SCOTTISH FIRE AND RESCUE SERVICE

SUSTAINABILITY

Working together for a safer world

Scottish Fire and Rescue Service

ENERGY AND CARBON STRATEGY 2020 – 2030

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Last Reviewed/Amended: May 2020

Date of Next Review: TBC

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1. INTRODUCTION

On 25th September 2019 the Scottish Government (SG) passed legislation committing Scotland to achieving net zero carbon emissions by 2045. In response, SFRS has developed a Climate Change Response Plan 2045, detailing how climate change may impact upon our operational requirements and assets. The plan outlines how SFRS contributes to climate change and the measures that will be required to enable SFRS to also achieve net zero carbon emissions within that timescale.

The energy used in heating and powering our estate and fuelling our fleet are our primary sources of carbon emissions. As such, an Energy and Carbon Strategy (ECS) is a fundamental element in delivering our Climate Change Response Plan 2045.

Effective energy management lies at the core of our adopted Environmental Management System as illustrated in Figure 1. The SFRS Environmental Management System was agreed and implemented by the Environment and Carbon Management Board (ECMB) in October 2019. This hierarchy illustrates the importance of good energy and carbon management in reducing our overall impact on the environment and sets the context and role of the ECS in delivering our wider environmental responsibilities.

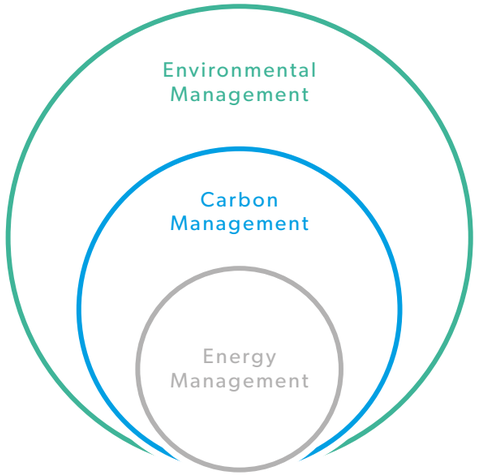


Figure 1: Environmental Management Hierarchy

Figure 2 illustrates where the Energy and Carbon Strategy sits within our strategic planning hierarchy in relation to Asset Management.

The Energy and Carbon Strategy will support the Fleet, Property and Digital Strategies to ensure there is a consolidated approach to energy management and carbon reduction across all fixed and mobile assets.

The table in Appendix A outlines how the various aspects of the Energy and Carbon Strategy support the SFRS Values.

Figure 2: SFRS Asset Management Plans and Policies

2. OUR ENERGY USE

In 2018/19, SFRS used the same amount of energy it takes to power and light 16,486 UK homes for a year. [1] Overall, however, our energy use within SFRS reduced by 1,615,000 kWh (2%) since the baseline was established in financial year 2015/16. Figure has 3 shows the trends by fuel.;

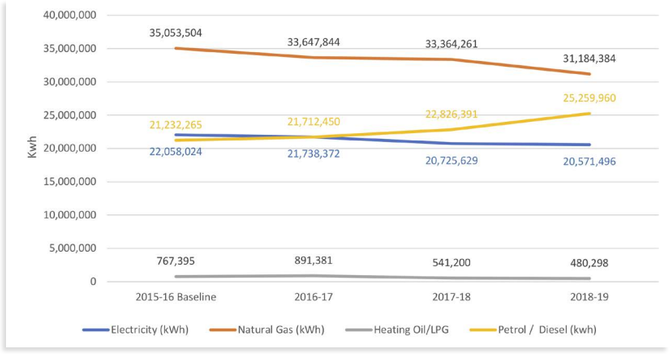


Figure 3: SFRS energy use trends from 2015/16 baseline.

KEY ENERGY USE TRENDS

Gas is primarily used for space heating and hot water storage. Site closures from 2015-2017 have contributed to a reduction in gas use. Gas use for space heating is very weather dependent and the drop-in gas use in 2018/19 is mainly from the milder winter. Currently 148 SFRS buildings use gas for space heating. Carbon emissions from gas represent 59% of total energy used in our building stock or 30% of our carbon footprint.

Electricity is currently used primarily within fixed assets although use has dropped by 6.7% from the baseline, mainly due to estate rationalisation and improved data utilisation.

The electricity use will begin to include more mobile assets in the near future as electric vehicles are gradually introduced into SFRS light vehicle fleet. In 2019 we received support from Transport Scotland for the delivery of our first 45 EV pool cars and developed charging Hubs at 10 strategic sites. This represents phase one of an ongoing programme which is currently moving into phase two with additional support being provided for the additional charging infrastructure. Our long-term vision is to facilitate a national charging network for all blue light services.

Petrol/Diesel This is primarily used to power our fleet vehicles. Petrol and Diesel use has been rising steadily in the last two years with overall use increased by 19% from our 2015/16 baseline year. We currently operate 743 Heavy vehicles (<3.5 tonnes) made up of mostly response vehicles of various operational roles. We also operate a light fleet made up of 702 cars and 227 vans of various ages and sizes. The increase in fuel use over the last two years correlates with Flexi Duty Officer (FDO) cars switching from leased vehicles to SFRS provided cars. This change process was delivered through a strategic business case to transfer all FDOs to provided cars with the subsequent efficiency savings which have been achieved. The switch to provided cars is indicated to be the direct cause of the upward trend in fleet energy use, however the previous business mileage fuel usage couldn't be captured under the leased car scheme and this new figure above will now be considered as the new base line for future monitoring and performance targets.

Heating oil is currently used within 5 buildings. Consumption has fallen dramatically over recent years as oil fired sites have been closed. Overall, energy use from fixed assets remains broadly static. Fleet energy use has been rising steadily over the last two years. To better understand the drivers of our energy use and therefore where improvements can be made, we have applied two further lenses of analysis, firstly by purpose and secondly by asset type.

1 Based on average electricity use of a UK home, Source: Ofgem

ENERGY USE BY PURPOSE

Our principal energy loads are represented graphically below. The Energy Map depicted in Figure 4 clearly illustrates that energy for space heating (gas and electricity combined) is dominant, closely followed by fleet fuel. Although smaller, lighting and power use and our ICT infrastructure are still significant. Air conditioning (AC) includes heating and cooling of our larger office spaces together with cooling ICT infrastructure. Every energy use is significant and each one holds opportunity for increased efficiency and the reduction of energy waste.

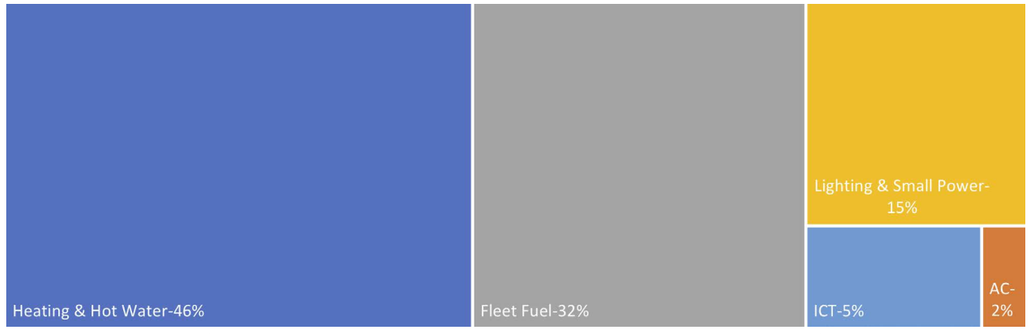


Figure 4: SFRS Energy Map (Sources: EDF Powernow Metering, TEAM Energy Bureau, SFRS internal Energy Audits)

ENERGY USE BY ASSET TYPE

Building Type	No of Sites	% of Total SFRS Floor space	% of Total SFRS Energy Use (kwh/yr.)
Wholetime Fire Station	74	53.0%	60.1%
Retained Fire Station	247	29.4%	17.9%
Volunteer Fire Station	35	1.4%	0.9%
Offices and Control Centres	7	9.3%	11.4%
Asset Resource Centres and Training Centres	8	6.7%	10.2%
Total	**371**	**100%**	**100%**

Table 1: SFRS Fixed Asset Overview

SFRS operate 74 wholetime fire stations, 73 of which are heated by gas. These buildings are in 24 hr operation and as such are very energy intensive. As displayed in Figure 5, space heating for this building type is used in three main areas: appliance bays, drying rooms and space heating. Appliance bays use the largest amount of heat energy. These spaces are typically overheated, leading to large amounts of energy waste. Drying rooms, which are relatively small areas, also use large amounts of energy as heat is forced into the space 24hrs/day with little demand. Both areas present the greatest opportunities for energy reduction in a fire station.

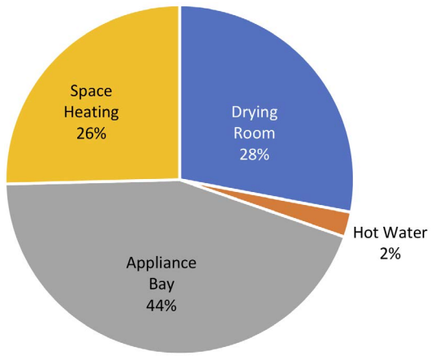


Figure 5: Annual Gas Use by End Consumer – Wholetime Station

SFRS also operates 282 retained and volunteer fire stations across Scotland. Of these 201 are off the gas grid and use electric heating of various types, ages and conditions. The heating of space and hot water in these buildings represents over 60% of the total energy consumption of the building. Most electric heating systems within these buildings have poor controls. The heating is typically turned on around the end of September and runs constantly through to April. Large electrically heated storage tanks for hot water are also common in these buildings and are running 24/7 with little demand.

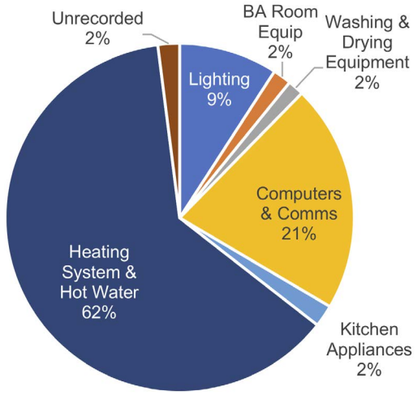


Figure 6: Electricity Use by End Consumer: retained station with electric heating

SFRS has an extensive fleet consisting of 1,849 vehicles. As displayed in Table 2, the majority of these are heavy vehicles, cars and vans. Whilst the cars travel the most miles, the heavy vehicles are responsible for over four times the carbon emissions, see Figures 7 and 8. The light vehicle fleet is generally support vans that are used for transferring stock and equipment between stations and stores. The light vehicles' carbon emissions are high, relative to the number of vehicles.

Fleet Group	Annual CO_2 Emissions (tonnes)	Annual Mileage	Fleet Size
Cars	1,028	4,284,402	702
Heavy Vehicles	4,361	3,112,673	750
Light Vehicles	795	2,314,097	337
Specialist Vehicles	3	5233	7
Other	53	140470	53
Total	**6,240**	**9,856,875**	**1,849**

Table 2: SFRS Mobile Asset Overview

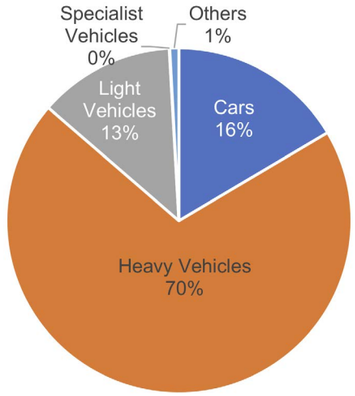


Figure 7: Fleet Annual CO_2 Emissions by Vehicle Type

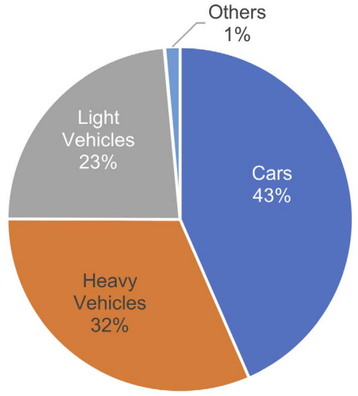


Figure 8: Fleet Annual Mileage by Vehicle Type

3. ENERGY DRIVERS AND EXTERNAL INFLUENCES

Internal and external drivers influence how SFRS selects energy type and manages energy use. Historically these have been around cost, availability and performance, combined with measures to ensure resilience where possible e.g. energy storage or backup facilities. Going forward these drivers will change as we seek to achieve carbon neutral status, with greater focus on transitioning to low carbon fuels, while maintaining performance, resilience and affordability.

3.1 GOVERNMENT POLICY

Government policy has a major influence on the energy strategy of any large energy consumer, determining the market and therefore the range of opportunities. Scottish Government policy is currently dynamic, continuously expanding and evolving, especially regarding carbon reduction.

In December 2017, the Scottish Government published its high-level **Scottish Energy Strategy 'The Future of Energy in Scotland'** [2]: which sets out a vision for energy in Scotland to 2050. Of the six strategic priorities, SFRS can contribute in two main areas, namely; Energy Efficiency, and Renewable and Low Carbon Solutions.

The accompanying implementation Route Map, **Energy Efficient Scotland** (May 2018), states that all non-domestic properties in Scotland must achieve significant energy efficiency transformation by 2040. SG is currently undertaking a benchmarking exercise of non-domestic buildings in Scotland which will inform and set new energy reduction targets for our buildings over the next 20 years. The core hierarchy of the Route Map is clear and SFRS is adopting this approach to ensure alignment with SG policy objectives and with available funding mechanisms when they become available.

The new Scottish building regulations will prevent the use of natural gas for space heating in new buildings from 2021.

The Scottish Government's **National Transport Strategy 2** highlights that transport is currently Scotland's largest carbon emission source and pledges to 'Take Climate Action' by phasing out petrol and diesel cars by 2032, whilst enabling greener and cleaner choices for travel. SFRS will support this pledge by identifying opportunities to remove hydrocarbon fuelled vehicles where possible, and to work to replace older vehicles and engines with cleaner alternatives.

2 Link to SG Energy Strategy: Scottish Energy Strategy: The Future of Energy in Scotland

3.2 PERFORMANCE/TECHNOLOGY

SFRS uses a number of traditional methods and technologies to heat and power our buildings, fuel our fleet and provide a required level of resilience within our operations. Ongoing evolution and improvement of these systems along with the introduction of new technologies will be key to SFRS achieving our carbon reduction targets. Table 3 outlines the technologies we currently use, tried and tested technologies we can adopt, and future technologies that may become available within the 10-year period of this strategy.

	Current SFRS Technology	Low Carbon Alternatives Now Available	Secondary Source (reserve)
Heating-Gas	• Gas boilers • Basic controls	• Biomass • Ashp • Gshp • Improved controls	• Hydrogen ready boilers
Heating-Electric systems	• Electric panel and storage heaters • Poor controls	• Infrared • Ashp • Smart controls	• Smart buildings • Internet of things
Building Fabric	• Poor building fabrics • Single glazed windows	• Retrofit insulation • Triple glazing	• Passive standard building regulations
Building Power	• Grid energy	• Solar pv • Combined heat and power • Wind generation • Battery storage	• Smart and flexible grid • Low carbon national grid
Fleet	• Internal combustion engines • (Diesel/petrol)	• Ev/ulev vehicles for light fleet • Smart ev charging-vehicle to grid	• Low carbon alternatives for heavy fleet

Table 3: Current and Future Technologies

3.3 AFFORDABILITY

Based on SG energy tariff pricing predictions, the cost of powering our existing asset base could rise by 16% by 2025. Figure 9 represents the combined cost of gas, electricity, heating oil and transport fuel.

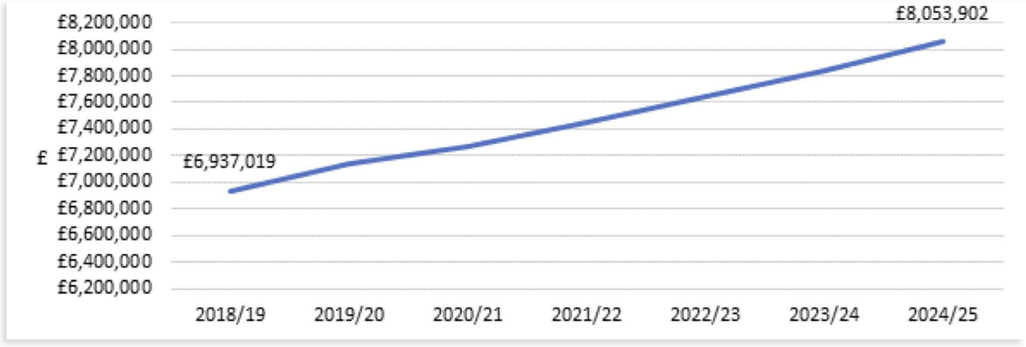


Figure 9: SFRS Fixed Assets Energy Cost Projection

This stark financial prediction is another key driver to encourage adoption of a new energy strategy.

3.4 RESILIENCE

Historically, SFRS has used grid energy and bunkered fuel to power all assets. We currently depend on fossil fuels to provide heat on approximately 76% of the estate floor area, including all large sites, and have no secondary back up for gas fired space heating.

Where back-up systems and reserves are available, these are typically based on high-carbon fuels, e.g. diesel generators and bunkered fuel. All key national sites, including those designated as critical national infrastructure, and remote rural or island hubs are fitted with diesel stand-by generators providing resilience against power cuts. All key ICT and mobilisation infrastructure is protected locally using a battery-based Uninterruptible Power Supply (UPS) to protect the equipment from damage caused by power interruption in the event of a power cut while the power source transfers from grid to generator. A smaller number of our buildings hold heating oil or LPG tanks where there is no grid gas. Diesel fuel is bunkered in large fuel tanks at several sites, which are subject to stringent environmental controls.

As such, the service is exposed to business continuity risk from the following infrastructure level energy systems:

- Failure of electricity distribution network, Black Start scenario,
- Failure of standby generators and UPS at key sites,
- Failure of natural gas supply network,
- Fuel supply shortages for our fleet.

The capacity and integrity of this infrastructure will have a direct influence upon the energy supply and generation options open to us as we develop over the short, medium and long term. Table 4 illustrates how we currently use energy and where we can store fuel to mitigate against the risks of power cuts and diesel fuel shortages, providing resilience.

Fuel Need	Primary Source	Fuel Properties	Secondary Source (reserve)	Fuel Properties	Carbon Reduction Measure
Space heating	Grid gas on 148 sites including all large buildings.	Carbon based fossil fuel	None	N/A	Find an alternative to primary and consider the need for a secondary
Space heating	Grid electricity on approx. 220 smaller buildings	Grid electricity is decarbonising in a progressive and planned fashion which will return long term carbon reductions	Generator (diesel powered)	Carbon based fossil fuel	Consider the role of the secondary and consider its future use together with low carbon alternatives
Space heating	Heating oil	Carbon based fossil fuel	Heating oil is held on site in bunkered tanks thus forming its own reserve	Carbon based fuel	Find an alternative to primary and consider the need for a secondary
Power in fixed assets (buildings)	Grid electricity	Steadily decarbonising	Generator (diesel powered)	Carbon based fossil fuel	Consider the role of the secondary and consider its future use together with low carbon alternatives
Power for critical national infrastructure	UPS systems filtering grid electricity	Steadily decarbonising	Generator (diesel powered)	Carbon based fossil fuel	Consider the role of the secondary and consider its future use together with low carbon alternatives.
Fleet	Diesel drawn from Service reserves of public fuel stations	Carbon based fossil fuel	SFRS bunkered fuel	Carbon based fossil fuel	Find alternatives to both primary and secondary fuel sources.

Table 4: Energy Use and Resilience

4. ENERGY MANAGEMENT HIERARCHY

We will follow an established hierarchy of energy management, setting out a clear process of reducing the energy demand of our buildings and fleet. The priority of specific energy reduction projects will be informed by the hierarchy and its key themes. This embeds a clear and consistent approach linking directly to SG guidance.

For example, before installing renewable generation on a site we will;

- Assess current energy use in the building,
- Identify and mitigate against energy waste,
- Then design new heating, power and lighting systems to meet the reduced load identified.

This consistent approach will deliver benefits which would typically include;

- Reduced energy load and carbon emissions from our buildings and fleet,
- Reduction in infrastructure required to deliver the reduced energy load,
- Savings in energy consumption,
- Savings in capital investment in active energy systems,
- Whole system approach maximising resource efficiency.

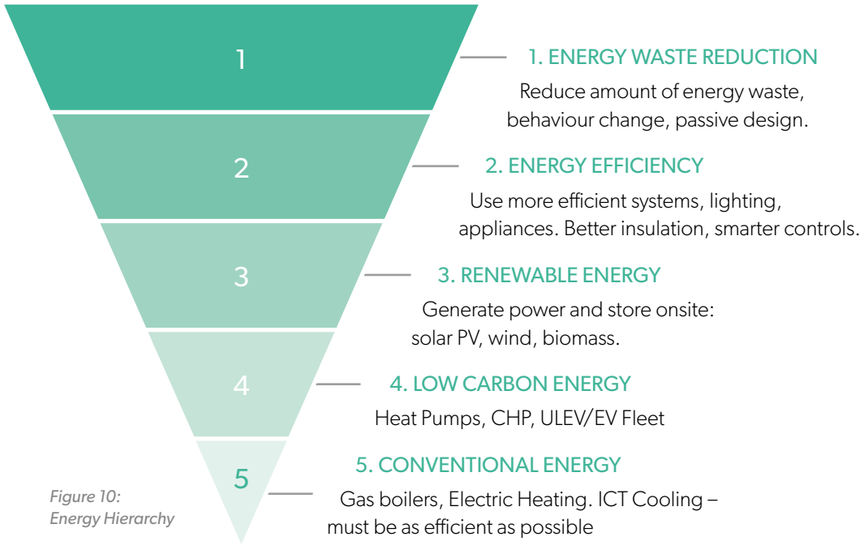


Figure 10: Energy Hierarchy

Specific carbon reduction actions will depend upon the identification, design, resourcing and financial support of a programme of specific and targeted carbon reduction projects. The projects will be set out in successive five-year Carbon Management Plans (CMP). The first CMP will be launched in 2020, seeking to enable and deliver a 50% carbon saving from our 2015 baseline carbon footprint by 2025.

4.1 DEVELOPING OUR STRATEGY AND PROGRAMME

SFRS follows the guidelines of ISO 14001 Environmental Management System (EMS) which incorporates the principles of internationally recognised ISO 50001 Energy Management System. SFRS will follow these principles to develop and run an energy management programme. These steps are as follows

1. Commitment from senior management and reference to high level strategic plans
2. Identification of opportunities through existing assets and datasets
3. Management plans developed (Carbon Management Plan-sub theme strategies)
4. Take Action-Implement rolling programme(s)
5. Monitor and review progress through internal and external mechanisms

COMMIT	IDENTIFY OPPORTUNITIES	PLAN	TAKE ACTION	MONITOR AND REVIEW
• ECMB • Resource commitment • SFRS Strategic Plan 2019-22 • SFRS Asset Management Plan 2019-2029 • SFRS Environmental Policy and Objectives 2017-2020 • SFRS Fleet Strategy	• Asset registers • Planned maintenance programme • Powernow platform • Display energy certificate database • Benchmark building performance • Site energy surveys • Metering data • Identify funding streams and route to market	• Carbon management plan • SFRS Energy Strategy • SFRS Fleet Emission Improvement Plan • Project Register • Set KPI's • Set timelines • Project planning and collaboration • Develop Monitoring and reporting mechanisms	• Implement projects • Staff training and awareness	• Monitoring and targeting system • Review progress against targets annually • Report progress to ECMB, SLT and board • Public Bodies Climate duties reports • Sustainability performance

Figure 11: Energy Management Programme.

4.2 ASSET TRANSFORMATION

Our existing assets have been designed around the use of high carbon gas, oil and diesel. These assets must be transformed to allow them to either use low carbon energy or be replaced by a range of new assets designed around low carbon energy use. This process requires the transformation of almost all SFRS assets and represents a huge task for the service.

The current planned replacement cycle for a building is typically 50 years, heavy fleet 15 years and light fleet up to 8 years. On this basis, only the light fleet could be fully replaced within the timeline to 2030. In addition, the current level of capital funding is insufficient to maintain the planned replacement schedule, leading to assets in operational use, albeit fully maintained, beyond planned replacement dates.

A key principle is to ensure that where assets can be transformed, energy efficiency is incorporated within the new/refurbished asset. Work is ongoing to agree a Standard Station Design for future fire station development, which among other things will incorporate energy efficiency technologies.

Equally, by ensuring we have the optimum number of buildings, sites and structures required to deliver our service across Scotland, we will avoid unnecessary energy usage and optimise the expenditure in managing and maintaining these assets.

4.3 COLLABORATIVE WORKING

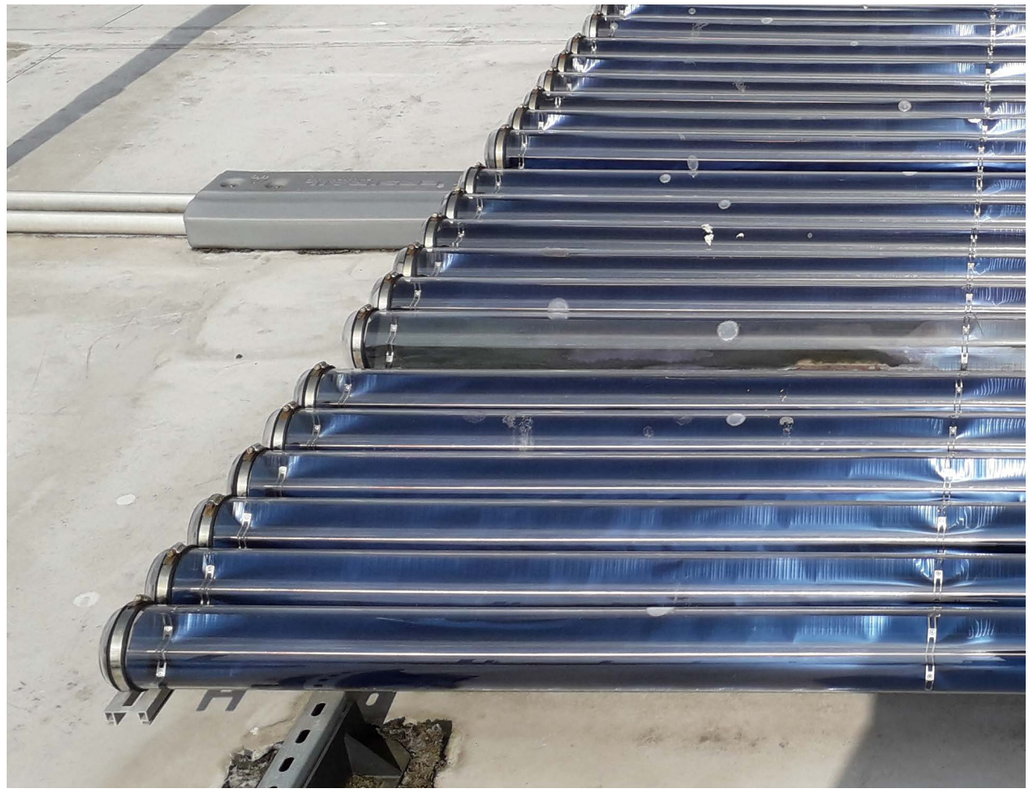
SFRS currently shares 31 strategic sites with partner organisations, e.g. Police Scotland, Scottish Ambulance Service. In working towards a modern energy efficient asset base, we will maximise collaborative opportunities in order to drive public resource efficiency, reducing our collective environmental impact.

4.4 PROJECT FUNDING

Funding for SFRS is currently allocated on an annual basis, which is not well suited to long term energy reduction projects and programmes. Some of the larger scale investment required can only be facilitated by a significant capital injection up front, which will return ongoing savings over a number of years. Many existing energy investment frameworks would require SFRS to enter a long-term energy performance contract or to borrow and re-pay capital. These processes do not align with the current Scottish Government funding model.

A successful energy management programme will depend on the availability of funding support and availability of effective procurement routes. Lack of funding or access to appropriate procurement routes and services is a significant risk to low carbon transition.

Work will continue, in conjunction with the Scottish Government Sponsor Team, to identify opportunities to access appropriate funding to enable the required investment.



5. PROJECT THEMES

In seeking to manage our energy use, in support of carbon reduction commitments, the following project themes will be adopted, based on the Energy Hierarchy;

5.1 ENERGY WASTE REDUCTION

It is estimated that on average 40% of current energy consumption across our estate is unnecessary. [3]
Some examples of significant energy waste across SFRS sites are:

- Appliance bays being over heated,
- Drying rooms being force heated 24hrs/day whether or not in use,
- Ineffective heating / cooling controls,
- Heating systems running in empty buildings,
- Retained stations maintaining 19-210C constantly whether in use or not,
- Oversized heating boilers and systems,
- Portable heaters under desks in office spaces adding significant energy loads to the building and frustrating the operating parameters of building systems,
- Lights on in unoccupied buildings or unoccupied spaces.

We will look to utilise existing assets such as our building management systems and metering infrastructure to identify and mitigate energy waste.

BEHAVIOUR CHANGE STRATEGY

With a workforce of around 7,400 staff (2020/21 figures), staff behaviour, knowledge and attitudes to energy use contribute significantly to our energy use and carbon footprint. Each employee has a role to play in helping SFRS reduce its resource use through improved energy use behaviour.

Research has shown that ongoing staff engagement in this area can yield anything form 2-5% overall reduction in resource use along with the positive cultural impacts. According to Scottish Government research [4], changing behaviour requires a combination of different interventions at an individual, societal and material level. Crucially, providing information on why the change is needed and how individuals can benefit is needed as it can have a significant impact. Embedding behaviour change takes time. Research from University College London [5] indicates that new habits take 66 days to form. To change resource efficiency habits, an ongoing programme of engagement is required.

A structured plan will be followed to develop and maintain successful employee engagement using the following approaches;

- Green Champions networking
- Training input and materials
- Regular communication

3 Based on findings from a number of previous SFRS heating projects where better controls were implemented on energy use, reducing energy use by 40% and mitigating against energy waste

4 Influencing Behaviours – A User Guide to the ISM Tool - Scottish Government (2013)

5 How are habits formed: Modelling habit formation in the real world – Lally et al (2009)

GREEN CHAMPIONS NETWORKING

We will develop a **National Green Team Network** of green champions, which will include employees from all areas of SFRS, empowering staff to take ownership and implement more sustainable practises within their own working environment. Other national Public Bodies such as Historic Environment

Scotland (HES) have been running successful national green teams for several years. Having Green Team members at a local level will give "eyes and ears" to identify local green issues across our organisation. Activities which green team members could develop and be involved in include:

- Energy and waste focus groups,
- Regional Green Team workshops for members to network and share information/ideas,
- Displaying support materials and posters at sites,
- Undertaking environmental compliance checks to support the EMS.

The Sustainability Team will provide guidance, tools and training for green team members, empowering them to make positive impacts on their local working environment and spread the message to their colleagues. A clear Terms of Reference will be drafted to ensure the green team member role is clear and will make positive impacts where needed. The Sustainability Team will have a mentoring and support role but it is hoped network members will manage it day to day.

The service will continue to engage within the national **Green Action Group** with other UK fire and rescue services, facilitating annual national energy saving competitions. This has proven successful in helping reduce behaviour related energy use in our fire stations.

TRAINING INPUT AND MATERIALS

Through our Training Department we will develop appropriate training modules for staff, to increase awareness and provide tools to make a positive impact within their working environments. Engagement with new recruits will be a priority, embedding good behaviours at the beginning of their careers to deliver long term impacts.

REGULAR COMMUNICATION

Getting information and messages to staff efficiently will be key to successfully embedding behaviour change. The following existing channels will be used:

- Newsletter items on positive stories and achievements by staff,
- A resource library on the sustainability team iHub page,
- Live dashboards located at our key corporate site reception areas of SFRS energy use and carbon emissions using our exiting EDF Power Now platform and Energy Bureau Software,
- Small widget on front page of iHub tracking overall SFRS carbon emissions (updates daily).
- Social Media posts to notify the public of successes and ongoing campaigns.

Throughout the year there will be seasonal campaigns, targeted to all employees to maintain momentum and keep staff engaged. These will generally be categorised as follows

- Spring: Biodiversity/Green Spaces related
- Summer: Active travel
- Autumn: General climate change
- Winter: Energy reduction related

These will be regularly reviewed with set performance metrics established to measure impacts.

The estimated benefits and cost levels relating to energy waste reduction interventions are displayed in Table 5.

Energy Reduction Intervention	Benefits (Estimated)	% Reduction Attributable To:	Cost (£)
Optimise existing heating systems parameters through bms	10-20% Energy reduction	Space heating	Low
Staff engagement-green champions	2-5% Energy reduction	Space heating and power loads	Low
Upgrade existing space heating and lighting controls	10-20% Energy reduction	Space heating and power loads	Medium
Convert gas heated drying rooms to dehumidifiers	10-20% Energy reduction	Space heating	Medium

Table 5: Energy Waste Reduction

5.2 ENERGY EFFICIENCY

BUILDING FABRIC IMPROVEMENTS

Most of our whole-time and retained fire stations were designed and constructed over 40 years ago. Consequently, many of these buildings are uncomfortable, cold and draughty with little thermal insulation. Many buildings have poor quality doors and windows, additionally large single skinned appliance bay doors have poor heat retention. Internally, poor separation between large cold appliance bays and the rest of the building creates heat sinks that lead to increased fuel use. Draughty buildings cause heat loss through increased air movement. These combined factors cause significant energy waste, uncomfortable working environments and financial loss.

In delivering energy efficiencies it is essential to improve the thermal qualities of the building fabric. Reducing the heat loss of a building will in turn allow for a smaller heating system to be installed which increases energy efficiency and reduces costs. SFRS will consider building envelope improvement as a key component of heating system maintenance or replacement.

The estimated benefits and costing levels relating to energy efficiency interventions are displayed in Table 6.

Energy Reduction Intervention	Benefits (Estimated)	% Reduction Attributable To:	Cost (£)
Improve U-values of Walls*	3-0% Energy Reduction and Carbon Reduction	Space Heating and Thermal load	Medium
Improve U-value of Roof*	3-30% Energy Reduction and Carbon Reduction	Space Heating and Thermal load	Medium
Install double glazing and upgrade external doors*	10-30% Energy Reduction and Carbon Reduction	Space Heating and Thermal load	Medium
LED Lighting with smart controls	10-20%	Power Loads	Medium
Increase natural lighting in buildings	5-10%	Power Loads and Space Heating	Medium

Table 6: Energy Efficiency

5.3 RENEWABLE ENERGY

ONSITE GENERATION AND BATTERY STORAGE

Onsite generation and storage of power offers many significant benefits and opportunities to reduce our carbon emissions. Currently we have eight solar PV installations across our estate ranging in size from small 4Kwp Systems to a large 200kwp System at our Newbridge Asset Resource Centre. The potential benefits of adopting more of these technologies are:

ON SITE GENERATION

- Reduces grid energy costs,
- Opens options to decarbonise heating and hot water systems,
- Provides options to power EV fleet from onsite generation.

ENERGY STORAGE

- Increases organisational resilience from potential power cuts,
- Ability to store cheap power and discharge during peak tariff period to reduce costs,
- Could replace emergency diesel generators.

Established onsite power generation technologies including wind and solar are potentially suitable for much of the SFRS estate. Hybrid Solar and Wind systems are emerging on the market. Many of our western coastal sites are well suited to this technology. We are currently trialling a Solar PV and battery storage installation on a Whole-time station and are developing plans for a similar system for retained station use. These projects are being piloted to find the best use for emerging technologies within our estate.

The estimated benefits and costing levels relating to renewable energy installations are displayed in Table 7.

Energy Reduction Intervention	Benefits (Estimated)	% Reduction Attributable To:	Cost (£)
Solar/Wind Power generation	Increased Resilience and Carbon Reduction	N/A	High
Battery Storage	Increased Resilience and Carbon Reduction	N/A	High

Table 7: Renewable Energy

5.4 LOW CARBON ENERGY

LOW CARBON ELECTRICITY

Moving away from the traditional model of 100% reliance on one source of electricity supply will open up other options for a more sustainable energy mix. These options are:

- Grid Supplied Electricity: SFRS will always have a requirement to use power supplied by the national grid, however much of the carbon saving to date has been facilitated by grid electricity becoming 'cleaner'. Electricity will always have carbon embedded in its transmission,
- Onsite Generation: The increased use of clean and renewable energy generation technologies will strengthen organisational resilience, reduce our carbon footprint and insulate SFRS from rising energy costs.
- Energy Storage: Battery storage will allow SFRS to store electricity from the grid during low tariff periods and use it during peak periods. Stored energy from onsite generation will allow for low carbon electricity to be used onsite for all the main electrical energy use sources such as Electric heating, Cooling and hot water storage, electric vehicle (EV) charging and lighting our buildings at night.

HYDROGEN

Well established as a global fuel, hydrogen has been adopted increasingly by the shipping, rail and haulage industries. The use of hydrogen for cars in Europe is less well established, however, as the global market for hydrogen vehicles develops then, a supply chain may be established. Scottish areas of hydrogen development include Aberdeen, where there are hydrogen filling stations for cars; and shipping developments being progressed by Caledonian MacBrayne and the shipping industry on the Clyde. Hydrogen has an added advantage to EV technology as the refuelling process is like petrol and diesel, making it swift and familiar. Hydrogen can be bunkered and transported in tankers, similarly to diesel, enabling flexible refuelling of fleet vehicles.

BIOMASS

Currently a viable alternative to space heating, however biomass is restricted to buildings only. It is considered as a carbon neutral product and can deliver significant carbon reduction; however, the process of combustion produces particulates in the atmosphere, which may rule out its widespread use as it could be viewed as contributing to atmospheric pollution. It does have the potential to offer an organic and sustainable energy route and can be bunkered easily and in large volumes thus offering resilience.

ALTERNATIVE FUELS

Alternative fuels, known as non-conventional and advanced fuels, are any materials or substances that can be used as fuels, for example bio-diesel, bio-alcohol (methanol, ethanol, butane), refuse-derived fuel, vegetable oil, propane and other biomass sources. Along with more established fuel sources there maybe scope for SFRS to adopt alternative sources of fuels to power our mobile or fixed assets. This would be dependent on availability and security of supply. Some organisations such as McDonalds use sources readily available within their organisation such as used cooking oil and have converted to Bio-Diesel to fuel their heavy fleet. SFRS do not do not currently have any internal alternative fuel sources.

HEAVY FLEET

It is currently unclear whether the decarbonisation of this part of the fleet will be achieved utilising EV technology, hydrogen or other solutions. A new fuel will need significant infrastructure developed to support transition. However, there is significant opportunity to reduce associated carbon emissions from our existing heavy fleet through a review of current use patterns.

ELECTRIC VEHICLES

Mobile asset transformation will increase electricity consumption in the short to medium term and could introduce new fuels in the longer term. These changes will have a significant impact on our existing electricity infrastructure, consumption trends and cost. To facilitate this transition appropriate infrastructure needs to be designed, developed and installed.

Battery storage backed up with onsite renewable generation technology has an important part to play in this and will allow SFRS to store EV fuel in the same way that we currently bunker fossil fuel for transport. This will ensure resilience during power outages, as well as insulation from rising energy prices.

SFRS intends to take a strategic approach to EV adoption aligning with grant funding opportunities as appropriate.

Use patterns are specific to each type of fleet vehicle and its purpose. EV infrastructure will need to support each user group and be in place in advance to facilitate the adoption of EV fleet.

We have commissioned the Energy Saving Trust to execute a Fleet Transport Review, analysing fleet composition, behaviours, use patterns and energy use. The review will facilitate a detailed baseline, setting current fleet performance, carbon emissions and how best to deploy the EV fleet.

Table 8 gives an indication of the scale of infrastructure needed to support a transition of EV for our light fleet. Building resilience into this transition will be key to its success.

Theme	Charge Points (60% 7kw, 40%, 11kw)	Charge Point Capacity (kw)	Energy storage (kw)	Onsite generation (kw)
Workshops and Stores	80	578	560	560
Corporate Sites	40	289	140	280
City HUBS (Wholetime stations)	56	404	392	392
Major Routes (A9, N900)	30	217	210	210
Large Islands	40	289	280	280
Community Hubs	4	29	28	28
Total	**250**	**1806** [1]	**1754** [3]	**1754** [3]

Table 8: SFRS EV Infrastructure Projection

1 Based on a mix of 60% being 7kw charger's ad 40% being 11kw chargers
2 Battery capacity is sized to give one full charge to 100% of Light fleet in event of grid failure.
3 Based on average annual yield of Solar PV @ 800kwh/KWP/Yr to serve 1950kwh/yr/EV vehicle energy use @ 6000 miles/year/unit

ACTIVE TRAVEL

Active travel will play its part in SFRS transitioning to a carbon neutral organisation. The development of EV bike technology is making active travel more accessible to a wider group of people and users. The deployment of EV bike charging stations at key sites will be part of our transition to EV transport methods.

LOW CARBON HEATING

Space heating represents the dominant energy cost to the service. A number of low carbon heating technologies are emerging from the market which could meet our needs. These include:

- Air Source Heat Pumps (ASHP)
- Biomass Heating
- Combined Heating and power (CHP)

SFRS is trialling a conversion of one of our rural oil heated stations to low carbon ASHP's. We intend to develop this concept further harnessing onsite generation which could deliver a carbon neutral fire station. The application of existing biomass boilers at NHQ holds significant potential for carbon reduction. Some SFRS sites feature CHP technology and their performance is being monitored to gauge the potential for future roll out across the rest of the estate. These existing technologies, together with fast emerging new technologies, provide the means to deliver the carbon and energy savings required to meet the 2030 target.

LOW ENERGY LIGHTING

Energy use from lighting in whole time stations typically represents about 20% of total electricity use of the building and 8-10% for retained stations. Lighting systems waste energy by:

- Being left on throughout building with nobody occupying spaces,
- External lights left on all day.

High efficiency LED lighting with smarter controls has been rolled out across the estate for several years and it is now policy within the property teams that any lighting replacements and upgrades are LED with controls. As this is being driven as a maintenance activity the impact is localised, however there remains scope for enhanced application across the estate. SFRS Sustainability Team are currently undertaking a high-level survey to identify how much old inefficient lighting is still in use to determine the scope for further savings. This data will inform a programme of further investment opportunities in LED lighting systems.

The estimated benefits and cost levels relating to the low carbon energy and new build design interventions are displayed in Table 9.

Energy Reduction Intervention	Benefits (Estimated)	% Reduction Attributable To:	Cost (£)
ASHP's	Energy reduction and carbon reduction	Space heating	High
Biomass Heating	Increased resilience and carbon reduction	Space heating	High
Combined Heat and Power	Energy reduction and carbon reduction	Space heating and power loads	High
EV charging network for light fleet	Carbon reduction of fleet	Fossil fuels for transport	Grant funding
EV charging network for Heavy electric fleet	Carbon reduction of fleet	Fossil fuels for transport	Unknown
Adopt cradle to grave sustainable specification into all new build projects	Lower whole life costs, energy reduction and carbon reduction	All resource use attributed to building operation minimised	% of Capital build cost

Table 9: Low Carbon Energy and New Build Design

5.5 CONVENTIONAL ENERGY

Work is ongoing to reduce the energy consumption of conventional systems, with a trial project already installed at Bo'ness Fire station. This is a whole systems approach and include measures such as:

- Rationalisation of heating system size to reduce overall energy load,
- Separate zoning of different areas of building,
- Decommissioning of forced heat to drying room and in favour of efficient dehumidification systems,
- Improved heating controls,
- Improved appliance bay heating approaches,
- Insulation lagging of all exposed pipework.

Scottish Gas Networks and National Grid are currently working to decarbonise the gas network, however this is currently projected only to reduce the carbon footprint of the gas network by around 18%. The projected saving will not enable SFRS to meet the SG targets, therefore consideration is being given to phasing out gas fuelled heating systems in favour of low carbon alternatives over the coming years.

5.6 ENERGY MATRIX

Using the energy hierarchy, we can rate the potential impact, investment level and lifecycle costs of each proposed project theme. The Energy Matrix in Table 10 shows that most project themes sit high within the hierarchy which is favourable. Each SFRS project will be set against these criteria to assess how it fits into this matrix. This allows for a more efficient approach and maximises the impact of any measures put in place. As a rule, lifecycle costs of measures increase as you go lower on the hierarchy.

PROJECT THEMES										
Energy Mgt Hierarchy	Energy Waste Reduction	Building Fabric Upgrades	Onsite Generation and Battery Storage	Low Carbon Heating	EV Charging	Behaviour Change / Green Team	Low Energy Lighting	Low Carbon New Builds	Traditional Heating	LIFE CYCLE COSTS
1. Energy Waste Reduction	✓	✓				✓	✓	✓		
2. Energy Efficiency	✓	✓		✓			✓	✓		
3. Renewable Energy			✓	✓	✓			✓		
4. Low Carbon Energy			✓	✓				✓		
5. Conventional Energy									✓	

Low to Medium Investment Cost | **High Investment Cost**

Table 10: Energy Matrix

6. TIMELINE OF PROGRAMME

Table 11 outlines a rough timeline of our 10-year programme to 2030. Ongoing research will continue throughout the programme to ensure SFRS adapts and utilises the best available technologies and measures as they develop.

	Short Term 2020 – 2022	Medium Term 2022 – 2030
Planning and Policy	• Implement CMP 2020-2025 • Ongoing planning of next CMP phase • Dedicated funding mechanisms and supply chain to be developed for long term programme success	• Review performance of adopted project themes.
Technologies and Measures	• Trial suitable onsite generation and storage strategies • Trial and prove business case for widespread adoption of low carbon heating solutions to SFRS estate. • New build and refurbishment projects to adopt sustainability measures.	• All new heating upgrades to be low carbon option. • Ongoing research and adoption of new suitable technologies as they emerge.
Carbon Reduction	• Significant energy, carbon and cost savings reduction achieved through mitigating energy waste. • Implement more efficient heating strategy for appliance bays, dorms and drying rooms	• "Low hanging fruit" opportunities expected to be exhausted. Hard work begins.

Table 11: Programme Timeline

APPENDIX A: BENEFITS OF ENERGY STRATEGY

	PROJECT THEMES			
	we value Safety **Health, Safety and Wellbeing**	we value Teamwork **Staff Behaviour Change**	we value Respect **Respect for the Evironment and Health of Others**	we value Innovation **Embracing new Technologies**
Reduction in climate change impacts at a national and global level	✓	✓	✓	✓
Influencing change and leading by example.		✓	✓	
Strengthening SFRS organisational resilience		✓	✓	✓
Complementary to the SFRS Environmental Policy	✓	✓	✓	
Integral to the SFRS Carbon Management Plan	✓	✓	✓	✓
Reduction in CO2 and other harmful air pollutants	✓		✓	✓
Investing in and trialling new technologies to strive to meet our ambitious carbon reduction targets			✓	✓

WANT TO KNOW MORE?

SFRS has a dedicated sustainability team that can help and support you with all things relating to resource efficiency. You can either visit our dedicated iHub page (*ihub.firescotland.gov.uk/sustainability*) or email us directly at: *SFRS.sustainability@firescotland.gov.uk*

You can also lo into your dedicated Energy Viewer Meter Portal where you can see a detailed dashboard of the actual energy use of your building, track and measure the impact of the actions you take and how you compare to other SFRS sites.

www.energymanagerlive.com/

www.firescotland.gov.uk