Hampshire & Isle of Wight Fire & Rescue Service

Carbon Reduction Strategy Planning

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Version 4

CARBON TRUST

Hampshire & Isle of Wight FIRE & RESCUE SERVICE

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Background and Context

Growing acknowledgement of the latest science and recommendations from the Committee on Climate Change has resulted in unprecedented recognition of the global climate emergency, and **the need to act urgently in order to reduce carbon emissions and the environmental, economic, and social impacts of climate change**. In 2019, the UK Government set a target of achieving net zero emissions by 2050. Since this time Hampshire and the Isle of Wight have declared climate emergencies. The Hampshire and Isle of Wight Fire and Rescue Service (HIWFRS) have been working over a number of years to measure and reduce their carbon emissions. Fire and Rescue services are likely to be impacted differently than many organisations with respect to climate change because they are first responders to the consequences of extreme weather events. In the UK climate change is expected to bring more extremes: longer dry periods and more intense rainfall. When these conditions lead to fires or floods, fire and rescue services will respond. In this sense the carbon emissions reduced by the Hampshire and Isle of Wight Fire and Rescue Service not only contribute to wider UK and International targets, but are also beneficial for the communities they serve, and their own operational reality.

This report aims to build on the previous work of the fire and rescue service and to support the development a bold new carbon reduction strategy. To do this, the report analyses the **footprint of the fire and rescue service**, discusses different **science based target options**, and **identifies potential emissions reduction projects** focusing on ten sites across the estate as well as the vehicle fleet.

Hampshire and Isle of Wight Fire and Rescue Service (HIWFRS) is the statutory fire and rescue service for the county of Hampshire and the Isle of Wight. The service currently operates from 1 Corporate Service Headquarters (SHQ) and 61 Operational Sites (15 Whole Time and 46 Retained/On-Call). Associated annual building energy costs for the estate are in excess of £517,000. Additional direct emissions are also assumed to originate from the vehicle fleet which is made up of approximately 400 vehicles.

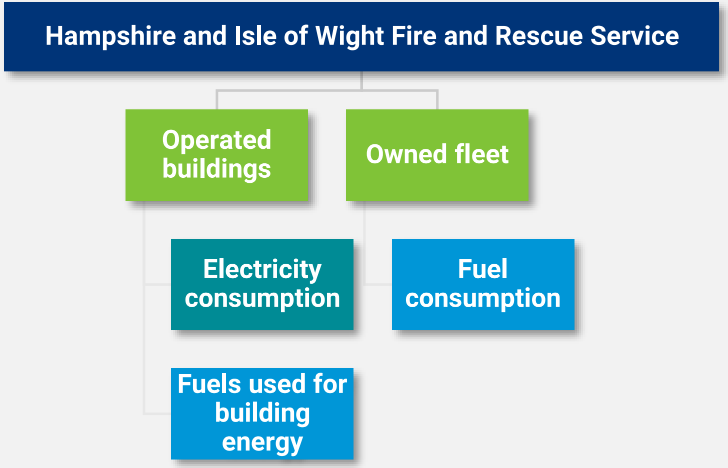
Footprint

Carbon Footprint Methodology

This chapter provides an inventory of greenhouse gas emissions for the Hampshire and the Isle of Wight Fire and Rescue service (HIWFRS) for the financial year 2019/20. This inventory, or footprint, is the 'baseline' against which future progress will be evaluated.

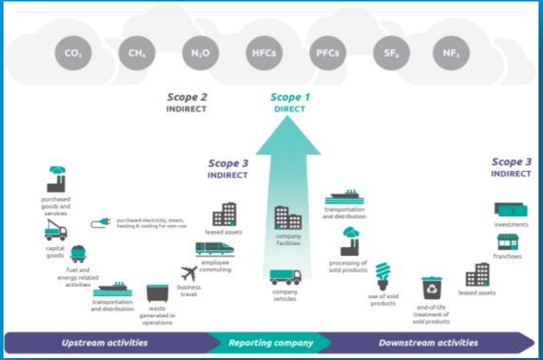
Methodology

This footprint has been calculated according to the Greenhouse Gas (GHG) Protocol, the most widely used and accepted methodology for greenhouse gas accounting. The GHG Protocol classifies emission as either scope 1, 2, or 3 (figure 1). This chapter presents the scope 1 and 2 footprint for the HIWFRS. In the case of the fire and rescue service, a scope 1 and 2 footprint focuses on the emissions produced by fuel and electricity used in buildings and vehicles. Wood burnt for training exercises is also included but makes a very small contribution to total emissions (0.1%).



Scope 1	Gas and gas oil consumption, typically space and water heating in operated buildings
	Long-lease/company-owned vehicle fuel consumption
	Wood burnt for training
Scope 2	Electricity consumption in buildings

Figure 1: The GHG Protocol emissions classification



- **Scope 1:** Direct emissions from combustion of gas and other fuels.
- **Scope 2:** Emissions resulting from purchased electricity, heat, or steam.
- **Scope 3**: Emissions made by third parties in connection with operational activities.

How Carbon Footprints are Calculated

Calculating a carbon footprint

A carbon footprint is calculated by multiplying **activity data** (e.g. litres of vehicle fuel, kWh of electricity/gas) by an associated **emissions factor.**

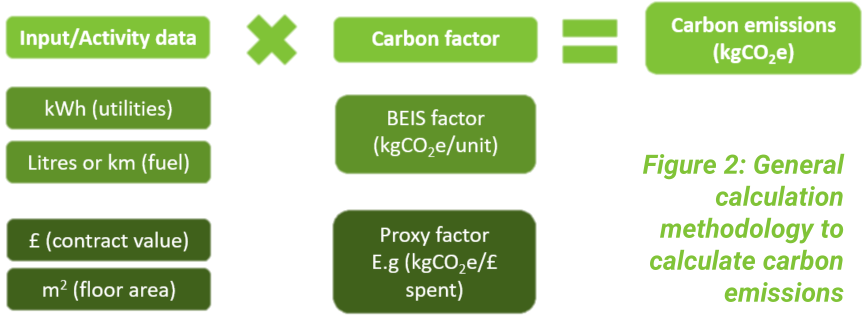


Figure 2: General calculation methodology to calculate carbon emissions

What does CO_2e mean?

Carbon dioxide (CO_2) is the most well known of all of the greenhouse gases. There are six other commonly reported GHGs, which can be seen in figure 1 on the previous page. In footprinting carbon dioxide equivalent (CO_2e) is used in order to express the impact of the other gases in terms of the amount of CO_2 that would create the same amount of warming.

Data availability and the use of benchmarks

Where possible, real activity data should be collected throughout the reporting period for use in the footprint calculation.

- Emission factors are updated annually and published by the UK Government's department for Business, Energy and Industrial Strategy (BEIS).

If activity data is not available, various **benchmarks and proxies** can be used:

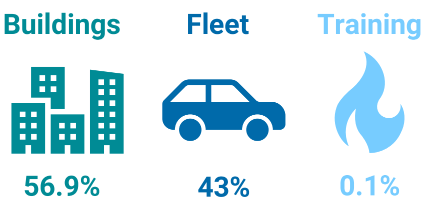
- Benchmarks can be used to approximate activity data. For example, typical electricity consumption per m^2 of a building.
- When input data is scarce, proxy factors can be used in place of the BEIS factors to approximate emissions from the available input data (e.g. contract value).

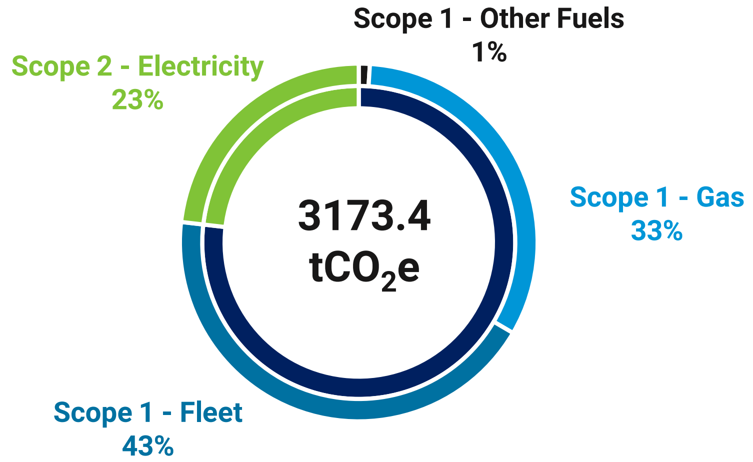
HIWFRS have provided real activity data for all activities for the 19/20 financial year (FY) with the exception of two areas. 1) For gas oil consumption the data on the litres purchased was only available for the 18/19 FY. As such, a 7.1% consumption decrease was applied to gas oil to align it with the estate's gas consumption change between the 18/19 FY and the 19/20 FY and is assumed to take into account differences in weather and heating demand between years. 2) The fuel-use data for 55 vehicles in the Isle of Wight region was not available. To estimate the fuel use and emissions, the average litres/vehicle type from the mainland regions was applied to the 55 Isle of Wight vehicles.

Hampshire & Isle of Wight Fire and Rescue Service FY 19/20 Footprint

The HIWFRS footprint for the 2019-2020 FY was 2,992.3 tCO_2e.

- **Scope 1 vs. Scope 2 emissions:** 77% of the footprint are scope 1 emissions from fleet and building fuel consumption. Scope 2 emissions account for the remaining 23% from building electricity use.
- **Emissions by activity**: Approximately 60% of the footprint emissions are from electricity and heat use in buildings. Fleet fuel consumption is responsible for 43% of emissions. 0.1% of emissions occurred when wood was burnt for training.
- **Avoided Emissions: 142.8 tCO_2e** were avoided through renewable energy generation from solar PV.





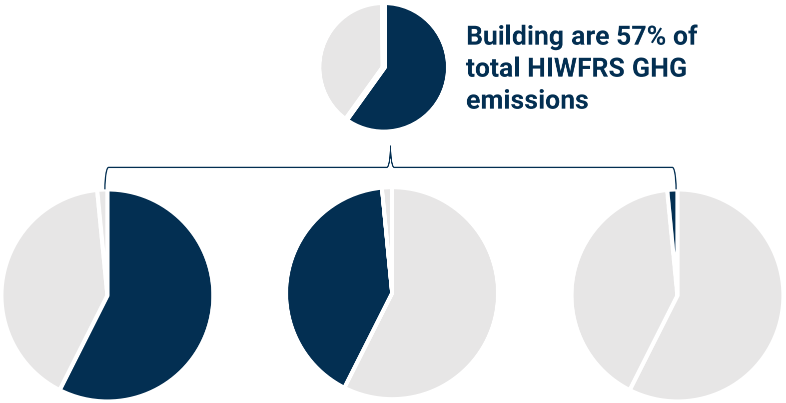
Scope	Emission source	tCO_2e
1	Natural gas	1,029.9
1	Other fuels	31.6
1	Fleet	1,376.8
2	Electricity	735.2
	Total Emissions	**3173.4**
	Avoided emissions (Solar PV)	*-143.8*

Footprint in Detail: Fire & Rescue Stations

The next pages in this chapter explore the ~57% of greenhouse gas (GHG) emissions that come from the energy used by the 61 fire and rescue stations and 1 corporate Services Headquarters in the Hampshire and Isle of Wight estate.

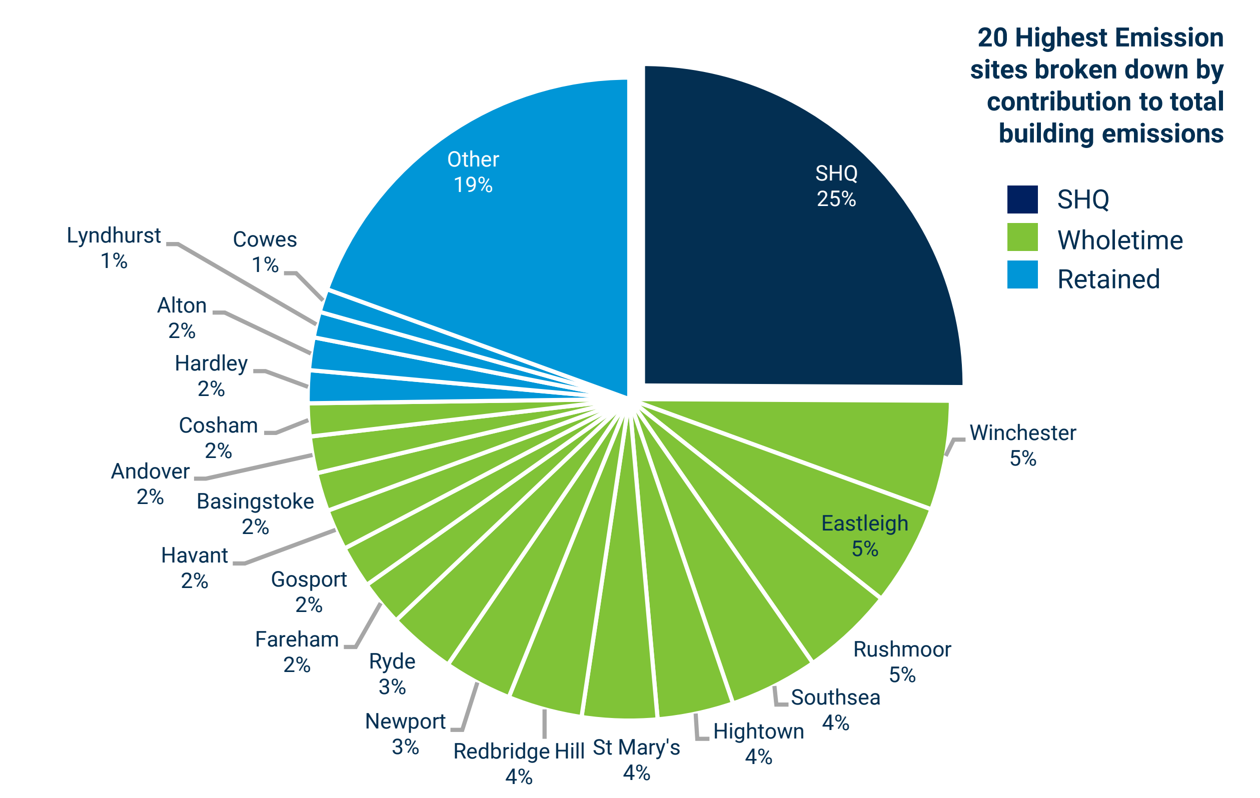
By fuel, gas consumption creates the majority (57%) of building GHG emissions. 75% of the most GHG emission intensive buildings are also the highest fossil fuel intensive buildings.

Building emissions by source



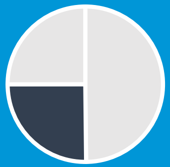
*Where sites have partners operating, emissions for all parties are included.

Footprint in Detail: Fire & Rescue Stations



Wholetime: 50%

Retained: 25%



SHQ: 25%

*Where sites have partners operating, emissions for all parties are included.

Footprint in Detail: Fire & Rescue Stations

Comparing HIWFRS building performance with other fire and rescue services

The chartered institute of building service engineers (CIBSE) have produced benchmarks in terms of energy consumption per floor area (kWh/m^2/year) for buildings of different uses. The benchmarks are based on the display energy certificates (DEC) from 259 fire and rescue stations. Comparing HIWFRS against these benchmarks gives a sense of how the service compares relative to other services.

CIBSE typical and good benchmarks

kWh/m^2/year	Historic (2013)		Current (2019)	
	Good	Typical	Good	Typical
Gas	385	540	171	223
Electric	55	80	55	69

This table show the most recent benchmarks available as well as historic benchmarks.

HIWFRS building performance

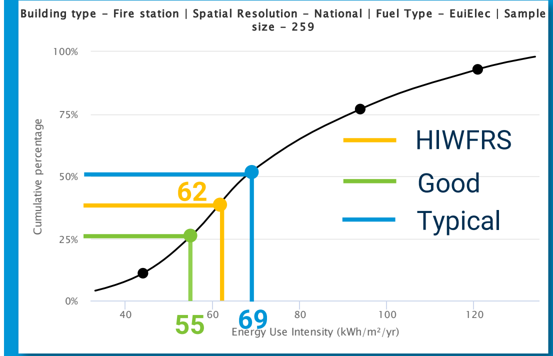
HIWFRS performs better than the typical fire and rescue station with respect to electricity consumption but narrowly misses the top 25% of "good" performing buildings.

HIWFRS is in the top 20% of best performing sites with respect to fossil fuel consumption outperforming both the typical and good benchmarks.

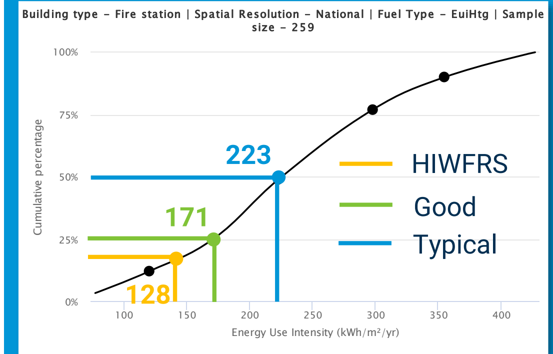
Property Type	Emissions (tCO_2e)	Fossil Fuel (kWh/m^2)	Electricity (kWh/m^2)
Wholetime	893	146	55
Headquarters	451	91	61
Retained	449	109	66
HIWFRS buildings	1,793	128	62

*Where sites have partners operating, emissions for all parties are included.

Electricity intensity: CIBSE good & typical benchmarks and HIWFRS performance



Fossil Fuel: CIBSE good & typical benchmarks and HIWFRS performance



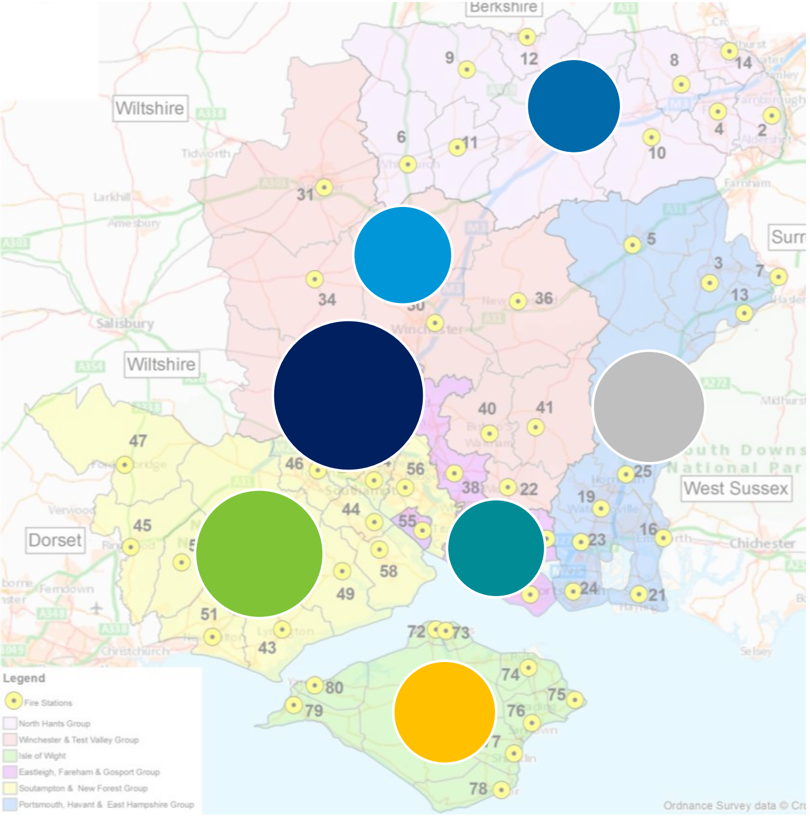
Regional Emissions

The **Headquarters** is responsible for **25%** of emissions from fuels used for building energy (Natural gas, electricity, and gas oil) followed by the **Southampton and New forest group,** contributing **18%**.

However, per unit floor area, the **Portsmouth, Havant and East Hampshire** has the highest average energy intensity at kWh/m².

Over the next pages we explore the emissions hotspots and energy performance of each region in more detail

	Region	Total tCO_2e	tCO_2e/m^2	kWh/m^2
	Service Headquarters	450.7	0.03	76
	Southampton and New Forest	325.7	0.03	146
	Portsmouth, Havant and East Hampshire	247.5	0.04	200
	Isle of Wight	206.9	0.04	212
	Winchester and Test Valley	194.3	0.04	187
	Eastleigh, Fareham and Gosport	190.7	0.04	187
	North Hampshire	176.7	0.04	193



Service Headquarters

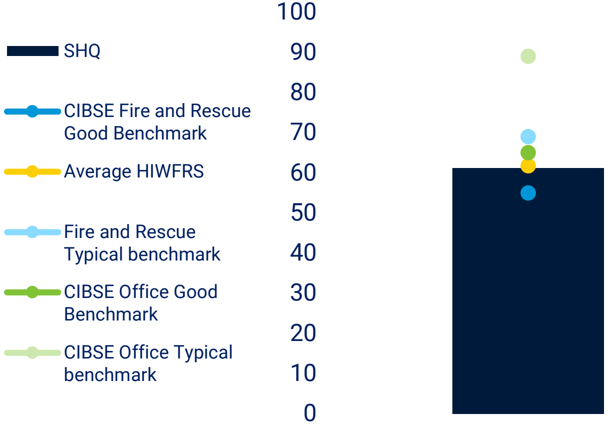
The service headquarters (SHQ) is responsible for 25% of HIWFRS building emissions with an overall floor area of 13895 m^2 (~28%). SHQ is the highest emitting group in HIWFRS. However, SHQ is also the top performer with respect to emissions intensity and energy intensity when compared with the other groups.

The low overall emissions intensity relative to the other HIWFRS buildings is partially due to the building's use which is more comparable to an office setting than operational buildings. The graphs below show the building's electricity and fossil fuel intensity compared against CIBSE benchmarks for local authority offices, fire and rescue services, and the HIWFRS average.

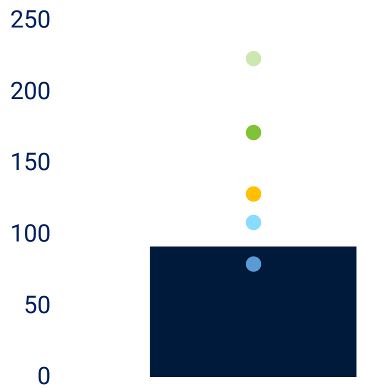
Site	Emissions intensity (tCO_2e/m^2)	Absolute Emissions (tCO_2e)
HQ	0.03	451

SHQ performs better than the HIWFRS average and the CIBSE fire and rescue service good benchmarks. When compared to local authority offices, SHQ performs better than typical buildings but doesn't quite achieve the top 25% of good buildings

Electricity intensity (kWh/m2)



Fossil Fuel intensity (kWh/m^2)



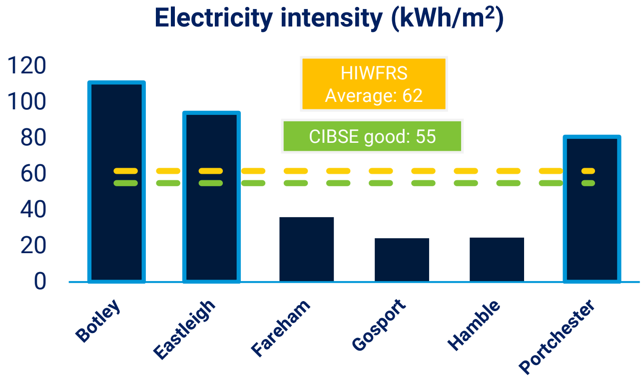
Eastleigh, Fareham and Gosport

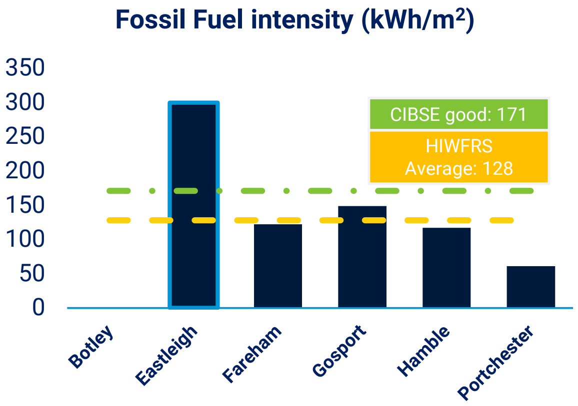
The 6 stations in the Eastleigh, Fareham, and Gosport region make up 11% of building emissions with an overall floor area of 4284 m^2 (8.5%). Three of the stations are wholetimes sites and three are retained sites. The three wholetimes sites are Eastleigh, Fareham, and Gosport.

Within the region Eastleigh stands out as a potential driver of emissions. Eastleigh has the second highest emissions intensity of any HIWFRS building and high electric and fossil fuel intensities.

Botley and Portchester also have electricity intensities above the CIBSE good benchmark, however Botley has no fossil fuel use and Portchester has low fossil fuel emissions intensity.

Site	Emissions intensity (tCO_2e/m^2)	Absolute Emissions (tCO_2e)
Botley	0.03	5
Eastleigh	0.08	91
Fareham	0.03	41
Gosport	0.03	38
Hamble	0.03	10
Portchester	0.03	5





Isle of Wight

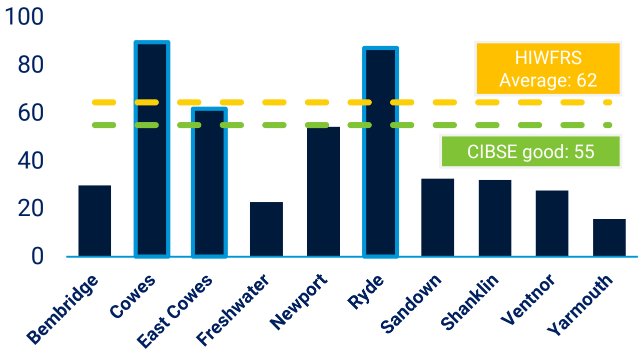
The 10 stations in the IoW contribute 12% of building emissions with an overall floor area of 5,339 m^2 (11%). The Isle of Wight has the second largest emissions intensity and the largest energy intensity of all of the HIWFRS groups. The two wholetime sites in the region are Newport and Ryde.

Four sites stand out as potential drivers of high emissions intensity:

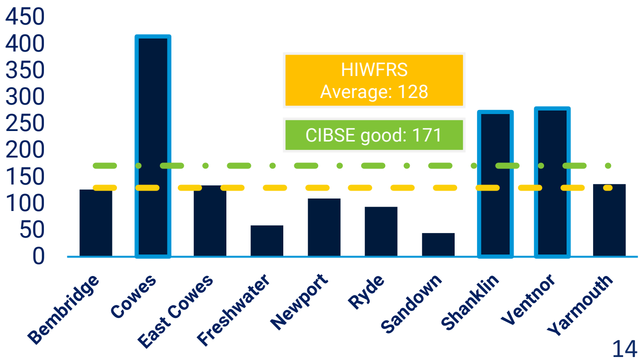
1) Cowes has the highest emissions intensity of all HIWFRS sites and performs poorly across all metrics, particularly fossil fuel intensity.
2) Shanklin and Ventor have relatively high fossil fuel intensity which is likely to be impact their overall emissions intensity.
3) Overall Ryde has the second largest emissions in the region and relatively high electricity intensity.

Site	Emissions intensity (tCO_2e/m^2)	Absolute Emissions (tCO_2e)
Bembridge	0.03	6
Cowes	0.10	21
East Cowes	0.04	10
Freshwater	0.02	4
Newport	0.03	62
Ryde	0.04	61
Sandown	0.02	5
Shanklin	0.06	19
Ventnor	0.06	13
Yarmouth	0.03	7

Electricity intensity (kWh/m^2)



Fossil Fuel intensity (kWh/m^2)



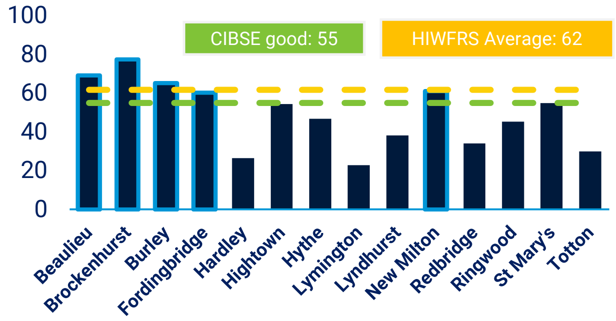
Southampton and New Forest

The 14 stations in the Southampton and new forest region make up 18% of building emissions with an overall floor area of 9622 m^2 (19%). Hightown, Redbridge, and St. Mary's are the three wholetime sites in the region. This group is the second largest emitter overall behind SHQ, however it has the second lowest emissions and energy intensities, also behind SHQ. All but one station, St Mary's, perform better than CIBSE fire and rescue service benchmarks in terms of fossil fuel intensity.

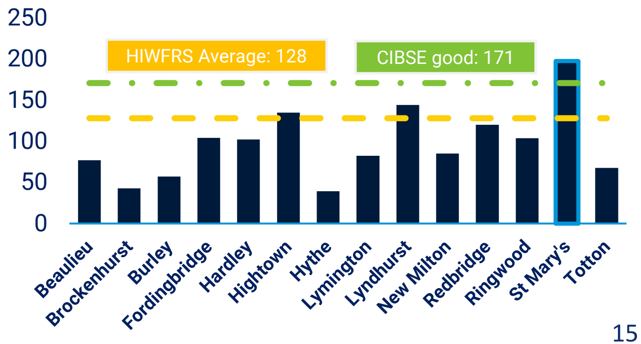
Five sites have electricity intensity that is above the CIBSE good benchmark for fire and rescue services: Beaulieu, Brockenhurst, Burley, Fordingbridge, and New Milton.

Site	Emissions intensity (tCO_2e/m^2)	Absolute Emissions (tCO_2e)
Beaulieu	0.04	7
Brockenhurst	0.03	5
Burley	0.03	6
Fordingbridge	0.03	8
Hardley	0.03	30
Hightown	0.04	69
Hythe	0.02	7
Lymington	0.02	7
Lyndhurst	0.04	23
New Milton	0.03	14
Redbridge	0.03	67
Ringwood	0.03	12
St Mary's	0.05	68
Totton	0.02	4

Electricity intensity (kWh/m^2)



Fossil Fuel intensity (kWh/m^2)



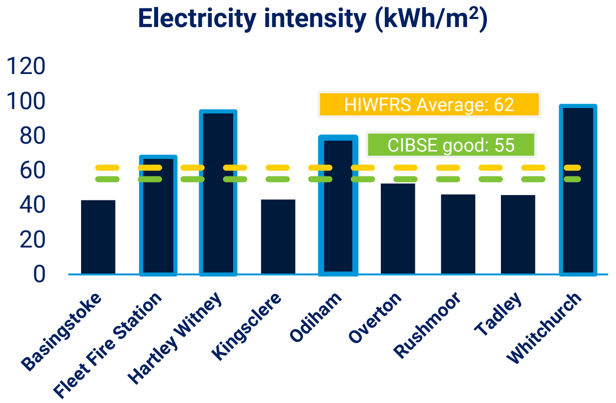
North Hampshire

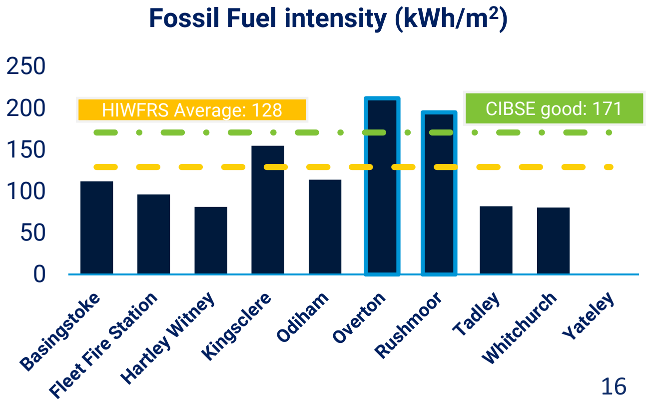
The 10 stations in North Hampshire make up ~10% of building emissions with an overall floor area of 5524 m^2 (11%). Basingstoke and Rushmoor are the two wholetime sites in the region and as such have the highest absolute emissions.

1) Whitchurch, Hartley Witney, and Odiham all have electricity intensities above the HIWFRS average.

2) Overton and Rushmoor are the two sites with the highest fossil fuel intensities in the region. Decreasing these intensities will reduce the overall emissions intensities for both sites.

Site	Emissions intensity (tCO_2e/m^2)	Absolute Emissions (tCO_2e)
Basingstoke	0.02	35
Fleet Station	0.04	8
Hartley Witney	0.04	7
Kingsclere	0.04	7
Odiham	0.05	9
Overton	0.05	11
Rushmoor	0.05	84
Tadley	0.03	5
Whitchurch	0.04	6
Yateley	0.02	5





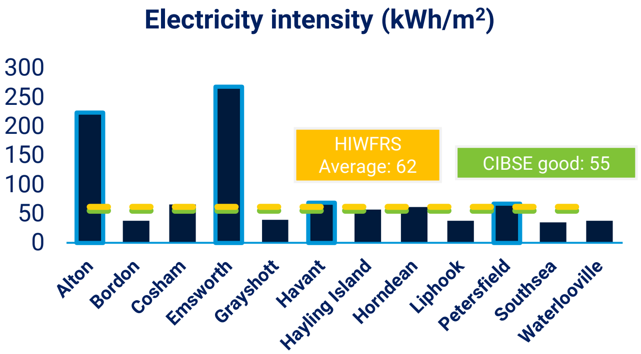
Portsmouth, Havant and East Hampshire

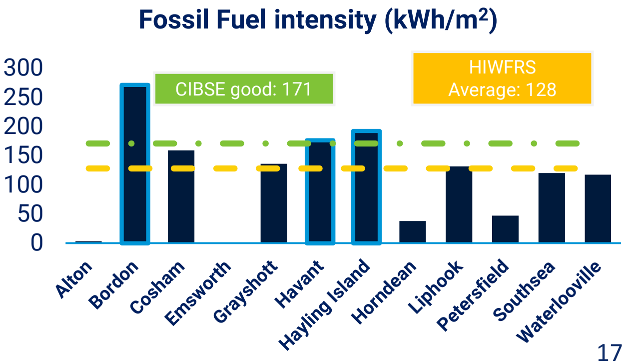
The 12 stations in the Havant and East Hampshire region make up ~14% of building emissions with an overall floor area of 6265m^2 (12.5%). Overall this region has the third largest total emissions and has the worst performance in terms of emissions intensity. Cosham, Havant, and Southsea are the three wholetime site in the region and contribute the largest amount of emissions.

Bordon stands out for high fossil fuel intensity. Its is one of three sites alongside Havant and Hayling Island that have a fossil fuel intensity exceeding the CIBSE good benchmark and the HIWFRS average.

Alton and Emsworth both have very high electricity intensities. Its worth understanding what electric heating equipment may be in use in these stations.

Site	Emissions intensity (tCO_2e/m^2)	Absolute Emissions (tCO_2e)
Alton	0.06	29
Bordon	0.06	18
Cosham	0.05	30
Emsworth	0.07	8
Grayshott	0.04	6
Havant	0.05	37
Hayling Island	0.05	10
Horndean	0.02	4
Liphook	0.03	6
Petersfield	0.03	8
Southsea	0.03	80
Waterlooville	0.03	11





Winchester and Test Valley

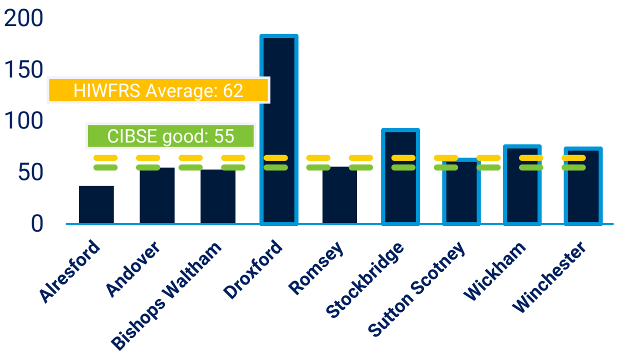
The 9 stations in Winchester and the Test valley make up ~11% of building emissions and ~11% of overall floor area (5192 m²). Andover and Winchester are the two wholetime sites in the region and as such have the highest absolute emissions. Overall Winchester has a very low fossil fuel intensity. In combination with a electricity intensity of 73 kWh/m²/year which is just above a CIBSE typical intensity of 69 kWh/m²/year, Winchester has an overall low emissions intensity.

Droxford and Stockbridge have the highest electricity intensity but also used no fossil fuels.

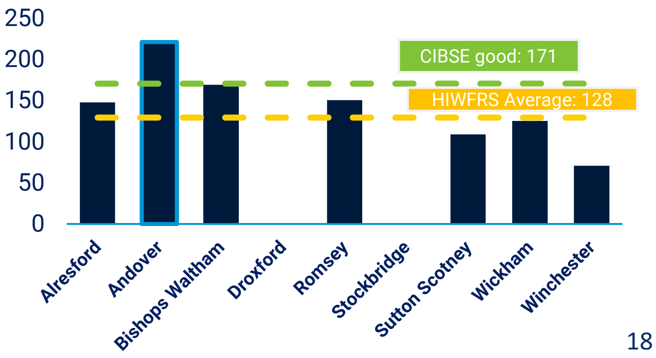
Andover has relatively high fossil fuel intensity which increases its overall emissions intensity.

Site	Emissions intensity (tCO_2e/m^2)	Absolute Emissions (tCO_2e)
Alresford	0.05	17
Andover	0.05	33
Bishops Waltham	0.04	6
Droxford	0.05	6
Romsey	0.04	13
Stockbridge	0.02	5
Sutton Scotney	0.04	8
Wickham	0.04	7
Winchester	0.03	99

Electricity intensity (kWh/m²)

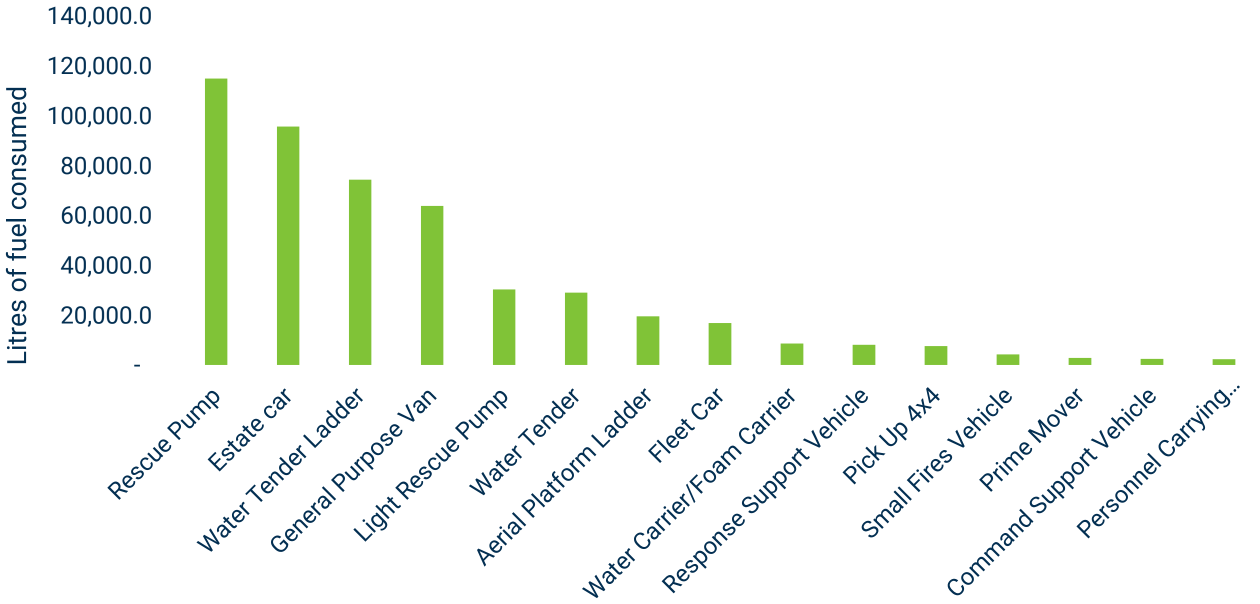


Fossil Fuel intensity (kWh/m²)



Footprint in Detail: Fleet

- Fleet fuel consumption represents 43% of HIWFRS scope 1 and 2 emissions.
- HIWFRS is responsible for over 400 vehicles that consumed an estimated 532,522 L of fuel in the reporting period.
- 98% of fuel consumed was diesel (2% petrol).
- The 15 largest fuel consuming groups of vehicles are shown in the graph below and represent 91% of fleet fuel use.



Science Based Target

Science-Based Targets

What is a science based target?

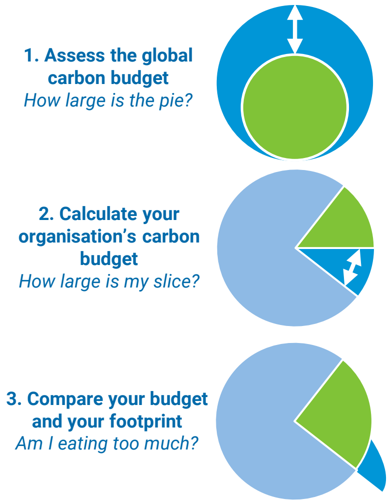
In the Paris Climate Agreement 195 nations agreed to limit the increase in global average temperatures to 2°C and pursue efforts to limit the increase to 1.5°C, relative to pre-industrial levels. A carbon emissions target is defined as science-based if it is in line with the scale of reductions required to keep global temperature increase below 2°C.

How are emissions reductions aligned with 2°C or 1.5°C?

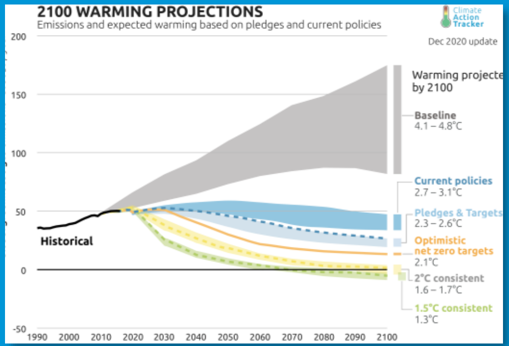
Science based targets start by understanding the global carbon budget, or the total amount of emissions that can be still be put into the atmosphere and keep temperatures below 2°C. Organisations can choose to either align with a 1.5 ° C (1.5DS) scenario or a well-below 2 ° C scenario (2DS). From here, the individual carbon budget for an organisation can be determined by using one of two methodologies:

1) **Absolute contraction:** defines a minimum year-on-year percentage reduction that must be achieved by all sectors in all regions of the world to achieve the stated scenario. For a two degree scenario, the annual reduction is 2.5% of the baseline year; for a 1.5 degree scenario, the annual reduction is 4.2% of the baseline year.

2) **Sectoral Decarbonisation Approach (SDA):** takes into account the challenges and costs that different sectors face when decarbonising. The emissions intensities of all organisations within a specific sector must converge at 2060.



The absolute contraction methodology has been applied to HIWFRS. The methodology underpinning SDA has not been applied to fire and rescue services. Additionally, SDA is limited to understanding a 2DS target.



Emissions pathways and warming projections

What is Net Zero?

In 2019 the UK Government set a target for the UK to achieve net zero emissions by 2050. This target was recommended by the Committee for Climate Change in order to meet the UK's Paris Agreement commitments.

Net zero means reducing emissions close to zero and using offsets or greenhouse gas removal to account for any remaining emissions that are extremely difficult to eliminate. For most sectors net-zero requires reducing emissions close to zero without offsetting. There is no one agreed definition of what net zero means for an individual company or organisation though there is general consensus that it is a ambitious target. The Carbon Trust defines net zero for a company or organisation as a target that reduces scope 1, 2 and 3 emissions in line with 1.5 ° C science-based target and compensates for any residual emissions with greenhouse gas removals.

The scope of this work was to look at science based targets, nonetheless on the next page we try to understand these targets in the context of the UK's net zero target.

Targets for HIWFRS

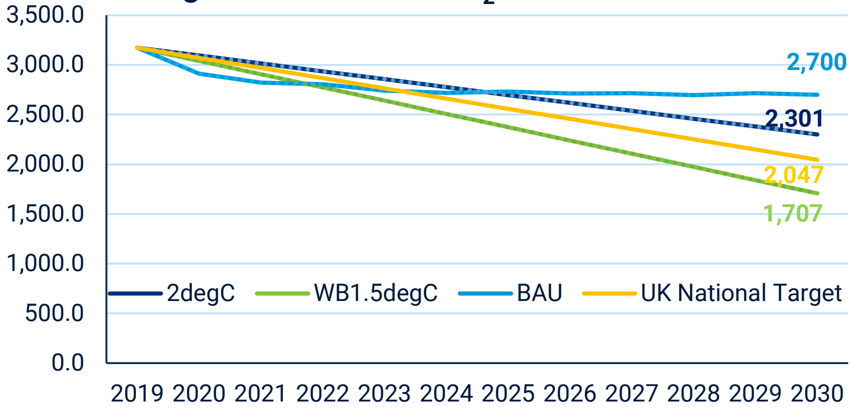
Four scenarios have been modelled to help decide an appropriate 2030 emissions reduction target for the HIWFRS:

1) A do-nothing or **business-as-usual (BAU)** scenario
2) Science-Based Target: A **well-below 2 ° C (2degC)** scenario
3) Science-Based Target: A **1.5° C (1.5degC)** scenario
4) A **UK National Target** scenario

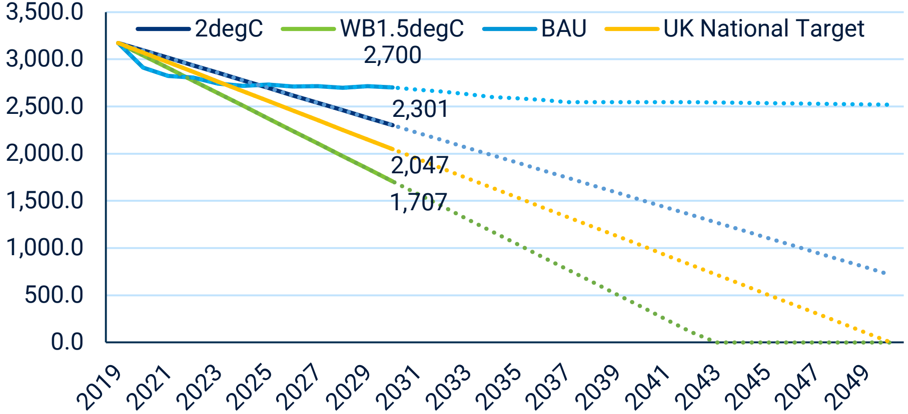
Scenario	2030 target (tCO_2e)	Percentage reduction 2019-2030	Year on Year emissions reduction (tCO_2e)	Percentage reduction 2031-2050
Business-as-usual (BAU)	2,700	16%	Varies	6%
Science Based: 2 ° C	2,301	28%	79.3	68%
Science Based: 1.5° C	2,047	46%	133.3	100%
UK National Target	1,707	35%	102.4	100%

The graph below on the left shows the emissions target options between now and 2030. Emissions reduce under a BAU scenario due to decarbonisation of the electricity grid. The **1.5° C science-based target** is the most ambitious target, the **well-below 2 ° C** is less ambitious. We've mapped the trajectory of these targets out to 2050 in the right hand graph in order to understand how they perform in the context of the UK's 2050 net zero target, show by the **UK National Target** scenario. The **well-below 2 ° C** is not ambitious enough to be on the path to zero emissions by 2050. On the other hand, the **1.5° C target** is on a path to achieve zero emissions by 2043.

2030 targets Emissions / tCO_2e



Target trajectories out to 2050 Emissions / tCO2e



Target Landscape

When setting targets it can be useful to understand what similar organisations are doing. Below the carbon strategy and targets are provided for three fire and rescue services.

The London Fire Brigade aims to continually reduce their carbon and air quality impacts by focusing on the emissions that they can control from their fleet and buildings. Some of their actions to date include: complete electrification of their car fleet, installed vehicle charge points accessible to the public at 9 stations, maintained ISO 14,001 accreditation for management and 10 high risk stations, and planted forest.

The Avon Fire and Rescue Service set a 1.5 degree – aligned target to reduce emissions from its sites and operations by 50% by 2020 and 65% by 2030 (2009 baseline). The service also committed to generate 20% of energy demand from renewable sources.

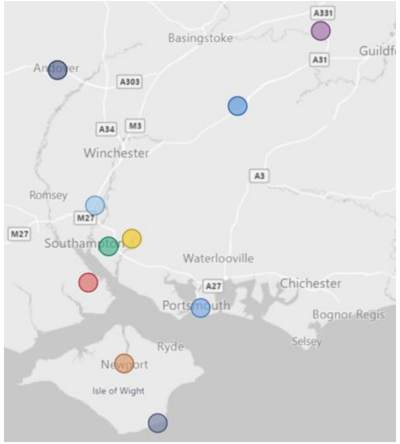
The Greater Manchester Fire and Rescue Service set an overall target to be carbon positive by 2050, meaning that “the service averts more greenhouse gases than it produces”. The service’s Interim target is to achieve a 50% reduction by 2020 (against a 2008/9 baseline) in line with 1.5 degrees.

Carbon Reduction Opportunities

Introduction to Project Identification

The Carbon Trust has performed desk-based analysis across 10 sites to identify decarbonisation initiatives. In-person site visits could not be conducted as the project was delivered amidst national travel restrictions due to the COVID-19 pandemic. The 10 sites were selected to provide a representative overview of HIWFRS's estate such that recommendations could be extrapolated across the wider estate where possible. The 10 sites include:

Alton	Service Headquarters (SHQ)
Andover	Newport
Botley	Rushmoor
Hardley	Southsea
Hightown	Ventnor



A data collection phase was initiated for each site. The project identification was based on the data received, primarily condition surveys, past audit reports, and boiler service reports. **This chapter explores the carbon savings and the estimated costs associated with implementing different decarbonisation measures at the 10 sites identified above and does not quantify the anticipated extrapolation to the wider estate.** The decarbonisation measures considered include:

- Lighting upgrade to LED
- Solar PV
- Double glazing and wider building fabric measures
- Building heating
- Fleet electrification
- General energy management

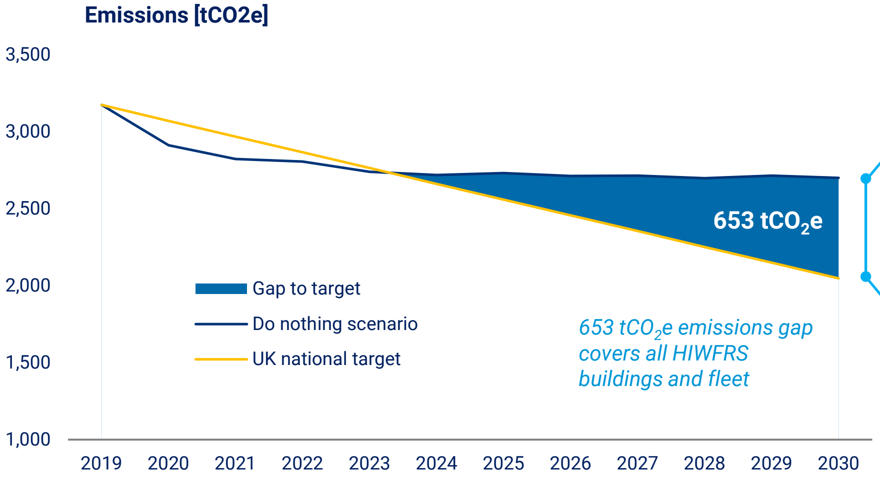
Between now and 2030, the carbon intensity of the UK's national grid is expected to reduce by 64%.

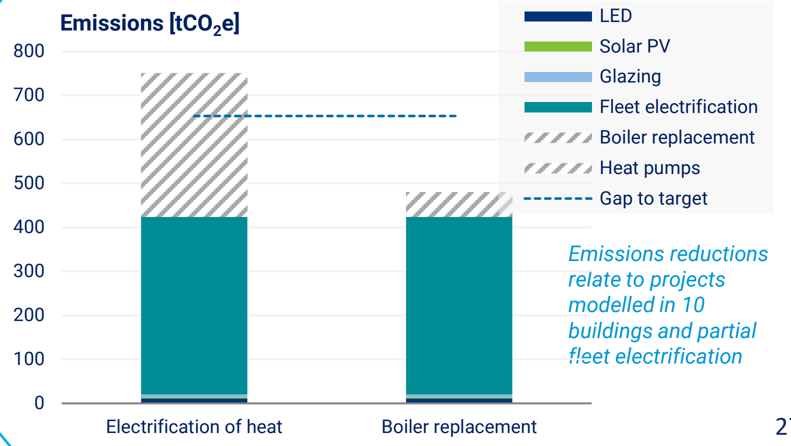
The carbon intensity of the UK's electricity supply is reducing as renewable generation (e.g. wind, solar) is replacing traditional fossil fuels (e.g. coal, natural gas). Many of the recommendations made in this report focus on the 'electrification' of conventional fuel sources so that this greener electricity can be utilised by the Service.

Project Summary

In a do-nothing scenario, HIWFRS's footprint is expected to decrease due to the decarbonisation of the national grid. In this scenario, HIWFRS has an anticipated gap-to-target of **653 tCO_2e** by 2030 against the UK national target option. These are emissions that the Service will have to proactively reduce to reach their decarbonisation target. The results below show the expected impact of the implementation of projects at the 10 sites considered towards the UK national target, and **do not account for extrapolation of the measures across the wider estate.**

Two scenarios were modelled to understand how the target might be achieved (*below*). The two scenarios demonstrate the potential to reduce emissions from the installation of low carbon technologies across the 10 sites evaluated as well as partial fleet electrification. The scenarios vary in terms of their approach to heat decarbonisation. One scenario replaces gas boiler systems with heat pumps, whilst the other assumes a like-for-like replacement with more efficient boilers. In practice complete electrification of heat through the use of heat pumps may not be achievable due to building characteristics; it's likely that a hybrid approach will be taken which implements the most appropriate heating technology based on site specific conditions including building fabric and overall efficiency. Nonetheless, the results underscore the importance of electrification and demonstrate that it will be required for HIWFRS to achieve their decarbonisation ambitions.





Project Summary

For each of the 10 sites considered the anticipated financial requirement was estimated, including capital costs (CAPEX), annual savings, and cost of carbon abated. This financial assessment was also undertaken for the fleet electrification projects considered. The results are summarised in the table below and show that the environmental and business case for many of the technologies are conflicting. This demonstrates the need for HIWFRS to:

- Actively include environmental considerations and weighting in procurement decisions
- Avoid siloing individual projects and take an estate-wide view to optimise the distribution of technologies across the estate
- Retain an active view of the market (e.g. cost reductions, government support) and be prepared to engage with specialised market instruments to improve the financial viability of marginal business cases (e.g. specialised tariffs)

Additionally, the financial results by-site indicate a disparity between retained and wholetime sites that will require consideration. In particular, the business case for retained sites is weakened by the lack of consumption and therefore annual savings. In the short-term, we recommend targeting resource at the wholetime sites and retained outliers, where the environmental gains are largest and the business case is stronger. The following pages explore these projects in more detail. The assumptions used to develop these estimations can be found in the appendix.

Below: financial summary of the projects analysed over the 10 sites and fleet

Project	**CAPEX** [GBP]	**Annual savings** [GBP]	**Simple payback** [yrs]	**Carbon savings ‘19 – ‘30** [tCO_2e]	**CAPEX/tCO_2e**
LED	101,700	14,125	7.20	171	595
Solar PV	43,740	3,958	11.1	46	951
Gas boiler replacement	78,998	12,041	6.56	662	119
Heat pumps	648,500	21,009	30.9	3,702	175
Glazing	195,375	2,276	85.8	82	2,382
Fleet electrification	3,279,228	210,857	15.6	4,597	713

Solar Photovoltaic (PV)

Summary Recommendations. Solar PV is the most affordable method of producing on-site renewable electricity. In the absence of feed-in-tariffs, solar PV should be prioritised where on-site usage can be maximised. Emission reductions relative to the National Grid will decrease out to 2030 and solar will increasingly be viewed from a financial standpoint, rather than one that achieves significant emissions reductions across the estate.

Introduction. Solar PV is a modular, scalable technology that allows for renewable electricity to be produced at source. Cost reductions over the past decade have made it an increasingly-attractive technology and resulted in it's accelerated roll-out at both utility and small-scale.

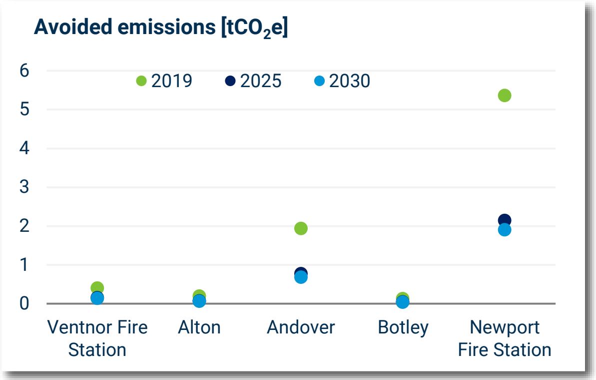
State of play. HIWFRS has ~700kW of solar PV installed across 16 sites, which generated 560MWh of electricity in FY 18/19 and avoided 144 tCO_2e of emissions. The market in the UK is established and there are plentiful providers of solar PV and related services. However, UK government support for small-scale projects has been significantly curtailed and any project will be subject to market prices.

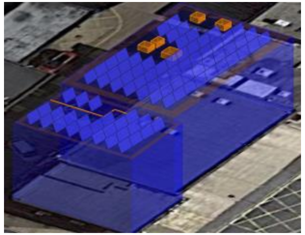
Project identification. HelioScope software was used to model rooftop Solar PV on 5 of the Project ID stations, Ventnor, Alton, Andover, Botley, and Newport. The remaining 5 Project ID sites already have solar PV installed. Key findings include:

- A further **48.6 kW** of solar PV could be feasibly installed, generating 43,107 kWh per annum
- Across retained and wholetime sites, it is envisaged this would result in an onsite energy saving of **31,483 kWh** with 11,624 kWh being exported to the grid
- This represents an **8 tCO_2e** emission saving using 2019 emission factors, which is projected to decrease to **3 tCO_2e by 2030**
- The financial case for solar PV is significantly improved when more solar PV is consumed on site (displacing grid electricity at 12 p/kWh) as opposed to exporting to the grid (5 p/kWh)

Emission reduction

The avoided emissions of solar installations will decrease out to 2030 as the national grid decarbonises and the variance between local, zero-carbon generation and national generation decreases.





Right: Helioscope software was used to model solar PV installations on HIWFRS sites *(Pictured: Newport fire and rescue station)*

LED

Summary Recommendations. Good quality LED luminaires offer superior illumination, control and energy performance over many of the Service's incumbent lamp types. They should be installed by default across the estate, either proactively or reactively. The business case for LED lighting improves with increasing occupancy hours; a proactive approach to LED roll-out across wholetime sites should be conducted, whilst a reactive replacement schedule for retained sites is recommended to maximise the reach of annual budgets.

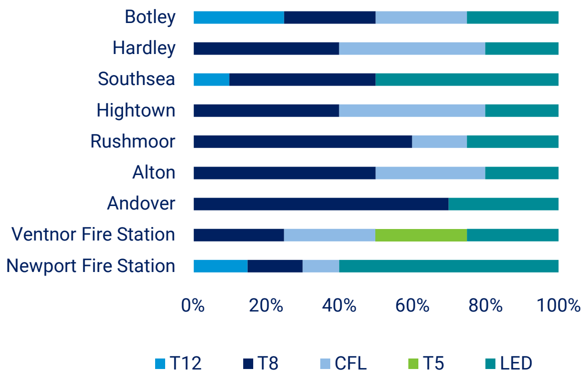
Introduction. LEDs have the highest efficiency and lamp life of all widely used lighting types. Cost reductions and a step-change in the technological performance of LED lighting over the past 10-15 years has made them the mainstream solution for the vast majority of lighting applications in the UK.

State of play. HIWFRS has a mixture of lighting installed across the sites: incandescent tungsten, tubular fluorescent lamps (T12, T8, T5) compact fluorescent lamps (CFLs), and LEDs. The Service is actively trying to roll-out efficient LED lighting across the estate and has recently performed a lighting upgrade at Hamble Fire and Rescue Station that will serve as a blueprint for future lighting-replacement programmes.

Project identification. Available condition surveys and audit reports across the 10 project ID focus sites were used to determine the installed lighting types. The costs and emission savings from upgrading the sites to LED were estimated. Key findings include:

- An annual electricity saving of **117,705 kWh** was estimated across 9 sites, equating to fuel savings of ~£14,000 yr.
- By 2030, this is expected to save **10.8 tCO_2e** annually.
- The financial case for LED lighting depends on the usage of the newly-installed lighting. For wholetime sites the simple payback varies from 5.0 – 8.1 years (depending on the incumbent lighting). For retained sites, the average payback is > 10 years (*see assumptions*).

Installed lighting estimate [% of floor area]]



Fire & rescue station	kWh saving	2019 tCO_2e	2030 tCO_2e
Botley	1,966	0.50	0.18
Hardley	8,430	2.15	0.77
Southsea	32,838	8.39	2.99
Hightown	19,339	4.94	1.76
Rushmoor	34,199	8.74	3.11
Alton	3,871	0.99	0.35
Andover	5,225	1.34	0.48
Ventnor	319	0.08	0.03
Newport	11,518	2.94	1.05
TOTAL	**117,705**	**30.1**	**10.8**

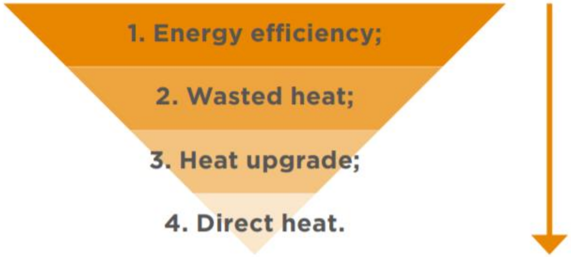
Heat Hierarchy: a Strategic Approach to Heat Decarbonisation

Gas consumption for space and water heating in buildings accounts for 35% of HIWFRS's measured footprint. Compared to electricity, the emission factor for gas usage is less sensitive to policy and technology changes and is expected to remain relatively constant between now and 2030. In order to achieve their decarbonisation targets, HIWFRS will therefore have to proactively target a significant reduction in gas use across the estate.

The challenge of heat decarbonisation is multifaceted and there is no one-size-fits-all solution that can be implemented across the estate. However, we recommend that any approach to heat decarbonisation should consider the heat hierarchy outlined below. The hierarchy has four key stages, which should be addressed in chronological order:

- **Energy efficiency.** Reduce the heating demand of the building by improving its thermal performance through fabric upgrades (e.g. insulation, draught proofing). As the initial step, this is referred to as a fabric-first approach and should be maximised for each building within the bounds of reasonable viability (i.e. respecting technical and financial constraints) regardless of the heat source.
- **Wasted heat.** Utilise any heat that is already being produced in other processes but wasted.
- **Heat upgrade (i.e. heat pumps).** 'Upgrading' heat refers to the process of raising a low-temperature heat source to a higher temperature that can be utilised in heating system. This process requires an energy input (e.g. electricity) and is the function of heat pumps.
- **Direct heat.** This is where energy is directly inputted for the *creation* of heat (e.g. fuel into a boiler). This should be restricted to when wasted heat is not available, or the use of a heat pump is not technically or financially feasible.

A net-zero HIWFRS will likely involve a combination of the above measures in varying proportions. The appropriateness of each option needs to be assessed in the context of the fabric and efficiency of each building to ensure that the space is adequately heated. Due to the remote nature of the assessment, the service should look to consolidate this work with further site specific investigations, using the heat hierarchy as a foundation.



Above: the heat hierarchy

Source: ADE, A framework for net-zero for new and existing buildings.

Building Fabric - Glazing

Summary Recommendations. Improving thermal performance across the estate should be a short-term priority for the Service, and a coordinated approach to upgrades should be formalised. Fabric upgrades will achieve emission reductions and improve user comfort regardless of the heating mechanism, and will be essential for the Service to adopt low-temperature electric heating.

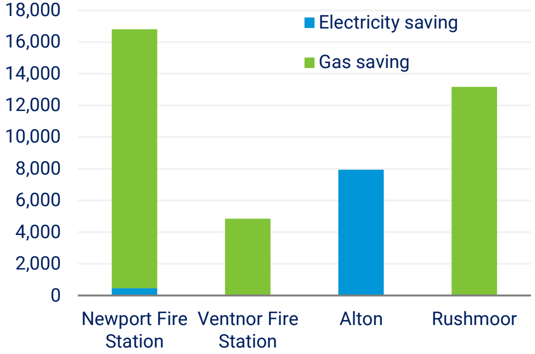
Introduction. Building fabric refers to the components of a building that regulate interactions between the interior and exterior of the building (e.g. windows, roofs, walls). The combined effect of a building's fabric governs temperature, air, and moisture transfer of a building, and a balance of these interacting elements is required to ensure effective building management and user comfort.

State of play. Benchmarking identified that HIWFRS is in the top 20% of best performing sites with respect to fossil fuel consumption, signalling that the thermal fabric of the general building stock is sound. The condition surveys analysed were non-intrusive and could not provide details on insulation. Of the buildings inspected, the majority were reported to be either fully or partially double glazed. Some audit reports (e.g. Alton, Newport) did indicate that additional sealant was required for draught-proofing and to prevent moisture build-up.

Project identification. Using information from condition surveys, the impact of upgrading single glazed units to double glazing across 4 sites was modelled. Key findings include:

- Across the four sites, energy savings of **34,373 kWh per year** can be realised, equating to 7-8 tCO_2e of emission reductions across gas and electricity
- Payback times vary between **44.1 to >100 years**, with electrically heated sites benefitting from lower payback terms due to higher tariff rates. The business case for sites with higher specific consumption (kWh/m^{-2}) is significantly more favourable.

Annual energy savings [kWh]



	Newport Fire Station	Ventnor Fire Station	Alton	Rushmoor
% requiring upgrading	**80%**	**100%**	**100%**	**20%**
Upgraded glazing m^2	**217**	**22**	**77**	**53**

N.B. The remote assessment has limited the degree to which building fabric recommendations can be made. However, this report has identified building fabric as a core priority for the Service to investigate in the short-medium term. It is recommended that an updated estate-wide analysis is undertaken to prioritise buildings for fabric improvements.

Heat Pumps

Summary recommendations. The installation of heat pumps should be considered for every heating system requiring replacement and installed as standard in new builds. Heat pumps are not a like-for-like replacement with gas boilers or conventional electric heating and improved energy efficiency in buildings is a pre-requisite for heat pump retrofit. Whilst not practically suitable for all applications, the electrification of heat at some sites will be required for the Service to achieve their decarbonisation targets.

Introduction. Heat pumps are a highly efficient form of electric heating. They *can* save ~60-70% of emissions compared to conventional electric heating and have lower running costs if operated efficiently. Heat pumps perform optimally at lower temperatures than conventional heating systems and require a thermally efficient site to operate effectively.

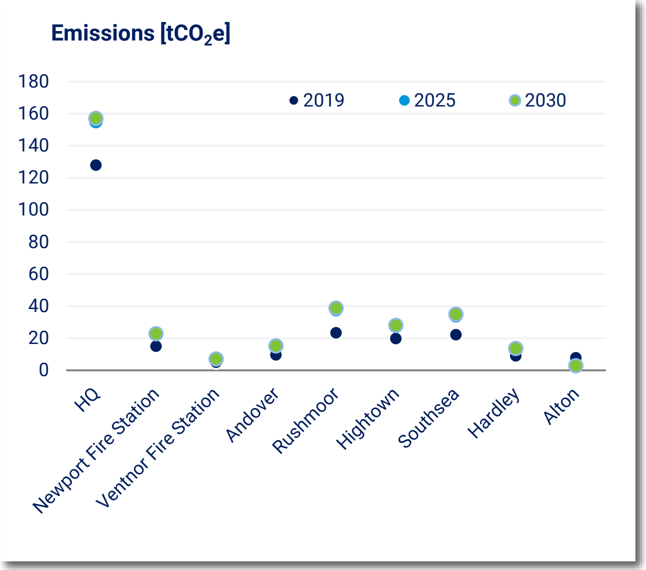
State of play. Currently, there are no heat pumps installed in the HIWFRS estate. They have been considered in the Service's briefing framework where it recommends that a site-by-site options appraisal is conducted to determine the suitability of heat pumps.

Project identification. The replacement of existing central heating systems with an efficient heat pump was modelled for 9 sites. Any supplementary heating was excluded from the analysis. Key findings include:

- A reduction of **425 tCO_2e** could be achieved by 2030. Installation of a heat pump at the SHQ alone is estimated to reduce emissions by 160 tCO_2e.
- The business case for installing a heat pump is poor for the majority of sites and **environmental weighting** will have to be included to promote their procurement. Current government support to incentivise heat pump use in the form of the non-domestic renewable heat incentive (RHI) is due to finish in March 2021. New support mechanisms are expected to replace RHI, which HIWFRS should consider when announced.

Emission reduction

The emission savings associated with electrifying heat increase as the national grid decarbonises. This will be further improved if the heat pump is powered by on-site renewable power.



Boiler Upgrades

Summary recommendations. In accordance with the heat hierarchy, alternative heat sources are preferred solution over boiler upgrades. However, it is recognised that technical and/or financial constraints may limit the feasibility of these alternative sources (e.g. heat pumps). When this is the case, boiler upgrades can contribute to decarbonisation through efficiency gains while also making sure that the building is heated properly.

Introduction. Gas boilers being the preferred heating mechanism in the UK, with 1.67 million gas boilers sold in 2019. Though gas-fired boilers are carbon intensive, they provide flexibility in heating several building archetypes and often present attractive business case relative to low-carbon alternatives. Advances in boiler design has increased the efficiency of new boilers to over 90%.

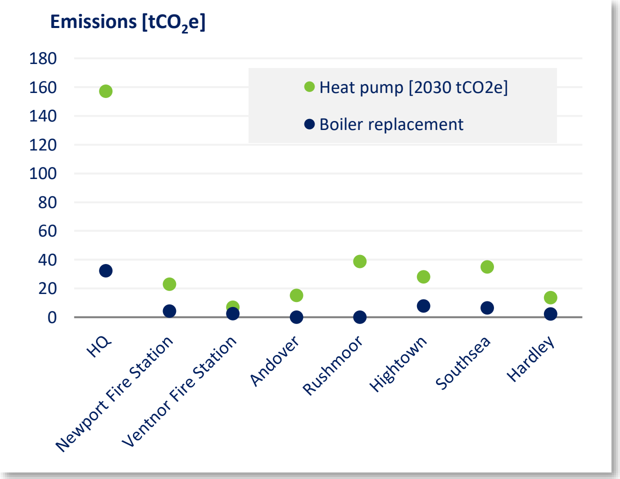
State of play. Most sites have gas-fired boilers connected to central heating with radiators. Underfloor heating exists in some sites. Supplementary electric heating was found in several sites, suggesting a lack of efficacy from the main heating system or that the central heating does not cover all areas. Four stations that were not selected for project ID, Alresford, Sutton Scotney, Beaulieu, and Odiham, use boilers fuelled by gas oil, which is more emissions intensive than gas.

Project identification. The replacement of incumbent boiler systems operating at an efficiency of less than 80% with a condensing boilers (operating at 92% efficiency) was modelled at 8 sites. Key findings include:

- Annual **gas savings of 301,028 kWh** can be realised, resulting in cost savings of £12,041 and emission savings of **55 tCO_2e**
- Replacement gas boilers present a strong financing case. However, the emission savings associated with their widespread replacement is not compatible with the Service's decarbonisation ambitions, particularly for larger sites.

Emission reduction

Emission savings can be realised through increased efficiencies and the reduction in gas consumption for a given heat load. However, their relative carbon intensity means that the Service should only pursue like-for-like replacement when the financial or technical constraints for low-carbon technologies are overwhelming.



Applying the Heat Hierarchy and Moving to Low Carbon Heat

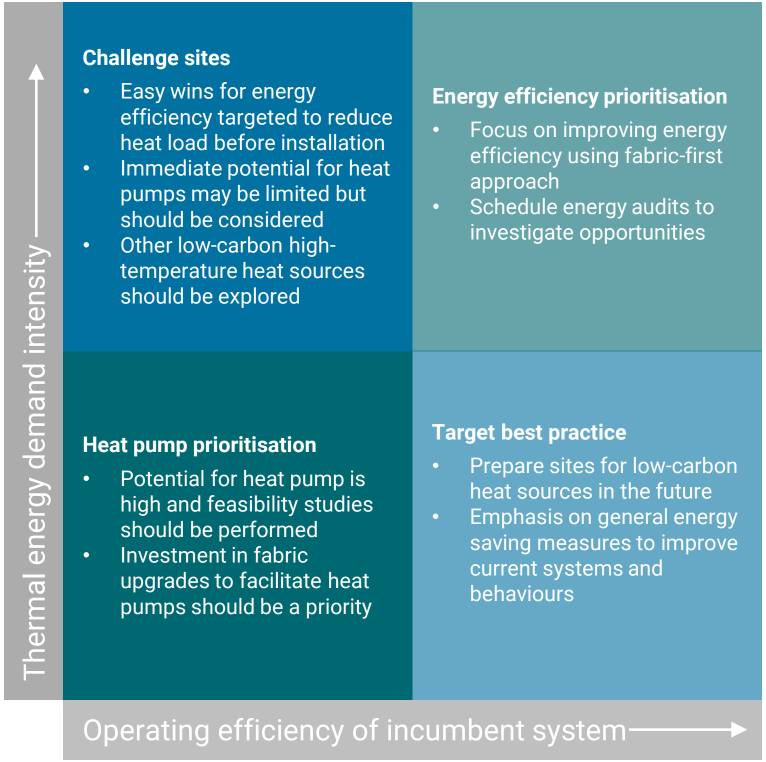
A broad approach to applying the heat hierarchy should be understood and established. However, it should be recognised that site specific conditions at each station will ultimately determine which technologies and interventions are both appropriate and financially viable.

Technology Replacement Mapping. As a good first step, mapping the expected heating technology replacement timeline and the operation efficiency of current systems will help prioritise sites for energy audits and heat pump assessment. This mapping should be updated regularly; any heating system that comes up for renewal should have an assessment performed that considers alternative heating technologies including heat pumps.

The approach will vary site-by-site. The matrix to the right explores likely actions depending on the thermal energy demand intensity of the site and the immediacy of heating technology replacement. This matrix is only a start, each site is unique in practice, and the approach will be different site-by-site. Low carbon heating will be technically feasible for every site, but some sites will be financial prohibitive due to the amount of retrofit required to achieve the required levels of thermal performance.

Top tips for low carbon heating:

- Understanding flow temperature is important. Lower flow temperatures are more compatible with the efficient operation of heat pumps, and heat pump business cases become favourable when temperatures are <45°C.
- Flow temperatures are a function of the building’s thermal retention and area of heat emitters (e.g. radiators). A building with high heat retention and large heat emitters is a prime candidate for installation of a heat pump.



Fleet

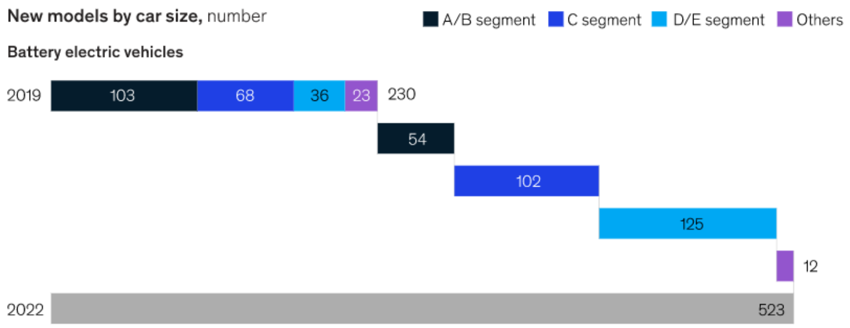
Summary Recommendations. Significant fuel-switching of the fleet is required for the Service to achieve their decarbonisation ambitions. The Service should commit to a phased fuel-switching of the fleet, accounting for vehicle type and use. The supporting infrastructure requirement is the largest constraint to electric vehicle (EV) deployment and the Service should, as a priority a) ratify internal support for infrastructure roll-out, b) understand the financial and technical requirements accounting for local constraints, c) explore potential funding avenues, and d) seek collaborative partnerships.

Introduction. Fuel consumption in the Service's fleet accounts for 43% of the baseline footprint. As with gas, the emission factors associated with liquid fossil fuels will not decrease significantly between now and 2030 and fuel-switching will be required to achieve meaningful reductions in emissions. However, the provision of a reliable, efficient and available fleet is central to the Service's function and cannot be compromised in any decarbonisation strategy.

State of play. HIWFRS currently operate a fleet of over 460 vehicles and have 2 EVs in active service (Nissan Leaf). Uptake and use of EVs has been low, predominately due to their limited range and lack of understanding amongst users. However, EV technology has improved drastically in recent years and the market is becoming far more saturated and competitive as mainstream manufacturers begin to offer electric ranges. This is expected to continue, and McKinsey estimate that 523 new electric vehicle models will be launched between 2019 – 2022 across a variety of vehicle sizes.

Despite the growing market, a technology review and targeted interviews identified that the low-emission vehicle market for larger specialised vehicles in the fleet is largely in concept phase and not suitable for immediate consideration. The focus of this plan is therefore on the fleet cars and vans where there is a far more established market for low-to-zero emission vehicles.

HIWFRS benefit from a CAPEX discount on all vehicles under the CCS framework. Government grants are also available for the procurement of electric cars and vans.



Above: the global EV market is underdoing a period of rapid growth

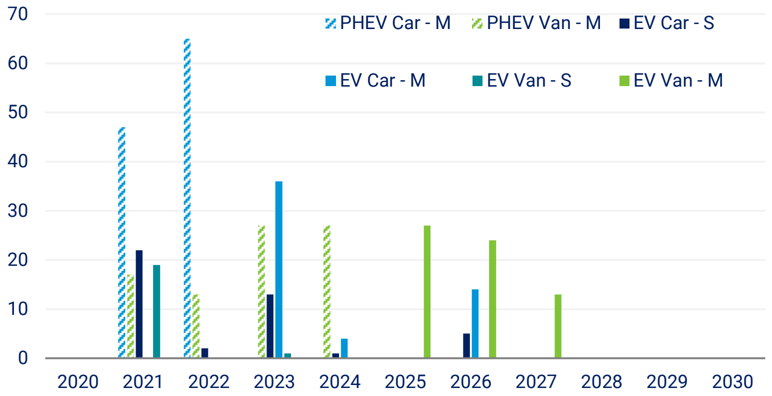
Source: McKinsey, Electric Vehicle Index 2020

Fleet

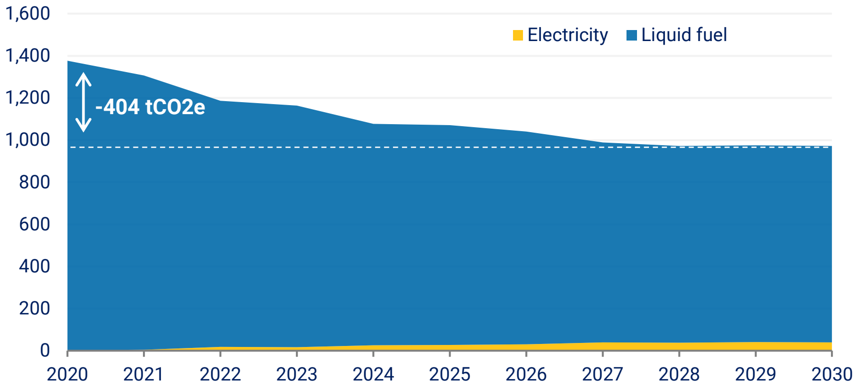
Project identification. The Service operate a multiservice fleet that covers 33 individual types of vehicle. Of these, 7 were of appropriate size to be considered for full or partial electrification in this plan. Each vehicle type was categorised into a generic vehicle type (car or van) and size (small or medium), for which a suitable internal combustion engine (ICE), plug-in hybrid electric vehicle (PHEV) (only medium-sized vehicles), and electric vehicle (EV) models were identified. Key findings include:

- **377 vehicles** that are due for replacement between now and 2030 are suitable for full or partial electrification. These vehicles account for ~170,000 L of annual fuel consumption (32% of the Service's total). 'Suitability' has been determined from a sectoral market review only and is designed to show the potential impact of fleet electrification. As detailed on the next slide, significant advances in charging infrastructure will also be required to support the roll-out.
- At the point-of-use the **business case for PHEVs and EVs is competitive** for the majority of vehicle types and sizes compared to ICE equivalents.
- The proposed electrification could result in reductions in annual emission reductions of **404 tCO_2e** and annual operating costs of **£210,857** by 2030.

Vehicle phasing [no. of vehicles]



Fleet emissions [tCO_2e]



N.B. These calculations assume that PHEV's are operated according to manufacturer's specifications. Some studies have shown that the real-world environmental performance of PHEV's is significantly compromised by inefficient operation (e.g. relying solely on the liquid fuel without electric charge). The Service should make any users of PHEV aware of this and promote optimised usage through training, signage etc.

Electric Vehicle Infrastructure

The business and environmental case for PHEV and EVs at the point-of-use is competitive and will continue to improve. The Service should prioritise securing access to a robust and available charging network to facilitate the roll-out of electric vehicles. Detailed technical and economic analysis of infrastructure requirements is outside of the scope of this assessment, however it is recommended that the Service:

Understand the financial and technical requirements accounting for local constraints

Charging infrastructure costs vary significantly based on the number, wattage and specification of chargers required. Higher wattage charge-points are more expensive but required if vehicles need to charge rapidly over shorter periods of time, whereas more lower-wattage charge-points could be installed if it's feasible for EVs to charge over longer periods. The specification for any given-wattage varies too; the cost of a basic 7.4 kW charger (common for van charging) could be as low as £300 but rise to over £1,200 if smart-charging is incorporated. Civil and engineering costs have to be taken into account, which are heavily influenced by site conditions (e.g. length of any trenchwork, ground conditions); assessments in some areas of the UK estimate the installation cost of a 7kW charger at £5,000 with the caveat that these can vary significantly. Once the charging requirement is estimated, a site survey should be conducted to determine the available grid capacity at the site. Depending on local network capacity, grid upgrades may be required that will carry significant additional cost.

Explore potential funding avenues

Recognising the potential costs of EV infrastructure, grant schemes and innovative financing mechanisms exist that can support infrastructure deployment. The UK Government operates a workplace charging scheme, offering a grant contribution of £500 per socket for charge points installed at the workplace. Depending on ownership model preferences, various levels of private-sector involvement can also be sought to minimise the upfront financial requirement. Due to the size and predictability of the fleet, the Service is in a strong position to attract private sector funding by guaranteeing a substantial level of demand for installed charge points.

Seek collaborative partnerships and engage with support schemes

Local and national-level initiatives exist that can help the Service develop a network of usable infrastructure. ESPO Vehicle Charging Infrastructure and CCS Vehicle Charging Infrastructure Solutions are two national frameworks that can support Central Purchasing Bodies in the procurement and installation of infrastructure. At a local level, Hampshire County Council manager the Central Southern Regional Framework that is open to public sector organisations across Hampshire. Additionally, Energy Savings Trust offer free fleet strategic assessment the UK that can assist with initial strategic and technology advice. Currently, Flexible Power Systems ltd. is also offering free fleet strategy assessments for vans that are monitored with telematics or a job management system as part of an Innovate UK funded project.

General Energy Saving Measures

Energy and cost savings can be readily achieved through the implementation of best-practice energy management and engagement. The associated costs of these measures are often relatively low and can be generically applied across the estate with limited site-specific considerations. These include:

a) **Pipework insulation.** Several condition surveys report a lack of insulation around pipeline, flanges, and valves. Significant energy savings can be made by incorporating low cost, insulating covers on exposed areas. This is of particular importance in plant rooms where the water is hottest and the heat loss to the environment is greatest. This is easy to implement and payback can be expected to be <1 year under normal operating conditions.

b) **Enhanced controls** can be used to better align site usage to occupancy, weather/loads compensators can be readily applied to boiler systems (typical payback 2-3 years) and where practically feasible lighting controls should be integrated with the role out of LEDs (typical payback 2-3 years).

c) **Reinforcing and communication an energy management strategy** will provide guidance for the operation of buildings. It was evident from the review of conditional surveys that various levels of supplementary heating is used throughout the estate. A rationalised approach to heating (and other operational considerations) should be provided for various site-types (e.g. wholetime vs. retained).

d) **Staff awareness.** Carbon Trust experience shows that typically around three-quarters of staff in a workforce are keen to help their employer reduce their environmental impact but often don't feel engaged. Engagement with staff yields energy savings in two main ways: changing of day-to-day behaviour and the generation of ideas. A successful engagement strategy goes beyond just displaying posters, and should:

- Include everyone from the chief executive to the part-time worker
- Be part of an overall energy management strategy
- Involve general awareness training for all staff and specialist training for some
- Provide regular feedback on progress towards targets

Looking Towards a 2030 Target

Analysis of the 10 sites has identified several objectives in the context of a 2030 decarbonisation target. A phased outlook is also presented that presents a view on how the Service should approach decarbonisation in the next decade:

- General energy saving measures (page 39) and LED lighting are no-regret measures that should be considered as BAU across the estate and implemented as common practice.
- Solar PV should be prioritised where on-site usage can be maximised and the business case is strong. From a carbon-centric perspective, budget allocation to Solar PV should not diminish the budget available for heat or fleet decarbonisation.
- Recognising budgetary constraints, it is recommended that expenditure to achieve carbon savings is focused on **a)** heat decarbonisation, either through thermal improvements to a building or installation of a low-carbon heat source, and **b)** transition to low emission vehicles.

Short term outlook (2021 – 2023) *Form an estate-wide approach to priority decarbonisation areas:*

- Ratify a 2030 decarbonisation target, and agree a governance structure and responsible person(s) for the annual reporting of the Service's carbon footprint to monitor progress against the target. If possible, an annual budget for priority decarbonisation initiatives should be ringfenced that should be additional to BAU upgrades.
- Perform estate-wide mapping of incumbent heating systems and thermal performance of buildings to form the basis of an estate-wide heat decarbonisation strategy. The heat hierarchy should be integrated into the Service's decision making and facilities managers should become familiar with it's implementation.
- Estates and fleet teams should co-ordinate the roll-out of electric vehicle charging infrastructure. Priority sites should be identified and early engagement with local stakeholders should be pursued as a priority to identify delivery and funding mechanisms. To the extent that infrastructure permits, EV procurement should commence in parallel.
- A campaign to promote EV uptake and raise awareness of their correct use should be performed to ensure they are adopted by fleet users.

Looking Towards a 2030 Target

Medium and long term recommendations are inherently subject to greater degrees of uncertainty. These actions are made based on the current state-of-play and should be reviewed and updated as part of the annual reporting and governance.

Mid term outlook (2023 – 2027) *Embed the strategies into estate operations, and begin to consider indirect impacts*

- The heat decarbonisation strategy should be implemented such that the heat hierarchy principles are embedded into the running of the estate, and a rolling cycle of fabric improvements and installation of low-carbon heat sources is initiated. Fossil-fuel boiler replacements should be isolated to challenge sites and low-carbon heating should become the default option for system replacements.
- Fully electric vehicles should become the default option for vehicle replacement across all non-specialised vehicles. The service should leverage available charging infrastructure in the local area in addition to the installation of private charge points to ensure adequate vehicle availability.
- Begin to consider the wider environmental impact of the Service (i.e. supply chain), and measure and report on the Service's scope 3 emissions. Separate action planning and target setting should be considered for these emission sources.

Long term outlook (2027 – 2030) *Integrate harder-to-decarbonise areas into HIWFRS's decarbonisation strategy*

- Approach harder-to-decarbonise areas of the estate (e.g. specialised fleet vehicles, challenge sites) as anticipated technology advancements, cost reductions and policy support create a more favourable environment for action.
- In general operation, replacement of assets with fossil fuels should be viewed as a special case and low-carbon technologies should be implemented on a BAU basis.
- Implementation of a scope 3 action plan (e.g. supply chain engagement, green procurement) to reduce the Service's indirect emissions.

Resources to Help Deliver Decarbonisation

Resource Name	Resource type	Notes	Link
Salix Finance	• Interest-free finance • Recycling Fund		https://www.salixfinance.co.uk/
Non-domestic Renewable Heat Incentive (RHI)	Financial incentive; payments received based on heat generation	Due to finish March 2021; expected to be replaced by another mechanism	https://www.ofgem.gov.uk/environmental-programmes/non-domestic-rhi
Energy Technology List	List of the top performing equipment to help make sure new purchases are efficient. Includes heat pumps, boiler equipment, automatic monitoring and targeting equipment, and more.		https://etl.beis.gov.uk/purchasers
Local authorities and sixth carbon budget	A guide for local authorities on their local contributions to the sixth carbon budget		https://www.theccc.org.uk/wp-content/uploads/2020/12/Local-Authorities-and-the-Sixth-Carbon-Budget.pdf
Smart Export Guarantee	Financial support mechanism for renewables up to 5 MW (replaced the feed-in-tariffs)	For solar PV self-consumption or privately selling the power generated generally give better returns than the smart export guarantee	https://www.ofgem.gov.uk/environmental-programmes/smart-export-guarantee-seg/about-smart-export-guarantee-seg#:~:text=The%20smart%20export%20guarantee%20(SEG)%20is%20an%20obligation%20set%20by,force%20on%201%20January%202020
The Workplace Charging Scheme	voucher-based (grant) scheme that provides support towards the up-front costs of the purchase and installation of electric vehicle chargepoints.		https://www.gov.uk/government/publications/workplace-charging-scheme-application-form
Plug In Vehicle Grant	Grant	Not that noticeable because this comes off the retail price	https://www.gov.uk/plug-in-car-van-grants
Public Sector Decarbonisation Fund	Grant funding	Administered by Salix, but different from their normal offering. Currently oversubscribed but could well be back for another round.	https://www.salixfinance.co.uk/PSDS
OZEV grant schemes	OZEV grant schemes for the installation of electric vehicle charging infrastructure		https://www.gov.uk/government/collections/government-grants-for-low-emission-vehicles
RE-fit	A procurement initiative for public bodies wishing to implement energy efficiency measures and local energy generation projects on their assets, with support to assist you in the development and delivery of the schemes		https://localpartnerships.org.uk/our-expertise/re-fit/

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Appendix: Detailed financial results & Assumptions

Detailed Financial Results

Solar PV

Site	Installed capacity [kWp]	Generation [kWh]	Of which on-site [%]	CAPEX [GBP]	Annual OPEX [GBP]	Annual saving [GBP]	NPV [GBP]	IRR [%]
Ventnor	7.5	7,912	20%	£6,750	£62	£444	£639	4%
Alton	5.4	4,001	20%	£4,860	£45	£212	-£1,938	-1%
Andover	8.1	7,587	100%	£7,290	£67	£844	£5,003	10%
Botley	2.7	2,617	20%	£2,430	£22	£145	-£363	2%
Newport	24.9	20,990	100%	£22,410	£205	£2,313	£11,134	8%

Heat pumps

Site	Assumed heat load [kWhg]	Heat pump size [kW]	CAPEX [GBP]	Annual saving [GBP]	Simple payback [yrs]	NPV [GBP]	IRR [%]
HQ	713,490	251	£376,500	£16,530	22.8	(£430,895)	-
Newport	118,970	42	£35,700	£237	150.6	(£98,503)	-
Ventnor	32,050	11	£9,350	£284	32.9	(£23,244)	-
Andover	85,772	30	£25,500	(£80)	-	(£73,228)	-
Alton	52,380	18	£15,300	£3,658	4.2	£26,829	-
Rushmoor	231,577	82	£69,700	(£823)	-	(£207,124)	-
Hightown	125,665	44	£37,400	£1,135	32.9	(£92,977)	-
Southsea	194,427	68	£57,800	(£73)	-	(£164,744)	-
Hardley	70,983	25	£21,250	£141	150.6	(£58,633)	-

Detailed Financial Results

Replacement boilers

Site	Assumed heat load [kWhg]	Boiler size [kW]	CAPEX [GBP]	Annual saving [GBP]	Simple payback [yrs]	NPV [GBP]	IRR [%]
HQ	713,490	160	£17,967	£7,031	2.6	£63,018	39%
Newport	118,970	140	£10,069	£905	11.1	£356	4%
Ventnor	32,050	40	£5,399	£515	10.5	£538	5%
Hightown	125,665	135.4	£15,244	£1,717	8.9	£4,534	7%
Southsea	194,427	300	£17,967	£1,409	12.8	(£1,740)	2%
Hardley	70,983	130	£12,352	£463	26.7	(£7,020)	-6%

Electrification of the fleet (N.B. figures presented are counterfactual to procurement of ICE vehicles, and do not include charging infrastructure)

Vehicle type/ size	Number of vehicles	CAPEX [GBP]	Grant [GBP]	Annual savings [GBP]	Simple payback [yrs]	NPV [GBP]	IRR [%]
EV - Car - S	43	£560,208	£129,000	£18,187	23.7	(£279,951)	-13%
PHEV - Car - M	112	£689,374	£0	£85,833	8.0	£24,463	4%
EV - Car - M	54	£781,286	£162,000	£30,925	20.0	(£362,094)	-11%
EV - Van - S	20	£235,557	£140,084	£9,973	9.6	(£12,531)	0.8%
PHEV - Van - M	84	£1,038,375	£0	£11,832	87.8	(£1,036,279)	-
EV - Van - M	64	£917,511	£512,000	£54,106	7.5	£44,468	6%

Detailed Financial Results

Double glazing

Site	Total window area [m2]	Upgradable area [%]	CAPEX [GBP]	Annual saving [GBP]	Simple payback [yrs]	NPV [GBP]	IRR [%]
Newport	271.59	80%	£119,500	£710	168.2	(£106,950)	-10%
Ventnor	21.9	100%	£12,045	£194	61.9	(£8,610)	-5%
Alton	76.5	100%	£42,075	£953	44.1	(£25,233)	-3%
Rushmoor	263.7	15%	£21,755	£418	52.0	(£14,371)	-4%

LED

Site	Incumbent lighting [-]	Upgradable area [%]	CAPEX [GBP]	Annual saving [GBP]	Simple payback [yrs]	NPV [GBP]	IRR [%]
Newport	T8 / T12 / CFL	40%	£11,226	£1,382	8.1	£9,738	11%
Ventnor	T5 / T8 / CFL	75%	£2,710	£38	70.8	(£2,079)	-7%
Andover	T8	70%	£6,586	£627	10.5	£2,925	8%
Alton	T8 / CFL	80%	£6,324	£464	13.6	£1,331	5%
Rushmoor	T8 / CFL	75%	£20,437	£4,104	5.0	£41,807	20%
Hightown	T8 / CFL	80%	£21,252	£2,321	9.2	£16,997	10%
Southsea	T8 / T12	50%	£19,863	£3,941	5.0	£39,903	19%
Hardley	T8 / CFL	80%	£11,117	£1,012	11.0	£5,556	8%
Botley	T8 / T12 / CFL	75%	£2,186	£236	9.3	£1,702	10%

Assumptions

Financial figures have been estimated from industry standard benchmarks and the desktop survey. Where data gaps exist we have used reasonable assumptions to complete the data. This Action Plan and the figures presented should only be used as a high level guide; for any detailed business case preparation multiple quotes from suitably qualified suppliers/installers should be sought for specific suggested projects, and all suggested projects will require verification and detailed assessment prior to proceeding with implementation. All opportunities included have each been assessed independently in terms of their potential for saving energy and payback. The overall savings figures shown may not fully be achievable due to interactions between measures.

General assumptions include:

- Natural gas and electricity prices of 3p/kWh and 12p/kWh respectively.
- Excluding fleet, any annual maintenance savings are not considered at this stage but increased maintenance costs (e.g. cleaning on solar panels) are incorporated.
- Costs provided are indicative figures for supply and install only. No cost allowance is included for measurement and verification and other on costs such as contingency, overhead and profit, asbestos removal, design, project management, VAT, business rates etc.
- Life Cycle Cost Analysis was undertaken with a 0.035 discount rate and energy cost escalation in line with a Fixed 0% scenario.
- It has been assumed that site data provided (e.g. building condition reports) are accurate and no significant changes have been implemented since.

Project-specific considerations include:

Double glazing

- Costs assume a typical glazing-to-floor area ratio of 10 - 15% and a capital cost of £550/m2. The CAPEX was based on a small sample of costs provided by HIWFRS and is higher than the market average due to the specification required. The costs and paybacks are therefore higher than would be deemed ‘typical’.
- Energy savings assume that 26% of heat loss occurs through windows and U-values of 4.8 W m-2 K-1 and 2.0 W m-2 K-1 for single and double glazed windows respectively.

Assumptions

Boiler replacement

- Boilers were sized based on a like-for-like replacement with the current installation, and reductions in boiler sizes can be expected if fabric upgrades are performed prior to installation.
- Cost data has been taken directly from SPONS and is reflective of standard industry estimates (https://www.priceguidesdirect.co.uk/spons/all-spons-titles)

Heat pumps

- Heat pumps have been sized according to the current heat demand, which will likely decrease as fabric improvements are made. The heat pumps are assumed to operate at coefficients of performance (COP) of 2.5 for air-source, and 4 for ground-source. This condition assumes the efficient operation of the heat pump that will require a low-temperature heating system and likely require fabric upgrades and/or larger heat emitters. The costs of these ancillary requirements have not been included, and the costs presented are specific to the heat pump only.
- Costs data is a combination of SPONS and soft market testing conducted by the Carbon Trust.
- The displacement of any supplementary heating is not included. A detailed feasibility study should account for the required heat load of the whole site, and displacing any supplementary electric heating is expected to improve the presented financial case.
- Due to the heat load of SHQ, a ground-source heat pump (GSHP) has been modelled. An air-source heat pump (ASHP) has been modelled for all the remaining sites.

LED

- Existing light fittings were assumed from qualitative condition survey reports. Baseline annual lighting hours were estimated for wholetime (2,236 hours) and retained sites (728 hours) and adjusted on a site-by-site basis in alignment with expected consumption benchmarks for lighting (~20-30% of total electricity consumption).
- The costs include replacement of whole luminaire and therefore represent conservative capital costs. Paybacks are expected to be lower if the fitting can remain in-situ and lamp replacement is conducted only. Savings and costs have been calculated on a per m^2 floor area basis, which has a large associated uncertainty and should be verified with in-person site audits. The payback for LED lighting is accepted to be 2-3 years in most scenarios.

Assumptions

Solar PV

- Solar capacity and generation were modelled using HelioScope software. Capital costs were estimated using an assumed cost of £900/kWp, and annual cleaning/service costs total £8.25/kWp.
- Retained sites assumed to consume 20% of generated electricity on-site, increasing to 100% for wholetime sites. Any exported electricity brings in revenue of 5p/kWh, whilst on-site energy usage displaces electricity at 12p/kWh.

Fleet

- Prices and fuel economy figures were derived from a market review of mainstream manufacturers. Where there are a range of EV models available, the model with the highest range has been selected to better fit the requirements of the service. It should be noted that cheaper models are available, however interviews with the Service made it clear that there is a cultural barrier to uptake and procurement of high quality EVs was prioritised to encourage their uptake.
- All costs assume outright ownership and sell-on income at the end of the vehicle lifetime (estimated from an annual depreciation of 5%). The lifetime use of cars and vans was assumed to be 6 and 8 years respectively. The annual mileage of the vehicles was estimated from typical consumption of the vehicles in the baseline data.
- HIWFRS procure vehicles through approved 'blue light' frameworks that provide capital discounts. From soft market testing these were assumed to be: ICE vehicles, 22.5%; hybrid vehicles, 17.5%; fully-electric vehicles, 6.5%. These were applied in addition to the plug-in grants available for eligible cars and vans.
- The cost of charging infrastructure has not been included. All costs are presented as counterfactual to the procurement of an equivalent ICE model.
- Where actual fuel data was not available the average fuel consumption for the given vehicle type across the service was used as an approximation.