LFC 26-031

Equipment Asset Replacement Programme 2026-31

Report to:	**Date:**
Investment & Finance Board	26 March 2026
Commissioner's Board	14 April 2026
Deputy Mayor's Fire Board	12 May 2026
London Fire Commissioner	

Report by:

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Report classification:

For decision

For publication

No

Values met

Service

PART ONE

Non-confidential facts and advice to the decision-maker

Executive Summary

The purpose of this report is to seek approval for the renewal and upgrade of LFC's existing operational equipment assets that have reached the end of their recommended useful life. This would create a replacement program for the next five financial years (2026/27 – 2030/31) all of which are fully funded within the existing FLEET capital budget.

Approval is sought for 21 support vehicles to be replaced, fully funded from the available budget.

For the London Fire Commissioner

The LFC agrees that a contract for asset life replacements be entered into in accordance with the arrangements set out in Part Two of this report.

1 Introduction and background

1.1 LFC holds a contract with Babcock Critical Services (Vehicle and Equipment Contract 2014) to conduct asset life replacements at the contracted end of assets life. LFC maintains a 20-year forecast for asset life replacements, which is shared monthly with Finance to support budget planning.

1.2 The purpose of this report is to seek approval for the renewal and upgrade of LFC's support operational equipment assets for the next five financial years (2026/27 – 2030/31). These are already identified within the Vehicles and Equipment 2014 contract with Babcock Critical Services. Approval is also sought for the life replacement of 21 support vehicles.

1.3 The assets covered in this report include operational equipment and 21 support vehicles (support vans), along with estimated modifications costs. The report provides details of the equipment assets included in the five-year plan, the forecasted spend dates, and estimated costs. These cost estimates will be refined through the procurement process conducted by Babcock Critical Service on behalf of LFC.

1.4 For the 2026/27 support vans, while the broader shift to electric vehicles may necessitate additional infrastructure, such as charging facilities, these elements fall outside the scope of this paper and are covered in LFC-25-070.

2026/27 Support Vehicle Replacements

1.5 The 2026/27 support vehicle replacements will transition to electric models from diesel,

resulting in a cost increase that exceeds the standard 3% annual RPI adjustment. For context, a diesel van purchased by LFC for £25,500 in 2018/19 now costs £33,935—a 33.08% rise driven by inflation and market changes.

1.6 During the most recent batch of support vehicle replacements in 2025/26, the procurement process identified an electric-vehicle training cost, specific to the vehicle supplier, for Babcock Technicians responsible for routine servicing. If another supplier is chosen for the 2026/27 programme, an additional training cost may be incurred due to differing maintenance requirements between manufacturers. LFC have factored these potential training costs into the 2026/27 financial planning.

1.7 The FLEET Strategy 2024-35 aligns with the Brigades CRMP (Community Risk Management Plan) carbon reduction commitments and the mayors preferred Accelerated Green decarbonisation pathway which in the context of vehicles requires aged polluting petrol and diesel assets be substituted with zero tailpipe emission equivalents when due for replacement.

1.8 Electric vans will predominantly be charged using existing vehicle charging facilities available throughout the LFC estate.

1.9 A summary of the forecasted workstreams, cost and delivery dates has been included in the tables within this report and the Part Two report.

2 Objectives and expected outcomes

2.1 The purpose of this report is to seek approval for the renewal and upgrade of LFC's existing operational equipment assets that have reached the end of their recommended life. This would create a replacement program for the next five financial years (2026/27 – 2030/31). Procurement is covered under the Vehicles and Equipment 2014 contract with Babcock Critical Services. LFC are also seeking approval for the light vehicle replacements in 2026/27 only.

2.2 As part of our commitment to achieve value for money (VFM), LFC have reviewed each asset by department to determine whether it could be removed if operationally feasible or have its life extended if it does not pose a risk to reliability or compliance. The anticipated approval value is outlined in part two, with separate tables providing a detailed breakdown of expenditures for each asset. The specified delivery years establish a measurable timeframe, which will be further refined as the projects progress.

2.3 Light vehicle replacements will transition from diesel Internal combustion engines (ICE) to zero-emission alternatives such as Electric Vehicles (EV's), aligning with the London Mayor's focus on tackling air pollution and utilising net-zero energy as outlined in the LFB Fleet Strategy 2024 - 2035 (attached in appendix). LFC-25-070 which lead to DMFD277 for EV Charging Infrastructure has been published and is accessible on www.london-fire.gov.uk/about-us/our-decisions/.

2.4 At the end of their serviceable life, the vehicles and equipment will be resold by Babcock Critical Services Limited in accordance with the provisions of the 2014 Vehicle and Equipment Contract. Proceeds from the disposal of the assets are returned to a central revenue account and may be used to offset capital borrowing costs. The disposal process also ensures compliance with the London Fire Brigade's obligations under the Environmental Duty of Care

Regulations.

2.5 The LFC is able to generate capital receipts through the sale of surplus assets. This is a limited resource as the majority of the LFC's assets are currently in operational use as part of front-line service delivery and response. The timing and value of the capital receipts may also be further delayed or reduced due to planning requirements and changes in market conditions.

3 Year One – 2026/27 Finance Year

3.1 In the first year of the five-year replacement plan, the following assets are scheduled for end-of-life replacement under the Vehicles and Equipment 2014 contract with Babcock Critical Services. The financial value of these replacements will be disclosed in Part Two of this report.

3.2 The life of each asset was determined during the 2014 V&E contract implementation. The reasoning behind this was to provide a contractual obligation and costs associated over a 21-year contract. It also serves to provide:

- Timelines to plan asset replacement, supporting capital budgeting and avoiding large unfunded expenses
- Ensures that equipment stays current, efficient, safe, and compliant with regulations.
- Knowing the expected lifespan helps schedule preventive maintenance.
- It reduces the risk of unexpected breakdowns and extends the asset's life.
- Helps in cost forecasting for repairs vs. replacement.
- At the end of its useful life, an asset may still have residual value (e.g. resale or scrap).

3.3 **Battery Powered Tools** - When battery-powered tools were first added to the inventory, Babcock and FLEET agreed to set the asset life at 5 years—shorter than the 10–12 years typically assigned to fuel-powered tools. This decision was made to closely monitor the performance and longevity of battery tools, with the aim of potentially extending their lifespan based on actual usage and battery health. LFC and Babcock Critical Services have carried out a full review of all battery-powered operational equipment and determined where a complete tool replacement is not required, and that replacing the battery alone is sufficient. This is shown in the 'Has life been extended?' column in the tables below. This approach promotes more responsible asset management by focusing on the actual condition of equipment rather than automatically replacing it at the end of its contracted life.

3.4 Table one:

Light Vehicle Replacements - 2026/27

Workstream	No.	Asset on the run	Replacement date	Has life been extended?
Community Fire Safety Vans	3	Sep-19	Sep-26	No
Brigade Control Centre Minibus	2	Sep-19	Sep-26	No
Regional Area Support Vans	3	Sep-19	Sep-26	No
Water Office - Hydrant Inspection Vans	4	Sep-19	Sep-26	No
Babcock Training Vans	2	Sep-19	Sep-26	No
Brigade Control Centre Van	1	Jun-19	Sep-26	No
Operational Resilience Conference Van	1	May-19	May-26	No
Operational Support Centre REPLO	2	Dec-19	Dec-26	No
Operational Support Centre Delivery	2	Dec-19	Dec-26	No
IT Equipment Carrier Van	1	Dec-19	Dec-26	No

Operational Equipment Replacements 2026/27

Workstream	No.	Asset on the run	Replacement date	Has life been extended?
Portable Battery Lighting	361	2021/22	2026/27	No
Portable Battery Lighting Chargers	460	2021/22	2026/27	No
Rescue Platform (Lucas)	17	N/A	2026/27	No
Fire Rescue Unit Hydramites	18	N/A	2026/27	No
Fire Rescue Unit Portable CCTV *	19	2019/20	2026/27	No

4 Year Two – 2027/28 Finance Year

4.1 Table two:

Operational Equipment Replacements 2027/28

Workstream	No.	Asset on the run	Replacement date	Has life been extended?
Reciprocating Saw (Pump Ladder)	44	2017/18	2027/28	No
Disc Cutter (Pump Ladder)	44	2017/18	2027/28	No
Lightweight Portable Pump (LPP)	43	N/A	2020/21	6 yrs

5 Year Three – 2028/29 Finance Year

5.1 Table three:

Operational Equipment Replacements 2028/29

Workstream	No.	Asset on the run	Replacement date	Has life been extended?
Ground Attack Monitors	130	N/A	2022/23	5 yrs
Major Lighting Unit	10	N/A	2024/25	4 yrs
Fire Rescue Unit Battery Pump SPU 16	37	N/A	2021/22	No
Fire Rescue Unit CU3040 NCT Cutter	63	N/A	2021/22	7 yrs
Fire Rescue Unit Hydraulic Spreader 3240+	63	N/A	2021/22	7 yrs
High Pressure Branch	352	2018/19	2028/19	No
Combi Tool & Chargers	161	2018/19	2028/29	No
Cutter Tool & Chargers	161	2018/19	2028/29	No

6 Year Four – 2029/30 Finance Year

6.1

Operational Equipment Replacements 2029/30

Workstream	No.	Asset on the run	Replacement date	Has life been extended?
5.5M Cadets Ladder	14	N/A	Rolling	No
Forced Entry Equipment (Hydraulic)	120	2019/20	2029/30	No
Controlled Dividing Breeching	150	2017/18	2029/30	No
Low Pressure Airbag Controller Unit	32	2017/18	2029/30	No
Rapid Stabilisation Strut	19	2017/18	2029/30	No

7 Year Five – 2030/31 Finance Year

7.1 In the fifth year of the Asset Replacement Programme, a performance review will be conducted for the electric vehicles introduced in 2025/26, like the approach taken in Year 3. This review will determine whether the vehicles are suitable for life extension or require life replacement, as originally forecasted in contractual planning.

Operational Equipment Replacements 2030/31

Workstream	No.	Asset on the run	Replacement date	Has life been extended?
Thermal Imaging Camera*	216	2022/23	2027/28	2 yrs
Inflatable Rescue Boats	5	2018/19	2030/31	No
Smoke Blocker Curtain	155	2020/21	2030/31	No
Ejector Pump	157	2018/19	2030/31	No
Inflatable Rescue Path (2 Metre)	47	2018/19	2030/31	No
Inflatable Rescue Path (5 Metre)	6	2018/19	2030/31	No
Fire Rescue Unit Air Lifting Bags	19	2018/19	2030/31	No
Core Tech Hose*	266	2018/19	2030/31	No
Standpipe Double Head with Blank Cap	111	2018/19	2030/31	No
Standpipe Long 1050mm	87	2018/19	2030/31	No
Standpipe Standard 900mm	169	2018/19	2030/31	No
Dividing breeching	17	2018/19	2030/31	No
Collecting breeching	169	2018/19	2030/31	No
Hydrant Key and Bar	327	2018/19	2030/31	No

** **Core Tech Hose** is the hose used for hydraulic cutting equipment that prevents hydraulic injection injuries. Should the hydraulic cutters be replaced with an equivalent battery tool, the hose will be removed from the inventory, disposed of, and not replaced. This will remove the health and safety risk of hydraulic injection injuries, and the cost of replacing them.*

8 Values Comments

8.1 The LFC notes the Fire Standards Board requirements around adopting and embedding the Core Code of Ethics at an individual and corporate level. Following extensive engagement, the LFC has introduced Brigade values which build on and do not detract from the Code of Ethics.

8.2 The Asset Replacement approach reflects LFC's commitment to its core values. By including a contingency for cost fluctuations in the volatile electric van market and extending asset life where possible, LFC ensures continuity of service and maximises value. Integrity is upheld through transparent budgeting and recognition of project complexities, while learning from past experiences informs smarter decision-making and budgeting. Though not explicitly stated, teamwork and equity are demonstrated through collaborative resource management and fair asset utilisation, and courage is shown in proactively addressing potential market challenges through budget uplifts.

9 Equality Comments

9.1 The LFC and the Deputy Mayor for Planning, Regeneration and the Fire Service are required

to have due regard to thePublic Sector Equality Duty (section 149 of the Equality Act 2010) when taking decisions. This in broad terms involves understanding the potential impact of policy and decisions on different people, taking this into account and then evidencing how decisions were reached.

9.2 It is important to note that consideration of the Public Sector Equality Duty is not a one-off task. The duty must be fulfilled before taking a decision, at the time of taking a decision, and after the decision has been taken.

9.3 The protected characteristics are age, disability, gender reassignment, pregnancy and maternity, marriage and civil partnership (but only in respect of the requirements to have due regard to the need to eliminate discrimination), race (ethnic or national origins, colour or nationality), religion or belief (including lack of belief), sex, and sexual orientation.

9.4 The Public Sector Equality Duty requires decision-takers in the exercise of all their functions, to have due regard to the need to: eliminate discrimination, harassment and victimisation and other prohibited conduct. Advance equality of opportunity between people who share a relevant protected characteristic and persons who do not share it.

9.5 foster good relations between people who share a relevant protected characteristic and persons who do not share it.

9.6 Having due regard to the need to advance equality of opportunity between persons who share a relevant protected characteristic and persons who do not share it involves having due regard, in particular, to the need to:

- remove or minimise disadvantages suffered by persons who share a relevant protected characteristic where those disadvantages are connected to that characteristic.
- take steps to meet the needs of persons who share a relevant protected characteristic that are different from the needs of persons who do not share it.
- encourage persons who share a relevant protected characteristic to participate in public life or in any other activity in which participation by such persons is disproportionately low.

9.7 The steps involved in meeting the needs of disabled persons that are different from the needs of persons who are not disabled include, in particular, steps to take account of disabled persons' disabilities.

9.8 Having due regard to the need to foster good relations between persons who share a relevant protected characteristic and persons who do not share it involves having due regard, in particular, to the need to:

- tackle prejudice
- promote understanding.

9.9 FLEET will complete Equality Impact Assessments (EIAs) for each individual workstream once projects are live. This approach ensures that the specific asset under assessment is clearly identified through the procurement process and can be properly reviewed. Each of the projects included in this report will therefore have its own EIA

undertaken at the point the relevant workstream becomes live.

10 Other considerations

Workforce comments

10.1 This report has been prepared to seek approval for the expenditure outlined in Part Two. Workforce consultation is not required. The financial value referenced remains confidential to protect LFC's commercial interests and prevent market prejudice.

Sustainability comments

10.2 This report discusses the increased electrification to the LFC fleet and supports the LFC Sustainable Development Strategy aims.

10.3 This report does not introduce any significant sustainability impacts, however where new policies; projects and new equipment arise, they are subject to the Brigade's sustainable development impact assessment process.

10.4 Sustainability have been consulted and have advised they have no further comments to add.

10.5 FLEET will complete Sustainability Impact Assessments for individual workstreams once projects are live. This ensures that the specific asset under assessment is clearly defined through the procurement process and that sustainability impacts can be appropriately identified and reviewed. Each of the projects included in this report will therefore have its own Sustainability Impact Assessment undertaken when the relevant workstream becomes live.

Procurement comments

10.6 The Babcock Critical Services (BCS) Vehicle and Equipment (V&E) contract is the LFCs route to market to source vehicles and equipment and the outsourced maintenance function for the LFC fleet and equipment

10.7 These projects will be sourced through the V&E contract. This allows the LFC to utilise BCSs supply chain.

10.8 The LFC Fleet and Procurement teams will be directly involved in the development of the individual procurement strategies, tender lists and evaluation criteria.

10.9 The tenders will be issued and managed via the BCS tender platform.

10.10 These procurements will be compliant with these procurement legislation and the LFC Scheme of Governance.

Communications comments

10.11 This report has been prepared to seek approval for the expenditure outlined in Part Two and does not require internal communications. The financial value referenced remains confidential to protect LFC's commercial interests and prevent market prejudice. End users of the assets

scheduled for replacement within the period covered by this report will be consulted individually as part of the asset replacement project.

11 Financial comments

11.1 Financial comments have been included in Part Two of this report.

12 Legal Comments

12.1 Under section 9 of the Policing and Crime Act 2017, the London Fire Commissioner (the "Commissioner") is established as a corporation sole with the Mayor appointing the occupant of that office. Under section 327D of the GLA Act 1999, as amended by the Policing and Crime Act 2017, the Mayor may issue to the Commissioner specific or general directions as to the manner in which the holder of that office is to exercise his or her functions.

12.2 By direction dated 1 April 2018, the Mayor set out those matters, for which the Commissioner would require the prior approval of either the Mayor or the Deputy Mayor for Fire and Resilience (the "Deputy Mayor"). Paragraph (b) of Part 2 of said direction requires the Commissioner to seek the prior approval of the Deputy Mayor before "[a] commitment to expenditure (capital or revenue) of £150,000 or above as identified in accordance with normal accounting practices...".

12.3 In accordance with Section 5A Fire and Rescue Services Act 2004 (FRSA 2004), the London Fire Commissioner, being a 'relevant authority,' may do 'anything it considers appropriate for the purposes of the carrying- out of any of it's functions…'

12.4 General Counsel observes that this procurement process will be carried out in compliance with the LFC Scheme of Governance.

List of appendices

Appendix	Title	Open or confidential*
1	LFB-Fleet-Strategy-2024-2035-v1	Open

Part two confidentiality

Only the facts or advice considered to be exempt from disclosure under the FOI Act should be in the separate Part Two form, together with the legal rationale for non-publication.

Is there a Part Two form: Yes

LFB Fleet Strategy 2024-2035

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Authors : Mark Smith - Fleet Strategy and Carbon Net Zero Manager

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LFB
LONDON FIRE BRIGADE

Contents

1 Executive Summary

London Fire Brigade's Fleet is made up of both vehicles (over 350 including nearly 250 HGVs) and operational equipment (approximately 100,000 items) utilised on the front line. Fleet and the associated equipment are managed through the Vehicle and Equipment contract with Babcock International Group and Operational Support Group (OSG).

This strategy encompasses the decarbonisation and modernisation of LFB's fleet of vehicles and associated equipment. The strategy has been co-authored with Babcock International. They have provided technical and market content.

This strategy is derived from the LFB Carbon Net Zero Strategy and the Community Risk Management Plan that both have several principles and programmes that relate to the work being completed within this strategy. The purpose of this strategy is to provide a guiding direction and principles to follow for the duration of the Babcock V&E contract, when replacing the vehicles and equipment at their planned replacement dates and meeting the Mayoral aspiration of Carbon Net Zero by 2030. In addition, the Estate Strategy is being composed at the same time and these two strategies will need to work together in order to accomplish LFB's goals.

This strategy has drawn on lessons and engagement from key stakeholders, encompassing existing working groups and boards across LFB. The strategy was shared for input with enabling services such as strategy and risk, and property, and to be presented to the next Carbon Net Zero Project Board. These collaborative efforts shaped the guiding principles embedded in the strategy, reflecting drivers in Change Programmes 3, 6 and 8.

Considerations for the fleet strategy:

- The current fleet approach is for replacement of similar vehicles and equipment on fleet at defined end of life dates subject to modification to suit operational requirements but does not account for alternative methods of propulsion.
- The fleet consists of a wide variety of vehicles, with the highest volume being 188 Dual Pump Ladders (DPL) which may be considered as a 'typical fire engine' (143 of these are operationally available at any one time). These are the exact same type of vehicle with two different equipment stowage arrangements, of which the majority of what is carried is the same, to meet the first response needs of Londoners.
- Fire and Rescue Services across the country deal with different conditions in comparison to London. London has a unique risk profile as it includes the majority of high-rise premises in the UK, yet also encompasses river rescue and rural settings.

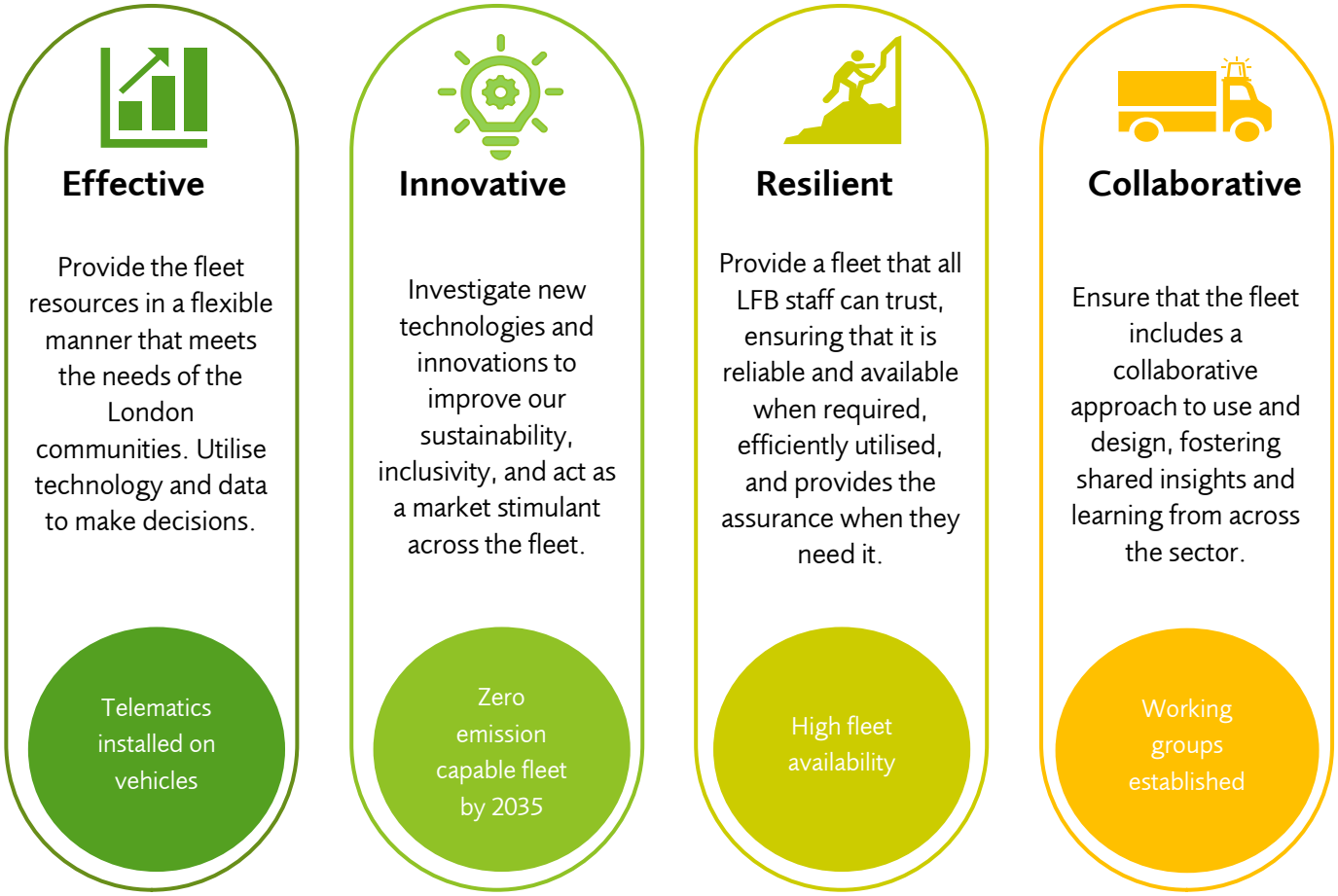
This strategy will ensure that LFB deploy the latest technological innovations to have a fleet that is fit for purpose, effective and resilient, encompassing the sustainable goals of the organisation.

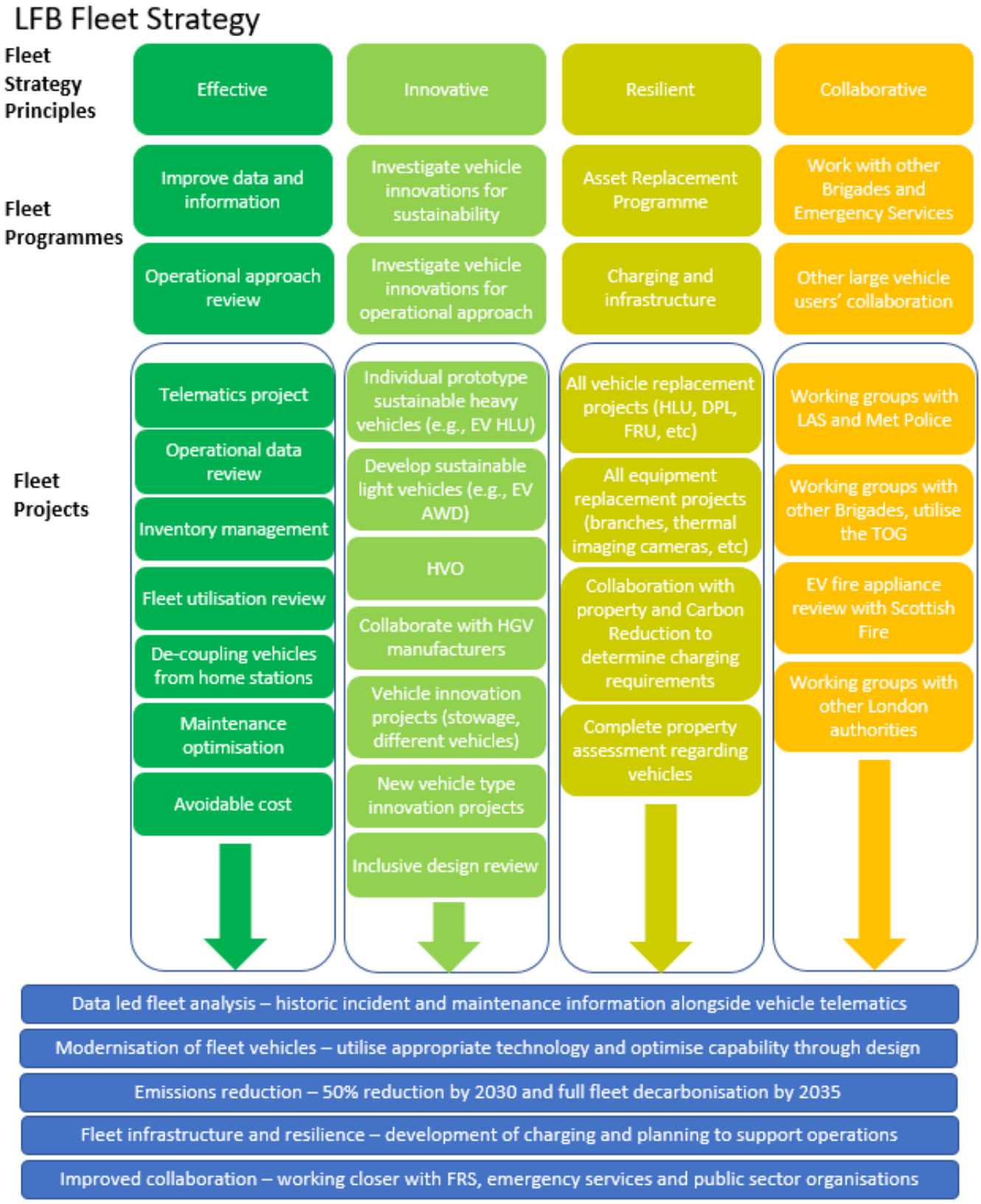
The outputs of this strategy will be:

- Data led fleet analysis – Historic incident information, maintenance, and fuel records along with telematics data will be utilised alongside future brigade requirements to determine future fleet requirements.
- Modernisation of fleet vehicles - new fleet vehicles will utilise appropriate technology and improvement in design to optimise capability and accessibility.
- Optimisation of Fleet Management- There will be a review into the operational assets and decisions regarding any future vehicles and equipment lifecycles will be data led. This will include assessment of de-coupling and fleet maintenance practices.
- Emissions reductions- By 2030 LFBs Fleet carbon emissions will have been reduced to approximately 50% of its 2022 consumption, with full fleet decarbonisation forecast for 2035.

- Fleet Infrastructure and Resilience– Development of vehicle charging and associated equipment/planning to effectively support LFB operations.
- Improved Collaboration- Working more closely with other brigades and emergency services nationally to share new fleet technology experience and knowledge, working with GLA partners and other public sector organisations within London to support resilience and modernisation.

The four principles of the fleet strategy and the supporting workstreams are:




LFB Fleet Strategy
Fleet Strategy Principles
Effective
Innovative
Resilient
Collaborative
Fleet Programmes
Improve data and information
Investigate vehicle innovations for sustainability
Asset Replacement Programme
Work with other Brigades and Emergency Services
Operational approach review
Investigate vehicle innovations for operational approach
Charging and infrastructure
Other large vehicle users' collaboration
Fleet Projects
Telematics project
Operational data review
Inventory management
Fleet utilisation review
De-coupling vehicles from home stations
Maintenance optimisation
Avoidable cost
Individual prototype sustainable heavy vehicles (e.g., EV HLU)
Develop sustainable light vehicles (e.g., EV AWD)
HVO
Collaborate with HGV manufacturers
Vehicle innovation projects (stowage, different vehicles)
New vehicle type innovation projects
Inclusive design review
All vehicle replacement projects (HLU, DPL, FRU, etc)
All equipment replacement projects (branches, thermal imaging cameras, etc)
Collaboration with property and Carbon Reduction to determine charging requirements
Complete property assessment regarding vehicles
Working groups with LAS and Met Police
Working groups with other Brigades, utilise the TOG
EV fire appliance review with Scottish Fire
Working groups with other London authorities
Data led fleet analysis – historic incident and maintenance information alongside vehicle telematics
Modernisation of fleet vehicles – utilise appropriate technology and optimise capability through design
Emissions reduction – 50% reduction by 2030 and full fleet decarbonisation by 2035
Fleet infrastructure and resilience – development of charging and planning to support operations
Improved collaboration – working closer with FRS, emergency services and public sector organisations

2 Purpose and Strategic Drivers

2.1 Purpose

This purpose of this document is to provide a fit for purpose and flexible vehicle and equipment fleet with high capability and reliability, encompassing the sustainability goals of the organisation. This fleet strategy will encourage collaborative working and the utilisation of data driven strategic decisions to supply the necessary assets to operational colleagues, maintaining operational responsibilities to ensure the community's safety.

LFB Fleet Strategy will be paired with annual Fleet Strategy Action Plans: these will provide a high-level plan with detailed individual projects as summarised within the table on previous page for LFB FLEET to support the needs of LFB's Community Risk Management Plan, ensuring LFB has a fleet of vehicles and equipment, including the iconic frontline fire appliances, which allow the organisation to satisfy its duty of protecting Londoners.

2.2 Strategic Drivers

In 2022 the Mayor of London published 'Analysis of a Net Zero 2030 Target for Greater London' which identifies the Accelerated Green scenario as the preferred pathway to net zero. This provides major decarbonisation but supports the principles of interim offsetting measures and the need to consider the remaining life of existing public assets.

Following extensive public consultation LFB shared LFB Community Risk Management Plan (CRMP) in 2022 which confirms LFB commitment to reducing impact on the environment and stated the target of aiming to reach net zero carbon by 2030. This strategy defines net zero to include Scope 1 and Scope 2 emissions in accordance with methodologies laid out in the Greenhouse Gas Protocol[1]. In 2020/2021, this equated to 10,991 tonnes of CO_2e.

This strategy also delivers CRMP commitments to work closely with strategic partners, modernising enabling services technology, adapting to changing demand and Net Zero.

Principles 4, 5 and 6 from the Carbon Net Zero Strategy (Offsetting and alternative fuels, fleet decarbonisation and smart energy use respectively).

Principles of collaborative procurement established by the GLA Collaborative Procurement Board[2].

Mayor of London - London Environment strategy (May 2018) Leading by example – the Mayor and wider GLA group should lead by example. Organisations like Transport for London (TfL), as well as organisations the Mayor has oversight of, such as the Metropolitan Police and London fire brigade, can set examples and use new technologies. The wider need for LFB to improve air quality in London in accordance with the ULEZ[3] standards.

Diesel obsolescence – November 2021 the UK Government announced the sale of new petrol and diesel vehicles would be phased out from 2030 to only allow Battery Electric Vehicles (BEVs) and hydrogen Fuel Cell Electric Vehicles (FCEVs) to be sold in mainstream road-going markets in the UK with both having zero tailpipe emissions. The Prime Minister has since announced that the ban would be pushed back to 2035.

2.2.1 Health and Safety

The LFB Health and Safety policy (597) sets out clear requirements for all brigade activities with reference - *4.16 Providing safe plant, equipment, working conditions and safe systems of work*. - providing a clear standard that all vehicles and equipment provided by the fleet strategy must meet.

Replacement of assets provides the opportunity to review any incidents involving previous versions of fleet equipment, changes in legislation/guidance and developments in technology to ensure that new vehicle and equipment designs provide further enhancement of safe working conditions.

The change to zero tailpipe emission vehicles and equipment provides clear health and safety benefits in improving air quality and reducing noise in work environments in the immediate vicinity of operational equipment whilst also reducing the need for colleagues to handle conventional refuelling equipment, but

[1] Greenhouse Gas Protocol | (ghgprotocol.org) **Scope 3** emissions from sources not owned or controlled by LFC are not within scope of this strategy, however under the requirements of the GLA group Responsible Procurement Implementation Plan (RPIP) LFC are working with suppliers to reduce supply-chain carbon emissions.
[2] Collaborative Procurement Board | London City Hall
[3] Ultra-Low Emission Zone - Transport for London (tfl.gov.uk)

potentially also presents some elements of risk with the introduction of vehicle traction batteries and associated charging equipment.

Electrical safety will be a key consideration in all vehicle prototyping and subsequent fleet procurement. All technical developments and legislation will be taken into account including but not limited to:

- BSI pas-7060,7061 & 7062 - Electric Vehicle Standards
- BS ISO 6469 – Electrically propelled road vehicles. Safety specifications Rechargeable ESS.
- ECE Regulation 100 Rev.3 – Harmonized Technical Standard for Wheeled Vehicles
- ISO/SAE 21434:2021 – Road Vehicles Cyber Security Engineering

2.2.2 Reduction of Road Risk

Whilst operational road risk can be affected by various elements, such as driver behaviour and traffic conditions- replacement and modernisation of the fleet presents the opportunity to improve vehicle safety by applying advancements in design and technology.

The London Vision Zero action plan sets out bold and ambitious plans to eliminate deaths and serious injuries from London's transport network. Associated with this plan, TfL's Direct Vision Standard sets requirements for improved driver vision whilst operating HGVs over 12-ton GVW within London.

All LFB HGV support vehicles will meet the criteria of the Direct Vision Standard and whilst fire appliances are exempt from the standard, improvements in vehicle design as a result of the Direct Vision Standard which are able to will be integrated into new appliance specifications.

2.2.3 Equality, Diversity, and Inclusion

This fleet strategy covers the decarbonisation and replacement of LFB fleet assets utilised by members of LFB staff. Whilst vehicles and equipment utilised by the brigade are subject to several legal and other safety requirements which determine much of the vehicles design, for example - *BSEN1846 Safety and Performance Standard for Fire Fighting and Rescue Service Vehicles,* there is the opportunity for the brigade to consider and where possible improve the inclusiveness and accessibility of the fleet by utilising an inclusive design review process.

This process is applied as a "business as usual" practice for every fleet replacement project, consulting with users and reviewing outgoing assets for areas of improvement to be included by the LFB FLEET team in the next assets specification. An example of physical changes between generations of vehicles to improve inclusiveness via accessibility as a result of FLEET teamwork is the change of Command Support Units from the previous truck body type to the new low floor "bus" body type, this change allows much easier access due to the removal of steps to enter and exit the vehicles.

Further considerations for fleet replacements will include how information is presented to the user – partly as a neurodiversity consideration but also for practicality - some manufacturers information is presented in intensive and highly technical formats, generally using extensive black text on white backgrounds. Reducing un-necessary text at the point of use and considering the format of text and colours used for backgrounds where possible should prove to be particularly beneficial for neurodivergent colleagues, any changes of this type will be subject to consultation with the Neurodiversity ESG to ensure the quality of the solutions provided. All asset specifications and/or modifications are designed and approved by the LFB FLEET team, with all modifications completed or managed by Babcock as part of the vehicle and equipment maintenance contract.

All procurement is completed in line with LFB Policy 696 - The GLA group responsible procurement policy, of which Sections 5 & 6 detail requirements relating to EDI from LFBs supply chain.

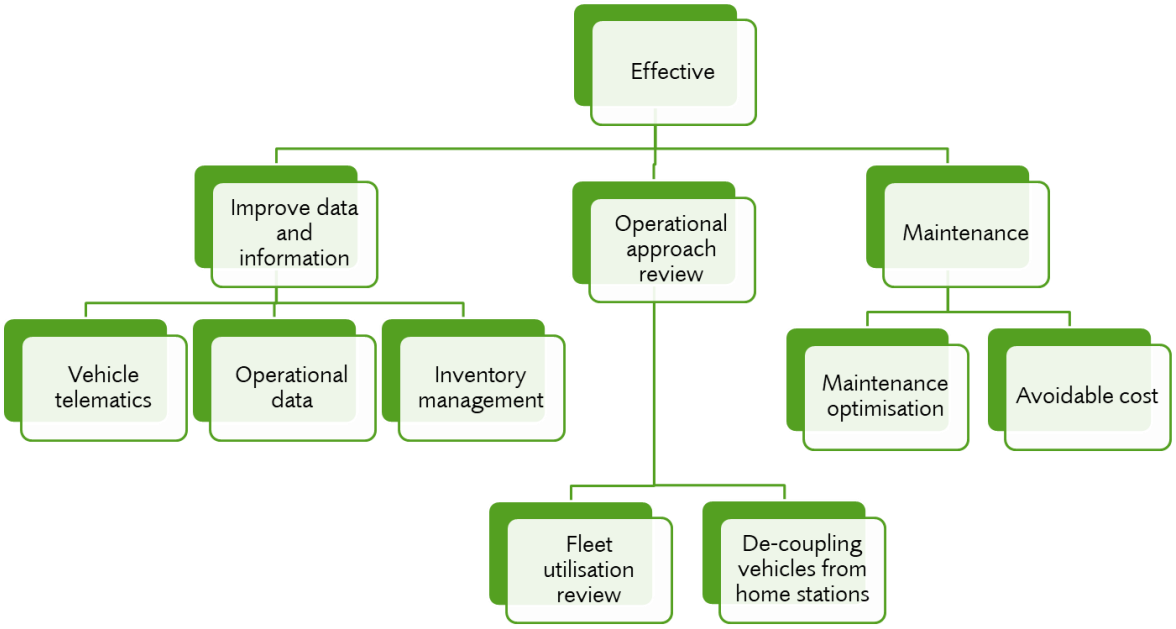
2.3 Assumptions

The Mayor of London's Objective	An objective of this Fleet Strategy is to achieve carbon net zero tailpipe emissions for London Fire Brigade's fleet of vehicles. It is assumed the Mayor of London does not change the targets that underpin this strategy. For example, the exclusion of emissions created during the manufacture and transport of the vehicles from the carbon targets before they join London Fire Brigade's fleet.
The Mayor of London's Target Date	The aspirational date specified by the Mayor of London for London Fire Brigade to achieve this objective will remain as 1st January 2030, as opposed to the central government target date for the UK to achieve this objective by 2050.
Technology Market	The technology market, both vehicle and fuel, will mature over the coming decade, improving capability, reliability, and affordability of new and converted solutions. Original Equipment Manufacturers (OEMs) are expected to be incentivised to develop capable, reliable, and affordable solutions as national and international demand for alternatively fuelled vehicles increases.
Operational Approach	London Fire Brigade's current operational approach can be evolved and adapted and the 'like for like' asset replacement strategy can be innovated to include zero tailpipe emission technology.
Fleet Resilience	London Fire Brigade's fleet requires the same/improved level of resilience achieved through business continuity planning. Alternatively fuelled vehicle solutions will be available that do not negatively impact the resilience of London Fire Brigade's fleet. This includes the fuelling and any new part requirements resulting from the transition to alternatively fuelled vehicles.
Infrastructure	London Fire Brigade's infrastructure, specifically fire stations, can be developed in a timely manner to accommodate the needs of the fleet as the vehicles and equipment are transitioned over to alternative solutions. This will also require revision of station management policies regarding the use of infrastructure.

Electricity Supply	Sufficient carbon net zero electricity will continue to be available and economically viable. This is expected to be a combination of zero carbon electricity purchased from suppliers and that generated locally at LFB premises utilising solar panels.
Fleet Funding	Increased funding is available to allow the Fleet Strategy objectives to be achieved by the specified target date.
Resource Training	London Fire Brigade and Babcock staff will be adequately upskilled via a long-term plan providing comprehensive training, whether that be for the operation, management, or maintenance of alternatively fuelled vehicles.
Stakeholder Engagement	There is organisation-wide buy in and alignment to this Fleet Strategy from London Fire Brigade stakeholders throughout the duration of this transition to the modernised vehicle and equipment fleet which will be achieved with ongoing communication and internal stakeholder management.
Workforce	Any assets will be as inclusive as possible, whilst maintaining practicality, for all members as London Fire Brigade's workforce continues to diversify over the coming decade.
London's Risk Profile	Any developments to London's risk profile are disseminated throughout London Fire Brigade and encompassed, where relevant, into the application of this Fleet Strategy.

3 Principles

3.1 Principle 1 – Effective Programme



3.1.1 Vehicle Telematics and Operational Data

Real time, accurate data is necessary to understand exactly how LFB use the current fleet and therefore which solutions will be a success. A limited level is presently in operation across the fleet with a review currently underway to investigate more widespread use. Investment in technology and data will be the subject of discrete business cases aligned to the LFB governance process.

There is a wide range of possible opportunities to gather data and generate information on fleet utilisation and impact. These include, but are not limited to:

- Telematics
  - Location
  - Vehicle use (drive)
  - Equipment use (auxiliary power requirement – fire pump/turntable ladder)
  - Fuel usage/battery state of charge
- Operational data
  - Fuel dispensed/Vehicle charger information
  - False alarms attended
  - Vehicles required vs personnel required vs equipment required

The decision to invest in and develop any solution will be based on data provided by telematics and operational records. The two programmes within this principle and the projects within them are shown in the graphic below and on the plan on a page.

3.1.2 Inventory Management

The fleet includes over 100,000 pieces of equipment, the aim of this project is to implement a software solution to track each item of equipment, maintain maintenance records, life cycle costings and service details. The software will also enable firefighters to raise equipment maintenance jobs, transfer equipment between appliances and report any issues. Additionally, the system will be used to collate all requests for new equipment or service requests to intelligently route the day van service eliminating the need to visit stations unnecessarily.

Equipment will be provided with a unique identity using tags, scanning hardware will also be procured to read the tags intelligently and efficiently. This solution would also align the Brigade to other blue light partners such as the LAS and other Fire and Rescue Services.

A further benefit of employing this solution is the potential for cost saving in relation to a reduction of the amount of equipment held within the Brigade due to the removal of stockpiling of equipment, lower fuel consumption due to a reduction of day van service miles, and the ability of the Brigade to procure with accurate historical data in the future.

3.1.3 Fleet Utilisation Review

Utilising the data collected through telematics and the operational data available, it is the intention of this strategy to complete a review of the fleet. The purpose of this review is to determine whether LFB's fleet is suitable for the ever present and changing risks of London. Considerations for this review are as follows: are LFB are making the most of the various appliances and equipment across the fleet, in what situations are the vehicles and equipment used in and what exactly they are used for in these scenarios, how often the assets are used, do they need to be more readily available or in more specialist situations, amongst others.

The outcomes of this review will be a good understanding of the fleet and how it is utilised in various scenarios, what vehicles and equipment may be required in the future to meet the needs of London communities, what work may need to be done to the current fleet to bring it up to the required level and peak efficiency.

Some data analysis was completed as an initial part of the strategy development to gain understanding of the operational data available and what additional data may be required. Please see the tables below:

Asset Types	**Incidents Attended**
Bulk Foam Unit	11
CBRN Unit	356
Command Unit	2,027
Deputy Assistant Commissioner	6

Equipment Lorry	19
Fire Boat	108
Fire Investigation Unit	1,466
Fire Rescue Unit	8,620
High Volume Pump Base	18
High Volume Pump Hose Pod	1
Hose Laying Lorry	40
Incident Support Personnel	142
Ops Support Unit	461
Prime Mover (Resilience)	32
Pump	39,479
Pump Ladder	82,008
Pump Ladder - Single Pump	50,100
Pump Ladder @ FRU/ALP Stn	20,977
Station Commander	898
Turntable Ladder	5,393
Turntable Ladder 64m	500
USAR Pod (Resilience)	6
Grand Total	**212,668**

Incident Type	No of Incidents	Average Incident Duration Seconds	Average Pump Count	Average Pump Hours	Average No. FRU	Average No. Aerials
AFA	46,566	809.12	1.82	1.83	0.07	0.11
Chimney Fire	15	2,503.47	1.73	2.33	0.00	0.27
False alarm - Good intent	11,840	1,046.71	1.77	1.80	0.07	0.12
False alarm - Malicious	1,009	995.02	1.81	1.83	0.07	0.11
Flood call attended - Batch mobilised	234	11,801.02	1.01	2.44	0.00	0.00
Late Call	7		1.14	1.14	0.00	0.00
NULL	2,279	644.00	1.20	1.19	0.00	0.00
Primary Fire	9,118	2,303.93	2.75	5.22	0.11	0.19
Secondary Fire	10,157	1,180.56	1.18	1.32	0.00	0.01
Special Service	46,445	1,663.93	1.11	1.29	0.08	0.01
Standby	7		1.14	1.14	0.14	0.00
Use of Special Operations Room	37	757.50	1.00	1.00	0.00	0.00
Grand Total	**127,714**	**1,298.59**	**1.56**	**1.82**	**0.07**	**0.07**

3.1.4 De-coupling Vehicles

Currently LFB's fleet of vehicles have a specific home station for each vehicle and vehicle type. This is based on the most appropriate strategic location for the type of appliance and the ability to fit the appliance in the station. This is most notable for the 64m Turntable Ladders (TLs) that are on a 32-ton chassis vehicle, 12m long and nearly 4m tall, which are the biggest vehicle on the fleet and are only able to fit in a small number of stations because of this. The intention of de-coupling is to increase the flexibility of the fleet and balancing the operational usage across vehicles that have previously been at busier stations with vehicles that have

previously been at quieter stations. This will have benefits seen by both operational colleagues and the FLEET team, through reduced equipment restows with longer gaps between them saving LFB time, money and will have a positive impact on the reduction of CO2 emissions of the fleet. In addition, wear will be more evenly distributed across the fleet ensuring that there will be a reduced risk to some vehicles needing significantly more repair work, increased downtime in workshops and becoming unviable towards the end of their operational life.

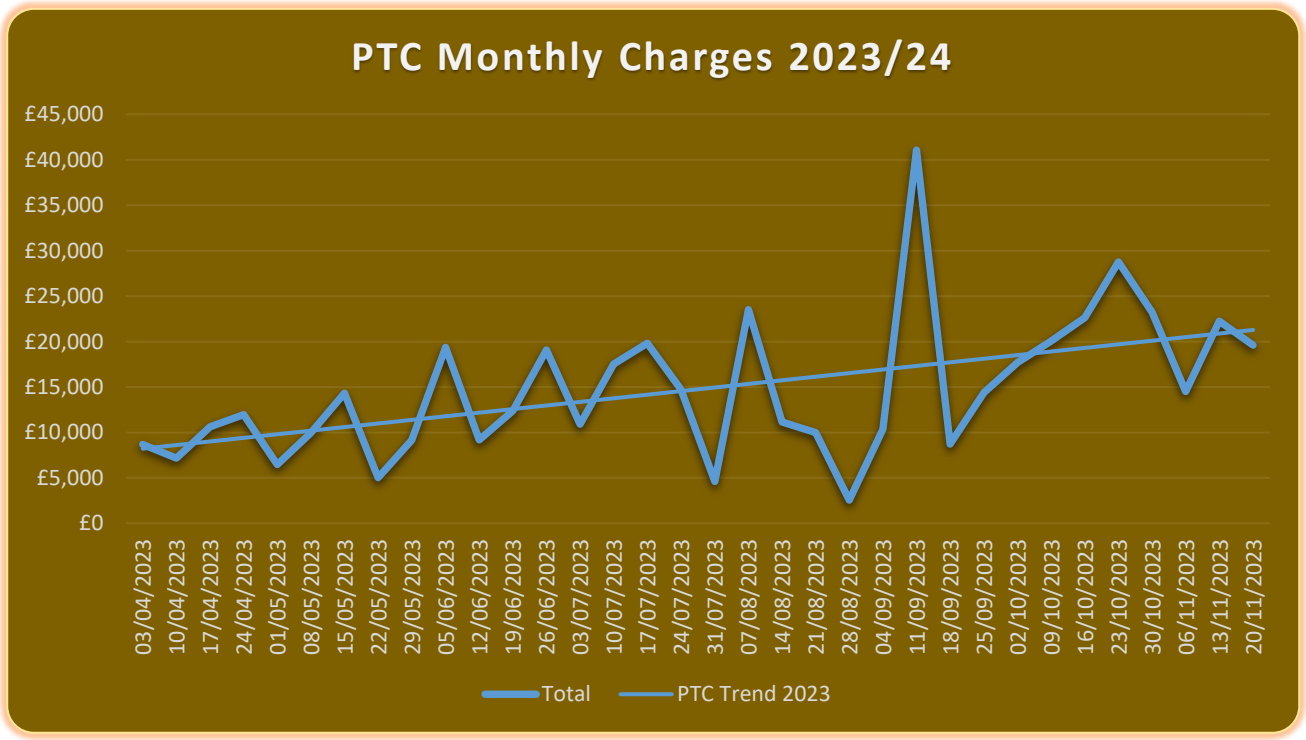
3.1.5 Maintenance Optimisation

Maintenance is an integral part of fleet management ensuring efficiency and reliability throughout the operational life of vehicles and equipment. Ensuring this is completed in a timely and professional manner is vital. LFB outsource the maintenance of vehicles and equipment to Babcock International Group as mentioned throughout this strategy. LFB comprehensively monitor vehicle off road time along with analysis of repair information to ensure maximum availability of assets.

Quality assurance is provided by Applus who complete independent inspection of vehicles completed by Babcock and provide detailed assessment ad reporting to LFB FLEET.

Pass Through Costs (PTC) are all repair and maintenance costs (non-fair wear and tear) which are not covered by the terms of the contract with Babcock.

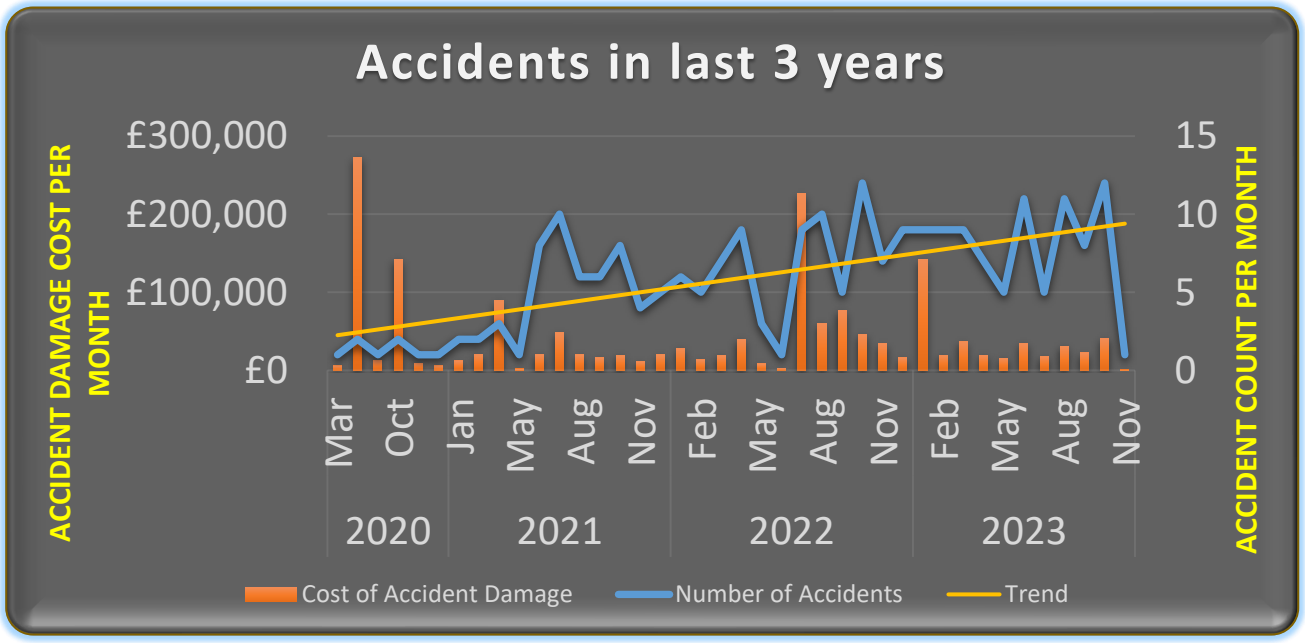
Summary information for these is provided by Babcock at predetermined dates, including an overview of all the maintenance completed as part of a service or coded defect that they do not consider to be included within the contract. This is reviewed internally by the engineers within FLEET and accepted or rejected. Through the current process monetary savings have been made, but the future project around this process is to ensure that the items that come up on a regular basis are either absorbed into the normal maintenance cost, or training and engineering solutions are provided to reduce the instances of reoccurrence.



As can be seen in the graph above the PTC monthly costs for 2023 show an upward trend. This could be due to several factors, such as increased accident damage, inflationary cost increases of parts and number or type of vehicles in the workshop at any one time. However, this project will investigate the reasons behind this and aim to reduce the monthly costs going forward.

3.1.6 Variable Costs

The graph below demonstrates the increase in accidents over the last three years and the costs associated with these.



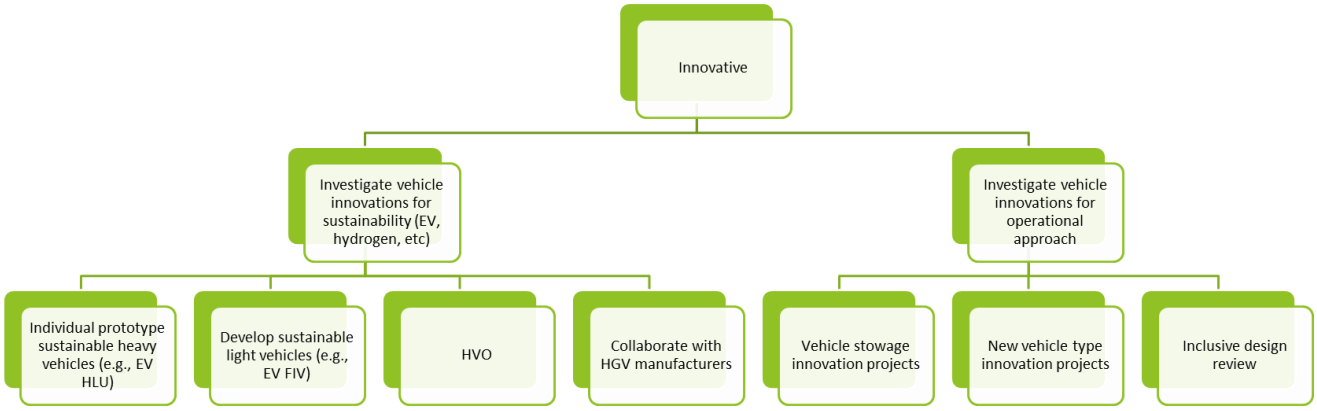
This accident data is regularly collected, updated, and analysed to:

- Monitor costs and associated vehicle downtime.
- Determine repeat issues.
- Identify risks.
- Identify training requirements.
- Educate operational users about the causes of accidents and costs to the organisation.

3.2 Principle 2 – Innovation Programme

LFB has committed to moving to a state of Carbon Net Zero. The ongoing evolution of the technology market, and previous stimulation of the market by LFB through their ZEPA (Zero Emission Pumping Appliance) project, indicate that there is a need for LFB to remain focused on emerging trends and technologies globally.

The below chart shows the programmes and summary of the projects for the second principle of the strategy:



3.2.1 Indicative Projects and Information

- Inclusive Design Review
- Ensure the completion of equality impact assessments per vehicle, equipment, and stowage solution changes.
- Ensure inclusion is in mind when designing and procuring vehicles.
- Vehicle Stowage Projects
- Equipment and vehicle stowage review, determine types of equipment used at commonly attended incidents and where they are stowed on vehicles.
- Ensure that a stowage review is undertaken when a new piece of equipment is required to be carried on a vehicle and make decisions on whether any equipment can be moved or removed to make space.
- Utilising data to make decisions on whether equipment should be non-mobile specials for certain times of year, incidents, or activities.

3.2.2 New Vehicle and Equipment Projects

- Determine whether there are any known or emerging risks that would benefit from new types of vehicles and equipment.
- Proof of concept vehicles.
- Innovative Carbon Reduction technology
- Continually assess vehicle technology market for innovative new solutions.

3.2.3 Individual Prototype Vehicles

- Where needed prototype vehicles will be developed with the aim of adding them to the operational fleet for assessment and training in advance of the scheduled replacement of that vehicle type. This will most likely be limited to specialist heavy vehicles.

3.2.4 HVO Project Implementation

- Following the successful conclusion of the present limited two station HVO trial, it is intended to deploy HVO to all stations with compatible vehicles and bunkered fuel facilities and then optimise the use of these facilities where practical whilst retaining access to conventional fuel cards.

These innovations will lead to an improvement of our operational capability, adhere to LFB carbon reduction commitments, and ensure inclusion is at the forefront.

3.3 Assessment of Alternatives to Diesel Fuelled Fleet Vehicles

Solution A – Battery Electric Vehicle (BEV) – Decision: Viable - Pursue

- BEV is a zero-tailpipe emissions option.
- Electric infrastructure will be viable in Greater London.
- BEV alternatives to most Fleet Types are already commercially available.

Solution B – Hydrogen – Decision: Unviable – Do not pursue for the next 12 months

- **B(1) – Hydrogen Fuel Cell Electric Vehicle (FCEV)**
- **B(2) – Hydrogen Internal Combustion Engine (H_2 ICE)**
- Carbon zero tailpipe emission option which is carbon net zero subject to the usage of green hydrogen, however, when used in Internal Combustion Engine hydrogen is not zero tailpipe emissions due to the nitrogen oxide emissions.
- No reliable supply of green hydrogen is available and there is very limited refuelling infrastructure in Greater London.
- Hydrogen alternatives to most Fleet Types are not commercially available.

Solution C – Biofuel – Decision: Viable – Pursue HVO as interim measure

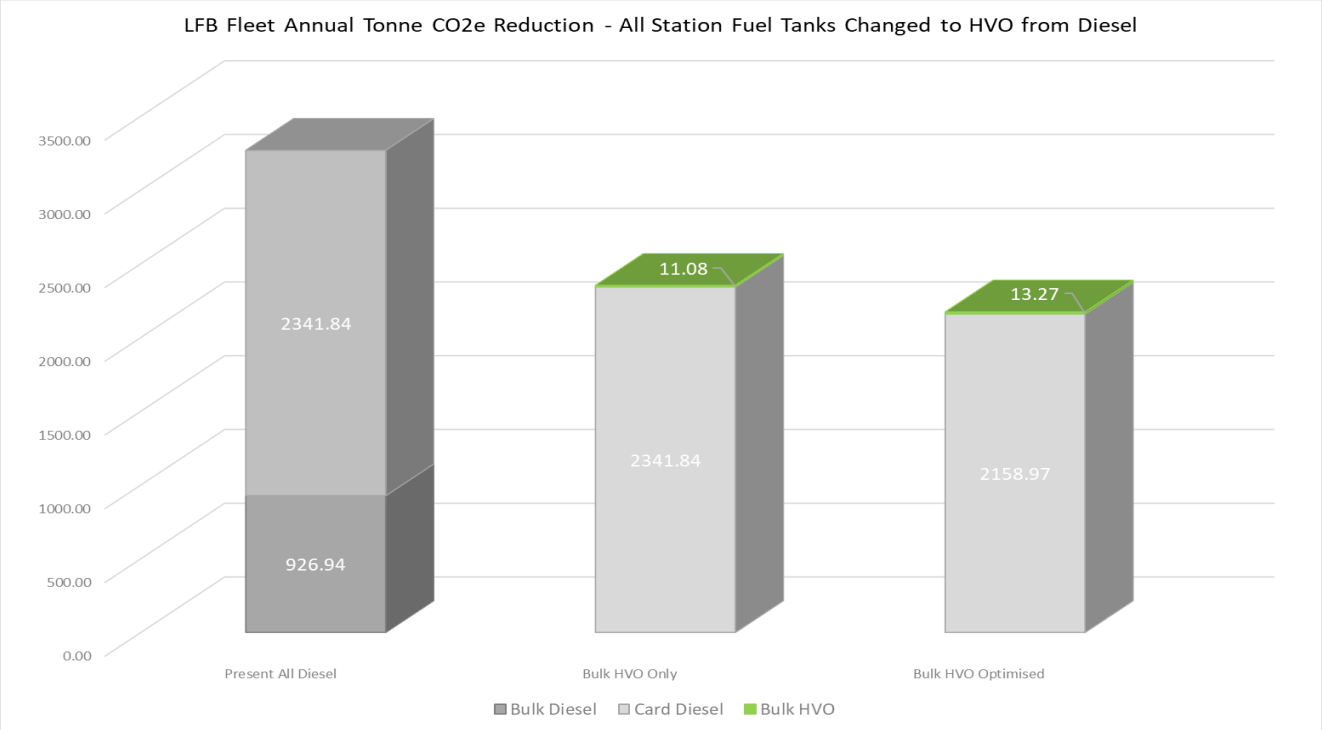
- HVO (Hydrotreated Vegetable Oil) provides a reduction in carbon emissions due to the lack of fossil fuel usage when compared to diesel and may offer a partial reduction in tailpipe emissions.
- HVO not widely available at public fuelling stations – bulk fuel tanks (strategic diesel tanks) would need to be utilised.
- Most diesel vehicles on fleet are HVO compatible.

Solution D – Synthetic Fuel – Decision: Unviable – Do not pursue for the next 12 months

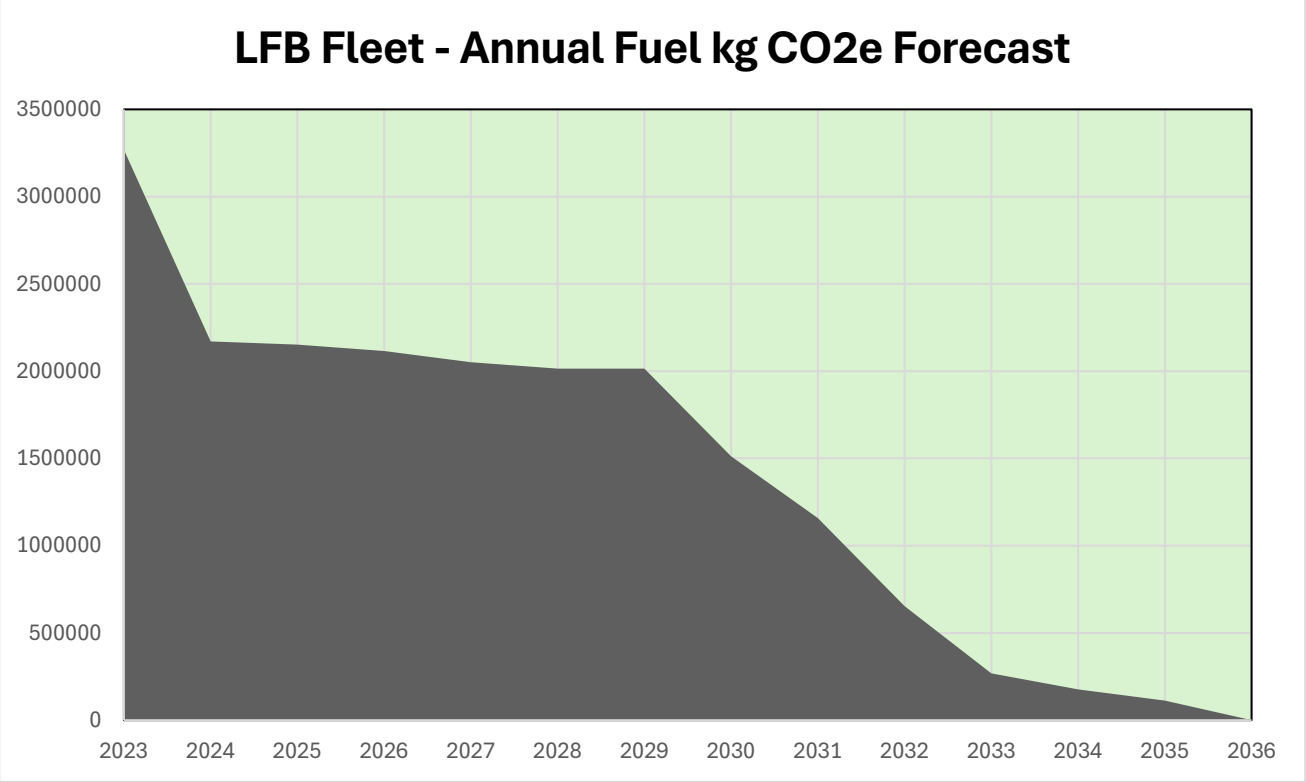
- Synthetic fuels are produced by capturing carbon from the atmosphere and using renewable electricity to convert this into a combustible liquid, and hence are carbon net zero, however not carbon zero tailpipe emissions.
- Synthetic fuels are inefficient and are currently prohibitively expensive – the amount of energy used to produce them does not equate to the energy they release.
- The diesel vehicles on fleet are synthetic fuel compatible.

A number of innovations are required, not just in terms of the vehicle propulsion, but with regards to the stowage on vehicles, equipment carried and potentially different types of vehicles. These projects will be led by the data collected and analysed with the help of the work completed through the first principle. In addition, HVO is an interim measure that will be utilised in some of the fleet until a fully zero tailpipe emissions option.

The graph below shows the carbon emission reduction when the bulk fuel tanks at stations are changed to hold HVO instead of diesel.



Following the ARP replacements that are currently planned the below graph demonstrates how the carbon emissions will decrease with the use of HVO across the vehicles at the bulk fuel tank stations in 2024 and then the replacements of each of the vehicles with zero tailpipe emission alternatives.



There is not presently an existing comprehensive solution ready which is able to fully decarbonise the LFB fleet. As such possible solutions have been analysed for suitability of progression, as tabled above and further detailed in Appendix 2.

Decarbonisation has been started successfully prior to the commencement of this strategy by replacing cars and light 4x4 vehicles with BEV and PHEV models.

The next step of decarbonisation is expected to be achieved by the expanded use of HVO fuel in our existing vehicle fleet, based at stations with bunkered fuel facilities.

Following this, further decarbonisation and removal of exhaust emissions is planned to be achieved by electrification of the fleet as assets become due for renewal as per the asset replacement programme. Existing diesel vehicles will not be removed from service early but will be replaced with zero tail pipe emission vehicles at their next scheduled replacement.

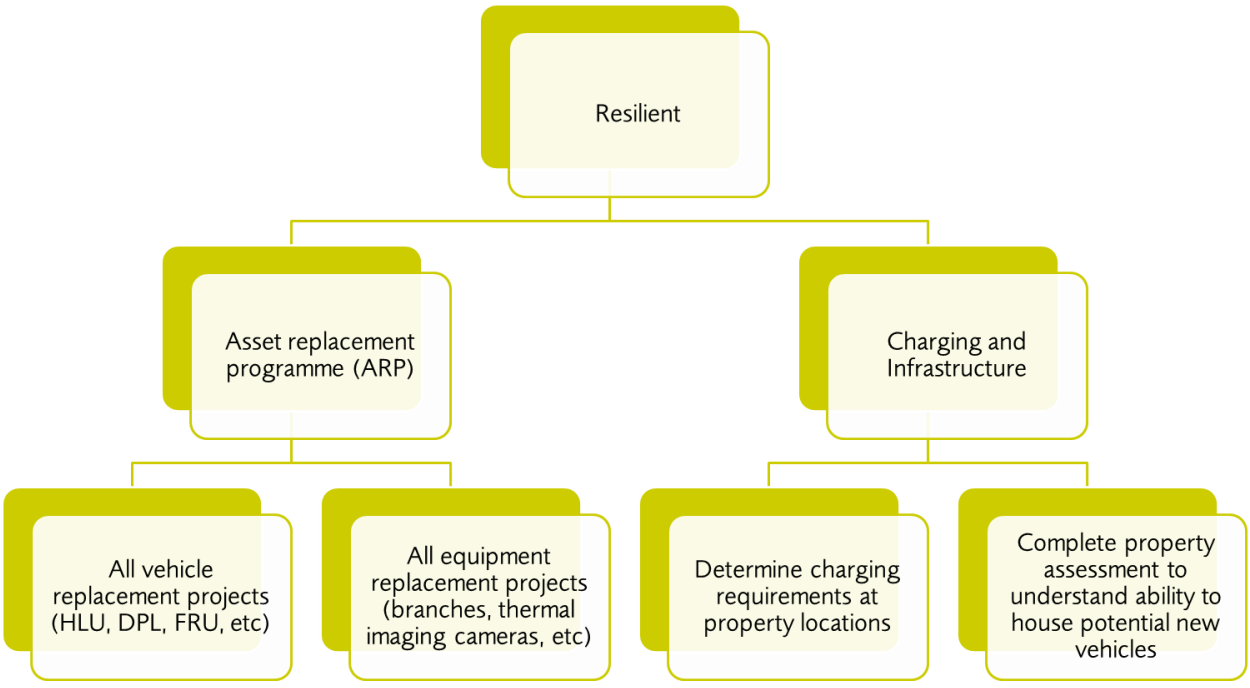
LFB vehicles have varying degrees of complexity, in some cases this will require development and prototyping of vehicles prior to replacement commitment.

Deployment of electric vehicles requires appropriate charging and support infrastructure to provide operational resilience, this will be forecast and planned in line with fleet replacement.

Whilst Hydrogen and E-Fuels options have been assessed as not viable presently or in the foreseeable future they will be reviewed annually for progress within their sectors. Any other potential new technologies will also be reviewed as part of this process.

3.4 Principle 3 – Resilience Programme

The Asset Replacement Programme (ARP) is the current fleet replacement programme and that encompasses all vehicle and equipment replacement projects. This will be accompanied by the required charging infrastructure.



3.4.1 All Vehicle and Equipment Replacement Projects

All current and replacement vehicle and equipment projects are included in FLEET capital projects and replacement programme and the department financial forecasts. Any new vehicles and equipment would need to have a business case and be approved before becoming a live project. These display a level of resilience because these will be programmed in at each replacement cycle unless it is otherwise agreed, and therefore, it is expected that they will be available in the future.

As Babcock are the holder of LFB's vehicle and equipment contract, they are the suppliers for the procurement of the assets within that and therefore, the procurement exercises are completed through their tender process.

During the final stages of the procurement process, the assets are attributed an operational life, this is achieved through the life policy given to the piece of equipment before and recommendations from OEMs.

Once the life of the asset has been determined, there is an expected maintenance cost to the vehicle or equipment, this is called the slot price and is a charge paid at specified increments.

When the asset has reached the end of its operational life, it's replaced, currently like for like with a review of the requirements. However, it is suggested to complete a more thorough review of whether the equipment is still required or not based on the data, rather than assume that it still is.

LFB Asset Replacement Programme 2024-35

	Fleet	Code	Qty	Life	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Specialist Heavy Vehicles	Hose Layer Units	HLU	5	12			5									
	Cold Cutter	CC	1	7			1									
	Pumping Appliances	DPL	188	12						53	41	52	42			
	All Wheel Drive	AWD	1	10									1			
	Detection Investigation Monitoring	DIM	1	10									1			
	Fire Rescue Units	FRU	18	12										18		
	Heavy Distribution Unit	HDU	5	12											5	
	Command Units	CSU	9	12											9	
	Operational Support Units	OSU/LRL	9	12											9	
	Aerials - 32m	TL	12	15												12
	Aerials - 64m	TLE	3	15												3
Light Vehicles	SOG & Commissioner 4X4	CH	9	5	3	6										
	Vans (Various/All)	MV/MVT/UV/UVL/FID/FIV	26	7	5	8	27	14	5							
	Pool Cars	CEV	52	5					50							
	ERD Cars	CEV	2	5					2							

Prototype Development	
Procurement	
Replacement	

3.4.2 Charging and Infrastructure

Vehicle charging and associated equipment will be required at all LFB stations and other premises where fleet vehicles are based. Requirements for increased power supply have presently been estimated at 500kVa capacity per site but this is subject to confirmation which will be determined from the type and number of fleet vehicles based at each location and operational data.

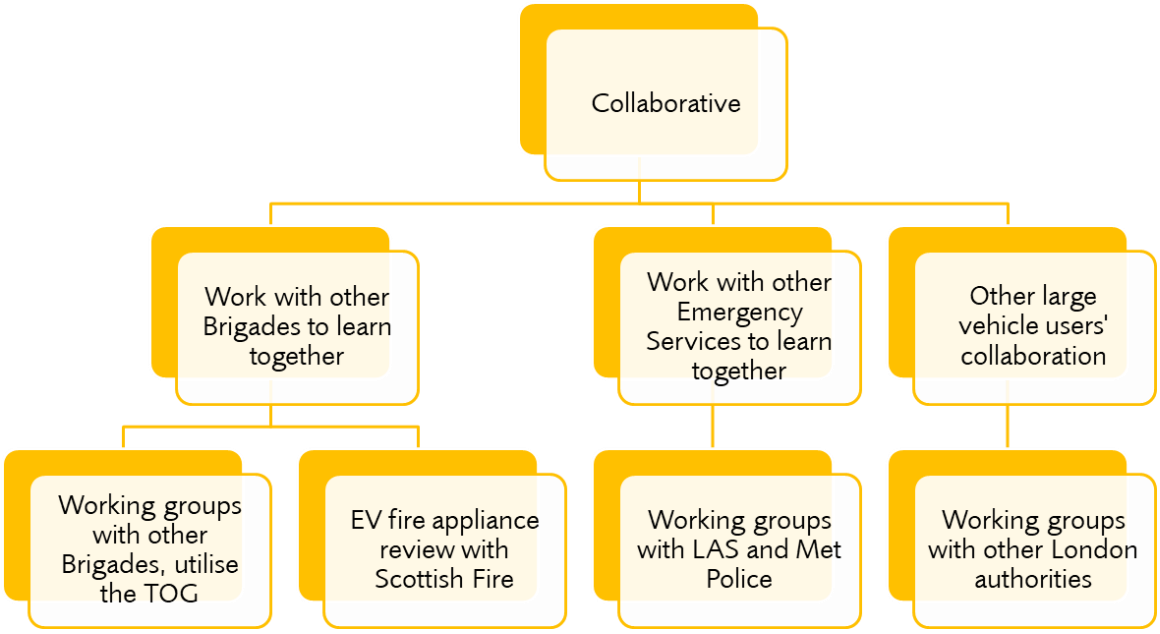
Charging equipment will need to be installed in accordance with, and in advance of the fleet asset replacement programme.

Power supply resilience will be included in the fleet projects to ensure that all operational requirements can be met, this will include premises and/or mobile ESS (energy storage systems) such as batteries or in the short term possibly generators. Vehicle-to-Vehicle power management will also be assessed for viability.

3.4.3 Premises Resilience

Subject to the outcome of new vehicle development and resultant potential changes in the weight or size of fleet vehicles there may be premises related issues which effect the viability of operating certain types of vehicles at some locations, this will be a consideration of the asset projects with the intention of avoiding complication where possible.

3.5 Principle 4 – Collaborative programme



LFB are undertaking decarbonisation and modernisation of our fleet at the same time as many other organisations. This presents the opportunity to collaborate to share progress, knowledge, and experience with similar emergency service organisations nationally via the TOG (Technical Officers Group) of the NFCC and possibly even internationally with other fire and rescue services.

There may also potentially be opportunities to work with a variety of GLA or other public sector related bodies within London to secure mutual resilience for vehicle charging and/or possibly reduce infrastructure costs by aligning grid connection upgrade projects.

We will maintain membership and participation with organisations such as ZEMO Partnership and OZEV Specialist Vehicle Group to ensure that we are ahead of legislative changes.

Working with vehicle manufacturers and organisations such as Innovate UK may help promote the requirements of emergency service customers whilst stimulating the market. We will also remain open where appropriate to working with academia and other Babcock clients such as military vehicle users.

Work on the inventory management system engages with contractors that work with other fire and rescue services, allowing utilisation of their knowledge within this area.

LFB have visited Rosenbauer in Austria to evaluate their zero emission capable appliances, whilst the manufacturer stressed that these vehicles are still in the process of development there are pros and cons with their designs which will continue to be evaluated for use by LFB alongside other alternatives.

4 The Initial Direction – Our Recommended Next Steps

Given the outlined potential solutions, the following business case details the recommended next steps to bridge the gap between now and a carbon zero tailpipe emission fleet.

This direction is to be reviewed annually to:

- Evaluate the progress made against the annual Fleet Strategy Action Plan.
- Evaluate the vehicle solutions, both old and new, taking into account any new developments.

4.1 2024 -2026

Complete the ongoing HVO drop-in biofuel trial by March 24. Assuming successful conclusion then transition diesel fleet based at sites with bunkered fuel to HVO by September 2024.

- Pilot telematics across all vehicles and operational data to be recorded across all incidents.
- Engage with peer group organisations to share learnings and align needs.
- Conduct an infrastructure review across LFB's estate, considering the number of vehicles based at each site, their utilisation and electrical consumption, to provide the groundwork for the fleet transition. Work with the LFB Carbon Net Zero project on the specification and number of required electrical charging posts.
- Replace current ICE light vehicles (cars and vans up to 3.5t) with new OEM BEV alternatives.
- Replace current ICE heavy vehicles (HGVs) with no significant auxiliary power requirement (i.e. not Pumping Appliances and Turntable Ladders) with BEV alternatives.
- New from OEM
- Evaluating Repower Options (conversion from diesel to electric)
- Maintain focus on the technology market as new solutions emerge and reach suitable levels of maturity – investigate, prototype, evaluate, and trial alternatively fuelled options to replace current diesel HGVs with significant auxiliary power requirements (i.e. Pumping Appliances and Turntable Ladders).
- New from OEM
- Evaluating Repower Options (conversion from diesel to electric)
- In advance of the next scheduled DPL replacement, carry out concurrent prototype and evaluation workstreams comprising multiple specifications of ZEPA from a variety of suppliers, with and without range extenders, due to finite timescale available.
- Consider expansion of HVO use in the longer term for the Fire Boat fleet, due to the complexity, cost, and limited availability of alternatively fuelled solutions of these types of assets. Evaluate carbon offsetting the emissions they produce as an interim solution until they are replaced with zero tailpipe emission alternatives.
- Pilot transferring remaining ICE-powered Operational Equipment to electric alternatives as and when suitable solutions come to market before the 2030 Mayoral target date.

Each stage of this progress which facilitates a change of equipment for operational staff will include fully costed training in advance of implementation and additional support whilst initially utilised to ensure smooth transitions to new equipment types.

4.2 Transition

The Mayor of London has specified 2030 as the target for London to achieve carbon net zero, however LFB's fleet contains specialist vehicles which are unlikely to be available to purchase before 2030. Additionally, many of these assets are presently relatively new, having been purchased as Euro VI vehicles to meet the ULEZ standards.

LFB internal fleet analysis has shown that, whilst challenging from a technical perspective, carbon net zero can be achieved by 2035 by replacing vehicles with zero tailpipe emission alternatives at their next scheduled replacement. An independent review was completed by Egnida which came to a similar conclusion.

Quantified pressures of the 2030 Mayoral target date:

- Light vehicles: 2 specialist light vehicles would need to be replaced before their disposal dates to meet the 2030 Mayoral target. These include the All-Wheel Drive appliance which is not yet available in any zero tail pipe emission variants, and the Detection Investigation Monitoring van.
- Heavy vehicles (with no significant auxiliary power requirement): 35 HGVs would need to be replaced up to 5 years before their scheduled replacement dates to meet the 2030 Mayoral target. These include all Fire Rescue Units, Command Support Units, Operational Support Units, and Heavy Distribution Units.
- Heavy vehicles (with significant auxiliary power requirements): 150 HGVs (pumping appliances and turntable ladders) would need to be replaced between 2 and 5 years before their scheduled replacement dates to meet the 2030 Mayoral target.

Therefore, LFB will continue to use existing vehicles until their defined replacement dates, where they must then be replaced with alternatively fuelled vehicles.

Fixed replacement cycles (defined asset life policies) are a constraint which could be evolved. Replacement cycles could be extended into regular, evenly spread replacements, which would be associated with benefits to financial reporting (lower, more consistent spend rather than low spend followed by high spend). LFB's contract with Babcock would need to be reviewed to understand how spare appliances would operate i.e. a diesel only fire station being provided with a BEV spare.

4.3 Appropriate Funding

The existing fleet budget will not cover the investment required to replace the entirety of LFB's fleet with carbon zero tailpipe emission alternatives. Both the procurement of new assets and meeting their corresponding infrastructure requirements will necessitate increased funding, and hence there is a gap between the current fleet budget which is already provided for the current 'like for like' asset replacement strategy and the required alternatively fuelled fleet budget (of both capital expenditure and operational expenditure).

The cost of any alternative power solution is high – alternatively fuelled vehicles are currently more expensive than fossil fuel powered vehicles, although this increase will reduce as international demand grows. LFB currently does not have the available funds for an immediate changeover, therefore a slow, iterative process is much more viable. The assets procured will have corresponding infrastructure requirements; fire stations will need to be developed, both physically and in the way they are managed, to accommodate the needs of the fleet as it is transitioned over to alternatively fuelled solutions.

The ZEPA (Zero Emission Pumping Appliance) project initially planned for Stage 1 to provide the first vehicle with Stage 2 consisting of 10 more vehicles of similar specification. Due to delays in operational testing of the first vehicle and limited time available for testing this funding will now be used to develop individual alternative DPL prototypes along with other specialist vehicle types as opposed to multiple ZEPA Stage 1 equivalent vehicles.

In addition to fleet asset costs, significant investment will be required in vehicle charging equipment and associated electrical infrastructure. However, this equipment should last much longer than the vehicle fleet which it serves, and future fuelling costs of the fleet will be significantly reduced by the change to electric from diesel vehicles.

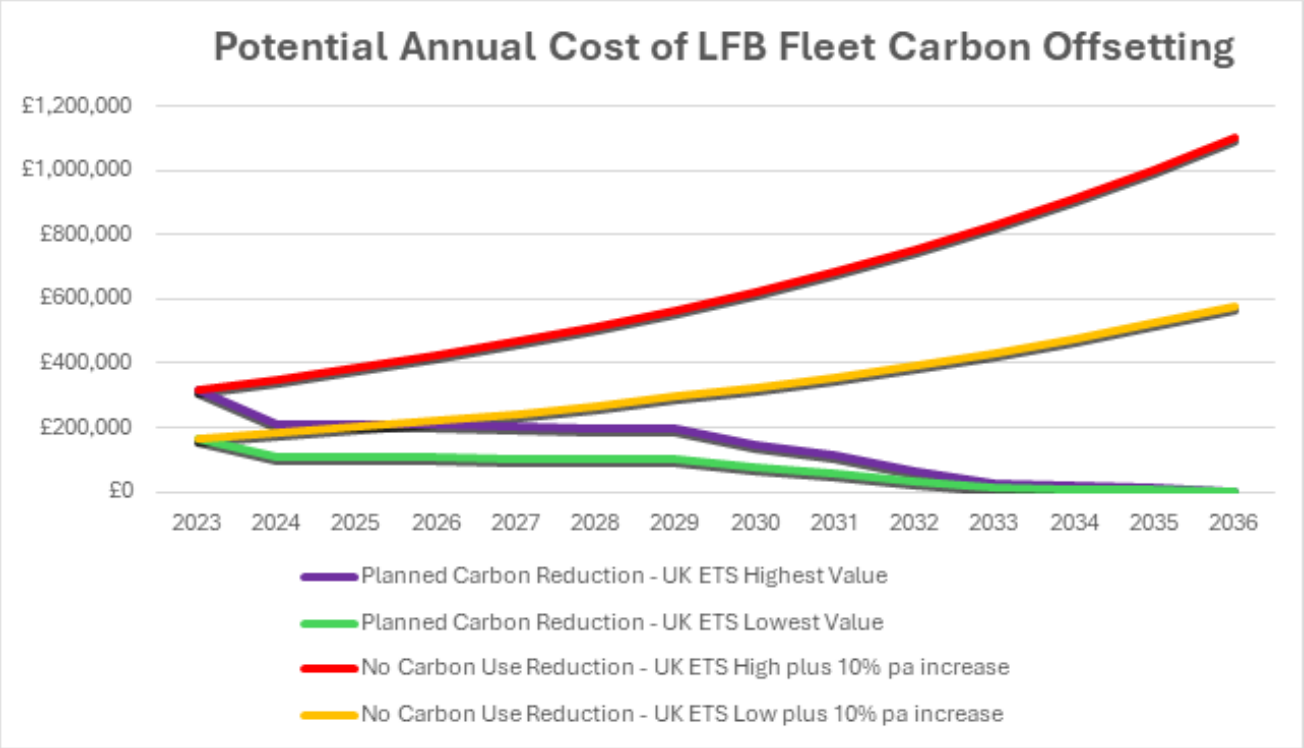
There may also be some requirement for investment in reinforcement of station floors or other similar work dependant on the outcome of our fleet modernisation projects. This will not be able to be quantified until vehicle specific project work has been matured.

4.4 Potential Cost of Offsetting

To achieve Carbon Net Zero from LFB fleet operations it may be necessary for LFB to purchase carbon offsets against the equivalent remaining carbon (fossil fuel) use. Whilst there isn't presently any clear guidance available on the future cost or availability of these offsets and there isn't a specified scheme which LFB would be required to use, the UK governments Emissions Trading Scheme gives an indication of potential future carbon offsetting cost.

The UK ETS (Emissions Trading Scheme) replaced the UKs participation in the EU ETS. Under the scheme a reducing number of allowances are available for purchase each year by annual auction by organisations which continue to consume carbon. As the number of available allowances reduces it is expected that they will increase in price. As the allowances are subject to market forces the value of carbon aligned to them can increase or decrease, although the latter is unlikely over the longer term.

Using the present UK ETS scheme highest and lowest values as a guide with 10% annual increases applied, the annual potential costs of carbon offsetting per year for LFB fleet planned decarbonisation and also no carbon use reduction (theoretical continued full diesel fleet use) are estimated in the graph below.



4.5 Babcock Repair and Maintenance Support Considerations:

There are aspects of achieving this objective, most notably the transition to electric vehicles which directly affect Babcock's ability to provide repair and maintenance support safely and competently for the LFB fleet.

The Ruislip Workshop operation will as a minimum require the following preparation:

- Training of engineering, management, and support staff.
- Assessment of Site infrastructure in relation to use for new vehicle types (size/weight etc)
- Electrical capacity to support vehicle charging requirements.
- Provision of vehicle charging equipment, potentially including moveable chargers within the vehicle workshop bays and provision for charging completed vehicles before return to station.
- Specialist tooling, including MRTs (Mobile Repair Technicians)
- Safety and PPE (Personal Protective Equipment)

The risk profile will need to be revaluated because of the transition from carrying out maintenance activities on traditional Internal Combustion Engine (ICE) vehicles to carrying out maintenance activities on alternatively fuelled vehicles, resulting in the introduction of appropriate risk mitigating factors.

A similar approach will need to be adopted for LFB's vehicle training provider, Babcock Training, who's sites will also require preparation such as electric charging infrastructure, including site capacity, alongside fuel storage and refuelling facilities.

5 Supporting Information

5.1 London Fire Brigade

The London Fire Brigade (LFB) is the firefighting, rescue, and emergency planning service for Greater London. LFB is the busiest Brigade in the United Kingdom and one of the largest firefighting and rescue organisations in the world covering 1587 square kilometres and having attended over 125,000 incidents in 2022 alone. Its mission is to serve and protect London.

LFB is led by the London Fire Commissioner (LFC), the fire and rescue authority for London and employs over 5,000 people, operating from 109 locations including 102 fire stations, the river station and support premises such as headquarters in central London. LFB's vehicles and equipment are required to be reliable and readily available, where unavailability of vehicles and equipment has a significant impact on the Brigade's ability to perform its statutory requirements.

5.2 Vehicle and Equipment Contract

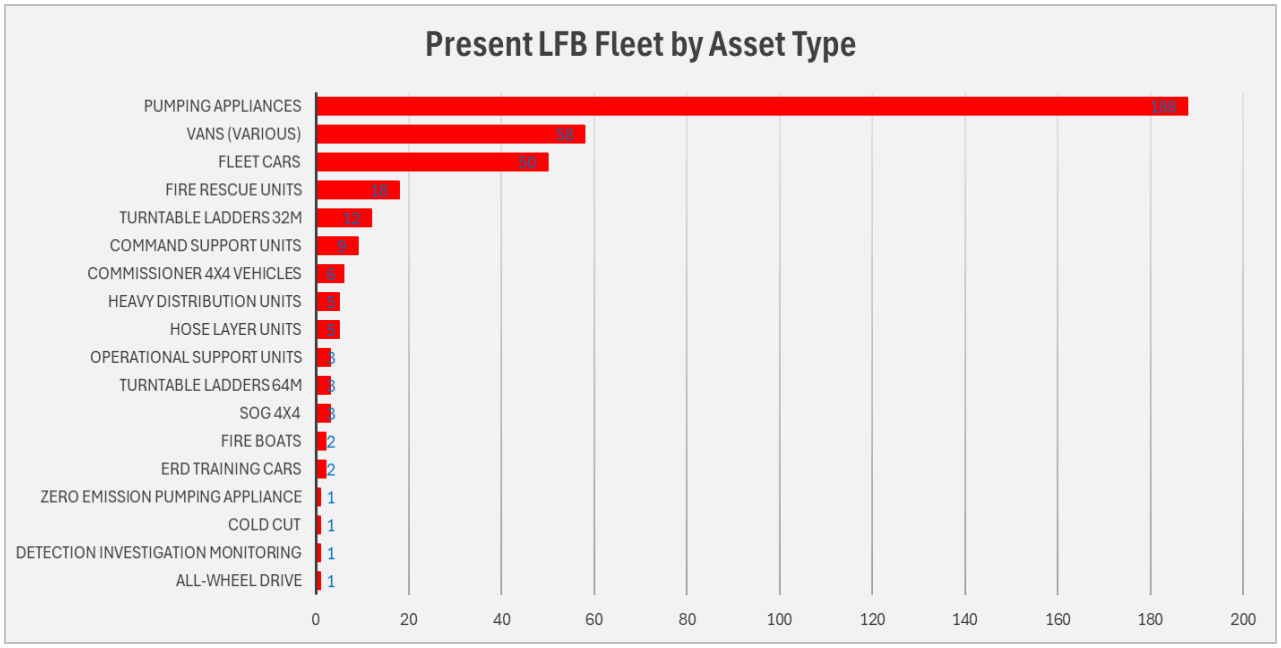
In May 2014, LFB entered a 21-year responsibility for Babcock International Group to manage and maintain LFB's fleet of operational vehicles and equipment, with the aim to improve availability of both vehicles and specialist equipment across Greater London. Babcock support LFB's delivery of vital services to make London a safer city and sustain its status as a world-class fire and rescue service. All assets included within the contract are LFB capital purchases exclusively supplied by Babcock for the duration of the contract.

Babcock International Group is a leading provider of critical, complex engineering services which support national defence, save lives, and protect communities. Babcock focuses on three highly regulated markets – defence, emergency services and civil nuclear – delivering vital services and managing complex assets in the UK and internationally. Babcock is a trusted partner who understands the key roles that technology, expertise, infrastructure, and assets play in ensuring its customers can deliver.

LFB's Vehicle and Equipment (V&E) repair and maintenance contract with Babcock (Critical Services Ltd.) incorporates the Asset Replacement Programme (ARP), for the exclusive replacement of all vehicles and operational equipment covered by the contract. Only non-branded leased cars and equipment managed by the Operational Support Group are outside the scope of the contract with Babcock.

5.2.1 LFB's Current Fleet

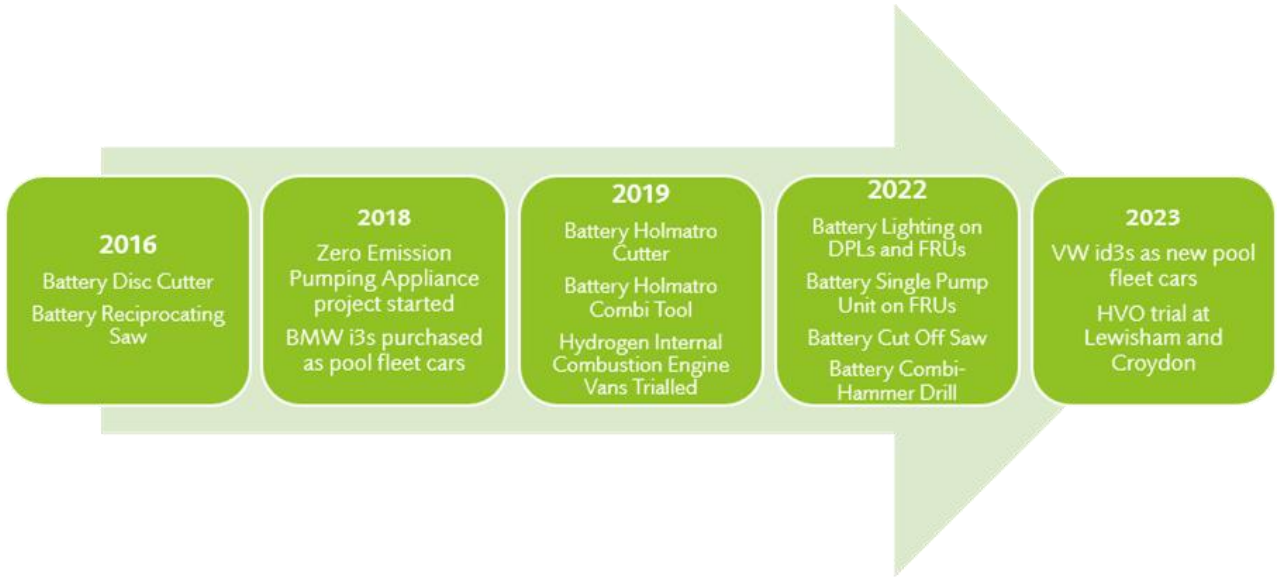
LFB's current fleet of vehicles is comprised of the following vehicle assets:



In addition to approximately 100,000 items of Operational Equipment, including Thermal Imaging Cameras, Firefighting Branches and Ground Attack Monitors.

5.2.2 Asset Replacement Programme

The Asset Replacement Programme (ARP) is a core deliverable within the 21-year V&E Contract for the replacement of vehicles and operational equipment operated by LFB. The current fleet, which is maintained and managed by Babcock. Assets are replaced within their fixed replacement cycles as defined and revised by LFB FLEET with specification variation driven by LFB's policies, operational requirements, and industry product improvements. The constraints of ensuring value, compatibility with existing infrastructure and training costs all need to be embedded into the programme.



The above graphic shows the work already completed as part of the Asset Replacement Programme to phase out polluting equipment and replace with battery operated alternatives to achieve carbon reduction goals across the fleet.

5.2.3 Infrastructure

LFB's Carbon Net Zero Programme is ongoing, with LFB's Estate Strategy currently under development, where one of the most notable goals is the electrification of all 102 fire stations consisting of appliance bays ranging from 2 to 7 in number, all housing at least one appliance. There is a significant age range across the estate, with some old fire stations, and some very new, such as Walthamstow (2012) and West Norwood (2016), where Plumstead is due to be completely refurbished by 2024.

Some of the older fire stations do not possess the ability to house larger vehicles due to the size of vehicle ingress and egress points. An example of this is Bromley Fire Station, where LFB have needed to modify an appliance's ladder gantry to allow the vehicle to pass through the station's restrictive archway. In addition, several fire stations have basements which could be limiting for new technologies due to appliances potentially increasing in weight. The load capacity of fire station appliance bays will need to be assessed to determine whether they can withstand the extra weight that may accompany alternatively fuelled vehicles.

Consideration will need to be given to the electrical capacity available across LFB's estate to allow for the accommodation of future appliances. Currently, except for Hammersmith, none of LFB's fire stations have the required electrical capacity to power the volume of 150 kW (230 A) charge points necessary to meet the changing needs of the number of fleet vehicles based there. The anticipated electrical load capacity is expected to require Distribution Network Operators (DNOs) to install sub-stations solely for the use of each fire station, and hence the present limitations of the estate will need to be considered as part of any future fleet trials and replacements.

In line with the introduction of the plug-in electric BMW i3 Fleet Cars in 2018, 22 kW AC charge points

were installed throughout LFB's estate. The intention presently is for 150 kW charge points to be installed in the leadup to 2030 at fire stations in advance of the deployment of electric HGVs, this will be reviewed as more information around vehicle manufacturers charging requirements and LFBs operational usage can be confirmed.

5.2.4 Technology Market

Over the last two years the range of electric light vehicles (cars and vans) available has developed with a much higher volume of vehicles now being in line with LFB's specifications. Significant progress has been made by the heavy vehicle industry with the major seven manufacturers now all offering ranges of electric HGVs. There are also several businesses providing conversion from diesel to electric alongside chassis preparation for specialised electric vehicles. The existing market for alternatively fuelled fire appliances (specialist HGVs with auxiliary power requirements such as Pumping Appliances and Turntable Ladders) is extremely limited, with no perfect alternatively fuelled solution is available now, where currently only Emergency One (E1) and Rosenbauer have produced completed fire appliance vehicles.

5.2.5 Operational Approach

LFB's operational approach to firefighting and rescue operations is determined by LFB's Operational Policy and Assurance (OP&A) department. Current response targets are 6 minutes on average for the first appliance, and 8 minutes on average for the second appliance, where an appliance must arrive at an incident anywhere in London within 10 minutes for 90% of incidents and within 12 minutes for 95% of incidents. There are a predetermined number of the appliances located strategically in areas of London where they may be required

to mitigate the risk associated to that specific area. One key technical requirement of the Pumping Appliances is that they are specified to be able to pump for 4 hours continuously without refuelling.

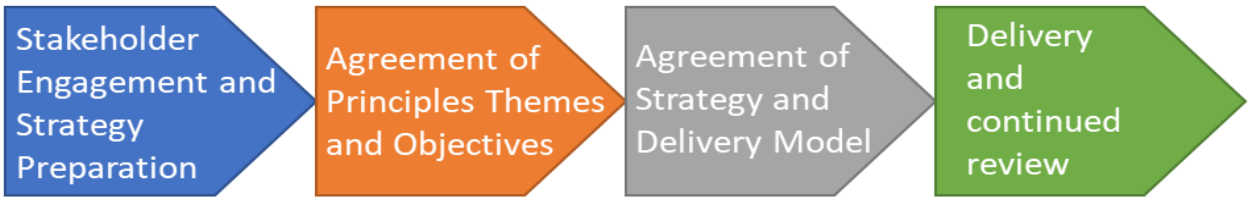
Currently, all appliance replacements have been procured on a 'like for like' basis to maintain crew familiarity with the previous generation of vehicles. To date there has been little appetite for changing, innovating, or adapting LFB's operational approach – the historic 'like for like' asset replacement strategy has limited opportunities for operational change. There have been several new appliances introduced to LFB's fleet to mitigate operational risk in specific circumstances, such as the three 64m Turntable Ladders, however, there has not been a full review of the current 188 Pumping Appliances, considering how they could best be configured to meet any new and emerging risks facing Londoners.

There are frequent requests to introduce new items of equipment to the frontline Pumping Appliances, allowing one vehicle type to attend the vast majority of incident categories. These crews then have the ability to call on more specialist assets when the relevant criteria are met. However, the current Pumping Appliances have limited stowage space available for equipment and as a result these vehicles are already at capacity, hence it is becoming increasingly challenging to meet these additional equipment requirements without removing the presently stowed integral items of equipment.

6 Methodology

6.1 Developing a Vision, Principles and Projects for the Fleet

LFB's Fleet Strategy has been developed in stages:



6.2 The Strategic Context for Development of the Strategy

The LFB is undergoing a transformation programme to improve its culture, governance, and performance in the aftermath of the Grenfell Tower fire in 2017, which was the deadliest fire in the UK since World War II.

The LFB is facing new and emerging risks and challenges that require it to adapt and innovate its services and capabilities including climate change, population growth and security and resilience threats such as terrorism and the fleet will continue to play a vital enabling role in this.

6.3 Preparation for the Strategy

We've incorporated insights and input from our meetings and discussions with crucial stakeholders, sourced from existing working groups and boards across LFB covering Carbon Zero, accident damage, health and safety and equipment design. Additionally, the strategy has been circulated for feedback among enabling services such as strategy and risk, and property. It will be shared with the next Carbon Net Zero Project Board. This engagement process laid the foundation for the principles outlined in the strategy and the drivers in Change Programmes 3, 6 and 8.

This strategy was created in partnership between LFB and Babcock, with research and engagement throughout the emergency services and heavy vehicle supply industries.

6.3.1 The LFB Community Risk Management plan

LFB Community risk management plan

The Community Risk Management Plan (CRMP) is summarised in the diagram below.

The programmes within this strategy relate more closely to CRMP pillar "Representing You" as it sets out a drive towards achieving Net Zero across the fleet.

6.3.2 Views from Stakeholders

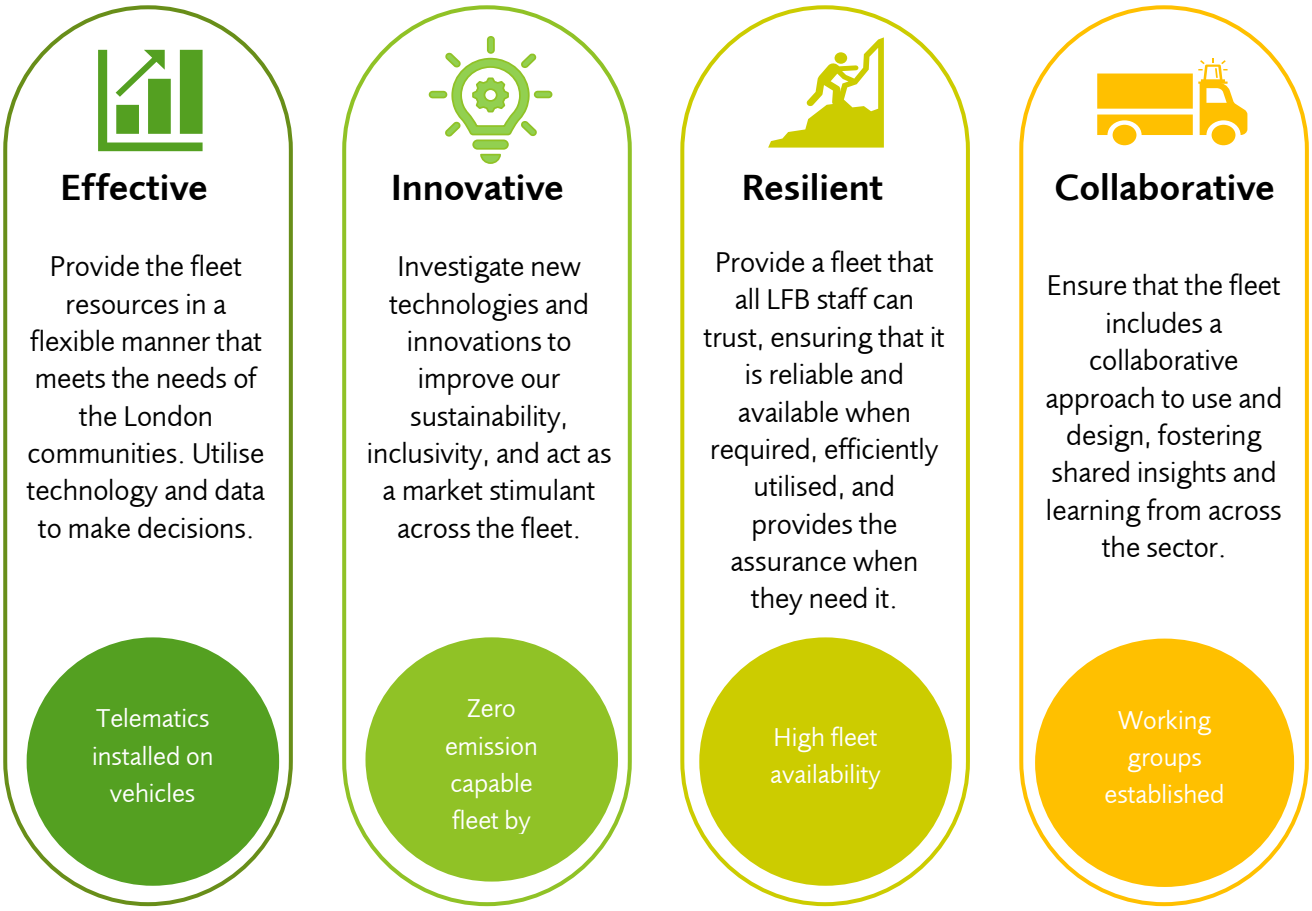
Stakeholder engagement took place early in the development of the problem statements, vision, and principles. This strategy has had a more accelerated timeline than other strategies and therefore, the stakeholder engagement has not been in depth as required. The stakeholder groups engaged with consisted of uniformed and non-uniformed staff at a high level within the Brigade, due to the timeline it is expected that more stakeholder engagement will have to take place as the projects progress.

The engagement consisted of sharing the problem statements, vision, and principles with the selected groups. Any feedback was taken on board and incorporated into the final versions of each. These are displayed in the section below.

Many opportunities were identified during the stakeholder engagement including the potential to better understand in detail the utilisation of the fleet to drive improvements within it. As departmental strategies emerge, the FLEET will continue to consult with stakeholders to introduce and implement more specific requirements across the fleet.

6.4 Fleet Strategy Principles, Vision, and Objectives

6.4.1 Principles



6.4.2 Fleet Vision

The agreed vision for the LFB Fleet is:

Create a strategy that provides a fit for purpose and flexible London Fire Brigade fleet with high capability and reliability, encompassing the sustainable goals of the organisation, encouraging collaborative working and utilising data driven strategic decisions in order to supply all the necessary assets to all of our operational colleagues, maintaining operational responsibilities to ensure their and our community's safety in various situations.

6.4.3 Problem Statements

The below problem statements were developed through collaboration within the FLEET team and stakeholders. These have been able to provide direction for the areas that need improvement and help to determine the principles and therefore the projects within this strategy.

Currently, our maintenance contract consists of an asset replacement program that focusses on like for like replacements and a Property Departmental Carbon Net Zero Strategy that includes a Mayoral target of CNZ by 2030. We do not have a dedicated fleet strategy in its entirety.

Across the Brigade's 102 fire stations there are 188 DPLs with 143 available for use at any time. These are all the exact same vehicle, utilised in two stowage variations to carry the majority of the same equipment to

incidents. In a dynamic city such as London, LFB fleet needs to meet operational needs efficiently and effectively in an agile and flexible manner.

In addition, there are a number of other FRS across the country that have differing fleet make ups, and while they may have varying conditions in comparison to London, there are learning opportunities for LFB to engage with.

7 Appendix 1 - Telematics Briefing Note published March 2023

Summary

This briefing note outlines a phased plan of introducing telemetry onto the London Fire Brigades fleet of vehicles, and the benefits and opportunities it presents.

Background Information

A number of London Fire Brigades vehicles already have telemetry capabilities that are built in by the manufacture which can be activated for a monthly subscription fee. There are several telemetry solutions available on the market, however for ease, this report will look at the existing capabilities, E1 Fleet Telemetry and Scania Telemetry to provide examples of costs.

Recommendations

It is recommended that authorisation is given to carry out a phased implementation of telemetry onto London Fire Brigades fleet of vehicles over the three stages outlined in this briefing note. Phase one is a pilot of 31 vehicles, phase two is installing and activating telemetry on all front-line response vehicles, and phase three is to install and activate telemetry across the whole fleet, including vans and cars. It must be noted that the costs within this report are estimates only and will change depending on the provider we chose.

Phase one: Pilot of 10 Training Vehicles, 15 TLs, ZEPA 1, and five EFCC vehicles. This will help to determine the vehicles usage, what it will influence (maintenance regimes, real life data, real time data etc), at incident pumping data and to see how our vehicles are used at incidents to advise future vehicle strategies and usage.

Phase One pricing table redacted.

Phase Two: Role out of telemetry to all front-line response vehicles as detailed in the below table. This will provide LFB with valuable insight on how often front-line vehicles are used, what and how long they are used for, and assist with future vehicle strategies, based on real life data.

15 DPLs have already been captured in Phase One, leaving 174 requiring telemetry and 189 requiring annual subscriptions.

All 15 Aerials have already been captured in Phase One, and so will only require annual subscription fees.

ZEPA 1 has already been captured in Phase One, and so will only require annual subscription fees.

Phase Two pricing table redacted.

Phase Three: Role out of telemetry across the remainder of the fleet cars and vans. This stage will involve continuing annual subscriptions for all previously shown fleet, with the addition of cars and vans telemetry installation and annual subscription costs.

Phase Three pricing table redacted.

Benefits

Telemetry data can be tailored to provide information specific to LFBs requirements. For example, information can be extracted on geofencing, speed travelled, braking pressure, instant vehicle defect warnings, blue light activation mode, PTO (power take off), 'arrive at scene' data, and pumping data. This information can be collated within an application and exported for review and inform vehicle output specifications for new and replacement assets, as well as feeding into future fleet strategies.

Furthermore, telemetry can support accident investigations in a timelier manner, and provide a clarified understanding of events. Accident investigations will become more efficient, and support our staff involved in incidents by offering clarity around the events. Not only can telemetry support investigations around accidents, it can also assist with security related incidents. LFB have experienced a high number of equipment thefts from the fleet which has resulted in high replacement costs. Telemetry can provide enhanced vehicle security and additionally provide greater assistance with investigations by supporting internal and Police investigations.

Other more generic telemetry benefits include:

- Real-time vehicle monitoring,
- Maintenance optimisation,
- Enhanced vehicle security,
- Fuel/energy usage and efficiency,
- Eco-driving training and carbon footprint monitoring - This feedback encourages eco-driving techniques, such as smooth acceleration and deceleration, maintaining steady speeds, and avoiding unnecessary idling (when not responding to emergencies). This type of data can be used to reduce LFBs carbon footprint, inform fleet strategies and even be more far-reaching by educating drivers in their personal vehicles to drive in an eco-friendlier way.

Considerations

It is worth noting that only the vehicles manufacturer can provide accurate speedometer data, and that aftermarket telemetry will only provide GPS speed data, which is not as accurate and based on a time / distance calculation.

If LFB were to go with multiple telemetry systems, based on the vehicle manufacturer, there would be numerous different systems to subscribe to and manage.

There is an associated amount of administration that comes with managing telemetry data that LFB FLEET do not have capacity to manage. This will come at an increased revenue, if LFB were to adopt this role.

Babcock Critical Services would also benefit from LFB having telemetry on the FLEET, as they manage the maintenance on LFB's behalf. This fact has been acknowledged by Babcock, however to date discussions around whether they would contribute to the costs have not been had.

8 Appendix 2 - Assessment of future fuel/vehicle technology for LFB fleet.

Summary Table

Solution	A	B(1)	B(2)	C	D
Description	Battery Electric Vehicle	Hydrogen Fuel Cell Electric Vehicle	Hydrogen Internal Combustion Engine	Biofuel	Synthetic Fuel
Abbreviation	BEV	FCEV	H_2ICE	HVO	E-Fuel
Alignment to Target (Carbon Reduction)	High	Medium	Medium	Medium	Medium
Efficiency	High	Low	Low	Medium	Low
Maturity	Medium	Low	Low	High	Low
Future Proof	High	Low	Low	High	Medium
Operational Fit and Resilience	Medium	Low	Low	High	High
Transition Requirements	Medium	High	High	Low	Low
Capital Cost	Medium	High	High	Low	Low
Running Costs	Low	High	High	Medium	High
Pursue?	YES	NO	NO	YES	NO

Analysis of each Solution:

Solution A- Battery Electric Vehicles

Recommendation

It is recommended that Battery Electric Vehicle options are progressed and prioritised by the LFB Fleet Strategy due to the reasons detailed below. However, the fleet market will be reviewed annually in case of any significant changes or new developments within its sector.

Electric Vehicle Types

There are fundamentally two types of Electric powered vehicles:

- Battery Electric Vehicle (BEV) – these vehicles are powered by electricity only. All BEVs store power in their batteries, supplied by chargers, which is used to drive electric motors only. BEVs emit zero tail pipe emissions which make them the best option, meeting all our environmental commitments.
- Hybrid Vehicle (HEV, PHEV, mHEV, REEV) – there are various types of hybrid vehicles, all of which operate partly as electric zero tailpipe emissions and partly with engines running. Some (PHEV and REEV types) can plug into chargers to operate partially as BEVs as well as being engine powered, others (HEV and mHEV) aren't able to accept power from chargers so are powered by their engines running causing tail pipe emissions.

All hybrid vehicles have some degree of tailpipe emissions, so whilst acceptable for "Zero Emission Capable" short term requirements these vehicles do not meet the medium/long term "Fossil Fuel Free" or "Zero Emission" requirements, as such they are not recommended to be purchased.

Electricity Generation

Electricity has the potential to provide zero carbon emissions when used as a vehicle fuel, but only when produced from clean energy sources such as solar or wind. This clean electricity is available to purchase by means of a "Green Tarif" whereby our electricity supplier purchases the equivalent amount of electricity that we use from green sources on our behalf.

We can also generate our own clean electricity locally using solar panels at our premises, or other designated sites, and could potentially also utilise wind generation although this is presently impractical due to the size of equipment and consistent wind speed required compared to the geographical area which we operate in.

Presently LFB have a solar capacity split between around 70% of our sites totalling 1.1MWp which will generate around 1250MWh per year. There is scope to increase this significantly which could surpass the volume of electricity required to run some of our premises and then contribute to power used to operate our vehicles. Onsite energy storage could maximise the utilisation of solar energy for vehicle charging.

Access to Electricity

All LFB sites have access to electricity, and almost all presently have a limited number of vehicle chargers installed, however these are all lower speed AC chargers which will not be suitable for charging large vehicles.

Almost all sites will require significant increases in the capacity of their grid connections to enable charging of the full range of electric vehicles at appropriate speeds.

Investment will also be needed in vehicle charging equipment matching the requirements of the fleet. This will need to be planned and rolled out carefully together with the fleet replacement programme and increases in grid connection capacity.

Resilience

Electric vehicles require planning around resilience in operation, but there are several ways to provide this against local power supply disruption and/or long duration incidents which need to be investigated/evaluated:

- Static energy storage – Battery or mechanical at LFB sites (charge vehicles during power cuts)
- Portable energy storage – Battery mounted on dedicated vehicle or palletised for HDU delivery.
- V2V – Vehicle to vehicle power, use of spare battery capacity in support vehicles to power others
- Third party charging – Public EV charging within London is unlikely to be able to accommodate large vehicles, but TFL bus depots and Council refuse collection vehicle premises may be viable emergency resilience vehicle charging facilities, in addition to any suitable London Ambulance, Metropolitan Police or other TFL sites such as Highways or Tube depots.
- Portable generation – Generator mounted on dedicated vehicle or palletised for HDU delivery (this is not a zero-emission option but could be utilised in the short/medium term).

Cost – Infrastructure

The cost of each Fire Station electrical upgrade and vehicle charging installation will vary dependant on premises requirements and expected fleet utilisation. Total, average, and peak power requirements will need to be assessed for electrical upgrades for each location, this information can be extracted from present and historic vehicle fuel/charging and premises gas & electric records. This combined with the expected number of vehicles, battery capacity and charge rates of the vehicles likely to be based at each site will provide an accurate guide for what is required.

The use of energy storage systems has the potential to reduce grid infrastructure costs whilst providing access to high-speed charging for some sites.

Cost – Electricity

The cost of electricity is subject to market variation but is generally somewhere around 50% of the cost of conventional vehicle fuel when purchased from a utility provider (electricity purchased from high-speed public EV charging networks has cost parity with conventional fuel). Maximising premises solar capacity combined with managed energy storage provides the opportunity to reduce operational electricity costs significantly in addition to its resilience benefits.

Availability of Electric Vehicles

At the time of writing the electric vehicle market is still relatively immature. There are now over 1 million electric vehicles in the UK, the vast majority being cars with around 90 different models now available. The electric van market is much smaller with only around 50,000 vehicles registered from 25 models presently available, but more types of vans and options with improved battery capacity and charging capability are entering the market.

Electric HGV registration figures are misleading as they are classified by DVSA as vehicles above 3.5t (so include larger vans, along with legacy EVs such as milk floats), the DVSA figure is around 2000 vehicles registered, however the actual number of electric HGVs over 7.5t in the UK appears to only be around 500of this figure at least half are refuse collection vehicles. However, within the last year all the main seven European truck manufacturers have started supplying or accepting orders for electric HGVs with models covering most of their ranges, registration figures are increasing steadily.

There aren't presently any electric HGVs available ready made in Fire Service specifications, but the market has progressed significantly since the start of the ZEPA project, and a growing range of electric trucks are available. In addition to new electric HGVs there are also some options for repowering diesel vehicles to electric or purchasing new glider chassis (supplied without engine or gearbox) from manufacturers and having electric drivelines installed which can be investigated.

Additionally, there are also over 2500 electric buses in the UK with over 1000 in use within London on TFL contracts.

Efficiency

BEV are more energy efficient than any other type of vehicle. Very little power is wasted into producing heat or noise compared to internal combustion engine vehicles and EVs benefit from regenerative braking where the vehicles motors are used in reverse to slow the vehicle returning some energy to the vehicle's batteries.

The supply of electricity to vehicles is also more efficient than any other fuelling process as power is transmitted from production to the point of distribution by the electricity grid with only minimal transmission losses. All other fuel types rely on additional use of energy to change their state, compress/pump and transport them to their point of use, often including the use of additional diesel-powered road tanker vehicles.

Battery Safety

Whilst incidences of electric vehicle battery fires are very low per number of vehicles registered when compared to conventional vehicles fires, the nature of an EV fire can be substantially more severe, prolonged, and difficult to deal with.

However, improving battery chemistry and design, and development of electric vehicle technology continue to reduce the risks of incident.

Whole vehicle safety, including electrical design will remain a paramount specification and procurement criteria.

Solution B (1&2) – Hydrogen Vehicles

Recommendation

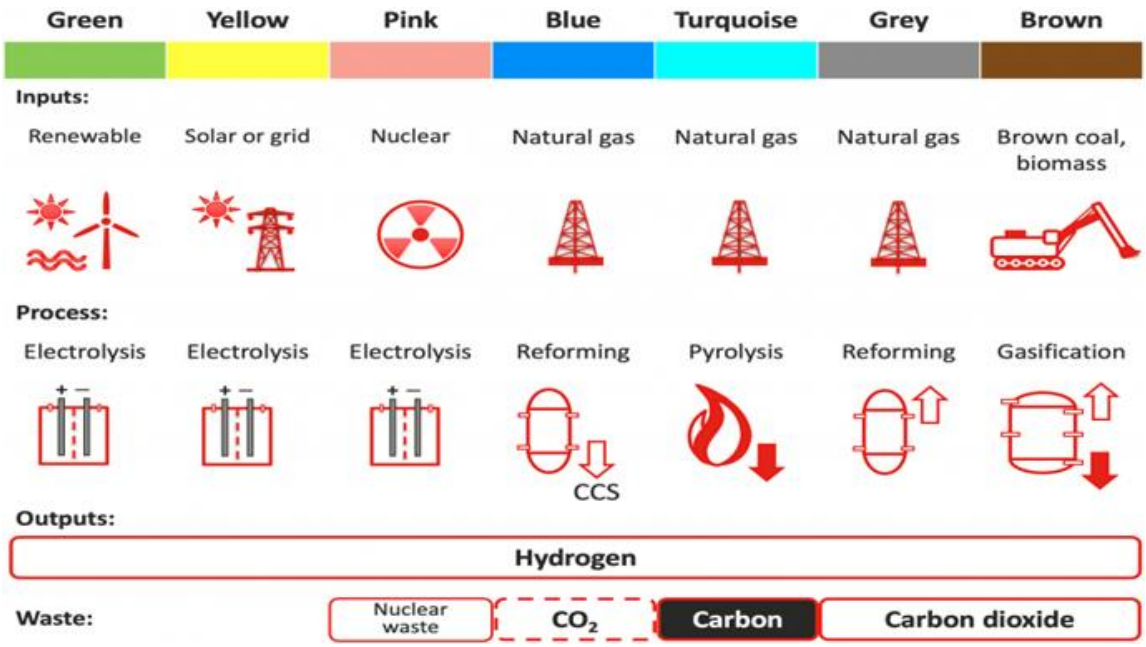
It is recommended that Hydrogen options are presently suspended from LFB Fleet Strategy due to the information detailed below. However, Hydrogen as a vehicle fuel will be reviewed annually in case of any significant changes or progress within its sector.

Information

Hydrogen Generation

Hydrogen has the potential to provide zero carbon emissions when used as a vehicle fuel, but only when provided as "Green Hydrogen" – being that manufactured from clean (solar or wind generated) electricity using electrolysis to split water into hydrogen and oxygen. There is however not presently any suitable supply of Green Hydrogen readily available in South-East England.

Most other types or "Colours" of Hydrogen presently available are sourced from fossil fuels, although some reduce their carbon emissions by means of physical carbon capture and storage (CCS). As such these cannot be considered as zero carbon emissions fuels.



Source: https://broadleaf.com.au/resource-material/the-colour-of-hydrogen/

Hydrogen Vehicles

There are fundamentally two types of Hydrogen powered vehicles:

Hydrogen Internal Combustion Engine (H2ICE) – these vehicles are broadly similar mechanically to conventional diesel or petrol vehicles but burn Hydrogen instead of conventional fuel. Whilst they can be classed as zero carbon emissions (subject to the use of Green Hydrogen only) the vehicles do still emit limited NOx exhaust emissions, so are not zero tail pipe emissions

Hydrogen Fuel Cell Electric Vehicle (FCEV) – these vehicles process hydrogen using an onboard fuel cell into electricity. This electricity is supplied to the vehicles batteries where it is stored until required by the vehicles electric drive motor, in the same way as a Battery Electric Vehicle (BEV). The only emission from the fuel cells process is water, so these vehicles are classed as zero tail pipe emissions

Availability of Hydrogen Vehicles

There are presently no new hydrogen vehicles available for sale in the UK from mainstream vehicle manufacturers. Toyota and Hyundai have both previously supplied hydrogen cars, with 106 supplied by Toyota and 29 by Hyundai presently licenced according to DVSA statistics. There are 62 hydrogen buses licenced and 15 other vehicles which all appear to be one-offs, so project or development vehicles.

Several light vehicle manufacturers such as Toyota, BMW and Stelantis Group have stated interest in development of hydrogen vehicles and provided some press information, but none presently have firm dates for vehicle availability.

Several heavy manufacturers including Mercedes, Volvo and DAF have all stated that they are working on development of hydrogen HGVs. Volvo and Mercedes have working prototype vehicles and Iveco have recently purchased a hydrogen vehicle manufacturer. There are presently no confirmed availability dates for any hydrogen HGVs.

Access to Hydrogen

At the time of writing there are understood to only be two active Hydrogen refuelling stations in London, Air Products at Hatton Cross for cars and Ryze at Metroline Bus Depot Perivale, which can accommodate large vehicles, but has an unknown availability to provide fuel for third party customers.

There do not appear to presently be any developed plans for implementation of Hydrogen filling stations within or practically near to London, so any use of Hydrogen vehicles would be subject to LFB investing in LFB's own hydrogen refuelling infrastructure.

Cost – Infrastructure

The cost of each fire station hydrogen refuelling installation would vary dependant on site requirements but should be expected to average between £500,000 to £1,000,000 per site. If on-site electrolysis (producing Hydrogen from electricity) were utilised this cost would likely be increased by a further approx. £300,000 to £500,000.

Each refueler installation will require a minimum 3-phase 415v 63amp electrical supply to power the compressors required to bring the stored hydrogen from the low delivered pressure up to a high enough pressure to be dispensed efficiently.

In the case of FCEV heavy vehicles being operated a significant level of electric vehicle charging equipment investment will also be required for the vehicle batteries in addition to the hydrogen refuelling equipment, although this would be significantly lower power than the capacity required for full BEV assets.

Cost – Hydrogen

The cost of delivered Grey Hydrogen varies significantly but is presently understood to be around £35 per kg, Green Hydrogen is not yet readily available but is more expensive to produce. Whilst it is difficult to draw accurate comparisons this can be interpreted as being a cost of roughly £600-£800 to fill a vehicle such as a

pumping appliance with Grey Hydrogen, this would compare with around £200 for diesel, or potentially significantly less for electric (all subject to fuel and electricity price fluctuations and tank/battery size).

Practicality

In accordance with British Compressed Gas Association (BCGA) Code of Practice 33 - set horizontal minimum spacings are required for separation distances between Hydrogen equipment installations and various other fixed installations such as buildings or boundaries at our premises. These distances vary according to the type of fixed installation, but for the purpose of this BN can be simplified to an eight-metre clear radius surrounding the combination of equipment required to receive, store, and dispense Hydrogen into vehicles.

This equipment would most likely comprise of low-pressure storage, compressor, high-pressure storage and a refueler dispenser which would have a likely combined footprint in the region of 2.5x10 metres. Dependant on lay out and site-specific variation (size of storage required due to no of vehicles) this would lead to a total area being required of approx. 26x18.5 metres or 400-450 square metres. For visualisation this is roughly the size of the entire yard area at Chelsea or around a quarter of the yard at Croydon Fire Stations.

Hydrogen is delivered by heavy goods vehicles (diesel/Hydrotreated Vegetable Oil powered as required by Agreement Concerning the International Carriage of Dangerous Goods by Road regulations), there are limited supplies of Hydrogen available so road tanker delivery distances are likely to be significantly greater than for conventional fuel, also due to the low volumetric efficiency of Hydrogen more deliveries would be required than for conventional fuel to provide the same amount of energy.

Dependant on the quantity required delivery is generally either by 44t artic, using 40-foot multitube trailers which are then left on site as low-pressure storage and swapped for full trailers when emptied, or in smaller quantities in Manifolded Cylinder Pallets (MCPs) which are generally delivered using 26-32t rigid trucks utilising the vehicles on board equipment to lift the MCPs in and out of the storage enclosure as required. Areas for safe station access and operation of these vehicles would also need to be assessed at each location.

Efficiency

The use of Green Hydrogen for transport is much less efficient than the direct use of electricity. This is because Green Hydrogen starts as clean electricity, is then converted to Hydrogen, physically transported and then either converted back to electricity via a fuel cell or burnt in an internal combustion engine.

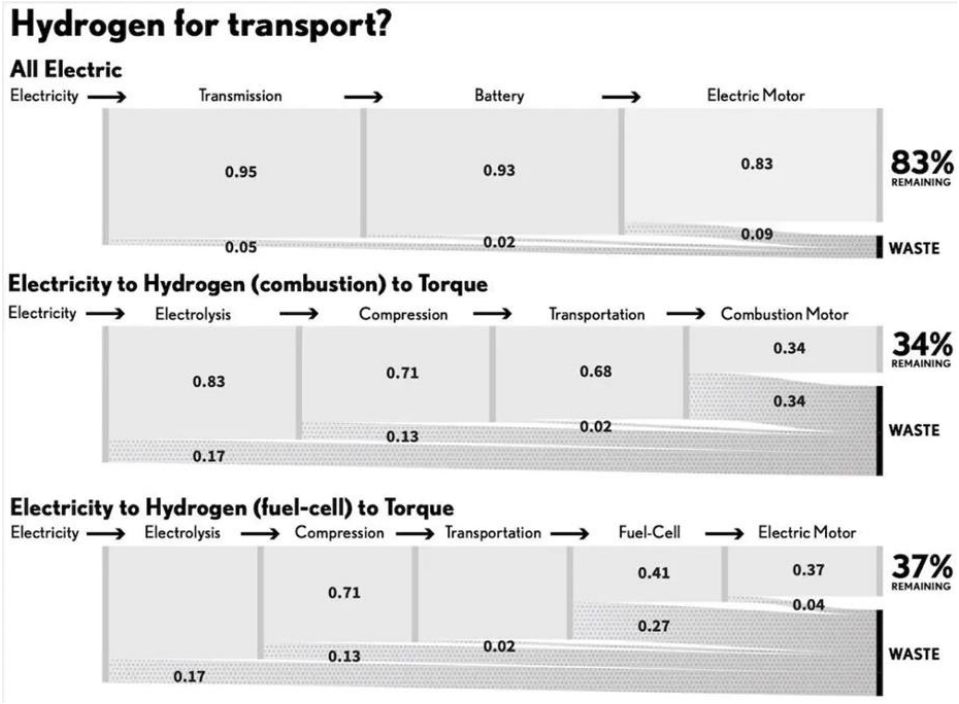


Diagram source – "The Big Switch" by Saul Griffith

Solution C – Biofuel

Recommendation

It is recommended that HVO options are included in LFB's Fleet Strategy due to the information summarised below. However, the use of HVO by LFB fleet is recommended as a temporary measure only, to reduce carbon emissions from existing conventional diesel fleet vehicles based at sites with bulk fuel tank facilities prior to their replacement with zero emission vehicles.

Why do we need an Interim Solution?

Whilst the future of the LFB fleet will be zero tail pipe emissions we presently operate predominantly diesel vehicles. For the remaining lifespan of these vehicles prior to replacement the use of HVO will achieve a partial but significant reduction in Carbon and exhaust emissions.

If the replacement of any specific types of fleet vehicles are delayed further than planned due to lack of viable zero tailpipe emissions options, the use of HVO provides the lowest possible emissions from their continued use.

What is HVO?

HVO is a "drop-in" synthetic replacement for conventional diesel fuel. As such HVO can be used with most of the conventional Internal Combustion Engine (ICE) diesel vehicles and refuelling equipment, so does not require LFB investment in fleet related infrastructure.

HVO is a paraffinic synthetic fuel which has lower hydrocarbon content than diesel and no sulphur, this eliminates up to 90% of net CO2 and reduces Nitrogen Oxide (NOx), Particulate Matter (PM) and Carbon Monoxide (CO) exhaust emissions.

HVO Production

The majority of plant and animal oils can be used as feedstocks for the production of HVO. HVO production firstly introduces hydrogen into the raw fat or oil molecules of the feedstock, then converts them to hydrocarbons by removing their oxygen content as water and/or carbon dioxide.

Access to HVO

Whilst not presently readily available from retail fuel filling stations there are several bulk fuel suppliers that are able to provide deliveries of HVO to LFB stations with fuel tank facilities. As such our fleet which presently refuel from our own tanks can switch to HVO easily.

Full fleet use of HVO would be subject to review of present refuelling procedures. It may be that a small number of additional temporary fuel tanks at specific stations could be used to increase access to HVO where suitable.

Cost of HVO

HVO is more expensive than diesel per litre, the exact additional cost varies dependant on fuel price fluctuation but can be assumed to be an increase of between 15-30%. Some reports suggest a slight efficiency improvement from HVO over conventional diesel, but this cannot be confirmed at the time of writing.

The cost of HVO may increase in line with demand as we get closer to 2030. There is also the potential for future multi-tiered pricing of HVO dependant on its CO2 reduction. I.e. the lowest carbon reduction HVO produced from plentiful cheap feedstock such as imported palm oil would be the cheapest to purchase, and then require substantial carbon offsetting to achieve net zero. Whereas the highest carbon reduction HVO produced locally with used cooking oil products as its feedstock would be more expensive but then require minimal carbon offsetting to achieve net zero.

Emissions

HVO is not a zero-emission fuel. However, its suppliers state that in comparison to diesel it achieves:

- Reduction in greenhouse gas/CO2 emissions by up to 90%
- Reduction in NOx emissions by up to 27%
- Reduction in particulate matter emissions by up to 30%
- Reduction in carbon monoxide emissions by up to 24%

Sustainability

The reduction in greenhouse gas emissions of HVO are "well-to-wheel" and as such are dependent on the source of the feedstock used to produce the fuel, the production process, and its transportation. The lowest emissions are only achieved when feedstock such as use cooking oil is used.

The supply of HVO from used cooking oil products will never be able to scale to meet all potential offtake, as nationally and globally we use far less cooking oil products than vehicle fuel. The production of new crops specifically for use in HVO production can have a negative effect on carbon reductions, particularly if rain forest or other "Carbon Soaks" are cleared to produce palm oil for this purpose.

As such any business supplying LFB with HVO should be required to be International Sustainability & Carbon Certification (ISCC) certified and should be able to demonstrate a fully validated and auditable supply chain, including presentation of Proof of Sustainability certification.

LFB Fleet Compatibility

Compatibility and vehicle manufacturer approvals for the use of HVO have been audited on behalf of LFB by Babcock. Whilst almost all fleet vehicles can use HVO, the New Dimension MAN prime movers and around 30 MAN vans do not have the required approval, these vehicles will need to continue to use conventional diesel. HVO and diesel can safely be mixed in any ratio, so should HVO not be available at any site diesel can be used temporarily.

Solution D – Synthetic Fuel

Recommendation

It is recommended that Synthetic also known as E Fuel options are presently suspended from LFB Fleet Strategy due to the information detailed below. However, E Fuel as a vehicle fuel will be reviewed annually in case of any significant changes or progress within its sector.

Information

What are E Fuels?

E Fuels are "drop-in" synthetic, and sometimes described by their manufacturers as "Carbon Neutral", replacements for conventional fossil based liquid fuels such as petrol and diesel. As such E Fuels can be used with conventional Internal Combustion Engine (ICE) vehicles and refuelling equipment, so do not require investment in fleet related infrastructure.

Whilst E Fuels and HVO are similar from the vehicle user's perspective they are manufactured using different processes from different source materials. E Fuels use carbon captured from the atmosphere as their base material, whereas HVO utilises vegetable or animal oils or fats.

E Fuel Production

E Fuel is manufactured using a process called Fischer-Tropsch Synthesis which combines Carbon captured from the atmosphere with Hydrogen, with the use of high temperature and pressure via a catalyst (usually containing Cobalt) which binds the Carbon and Hydrogen together to form a liquid. The liquid is then upgraded to a suitable form for use as a vehicle fuel.

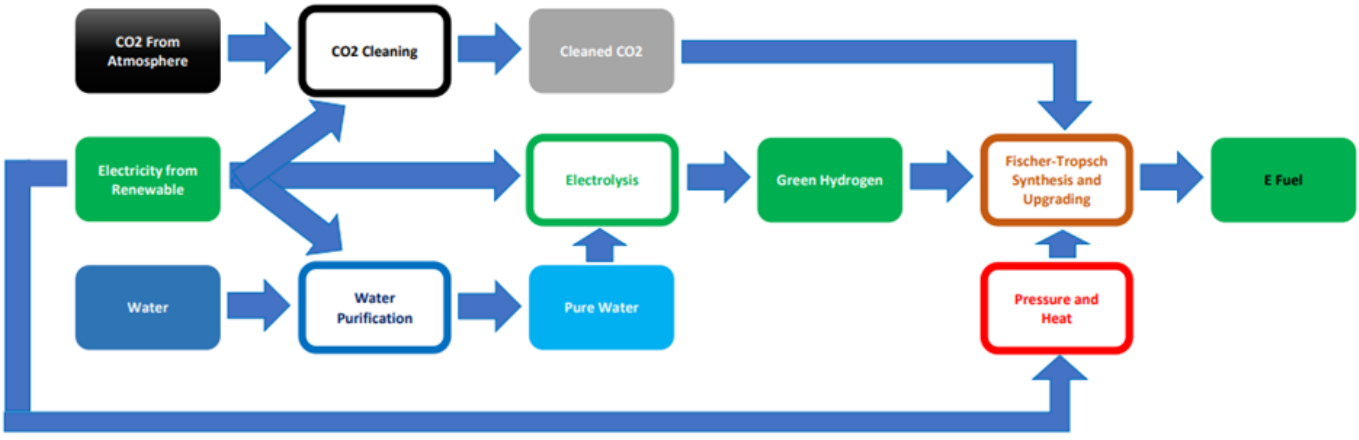


Table 1: Fischer-Tropsch Synthesis Process

Access to E Fuels

E Fuels are, at the time of writing, still in an immature phase of development with no regular supply available and very high development period pricing understood to be more than £1000 per litre. There have been several motor trade press articles quoting "industry insiders" who expect the eventual actual market price to be around the £35 per gallon/ £7.70 per litre figure, however this is purely speculation at this stage.

E Fuels are not yet commercially available. LFB presently purchase liquid fuel via the CCS framework, this only allows for specific named types of fuels not including E Fuels, but the present framework expires in January 2025 so further issues of the framework may include E Fuels. The alternative YPO and ESPO frameworks are both worded to allow for "other liquid fuels" in addition to petrol and diesel which may allow for E Fuels once they are available.

Emissions

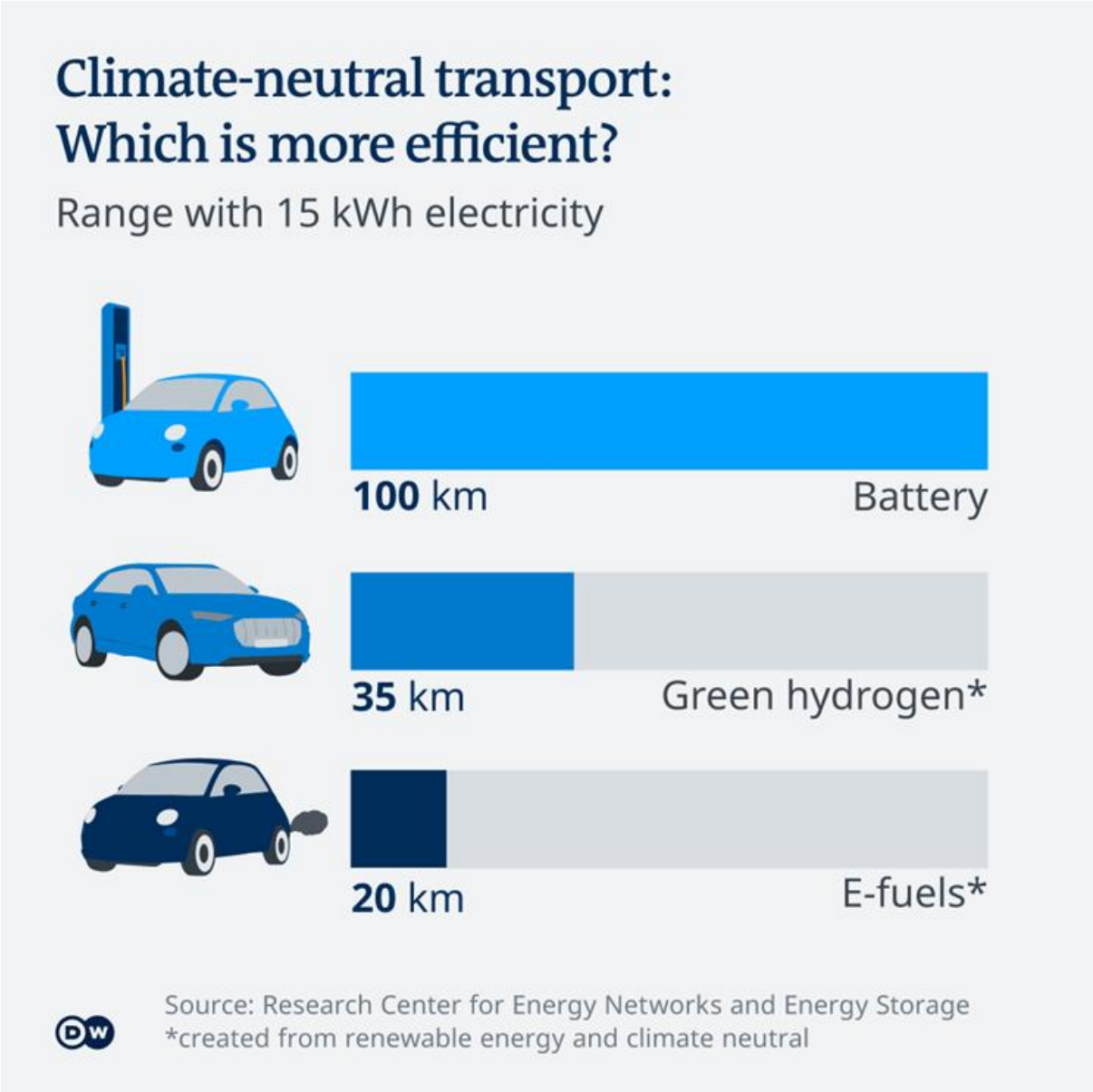
E Fuels are not zero exhaust emissions fuels. The E Fuels are combusted inside the engine in the same ways that petrol and diesel are burned. However, as the carbon which is burnt within the E Fuel has been removed from the atmosphere during production of the fuel, as opposed to having been newly released via extraction from fossilised sources, and then returned to the atmosphere when used the E Fuels are described as being "Carbon Neutral".

Exhaust emissions are made up of several different types of gases and particulate matter, tests have been completed comparing vehicles running on E Fuels against conventional fuels. Testing of E Fuels using a petrol Mercedes A180 was completed by IFP Energies Nouvelles in France and published by Transport and Environment on 06/12/21, a summary of the tests emissions findings is tabled below.

Exhaust Emission	**Comparison**
NOx	Equivalent to petrol
Carbon Monoxide	Increased vs Petrol
Hydrocarbon	Reduced vs Petrol
Regulated Particle (larger than 23nm)	Reduced vs Petrol
Unregulated Particle (larger than 10nm)	Reduced vs Petrol
Ammonia	Increased vs Petrol

Efficiency

Whilst the miles per gallon consumption of vehicles using E Fuel is expected to be similar to that of vehicles using petrol or diesel, the amount of energy (clean electricity) required to produce E Fuels make them one of the least efficient ways of powering vehicles.



Graphic – www.dw.com – Gero Rueter 25/05/22

9 Appendix 3 – Key Contacts

The key contacts engaged in the definition of LFB's Fleet Strategy are identified in the below table:

Business	Title	Person	Engagement	Duration
LFB	Assistant Director Property and TSS	Laura Birnbaum	Governance	Governance
LFB	Deputy Assistant Commissioner	Mark Davidson	Governance	Governance
LFB	Head of Contract Management and Performance	Tim Claringbull	Owner	Full
LFB	Fleet Strategy and Carbon Net Zero Manager	Mark Smith	Technical Contributor	Full
LFB	Head of FLEET, Engineering Manager	Vic Macias	Technical Contributor	Full
LFB	Technical Officer	Charlotte Smith	Technical Contributor	Full
Babcock	Fleets Contract Director	Sandy Donald	Governance	Governance
Babcock	LFB Fleet Contract Manager	Dave Elliott	Governance	Governance
Babcock	Engineering and Technical Manager	Neil Corcoran	Technical Contributor	Full
Babcock	Asset Replacement Programme Manager	Fiona Macdonald	Contributor	Full
Babcock	Alternative Fuels Project Engineer	Ross Maclennan	Author	Full