$e (248.63 ktCO$_2$e/65,285/1000).
- The 2,600 council owned houses will provide 9,800 tCO$_2$e of carbon savings (2,600 x 3.80 tCO$_2$e).

Target 15. By 2029 all local schools will be retrofitted

Council Baseline (2018)	Electricity kWh	Electricity tCO$_2$e	Gas kWh	Gas tCO$_2$e
Schools	9,284,409.41	2,373.10	13,026,155.00	2,660.98
			Total CO2 emissions schools	5,034.08

- Energy figures for schools for electricity are 9,284,409.4 kWh per annum and gas 13,026,155 kWh per annum as per 2018 baseline.
- Considerations for transmission and distribution factors have already been accounted for in the council estates and corporate portfolio carbon footprint.
- Therefore, electricity related emissions for schools are 2,373.10 tCO$_2$e and gas related emissions are 2,660.98 tCO$_2$e per annum.
- The total carbon dioxide emissions for schools for 2018 baseline are **5,034.08 tCO$_2$e.**

Target 16. By 2030, 20% of households to be retrofitted to deep retrofit standard as defined by Scatter

- There were 65,285 households registered in Wokingham Borough by the end of 2017. Carbon dioxide emissions from domestic gas usage as reported by BEIS (2017) accounted for 177.23 ktCO2e.

- The current Government ambition is to achieve a 10% reduction in energy used for heating in existing homes by 2030[12]. If applying this scenario, by 2030, 6,529 houses should have been retrofitted to carbon neutral standards.
- The council ambition is to encourage residents to retrofit their homes by a further 10%, achieving a 20% of the households registered in the Borough to be retrofitted to carbon neutral standards. Actions 16.1 Develop and deliver an ECO (Energy Company Obligation) offering, 16.2, Green Homes Grant and 16.3 Green Bank Scheme aim to support residents to retrofit their homes. This 10% accounts for 6,529 households.
- The potential carbon dioxide emissions saved by the 10% retrofitting target account to **44,307 tCO$_2$e.**

Households	Existing homes	ktCO2e
2017	65,285	177,230
Government ambition 10%	6,529	17723
Council ambition 10%	**6,529**	**17723**
20% Households	13,057	35,446.0

Carbon Sequestration

Target 17. Plant 250,000 trees throughout the Borough by 2025

The target to plant 250,000 in the Borough is projected to result in a habitat change that will capture an additional **3.5 ktCO2e** per year. The number of trees is expected to require approximately 250 hectares of land, as this is a good density for biodiversity and planting for high forest.

Action 17.1 Create a new forest that will increase the number of trees in the Borough to improve carbon capture and biodiversity net gain

- Large scale (greater than 5ha) woodland planting on council owned land on high carbon capture potential sites such as arable land, improved grassland, etc.
- Current woodland cover estimated at 2,576 ha of Wokingham Borough (14.3%). Planting 115 ha more woodland (and associated green infrastructure) would get the borough woodland land cover close to 15%.
- Carbon sequestration potential of 7.83 tCO2e equivalent per hectare in first year of planting, **13.7 tCO2e** thereafter.

Action 17.2 Deliver small-scale woodland planting on council estate in existing parks and opens spaces sites.

- Estimate 5 to 10 ha of land available (circa 8,000 to 16,000 trees if planted as woodland).
- Planting 7ha of woodland and 3ha of community orchard would approximate 13,000 trees. This level of planting could sequestrate 72 tCO2e a year in

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[12] UK housing fit for the future? Committee on Climate Change 2019.

2022/23 and 114 tCO_2e a year thereafter (for 70 years or so if woodland grown to high forest). In other words, total sequestration would be circa **7,938 tCO2e**.

Action 17.3 Support woodland and hedgerow creation on private sites.

- Recommend running scheme as yearly rounds with a ceiling of 16,000 whip trees (equivalent to 10ha broadleaf woodland) per year.
- If run in 2022/23, 2023/24, and 2024/25 with complete take up it has a potential to deliver 48,000 trees.
- Assuming conversion of improved grassland or arable to woodland, each tranche of a combination of sites adding up to 10ha could sequestrate 78 tCO_2e a year in 2023/24 and 137 tCO_2e a year thereafter (for 70 years or so if woodland grown to high forest). In other words, total sequestration would be circa **9,531 tCO_2e** per 10ha tranche.

Action 17.4 Make Wokingham a Garden Forest by promoting and encouraging residents to plant new trees

- This scheme will seek to deliver 6,000 trees. Estimate that a scheme with approximate 10% of householder take up rate has the potential to deliver 6,000 to 7,000 trees planted. Recommend that that the scheme should be budgeted to have a 10,000 tree ceiling.
- Estimate that 10,000 garden trees is equivalent to 25ha of woodland except with a more frequently disturbed soil (so carbon is mainly sequestrated in the tree) so scheme could deliver sequestration of circa 165 tCO_2e per year for 30 years (16.5kg per tree per year average) totalling **4,950 tCO_2e** in total.

Target 18. Carbon sequestration by design - improving carbon sequestration rates in future land management decisions, approximately 0.62ktCO_2e savings

- Allocated sites within current iteration of the LPU sum to 460ha. On the basis that approximately a quarter of this is nudged towards being green infrastructure with a high carbon sequestration rate (mix of woodland and species rich grassland with roughly 8 tCO_2e per ha sequestration rate) and half the green infrastructure is delivered by 2030, the policy and strategy focus will cause 460 tCO_2e benefit by 2030.
- Alongside this, if the Local Nature Recover Strategy and Natural Flood Management approach can tilt the balance that an additional 20ha of land use change (at a similar sequestration rate to green infrastructure above) is supplied to the BNG and environmental services markets by 2030 then this will lead to another 160 tCO_2e per year.
- Total estimated carbon sequestration **660 tCO_2e per year**.

Action 18.1 Develop the Wokingham Borough Tree Strategy to support long-term creation and retention of woodland and trees.

- Improving the retention rate of trees and encouraging planting of woodland on private land - The longer trees are standing the longer carbon is locked up.

Action 18.2 Include in the Local Plan Update policy for carbon sequestration potential.

- Assuming roughly 70ha of green infrastructure created in the LPU cycle. A nudge of 10% cover from high intensity maintenance grassland to low intensity species rich, brought about by good design guiding, could sequestrate a further **42 tCO_2e per year**.

Action 18.3 Develop the Local Nature Recovery Strategy to provide complementary funding source to aid land use change (LULUCF being a carbon sink)

- On assumption that average of 2.5 units per ha (not including current woodland area) can be generated @ £15,000 per unit, the 5% uplift on a LNRS (over and above the national strategy area) would generate value on the biodiversity potential of £5,276,250

Action 18.4 Develop a Natural Flood Management partnership and scheme

- Within Natural England's Research Report 43, the change of use from arable land to wetland has examples of carbon sequestration rates of circa 8 to 17 tCO_2e per hectare per year.
- Working from figures in the report, on the basis that soil carbon loss under agriculture might be at a rate of 0.6% per year and carbon stocks for this habitat average 43 tCO_2e per hectare, natural flood management measures that prevent degradation might prevent **0.25 tCO_2e** per hectare being released into the atmosphere.

Target 19. Transition to low intensity (high carbon sequestration) land management, approximately 2.4 t CO_2e savings per annum

- Pilot for grassland cutting management transition leads to 10% change in Environmental Localities sites and 5% change on rural roadside verges by 2025 = 94 tCO_2e.
- Potential for a wider rollout of rural roadside verges transition by 2025 to 25% = another 80 tCO_2e.
- Small scale NFM projects x 20 each capable of 1/4tCO_2e benefit per year can be introduced to existing sites = another 5 tCO_2e.
- 300 extra open growing oak trees (or equivalent are planted by 2025 with a pro rata tCO_2e sequestration rate of 45 tCO_2e per year.

Action 19.1 Work to transition Grassland Management to less frequent cutting scheme allowing wildflowers to bloom and set seed

- A goal of 642 tonnes per year (0.64 ktCO$_2$e) would be targeted to be met in the period 2025 to 2030
- Converting 1/3 of the approx. 125ha of improved grassland within Environmental Localities portfolio to species rich grassland on a once a year cut could sequester an additional 242 tCO$_2$e per year (33% of 125 x 5.87, for conversion rate of improved to pollen and nectar mix from NERR043).
- Converting rural highways verge to cut and collect, estimate of 4 tCO$_2$e per hectare would equate to 400 tCO$_2$e per year for 100% conversion.
- 5% pilot is estimated to have the potential to sequestrate 20 tCO$_2$e per year.

Action 19.2 Work to transition Grassland Management to support the Restoring Biological Processes

- Converting 1/3 of the approx. 125ha of improved grassland within Environmental Localities portfolio to species rich grassland on a once a year cut could sequester an additional 242 tCO2e per year (33% of 125 x 5.87, for conversion rate of improved to pollen and nectar mix from NERR043).
- Converting rural highways verge to cut and collect, estimate of 4 tonnes per hectare would equate to 400 tonnes CO2e per year for 100% conversion. 5% pilot is estimated to have the potential to sequestrate 20 tonnes of CO2e per year.

Action 19.3 Implement Citizen Science Engagement for Hedgerow Restoration

- One mature oak tree is estimated to be 10.5 tCO$_2$e. If hedgerow restoration can be encouraged through use of a streamlined assessment and interpretation tool and this nudges to increase the % of hedgerow with oak standards up by just 1% in the borough, this will equate to (approximately) an additional 3,200 tCO$_2$e captured over the next 70 years.

Schools and Young People

Target 21 - Encourage and support school children in the Borough to take an active role in reducing carbon emissions

- A study at San Jose State University found that a 9 hour university course on climate change taught over two semesters reduced the annual carbon footprint of each students by an average of 2.86tCO$_2$e.
- This figure has been used to calculate the impacts of 1 hour of discussion and education about the climate emergency in the schools in Wokingham Borough. Therefore the average annual carbon saving attached to 1 hour of targeted learning is (2.89 / 9) 0.318tCO$_2$e.
- This will be reduced by 50% to 0.159tCO$_2$e to allow for lower levels of education and engagement as well as the fact that younger students have less power over purchasing decisions etc. and therefore over their entire carbon footprint.
- Please note that these are all assumptions based on students putting learning into physical action to reduce their carbon emissions and as children, students

are less able to make these changes but may encourage their parents/guardians to make changes.

Action 21.1 - Deliver annual climate emergency assemblies at local schools with the aim for every year group in each secondary school to receive an assembly annually.

- Assemblies are around 20 minutes meaning the sessions of learning will have at least a two thirds less impact than a full hour of learning the aforementioned study these assumptions are based on. The carbon reduction impact of one assembly per student is therefore $53KgCO_2$ ((0.159 / 3)x 1000).
- There is an average of 161 pupils in a year group meaning the impact of one assembly to a year group is $8.5tCO_2$ ((53 x 161)/1000).
- With 5 year groups in each of the 11 secondary schools across the borough there are 55 assemblies to deliver each year with the potential carbons savings of 469.3 tCO_2e (8.5 x 55).
- As the San Jose study saw a decrease in students total carbon footprint, this includes out of scope consumption emissions such a purchase and food choices. The UK's carbon footprint is 21% direct and 79% indirect (consumption) emissions. Therefore we can only claim for 21% of this figure as savings towards our total carbon footprint of $580.3KtCO_2$. Total savings are **98.5tCO_2** (469.3 x 0.21).

Action 21.2 - Create climate committees in schools to increase engagement with climate emergency issues and ownership of actions to reduce carbon dioxide emissions.

- One committee per school starting with the 11 secondary schools in the borough.
- Full, voluntary engagement with approximately 15 members will produce the full $0.318tCO_2$ found in the research paper sourced above. This amount with then account for any trickle down of various campaigns and activities around the school. Per committee this will be 4.77tCO2 (0.318 x 15).
- One committee in each of the borough secondary schools therefore has the potential to save $52.5tCO_2e$ per cohort, bearing in mind that the turnover of pupils as members of the committee may not change drastically throughout the 5 year duration of a secondary school career (0.318 x 15).
- As the San Jose study saw a decrease in students total carbon footprint, this includes out of scope consumption emissions such a purchase and food choices. The UK's carbon footprint is 21% direct and 79% indirect (consumption) emissions. Therefore, we can only claim for 21% of this figure as savings towards our borough's carbon footprint. Total savings are **11tCO_2** (52.5 x 0.21).

Action 21.3 - Deliver the Youth Climate Conference to increase awareness and understanding of climate emergency issues amongst children and young adults attending

- The Youth Climate Conference will occur annually with a duration of 2 hours and maximum capacity of 80 students.

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- Two hours of learning per pupil has the potential carbon saving impact of 0.318tCO2 (0.156 x 2).
- For full attendance at the Conference that has the potential carbon saving impact of 25.44 tCO_2 annually, providing full engagement and that the cohort changes year on year to maximise audience and reach (0.318 x 80).
- As explained above, we can only claim for 21% of this figure as direct carbon emission savings towards reducing our borough's carbon footprint. Total savings are **5.3tCO$_2$** (25.44 x 0.21).

Action 21.4 - Encourage schools to include climate emergency issues in teaching time to be cover in at least one subject.
- One hour of climate emergency subject matter addressed to an average sized class could result in emission reduction of 4.68tCO$_2$ annually (0.156 x 30).
- If this is carried out across the whole of an averaged sized secondary school within the borough of 1130 pupils the saving could be up to **176.3 tCO$_2$** (0.56 x 1130).
- As explained above, we can only claim for 21% of this figure as direct carbon emission savings towards reducing our borough's carbon footprint. Total savings are **37tCO$_2$** (176.3 x 0.21).

Action 21.7 - Support schools to implement carbon sequestration projects.
- Assuming schools have space and ambition to plant 30 trees on their grounds (the size of a copse or short hedge as recommended by the Woodland Trust). 30 saplings planted sequesters approximately 1.8 tons of CO_2 over 10 years of growth so 0.18 tons on average over that decade of initial growth.
- There are 70 non-independent schools in Wokingham borough. With the initial target for 10% of these schools to plant tree that would mean average annual CO_2 emissions savings of **1.26tCO$_2$** (0.18 x 7).

Action 21.8b - Waste reduction: Investigate Freecycle for food schemes, to reduce food from schools go to waste and gets used, either for food banks or homeless shelters
- 605.59 KgCO2e is emitted per tonne of food waste going to landfill.
- More information is needed to create an accurate carbon emissions savings calculation.

Target 22 - Celebrate schools achievements in climate emergency initiatives and inspire the future generations

Action 22.2 - Nurture creativity and resourcefulness amongst children and young adults through the roll out of the Dragons Den Climate Competition out across all secondary schools in the borough.

- Groups taking part in the competition can be up to 5 pupils. They are likely to have full engagement if taking part as participation is optional.
- Therefore potential savings could be up to 1.59 tCO$_2$e (0.318 x 5). This is a big impact for a small group of pupils and will include the associated carbon savings of the winning mitigation for the school.

- As explained above, we can only claim for 21% of this figure as direct carbon emission savings towards reducing our borough's carbon footprint. Total savings are **0.34tCO$_2$** (1.59 x 0.21).

Waste & Recycling

The figures used in the above table are calculated based on the premise that preventing the loss of recyclable material means less goes to
landfill sites and less is produced, removing the emissions from these processes. While there are still some emissions from the process of recycling the material itself, these are considerably lower and have been accounted for in the calculations as shown below. All figures are rounded to 2 decimal places for simplicity within this document, although more precise numbers were used to calculate totals, which is why there are some marginal discrepancies. All figures are based on government figures on GHG reporting where available, or from strong online secondary data where required, with the references outlined in the appendix. While the recycling processes themselves may occur outside the borough, it is the decisions and actions of residents within the borough which allow such actions to happen, therefore meaning they fall into our scope. These savings are calculated to show the potential annual savings per year, therefore acting against the overall emissions and eventually contributing towards the net zero goal. Each of these has been done for the current year due to the considerable changes in actions and results from covid meaning these are the most accurate available. As mentioned in the full report, target 25 about implementing an re3 contamination policy to reduce contamination has been removed from the current plan as it is currently being reviewed as part of the wider waste strategy, while target 28 has been removed as it has been incorporated into the table and this methodology document in the form of carbon savings. As this is scope 3 emissions these removals have no effect on the total savings.

Target 23 - Eliminate loss of MDR recyclable material in the form of wet paper

- 1,041.84 KgCO$_2$e is emitted per tonne of paper or board going to landfill.
- 21.32 KgCO$_2$e is emitted per tonne of paper or board being recycled.
- Total deductions of specifically wet paper/board (Kerbside and HWRC Recycling)= 3327.92+1.31 = 3329.23
- 583 KgCO2e is emitted per tonne of raw material produced.
- (583+1041.84-21.32) x 3329.23 = **5188.67 tco2e** would be saved.

Target 24 - Eliminate loss of MDR recyclable material in the form of wet paper

Action 24.2 Improve residents' engagement with waste and recycling initiatives via partner Green Redeem

- By renewing garden waste we therefore expect a similar amount of green waste to be collected and recycled.
- Current amount is 12129.59 tonnes
- 578.99 KgCO$_2$e is emitted per tonne of food waste going to landfill.

- 21.32 KgCO$_2$e is emitted per tonne of food waste being recycled.
- As this is garden waste there is no raw material to substitute for.
- 12129.59*(578.99-21.32)= 6764.34 tco2e saving per year

- An average of 825 people engaged per post on social media in the baseline year, which is 330 households (825/2.5 average people per household)
- If this many people were to follow the advice and subsequently increase their recycling amount and quality by 10% it would lead to:
- (0.22) * 0.1 * 330 = 7.31 tco2e saving per year
- 7.31+6764.34 = **6771.65 tco2e** total

Action 24.3 Target low participation areas to increase food waste tonnage to increase participation above 50%

- Current amount is 6119.79 which is 17.17% of 35634.
- So 17.17% of 50164.8 is 50164.8*0.1717= 8613.29
- 8613.29 - 6119.79 = 2493.5 tonnes increase
- 626.91 KgCO$_2$e is emitted per tonne of food waste going to landfill.
- 21.32 KgCO$_2$e is emitted per tonne of food waste being recycled.
- 680 KGCO2e is emitted per tonne of raw material produced on average in Europe.
- (680+626.91-21.32)*2493.5= **1664.69 tco2e** saved.

Action 24.4 Increase & improve facilities for glass recycling

- Current amount is 4008.60+254.55 = 4263.15 which is 11.96% of 35634.
- So 11.96% of 50164.8 is 50164.8*0.1196= 5999.71.
- This is an increase of 1736.56tonnes.
- 8.93.
- 21.32 KgCO$_2$e is emitted per tonne of glass being recycled.
- 670 KGCO2e is emitted per tonne of raw material produced.
- (670 + 8.96 - 21.32) x 1736.56 = **1142.03 tco2e** saved.

Target 24.5 Proactive approach to partner with housing developers to deliver waste management facilities in new developments

- Again this assumes a 10% increase in quality and amount of recycling if advice is followed by new residents
- Plan to build 1800 new homes
- (0.22) * 0.1 * 1800 = **39.86 tco2e** increase and so savings per year

Target 25 - Zero waste going to landfill by 2050

Assuming 30% remaining waste, if this is used for combustion to produce energy rather than recycling then nothing goes to landfill. Savings here arise from the prevention of landfill and related emissions and not having to burn fossil fuels.

- The remaining 30% would all be used for combustion
- Remaining amount is 0.3*71664 = 21499.2 tonnes

- 21.32 KgCO$_2$e is emitted per tonne from combustion
- 437.37 emitted if going to landfill as residual waste
- Nothing saved from production here.
- 21499.2*(437.37-21.32)= **8944.74 tco2e saved**

Savings this year:
While it is again impossible to be exact, the main areas (over 500tonnes per year) have been identified below and estimates used based on average figures. For the overall MDR figures a split of 80%carboard, 5% aluminium and 15% plastic has been used based on the UK average figures. These figures contain life-cycle emission savings which are not included in the current scope so are not used in the summary detail.

For cardboard:

- Current amount is 52315.75 tonnes (6519.69*0.8)
- 1,041.84 KgCO$_2$e is emitted per tonne of paper or board going to landfill.
- 21.32 KgCO$_2$e is emitted per tonne of paper or board being recycled.
- 583 KGCO2e is emitted per tonne of raw material produced.
- (583+1041.84-21.32) * (6519.69*0.8)= 8123.86 tco2e saved this year.

For aluminium:

- Current amount is 325.98 tonnes (6519.69*0.05)
- 8.93 KgCO$_2$e is emitted per tonne of aluminium going to landfill.
- 21.32 KgCO$_2$e is emitted per tonne of aluminium being recycled.
- 1570 KGCO2e is emitted per tonne of raw material produced.
- (1570+8.93-21.32) * (6519.69*0.05) = 507.45 tco2e saved this year.

For plastic:

- Current amount is 977.95 tonnes (6519.69*0.15)
- 8.93 KgCO$_2$e is emitted per tonne of plastic going to landfill.
- 21.32 KgCO$_2$e is emitted per tonne of plastic being recycled.
- 6000 KGCO2e is emitted per tonne of raw material produced.
- (6000+8.93-21.32) * (6519.69*0.15) = 5852.01 tco2e saved this year.

For glass:

- Current amount is 4263.15 tonnes
- 8.93 KgCO$_2$e is emitted per tonne of glass going to landfill.
- 21.32 KgCO$_2$e is emitted per tonne of glass being recycled.
- 670 KGCO2e is emitted per tonne of raw material produced.
- 4263.15 x (670+8.93-21.32) = 2803.49 tco2e saved this year.

For Food Waste:

- Current amount is 6119.79 tonnes
- 626.91 KgCO$_2$e is emitted per tonne of food waste going to landfill.

- 21.32 KgCO$_2$e is emitted per tonne of food waste being recycled.
- 680 KGCO2e is emitted per tonne of raw material produced on average in Europe.
- (680+626.91-21.32)*6119.79 = 4085.63 tco2e saved this year

For Green Waste:

- Current amount is 12129.59 tonnes
- 578.99 KgCO$_2$e is emitted per tonne of green waste going to landfill.
- 21.32 KgCO$_2$e is emitted per tonne of green waste being recycled.
- As this is garden waste there is no raw material to substitute for.
- 12129.59*(578.99-21.32)= 6764.34 tco2e saved this year

For Wood:

- Current amount is 2570.31 tonnes
- 828.07 KgCO$_2$e is emitted per tonne of wood going to landfill.
- 21.32 KgCO$_2$e is emitted per tonne of wood being recycled.
- 0 KGCO2e is emitted per tonne of raw material produced due to sequestration in growing trees via sustainable practices.
- 2570.31*(828.07-21.32)= 2073.59 tco2e saved this year

For Scrap metal:

- Current amount is 856.76 tonnes
- 8.934 KgCO$_2$e is emitted per tonne of scrap metal going to landfill.
- 21.32 KgCO$_2$e is emitted per tonne of scrap metal being recycled.
- 1900 KGCO2e is emitted per tonne of raw material produced (steel used).
- 856.76*(8.934+1900-21.32) tco2e saved this year

For Others:

- The remaining amount is 4481.84
- 423.37 KgCO$_2$e is emitted per tonne of other waste going to landfill.
- 21.32 KgCO$_2$e is emitted per tonne of wood being recycled.
- 1622.57 KGCO2e is emitted per tonne of raw material produced (average of others as no official figures available).
- 4481.4 * (423.37+1622.57-21.32) = 9074 tco2esaved this year

Per Household:
Figures for consumptions emissions assuming the same composition of waste – 50.28% residual waste, 14.63% Cardboard, 0.9% Aluminium, 2.74% plastic, 11.96% glass, 7.21% wood, 2.40% scrap metal, 17.17% food waste, 34.03% green waste, 12.58% other.

- Residual: 0.514*423.37=217.61
- Cardboard: 0.509*0.14*21.32= 1.59
- Aluminium: 0.509*0.009*21.32= 0.10

- Plastic: 0.509*0.02*21.32= 0.30
- Glass: 0.509*0.12*21.32= 1.3
- Wood: 0.509*0.07*21.32= 0.78
- Scrap Metal: 0.509*0.02*21.32= 0.26
- Food Waste: 0.509*0.17*21.32= 1.86
- Green Waste: 0.509*0.34*21.32= 3.69
- Other: 0.509*0.12*21.32= 1.36

Savings without life-cycle emissions:

- 35634 tonnes were recycled this year.
- If this amount had gone to landfill it would have produced (423.37*35634)/1000= 15086.37 tonnes
- By recycling this was reduced to (21.32*35634)/1000= 759.72tonnes
- Therefore there has been a saving of (15086-759.72)=**14326.28 tco2e**

New Development

Target 31. From 2021, 100% council new development is built to carbon neutral standards

Action 31.1 All new council properties non-residential will be built to the highest efficiency standards from 2021

It is imperative that new homes in the council must be built to be low-carbon, energy and water efficient and climate resilient. Getting the design of the new homes right from the outset is vastly cheaper than forcing retrofit later. Government projections suggest that from 2025 at the latest, no new homes should be connected to the gas grid. They should instead be heated through low carbon sources, have ultra-high levels of energy efficiency alongside appropriate ventilation and, where possible, be timber-framed.

Building new homes to net-zero carbon standards would not generate carbon savings, however, it will stop new carbon dioxide to be generate.

Action 31.2 All new council homes will be built to the highest efficiency standards by 2024 – Gorse Ride Regeneration Project

- Gorse Ride development consist on the state regeneration of 255 houses which will be design to net-zero carbon standards with no supply of domestic gas.
- The Borough's carbon footprint for domestic gas is 177.23 $ktCO_2e$ and for domestic electricity is 71.47 $ktCO_2e$ (BEIS 2017), generating a total of 248.63 $ktCO_2e$.
- As of December 2017, there were 65,285 houses registered in the Borough. It is assumed that the carbon footprint per house is 3.80 tCO_2e (248.63 $ktCO_2e$/65,285/1000).
- The 255 houses in this regeneration project will provide 950 tCO_2e of carbon savings once completed (255 x 3.80 tCO_2e).

Target 34 - Raise awareness in the community about the climate emergency agenda

- The carbon produced from electricity used on WBC sites accounts for 7,098 tCO_2e.
- A report by Rare (Centre for Behaviour and the Environment) suggests that 30 behaviour mitigations in 4 categories (food, agriculture and land management, transport and energy and materials) can result in a 19.9-36.8% reduction in tCO_2e emissions.

Action 34.7 - Support changes in work practices and behavioural change amongst local businesses
- According to a government report[13] when behaviour change effective in households up to 1.3 tCO_2e can be avoided. At this stage due to a gap in the literature available we will use this for commercial buildings in the borough.

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[13]https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69797/6921-what-works-in-changing-energyusing-behaviours-in-.pdf