

Welsh ZE Waste and Recycling Vehicle Programme – LA Engagement Workshop –

Session Chair, Steve Carroll

26th April 2023

ZE Waste and Recycling Vehicle Project



Andrew Bishop, WG
Programme Lead

Aims to
accelerate and
de-risk

Access to
Support



Mark Brown, Programme
Manger

WG net-zero
2030 target

Try before you
buy



Steve Carroll, Support Lead
Peter Speers, Project Manager
Vicente Jofre Matamala, LA Liaison Officer and
Technical Support
Sophie Naylor, Data Analyst

Vehicle Purchase
Grant Support

Shared learning
and
dissemination

Objectives for Day

- **Share** learnings successes and challenges from deploying vehicles
- **Discover** programme tools and insights available for deployment planning
- **Understand** local authority support needs

Agenda

- 13:30 Welcome and Programme Status
 - 13:50 Local Authority Updates – Vehicle deployments in Wales
 - Newport, Neath Port Talbot, Denbighshire

 - 14:50 Break!

 - 15:00 Performance Review, Cenex – Learning from a Year of Data
 - Performance Discussion Session
 - 15:40 Programme Support Available
 - Support Discussion
 - 16:00 Close
-

Programme Update

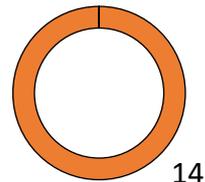
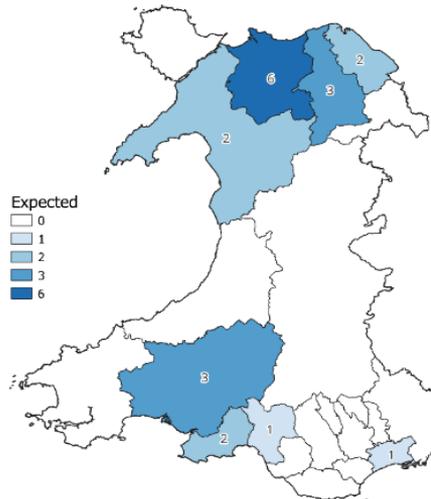


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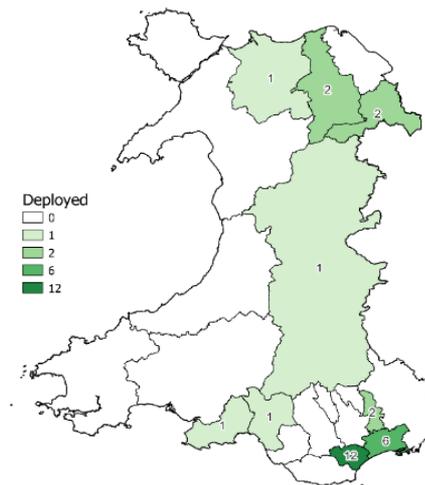
Deployment Status

Local Authority	Deployed	Expected
Cardiff	12	
Newport	7	
Denbighshire	2	3
Torfaen	2	
Wrexham	2	
Conwy	1	6
Powys	1	
Swansea	1	
Neath Port Talbot	1	1
Carmarthenshire	3	
Flintshire		2
Vale of Glamorgan		2
Grand Total	32	14

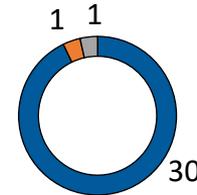
46 Vehicles Funded across
12 Different Local Authorities



Expected



■ RCVs
■ RRVs
■ Sweepers



Deployed so far

Deployment Status



26t eRCV

- Providers:
 - Dennis Eagle (26)
 - Electra (3)
 - RVS/E Moss (1)



12t eRRV

- Providers:
 - Romaquip (1) (8)
 - Terberg (6)



eSweeper

- Providers:
 - Bucher (1)

Blue: Deployed
Orange: Expected

Support Discussion

To join the Q&A Session please open link in chat.



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– Break –



– Performance Update – Learning from a Year of Data



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Data Collection Activities

Automatic Data

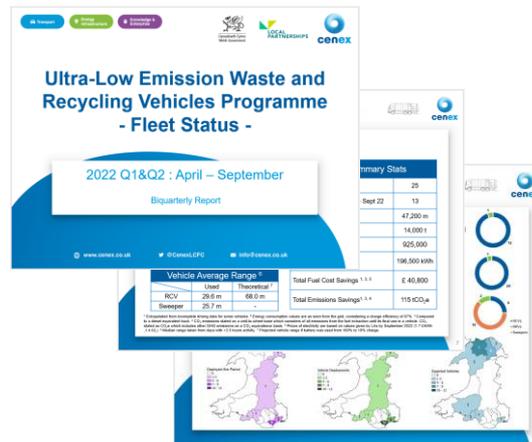
- Vehicle Telemetry
- Charging Logs
- Weighbridge Logs

Manual Data

- Onboarding Forms
- Operation Notes

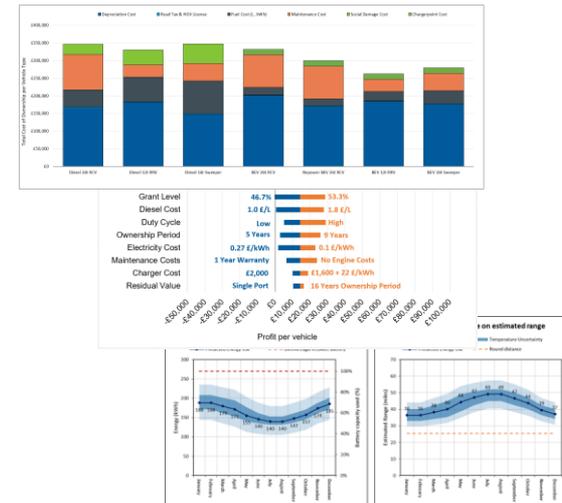
Input

Period Summaries



Output

In-Depth Analysis



Data Collection Activities

Automatic Data

- Vehicle Telemetry
- Charging Logs
- Weighbridge Logs

Manual Data

- Onboarding Forms
- Operation Notes

Input

Support Tools

New Electric Vehicle Checklist – To simplify the work of fleet/energy managers during acquisition and planning for new ULEVs.

Responsibility for:
Task 1: Fleet Manager
Task 2: Energy manager or Chargepoint leader

Ref	Relevant Steps	Status	Notes
1	Reading this Checklist	✓	Congratulations, you are now part of the change!
2	List fleet vehicle replacement requirements based on the requirements list		
3	Identify any extension vehicle alternatives based on the requirements list		
4	Contact vehicle provider to obtain a quote and confirm on required charging infrastructure (if not chargepoint and recommended options)		

The tool lays out all the steps involved in new EV onboarding, from research to deployment. Including details on infrastructure and vehicle steps.

ZE Vehicle Catalogue – For fleet/waste managers to reduce research time on ULEV RCVs, RRVs, and Sweepers available in the market.

Appendix C – Available Vehicles – RCVs – Page 1

Manufacturer	Model	Year	Price	Range	Capacity
Hyundai	IONIQ	2016	£12,999	124 miles	1000kg
Hyundai	IONIQ	2017	£13,999	124 miles	1000kg
Hyundai	IONIQ	2018	£14,999	124 miles	1000kg
Hyundai	IONIQ	2019	£15,999	124 miles	1000kg
Hyundai	IONIQ	2020	£16,999	124 miles	1000kg
Hyundai	IONIQ	2021	£17,999	124 miles	1000kg
Hyundai	IONIQ	2022	£18,999	124 miles	1000kg
Hyundai	IONIQ	2023	£19,999	124 miles	1000kg
Hyundai	IONIQ	2024	£20,999	124 miles	1000kg
Hyundai	IONIQ	2025	£21,999	124 miles	1000kg
Hyundai	IONIQ	2026	£22,999	124 miles	1000kg
Hyundai	IONIQ	2027	£23,999	124 miles	1000kg
Hyundai	IONIQ	2028	£24,999	124 miles	1000kg
Hyundai	IONIQ	2029	£25,999	124 miles	1000kg
Hyundai	IONIQ	2030	£26,999	124 miles	1000kg
Hyundai	IONIQ	2031	£27,999	124 miles	1000kg
Hyundai	IONIQ	2032	£28,999	124 miles	1000kg
Hyundai	IONIQ	2033	£29,999	124 miles	1000kg
Hyundai	IONIQ	2034	£30,999	124 miles	1000kg
Hyundai	IONIQ	2035	£31,999	124 miles	1000kg
Hyundai	IONIQ	2036	£32,999	124 miles	1000kg
Hyundai	IONIQ	2037	£33,999	124 miles	1000kg
Hyundai	IONIQ	2038	£34,999	124 miles	1000kg
Hyundai	IONIQ	2039	£35,999	124 miles	1000kg
Hyundai	IONIQ	2040	£36,999	124 miles	1000kg
Hyundai	IONIQ	2041	£37,999	124 miles	1000kg
Hyundai	IONIQ	2042	£38,999	124 miles	1000kg
Hyundai	IONIQ	2043	£39,999	124 miles	1000kg
Hyundai	IONIQ	2044	£40,999	124 miles	1000kg
Hyundai	IONIQ	2045	£41,999	124 miles	1000kg
Hyundai	IONIQ	2046	£42,999	124 miles	1000kg
Hyundai	IONIQ	2047	£43,999	124 miles	1000kg
Hyundai	IONIQ	2048	£44,999	124 miles	1000kg
Hyundai	IONIQ	2049	£45,999	124 miles	1000kg
Hyundai	IONIQ	2050	£46,999	124 miles	1000kg
Hyundai	IONIQ	2051	£47,999	124 miles	1000kg
Hyundai	IONIQ	2052	£48,999	124 miles	1000kg
Hyundai	IONIQ	2053	£49,999	124 miles	1000kg
Hyundai	IONIQ	2054	£50,999	124 miles	1000kg
Hyundai	IONIQ	2055	£51,999	124 miles	1000kg
Hyundai	IONIQ	2056	£52,999	124 miles	1000kg
Hyundai	IONIQ	2057	£53,999	124 miles	1000kg
Hyundai	IONIQ	2058	£54,999	124 miles	1000kg
Hyundai	IONIQ	2059	£55,999	124 miles	1000kg
Hyundai	IONIQ	2060	£56,999	124 miles	1000kg
Hyundai	IONIQ	2061	£57,999	124 miles	1000kg
Hyundai	IONIQ	2062	£58,999	124 miles	1000kg
Hyundai	IONIQ	2063	£59,999	124 miles	1000kg
Hyundai	IONIQ	2064	£60,999	124 miles	1000kg
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Hyundai	IONIQ	2109	£105,999	124 miles	1000kg
Hyundai	IONIQ	2110	£106,999	124 miles	1000kg
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Hyundai	IONIQ	2167	£163,999	124 miles	1000kg
Hyundai	IONIQ	2168	£164,999	124 miles	1000kg
Hyundai	IONIQ	2169	£165,999	124 miles	1000kg
Hyundai	IONIQ	2170	£166,999	124 miles	1000kg
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Hyundai	IONIQ	2173	£169,999	124 miles	1000kg
Hyundai	IONIQ	2174	£170,999	124 miles	1000kg
Hyundai	IONIQ	2175	£171,999	124 miles	1000kg
Hyundai	IONIQ	2176	£172,999	124 miles	1000kg
Hyundai	IONIQ	2177	£173,999	124 miles	1000kg
Hyundai	IONIQ	2178	£174,999	124 miles	1000kg
Hyundai	IONIQ	2179	£175,999	124 miles	1000kg
Hyundai	IONIQ	2180	£176,999	124 miles	1000kg
Hyundai	IONIQ	2181	£177,999	124 miles	1000kg
Hyundai	IONIQ	2182	£178,999	1	

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		FY 21/22				FY 22/23		
		Q1	Q2	Q3	Q4	Q1	Q2	Q3
Vehicles Deployed	RCV	4	7	11	13	24	25	26
	RRV	0	0	0	0	0	0	1
	Sweeper	0	0	0	0	1	1	1
Energy Used ¹		12,900 kWh	41,000 kWh	79,700 kWh	127,400 kWh	206,800 kWh	323,800 kWh	459,600 kWh
Diesel Saved		3,400 L	9,700 L	19,300 L	32,200 L	51,400 L	85,900 L	115,100 L
Emissions Saved	WTW CO ₂	8 t	21 t	41 t	70 t	107 t	185 t	242 t
	NOx	14 kg	37 kg	72 kg	161 kg	302 kg	503 kg	693 kg
	PM	59 g	170 g	337 g	601 g	1,027 g	1,660 g	2,280 g

		Operating Hours	Daily Energy from Grid ²	Daily Battery Use	Energy Efficiency ³	Daily Miles Driven	Theoretical Mileage ⁴
Cardiff	RCV	9.0 h	146 kWh	42%	0.26 ^{m/kWh}	33 m	69 m
Neath Port Talbot	Sweeper	6.1 h	160 kWh	68%	0.19 ^{m/kWh}	27 m	35 m
Newport	RCV	7.9 h	159 kWh	46%	0.18 ^{m/kWh}	26 m	50 m
Powys	RCV	13.1 h	196 kWh	57%	0.24 ^{m/kWh}	37 m	65 m
Swansea	RCV	6.7 h	136 kWh	39%	0.30 ^{m/kWh}	35 m	80 m
Torfaen	RCV	7.5 h	168 kWh	49%	0.17 ^{m/kWh}	26 m	47 m
Average		8.2 h	153 kWh	45%	0.23 ^{m/kWh}	29 m	61 m

Deployments

- 460,000 kWh
- 115,000 l diesel saved
- 242 t CO₂, 700 kg NOx, 3kg PM saved

Avg. eRCV stats

- 39 – 57% SoC used per day
- 26 – 33 miles per day
- 0.17 – 0.3 miles/kWh
- 47 – 80 miles max. range

Overall Performance Stats



Configuration: 26t 6x2 Rear Steer

Battery Capacity: 300 kWh (270 kWh usable)

Motor Power: 200 kW motor

Charge time: 6.75 h (20 – 100%)

Avg. drive efficiency: $0.23 \text{ mi}/\text{kWh}$ (real-world)

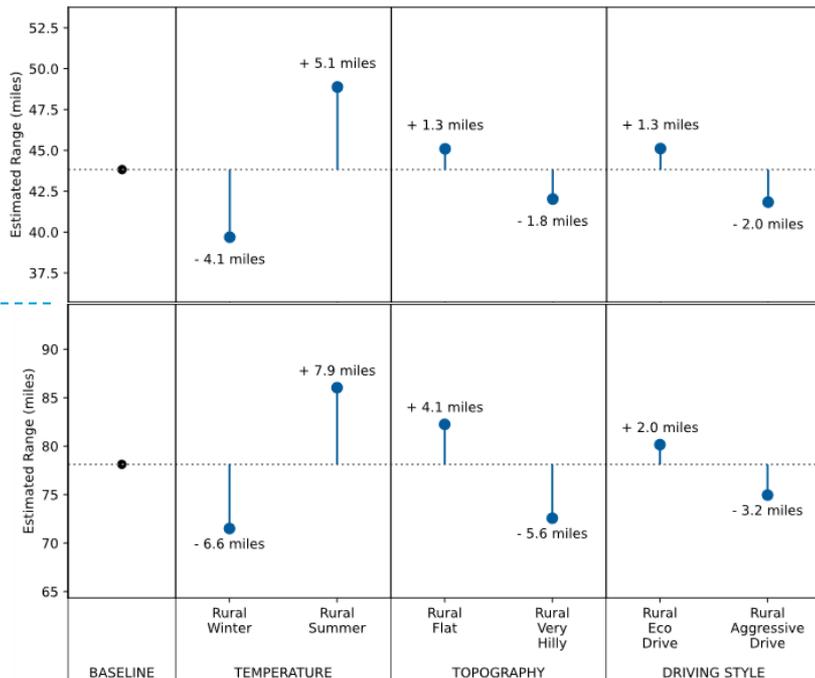
Urban collection range: ~ 40 miles (real-world)

Rural collection range: ~ 80 miles (real-world)

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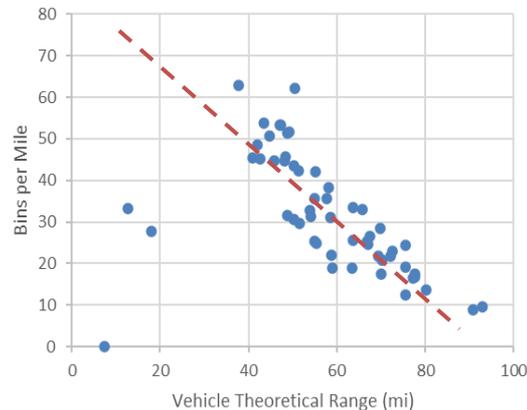
Overall Performance Stats

Urban Rounds



Rural Rounds

Bin Collection Density vs Vehicle Range



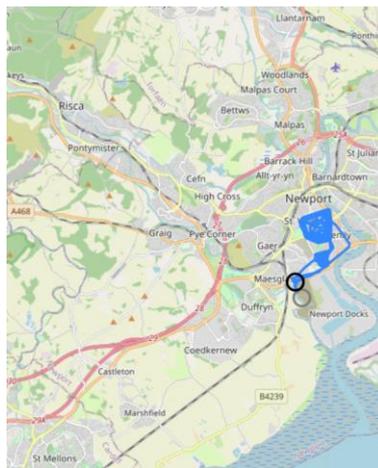
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Deep Dive – Dennis Eagle eCollect in Newport

eRCV Operations – Deep Dive

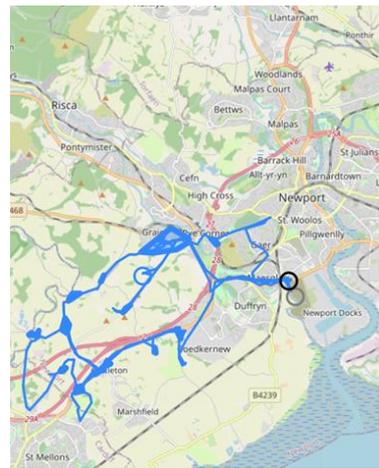
Example – Urban Collection

Bins Collected	2,018
Distance Driven	16 miles
Energy Consumed	113 kWh
Battery Remaining	62%
Avg. Speed	1.7 mph
Estimated Range	38 miles



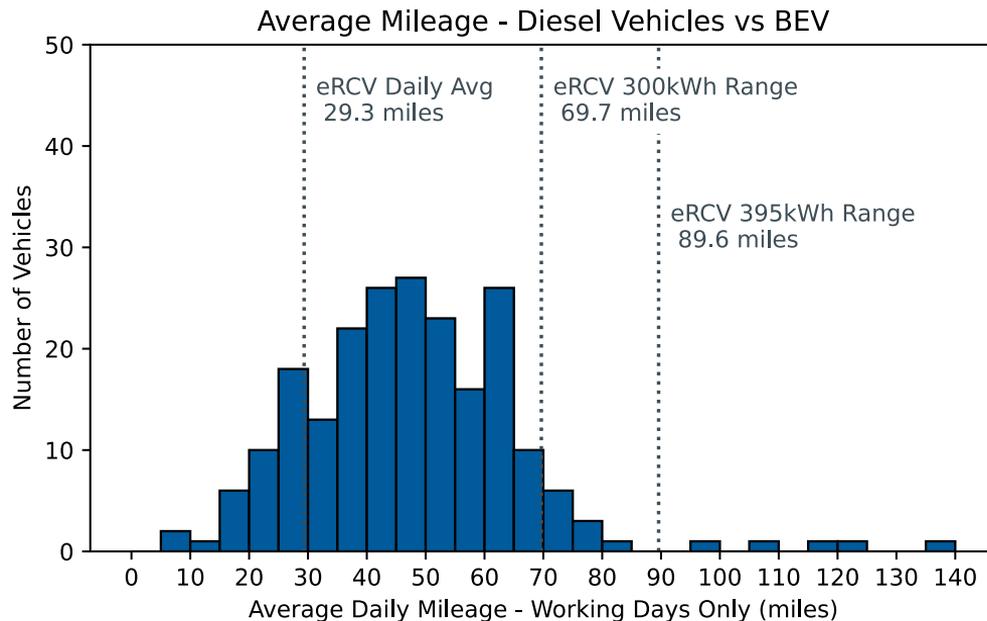
Example – Rural Collection

Bins Collected	701
Distance Driven	42 miles
Energy Consumed	141 kWh
Battery Remaining	53%
Avg. Speed	5.4 mph
Estimated Range	80 miles



Suitability of eRCVs Across the Welsh Fleet?

- Theoretical range of 300kWh 26t eRCVs as currently driven would cover 92% of 22-26t diesel RCVs.
- A larger 395 kWh battery is estimated to cover 97% of 22-26t diesel RCVs.



22-26t RCVs only – 217 vehicles

Deep Dive – Bucher V65e Sweeper in NPT

Bucher Truck Mounted Sweeper Specifications*



Configuration: 16t 4x2

Battery Capacity: 200 kWh (200 kWh usable)

Hopper Volume: 6.5 m³

Charge time: 5 h (20 – 100%)

Avg. drive efficiency: 0.19 $\frac{mi}{kWh}$ (real-world)

Typical Range: 25 – 50 Miles (real-world)

Typical Operation Time: 6 – 10 Hours (real-world)

*All data collected for the Bucher Sweeper is limited to Neath Port Talbot during a period of 6 months.

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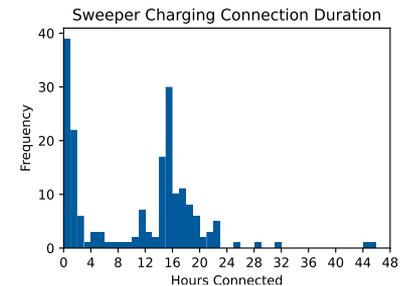
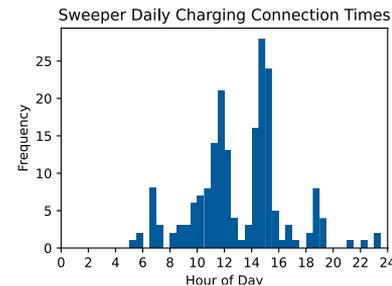
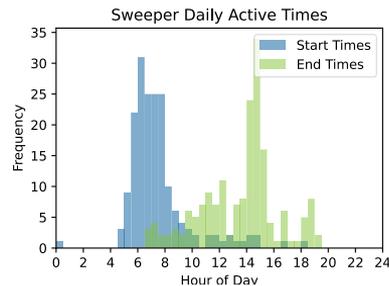
Deep Dive – Bucher V65e Sweeper in NPT

eSweeper Operations in NPT*

The Sweeper appears to be well utilised with daily battery use varying from 43 – 83%, with an average of 68%.

	Distance Travelled	Total Time Moving	Time Sweeping	Battery % SoC use	Load Collected
Typical Daily Range	16 - 42 miles	4.0 - 6.7 hrs	36 - 63%	43 – 83%	1.3 - 5.2 t
Daily Average	27 miles	5.6 hrs	53%	68%	2.7 t

- The vehicle is typically operated for ~6-7 hour shifts.
- The vehicle is often charged overnight from the end of its shift.
- Frequently recharged for a short session in the middle of a shift.



*All data collected for the Bucher Sweeper is limited to Neath Port Talbot during a period of 6 months.

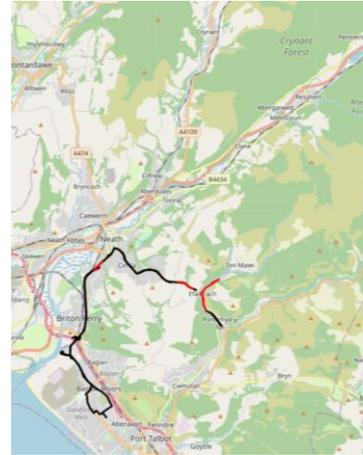
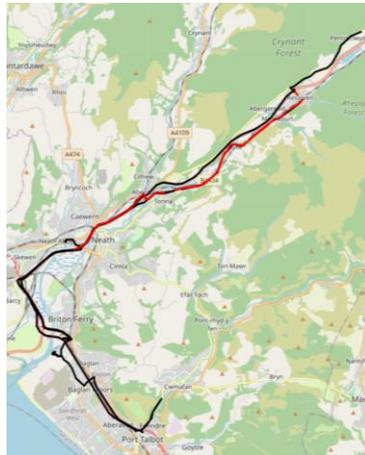
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Deep Dive – Bucher V65e Sweeper in NPT

eSweeper Operations – Deeper Dive

27/10/22 – Higher Consumption Day

Total Distance	65 miles
Active Time (ignition on)	6 hrs 14 min
Battery Used	90%
% Time Sweeping	49%
Average Consumption	28.9 kWh/h



04/11/22 – Lower Consumption Day

Total Distance	23 miles
Active Time (ignition on)	7 hrs 31 min
Battery Used	64%
% Time Sweeping	30%
Average Consumption	17.0 kWh/h

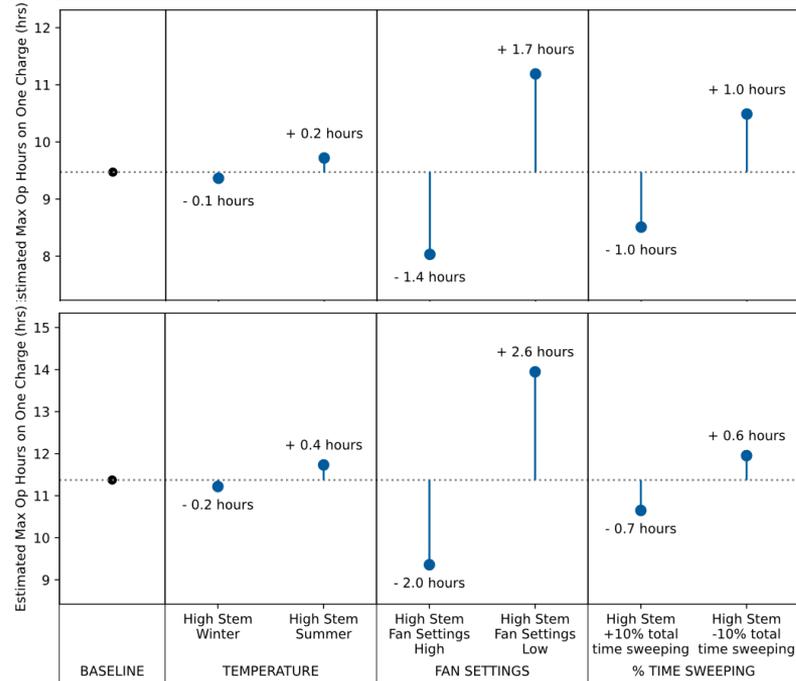
— Travel

— Active Sweeping

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Deep Dive – Bucher V65e Sweeper in NPT

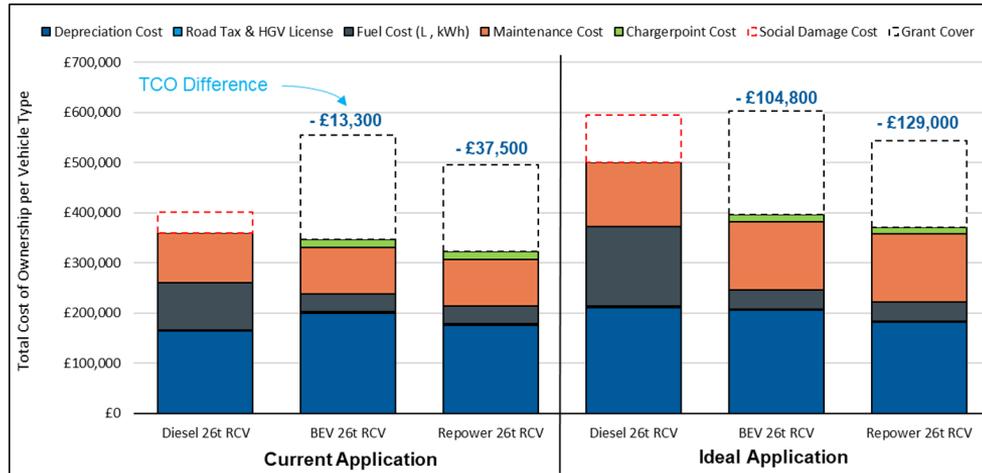
Temperature, Fan Settings, and Time Sweeping Effects on Range



High Sweeping/Driving Ratio

Low Sweeping/Driving Ratio

Pushing the Performance Window

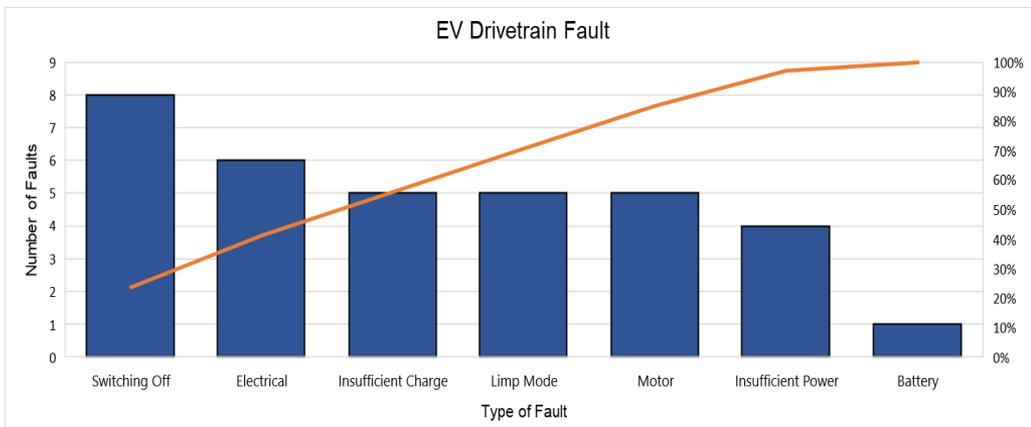


- **Charging using night rate electricity** would save a further **£1,700** per annum (annual mileage of 7,700 miles).
- **Increasing the annual mileage** would further increase fuel savings by **£5,100** and emissions savings by 31% per annum.
- **Repowered eRCVs** have proved to be equally reliable, while being **£70,000** cheaper than the new eRCVs.
- Investment on **driver training** has the potential to save **£1,500** per annum.
- **Increasing planned vehicle lifetimes** (from 7 to 9 years) has the potential of further increasing fuel savings by **£26,000** and **£2,600** in engine related maintenance. Despite the higher maintenance costs.

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Reliability Learnings

	Planned	Unplanned	Total Availability
Average Diesel	87.5%	89.3%	78.2%
Average Electric	93.1%	84.9%	78.6%



- Small sample size, 3 – 6 months of data collected so far.
- DE – 80% of faults EV Drivetrain (new design not systematic in EVs).
- Diesel, older, 80% of faults are body/lift related.
- Most faults could be improved by direct collaboration with DE.
- Currently the eRCVs are operating at a similar availability as the older RCVs.

Conclusions

- We have collected lots of data and characterised the performance window of the DE RCV and Bucher Sweeper.
- **DE's RCV has a range of 40 – 80 miles**, mainly dependent on bin collection density but temperature and topography are relevant as well.
- **Bucher's 16t Sweeper provides 6 – 10 hours of operation**, with the ratio of sweeping vs driving having the largest impact. Fan settings also influence largely the range.
- **Yearly operation savings are £7,100 and can be easily doubled.**
- Vehicles are being underutilised and **savings can be increased by 500%.**
- We look forward to getting data from different RRVs and RCVs this year to assess.

Performance Discussion Session

Programme Support



Programme Support – Financial

Grant Funding Over Purchase Costs

- Most zero emission vehicles in waste fleets are covered.
- **Purchase costs are halved.**
- Vehicle lifetime savings.

Try Before You Buy (Vehicle Loan from Neighbouring Authority)

eRCV



eRRV



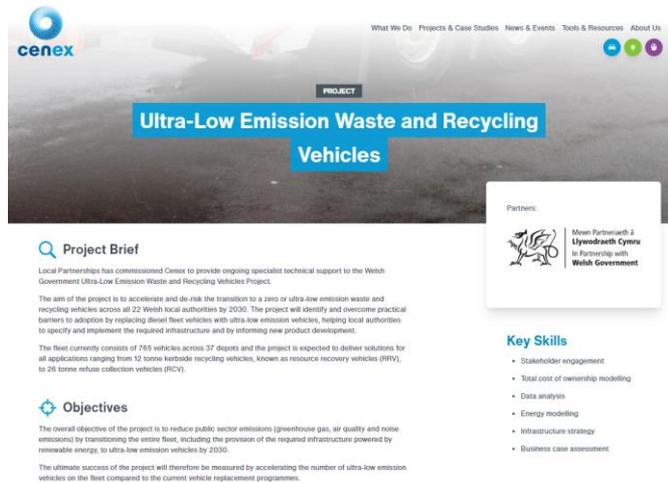
eSweeper



Programme Support - Implementation

Programme Website

Support Tools



PROJECT
Ultra-Low Emission Waste and Recycling Vehicles

Project Brief
Local Partnerships has commissioned Cenex to provide ongoing specialist technical support to the Welsh Government Ultra-Low Emission Waste and Recycling Vehicles Project.

The aim of the project is to accelerate and de-risk the transition to a zero or ultra-low emission waste and recycling vehicles across all 22 Welsh local authorities by 2030. The project will identify and overcome practical barriers to adoption by replacing diesel fleet vehicles with ultra-low emission vehicles, helping local authorities to specify and implement the required infrastructure and by increasing new product development.

The fleet currently consists of 755 vehicles across 37 depots and the project is expected to deliver solutions for all applications ranging from 12 tonne kerbside recycling vehicles, known as resource recovery vehicles (RRV), to 26 tonne refuse collection vehicles (RCV).

Objectives
The overall objective of the project is to reduce public sector emissions (greenhouse gas, air quality and noise emissions) by transitioning the entire fleet, including the provision of the required infrastructure powered by renewable energy, to ultra-low emission vehicles by 2030.

The ultimate success of the project will therefore be measured by accelerating the number of ultra-low emission vehicles on the fleet compared to the current vehicle replacement programmes.

Partners:
Mein Partneriaeth â Llywodraeth Cymru in Partnership with Welsh Government

Key Skills

- Stakeholder engagement
- Total cost of ownership modelling
- Data analysis
- Energy modelling
- Infrastructure strategy
- Business case assessment



- Tools
 - Vehicle Round Planning Tools
 - Electric Vehicle Planning Checklist
- Insights
 - ZE Vehicle Availability Catalogue
 - Improving the Economic Performance of Electric RCVs
- Guidance
 - Infrastructure planning guidance and documents

Programme Support – Implementation

Cenex' Support Tools

Appendix C – Available Vehicles – RCVs – Page 1

 <p>Dennis Eagle eCollect 6x2</p> <p>Length 10.3 m Width - GVW 38t Range - Power Type Battery Electric Batt 300 kWh Out Now (2020) Power 200 kW ⚡DC ⓪ 6.75 h</p>	 <p>Dennis Eagle eCollect 4x2</p> <p>Length - Width 2 m GVW 18t Range - Power Type Battery Electric Batt 180 kWh Out Now (2022) Power 200 kW ⚡DC ⓪ 3.5 h</p>	 <p>Mercedes eEonic 6x2</p> <p>Length 8.5 m Width 2.5 m GVW 27t Range 62 mi Power Type Battery Electric Batt 336 kWh Out Now (2021) Power 400 kW ⚡DC ⓪ 1.5 h</p>
 <p>Electra eCompact 6x2 [1]</p> <p>Length 10.3 m Width - GVW 27t Range - Power Type Battery Electric Batt 140 – 315 kWh Out Now (2018) Power - ⚡DC ⓪ -</p>	 <p>Electra eCompact 4x2 [2]</p> <p>Length - Width 2 m GVW 19t Range - Power Type Battery Electric Batt 140 – 315 kWh Out Now (2019) Power - ⚡DC ⓪ -</p>	 <p>Renault D Wide Z.E. 6x2</p> <p>Length - Width - GVW 26t Range - Power Type Battery Electric Batt 350 kWh Out Now (2021) Power 210 kW ⚡DC ⓪ -</p>

[1] Reposer of Mercedes Eonic.
[2] Reposer of Dennis Eagle RCV.

ehicles – Sweepers – Page 1

 <p>Hydrogen FC</p> <p>Length - Width - GVW 16t Power Type Hydrogen FC Batt - Storage - Water Load - Hopper Size - Out Now (2020) Power 1565 L Load 6.5 m³ ⚡DC ⓪ 5 h</p>	 <p>Bucher CityCat VS20e 4x2</p> <p>Length 4.2 m Width 2.1 m GVW 3.5t Power Type Battery Electric Batt 45 kWh Water Load 425 L Hopper Size 2 m³ ⚡DC ⓪ 2.5 h Out Now (2021)</p>	
 <p>Bucher CityCat V20e 4x2</p> <p>Length 5.3 m Width 2.1 – 2.7 m GVW 3.5t Power Type Battery Electric Batt 63 kWh Water Load 425 L Hopper Size 2 m³ Out Now (2021) ⚡DC ⓪ 3 h</p>	 <p>Boschung Urban Sweeper 2.0 4x2</p> <p>Length 6.2 m Width 2.5 – 3.8 m GVW 10.5t Power Type Battery Electric Batt 137 kWh Water Load 880 L Hopper Size 5.6 m³ Out Now (2022) ⚡DC ⓪ 2 h</p>	 <p>Boschung Urban Sweeper 2.0 4x2</p> <p>Length 4.3 – 5 m Width 2.3 – 2.6 m GVW 4t Power Type Battery Electric Batt 54.4 kWh Water Load - Hopper Size 2 m³ Out Now (2018) ⚡DC ⓪ 1.75 h</p>

[1] Reposer of Mercedes Eonic.



New Electric Vehicle Checklist

The following checklist has been made to support the acquisition and integration of new zero emission vehicles into waste management fleets under the Welsh Governments ZE Waste and Recycling Programme. The check list includes the main high-level aspects of research, infrastructure planning, and fleet integration. Please note, the below list is for guidance only, depending on your specific project the tasks may need to be undertaken in a different order. The authors of this document can not be held liable for the installation and commissioning of your new electric vehicles or infrastructure.

If any further support or advice is required, please contact vicente.jofre@cenex.co.uk.

Responsibility key:

Text = Fleet manager

Text = Energy manager or Chargepoint operator

Num	Relevant Steps	Status	Notes
1	Reading this Checklist	✓	Congratulations, you are now part of the change!
2	List fleet vehicle replacement requirements.		
3	Shortlist zero emission vehicle alternatives based on the requirements list.		

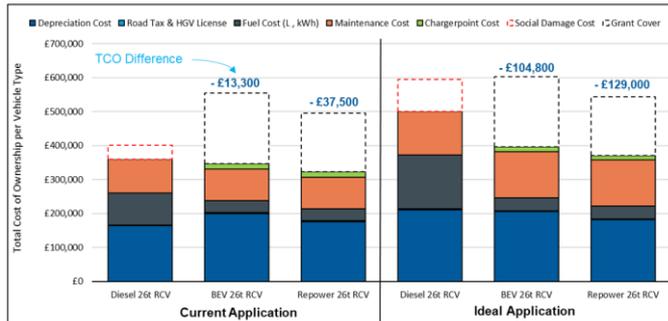
Easy step by step tool to make EV purchase and onboarding easier!

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Programme Support

Cenex' Support Tools

Current and Potential eRCV Economic Performance¹. The figure below describes two scenarios. The first one considering the average operations of the eRCVs throughout Wales, and the second scenario shows the potential with optimised utilisation of the vehicles and charging regime. Both scenarios are inclusive of the Welsh Government purchase grant.

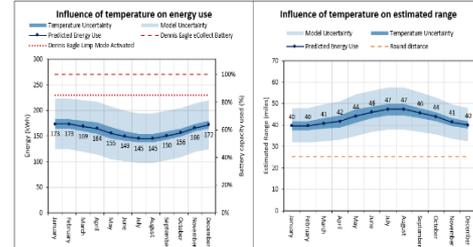


Improving Performance. The chart above shows that improving vehicle utilisation and operating practises can increase TCO savings by up to ~500%! Operating the vehicles over

Learn how to increase your cost savings from operating eRCVs by up to 500%

Model Inputs		
Daily Round Data	Value	
Distance (miles)	25.4	
Round time (hours)	7.075	
Elevation gain (metres)	440	
Bin Lifts	1035	
Load collected (tonnes)	13.95	
Driving Style Score (0-100)	78	
Temperature (degrees C)	15.5	
Charging Requirements Data		
Electricity cost (£/kWh)	0.15	
Overnight down time (hours)	16	
Results		
Daily Round Energy and Range	Result	Uncertainty
Energy (kWh)	144	± 40 kWh
Estimated range (miles)	87.7	± 7 miles
Charging Requirements		
Charging cost (£/month)	£78.75	± 6.63
Charging time at 40 kW (hours)	4.1	± 1.1
Minimum charging power (kW)	10.3	± 2.9

Results Visualisation



Simplify the planning of rounds and energy consumption for fleet/waste managers!

What support would be useful going forward?

Planned for this year

Development of a project specific
website (one-stop-shop)

Performance models & insights

Quarterly workshops & regular
correspondence

Advice

What support would be most effective?

Procurement support (vehicles & infra.)

Fleet transition planning worked examples

Wider round planning support to fit EVs

1-1 Expert advice

Training workshops

Cost modelling tools

Supplier days and events

Increased shared learning

Support Discussion

To join the Q&A Session please open link in chat.



Thank you for your time!

Contacts for Grant Applications

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Thank you for listening

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