Transport | Energy Infrastructure | Knowledge & Enterprise

Llywodraeth Cymru
Welsh Government

LOCAL PARTNERSHIPS

cenex

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

2023 Q2 (April-June)

Summary Deployment and Performance Report

www.cenex.co.uk @CenexLCFC info@cenex.co.uk

Document Control

	Name and Job Title	Organisation
Prepared for:	Catrin Roberts, Head of Infrastructure Investment and Performance Improvement	Welsh Government
	Mark Brown, Project Director	Local Partnerships
Prepared by:	Vicente Jofré Matamala, Assistant Technical Specialist and Sophie Naylor, Technical Specialist	Cenex
Approved by:	Peter Speers, Principal Technical Specialist	Cenex

Revision No.	Details	Date Issued
1	Initial release	11/09/2023
2	Revised version	21/11/2023

Company Details
Cenex
Holywell Building
Holywell Park
Ashby Road
Loughborough
Leicestershire
LE11 3UZ

Registered in England No. 5371158

Tel: 01509 642 500

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 April and June 2023. Results from the previous quarter (January-March 2023) are also shown for comparison.*

* 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 April-June 2023

- **35** zero emission vehicles deployed (30 RCVs, 4 RRV, 1 Sweeper)
- **30,500 miles** reported[1]
- **71 tonnes of WTW CO_2e** emissions saved[1 - 4]
- **24 kg of NOx** and **264 g of PM** emissions avoided[1, 2, 3]
- On average, electric RCVs travel **31 miles per day** using **less than half their battery capacity**[1]
- The electric sweeper travelled **23 miles per day** using **74% of its battery**[1]
- The usable range for the RCVs is **73 miles** and for the Sweeper **28 miles.**[1, 5]

[1] Extrapolated average 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) 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 80% battery usage.

Summary Deployment Status 2023Q2

New vehicles deployed during the reporting period

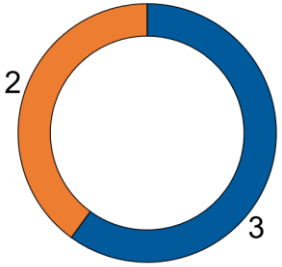
- 3 x Electra **RCVs** in Carmarthenshire
- 1 x Romaquip **RRV** in Conwy
- 1 x Terberg/Electra **RRV** in Neath Port Talbot

New orders during this period

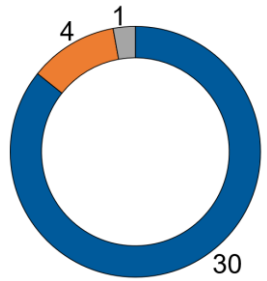
- 2 x Faresin **Telehandlers** in Gwynedd
- 3 x Terberg/Electra **RRV** in Merthyr Tydfil

35 ULEVs Deployed So Far

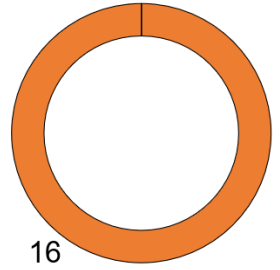
Deployed This Period (5)



Deployed So Far (35)



Pending Delivery (16)



RCVs
RRVs
Sweepers

cenex

Detailed Deployment and Reporting Status 2023Q2

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]:

0.24

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

0.17 – 0.38

Sweeper:

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

0.19

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

0.19

[1] Extrapolated average from all operating vehicles during the reporting period.

Estimated Annual Vehicle Emission and Diesel Savings

RCV:

Yearly Emissions Savings[1–3]:

WTW CO_2e [3]	NOx	PM2.5
11 t	28 kg	100 g

Annual Social Damage Cost Savings [2, 4]:

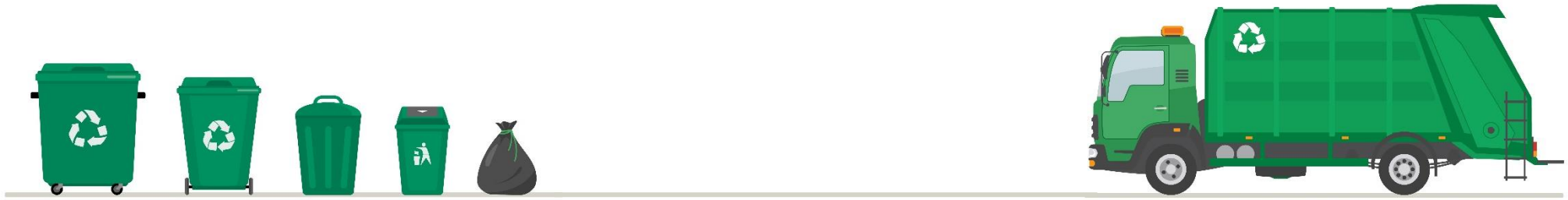
£3,000

Yearly Fuel Cost Savings[2, 5]:

£2,000

[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



cenex

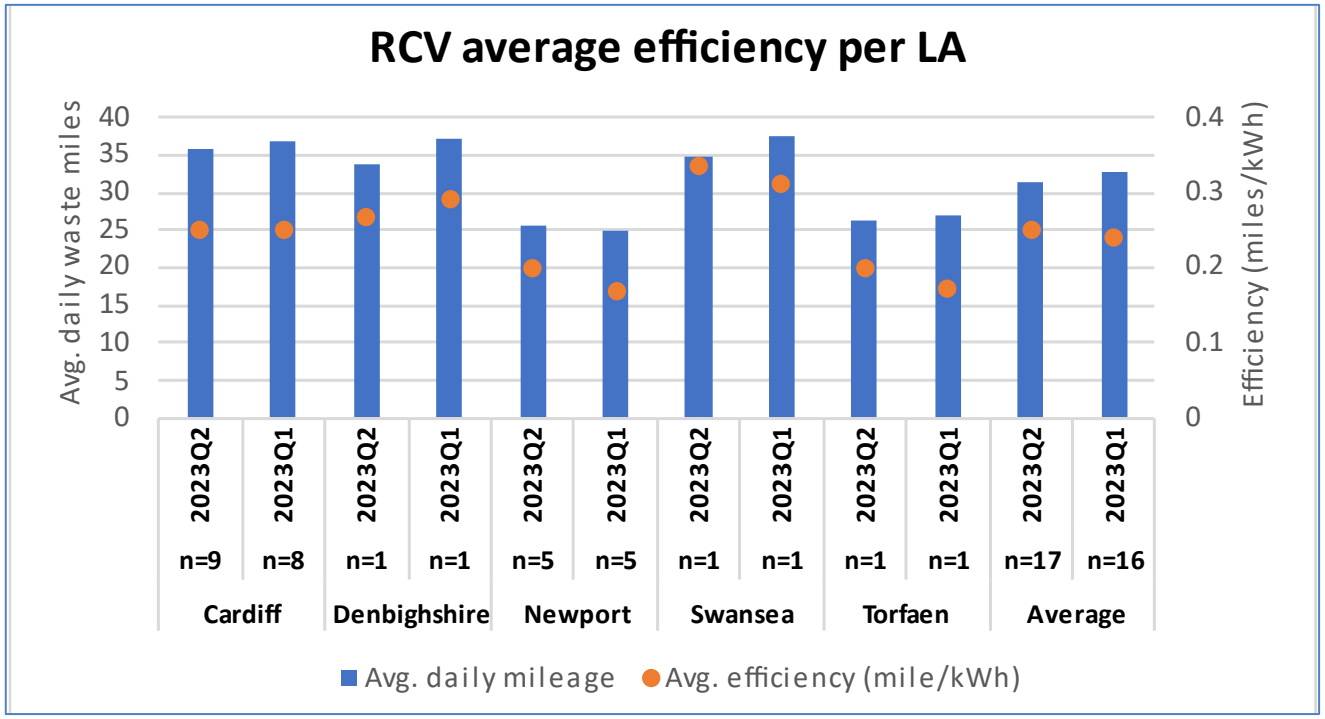
RCV Summary Quarterly Reporting per LA[1]

LA	2023Q2					2023Q1				
	# 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	13,560	218,237	4,090	12	12	11,001	145,113	2,960
Denbighshire	2	2	2,793	75,469	905	2	2	1,484	31,695	469
Newport	6	6	6,678	207,826	2,904	6	6	7,406	246,528	3,702
Powys	1	1	3,471	35,626	665	1	1	3,189	32,011	608
Swansea	1	1	1,388	6,769	325	1	1	631	2,666	134
Torfaen	2	2	1,623	42,208	520	2	2	1,638	60,244	1,043
Wrexham [2]	2	0				2	0			
Totals	**26**	**24**	**29,513**	**586,136**	**9,408**	**26**	**24**	**25,349**	**518,258**	**8,916**

- The average eRCV being tracked by the programme travelled just under 1,250 miles, collected from 24,150 properties, and tipped a total of 400 tonnes of refuse during Q2 of 2023.
- As new vehicles were deployed during 2023, their usage increased over the course of 6 months recorded above: mileage was up ~15% and properties collected by ~10%.
- 2 out of the 26 RCVs are currently not 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.

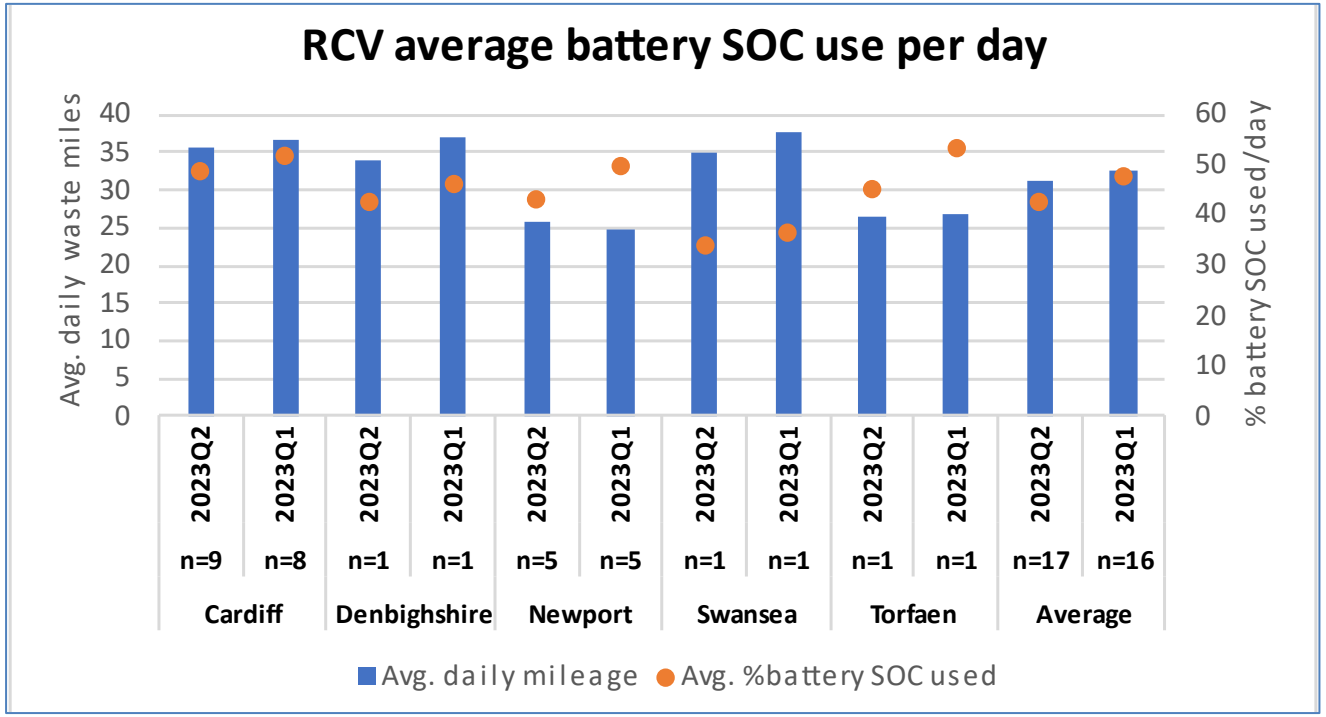
RCV Average Efficiency Per LA[1, 2]



- eRCV driving efficiency (measured as number of waste miles per battery kWh used) was seen to improve for most LAs between Q2 and Q1.
- Increased efficiency is expected with warmer weather: less cabin heating and lighting is required, and air and rolling resistance decrease with higher temperatures.
- Ongoing data collection will give a clearer picture of the factors that affect performance through the seasons as the number of vehicles in the programme increases and the dataset grows.

[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.

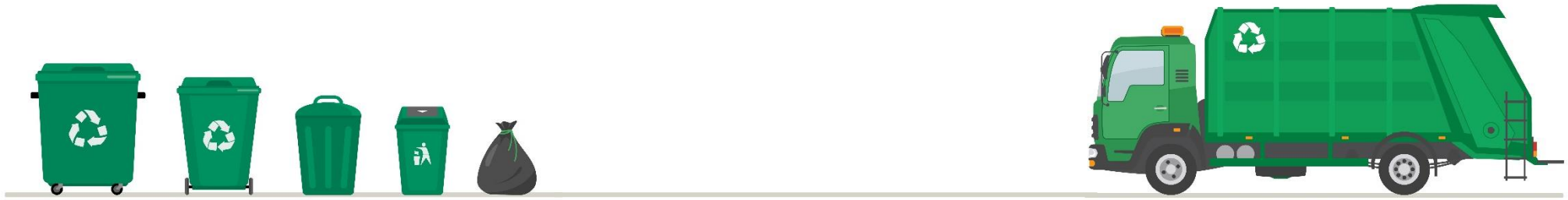
RCV Average Daily Battery SOC Use Per LA[1, 2]



- 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 decreases during warmer months for most vehicles in the programme, hence the SOC usage decreases.

[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.

Sweeper Performance



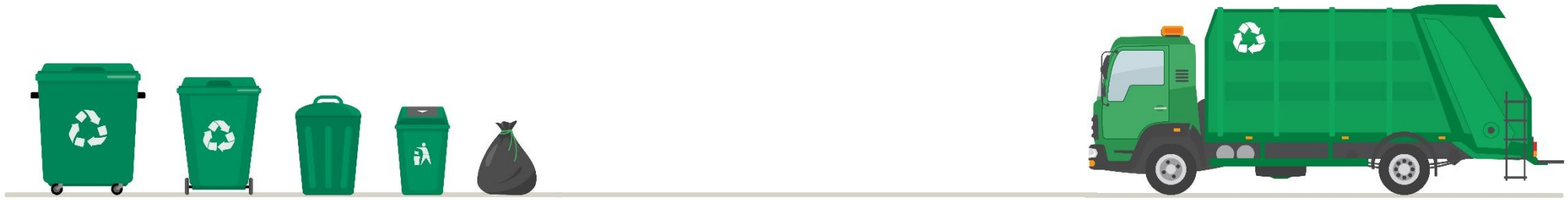
cenex

Sweeper Summary Quarterly Reporting per LA

LA	2023Q2			2023Q1		
	# Vehicles Deployed	# Vehicles Reporting	Distance (miles)	# Vehicles Deployed	# Vehicles Reporting	Distance (miles)
NPT	1	1	1,019	1	1	1,451
Totals	**1**	**1**	**1,019**	**1**	**1**	**1,451**

- There is only one sweeper currently being analysed in Wales.
- During the second quarter of the year the vehicle travelled ~30% fewer miles than in the first quarter of the year.

Cost and Emission Savings



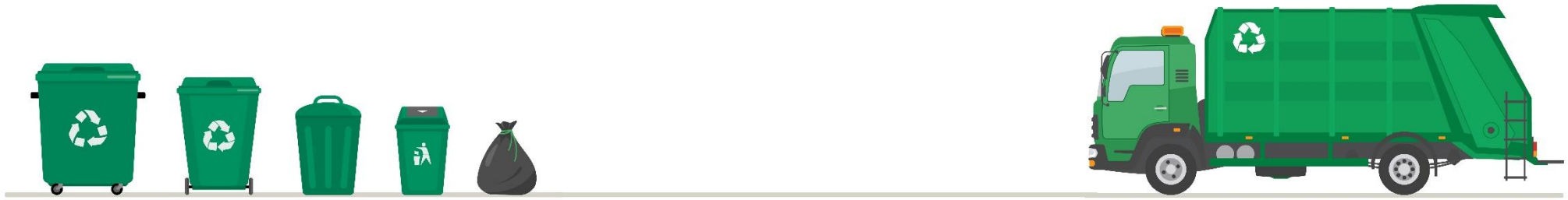
Average Quarterly Cost and Emission Savings per RCV

2023Q2	Energy from grid (kWh)	Diesel saved (L)[1,2]	Fuel cost saving (overnight charging)	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	5,278	1,344	£883	£540	£673	2.9	6.6	27.0

- 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 provide significant operating cost and emission savings compared to diesel equivalents.

[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!

cenex

Appendix C – Greenhouse and Air Quality Emissions Factors

Social Damage Costs by 2023Q2[1]

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

Emissions From Energy Source by 2023Q2[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).