Ubico Limited

West Oxfordshire District Council Trial of Battery Electric Refuse Collection Vehicle (e-RCVs)

Internal Briefing Paper

To: Rob Heath, Director of Operations; Marc Osment, WODC Operations Manager.

From: Ian Bourton, Ubico Head of Fleet Operations

Background

- At the West Oxfordshire District Council (WODC) electric vehicle meeting (11 March 2024) where Elected Members, Ubico and Publica were present, discussions were had in relation to the feasibility of operating one, maybe two, 27 tonne open chamber battery electric refuse collection vehicle(s) (e-RCV) to collect residual waste within the WODC collection area.

- Ubico provided some expert guidance to the meeting, including that this type of vehicle was available in the market and that Ubico had undertaken some tachograph analysis to support the operational activity of an e-RCV. This analysis confirmed, on paper, that in certain WODC areas an e-RCV could be practically utilised for residual waste collections.

- Ubico also provided some expert guidance to the meeting on the known problems, benefits and constraints of e-RCVs, the early adoption risk that WODC would face and the necessary recharging infrastructure that would be required.

- The known constraints of the current and available e-RCVs to operate within the WODC collection area include the rural locations and distances to be travelled, the topography of the area and the current recharging infrastructure capability at WODC operational depots. The known industry constraints include the introduction of new technology for e-RCVs (battery electric trucks ARE new technology and cannot be compared with battery electric cars/vans), power train reliability and capability, variable energy sources required for RCVs (hydraulics, pneumatics etc).

- An action was generated from the vehicle procurement strategy meeting for Ubico's Head of Fleet to organise a trial of e-RCV.

- The operational trial dates were organised for Tuesday 14th May 2024 to Thursday 23rd May 2024 inclusive (8 working days). The vehicle trial was arranged through Ubico and Dennis Eagle Limited (the leading UK manufacturer of RCVs) and the vehicle deployed was a 27 tonne (gross vehicle weight) 'e-Collect' e-RCV.

Note; due to vehicle/charging failures during the trial the vehicle did not operate at all on the 24th May 2024. However, an additional trial day (Monday 27th May 2024) was added, in agreement with the manufacturer maintaining 8 working days for the trial data.

- A post-trial briefing paper was requested from Ubico's Head of Fleet Operations. This is that paper, generated from the vehicle CANbus data, industry expertise and knowledge and in liaison with the Ubico operational teams at WODC.

Trial Approach

- Ubico Fleet issued trial recording documents and completion instructions to drivers, loaders, and operational supervisors to record experiences of practical vehicle use and operation.

- Ubico Operations at WODC compiled daily route maps for areas that were known to be achievable, and those that would be challenging for the e-RCV. The Operations team dedicated a supervisor to monitor the practical performance and to liaise with the trail team.

- The fleet team were enabled to capture the CANbus data from the vehicle which contains vehicle performance and operational data in electronic form.

- The actual trial was executed seamlessly to the plan by the drivers, loaders, fleet, and operational management to provide some useful conclusions.

Relevant Vehicle Operational CANbus Data

- Operational activity data was collected from the vehicle on each day the vehicle was in use and relevant data is covered in this document.

- The e-RCV vehicle covered an average of 50.36 miles over the trial period, operating between 37.2 miles and 75.8 miles.

Date	Kms Covered	Miles Covered	No. Loads
14.5.24	60	37.2	1
15.5.24	73	45.3	2
16.5.24	65	40.3	2
17.5.24	96	59	2
21.5.24	80	49.7	1
22.5.24	90	55.9	2
23.5.24	64	39.7	2
27.5.24	122	75.8	1

- On 27th May 2024, the maximum mileage covered of 75.8 miles included the e-RCV returning with 23% of its battery energy remaining. This is impressive but it should be noted that the

weather conditions to operate an e-RCV on the day were ideal at 16 degrees centigrade, with no vehicle heating or air conditioning in use. Regenerative breaking, feeding energy back into the battery, would also have been in use on this day due to the topography of the operational area.

- Regenerative braking is standard functionality for e-RCVs and with good driver application it can recover several kWh of energy.

- E-RCV batteries operating between 0 and 5 degrees centigrade typically lose 12% of their energy capability. The e-RCV heater or air conditioning operating for a full shift will typically lose 15% of the vehicle's energy capability.
  It should be noted that the best daily mileage obtained during the trial would have extinguished all the vehicles battery energy before the completion of the collection round, if it had not been ideal conditions.

- The vehicle was capable of completing the two loads that are required during a WODC operational day.

- The vehicle completed 4,220 packing cycles during the trial, averaging 528 per day. The maximum cycles for one day being 638 (16th May 2024).

- The vehicles bin lift (an electric Terberg OmniDel Twin Auto Lift) lifted 6,683 wheelie bins, averaging 835 per day. The maximum number of bins lifted on any one day was 1052 (16th May 2024). On this day the bins were a combination of two sizes - 240 and 180 litre, mixed with some manual loading of residual waste bags.

- The vehicle collected a combined weight of 94,820kg (94.82 tonnes) of residual waste over the 8 working day, and average of 7,294kg (7.294 tonnes) per day.
  The maximum load compacted during one collection round before needing to tip was 10,480kg (10.48 tonnes). This is comparable to a 26 tonne diesel RCV of similar design.

- The CANbus data shows that the vehicle stopped charging at 85% overnight on the 17th May 2024. This fault remains unexplained but was an unforeseen 15% reduction in energy for the crews to undertake their collection round.

- The CANbus data shows a complete failure to charge over the weekend of 19th May 2024. Investigations conclude a failing of the vehicles recharging technology. This would have led to an unforeseen service failure during the trial but was replaced by a diesel vehicle from the WODC vehicle fleet.

- The average energy that the vehicle used collecting residual waste over the 8 days was 56% per day. It should be noted that the vehicle was used in ideal temperatures with no heating or air conditioning in use by the driver.

- The air conditioning is used less in the e-RCV as there is no heat generated from the diesel engine. The engine usually sits directly below the driver's cab, providing some cab heat. The heating on the e-RCV would usually be used more in the winter, for the same reason that there is no naturally generated engine heat. Therefore, vehicle energy available to operate the vehicles drive train and packing modes are significantly reduced during the winter.

- The table below shows the kWh used per day, the kWh used per tonne, per bin lifted and per km travelled, of residual waste collected:

Date	kWh used	kWh per Tonne	kWh per Bin	kWh per km
14.5.24	**105**	14.71	0.19	1.75
15.5.24	**150**	10.71	0.15	2.05
16.5.24	**156**	10.89	0.15	2.40
17.5.24	**171**	12.56	0.19	1.78
21.5.24	**177**	20.25	0.27	2.21
22.5.24	**204**	16.04	0.21	2.27
23.5.24	**153**	10.52	0.16	2.39
27.5.24	**231**	23.72	0.36	1.89

- The e-RCV has a dashboard alert indicator to the driver when 15% energy remains to encourage the driver to return to base or to find a recharge station. At 10% the indicator turns red and goes into limp/low energy use mode.

- If batteries become fully depleted the recovery of the e-RCV is necessary. The recovery is significant, will require specialist HGV recovery and will require the prop and half shaft removal to allow a 'suspend and tow' recovery.

Driver/Loader Operational Feedback

- The driver and loader crews recorded daily feedback on how they felt about operating the e-RCV. The views were generally positive. Some of the crew comments are listed below.

- The position of the batteries is lower when compared to the position of the fuel tank. Although this didn't cause any problems within the WODC area, it should be noted.

- Frustration when the vehicle failed on charging, another vehicle had to be sought (diesel).

- Communication is better as the loaders could hear each other clearer because of reduced noise levels. Loaders could also hear ambient noise around them better and felt safer. Drivers commented that they could hear very well – traffic noise and loader noise/communications.

- Reduced noise levels from the vehicle could be a danger to pedestrians crossing the road who would normally hear a diesel vehicle.

- Would missed bins increase as some residents rush out with their wheelie bin when they hear the diesel vehicle approaching? With e-RCV there is minimal sound to advise residents the crews are working in their street.

- Drivers feel more relaxed and less stressed as the drive feels calmer. This positive effect on the driver can lead to reduced road traffic collisions.

- Throttle response is impressive especially after bin loading. Wheelie bin lifting is quiet and fast. Wheelie bin lifters can be used without engaging neutral.

Points of Note

- Currently the trial e-RCV has a single gear transmission. This translates into a factory set top speed of 38mph but allows a hill climb. This could cause some issues on dual carriageways within the WODC collection area (there are no motorways in WODC collection area).

- The increased torque from electric motors and faster wheelie bin lifting operation allows for a more efficient operation, with a greater number of bin collections a possibility. Industry e-RCV users have found that crews finish their collection rounds quicker than with a diesel RCV – some by up to 30 minutes.

- Driver performance and the application of acquired skills for driving e-RCVs have a variable impact on the energy used during the operational day. Conserving vehicle energy by eco-driving, use of regenerative braking, controlled torque on take-off are some of the driver skills that can have a significant effect on vehicle performance.

- The e-RCV on trial is a current but first-generation model and comes with reliability issues that should be expected with new vehicle technology. WODC would be early adopters of this technology and thus should assume unexpected failures that cannot be put right quickly, potentially leading to service failures. WODC would need to facilitate a contingency should Ubico operations experience similar e-RCV reliability issues that were experienced during the trial, and thus avoid a service failure.

- Failures of recharging infrastructure are not uncommon. A failure to recharge an-RCV due to an outage or similar supply interruption would lead to a service failure for that collection round unless a contingency is in place. Clearly with a diesel RCV refuelling could be undertaken at any refuelling forecourt, and option that is not available for e-RCVs.

- To recharge e-RCVs similar to the trial vehicle, each e-RCV would need an infrastructure with off-board vehicle charging supply of 600 volts minimum (up to 80A), direct current (DC). The charger plug would need to be 48 kW CCS2 connection type. WODC would need to secure funding (on top of the vehicle price) to install a recharging infrastructure that meets this specification into Downs Road. Note Downs Road is a leased depot and not owned by WODC.

- Standard diesel residual waste collection vehicles have a maximum gross weight of 26 tonnes. Standard e-RCVs are registered with an extra tonne by the manufacturers, providing a maximum 27 tonne gross vehicle weight. This extra tonne accounts for the additional weight of the batteries. This means in practice that there is no loss of the vehicle payload to the operator when using an e-RCV.

- The supply into Downs Road has been identified as having adequate capacity to recharge two 27 tonne 300 kWh e-RCVs. This would need to be confirmed prior to any installation project commencing.

Conclusion

- Ubico operation teams had no operational issues with completing the collection rounds that were within 60 miles routing from the Downs Road depot.

- The trial materialised generally as expected. Ubico currently operate six residual waste collection rounds for WODC and could accommodate the objective of operating two e-RCVs, replacing two diesel RCVs. However, the e-RCVs would need to be practically utilised across different collection crews to achieve a full week's work from the vehicle.

- A contingency of a spare vehicle(s) would be required to support the operation of an e-RCV. As is represented throughout similar organisations operating e-RCVs, WODC would be early adopters of this type of technology and should assume some unexpected failure from the vehicle and the recharging infrastructure.

- The vehicle on trial was a first-generation e-RCV with single gear electric motors and dual manufacturer technology integrated on board. A second-generation e-RCV by the same manufacturer is being produced that elevates these two significant issues. It would be prudent to wait until the second-generation e-RCV is available if WODC decide to purchase e-RCVs. Delivery dates for second generation e-RCVs of this type are expected around August 2025.

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