CLIMATE ACTION for Forest of Dean

Forest of Dean District Council Offices Heat Decarbonisation Plan 2021–2030

Contents

Purpose

In December 2018, the Forest of Dean District Council, referred to here on in as either FoDDC or the Council, declared a Climate Emergency and set itself the target of becoming carbon neutral across all of its own operations and assets, as well as across the district as a whole, by 2030. FoDDC's Climate Emergency Rapid Action Plan identified installing renewable energy technology on council owned property as a key step towards achieving this.

The purpose of the Heat Decarbonisation Plan (HDP) is to describe how FoDDC intends to replace the fossil fuel reliant heating system at its Coleford offices with a renewable heat generation system along with measures to reduce heat energy demand in order to help achieve its carbon neutral goals. In order to be considered truly renewable, the replacement heat source (an air source heat pump) will need to be powered by renewable electricity and so measures to ensure this can be achieved are also outlined. By producing this HDP, it is hoped that FoDDC can provide a clear example of how other organisations within the district such as schools and businesses can plan to decarbonise the heating system in their own buildings.

This HDP was agreed by the Council's cabinet on 11th November 2021.

Introduction

This HDP is part of a wider plan to decarbonise the FoDDC's operations and assets, initially outlined in brief in its Climate Emergency Rapid Action, published in 2020, as well as in more detail in the Council's more comprehensive Climate Emergency Strategy and Action Plan 2022-25, expected to be published towards the end of 2021. As well as decarbonising the FoDDC's energy supply, the Action Plan will outline the steps it will take to reduce carbon emissions from sources such as its vehicle fleet and leisure centres, as well as actions for leading and influencing the transition to carbon neutrality across the Forest of Dean district.

The Council's gas and electricity consumption (for both its office building and its leisure centres) has been identified as a key source of greenhouse gas (GHG) emissions (Figure 1), and so decarbonising its gas and electricity supply is therefore a key priority.

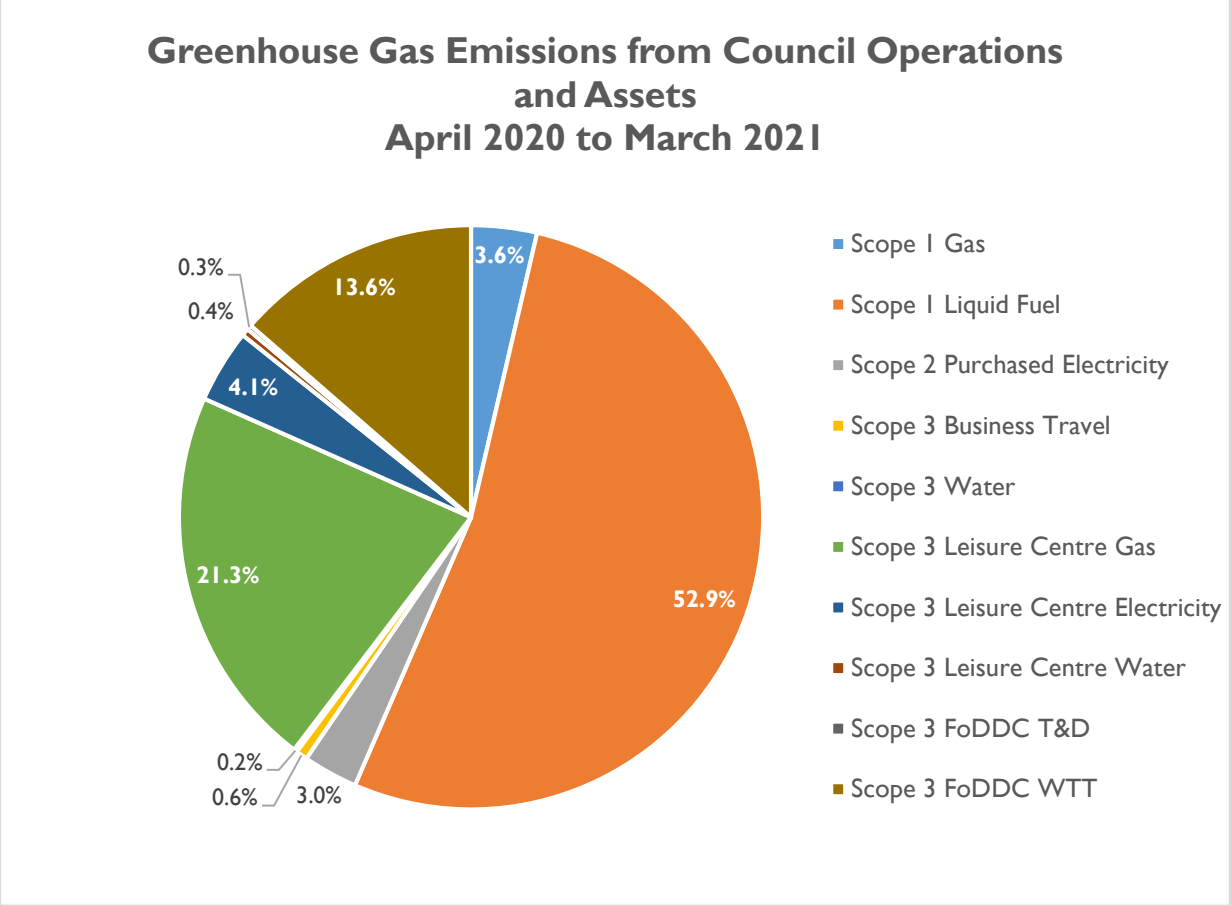

Figure 1: GHG emissions by source from Council owned operations and assets for the period April 2020 to March 2021.

The HDP also sits within the context of a broader ongoing programme of works to decarbonise FoDDC's Coleford offices, so far largely focused on reducing electricity demand and decarbonising the electricity supply. This includes works and measures such as installing a solar PV and battery storage system on the building's roof, fitting LED lighting throughout, and fitting 7 day times to printers, as described in more detail later on in this HDP. As part of the preliminary work carried out in preparation of producing this HDP, FoDDC commissioned Inspired Efficiency to carry out an energy audit of the Coleford offices in August 2021.

An audit of Lydney Leisure Centre, has also been undertaken as part of the FoDDC's wider decarbonisation agenda, with the intention that similar will also be done at the Council's other leisure centres. Given that the Council is not the owner of the majority of these leisure centre buildings and that the rest of its estate includes a wide range of other buildings, including commercially let premises, with a diverse range of needs and opportunities, these are outside of the scope of this HDP. The development of separate HDPs for these will be considered, in partnership with third party service providers and building owners/tenants where applicable.

The building

Background

The offices are located in the centre of Coleford (Figure 2) and can accommodate 300 staff, the majority of whom work for the Council, but also includes a smaller number of people employed by the Department for Work and Pensions (DWP). The DWP rent space on the ground floor west wing, along with a small amount of space in the open plan area to the rear. General office hours are from 07:30 to 18:30 Monday to Friday with the council chambers typically used until 20:00 three evenings a week, however this has been severely disrupted due to the Covid-19 pandemic.

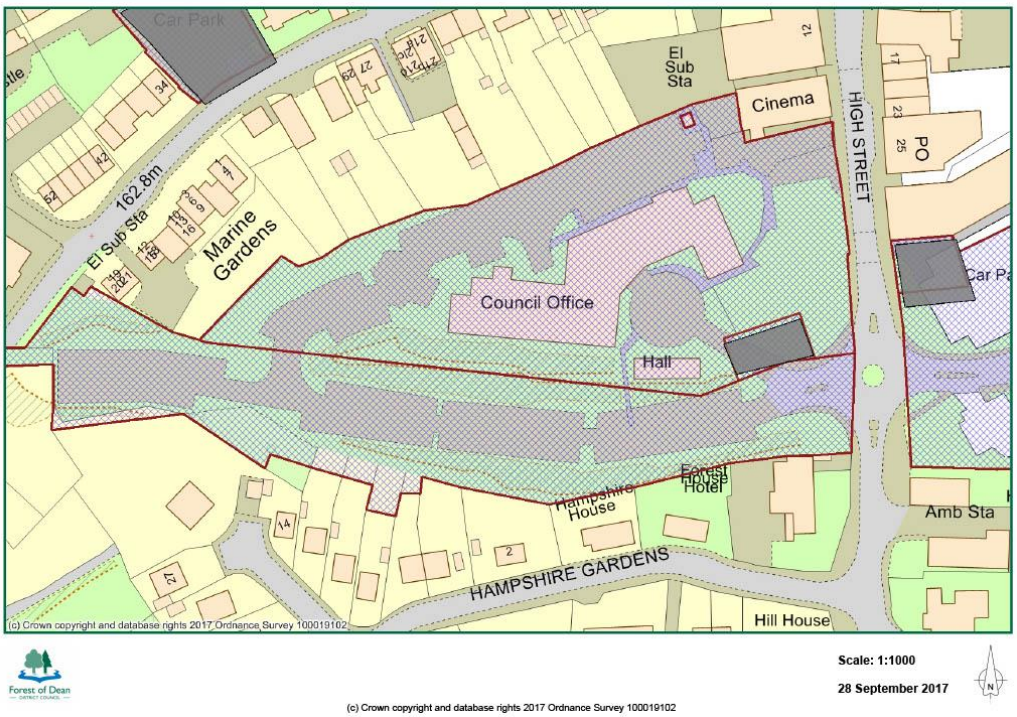

Figure 2: Site plan for the Coleford offices. Note: the building labelled 'Hall' belongs to the British Red Cross and is not included in this HDP.

The office building (Figure 3) was constructed and opened in the late 1980's and is arranged over three storeys plus a partial basement area. Total floor space is 4956.8m^2. The basement covers half of the ground floor area and comprises predominantly storage areas, but also houses the facilities management team's offices/stores, a training room, a kitchen and toilet and shower facilities. The ground floor comprises the public reception area, interview rooms, offices, toilets, and staff kitchen facilities, whilst the first floor comprises more offices including the ICT department and server room with additional toilets and kitchen facilities. The second floor comprises the main council chamber and committee rooms, and offices with toilets and

minor catering facilities. The remainder of the site area is predominantly covered by a tarmac car park serving the site, which surrounds the office building to the north, south and west.

Figure 3: The Coleford Offices' main entrance facing south.

Building fabric

It is a red-bricked building using column and beam construction with curtain walls containing 100mm concrete block infill panels. The external walls are of cavity construction with brick outer and block inner skins, with a cavity width of around 75mm. The cavity contains 25mm PIR board insulation, leaving 50mm of air space (Figure 4).

The internal floors use concrete (Bison) beam and block construction with a screed finish approximately 60mm thick, accommodating electrical floor trunking and service boxes at various locations. The building has a pitched roof constructed with concrete roofing tiles, and roof insulation has been found to be present, and assumed to be a minimum of 100mm thick glass fibre type based on the age of the property. All the building's windows and doors are aluminium framed with double glazed sealed units installed.

Surveys carried out to date have confirmed that there is no asbestos present in the property.

Figure 4: 25mm thick PIR board cavity wall insulation with 50mm air space.

Ventilation

Mechanical ventilation in the building is minimal, being largely confined to kitchen and toilet standalone extraction systems (there is no heat recovery on these systems). There is also some split/cassette type room cooling to areas within the basement and the ICT server room areas. Despite this, there have been no particular challenges around overheating.

Energy generation and consumption

The building is currently heated from four 115kW Remeha Quinta 115S gas condensing boilers (Figure 5) which were installed in 2017. Hot water is heated centrally from a direct gas-fired storage water heater (Figure 6). Between April 2020 and March 2021, the building consumed 370,482 kWh of gas, resulting in emissions of 68,121 kg CO_2e (Table 1). Despite the offices being largely unoccupied during 2020/21 due to the Covid-19 pandemic lockdowns, the building still required heating, and consumption was actually greater than in 2019/20 (363,810 kWh), which in turn was greater than in 2018/19 (346,773 kWh).

Figure 5 and 6: The current gas-fired boilers and hot water heater used in the building.

Between April 2020 and March 2021, the building consumed 185,033 kWh of electricity. This was a significant drop from the previous year (253,676 kWh) due to the lower electricity demand as a result of minimal building occupancy, however this is expected to increase again as staff begin to return to the office.

All electricity used in the building is currently drawn from the national grid via a REGO backed green tariff, rather than a 'true green' renewable supply. FoDDC currently uses a location-based rather than market-based approach to calculating electricity emissions, and consequently uses average UK-wide electricity grid emissions factors to do this. Based on this approach, emissions from building electricity consumption in 20/21 were 43,139 kg CO_2e. The Council pays the utility bills directly and levies a service charge to the DWP proportionate to occupied area.

Table 1: Coleford Offices energy consumption, intensity, and GHG emissions in 2020/21.

Source	Consumption (kWh)	Energy intensity (kWh/m²)	GHG emissions (kg CO_2e)
Gas	370,482	74.74	68,121
Electricity	185,033	37.32	43,139

Resources

Responsibility for the delivery of this HDP will be shared amongst members of the Council's Coleford Decarbonisation team. The current members of this team are:

Andrew Dike – Property and Facilities Manager

Ivan Hackett – Building Services Officer

Alastair Chapman – Sustainability Team Leader

Daniel Paine – Climate Emergency Officer

Cllr Richard Leppington – Cabinet Member for Finance

Cllr Chris McFarling – Cabinet Member for Climate Emergency

The team have the skills and knowledge required to deliver the programme detailed in this HDP, having had experience of delivering other decarbonisation works (described later on) as part of the Coleford Decarbonisation project. The team has a mixture of energy, carbon, facilities, finance and project management skills and experience that will ensure it is able to successfully oversee the implementation of the programme.

In terms of financial resources to deliver the programme, FoDDC has limited funds with which it can invest in the improvement and up-keep of its buildings and estate, and therefore will look to bid for appropriate central government grant funding when it is available, such as future rounds of the Public Sector Decarbonisation Scheme (PSDS). There is potentially some available budget for the initial works detailed in this HDP, resulting from an underspend on some recent PSDS grant funded works.

Energy efficiency and demand reduction

A fabric first approach to building design involves maximising the performance of the components and materials that make up the building fabric, before considering the replacement of the existing heating system with a renewable one. This approach ensures that heating demand is reduced first in order to minimise the required size of the replacement heating system, therefore also reducing capital and operational costs, as well as the embodied energy and carbon of the system.

Following this approach, in April 2021, insulation was installed on naked heating valves and pipes as part of a wider package of measures part funded by a grant from the first round of PSDS. Additionally, the 'comfort' heating set point was reduced from 22°C to 21°C and the 'economy' set point from 12°C to 10°C.

In August 2021, FoDDC commissioned Inspired Efficiency to carry out an energy audit of the building. The resulting report recommends that additional cavity wall insulation (CWI) is injected into the walls where appropriate. Installing CWI will help to reduce heat loss and improve the comfort of the space, but due to limited mechanical ventilation in the building, needs to be considered alongside other control measures such as adjusting thermostatic radiator valves (TVRs) or room sensors to ensure that the space does not overheat because

of the additional insulation. Due to risks of damp and condensation, FoDDC will look to obtain multiple CWI surveys to ensure the building is suitable for additional CWI , and ensure that any contractor commissioned to install CWI is registered with the Cavity Guarantee Insulation Agency (CIGA).

On 18th November 2021, an infrared thermal imaging survey was carried out by Inspired Efficiency in order to identify any further weaknesses in the building fabric. The results of the survey suggested that some of the existing PIR board insulation in the walls could be performing poorly in some places, particularly around windows. It should be noted that the weather conditions on the day of the survey were not ideal, given it was still rather warm for November. This resulted in poor contrast, and some sunlight resulted in reflectivity issues from windows and doors.

Figure 7 and 8: Outputs from the thermal imaging survey suggesting some of existing PIR board insulation in the walls could be performing poorly around windows.

In light of the increased gas consumption in recent years, the heating system's efficiency will be investigated empirically to identify a potential cause of this.

A heat recovery ventilation system may also be appropriate in order to improve airflows within the building and further reduce the size of the ASHP that is needed.

Once any energy saving measures have been implemented, energy consumption will be monitored in order to determine the size of the renewable heat system required.

Renewable heat generation

There is currently no renewable heating technology in the building. As part of Inspired Efficiency's report, it has been recommended that the existing direct gas-fired storage water heater should be replaced by local electric point of use hot water heaters installed in the toilet and kitchen areas. The existing centralised system is currently set to run twenty-four hours a day, seven days a week. Consequently, the water is heated for long periods when there is little demand for hot water, which is generally limited to handwashing, the staff kitchenette sinks and some of the cleaning.

A replacement localised electric system would heat water only when the tap is turned on and does not have any stored hot water element, also presenting a lower legionella risk. As such, it is very energy efficient as it only ever heats the hot water that is required. Installing electric hot water units will remove the need for the gas boiler and associated pumps to have to operate outside of the heating season. As the existing hot water heater is coming to the end of its life, its removal and replacement will be an immediate priority for the Council. The building has been assessed as needing ten electric point of use water heaters.

The four 115kW Remeha Quinta 115S gas condensing boilers used for space heating, installed in 2017, can be expected to have a serviceable life of a further 15 years before needing to be replaced. The boilers are very efficient, converting 96% of gas burned into useful heating. Given the recent financial outlay on the boilers by the Council, there is an economic case for not replacing the boilers at this early stage. There are also consequences of replacing them from a climate change mitigation perspective, given the significant embodied carbon in the boilers from the extraction of raw materials, manufacturing, transportation, installation, and potential decommissioning and disposal stages of their lifecycle, as well as the embodied carbon in any replacement renewable system. Nevertheless, waiting 15 years to replace the boilers would take the Council past its target of reaching carbon neutrality across its operations and assets by 2030, unless any emissions from gas consumption in the building beyond this point is offset by some other means. Consequently, the Council will review the status of the boilers again in the years leading up to 2030.

Inspired Efficiency assessed the opportunities for renewable heat generation on site, and recommended that when the existing boilers are replaced, this should be with an air source heat pump (ASHP). ASHPs are powered by electricity, take heat from the air and transfer this into water which can then go into the heating system. A new ASHP is likely to need a heating capacity of upto 350kW, although this estimate is based on the equivalent of replacing the current gas boilers with similar capacity, whereas implementing energy efficiency measures first would mean a smaller capacity ASHP would be needed. The ASHP could be located at the rear of the building close to the emergency diesel generator which is in proximity to the

incoming power supply and immediately below the roof top plant room. Where it is identified additional independent heat pumps could produce greater efficiencies in some rooms, these will be considered.

As heat pumps operate on a low temperature basis, some of the radiators and other heat emitters around the site may require upgrading. Most of the existing radiators are K2 or K3 units and with increased wall insulation can be expected to be sufficient for an ASHP running with a 55°C flow temp as many of the modern units now do. There are some smaller, single skin radiators which may require a simple replacement for a K3 radiator of the same size. The heating distribution pipework appears to be suitable without further change.

Ground source heat pumps have also been considered, however the layout of the site makes installation challenging due to the sloping tarmac car park that surrounds the building (Figure 2). Their higher capital costs in comparison to ASHPs also make the latter a more attractive option, particularly as the energy efficiency of ASHPs is expected to continue to improve, and their price to fall. Biomass boilers have been ruled out due to concerns around air pollution given the building's town centre location. Additionally there is currently no district heating network planned for the area.

Electricity loading capacity to support a switch to electric heating solutions

The site currently has one main electricity incomer which is a 315amp 3 phase supply located in the mains electrical intake room. The available capacity for the site appears to be 200kVA and the maximum demand recorded by the meter was noted as being 37kVA. Therefore, there appears to be sufficient available electrical capacity on the site at present to support future heat decarbonisation. The site also has a 150kVA diesel generation for emergency power which is rarely used.

The building has already previously undergone some energy efficiency improvements in recent years. LED lighting was installed in the area currently occupied by the DWP as part of renovation works completed in 2018. Some circulation areas are also fitted with LEDs and automatic occupancy sensing lighting controls, as are the majority of toilets.

FoDDC received grant funding from the first round of PSDS in 2021 to part fund the installation of a 95.3kWp solar PV system including 57kWh battery storage. The system is expected to generate around 75,000 kWh a year, saving an estimated 15,925 kg CO_2e, with the remaining electricity demand being supplied by the national grid. The Council also intends to explore options for improving the renewable credentials of its grid-supplied electricity.

Several energy efficiency and demand reduction measures have also been incorporated into the solar PV project, including replacing the existing lighting in the building with LEDs, installing some automatic lighting controls, fitting seven-day timers on printers. A contractor has been

instructed to install the LED lighting, with the work due to be completed by winter 2021. The other measures have already been successfully implemented. These additional measures combined are estimated to save a further 64,837 kWh of energy per year, equivalent to 16,416 kg CO_2e.

Supporting information

Table 2: Coleford Offices gas consumption (kWh) in 2019/20 and 2020/21

Year	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	**Total**	**Cost (£)**
2019/20	29,563	14,067	6,899	2,507	1,709	4,895	31,311	48,361	60,409	55,823	55,419	52,847	**363,810**	**12,178**
2020/21	23,260	14,700	5,299	3,942	3,952	13,417	33,513	42,757	62,982	63,989	57,603	45,068	**370,482**	**10,183**

Table 3: Coleford Offices electricity consumption (kWh) in 2019/20 and 2020/21

Year	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	**Total**	**Cost (£)**
2019/20	23,362	21,941	20,961	21,750	19,961	21,346	23,538	21,076	20,037	21,039	19,298	19,367	**253,676**	**38,249**
2020/21	15,707	15,792	15,079	15,387	14,411	14,812	15,485	15,189	15,398	16,005	14,947	16,821	**185,033**	**28,009**

Table 4: Energy, cost and carbon savings of recommended measures, based on modelling by Inspired Efficiency

Measure	Estimated Annual Energy Saving (kWh)	Estimated Annual Cost Saving (£)*	% Energy Reduction	Estimated capital cost (£)	Simple Payback (years)	CO_2 savings (tCO_2e/yr)**
Replace gas-fired hot water system with electric point of use hot water heaters	43,657	£1,225	7.07%	£12,600	10.29	8.05
Inject cavity wall insulation into walls	53,780	£1,509	8.71%	£24,336	16.13	9.92
Replace existing heating systems with ASHP	220,885	-£5,074***	35.77%	£184,000	N/A	34.70

* Based on September 2021 prices of 14.75p/kWh and 2.4p/kWh for electricity and mains gas respectively.

** Carbon savings are based on the current DEFRA carbon emissions factors for 2021.

*** Estimated to result in an increase in energy costs due to increased electricity consumption, despite fall in overall energy consumed.

Display energy certificate (DEC)

HM Government

Forest of Dean District Council
Council Office
High Street
COLEFORD
GL16 8HG

Operational rating
B

Certificate number:	9005-9234-7139-7768-1614
Valid until:	11 February 2022
Total useful floor area:	4956.8 square metres

Energy performance operational rating

The building's energy performance operational rating is based on its carbon dioxide (CO2) emissions for the last year.

It is given a score and an operational rating on a scale from A (lowest emissions) to G (highest emissions).

The typical score for a public building is 100. This typical score gives an operational rating of D.

Score	Operational rating	This building	Typical
0-25	A		
26-50	B	48 | B	
51-75	C		
76-100	D		100
101-125	E		
126-150	F		
150+	G		

This building's energy use

Energy use	Electricity	Other fuels
Annual energy use (kWh/m2/year)	38.72	75.87
Typical energy use (kWh/m2/year)	95	116.65
Energy from renewables	0%	0%

Previous operational ratings

Date	Operational rating
February 2021	48 | B
February 2020	58 | C
February 2019	64 | C

Total carbon dioxide (CO2) emissions

This tells you how much carbon dioxide the building emits. It shows tonnes per year of CO2.

Date	Electricity	Heating	Renewables
February 2021	106	73	0
February 2020	145	68	0
February 2019	165	72	0

Assessment details

Assessor's name	Matthew Fulford
Employer/Trading name	Inspired Efficiency Ltd
Employer/Trading address	1 The Coaches, Fields Road, CHELTENHAM, Glos
Assessor's declaration	Contractor to the occupier for non-EPBD services.
Accreditation scheme	CIBSE Certification Limited
Issue date	3 October 2021
Nominated date	12 February 2021

Figure 9: Display Energy Certificate (DEC)

Plans for the building

A significant amount of the office space, particularly on the ground floor, is currently not in use by the Council and there is potential that some space could be made available to let to other organisations. This is due to continued low building occupancy as a result of the Covid-19 pandemic, and the Council's intention to switch to an agile working strategy, enabling staff to choose whether to work at the office or from home. This could affect the energy demand for the building, and therefore alter some of the energy and cost saving outcomes that have been modelled.

Key challenges

The most significant barriers to an organisation implementing a HDP are having sufficient staff time and skills, appropriate leadership and governance, and having the financial resources in place to be able to fund works. As previously mentioned, the decarbonisation of the Coleford offices is currently being overseen by a project group with representation from property and facilities management, the sustainability team, as well as political leadership in the form of the Cabinet members for Finance and Climate Emergency. The continuation of this political leadership and staff resource will be vital in determining the success or failure to implement this plan. The continued availability of central government funding in the form of grants or loans will also be important.

Where capital investments are expected to deliver operational savings, developing a successful business case for the decarbonisation of the building's heat supply may also present a challenge. This is due to the predicted higher energy costs of switching from gas to an electrified heat source, although recent spikes in the price of gas may challenge this assumption. As well as fluctuating energy prices, unknowns around future building occupancy also make it more difficult to predict future energy demand and therefore energy costs and savings.

Finally, there is the challenge of overcoming potential resistance to change within the Council, and effectively communicating that although electrified heat may potentially be more expensive than the (usually) low-cost incumbent gas-fired heating system, the choice is ultimately not between natural gas and air source heat pumps, because shortly policy will not permit the install of new gas boilers. The real choice is deciding when to decarbonise, whilst it is with within the Council's control, taking into consideration the Council's carbon neutral goals and the lifespan of the building's current gas boilers, rather than waiting for the transition to be enforced through future changes in government policy.

Summary of intended actions

Table 5: Summary of action detailed in the HDP and timeframes for implementing them.

Action	Time frame	Estimated capital cost (£)	CO_2 savings (tCO_2e/yr)
Replace gas-fired hot water system with electric point of use hot water heaters	As soon as internal/external funding is available	£12,600	8.05
Inject cavity wall insulation into walls (if confirmed appropriate following further investigation)	As soon as internal/external funding is available	£24,336	9.92
Empirically investigate the performance of the current heating system	Winter 2021/22	N/A	TBC
Replace existing heating systems with ASHP	No immediate action. To be reviewed again before 2030	£184,000	34.70

These actions will be reviewed every two years by the Council's Property Services team and updated in line with any changes in technology or building use etc., or when new information becomes available e.g. the outcome of a thermal imaging survey.