Net Zero Carbon Emissions Trajectory for Three Rivers District Council

Report

Report produced in July 2022

APSE (Association for Public Service Excellence) is a not for profit local government body working with over 300 councils throughout the UK. Promoting excellence in public services, APSE is the foremost specialist in local authority front line services, hosting a network for front line service providers in areas such as waste and refuse collection, parks and environmental services, leisure, school meals, cleaning, housing and building maintenance.

APSE Energy is APSE's local authority energy collaboration. The vision for the collaboration is to form an "effective collaboration of a large number of local authorities to enable and facilitate the local municipalisation of energy services. By this we mean the public and community, as well as private, ownership and managerial control of local energy generation, supply networks and delivery of energy efficiency works. Local authorities working together in this way would have great influence and would be able to deliver economies of scale in green energy to promote economic growth and combat fuel poverty.

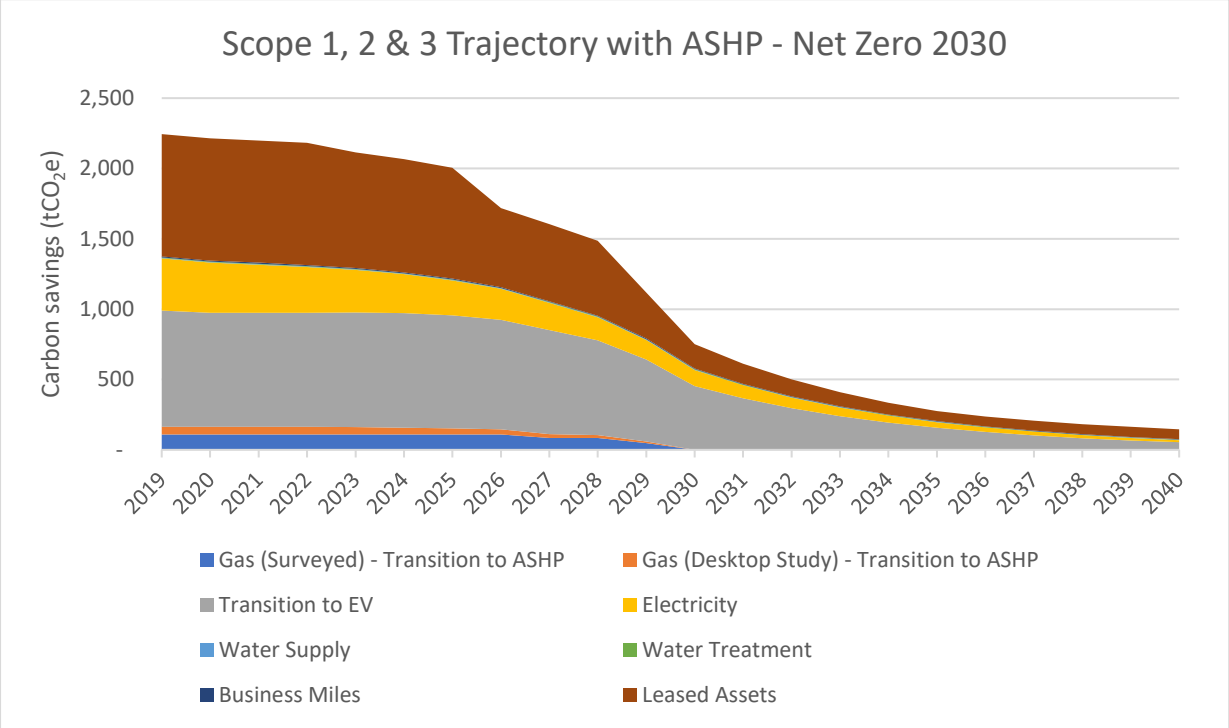
Association for Public Service Excellence
3rd floor Trafford House
Chester Road, Old Trafford
Manchester, M32 0RS
Telephone: 0161 772 1810
fax: 0161 772 1811
Email: enquiries@apse.org.uk
Web: www.apse.org.uk

Contents

Executive Summary

This report shows calculations for the carbon emissions baseline of Three Rivers District Council and an estimated projection of emissions after interventions are made with a net zero carbon target of 2035.

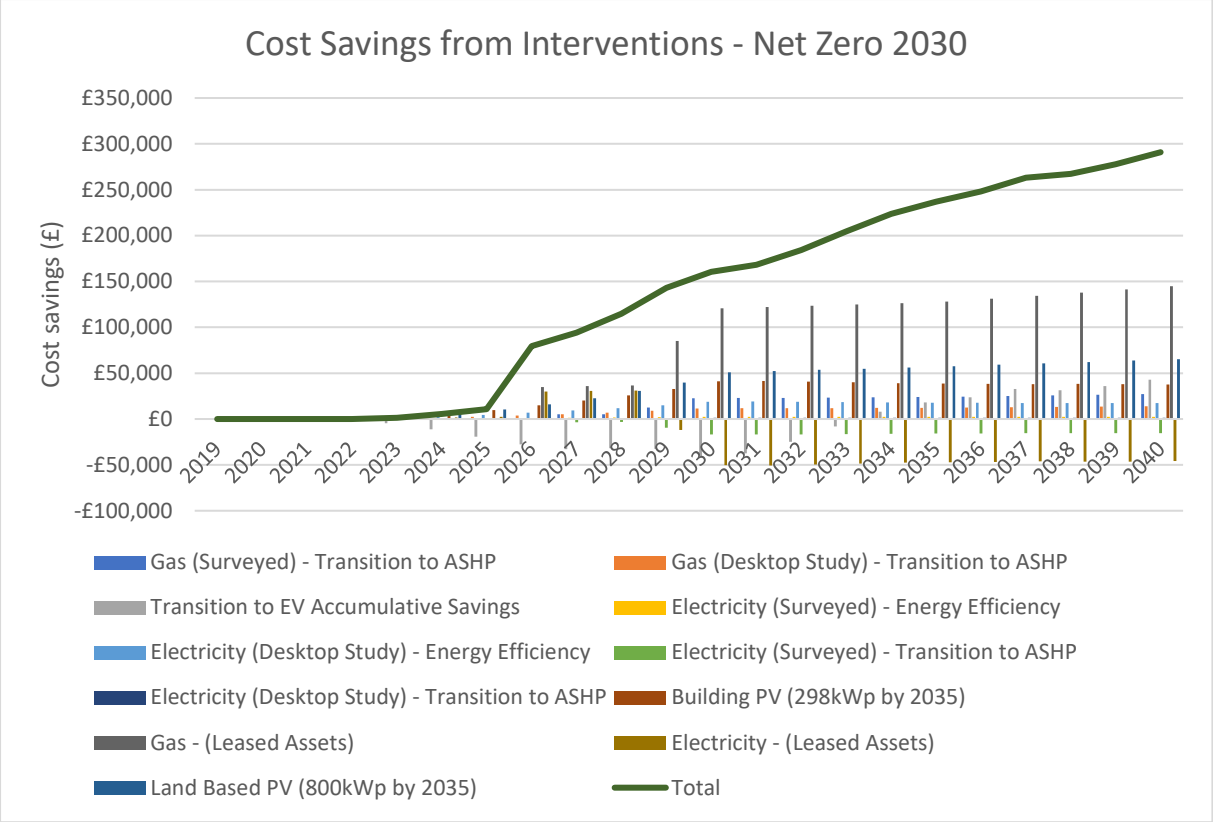
The trajectory below shows a projection of the Scope 1, 2 and known Scope 3 carbon emissions for the net zero targets of 2030 and 2035 respectively. The total emissions from all Scope 3 sources are not known to date.



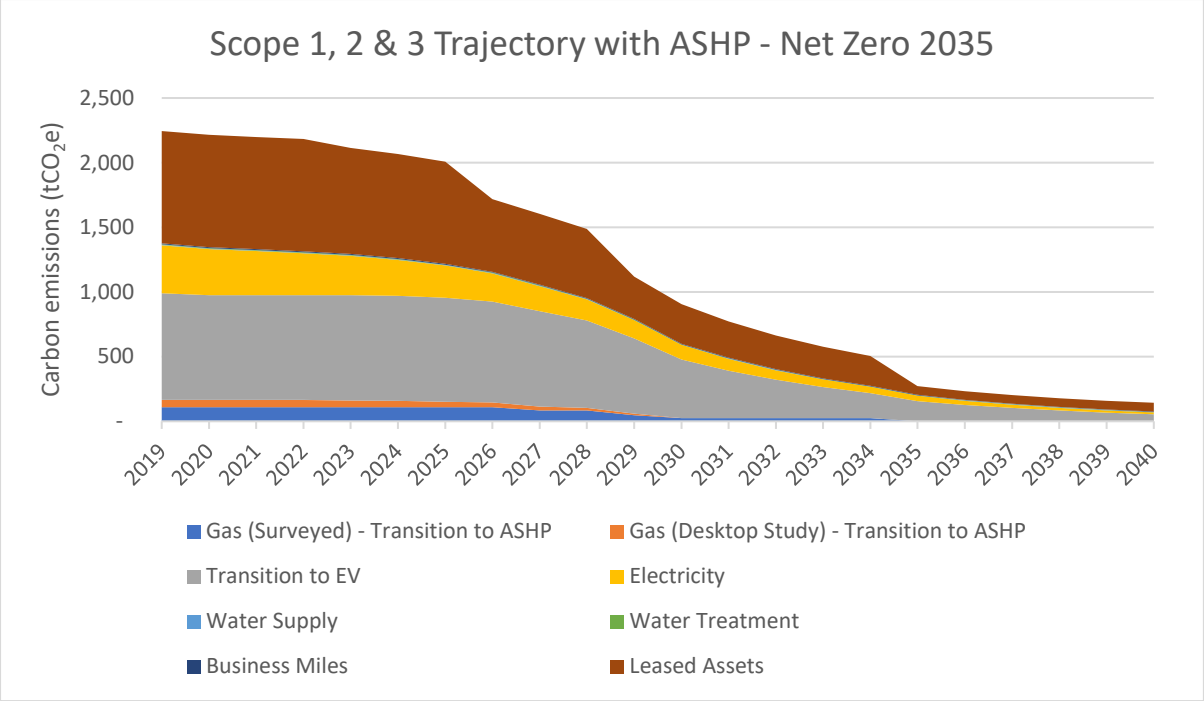
This trajectory represents an overall saving of 1,493tCO$_2$e (67%) when comparing 2019 to 2030.

It is estimated that there will be 751tCO$_2$e from hard to reduce sources that will be unavoidable by 2030 that will need to be offset, and it is assumed that this can be offset through a land – based PV and tree planting scheme which will cost £736,360 combined.

Carrying out the recommended initiatives will result in financial savings over the term as shown in the chart below:



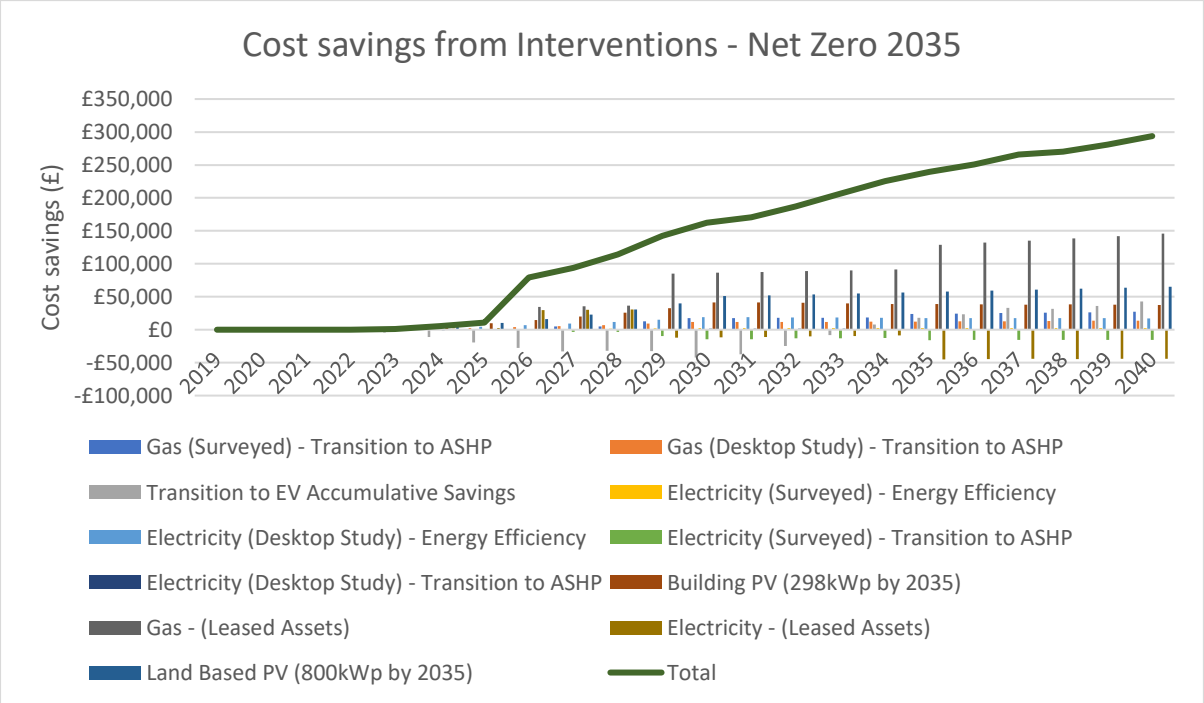
It is estimated that a financial budget of £19million is required to reach net zero carbon by 2030 for corporate assets by being more energy efficient in buildings, installing air source heat pumps, generating power, and developing a tree planting scheme. It is estimated that these initiatives will financially benefit the Council by £160,626 per year in 2030.



This trajectory represents an overall saving of 1,706tCO_2e (71%) when comparing 2019 to 2035.

It is estimated that there will be 271tCO_2e from hard to reduce sources that will be unavoidable by 2035 that will need to be offset, and it is assumed that this can be offset through a land – based PV and tree planting scheme which will cost £725,940 combined.

Carrying out the recommended initiatives will result in financial savings over the term as shown in the chart below:



It is estimated that a financial budget of £19million is required to reach net zero carbon by 2035 for corporate assets by being more energy efficient in buildings, installing air source heat pumps, generating power, and developing a tree planting scheme. It is estimated that these initiatives will financially benefit the Council by £239,663 per year in 2035.

Three Rivers District Council Net Zero Carbon Emissions

1 Introduction

This report provides the findings of the carbon footprint calculations for Three Rivers District Council which can be used as a benchmark to record current emissions and to track performance against future emissions. The carbon footprint has been undertaken in accordance with best practise guidance by the Greenhouse Gas Protocol[1] and calculated using 2019 conversion factors for the carbon dioxide equivalent (CO_2e is explained further in Section 2.2) published by the Department for Business, Energy & Industrial Strategy (BEIS)[2].

The reporting compares the financial years of 2018/19, 2019/20 and 2020/21.

The carbon footprint is categorised into scopes, which cover:

Scope 1 (direct) emissions are from activities owned or controlled by the Council. Examples of Scope 1 emissions include emissions from combustion in council owned or controlled boilers, furnaces and vehicles.

Scope 2 (indirect) emissions are associated with purchased electricity, heat, steam and cooling. These indirect emissions are a consequence of the Council's energy use, but occur at sources that the Council do not own or control. Examples include grid supplied electricity and heat provided through a heat network.

Scope 3 (other indirect) emissions are a consequence of the Council's actions that occur at sources the Council do not own or control and are not classed as Scope 2 emissions. Examples of Scope 3 emissions include business travel by means not owned or controlled by the Council (grey fleet), disposing of the Council's own waste and purchased goods in the supply chain, etc.

2 Carbon Footprint

2.1 Carbon Reporting Boundaries

The organisational boundaries determine what emission are the responsibility of the Council or others. This can be based on who owns, operates, or exerts control over certain assets and can be based on financial or operational control. The buildings categorised under Scope 1 & 2 within this reporting are those where energy is purchased or acquired and consumed by

[1] https://ghgprotocol.org/guidance-0
[2] https://www.gov.uk/government/collections/government-conversion-factors-for-company-reporting

the Council. The vehicles categorised under Scope 1 are vehicles that the Council own, lease and operate purely for the Council's own operations.

Scope 3 emissions are classified under 15 different categories as detailed under Appendix C. As Scope 3 emissions are under the influence of the Council, but not under its direct control, it can be difficult to obtain the necessary data to calculate the associated carbon emissions from some Scope 3 sources. One of the larger contributors to carbon emissions is purchased goods and services.

Emissions from assets a company owns and leases to another entity, but does not operate, can either be included in Scope 3 or excluded from the inventory.

Table 3 below shows all of the sources that make up the reporting boundary for the Council, within this report.

The emissions from these sources represents a good data set for a Council, as it is not uncommon for Councils to only have data available for electricity and gas only.

There are sources that are missing from the reporting and the largest contributor is likely to be from purchased goods and services, which is generally very difficult to gather data and calculate emissions. This category includes all upstream (i.e. cradle-to-gate) emissions from the production of products purchased or acquired by the Council in the reporting year. Products include both goods (tangible products) and services (intangible products).

Cradle-to-gate emissions include all emissions that occur in the life cycle of purchased products, up to the point of receipt by the Council. Relevant purchases to the Council may include capital goods, such as office supplies, office furniture, computers, telephones, travel services, IT support, outsourced administrative functions, consulting services, janitorial, landscaping services, maintenance, repairs and operations.

The Council should set up procedures to record all emission sources related to its operations for future reporting, and it is likely that the overall emissions will increase as the data quality improves.

2.2 Carbon Emissions

Appendix A (previously provided) is an Excel spreadsheet that shows a breakdown of the emissions by source. APSE Energy have calculated the carbon emissions for 2019/20. Appendix A shows a summary for emissions and separate tabs showing a breakdown for each source in 2019/20.

Emissions are calculated as carbon dioxide equivalent (CO_2e), which is a term used to combine the seven most threatening gases that have the highest Global Warming Potential. This includes carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride and nitrogen trifluoride.

The carbon footprint has been calculated using the best data that was available to the Council during the reporting year and it is the Council's responsibility to confirm the accuracy.

2.2.1 Emissions for 2020/21

The set of data below shows a summary of the most recent year available of 2020/21.

Table 1: Carbon emissions by source for 2020/21

2020/2021			
Emissions Source	**Scope**	**% Split**	**tCO2e**
Gas	1	5%	109
Vehicle - Council owned	1	40%	863
Electricity	2	9%	184
Gas - WTT	3	1%	14
Vehicle - Council owned - WTT	3	10%	207
Electricity - T&D	3	1%	16
Electricity - WTT	3	1%	28
Water Supply	3	0.1%	2.9
Water Treatment	3	0.3%	5.7
Vehicle - Employee	3	0.3%	5.6
Leased Assets	3	33.4%	718
Total	_	**100%**	**4,570**

Chart 1: Carbon emissions by source for 2020/21

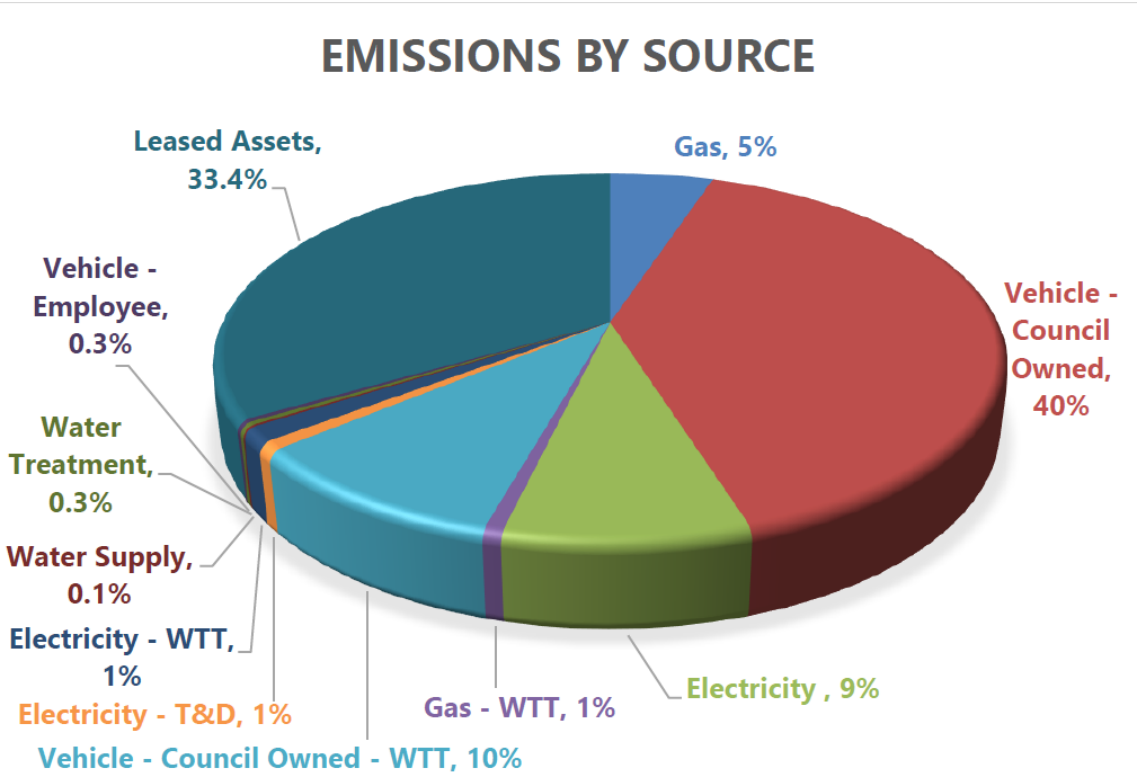
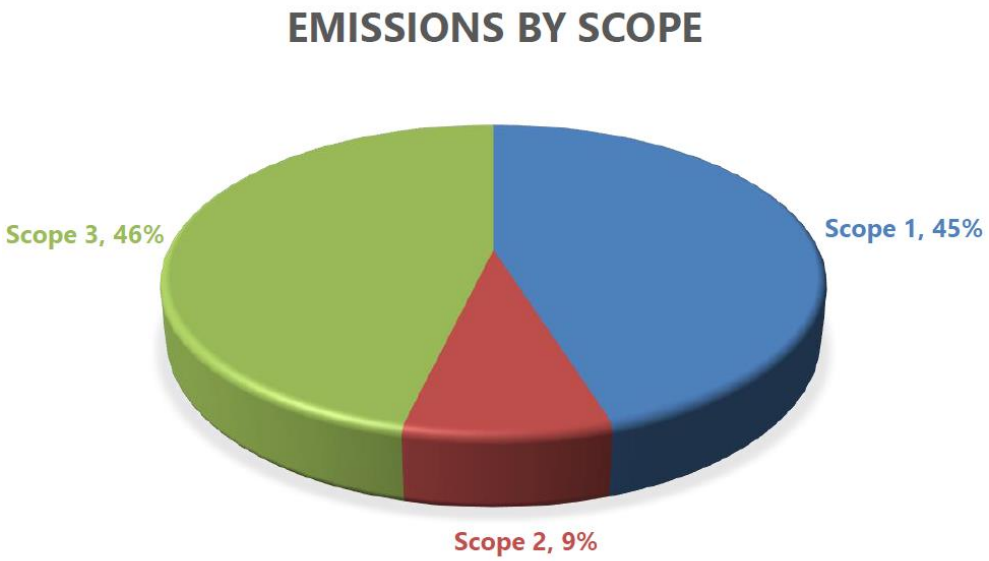


Table 2: Carbon emissions by scope for 2020/21

Emissions Source	% Split	tCO2e
Scope 1	45%	972
Scope 2	9%	184
Scope 3	46%	997
Total	**100%**	**2,153**

	Tonnes of CO_2e		
	Apr 2018 – Mar 2019	**Apr 2019 – Mar 2020**	**Apr 2020 – Mar 2021**
Scope 1 - Direct Emissions	**994**	**989**	**972**
Natural Gas	136	131	109
Council Owned Vehicles	858*	858*	863
Scope 2 – Electricity Emissions	**340**	**273**	**184**
Total Scope 1 & 2 Emissions	**1,333**	**1,263**	**1,156**
Scope 3 – Indirect Emissions	**894**	**1,128**	**997**
Gas – Well to tank emissions	19	17	14
Council Owned Vehicles - Well to tank emission	202	204	207
Electricity – Distribution and transmission emissions	29	23	16
Electricity – Well to tank emissions	55	41	28
Water Supply	N/A	2	3
Water Treatment	N/A	5	6
Employee Vehicle emissions	21	7	6
Leased Assets	569	827	718
Total Gross Emissions	**2,227**	**2,390**	**2,153**
Carbon offset	0	0	0
Solar PV Exported	0	0	0
Total Net Emissions	**2,227**	**2,390**	**2,153**
Further Information			
Solar PV Generated	15,098	16,981	23,362
Degree Days at 15.5 ^{O}C	1,757	1,856	1,875
(an indicator of heat demand)			
Total electricity kWh	1,199,498	1,069,206	790,348
Total gas kWh	737,763	714,341	593,671

Chart 2: Carbon emissions by scope for 2020/21



2.2.3 Comparison of Emissions for 2018/19, 2019/20 and 2020/21

Table 3: Difference in carbon emissions by year

* See 3 Notes and Observations Scope 1 &2 (page 11) re 'Consumption data was only provided for council owned vehicles in 2020/21'.

Chart 3: Scope 1 carbon emissions by year

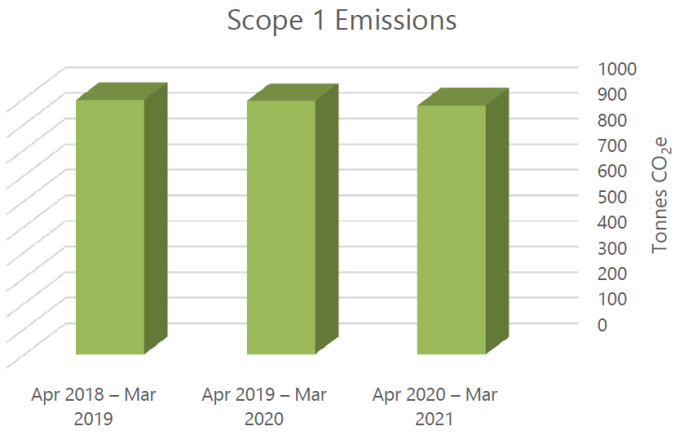


Chart 4: Scope 2 carbon emissions by year

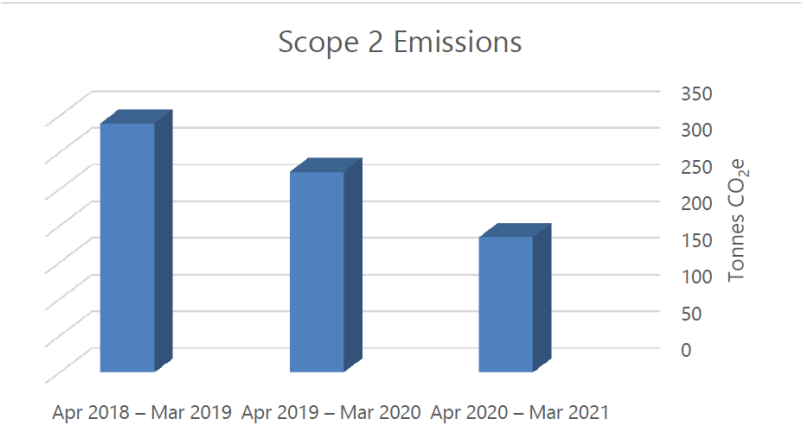


Chart 5: Scope 3 carbon emissions by year

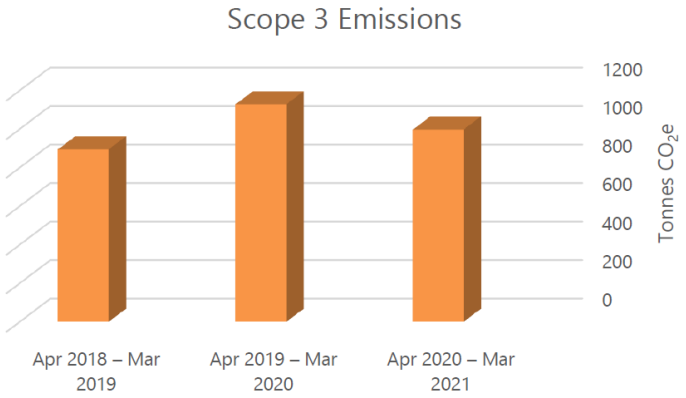
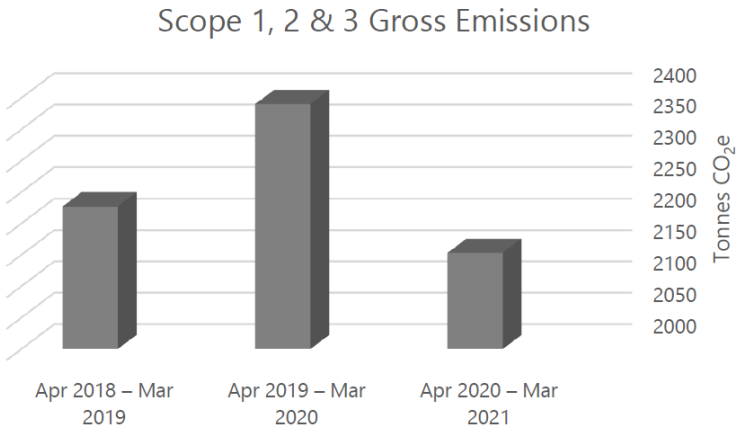


Chart 6: Scope 1, 2 & 3 carbon emissions by source by year



3 Notes and Observations

3.1 Scope 1 & 2

Appendix A is an Excel spreadsheet that shows a breakdown of the emissions by source and makes a comparison between 2018/19, 2019/20 and 2020/21. This can be used to develop a carbon strategy by identifying and approaching assets with the highest emissions.

There are two recordings for gas usage at Watersmeet, which is assumed to be because there are two gas meters on site. The gas consumption for Watersmeet Theatre 1 and 2 is recorded twice in 2018/19 (195,566kWh). This was confirmed as an error and an average has been applied for gas meter 1 and used in 2018/19.

The sites below are recorded as having zero consumption between 2019 and 2021 as the utility companies will not provide meter reading and charges:

- Baldwins Lane Pavilion
- King George V Pavilion
- Oxhey Bowls Pavilion

Consumption data was only provided for council owned vehicles in 2020/21, not for 2018/19 or 2019/20. The Council had been recording the average emissions from vehicles through the last 9 years and the average is 858, which has been used for the missing years - 2018/19 and 2019/20.

3.2 Scope 3

The Council acknowledge that there is a lot of missing data for water consumption. Going forward water supply and treatment data should be recorded as it is issued from the supplier.

4 Recommendations for gathering data going forward

4.1 Scope 1 and 2 Emissions

The Council should develop a procedure for gathering and storing data as it is made available. The benefit of this is that the carbon reporting process is streamlined and progress towards targets can be tracked.

APSE Energy can support by gathering data on behalf of the Council and storing it on energy management software. The Council will be provided with password protected access to the cloud-based database so it can access the data and generate cost and carbon reports. APSE Energy can use this data to provide streamlined reporting to the Council in subsequent years.

4.2 Scope 3 Emissions

Scope 3 emissions are separated into 15 different categories which includes waste, staff travel and the purchased goods supply chain. Scope 3 emissions can amount to a higher proportion of total emissions than Scope 1 and 2 combined and represent the most significant opportunity to reduce carbon emissions and the impact to climate change. So, understanding these risks through accurate and consistent measurement, evaluation and reporting should improve both resilience and reputation.

ASPE Energy can provide further guidance on how to gather Scope 3 data from third parties and assist in calculating emissions.

<u>Waste</u>

It is apparent that the Council were only measuring its waste from the Three Rivers House which includes the Police who operate out of the same building, but not the depot or other sites.

Apart from Covid and the office closure causing a massive reduction in waste – the two years previous to this involved a massive clear out as the Council moved from "paper" to digital, and refurbished and modernised the office which included the disposal some furniture.

The method of recording waste from Three Rivers House has been questioned and it was decided to exclude waste from this reporting period due to the accuracy.

<u>Transmission and Distribution</u>

Transmission and distribution (T&D) factors are used to report the Scope 3 emissions associated with grid losses (the energy loss that occurs in getting the electricity from the power plant to the premises). 13

Well to Tank

Fuels have indirect Scope 3 emissions associated with the production, extraction, refining and transport of the fuel before their use known as Well-to-tank (WTT). WTT emissions have been recorded for:

- Electricity
- Gas
- Transmission and Distribution
- Council Owned Vehicles

5 Pathway Methodology

5.1 Energy Efficiency

The energy and carbon data were taken from energy audits for 15no. sites: The Aquadrome, Baldwins Lane Pavilion, Barn Lea Hall, Basing Bowls Pavilion, Basing House, Chorleywood Cemetery, King George V Pavilion, Leavesden Pavilion, Maple Cross Pavilion, Oxhey Pavilion Green Lane, Rickmansworth Golf Course, Scotsbridge Pavilion, South Oxhey Leisure Centre, Watersmeet Theatre and William Penn Leisure Centre. For these sites recommendations have been made based on the type of building and what suitable improvements could be made. Three Rivers House was not surveyed by APSE Energy however, it is known that heat pumps are to be installed in December 2022 and this is reflected in the trajectory.

For the remaining sites that were not audited the energy data has been taken from the prior carbon footprint report, and a more generic approach has been taken to produce a carbon trajectory report. These methods have been detailed below in sections 5.2, 5.3 and 5.4. Appendix B shows generic measures that could be taken to reduce energy usage from the 2019/20 baseline emissions. This is a desktop assessment based on the consumption data and typical saving initiatives and is not based on site survey information. Estimated energy savings and forecast capital costs shown are for representative purposes to give an illustrative outcome and should not be used for budgeting purposes.

The trajectory and savings detailed in Appendix B can be used as a KPI to track performance of reducing emissions against the 2019/20 baseline year.

The Council should be able to achieve significant carbon and cost savings by reviewing its maintenance policies to specify highly efficient plant and services, and low emission vehicles, rather than replacing like-for-like. Changing policies to specify materials with low embodied carbon should also reduce Scope 3 emissions by considering the carbon life cycle cost in terms of the supply chain, operation and decommissioning.

It is recommended that a detailed audit and feasibility study is carried out for all remaining assets to determine the site-specific initiatives. This will provide an indication of the realistic interventions that could be provided and the likely cost savings, capital cost and carbon savings. The trajectory should be treated as a live document and updated once more accurate information is available following site surveys.

The following assumptions have been made which can be updated once more information is available:

- future CO_2 emissions and tariff rates have been taken from the Treasury Green Book supplementary appraisal guidance on valuing energy use and greenhouse gas (GHG) emissions published by BEIS[3]. These emissions factors include transmission and distribution losses, including significant losses due to power station inefficiency meaning that the emissions factors differ slightly to those calculated in Section 2;
- BEIS have not published future CO_2 emission factors for natural gas. Although it is likely that the carbon emissions factor of gas will decrease as non-fossil fuel gases are injected into the grid, such as hydrogen, the applied emissions factor of gas in this pathway was constant for each year;
- the energy costs are calculated using the retail fuel price which includes the Climate Change Levy but excludes standing charges that are not directly impacted by consumption fluctuations;
- the intervention capital cost is calculated by multiplying the typical payback of the intervention by the annual energy cost savings, with the exception of heat pumps which is explained later;
- not all interventions are applicable to each site e.g. replacement lighting is the only intervention that is assumed in car parks; and no savings are projected on certain assets such as door entry or CCTV;
- the pathway is based on current technology available today and assumes that all interventions could be delivered by 2035.

[3] https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

5.2 Interventions for Reducing Gas usage (Heat)

Generic interventions for heating (gas usage) include:

Intervention	Saving on Heat Demand	Payback in Years	Detail
More efficient plant	20%	8	Could include more efficient boilers
Controls	15%	5	Could include a new or optimised BMS for larger sites and controllers and TRVs for smaller sites
Insulation	15%	10	Could include building fabric insulation, draught proofing, pool cover and pipework insulation
Other	15%	5	Could include more efficient heat emitters, heat recovery and distribution improvements

It should be noted that savings from these interventions have been calculated concurrently rather than independently i.e. each intervention reduces the heat demand following on from the previous intervention. For example:

- 100kWh less 20% saving from more efficient plant = 80kWh >
- 80kWh less 15% saving from controls = 68kWh >
- 68kWh less 15% saving from insulation = 58kWh >
- 58kWh less 15% saving from 'other' = 49kWh
- Total reduction = 51%

5.2.1 Heat Pumps

Using heat pumps is a good initiative for heating systems because the carbon factor of electricity will reduce as the grid is decarbonised; and due to their efficiency and Coefficient of Performance (COP). For a heat pump, a COP value of 3 means that 1kW of electric energy is needed to generate 3kW of heat.

Replacing gas boilers with heat pumps can be very expensive. This is because the existing boilers distribute heat at around 80°C and heat pumps distribute heat at around 50°C. It is most likely that an ASHP installation would require design, high levels of insulation, low levels of air infiltration, controls, an external location for plant and possible upgrade of

emitters and pipework. In most cases, it is assumed that the cost to retrofit an existing site with a heat pump and the associated infrastructure would be disproportionate compared to the benefits unless financial incentives are used such as the Renewable Heat Incentive or grant funding as with the Public Sector Decarbonisation Scheme.

Heat pumps will also increase the building's electricity demand. This could be offset by reducing the electricity usage through other methods, such as LED lighting, but in most cases the overall electricity consumption is likely to increase. An investigation is required to review the buildings Maximum Demand, Maximum Import Capacity, and new electrical load to determine if a larger electrical incoming supply is required. The Distribution Network Operator should also be contacted to understand any restrictions on the grid in the local area.

A detailed feasibility study is required for each building to review the viability of low carbon heating.

It is very difficult to estimate the capital cost for heat pumps. A Ground Source Heat Pump (GSHP) is more efficient than an Air Source Heat Pump (ASHP) but is generally much more expensive as it involves significant ground works to bury the slinkies. The costs are also heavily affected by the heat emitters as it is likely that the radiators and pipework will need to be replaced at a high cost, plus the cost to increase the electrical supply can be very high, but these elements are not normally known without a detailed investigation.

Barton Way Pavilion was not surveyed and a capital cost estimate for an ASHP was based on the costs from the energy audits for other Three Rivers properties and apportioned for Barton Way Pavilion based on the kWh gas used for heating.

It is likely that changes in technology will mean that options for more low carbon heating systems will be available by 2035.

5.3 Interventions for Reducing Electricity Usage

Generic interventions for electricity include:

Intervention	Saving on Electricity Usage	Payback in Years	Proportion of building services	Apportioned saving across whole building	Detail
LED Lighting and Control	60%	6	33%	20%	Replace existing luminaires with LED & automatic control
Controls and HVAC	15%	5	41%	6%	Controlling building services with a BMS
Office Equipment	15%	5	15%	2%	Replacing aging equipment with more efficient equipment
Other	15%	5	11%	2%	Could include variable speed drives, motors, hand dryers

*Building information sourced from the Chartered Institute of Building Services Engineers (CIBSE)

Savings from these interventions have been calculated independently from the total electricity usage and their estimated proportion to building services e.g. lighting is assumed to account for 33% of all electricity usage in a building and a potential saving of 60% could be achieved from installing LED lighting and control which leads to an apportioned whole building saving of 20%.

A change in policies to upgrade existing building services to the most efficient option through planned maintenance, and upgrade fossil fuel vehicles to low emission vehicles when they are due to be replaced, will impact the action plan significantly.

5.4 Project Phasing

For the audited premises the replacement of a specific building's boilers have been programmed to begin at the end of their useful life (15 years) depending on the net zero target year. For the buildings that have boilers that are not yet 15 years old in 2029 with a target year of 2030 it has been programmed that their replacement commences in 2029 and if the target year is 2035 the replacement is set to commence in 2034 if not yet 15 at that point to keep in line with the Council's net zero emissions plan.

For the remaining buildings, replacing boilers have been programmed to start in 2023 and end by 2030, with the delivery of projects ramping up each year. This is shown in the table below.

	2023	2024	2025	2026	2027	2028	2029	2030
Percentage of Projects Delivered Per Year	5%	8%	10%	12%	13%	15%	17%	20%

All other projects have been programmed to start in 2023 and end in 2030, due to other projects such as LED lighting and installing solar panels stack up financially and should be completed without delay. It assumed that all vehicles will be upgraded to low emission vehicle by 2030 as there is a draft plan to ban the sale of all new petrol and diesel vehicles by 2030.

6 Achieving Net Zero Target of Council Emissions

A "net zero" target refers to reaching net zero carbon emissions by the nominated year of 2035, as provisionally chosen by the Council, but differs from zero carbon, which requires no carbon to be emitted at all.

Net-zero refers to balancing the amount of emitted greenhouse gases with the equivalent emissions that are either offset or sequestered through rewilding and tree planting or carbon capture and storage. It is much more beneficial to reduce carbon emissions and then offsetting techniques can be used for hard to reduce emissions.

6.1 Power Generation

6.1.1 Solar Panels on Buildings

The model assumes that 298kWp of PV could be installed by 2030. As the Council has around 20 buildings it is assumed that this is the expected total size of PV and it is recommended to carry out a detailed feasibility study across the estate to review the suitability of buildings.

6.1.2 Solar Panels on Land

The trajectory assumes that 800kWp land-based PV has been installed which would count towards carbon offsetting, this could be done in an open space such as grassland or a car park canopy. This is considered a carbon offset as it is assumed that the system will connect directly to the electricity grid rather than connect directly to Council owned buildings through a private wire.

The amount of available land for PV is unknown at this stage. It is recommended to carry out a detailed feasibility study to determine the amount of generation that could be possible via land-based PV.

6.2 Water Supply and Wastewater

Water supply and wastewater combined account for 0.3% of the total emissions and 7.2tCO_2e. However, simple measures can be taken to reduce water usage and cost such as installing low flow appliances and fixing leaks.

It is recommended to enter a consolidated water contract so that all supplies are on a group contract for both supply and wastewater. Conditions of the contract could be that Automatic Meter Readers (AMR) are installed which will improve the accuracy of billing and can also be configured to identify leaks quickly.

It has been assumed that emissions from water supply and wastewater will reduce by 5% annually up to 2035.

6.3 Business Miles

Business miles account for 0.3% of the total emissions and 7.4tCO_2e.

It has been assumed that emissions from business miles will reduce by 5% annually up to 2035.

6.4 Leased Assets

Leased Assets account for 39% of the total emissions and 869tCO_2e.

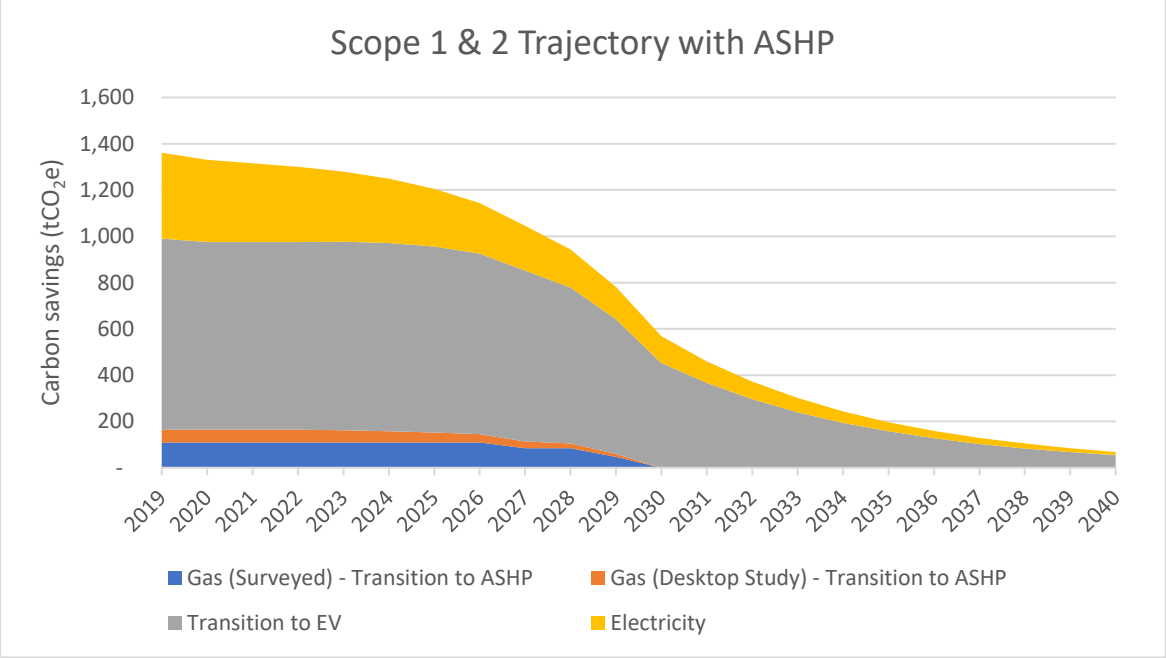
For the surveyed properties (South Oxhey Leisure Centre and William Penn Leisure Centre) the calculations for the emissions trajectory have been done in the same way as the surveyed properties detailed in Section 5.1 – Energy Efficiency. Sir James Altham pool is to be decommissioned in 2025 and the carbon trajectory reflects this to removes the associated emissions entirely. For the other unsurveyed property (the Fairway Inn) it has been assumed that the emissions will reduce by 5% annually.

6.5 Trajectory to 2040

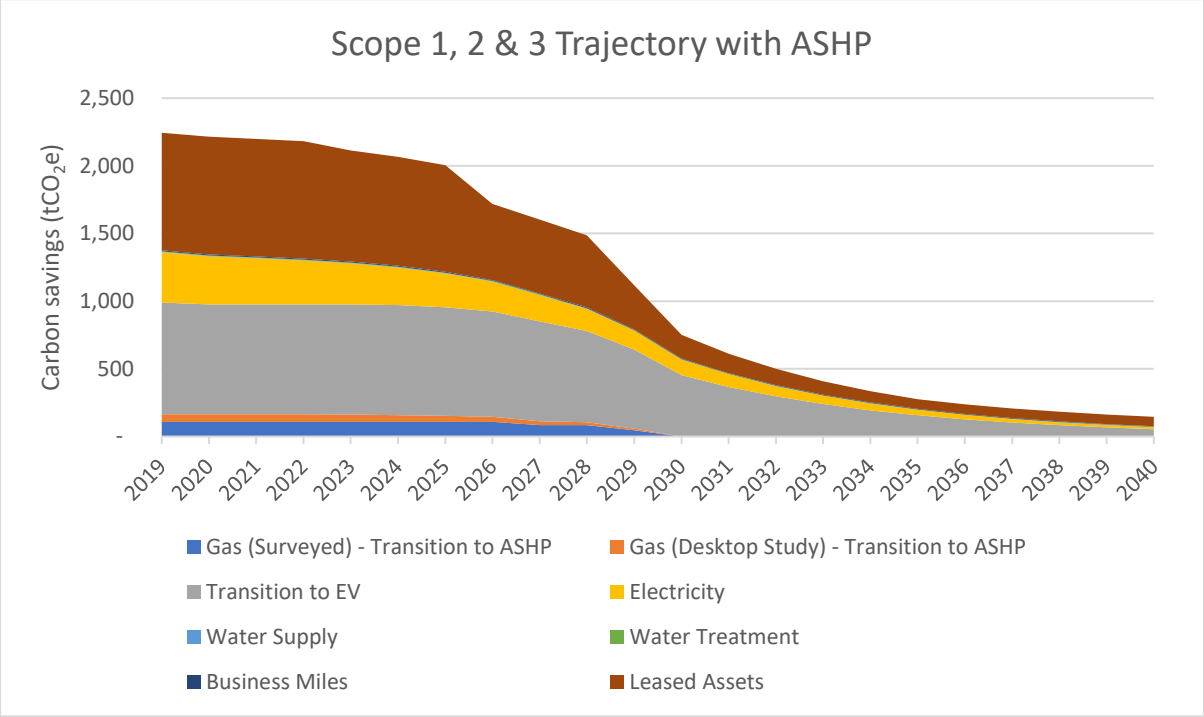
Future emissions data was taken from the Treasury Green Book supplementary appraisal guidance on valuing energy use and greenhouse gas (GHG) emissions.

A breakdown of the year-on-year carbon savings can be found in Appendix B.

For comparison's sake the following two trajectory graphs show the carbon trajectories of scope 1, 2 & 3 emissions for a net target zero year of 2030:



The graph above shows the carbon savings when installing heat pumps and removing gas boilers entirely by 2030. This is a carbon saving of 58% compared to 2019/20 if replacing gas boilers with ASHP.

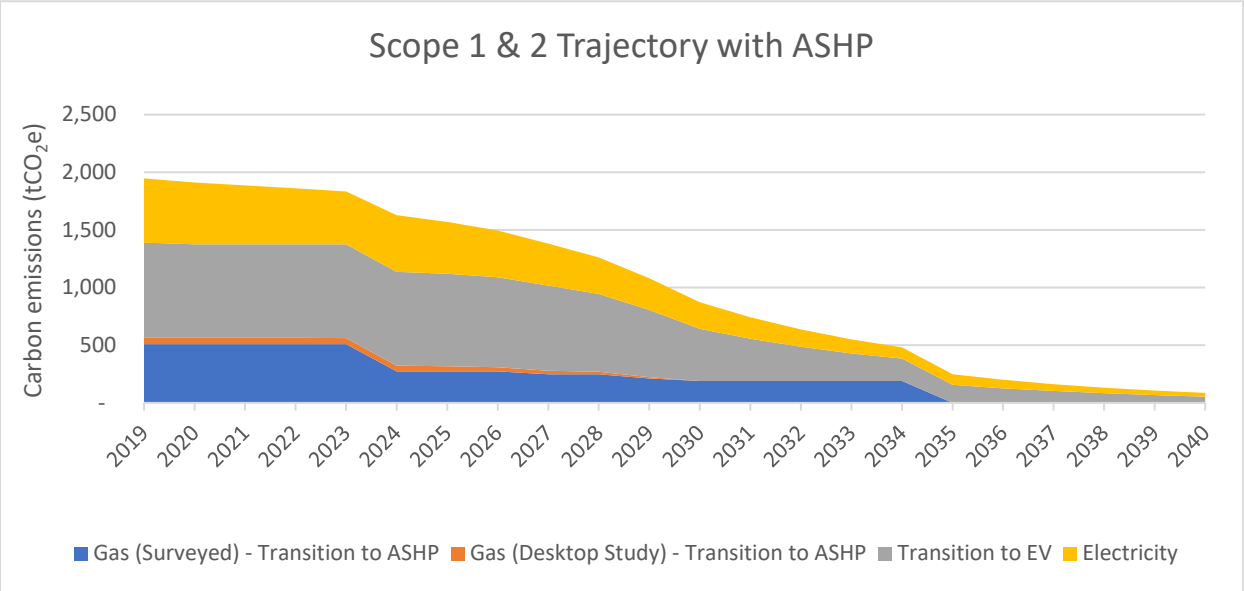


The trajectory in the graph above shows that there are 751tCO_2e that are unavoidable up to 2030 if boilers are replaced with ASHP. This is the amount of carbon that will need to be offset to balance the emissions that cannot directly be removed based on current technology and within a reasonable budget.

The following trajectory graphs unless indicated otherwise will be the carbon/cost trajectories assuming the boilers are replaced by ASHP with a net zero target year of 2035. This is due to the carbon savings being higher than replacement with electric heaters and it will be more realistic to replace the boilers nearer 2035 as they will not be nearing the end of their useful life by 2030.

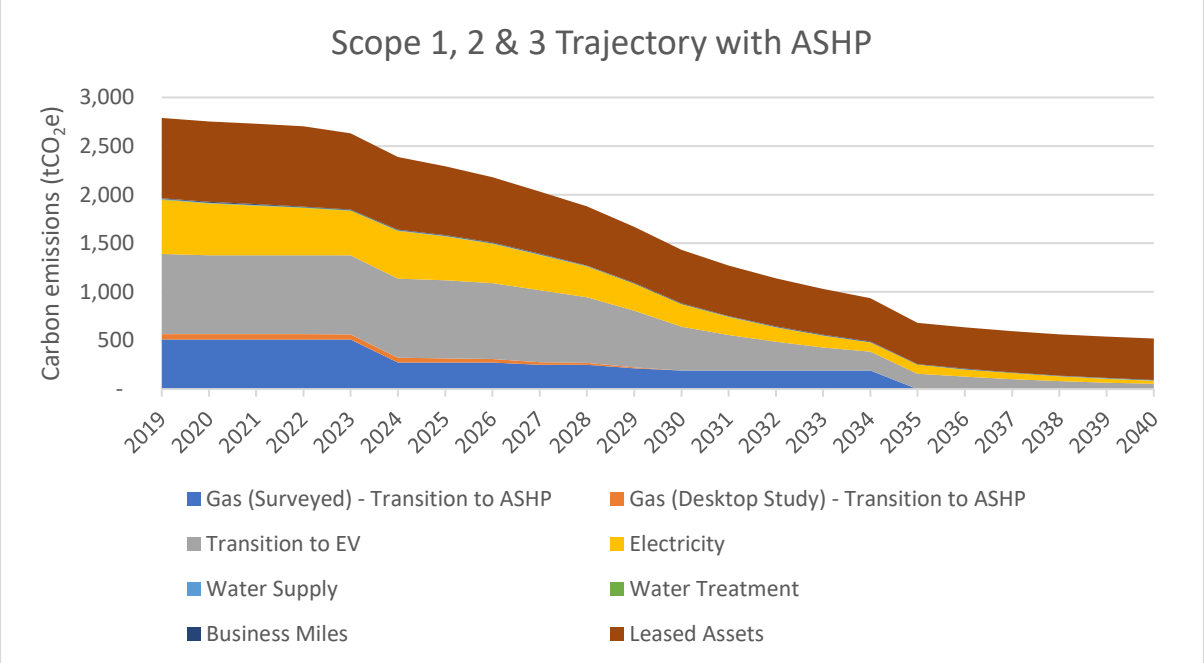
The graph below shows the carbon emission trajectory if the Council replaced the boilers with ASHP.

Carbon Emissions Trajectory 2019 to 2040 with ASHP



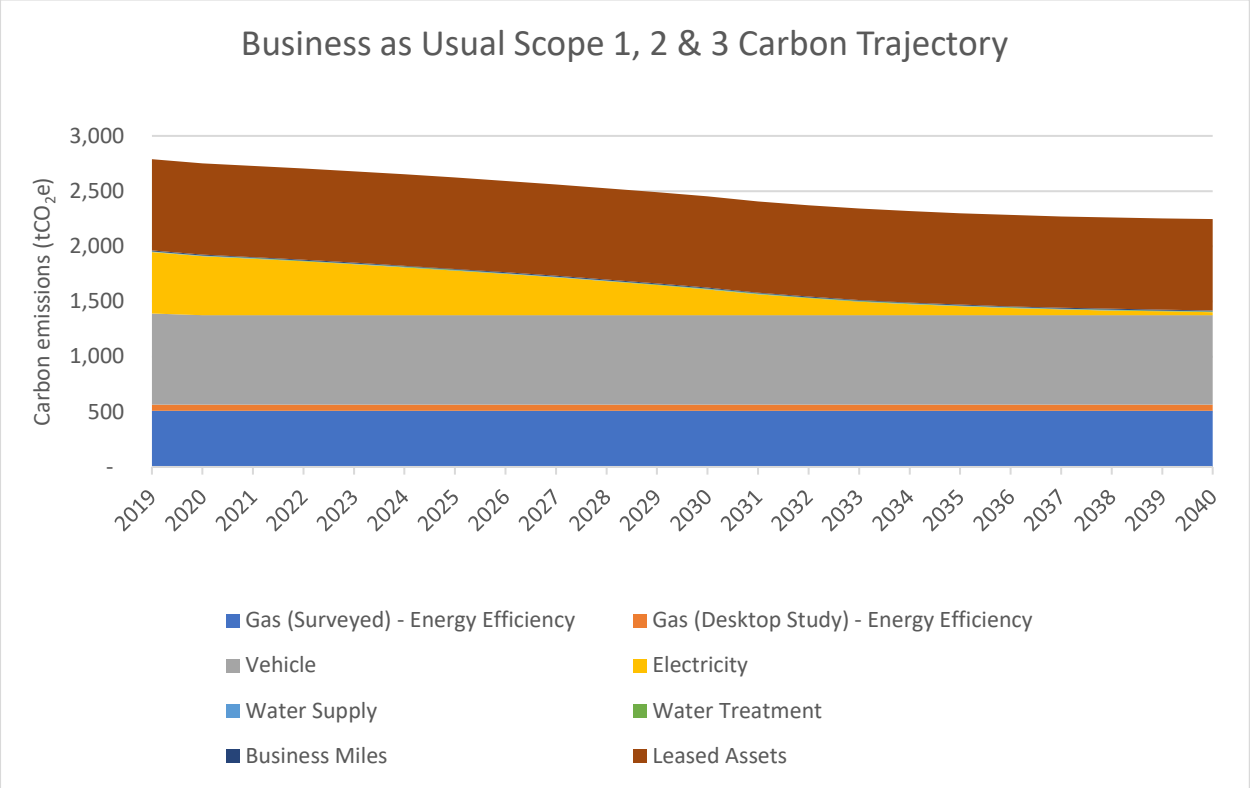
The graph above shows the carbon savings when installing heat pumps and removing gas boilers entirely by 2035. This is a carbon saving of 87% compared to 2019/20 if replacing gas boilers with ASHP.

Carbon Emissions Trajectory 2019 to 2040 with ASHP for Scope 1, 2 & 3



The trajectory in the graph above shows that there are 271tCO_2e that are unavoidable up to 2035 if boilers are replaced with ASHP. This is the amount of carbon that will need to be offset to balance the emissions that cannot directly be removed based on current technology and within a reasonable budget.

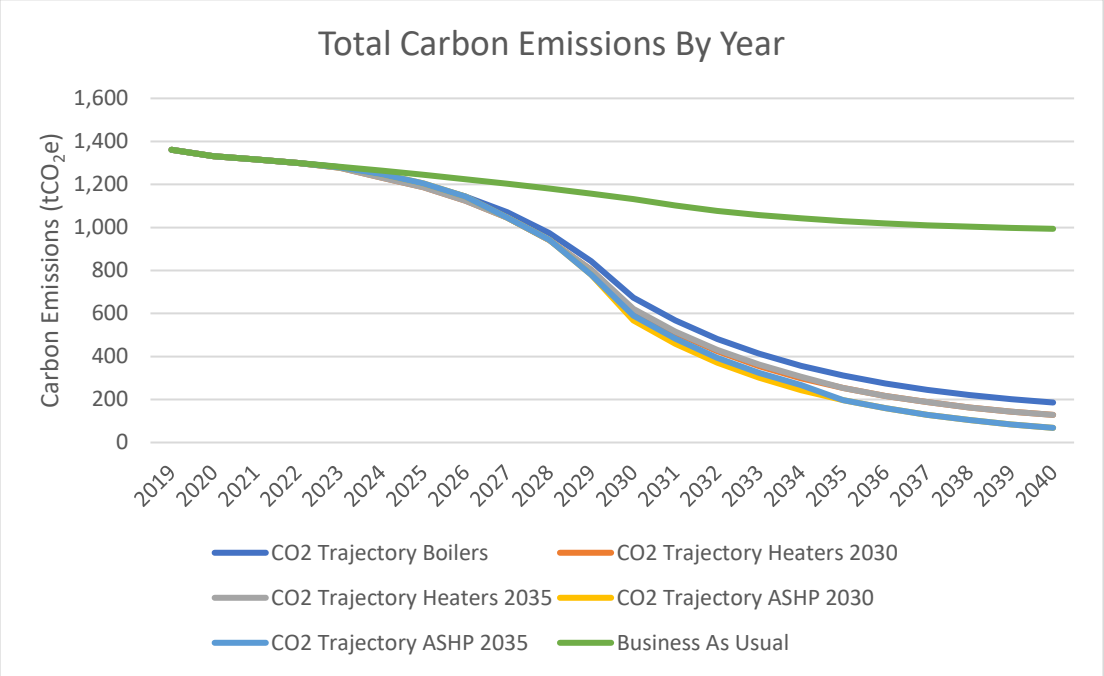
Business as Usual Carbon Emissions Trajectory 2019 to 2040 with no Interventions



The table above shows the trajectory if no interventions were delivered, and the amount of energy used by the Council is the same across the term. There is a decrease in electricity carbon emissions as the grid decarbonises, but emissions from other sources barely change. By doing nothing, the carbon emissions in 2035 will be 2,298tCO_2e.

6.5.1 Boiler vs. Electric Heaters vs. Heat Pumps

Carbon Emissions Trajectory 2019 to 2040 comparing Heating by Gas Boilers and ASHP Emissions



The years indicate the target year that the boilers will be replaced by (e.g. CO2 trajectory ASHP 2035 indicates that the boilers will be replaced by 2035 with Air Source Heat pumps). Both the "Trajectory Heater" and "Trajectory ASHP" lines in the graph above includes those interventions to improve efficiencies by improving controls and insulation and replacing existing gas boilers with their respective low carbon heating source. The graph shows that there is a significant reduction in emissions if all are replaced with Electric heaters and even further savings if replaced with heat pumps.

It is therefore the recommendation that all boilers are replaced with heat pumps.

6.5.2 Offsetting when Installing ASHP

A carbon offset is a reduction in emissions of CO_2e made to compensate for emissions made elsewhere. There are several ways of offsetting carbon emissions such as carbon capture and storage however, this is not deemed financially or technically feasible to the Council. More typical options available to the Council to directly offset emissions include renewable energy generation projects and rewilding/tree planting. However, the effectiveness of tree planting to quickly offset emissions can be questioned as it can take many decades for trees to reach maturity.

It is assumed that solar PV could be placed on land with a generation capacity of approximately 800kWp generating 760MWh of electricity that feeds directly into the electricity grid. This could include open space, car parks, etc.

A 800kWp system would have a capital cost of approximately £720,000 and would offset 34tCO_2e per year by 2035 and 12tCO2e per year by 2040. This demonstrates that the carbon offset benefits of a 'solar farm' decrease as the grid decarbonises.

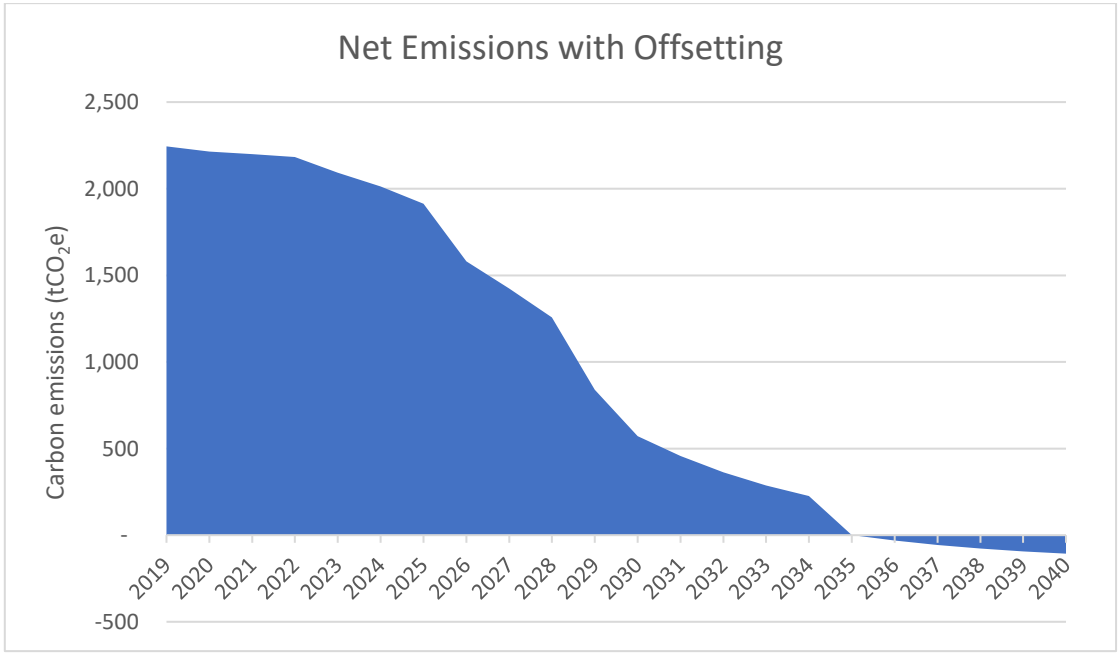
The installation of 800kWp PV would leave 648tCO_2e of unavoidable emissions by 2035 that will need to be offset. The Woodland Trust states that it costs £25 to offset 1 tonne of CO_2 in British woodlands which would result in a cost of £16,200 to offset the remaining emissions per year.

There are other schemes that provide carbon offsetting through international planting schemes such as One Carbon World which contributes funding towards large scale forestry schemes for as much as £1.20/tCO_2e.

A detailed feasibility study is required to determine the impact that planting will have as a carbon sink. It will provide an understanding of what will be needed to ensure that mature trees are in place to absorb the appropriate amount of CO_2 by 2035.

The graph on the next page shows the pathway for net zero carbon which includes reducing carbon initiatives and installing ASHP combined with offsetting measures. The graph shows that the Council will be net zero in 2035 and net carbon positive in subsequent years if the same level of offsetting is applied year-on-year.

Carbon Emissions Trajectory to 2040 with Carbon Offsetting and ASHP



6.5.3 Forecast Capital Cost with ASHP

Investing in energy efficiency projects and power generation will, in most cases, have a positive financial benefit with a good return on investment. The Council should set its own guidelines on a cap for ROI to measure the viability of projects.

Grid supplied electricity and gas rates are taken from BEIS modelling published in October 2021[4]. Market conditions have changed drastically since this time for several reasons and largely due to the war in Ukraine. It is therefore likely that the forecast energy rates provided are outdated, but this was still the best source to use at the time of writing.

The future grid export rates are based on the current price and increased by 2.5% annually.

[4] https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

Forecast Capital Cost and Financial Savings from Initiatives including ASHP

Intervention	Cost of all interventions	Accumulative cost saving up to 2035	Total annual saving of all interventions in the year 2035	Accumulative CO2e Savings by 2035	Accumulative £/CO2e Savings by 2035
Gas (Surveyed) - Transition to ASHP	£1,881,000	£136,000	£23,896	644	£2,920
Gas (Desktop Study) - Transition to ASHP	£467,800	£100,700	£12,202	483	£970
Transition to EV Accumulative Savings	£12,620,200	-£246,300	£17,950	3,860	£3,270
Electricity (Surveyed) - Energy Efficiency	£42,570	£21,600	£2,378	1,222	£30
Electricity (Desktop Study) - Energy Efficiency	£112,960	£161,400	£17,742	943	£120
Electricity (Surveyed) - Transition to ASHP	£0	-£100,100	-£15,794	-65	£0
Electricity (Desktop Study) - Transition to ASHP	£0	£7,100	£1,264	571	£0
Building PV (298kWp by 2035)	£285,265	£352,400	£38,737	271	£1,050
Total Energy - (Leased Assets)	£2,948,410	£752,500	£83,611	6,220	£470
Land Based PV (800kWp by 2035)	£720,000	£453,100	£57,677	2,942	£240
Tree Planting	£5,940	N/A	N/A	2,059	£3
Total	**£19,084,145**	**£1,638,400**	**£239,663**	**19,151**	**£997**

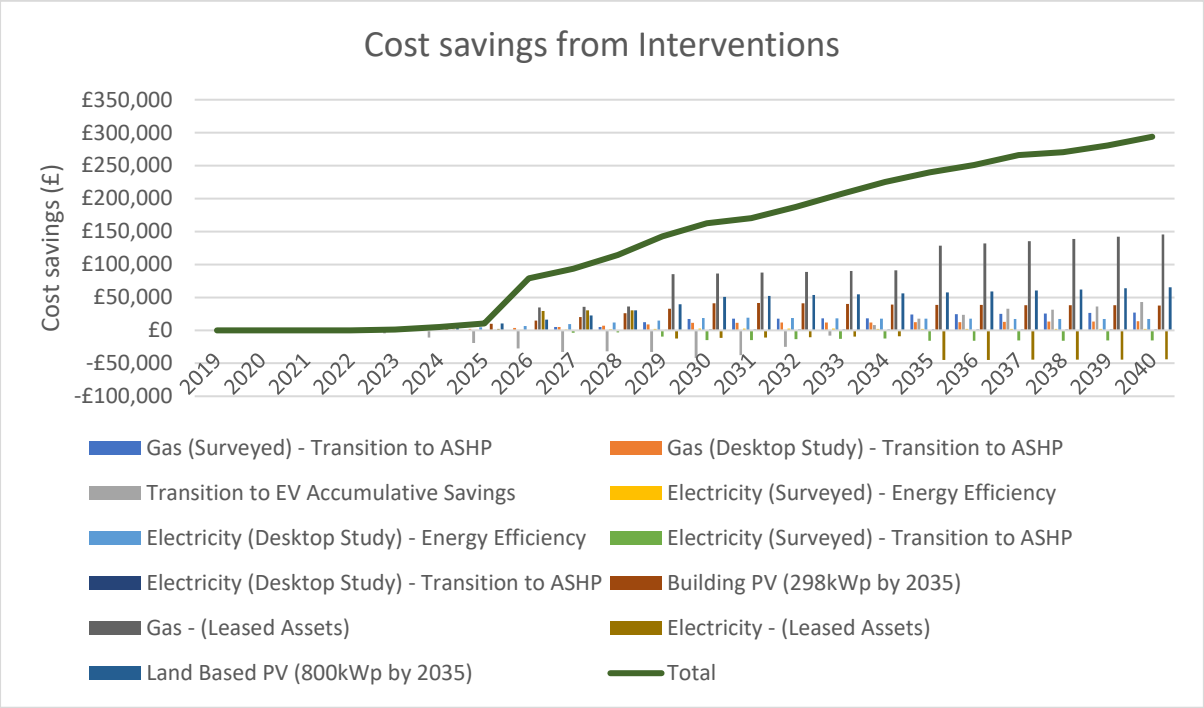
This shows that the forecast capital cost to achieve net zero in buildings is £19million and the total annual savings achieved by 2035 would be the equivalent of £239,663 per year.

The forecast capital cost to implement the changes with an offset by 2030 would be £19,094,565 and this will be approximately £10,000 more compared to 2035. The difference will only come in the offsetting of trees as the energy savings will be the same but the carbon emissions will be lower in 2035 compared to 2030 as the grid continues to decarbonise. Inflation on the capital cost has not been taken into account, however the cost of projects are likely to increase with inflation but the cost could also come down due to government subsidies and supply and demand.

6.5.4 Cost Savings with ASHP

The graph below shows the total savings if all initiatives are installed.

Cost savings from interventions between 2019 to 2040

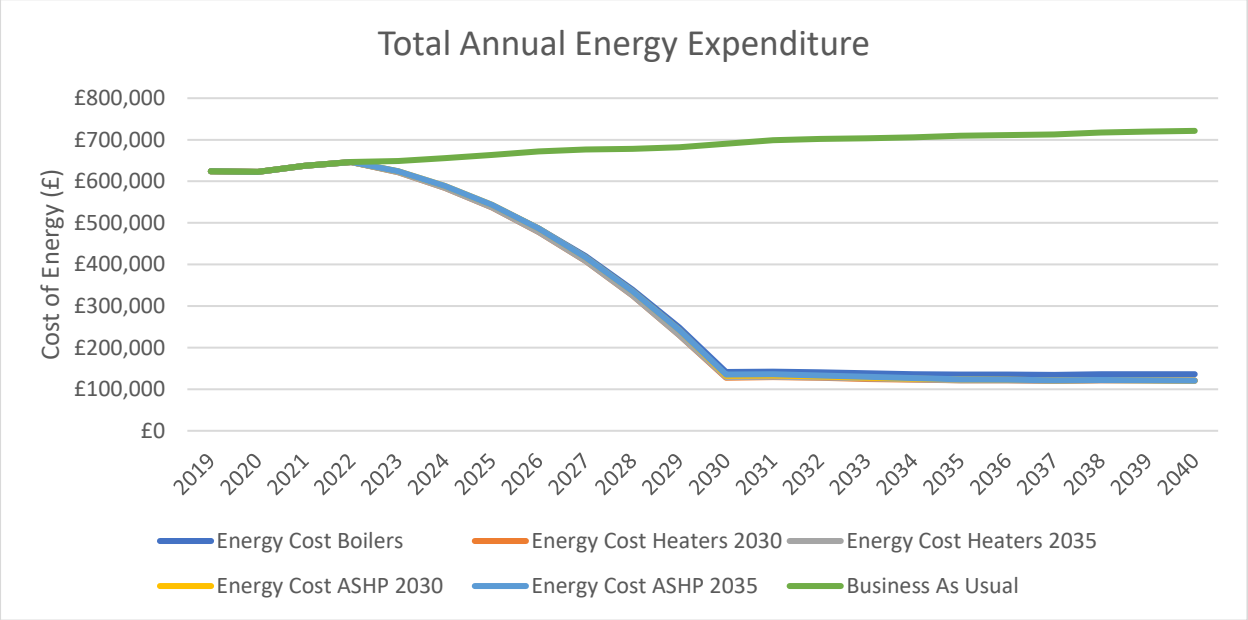


The graph takes into account savings made through efficiency savings (insulation, controls, etc.) and installing heat pumps. It should be noted that it will generally be more expensive to run a heat pump compared to a gas boiler if no other interventions are included as the cost of electricity is typically 4 times more expensive than gas up to 2035. However due to the fact that majority of the boilers are not to be replaced until 2029/2034 respectively the cost increases cannot be seen, due to the fact that the spark gap is predicted to be closer in later years and the reduction in annual kWh makes up this difference.

Although the 800kWp solar farm is larger than the 298kWp system on buildings, the financial savings are not proportional as the [current] export rate for a solar farm is much less than the savings achieved by having PV on buildings and reducing the amount of electricity purchased from the grid.

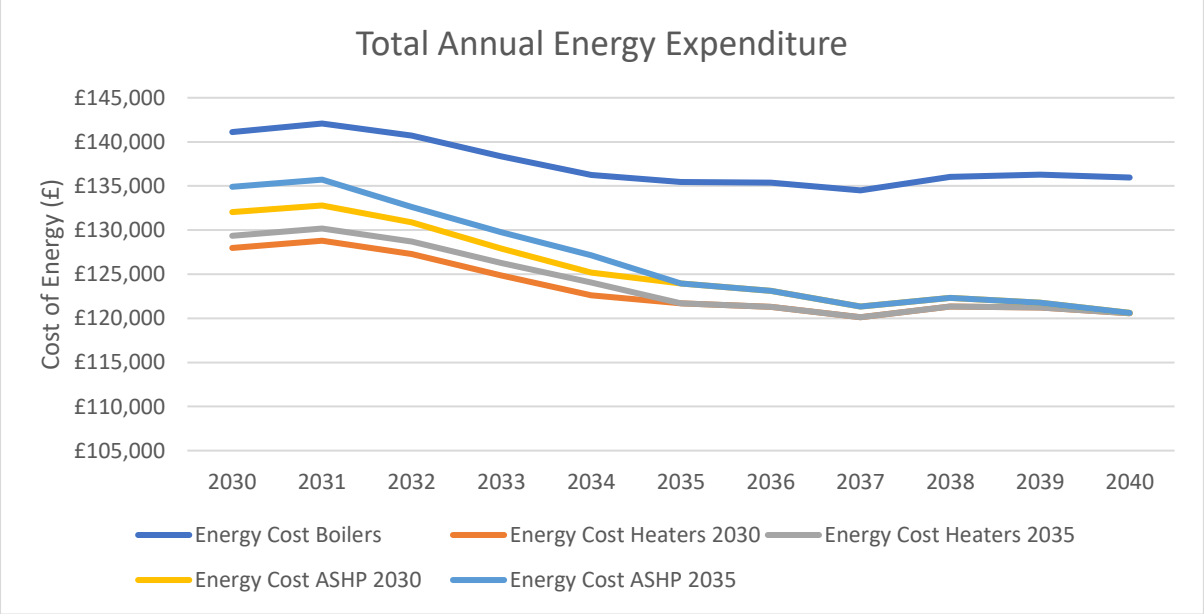
Annual cost comparison between Gas Boilers and ASHPs between 2019 to 2040

The graph below shows the cost on energy bills by comparing the installation of gas boilers with electric heaters and heat pumps as well as making the other capital investments, and with business as usual.



The graph above shows that the cost of Boilers vs Heaters vs ASHP is quite close due to the boilers not being replaced with electric until later in the project life.

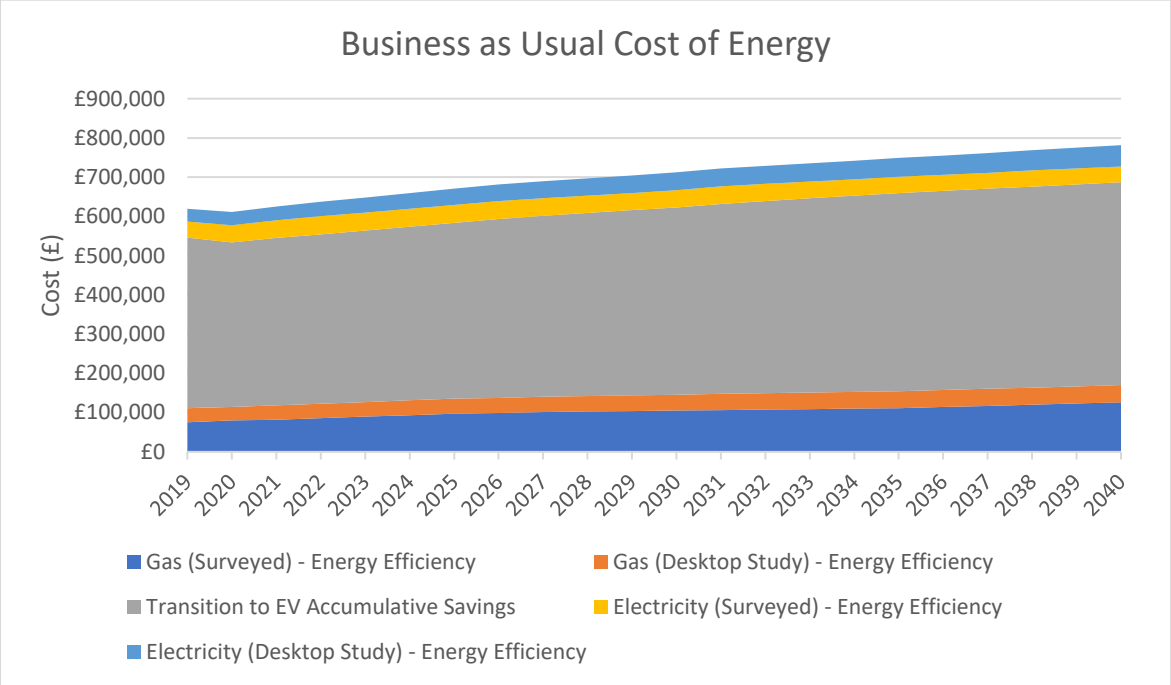
For clarity the graph below shows the cost of bills from 2030 with the various interventions that may be applied.



The graph above shows that the cost of Heaters is cheaper than ASHP, this is due to the not all surveyed boilers being replaced with electric heaters from the recommendations, but also able to have the energy reductions related to new boiler controls and such. As can be seen

however the ASHP becomes cheaper as the electricity cost reduces relative to the cost of natural gas.

Annual energy expenditure for Business as Usual with no interventions between 2019 to 2040



The graph shows that energy costs will increase from £587,000 in 2019 to £701,000 by 2035 if energy consumption remains the same.

The forecast unit rate is taken from the 'Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal'. This was published in October 2021 and markets have changed significantly since so it is likely that future operational costs, and savings, will be higher.

7 Conclusion

It is recommended to report annually on the progress of reducing carbon emissions.

Emissions from the Council's own operations should be calculated using the methodology in this report and policies and procedures should be put in place to record emissions data as it is made available rather than trying to retrieve the data in bulk retrospectively.

Further investigations are recommended to calculate Scope 3 emissions such as purchased goods and services, waste, and employee commuting; and what initiatives could be applied to reduce emissions. Overall emissions will increase when adding in additional sources as data quality improves.

The trajectory and savings detailed in Appendix B and the wider programme can be used as a KPI to track performance of reducing emissions against the 2019/20 baseline year.

The Paris Climate Agreement aims to keep global temperature increases well below 2°C and pursuing 1.5°C. This calls for organisations to set a 'carbon budget' which is a term used to indicate the maximum amount of carbon an organisation can produce over a period of time to stay within the Paris Agreement. This often requires setting a science-based target and carbon budget.

The minimum reduction required for targets in line with well-below 2°C scenarios is 2.5% in annual linear terms over 15 years. Organisations are strongly encouraged to adopt targets with a 4.2% annual linear reduction to be aligned with limiting warming to 1.5°C, which is a reduction of 63% over 15 years. This carbon trajectory should reduce emissions by 76% between 2019 and 2035.

For the buildings that were not subject to an energy audit the carbon trajectory in this report is a desktop study performed without any prior knowledge of the building estate and is based on rule of thumb, and engineering and industry experience. A detailed energy audit should be provided for each building to provide a clear action plan of what interventions can be provided, their capital cost, funding opportunities and the cost/carbon savings.

Appendix A – Carbon Footprint Calculations

(Separate Spreadsheet)

Appendix B – Carbon Trajectory Report

(Separate Spreadsheet)

Appendix C – Data that should be gathered to report on Scope 3 emissions

The reporting of Scope 3 emissions is discretionary. The table below provides further guidance on the information required to calculate emissions from Scope 3.

Item	Category	Details Required
1	Purchased goods and services	This category includes all upstream (i.e. cradle-to-gate) emissions from the production of products purchased or acquired by the Council in the reporting year. Products include both goods (tangible products) and services (intangible products). This category includes emissions from all purchased goods and services not otherwise included in the other categories of upstream scope 3 emissions (i.e. category 2 through category 8 below). Cradle-to-gate emissions include all emissions that occur in the life cycle of purchased products, up to the point of receipt by the Council. Cradle-to-gate emissions may include: • Extraction of raw materials • Agricultural activities • Manufacturing, production, and processing • Generation of electricity consumed by upstream activities • Disposal/treatment of waste generated by upstream activities • Land use and land-use change • Transportation of materials and products between suppliers • Any other activities prior to acquisition by the reporting company Relevant purchases to the Council may include capital goods, such as office supplies, office furniture, computers, telephones, travel services, IT support, outsourced administrative functions, consulting services, janitorial, landscaping services, maintenance, repairs and operations.

		For accurate carbon reporting emissions, the Council should request cradle-to-gate emission factors for materials used by suppliers to produce purchased goods such as Environmental Product Declarations (EPDs). It is likely that many suppliers will not be able to provide all the emission data. If an EPD cannot be provided, supplementary information required includes the volume of product (kg) and the carbon emission factor (kg CO_2e). A policy should be developed so that suppliers in the supply chain are required to provide this data as part of the contract, where the volume of goods is noteworthy.
2	Capital goods	Capital goods are final products that have an extended life and are used by the Council to manufacture a product, provide a service, or sell, store, and deliver merchandise. Capital goods are treated as fixed assets or as plant, property, and equipment (PP&E). Examples of capital goods include equipment, machinery, buildings, facilities, and vehicles. The required information is the same as Category 1 above. A policy should be developed so that suppliers in the supply chain are required to provide this data as part of the contract.
3	Fuel- and energy related activities (not included in Scope 1 or Scope 2)	Transmission and distribution (T&D) losses have been included and calculated from the data provided in Scope 2.
4	Upstream transportation and distribution	Category 4 includes emissions from: • Transportation and distribution of products purchased in the reporting year, between suppliers and its own operations in vehicles not owned or operated by the Council. • Third-party transportation and distribution services purchased by the Council in the reporting year (either directly or through an intermediary), including inbound logistics, outbound logistics (e.g. of sold products), and third-party transportation and distribution between the Council's own facilities. The Council requires data on: • Quantities of fuel (e.g., diesel, petrol, jet fuel, biofuels) consumed

		• Amount spent on fuels • Distance travelled • Vehicle type This may include managed assets - Vehicles that are used by the Council but are not owned by the organisation and generally do not appear on the organisation's balance sheet, for example, maintenance contractor vehicles, outsourced refuse and recycling trucks, road sweepers, grounds maintenance mowers etc. A policy should be developed so that suppliers using their own vehicles are required to provide this data as part of the contract.
5	Waste generated in operations	This includes emissions from third-party disposal and treatment of waste generated in the Councils owned or controlled operations in the reporting year. This category includes emissions from disposal of both solid waste and wastewater. The Council should request volume and emissions data from the waste treatment company applicable to **its own waste stream**. If this cannot be provided, the emissions can be calculated by requesting the volume of waste, type and disposal method: Example of data required: Total weight (kg) of waste type and disposal method e.g. • 5,000kg municipal waste to landfill • 500kg organic garden waste to composting • 1,000kg metal recycled • 1,000kg plastic recycled • 1,000kg paper recycled Data is required for the volume of supply and wastewater in cubic metres (m^3) from water bills. Local authorities have an important role in waste prevention and sustainable waste management through awareness-raising campaigns, providing separate collection for recycling and food waste, and implementing waste-to-energy schemes. It is therefore voluntary on whether the Council choose to include the emissions from waste associated with the whole borough, or just the Council's own operation.

6	Business travel	Travel for assets not owned or directly operated by the Council. This includes mileage for business purposes in cars owned by employees, public transport, hire cars etc. Require details for: <u>Vehicle</u> Fuel type, size of vehicle and distance for: • Car • Motorbike • Taxis • Bus • Rail <u>Flights</u> • Airport travelled to/from • Number of passengers • Class type • Distance <u>Ferry</u> • Foot or car passenger • Distance
7	Employee commuting	This category includes emissions from the transportation of employees between their homes and their worksites. Emissions from employee commuting may arise from: • Car • Bus • Rail • Other modes of transportation Staff would be required to provide method of transport and distance travelled. It may be difficult and time consuming to collect accurate data.
8	Upstream leased assets	This category is applicable from the operation of assets that are leased by the Council. If the Council procures the energy then this should be considered as Scope 1 and 2. If the landlord is responsible for the Scope 1 and 2 emissions, the Council should include the reporting under Scope 3. An example may include an office that the Council lease from a

		private landlord. All energy bills may be included as part of the lease and the energy contract is under the name of the landlord. The Council should therefore request the energy data from the landlord and include this under Scope 3. Data required include the Scope 1 and 2 data from the leased asset.
9	Downstream transportation and distribution	This category includes emissions that occur in the reporting year from transportation and distribution of sold products in vehicles and facilities not owned or controlled by the Council in the reporting year. It is assumed that this category is not applicable to the Council as it does not manufacture and sell products.
10	Processing of sold products	It is assumed that this category is not applicable to the Council as it does not manufacture and sell products.
11	Use of sold products	It is assumed that this category is not applicable to the Council as it does not manufacture and sell products.
12	End-of-life treatment of sold products	It is assumed that this category is not applicable to the Council as it does not manufacture and sell products.
13	Downstream leased assets	This category is applicable where the Council is the landlord to a lessee. If the Council procures the energy on behalf of a lessee then this should be considered as Scope 1 and 2. An example of this is where the Council may lease a premises to a lessee and include all energy costs as part of the lease. The energy contract is under the name of the Council and is therefore reported under Scope 1 and 2. If the lessee is responsible for the Scope 1 and 2 emissions, the council should include the reporting under Scope 3. An example of this is a shop that the Council own and the occupant pays for the energy bills and the contract is under their name. The Council should request the energy data from the shop occupier and report this under Scope 3. Data required include the Scope 1 and 2 data from the leased asset.

14	Franchises	It is assumed that this category is not applicable to the Council as it does not operate any franchises.
15	Investments	This category includes scope 3 emissions associated with the Council's investments in the reporting year, not already included in scope 1 or scope 2. This category is applicable to investors (i.e. organisations that make an investment with the objective of making a profit) and organisations that provide financial services. This category also applies to investors that are not profit driven (e.g. multilateral development banks). Investments are categorised as a downstream scope 3 category because providing capital or financing is a service provided by the organisation. Category 15 is designed primarily for private financial institutions (e.g., commercial banks), but is also relevant to public financial institutions (e.g., multilateral development banks, export credit agencies) and other entities with investments not included in scope 1 and scope 2. The Councils scope 3 emissions from investments are the scope 1 and scope 2 emissions of investees. For purposes of greenhouse gas accounting, this standard divides financial investments into four types: • Equity investments • Debt investments • Project finance • Managed investments and client services An example of the information required is the Scope 1 and 2 emissions from the bank where an investment is in place. This is based on the Council's proportional share of investment in the investee. If the Council has £1million invested in the bank and the banks total investments amount to £100million, the Council should report on 1% of the banks Scope 1 and 2 emissions. It is assumed that this information will be difficult to collate from third parties and that the total emissions will be proportionally small compared to other emission sources and these emissions could be excluded from the reporting.