Net Zero Waste Collection

Report on the findings from an 8-week pilot of eRCVs with Serco

eRCVs – electric refuse collection vehicles

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10%* of the UK's total carbon emissions come from fleets, and switching diesel vehicles to electric removes these emissions.

*www.gov.uk/government/statistics/transport-and-environment-statistics-2023/transport-and-environment-statistics-2023

"VEV and RVS supported us and our drivers throughout the pilot, answering questions and resolving operational and technical issues speedily. It was a well run and smooth project."

George Roach
Performance and Compliance Director, Serco

Executive Summary

Proving the case for eRCVs with Serco and three Hampshire Councils.

Serco supports some of the largest councils in the UK, providing a range of outsourced services. Over 300 councils have declared climate emergencies, and as a key supplier to councils, Serco has a responsibility to help manage emissions to meet sustainability goals.

Refuse and recycling collection accounts for a significant proportion of a council's emissions total. Serco have already undertaken a range of carbon saving initiatives including running vehicles on hydrogenated vegetable oil (HVO) and futureproofing depots for fleet electrification with grid connections and underground cable ducts for ease of charger installation.

And now Serco is working with VEV to transition its existing diesel RCV fleets to electric. eRCVs have zero exhaust emissions and quieter operations, which improves air quality, safety and comfort for citizens and employees.

VEV first conducted a feasibility assessment for the electrification of Serco's RCV fleet at one of the Hampshire council depots, using vehicle telematics and other operational data. We modelled the routes to identify which were ready for EV and would be a fit for the pilot based on distance, tonnage and bin lifts.

To demonstrate the emissions savings, operational feasibility, and business case to electrify RCV fleets, VEV and Serco have run a pilot of eRCVs on select routes across two depots serving three Hampshire councils. The electric vehicles for the pilot were provided by RVS, the refuse vehicle solution provider.

Waste collection is a significant proportion of a council's total emissions

Council 1

38%

of borough wide emissions – the largest

Council 2

17%

of operational emissions – second largest

RVS refurbished and repowered two diesel RCVs into as-new electric vehicles which added further carbon emission savings in terms of manufacturing and can deliver a better TCO.

Lessons were learned during the trial, including the importance of including drivers and operational teams in the transition from day one. Also, the vehicles returned to base with an average 41% battery charge, which negated range anxiety during the pilot. The available charge also offered operational flexibility to adjust charging windows and/or complete unplanned additional rounds. It's important not to over-specify EV fleets and to model the data to suit the operational requirements.

The insights from the trial have informed Serco's roll-out plans for eRCV waste collection with the councils in Hampshire and elsewhere in the country, to get to net zero emissions for net zero cost increase.

On behalf of the whole team here at VEV, I will add that it has been an absolute pleasure working with Serco and RVS on this project. We are proud of our collective accomplishments and look forward to continuing our work together towards net zero waste collection.

Mike Nakrani,
CEO, VEV

The pilot demonstrated the performance, sustainability, reliability and business case of the eRCV as equal to or better than diesel.

- The eRCVs completed their rounds successfully.
- Drivers reported that the vehicles performed better, and they preferred the driving experience to the usual diesel RCVs.
- The carbon savings achieved purely during the 8-week pilot were equivalent to removing two cars from the road per year.
- TCO was at parity with diesel vehicles, with further savings of 4-14% possible through driver training, larger batteries and expected lower eRCV service & maintenance costs.

Pilot Scope and Goals

The eRCV pilot ran for 8 weeks from March 18th to May 10th, 2024, at two council depots in Hampshire where the waste collection is managed by Serco.

Objectives

The goal of the pilot was to demonstrate the emissions savings, operational feasibility and business case for operating eRCVs, following the earlier positive feasibility assessment.

Serco wanted to gather real-world data from daily operations to inform its roll-out plans for eRCVs and:

- Demonstrate the reliability of the electric vehicles and their ability to complete specified routes with minimal operational impact.
- Show the sustainability of the new solution, including tailpipe emissions reduction.
- Demonstrate the performance of the integrated charging, vehicle and energy solution.
- Assess the ease of use and driver attitudes to and experience of using the eRCVs.

Vehicles

Two RCV diesel vehicles were refurbished and repowered by RVS into as-new electric vehicles. This process involves removal of all diesel components and installation of the EV components followed by commissioning of the EV software, and charge & discharge testing. The chassis is decontaminated, steam cleaned and fully repainted. The vehicle undergoes a DVSA VTG10 and final quality test.

Council 1

- Vehicle – Mercedes Benz Econic
- Body – Dennis Eagle OL23

Council 2

- Vehicle – Dennis Eagle Elite 6
- Body – Dennis Eagle OL19N

Bin Lift Make & Model

- Terberg OmniDEL
- GVW 26ton
- Battery kWh 280
- Estimated Binlifts 1500-2500

Charging Infrastructure

VEV installed one AC charger at each site to charge the vehicles and branded the charging bays.

The 22kW Autel Maxicharger was selected for its high durability, reliability and easy maintenance. We tested and proved the integration with VEV-IQ.

Control Centre – VEV-IQ

VEV's software management platform VEV-IQ was used to monitor multiple parameters throughout the pilot programme, including the eRCVs' operational routes, charging schedules, power usage, and CO_2 savings for the two depots and Serco.

Telematics

Through our collaboration with telematics specialist Webfleet, we installed telematics devices into the converted vehicles to capture telematic, driver behaviour and battery data. Through our Webfleet integration we were then able to pull that data through into our platform to support remote monitoring and our analysis.

Route Types

69 collection routes were selected to provide a mixture of distance, number of bins and weights. There were 7 rounds from Depot 1 and 6 from Depot 2. A round is a week's worth of collections. Each round consists of 5 unique routes, one for each day of the week.

Drivers

10 drivers took part in the trial as the vehicle was rotated through their rounds. They were all experienced RCV drivers and received training from RVS on how to drive an EV, as well as ongoing coaching to improve their efficiency.

Power

The power sources were checked to ensure sufficient supply before installing the chargers. Energy usage was tracked in VEV-IQ throughout the pilot.

Using repowered vehicles added further carbon emission savings in terms of the manufacturing process.

The success of the Pilot prompted Serco to continue to run the eRCVs beyond the pilot end date – they're still on the road.

Key Findings

Vehicle efficiency/performance

Objective	Outcomes		
01 Demonstrate the reliability of the electric vehicles and their ability to complete specified routes with minimal operational impact	69 rounds completed	2,132 electric miles driven	41% average battery back at base
02 Show the sustainability of the new solution, including tailpipe emissions reduction	8,898 KG tailpipe emissions removed	£2,314 fuel savings	
03 Demonstrate the performance of the integrated charging, vehicle and energy solution	>13 mWh mWh energy delivered	>51,000 bin lifts	>897 tonnes waste collected

Key Findings

Reliability

- The eRCVs matched the reliability of the diesel fleet, completing all rounds where the vehicle was dispatched.
- The 41% average battery capacity remaining at base negated any range anxiety during operations. It also provided the fleet managers with the flexibility to either reduce the required charging window for the vehicles or utilise the extended range to carry out additional unplanned collection rounds.
- There were some rounds where the vehicle couldn't be dispatched in the morning, either where it hadn't been sufficiently charged (see 'Learning from the unexpected' on page 15) or due to a minor non-EV related fault with the vehicle that required an engineer to visit.
- Driver coaching and vehicle optimizations led to efficiency improvements during the trial. RVS provided driver coaching for each new driver, accompanying them on their first rounds to support their transition to an EV.

Takeaways

The eRCVs were as efficient as diesel vehicles (including sharing some of the challenges in running a waste fleet).

For councils and waste fleets aiming to switch to net zero waste collection, we recommend running a trial phase to help identify and resolve potential issues before moving to a scaled roll-out.

Key Findings

Sustainability

- The pilot resulted in a reduction of 8,898 kg of CO_2 over the 8 weeks equivalent to removing two cars from the road for a complete year.
- The transition to EVs will greatly contribute to the emissions goals of the councils, both of which have declared climate emergencies.
- Council 1 aims to be a net-zero borough by 2030, addressing the 38% of operational emissions from the waste fleet.
- Council 2 aims to be carbon neutral by 2030, addressing the 17% of total emissions from waste.

Takeaways

For councils and waste fleets targeting carbon emissions, switching to EVs will have an immediate effect in their area.

Not measured during the trial but equally important are particulate emissions, which have harmful health effects, and noise pollution.

Key Findings

Efficiency

Efficiency varied as we changed rounds and drivers, but trended up in the 8 weeks as drivers learned how to drive an EV and adjustments were made to the vehicles. For example, learning to feather the accelerator to account for the torque of the EV and vehicle adjustments to reduce auxiliary power consumption.

Council 1

- Efficiency varied between 0.13 – 0.28 miles/kWh.
- This is the difference between being able to complete a 37- or a 78-mile trip.

Council 2

- Efficiency varies between 0.10 – 0.22 miles/kWh.
- This is the difference between being able to complete a 28- or a 60-mile trip.

Takeaways

The importance of efficiency optimisation is highlighted by the variances in the figures shown here.

When considering a move to an electric RCV fleet, focus on improving efficiency and reducing variability to ensure predictable operations. Key factors include:

- Driver training
- Route optimisation
- Vehicle auxiliary loads (e.g., bin lifts)

Key Findings

Power

Analysing efficiency highlights that range isn't just a factor of battery size and distance. Operational planning must account for auxiliary power use when planning routes.

Charging Schedules

- The average charging window was 16 hours.
- Average charging session took 160-210kWh.
- Average charge SOC (state of charge) – 50-65%.
- At 22kW, this requires around half of the charging window.

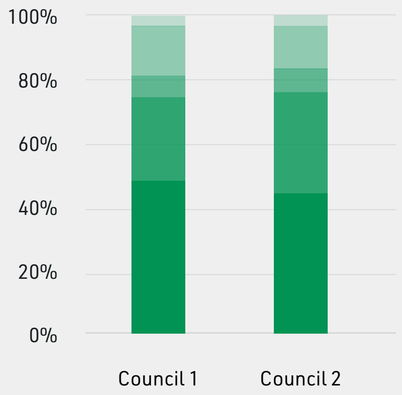
AC versus DC Charging

- Moving to DC charging opens opportunities for added resiliency and flexibility.
- For example, the ability to do emergency charging sessions and having the option in the schedule to switch to cheaper energy tariff times.
- A 60kW charger takes 3 hours – 120kW takes 1.5 hours.

Takeaways

- eRCVs consume substantial amounts of power. It is crucial to complete a grid and solar power assessment.
- Charging multiple vehicles consecutively can exceed grid capacity, leading to fines or vehicles not being fully charged.
- Due to the duty cycles of eRCVs returning early afternoon they are well suited to solar energy.
  - This reduces energy costs and carbon emissions.
  - It increases the number of vehicles charged without a grid upgrade.

Power Consumption is split 50/50 between driving and auxiliary power



Key Findings

Driver Feedback

Driver feedback was positive, with attitudes towards EVs improving significantly over the course of the trial. At the end of the trial, the majority of drivers would have preferred to keep the EV than go back to their diesel vehicle.

Specifically, drivers appreciated the performance, comfort, and quiet operation of the eRCVs, with a strong preference for EVs over diesel vehicles at the end of the trial.

There were three drivers that rated their experience negatively due to some early operational issues, which were addressed as the vehicles were integrated into the fleet but impacted the drivers' perceptions of reliability.

Takeaways

Driver feedback highlights the importance of real-world use of EVs to overcome scepticism from drivers and operational teams.

Early and frequent communication with drivers and operations teams is critical to help identify, mitigate and resolve any challenges.

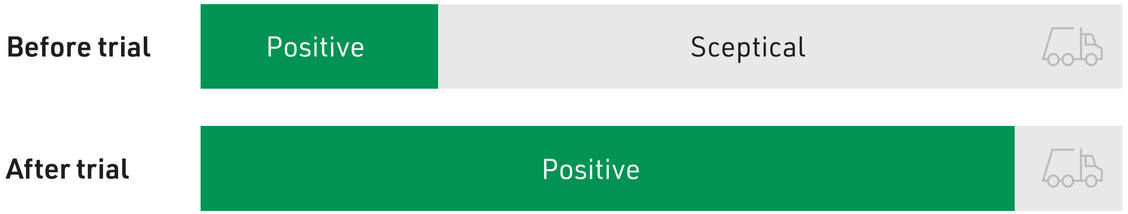
"It's really easy to charge, just like plugging something in at home."

eRCV Trial Driver

Key Findings

Driver Feedback

Attitudes towards EV improved through the trial



Comments from some of the drivers

"No specific problems with the comfort of the EV – I just don't like driving the Mercedes."

"A very enjoyable experience."

"Can I keep it?"

"I like how quiet it is, I can finally listen to the radio while I'm driving. Can hear my colleagues too, although that's not always a good thing!"

Key Findings

Business Case

Cost Parity eRCV: diesel RCV

The pilot showed that eRCVs will deliver net zero emissions for net zero cost increase, and enable councils to improve air quality in their communities.

We modelled a range of TCO scenarios using the data from the pilot. With the most conservative base case assumptions, the TCO of the eRCV was ~10% higher than the ICE RCV. This takes into account current low diesel prices and a conservative maintenance provision.

However, there is potential for further cost reductions to close that gap and move eRCVs to at or below parity with diesel RCVs as operational practices evolve:

Driver training
When driven well, an electric vehicle can typically increase its range by up to 20%, improving operational efficiency, and keeping energy costs down.

Vehicle efficiency improvements
Adjustments are being made to the vehicles to optimise energy consumption, including software constraints on harsh acceleration and adjustments to the PTO & packer/compactor, and the vehicles' AC/heating systems.

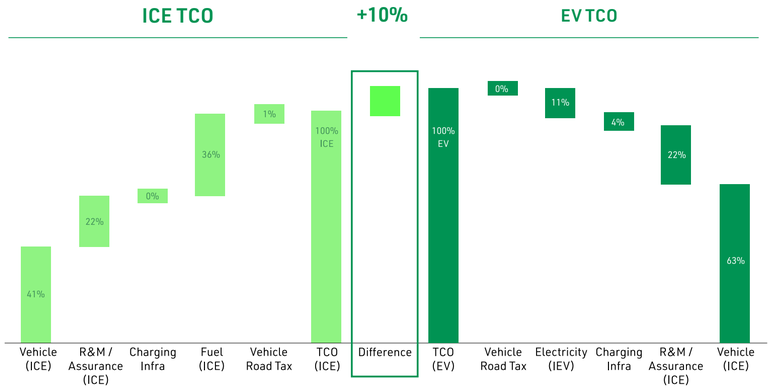
Service and maintenance costs
We anticipate eRCVs will require less service and maintenance than diesel RCVs, so expect the conservative provision to come down.

Additional 14% TCO saving

With further optimisation and conservative modelling across service, maintenance & repair strategy, vehicle technology advances and fuel regulatory policy, a further 14% saving is possible. This excludes fuel price increases and government subsidies that can make the TCO even more beneficial.

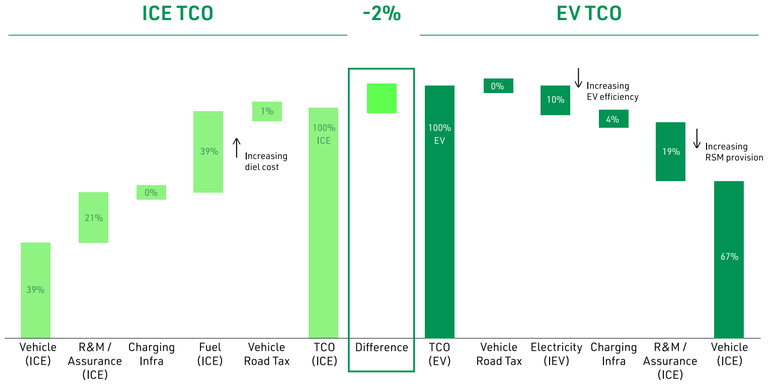
Conservative RCV TCO: ICE vs Electric

(% of ICE TCO, % of EV TCO)



Optimised RCV TCO: ICE vs Electric

(% of ICE TCO, % of EV TCO)



Key Findings

Lessons Learned

Continuous monitoring and data analysis throughout the pilot identified improvements that optimised Serco's eRCV operations. These actions helped extend vehicle range, reduce variability, improve TCO and increase confidence in running the longer routes.

Workforce

- Effective driver education is crucial for maximising EV efficiency, emphasising the importance of smooth driving practices.
- Changes to working practices can become a blocker to net zero goals if the workforce is not properly consulted, trained and listened to.

Power

- A robust energy strategy is essential to accommodate the increased power consumption at depots, which is expected to increase by a factor of 13x.

Technology

- Connected vehicle technology facilitates remote diagnostics and rapid issue resolution, minimizing downtime and enhancing operational reliability. Developing a comprehensive issue – response register is recommended for streamlined maintenance.
- Detailed tracking of auxiliary systems' power consumption provided insights for optimizing overall vehicle efficiency, enabling the extension of electrification to longer routes.

Learning from the unexpected

A vehicle stopped charging during a charging session, requiring manual restarts at site, and causing disruption to one round due to insufficient range.

The issue was identified as the driver returning to the vehicle and turning on the ignition which automatically stopped the charging session. Drivers and managers were alerted.

Alerts should be delivered to fleet managers when charging stops and training provided to drivers to ensure they check the vehicle is on charge.

Recommendations for Roll-out

A key objective for Serco was to gather real-world data from daily operations to inform its roll-out plans for eRCVs across multiple sites in the UK, starting with the two depots in Hampshire.

Informed by the findings of the pilot, we analysed the remaining routes at the depots for readiness to electrify and developed a phased roll-out plan.

We provided a TCO-optimised 3-phase roll-out plan encompassing a grid upgrade, solar power installation and optimisation stream.

The plan includes provision of the VEV-IQ management platform for smart charging and optimised operations based on monitoring and trialling operational changes.

With the current grid capacity and base demand, there is sufficient energy available to charge a certain number of EVs at both depots. Above this, additional power from a grid upgrade or solar installation would be required to complete charging on some days.

About SERCO

Serco brings together the right people, the right technology and the right partners to create innovative solutions that make a positive impact and address some of the most urgent and complex challenges facing the modern world.

With a primary focus on serving governments globally, Serco's services are powered by more 50,000 people working across defence, space, migration, justice, healthcare, mobility and customer services.

Serco's core capabilities include service design and advisory, resourcing, complex programme management, systems integration, case management, engineering, and asset & facilities management.

Underpinned by Serco's unique operating model, Serco drives innovation and supports customers from service discovery through to delivery.

More information can be found at serco.com.

About Serco in Environmental Services

Serco brings together the right people, the right technology and the right partners. They help create innovative solutions that make a positive impact and address some of the most urgent and complex challenges facing the modern world.

Serco's Environmental Services business provides refuse and recycling collection, street cleansing, vehicle maintenance and landscapes services to UK local authorities. We also operate fully integrated waste and recycling contracts which include waste and recycling treatment, processing, recovery and disposal. The company works in long term partnership with 16 local authorities, bringing together expert knowledge and experience to drive positive social outcomes for the environment, customers, communities and colleagues.

About RVS

Refuse Vehicle Solutions (RVS) is the UK's leading independent supplier of New, Quality Used, Refurbished and Electric Conversion refuse collection vehicles.

Combining over 100 years of experience, RVS possess a complete understanding of the waste sector's demands and requirements, enabling our success in all aspects of RCV provision and maintenance.

RVS are proud to be at the forefront of the waste fleet electrification movement, helping the industry meet its sustainability goals, and evolving together towards a cleaner, greener future.

For more information, visit refusevehiclesolutions.co.uk.

The Complete Refuse Vehicle Solution

About VEV

VEV helps organisations deliver on their carbon reduction ambitions with an end-to-end fleet electrification solution that integrates across vehicles, charging infrastructure and power.

VEV is owned by Vitol, a world leader in energy, which to date has committed circa $2 billion to sustainable energy initiatives worldwide.

VEV navigates the complexities of EV transformation to design and implement cost-effective EV fleets optimised for specific fleet requirements. It supports EV fleet operations to guarantee resilience and keep mission-critical fleets running on the road.

Bespoke, scalable business solutions are designed around the customer's own fleet data analysed by a powerful assessment tool, VEV-IQ, and VEV's experts in energy and sustainable e-mobility. VEV sets businesses up for success in an electrified future.

More information at vev.com

The Future is Electric