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Ultra-Low Emission Vehicle (ULEV) Waste and Recycling Vehicles Programme

2023 Q4 (October-December)

Summary Deployment and Performance Report

Document Control

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Introduction to the Programme and Aim of the Report

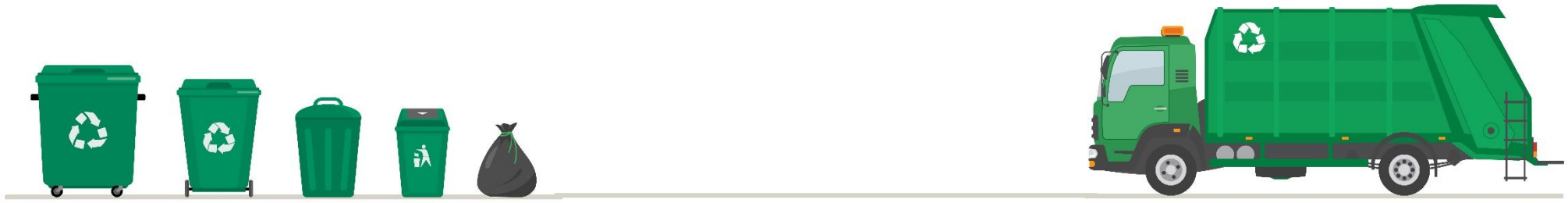
The Ultra-Low Emission Waste and Recycling Vehicles programme aims to accelerate and de-risk the transition to ultra-low emission vehicles (ULEVs) within the Welsh public sector waste fleets by 2030. The programme helps local authorities (LA) to transition to ULEVs by:

- Providing business case justification for additional capital funding.
- Deploying vehicles in Welsh waste and recycling operations.
- Supporting charging and refuelling infrastructure installations.
- Increasing the availability of viable ULEVs.

This report summarises the performance of ULEV waste and recycling vehicles deployed by Welsh local authorities based on data collected between October and December 2023. Results from the previous quarter are also shown for comparison, plus a summary of all data and analysis to the end of 2023.*

* During the reporting period, some vehicles did not produce a complete set of data due to telemetry system issued. For these vehicles, data has been extrapolated based on the remaining vehicles for which reliable data was available to estimate their real-world performance. Any missing data throughout the report is shown by a dash (-).

Summary



Project Highlights 2023Q4

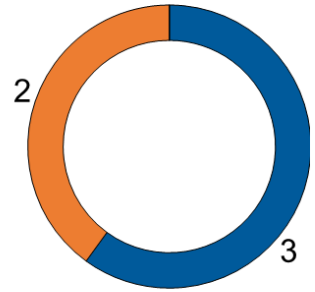
- **38** zero emission vehicles deployed (30 RCVs, 4 RRVs, 1 Sweeper)
- **30,400 miles** reported[1]
- **75 tonnes of WTW CO_2e** emissions saved[1 - 4]
- **145 kg of NOx** and **615 g of PM** emissions avoided[1, 2, 3]
- Electric RCVs travel **34 miles per day** and have a **usable range of 67 miles**[1,5]
- The electric RRV travelled **28 miles per day** and has a **usable range of 42 miles**[1,5]

[1] Extrapolated from all operating vehicles with useable data during the reporting period. [2] Compared to a diesel equivalent truck. Baseline fuel consumption figures for the sweeper (including auxiliary engine fuel use) and RRV were not available so emission savings for the electric equivalent cannot be reported [3] CO_2 emissions stated on a well-to-wheel base which considers of all emissions from the fuel extraction until its final use in a vehicle. CO_2 stated as CO_2e which includes other GHG emissions on a CO_2 equivalence basis. [4] Estimated as per guidance of the TAG data book (May 2023). [5] Usable range is calculated for based on manufacturers' reported values or to 80% battery usage.

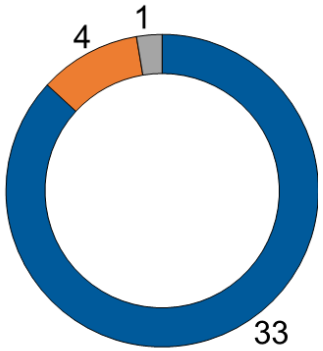
Summary Deployment Status 2023Q4

38 ULEVs Deployed So Far

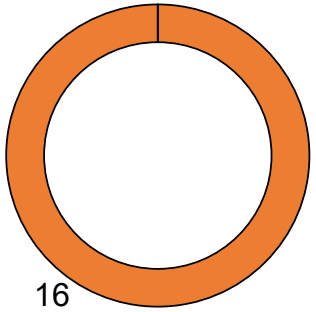
Deployed This Period



Deployed so far



Pending Delivery



RCVs
RRVs
Sweepers

Detailed Deployment and Reporting Status 2023Q4

Local Authority	Type of Vehicle	Delivered	Pending Delivery	Reporting Data[1]
Cardiff	RCV	12	0	12
Carmarthenshire	RCV	3	0	3
Conwy	RRV	1	6	0
Denbighshire	RCV	2	0	2
	RRV	0	3	-
Flintshire	RRV	2	0	-
Merthyr Tydfil	RRV	0	3	-
Neath Port Talbot (NPT)	RRV	1	0	1
	Sweeper	1	0	1
Newport	RCV	7	0	7
	RRV	0	2	-
Powys	RCV	1	0	1
Swansea	RCV	1	0	1
Torfaen	RCV	2	0	2
Vale of Glamorgan	RRV	0	2	-
Wrexham	RCV	2	0	0

[1] Vehicles that have been delivered but are presented with a dash have not yet finished their bedding in period which is a month after the vehicle was fully deployed.

Estimated Annual Vehicle Performance

RCV:

Energy efficiency (miles/kWh) average[1]:

0.25

Energy efficiency (miles/kWh) range of values[1]:

0.17 – 0.34

RRV:

Energy efficiency (miles/kWh) average[1]:

0.33

Energy efficiency (miles/kWh) range of values[1]:

0.33

[1] Measured average from all vehicles with usable data during the reporting period. Data from only one RRV was available for this report.

Estimated Annual Vehicle Emission and Diesel Savings

RCV:

Yearly Emissions Savings[1–3]:

WTW CO_2e [3]	NOx	PM2.5
11 t	27 kg	101 g

Annual Social Damage Cost Savings [2, 4]:

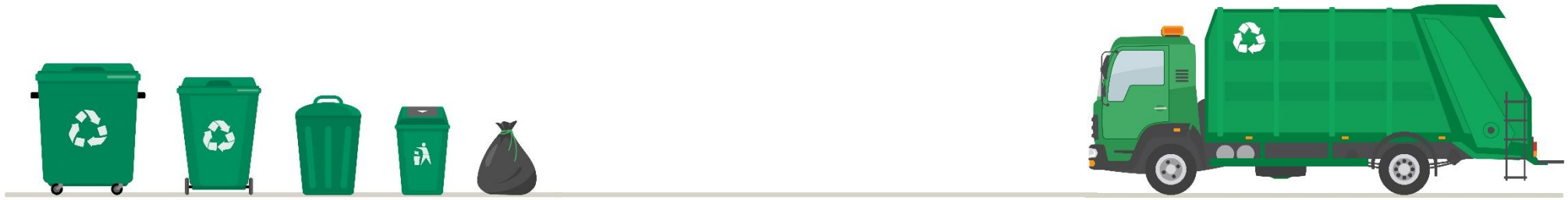
£3,000

Yearly Fuel Cost Savings[2, 5]:

£2,200

[1] Extrapolated averages from all operating vehicles during the reporting period and the previous three quarters. Baseline fuel consumption figures for the sweeper (including auxiliary engine fuel use) were not available so emission and cost savings for the electric equivalent cannot be reported. [2] Compared to a diesel equivalent truck. [3] CO_2 emissions stated on a well-to-wheel base which considers of all emissions from the fuel extraction until its final use in a vehicle. CO_2 stated as CO_2e which includes other GHG emissions on a CO_2 equivalence basis. [4] Values obtained as per guidance of the WelTAG data book (Jul 2023). [5] Long-term prices based on 7-year estimate from HM Treasury: Green Book 2023 – 2030 (18.3 p/kWh ,1.27 £/L).

RCV Performance 2023Q4



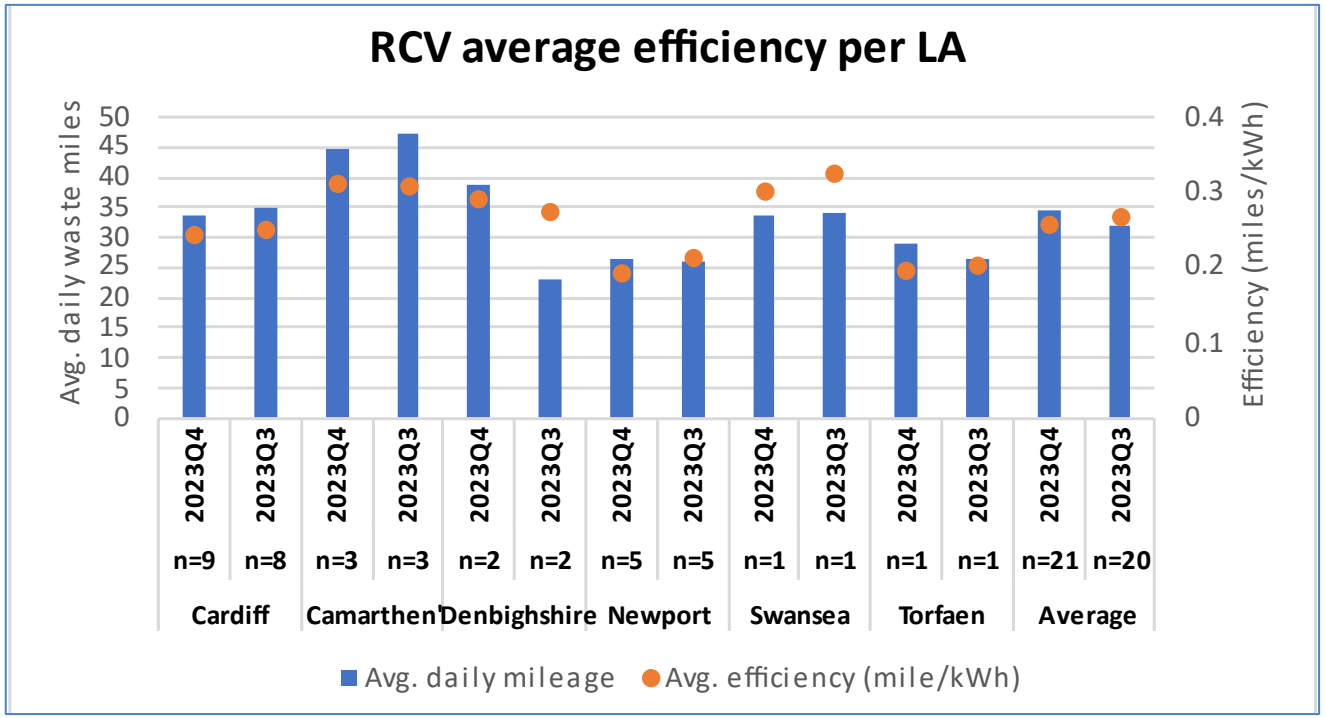
RCV Summary Quarterly Reporting per LA[1]

LA	2023Q4					2023Q3				
	# Vehicles deployed	# Vehicles reporting	Waste miles	# Bins emptied	Waste collected (t)	# Vehicles deployed	# Vehicles reporting	Waste miles	# Bins emptied	Waste collected (t)
Cardiff	12	12	9,117	134,278	2,713	12	12	12,408	216,233	3,785
Carmarthenshire	3	3	4,682	-	-	3	3	4,402	-	-
Denbighshire	2	2	3,861	54,446	637	2	2	3,534	74,986	973
Newport	6	5	7,483	217,790	3,147	6	5	8,087	242,032	3,373
Powys	1	1	1,342	11,866	246	1	1	2,988	30,191	560
Swansea	1	1	1,777	10,038	491	1	1	2,038	11,318	531
Torfaen	2	1	675	20,721	252	2	2	1,045	32,610	402
Wrexham [2]	2	0				2	0			
Totals	**29**	**25**	**28,936**	**449,140**	**7,486**	**29**	**27**	**34,501**	**607,370**	**9,624**

- The average eRCV being tracked by the programme travelled just over 1,100 miles, collected from 17,200 properties, and tipped a total of 290 tonnes of refuse during Q3 of 2023.
- In all authorities except for Carmarthenshire, RCV usage was lower in 2023Q4 compared to 2023Q3.
- 4 out of the 29 RCVs are not currently reporting data for the programme.

[1] Extrapolated average from all operating vehicles during the reporting period. [2] Local Authority did not provide data during this reporting period.

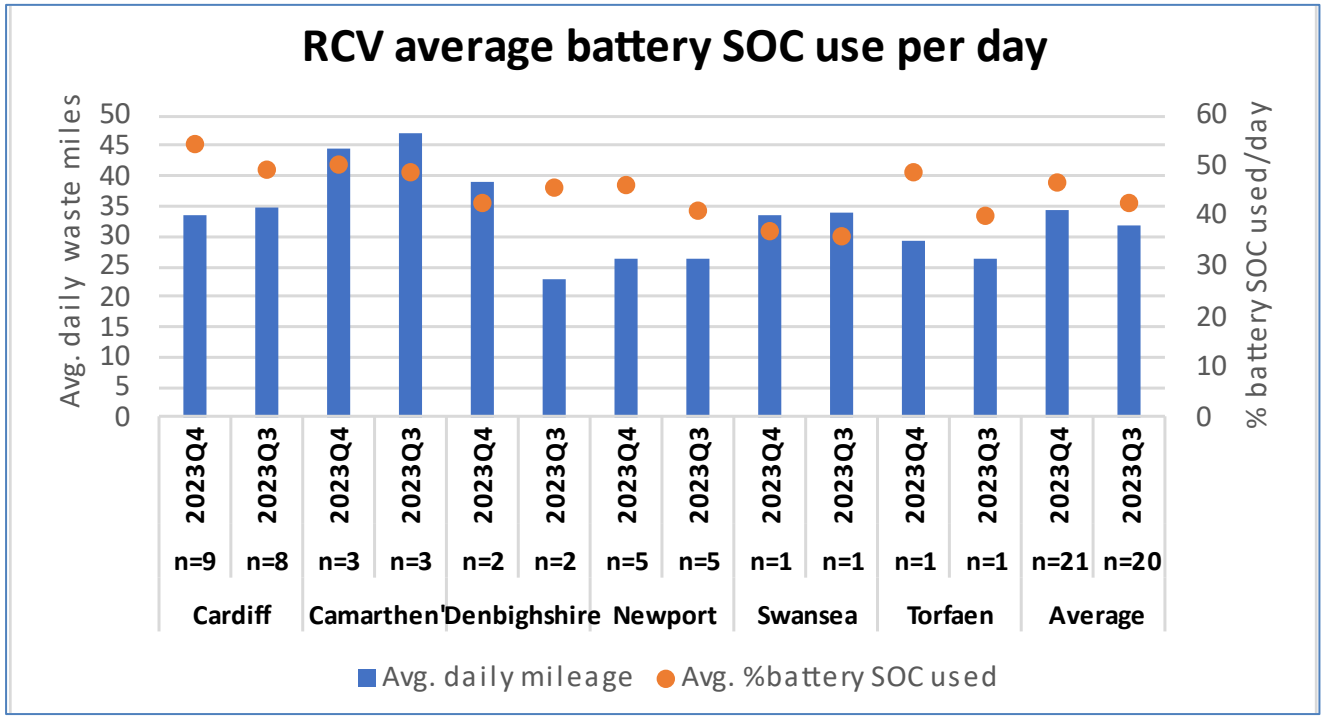
RCV Average Efficiency Per LA[1, 2]



- eRCV driving efficiency (measured as number of waste miles per battery kWh used) was seen to decrease for most LAs between Q4 and Q3.
- Decreased efficiency is expected with colder weather: more cabin heating and lighting is required, and air and rolling resistance increase with lower temperatures.

[1] Data displayed as recorded during the reporting period (not extrapolated). [2] Vehicles that do not have a complete set of daily distance and charging data for the quarter, or that have been used for fewer than ten days, have been excluded from this analysis. The graph shows the number of vehicles (n) included each quarter.

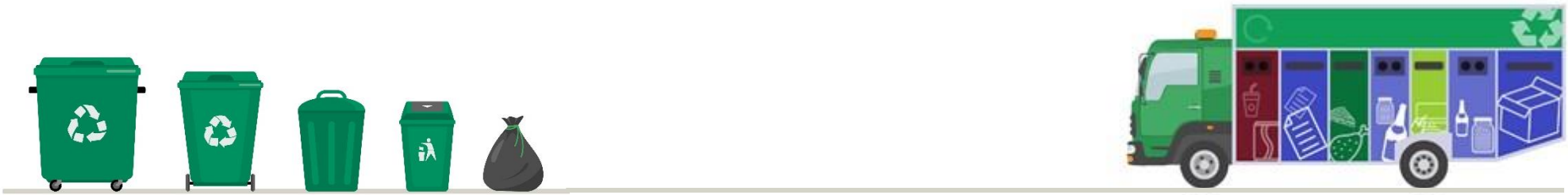
RCV Average Daily Battery SOC Use Per LA[1, 2]



- The State of Charge (SOC) of the vehicle is effectively the inverse of the drive efficiency graph on the previous slide – i.e., the more efficient the vehicle, the lower the SOC usage.
- As shown in the previous slide, the energy use increases during colder months for most vehicles in the programme, hence the daily SOC usage increases.

[1] Data displayed as recorded during the reporting period (not extrapolated). [2] Vehicles that do not have a complete set of daily distance and charging data for the quarter, or that have been used for fewer than ten days, have been excluded from this analysis. The graph shows the number of vehicles (n) included each quarter.

RRV Performance 2023Q4



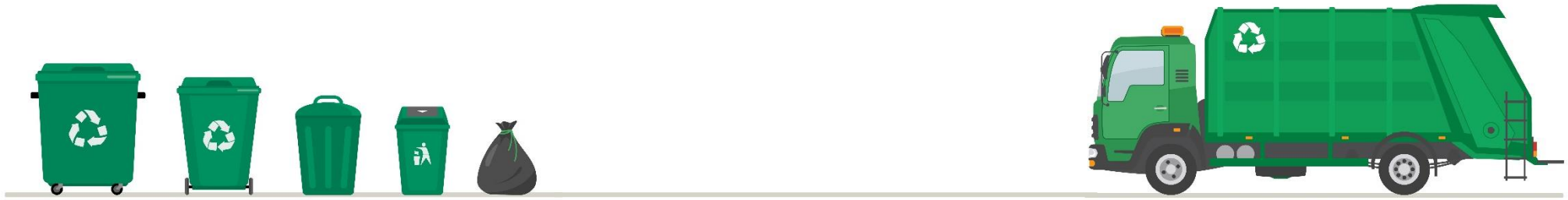
RRV Summary Quarterly Reporting per LA[1]

	2023Q4					
LA	# Vehicles Deployed	# Vehicles Reporting	Total Distance (miles)	Efficiency (miles/kWh)	Average Daily Distance (miles)	Range (miles)
Neath Port Talbot	1	1	1,485	0.33	28	42
Totals	**1**	**1**	**1,485**			

- Only one RRV in Neath Port Talbot is currently reporting data to the programme.
- The vehicle reported its first data in 2023Q3, travelling 1,900 miles. There was insufficient telemetry data on battery use in that quarter to report its efficiency.

[1] Data displayed as recorded during the reporting period (not extrapolated).

Cost and Emission Savings 2023Q4



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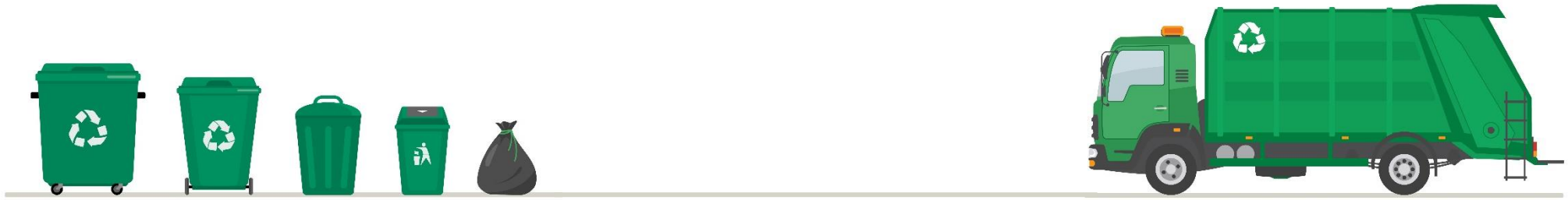
Average Quarterly Cost and Emission Savings per RCV & RRV

2023Q4	Energy from grid (kWh)	Diesel saved (L)[2]	Fuel cost saving (overnight charging)[2]	Fuel cost saving (long term)[2,6]	Societal damage cost saving[3,4]	WTW CO_2e saved (t)[3,5]	NOx saved (kg)[5]	PM saved (g)[5]
Average per RCV	5,331	1,355	£993	£666	£822	3.0	5.6	23.9
Average per RRV	5,177	855	£698	£133	£432	1.3	5.5	17.4

- Costs are based on **best case energy prices** using lowest-rate overnight charging rate, and **long-term fuel prices** using figures from current Government policy advice.
- Based on these assumptions, eRCVs and eRRVs have the potential for operating cost and emission savings compared to diesel equivalents provided they are charged overnight using cheaper rate electricity.

[1] Extrapolated figures from all operating vehicles during the reporting period. [2] Compared to a diesel equivalent truck. [3] CO_2 emissions stated on a well-to-wheel base which considers of all emissions from the fuel extraction until its final use in a vehicle. CO_2 stated as CO_2e which includes other GHG emissions on a CO_2 equivalence basis. [4] Values obtained as per guidance of the WelTAG data book (Jul 2023). [5] Values obtained as per guidance of DEFRA for company reporting (2021). [6] Long-term prices based on 7-year estimate from HM Treasury: Green Book 2023 – 2030 (18.3 p/kWh ,1.27 £/L).

Project Annual Totals



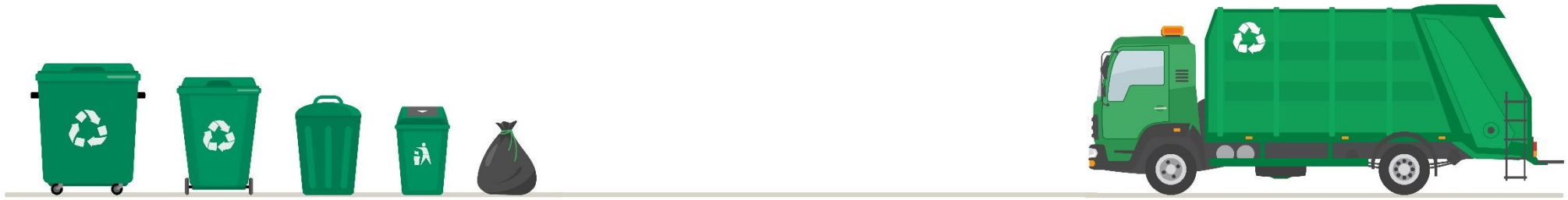
Annual Totals

Annual totals					
Year		2021	2022	2023	Total
Vehicles reporting data	RCV	11	25	27	**27**
	RRV	0	0	1	**1**
	Sweeper	0	1	1	**1**
Electricity used (kWh)		79,700	379,900	521,203	**980,803**
Diesel saved (L)		19,300	95,800	136,651	**251,751**
Emission savings	WTW CO_2 (t)	41	201	304	**546**
	NOx (kg)	72	621	620	**1,313**
	PM (g)	337	1,943	2,562	**4,842**
Social damage cost savings (£)		12,038	62,229	79,121	**153,387**

- Since 2021, the switch to electric vehicles in the programme has avoided the use of over quarter of a millions litres of diesel in Welsh waste and recycling vehicles, resulting in **more than 500 tonnes of CO_2e savings**.

[1] Extrapolated figures from all operating vehicles during the reporting period. [2] Compared to a diesel equivalent truck. [3] CO_2 emissions stated on a well-to-wheel base which considers of all emissions from the fuel extraction until its final use in a vehicle. CO_2 stated as CO_2e which includes other GHG emissions on a CO_2 equivalence basis. [4] Values obtained as per guidance of the WelTAG data book (Jul 2023). [5] Values obtained as per guidance of DEFRA for company reporting (2021). [6] Long-term prices based on 7-year estimate from HM Treasury: Green Book 2023 – 2030 (18.3 p/kWh ,1.27 £/L).

Appendices



Appendix A – Abbreviations and Annotated Map

Abbreviations

Acronym/Term	Definition
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalents
EV	Electric Vehicle
eRCV	Electric Refuse Collection Vehicle
LA	Local Authority
NO_x	Oxides of Nitrogen
PM	Particulate Matter of 2.5 microns or less
RCV	Refuse Collection Vehicle
RRV	Resource Recovery Vehicle
Rural	Steady continuous speed
ULEV	Ultra Low Emissions Vehicle
Urban	Many stops and starts
SOC	State of Charge
WG	Welsh Government
WTW	Well to Wheel

Welsh LAs

Appendix B – Further Information Sources

Guidance Documents

The project web page has further information to help you transition and plan for your ULEV waste and recycling fleet and infrastructure.

https://www.cenex.co.uk/projects-case-studies/ultra-low-emission-waste-and-recycling-vehicles/

Additional Help

Free consultation sessions from electric vehicle and infrastructure specialists at Cenex are available to support your planning for deploying waste vehicles and infrastructure. These can be arranged through your Welsh Government contact. Arrange a consultation today!

Appendix C – Greenhouse and Air Quality Emissions Factors

Social Damage Costs[1]

Carbon Cost (£/tCO$_2$e)	NOx Cost (£/tNOx)	Particulate Matter Cost (£/tPM2.5)
272	11,899	86,119

Emissions From Energy Source[2]

UK Grid Emissions (WTW kgCO$_2$e/kWh)	Diesel (100% Mineral) (WTW kgCO$_2$e/litre)
0.2913	3.33427

[1] Values obtained as per guidance of the TAG data book (May 2023). [2] Values obtained as per guidance of DEFRA for company reporting (2021).