NET ZERO TIMHAUL

PROGRESS REPORT

EDITION 2024

James Jones & Sons Limited

Scottish Forestry
Coilltearachd na h-Alba

VOLVO

SCOTLOG • SCOTBARK

CREEL MARITIME LTD
PROGRESSIVE SUPPLY CHAIN MANAGEMENT

Contents

Executive Summary

This report describes the progress to date in exploring and understanding electrification towards net zero emissions in the HGV sector with a particular focus on timber transport.

A rapid uptake of low-emission HGVs is needed to meet Scotland's net zero target by 2045, and diesel HGVs will be phased out in the near future meaning alternative drive trains are critical.

New business models cannot disadvantage early adopters and must ensure a fair income to hauliers and businesses that adopt low carbon and net zero measures.

The transition to BEV commercial vehicles is however, to date, challenging due to a lack of proven business cases.

The Net Zero Timhaul pilot project, as funded by Scottish Forestry, deployed two BEV HGVs in 2023 to explore barriers and opportunities and build confidence, and support the transition.

At time of writing, as end of year 1, the lorries have collectively driven just under 40,000 miles with JJ23 having travelled 13,115 miles saving 30.73 tonnes CO2eq, and SL73 completing 26,172 miles saving 45.99 tonnes of CO2eq.

"*On balance the trial has been extremely worthwhile, and we are very pleased to have been able to contribute in some small way to the larger goals of decarbonisation. We hope to continue with the vehicle once the trial concludes*."

- Stuart Catto, MD at Scotlog Sales.

"*Despite some teething issues which have been solved, James Jones & Sons have had the lorry in operation for a year now with both drivers and managers reporting positive experiences, and the lorries performance have exceeded expectations. An extension to this trial may be considered if further funding is available*."

- David Leslie, Joint MD at James Jones & Sons Ltd

"*The statistics speak for themselves. Electric trucks convert nearly 90% of the energy they consume into usable power, while diesel and future hydrogen waste a staggering amount. For businesses, this efficiency directly translates into significant savings and environmental benefits, especially considering the severe air pollution caused by diesel trucks. Whist deployment remains challenging in the forestry haulage landscape, the trial is currently proving invaluable in terms of learning points for our industry, and the wider haulage sector*"

- Neil Stoddart, MD at Creel Maritime Ltd

Introduction

In 2023, 5.8 million tonnes of wood (>230,000 lorry loads) were harvested from Scotland's forests and delivered, primarily on 44-ton diesel lorries, to state-of-the-art sawmills, board manufacturers, and other processors (Fig. 1), to support more than 34,140 jobs and realise £1.1 billion GVA for Scotland's economy[1].

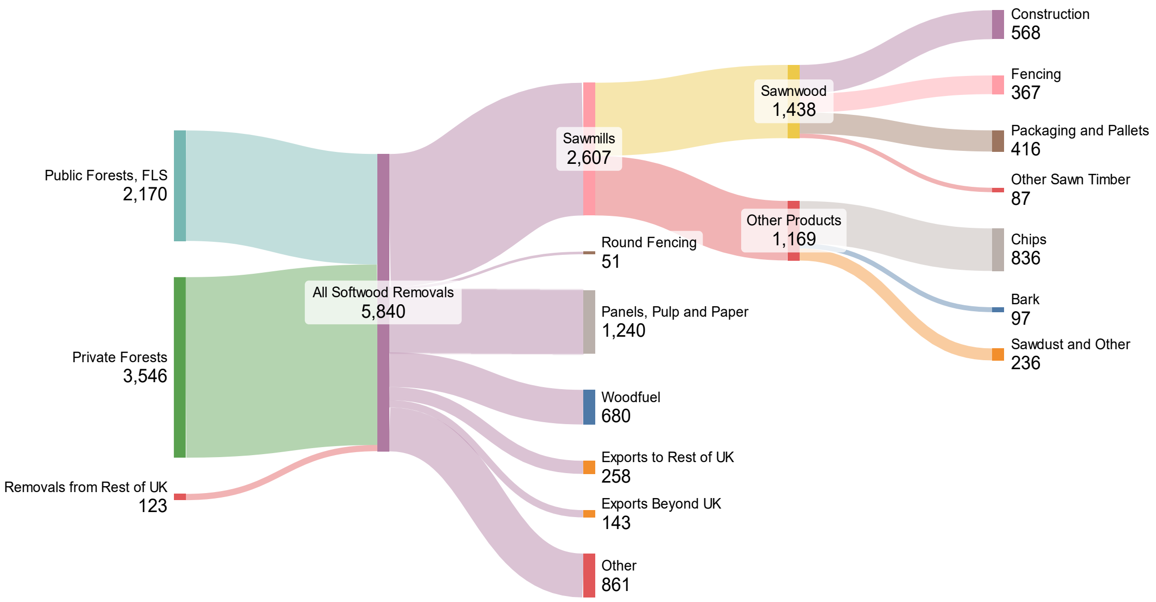

Figure 1: Estimated flow of materials from Scotland's forests to products (000s green tonnes)[2]

It is not unreasonable to estimate, more than 90% of this volume is moved by HGV. Road haulage is therefore critical to this supply chain as it represents the physical link between rural forests and the value-add industries which are usually closer to urban centres, and end consumers. Conceptually however, it is frequently under-represented, falling between growing trees and processing timber, the two dominant parts of the supply chain. To illustrate the scale, timber haulage costs represent c 30% of the delivered costs of roundwood (and of this, around 30% of transport costs are derived from fuel)[3].

It is also remarkable that Forestry is an inherently green industry due to the amount of carbon trees capture and store, acting as the only effective sink for carbon in Scotland removing and 7.9 MtCO2e emissions (2022)[4]. Despite this advantage, whilst Heavy Goods Vehicles (HGVs) play a critical role in wood fibre supply chains, they remain a major source of greenhouse gases with the combined annual emissions from UK timber haulage by road estimated around 69,552 tonnes[5] .

In the wider context of UK targets to phase out diesel HGVs and achieve zero-emissions by 2040[6], and Scottish government plans to accelerate decarbonising the haulage industry[7], the forestry sector recognises that decarbonisation is no-longer an option and is eager to leverage contemporary technologies to address this challenge[8]. Electric Vehicles (EVs) have the

[1] Economic Impacts of Forest Based Activities in Scotland
[2] Forestry Statistics and Forestry Facts & Figures
[3] Transport - The Profit and Loss of Forestry
[4] Scottish Greenhouse Gas Statistics 2022
[5] Road Haulage Decarbonisation Overview Report
[6] UK confirms pledge for zero-emission HGVs by 2040
[7] HGV Decarbonisation - Pathway for Scotland
[8] Road Haulage Decarbonisation Overview Report

potential to reduce these HGV emissions by 50-70%[9]. However, although they now are very familiar as consumer vehicles with c.20% new cars sold globally being electric[10], questions remain around costs, reliability and performance of "novel" greener technologies such as EV HGVs – especially in often highly variable and technically demanding forestry applications.

In 2021, less than 0.1% of heavy-duty trucks in the global fleet were electric[11], and less than 15% of UK timber hauliers had given any consideration to alternative powertrain sources[12] demonstrating a clear need to raise awareness, increase understanding, and build confidence. For scale, estimates suggest 690 timber trucks in the UK with 65% (c.450) based in Scotland[13].

In early 2024, a review of UK available EV HGVs identified c.19 models across nine manufacturers of which eight (including the pilot vehicles) would be appropriate for 40 tonne timber haulage applications[14]. A typical diesel HGV can travel over 1,200 km on a full tank of diesel, and the average maximum distance for EV HGVs (at a combined weight of 44 tonnes) is 475 km (true average all EV HGVs is 275 km). Alongside the fact that EV HGVs have been estimated to cost two to three times more than diesel equivalents for initial purchase[15], and there are remaining uncertainties around equivalence and residual values, hauliers resistance to a "leap of faith" is understandable.

To mobilise rural revitalisation[16] and ensure a just transition[17], no sector, or its workers, or its customers should be unfairly burdened with the costs of decarbonisation, and we must strive to ensure equal access to zero emission technologies and vehicles with particular focus on sectors such as forestry with limited modal shift options and low demand reduction potential.

This pilot project was therefore developed on behalf of and in collaboration with stakeholders to explore EV opportunities for different applications typical of timber haulage, identify current and future barriers and develop effective mitigations, build confidence in the new technologies for stakeholders and operators, enhance coordination and cooperation between supply chain actors, and to help inform a rapid strategic transition towards net zero.

Figure 2: The project team showcasing JJ23 with MSP Lorna Slater at the 2023 Royal Highland Show and upon delivery at the Lockerbie site.

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[9] Global EV Outlook 2024
[10] Why electric cars will take over sooner than you think - BBC News
[11] Global EV Outlook 2022
[12] Timber Transport Survey 2021
[13] Timber Transport Survey 2021
[14] Appendix 1
[15] The Electric Car Guide – Electric Lorries and HGVs in the UK 2024
[16] National Planning Framework 4
[17] Just Transition - A Fairer, Greener Scotland

Partners

With headquarters in Larbert and a history of innovation stretching back 180 years, James Jones & Sons are one of the largest and most progressive timber processing companies in the UK. As a vertically integrated business with interests in timber harvesting, sawmilling, pallets & packaging, and distribution, James Jones & Sons were very pleased to trial a 40-tonne articulated lorry operating from their Stevenscroft sawmill near Lockerbie to transport timber to the Hangingshaw Distribution Centre at Johnstonebridge.

Scotlog have over thirty years' experience shipping and handling bulk and general cargoes in Inverness and providing efficient transfer options for cargoes for, or from any part of Scotland or the North. With extensive interests in transport, distribution and the landscaping and horticulture sectors, they are using a 44-tonne truck to move roundwood timber from Inverness Harbour to West Fraser and other local mills in the Highlands.

The project funders, Scottish Forestry are a Government agency responsible for policy, support and regulations whose goal is sustainable management and expansion of forests and woodlands. Scottish Forestry remain committed to supporting haulage best practice and enabling projects such as EV Timhaul which minimise environmental and social impacts of timber, support Scotland's Climate ambitions, and ensure a future fit industry.

Inverness based Creel Maritime are a forward-thinking environmentally conscious shipping and logistics company founded in 2019. With significant interests in the development and deployment of transition fuels including electric, methanol, and Hydrated Vegetable Oil (HVO) in HGVs, Non-Roadgoing Movable Machinery, and marine vessels, Creel were very pleased to support this work and ideally placed to manage the project.

The participants would also like to give thanks to Volvo Trucks for supporting development and delivery of this project, their ongoing technical support, and their dedication to supporting forestry's EV transition.

Finally, the partners would also like to thank Ferguson Transport, JST Services and Highland Industrial Services who were originally planning to trial additional EVs and made significant contributions to the pilot design but were unable to take part at that time due to differences in readiness for EV transition at regional, local and business levels discussed hereafter. At least one of these partners is now participating in another electrification trial demonstrating that the sectors dedication to decarbonisation is unwavering, and that an iterative approach is critical to developing viable business models and effectively deploying EV HGVs.

Lorries

The study Electric Vehicles (EVs) are both Volvo FH Electric tractors with power units (options for 4-6 batteries offering 360-540 kWh) and trailer modifications specific to the use case/ business (Fig.3).

The 4x2 axle 40-tonne James Jones & Sons lorry (Fig. 3 RHS) has a 5-battery configuration with 450KwHr capacity and uses a 16.5m flatbed trailer. Contrastingly, the 44-tonne Scotlog lorry (SL73 Fig. 3 LHS) is a 6x2 '6 & drag' configuration operating a 6-battery system with 540KwHr capacity and tri-axle trailer fitted with a specialist Metsatek timber body and Ecco bolsters.

These were compared to a direct diesel equivalent Volvo FH Diesel tractor unit with a 13ltr 500Bhp engine.

Figure 3: Same but different – SL73 preparing to move roundwood timber from Inverness Harbour to the West Fraser facility at Dalcross where it is processed into OSB, particle board, and MDF; and JJ23 leaving the Stevenscroft site with sawn timber products ready for use in sustainable construction.

Neither truck was configured with a typical hydraulic timber crane as applications did not require this, and at the time of order – technical information on power consumption and characteristics from an electric hydraulic Power Take Off (PTO) was not available from OEM's. In combination with operational constraints such as charging access in rural areas, in-forest operations were beyond the scope of this project but may be investigated in later years.

As part of the service, Volvo Trucks also offer support to optimise usage of the EV with IOT connection and virtual modelling services for route and range planning, positioning, and likely performance, and includes follow-up reports on energy usage and various other mechanical/ technical performance metrics through a digital portal to enable real time monitoring and enhance fleet management/ efficiencies.

The chargers were both 160W Autel MaxiCharger DC units supplied with Type 2 CCS connectors, dynamic load balancing meters, and a cloud based back-office support service for the contract duration.

Findings – Chargers

This project has identified various integrated design considerations specific to deploying EV HGVs which are critical to enabling a better transition.

Site

Depot-based charging brings the advantage of lower energy cost (pence per kWh) and carbon savings for back to base operations and is also a common way of working in haulage. However, limited area means efficiency and physical space is always a primary consideration. From this, when charging requirements are combined with other factors such as battery storage systems, transformers and power control units, and safe practices including fire prevention, changes to established site operations or planning permission for more substantive alterations such as new buildings to house chargers may be required[18].

To illustrate, new buildings to house the chargers were required at the Lockerbie site to ensure fire safety as it is a wood processing business and Scotlog had to purchase additional longer cabling due to alignment issues when installing the charger. Similarly, depot working practices will typically inform opportunity. For example, coupled and disconnected tractor trailers would have very different requirements, and drive through or reverse in bays for charging may be required accordingly, therefore layouts may have to be adapted for manoeuvring and charging vehicles safely. From this, space, proximity to buildings, operations, cabling costs etc, pedestrian pathways, traffic flows, and safety are key considerations.

Power

Higher power charging is more expensive to deliver as a higher capacity electricity network connection, more expensive chargers and associated infrastructure are needed but enable benefits such as faster charging. However, power demand to charge these batteries in relatively short times, with particular reference to businesses with fleets of vehicles, can in some areas can exceed the capacity of local networks. In the shorter term this means there will be sites that can't be electrified, or where electric routes may be limited (as with this study), until local grid upgrades and reinforcement takes place.

This will also influence opportunities to work towards shared charging with destination sites with particular reference to rural businesses such as forestry. Network Operators are aware and are working towards a solution but in the interim, resources to identify sites where there is little chance of installing charging are available[19]. However, it is of great interest that James Jones & Sons are working towards operating a net zero hub in Lockerbie by using, renewable power sources such as solar, wind and woody biomass, together with battery storage, so there may be opportunities for some businesses to "escape" such grid constraints[20].

Installation

Both partners report experiencing initial challenges in securing support from the service provider to start and begin charging. The process of registering a SIM card to enable communication with the service provider took several weeks to fully understand the requirements and complete the registration. As a further demonstration of site considerations, Scotlog relocated the charger to a second spot in the yard after realizing that operations were being affected by the lorry while charging at the initial location. The new location is more suitable for overnight parking and charging. Overall, some delays were experienced at the outset, but the chargers and the service have been running smoothly since.

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[18] Charger connector placement on the vehicle is to be standardised to be on the left-hand side behind the front wheel but this may still vary so vehicle design should also be considered

[19] Network Infrastructure and Usage Map (NIUM) — UK Power Networks (opendatasoft.com)

[20] Bsi ZERFD Standards Programme

Public charging

The EVs routes were effectively limited by the lack of charging infrastructure. Similarly, the partners had planned to take one of the EVs a conference in Southern England but there simply weren't enough chargers to complete such a long journey without resorting to diesel charging. Effective public charging infrastructure for HGVs would provide operators with vastly increased flexibility enabling longer routes and variable destinations more typical of timber haulage. However, at 7% total charging infrastructure in the UK[21], appropriate fast charging facilities are not sufficiently available at this time, but the Network Operators are working to enhance networks. Although there are no installation costs to operators, this will generally be more expensive, and availability isn't guaranteed. It should also be noted that the emissions payoff can be affected by energy mixes as a function of grid carbon[22].

In the interim, alongside the EV Timhaul pilot, the upcoming £100 million Electric Freightway demonstrator programme[23] and similar projects such as the £19 million (2021) CENEX Battery Electric Truck Trial (BETT)[24] give a strong indication of government aims to rapidly catalyse the rollout of additional charging infrastructure for EV HGVs in many more locations in the short term by increasing market demand/the UK EV HGV fleet so the outlook towards a critical mass of charging infrastructure is increasingly positive.

Shared depots

HGV charging infrastructure will eventually achieve necessary coverage but allowing hauliers to use chargers at destination sites when loading and unloading could help to maximise the potential range and application of EV HGVs in the interim.

Shared locations within supply chains are obvious, but given the remote, and often temporary nature of forest operations, collaboration across other businesses with complimentary working patterns and similar EV transition aims such as bus depots or dairy farms, could also support a much faster transition and enable efficient use of limited connections and charging infrastructure. To ensure that the right chargers are placed at the right locations, dwell-time (time spent stationary at the depot) and charging power (charger's power delivery vs capability vehicle's capacity to ingest that power) should be considered and routes will need to be carefully analysed to determine required infrastructure and the most appropriate approach to developing networks.

Future fit

At present, hauliers are mainly transitioning parts of their fleet, but the proportion and rate of change will increase as the technical maturity increases and economic constraints reduce. On one hand, lead-in times for ordering EV HGVs should be considered but, careful reflection should also be given to scalability of charging solutions within depots so that infrastructure can be adapted and/or upgraded to support increasing future fleets or changes in business and reduces additional costs to renew or upgrade as the technologies develop.

> "*In a world where decarbonisation is no longer an option, this pilot project has been a great illustration of what's possible when people and organisations work together towards a common goal.*"
>
> - William Clark, Forest Transport and Innovation Advisor, Scottish Forestry

[21] EV Charging Statistics 2024
[22] Electric vehicles and the energy generation mix in the UK: 2020–2050
[23] Gridserve – Electric Freightway
[24] BETT – Battery Electric Truck Trial Final Report

Findings – Vehicles

This project has identified various strategic and operational considerations specific to deploying EV HGVs which are critical to enabling a better transition.

Cost of ownership

Initial investment costs for low-emission vehicles and supporting infrastructure are often high, deterring fleet operators from transitioning. Given the differential in CAPEX, cost benefit and Total Cost of Ownership are understandably key drivers for any business making decisions to invest in EV HGVs. For the purposes of this pilot study, the difference between the costs of the EV HGV and the diesel equivalent were supported to help the operators overcome early adopter risks.

The partners will be carrying out Total Cost of Ownership (TCO) analysis in the final report to help operators understand what factors drive the economic viability of EV HGVs.

"*Scotlog Sales Ltd have been extremely satisfied with the operation of SL73 on its principal task of short distance shunting of round timber. The vehicle works two shifts five days per week, and the charging pattern and speed of charging means that in terms of loads moved, there has been no loss of productivity compared to diesel trucks, with over 56,000 tonnes of material transferred from the Port of Inverness to West Fraser's Dalcross site as of December 2024. When the grant support is factored into the overall financial picture, the cost of moving material by electric is ICE vehicles are virtually equivalent*".

– Stuart Catto, Managing Director of Scotlog Sales

Payload

When scoping this programme, there were concerns that the EV HGVs would face limitations in range and payload capacity compared to traditional diesel vehicles. In the UK, vehicles over 41 tonnes operate under special arrangements. 44 tonnes is allowed for combined (road to rail) transport. A vehicle is overloaded if it exceeds the plated weight limits. A vehicle could be overloaded on all its axles, on its gross weight and on its train weight.

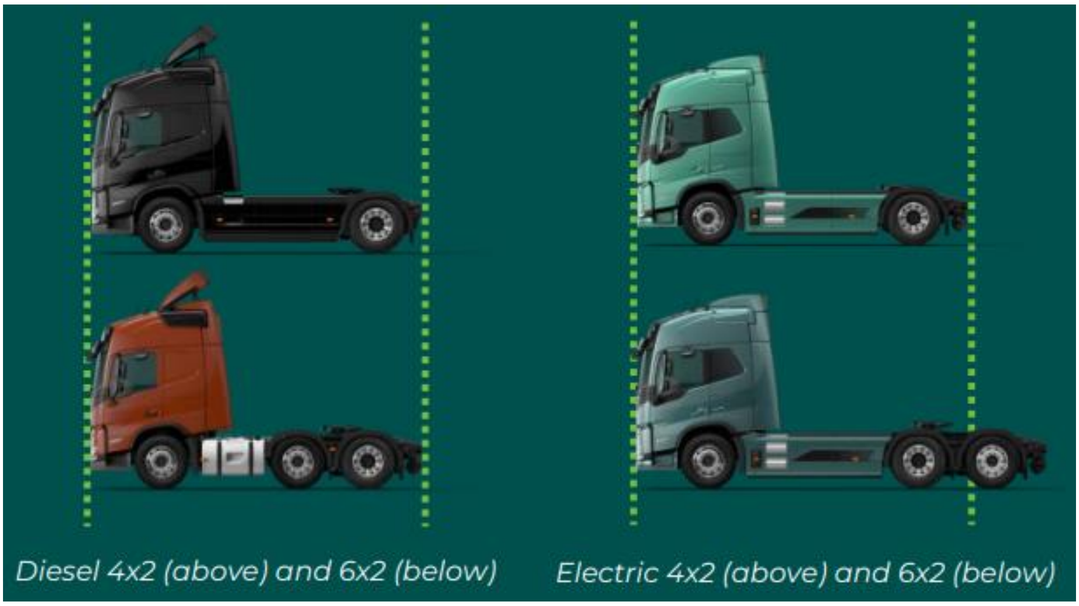

Figure 4: ICE vs EV HGV axle configurations to accommodate batteries.

EV batteries are inherently heavier than fuel tanks and the maximum permitted weight for any HGV in the UK is 44 tonnes. Similarly, tractors for operations greater than 42 tonnes must have three axles and compared to a diesel tractor (Fig. 4), due to the size of the battery, EV tractor chassis will have to be longer to accommodate the batteries which also increases the weight but can create an additional problem wherein adding a standard trailer could exceed the maximum permissible length of 16.5m.

This led to initial concerns around payload penalties as where smaller EVs have additional weight margins which can compensate, heavier vehicles could potentially have to reduce capacity which would in turn affect operations and cost benefit models. Both SL73 and JJ23 are operating to maximum plated weight limits under UK restrictions[25] therefore demonstrating there was no penalty in this case.

Range

Range remains a major difference. A typical diesel HGV can travel over 1,200 km on a full tank, whereas the average maximum distance for EV HGVs (at combined gross weight of 44 tonnes) is 475 km (true average all EV HGVs is 275 km) but diesel vehicles have theoretically unlimited range due to their ability to quickly refuel and extensive networks of fulling stations, while EV HGVs need both more frequent and longer duration charging stops.

Clearly, this is associated with charging infrastructure and technological maturation and is reflected in this projects Return-to-Base (RTB) design, but solutions are being developed therefore we can be confident that operators will extend their use to more challenging routes as they become more confident in vehicle capabilities and access to charging.

At time of writing, as end of year 1, the lorries have collectively driven just under 40,000 miles with JJ23 having travelled 13,115 miles saving 30.73 tonnes CO2eq, and SL73 completing 26,172 miles saving 45.99 tonnes of CO2eq. The partners will include Payoff Distances once the trial has finished in the final report but in the interim, the variation in emissions reduction per mile where JJ23 achieves 2.34 kg CO2eq/mile and SL73 1.75 kg CO2eq/mile is a good illustration of differentials as a function of operating model[26].

Overall, performance has remained consistent over the year for both lorries, and the batteries continue to operate efficiently. Despite the teething problems, it also of note that both operators have been impressed with quality of manufacture, driving comfort, and operational benefits. For example, the improved powertrain and suspension have enhanced right turns out onto a main trunk road due to strong torque and acceleration characteristics compared to their diesel counterparts, therefore promoting safety whilst also saving time, energy and stress.

Regenerative braking also means EV HGV drivers waste less energy, emit fewer emissions and get more ‘bang for their buck’ – in the same way this assists petrol-engine mild hybrids and plug-in hybrid models cover more kilometres per tank, and boosting the range of fully electric models. Regenerative braking works by using the kinetic energy usually lost during braking and storing it. In simple terms, regenerative braking puts the vehicle’s motor into reverse, turning it into a generator while slowing the vehicle. The power generated is stored in the battery for re-use.

As an interesting note, while regenerative braking reduces wear on the brake pads and discs, making them last longer, all Volvo models also come with a standard braking system too, so it’s actually recommended that even fully electric vehicle drivers also use the normal braking system frequently to avoid any build-up of dirt and rust.

[25] The Road Vehicles (Authorised Weight) (Amendment) Regulations 2023

[26] This does not include the ‘total lifecycle’ Co2 production cost – will be reported in year 3.

Route

Hauliers rely on their fleets to deliver goods efficiently and on schedule, and any unplanned downtime can disrupt operations, incur costs, and damage customer relationships. Similarly, getting back to base in a timely fashion is critical to operations and welfare. From this, charging (range) anxiety can become a serious issue for operators. To help manage this, Volvo Trucks (and other OEMs) provide a simulation service as part of the EV HGV purchase process where they work with operators to assess planned routes using the battery power, range of the vehicles, road types (elevations etc), available charging infrastructure, and cumulative annual milage (sometimes limited by lease contract) to ensure routes are suitable for electrification.

To illustrate, recent work from the Centre for Sustainable Road Freight[27] found that most routes for HGVs would be feasible if both depot and route charging are available, however, if only depot charging is provided with no access to shared charging, only 66% of modelled routes could be completed. Scotlog did attempt to run further than originally planned routes, but this resulted in "charging anxiety" and premature return to the depot due to the unavailability of suitable charging infrastructure. However, the exercise was important in identifying the problems encountered should they wish to extend the operation of the vehicle.

Operations

Battery Electric Vehicles (BEVs) such as the EV HGVs may face several challenges that hinder their operation in forest environments, particularly for forestry work. To explain, off highway legs of forestry operations often involves remote routes, challenging terrain, steep inclines, and heavy application hauling, which can place high power demands on the vehicle and the EV HGVs may not yet have the necessary battery capacity to handle these strenuous conditions without significant performance trade-offs. Further, in some cases such as this pilot, EV HGVs in in-forest haulage may not be as durable given the additional weight and location of the batteries.

These challenges are now understood and there is ongoing development in electric vehicles for heavy industries, including forestry. Advances in battery technology, charging infrastructure, and electric motor performance may make BEVs more viable for forestry work in the future. Swedish company SCA, together with OEM Scania, are already testing the world's first in-forest electric timber truck with a capacity of 80 tonnes[28] suggesting a “total” EV HGV solution for forestry will be operational in the near future.

As a note, the specific design of a vehicle also means that if for any reason it is not possible to carry out its regular work, then there are few other options available such that the vehicle may be idle on days when customer requirements or operational pressures do not allow for that transfer of materials. However, a user who is more involved in moving to and from multiple sites may be able to manage around these limitations.

Shift patterns

To ensure efficient operations and driver welfare the charger capacity needs to be matched with the battery size, well-time and use-case scenarios to ensure that batteries are charged in a timescale that fits with work schedules.

Both operators have scheduled fast charging occurring during regulated driver breaks but Scotlog operate SL23 on a 2-shift schedule with fast charging between shifts, whereas the James Jones driver resides in JJ23 when not working so allowing trickle charging overnight whilst they are sleeping in the cab. This model ensures readiness and continuous operation,

[27] Towards Zero Emission HGV Infrastructure in Scotland (transport.gov.scot)
[28] SCA's world-unique electric timber truck from Scania has arrived

but most importantly, takes advantage of charging during off-peak hours to help minimise energy costs and reduce strain on the infrastructure.

Going forward, multiple charging scenarios are envisaged and the mix of chargers at any site needs to be pre designed to meet the needs of the EV HGVs that are likely to visit, and this will be see variation from differing hauliers having alternative work patterns.

Driver training

The EVs drive identically to ICE but Volvo provided specialised training on effectively using regenerative braking. The trainer conducted sessions for the initial drivers and operations staff at both sites. Each route was mapped, and the lorry was programmed to maximize the weight-to-power ratio and optimize braking points along the route to enhance regeneration. Since the initial training, the trainer has not needed to return to the site for additional training or to reprogram the routes. As a note, the EVs record and centralise an incredible amount of real time data which has enhanced both the fleet management, and driver experience.

Maintenance

The project identified some improvement opportunities as regards maintenance but would highlight these were in many ways early adopter issues which have been solved.

To explain, Volvo Carlisle initially did not have a charge point, which impacted operational time for JJ23 as EV HGV’s need to be fully charged before and again after regular maintenance and servicing. Similarly, workshops may not have all of the correct tooling and equipment for repairs, and parts may have to be ordered from the factory as the stock doesn’t yet exist in all regions of the UK which led to delays.

By contrast, Volvo Inverness have been maintaining the cities electric bus fleet for several years and so necessary equipment and processes were already in place and services were more streamlined for SL73.

Volvo Carlisle have now invested in a battery bank facility to support trickle charging and are building up tooling and parts stocks as the fleet expands, so this issue is resolving over time, but may vary by area, and manufacturer, so diligence is necessary when planning.

Payoff distance

The partners will be carrying out total payoff distance analysis in the final report to help operators understand what factors drive the economic viability of EV HGVs.

The vehicle cannot be faulted from a driver’s perspective, with comfort and responsiveness that is well in excess of an equivalent ICE vehicle. Reliability has also been excellent, and any issues have been dealt with quickly and responsively by the local Volvo centre.

- Principal Driver at Scotlog Sales

“Some reliability issues reduced overall utilisation of the lorry, however, most of these were resolved relatively quickly, and were understandable given this is a prototype vehicle. Overall, we’ve been extremely pleased with the performance.”

- Principal Driver at James Jones and Sons Ltd

Findings – Operators

Two surveys were issued to the Fleet Managers and Drivers of the EVs to explore satisfaction across various criteria. The limited sample (n=2) makes surveys difficult to interpret but some conclusions can be drawn.

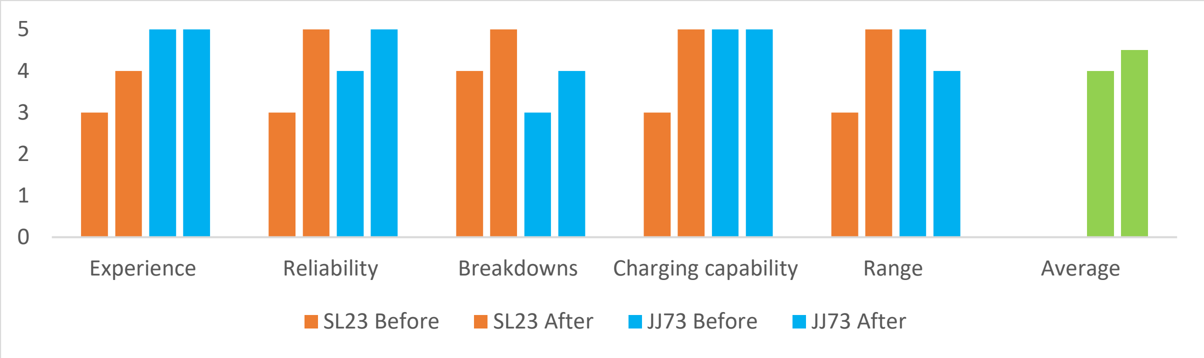

Figure 5: Fleet manager survey showing specific responses to criteria and average.

Overall, the lowest score recorded in the Fleet manager survey was a 3, which is promising for a demonstrator project but the differences between sites are apparent in that SL73 received high scores for Reliability and Breakdowns, indicating little to no problems in these areas, whereas JJ23 scored mid-range. This is likely a reflection of the availability of support in Inverness as a function of the Volvo garage already working on EVs as opposed to Lockerbie where tooling etc had to be updated and resultant delays were experienced.

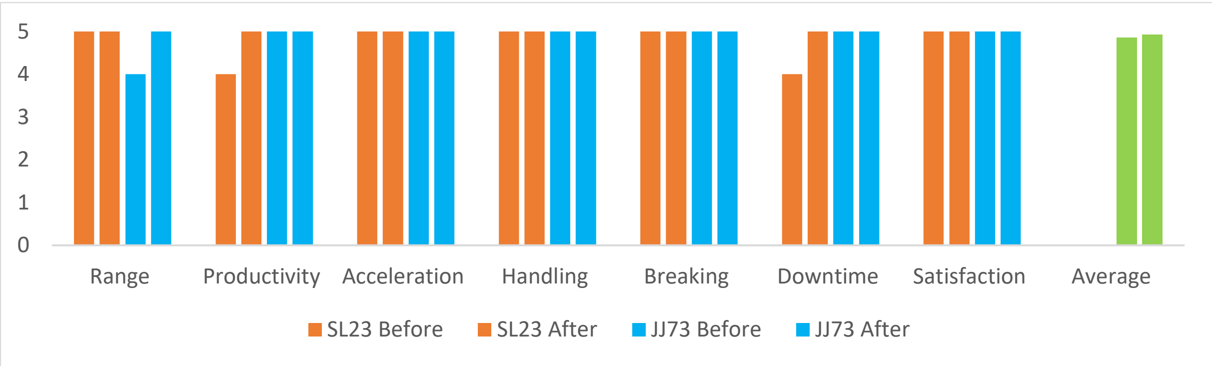

Figure 6: Driver survey showing specific responses to criteria and average.

Contrastingly, SL73 management recorded mid-satisfaction scores for Charger Capabilities, Driving Range, and Overall Experience whilst JJ23 management reported high satisfaction scores. Although the specific reasons are unclear, the lower scores for SL23 are likely to reflect frustration at limited range whereas JJ73 was always intended to operate a fixed route.

The key point, however, is that the scores have increased between timepoints across the majority of measured criterion for both fleet managers demonstrating a largely positive experience where any issues have improved over time. The only exception to this is JJ73 as regards range but this is understandable given their ambitions to take the lorry to a major expo/conference near Birmingham which simply wasn't possible due to the lack of appropriate charging infrastructure.

The Driver survey also reflected this position in that all scores were high at both timepoints, the scores increased across the study within criterion, and on average, although marginal, the scores improved. Overall, indicating a positive experience with the electric HGV.

Conclusions – Year 1

Pilot studies such as this are defined as “a small-scale preliminary experiments designed to help qualify and quantify the feasibility, effectiveness, and potential outcomes of a project before progressing to a full trial”.

It would be easy to read this report and only see the challenges (opportunities!) encountered, many of which were obvious after the fact but weren’t apparent during planning, and to think that EV HGVs need more time to mature, but it was a pilot project so identifying (and solving!) these issues was always the aim.

From this, while the integration of battery electric heavy goods vehicles (BEVs) such as the trial HGVs into the Forestry sector presents some challenges, the encouraging findings of this interim report alongside the hugely positive experiences of the fleet managers and the drivers despite any issues, and significant interest and support from their customers, is a great testament to the vehicles, strengthening the argument that EV HGVs represent a promising pathway towards reducing carbon emissions, lowering operating costs, and enhancing sustainability for forestry supply chains.

There is no getting away from the increased purchase CAPEX cost of an EV HGV compared to current diesel equivalents. For a 200+ truck company, procuring 5 EV HGV’s will not be noticed on the balance sheet, but this is a definite barrier to ‘standard’ haulage companies. Where standard haulage sector profit margins are in the 2.5- 5% bracket, the hurdle of an OEM replacement asset costing up to 3+ times the cost of diesel equivalent is simply unattainable / unworkable without further support. This study will report on cost benefit/payoff in year 3.

In the interim, continued investment in technology and infrastructure, combined with supportive policies, could accelerate the transition to cleaner, more efficient transportation in forestry operations. However, due to the required flexibility of ex forest haulage (port and road forest sector haulage aside), at this stage, it can be concluded that some regions, and parts of the supply chain are more ready for fleet electrification than others at this time. However, as demonstrated by the project partners, this does not preclude return to base business models or indeed networks of businesses within and between supply chains from transitioning to EV HGVs and capitalising on the benefits.

This is improving and will resolve in the near term but it is worthy of consideration that HGVs are only part of the forest supply chain in that Non-Roadgoing Movable machinery such as forwarders and harvesters also require (rebated) diesel, and there are commonalities with requirements for agriculture, such that a more practical approach will be to explore opportunities around greener lower emission ‘drop in fuels’ that can integrate with existing assets and fuel supply. This technology should be developed in parallel with EVs with particular reference to Fuel Cell EVs and potentially complimentary remote charging.

With ongoing research and collaboration, this preliminary study supports the position that EV HGVs do offer a key role in transforming the forestry sector and others into a more environmentally responsible and economically viable industry.

We look forward to sharing our next report in 2025 but please do not hesitate to get in touch with Creel Maritime Ltd if you have any questions or need more information.

Recommendations – Year 1

Adequate **pre planning** for integration of a BEV truck into any size fleet is paramount.

From when this process was started for the Net Zero Timhaul project in late 2022, many of these issues have been solved, or are easier to work through, as the knowledge of suppliers has increased.

Main considerations that we have learnt are critical are >

1. **Range and Payload Capacity:** Critical to evaluate whether the EV HGV's range aligns with typical haulage routes and the truck's payload requirements.

2. **Charging Infrastructure:** Ensure that base load power is available and capable of supporting the fleet's operational needs. Fast-charging infrastructure at depots will increase efficiency.

3. **Total Cost of Ownership (TCO):** While EV HGVs typically have lower fuel and maintenance costs, the upfront purchase price is much higher. OEMs are now offering incentives but subsidies that reduce initial costs may be required.

4. **Operational Downtime:** EV HGVs require longer refuelling times and adapted working patterns compared to diesel trucks. Scheduling and route planning must accommodate charging times, particularly for high-demand or 24/7 operations.

5. **Energy Management:** Implement an additional layer of detailed management to ensure efficient energy usage strategies, such as optimising routes for energy savings, using regenerative braking, and training drivers on energy-efficient driving practices.

6. **Maintenance and Support:** EV HGVs have fewer moving parts than internal combustion engine trucks, which will reduce maintenance needs. However, fleet operators must discuss with OEM and local suppliers to ensure they have access to specialised repair services (charging), parts and tooling for electric drivetrains.

7. **Driver Training and Adaptation:** Investing in training re operating BEVs is considered worthwhile, including managing battery levels, using regenerative braking, and adapting to the unique driving experience of a BEV.

8. **Battery Lifecycle and Replacement:** Early days re Net Zero Timhaul to evidence this, but consideration should be given to the battery's lifespan, potential degradation over time, and the cost of battery replacement, which could be a significant factor in long-term fleet management.

9. **Adaptation of RAMS:** re risks associated with fires in Battery Electric Vehicle (BEV) trucks, especially those with large battery packs weighing around 6 tonnes, are significant and multifaceted. The sheer size and energy density of these batteries increase the potential for catastrophic fires in the event of an accident, thermal runaway, or malfunction. These challenges make managing and mitigating fire risks in BEV trucks more complex compared to traditional internal combustion engine vehicles and require suitable planning.

Future thinking

Forest haulage

While the electric trucks are currently most efficient in their designated roles, we have explored potential for in-forest applications. Theoretically, they could be utilised in this context, but several conditions must be met including the forest must be relatively close to minimise travel distances and optimise efficiency; the trucks would need to operate alongside a crane-equipped truck for loading and unloading, as they cannot self-load; and implementing a buddy system introduces additional costs and logistical complexities, potentially offsetting any efficiency gains. Given these considerations, while the EV trucks show promise, their current capabilities are best suited for non-forest applications, but Scania are currently working with SCA to test the world's first electric timber truck with a capacity of 80 tonnes[29] operating on a 30km fixed route with some in-forest road requirements, so the utility of the EVs is expanding.

Electric Roads[30]

The Centre for Sustainable Road Freight (SRF) puts forward an interesting case as regards overhead conductive transmission wherein a two-pole catenary system ensures reliable and stable energy supply to the vehicle at highway speeds with electricity passing directly from the overhead line, through an inverter to the electric motor on the vehicle. From this, a different design of lorry is required, and infrastructure would have to be developed at significant costs, but the system yields significantly higher energy and cost efficiency than other solutions.

Prioritising Charging corridors[31]

Six public charging locations with ultra-fast 300kw charge points aimed at E-Trucks have been launched along a 600km stretch of the Rhine-Alpine corridor across Germany which is one of the busiest road freight routes in Europe. Once complete, using the Aral pulse charging corridor, an EV Truck will be able to cover over 600km across Germany along one of European's major road transport routes. Similar thinking could be brought to key trunk routes and timber haulage corridors enabling much longer routes in key areas.

Data-Driven Fleet Management[32]

Advanced data analytics platforms are already being used to optimise fleet management, within businesses, but commercial sensitivities means this data is not shared within or between sectors therefore, in the absence of good route data, it is difficult to develop evidence led strategic approaches to designing and deploying charging infrastructure hence limiting fleet operators progress in transitioning to electric vehicles both within and between sectors.

Alternative fuel trains[33]

"Alternative fuels" means fuels or power sources that serve, at least partly, as a substitute for fossil oil sources in the energy supply to transport and which have the potential to contribute to its decarbonisation and enhance the environmental performance of the transport sector. In agreement with the European Commission's 2050 Long-term Climate Strategy[34], it is likely that multiple fuel solutions are likely to be required, but to a different extent in each of the transport modes. From this, future work should consider energy recovery applications and relevance in BEVs with a view to updating the existing fleet and enabling charging options using biomass in remote and rural areas.

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[29] SCA's world-unique electric timber truck from Scania has arrived – SCA
[30] M180 'eHighway' trial: Jobs boost hope over electrified m-way scheme - BBC News
[31] bp pulse builds Europe's first public charging corridor for electric trucks along major logistics route | News and insights | Home
[32] GRIDSERVE: Milestone Hit in UK's Electric HGV Integration | Energy Magazine (energydigital.com)
[33] Decarbonisation of mobile agricultural machinery in Scotland
[34] EC 2050 long-term climate strategy

Appendix 1

Electric lorries and HGVs available to buy in the UK in 2024[35,36]

Manufacturer/ Model	Axel config.	GCW[A] (T)	Battery[B] (kWh)	Charge time		Max range[c] (Miles)
				AC	DC	
Renault Trucks **Master Z. E.**	4x2	1.6	52	6	2	75
Magtec **MEV75**[D]	Rigid 4x2	7.5	160	-	3	124
Mitsubishi **FUSO eCanter**	Rigid 4x2	8.6	124	6	1.5	124
Renault Trucks **E-Tech D**	Rigid 4x2	16	565	5	2	347
Volvo **FL Electric**	Rigid 4x2	16.7	565	8	2.3	280
Magtec **MEV190**[D]	Rigid 4x2	19	300	-	3	124
MAN **eTGM**	Rigid 4x2	26	185	8	1	118
Renault Trucks **D Wide Z.E.**	Rigid 4x2, 6x2	26	375	5	1.5	186
Volvo **FE Electric**	Rigid 4x2, 6x2	27	375	8	2.3	171
DAF **LF Electric**	Rigid 4x2	29	282	6.5	1	174
DAF **CF Electric**	Rigid 6x2, 6x2x4	37	350	-	1.25	155
Scania **Electric R-Series**	Tractor 4x2, 6x2, 6x4 Rigid 6x2x4	42	520	-	1.2	342
Volvo **FH Electric**	Tractor: 4×2, 6×2, 6x4 Rigid: 4×2, 6×2, 6×4, 8×2, 8×4	44	540	9.5	2.5	186
Volvo **FM Electric**	Tractor: 4×2, 6×2, 6x4 Rigid: 4×2, 6×2, 6×4, 8×2, 8×4	44	540	9.5	2.5	186
Renault Trucks **E-Tech C**	Tractor 4x2, Rigid 4x2, 6x2	44	540	-	2.5	311
Renault Trucks **E-Tech T**	Tractor 4x2, 6x2 Rigid 4x2, 6x2	44	540	-	2.5	311
Iveco **S-Way Electric**[D]	Tractor 4x2	44	738	-	1.5	311
Mercedes-Benz **eActros 400**	Tractor 6x2	44	621	-	1	186
DAF **XF Electric**	Tractor 4x2, 6x2	50	525	-	1	311
Nikola **TRE**[E]	Tractor 4x2, 6x2	37	738	-	1.5	330
Tesla **Semi**[E]	Tractor 6x2	40	-	-	-	500

[A] Gross Combined Weight, [B] Performance and efficiency as new, [C] Under ideal conditions – may vary depending on the power of a battery, the load, and various conditions e.g. driving style, road incline, temperature etc., [D] More models - selected largest battery, [E] Not yet available

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[35] Adapted from The Electric Car Guide – Electric Lorries and HGVs in the UK 2024

[36] Another manufacturer (Tevva) was listed but closed early 2024

Gallery

Royal Highland Show, Edinburgh, June 2023

JJ23 BEV Maiden Haul, Lockerbie, July 2023

Truckfest, Edinburgh, August 2023

SL73 BEV Maiden Haul, Inverness, October 2023

This project was developed with support from the Strategic Timber Transport Fund which has been enabling sustainable transport of timber in rural areas of Scotland and delivering benefits for local communities and the environment through innovative projects and partnerships since 2005.