CARBON MANAGEMENT PROGRAMME

BACKGROUND, BASELINE AND FIRST STAGE ACTION PLANNING

TEWKESBURY BOROUGH COUNCIL

JUNE 2020

PRODUCED FOR:

TEWKESBURY BOROUGH COUNCIL

BY:

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FINAL DRAFT

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EXECUTIVE SUMMARY

TBC declared a climate emergency at full council on 1st October 2019. A key part of this declaration was the preparation of revised Terms of Reference to include an audit of the Council's current position, an action plan to achieve carbon neutrality by 2030.

The audit collated and analysed data to set out the current 'carbon footprint' from a number of council buildings and associated activities. The Action Plan sets out a number of short, medium and long term actions that will enable the council to meet its 2030 target.

The Council's carbon footprint was established by analysing data associated with scope 1, 2 and 3 emissions[1] in line with the Greenhouse Gas Protocol.

The Council has committed to doing all in its power to make Tewkesbury Borough Council offices carbon neutral by 2030 specifically via addressing CO_2 emissions from operations for which it is directly responsible. This includes the following:

- Electricity, gas and water consumption from owned buildings that are used to provide a public service, therefore excluding any buildings used for commercial purposes. Therefore the TBC estate included is as follows:
    - TBC Council Offices – less areas occupied by tenants
    - Tewkesbury Leisure Centre
    - Roses Theatre
    - Tewkesbury Cemetery
    - Cold Pool Lane Sports Pavilion
    - 5 x domestic properties providing housing support
- TBC Fleet (including vehicles of waste contractors UBICO)
- TBC Grey Fleet – specifically being vehicles owned and used by employees or Councillors of TBC for Council purposes. Business travel by public transport is not presently included in this report does not include CO_2 emissions resulting from office based waste, due to detailed data being unavailable at the current time.

[1] **Scope 1:** Direct emissions from activities owned or controlled by your organisation: ***Gas & Owned Transport;***
Scope 2: Indirect energy emissions released into the atmosphere that are associated with your consumption of ***purchased electricity;***
Scope 3: Other indirect emissions that are a consequence of your actions occurring at sources you do not own or control and are not classed as Scope 2 emissions. For example: ***business travel (staff vehicles of Public Transport), waste disposal, materials or fuels (water) your organisation purchases***

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Using the Government's Greenhouse Gas Reporting Conversion Factors for 2019 (advanced data set) a baseline emissions level for the council has been established, as shown:

TBC 2019 CO_2 Emissions by Scope	CO_2 Emissions (T/CO_2e)	% of Total	Detail of Scope Composition
Scope 1	1,124.79	70.30%	Gas Consumed; Owned Transport (Incl. UBICO)
Scope 2	185.68	11.61%	Electricity Consumed
Scope 3	289.46	18.09%	Extraction, Refinement and Transportation of all raw fuels; Water; Business Travel (unowned vehicles)
Total	**1,599.93**	**100%**	

Of the total 1,599.93 tonnes CO_2e baseline, the most significant individual component is the TBC Fleet, accounting for 891.77 tonnes with a further 695.50 generated from Buildings. There are multiple options that have been identified for each contributing facet of emissions that range from: enhancing sustainable procurement and implementing energy efficiency measures; through to, increased renewable energy generation and, conversion to an electric vehicle only fleet.

Energy surveys were completed at a number of council owned buildings as detailed in section 5. These provided information of a range of no cost, low cost and capital cost (where replacement of 'end of life' equipment is necessary) measures that would significantly lower energy demand levels. By reducing energy demand as much as possible, ahead of implementation of the major heating and renewable energy installations, appropriately sized solutions are possible, lowering installations cost given that they are required to generate or offset a lower overall energy need. A selection of the opportunities identified include:

SITE	Highlights	Cost Savings **p.a.**	CO_2e Savings **(Tonnes p.a.)**
Tewkesbury Council Offices	Optimising the heating to match demand by using weather compensation; Replacing the air conditioning units supplying the server room	***£17,359 (32%)***	***89.95 (65%)***
Roses Theatre	Improved heating control (temperature and weather related occupancy control); Air Source Heat Pump driven heating supply	***£4,425 (65%)***	***41.82 (80%)***

The Action Plan has been developed with the following priorities, presented in level of importance:

1. *Energy consumption is controlled and managed, reflecting demand times, levels (temperature for example) and relative to external weather conditions as necessary*
2. *Energy efficiency maximised through no and low cost measures*
3. *Replacement of 'end of life' equipment with most appropriate low carbon technologies*
4. *Remaining energy demand offset with renewable energy solutions aiming to consume as close to 100% of generated energy, therefore reducing use of 'imported' energy as much as possible*
5. *Finally consider procurement of 'green' energy tariffs as a belt and braces approach for any final imported energy demand remaining*

Additionally it is advised that, as far as possible, all gas consumption is removed, converting to electricity. This relates predominantly to all space heating as well as water heating at the Leisure Centre. Once demand reduction or energy efficiency has been optimised the solution focuses on utilising Heat Pump technology which delivers vastly improved efficiencies compared to more traditional and currently utilised combustion systems.

The emissions from the remaining electricity demand are negated through the installation of photovoltaic (solar power) systems.

Each Action Point has a commentary provided showing the implications of implementation in addition to suggested next steps required to progress. The Action Plan has been separated into 3 Phases; Short term (0 - 2years), Medium term (2 - 7 years) and Long term (7 – 10 years) against which each Action Point is contained.

The opportunity for significant cost reductions is shown in the action plan (section 7.5). From the data available and educated assumptions made, current annual costs of around £193,000 could be reduced to somewhere in the order of £55,000. Extra revenue that can be secured from the Renewable Heat Incentive (see section 7.3) and payments for exported energy generated from the solar PV system is estimated at more than £22,000 per annum. This brings total annual costs to around £33,000, ***delivering annual cost savings of more than 80%***.

Reflecting on priority 1, the monitoring and targeting of all data requires some consideration. The report provides options for this and suggests formalising this Carbon Management Programme through ISO 14001 (Environmental Management Systems) Certification which would give confidence to the council in the approach being taken as well as having systems and processes verified by an independent external body. It is recommended this is pursued once the plan of implementation has been adopted, and internal management systems in place against which the external certification can add best value.

Whilst it is necessary for the council to earmark budgets for capital and revenue expenditure, there is further work required before many of the action points in the Business Case can be completed. Certain technical feasibility surveys and subsequent costs of installation will be needed for, 'Return on Investment' scenarios to be produced. This is considered within the recommended next steps as follows.

In terms of the next 12 months priority should be given to the following activity:

1. Creation of Monitoring & Targeting processes across all elements of the Carbon Management Programme
2. Specification for procurement and securing appropriate quotes for phase 1 works
3. Production of full Business Case detail of all relevant Action Plan activities to support informed decision making
4. Coordination of any necessary feasibility studies for the Heat Pump and/or Solar Panel scenarios
5. Increase the level of sub-metering of services so as to enable accurate and specific reporting of impacts to be made
6. Regular production and presentation of update/progress reports to Full Council on at least a quarterly basis
7. Ensure council representation throughout Gloucestershire as required at meetings or networks and feedback relevant information and actions

CONTENTS

SECTION 1 INTRODUCTION

Tewkesbury Borough Council (TBC) has declared a Climate Change Emergency and aspires to achieving Carbon Neutrality in its own offices by 2030. TBC commissioned this study to produce a current status baseline and first stage Action Plan relating to the council's own buildings and business-related transport, in response to the emergency. The aim of the study is to provide an initial evidence base, financial implications and opportunities overview relating to its own estate, assumed for the purpose of this study to be the Council Offices, Leisure Centre, Roses Theatre and a number of other smaller council owned and operated facilities such as the Tourist Information Centres (TIC).

The analysis covers the Council's direct emissions from energy consumption for heat, power, transport and water with additional commentary about other areas of emissions which would warrant further review including waste arising from its own operations.

1.1 STRUCTURE OF THE REPORT

Section 2 provides a background to the international and national drivers for GHG emission reductions. It sets these in the context of the headline emissions associated with TBC's operations and considers how the continued greening of the energy grids and the uncertainties surrounding the future direction of national infrastructure will impact on local priority planning and influence TBC's action planning. The section provides an explanation of the internationally recognised Greenhouse Gas Protocols and how this is used to provide a standard methodology for measuring CO_2e emissions.

Section 3 collates and analyses current emissions data (electricity, heating fuel, fleet/business travel and water consumption/wastewater processing) for calendar year 2019 (or approximate data where the information is not available) from the Council's operations under Scope 1 - direct emissions, 2 - indirect emissions and 3 - all other indirect emissions as per the Greenhouse Gas Protocol.

Section 4 sets out the data requirements for ongoing emissions tracking against the baseline set out in section 3 to support ongoing emissions levels to be recorded and quantified in terms of CO_2 emissions; the gap between current performance and achieving a CN2030 standard.

Section 5 describes the nature of current energy usage in the Council Offices, Leisure Centre, Roses Theatre and a collection of other council owned and operated facilities following on site energy surveys and recommends demand reduction opportunities relevant to the current position categorised by no, low and high capital cost measures (including renewable energy as appropriate).

Section 6 identifies potential local and regional partnership opportunities to enable collaboration and reduced cost implementation.

Section 7 delivers the Action Plan and identifies further work following this baseline assessment necessary in order to achieve the Council's ambitions.

An Appendix supplies a commentary and business case options for the plan.

SECTION 2 INTERNATIONAL, NATIONAL AND LOCAL CONTEXT

A number of international and national studies, strategies and policies, provide the background to the need for emitters to consider reducing their contribution to climate change through reducing greenhouse gas emissions.

At an international level, on the 12th December 2015 the Paris agreement was reached coming into force in November the following year. The aim was to combat climate change and to accelerate and intensify the actions and investments needed for a sustainable low carbon future. The Paris Agreement's central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius.

In October 2018, the International Panel on Climate Change (IPCC) issued a special report on 'Global Warming of 1.5°C', following the UN Framework Convention on Climate Change in 2015. The report reviewed the differences in impacts and benefits between limiting the average rise in global temperature to 1.5°C versus 2°C. It found that a 2°C rise is significantly more disruptive, harmful, damaging economically, socially and environmentally, and that limiting global warming to 1.5°C may still be possible with political commitment and ambitious action from national and sub-national authorities and agencies. It concluded that 12 years remain to make the necessary changes to limit global emissions to 1.5°C; that current plans and actions are not ambitious enough and that emissions targets should aim for net zero by 2050 with emissions reduced by 45% by 2030.

At a national policy level, the Climate Change Act 2008 set a legally binding, UK-wide carbon emissions reduction target of 80% by 2050 from a 1990 baseline with emission reductions divided into interim five-yearly targets. However, in its Progress Report to Parliament in June 2018, the Committee on Climate Change (CCC) found that:

- The UK's greenhouse gas emissions have reduced by 43% compared to 1990 levels. Since 2012 seventy-five percent of the emission reductions have come from the power sector while security of supply has been maintained and average energy bills have fallen.

- The transport sector (27% of UK territorial emissions) was significantly off track from the cost-effective path for meeting the UK's emission targets.
- Domestic, Commercial and Industrial heating emissions (around a third of UK emissions) have not changed since 2009 with residential emissions not changing since 2013.
- Despite progress in the power sector the UK is not on course to meet the legally binding fourth and fifth carbon budgets and 'the UK's continued claim for climate change leadership now rests on continuing the reduction in power sector emissions.

However, in June 2019, following updated advice from the CCC in its report 'Net Zero – The UK's contribution to stopping global warming', the Government amended the Climate Change Act from an 80% reduction in emissions by 2050 against a 1990 baseline, to a target Net Zero Carbon target.

More recently the Court of Appeal determined that proposals to extend capacity at Heathrow Airport were inconstant with the Paris Agreement which has raised the potential for other similar challenges against infrastructure projects.

At a local level, more than 400 Councils have declared a Climate Change Emergency and agreed to work toward cutting CO_2 emissions at a faster rate than the UK government target of Net Zero Carbon by 2050. The commitment of TBC is to aspire to achieving Carbon Neutrality in its own offices by 2030.

2.1 DECARBONISATION OF ELECTRICITY, GAS AND TRANSPORT

The national context as described above, presupposes the decarbonisation of the national energy grids in terms of both gas and electricity by that date either in isolation or with some form of offsetting or Carbon Capture and Storage.

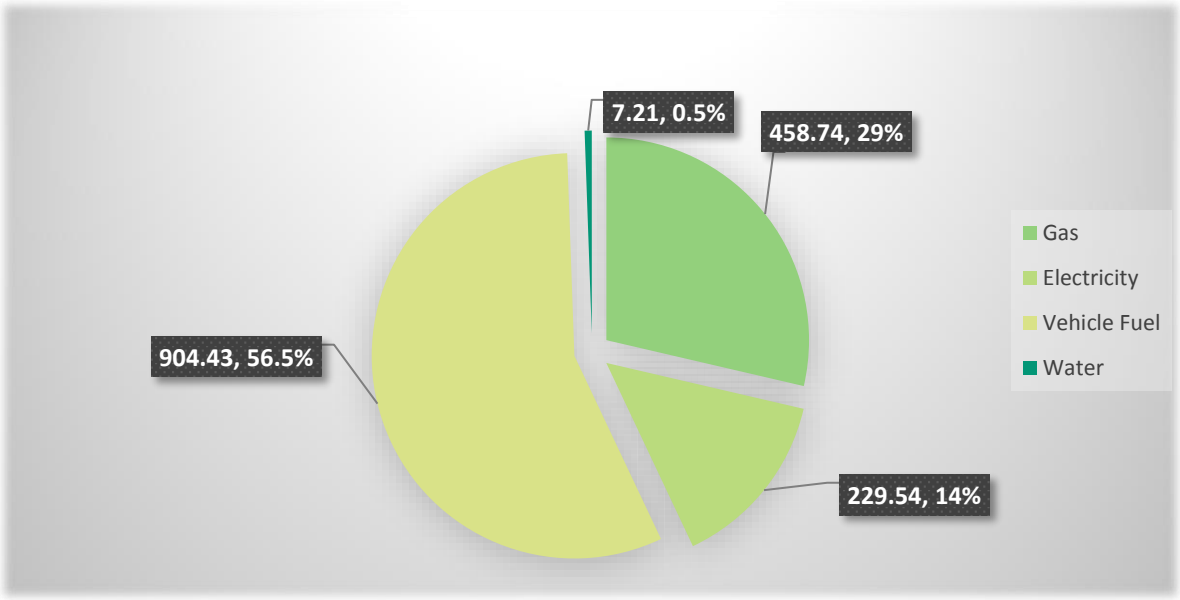
As a consequence of the new 2050 target, a tempting solution for any organisation is to maintain their current practices and wait for both the gas and electricity grids to be decarbonised by 2050 and therefore their carbon emissions would fall by virtue of the change in the source of the energy they consume.

Tewkesbury Borough Council's target relates to the Greenhouse Gas emissions associated with the business operations. The challenge of achieving net zero by 2030 is 20 years ahead of the government's target of 2050 and consequently the council must take positive action to achieve this well ahead of the theoretical decarbonisation of the grid supplies.

Figure 1 below represents the CO_2 emissions in Tonnes associated with TBC's activities from its main offices, the leisure centre, Roses Theatre, Tourist Information Centre (HAT Shop),

Tewkesbury Cemetery and five domestic properties providing support to the homeless. It is shown here for context for the following sections and broken down in greater detail in section 3.

Figure 1: Emissions by Source – Tonnes CO_2e, Percentage of Total



2.1.1 ELECTRICITY

229.54 Tonnes CO_2e	*14.35% of total emissions*

"(THE HOUSE OF COMMONS SCIENCE AND TECHNOLOGY COMMITTEE) HAS INDICATED THAT IT EXPECTS REQUIREMENTS FOR NEW POWER GENERATION CAPACITY TO BE MET THROUGH OFFSHORE WIND POWER, NUCLEAR POWER AND GAS-FIRED POWER WITH CARBON CAPTURE AND STORAGE. THERE IS HOWEVER CONSIDERABLE RISK THAT THESE TECHNOLOGIES MAY NOT PROVIDE THE GENERATION CAPACITY REQUIRED[2]. THERE IS THEREFORE RISK IN RELIANCE THAT THE MARKET WILL DELIVER THE DECARBONISATION TARGET FOR THE GENERATION OF ELECTRICITY AND THE GOVERNMENT HAS BEEN "CALLED UPON TO SET OUT HOW

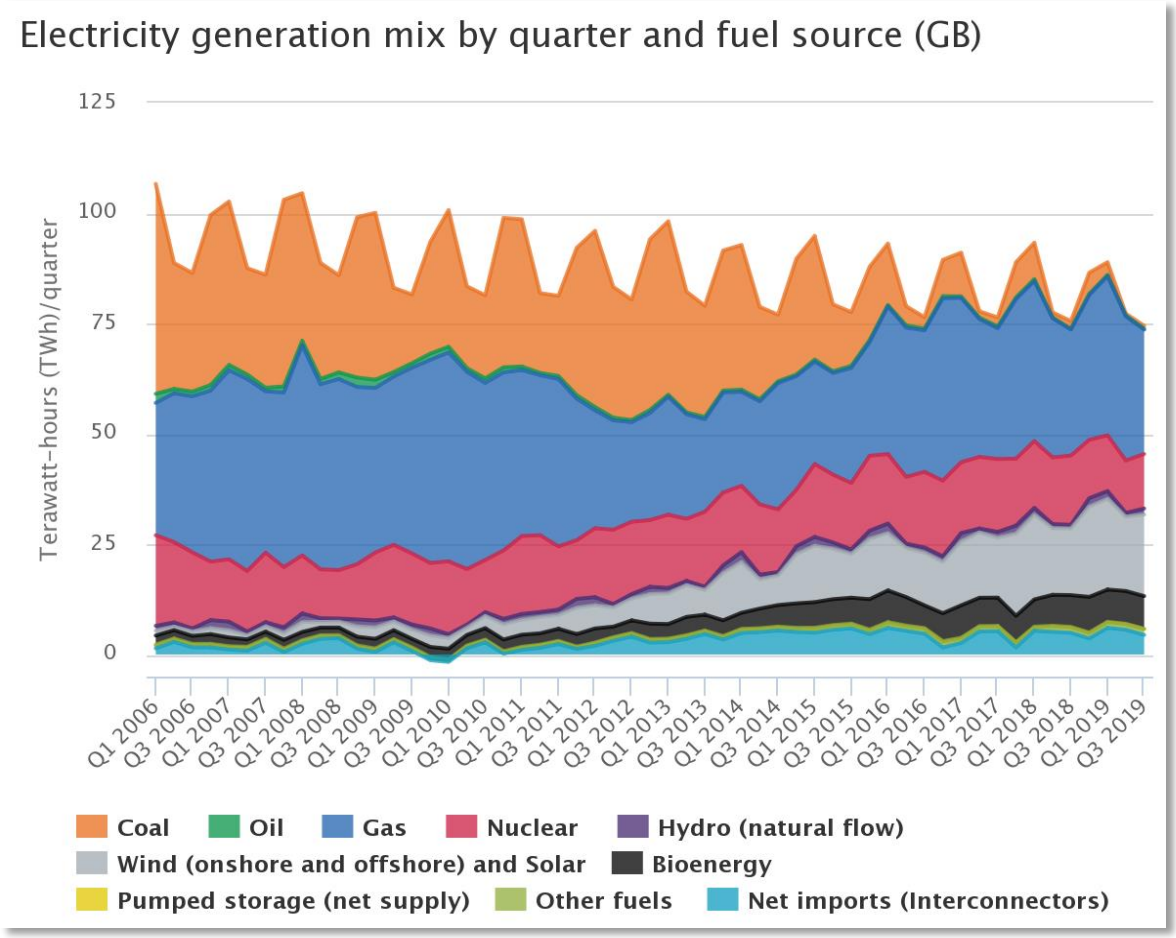
[2] Clean Growth: Technologies for meeting the UK's emissions reduction targets 20117-2019

IT INTENDS TO MONITOR AND ADDRESS ANY POTENTIAL SHORTFALL IN POWER GENERATION".

This emphasises the position that positive local action is needed to ensure that both demand is reduced to meet the available generation and concurrently supply is decarbonised to hit even a 2050 rather than a locally adopted 2030 target.

Fig. 2 shows the change since 2006 of the electricity generation mix. The biggest shifts have been away from coal and the growth in renewable generation. Consequently, the CO_2 emissions associated with the generation of grid electricity have fallen significantly.

Figure 2: Electricity Generation Mix

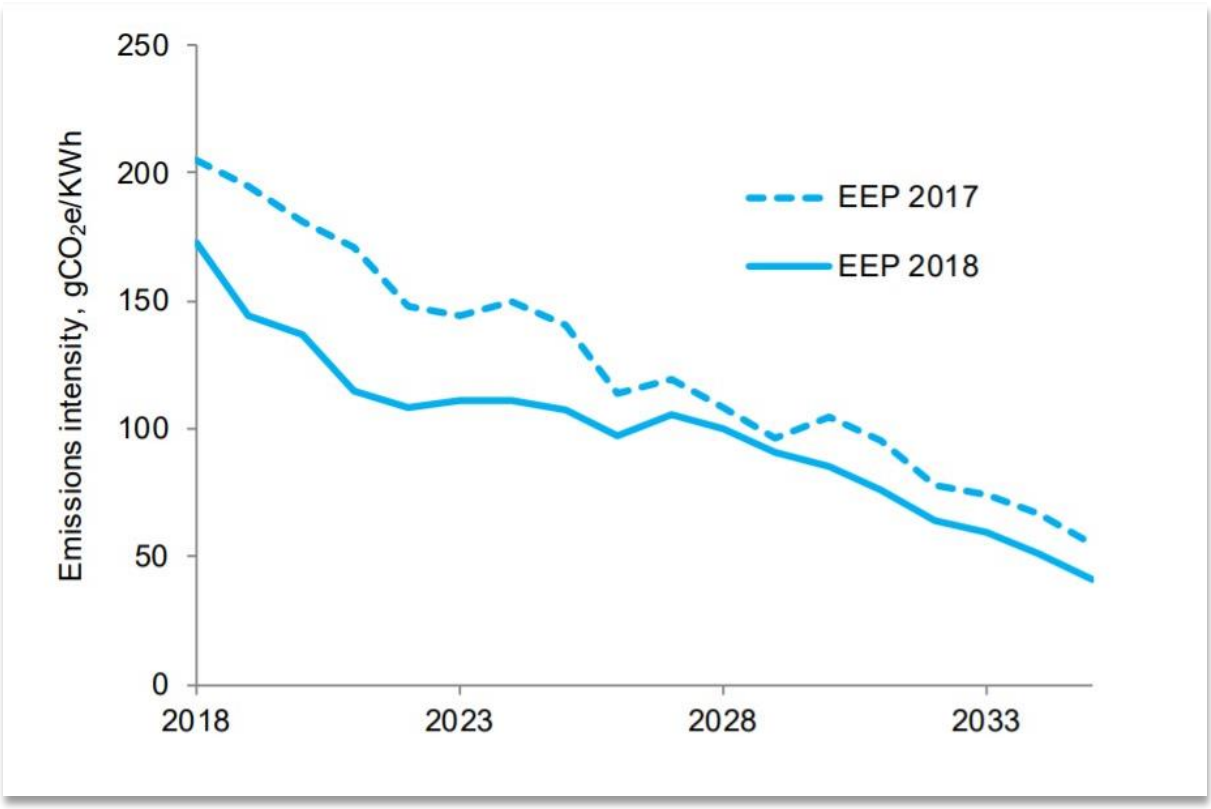


Source: BEIS Energy trends section 5: Electricity (ET 5.1) . Information correct as of January 2020

The increasing efficiencies of national grid electricity will continue to have a positive impact on TBC carbon emissions each year. The published government 'energy conversion factors'[3] that show the carbon emissions from electricity production evidence annual reductions. Consequently, even if electrical consumption at TBC remains static CO_2 emissions will gradually reduce.

Figure 3 shows the projected change in the CO_2 emissions associated with UK grid electricity up to 2035 and how the projections of electricity emissions intensity (the level of associated CO_2 in a unit of electricity) between 2017 and 2018 have reduced due to higher levels of renewables generation than anticipated. By 2030 it can be estimated that the intensity of grid electricity will have fallen to at least 97 gCO_2e/kWh from just under 150 gCO_2e/kWh in 2020.

Fig 3: Electricity Emissions Intensity



Source BEIS updated energy emissions projections 2018

[3] UK GOVERNMENT GHG CONVERSION FACTORS FOR COMPANY REPORTING 31/07/2020

2.1.2 GAS

458.74 Tonnes CO_2e	*28.67% of total emissions*

The position regarding the decarbonisation of gas both for use in the production of electricity and for heat is less clear. In December 2019 the Energy Networks Association (ENA) published a report titled 'Pathways to Net-Zero: Decarbonising the Gas Networks in Great Britain'[4]. By 2050 the ENA estimate that the current composition of grid gas will be replaced with a geographically defined mix of hydrogen and biomethane produced by anaerobic digestion and the thermal gasification of biomass. The trajectory for this ambitious transition does not make any significant headway until post 2030 and does not therefore provide an opportunity for TBC to meet its CN2030 target.

The National infrastructure Commission considers that 'the future pathway for decarbonised heat in the UK is not yet set but it will have a significant impact on the demands on the power system. Uncertainties exist around cost, technology, and consumer behaviour. In the absence of a single pathway, the Commission's power sector analysis considers two heating pathways:

- Electrification: represents a future in which most of the heating sector has been decarbonised largely by using heat pumps.
- Greener gas: represents a future in which heat is primarily provided by low carbon hydrogen.[5]

The lack of certainty at a national level in relation to the decarbonisation of gas presents real challenges in terms of long-term technology choices. The stance taken in relation to individual council properties deals with this uncertainty based on the condition of the current heating systems in each on the properties and when a decision needs to be taken for replacement. For example, the Leisure Centres heating system is a modern, well maintained gas powered plant with CHP and a design life beyond 2030, whereas the Civic offices heating is similarly gas powered but older technology and will not last to 2030 and therefore a fuel choice for heating needs to be made.

4 Energy Networks association by Navigant
Pathways to Net-Zero: Decarbonising the Gas Networks in Great Britain
https://www.energynetworks.org/assets/files/gas/Navigant%20Pathways%20to%20Net-Zero.pdf

5 National Infrastructure Commission – net Zero opportunities for the Power Sector March 2020

2.1.3 Transport Fuels

904.43 Tonnes CO_2e	*56.53% of total emissions*

Updated advice on meeting government's net zero 2050 target was published in May 2019 by the Committee on Climate Change (CCC) – the statutory advisors on emissions reductions for Government. This said that the market for electric cars and vans should scale up to 100% of new sales by 2035 at the latest (and ideally by 2030). TBC has already made significant progress in the move to decarbonising its own fleet operated from the main offices with a move from small fossil fuelled powered fleet cars to Hybrids, plug in Hybrids and now full EVs. The motivation for this being environmental, encouraging all frontline service providers to use council fleet rather than their own fossil fuel powered vehicles. With moves to HMRC car allowances and the enhancement of the fleet further, it is likely that the CO_2 emissions from the car fleet can be significantly reduced.

The more challenging element of the transition to EVs or ultra-low emission vehicles (ULEVs) relates to the operation of TBC's fleet of Refuse Collection Vehicles (RCVs) via UBICO, as technology is yet to mature in this sector with the best performing options from a CO_2 perspective being gas/methane. At this stage it is difficult to advise on any other strategy other than to monitor the technology as it develops and potentially stretch the vehicle service life (of the fleet at that time) to as close to the 2030 target as can be realistically accommodated (taking in to account procurement timescales) in order to benefit from the latest technology available.

2.1.4 WATER

7.21 Tonnes CO_2e	*0.45% of total emissions*

While water itself does not emit carbon when used, the emissions from water are associated with its supply, disposal and treatment in the form of the energy used to pump water and the maintenance of the supply, disposal and treatment networks. No account is made for any emissions associated with the biological treatment of wastewater. The emissions associated with TBC's water consumption are small when compared to the other emissions.

2.2 Greenhouse Gas Protocol

The Council's resolution was to 'Commit to doing all in its power to make Tewkesbury Borough Council offices carbon neutral by 2030'. While this report does provide the necessary baseline information in this respect, it also seeks to align this with what has become the standard practice under the 'Greenhouse Gas Protocols' (GGP) developed by the World Resources Institute in the late 1990's. Therefore, other premises are included in the assessment as detailed previously and including fuel consumption by UBICO in discharging TBC's statutory waste collection responsibilities. Under the GGP the operation of the leisure centres can fall in or out of scope however given the nature of the relationship between TBC and 'Places for People Leisure' it is considered that it is within scope. The greenhouse gas emissions (GGE) are therefore considered alongside the GGE associated with the offices but accounted for separately. The same logic has been applied to the Roses Theatre and the TICs.

Three categories of emissions by the Greenhouse Gas Protocol:

- Scope 1 (direct emissions) emissions are those from activities owned or controlled by your organisation. Examples: emissions from owned or controlled boilers, furnaces and vehicles; and emissions from chemical production in owned or controlled process equipment.

- Scope 2 (energy indirect) emissions are those released into the atmosphere that are associated with your consumption of purchased electricity, heat, steam, and cooling. They are a consequence of your organisation's energy use, but occur at sources you do not own or control.

- Scope 3 (other indirect) emissions are a consequence of your actions that occur at sources you do not own or control and are not classed as Scope 2 emissions. Examples are business travel by means not owned or controlled by your organisation, waste disposal, materials or fuels your organisation purchases, and also the emissions associated with the extraction, refinement and transportation of those raw fuels consumed as a result of your actions.

2.2.1 COMPARISON WITH HISTORICAL EMISSIONS

Table 1 shows historical data submitted by TBC to the Department of Energy & Climate Change (DECC) before the mandatory requirement was removed in 2013. Many councils have continued to monitor their emissions using the same methodology, but the data has not been collated nationally. The last submitted data is shown here for comparison purposes against the current calculations for calendar year 2019.

However, it should be noted that:

- The extent of scope 3 emissions has been extended since 2013 and the Council's asset base has changed with closure of Cascades, the opening of the new Leisure Centre and the reduction in floor space used by the Council in the main offices thereby reducing emissions proportionally.

- In calculating the total emissions for 2019, the emissions associated with all council owned properties (other than those purchased for investment purposes) have been included but the waste from the offices and public transport has not been included as there was no accurate data available. Due to the high emissions factor associated with waste generated from council operations, the total gross emissions for 2019-20 is highly likely to exceed those form the last recorded calculation in 2012-13.

Attention is drawn to the final column of the table below as there is frequent reference to the three emissions 'Scopes' that are included in the Greenhouse Gas Protocol against which this baseline has been produced.

Table 1 DECC - Local Authority own emissions reporting - emissions reported in tonnes of CO_2e DECC 2013 – Tewkesbury. (2019-20 data added)

Local Authority Own Emissions (CO_2e) Reporting to 2012/13							
	2008/9	2009/11	2010/11	20011/12	2012/13	*2019/20*	Scope Contents
Scope 1	1,356	1,529	1,410	1,228	1,442	*1,124.79*	Gas consumption; Owned Transport (incl. UBICO)
Scope 2	821	561	584	584	573	*185.68*	Electricity consumption
Scope 3	147	155	130	118	97	*289.46**	Water; Business travel (from unowned vehicles); Extraction, Refinement and Transportation of all raw fuels; Waste disposal
Total Gross Emissions	2,325	2,244	2,124	1,931	2,112	*1,599.93*	

*no data for Public Transport or Waste Disposal.

SECTION 3 CONSUMPTION AND EMISSIONS BY FACILITY

3.1 SCOPE OF DATA

TBC aspire to attain a carbon neutral status from its operations by 2030, specifically addressing CO_2 emissions for which they are directly responsible. At the current time, this includes the following:

- Owned buildings (referred to as **Buildings)** that are used to provide a public service, therefore excluding any buildings used for commercial purposes. Therefore the TBC estate included is as follows:
    - TBC Council Offices – less areas occupied by tenants
    - Tewkesbury Leisure Centre
    - Roses Theatre
    - Tewkesbury Cemetery
    - Cold Pool Lane Sports Pavilion
    - 5 x domestic properties providing housing support
- TBC Fleet (including vehicles of waste contractors UBICO)
- TBC Grey Fleet – specifically being vehicles owned and used by employees or Councillors of TBC for Council purposes. Business travel by public transport or taxi is not included

It is important to state that this report does not include CO_2 emissions resulting from office based waste. This is due to detailed data being unavailable (reflective of many Local Authorities at present) at the current time. The benefit of recording of such data would enable waste to be included as part of the emissions baseline.

Conversion factors from the Government's Greenhouse Gas Reporting Conversion Factors for 2019 (advanced data set) have been applied to the raw data provided by TBC in order to calculate the current level of CO_2e emissions and are available as an appendix to this report[6]. Each element includes as appropriate the Electricity Generation, Transmission & Generation, Well-to-Tank Electricity Generation, and Well-to-Tank Transmission & Distribution elements. Where water data is provided, both Supply and Treatment conversion factors have been applied. Conversion Factors for transport include both relevant fuel type and Well-to-Tank elements as appropriate, and details of all factors applied are detailed in the 'In scope emissions data' appendix calculations.

[6] TBC in scope emissions data calculations workbook

3.2 OVERVIEW OF FINDINGS

The headline figure shows a total of 1,599.93 tonnes/CO_2e per year from all included elements of TBC energy consumption. This is the total emissions from the three overarching categories of TBC operations as shown in the table below:

Table 2: Total Emissions by Category

TBC 2019 CO_2 Emissions	CO_2 Emissions (TCO_2e)	% of Total
Buildings	695.50	43%
Fleet	891.77	56%
Grey Fleet	12.66	1%
Sub-Total	1,599.93	100%

Tables below detail the composition of emissions by fuel/vehicle/user type from the headline categories:

Table 2.1: Emissions by Fuel/Vehicle/User

TBC Estate	Annual Consumption		CO_2e Emissions	
Utility	Unit	%	Tonnes	%
Electricity (kWh)	726,452	25	229.54	33
Gas (kWh)	2,208,033	75	458.74	66
Water (m3)	6,858	0	7.21	1

Table 2.2: Fleet Emissions

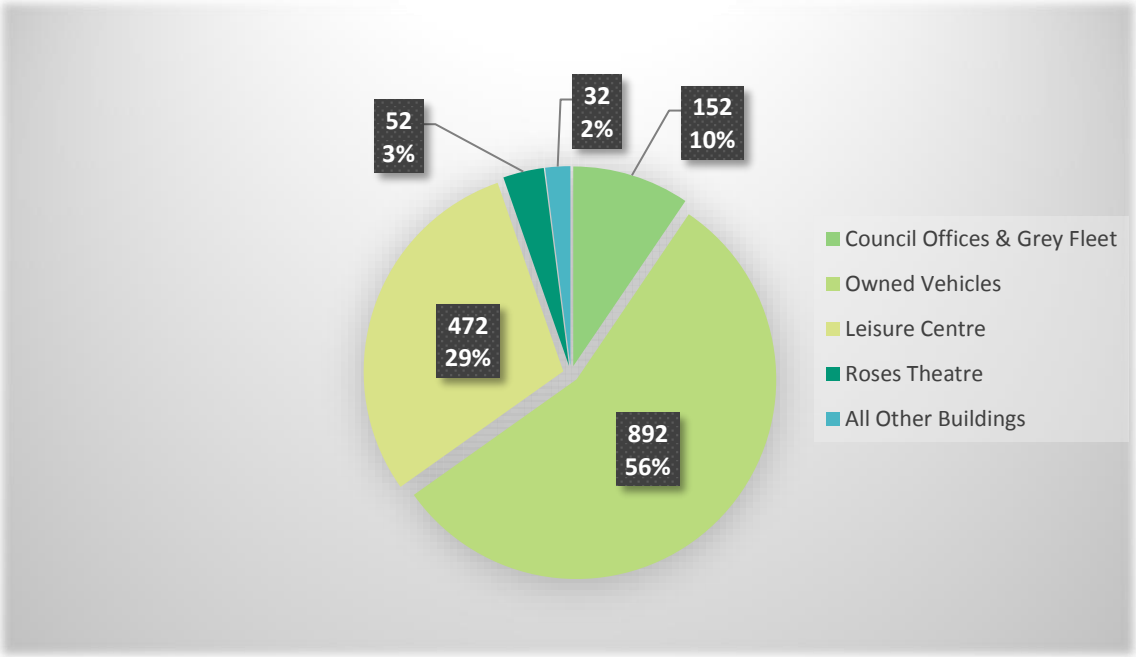
TBC Fleet - Including UBICO	Annual Mileage	Annual Kilometres	CO_2e Emissions
Cars	55,819	89,832	16.66
Vehicles >3.5 Tonnes	605,903	975,100	875.11

Table 2.3: Grey Fleet Emissions

TBC Grey Fleet	Annual Mileage	CO_2 Emissions
Staff	17,837	7.02
Councillors	14,337	5.64

Sub-category emissions are illustrated in the pie chart below and show 85% coming from Owned Vehicles (Fleet, including vehicles from waste contractor's UBICO) and the Tewkesbury Leisure Centre:

Figure 3: Proportional Emissions by Category



The remaining 15% of emissions however are not insignificant, and there are numerous measures that can be implemented across each element to achieve the overarching objective.

3.2.1 EMISSIONS BY 'SCOPE' (GREENHOUSE GAS PROTOCOL)

To consider the impact of emissions from activities for which TBC have responsibility when allocated to the relevant 'scope', the following tables are provided. The detail of scope shows each element that has been included in production of the baseline:

Table 3: Total Emissions by Scope

TBC 2019 CO_2 Emissions by Scope	CO_2 Emissions (T/CO_2e)	% of Total	Detail of Scope Composition
Scope 1	1,124.79	70.30%	Gas Consumed; Owned Transport (Incl. UBICO)
Scope 2	185.68	11.61%	Electricity Consumed
Scope 3	289.46	18.09%	Extraction, Refinement and Transportation of all raw fuels; Water; Business Travel (unowned vehicles)
Total	1,599.93	100%	

It is important to note that emissions from TBC office waste is not included at the current time as figures for this aspect of what would be Scope 3 emissions are unavailable, although the council is keen to establish a management system that will record by type the levels of waste (and subsequent emissions) produced for inclusion in the future.

Table 3.1 Granular Emissions by Scope

TBC 2019 CO_2 Emissions by Scope & Element			
Scope	Element	Emissions (T/CO_2e)	% of Total
Scope 1	Gas Consumed	405.95	25.37%
	Owned Transport	718.84	44.93%
Scope 2	Electricity Consumed	185.68	11.61%
Scope 3	Extraction, refinement & transportation of Scope 1 Gas	52.79	3.30%
	Extraction, refinement & transportation of Scope 1 Transport Fuel	172.93	10.81%
	Extraction, refinement & transportation of Scope 2 Electricity	43.86	2.74%
	Water	7.21	0.45%
	Business Travel (unowned vehicles)	12.66	0.79%
Total		1,599.93	100%

Table 3.1 builds on the total emissions by scope table, showing the specific impact of single elements of the TBC baseline, helping to inform prioritisation of actions for implementation.

Unsurprisingly, 73% of emissions fall within Scope 1 (34% from Gas consumption and 39% from Owned Fleet). Electricity consumption that forms Scope 2 accounts for 10% of total emissions, with the remaining 17% of emissions coming from Scope 3.

It is interesting to note that whilst gas consumption accounts for almost 83% of the combined electricity and gas consumption recorded, only 34% of total emissions are from gas consumption. This is due to the carbon content within a unit of gas presently being much lower than any other fuel type within this dataset, however the continual annual reductions of carbon levels in electricity should influence the council's prioritisation planning.

The following tables breakdown the emissions by Scope into more granular detail for the purpose of deeper analysis. This information is used to inform conclusions at the end of this section:

Table 4: Council Offices 2019-20 (including UBICO vehicles)

Source and Scope	Energy Consumption (MWh/Year)	GHG Emissions (Tonnes/CO_2e)
Scope 1 - **Gas** - **Owned Fleet mileage (not EVs) Including UBICO vehicles**	258.54	47.53 718.84
Scope 2 - **Electricity**	260.19	66.51
Scope 3 (excluding waste) - **Business Travel Councillors (Grey Fleet)** - **Staff Millage (Grey fleet)** - **Water** - **Extraction, refinement & transportation of raw fuels (Gas, Electricity & Scope 1 Transport)**		5.64 7.02 2.91 194.82
Total for TBC Offices	**518.73**	**1,043.27**

Table 4.1 Leisure Centre

Source and Scope	ENERGY CONSUMPTION (MWH/YEAR)	GHG EMISSIONS (TONNES/CO_2e)
Scope 1 - **GAS**	1,632.38	300.11
Scope 2 - **Electricity**	406.63	103.93
Scope 3 - **Water** - **EXTRACTION, REFINEMENT & TRANSPORTATION OF RAW FUELS FROM SCOPES 1 & 2**		4.24 63.58
TOTAL FOR LEISURE CENTRE	**2,039.01**	**471.86**

Table 4.2 Roses Theatre

SOURCE AND SCOPE	ENERGY CONSUMPTION (MWH/YEAR)	GHG EMISSIONS (TONNES/CO_2e)
SCOPE 1: GAS	233.9	43.00
SCOPE 2: ELECTRICITY	11.97	3.06
SCOPE 3 - **WATER** - **EXTRACTION, REFINEMENT & TRANSPORTATION OF RAW FUELS FROM SCOPES 1 & 2**		6.32
Total for Roses Theatre	**245.87**	**52.38**

Table 4.3 Other Premises (5 Dwellings, Hat Shop, Sports Pavilion (no data), and Cemetery)

SOURCE AND SCOPE	ENERGY CONSUMPTION (MWH/YEAR)	GHG EMISSIONS (TONNES/CO_2e)
Scope 1: Gas	83.22	15.30
Scope 2: Electricity	47.66	12.18
Scope 3 - **Water** - **EXTRACTION, REFINEMENT & TRANSPORTATION OF RAW FUELS FROM SCOPES 1 & 2**		0.07 4.87
Total For other buildings	**130.88**	**32.42**

3.3 DATA – AVAILABILITY, ACCURACY AND TIME PERIOD

3.3.1 DATA AVAILABILITY

Significant efforts were made by TBC to provide all electricity, gas, water, and transport data for production of an emissions baseline for the time period January to December 2019, however there are several pieces of missing data additional to the waste data previously mentioned.

Missing data:

- Water consumption at the Roses Theatre
- All data at the Sports Pavilion at Cold Pool Lane (mitigated by minimal current data usage throughout 2019)
- All data for the 5 domestic properties used to support Homelessness (see approach used to mitigate in section 3.3.2)

Based on the number of collection bins, estimated weight of bins and frequency of collection there is the potential for a sizable contribution from office waste to the total emissions level. This should be considered when assessing data presented in this report.

At the current time it is not unusual for Local Authorities to be unable to provide this data, but for completeness of the data there would be advantages recording of waste (by type) as soon as practicably possible.

It is considered that the impact of the missing data (excluding TBC Office waste) is unlikely to cause more than a 3% variance to the current figures provided. This is based on the level of confidence in the mitigated action taken in apportioning energy consumption within TBC Offices (based on actual consumption data for the whole building) and estimated consumption figures applied to the 5 domestic properties. Unless made explicit, where data for any element of consumption has not been provided, estimations of consumption have not been applied, and as such will not form part of the published emissions figures.

3.3.2 DATA ACCURACY

There are a number of concerns surrounding the accuracy of some of the data that was initially provided. Specifically these include:

- Apportionment of data within TBC Offices to exclude the energy consumption from the council's tenants. This was largely completed by calculating consumption based on floor area (also using each organisations' occupied floor area to estimate the electricity, gas and water consumption for communal areas)
- Roses Theatre data provided as a single annual consumption figure for both electricity and gas (then multiplied by three to provide figures for 3 years)
- Leisure Centre data counting energy generated from its combined heat and power plant within their CO_2 emissions calculations, meaning actual emission levels are significantly lower than provided data indicates
- Tenants being unable to provide any billing data to verify their consumption

- Energy consumption for each of the 5 domestic properties was produced on the basis of estimated energy consumption by floor area as provided by Energy Performance Certificates (EPC) that were secured for four of the five properties, alongside 2017 OFGEM data showing typical ratios of energy use for electricity and heating fuels. An average of the EPC data was used for the single property without an EPC. A number of the EPCs require updating, from which recommended improvements should be considered for inclusion within the overarching Action Plan

3.3.3 DATA TIME PERIODS

It was initially anticipated that the baseline data would be produced as an average (as appropriate) from the last 3 years (2016-2019) of available energy data, however the resource required in collating this, in addition to the probable high level of missing/unavailable data it was agreed that the baseline should be produced as far as possible using data for the calendar year 2019. The following list itemises any data included that was either outside of the intended timeframe or did not cover the whole of the intended timeframe:

- Grey fleet data covered April 2019 – January 2020, and as such was extrapolated from 10 months to 12 months in order produce a full year of data
- UBICO (waste contractor) fleet uses an average annual mileage (believed to be an average from time periods between vehicles being serviced, but this is not verified).
- Data from Roses Theatre could not be verified either in terms of accuracy (actual meter readings) or time period. It is taken in good faith that the single annual consumption figures for electricity and gas are based on actual consumption

There are several other minor variances such as annual data from November 2018 to November 2019 that had to be used but apart from this, all remaining data was derived from spreadsheets provided covering the 2019 calendar year.

SECTION 4 DATA REQUIREMENTS FOR ONGOING EMISSIONS TRACKING

4.1 ADOPTING THE GREENHOUSE GAS PROTOCOL AND GOVERNMENT CONVERSION FACTORS

Following the Greenhouse Gas Protocol (GGP) ensures that a systematic and accurate mechanism is in place for:

- Informing specific data requirements
- Supporting the process of data collection, collation and analysis
- Converting the data into a common value for monitoring, targeting and management purposes

Data requirements are informed by the component parts of the GGP's scope 1, 2, & 3 emissions categories (as detailed in section 2.2 above). It is relatively straightforward in satisfying both scope 1 & 2 requirements, however the breadth of scope 3 is such that it is currently not possible to populate all aspects (for example disaggregate Waste disposal, use of public transport – both of which the council

intends to integrate in the near future). A relevant benefit of the GGP for the council is that action can be put in place to ensure internal systems are developed to enable more elements of scope 3 to be added as appropriate, in line with the standardisation provided by the protocol.

A strong understanding of the data requirements makes it possible to establish systematic mechanisms for targeted collection, analysis and reporting. It is essential that accurate data is collected in a timely way, a task that will require some management given the multiple sources from which it will be provided.

Government carbon conversion factors are published annually (by BEIS – Department for Business, Energy & Industrial Strategy, and DEFRA – Department for Environment, Food & Rural Affairs) for reporting purposes. In producing this baseline, the 'advanced dataset' has been used, and it is recommended this is continued year on year as standard. There are a number of aspects that are important to include when converting data into CO_2e which relate to each of the 3 GGP emission scopes. For example, the consumption of Natural Gas within buildings has a conversion factor that is applied to the total kWh of gas used. This forms part of scope 1, however it is necessary to apply an additional conversion factor that takes into account the extraction, refinement and transportation of the raw fuel (referred to as 'well-to-tank'). For each fuel there is a similar (and sometimes more complex) combination of conversion factors needed in order to ensure all aspects of the production, supply and consumption (and disposal in the case of waste) are accounted for.

In production of the 2019 baseline a set of data worksheets were created for calculation of CO_2e from Gas, Electricity, Water and Transport. Attached as a calculations worksheet to this report is the full detail of data processing. As data for office waste was not available, there are no calculations produced the following is provided, therefore, to support its future inclusion.

Waste disposal is measured in tonnes, with separate conversion factors for different categories of waste. Additionally, individual conversion factors are applied to different methods of disposal. This is detailed as follows based on typical waste from office buildings:

Table 5: Emission factors associated with Waste disposal

2019 Carbon Conversion Factors (kgCO_2e) for Waste by Type and Disposal Option							
Disposal Option / **Waste Type**	**Re-use** *Waste re-used not recycle / taken to landfill*	**Open-Loop** *Recycling material into other products.*	**Closed-Loop** *Recycling material back into the same product.*	**Combustion** *Energy recovered by incineration & subsequent generation of electricity.*	**Compost** CO_2e emitted as a result of compost of a waste stream.	**Landfill**	**Anaerobic Digestion**
Mixed Food & Garden Waste				21.354	10.204	587.43	10.204
Glass		21.354	21.354	21.354		8.986	
Metal			21.354	21.354		8.986	
Electrical Appliances		21.354		21.534		8.986	
Electrical - Batteries		64.637				75.492	
Plastics		21.354	21.354	21.354		8.986	
Paper			21.354	21.354	10.204	1,041.9	

Multiplying the tonnage of each waste type by its relevant conversion factor produces the CO_2e data. It is important to note that identifying the appropriate waste disposal options will ensure accurate production of final data. Furthermore, the knowledge gained from understanding the detail of current disposal methods alongside awareness of the other opportunities for reducing the emissions impact will inform future decision making. It is likely that specific support can be provided from the council's waste contractors as required.

4.2 MANAGEMENT SYSTEM OPTIONS

The International Organisation for Standardisation (ISO) is probably the most recognised certification option should TBC choose to demonstrate formally their commitment and approach to environmental

management. The 14001 standard, Environmental Management Systems would provide a framework to help reduce waste, improve resource efficiency and potentially cut waste management costs.

It is possible however for a less formal approach to be implemented that would still enable TBC to effectively target, monitor and manage each of the component parts that contribute to their carbon management programme.

As with all effective project management it is essential to follow the Plan, Do, Check, Act approach that is underpinned by both supportive monitoring and targeting processes as well as essential organisation wide engagement and communications.

Given the council has already stated its commitment to the Climate Emergency, and has highest level senior management involvement, it is positive that this most essential of elements is already in place. Attention now is rightly focused on creating the appropriate systems and processes necessary for effective data monitoring, implementation planning and structuring of internal working teams delivering on plans.

The Council should decide which route (ISO or informal approach) is preferential at the current time. One suggestion would be to consider finalising production of all necessary internal systems to the point that they are operating appropriately for TBC ahead of having an external audit (through ISO providers). This would then enable any subsequent formal certification works to positively support the overarching council Carbon Management Programme.

4.3 INTERNAL DATA COLLECTION

To enable efficient and accurate reporting, it will be important that the relevant people are engaged with: what information is required; when it is needed; and why it is being requested. The communications plan will be effective in generating such awareness, support and enthusiasm for the programme of works.

In terms of specific data, the data annex attached to this report will outline the basic information needed. Essentially this comprises receipt of energy consumption data at the same date each month, either from energy bills (based on actual meter readings) or monthly meter readings taken by the accountable person for each of: electricity; gas/heating; water; and as appropriate transport and waste. Records of business travel by means of public transport (including taxis) should also be incorporated.

Whilst the extent of coordination required is considerable it should be positively recognised that the volume of data that has already been provided, it is clear that almost each category comprising the emissions baseline is already available. Establishing a coordinated and coherent mechanism for collecting and collating should make it possible to bring all data together without too much difficulty.

On receipt of all monthly actual consumption data it will be necessary to apply the relevant conversion factors in order to produce a common set of data (tonnes of CO_2e). The following table outlines the measurements needed to enable relevant carbon conversion factors to be applied:

Table 6: Fuel Measurements:

Fuel Type	Measurement/Quantification	Comments
Electricity	kWh	Recorded at meter exactly as required for conversion
Gas	Cubic Meters or Cubic Ft	Conversion to kWh required. Bills from suppliers does this
Water	Cubic Meters	Recorded at meter as required
Transport	Vehicle size/weight; Fuel type; distance travelled (miles & kilometres)	Conversion applies a mix of mileage and kilometres depending on type, but vehicle categories and fuel type are required in every instance
Waste	Always in tonnes	Breakdown of waste by type (see section 4.1) necessary

Each category of data can then be converted in to equivalent tonnes of CO_2, although it is important to note that emissions are produced in the extraction, refinement and transportation phases prior to the actual consumption of it as part of business operations. The initial extraction and refinement phase is categorised to as 'Well To Tank' (WTT) in the government published carbon conversion data sheets. The transportation of the fuel is called 'Transportation & Distribution' (T & D). The breakdown of emissions by phase is clearly shown in the supporting data calculations appendix, and effort has been made to illustrate where each part of the emission production process is recorded within the GGP Scope 1, 2, & 3 categorisation (see section 3.2).

4.4 CONCLUSIONS FOR CONSIDERATION

The priority is to establish and publish an agreed ongoing emissions tracking process for council and reporting. It can be seen that a current weaknesses surrounds availability and accuracy of certain data (detailed in Section 3 above), however it is also clear there is a significant volume of data already being collected. By formalising collection systems it will be possible to efficiently monitor, analyse and communicate and inform future decision making.

In addition to the several pieces of missing energy (electricity, gas and water) data from certain buildings there are two elements, in office waste disposal and public transport use for business activity, that once incorporated will provide a strong and comprehensive set of data that satisfies the primary needs of each of scope 1, 2 & 3 for emissions reporting.

Section 5 Summary of Energy Surveys and Recommendations

5.1 CONTEXT OF SURVEYS

In addition to a strong set of energy consumption data it is important to understand how and where energy is being consumed across council operations. In support of production of the action plan on-site energy surveys were conducted so as to inform energy saving measures for implementation. Reducing the overall energy demand not only achieves a lower emissions status and reduced running costs, it also means a smaller level of renewable energy is required both to supply the council's resulting energy demand (as far as possible) and offset any remaining energy necessary to be imported from current sources.

Site surveys were conducted at: TBC Offices; Roses Theatre; TIC (HAT Shop) and the Sports Pavilion at Cold Pool Lane. Attention was focused on the Offices and the Theatre as this was where the greatest opportunity for emission reduction was identified. The Leisure Centre was not included primarily because it is a new building with modern plant and therefore will be prioritised for attention nearer 2030. A survey was conducted at the Sports Pavilion (Cold Pool Lane), however this report contains no quantifiable data for the site as a result of limited energy consumption information being available. Tewkesbury Cemetery was visited, however consumption is so minimal the only recommendation is to establish rainwater harvesting. The 5 domestic (supporting homelessness) whilst not surveyed are included having applied data from available Energy Performance Certificates that has been manipulated to reflect typical consumption, which is explained later in this section.

Business Case Overviews in Appendix 1 give visual summary of costs, generations & revenues for project options.

An overview of the opportunities is presented below on a site by site basis. Not all suggested opportunities have been incorporated into the Action Plan because limited granular energy data has prevented it being possible to calculate and show specific savings (energy, carbon or financial). As such there will be a need for more detailed follow up activity in these areas as it will no doubt be possible to achieve greater consumption savings than the conservative savings quantified in the Action Plan. In each case below, the calculated carbon and financial savings to the Council are presented.

The Action Plan itself is presented in Section 7 along with a commentary and presentation of outline business cases as Appendix 1. This appendix makes the action plan table a user friendly tool for understanding options.

5.2 SURVEY RESULTS

5.2.1 TEWKESBURY BOROUGH COUNCIL OFFICE

Overview (based on apportioned floor area occupied by the Council)

Current: 138.84 Tonnes CO_2e per annum	*Current Cost: £53,661 per annum*
Savings: 89.95 Tonnes CO_2e per annum (65%)	***Cost Savings: £17,359 per annum (32%)***

Following a programme of recent building improvements there are a number of examples of positive sustainable energy management. This includes a 90KWp Solar PV array that provides almost 10% of the whole buildings electricity demand (or 20% of the apportioned electricity for which the council is responsible, given energy consumption of the multiple tenants falls outside the scope of this work), an efficient lighting system with both occupancy and daylight sensor control and low energy 'thin power' desktop IT combined with automatic shutdown (at 8.00pm) of equipment that remains on but not in use. There is also a policy of office rationalisation (8:10 ratio) helping to limit 'in office' consumption.

The primary recommendations are as follows:

Emissions associated with the Public Service Centre could be significantly reduced by replacing the present heating system. The current system is gas powered, providing heat from 10 modulating 48KW boilers. There is the potential for enhanced use of the TREND building management system if remote access were enabled (current control only from within the plant room).

Temperatures were recorded at 23°C and 24°C across different floors, presenting an opportunity for annual savings of 17.1 tonnes CO_2 & around £2,185 if reduced to 20°C. A further 15.4 tonnes CO_2 & £1,965 could be saved each year by optimising the heating to match demand by using weather compensation.

Both recommendations should be applied to the present system and integrated into the new system when implemented.

It is recommended that the current plant is replaced with Air Source Heat Pumps. Given the age of the current system (obsolete as replacement parts are difficult or even impossible to find) the timing of this opportunity is excellent.

Specialist surveys are required to accurately size the new system, and confirm the structural integrity of the roof (where they would be installed), the benefit of changing from what is presently a 60% efficient system to one that is 300-400% efficient is significant.

Annual savings (additional to those of the earlier recommendations) of 38.41CO_2 & £1,735 are realistic. Additionally, there is revenue generated from the production of energy through heat pumps. If installed before 2022 and based on current rates (2.75p/kWh), annual returns of £2,313 are possible.

In total the combined savings of addressing the heating system as recommended could provide a total annual cost benefit that represents nearly 55% of current annual energy cost for the whole building. CO_2 savings based on the apportioned floor area for which the council are responsible will be in the order of 50%of total current emissions.

There is a good opportunity for reducing emissions and costs associated with the server room. It is recognised that some improvements have already been made in this area, however the cooling units

are very old, and replacing them will double their efficiency, thus halving both costs and emissions. Additionally, increasing the temperature from 20°C to 22°C will provide a duality of benefit. Firstly, the incidental heat gains, primarily being the heat from adjoining rooms, means that the cooling units will be working to cool 2°C of heat that has been generated in part by the heating system. Setting these temperatures to similar levels negates this issue (and the new temperatures fall well within the recommended parameters of Air Conditioning Association – ASHRAE of 18-27°C) and furthermore reduces consumption by around 15% as a result of cooling to higher temperatures.

Replacing the units will save more than 13 tonnes CO_2, and reduce costs by in the order of £6,300p.a. The savings (after new units installed) from raising the cooling temperature could be as much as 2.75 tonnes CO_2, and reduce annual costs by more than £1,300. Total savings from improvements within the server room are 15.75 tonnes CO_2, and reduced annual costs of £7,600. Server consumption figures are based on data provided from the Air Conditioning Inspection report conducted in 2016 at TBC Offices.

To maximise energy savings, it is advisable to undertake an updated assessment of the current levels of insulation within the thermal envelope of the building. Built in 1977 (although recently renovated) it is expected that there will be at least partial cavity wall insulation in place, however the extent and quality of this is unknown. Insulation is recognised as one of the most effective energy saving measures, with well insulated buildings reducing levels of unwanted heat loss, minimising heating costs and providing vastly improved comfort levels all year round.

It is possible that savings could be achieved from voltage reduction/optimisation equipment, which reduces the level of the voltage supply. A previous study at the council offices indicated a voltage supply of around 242 volts.

Reducing this by 10 volts (remaining within published parameters) could achieve around a 4% reduction in consumption, however it is important to note savings will only be derived from voltage dependent loads (fluorescent lamps, motors etc.) although an additional benefit is increased lifespan of electrical equipment. If 4% savings were achieved, savings of 3.29 tonnes CO_2, and reduced annual costs of £1,561.

Following the implementation of demand reduction improvements it is then recommended that the capacity of the solar PV is extended so as to account for the remaining electricity requirements at the offices.

It is considered that with an appropriately sized PV system around 75% of the generated energy could be used within the building, thus removing 75% of the cost of imported electricity. This is detailed as part of a whole estate option within section 7.

Whilst not directly returning energy savings, it would be advantageous to increase the level of sub-metering in place within the offices. This would enable all tenants to be charged for their actual energy consumption, and also sub-metering server rooms and air conditioning units generates awareness of their true cost as well as providing actual data showing the impact of any energy saving measures implemented.

5.2.2 ROSES THEATRE

Current: 52.38 Tonnes CO_2e per annum	*Current Cost: £8,812 per annum*
Savings: 41.82 Tonnes CO_2e per annum (80%)	***Cost Savings: £4,425 per annum (50%)***

The heating situation at the Theatre has many similarities to that within the Council offices, and the recommendations in that regard are the same, in terms of replacement of current heating system with Air Source Heat Pumps. The heating control however requires additional attention, as certain areas of the building are presently being heated 24 hours a day, to temperatures well above recommended levels. A building energy management control system should be installed alongside the survey and subsequent installation of wall and roof insulation.

Savings from improved heating control (temperature and weather related occupancy control) are expected to be above 50% of current costs, making savings of 25 tonnes CO_2, and £4,045 against annual costs very realistic.

Additional savings will be realised through the change of use from Gas powered to Air Source Heat Pump driven heating supply. Around 16.82 tonnes CO_2, and £380 against annual costs (on top of the earlier savings of £4,045 identified).

Replacing the current single drive heating distribution pumps with variable speed drive pumps and the installation of time control on bar fridges and electric hot water heaters throughout will return conservatively calculated savings of around 0.38 tonnes CO_2, and £180 against annual costs. It is important to note that annual electricity costs at the Theatre are in the order of £1,750 compared to gas costs of over £7,000, hence the apparent low value of electricity energy savings shown.

It is recommended that all remaining emissions (heat pumps = 6.67 tonnes, remaining electricity demand emissions = 3.4 tonnes) are mitigated through installation of solar PV panels against which electricity costs will reduce further as a result of avoided imported electricity costs (around £1,100p.a. based on current costs).

A structural survey of the roof should precede installation of either Heat Pumps or Solar PV panels where both would be sited. The apparent available area of flat roof suggests ample room to accommodate the required levels of both technologies to achieve net zero carbon emissions.

5.2.3 TIC (HAT SHOP)

Current: 4.98 Tonnes CO_2e per annum	*Current Cost: £2,245 per annum*
Savings: 1.5 Tonnes CO_2e per annum (30%)	***Cost Savings: £559 per annum (25%)***

The Tourist Information Centre (HAT Shop) is a grade 2 listed building (with recent extension) of solid wall construction.

An aging wall mounted 28KW boiler (suitable for the size of building, that of a large domestic property) provides heating, although there is very little insulation evident which should be rectified as a matter of priority. It was confirmed that the building is either very cold or too hot, reflective of external weather conditions, and typical of an under-insulated building. Insulation of roof area and walls (dry lining) should be investigated. The majority of windows are single glazed which could benefit from removable secondary glazing to help reduce heat loss during cold weather. Given the very low annual heating costs, the implementation of these recommendations would be to improve internal comfort conditions, and removal of emissions rather than the impact of reduced costs.

The boiler is located in a small room only accessible from the lane running alongside the building. Changes would need to be made to this building in order for heat pumps to be fitted, and as such it might be more appropriate to upgrade the boiler with a like for like replacement (expected to realise 25% saving from improved efficiencies of 0.6 tonnes CO_2, and £133 against annual heating costs of £531).

The majority of the property has had a lighting retrofit, however there remain 27 halogen spot lights (50watts each) that should be replaced with 5 watt LED equivalents at the earliest opportunity. Savings of around 0.9 tonnes CO_2, and £426 against annual costs of £1,191 (36%) could be expected.

5.2.4 REMAINING BUILDINGS

5.2.4.1 SPORTS PAVILION – COLD POOL LANE

The Sports Pavilion is presently operating on minimal usage for the reason that there are drainage concerns that are preventing optimum utilisation of the facilities by the community. Therefore, the lack of energy data does not present the problems that it otherwise would. It is important however that a process is established between the council and the management team at the pavilion so as to secure accurate monthly electricity, gas and water readings for ongoing inclusion of the data within the scope of this programme. It was clear that there is a high level of building knowledge within the pavilion's management team which is positive to note.

There is a good opportunity to make use of the sizeable roof area for the purpose of installing solar PV panels, which should provide part of the solution for the overall additional renewable energy generation that is a recommended and significant feature of the overall solution. This said, it is hoped that the building will be extended so as to create a second floor, which if realised in the near future would need to be completed ahead of any solar panels being installed.

The building was erected in 2011 and as such has good levels of insulation, relatively modern heating and hot water plant (with hot water being the most energy intensive feature, as expected with local sporting facilities.

There are opportunities for increasing the energy efficiency of the building, important to implement prior to a return to optimum usage. Largely efficient lighting is in place, controlled by occupancy detectors which is positive to note, although there is high frequency fluorescent lighting in place that should upgraded with LED equivalents when replacements are required.

There is also a sizeable air extraction system zoned for individual area control. There is potential for these to become a significant energy consumer, especially as the control functions are easily accessible for all. It is recommended that the controls are secured within lockable Perspex (or similar) casings and that the controls are linked to a humidistat that will ensure they are only in operation as required within defined parameters.

One final point of note relates to the relatively high anticipated volume of water usage. Related to this are two important energy considerations. Firstly it is important that the three hot water cylinders are controlled to only store hot water for a short period ahead of expected usage. Given that the plant is efficient, it is expected that the time period for heating the water will be reasonably short, and whilst this is undoubtedly in hand, it is suggested that this process is tested in order to achieve the best outcome from both a demand, efficiency and cost perspective. Secondly consideration should be given to the application of flow restrictors which can achieve at least 15% reductions in consumption with little to no noticeable difference for the user.

5.2.4.2 FIVE DOMESTIC (HOMELESSNESS) PROPERTIES

There was no available energy consumption for the 5 domestic properties to be included within the Carbon Management Programme. The action taken to ensure that at least reasonable energy consumption could be incorporated was to include estimated energy consumption as identified within Energy Performance Certificates (EPC) that were found for four of the five properties. This data was provided in kWh/M^2 along with total floor areas for each property. By applying 2017 OFGEM data showing typical ratios of energy use for electricity and heating fuels it was possible to produce a reasonable estimate of the total energy consumption that was then apportioned in line with the 2017 OFGEM guidance. An average of the EPC data was used for the single property without an EPC.

To calculate the potential energy savings, the EPCs showed new 'potential' consumption in kWh/M^2, which was apportioned between heating and electricity fuels and then given a financial value on the basis of typical domestic energy tariff rates.

EPCs are valid for up to 10 years, and many of the EPCs found were either out of date or nearing required renewal. By updating these EPCs, and commissioning a more detailed survey review of each property it will be possible to secure more accurate savings data as well as more specific detail regarding energy consumption reduction opportunities that need to be applied ahead of any PV Power System that would be needed to mitigate any remaining energy demand.

Section 6 Local and Regional Partnerships

Over the course of the Carbon Management Programme TBC will need to benefit from a range of services and partnership opportunities. Collaborations that encourage funding, secure expertise inputs and that maximise on the multiple co-benefits possible from these kinds of endeavours will be valuable.

In terms of own estates work the main considerations are funding, technical expertise and, potentially community engagement, if projects were considered to be impactful on communities and requiring public support or, if the benefits of showcasing to encourage snowball community effects were considered valuable.

Funding

Since the main public sector financing tool Salix has been considered not viable for TBC other solutions must be considered. However, the funding landscape is not very clear at this time, EU funds and Incentive schemes were impacted by Brexit; public sector finances uncertain since COVID. The Action Plan considers the viability of schemes and it can be seen that there is a route to ROI but upfront funding will still be required. Some councils are considering bond schemes and this is something financial teams could consider but probably more viable on projects with obvious public interest and benefit attached.

Community Energy business models have been impacted by the changes in returns and there are few examples of them working directly with the Public Sector but the potential is there. Gloucestershire has one active Community Energy Cooperative but since we are moving to the age of democratised energy it is hoped that more are encouraged to evolve.

Affordability can also be increased through bulk purchasing and this is something to be considered as the plan of works is made and also lends itself to collaboration with other authorities making similar plans so deals can be brokered accordingly. Officer networks and any emerging County-wide coordination efforts on Climate Emergency and Recovery could be a good point of access to learning of those with similar ambitions.

Gloucestershire's Local Enterprise Partnership (Gfirst LEP) recently facilitated the production of the Gloucestershire Sustainable Energy Strategy (published January 2019[7]) that contains parallels with a number of the recommendations within this report. The emerging Local Industrial and Recovery Strategy, which is also very focused on the green agenda is also Gfirst led. Alongside these strategies LEP have been the managers of public funding for infrastructure and economic development and there are early signs that funding from National Government for home insulation and electric vehicles is on the horizon.[8] Initiatives like this may be able to help the council address fleet, staff mileage and energy efficiency issues at their homeless accommodations. Moreover the LEP Business Energy Sector Group

[7] https://www.cse.org.uk/downloads/file/gloucestershire-energy-strategy-2019.pdf

[8] https://www.bbc.co.uk/news/business-52851185

provides networking and knowledge of local service providers and innovations that could inform future plans.

The plan also recognises the role of partners to manage their own responsibilities to the council as their contract manager to support carbon neutral ambitions. Partnership working with UBICO is therefore a key part of increasing affordability for the council.

The council will also need to develop relationships with pool car firms and could explore incentive schemes for staff to take on electric cars as personal vehicles, they would then use for business as well through lease schemes.

Technical Expertise

The Department of Business, Energy and Industrial Services (BEIS) is currently the manager of funds relevant to energy projects. It funds regional support Hubs who have a remit to enable large scale installations. The South West Energy Hub, is hosted by West of England Combined Authority and will provide technical support and advice on project plans. This may well be more relevant to any Borough wide ambitions as they are interested in investment opportunities that could cover their costs, but they are a useful point of information with regards to consultants in the region; case study and experience in other councils and general technical support.

Local expertise comes in the form of Severn Wye Energy Agency (Gloucester) and Centre for Sustainable Energy (Bristol) who can provide sense checking on plans and give information on local supply chains and installers. These organisations are also experienced with community engagement if required.

Section 7 Draft Action Plan & Roadmap Rationale

7.1 OVERVIEW OF ACTION PLAN & ROADMAP

The proposed approach for achieving net zero carbon[9] is a combination of elements that include: recommendations based on the understanding of external influencing factors of national policy and the government's preferred direction of travel with regard to the Climate Emergency; consideration of the likely progress of the national energy infrastructure in 'Greening the Grid' by 2030.

Internal factors will increasingly influence the implementation of the Action Plan as the programme commences. This includes: any future changes to any local climate change, environmental or planning policies; financial capacity to enable completion of capital measures; availability of internal resources required or, significant changes to the council's estate or delivery of services.

[9] TBC to revisit the explicit wording of their commitment given the impact of and difference between what is required to achieve 'carbon neutrality' or 'net zero carbon'

The Action Plan has been developed with the following priorities, presented in level of importance:

1. Energy consumption is controlled and managed, reflecting demand times, levels (temperature for example) and relative to external weather conditions as necessary
2. Energy efficiency maximised through no and low cost measures
3. Replacement of 'end of life' equipment with most appropriate low carbon technologies
4. Remaining energy demand offset with renewable energy solutions aiming to consume as close to 100% of generated energy, therefore reducing use of 'imported' energy as much as possible
5. Finally consider procurement of 'green' energy tariffs as a belt and braces approach for any final imported energy demand remaining

It is recommended that as far as possible all gas consumption is removed, converting to electricity. This is predominantly for all space heating purposes as well as water heating at the Leisure Centre. Once demand reduction or energy efficiency has been optimised the solution focuses on utilising Heat Pump technology (mainly Air Source Heat Pumps – ASHP) which delivers vastly improved efficiencies compared to more traditional combustion systems.

The emissions from the remaining electricity demand are negated through the installation of photovoltaic (solar power) systems. Through a combination of mechanisms the scale of the system should enable a significant majority of the renewable energy generated to be consumed across the council's estate and transport fleet (using electric vehicles and required charging points).

7.1.1 SUPPORTING THE APPROACH

CONVERTING FROM GAS TO ELECTRICITY

It is known that the national electricity grid has and will continue to make large reductions to the level of carbon contained in electricity production and distribution. Having reduced by more than 40% in the recent past (over 10% since 2018) projections are for levels to fall significantly by 2030 against current levels, so much so that by 2025 it is likely to be a less carbon intensive fuel than natural gas.

It is also anticipated there will be an increase to the current level of 'Climate Change Levy' (CCL) that is already applied to gas and electricity consumption. If plans proceed, gas CCL will be equalised with that of electricity in the coming years. This has the following impacts:

- The confirmed annual increases[10] for 2021 & 2022 mean a real term cost increase of 5% based on the current TBC gas energy prices (£2,782).
- Were further increases to take place to equalise the gas and electricity CCL, then based on the 2022 electricity level then the impact to the council would be an increase in gas costs of over £9,600 per annum (nearly 20% on 2019 consumption).

[10] https://www.2ea.co.uk/CCL-Rates-Announced-for-2020_2021_2022.html

- It is important to note that the electricity CCL will reduce from 2020 so that in 2022 it will be over 9% lower, thus increasing the support for the recommendation to switch energy use away from gas to electricity.

INSTALLING PHOTOVOLTAIC (PV) POWER SYSTEMS

Given the scale of PV array recommended thought will need to be given to siting of the system (or more likely multiple smaller systems). One part of the next phase of work will be to conduct a thorough assessment of appropriate locations across the estate, or alternatively consideration of the implications of a single system (as seen appearing across many farmlands). The total size of the proposed system for offsetting the remaining electricity demand, for contextual purposes, would be slightly smaller than a typical professional football pitch (7,140M^2). Solar panel sizes do vary as well as do their respective performance/output. It will be important to strike the balance between size, performance and cost.

RENEWABLE ENERGY TARIFFS

An attractive option for any consumer to reduce their carbon emissions from grid electricity is to switch to a 100% renewable tariff. But not all renewable electricity tariffs are the same, with them being characterised as 'dark green' or 'light green' depending on how the renewable energy is sourced.

Dark green suppliers source enough power directly from renewable generators to match every unit of electricity that customers use over a year. Light green suppliers are able to say that they sell 100% renewable electricity despite not buying any power from renewable generators, instead, they buy power from a mix of generators from the open market and then buy green certificates to enable the energy to be sold as renewable.

This is made possible as for every unit of renewable power generated, OFGEM gives the generator a guarantee of origin certificate. Suppliers need these guarantees to be able to say the electricity they supply to their customers is renewable. In the case of dark green suppliers, they buy these certificates with the power they buy from renewable generators. Light green suppliers buy power from anywhere including high carbon sources, they then purchase the green certificates from a broker and are able to claim to sell renewable power without actually buying any and consequently are not directly enhancing further renewable energy rollout and working with generators to better match renewable supply and demand.

Generally the unit cost of electricity from dark green suppliers will be higher than that from light green suppliers, however there is no differential in the emissions factor used in calculating the carbon emissions as a standard figure is set for 'grid' electricity irrespective of supplier. The choice to purchase renewable electricity from a dark or light green supplier is therefore a more strategic action. This is because it would not change the overall CO_2 emissions calculation and accounting for the estate but ***it does encourage suppliers and network operators by enhancing the demand for pure renewables from source and therefore drives the pace for carbon neutrality within the grid faster,*** easing the progress for the council commitment.

7.2 DEVELOPING THE BUSINESS CASE

Where possible throughout development of this action plan the financial impact of each point has been demonstrated. There are however a number of unknowns that require deeper investigation so that a complete business case for each element can be produced. This relates to securing specific installation costs of recommended measures against which accurate return on investment figures can be produced.

In addition to this, the council will need to determine the speed at which it is able to progress implementation based on the availability of required finances. Early in 2020 there was an opportunity to utilise an external source of financing through SALIX (interest-free government funding to the public sector) which the council decided did not align with their internal financial policy. This example is highlighted in order to illustrate that once the full implementation costs are known, and respective return on investment figures produced it will be necessary for the critical factor of finances to be incorporated into any finally approved action plan so that implementation is delivered in line with the necessary time scales.

It should be noted that subject to the timing of Heat Pump or Solar PV installations there will be the potential for additional revenues to be generated, thus increasing return on investment terms. From Air Source Heat Pump installations revenue can be secured against the level of heat out put that is produced, this is from a scheme called the Renewable Heat Incentive. Based on current rates this is paid at £0.0275/kWh. The total generation (in excess of 500,000) would at today's rates generate more than £14,000 revenue per annum. It is expected that such revenue can be returned for installations completed by 2022.

From solar PV installations, it is possible to receive payments on the basis of generated energy that is exported back to the grid. This relies upon the local network operator being able to accommodate the levels of potential energy to be exported as previously stated. The payment rate for such exported electricity is presently £0.055/kWh, and against the total suggested PV offset of the Action Plan (following energy efficiency measures having been installed) there is the potential for around 300,000kWh of electricity to be exported, thus generating over £16,000 of revenue. It should be noted that better financial returns are derived from making use of any generated electricity because each kWh consumed on site represents a kWh of electricity that does not have to be imported from the grid, at charges of around £0.15/kWh. This is why the suggested on-site consumption of the 900,000kWh will represent savings against avoided costs of nearly £145,000, whereas for example were the same 900,000kWh exported, the revenue generated would only be around £49,500, thus demonstrating the importance of sizing systems to such a level that enables the vast majority of generated energy to be consumed 'on-site'.

Extending the benefit of utilisation of renewable generated energy are power purchase agreements (PPA). In their sleeved form are a tool for purchasing renewable energy to meet corporate carbon reduction goals. Sleeved PPAs are advantageous for organisations with large, fragmented loads or limited onsite opportunities to generate renewable energy. By 'sleeving' a PPA with a utility supplier, the consumer gains the ability to define the renewable generators (which they could own) and sleeve them to provide their supply. The utility provider manages any imports or exports in response to under or over supply. New models are developing where a number of smaller suppliers can contribute

to a local supply pool to serve defined users. Such solutions are worthy of investigation for TBC acting as a single consumer or potentially as part of a larger consortium which would in theory secure 100% renewable energy from local sources at a lower price for consumers and giving a better return for the generators and stimulating further growth in renewables.

Finally, to further support the accuracy of both development of any business case as well as demonstrating the actual business case returns, it is essential that excellent monitoring and targeting systems are in place. This will enable only real/accurate data to be used, and further enhance the value of the ongoing emissions recording solution that will be developed of the next 12 months. The additional benefit is also that accurate reporting can be maintained so as to inform evidence based decision making that will be needed throughout course of this 10 year programme of works.

7.3 PHASED IMPLEMENTATION

Within the Action Plan is a suggested 'phase' most appropriate for the implementation of each point. The whole implementation programme has been separated in to 3 overarching delivery phases:

- Phase 1 – the Short Term: up to 24 months (2022)
- Phase 2 – the Medium Term: 24 months to year 7 (2027)
- Phase 3 – the Long Term: Year 7 - 10 (2030)

In addition to making the scale of the programme more easily digestible, it also provides appropriate review, reporting and revision dates to enable formal evaluation of implemented activity and amends as required to the next phase of the action plan based on lessons learned from the previous phase.

It would be expected that there would be constant management oversight of progress, alongside reasonably detailed annual reporting (against the baseline) that provides commentary against actual progress of the Action Plan compared to the original plan.

7.4 SUPPORTING PROGRESS THROUGHOUT THE YEAR AHEAD

The following are a suggested scope of responsibilities based on the next steps required to take the Draft Action Plan forward to a position that enables informed implementation of emission reduction activities to commence. It also recognises the requirements of all involved parties and senior level reporting production/delivery. This is not an exhaustive list, but certainly captures the primary requirements to enable the momentum the council has initiated to be maintained:

1. Support the full creation of all Monitoring & Targeting processes across all elements (including tenant engagement) included in the Carbon Management Programme to ensure the capture of full and accurate data alongside the finalisation of the ongoing emissions tracking system
2. Specification for procurement and securing appropriate quotes (in line with council procurement policy) for works as prioritised by the council that relate to either the Action Plan or the recommendations from within the Baseline Emissions Report

3. Production of full Business Case detail (prioritising emissions and finance) of all relevant Action Plan activities so as to support informed decision making
4. Coordination of any necessary feasibility studies for the Heat Pump and/or Solar Panel scenarios to include:
    a. Engagement and written statements of electricity Network Operators position in relation to grid connectivity and related conditions
    b. Detailed assessment of specific locations for potential installation, and any related implications that result (rental costs of land, construction costs of canopies in car parks etc.)
    c. Subject to 4a, production of contingency options to include as appropriate utilisation of electric battery storage opportunities to achieve optimum financial case for the council
    d. In support of 4b, to provide a full cost report for each heat pump or solar panel installation that incorporates all investment requirements, any external financial mechanisms available, specific cost reduction detail and any wider additional revenue benefits that enable accurate budgets to be produced
5. Increase the level of sub-metering of services so as to enable accurate and specific reporting of impacts to be made
6. Regular production and presentation of update/progress reports to Full Council on at least a quarterly basis
7. Ensure council representation throughout Gloucestershire as required at meetings or networks and feedback relevant information and actions

It will be necessary for a budget to be allocated to the Carbon Management Programme so as to facilitate the capital expenditure requirements of the Action Plan. Such a budget would also include any necessary commissioning of specialist survey needs (Revenue) as identified in the Baseline Report as well as budget for implementation of the energy reductions recommendations (Capital). It is appreciated that such budgets may not either currently be in place or available given the 2020/21 financial year has already commenced, but it should be accepted that the installation of energy/emission reduction measures can only be initiated through investment. As such it is important there is council readiness for investment from 2021/22 through provision of budget proposals for the remainder of Phase 1, and earmarked budget for Phase 2 as appropriate.

7.5 THE 12 POINT ACTION PLAN

Action Plan Ref	Emission Category	Scenario	Current emissions level (Tonnes of CO_2e)	Emissions saved (Tonnes of CO_2e)	New emissions level (2019 conversion factors) shown in Tonnes of CO_2e	Projected 'New emission' level for 2030 (Tonnes of CO_2e)	Current annual operating cost (estimated where new solution identified)	Estimated new annual energy costs	Additional revenue	Time frame based on Draft Action Plan (Phase 1, 2 or 3)
AP1.1	Scope 1 & 3: Gas Demand	Convert from Gas boiler systems to Air Source Heat Pump for space and water heating	458.74	304.52	154.22	47.34	£63,248	£71,100 Only Leisure Centre has increase to annual cost	£14,403 Net annual cost saving = **£6,551**	**P1:** TBC Office, Roses Theatre & TIC (HAT Shop). **P2:** Domestic Properties (as appropriate) **P3:** Leisure Centre (however is installed after 2022 additional revenue may be unavailable)
AP1.2	Scope 2 & 3: Electricity	Mitigate ASHP demand with Solar PV System	154.22	154.22	0.00	0.00	£71,100	£17,777	£7,202	Aligned to AP1.1 implementation

Action Plan Ref	Emission Category	Scenario	Current emission level (Tonnes of CO_2e)	Emissions saved (Tonnes of CO_2e)	New emissions level (2019 conversion factors) shown in Tonnes of CO_2e	Projected 'New emission' level for 2030 (Tonnes of CO_2e)	Current annual operating cost (estimated where new solution identified)	Estimated new annual energy costs	Additional revenue	Time frame based on Draft Action Plan (Phase 1, 2 or 3)
AP2.1	Scope 1 & 3: Owned Transport	Own Fleet to only comprise electric vehicles and solar PV to offset fuel	16.66	16.66	0	0	£7,759	£0	Possible revenue generation from charge points in public car parks	**P1:** Aim to achieve full electric fleet by Dec 2022 **P1/P2:** Solar PV, charge points and Battery Storage
AP2.2	Scope 1 & 3: Contractors (only UBICO in this dataset)	Providers required to guarantee net zero carbon resulting from awarded contracts	875.11	875.11	0	0	Unknown	Unknown	N/A	Initiated in **P1,** full implementation by end **P3**
AP3.1	Scope 2 & 3: Electricity Demand	Implement demand reduction measures	229.54	30.09	199.46	61.23	£102,241	£89,090	N/A	**P1:** All demand reduction measures implemented

Action Plan Ref	Emission Category	Scenario	Current emissions level (Tonnes of CO_2e)	Emissions saved (Tonnes of CO_2e)	New emissions level (2019 conversion factors) shown in Tonnes of CO_2e	Projected 'New emission' level for 2030 (Tonnes of CO_2e)	Current annual operating cost (estimated where new solution identified)	Estimated new annual energy costs	Additional revenue	Time frame based on Draft Action Plan (Phase 1, 2 or 3)
AP3.2	Scope 2 & 3: Electricity Demand	Mitigate remaining demand following demand reduction with Solar PV installation	199.46	199.46	0	0	£89,090	£25,404	£8,601	**P2 & P3:** Size of solar array may require multiple systems
AP3.3	All Scopes: Domestic Properties Heating & Electricity	Demand reduction measures from EPCs to reduce demand to OFGEM published levels	27.10	6.61	20.49	13.31	£9,036	£7,113	£0	**P1** EPCs need updating savings applied for cost savings to occupants, this action should be prioritised
AP4	Scope 3: Grey Fleet	Convert mileage to kWh for PV offset	12.66	12.66	6.92	0	£14,478	£8,059	£0	**P1** As part of aggregated PV installation

Action Plan Ref	Emission Category	Scenario	Current emissions level (Tonnes of CO_2e)	Emissions saved (Tonnes of CO_2e)	New emissions level (2019 conversion factors) shown in Tonnes of CO_2e	Projected 'New emission' level for 2030 (Tonnes of CO_2e)	Current annual operating cost (estimated where new solution identified)	Estimated new annual energy costs	Additional revenue	Time frame based on Draft Action Plan (Phase 1, 2 or 3)
AP5.1	Scope 3: Water	Flow Restrictors at TBC Offices	7.21	0.29	6.92	N/A	£5,513	£5,291	£0	**P1**
AP5.2	Scope 3: Water	Offset remaining emissions through PV system	6.92	6.92	0	0	£5,291	£4,149	£0	**P1/P2**
AP6	Scope 3: Waste	Waste Management - Programme to be defined, adopted and implemented before emission implications can be quantified Data to be integrated upon creation of recording mechanisms								
AP7	Scope 3: Business Travel from Public Transport	Integration of emissions resulting from use of Public Transport for Business Travel - Data to be integrated upon provision of actual usage								
Total	-	-	**1,599.93**	**1,599.93**	-	-	**£193,240**	**£55,390**	**£22,354**	

APPENDIX

ACTION PLAN COMMENTARY

The following information provides more detail on methodology for calculating the impact of each action on a point by point basis. This includes suggested next steps required to initiate the action. Calculations supporting the saving opportunities are available within the attached appendix:

AP1.1: IMPROVE CONTROL OF HEATING SYSTEMS AT TBC OFFICE AND ROSES THEATRE FOLLOWED BY REPLACEMENT OF GAS CONSUMPTION WITH AIR SOURCE HEAT PUMP TECHNOLOGY ACROSS ALL ESTATE

Implementing measures that improve controllability of space heating including better provision for alterations to reflect operational need for the Facilities team will deliver substantial savings. Specifically, temperature and time control linked to specific external weather conditions could achieve cost savings in excess of £10,000 per annum that would return on investment in months rather than years, and reduce annual CO_2e emissions by more than 60 tonnes (4% of total).

Following this step the replacement of gas powered plant with air source heat pumps (ASHP) across the whole estate would enable more than 240 tonnes of emissions to be saved (15% of total). The financial implication of this step is, based on current gas and electricity costs and actual increase in costs of around £3,500 per annum, however when combined with the enhanced control features will deliver overall yearly savings of more than £6,500.

Action Plan point 1.2 impacts considerably on both the financial and environment opportunity, and must feature as part of the wider business case (which cannot be completed currently as heat pump specialists are required to provide accurate installation costs). An additional next step would require confirmation from structural engineers that the roof (or alternative appropriate siting locations) contain the structural integrity for the heat pumps to be installed.

Combined within the calculations is revenue that is generated as a result of implementing ASHP. This revenue is index linked and guaranteed for 20 years, but must be installed ahead of 2022.

One major factor that drives this opportunity is that the heating plant at both TBC offices and Roses Theatre are obsolete. They would benefit from replacement in the short term.

The final headline point concerns the Leisure Centre plant room. Whilst the benefit of ASHP is aligned particular well to a consistent demand at relatively low temperature (swimming pool), it is recognised that periodic maintenance resulting in refilling pool water would result in longer reheat times which would be reduced by having some gas powered plant in place as standby for this purpose. Given the relatively new age of the building and its plant, it is expected that final decisions surrounding changes would not be made until around 2027-28.

AP1.2: MITIGATE AIR SOURCE HEAT PUMP DEMAND THROUGH PV POWER SYSTEM

Compared against an existing efficiency performance of the gas powered boilers in place at the council offices and the theatre of around 60%, the minimum expected efficiency performance is 300% (given every unit of electricity consumed produces at least 3 units of heat), however there will still remain a demand for energy from the heat pumps. As such it will be necessary to mitigate this demand through the production of renewable energy, recommended through Solar PV installation/s. Implementation of this action will achieve a number of benefits. In addition to the reduction of around 154 tonnes of CO_2e per annum, it is estimated that around 75% of the generated renewable energy would be consumed across the estate, saving in the order of £53,000 as a result of avoided costs from importing grid energy. Furthermore, the remaining 25% could be sold in the form of an export bonus that would provide an additional £7,200 of revenue each year. The combined benefit of both AP1 recommendation could achieve an annual financial benefit of around £67,000. It should be noted that the cost of the heat pump installation is not known, however the illustration below provides the business case for this action.

All TBC Buildings — Solar PV Impact : Heat Pump Emissions Off-set

System Sizing by Area

Area required	2,910 m2
Estimated capacity	582.00 kWp

System Capacity & Export

PV system chosen capacity	582 kWp
Solar collection factor (shading)	100 %
Current electricity tariff	13.6 p/kWh
kWh used on-site (offset)	75 %
Deemed export rate	25 %

Export Generation

Bonus for exported units	5.5 p/kWh

Generation Breakdown

- Annual Generation	523,800	kWh
- Offset units	392,850	kWh (75%)
- Exported units	130,950	kWh

Annual Revenue Breakdown

Export bonus payment	£	7,202
Potential Import savings	£	53,331
Total Benefit	**£**	**60,533**

Economics

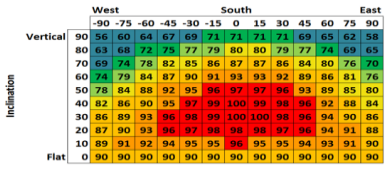
Full installed COST	£	407,400
Cost per kWp	£	700
Basic ROI		14.9%
Simple Payback	**6.7**	**years**

Panel Data

Panel type	Mid Performance
Specific peak output	200 W/m2
Annual output	900 kWh/kWp

Offset of Heat Pump demand:

Scenario	T/CO2e	Equiv Elec kWh
Based on projected 2030 emission factor for electricity	50.80	523,737



Likely Installed Costs (excl. any necessary infrastructure costs)

Solar PV - 25kV	£ 1,000	/kWp
Solar PV - 100k	£ 800	/kWp
Solar PV - 250k	£ 700	/kWp

It is important to note that negotiations will be required with the Distribution Network Operation (Western Power Distribution) as there would need to be capacity within the network for this level of exported electricity, although alternative solutions would be available should it not be possible to

export this level of generated energy. The suggested typical costs of £700/KWp are based (as with each solar PV example) on standard roof based installations. These costs will increase should additional infrastructure be required to accommodate implementation.

AP2.1: OWN CAR FLEET TO CONVERT TO ELECTRIC VEHICLE ONLY

The council has already commenced improvements to its existing own car fleet by introducing some electric/hybrid vehicles, although the majority continue to be petrol fuelled. Whilst annual fuel costs are not known, by using the governments advisory fuel rates[11] annual costs would be in the region of £7,750. Applying the same mileage through use of Electric Vehicles, the following table illustrates fuel costs based on a variety of recharging methods:

Vehicle	Current Annual Mileage	Estimated Cost/Mile	Cost Notes	Total annual Fuel Cost	CO_2 Emissions
8 x small/Med petrol cars	55,819	13.9	Current Cost	£7,759	16.66
KIA e-NERO	55,819	7.2	Public Charge Points	£4,019	4.76
KIA e-NERO	55,819	3.34	Home Charging	£1,864	4.76
KIA e-NERO	55,819	4.53	TBC Imported Electricity Cost	£2,528	4.76
KIA e-NERO	55,819	0	Solar PV Generation	£0	0.00

The vehicle used in the illustration is similar to the current fleet. Costs are based upon 3.5 miles enabled from each unit of electricity charged. Annual costs would reduce against current costs by over £5,200 if imported electricity were used for charging (based on current energy tariffs), however by incorporating council solar PV generated electricity the cost could be zero (an illustration of the solar PV calculations is provided in the data appendix). It is possible that battery storage may be required (depending on time of day of charge, and capacity of the PV system), and there would be costs incurred for the required electric charge points to enable vehicle refuelling. Further assessment is necessary for

[11] https://www.gov.uk/government/publications/advisory-fuel-rates/how-advisory-fuel-rates-are-calculated

a full business case to be produced that incorporates all these points, in addition to any difference in purchase/rental/maintenance costs.

AP2.2: WASTE CONTRACTORS TO ACHIEVE ZERO CARBON OUTPUT FROM SERVICE PROVISION

As part of a wider recommendation to consider how procurement of services can integrate zero carbon ambitions, the council is well placed to drive positive sustainable energy practice across the whole supply chain. Given the high level of emissions currently resulting from the Waste fleet services provided by UBICO, conversations should be commenced that start the planning process for achieving zero carbon emissions from this service.

It is recommended that a phased approach is adopted in implementing this solution agreeing progressive targets/milestone that are aligned to the retendering/procurement of the service in 2022 and again in 2027. These dates match exactly the start of the suggested phase 2 and 3 periods for implementation of this Action Plan, and as such reflect the major reporting periods against which progress and programme targets are reviewed and finalised.

A range of potential solutions will be available and as technology develops to enable decarbonisation of Refuse Collection Vehicles. A detailed approach can be finalised for the fleet of around 30 vehicles that is expected to include assessment of Electric, Bio-diesel, and Hydrogen powered options.

The current level of emissions from this element is around 875 tonnes CO_2e which represents almost 55% of the total baseline, so whilst this action point is unlikely to be fully implemented until near the end of this programme, there will need to be consideration of multiple factors that include procurement retendering dates and financing scenarios alongside the need for vehicle replacement as they reach end of useful life (anticipated midway through this 10 year implementation plan).

AP3.1: IMPLEMENT ENERGY EFFICIENCY MEASURES TO MINIMISE ELECTRICITY CONSUMPTION ACROSS ALL ESTATE

The initial recommendations for reducing electricity consumption are explained in section 5 and shown in the table below. These identify emission reductions of 30 tonnes (13%) that will deliver £13,000 of annual electricity savings (12.75%). The measures recommended fall into the category of either low cost or replacement of end of life equipment and as such should be implemented at the earliest opportunity. It is also important to highlight the wider benefit related to the size of any subsequent solar PV installation, which would be based on the energy demand. Smaller systems = lower costs.

Building	Opportunity	Annual Energy Savings (kWh)	Notes for Savings	Savings: T/CO_2 p.a	Savings in £/p.a
TIC (Hat Shop)	Complete LED lighting retrofit of 27 50w Halogens to 5w LED	2,843	Lighting assumed required 9 hrs a day 5 days a week, estimated elec unit rate 15p/kWh	0.90	£426
Roses Theatre	Replace Current heating pumps with Variable Speed Drives	598	Savings conservatively estimate based on 20% saving on 25% of current elec consumption	0.19	£90
Roses Theatre	Time control on bar chillers & Water heaters	598	Savings conservatively taken at 5% of total consumption	0.19	£90
TBC Offices	Increase cooling temperature from 20 to 22 degrees to remove cooling required to remove incidental heat gains. Similar savings as reducing volume of the room to be cooled	8716.2	This reduces volume of heat gains that require cooling. A 2 degree increase in cooling temp saves 2w/m2. assuming room is 5.6x10x2.5 = 190m2 gives 3,329KW heat gain, with 2.5COP = 1,332KW energy saved + 7884(15% of demand from new units) savings from cooling units cooling to a 2oC higher temp	2.75	£1,307
TBC Offices	Replace cooling units with modern equiv to increase coefficient of performance from 2.5 to at least 5	42048	Taking purely cooling demand from servers	13.29	£6,307
TBC Offices	Investigate potential for Voltage Reduction opportunities. Current levels recorded at 242V	10,408	A 10V reduction may return savings in order of 4%, subject to specialist survey	3.29	£1,561
TBC Offices	Flow reduction (aerators) on water taps to reduce energy	359.52	conservative saving of 20% on energy for hot water savings based on 105ltr capacity of 9 heaters emptied once daily	0.11	£54
TBC Offices	Flow reduction (aerators) on water taps to reduce water	N/A	Conservative savings on energy from 10% water consumption resulting from reduced flow rate	0.29	£222
TBC Offices	Upgrade Lighting in all maintenance areas	7,806	Areas used infrequently, estimated savings as 3% of total elec consumption taken	2.47	£1,171
Domestic Properties	Reduced consumption to align with OFGEM 'typical consumption' figures where EPC data indicates savings can be achieved	28,680	All savings based on each property achieving OFGEM published typical consumption levels. Cost savings use assumed unit rates as applied throughout this workbook	6.61	£1,923
TOTAL		**102,057**		**30.09**	**13,152**

AP3.2: MITIGATE REMAINING ELECTRICITY DEMAND WITH PV POWER SYSTEM

It is recommended that as much of the remaining electricity demand as is possible is satisfied from additional solar PV installations as illustrated in AP1.2 above. The following calculator provides the general detail of system requirements, indicative costs and potential returns:

All TBC Buildings — Solar PV Impact : Offsetting all electricity after demand reduction measures implemented

System Sizing by Area

Area required	3,475 m2
Estimated capacity	695.00 kWp

System Capacity & Export

PV system chosen capacity	695 kWp
Solar collection factor (shading)	100 %
Current electricity tariff	13.6 p/kWh
kWh used on-site (offset)	75 %
Deemed export rate	25 %

Export Generation

Bonus for exported units	5.5 p/kWh

Generation Breakdown

- Annual Generation	625,500	kWh
- Offset units	469,125	kWh (75% est)
- Exported units	156,375	kWh

Annual Revenue Breakdown

Export bonus payment	£	8,601
Potential Import savings	£	63,686
Total Benefit	**£**	**72,286**

Economics

Full installed COST	£	486,500
Cost per kWp	£	700
Basic ROI		14.9%
Simple Payback	**6.7**	**years**

Panel Data

Panel type	Mid Performance
Specific peak output	200 W/m2
Annual output	900 kWh/kWp

CO2e Offset Scenario

Scenario	T/CO2e	Equiv Elec kWh
Projected 2030 emission factor	60.57	
		624,395
2019 emission factor	197.30	

Approx Installation Costs - For Typical Roof Systems

Likely Installed Costs (excl. any necessary infrastructure costs)			
Solar PV - 25KW+	£	1,000	/kWp
Solar PV - 100KW+	£	800	/kWp
Solar PV - 250kW+	£	700	/kWp

The scenario shows that a significant PV array of 695kWp would be required for the new level of electricity demand to be matched. Covering an area of nearly 3,500 square meters (around half that of a professional football pitch), around 625,500kWh of electricity would be generated. It has been estimated that 75% of this could be utilised within TBC buildings, meaning the remaining 25% would be exported back to the national grid. There is potential revenue available of around £8,500 per annum, on the basis the Distribution Network Operator is able to manage this capacity. An early conversation would be recommended to discuss plans. The main saving however is realised from the avoided cost of purchasing grid electricity, where over £63,000 could be saved, but this is only achievable on the basis that 75% of the generated energy is consumed.

AP3.3: DEMAND REDUCTION MEASURES ACROSS ALL DOMESTIC PROPERTIES AND RENEWAL OF ENERGY PERFORMANCE CERTIFICATE (REMAINING DEMAND MITIGATED WITH AP3.2)

All of the cost savings identified have been incorporated into the relevant earlier action points, and the subsequent remaining demand included in AP 3.2 PV generation. All data in this section has been extrapolated from information provided with Energy Performance Certificates, and as such it is

recommended that more detailed assessments are conducted to increase certainty of the savings potential. It is clear however that there is a good opportunity for savings to be achieved, and given the nature of use of these properties, there are important social (health and comfort) benefits to be realised as a result of improved energy efficiency. Given the sensitivity surrounding the service they are supporting (homelessness) there are no identifiable characteristics provided within this report.

AP4.0: MITIGATE EMISSIONS FROM GREY FLEET THROUGH PV POWER SYSTEM

This action point addresses the emissions impact of vehicle use for business purposes made by employees and Councillors in their own cars. Over time, as the motor industry continues to raise efficiency performance and lower emissions levels the impact of Grey Fleet will reduce. Additionally it should be noted that the council have started making positive steps in this regard by encourage staff to make use of the council fleet vehicles which has started and will continue converting to Electric Vehicles. In terms of the overarching recommendation, it has been calculated that current annual costs will be in the order of £14,500 on the basis that £0.45/Mile is paid for business mileage made. The size of solar PV system (45KWp) necessary to cover the emissions level of 12.66 tonnes would generate levels of electricity (40,500kWh), that if consumed entirely within business operations, would delivery avoided imported costs of around £6,400, effectively reducing original costs to £8,100 on the basis the savings from avoided imported electricity costs are reconciled against the Grey Fleet.

AP5.1: INSTALL FLOW RESTRICTION TO REDUCE WATER DEMAND ACROSS ESTATE

An effective means of reducing water consumption is to install flow restrictors to tap. Reducing consumption by around 10 – 15% (10% taken in calculations) without noticeable effect, this is a simple, low cost measure. Within TBC Offices alone savings over £200 are likely. Whilst further investigation is required, larger savings could be secured through the integration of harvested rainwater within toilet systems. Naturally the overwhelming proportion of water use is within the Leisure Centre. As such it becomes necessary to concentrate on AP5.2.

AP5.2: MITIGATE REMAINING WATER CONSUMPTION (ONCE CONVERTED TO KWH) WITH PV POWER SYSTEM

A small 8KWp system would generate around 7,200 kWh of energy, sufficient to offset the equivalent level of emissions from the water consumption. On the basis the energy generated was consumed onsite, avoided electricity costs would provide nearly £1,150 of annual savings.

AP6.0: ESTABLISH FULL WASTE MANAGEMENT PROGRAMME FOR RELATED EMISSIONS TO BE INCORPORATED

Section 4.1 provides guidance in support of initiation of the council's waste management programme. Very rough estimations suggest the contribution to the emissions baseline from office waste could add as much as 35% to the total baseline figure. Clearly this illustrates the need for early action so as to be able to both incorporate the data and commence activity to mitigate the emissions accordingly. This element of emission should be included within Scope 3 emission data.

AP7.0: INTEGRATE EMISSIONS OF BUSINESS TRAVEL FROM PUBLIC TRANSPORT SERVICES

Certainly the data for staff travel via public transport is documented within the council, however it was not made available during the production of this report. It is not a difficult element to include within

the current data set and the government carbon conversion factors provide the necessary information (for bus, taxi, rail and motorcycles) to enable accurate CO_2e figures to be produced. This data will be included within Scope 3 data, although it is important to incorporate the 'Well To Tank' carbon emissions (also within Scope 3) in addition to the actual consumption data so as to ensure all facets of emission production are included.

COMBINED SOLAR PV

Many of the action points culminate in the removal of CO_2e emissions from energy by recommending the installation of solar PV systems. It is therefore useful to illustrate the combined total as though one system would be established to cover the offset of all energy demand remaining following demand reduction activities. Also included in this section is an illustration of the necessary scale of system that would be required if none of the actions were implemented and solar PV were used to offset the entire current baseline emissions. Naturally this is not a recommendation, but serves a useful purpose in supporting the impact that is achievable from energy efficiency action.

Tewkesbury Borough Council — **Solar PV Impact : PV Requirement after Action Plan measures installed**

System Sizing by Area

Area required	6,750 m2
Estimated capacity	1,350.00 kWp

System Capacity & Export

PV system chosen capacity	1,350 kWp
Solar collection factor (shading)	100 %
Current electricity tariff	15.9 p/kWh
kWh used on-site (offset)	75 %
Deemed export rate	25 %

Exported Generation

Bonus for exported units	5.5 p/kWh

Generation Breakdown

Annual generation	1,215,000	kWh
- Offset units	911,250	kWh (Est. 75% used on site)
- Exported units (see note 1)	303,750	kWh

Annual Revenue Breakdown

Export bonus payment	£	16,706
Potential Import savings	£	144,433
Total Benefit	**£**	**161,139**

Economics

Full installed COST	£	945,000
Cost per kWp	£	700
Basic ROI		17.1%
Simple Payback	**5.9**	**years**

Total PV Requirment after Action Plan measures:

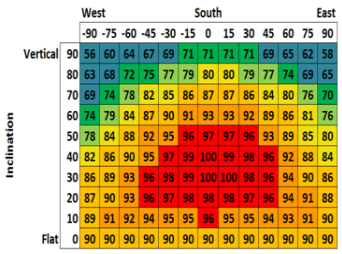
Total kWh:	1,209,812
Total CO_2e:	382.28

Panel Data

Panel type	Mid Performance
Specific peak output	200 W/m2
Annual output	900 kWh/kWp

Installation Costs for Standard Roof Systems

Likely Installed Costs (excl. any necessary infrastructure costs)			
Solar PV -	25kW+	£ 1,000	/kWp
Solar PV -	100Kw+	£ 800	/kWp
Solar PV -	250kW+	£ 700	/kWp



Note1: Exported Units - it is unlikely approval will be secured for this level of exported energy. The Distribution Network Operator should be consulted ahead of considering other options

Combining all of the recommended action plan points that require solar PV offset following the implementation of previous energy saving measures, this calculator illustrates that 1.25M kWh of energy need to be generated, meaning a system sized in the order of 1,350KWp is required. This physical size of this would be around 6,750 square meters, about 90% of the size of a football pitch. Should 75% of the generated energy be consumed 'onsite' in provision of energy required to maintain operations, then savings in excess of £140,000 per annum would be realised from the cost of avoided

imported electricity. Additionally, a further £16,700 could be acquired as a result of revenue from the export of the excess generation returned to the grid as a result of it not being consumed. This assumes the Distribution Network Operator has the capacity within the local network to take this level of exported energy. As previously stated, an early conversation should be held with Western Power Distribution in order to identify if this can be accommodated. This action removes the final 382 tonnes of CO_2 from the baseline emissions, however for completeness, should all or even a proportion of the 303,000kWh of exported energy need to be imported from the national grid, the council should ensure future energy suppliers can guarantee that the cost of such imported energy results in the identical additional level of renewable energy generation. This will complete the process of achieving carbon neutrality.

Finally the illustration below shows the extent of solar PV required should the council elect not to implement the Action Plan, choosing instead to invest in an array that would offset the totality of present emissions through a single mechanism:

Tewkesbury Borough Council — Solar PV Impact : Emissions Offset - All Baseline Emissions

System Sizing by Area

Area required	28,150 m2
Estimated capacity	5,630.00 kWp

System Capacity & Export

PV system chosen capacity	5,630 kWp
Solar collection factor (shading)	100 %
Current electricity tariff	15.9 p/kWh
kWh used on-site (offset)	7.5 %
Deemed export rate	92.5 %

Exported Generation

Bonus for exported units	5.5 p/kWh

Generation Breakdown

Annual generation	5,067,000	kWh
- Offset units	380,025	kWh (See note 1)
- Exported units (see note 2)	4,686,975	kWh

Annual Revenue Breakdown

Export bonus payment	£	257,784
Potential Import savings	£	60,234
Total Benefit	**£**	**318,018**

Economics

Full installed COST	£	3,941,000
Cost per kWp	£	700
Basic ROI		8.1%
Simple Payback		**12.4 years**

Inclination	West -90	-75	-60	-45	-30	-15	South 0	15	30	45	60	75	East 90
Vertical	90	56	60	64	67	69	71	71	71	69	65	62	58
	80	63	68	72	75	77	79	80	80	79	77	74	69	65
	70	69	74	78	82	85	86	87	87	86	84	80	76	70
	60	74	79	84	87	90	91	93	93	92	89	86	81	76
	50	78	84	88	92	95	96	97	97	96	93	89	85	80
	40	82	86	90	95	97	99	100	99	98	96	92	88	84
	30	86	89	93	96	98	99	100	100	98	96	94	90	86
	20	87	90	93	96	97	98	98	98	97	96	94	91	88
	10	89	91	92	94	95	95	96	95	95	94	93	91	90
Flat	0	90	90	90	90	90	90	90	90	90	90	90	90	90

Panel Data

Panel type	Mid Performance
Specific peak output	200 W/m2
Annual output	900 kWh/kWp

CO2e Offset (2019 emission data)

Scenario (see note 3)	T/CO2e	Equiv Elec kWh
Baseline emissions	1,599.93	5,063,405

Installation Costs for Standard Roof Systems

Likely Installed Costs (excl. any necessary infrastructure costs)			
Solar PV -	25kW+	£ 1,000	/kWp
Solar PV -	100Kw+	£ 800	/kWp
Solar PV -	250kW+	£ 700	/kWp

Note1:The level of offset units suggested represents approximately 55% of the combined 2019 electricity demand at TBC Offices and Leisure Centre

Note2: Exported Units - it is unlikely approval will be secured for this level of exported energy. The Distribution Network Operator should be consulted ahead of considering other options

Note3: Data calculations use only projected emission reductions in Electricity. It is currently expected emissions from other fuels will realise only minor improvements by 2030

The difference between the two calculators is stark. Choosing to purely invest in a single PV array to offset the whole of the baseline emissions would require a system more than 4 times the size of one that implements the recommended action plan. The cost would be at least £3.9 million, the return on investment over 12 years (compare with less than 6 should the action plan be implemented first), although it is possible more than 7.5% of the energy generated could be consumed on site, it would

required a degree of reconfiguration of internal energy management that by the very nature of electing this solution would not be something the council would necessarily be prepared to undertake.

The comparison between the two examples gives clear indication that the most financially and environmentally astute solution would be the one that implements recommendations akin to those suggested in the proposed action plan.

ACTION PLAN HEADLINES

All cost savings shown include a combination of actual energy costs and estimated energy costs where no data was available. Furthermore the cost of AP2.2 (UBICO Fleet), cost and emissions of AP6 (TBC Office waste disposal) and also AP7 (Business Travel from Public Transport) were not available for inclusion, and will certainly impact on actual final figures. It is therefore essential that whilst there is a high level of confidence in the emissions baseline figures based on data provided and subsequent calculations, most references to financial impacts should be considered as ball park figures at best.

The opportunity for significant cost reductions is clear. Based on the data available and the educated assumptions made, current annual costs of around £193,000 could be reduced to somewhere in the order of £55,000. Additionally, once the extra revenue that can be secured from the Renewable Heat Incentive (see section 7.3) and the payments for exported energy generated from the solar PV system is taken into account (estimated at over £22,000 per annum), this brings total annual costs to around £33,000 cost savings of more than 80% could be realised. However for informed decision making to take place, it is necessary for the full cost of implementation to be included so that the Business Case can be made supported by Return on Investment calculations.

That said, it is important to retain the primary driver being the Carbon Management Programme, which is of course to achieve carbon neutrality by 2030. Although there will be many actions with strong financial benefits, there will also be certain actions that will not deliver financial returns, but will be critical in eradicating CO_2 emissions.