Demonstration design and implementation

Electric Freightway Report 2

GRIDSERVE
ELECTRIC FREIGHTWAY

in partnership with

HITACHI
Inspire the Next

Innovate UK

Funded by UK Government

Electric Freightway, part of the Zero Emission HGV and Infrastructure Demonstrator programme, is funded by the Department for Transport and delivered in partnership by Innovate UK.

Foreword

Our second Electric Freightway Report focusses almost exclusively on charging. As GRIDSERVE can attest, any form of public EV charging provision is highly capital intensive and vastly complex. Infrastructure bottlenecks are several, including lack of power provision, convoluted and inconsistent local planning regulations and space constraints due to the pre-existing over-subscription of parking. And when seen through the lens of electric Heavy Goods Vehicles or eHGVs, all of those issues become super-sized.

It goes some way to explain why, at the time of writing, there remains precious few dedicated public eHGV charging stations available in the UK. The rule book is still being written with the support of our pioneering consortium members. This report goes some way to show how we're unpacking every detail, assessing swept path analyses, designing multi-bay configurations, developing power balancing algorithms and even creating digital systems to support these new use-cases. When you're delivering critical infrastructure for a sector that contributes £13.5 billion to the UK economy each year, sweating the small stuff matters.

While a lot of the early electrification wins for heavy goods transport have been focused on distribution vehicles, the national roaming of long-distance trucks, or what the industry refers to as 'tramping', is what we need to focus on to move the needle on climate change. It is therefore crucial that projects like Electric Freightway - part funded by Department for Transport and delivered in partnership with Innovate UK - remain front of mind as we attempt to build awareness, urgency and consensus from both government, industry and stakeholders to set a clear pathway for eHGV charging provision.

Sam Clarke Commercial Lead, GRIDSERVE

While the GRIDSERVE team have been busy planning and designing the crucial charging infrastructure that will be needed for eHGVs, the project's partners have been powering ahead with placing vehicle orders and welcoming the first Electric Freightway eHGVs into their fleets.

This has involved a great deal of learning by doing, with operators implementing interim charging solutions, training their drivers and discovering which routes their eHGVs work best on. Hitachi ZeroCarbon has been gathering data and insights to provide the first glimpses into the demonstration through this report.

Engaging with stakeholders such as drivers and operational managers is essential for the success of the Electric Freightway project. Their insights help identify and address concerns, ensuring a smoother transition to eHGVs. This collaborative approach, facilitated by Hitachi ZeroCarbon, is crucial for building consensus and support across the industry.

Leon Clarke Head of Operations and Delivery, Hitachi ZeroCarbon

01 Executive summary

Welcome to this second report from Electric Freightway, providing an overview of the work the project has done so far in planning and implementing eHGV infrastructure, highlighting the progress made in bringing eHGVs onto the road in the UK, exploring the views of drivers and operational teams towards electrification and providing an insight into some of the challenges that vehicle and charge point operators currently face in transitioning HGV to electric.

Electric Freightway

Electric Freightway is a collaborative demonstration project driven by GRIDSERVE, Hitachi and a consortium of industry stakeholders. The project aims to inform the UK's transition to zero tailpipe emissions freight, based on real-world experience. It is part of the Zero Emission HGV and Infrastructure Demonstrator programme, part funded by the Department for Transport and delivered in partnership by Innovate UK.

We're now a year into the first phase of the project, where we're designing and installing a network of eHGV charging stations across the UK. In total, up to 220 High Power chargers are expected to be installed by GRIDSERVE at around 30 public and private sites. In parallel, the project's HGV operator and truck manufacturer partners will put c.140 electric trucks on the road, operating them in a range of scenarios, including more challenging longer routes.

The first 18 trucks have been delivered, with the majority already on the road with our haulier partners. Orders have been placed for at least 70 more to join the demonstration in the coming months. Hitachi is capturing and analysing data from the vehicles and infrastructure, conducting stakeholder surveys and interviews, and publishing the project's findings through these reports. Following the first stage of the project, partners will continue to operate the trucks and chargers, reporting data for a total period of five years.

Project progress

- **18** eHGVs delivered with orders placed for over **70** more
- Designs progressed for **public and depot charging sites**, with work on the ground expected to start shortly

Key insights explored in this report

- **Space**, **power** and **safety** are the three interconnected - and sometimes conflicting - issues that constrain what is possible on sites
- The **depot planning phase** is complex and needs to be planned and resourced accordingly.
- **Timing vehicle orders** to coincide with less predictable infrastructure installations can be a challenge, but interim charging solutions are available
- **Senior managers** surveyed are largely positive towards the eHGV technology, possibly due to their greater experience owning and driving EVs.
- While **drivers** see some benefits in eHGVs, such as reduced noise and better acceleration, many are not convinced that eHGVs are the future for the industry and are concerned by factors including range and lack of charging facilities.

The challenges of installing eHGV charging infrastructure

Where the first project report described the objectives and approach of the project, this new report focuses on what we've learnt from designing project infrastructure and preparing for its operation. Installing this equipment to support the future growth of electric vehicles is challenging, requiring significant changes in the energy and transport sectors, together with changes to typical land use and to the investment case for buying and leasing vehicles. This is made even more difficult in the HGV segment, with larger vehicles requiring higher-powered charging, consuming even more space, power and network capacity.

The Electric Freightway team has spent considerable time selecting sites, planning and designing infrastructure so that we can deliver it within the time constraints of the project. This has uncovered a range of issues that HGV and site operators will face in the future, with one of the key learnings from our haulier partners being that the depot planning phase is far more complex than expected and needs to be planned and resourced accordingly. Our full learnings about how to overcome these challenges can be found in sections 03, 04 and 05.

Creating a nationwide public charging network

The publicly accessible Electric Freightway charging network is at the core of the demonstration and will be central in addressing one of the key risks hauliers face in operating eHGVs. Our research has found that many fleet and transport managers have experienced how the growth of passenger EV charging has made it easier to switch to a personal EV and so they recognise that the current lack of eHGV public infrastructure not only limits longer routes but means there's no 'plan B' in the event of unexpected disruption to daily operations.

The setup of the project's public infrastructure has taken longer than originally envisaged. While electricity connection capacity is the key barrier - and can impact site viability - there are a range of other factors that need to be considered. Public parking for HGVs is already often over-subscribed, meaning the replacement of HGV parking with charging bays is not always viable for site owners/operators. Changes to layouts of sites often necessitate lengthy negotiations and planning procedures, and ultimately HGV charging may not turn out to be viable in the immediate term.

Section 04 of this report looks at our work on public sites in more depth, giving insight into the factors that must be considered when planning and designing a site.

Adding eHGVs to existing fleets

The need for new charging infrastructure is led by demand for the eHGVs in the programme, and our project partners and members have been working hard to formulate plans, place orders and introduce eHGVs to their existing operations. Our first two vehicles hit the road in early May, at A.F. Blakemore and Son's Bedford depot, quickly followed by new eHGV deliveries to Samworth Brothers, Boughey and United Utilities.

The process of specifying eHGVs has been relatively trouble free, supported by the manufacturers' dealer networks and customer experience teams. However, some lead times have been longer than equivalent diesel HGVs as manufacturers continue to ramp up capacity for battery electric vehicles. The major issue faced has been timing orders to coincide with less predictable infrastructure installations, though temporary charging solutions have been successfully used to mitigate this.

Section 06 provides further details of the progress and lessons learned in this area.

Industry attitudes towards eHGVs

In order for the transition to zero-tailpipe emissions vehicles to be a success it is important that stakeholders at all levels of the haulier organisations are supportive, especially those in decision-making and operational planning roles. Driver buy-in and training are also important for a smooth and efficient transition. We've been gathering views from stakeholders before the trucks roll out through interviews and surveys, and we'll repeat this exercise once they've had experience of driving and managing electric trucks.

Initial results have shown that drivers and their managers currently have mixed views towards eHGVs. While there are positive expectations regarding noise and environmental impact there are several concerns regarding issues such as range, access to charging and impact on their work. As the demonstration progresses, and organisations gain more experience with eHGVs, we'll be looking closely at how these views evolve and how any issues identified could be resolved.

More detail on our findings so far can be found in Section 07.

The project is also looking to understand attitudes towards eHGV adoption across the wider industry, including operators of different sizes, in different sectors and at different stages of considering how they will decarbonise. Please add your voice by completing the anonymous survey here.

What's next?

The first eHGVs hit the road in early May 2024 and the number of vehicles in operation has been steadily growing. Hitachi ZeroCarbon has been collecting data on truck activities, as detailed in Section 08 and is now analysing vehicle movements and charging activity ready for our next report, which will share interim results from the demonstration. This is expected to be published in Spring 2025.

Alongside this, following detailed design and permitting, GRIDSERVE is ramping up its delivery of charging infrastructure. In addition to the provision of depot sites, work is expected to begin on the first public site in the coming weeks. As the demonstration progresses, and charging facilities come online, we will be regularly sharing updates on our website at https://www.gridserve.com/electric-freightway/ and on the GRIDSERVE and Hitachi ZeroCarbon social media channels.

02 Introduction

Electric Freightway is a collaborative demonstration project of electric heavy goods vehicles (eHGVs) and associated charging infrastructure throughout the UK. This second report details what we've learnt so far from planning and implementing the demonstration. The key learnings found in this report are intended to help the industry develop business cases for fleet electrification and hauliers specify charging for their trucks. The first report, introducing the project's aims, and the hypotheses that we're testing, can be found on our website.

The problem we're addressing

The objectives set for HGVs by the UK's net zero strategy are some of the most ambitious in the world, with all new HGVs under 26 tonnes expected to be zero emission from 2035 and all larger vehicles, such as those taking part in this demonstration, following by 2040[i].

There is a long way to go to meet these goals. At present, very few dedicated eHGV charging stations exist in the UK, and most existing charging infrastructure is not designed for the charging of large vehicles. Hauliers' depots also require significant modifications to allow for eHGV charging. The market for larger eHGVs is also in its infancy; freight operators require reassurance that eHGVs are capable of running their routes economically before they commit to investing in new technology.

What will the project result in?

The aim of the Electric Freightway is to kick-start the deployment of long haul zero emission Heavy Goods Vehicles (HGVs), with a multi-year demonstration of 40-44 tonne battery electric HGVs (eHGVs).

The consortium partners are trialling eHGVs across some of the most demanding routes in the UK to prove the capability of these vehicles and identify any requirements for technical or policy innovations to enable the transition to net-zero road freight.

The project will create a network of public charge points on major routes, designed specifically for eHGVs. Project partners will also commercialise the learnings from the project to further accelerate their eHGV transition and that of other businesses in the sector.

Electric Freightway will analyse the operational, financial and environmental impacts of the eHGVs, allowing the industry to develop business models for further scalable deployment of vehicles and dedicated infrastructure.

Where are we now?

Since the publication of the last report in February 2024, the Electric Freightway team has made good progress in getting the demonstration on the road. Most of our project partners have placed orders for electric trucks, with the first ten already in operation. GRIDSERVE has designed both depot-based and public high power charging stations and we expect the first sites to come online in the coming months.

While progress has been slower than originally envisaged, we've learned a lot along the way, and this report details the challenges encountered and how we've overcome them.

Meanwhile, Hitachi ZeroCarbon have been busy collecting data from the first vehicles and chargers. This data will provide insight into the performance of these vehicles operating across the UK. A comparative analysis will outline the ability of eHGVs to replace diesel HGVs in varying use cases and operating conditions. Analysis of this data is ongoing and initial results will be shared in the project's next report.

Alongside this, the industry has continued to make progress towards decarbonisation. More organisations have announced their intention to adopt eHGVs and additional investments in EV charging facilities have been announced worldwide. In the UK, sales of eHGVs increased 30% in Q2 2024, though from a low base, reaching 0.6% market share[ii].

The European parliament has adopted new more aggressive CO2 emissions standards for heavy-duty vehicles, requiring a 45% reduction compared to 2019 levels by 2030, 65% by 2035 and 90% by 2040[iii], providing a clear pathway to decarbonisation for European truck manufacturers.

How is the project funded?

Electric Freightway, part of the Zero Emission HGV and Infrastructure Demonstrator programme, is funded by the Department for Transport to the tune of almost £63m and delivered in partnership with Innovate UK.

The project partners are also committed to making significant investments in vehicles, infrastructure and resources to support the project, amounting to c.£37m of the £100+m project budget.

Project objectives

The goal of the Electric Freightway project, as part of the Zero Emission HGV and Infrastructure Demonstrator programme is that it:

> **"will stimulate multi modal transport and examine different use cases that will create invaluable insights to allow the wider market to follow."**

To do this, Electric Freightway will deliver:

> **"a demonstration which has a viable route to expanding nationally and internationally, as part of your long-term strategy to decarbonise this sector"**

In doing so, the project and GRIDSERVE will create a viable eHGV network:

- **At the lowest possible cost**
- **In the fastest possible timeframe**
- **Delivering maximum customer service**
- **At the forefront of eHGV electrification**
- **With net zero as the priority**

And prove or disprove our key hypothesis that:

> **Electric 40-44t HGVs are ready to replace diesel HGVs and can deliver the same function when the right infrastructure is in place.**

The scale of the project

The project is planned to involve:

c.140 eHGV trucks

c.220 high powered chargers

c.30 public and private sites

This will be achieved through collaboration between a network of partners throughout the sector. This wide-ranging group of companies includes independent and in-house hauliers, charge point operators, landowners, financiers, eHGV manufacturers (OEMS) and solution providers.

We are also working closely with other stakeholders such as the Department for Transport, National Grid, National Highways, The Connected Places Catapult and Innovate UK. All of these diverse organisations will need to come together in order to facilitate the transition to eHGVs and ensure that the required infrastructure is put in place.

Lead partner

GRIDSERVE is developing, delivering and operating the network of charging hubs at the motorway service areas as well as the commercial depot charging solutions, and the underlying technology platforms needed to provide a seamless charging experience. GRIDSERVE is also sourcing and reporting data for the project.

Principal partner

Hitachi ZeroCarbon is collating, analysing and reporting on findings throughout the project, leveraging experience from similar EV demonstration projects such as Optimise Prime. The reports and outputs will inform stakeholders, the wider market and government policy to drive the further decarbonisation of commercial fleets.

Project consortium

OEMs

The project is agnostic regarding vehicle OEMs and will work with whichever supplier hauliers choose to buy or lease from. The following companies are currently working closely with us as part of the consortium:

Hauliers

We're working with a range of companies across different aspects of the logistics chain, including dedicated 3rd party logistics companies as well as organisations operating their own vehicles in support of their wider business. For simplicity, we will collectively refer to these companies as 'hauliers' or 'operators' throughout this report.

Charging location partners
GRIDSERVE is working with landowners throughout the UK to secure locations for public and private charging infrastructure, including:

Leasing partners
Hauliers can choose to buy vehicles outright or through lease/contract hire arrangements with our leasing partners:

Project supporters
The project will also work with observers from a range of stakeholders to ensure that the findings from the project benefit the whole industry, including:

Project timeline
Electric Freightway is being carried out in two phases. The main activities of the demonstrator started in July 2023 and will run until July 2025. During this period, the project's infrastructure is being built and eHGVs are being put on the road. We are sharing insights through a series of reports and knowledge exchange activities based upon what we are learning from the examination of data and experiences of project partners.

Following this initial phase, the project's partners will continue to operate their eHGV fleets and infrastructure. Ricardo has been appointed by Innovate UK to act as an independent technical evaluator, continuing to collect and analyse data through regular reporting for a period of five years.

This report
Throughout the Electric Freightway project, we are publishing findings from the demonstration to help future hauliers and charge point operators make their transition to eHGVs as smooth as possible. For a detailed background on the project objectives and approach, see report one. This second report shares what we've learnt from the planning and rollout of electric HGVs and the first stage of the charging infrastructure.

Section 03 gives an overview of the planned project infrastructure, describing the different charging choices for hauliers and highlighting some design considerations that are relevant to all sites. Section 04 provides further detail on the considerations when planning public charging stations and Section 05 outlines what we've learnt from planning and implementing depot-based charging for eHGV fleets.

Section 06 provides some insights from the hauliers on how they've integrated eHGVs into their operations.

Alongside the technical design of the demonstrator we've been asking drivers and managers about their views on the transition to zero tailpipe emission HGVs. The first insights from this work can be found in Section 07.

Section 08 delves in to the work we've done in implementing the IT systems to support Electric Freightway, which are now gathering data for analysis.

Finally, Section 09 contains a look ahead to what will be happening next in the project.

Contacting Electric Freightway

If you have any questions about the programme, this report, or have any suggestions for how our future publications and analysis could be improved, please contact the Electric Freightway team at: feedback@gridserve.com.

You can find out more about the project at our website https://www.gridserve.com/electric-freightway/ which will be updated as the demonstration progresses.

03 eHGV charging infrastructure

Electric Freightway is installing a network of high-power charging stations designed for eHGVs. The stations will be located both at hauliers' depots and public locations at motorway service areas (MSAs) and truck stops. This section introduces some of the key considerations when implementing eHGV charging infrastructure, while the following chapters focus on the specifics of public and depot site implementations.

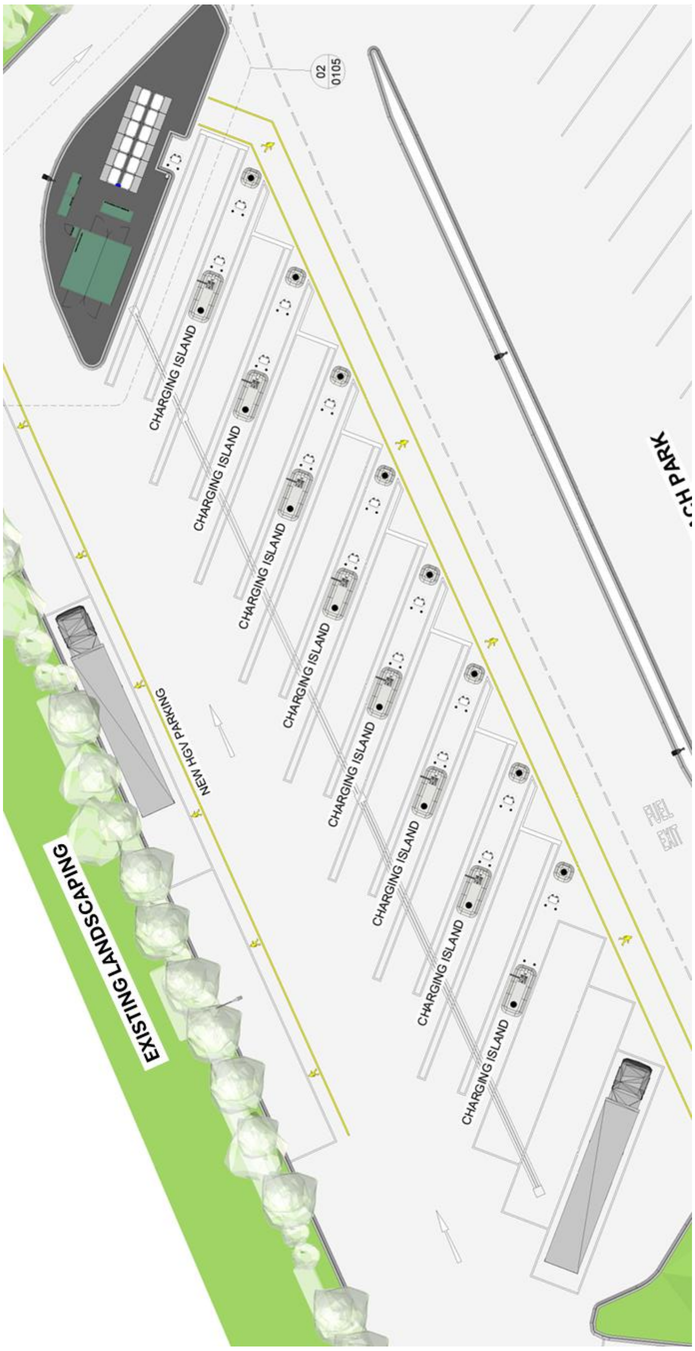
Introduction

Deploying charging infrastructure is at the centre of the Electric Freightway project. GRIDSERVE will provide charging infrastructure on our partners' depots as well as at publicly accessible charging hubs, primarily located at MSAs, throughout the UK. Some project partners will also make use of their own charging infrastructure delivered outside of this project.

Creating infrastructure of this nature from scratch is a big undertaking, yet it is essential that it's in place for the HGV sector to electrify. As one of the first movers in this sector we're learning a lot, and there's a lot still to learn as we reach the build stage of the project. GRIDSERVE has extensive experience of putting in place charging infrastructure for cars and light commercial vehicles (LCVs), a lot of which is being drawn upon through this project. While the charging technology is relatively similar, eHGVs are very different from cars – not only are they bigger, but they typically take longer to charge and are almost always on tight schedules, with drivers held to strict regulations around working hours.

Deploying the project's infrastructure has therefore had to be a team effort, closely involving hauliers, site operators and specialist contractors. We've also carried out practical tests and evaluated eHGV sites outside the UK so that we can learn from best practice. As a result of this complexity, the implementation of the infrastructure is taking longer than was originally envisaged when the project was first proposed, as challenges have been discovered and solutions found. The following sections of this report will cover these challenges in more detail but, in summary: space, power and safety are the three interconnected - and sometimes conflicting - issues that constrain what is possible on sites and therefore shape our design decisions.

Figure 1 - Typical drive through eHGV charging island layout



Space – At both depots and MSAs, space is normally at a premium. eHGV charging is less space efficient than standard parking bays and when charging is installed something else often must be moved. This can result in changes to established site operations or having to apply for planning permission for more substantive alterations – all of this can take a significant amount of time and resources.

Power – The amount of power needed to charge eHGVs is significant. Most vehicles carry around 500kWh of batteries – enough to power an average UK home for two months – and introducing the infrastructure to charge these batteries has significant impact on electricity networks. Network operators are working to meet demand, but in the shorter term there are sites that can't be electrified, or where electric routes will be limited, until local grid upgrades and reinforcement takes place.

Safety – ensuring that infrastructure and, more importantly, users are safe is the top priority for the Electric Freightway partners. There are risks around working with eHGVs that need to be understood and mitigated through good site design. This covers a wide range of factors, from ensuring sufficient manoeuvring space for vehicles to providing physically protected areas for pedestrians and taking the precautions needed for the unlikely event of fire.

Choosing where and how to charge

When transitioning to electric, HGV operators will need to carefully consider how they will keep vehicles charged while still carrying out their duties. Depending on the business requirements there are a range of potential options, and it's likely that most organisations will have to use a combination of different charging modes:

Depot-based charging brings the advantage of lower cost of energy (pence per kWh) but requires upfront investment and, as the following sections will outline, may not always be achievable on power and space constrained sites. Depot-based charging works well for back to base operations, where route distance is less than the range of the vehicle, but businesses operating longer routes away from their depots may not be able to rely on depot charging alone.

Public charging provides operators with increased flexibility; enabling longer routes, overnight tramping and potentially providing a backup should depot facilities not be available or if there are short term requirements for additional capacity. While there are no capital costs for the eHGV operator, it is however generally more expensive (pence per kWh) and may not always have the guaranteed availability when and where needed.

While public and depot charging are the two core modes being implemented in Electric Freightway, we expect a range of options to develop including:

Shared depots where hauliers make their facilities available to their peers, allowing a depot-like experience at locations where operators don't have their own depot, and making more efficient use of limited connections and charging infrastructure. Locations in other sectors, such as bus depots may also make their facilities available to selected partners when not in use.

Destination site charging at customer premises, taking advantage of the time that HGVs spend loading and unloading to top up their charge.

Routes will need to be carefully analysed to determine the amount of infrastructure needed and the most appropriate approach to charging.

Speed matters

As well as location, operators will have to consider speed when deciding when and how to charge. Even with the highest power chargers, powering an eHGV will take longer than fuelling a conventional diesel vehicle. How important this is depends on the specific way the vehicle is being used.

Higher power charging is more expensive to deliver, as a higher capacity electricity network connection, more expensive chargers and associated infrastructure is needed. It does however come with several advantages; charge sessions are faster and fewer chargers are needed. For operators with intensive shifts and limited space these advantages may be critical, but for other hauliers they may not matter. As eHGV charging can take place relatively unattended, it can often fit into periods when the vehicle would not be in use – overnight between shifts, while trailers are loaded or during breaks - this allows the use of slower charging, which may be more cost effective to provide.

The demonstration's charging facilities will aim to cater for these different scenarios, allowing us to analyse how infrastructure is used and what combination of options will be required in the future as eHGV operations grow. A key learning for depot charging is that often a blend of high-speed chargers combined with slower over-night chargers helps optimise charging of a fleet of vehicles with different operational requirements whilst minimising expensive electricity supply upgrades.

Implementing eHGV infrastructure

Over 200 high-power eHGV charge points are planned to be installed through the demonstration at up to 30 sites, consisting of both public charging sites (principally MSAs) and private depots.

There are differences between how each type of site is designed and developed (which will be explored further in sections 04 and 05) however the key steps of the process are similar, and are explained in Table 1.

While the steps are generally presented in the order that they need to happen, the process is iterative and some steps may need to be repeated if obstacles - such as operational and grid limitations - are uncovered.

Table 1 - Stages in designing and implementing an eHGV charging station

Stage	Description	Why this is needed & what to look out for
Viability	The initial viability study is required to rule out sites that don't make commercial or practical sense – for example public sites that see relatively little HGV traffic.	For operators with many sites and limited budgets, assessing viability at an early stage is vital so time is not wasted on unnecessary survey work. If applicable, the landlord and all internal stakeholders should be involved at this stage to secure their support.
Feasibility	A desktop analysis is performed to identify potential locations for charging and highlight constraints. Distribution Network Operator (DNO) capacity maps are consulted to establish whether capacity is available on the network in the local area.	Resources are available that help to identify sites where there is little chance of installing charging in the short term, including capacity maps[iv]. At some locations, such as industrial parks, an independent DNO (iDNO) may be responsible for providing capacity. The impact of meeting demand through different combinations of high and low speed chargers can also be considered.
Site surveys	The technical design team visit the site to carry out a more in-depth survey, observe site operations and meet local stakeholders.	Engaging with operational staff at local sites is critical as part of this stage, as they will have a good understanding of what will and will not work. Site surveys will also locate impediments that may not have been visible from a desktop survey, such as location of fuel tanks and underground obstacles.
Site location agreement	Agree in principle how the site will work – where chargers will be sited, what space can be used and how vehicles will move through the site.	An agreement is important to make sure that all stakeholders are aware of what is proposed and how it impacts on their operations. A number of departments such as transport/operations, safety and facilities may have different requirements that need to be accommodated through design revisions
Permissions	Permission is gained from the landlord for the works and a letter of authority is issued to the developer to engage with the DNO.	Landlords are generally supportive of investments in eHGV infrastructure, but the process of getting their formal approval can be lengthy, especially where they're represented by land management companies.
Proposal	A detailed proposal is built by the developer and issued to the site manager.	Ensuring designs are well documented and shared gives stakeholders full understanding of proposals and provides opportunity to raise any final comments and objections.
Point of Connection (POC)	Apply to the DNO for new or upgraded POC, if one is required.	The non-availability of electricity network capacity in a reasonable timeframe is the most likely factor to derail an electrification plan, and costs for connections can range from a few thousand to hundreds of thousands. POC requests require understanding of what will be connected and where and require payment of a fee, so can't take place earlier in the process.
Legal agreements	Agreements may be required with the site's landlord or other site users before work on the site can begin.	Other parties that might be impacted include any third parties working from the site who may be impacted or would need to use the infrastructure.

Stage	Description	Why this is needed & what to look out for
Engineering, Procurement and Construction (EPC) Contract	Agreement between the site owner and developer to work on the detailed design, procurement and build of the infrastructure, clearly defining responsibilities.	Electric Freightway used EPC contracts to clearly document the roles and responsibilities around design and construction. While this clarity is beneficial in the long term, the complexity of the contracts meant that a lot of time was spent getting the details right for the first agreements.
Distribution Network Operator (DNO) Agreement	Sign agreement for the additional network capacity needed.	Even once agreed, there will be a lead time before the connection is ready. This can vary significantly depending on the amount of work required. New connections crossing roads and third-party property can take substantially longer.
Build	Build of Electric Freightway chargers is just starting. Learnings from the build and operations phases will be covered in future reports.	
Operate and Maintain		

The role of standards

As the project is developing some of the first eHGV specific charging stations in the UK, a lot of time and effort during the design process is spent understanding the differences between truck and car charging, and developing suitable solutions. Other infrastructure developers and users can benefit from this work by learning from our experiences (both good and bad) and following best practice guidance.

The British Standards Institution (BSI) is supporting the Zero Emission HGVs and Infrastructure Demonstrator programme by fostering dialogue and collaboration between consortia and across the wider road freight industry, aiming to capture this best practice in the form of standards.

Standards provide an agreed method for achieving a result, through statements of good practice, designed to make things better, safer, and more efficient. They represent the consensus of a group of experts and stakeholders with an interest in the subject matter.

Capturing and sharing good practice can accelerate the scale up of zero-emission vehicles, by leveraging trials to resolve long-term issues, particularly in those areas where harmonisation and interoperability can help industry achieve efficiencies.

BSI's ZEHID standards programme is aimed at informing the industry about existing standards and providing guidance on a wide range of organisational activities, from manufacturing and testing components, to planning and designing charging and refuelling facilities, to creating a process or protocol. Where relevant, the programme is also seeking to fill gaps in areas where guidance does not exist or is not easily accessible.

The standards programme is being executed in two phases and is delivered in partnership with Connected Places Catapult:

- **Phase 1** of the programme ran from April 2021 to March 2022 and produced a suite of outputs to build robust foundations for the demonstrations. Focus areas have included trial data strategy, export potential, safety and regulations, standards, and market operations.
- **Phase 2** is running between December 2022 and March 2025 and will result in the development of three new standards, responding to the challenges and needs that consortia partners and other industry stakeholders have highlighted during an extensive preliminary engagement exercise.

Electric Freightway contributing to BSI's ZEHID Standards Programme

Contribution to Industry Engagement

Electric Freightway partners have been proactively involved in the industry engagement activities undertaken by BSI between December 2022 and May 2023, attending workshops and interviews, and discussing challenges and opportunities with other industry representatives.

This exercise identified challenges and opportunities in a range of areas, spanning from vehicle design to operational safety at charging stations, to vehicle recovery and maintenance during operation.

BSI carried out an analysis of existing or emerging, national and international standards for each of the topics raised during the engagement. Based on the analysis, it was possible to identify gaps in the existing standards and guidance landscape and compare those gaps with the most urgent priorities raised by stakeholders.

This explorative phase culminated in the publication of a Prioritization Report, summarising the findings of the engagement and background analysis, and recommending priority areas for future research and standardisation.

Contribution to the development of new standards

During the engagement process, three topics were identified as important areas for harmonisation and standardisation, as not currently appropriately addressed by existing industry guidance and standards:

- Planning, design and operation of publicly accessible charging stations for heavy vehicles;
- Workshops for inspection and maintenance of battery electric and hydrogen fuelled HGVs;
- Design and operation of hydrogen refuelling sites.

Based on such findings, three distinct guidance documents covering the three topics are currently being developed under BSI's supervision, using the BSI Flex standard methodology.

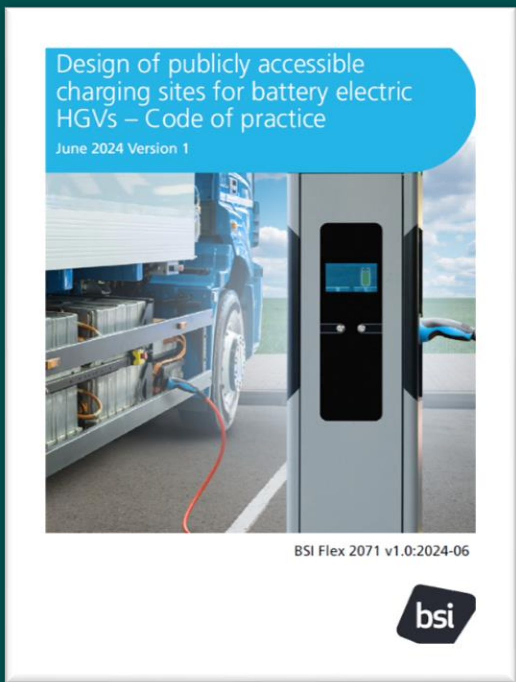
A BSI Flex is a way to develop consensus-based standards that dynamically adapt to keep pace with fast-changing markets; the content of the document is developed through an iterative review process, involving a leading technical expert in charge of drafting, and a group of industry experts and stakeholders providing feedback and comments.

The first of the three documents, **Flex 2071 – Design of publicly accessible charging sites for battery electric HGVs – Code of practice** has recently been released for public use and consultation. It will be updated, starting in September 2024, to incorporate feedback from industry.

Flex 2072 – Battery electric and hydrogen-fuelled heavy-duty vehicles – Workshops and protocols for maintenance and inspection was published in September 2024.

Several Electric Freightway partners are actively contributing to the standard development process through participation in the Advisory Group and sharing learnings and experience to be included in the guidance documents. In particular:

- GRIDSERVE and Volvo Trucks have been involved in the development of Flex 2071;
- Volvo Trucks was involved in the development of Flex 2072.



Ensuring interoperability and accessibility

These best practice-based standards are designed to ensure that charging infrastructure is accessible to all vehicles and users and operate in a safe and compliant way. They fill gaps in existing guidance and complement a range of other standards and guidance which were typically designed for charging smaller vehicles.

More fundamental issues of vehicle charging, such as the electrical and communications used between vehicles and infrastructure are standardised on a global basis through **IEC TC69**[v], ensuring that vehicles can consistently interface with chargers. Connector standards are set through the **Combined Charging System** (CCS)[vi] and **Megawatt Charging System** (MCS)[vii] standards established by CharIN.

The Institute of Engineering Technology publishes a **code of practice for Electric Vehicle Charging Equipment Installation**[viii]. This covers issues of electrical safety that need to be considered when installing infrastructure, together with building regulation, electrical and fire safety requirements that need to be complied with.

While not designed specifically with eHGVs as the target, BSI's **PAS 1899**[ix] provides guidance on ensuring that all charge points are accessible to all and free from barriers, while the **Public Charge Point Regulations**[x], sets out rules regarding payment, information and support for users of charge points.

All of these provide help and guidance to installers and this report will highlight some of the specific issues faced when applying them to eHGV charging.

The route to MW readiness

At present most eHGVs are limited to charging at 250-350kW, but it's expected that vehicles that can charge at up to 1MW will become more widely available over the coming years. This will allow vehicles to charge significantly faster, making the charging experience closer to that of diesel refuelling and allowing higher utilisation of the vehicle. One of the demonstration's goals is to be ready for megawatt charging.

CCS high power charging, which is used across most vehicles and charging sites in the project, is usually limited to around 350kW, and although higher power versions have been demonstrated, a new standard with larger connectors is needed to reach 1MW and above reliably. The **Megawatt Charging System (MCS)** is expected to meet this requirement and is currently being developed, with the final standard expected to be resolved later in 2024.

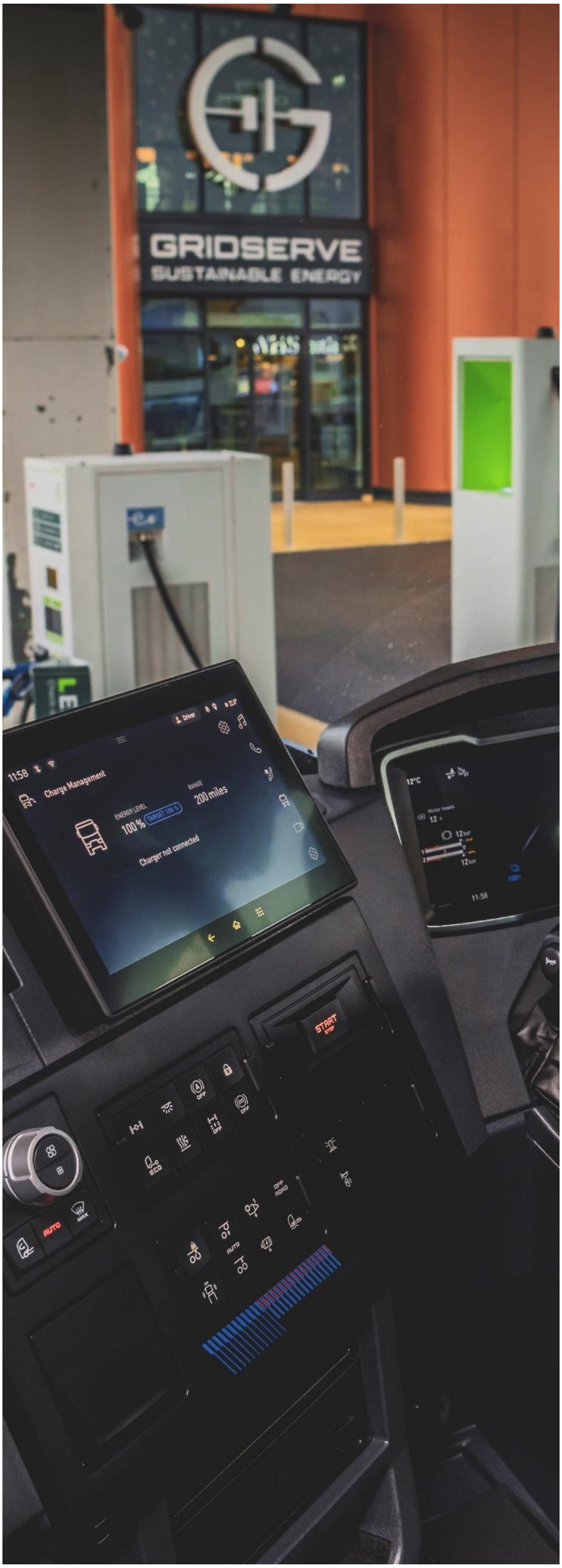
GRIDSERVE has been actively working with suppliers to determine what can be delivered in the scope of the project. This may include the provision of MW-ready charging or, should this not be possible, designing one or two sites with infrastructure that will enable an upgrade in the future. This could include the required power supply and cabling together with the capability for chargers or dispensers to be changed or upgraded in the future.

In addition to the availability of chargers there are other factors that need to be considered when planning megawatt charging, including:

- Site power capacity
- Whether battery energy storage systems are needed locally to reduce peak demand on the grid
- Potential utilisation of the charger, the space it occupies and the electricity connection – MW sites should also be able to charge lower power vehicles while there are few MW capable vehicles on the road
- Location and sizing of transformers, feeder pillars and power control units
- Practical issues of handling the bulkier cables needed for 1MW
- Charger connector placement on the vehicle is expected to be standardised to be on the left-hand side behind the front wheel arch (though vehicles may additionally have a CCS connector which could be elsewhere)

Given the higher expected cost of installation, the demand for MW charging needs to be considered and usage carefully analysed. For many use cases, MW charging will probably not bring significant benefits. At depots where eHGVs load or unload, they are likely to be parked for a significant period of time, making charging at a lower rate more suitable. Determining future higher power requirements should consider the ratio of dwell time (time spent stationary at the depot) to charging power (charger's power delivery capability and the vehicle's ability to ingest that power) to ensure that the right chargers are placed at the right locations.

On route, higher power charging will provide greater flexibility, but this may not always be necessary when drivers need to take mandated tacho breaks or only need a small top-up charge. The need for faster public charging is expected to be revealed as the project progresses.



Predicted growth in demand for eHGV charging

Alongside the planning of specific sites for the demonstration, GRIDSERVE has been investigating the potential future market for public eHGV charging in the UK. This work has considered future growth in eHGV volumes, taking into account a range of sources such as National Energy System Operator's *Future Energy Scenarios*.

Figure 2 - Predicted growth in number of eHGVs in Great Britain

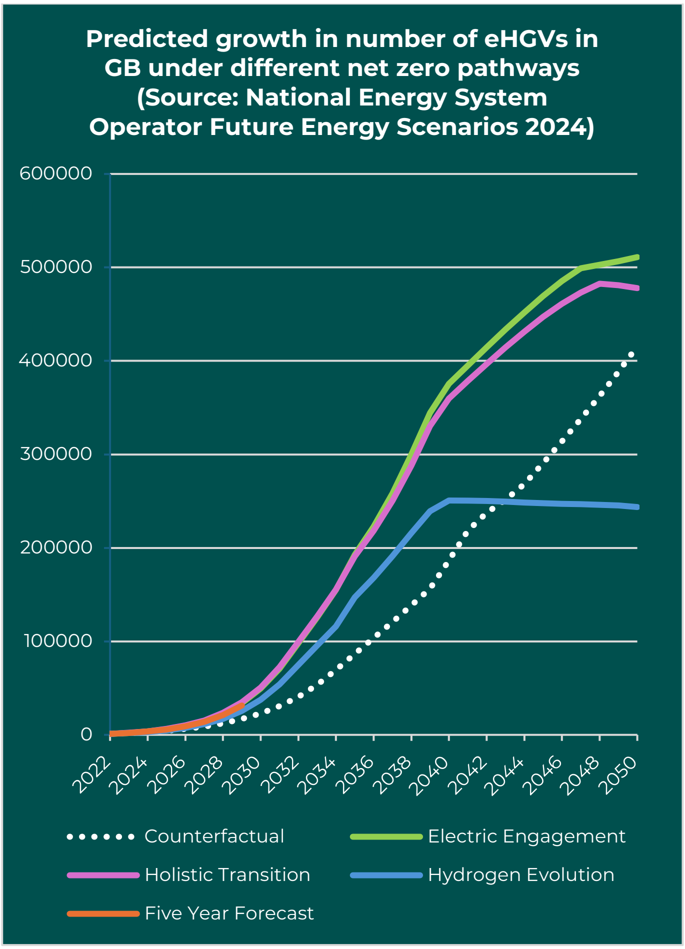


Figure 2 shows the modelled number of eHGVs on the road up to 2050, created to support the Future Energy Scenarios[xi]. The pathways show different routes to reaching net zero in Great Britain by 2050, against a counterfactual where some progress is made but the 2050 net zero target is missed. The Electric Engagement pathway (based on a situation where net zero is primarily met through demand electrification) and Holistic Transition (based on a mix of electrification and use of hydrogen) result in very similar growth projections for eHGVs. Even the Hydrogen Evolution pathway, which is based on faster adoption of hydrogen in industry, heat and heavy goods transport, predicts a steady growth in eHGV numbers until the late 2030s, when eHGV numbers stabilise and hydrogen is used for more challenging operations.

While the numbers of eHGVs predicted is significant and should demonstrate a strong need for public charging, the period up to 2030 sees relatively slow growth in all scenarios, when growth will accelerate, driven by a range of policy and technological factors.

Judging public infrastructure investments in the period up to 2030 is therefore challenging, as the slower early growth is likely to result in lower infrastructure utilisation at first, though the presence of the infrastructure may be required to encourage further growth. In addition to total demand, regional differences need to be considered and locations which see large volumes of HGVs, or are at suitable locations on long HGV corridors, are likely to see demand for charging earliest.

Fact checker

Will there be enough low carbon electricity to charge HGVs?

Electrification of transport and heating are two of the cornerstones of decarbonisation in the UK which are needed to achieve the legally binding target of net zero greenhouse gas emissions by 2050.

To achieve this, energy generation must switch to zero emission sources while at the same time catering to increased demand from vehicles and heating (via heat pumps). This poses significant challenges for the energy system in terms of ensuring sufficient zero carbon electricity is available at the right time and in the right place, implying more generation and more transmission and distribution grid capacity will be required.

The NESO (National Energy System Operator) was launched on 1 October 2024, after government buy-out of the Electricity System Operator, with a broader remit to take a long-term approach to strategic network planning to ensure security of supply and accelerate progress towards clean power.

How much electricity will be needed to power all the electric HGVs?

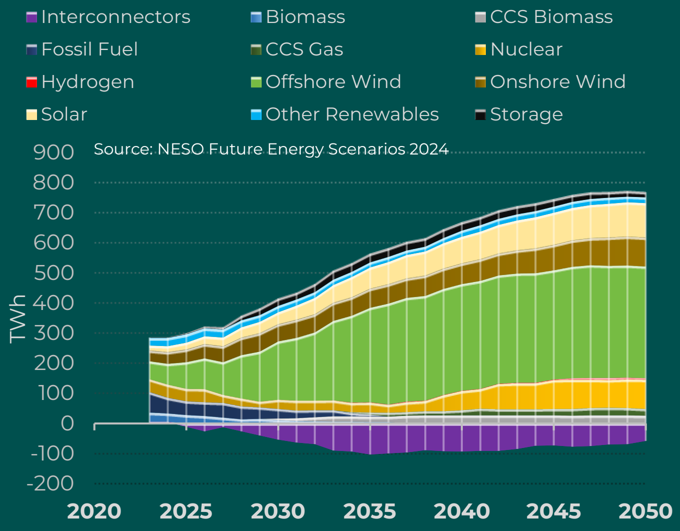
Every year NESO releases its *Future Energy Scenarios*, as discussed on the previous page. These are based on assumptions developed in consultation with industry stakeholders. Figure 2 on page 19 of this report shows the different eHGV uptake scenarios, with "Electric Engagement" projecting the greatest use of eHGVs.

This scenario assumes that there will be approximately **193,000 eHGVs over 3.5 tonnes on the road in 2035** with a rapid uptake thereafter leading to **511,000 eHGVs in 2050**. This translates into a total annual electricity demand for eHGV charging of roughly **8 TWh in 2035 and 35 TWh in 2050**. To put this in context, by 2050, when the sector fully electrifies, **HGVs are expected to account for 5% of the total UK electricity demand**. Overall, the Electric Engagement scenario assumes that the total electricity demand in the UK will increase by 72% between 2023 and 2050, from 329 TWh to 679 TWh.[xii]

How will generation keep up with this increase and decarbonise at the same time?

The transition is already well under way. On 30 September 2024 the last of UK's coal fired power plants closed, making it the first industrialised country to achieve this milestone. The UK Government has recently re-stated its commitment to a **fully decarbonised electricity system by 2035**[xiii] and made significant governance changes, including the creation of the NESO, and investments to enable the achievement of this target.

Electricity output by technology in Electric Engagement pathway



To meet the increasing demand, **generation will need to increase by a factor of 2.75** between now and 2050 as shown in the chart, below left. These projections are supported by a pipeline of generation projects, with offshore wind playing a leading role.[xiv]

With a system reliant on renewables, how will we ensure there's enough electricity available when needed?

The NESO is also responsible for matching the demand and supply of electricity on the system on second-by-second basis. To ensure that fluctuations in renewable generation do not cause issues, the system will need an increased amount of storage (mainly static batteries), interconnectors to Europe as well as flexibility of demand, including **smart charging and vehicle-to-grid**.

Smart charging can help balance the grid when demand is high and make use of surplus energy during periods of excess supply, while providing financial benefits to users. Although until now it has mainly been considered in relation to small vehicles (as demonstrated in the Optimise Prime project), **eHGVs also have the potential to contribute to grid balancing**, particularly those that remain plugged in overnight and where charging could be scheduled to respond to grid signals.

How will the grid ensure that power supply is available where the vehicles need to be charging?

This is perhaps the thorniest of questions. As detailed throughout this report, obtaining grid connections for motorway and depot charging has proven to be a significant obstacle for the project so far, both in terms of cost and installation timing. It is a recognised challenge, which affects generation as well as demand projects, and is being addressed on different levels by the NESO (tasked with system planning), National Grid (who operate the high voltage transmission system in England and Wales) and by Distribution Network Operators managing the lower voltage networks, to which most chargers will connect. For example, National Grid is planning to invest an unprecedented £60 billion between 2024 and 2029 to increase grid capacity.[xv]

However, there is no magic wand here and the logistics industry might also need to do its' bit. For example, changes to operations might be required in terms of route planning, infrastructure sharing and, in some cases, perhaps more significant modifications, such changing warehouse locations.

In summary, the HGV sector is an important piece in the UK decarbonisation puzzle and will contribute roughly 5% of UK electrical demand in 2050, assuming full electrification. At the same time the total electricity demand in the UK is projected to increase by 47% between now and 2050. There is a strong renewable energy project pipeline to ensure all this electricity comes from green sources by 2035. However, ensuring grid access in the right places remains the most pressing challenge for eHGV charging, on which the Government and grid operators need to focus.

04 Public eHGV charging stations

As part of Electric Freightway, GRIDSERVE is installing a network of high-power charging stations designed for eHGVs. The stations will be located at key locations throughout the UK road network to enable the demonstration partners, and other operators of eHGVs, to charge enroute to their destination and extend viable routes further than can be achieved with purely back-to-base charging.

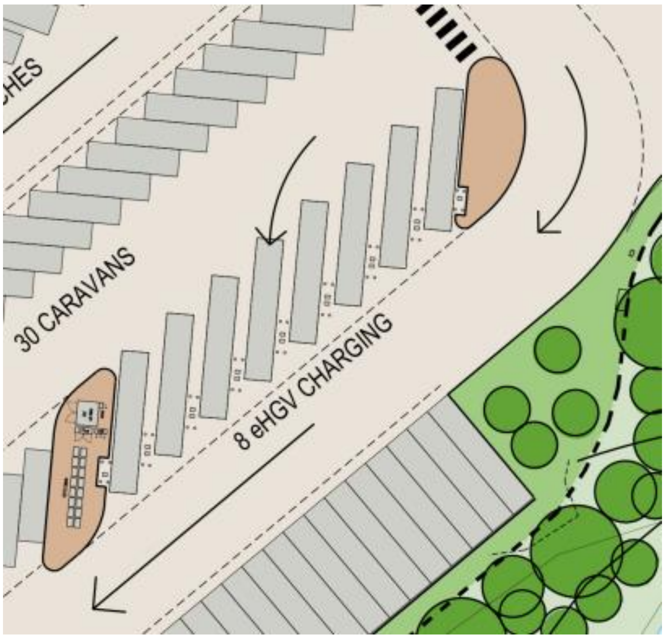
What has happened so far?

Planning the rollout

GRIDSERVE is working with operators of service areas across the UK to develop public charging facilities for eHGVs. Once complete, GRIDSERVE will operate a network of charging stations as an extension to their existing Electric Highway network.

The process for planning the sites follows the steps outlined in Section 03. A desktop study of UK Motorway Service Area (MSA) sites was undertaken to identify the most suitable locations, resulting in a shortlist that could be investigated in more detail. That list was shortened further as costs and timelines for connecting to the grid at many sites were not achievable within the scope and timeframe of the demonstration, or sites lacked the space for development of eHGV charging. Once suitable sites were identified, detailed planning and agreement with site operators could progress.

Figure 3 - Example of a proposed public charging site layout



Progress with developing the sites has taken longer than originally envisaged, as a range of challenges - which are explored further in this section - took significant time and resource to resolve. Once these challenges were overcome, complex commercial agreements with site owners were also necessary to progress works.

At the time of writing this report, several sites have entered the planning process and are being considered by the relevant councils. The number of eHGV charging bays varies typically from 4-12 depending on the local constraints.

The first site to receive planning permission supported by Electric Freightway development is Moto's MSA at Tamworth. However, there are still several steps to complete in the complex development process, e.g. long-form and DNO lease agreements before we can confirm site delivery.

The original scope of up to 17 public sites with high power eHGV chargers is proving challenging due to a shortage of suitable sites that can be completed by the end of the demonstration's implementation phase.

Site Design considerations

Designing a public charging site involves a complex trade-off between competing constraints. Careful consideration is needed to ensure that a site can be built and that it meets the needs of eHGV users.

GRIDSERVE has leveraged its experience in designing public charging facilities aimed at cars and light commercial vehicles throughout the UK to develop designs for public eHGV sites. The requirements for eHGVs do however differ significantly to those for smaller vehicles, and the team has worked closely with hauliers

Network development

Increasing power capacity on constrained sites

Space is also a constraint when DNOs are looking to increase the electricity capacity at MSAs to accommodate high power charging. A typical 33/11kV substation requires a 40mx40m plot, which can be difficult to accommodate given space constraints.

To address this, **National Grid** has worked with Brush to develop a more compact packaged substation solution that can be quickly rolled out, only takes the space of 2-3 12m shipping containers and can be deployed at a lower cost.

The first application of this, through the Take Charge innovation project, was at Moto's Exeter Services. The solution provides 12MVA of capacity (though can be specified for up to 20MVA) and is successfully powering GRIDSERVE and Tesla chargers on the site.

It is expected that demand for new 33/11kV substations will increase as the power demand from High Power charging of EVs and eHGVs increases at a site. National Grid is looking at where packaged substations could be used.

and MSA operators to understand requirements, visited existing eHGV charging stations in Europe to understand best practice and carried out practical experiments to understand how eHGVs will negotiate charging infrastructure.

This section summarises some of the key considerations that the Electric Freightway team has reflected on as part of the site selection and design development of the demonstration's public charging sites.

Grid capacity impacts the choice of chargers

Experience at passenger vehicle sites has shown that one of the biggest issues for any deployment of chargers is grid capacity, usually that provided at a regional level by a Distributed Network Operator (DNO). This has impacts both in terms of time to connect (in some cases more than a year, making it impractical for the purposes of the demonstration), the cost and the capacity that can be accommodated.

Capacity can also dictate the number of bays and charging rates that can be offered at a site. For example, if a DNO has 1.25MW available, this could provide three 350kW bays or a single 1MW bay, leaving a small amount of headroom.

DNOs are working to reduce the impact of network constraints on the electrification of transport by investing in upgrades and trialling solutions to manage capacity. The panel on the left highlights one of example of this.

Space is at a premium

The UK has a shortage of parking for HGVs, with many having to park in unofficial locations, which may be difficult to electrify. Some recent Department for Transport research[xvi] into this is summarised in the panel on the next page.

This was a particular problem for the project, as space constraints make electrifying MSAs particularly challenging. As sites have to provide a minimum number of HGV spaces and are generally at capacity, charging areas

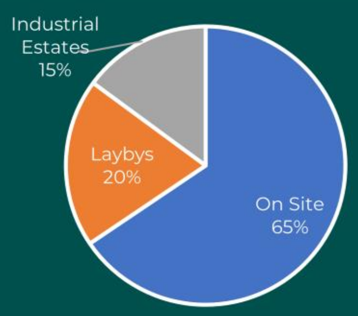
Electrification challenges

Space for HGVs

Space is often at a premium in depots, but it's especially an issue public sites like truck stops and MSAs.

These sites are often working at capacity for overnight truck parking, and research commissioned by the Department of Transport has shown that utilisation nationwide is at a 'critical' level, with 4,473 more HGVs parking on or near the strategic road network in England and Wales than there are official spaces, with many parking in laybys and industrial estates.

Location of vehicles observed parking overnight



In terms of site utilisation, 44% were found to be at a critical level, with 100 sites fully utilised. This problem has been getting worse over time, with a 21% growth in trucks stopping overnight, but only 5% growth in parking places between 2017 and 2021.

The change to eHGVs creates two problems:

Conversion of existing sites to provide charging is likely to reduce their capacity further. eHGV charging is less space efficient than standard parking, as spaces need to be sacrificed for charging equipment and associated manoeuvring space. Contractual requirements for a minimum number of HGV spaces may limit operators' ability to convert existing parking spaces to charging.

'Informal' parking, currently used by 35% of vehicles overnight may not be suitable for eHGVs, as they will need to charge at some point during their overnight break. This may put additional pressure on the official sites.

Increased use of informal parking also creates other problems, as these locations are not secured and drivers often lack sufficient access to facilities such as toilets and showers.

Planning constraints are seen as the key factor limiting development of new sites.

have to be designed to minimise impact to the existing usage of space for parking. This could involve being part of a wider plan for site expansion, or by reconfiguring site layouts to use space more efficiently.

The lack of eHGVs on the road and predicted low utilisation in the short term also makes allotting space to eHGV charging a difficult decision for MSA operators, who, while acknowledging the need for the infrastructure, face day-to-day capacity issues.

Public eHGV charging bays are generally designed with space for the trailer, as it is not expected that drivers will want, or have time, to disconnect the tractor unit.

Site layout impacts cost and feasibility

Even if there is electrical capacity at the site and available space, there can be additional complexities in creating a functional layout.

The high-power chargers chosen for public sites typically consist of a power control unit, which converts AC power from the grid to DC, and the charger (or dispenser) that connects to the vehicle. The power control unit is bulky and needs to be located in an area where it is out of the way of vehicles and can connect to the electricity supply. Combined units with power control and a larger dispenser unit are available but result in more infrastructure installed next to the vehicle with space and safety implications.

Where significant changes to layouts are needed, planning permission is likely to be required. This can be a lengthy and costly process (see section on Planning Consent below).

Longer semi-trailers

The Department for Transport has recently allowed operators to use longer trailers, following a long-running trial to assess their impact on road safety[xvii]. These trailers can be up to 2.05m longer than standard units. While at present they are operated by a small number of operators, it is expected that use of these vehicles will become more widespread in the future as they enter the mainstream market. Charging bays should be able to accommodate these vehicles, however a lot of legacy sites were not designed for longer vehicles and this can impact on what can be delivered at these sites. It is intended that all sites should be able to accommodate longer semi-trailers, although there may be individual bays at some sites which can only support a standard-length vehicle.

Planning consent

Once the design for a site is completed, it's often necessary to apply for planning permission. This process can be lengthy, as it requires aligning plans to planning policy and the production of documents for consideration, followed by a period of public consultation. While the main legal frameworks for planning are national, there are also local planning policies in each area that need to be understood and complied with to ensure that the development receives permission. This can add complexity to large national rollouts.

Smaller developments, especially where there's no impact on buildings, layouts or the public highway, may benefit from permitted development rights, where the charging equipment is less than 2.3m high. At public sites, where more invasive changes to layout are generally required or there are highway considerations, planning permission is more likely to be needed.

Maintaining biodiversity

Providing Biodiversity Net Gain (BNG) of 10% became mandatory on developments from February 2024. This means that all developments must result in better quality natural habitats, not just replace any habitats that are lost. This is preferably delivered on site, but, if it is not possible, can be achieved through enhancing off-site habitats. While the benefits of this are clear, it does add additional cost and complexity to developing a site.

Choosing the right chargers

The need for speed

The capacity of eHGV batteries is significantly larger than that of passenger vehicles, with most eHGVs in the trial expected to have batteries with a capacity of around 500kWh. The capacity of the chargers needs to be

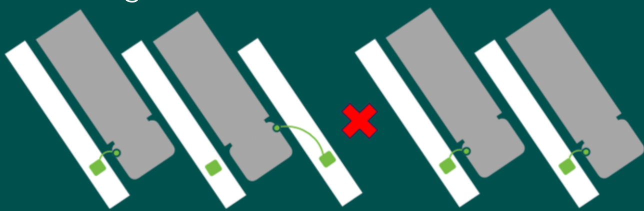
Design challenges

Charge Socket Position

For megawatt charging the MCS standard will specify that the charge port is always on the left of the vehicle. For CCS - currently the dominant charging type used by electric trucks - the location isn't specified, and manufacturers are free to decide where to place the connector.

Sockets are predominantly located on the drivers' side of the vehicle, but this can vary by manufacturer, with some offering a choice of location.

This creates a challenge for the design of charging stations, especially at public locations or at depots that will service a mixed fleet of vehicles. Drive through designs, with single chargers between bays can result in bays becoming unusable.



Several potential solutions being considered, all of which have pros and cons:

- **Longer cables** of up to 8 metres are available and can reach both sides, however these cables can be heavy, difficult to store when not in use, a trip hazard and liable to damage if not managed, or if users aren't trained.
- **Two chargers**, **or dual gun chargers** on each island provides flexibility at additional cost.
- **Bays designed and signed for either left or right side charging**, requires the correct ratio of vehicles to arrive.
- **Drive in/reverse out** bays with the charger at the front centre, creates road safety risks from reversing vehicles, especially if pulling a trailer.
- Chargers arranged so they can be **approached from both directions**. This requires longer bays and may introduce conflicts when manoeuvring.
- **Gantry mounted** connectors can provide flexibility but come at additional cost

matched with the battery size, dwell time and use-case to ensure that batteries are charged in a timescale that fits with eHGV schedules. Multiple different charging scenarios are envisaged, for example:

Scenario	Charger required
Tacho break of 45 minutes to 2 hours	>=350kW at max power
3–5-hour break	>=175kW
Long dwell time/ overnight, 8-12 hours	Maximum of 175kW and often as little as 40kW could be sufficient

The mix of chargers at any site needs to be designed to meet the needs of the eHGVs that are likely to visit, and likely varies by location, and may vary by time of day.

Selecting the right chargers for the job

GRIDSERVE is constantly looking to develop and introduce new technologies to enhance the end user experience, recognising that charging speed is a critical part of that experience.

Figure 4 - GRIDSERVE's EV charging test lab

GRIDSERVE's New Product Introduction (NPI) program takes new chargers, tests and validates their capabilities (Figure 4) and provides feedback on performance and design improvements that are needed to the manufacturer. The NPI program also looks at the impact of these charges on peripheral systems e.g., cable sizing, feeder pillar connection sizing, control systems etc.

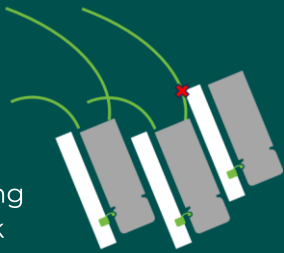
Safety considerations

Charging island and bay design

The charging island is the space between each bay where the charger is located. Particular care has to be taken to ensure that the charger is usable and the design protects users and infrastructure from harm

Swept path of the vehicle on the bay entry

Charging islands must be positioned so that they don't conflict with a vehicle's swept path on a typical approach.



The rear axles and overhang are most likely to be at risk of collision.

Charger location

The positioning of the charger must take into account the angle of the bay and manoeuvrability of the vehicle to prevent collisions.

Charging island width

The island must be wider than the charger to provide a safe zone for drivers to get in and out of vehicles and use the charger.

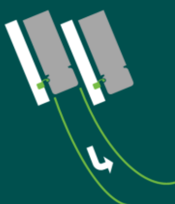
Bay width

Narrower bays may accommodate more chargers but may require more manoeuvring space and impact the safe space available for users and infrastructure.

Visual cues and physical protection

The driving position of an HGV is 1.5m above ground level. Any bollards or signage marking the extremities of the bay must be sized and positioned so that they're visible to prevent collisions.

Hostile vehicle mitigation (HVM) bollards can provide a second line of protection for infrastructure and users in the event of severe vehicle misalignment.



Swept path on exit

Prompts must be given to drivers to indicate when they should start to turn on leaving the bay to prevent collisions between trailers and charging islands.

Following a review of available options, ABB chargers were chosen for the initial Electric Freightway public sites, but other chargers are under review for the future. The stretch target is to also test megawatt-ready charging infrastructure.

Infrastructure that works for all eHGVs

For passenger vehicles, charging infrastructure is typically kerb-side with the charging units protected by bollards at the end of the parking bays. A 5m charger cable allows for easy reach and the vehicle can be reversed or driven forwards into the bay fairly simply.

The same is not true for eHGVs. The vehicles are significantly larger; they are less manoeuvrable with reduced visibility when reversing and, while the charge connector is often on the driver's side, this varies by vehicle brand. More information about the challenges of designing for different charging port positions can be found in the highlights section on the previous page.

Accessing and using the chargers safely

Safety of charging infrastructure has two main aspects – preventing damage to vehicles and infrastructure and providing a space that protects users from vehicles. The boxes on the right and on the previous page highlight some of the key design considerations to make sure that drivers are able to use the charger safely without risking their safety or causing damage to infrastructure.

GRIDSERVE carried out an extensive series of tests of eHGV charging bay designs to practically assess the swept path of vehicles manoeuvring in and out of charging bays (Figure 5 and Figure 6). This demonstrated the distances needed between rows of chargers where vehicles need to turn to approach the bays in a straight line and the bay widths needed to ensure that eHGVs can manoeuvre in without encroaching on the charging island and its protective bollards.

Safety considerations

Side effects of silence

While eHGVs travelling at low speeds will produce sound, either naturally or through an Acoustic Vehicle Alerting System, this may sometimes be drowned out by the background noise of a busy service area.

It is important, therefore, that the design of charging areas creates a safe space. Drivers must have access to areas that are protected from other vehicles, and all areas must have good visibility and provide the ability to escape to a safe space. Considerations include:

Charger location

The charging island should protect users of chargers. They should prevent access by vehicles whilst providing level access without steps for drivers.

Mounting and dismounting vehicles

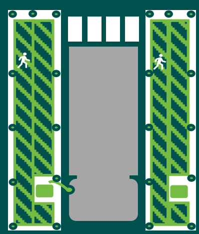
However, areas where drivers step down or up must be free of trip hazards such as kerbs, cables and bollards.

Charger orientation

The charger must not block visibility of oncoming vehicles. The chargers selected for GRIDSERVE public sites have an open frame allowing visibility from behind.

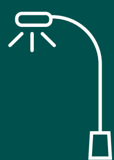
Walkways

Ideally there should be a walkway on both sides of the vehicle to provide access to the charging points and for inspection of the vehicle. The walkways must be free of obstructions and conflicts with neighbouring vehicles.



Lighting

The space between vehicles needs to be adequately lit for safety and security purposes. Lighting should be directed so that it doesn't disturb drivers resting in their vehicles.



Technical solutions

CCTV, sensors, audible vehicle approach announcements and other technologies could also be used to manage sites, and may be considered as site utilisation increases in the future.

Public charging station management

Accommodating reservations for public charging

The ability to guarantee a charging spot at a specific time is a common request from fleet schedulers. GRIDSERVE Programme Director John Whybrow has been exploring how this can be practically implemented in a public charging network.

"There are some important differences in requirements between charging of commercial EVs and domestic car charging, driven by factors such as driving time regulations, repeated and predictable routes and the importance of making just-in-time delivery or collection slots. These factors influence the demand for commercial charging at different times of day and the need for predictability of charger availability. Digital services to support such needs can be a big help to commercial charging customers and a differentiator for charge point operators.

As mentioned elsewhere in the report, GRIDSERVE is constantly looking to develop and introduce new technologies to enhance the end-user experience. As part of the Electric Freightway project, our investigation into commercial charging requirements centred initially around the idea of a booking system, as many other stakeholders also tend to focus on, but during the project we have learnt that the needs and viable options to meet them are more nuanced.

"How hard can it be?" we thought. A haulage route that cannot be completed within the range of a current eHGV, but one that the operator is keen to complete with a zero emission-in-use truck, will need a top-up charge, ideally booked at the optimum time within the schedule and rest stops. When longer tramping routes are electrified then it makes sense to take the mandated 9–12-hour overnight rest stop at a charger, to ensure the battery is full for the next day. To protect the tight schedules that most operations work to, being able to book those charging stops in advance seems logical. But what happens when an unavoidable delay occurs, e.g. due to traffic? Well, the system will need to dynamically move the booking, ideally fed by real-time updates from the vehicle telematics and location, the traffic conditions, the weather and other factors that might affect eHGV range and the timing of the rest break and charging stop.

So far so good, until you apply some real-world limitations, particularly in the open-access, public charge-point world, such as at an MSA. As you've read elsewhere in this report, eHGV charging bays are expensive and difficult to build. Space for the charger islands and electrical infrastructure at MSAs and truck-stops is limited, as is the grid supply. Therefore, development of charging sites is likely to be phased, perhaps starting with 4-6 bays before future expansion as demand increases. So, the number of bays at any given location might initially be small, leaving less options for booking in the first place and for accommodating changes of bookings or delayed arrivals.

How far in advance should a bay be reservable and therefore blocked as unavailable for opportunistic charging? Once a truck is parked and the driver is on a break that vehicle cannot be moved, so if an un-booked driver decides to stay an hour or two longer that could overlap a booking, which if all bays are in use would suddenly fail. For a 9-12 hour overnight stop you might have to reserve and block the bay for up to 12 hours beforehand, to ensure another driver on a tacho break does not block it for the reserved driver - but that is a charger that is then marked out of use or blocked with a barrier, potentially frustrating eHGV drivers wanting to turn up and charge on-the-go. Would you want three or four eHGV drivers waiting in a queue to charge where perhaps two bays are obviously empty, but reserved for drivers turning up an hour or two later?

The impacts of lost revenue while a charger is booked but also vacant must also be considered, as this affects the investment case for installing the chargers in the first place. Which then begs the question, how much can you charge for a booking, for how long, and will the cost of booking cause eHGV drivers to look for alternative public charge points with increased availability?

Electric Freightway is running a pilot and proof-of-concept for eHGV digital supporting systems, not just for booking but also for bay monitoring with ANPR (Automatic Number Plate Recognition), availability status, digital signage and advance notice of "busy sites" with alternatives highlighted. We hope to examine and answer many of the questions above and propose solutions that work for all users of commercial eHGVs, not just in the initial years, but through the periods of rapid growth in demand for charging that we expect will come in the near future."

Ready for the future

How and when the demand for public eHGV charging will develop is currently unknown and depends on a wide range of factors. Sites designed now are unlikely to perfectly meet future demand. As a result, sites are being designed to accommodate future changes once customer demands are better understood:

- A mixture of bays and charging capacities will be included in initial designs
- Where there are constraints, the way available capacity is split between chargers can be altered to best meet customer expectations
- Each charger mounting point has adaptive head frames which allow for different charger models to be deployed and provide some form of expansion future proofing as and when market demand and DNO capacity exists.

What's next

Construction of the first site is expected to begin once planning and legal steps are completed. Sites will begin opening, likely in phased deployments, early to mid-2025.

Figure 5 - Trial of different charging island configurations to understand manoeuvring characteristics of HGVs

Figure 6 - Manoeuvring a HGV around different charging island designs. Clockwise from top left: Tight turn into 90 degree bay; blind side reverse into 90 degree bay; exiting 45 degree bay; entering 45 degree bay

05 Depot based charging

In addition to the public charging infrastructure, most of the eHGVs in the demonstration will make use of chargers located at depots between shifts and overnight. GRIDSERVE has been planning and installing the majority of these, and this section explains the progress made so far and what we've learnt along the way.

What has happened so far?

Electric Freightway is delivering charging infrastructure to a range of different sites. GRIDSERVE is responsible for designing and implementing the depot infrastructure funded by the demonstration. Each site is designed to meet the needs of the haulier organisation using it, with the installations varying from small two bay charging stations to a large shared charging hub, serving three different operators on a customer site.

As with the public sites, progress on delivering depot charging has taken longer than originally envisaged. The process is complex, involving multiple stakeholders. Most hauliers are approaching charging for the first time, so there is a steep learning curve to understand what is possible on their sites and how decisions impact operations. This section aims to highlight some of the key considerations and process steps based on the experience of project partners.

Where vehicles have been delivered before chargers have been installed, the project's partners have implemented several interim measures that may be useful to businesses planning how to mitigate risk associated with their fleet transition. These are detailed in Section 06.

The pioneering nature of the project, together with funding complexities and the need to ensure public money is spent effectively, have contributed to the time taken to begin work. This is further amplified by the need to align vehicle orders with decisions on infrastructure. At the time of writing, ground surveys have begun at the first depots and plans are in place for the completion of all partner sites over the next year.

Depot infrastructure specification and design process

The general process of designing and implementing the eHGV charging stations is as set out in Section 03, however some aspects are of more importance in a depot.

Understanding site usage and constraints

In a public site, how the facility is used is generally well understood. In a depot it can vary significantly based upon the routes in operation and the haulier's rules, procedures and working practices.

Figure 7 - Surveying space available for eHGV charging at United Utilities' Manchester Bioresource Centre

For example, dwell time can vary significantly. Some operators will always keep tractors and trailers coupled, while others disconnect when trailers are loaded. This has a significant impact on how charging sites are designed, as tractor-only charging requires much less space for manoeuvring.

Many sites' safety procedures do not permit reversing out of bays or require supervision from a banksman for such manoeuvres. Where this is the case, drive through, or reverse in bays may be needed. Road layouts, such as one-way systems need to be considered, and may need to be altered, to allow eHGVs to enter and leave charging bays and return to their trailers.

Where possible these constraints should be identified before site design begins to reduce the need for re-design at a later stage.

Sizing the infrastructure

Vehicle movements need to be considered when deciding the number and location of chargers. Some depots operate only a day shift, while others use vehicles much more intensively with multiple shifts. The impacts of this on the power and infrastructure requirements can be significant.

If many eHGVs are frequently idle for a long period, multiple slower chargers may be preferable, whereas if vehicles operate across multiple shifts and arrive at different times needing a quick charge, a smaller number of high-power chargers would be more appropriate. Table 2 gives some examples of approximate charging times and appropriate use cases.

Table 2 - Uses of different charging speeds

Charge power	Time to charge*	Suitable use case
43kW	7 hours	Overnight between shifts
180kW	1 hour 40 mins	Longer dwells during loading or between shifts
360kW	50 mins	Shorter dwells; charging in a rest break
1MW	20 mins	Short breaks in intensive operations

*Based on 540kW battery with 80% usable capacity charged 20% to 90%. Not all eHGVs are capable of all speeds.

The choice of vehicle also plays a part, with current options having a mixture of left and right-hand charging. As with public sites, it is useful to design charging islands to service both sides of the vehicle, if possible, to deal with future expansion and fleet replacement.

Depot owners must also consider the future development of their site. While a fleet may begin with only a few eHGVs, it is likely that more will follow. They may also operate a mixed fleet of different eHGV and eLCV types, which all need to share the charging infrastructure. It may be more cost effective to over-size some infrastructure now, such as transformers, cabling and ground works, to aid future expansion.

Developing options and reaching agreement

Once the general requirements for charging are known, an initial desk-based study can take place, utilising aerial photography and plans to identify potential locations for charging infrastructure.

Details of the current electrical supply connection are requested, and initial enquiries are made to the DNO to establish whether there are any constraints that would prevent a connection upgrade.

Key factors that will be considered include:

- Space availability
- Power availability
- Proximity of buildings and structures
- Distance from chargers to electrical infrastructure
- Need to change site layout, land use and traffic flow.

If it is found that there is sufficient space and capacity, a number of options are suggested and discussed with depot stakeholders (Figure 8) to gain feedback at an early stage before proceeding to detailed survey and design.

Options could include:

- Alternative locations of infrastructure on the site
- Different arrangements and orientations of charging bays

- Number and power rating of chargers specified.

Once initial feasibility has been confirmed, and preferred options identified, comprehensive site assessments are then essential to identify space and physical constraints that may not have been apparent on an initial desk-based survey.

This can include observation of site activities, such as movement and parking of vehicles, investigation of the suitability of areas where cables need to be routed and survey of electrical infrastructure to ensure that it corresponds to site plans.

Figure 8 - Examples of layout diagrams developed to illustrate potential options at a depot site
Imagery © 2024 Google, Infoterra Ltd & Bluesky. Map data © 2024 Google

Getting everyone on board

To understand the constraints of a site, a large number of stakeholders need to be consulted, many of whom may have differing views on the best solution for the site. This needs to be done as early as possible in the process as failing to understand the requirements of particular stakeholders may result in significant delays while designs are revisited. Key parties within the site operation include:

Senior management will control budgets and contracts and will also be responsible for implementing actions that improve an operator's sustainability.

Legal, commercial and procurement teams will need to be involved in the agreement of contracts with suppliers.

Traffic and operational managers will bring understanding of vehicle movements, how charging can fit in with operations both in terms of time and location, or whether further operational changes will be required to use eHGVs.

Health and Safety teams will want to ensure that any installation complies with the operator's policies and does not result in vehicle movements that could pose a risk to staff on the site.

Facilities and energy teams will understand power capacity, electrical infrastructure, physical constraints (such as fuel tanks and underground services) and future plans that may impact the site (such as other alterations or decisions on leases).

Drivers will ultimately be the users of the facilities and will likely have informed opinions on what will and will not work.

There will likely need to be several revisions of plans to create a solution that works for all parties, so maintaining clear communication throughout is crucial.

External stakeholders

In addition to internal buy-in there are key external stakeholders that need to be engaged, as they can influence the success of a scheme.

DNOs should be engaged early in the process to understand whether securing power capacity will be possible in a reasonable time period.

If the operator does not own the site, gaining support of **the landlord** and/or their **land agent** is crucial to the planning process. Landlords are usually supportive of adding eHGV charging, but the approval process for any developments can be lengthy.

Understanding the **planning requirements** is important. Adding chargers to existing parking is generally seen as 'permitted development' and consequently doesn't require full planning permission. This can, however, depend on the specific location, the size of the chargers and the scale of the changes. This should be confirmed with the local planning department.

In some locations there may be **other third parties** who use the site and may be impacted. These could for example be other hauliers, customers and suppliers who visit the site, as well as services providers such as mechanical and electrical services (M&E) contractors.

Providing sufficient power for eHGV charging

The primary factor that has constrained the demonstration's ability to install charging infrastructure has been access to sufficient electricity network capacity.

Depots will generally need to be able to charge multiple eHGVs simultaneously, with operators often requiring high-power charging to minimise downtime. This will create electricity demand that is much higher than has previously been required by distribution centres and warehouses, so in most cases this will require a significant upgrade.

To put this in context, three 360kW chargers, or one 1MW charger will draw the equivalent of the peak demand of around 1,000 homes. These changes are significant for the electricity network and will likely require new cables or transformers to be provided. Where vehicles are parked for longer than needed for charging there may be some scope to manage charging in order to reduce the cost of upgrades.

> **"Three 360kW chargers, or one 1MW charger will draw the equivalent of the peak demand of around 1,000 homes"**

The relatively short timeframe of the project's implementation phase (until July 2025) is generally only sufficient to allow for sites where the DNO has existing capacity on the local network. This has ruled out several depot sites where there were capacity constraints, or providing a new connection would require significant, lengthy and disruptive works.

Requesting a new or upgraded point of connection

The DNO should be engaged as early as possible in the design process to understand the availability of capacity in the local area and any constraints that may be faced.

Great Britain is divided into 14 DNO regions, operated by six different companies[xviii]. In addition, some industrial sites may use an iDNO to manage the local network - where this is the case, they will need to be consulted rather than the regional DNO. All DNOs and iDNOs follow the same rules and general processes, though how they implement them can vary, and it may be necessary for operators with many sites to manage relationships with different connection teams across multiple organisations.

DNOs publish maps that provide a high-level view of network capacity and offer connection surgeries to discuss potential solutions for specific sites. They can also provide budget estimates for work. It should be noted however that the results of these initial informal enquiries are not binding, do not guarantee the availability of capacity and may not take account of site-specific conditions.

Connecting to the network

One of the primary challenges to fleet electrification is making sure vehicles have sufficient electrical capacity to charge. We asked Peter White, LCT Development Engineer at National Grid to provide some advice on how to best work with DNOs.

"When planning to get charge points installed and operational, it is important to think of the process from the energy system perspective – the DNO provides the critical link to an electrical power supply. Put simply, any plan to install EV charging needs to consider both the installation of chargers and necessary grid network connection work.

Depot sites will have an Agreed Supply Capacity (ASC) limit, which may not be sufficient for the fleet of new chargers you will require. If you don't know what your ASC is the DNO can inform you. The first step is to work out how much power you will need, based on current demand shown by your bills and the expected demand from the vehicles you plan to electrify. If predicted total demand exceeds the ASC, or EV demand exceeds 30% of the ASC, you will likely need some form of upgrade and, if this is the case, an early discussion with your host DNO or IDNO is advisable - **the earlier you start having this discussion the easier the journey will be**.

Power requirements can be viewed in two time horizons – what's needed now to power immediate investments in eHGVs and what will be needed in the long term for a fully decarbonised site; though there may be many steps in between.

It's advantageous for fleets to plan with long term requirements in mind: while the full capacity may not be needed now, having a long-term view will mean that civil works, generally the most expensive part of the upgrade process, can be designed to cope with future expansion. This will save money in the long run while also giving the DNO better visibility of future demand to help plan wider network upgrades, allowing them to offer a 'ramped capacity map' to the site operator aligned with fleet electrification.

In the shorter term, there are several solutions that may enable better use of existing capacity:

- **Smart charging** – can make sure the right vehicles are prioritised for charging and not over charged.
- **Load management** and **prioritisation** - charging can be scheduled in line with a **timed connection** giving more capacity at off peak times or managed so chargers don't always charge at full power
- **Optimising power use** – changing the timing of other power uses on site away from charging periods
- Using onsite **storage** and/or **generation** to offset the demand that's placed on the grid."

The response will include a proposal with timeline and costs. Once a point of connection offer is received, it is valid for a limited period. If not accepted within this time the application will expire and therefore must be re-submitted.

Once the site design is more advanced, a 'Point of Connection' application can be made to provide more capacity. This must be for a specific capacity in a specific location and incurs a fee of approximately £1,500-£1,800. Once requested, the DNO has 30 days to respond, although this can often take longer if requests are made for more information.

The cost of new electricity connections

There are several types of upgrades associated with new and upgraded electricity connections:

Simple upgrades: Where existing capacity exists on local infrastructure it may be relatively simple and inexpensive to provide a larger connection. As power requirements get higher the likelihood of this decreases.

On site there will need to be electrical upgrades behind the meter to supply the chargers from new circuits. There can sometimes be long lead times on certain pieces of equipment, such as transformers, panels and breakers which may lengthen the time taken before sites are energised, even when power is available. Where this is the case, these requirements need to be identified as early as possible so that orders can be placed.

Sole-use infrastructure upgrades: Items such as new cables and transformers to serve a site are paid for by the customer. Some elements of the works must be completed by the DNO, while others, termed contestable works, can be carried out by other approved contractors called Independent Connection Providers.

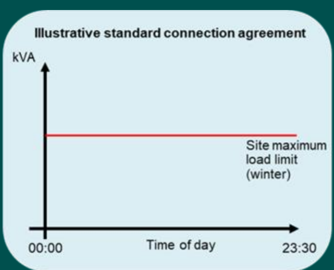
The cost and time required can vary considerably depending on the scope of works from a few thousand pounds to hundreds of thousands. For example, one depot studied was in an area where there was capacity, but upgrading the site connection would require a two-mile cable run under a nearby motorway, making the upgrade unfeasible within the resources of the demonstration.

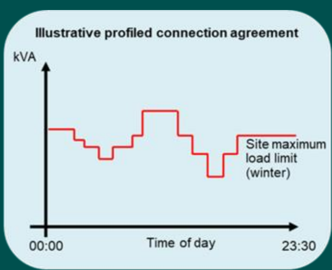
Upstream network upgrades: Some locations will lack the capacity on the local network to provide more power and will require upgrades of transformers and cables that serve multiple customers. End customers are not charged for this part of the upgrade, but it can also take a significant time to provide, as it will have to be budgeted for by the DNO and scheduled as

UK Power Networks and **Hitachi** tested a number of load management techniques as part of **Optimise Prime**, an innovation project where eLCVs serving **Royal Mail's** London delivery offices were smart charged to reduce network impact.

While the demand on these sites was significantly lower than is expected from eHGVs, the project successfully demonstrated how power demand could be reduced at specific times.

This was tested through 'profiled' connections, which limit peak usage but provide additional capacity when the network is less busy, as well as through more dynamic flexibility services where demand is turned down on request.





Providing this flexibility can allow the DNO to offer more capacity than would be available on a 'firm' connection (where capacity is guaranteed 24/7) with the added benefit of allowing operators to charge when there are lower power prices or when electricity is less carbon intensive.

The project also created a **Site Planning Tool**, aimed at helping fleet managers estimate their power requirements, and understand the benefits of smart charging, in advance of making a connection request to the DNO.

Find out more about Optimise Prime on the **project website**.

Hitachi ZeroCarbon has since further developed the software solution used in Optimise Prime to create **ZeroCarbon Charge**. The system is now allowing customers to ensure buses, eLCVs and eHGVs receive sufficient charge while keeping sites within their connection limits and charging when power is less expensive.

part of their network upgrades. There may also be knock on effects further upstream, such as the connection to the transmission system. Some upstream constraints can have such long timescales that it makes electrification of a site infeasible.

Where possible, DNOs prefer that customers share longer term plans with them so that they understand the amount of capacity that will eventually be required by the site, even if this isn't needed in the short term.

This can have long term benefits for the site operator, as ground works can be designed with provisions for future upgrades, reducing cost. It also enables DNOs to make longer term plans to meet future demand growth and offer ramped connection agreements, where capacity increases over time in line with demand. On the previous page, National Grid gave some tips on how to work with the DNO and manage limited capacity.

Ongoing costs: In addition to the upfront cost, more powerful connections will also result in a higher ongoing capacity charge. These are charged per kVA of available capacity per day and can be significant for larger connections. Where chargers are fed from a new separate connection there will also be additional ongoing standing charges.

Challenges of implementing eHGV infrastructure

As is the case with public sites, space is also a significant constraint on how charging infrastructure can be provided on depot sites. Generally, there is little unused space on a depot, so areas will have to be repurposed for charging infrastructure and processes may need to change to accommodate its use.

It may be necessary to optimise depot layouts to accommodate eHGV charging infrastructure while maintaining normal site operations. Accommodating large eHGVs, charging equipment, and manoeuvring space within existing depot layouts can be challenging, and in order to address these space limitations a range of alternative options may need to be considered, such as:

- Decoupling the trailer for charging
- Allowing reversing in specific circumstances
- Varying parking and road layouts

Where space is especially tight, bespoke non-standard infrastructure, such as feeder pillars and transformers or gantry mounted chargers can be considered, but this does add to the time and cost required, may have maintenance implications, and installers must ensure compliance with electrical and fire safety regulations.

Managing cost

Cost is a key consideration as part of the design process and the available budget can determine what is possible on a site. There are certain designs that can increase the cost of delivering a site significantly which should be avoided where possible:

- Long cable runs from the point of connection or transformer to the chargers. Not only is the cost of excavation more, but

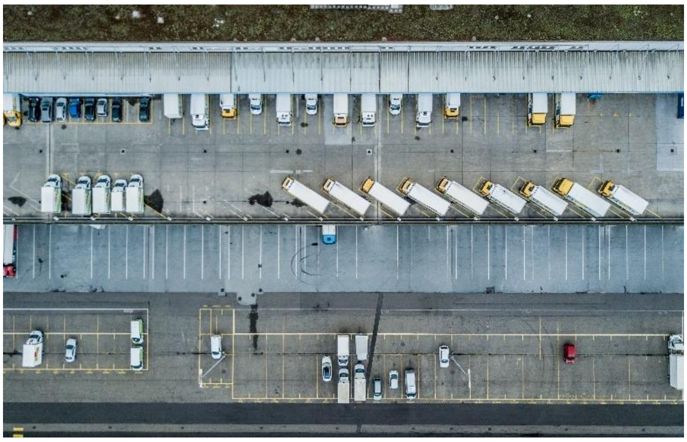
bigger cables are needed to prevent losses of energy over longer distances.
- Cable runs that cross large areas of tarmac incur much higher costs for excavation and remediation. Digs are also more likely to interrupt depot operations if they cross highways and parking areas.
- Remote charging locations where driver welfare facilities aren't available may require provision of toilets, lighting and other facilities if drivers are likely to spend extended periods there.
- Digs crossing neighbouring land or requiring purchase of additional land can add to the cost and may require extensive legal agreements.

Ensuring Safety

While depot sites are generally not open to the public, many of the same safety requirements still apply, and there may be additional restrictions imposed by site rules and processes. It's important that these restrictions are understood by the developer at the earliest opportunity so they can be incorporated into the design of the site from the start. As mentioned above, in some cases it might be necessary to update operational practices to allow the use of eHGV charging infrastructure.

The positioning of eHGV chargers must also consider existing site infrastructure, such as buildings, storage areas and underground fuel storage tanks (a common contingency measure on many depots), which can limit the locations on a depot where chargers can be placed. The Fire protection association's guidance **RC59**[xix] provides guidance on distances and precautions that need to be taken with regards to fire safety when vehicles are charging. For example, enclosed charging areas should be at least 6m away from storage areas and chargers must be 5m plus the length of the vehicle from any hazardous areas. Where chargers are in or adjacent to buildings the structures should meet minimum standards of fire resistance and detection.

The IET also publishes a **code of practice for Electric Vehicle Charging Equipment Installation**[xx]. This covers issues of electrical safety that need to be considered when installing infrastructure, together with building regulations and electrical requirements that need to be complied with.



Manoeuvring of vehicles within sites is often strictly regulated. One-way systems may limit how vehicles can be manoeuvred, especially reversing of vehicles when trailers are attached as this can be particularly hazardous. Additional precautions may have to be taken. Drive-through charging and angled bays are potential solutions but the bays will take up more space within the depot. Protective elements, such as bollards and wheel stops, can be added to prevent harm to infrastructure, and they must be specified to withstand the force of a loaded eHGV.

Planning and consents

In addition to the electrical aspect, consents may be required from a range of other stakeholders in order to proceed with installation. The time needed for these can vary significantly, so permissions should be sought as soon as practicable. Examples of consents needed include:

- Navigating complex planning permissions and processes, depending on the scope of development
- Engaging with landowners/agents and other stakeholders to address concerns and obtain necessary approvals
- Ensuring compliance with regulations
- Agreeing commercial terms with charging infrastructure installers.

Timelines need to be carefully managed and potential delays in the planning and consent stages should be expected.

Future considerations

Most hauliers are currently transitioning just a small proportion of their total fleet to eHGV. However, it's expected that they will continue to adopt more eHGVs over time as it becomes economically and technically viable to do so.

Consideration needs to be put into future scalability and expansion of charging infrastructure within depots, so that the infrastructure does not need to be completely redesigned when more vehicles are added. Options include:

- Providing additional charging capacity now to cope with future growth
- Designing the site and electrical infrastructure to be easily expanded e.g. with space planned for further chargers and spare distribution panels
- Discussing long-term electrification needs with the DNO, rather than requesting multiple small upgrades over time, which may prove more expensive.

Once completed, proactive maintenance and remote monitoring is expected to be essential to ensure the uptime of the infrastructure and minimise downtime of the eHGV fleet.

What's next

Following an extensive planning and design process and the completion of agreements with depot partners, construction of the first sites is about to get underway. Over the coming months we expect the build programme to ramp up, with sites being electrified in readiness for the arrival of more eHGVs in 2025.

06 Initial eHGV rollout

Electric Freightway partners are introducing eHGVs to their fleets throughout the project, and the first vehicles are already on the road. At the time of publication 18 electric trucks have been delivered to our haulier partners and project members. This section introduces some of the experiences and key learnings from the introduction.

What has happened so far?

The first Zero Emission HGV and Infrastructure Demonstration Programme funded eHGVs hit the road at the beginning of May 2024. Two funded vehicles are operating out of **A.F. Blakemore & Son's** Bedford distribution centre, delivering goods to Spar stores and other retailers in Southeast England. In addition, A.F. Blakemore are providing the project with data from two further eHGVs based at Willenhall in the West Midlands.

Watch A.F. Blakemore & Son's Andy Willmott and Dave Higgs explain why the company is introducing eHGVs to help meet their target of carbon neutrality by 2040

Since then, a number of other operators have started to receive their vehicles:

Samworth Brothers Supply Chain began using two eHGVs to transport goods between their bakeries, warehouses and other facilities in Leicester at the start of June. These urban routes, passing a number of schools, were prioritised as they are particularly sensitive to noise and pollution.

Based in the Northwest, **Boughey** is a leading logistics provider to the food industry. Their two eHGVs were introduced in June and are now operating on a range of routes out of their depot in Newcastle-under-Lyme.

United Utilities has received four eHGVs with tipper trailers. They will transport sewage sludge from wastewater treatment plants throughout the Northwest to the Manchester Bioresource Centre. At the centre, biogas is created from the sludge through anaerobic digestion. This is then used to generate electricity – powering the eHGVs as well as the grid.

At the time of writing, eight further eHGVs have been delivered and are being prepared for the road and over 70 orders have been placed for eHGVs to be delivered over the next year. Amazon, GXO, Kuhne + Nagel, Maritime, Royal Mail, Wincanton and XPO are expecting to launch their first Electric Freightway eHGVs over the coming months. BCA, Fergusons Transport and Yusen Logistics have all placed orders for eHGVs which will share a charging hub at Nissan's Sunderland plant from next year.

The schedule of deliveries is driven by a combination of factors, including the availability of build slots, timing of new models becoming available from OEMs and the lead time for the design and completion of charging infrastructure.

At present, all vehicles on the road are Volvo FM Electric tractor units, in 4x2 and 6x2 configurations, capable of a GWT between 40-44t, depending on the trailer and use case. As the project progresses, we expect to welcome a wider range of vehicles to the demonstration, including from Renault Trucks, DAF Trucks and Daimler Trucks.

Going the extra mile

While most operations have been small scale to start with, some of our partners have already been trying to push their eHGVs to their limits.

After just 10 days of local operations, **Samworth Brothers Supply Chain** sent one of their Volvo FM electric trucks, equipped with a solar powered refrigerated trailer on a delivery run from Leicester to Livingston – a distance of 623 miles – over two days. The truck managed to achieve a range of 260 miles on a single charge and spent five hours charging during the journey. While no dedicated eHGV charging sites were available, public charging stations were able to be used. The loads were delivered to Scotland on time.

"The main thing that you hear from people is around the range anxiety and, especially when we are carrying products, we wanted to make sure it would work. It definitely exceeded expectations.

It's a pleasure to drive – from an environmental stance we use these vehicles locally within city centres and it's particularly interesting when you're driving past schools and parks, knowing that you're not emitting the gases or emissions which you would on a normal diesel."

Truck Driver and Driver Trainer, Samworth Brothers

Purchasing the vehicles

As the operators were planning and implementing the rollout of their new vehicles, we've captured what went well and what was unexpected. Key lessons learnt include:

Aligning charging and vehicle procurement

Both vehicles and charging infrastructure currently have significant lead times, however fleet managers have generally found that vehicles are much easier to procure and have more predictable lead times than infrastructure. As discussed in the previous chapter, depot charging infrastructure timelines are much less certain, as they can be dependent on multiple parties, including DNOs, landlords and contractors. Most operators reflected that they should have started developing infrastructure earlier, ordering vehicles when the timeline became clearer.

Aligning investment with customer demands

End customers are a key factor in decisions made by hauliers. Customer contracts are key in creating the certainty needed to invest in new vehicles. Customer desire to decarbonise their supply chain can also be a key driver of decisions to offer zero tailpipe emissions logistics services. Many customers may however be averse to the risk that new technology brings and may not be open to additional costs and limitations that come with being an early adopter. Our surveys of management at hauliers have identified that while customers expect their suppliers to decarbonise, it's rarely expected that they will pay a premium for these services.

Investment and total cost of ownership

Cost is a key driver for businesses making decisions to invest in eHGVs. For the purposes of the demonstration, eHGVs are discounted (by the project's subsidy) to make them more comparable with equivalent diesel models.

Outside of the demonstration it will be necessary for operators to calculate and justify the cost of eHGV adoption. Electric Freightway will be carrying out total cost of ownership analysis in future reports to help operators understand what factors drive the economic viability of eHGVs.

The role of the dealer

The purchasing process for HGVs is very different from that of cars and vans, with purchasers having a much closer and longer-term relationship with dealers. Dealers work with operators throughout the vehicle lifecycle and support their customers in making fleet procurement decisions, selecting trailers and infrastructure providing maintenance and technical support throughout the vehicle's life.

We asked DAF dealer Ford and Slater to give us an insight into how they're adapting to electrification.

"First and foremost, we are here to support our customers, both for scheduled maintenance, and for times when they need us most. We are investing in high-speed DC charging infrastructure at our sites to ensure eHGVs always leave fully charged - this is key to ensuring uptime and negating the need for return to depot charging after inspections and maintenance.

We will also be the first brand and franchise to create a battery repair facility, where we will be able to service or replace batteries in the unlikely event of fault within packs or cell failure.
Our team is committed to helping transport decarbonise, from sales knowledge and guidance through to end of life second life usage support for batteries."

Josh Spencer
EV Sales Manager, Ford & Slater

Route planning prior to purchase

The dealer will take the customer through the OEM's route simulation as part of the purchase process. In this simulation, the operator shares the planned routes and loads that will be carried, while the OEM's route simulator will calculate whether the routes can be electrified, given the range of the vehicles and the expected charging infrastructure. The simulation also calculates what the annual mileage is expected to be.

This process helps to avoid vehicles being put on to routes that they're not suitable for, and ensure hauliers stay within the terms of vehicle warranties, which may limit total mileage.

Fleet managers have generally been positively surprised by the range of vehicles exceeding those promised in simulations by OEMs, and

Electric Freightway will continue to monitor the performance of vehicles to see how they perform in the real world compared with anticipated ranges.

Purchase vs Lease

We're still at a very early stage in the development of the eHGV market, which is expected to develop rapidly both in terms of vehicle sales and technology change. This means there is currently significant uncertainty of future depreciation of eHGVs, the lifetime of vehicles and batteries, and the ultimate resale values of vehicles.

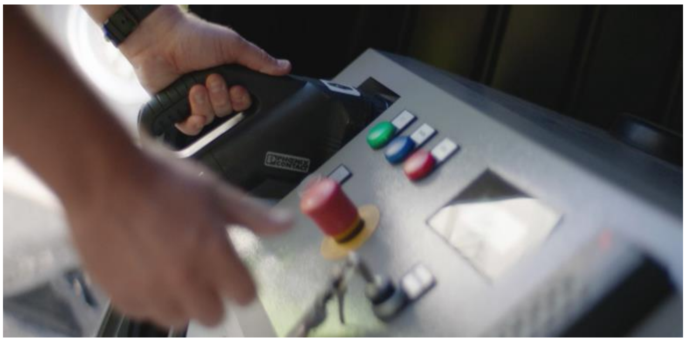
Leasing may be chosen by some hauliers to de-risk the process and prevent them being left with a stranded asset if the vehicle does not fully meet their requirements.

However, due to this uncertainty, lease prices are likely to incorporate a significant risk premium, or lessors may stipulate limitations on vehicle use to manage risk. Outright purchase on the other hand provides more flexibility over how vehicles are used and may cost less over the long term. In general, hauliers choose to purchase or lease in the same way they do for diesel HGVs, based on their preferences, cost or availability of capital and plans for vehicle lifetime. The haulier partners in Electric Freightway have a mix of owned and leased vehicles.

Interim charging solutions

Delivery of vehicles before charging infrastructure is ready is not always a showstopper. This occurred at several of the operators and solutions were found to charge the eHGVs.

Temporary chargers may be available and may be offered by vehicle OEMs. These are typically lower power DC chargers, providing up to 40kW and can be used as an interim measure until permanent infrastructure is complete. While they are low power, the ability to use these chargers will need some power capacity on the site and may require minor alterations to electrical infrastructure.



AC charging, providing up to 43kW, can often be installed more quickly than High Power DC chargers. Depending on the use case these can then be utilised permanently, used as a back-up in case of failure or used to charge other vehicles using the site. On some models of eHGV AC charging may be an option or not available, so lower-power DC charging may be more suitable.

Slower charging does place limitations on how eHGVs can be deployed as they may need around 10 hours to fully recharge. Most operators were able to work around this by using the vehicles on less demanding routes initially. Whether this works in the long term depends on whether vehicles are intended for use on one or multiple driver shifts per day.

Operational implications of changing to electric

The demonstration is still at an early stage with 18 eHGVs delivered at the time of writing this report. As a result, hauliers are still learning and experimenting with how they operate their vehicles.

Discussions with hauliers and OEMs have highlighted a range of initial observations, expectations and concerns regarding the transition to electric. The impact of these will be investigated further as the demonstration progresses. Some key issues include:

Vehicle operations

Range and route limitations

Difference in range is the key difference between diesel and electric vehicles. Diesel vehicles have practically unlimited range, due to their ability to quickly refuel, while current eHGVs need both more frequent and longer duration charging stops. Electric Freightway research, summarised in Section 07 has shown that this is a key concern of most stakeholders.

As high-power charging infrastructure has not yet been installed, most of the hauliers have begun by operating their eHGVs on less demanding routes, with the intention to extend their use to more challenging operations as they become more confident in vehicle capabilities and more charging infrastructure becomes available.

Nevertheless, the use of the vehicles so far has not been insignificant, with the project recording over 57,000 miles of eHGV trips by early October.

Maintenance

eHGVs contain many fewer moving parts than their diesel-powered counterparts, and it's assumed that due to this the maintenance burden will be less. Electric Freightway will be looking at how true this is as the demonstration progresses.

Early experience has shown that there can be some teething problems in how maintenance services for eHGVs are delivered. Some operators that already operate eHGVs have experienced issues with availability of parts and skills locally, due to the small volume of vehicles on the road, meaning repairs can take longer to perform.

The way maintenance is dealt with is also seen to be different by the vehicle operators. This may be in part due to most hauliers choosing to rely on OEMs and dealers for servicing of their eHGVs, when previously some would have utilised in-house facilities.

For example, with diesel vehicles, maintainers often use their experience to replace parts in advance of when they are likely to fail, however with eHGVs they are seen to be more likely to wait until the vehicle's systems report an issue. This can result in more trips to the garage and more time off the road each time a vehicle reports a component issue. The project will continue to monitor maintenance activity as the demonstration progresses.

Payload capacity

Batteries are heavier and larger than fuel tanks on large vehicles. While smaller alternative fuel vehicles have additional weight allowances to compensate for this, the largest trucks do not, as total allowable weight is limited to 44t for all vehicles. The impact of this is explained in the panel on the next page.

This limits what some hauliers can carry, however the impact varies by operator. Those that carry large volumes of lighter goods, such as parcels, will be very unlikely to hit weight limits, while hauliers who carry heavier goods may need to use more vehicles to compensate for reduced carrying capacity.

Higher payload may also impact on the range that can be achieved by an eHGV. Where payload weight information is available, we plan to look at how this affects energy use.

Image: Renault ZEHID Partner Day https://www.renault-trucks.co.uk/press-release/renault-trucks-celebrates-the-arrival-of-e-tech-tractor-units-at-zehid-partner-day

Payload type

The Electric Freightway partners are expected to carry a wide range of goods in their vehicles, using different types of trailer. These include:

- Standard solid sided, container or curtain sided trailers
- Refrigerated trailers for chilled and frozen goods
- Tipper trailers for bulk materials
- Car transporters
- Double deck high-capacity trailers.

Non-standard trailers generally have additional power demand from ancillary loads - powering hydraulic systems or refrigeration. This is normally provided either by power take off (PTO) from the tractor unit or an independent engine in the trailer.

Vehicles in the Zero Emissions HGV and Infrastructure Demonstrator Programme are specified to be zero emission in use where possible. This means that any trailers that require power should either use PTO from the tractor unit, their own batteries or zero tailpipe emission generation. The feature on the next page highlights some of the options and considerations when it comes to refrigeration and the benefits of decarbonising these trailers.

The Electric Freightway team will be looking at how PTO from the tractor unit, and the choice of trailer more generally, impact upon an eHGV's range and energy efficiency.

The need for and use of public charging

As of yet, vehicles have made very limited use of public charging as there is a lack of facilities

Electrification challenges

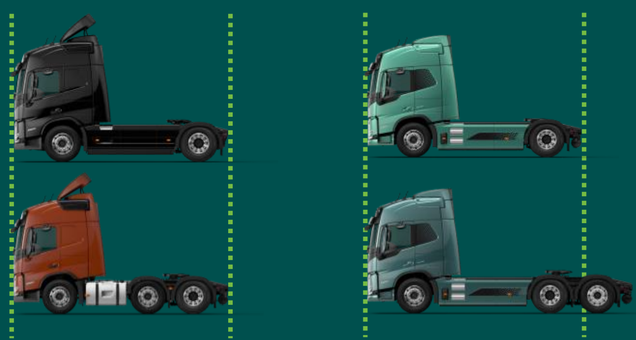
Weight and Length

UK Government regulations impose weight and length limits on vehicles to ensure they operate safely and do not cause undue damage to road infrastructure.

Electric HGVs contain batteries which are both larger and heavier (by approximately 3t on larger trucks) than the fuel tanks found on diesel-powered trucks. Weight and length restrictions interact to reduce the load that an eHGV can carry.

The additional weight of the batteries means that the maximum load in the trailer is reduced by the same amount. Under The Road Vehicles (Authorised Weight) (Amendment) Regulations 2023, a 2-tonne additional weight allowance has been made available for most electric trucks to offset this differential. However, the maximum vehicle weight is capped at 44t, the same as a diesel HGV, meaning the carrying capacity of the heaviest trucks is reduced.

Even this 44t maximum can be difficult to achieve with current electric trucks, as eHGV tractors over 42t must have three axles.



Diesel 4x2 (above) and 6x2 (below) *Electric 4x2 (above) and 6x2 (below)*

As shown in the diagram above, diesel tractors can accommodate two or three axles in the same body, while the space needed for the battery means electric tractors have to be longer.

This creates a problem with vehicle length. Adding a standard trailer would exceed the normal maximum length of 16.5 metres.

As a result, 44t payload may only be achievable for non-standard loads such as tippers for bulk materials, which use a shorter trailer.

brings infrastructure into use over the next year. This will allow partners to continue pushing their vehicles further by attempting more challenging routes.

Next steps

Over the coming months more eHGVs will join the demonstration, with the target of c.140 vehicles expected to be met in Spring 2025.

The growing fleet will provide us with a more varied sample including multiple brands and models being used on a wide range of use cases. As trucks are delivered, we'll be profiling more of our demonstration partners at www.gridserve.com/electricfreightway.

Electrification challenges

Keeping it cool

Several of the project partners use **refrigerated trailers** to transport some or all of their goods, including chilled and frozen food products. Traditionally these trailers are kept cold using diesel-powered auxiliary transport refrigeration units (TRUs).

TRUs on trucks are often **more polluting** than the tractor itself because they are classed as 'non-road mobile machinery' and have to comply with a less stringent set of regulations. According to ongoing research by Zemo Partnership[xxi] funded by the Department for Transport, under the latest regulations a TRU can emit 1.5x the NOx, 3x more particle mass and 300x more particles than a Euro VI standard truck. Older trailers (predating 2019) may emit even more.

While there are no official figures, there are believed to be over 40,000 auxiliary TRUs on the roads, and, unlike trucks, there is no timeline set for the end of diesel sales.

While the development of solutions is at a relatively early stage, there are several options for zero tailpipe emission refrigeration, either as new or retrofit solutions:

- **Solar powered refrigerated trailers with batteries**
- **Axle-driven refrigeration**
- **Separate charger/battery only solutions**
- **Using PTO from the tractor**

Using HVO or biofuel and plugging in the TRU when stationary at depots can also help reduce the impact of trailers that are not fully electrified.

Electric Freightway is endeavouring to ensure eHGVs are predominantly pulling zero tailpipe emission trailers, utilising existing and new investments by our haulier partners. We recognise however that this will not always be possible, especially where hauliers have a large fleet of trailers that they need to use flexibly with their tractors. In this case we will make sure that the number of trucks in refrigerated operations matches the number of zero tailpipe emission trailers in the fleet.

Over the course of the demonstration we hope to be able to compare trucks using a number of different refrigeration technologies, paying particular attention to the impact on overall efficiency of the vehicle.

Image: https://www.samworthbrothers.co.uk/investing-in-electric/

07 Attitudes towards eHGVs

The change to eHGVs will have a significant impact on people throughout haulier organisations. Drivers will have to adapt their driving style; fleet managers will need to understand new limitations on their scheduling and technical managers will have to reconsider how they approach maintenance. Electric Freightway has embarked on a first round of surveys and interviews to understand the attitudes of stakeholders towards eHGVs ahead of their introduction. The second round of surveys will be carried out in 2025 to capture attitudes after the vehicles have been in use.

Survey objectives

In Report 1, the project listed a number of hypotheses which the demonstration intends to test. Some of these will be answered through the analysis of the performance of vehicles and economic factors, others require understanding of how drivers and other stakeholders react to eHGVs and the changes their introduction brings to the industry.

Previous demonstration projects and academic studies[xxii] in the UK and abroad, have explored enablers of and barriers to eHGV adoption. The most prominent enablers included company strategy, external stakeholder/ investor pressures, regulations and subsidies, as well as company image/branding and potential cost reductions. Business model impacts, availability of charging infrastructure and charging times, grid capacity problems, TCO, uncertainty regarding future technology mix and government support featured amongst barriers in addition to vehicle range and loading capacity.

BETT[xxiii] was the only project undertaken in the UK with a similar scope to Electric Freightway. It trialled smaller prototype DAF vehicles with public sector fleets. BETT showed that driver and fleet manager opinions evolved significantly as they gained experience with the new technology. For example, while their perceptions of vehicle performance and driving comfort generally improved over time, range and performance anxiety increased amongst drivers, while at the same time fleet managers became more comfortable with the range, indicating that feedback/live monitoring information provided to drivers could have been more effective.

Building on the learning from previous projects, Electric Freightway aims to gather the views of a broad range of stakeholders within the UK transport industry as part of the largest survey of this kind undertaken in the UK and possibly globally.

The objectives of the stakeholder survey activity are three-fold:

1. **To identify perceived barriers and enablers to eHGV adoption to be able to propose measures to address them, e.g. policy measures, information and training.**
2. **To measure whether and how the perceptions evolve as the project progresses and the participants gain more experience with eHGVs.**
3. **To capture opinions on the specific technologies and methods applied in the demonstration, e.g. public and depot charging.**

The diversity of fleets within the programme and the richness of quantitative data collected from the vehicles will also allow us to explore how stakeholder perceptions might differ based on organisational characteristics, e.g. strategic priorities regarding decarbonisation, types and length of routes driven.

Hear more about how and why we're analysing stakeholder attitudes and behaviours from Anna Wieckowska, Electric Freightway's Customer and Sector Insight Lead in this video

Approach

The approach has been designed in collaboration with consortium partners, piloted with one of the hauliers and subsequently refined. The aim was to capture a broad range of views from different stakeholder groups as well as explore some of the themes in more detail with relevant stakeholders. Therefore, a blended approach combining on-line questionnaires and interviews was developed for the first iteration, as summarised in Table 3.

Table 3 - Survey approach to stakeholders – first iteration

Stakeholder group	Approach	Focus themes for first iteration
Drivers	Anonymous online questionnaire	• Expectations of vehicle performance and driving comfort • Expectations regarding charging, including ability to charge enroute during breaks • Expectations of the need for training and additional instructions on charging • Views on benefits and concerns regarding zero emission HGVs
Driver Trainers	Online questionnaire. Some follow up interviews	• Vehicle performance and driving comfort • Training drivers to drive eHGVs • Driver performance assessment and KPIs • Training provided by OEMs
Operational Managers/ Schedulers	Online questionnaire. Some follow up interviews	• Vehicle performance • Scope for electrification given current technology • Impacts of operations • Costs of transition
Technical Managers/ Fleet Engineers	Online questionnaire. Some follow up interviews	• Vehicle performance • Impact on the way vehicles are maintained and serviced • Impact on organisational capabilities/ skills • Scope for electrification given current technology
Senior Managers	On-line questionnaire followed by a 30 min on-line interview	• Future technology landscape • Impact on the industry • Cost of transition, TCO expectations • Government policy • Strategic enablers and barriers

The stakeholder groups targeted by the survey are:

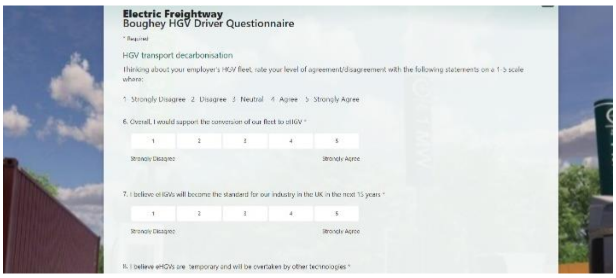
- **Drivers** – qualified HGV drivers, including permanent employees, agency, contractors or sub-contractor organisations of the project partners.
- **Driver Trainers** – some project partners have dedicated in-house trainers, responsible for all aspects of driver training, as well as performance monitoring. These individuals were often the first to receive OEM training on eHGVs to be able to disseminate the knowledge within their organisations.

- **Operational Managers/Schedulers** – managers responsible for operations, including route scheduling and allocation of vehicle to routes. In some organisations these two responsibilities are combined in one role, in others they may be separate.
- **Technical Managers/Fleet Engineers** – individuals responsible for vehicle maintenance and repairs. These activities are in-sourced to a varying extent, with some organisation relying mostly on dealers and others having in-house workshops and technicians.
- **Senior Managers** – senior managers within different functions contributing to decision making on fleet decarbonisation strategy and playing key roles in its execution.

The approach was designed to cover some common topics with all the stakeholders while at the same time exploring different focus themes in more detail via either additional questionnaire or interview questions with particular stakeholder groups. Common themes/ questions explored across stakeholder groups include:

- Overall support for decarbonisation and electrification of their employer's fleet
- Expectations on the future technology landscape and dominant technologies in the sector (i.e. diesel, biofuel, electric, hydrogen or other)
- Expectations regarding practicality, reliability, ease of uses and safety of depot and public charging
- Cost implications of the transition away from diesel for the industry
- Environmental and societal benefits of switching to eHGVs
- Customer expectations
- Key barriers and enablers to electrification.

Figure 9 - Example of a survey carried out with driver trainers



Progress to date

The timing of the surveys is staggered and depends on the timing of vehicle order and planned vehicle delivery. To start the first iteration of the surveys, the haulier must have ordered the vehicles.

As of September 2024, the project team had started the process with the first four project partners. 115 questionnaires and 14 interviews had been completed in total, with breakdown by stakeholder group shown in Table 4.

Table 4 - Survey progress Iteration 1

Stakeholder group	Number of questionnaires and interviews completed
Drivers	89 questionnaires
Driver Trainers	7 questionnaires 1 interview
Operational Managers/ Schedulers	9 questionnaires 5 interviews
Technical Managers/ Fleet Engineers	3 questionnaires 1 interview
Senior Managers	7 questionnaires 7 interviews

Early findings

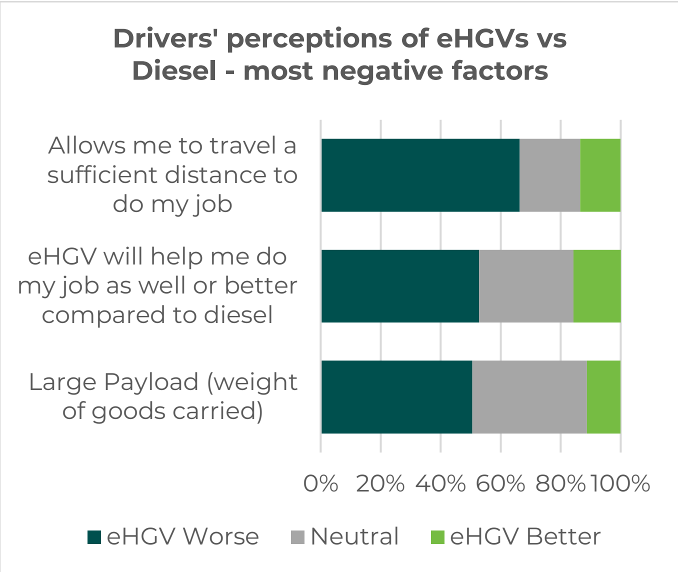
The first iteration of surveys with the project's partners is still ongoing and will be published in a future report, however we are able to share some early observations from the results received so far. It should be noted that these results are based on a relatively small group of organisations and respondents and the outcome may change as more drivers and managers are surveyed.

Expectations of vehicles and charging

There are many aspects of a vehicle that can impact driver attitudes. To explore this, we asked drivers about their perceptions and expectations regarding a number of specific eHGV features. Questions were asked on a five-point scale but have been aggregated into a three-point scale here for clarity.

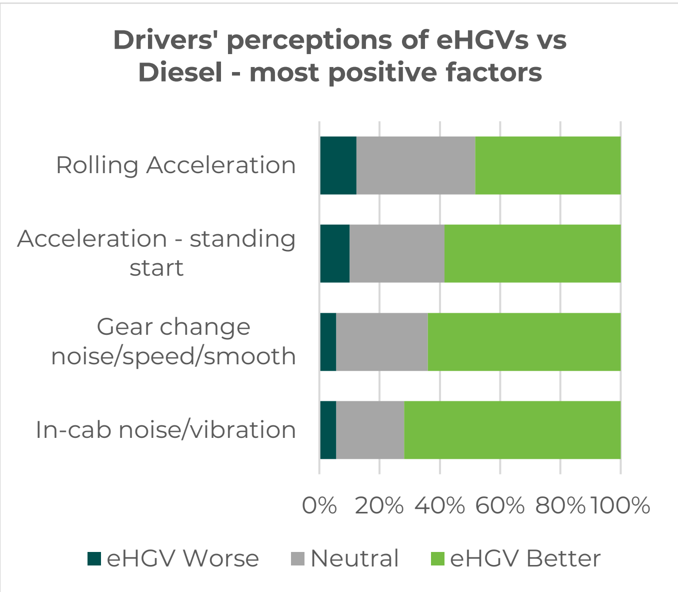
Concerning the performance and comfort of the vehicles themselves, all factors received a mix of positive and negative reactions. The most negative expectations (Figure 10) were around **vehicle range, payload** and the resultant **impact on ability to complete their job**.

Figure 10 - Negative perceptions of eHGVs



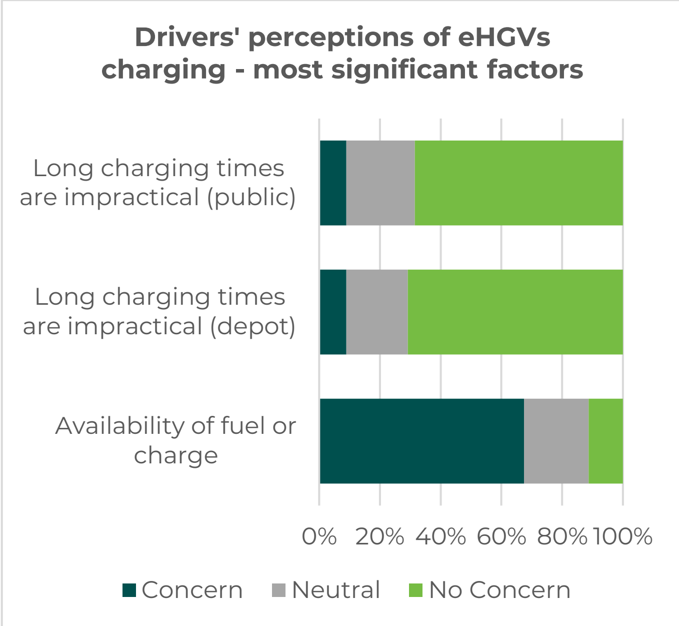
The most positive expectations are around **noise**, **gear changes** and **acceleration** (Figure 11).

Figure 11 - Positive perceptions of eHGVs



Turning to expectations of charging; **availability of chargers** was the key negative factor (Figure 12). Drivers generally didn't express concerns over the practicality of long charging sessions, either at depots or public sites. Most drivers didn't express a strong opinion on other factors, such as safety, ease of use or reliability.

Figure 12 - Driver expectations of charging



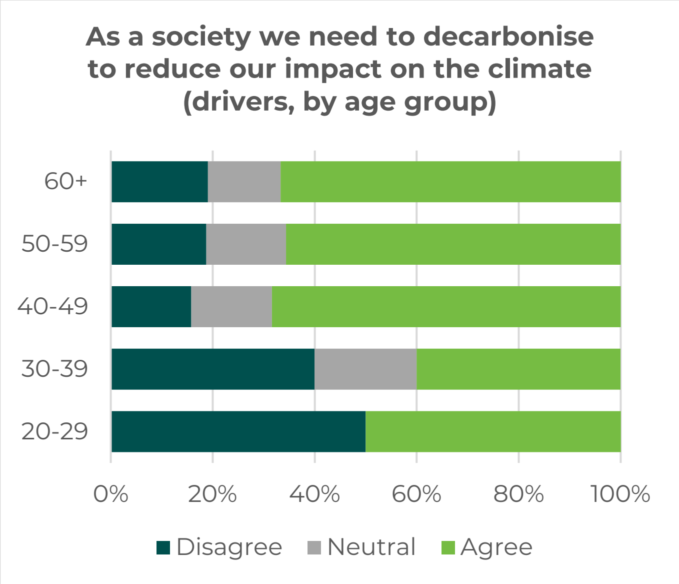
Relationship between age and views on decarbonisation and change

Within the wider population, age plays a significant role in shaping attitudes toward electric vehicles. Younger generations, driven by environmental concerns and a greater familiarity with new technologies, are generally more positive toward EV adoption. For example – according to existing research – those aged less than 30 in the UK are more likely to switch to an EV than other age groups[xxiv]. In general, HGV drivers are higher in age than the wider workforce as a whole, with almost 60% aged over 45, vs 41.5% across all industries in 2021[xxv], and the population of drivers is continuing to age. This is reflected in the demographics of our respondents. Many drivers have also been employed in the industry for a significant period of time.

We have explored whether this is a significant factor when it comes to views on the move away from diesel and general concern for the environment.

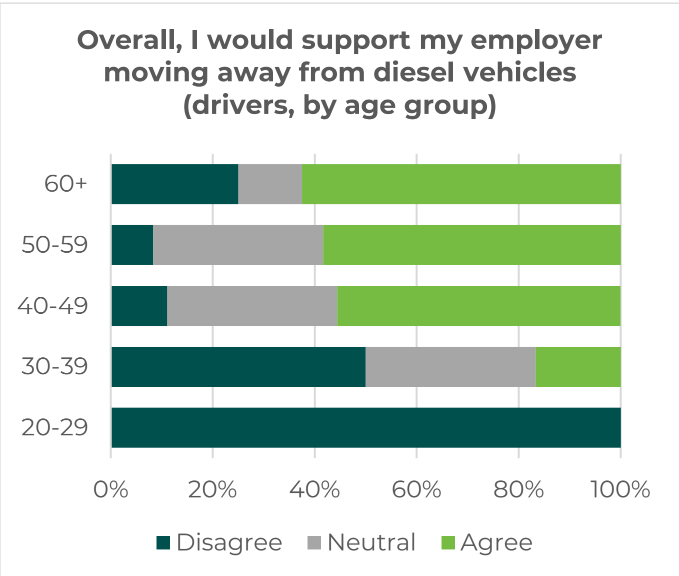
First, we asked about general views on the climate. Figure 13 shows that while there were a variety of views, with the majority of respondents supporting the principle of decarbonisation overall. This was supported most strongly by over 40s and there was an even split of views in under 40s.

Figure 13 - Views on decarbonisation



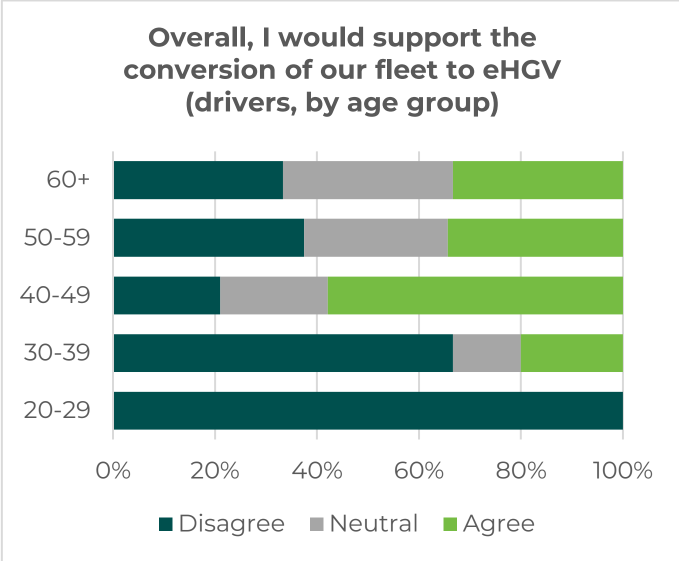
We then asked more specific questions, firstly about moving away from diesel (Figure 14). Again, the majority of respondents aged over 40 are in favour, though there is a significant minority who disagree or are neutral. In the younger age groups we see an even more negative reaction, with a small minority advocating the move from diesel.

Figure 14 - Views on move away from diesel



When asked specifically about converting to eHGVs (Figure 15) the response becomes more negative across all the age groups. The split between agree and disagree for all drivers is almost 50:50.

Figure 15 - Views on adopting eHGVs



Surprisingly, the younger age groups show the strongest negative sentiment, though it should be noted that, at this stage, the sample in the youngest age group is small (N=2) and we expect the results could change as the survey and sample size progresses.

Gender differences, which are often mentioned in the context of adoption of environmentally friendly technologies, were not explored. However, in the UK a very small proportion of HGV drivers are females, with only a few per organisation. We have not asked about the respondents' gender, as this was likely to make any female respondents easily identifiable and potentially less likely to respond.

Key benefits and concerns

To help us better understand what was driving these varied views we included a free text field and asked respondents to list top three positive and negative aspects of eHGVs. The summarised results are presented in the word clouds below (Figure 16 and Figure 17).

Figure 16 - Positive aspects of eHGVs mentioned by drivers

The main positive expectations from drivers were around noise levels and environmental impacts. There were also some performance related comments regarding technical aspects of the vehicles.

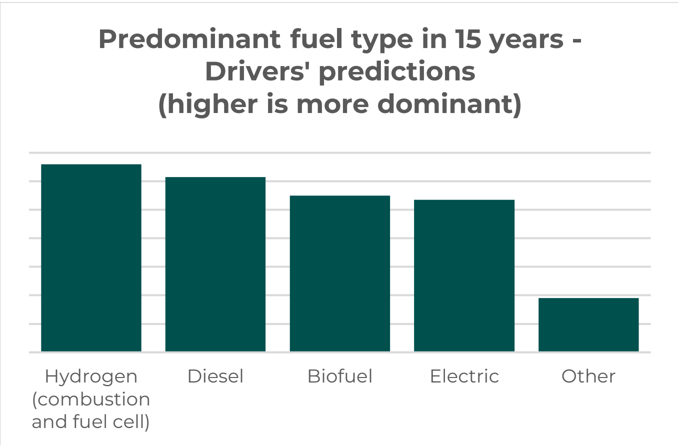
Figure 17 - Concerns regarding eHGVs mentioned by drivers

The overwhelming concerns were around charging (in terms of time taken and availability) and vehicle range. Drivers also raised a wide range of other concerns including environmental impact of batteries, safety, cost and performance.

The future of the sector

All respondents were asked to rank five options for the dominant technology powering eHGVs in 15 years' time, when restrictions on sales of diesel HGVs will be coming into effect. Views varied considerably; however, some clear trends can be seen from the data and there is an especially clear difference in views between drivers and managers.

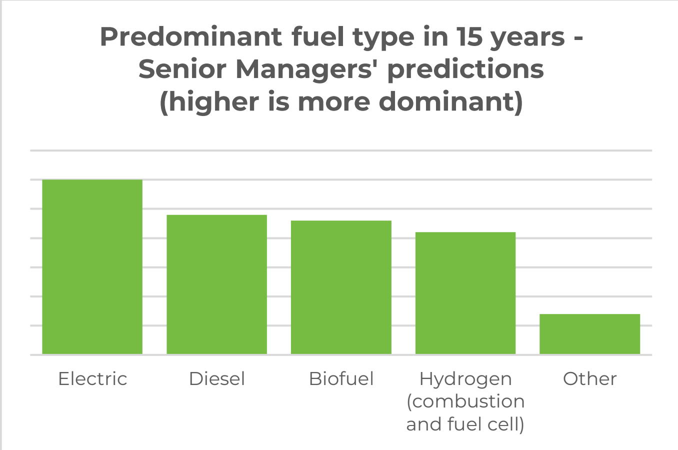
Figure 18 - Drivers' ranking of future options



As Figure 18 shows, more drivers see hydrogen as the leading technology in 15 years, closely followed by diesel, with electric in fourth position behind biofuels.

The view of senior managers (Figure 19) is the complete opposite, with electric seen as the primary technology, and hydrogen the least selected option.

Figure 19 - Senior Managers' ranking of future fuel options



We've considered some of the reasons why this might be the case. One factor may be that the managers responding are unusually pro-EV due to their involvement in the demonstrator. Experience of electric technology may be another differentiator between these groups. 70% of senior managers either own or are considering buying an EV, while only 25% of drivers had some EV experience, none own an EV and just 3% are considering making the switch in the next year.

Next steps

The first iteration of surveys will continue in advance of each haulier receiving eHGVs into their fleet. The second iteration will look at how views change once hauliers have had more experience of eHGVs and the associated infrastructure through the demonstration. These will be conducted during 2025.

We are looking to understand attitudes towards eHGV adoption across the wider industry, especially from HGV operators of different sizes, to complement what we are learning from project partners. Complete the survey at forms.office.com/r/kKtwneUXmM.

08 Project data and systems

Data plays a key role in effectively managing eHGV charging, both in day-to-day operations and understanding how to improve longer term efficiency. Interpreting data from eHGVs is at the core of Electric Freightway and this information will be key in allowing the industry to make sound investment decisions, overcoming the uncertainty that surrounds this new technology.

Collecting and analysing data for analysis

Electric Freightway is collecting data from vehicles, chargers, hauliers, OEMs and weather services. As more trucks join the demonstration, the volume of data will continue to grow.

Hear from Hitachi Zero Carbon's Colm Gallagher and Anna Maudet as they explain how the Electric Freightway data gathering will allow HGV operators to make informed decisions on electrification in this video

Implementing the platform

Hitachi ZeroCarbon has successfully delivered a robust data analytics platform designed to empower its data science team.

This platform is built to be secure and scalable, ensuring it can handle growing data demands while protecting sensitive information. It includes strict data access restrictions to safeguard against unauthorised access. Additionally, we have implemented reliable backup and restore mechanisms, ensuring data integrity and availability at all times. The platform is set to significantly enhance the data science capabilities and drive innovation for the Electric Freightway project.

Integrating with telematics and other services

With the permission of our haulier partners, the data platform integrates with APIs from a number of third-party services, most notably the telematics systems of our partner OEMs. Diesel vehicle data is also collected from the OEM systems where possible, as well as from telematics services used by partner hauliers. The OEM support has been invaluable to the project for integrating these services.

Data protection considerations

While the project does not ingest personal data from any of its partners, the precise movement of vehicles and loads remains commercially sensitive. Hitachi ZeroCarbon is committed to protecting this data by following industry best practices, including encryption of data in transit and at rest, implementing strict access controls, and conducting regular security audits and vulnerability assessments to identify and mitigate potential risks.

Additionally, Hitachi's SOC (Security Operations Centre) team continuously monitors the platform for any signs of suspicious activity, ensuring that data remains secure and protected at all times.

Analysing the data

The analysis being carried out seeks to objectively compare the performance of diesel HGVs and eHGVs operating on roads across the UK. All operations must be normalised to ensure a fair comparison. For example, the performance of each vehicle on any given day will be subject to independent variables including weather conditions, traffic and route topography. The analysis addresses these changing conditions by taking the following approach for all data gathered:

1. **Common data model**: Each data source will have its own data schema. The first step is to map each data point onto a common schema so that data from different sources is ready to be analysed together. This

improves the efficiency of the main body of analysis.
2. **Operational analysis**: Characterising each vehicle and fleet operations is important to understand the coverage of the data available and the breadth of operating conditions.
3. **Feature engineering**: Data points are supplemented with relevant data from additional sources to enable data normalisation. For example, for a telematics data point, the weather conditions (temperature, relative humidity and precipitation) at the same location and timestamp are added to the data.
4. **Route labelling**: A rule-based system is used to label each individual trip based on the duty cycle of the trip (e.g. distribution, tramping etc.). Labels are used at a later stage to segment the data for analysis.
5. **Route similarity matching**: It is important that a variety of fleet and vehicle types are analysed together. For this, we need a means of identifying similar routes driven, when the start, end and waypoints may vary. This algorithm enables similar routes to be grouped and analysed.
6. **Performance quantification:** The segmented data is analysed to quantify the performance of each vehicle and input this data into the TCO modelling to understand the impact this real-world performance has across the lifetime of the vehicle.

Challenges encountered

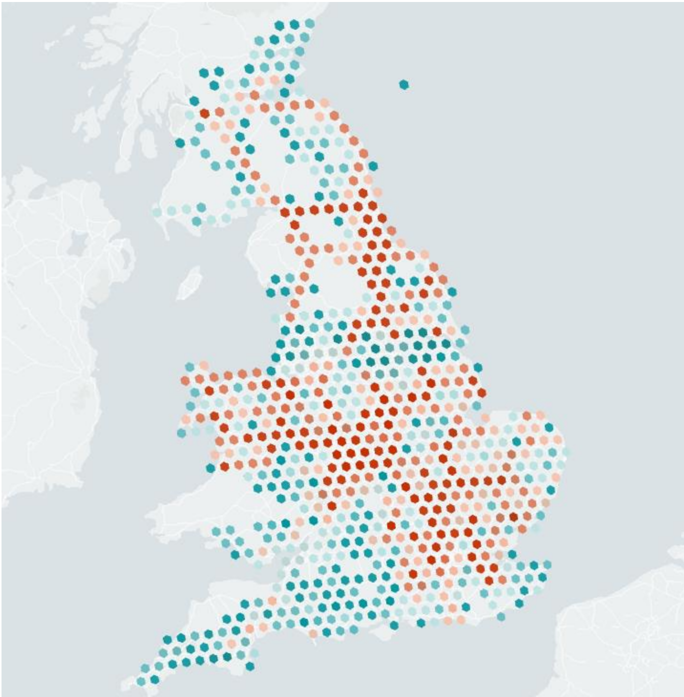
The primary challenge faced is the availability of the telematics data required to test the project hypothesis in a statistically significant and robust manner.

It is common for telematics systems to be based on the Fleet Management System (FMS) standard. This is a standard interface for accessing vehicle data that was designed around diesel vehicles. Updates to the standard in recent years have made eHGV specific signals available, however, the data available remains quite high level.

Some OEMs have gone further to make data that is not defined in the FMS-standard available. For example, both Renault and Volvo offer parameters such as energy regenerated, energy consumed by auxiliary systems and energy consumed while plugged in. This more comprehensive data set enables analysis to be carried out at a greater level of detail than would otherwise be possible.

The other main challenge faced so far is the coverage of the data set. Vehicles need to operate for several months so that the data set includes operations across seasons, routes and behaviours.

Figure 20 - Heatmap of data coverage across UK as of August 2024



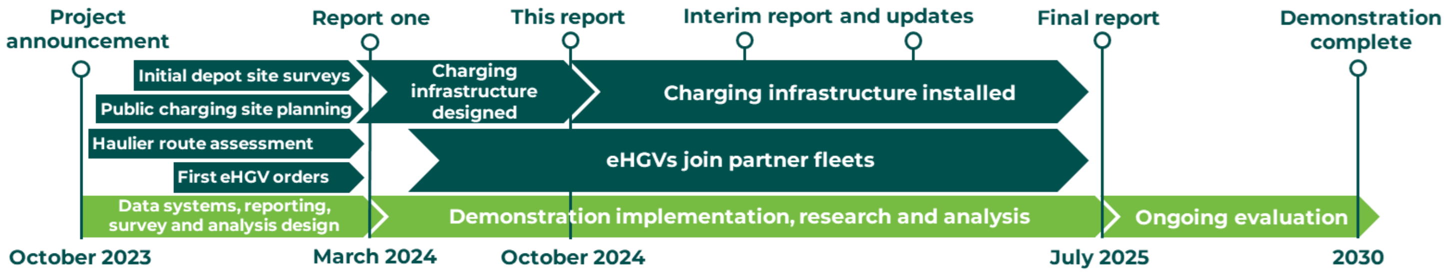
Next steps

The focus for the next six months will be on three main areas:

- Gathering data across Autumn and Winter operations to deliver cross-seasonal data for the first batch of vehicles integrated in the Hitachi ZeroCarbon platform.
- Finalising and the analysis approach to test hypotheses and produce the initial set of results and conclusions.
- Deep-dive analysis into most popular route, archetype routes and individual fleets.
- Testing data availability for expanding the analysis to include additional parameters such as tyre and trailer characteristics.

09 Next steps

Since the last report at the beginning of March, significant progress has been made in getting the project on the road. Hauliers have placed significant volumes of vehicle orders, and the first eHGVs have been successfully operating and making zero carbon deliveries. Data from all the trucks is being captured for analysis, with the first results expected to be shared in future reports. Progress on infrastructure has been slower than anticipated but has involved a busy schedule of survey, design and contractual work, putting the project in a good position to install the required charging systems over the coming year, as shown in the diagram below:



Charging infrastructure

Following an extensive planning and design process and the completion of agreements with depot partners, ground surveys have begun and construction of the first sites is about to get underway. Over the coming months we expect the build programme to ramp up, with sites being electrified in readiness for the arrival of more eHGVs in 2025.

Deployment of the public charging network is also expected to begin once the necessary planning and legal steps have been completed. Sites will begin opening, likely in phased deployments, early to mid-2025.

eHGV procurement

Eighteen eHGVs have been delivered to project partners, with many more orders placed. We're expecting a broader range of vehicles to join the demonstration as more OEMs bring their products to market and we approach our target of c.140 eHGVs in 2025.

Attitudes research

The first round of the attitudes research is continuing, and each operator will be surveyed before their eHGVs hit the road.

In spring 2025 we will embark on a second round of surveys and interviews in order to gauge changes in opinion once drivers and managers get experience of having the

vehicles in their fleet. The results are expected to be published in our final report next summer.

Learning from implementation

This report focused on what we've learnt from planning and designing infrastructure and ordering vehicles. As the focus moves to public sites, and hauliers begin testing vehicles on more challenging routes, we expect to continue to discover more about eHGV implementation, and we'll be sharing these insights through future reports.

Data gathering and analysis

Data gathering is ongoing from all of the eHGVs and chargers funded by the project. This also includes a representative sample of diesel vehicles operated by project partners and members that is used to form a baseline for comparative analysis.

Work is ongoing to analyse this data and understand how efficiently the eHGVs are operating compared to their diesel equivalents.

Future reports

In the coming months we plan to share updates and interim results from the demonstration. Our reports will keep the industry updated on the progress in deploying infrastructure and vehicles and will provide insights from our data analysis once there is a representative sample of eHGVs on the road. In addition, our future reports will provide more complete findings from our first-round surveys and analysis of the total cost of ownership of eHGVs.

Keep up to date with the progress of the demonstration on our website https://www.gridserve.com/electric-freightway/.

10 Acknowledgements, Glossary, References and Links

Acknowledgements

The Electric Freightway team would like to thank all the partners and members of the consortium who have contributed to the production of this report. In addition, we would especially like to thank the British Standards Institution and National Grid for providing insight into how they're supporting operators make the move to zero tailpipe emission vehicles.

Glossary

AC	Alternating Current
ANPR	Automatic Number Plate Recognition
API	Application Programming Interface
ASC	Agreed Supply Capacity
BETT	Battery Electric Truck Trial, a UK trial carried out by DAF and Cenex, with financial support from SBRI Zero Emission Road Freight Competition
BEV	Battery Electric Vehicle
BNG	Biodiversity Net Gain
BSI	British Standards Institution
CCS	Combined Charging System, the connector standard for high-power DC (except megawatt) charging in the UK
DC	Direct Current
DNO	Distribution Network Operator
eHGV	Electric Heavy Goods Vehicle, a zero tailpipe emission HGV powered by electricity
eLCV	Electric Light Commercial Vehicle
EPC	Engineering, Procurement and Contracting
EV	Electric Vehicle
FMS	Fleet management system – a telematics standard for commercial vehicles
GB	Great Britain
GWT	Gross Weight Tonnes, the combined weight of the vehicle, its trailer and the maximum payload it can carry
High Power charger	A DC charger capable of charging an electric vehicle at 150kW or over
HGV	Heavy Goods Vehicle, also referred to as LGV (Large Goods Vehicle) or HDV (Heavy-Duty Vehicle). A vehicle with over 3.5t GWT s in UN(ECE) category N2 or N3.
HVM	Hostile Vehicle Mitigation
iDNO	Independent Distribution Network Operator
IET	Institute of Engineering and Technology
kW/MW	Kilowatt/Megawatt, a measure of power
kWh/TWh	Kilowatt hour (electricity delivered over 1 hour at 1kW)/Terawatt hour (1,000,000,000kWh)
LCV	Light Commercial Vehicle (A commercial vehicle with GWT ≤3.5t)
M&E	Mechanical and Electrical Services
MCS	Megawatt Charging System
MPG	Miles Per Gallon
MSA	Motorway Service Area, also known as services or service stations that offer places for drivers to rest and refuel vehicles
NESO	National Energy System
OEM	Original Equipment Manufacturer, a term used to refer to the manufacturer of HGVs
POC	Point of Connection, the connection between the electricity distribution network and a customer
PTO	Power Take-Off, the use of power from the tractor unit to power loads located in the trailer
SOC	Security Operations Centre
TCO	Total Cost of Ownership
TRU	Transport Refrigeration Unit
ZEHID	Zero Emission HGV and Infrastructure Demonstrator Programme

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