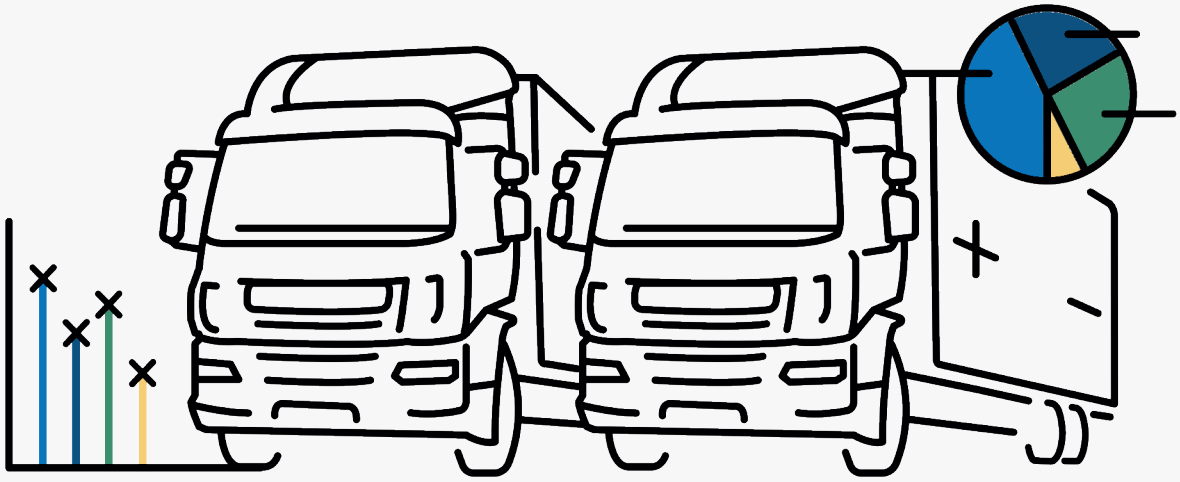
cenex

Lowering your emissions through innovation in transport and energy infrastructure

Transport
Energy Infrastructure
Knowledge & Enterprise

BETT – Battery Electric Truck Trial Launch Report

APRIL 2022



BETT
BATTERY ELECTRIC TRUCK TRIAL

- Trial of **20 19t DAF Electric Trucks**
- **9 Public Sector Fleets**
- **12-month Trial**
- **Dissemination** of Study Learnings
- Battery Electric Truck Fleet **Planning Tools**

Keep up to date with the trial here

In Partnership with

cenex

DAF
A PACCAR COMPANY

UKRI UK Research and Innovation

HM Government

1 Executive Summary

1.1 Introduction to this Report

In June 2021 DAF trucks were awarded funding from InnovateUK to commence with a deployment of 20 electric trucks in project BETT (Battery Electric Truck Trial). This BETT Launch Report was published in early 2022 in conjunction with the deployment of the electric trucks into trial participating fleets.

1.2 Case for Electric Trucks

All vehicles in the UK must switch to zero tailpipe emission alternatives to reach 'net zero' carbon emissions by 2050. The UK has set targets to phase out non zero emission HGVs up to 26 tonnes in 2035, and all non-zero emission HGVs by 2040. Decarbonising HGVs will be challenging due to the high mileages and weight of these vehicles.

One of the most promising options for decarbonising HGVs are battery electric vehicles (BEVs), which store energy in a battery and deliver power to the wheels through an electric motor. Electric HGV uptake is expected to increase in the coming decade. Product availability is improving and the economic case is strengthening.

The main drivers for fleets to switch to BEVs are to reduce emissions, comply with regulation, and save money.

1.3 Introduction to BETT

Cenex is providing DAF trucks with specialist support during BETT in the areas of independent trial analysis, study and dissemination.

The trucks on trial are DAF Electric LF's, a 19-tonne battery electric truck. The truck has range of up to 175 miles on each battery charge and can be rapid charged at 150 KW for quick turn-around between shifts.

The participating fleets are Blackpool Council, Eastern Shires Purchasing Organisation, Leeds Teaching Hospitals, NHS Supply Chain, NHS Northern Care Alliance, Rochdale Borough Council, Tameside Metropolitan Borough Council, University Hospitals Birmingham, and Yorkshire Purchasing Organisation. The objective of BETT is to generate evidence to show fleet operators that electric trucks can cover real-world operations. This will primarily be achieved by collecting data from trial vehicles to understand their

1 Executive Summary

real-world performance and comparing against diesel equivalents to assess operational, economic and environmental performance. The outputs will help fleets understand the best way to implement the vehicles and charging and inform on any barriers to adoption.

1.4 Fleet and Driver Perceptions

Cenex is collecting data on drivers' and fleet managers' attitudes to BEV usage through the lifecycle of the trial.

Our pre-trial interviews with fleet managers found that:

- **Experiences of BEVs varied across the fleets, with some having multiple small BEVs in use and others with no experience at all before receiving the DAF truck.**
- **The main concern for the fleets was around the ability of the vehicles to achieve the quoted range, especially when there are additional auxillary power requirements.**
- **Fleets with fixed routes expected BEV implementation to be easier, rather than fleets which respond to customer needs who have less foresight of required range.**

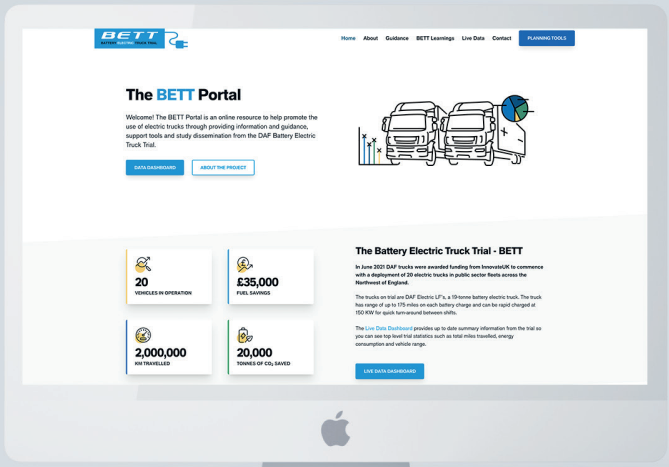
Our pre-trial survey of drivers found that:

- **Fewer than one in five drivers (19%) had driven an electric vehicle prior to BETT.**
- **Vehicle performance and comfort is expected to be better in the BEV.**
- **Reliability, range and recharging are a concern or area of uncertainty for many drivers.**
- **Drivers are generally environmentally conscious and supportive of the introduction of BEVs.**

1.5 BETT Fleet Portal and Planning Tool

The **BETT Portal** is an online resource to help promote the use of electric trucks through providing information and guidance, support tools and study dissemination from the DAF Battery Electric Truck Trial. It includes guidance on BEV trucks, a BETT learnings zone reporting results from the trial, a dashboard with trial statistics, and a depot planning tool to calculate the expected range and charging requirements from an electric truck.

To stay up to date with BETT sign up for regular project updates through the BETT Portal.



2 Case for Electric Trucks

2.1 Need for Decarbonisation

All vehicles in the UK must switch to zero tailpipe emission alternatives to reach 'net zero' carbon emissions by 2050. **Decarbonising heavy goods vehicles (HGVs) will be challenging for several reasons:**

- The size and weight of HGVs mean they need large batteries to provide sufficient energy to move the vehicle.
- Large batteries are also necessary as HGVs often cover long distances.
- Public chargepoints are not currently designed for the physical size of HGVs, and the high energy requirements could put a strain on the National Grid.

Although HGVs are a small proportion of the UK vehicle parc, it is important that they are decarbonised because they make a relatively high contribution to CO2 emissions due to their high mileages and low fuel economy.

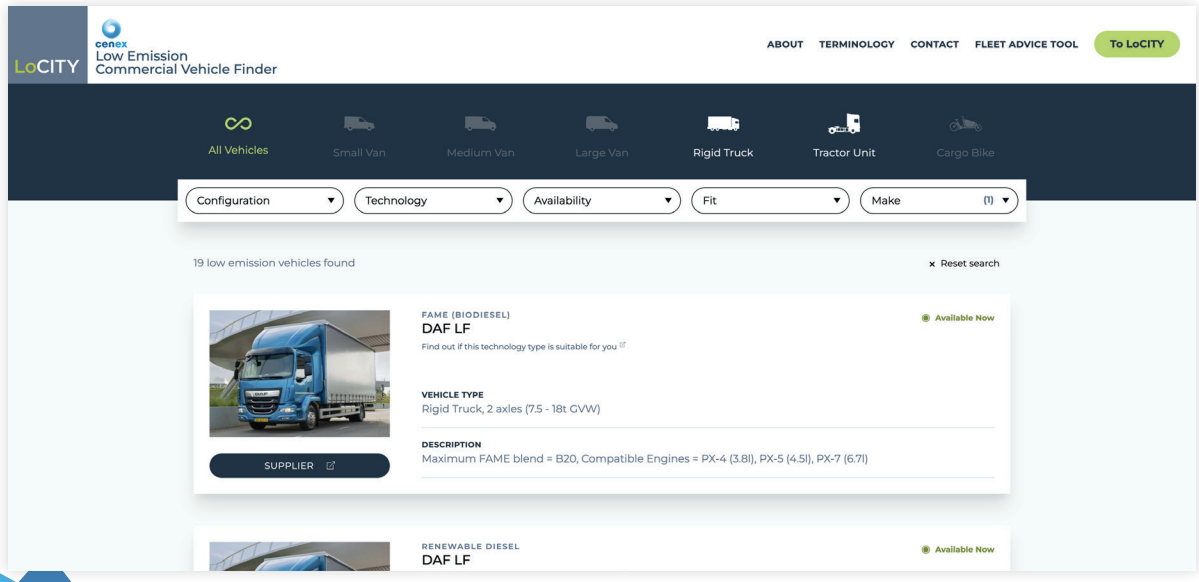
While HGVs are efficient in terms of tonnes of goods moved, the current diesel fleet must be replaced by low emission alternatives so the UK can meet its greenhouse gas emissions targets. Low emission vehicles must also meet fleets' operational requirements and be viable in terms of capital, operating, and whole life costs.

2.2 Battery Electric HGVs

Battery Electric Vehicles (BEVs) store energy in a battery and deliver power to the wheels through an electric motor. Braking energy is captured by the electric motor and stored as electrical energy in the battery, helping to increase the range of the vehicle.

Battery electric HGVs are classified by Cenex as a medium maturity technology, as manufacturers already offer products for sale in the UK but they are deployed in small number or trials and demonstrations only. Ongoing improvements in battery technology and investment by manufacturers mean that the viability of BEVs is increasing, even for the heaviest vehicles.

Electric HGV uptake is expected to increase in the coming decade. Product availability is improving and the economic case is strengthening. While early BEV trucks were low volume retrofit solutions, products are now also available from mainstream manufacturers, and product lines are growing. Many manufacturers now have medium duty pure BEVs, with a roadmap for developing heavier articulated vehicles. **The Cenex Commercial Vehicle Finder**[1] has the latest information on the current vehicle market and expected release dates for new products.



[1] *https://commercialvehiclefinder.cenex.co.uk/*

2 Case for Electric Trucks

2.3 Why Consider Electric Trucks?

There are three main drivers for fleets to consider switching to electric trucks:

1. To reduce emissions.

Electric HGVs have zero pollutant emissions at the point of use. Electric HGVs have significantly lower CO2 emissions than diesel vehicles, even when assessing on a well-to-wheel (WTW) basis[2] and when using standard UK grid electricity.

2. To comply with policy and regulation.

Policymakers are introducing rules to phase out diesel vehicles and introduce zero emission alternatives. The EU has set emissions targets for HGV manufacturers and these are likely to be adopted in the UK. The UK has set targets to phase out non zero emission HGVs up to 26 tonnes in 2035, and all non zero-emission HGVs by 2040. Cities are also taking actions to reduce use of older diesel vehicles through emissions and congestion charging zones. Fleets should stay ahead of policy in this area by trialling zero emission capable vehicles.

3. To save money.

Electric HGVs have an upfront price premium compared to a diesel model. However, these vehicles should save money in running costs (energy and maintenance), compared to diesel. There may also be savings on congestion or emissions charging zone fees. Financial assessment should therefore be based on the total cost of ownership (TCO), rather than just upfront or running costs. The trial will study the scenarios where savings can be achieved from Electric HGVs.

[2] Well-to-wheel emissions include the emissions from producing, transporting and combusting fuel

3 Introduction to BETT

3.1 Project Overview

In June 2021 DAF trucks were awarded funding from InnovateUK to commence with a deployment of 20 electric trucks in a project called BETT (Battery Electric Truck Trial). Cenex is providing DAF trucks with specialist support during BETT in the areas of independent trial analysis, study and dissemination.

The deployment of the BEV trucks is in partnership with the end-users; government entities comprising the NHS, local authorities and purchasing framework providers, who will be trialling the vehicles and the respective chargers. The learnings from the trial will be made available to fleets, via a public website (The Battery Electric Truck Trial Planning Portal) to learn from this experience and make informed decisions as they plan their transition to a lower-carbon fleet.

The trucks on trial are DAF Electric LF's, a 19-tonne battery electric truck. The truck has range of up to 175 miles on each battery charge and can be rapid charged at 150 KW for quick turn-around between shifts.

The trial vehicles include different types of ancillary systems that will operate from the battery. This includes tail-lifts and refrigeration units.

3.2 Fleets and Vehicles

There are nine organisations operating a total of 20 vehicles. These organisations are introduced in the **table below**.

FLEET	VEHICLES DEPLOYED	OPERATIONS
Blackpool Council	1	General movement of equipment around the town
Eastern Shires Purchasing Organisation	2	Distribution of goods to public sector organisations
Leeds Teaching Hospitals	2	Distribution and collection of hospital waste bins
NHS Supply Chain	8	Distribution of supplies to hospitals
NHS Northern Care Alliance	2	Distribution to and collection from hospitals
Rochdale Borough Council	1	Household distribution of wheelie bins
Tameside Metropolitan Borough Council	1	Household distribution of wheelie bins
University Hospitals Birmingham	1	Delivering supplies to hospitals
Yorkshire Purchasing Organisation	2	Delivering supplies to schools
TOTAL	**20**	

3.3 Objectives and Approach

The UK Government is planning a shift to zero emission trucks to help meet their net-zero emission target, and zero emission zones are expected to appear in cities as we move to the middle of this decade. Fleets and

3 Introduction to BETT

cities are keen to shift to zero emission alternatives but there is little information available on the real-world performance of the vehicles. This trial will help understand the best way to implement the vehicles and charging into fleets and inform on any barriers to adoption.

The 12-month truck trial commenced in April 2022. Cenex is providing specialist support on independent trial analysis, study and dissemination and will report study results in the Trial Learnings section of the BETT Portal website. Trial study areas include vehicle operation, economic and environmental performance, user acceptance as well as life cycle emissions and much more.

The overall objective of the trial is to generate evidence to show fleet operators that electric trucks can cover real-world operations. **This will involve:**

- **Collecting data** from trial vehicles to understand their **real-world performance**
- **Obtaining data** from fleets on diesel equivalents to allow comparison of **operational, economic and environmental performance**
- **Analysing** and **reporting** trial data
- **Surveying drivers** and **fleet managers** to gather opinions on experience with **driving/charging/operating vehicles** compared to diesel trucks

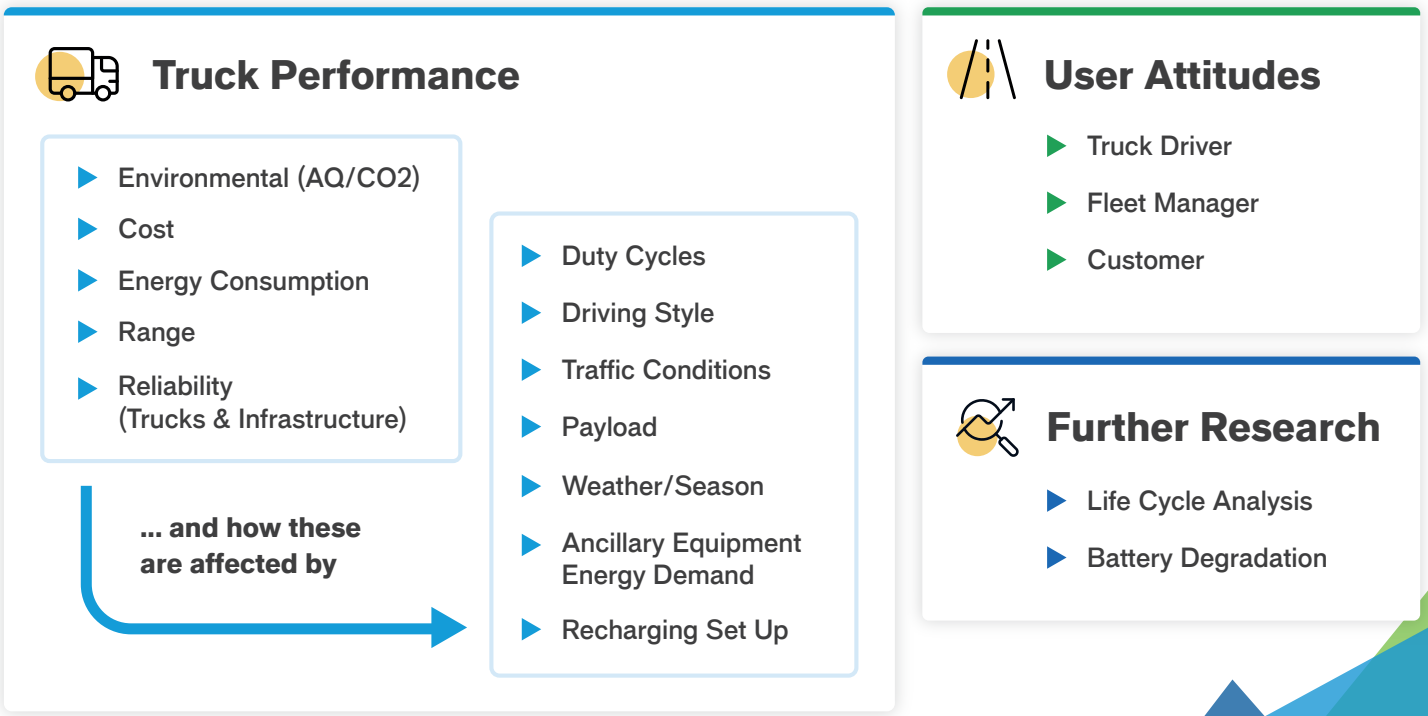
Data loggers have been fitted to all trial vehicles to monitor detailed telemetry about the vehicle operations, energy consumption, driving behaviour and charging patterns. A bespoke private dashboard has been developed to enable all trial participants to view up-to-date information on how their vehicles are operating and performing.

3.3 Outputs and Reporting

Outputs will be reported in the BETT Portal. Results will cover three areas:

- **Truck performance:** environmental performance, cost, energy consumption, range and reliability.
- **User attitudes:** encompassing drivers, fleet managers, and customers.
- **Further research:** life-cycle analysis and battery degradation.

The project outputs are displayed **in the graphic below**.



3 Introduction to BETT

Trial performance statistics will be updated in the BETT Portal on a daily basis. These include core statistics around vehicle miles travelled, range, energy, emission savings and running costs.

On a quarterly basis the Portal will also be updated with results of a 'deep dive' into a particular topics related to the performance of the vehicles:

- **Reporting period 1 (April 2022-June 2022):**
  Energy consumption variation with traffic (urban/rural/motorway), and pre-trial driver and fleet manager perceptions.
- **Reporting period 2 (July 2022-September 2022):**
  Energy consumption variation with driving style, charging efficiency analysis, and mid-trial driver and fleet perceptions.
- **Reporting period 3 (October 2022-December 2022):**
  Energy consumption variation with usage type, and factors which influence vehicle economics.
- **Reporting period 4 (January 2022-March 2023 and final reporting):**
  Seasonal energy consumption variation after a year of usage, and final driver and fleet manager perceptions.

Trial data will also allow research into the following topics:

- **Life cycle assessment (LCA).**
  LCA will show the manufacture, in use, and end of life emissions of the truck and a conventional comparator vehicle. Scenarios will show how lifecycle emissions vary with current and future electricity and conventional fuel production pathways.
- **Battery degradation.**
  Analysis to understand the long-term effects of charging and driving style.

Learnings from BETT will be used as follows:

- DAF will gain a detailed understanding of the real-world performance of individual vehicles and the overall fleet.
- Participating fleets will understand how their drivers use and view the vehicles that they operate.
- Non-participating fleets will be able to learn from the trial and assess how electric trucks could fit with their operations and dismantle EV myths via trial data.
- UK Government will be able to use the trial results and learnings to inform policy development in the area of zero emission trucks.

4 Fleet and Driver Perceptions

As part of BETT Cenex is collecting data on drivers' and fleet managers' attitudes to BEV usage. Each vehicle driver and fleet manager will be asked to complete questionnaires or participate in an interview before the trial, at least once during the trial, and at the end of the trial. This will allow us to understand their expectations of the vehicles, identify their concerns and challenges, and assess whether their attitudes change during the trial period.

4.1 Fleet Perceptions

The pre-trial interview of fleet managers covered information on the fleets (typical operations and previous experience of BEVs), environmental knowledge and behaviour, and views on BEVs compared to other vehicles and expectations of vehicle performance. **The findings are summarised below.**

Typical operations and previous experience of BEVs

There is a range of fleets with different operations in the trial, which can broadly be split into two categories: distribution fleets and ad-hoc service fleets. Experiences of BEVs varied across the fleets, with some having multiple small BEVs in use and others with no experience at all before receiving the DAF truck. Only a few fleets (or fleet managers) had previously been involved in a low emission vehicle trial. In general, the attitude towards the trial was positive and open.

Environmental knowledge and behaviour

Fleets consistently reported concern about the impact of poor air quality. Many of the fleets talked about seeing and smelling diesel vehicles and being aware of the harm this is doing. None of the fleets questioned the need for action to decarbonise transport. However, most were not convinced that BEVs would be the only solution.

All participating organisations have policies and initiatives to decrease carbon emissions. There was a mixed response on the publicity fleets would be seeking for the deployment of the BEV truck. Some were keen to get exposure and viewed having the truck on the fleet as an opportunity to raise awareness of their decarbonisation agenda. In contrast, other fleets felt they wanted to wait and see how the trial went before publicising it widely.

Most fleet managers have thought about switching to a personal EV, but most have ruled it out due to (perceived) insufficient range or high cost.

Views and expectations of BEVs

Fleet managers expect that BEV trucks would considerably improve air quality and reduce noise. The main concern for the fleets was around the ability of the vehicles to achieve the quoted range, especially when there are additional power requirements.

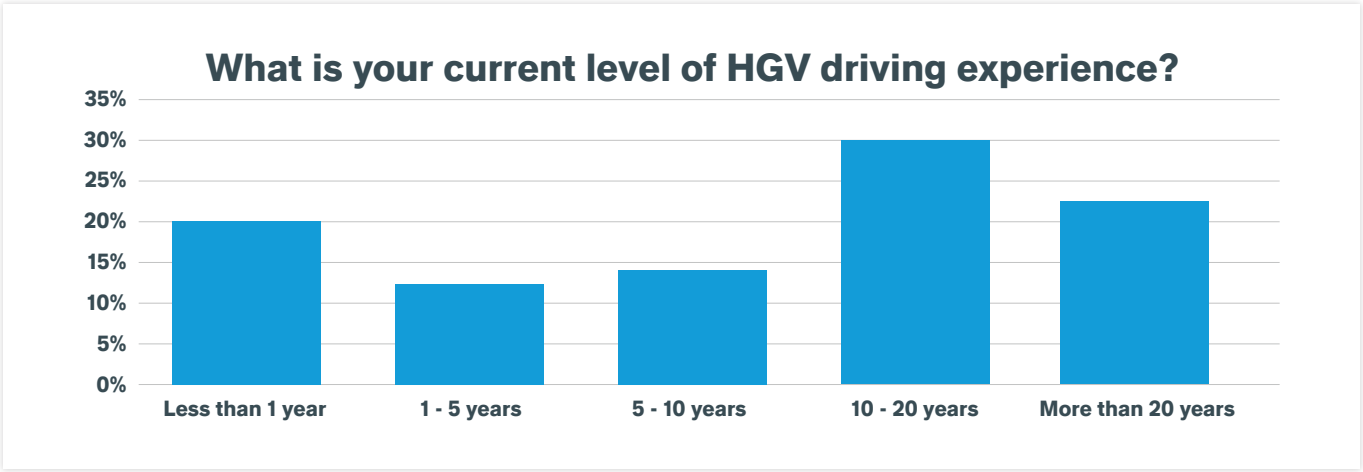
There was a difference in expectations and views between the distribution fleets and the ad-hoc service fleets. The distribution fleets had a better understanding of the duty cycles on which the BEVs would be deployed and were therefore more able to estimate whether the BEV would be able to complete the routes. The ad-hoc service fleets do not have set routes or duty cycles, making it harder for them to determine whether the BEV truck would suit the work. They were expecting to do more testing of journeys and tasks to see where the BEV could operate.

4.2 Driver Perceptions

The pre-trial survey of drivers covered driving behaviour and experience, environmental knowledge and behaviour, views on BEVs compared to other vehicles, views on charging, and expectations of BEV performance.

The results of the surveys are presented below. We received responses from 59 drivers. We have anonymised all results and aggregated findings across the nine participating fleets.

4 Fleet and Driver Perceptions



About the Drivers

Fewer than one in five drivers (19%) had driven an electric vehicle prior to BETT.

Nearly half of the drivers were in their 50s, with most of the rest in their 30s or 40s, which matches the wider logistics sector.

There is a wide spread of experience levels in the BETT sample, ranging from less than one year to more than 20 years. The most common category is drivers with 10 to 20 years' experience.

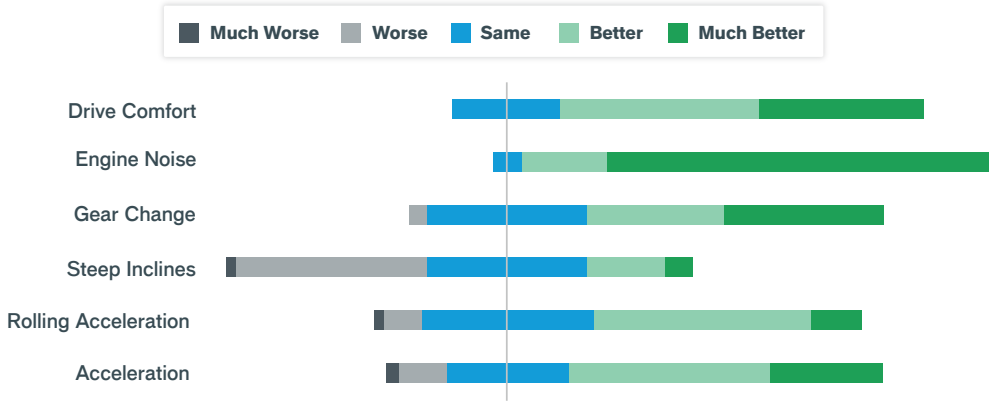
Attitudes towards and expectations of BEVs

Drivers were asked a series of questions about their expectations of the performance and driving characteristics of BEVs compared to conventional diesel vehicles, levels of anxiety around driving BEVs, and their attitudes to BEVs in the context of environmental issues.

These questions identified a wide range of views on different aspects of using and charging a BEV. The main findings were that:

1. Vehicle performance and comfort is expected to be better in the BEV.

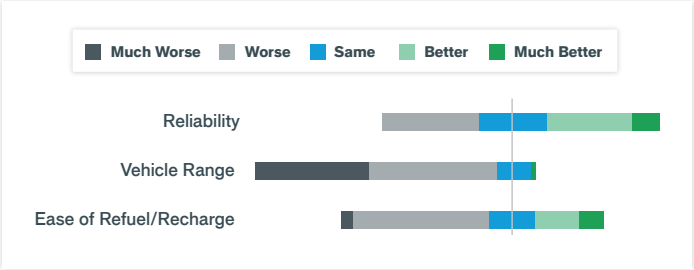
- Around two thirds (65%) expected overall drive comfort to be better in the BEV.
- More than three quarters (78%) of drivers expected acceleration from standing to be the same or better in the BEV. 70% expected rolling acceleration to be the same or better.
- The majority (81%) expected gear change performance (speed of change and smoothness) to be the same or better in the BEV.
- There was some concern about steep inclines with one third (36%) expecting the ability to handle steep inclines to be worse in the BEV.
- The majority (83%) expected noise and vibration to be better (less) in the BEV.



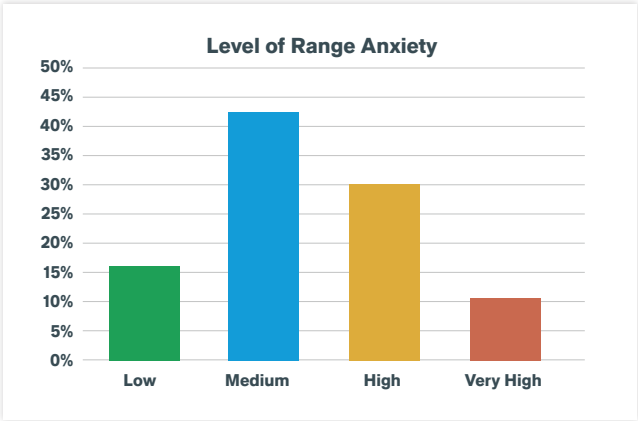
4 Fleet and Driver Perceptions

2. Reliability, range and recharging are a concern or area of uncertainty for many drivers.

- There were mixed views on expected reliability, with 22% expecting better performance, 25% worse performance, and 29% who didn't know.
- Almost two thirds (61%) expected vehicle range on a single charge/tank to be worse in the BEV.
- Over one third (34%) expect ease of charging to be reduced in the BEV (compared to refuelling a diesel vehicle).
- Around one third of drivers answered 'don't know' to questions about the ease, safety, and reliability of charging which reflects the likely uncertainty due to most drivers having never driven an EV before.

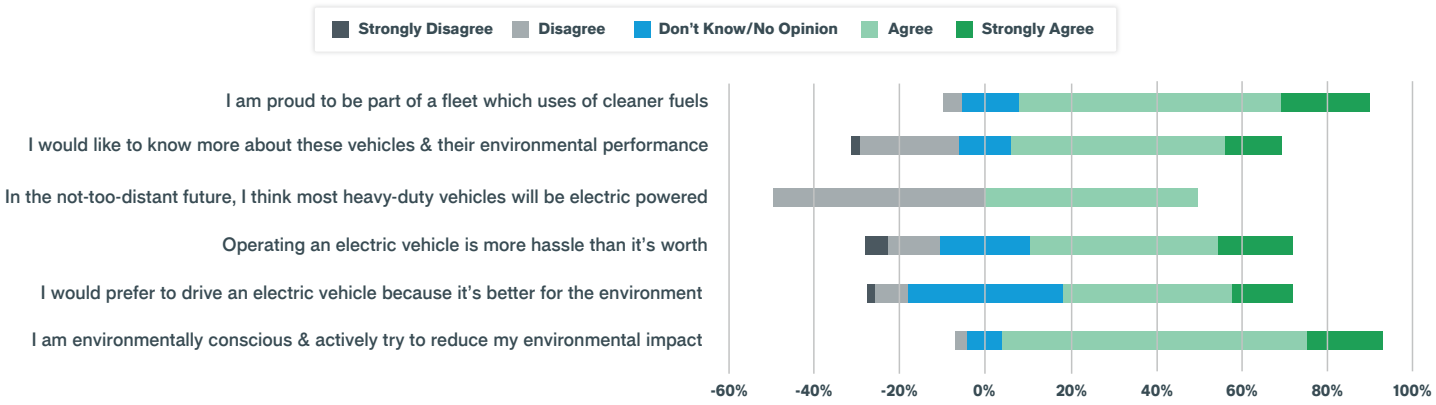


- 70% of drivers have medium or high levels of 'range anxiety'.



3. Drivers are generally environmentally conscious and supportive of the introduction of BEVs.

- The vast majority (90%) are environmentally conscious and actively try to reduce their environmental impact.
- Over half (54%) would prefer to drive a BEV because it is better for the environment.
- More than half (61%) would like to know more about BEVs and their environmental performance.
- The vast majority (88%) are proud to be part of a fleet which explores the use of emissions reducing technologies.
- The vast majority (84%) think the environmental performance of the BETT vehicles will be better than diesels, the rest answered "don't know".



We will report on the mid-trial and end of trial fleet and driver surveys in subsequent BETT project reports comparing the drivers' expectations to real-world experiences.

5 BETT Fleet Portal and Planning Tool

5.1 BETT Portal

The **BETT Portal** is an online resource to help promote the use of electric trucks through providing information and guidance, support tools and study dissemination from the DAF Battery Electric Truck Trial.

The Portal includes the following resources:

BETT Guidance: Guidance pages introduce different aspects of battery electric trucks, from policy trends to practical guidance on assessing and implementing battery electric trucks in fleets.

BETT Trial Learning: The 12-month truck trial commenced in April 2022. Cenex leads the study programme and will report study results in the Trial Learnings section of this site. Trial study areas include vehicle operation, economic and environmental performance, user acceptance as well as life cycle emissions and much more.

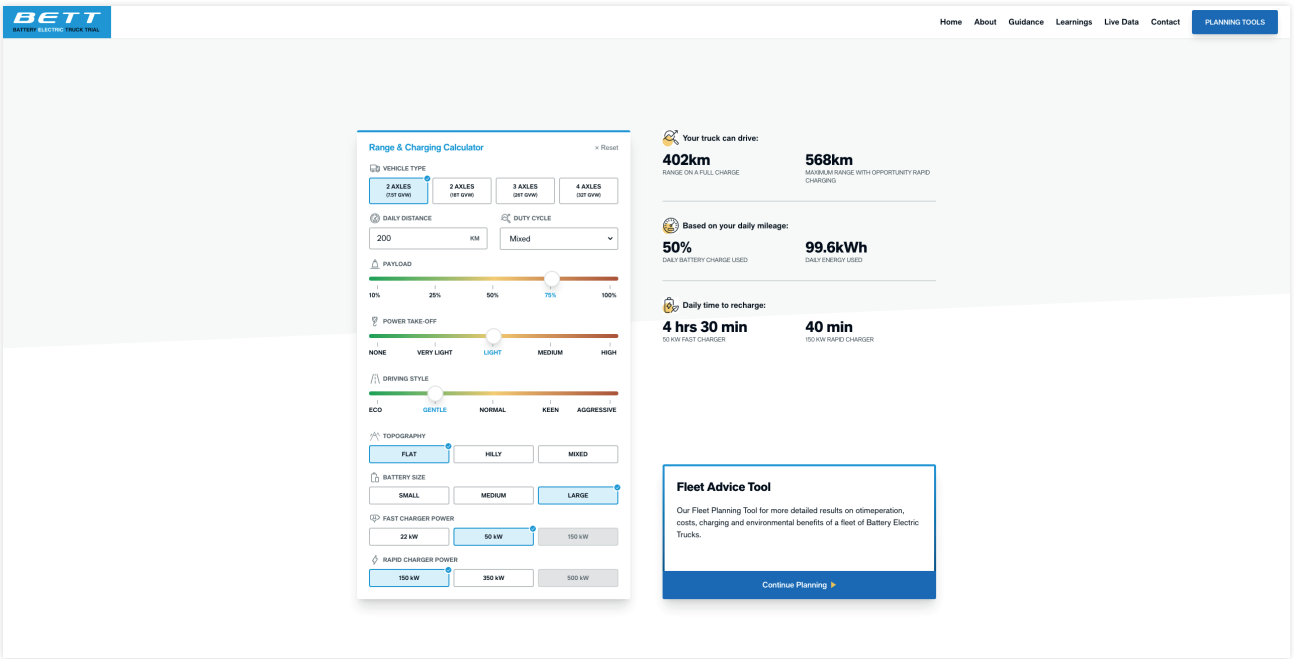
BETT Live Data Dashboard: The Live Data Dashboard provides top level trial statistics that are updated on a daily basis such as total miles travelled, energy consumption and vehicle range.

BETT Depot Planning Tool: to calculate the expected range and charging times from an electric truck. This is explained in more detail below.

5.2 BETT Planning Tool

The **BETT Planning Tool** allows users to calculate the expected range and charging times from a BEV truck using information on fleet's own duty cycles. For those willing to invest a bit more time, an advanced version of the Depot Planning Tool also allows users to plan a fleet of BEV trucks. Here the user will get insights into the charging operation and energy use of their fleet as they build up different groups of vehicles, with their own shift patterns, charging requirements, and costs. When they finish building their fleet they will be able to view a breakdown of the results for their entire fleet, including the savings on fuel, environmental savings, infrastructure costs and more.

Depot Planning Tool



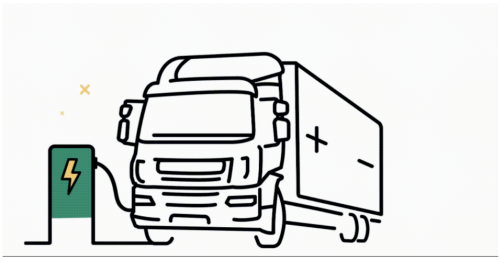
5 BETT Fleet Portal and Planning Tool

Live Data Dashboard

BETT Live Data Dashboard

Live stats from the trial trucks.

Visit the BET Planning Tool to see how the trucks would perform over your operations



20 TRUCKS IN OPERATION

3,500,000 kW ELECTRIC CONSUMED

250,000 JOURNEYS

2,000,000 km DISTANCE TRAVELLED

Performance

RANGE ON FULL CHARGE

150 km AVERAGE

300 km RURAL

200 km URBAN

100 km MOTORWAY

UTILISATION

40 % DRIVING

20 % CHARGING

40 % PARKED

DAILY BATTERY USE

60 % SoC AVERAGE

DAILY DISTANCE TRAVELLED

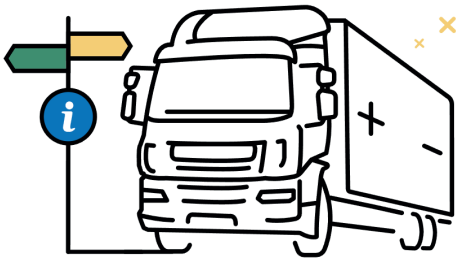
150 km AVERAGE

350 km MAX

Guidance

Guidance

This section provides a range of information and guidance on electric truck markets, suitability assessments and operating and charging your trucks. Click on the links below to explore these subjects. There is a Key Points box for each section, or if you are interested in the detail you can expand the text under each Key Points box.



Introduction to Electric Trucks

1. Overview of Electric Trucks
2. Market Trends: Technology
3. Market Trends: Policy

READ GUIDANCE

Assessing Suitability

1. Factors to Consider
2. Grants and Incentives
3. Fleet Suitability: An eight-point plan
4. Depot Infrastructure Assessment

READ GUIDANCE

Operating and Charging

1. Fleet and Driver Management
2. Repair and Maintenance
3. Charging Rates, Types and Locations
4. Costs

READ GUIDANCE

BETT Portal: www.bett.cenex.co.uk

BETT Planning Tool: bett.cenex.co.uk/tools/

Contact

BETT is being managed by DAF Trucks. Cenex are responsible for research, study aspects and dissemination. If you would like to find out more about the DAF Truck range, then please contact DAF on the details below.

If you have any comments or questions on the study aspects, this website or the fleet tools then please contact Cenex.

Battery Electric Trucks

E: reception@daftrucks.com

T: 00 (44) 1844 261111

W: www.daf.co.uk/en-gb

Haddenham Business Park, Pegasus Way, Haddenham, UK

DAF is the only major commercial vehicle manufacturer producing trucks here in the UK, with their factory in Leyland producing over 15,000 vehicles every year. Almost every DAF vehicle registered in the UK, is built here in the UK.

Trial Enquiries

E: info@cenex.co.uk

T: 01509 642 500

W: www.cenex.co.uk

Holywell Building, Holywell Park, Ashby Road, Loughborough, Leicestershire, LE11 3UZ

Cenex focuses on low emission transport & associated energy infrastructure and operates as an independent RTO and consultancy, specialising in project delivery, innovation support and market development.

Meet the Fleets

To stay up to date with BETT sign up for regular project updates through the BETT Portal.

In Partnership with