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

Where possible all data is gathered from official government figures, to the most local possible level. Unfortunately, with the limited availability of data in some areas or the complex, untethered nature of some of the actions, with how they interact and interlink with other actions, it is not possible to allocate specific savings to each one separately. These targets are therefore noted in the main plan as "Included in total" as they contribute towards the overall goal of that section. However, where possible to specifically identify savings underneath each major action, these are also defined below. Total savings from each overall action, reflecting those used in the summary tables in the main document, are highlighted in bold.

## Carbon Emissions Trajectory

Carbon emissions trajectories are used to identify the expected outcomes from the combined actions of the council and all residents. These are best estimates as it is impossible to make exact predictions.

Current business as usual (BAU) projections from SCATTER, following a methodology based on numerous government strategies and incorporated targets and using 2019 BEIS data, estimate a 14% reduction by 2030. This has changed from previous iterations as it is now based on a more bottom-up approach, in order to minimise double counting by ensuring savings from government strategy do not overlap with those from council actions.

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.

## Transport

Targets here are based around the vital overall goal of reducing ICE (internal combustion engine) mileage, both for private and commercial purposes. They are therefore split under these 2 primary areas, with the sub targets all contributing towards the main goals by a percentage (eg contributing 10% of the 50% total reduction). Targets here are all inevitably slightly interlinked, but this methodology has been chosen to minimise double counting where possible. These are stretched targets which are aimed for in order to minimise emissions where possible, though there remains a deficit in some areas, such as reducing travel and train usage actions, where we recognise more action is needed to meet these figures.

Currently the total mileage covered by private ICE vehicles (excluding freight) is 475,240,000 miles. Therefore, a 50% reduction in this total mileage represents a saving of 237,620,000 miles, which is broken down against the total number of petrol/diesel cars and motorbikes in the borough, as each has a different level of emissions per mile travelled and average annual distance covered. By using these figures, the total savings for each vehicle type has been calculated and added together to get the total savings possible. In this way the estimate is more accurate than using an average savings per mile covered across each type. This is outlined more clearly in the below table:

| Project | Current amount (per year) | Average usage (per year) | Current total figure | Target total figure | Total Reduction | Carbon Saving Units | Carbon Saving per unit | Total Carbon Saving (tCO2e) |
|---|---|---|---|---|---|---|---|---|
| 50% Reduction in petrol private car mileage | 66100 | 4741 | 31,338,0100 | 156,690,050 | 156,690,050 | kg/Miles | 0.29103 | 45,601.50 |
| 50% Reduction in diesel private car mileage | 33900 | 4741 | 160,719,900 | 803,59,950 | 80,359,950 | kg/Miles | 0.27901 | 22,421.22 |
| 50% Reduction in private motorbike mileage | 38000 | 30 | 1,140,000 | 570,000 | 570,000 | kg/Miles | 0.16559 | 94.3863 |
| 50% Reduction in ICE vehicle mileage | 138000 | | 475,240,000 | 237,620,000 | 237,620,000 | kg/Miles | | 68,117.12 |

Within this total saving of 68,117.12 tCO$_2$e, this total target is then split into a number of actions which will each contribute towards a percentage reduction of the initial total mileage.

**Action 1.1: 33% Reduction From EV Registration**

- 33% of total ICE mileage will be reduced by switching to electric vehicles instead.
- 33% of the total 68,117.12 is **44,957.29 tCO$_2$e**
- Importantly, the initial total mileage figure excludes current EV mileage as this does not apply to ICE miles.
- This target has been arrived at following consultant analysis and expected EV registration numbers by 2030.

    **Action 1.1.3** - 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 results 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 247,480.2 miles a year driven by internal combustion engine cars (52.2 x 4741 miles).
- This mileage would emit 72.02 $tCO_2e$ per annum ((247,480.2 x 0.29103)/1000).

**Action 1.1.5** - 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 (100,000 x 0.4).
- The target aims to support the transition of 20% of this fleet 8,000 cars to EV (40,000 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 $tCO_2e$ per annum ((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.

**Action 1.2: 5% Reduction From Reduced Travel**

- 5% of total ICE milage will be reduced by removing journeys from the road.
- For these targets this means removing entire car journeys as the user utilises car share opportunities instead.
- 5% of the total 68,117.12 is **6,811.71tCO$_2$e**
- However, current actions currently reach 5,577.34, as detailed below, meaning there is a deficit of 1,234.36 to be addressed in upcoming iterations.

**Action 1.2.1:** 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 $0.29103KgCO_2$ of emissions per mile by an average petrol car ((0.29103 x 14,400,000)/1,000) means that 4,183 $tCO_2e$ could be saved per annum if sustained.

**Action 1.2.2** - 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.
- Using the above data in 3.1, but based on a 10% figure instead, total savings for this target are 1,394 $tCO_2e$ per annum

**Action 1.3: 2% Reduction from Increased Public Transport Use**

- 2% of total ICE mileage will be reduced by switching to use buses or trains instead.
- 2% of the total 68,117.12 is **2,724.68 $tCO_2e$**
- This figure is based on doubling bus and train usage numbers, as detailed below.
- However, as there are no actions around trains at this time, these savings have been temporarily removed, meaning actions currently reach 173.73 as detailed below, meaning there is a deficit of 2,550.95 to be addressed in upcoming iterations, primarily from trains.

**Action 1.3.1: 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 therefore 0.79 km.
- Buses emit 103.0 $gCO_2$ per passenger per km, multiplying this by the average km per passenger per year (0.79) equates to 81 $gCO_2$ 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 (0.79) equates to 142.9 gCO2 emissions per passenger per year.
- We are assuming residents are replacing a car journey with a bus journey for this action. Therefore, the new 2,800,000 bus passengers will have reduced 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 $tCO_2e$ per annum.

**Action 1.3.9** - Re-optimising the routes and capacity for school buses by re-tendering the contracts.

- Initial 14 routes covered 93750.49km per year
- Multiplied by the kg per km for euro6 buses (0.04) or 0.265 for one diesel route covering 6054.33
- This equates to 5114.22 $kgCO_2e$
- New 8 routes cover 52042.83km per year
- Multiplied by the same emissions factors (including identical diesel route)
- This equates to 2562.83 $kgCO_2e$
- Therefore the change has resulted in 2551.38 $kgCO_2e$ of savings, or 2.55 $tCO_2e$ per annum

**Action 1.4: 10% Reduction From Increased Active Transport use**

- 10% of total ICE milage will be reduced by switching journeys for active transport methods such as walking and cycling.
- 10% of the total 68,117.12 is **13,623.42 tCO$_2$e**
- However, current actions currently reach 16,163.4, as detailed below, meaning there is a surplus here of 2,539.97 which could cover some of the previous sections' deficits (in terms of carbon accounting towards the overall savings estimates by 2030).

**Action 1.4.1** - To provide more primary school children with the opportunity to develop practical skills and an understanding of how to cycle safely, leading to greater chance of adoption, both now and in the future.

- Currently there are approximately 2000 children trained across all levels of bikeability at the boroughs primary schools each year.
- On average, children travel 1.6 miles to primary school[1]. Multiplying these figures together means 6,400 miles are travelled per day to and from school by these children ((1.6 x 2000) x 2).
- There are 190 days in an academic year meaning this small group of children will be travelling 1,216,000 miles per year (6,400 x 190). If assuming these children will all transition from being driven to and from school to cycling to and from school:
- Multiply this figure by the carbon emissions produced per mile driven in an average sized petrol car ((1,216,000 x 0.29103KgCO$_2$e)/1000) to find that 353.89 tCO$_2$e emissions could be saved per academic year

**Action 1.4.2** - 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 is then multiplied by the emissions per mile produced from an average sized petrol car shows potential savings of 137.7tCO$_2$e per annum ((473439.3 x 0.29103)/1000).

**Action 1.4.3** - Role out the Healthy School Streets programme to help achieve a further 10% reduction in the number of children being driven to school by March 2026.

- See the calculations for Action 1.4.2 as this follows an identical calculation.

**Action 1.4.4** - 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%.

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[1]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 assuming they all currently commute to work in this calculation.
- 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 $tCO_2e$ per annum can 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 1.4.5** - 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%.

- The total annual mileage in the borough by all modes is 475,240,000.

**Cycling**
- National Modal Share by distance travelled for cycling is 1%. This equates to 4,752,400 miles in Wokingham Borough (475,240,000*0.01).
- The target increase to 5% share would mean a rise to 23,762,000 miles being cycled rather than driven (475,240,000*0.05)
- This is a difference of 19,009,600 miles (23,762,000-4,752,400)
- Multiplying this figure by the emissions per mile of an average sized petrol car means saving up to 5,532.36 $tCO_2e$ per annum ((19,009,600 x 0.29103)/1,000)

**Walking**
- National modal share by distance travelled for walking is 3%. This equates to 14,257,200 miles a year in Wokingham Borough.
- An increase to 8% of modal share would be a further 23,762,000 miles a year walked instead of driven (4,752,400*5)
- This would mean 6,915.45 $tCO_2e$ could be saved annually ((23,762,000 *0.29103)/1000)
- Therefore the total savings from this action would be 12,447.81 $tCO_2e$ per annum

**Action 1.4.6** - 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 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 $tCO_2e$ per annum (((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.
- Annually, the average walking miles for people living in 'rural towns and fringe' regions is 183 miles or 3.5 miles per week.
- Therefore this 2% increase in residents walking will save 376,980 miles (183 x 2060) which would have otherwise been driven (assumption).
- These miles, if driven, would emit a total of 109.71 $tCO_2e$ per annum ((376,980 x 0.29103)/1000).
- Therefore the total savings from this action would be 212.59 $tCO_2e$ per annum

**Action 1.4.7** - 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.
- Assuming an average annual mileage driven is 4741 miles. Total miles for this group is 187,117,788 a year (39,468 x 4741)
- A 3% reduction on this would represent a fall of 5,613,533.64 miles (187,117,788*0.03)
- Emissions for this amount of mileage is 1,633.71 $tCO_2e$ per annum ((5,613,533.64 x 0.29103)/1000).

**Action 2:** 22% decrease in road freight

- An Industrial Freight Management policy designed to reach this 22% reduction target would reduce Van and Lorry total mileage.
- This would save a total of **23,240.92 $tCO_2e$**, as detailed in the table below.
- There is also a new target around cargo bikes, though savings for this have yet to be attributed.

| Project | Current amount (per year) | Average usage (per year) | Current total figure | Target total figure | Total Reduction | Carbon Saving Units | Carbon Saving per unit | Total Carbon Saving (tCO2e) |
|---|---|---|---|---|---|---|---|---|
| 22% reduction in Van mileage | 8,400 | 13,000 | 109,200,000 | 85,176,000 | 24,024,000 | kg/Miles | 0.41028 | 9,856.56 |
| 22% reduction in Lorry mileage | 700 | 62,751 | 43,925,700 | 34,262,046 | 9,663,654 | kg/Miles | 1.38502 | 13,384.35 |

**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%.[2]

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

- Excluding motorcycles, which are not included in these findings, this new total would suggest that (146,971,000) miles less were driven as a result of the above (474,100,000*0.31)
- Approximately 66% of this is petrol and 33% of this is diesel
- This relates to savings of 13,532.1 $tCO_2e$ for diesel (146,971,000*0.33*0.27901/1000)
- And savings of 28,230.16 $tCO_2e$ for petrol (146,971,000*0.66*0.29103/1000)
- Therefore, total savings of at least 41,762.26 $tCO_2e$ 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.

## Renewable Energy Generation

Emissions from fossil fuel burning to supply electricity remains a significant contributor to the borough's emissions, as the majority is provided via the national grid and hence emissions are calculated based on the current composition of energy providers which feed in to this. Therefore, by generating our own renewable energy through large schemes such as solar farms, this can be fed back into the grid and reduce the overall requirement and composition of fossil fuel provision. Hence, this is the method used for calculating the savings possible, identifying how many $tCO_2e$ the renewable generation in our borough will reduce the need for such alternatives.

### Action 3.1. Increase the generation of renewable energy through investment in solar farms to generate 55,000 MWh per year

- The current trajectory for the solar farm estimates that 2 farms will generate approximately 55,000,000 KWh per annum of electricity by 2030.
- However, a further 2 farms are still planned to significantly increase this figure in future, but are not accounted here against the current 2030 target.
- Using the UK Government GHG Conversion Factors, 0.2556 kg $CO_2e$ is emitted for every KWh generated by the current grids composition (including fossil fuels)
- Hence, replacing these fossil fuel related emissions with 55,000,000 KWh generated from purely renewable sources, with 0 emissions, will save **14,058 $tCO_2e$** (0.2556 x 55,000,000 / 1000)
- Emissions here are associated with the generation of electricity at a power station and do not include transmission and distribution for simplicity, though this figure would be marginal.

### Action 3.2. Increased renewable energy generation to generate equivalent to 1550 kWh per household

- There are approximately 2,112 installations of renewable energy in Wokingham, which generates 41,155 MWh renewable electricity (BEIS Sept 2019). Of this, 2,106 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 as reported by SCATTER is currently 26,984.5 MWh. 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.
- The estimated annual generation for the borough by 2030 is 106,938.43 MWh per annum.

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- 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 per annum.**

| Small-scale PV generation | MWh | KWh | kg CO$_2$e | tCO$_2$e |
|---|---|---|---|---|
| Baseline | 26,984.53 | 26,984,530.85 | 6,897,246.086 | |
| 2030 pathway | 106,938.43 | 106,938,426.76 | 27,333,461.88 | 27,333.46 |

**Action 3.2.1** 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.

- From the below table, it is shown that this energy generation relates to an estimated carbon saving of 6.90 tCO$_2$e per annum.

| KWh | kg CO$_2$e | tCO$_2$e |
|---|---|---|
| 27,000 per year | 6,901.20 | 6.90 |

**Action 3.2.2** Support residents and local businesses to reduce their energy usage and carbon emissions and increase the uptake of renewable energy installations

- It is estimated that 15,000 households apply for funding for the installation of PV 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[3]
- Estimated carbon savings 9,585 tCO$_2$e per annum.

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

**Savings this year:**
- With the generation of 42,572.84 MWh renewable electricity in the last recorded year (2020), the borough saved 10,881.62 tCO$_2$e against fossil fuel sources (42,572.84*0.2556).

**Retrofitting Domestic and Commercial**

**Action 4.1 Gorse Ride Regeneration Project**

- The Gorse Ride development consists of the state regeneration of 255 houses which will be design to net-zero carbon standards with no supply of domestic gas.
- There were approximately 70,000 households registered in the borough in 2019.
- It is assumed that the carbon footprint per house is 3.67 tCO$_2$e (256.7/70,000*1000).
- The 255 houses in this regeneration project will therefore provide savings of **935.85 tCO$_2$e per annum** once completed (255 x 3.67).

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[3] Renewable Energy Sources, Carbon Trust 2018

**Action 4.2 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 186.9 $ktCO_2e$ and for domestic electricity is 59 $ktCO_2e$, with 10.8 $ktCO_2e$ from other fuels (BEIS 2019), generating a total of 256.7 $ktCO_2e$.
- As of 2019, there were approximately 70,000 houses registered in the Borough. It is assumed that the carbon footprint per house is 3.67 $tCO_2e$ (256.7/70,000*1000).
- The 2,600 council owned houses will provide carbon savings of **9,542 $tCO_2e$ per annum** (2,600 x 3.67 $tCO_2e$).

**Target 4.3. By 2029 all local schools will be retrofitted**

| Council Baseline (2018) | Electricity kWh | Electricity $tCO_2e$ | Gas kWh | Gas $tCO_2e$ |
|---|---|---|---|---|
| **Schools** | 9,284,409.41 | 2,373.10 | 13,026,155 | 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 $tCO_2e$ and gas related emissions are 2,660.98 $tCO_2e$ per annum.
- Therefore, total potential savings are **5,034.08 $tCO_2e$ per annum.**

**Target 4.4. 75% of Homes to be EPC C rating or above**

- Government EPC figures show that there are currently 57,383 EPC certificates for the borough
- 27,485 of these are currently rated C or above, which is 47.89%
- Aligning this to the 70,000 homes figure from previous calculations, to account for homes missing certificates, this would relate to 33,600 homes.
- Reaching 75% of 70,000 would mean 52,500 homes at C rating or above.
- This is therefore an increase of 18,900 homes.
- As the majority of ratings below C are in the D category, this has been used to find the average savings from improvement.
- It is suggested that going from EPC rating D to C can reduce emissions by up to 80%.
- This would be savings of 2.936 $tCO_2e$ per house, (out of the total 3.67 from, above).
- 2.936*18,900 is **55,490.4 $tCO_2e$ per annum**.

**Carbon Sequestration**

**Action 5.1 Cover 170 hectares with new trees in the form of woodlands, hedgerows and orchards**

- This has a carbon sequestration potential of 7.83 tonnes of $CO_2e$ equivalent per hectare in first year of planting, 13.7 tonnes thereafter within the research average.
- Therefore 170*13.7 = **2,329 $tCO_2e$ per annum**

This is the estimated yearly saving, 2 years after project completion. Trees planted for the project will be UK and Ireland Sourced and grown. This will help with reducing the risk of pests and disease as well as reducing the carbon emissions related to transporting trees from overseas.

**Action 5.2 Carbon sequestration by design - improving carbon sequestration rates in future land management decisions**

**Action 5.2.1 Develop the Wokingham Borough Tree Strategy to support long-term creation and retention of woodland and trees.**

- 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**.
- 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 5.2.2 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 5.2.3 Develop the Local Nature Recovery Strategy to provide complementary funding source to aid land use change (LULUCF being a carbon sink)**

- On assumption that an 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 5.2.4 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.

**Action 5.2.5 Work to transition Grassland Management to less frequent cutting scheme allowing wildflowers to bloom and set seed**

- A goal of **642 $tCO_2e$ per annum** would be targeted to be met in the period 2025 to 2030, similar to the below calculations.

**Action 5.2.6 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.
- Therefore, a total of **642 tCO$_2$e per annum** would be sequestered**.**

**Action 5.2.7 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.
- 300 extra open growing oak trees (or equivalent are planted by 2025 with a pro rata tCO$_2$e sequestration rate of **45 tCO$_2$e per annum.**

**Savings this year:**

- Alongside hedgerows and grassland management, the 15,400 trees planted since October have contributed towards offsetting at least an estimated 2,310 tCO$_2$e (15,400*0.15)
- If one young tree saves approximately 1/100 of a mature one, this is 0.15 tCO$_2$e.
- This is an estimation as it is impossible to exactly calculate, but with the additional measures such as hedgerows etc this is a more accurate figure.

**Waste & Recycling**

The figures used here 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.

**Action 7.1** - **Achieve 70% recycling target.**

**Action 7.1.2 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 13,247.61 tonnes
- 578.99 $KgCO_2e$ is emitted per tonne of food waste going to landfill.
- 21.32 $KgCO_2e$ is emitted per tonne of food waste being recycled.
- As this is garden waste there is no raw material to substitute for.
- 13,247.61*(578.99-21.32)/1000= 7387.79 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+7387.79 = A total of **7,395.10 tCO$_2$e savings per annum**.

**Action 7.1.3 Target low participation areas to increase food waste tonnage to increase participation above 70%**

- Current amount is 6,425.57 tonnes
- Estimated that the average household throws away 1.96kg of food per day[4], which is a total of 715.4kg per year
- For 70,000 households this is 50,078 tonnes (715.4*70,000/1,000)
- If 70% of households can recycle all of this waste (or 70% in total for all households), this would therefore send 35,054.6 tonnes to be recycled rather than landfill (50,0078/2)
- 626.91 $KgCO_2e$ is emitted per tonne of food waste going to landfill.
- 21.32 $KgCO_2e$ 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)*(35,054.6 -6,425.57)/1000 = **36,805.19 tCO$_2$e savings per annum**.

**Action 7.1.4 Increase & improve facilities for glass recycling**

- Current amount is 3,614.38+295.20 = 3,909.58
- The average UK household uses 500 glass bottles and jars every year[5], which equates to 113kg of glass (8oz per glass bottle)
- Again aiming for 70% of households to recycle all of this (or 70% in total for all households) would mean 5,537 tonnes of glass (113*70,000*0.7)/1000
- 8.93 $KgCO_2e$ is emitted per tonne of glass going to landfill.
- 21.32 $KgCO_2e$ is emitted per tonne of glass being recycled.
- 670 $KGCO2e$ is emitted per tonne of raw material produced.
- (670+8.96-21.32)*(5,537 -3,909.58)/1000 = **1,070.25 tCO$_2$e savings per annum**.

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[4] https://www.theecoexperts.co.uk/home-hub/food-waste-facts-and-statistics#:~:text=Average%20food%20waste%20per%20household,kg%20of%20food%20per%20day.
[5] https://www.recyclingbins.co.uk/recycling-facts/

Assuming 27% of the remaining waste (After 70% goes to recycling) is used for combustion to produce energy rather than recycling then savings here arise from the prevention of landfill and related emissions and not having to burn fossil fuels.

- The remaining 27% would all be used for combustion
- Remaining amount is 0.27*71624 = 21487.2 tonnes
- 21.32 $KgCO_2e$ is emitted per tonne from combustion
- 437.37 emitted if going to landfill as residual waste
- Nothing saved from production here.
- 21487.2*(437.37-21.32)= **8,939.75 $tCO_2e$ savings per annum**.

**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 6,872.41 tonnes (8590.51*0.8)
- 1,041.84 $KgCO_2e$ is emitted per tonne of paper or board going to landfill.
- 21.32 $KgCO_2e$ 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) * (6,872.41/1000) = 11,020.05 $tCO_2e$ saved this year.

For aluminium:

- Current amount is 429.52 tonnes (8590.51*0.05)
- 8.93 $KgCO_2e$ is emitted per tonne of aluminium going to landfill.
- 21.32 $KgCO_2e$ is emitted per tonne of aluminium being recycled.
- 1,570 KGCO2e is emitted per tonne of raw material produced.
- (1,570+8.93-21.32) * (429.52/1000) = 669.02 $tCO_2e$ saved this year.

For plastic:

- Current amount is 1288.58 tonnes (8590.51*0.15)
- 8.93 $KgCO_2e$ is emitted per tonne of plastic going to landfill.
- 21.32 $KgCO_2e$ is emitted per tonne of plastic being recycled.
- 6,000 KGCO2e is emitted per tonne of raw material produced.
- (6,000+8.93-21.32) * (1,288.58/1000) = 7,715.51 $tCO_2e$ saved this year.

For glass:

- Current amount is 3909.58 tonnes
- 8.93 $KgCO_2e$ is emitted per tonne of glass going to landfill.
- 21.32 $KgCO_2e$ is emitted per tonne of glass being recycled.

- 670 KGCO2e is emitted per tonne of raw material produced.
- $(3909.58/1000) * (670+8.93-21.32) = 2,570.98$ $tCO_2e$ saved this year.

For Food Waste:

- Current amount is 6425.47 tonnes
- 626.91 $KgCO_2e$ is emitted per tonne of food waste going to landfill.
- 21.32 $KgCO_2e$ is emitted per tonne of food waste being recycled.
- 680 KGCO2e is emitted per tonne of raw material produced on average in Europe.
- $(680+626.91-21.32) * (6425.47/1000) = 8,260.52$ $tCO_2e$ saved this year

For Green Waste:

- Current amount is 13247.61 tonnes
- 578.99 $KgCO_2e$ is emitted per tonne of green waste going to landfill.
- 21.32 $KgCO_2e$ is emitted per tonne of green waste being recycled.
- As this is garden waste there is no raw material to substitute for.
- $(13247.61 /1000) * (578.99-21.32)= 7,387.79$ $tCO_2e$ saved this year

For Wood:

- Current amount is 3021.99 tonnes
- 828.07 $KgCO_2e$ is emitted per tonne of wood going to landfill.
- 21.32 $KgCO_2e$ 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.
- $(3021.99 /1000) * (828.07-21.32)= 2,437.99$ $tCO_2e$ saved this year

For Scrap metal:

- Current amount is 944.1 tonnes
- 8.934 $KgCO_2e$ is emitted per tonne of scrap metal going to landfill.
- 21.32 $KgCO_2e$ is emitted per tonne of scrap metal being recycled.
- 1,900 KGCO2e is emitted per tonne of raw material produced (steel used).
- $(944.1/1000) * (8.934+1900-21.32) =1,783$ $tCO_2e$ saved this year

For Others:

- Current amount is 2797.6 tonnes
- 423.37 $KgCO_2e$ is emitted per tonne of other waste going to landfill.
- 21.32 $KgCO_2e$ is emitted per tonne of wood being recycled.
- 1,622.57 KGCO2e is emitted per tonne of raw material produced (average of others as no official figures available).
- $(2797.6/1000) * (423.37+1622.57-21.32) = 5,664.08$ $tCO_2e$ saved this year

Therefore a total of 47,908.54 $tCO_2e$ saved this year, which is 0.67 $tCO_2e$ per household (47,908.54/70,000)

**Consumption emissions**

Given the total amount of recycled waste is 38,852, this means per household an average of 0.55 tonnes of waste is being reused/recycled (38,852/70,000), against 0.46 tonnes of residual waste, with the majority going towards EfW (only 0.05tonnes to landfill).

While it is impossible to calculate exactly which materials these will relate to, some of the more significant elements can be estimated to demonstrate the separate consumption emissions being produced from the disposal of each material. Therefore, within this household figure, it is estimated that 194.75 $tCO_2e$ arises from residual waste and 11.7 $tCO_2e$ arises from all the recyclables combined.

Figures for consumptions emissions assuming the same composition of waste – 46% residual waste, 54% recyclables. The latter is then broken down into: 22% MDR, 10% glass, 8% wood, 2% scrap metal, 17% food waste, 34% green waste, 7% other.

- Residual: 0.46*423.37= 194.75
- MDR: 0.55*0.22*21.32= 2.58
- Glass: 0.55*0.1*21.32= 1.17
- Wood: 0.55*0.08*21.32= 0.94
- Scrap Metal: 0.55*0.02*21.32= 0.23
- Food Waste: 0.55*0.17*21.32= 1.99
- Green Waste: 0.55*0.34*21.32= 3.97
- Other: 0.55*0.07*21.32= 0.82

**Savings without life-cycle emissions:**

- 38852 tonnes were recycled this year.
- If this amount had gone to landfill it would have produced (423.37*38852)/1000= 16448.77 tonnes
- By recycling this was reduced to (21.32*38852)/1000= 828.32 tonnes
- Therefore there has been a saving of (16448.77-828.32)=15620.45 $tCO_2e$

**Energy from waste:**

- 22770 tonnes of waste going to EfW
- National average of 557kWh/t generated per tonne of waste input in 2020[1]
- This generates 12.68 gWh this year.

## New Development

### Action 8.6 From 2021, 100% council new development is built to carbon neutral standards

### Action 8.6.1 All new council properties will be built to the highest efficiency standards from 2021

It is imperative that both new homes and non-residential 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 prevent any additional emissions.

This section of the action plan focuses on promoting and accelerating the shift to more sustainable behaviours amongst our residents, businesses, schools and community organisations and will feed into the carbon savings achieved elsewhere on this action plan, such as increased use of public transport, as well as reducing out of scope emissions from purchases of goods and services. The majority of the actions are therefore listed as 'Neutral' for their carbon savings.

**Council Emissions**

**Action 11.1.** Reduce by 70% $CO_2$ emissions produced by council related travel by 2030

- A staff travel survey carried out in 2020 to WBC staff in 2020 showed that approximately 3,482,615 miles are driven to WBC workplaces annually (pre-covid).
- In addition, Council staff travelled an estimated 896,957 miles for council work this year.
- Therefore, total staff mileage is 4,379,572 per year.
- A 70% reduction in this total would be 3,065,700.4 less miles (4,379,572 x 0.7)
- This would therefore save **892.21 tCO$_2$e per annum** (3,065,700.4 x0.29103/1000).
- Council EV adoption targets 8 and 7.5 also contribute towards the overall 70% reduction, with the specific 8.1 action's savings included in this total.

   **Action 11.1.1** - Deliver a strategy to reduce grey fleet miles from work related trips by 30%

   - 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.
   - Council staff travelled 896,957 miles for council work this year.
   - 30% of this is 269,087.1 miles (896,957*0.3)
   - Therefore this reduction would save 78.31 tCO$_2$e per annum (269,087.1 x0.29103/1000).

   **Action 11.1.2** - 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 staff travel survey carried out in 2020 to WBC staff in 2020 showed that approximately 3,482,615 miles are driven to WBC workplaces annually (pre-covid)
   - These journeys cause the emission of approximately 1,013.54 tCO$_2$e each year ((3,482,615*0.29103)/1000).
   - A 40% reduction of this would therefore represent 405.42 tCO$_2$e per annum of savings annually (1,013.54*0.4)

   **Action 11.1.3** - Incentivise council staff to mode shift to active and sustainable transport to reduce by 30% the CO2 emissions from staff travelling to work by 2025.

   - A 30% reduction would be as above but 304.06 tCO$_2$e per annum of savings (1,013.54*0.3).

**Action 11.2.1** Council's car fleet becomes entirely ultra-low emission by 2028.

- The council has currently 19 vehicles, of which 16 are owned and 3 are leased, as shown below:

**Owned**

| | |
|---|---|
| Hyundai 1800 2.5 CRDi 5 dr MPV | 5000 |
| Ford Connect 210 LWB 1.6 95ps Van | 12000 |
| Ford Ranger Pick-Up (54 reg.) | 7000 |
| Rodeo Denver Max D/C Pick-Up (2009) | 7000 |
| Ranger XL 4x4 TDCI | 10000 |
| Landini Agricultural Tractor | 7675 |
| Peugeot Expert Professional | 7675 |
| EV Van | 7675 |
| Ford Tourneo Connect 8-Seat Minibus | 2400 |
| Ford Transit Connect Van | 7675 |
| Vauxhall Vivaro 9 seat Minibus (2012) | 7675 |
| Ford Transit Tourneo 9-Seat Minibus (2009) | 7675 |
| Ford Transit 17-Seat Minibus | 7675 |
| Ford Tourneo Connect Trend 8-Seat Van | 7675 |
| Ford Transit 17-Seat Minibus | 7675 |
| Nissan E-NV200 Panel Van (Electric) | 7675 |

**Leased**

| | |
|---|---|
| Vauxhall Vivaro Combi | 7675 |
| Ford Transit Connect 1.8 | 7675 |
| Citroen Berlingo Van 1.6 | 7675 |

- 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 therefore **45.39 tCO₂e per annum**, following the GHG Accounting tool emission factors where this is used (this includes energy for the EV's).

## Action 11.3 By 2030 All council CCS 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, as these are been addressed in target 15. Therefore, electricity related emissions for the council estate are 1,496.66 tCO₂e per annum.
- An additional 3,259 tCO₂e 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 tCO₂e per annum (2018 baseline year).
- The total carbon dioxide emissions council estates / corporate property portfolio excluding schools for 2018 baseline are **6,612.30 tCO₂e.**

| Council Baseline (2018) | | Electricity kWh | Electricity tCO₂e | Gas kWh | Gas tCO₂e |
|---|---|---|---|---|---|
| **Council Property** | | 5,855,473.60 | 1,496.66 | 9,088,705 | 1,856.64 |
| **Transmission and distribution factors** | | | 3,259.00 | | |
| | | | | Total CO2 emissions | **6,612.30** |

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