cenex

Lowering your emissions
through innovation in transport
and energy infrastructure

An Introduction to Zero Emission Police Fleets

Cenex Insight - April 2023

An electric Ford Mustang Mach-E police concept on show at the Emergency Services Show in Birmingham

The Challenge

Emergency service fleets, like all fleets, must lower their emissions in line with net zero and sustainability targets, particularly the end of new combustion engine sales in 2030.

To date, police services in the UK have deployed at least 430 electric vehicles and 808 chargepoints, out of more than 31,000 police vehicles across 45 constabularies, mostly in non-response use cases.

It is important all police vehicles transition to zero emission vehicles, which can be challenging for a variety of reasons, including:

> Emergency response vehicles are in use 24 hours a day, need to be available at short notice, and can be driven at sustained high speeds.

> Regional coverage is provided by many sites with relatively few vehicles at each. This means that infrastructure requirements must be planned and implemented on a site-by-site basis and there is a risk of overprovision of infrastructure to meet their operational requirements.

Police fleets also have a wide variety of vehicles in use across multiple operational requirements which can make it difficult to identify a specific technology, or technologies, that is most appropriate.

It is therefore important to gain a full understanding of the fleet – including daily mileage variation, vehicle specifications, and operational constraints – before making decisions on the technology to deploy.

Cenex can provide emergency services with the knowledge and tools required to make informed decisions about zero emission vehicles and will continue to develop support for an efficient and effective transition.

Vehicles

Police services use a wide range of vehicles in their fleet, from armed and marked response vehicles to personnel carriers and cell vans, each with unique operational and technological requirements.

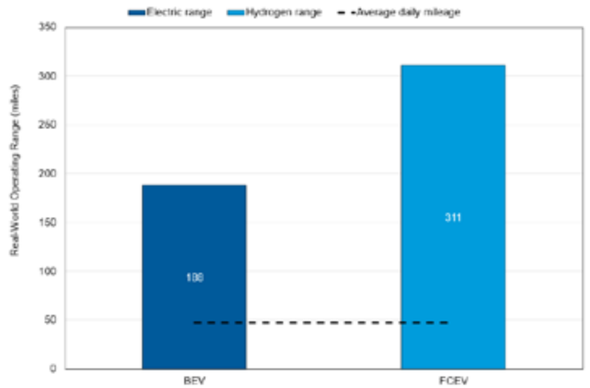
Often the same make and model can be used for very different roles, with their own usage patterns and operational constraints. For example, a medium car such as a Vauxhall Astra can be used as a marked response vehicle or as an unmarked vehicle for general use.

Smaller, unmarked vehicles with no response capability are far easier to transition to zero emission vehicle technologies in the short term.

Large cars, SUVs, vans, and pickup trucks used for more specialist roles – such as high speed response and pursuit vehicles, or to transport prisoners – are more difficult to transition as they have higher energy requirements and some of the highest annual mileages, typical up to 50,000 miles.

Battery electric vehicles are available today with 40 kWh to 90 kWh batteries, real-world ranges of up to 220 miles, and DC charging capabilities that can add significant range in as little as 30 minutes.

Analysis by Cenex has shown that battery electric vehicles have sufficient real-world range for over 80% of a typical police fleet to complete twice its average daily mileage on a single charge only.



Vehicles

A typical police vehicle could also save £6,000 to £7,000 in total cost of ownership over the life of the vehicle and reduce greenhouse gas emissions by 70% when using the current UK electricity grid.

Despite these benefits, police will still need to adapt their operations to accommodate battery electric vehicles, and some vehicles may need zero emission technologies to develop more before they are suitable before 2030.

Hampshire Police trialled the Tesla Model 3 in 2022. Credit Hampshire Roads Policing Unit, Twitter

Fuel cell technology could offer the benefit of increased range – up to 400 miles on a full tank – and shorter refuelling times (3-5 minutes) which would be better suited to traffic vehicles, marked operational cell vans, and armed response vehicles.

There are, though, few hydrogen refuelling stations across the country and fuel cell electric vehicles are more expensive to own and operate – however the business case is predictedd to improve significantly between now and 2030, particularly for HGVs and other challenging applications.

London Metropolitan Police Toyota Mirais at a Hydrogen Refuelling Station

Chargepoints

Police fleets will need to develop a detailed understanding of their journey patterns, dwell times and daily energy requirements to plan for, and optimise, their charging infrastructure.

Cenex recommends the lowest-power charger that can deliver the relevant energy in the available time as this has a lower cost and the least impact on the grid connection.

The number of chargepoints required is closely linked to the number of vehicles charging and the amount of downtime, for example:

- For a large number of EVs charging for longer periods of time, a greater number of chargepoints will be required but at lower speeds
- For a large number of vehicles charging for shorter periods of time, fast or rapid chargepoints become necessary to ensure adequate charge.

Infrastructure costs can be minimised by ensuring there is not an overprovision of chargepoints or power supply to a site through the following mitigation measures:

- Sharing chargepoints between vehicles and services, such as local Fire & Rescue
- Load management systems to prevent the electricity supply from being overloaded
- Engage with the DNO early to get accurate connection cost budget estimates
- Plan for future chargepoints.

Although using the public charging network is not ideal for a police fleet, it is likely that vehicles will occasionally have to use them.

Innovative Infrastructure

Wireless charging

Wireless charging technology is in the early stages of development but presents an innovative option for police fleets in the future.

Where vehicles are parked regularly for short periods of time, static wireless charging allows the battery to top up in short bursts.

From an operational perspective, there are time savings in not having to plug and unplug charging cables each time.

Vehicle-to-Grid (V2G)

V2G is a system whereby plugin electric vehicles, when connected to a V2G charger, can provide bi-directional flows of energy to charge, store and discharge electricity when necessary.

By controlling the timing of charging and discharging, customers can use less carbon-intensive or cheaper electricity, and reduce battery degradation.

Research by Cenex shows that vehicles with high plug-in times optimise the benefits of V2G, and would therefore suit non-response vehicles best.

Hydrogen

A fixed hydrogen refuelling station (HRS) with onsite hydrogen production offers an economic solution for large scale fleets and is the business model for most public refuelling stations but requires high capital expenditure and is a complex long-term project.

A whole police fleet could generate reasonable demand for a typical public hydrogen refuelling station at a single location. However the demand at each individual location is much lower and the majority of demand would come from vehicles that can reasonably transition to electric.

Collaborating with other public service fleets, such as council vehicles or ambulance and fire services, could generate the demand from specialist vehicles required to justify the business case for a HRS.

Factors Affecting Range

Journey Type and Driving Style

Cenex has analysed test data from battery electric and fuel cell electric vehicles to understand the impact of journey type (low speed city driving with lots of stop starts vs. higher constant speeds on A-roads) and driving style (sedate vs. aggressive driving with full power acceleration, harsh mechanical braking and higher speeds) on a vehicle's range.

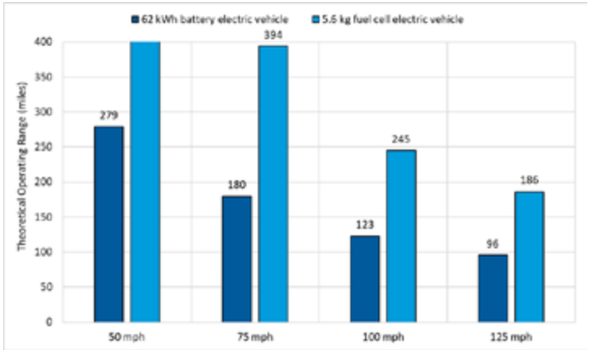
These studies gave the following conclusions:

- Maximum range is achieved during city and town driving for battery electric vehicles; range is 30% lower for standard higher speed journeys.
- Aggressive driving reduces range most in city and town driving for battery electric vehicles; range is reduced by 20% to 40% when driving aggressively in urban environments due to more braking and acceleration events.
- A fuel cell electric response vehicle has a 45% lower range than an equivalent vehicle with incentivised eco driving; range is still at least 186 miles under these conditions.

Sustained High Speeds

Cenex has developed vehicle simulation models that are representative of zero emission large cars such as the Tesla Model 3 and Toyota Mirai to understand the potential impact of sustained high-speed driving on the range of these vehicles (see graph below).

This analysis presents a worst case scenario for response vehicles but highlights the importance of developing a full understanding of police vehicle duty cycles to inform technology requirements.



Essex Police Fleet and Infrastructure Strategy

Essex Police and Essex County Fire & Rescue Service commissioned Cenex to develop a Zero Emission Vehicle Fleet and Infrastructure Strategy.

Cenex took a baseline of the current fleet composition and emissions and used this to assess the suitability of battery electric and fuel cell electric vehicles, then calculated the number and type of charging infrastructure required and the potential demand for renewable hydrogen by location.

The results summarised the capital costs, running costs, and emissions impacts of different replacement scenarios, as well as a detailed fleet transition roadmap and action plan.

The work shows that over 75% of the fleet could be replaced by battery electric vehicles with sufficient range to complete their average daily mileages.

This would provide total cost of ownership savings and reduce greenhouse gas emissions by around 50% based on the current UK electricity grid.

Response vehicles account for the majority of the fleet's greenhouse gas emissions, so Cenex recommends that Essex Police trial and demonstrate zero emission variants initially to see what impact they have and what operational changes may be required before full implementation.

Cenex and Police Fleets

Zero Emission Fleet Vehicles for European Rollout

As part of the pan-European ZEFER Project, the Metropolitan Police Service (MPS) operates 10 FCEV Toyota Mirais as general purpose police vehicles, joining 11 Mirais already in its fleet.

To date they have completed around 207,700 km using 2,391 kg of hydrogen dispensed from three HRS, predominantlyTeddington in central London.

Cenex lead on the vehicle and HRS monitoring and provide independent assessments of the commercial, operational and environmental performance.

Low Emission Vehicles for Police Fleets Workshop

Cenex ran low emission vehicle and infrastructure masterclasses to support staff across a Constabulary.

The programme covered an introduction to the different technologies, operational performance, maintenance requirements and charging equipment as well as policy, finance, and future innovations.

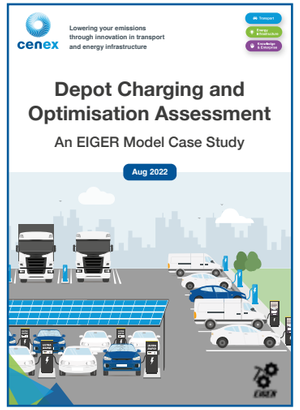
EV-elocity

The West Midlands Police installed two eNovates 10 kW V2G units in their headquarters' car park for fleet vehicles through the EV-elocity project.

These units were used to charge (and discharge) two non-emergency response Nissan Leafs.

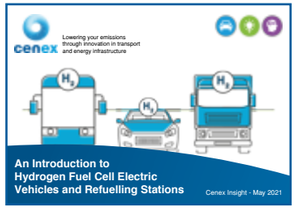
The project found that EV battery degradation can reduce by one-eighth, and up to 450 kg of emitted CO_2, or £400, could be saved per vehicle each year.

Further Reading



Depot Charging and Optimisation Assessment

An Introduction to Battery Electric Vehicles



An Introduction to Hydrogen Vehicles and Refuelling Infrastructure

Niche Vehicle Network: First Response Hybrid Motorcycle

Case Study: Essex Police and Fire & Rescue Fleet & Infrastructure Strategy

An Introduction to Zero Emission Fire & Rescue Fleets

Transport

Energy Infrastructure

Knowledge & Enterprise

cenex

Lowering your emissions through innovation in transport and energy infrastructure

Find more free-to-access resources and reports at www.cenex.co.uk/resources

Cenex

Tel: 01509 642 500
Email: info@cenex.co.uk
Website: www.cenex.co.uk
Twitter: @CenexLCFC
LinkedIn: Cenex