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

Session Chair, Steve Carroll

26th April 2023

ZE Waste and Recycling Vehicle Project

Llywodraeth Cymru Welsh Government

Andrew Bishop, WG Programme Lead

LOCAL PARTNERSHIPS

Mark Brown, Programme Manger

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

- Aims to accelerate and de-risk
- Access to Support
- WG net-zero 2030 target
- Try before you buy
- Vehicle Purchase Grant Support
- Shared learning and dissemination

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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

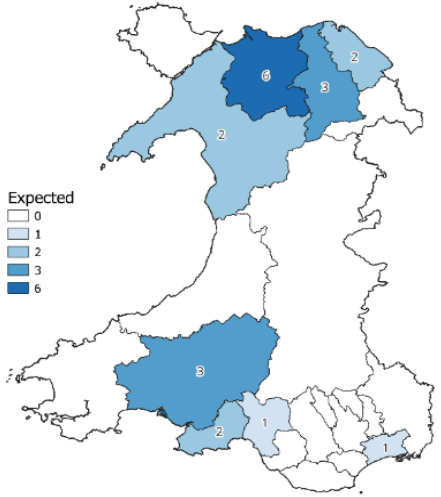
Agenda

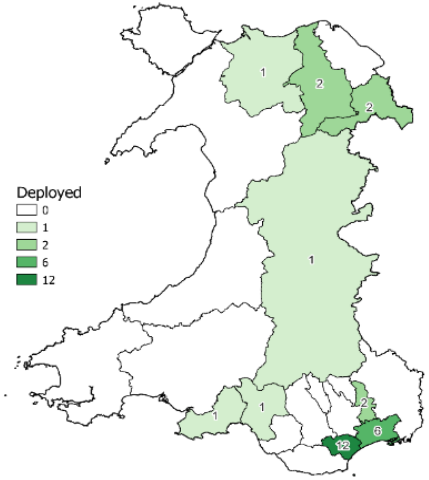
- 13:30 Welcome and Programme Status
- 13:50 Local Authority Updates – Vehicle deployments in Wales
  - Newport, Neath Port Talbot, Denbighshire
- 14:50 Break!
- 15:00 Performance Review, Cenex – Learning from a Year of Data
  - Performance Discussion Session
- 15:40 Programme Support Available
  - Support Discussion
- 16:00 Close

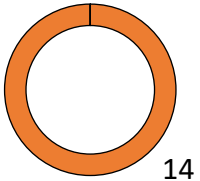
Programme Update

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

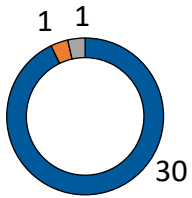






Expected

RCVs
RRVs
Sweepers



Deployed so far

46 Vehicles Funded across

12 Different Local Authorities

Deployment Status

26t eRCV

- Providers:
  - Dennis Eagle (26)
  - Electra (3)
  - RVS/Emoss (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.

– Break –

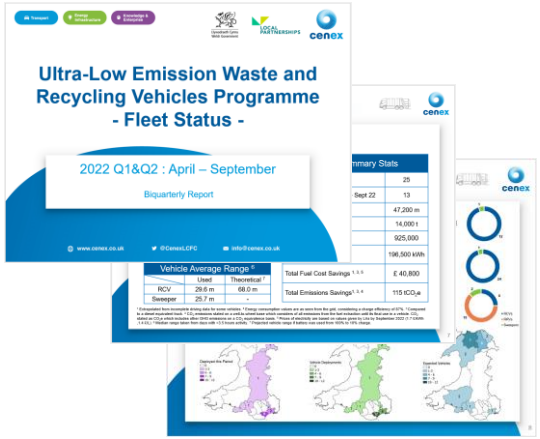
– Performance Update – Learning from a Year of Data

Data Collection Activities

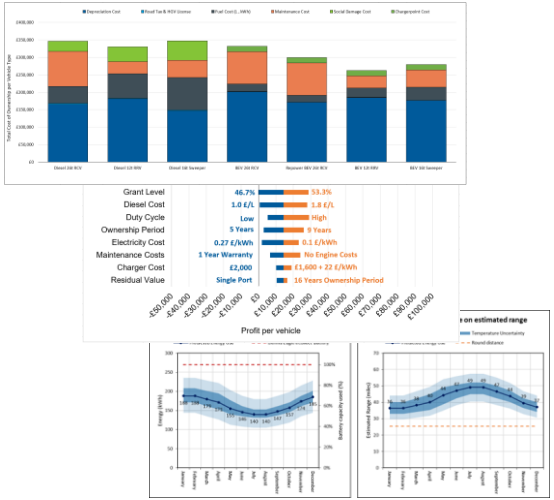
Automatic Data
- Vehicle Telemetry
- Charging Logs
- Weighbridge Logs

Manual Data
- Onboarding Forms
- Operation Notes

Period Summaries



In-Depth Analysis



Input

Output

Data Collection Activities

Automatic Data

- Vehicle Telemetry
- Charging Logs
- Weighbridge Logs

Manual Data

- Onboarding Forms
- Operation Notes

Support Tools

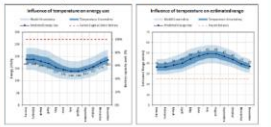
New Electric Vehicle Checklist – To simplify the work of fleet/energy managers during acquisition and planning for new ULEVs.

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.

The catalogue is updated every quarter, to ensure that time is saved for all fleets. All technologies are available for fleet wide deployments or trials.

Vehicle Energy Consumption Model – For fleet/waste managers to estimate how much battery they could use based on their round characteristics, and for energy managers to understand the amount of energy required to charge the vehicle each day.

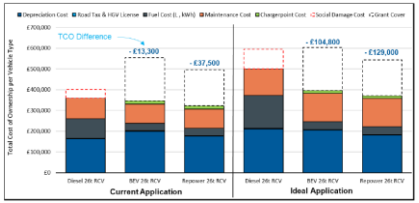


It should be used by all local authorities before trialling and deploying eRCVs to make sure the battery is sufficient for their needs, and they understand how energy might vary across the year.

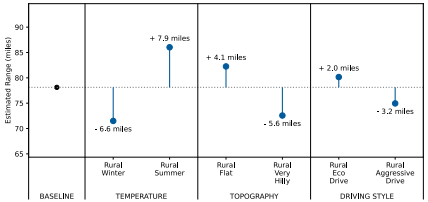
Bespoke Support from Cenex – Cenex provides support as part of the programme, any LA can request advice in planning, acquisition, and deployment of low emission vehicles and their required infrastructure.

Fleet reviews, Infrastructure assessment, and operational advice can alleviate the load on the LA and accelerate ULEV transition.

Improving Economic Performance



Vehicle Performance Analysis



Input | **Output**

Welsh ULEV – LA Engagement Workshop

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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 $^{mi}/_{kWh}$ (real-world)

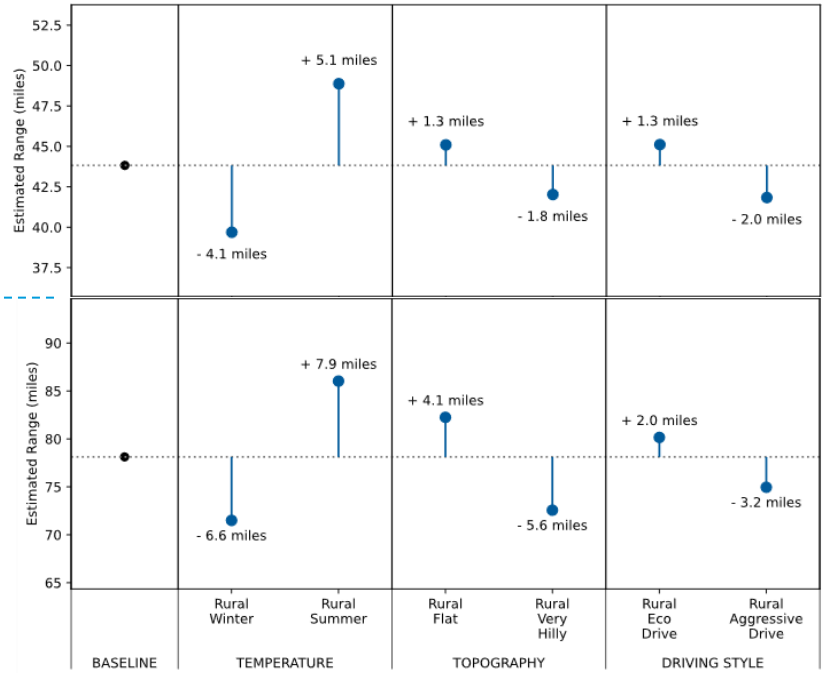
Urban collection range: ~ 40 miles (real-world)

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

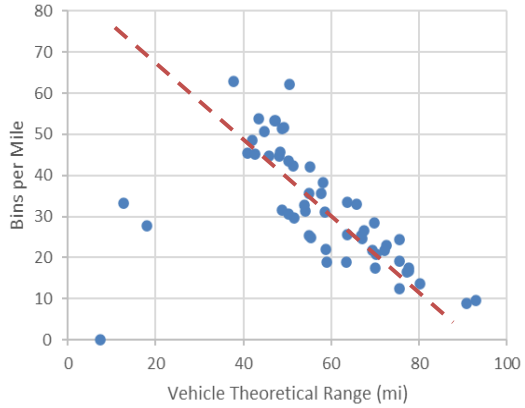
Overall Performance Stats

Urban Rounds

Rural Rounds



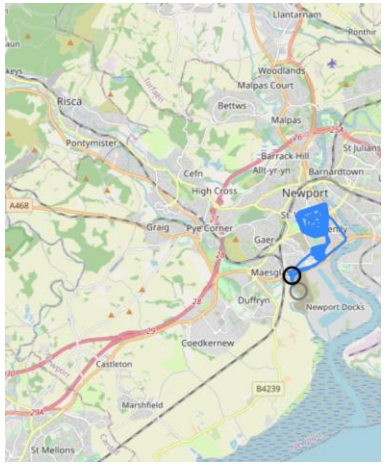
Bin Collection Density vs Vehicle Range



Deep Dive – Dennis Eagle eCollect in Newport

eRCV Operations – Deep Dive

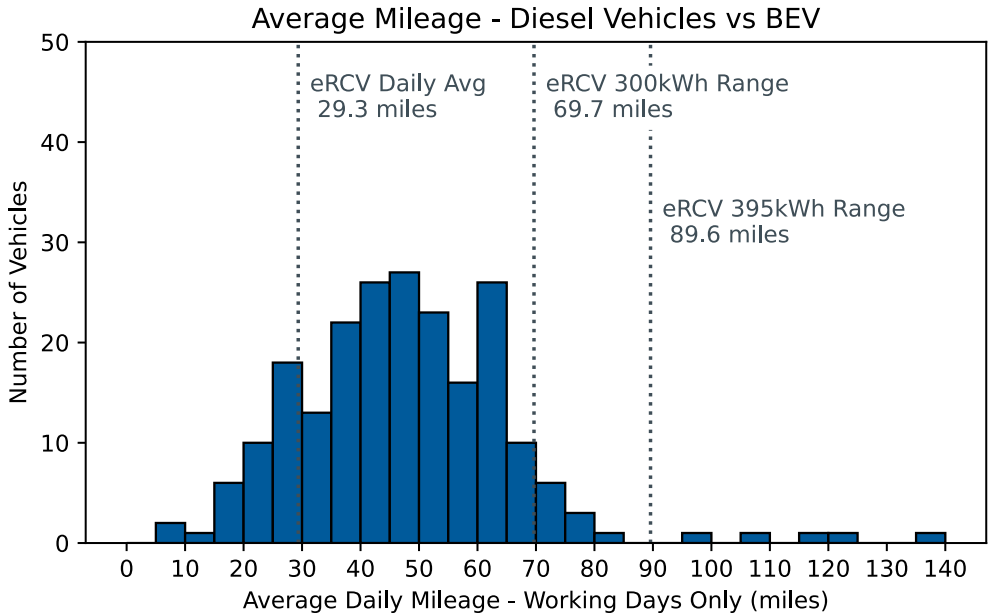
Example – Urban Collection	
Bins Collected	2,018
Distance Driven	16 miles
Energy Consumed	113 kWh
Battery Remaining	62%
Avg. Speed	1.7 mph
Estimated Range	38 miles



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 m^3

Charge time: 5 h (20 – 100%)

Avg. drive efficiency: 0.19 $^{mi}/_{kWh}$ (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.

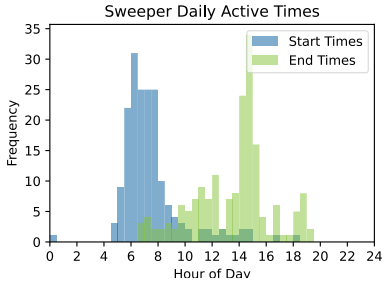
Deep Dive – Bucher V65e Sweeper in NPT

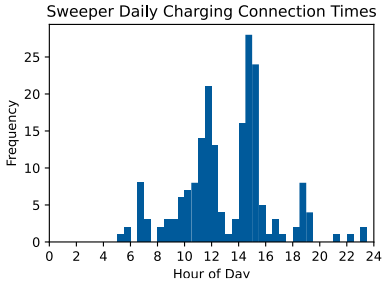
*eSweeper Operations in NPT**

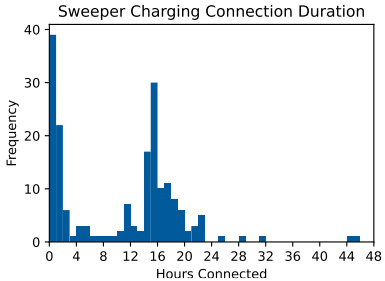
The Sweeper appears to be well utilised with daily battery use varying from 43 – 83%, with an average of 68%.

	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.





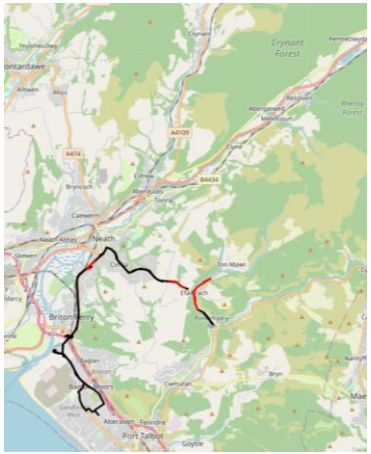


*All data collected for the Bucher Sweeper is limited to Neath Port Talbot during a period of 6 months.

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



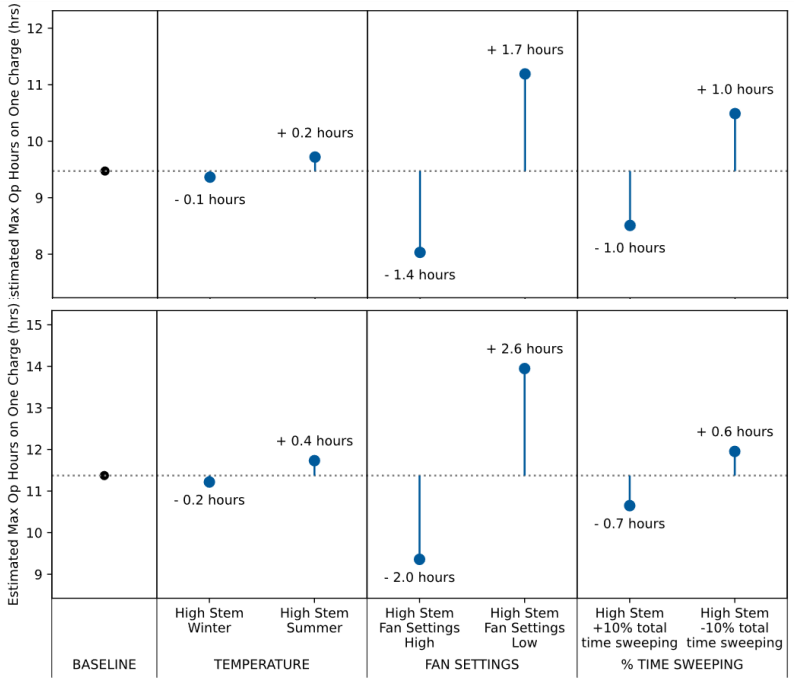
04/11/22 – Lower Consumption Day	
Total Distance	23 miles
Active Time (ignition on)	7 hrs 31 min
Battery Used	64%
% Time Sweeping	30%
Average Consumption	17.0 kWh/h

Travel

Active Sweeping

Deep Dive – Bucher V65e Sweeper in NPT

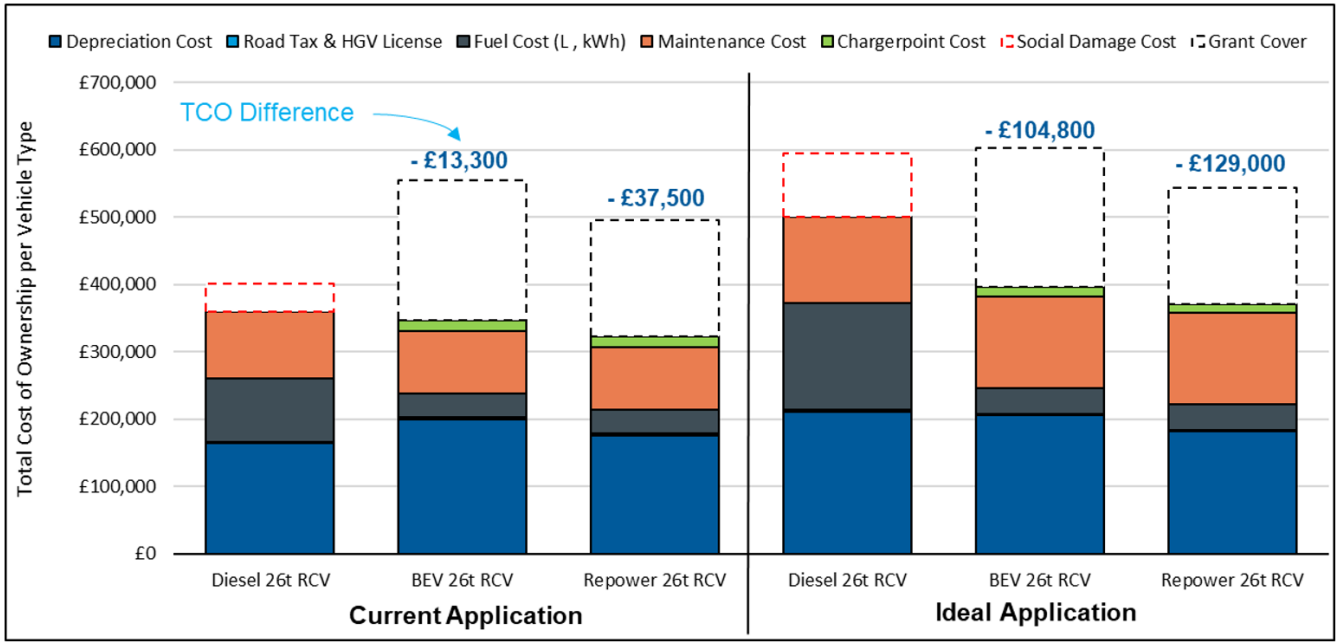
Temperature, Fan Settings, and Time Sweeping Effects on Range



High Sweeping/Driving Ratio

Low Sweeping/Driving Ratio

Pushing the Performance Window



- The vehicles are underutilized currently.

Current OPEX Savings:

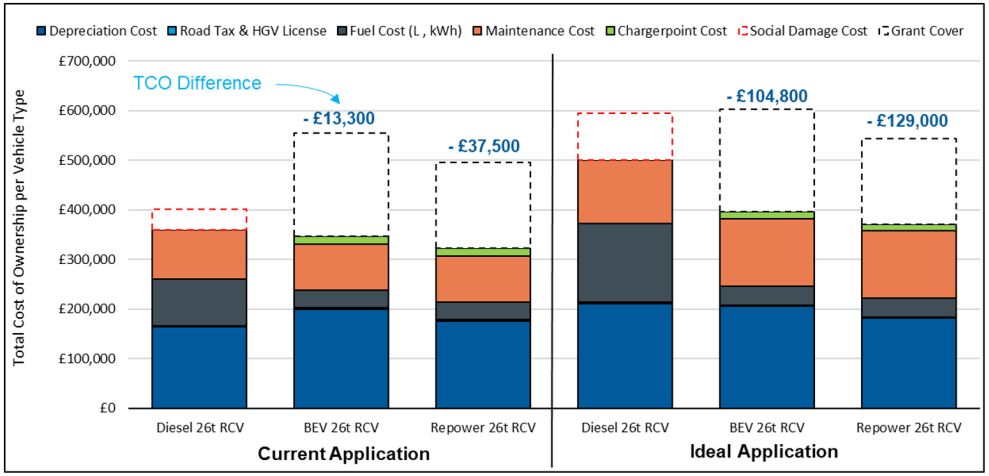
£7,100

Potential OPEX Savings:

£14,200

Improving vehicle utilization could increase TCO savings by ≈500%

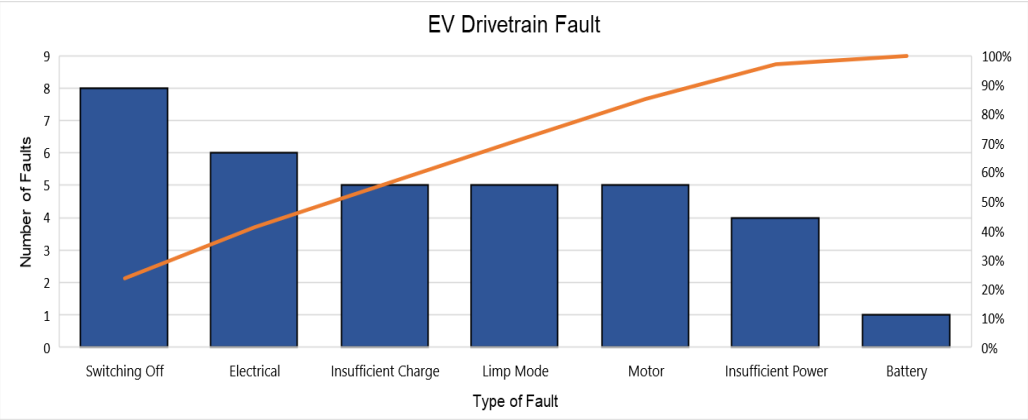
Pushing the Performance Window



- **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.

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

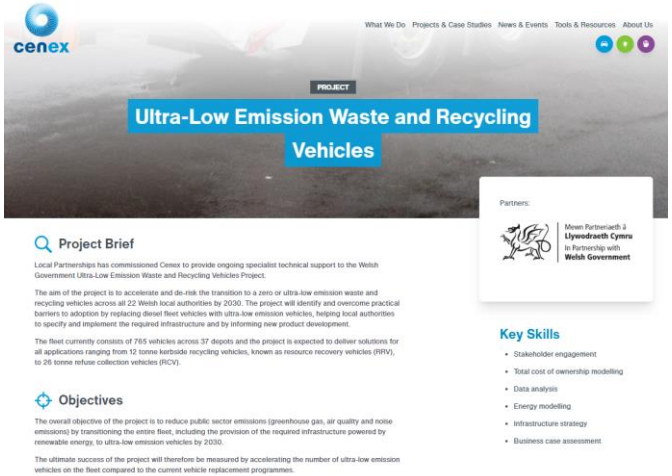
eRRV

eSweeper

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

Programme Support - Implementation

Programme Website

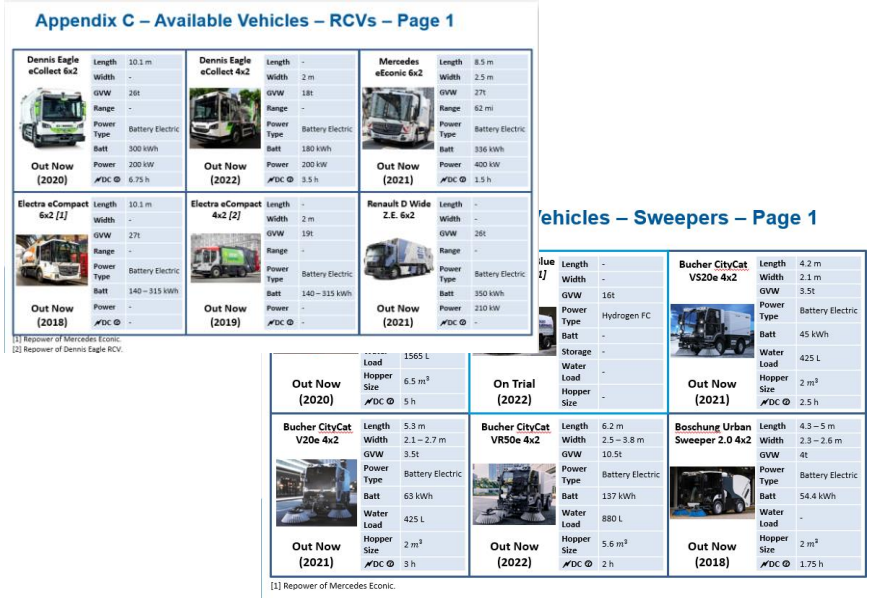


Support Tools

- 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

Dennis Eagle eCollect 6x2	Length 10.1 m; Width -; GVW 26t; Range -; Power Type Battery Electric; Batt 300 kWh; Power 200 kW; DC @ 6.75 h	**Dennis Eagle eCollect 4x2**	Length -; Width 2 m; GVW 18t; Range -; Power Type Battery Electric; Batt 180 kWh; Power 200 kW; DC @ 3.5 h
Out Now (2020)		Out Now (2022)	
Mercedes eEconic 6x2	Length 8.5 m; Width 2.5 m; GVW 27t; Range 62 mi; Power Type Battery Electric; Batt 336 kWh; Power 400 kW; DC @ 1.5 h	**Electra eCompact 6x2 [1]**	Length 10.1 m; Width -; GVW 27t; Range -; Power Type Battery Electric; Batt 140 – 315 kWh; Power -; DC @ -
Out Now (2021)		Out Now (2018)	
Electra eCompact 4x2 [2]	Length -; Width 2 m; GVW 19t; Range -; Power Type Battery Electric; Batt 140 – 315 kWh; Power -; DC @ -	**Renault D Wide Z.E. 6x2**	Length -; Width -; GVW 26t; Range -; Power Type Battery Electric; Batt 350 kWh; Power 210 kW; DC @ -
Out Now (2019)		Out Now (2021)	

[1] Repower of Mercedes Econic.
[2] Repower of Dennis Eagle RCV.

…Vehicles – Sweepers – Page 1

…ilue 1]	Length -; Width -; GVW 16t; Power Type Hydrogen FC; Batt -; Storage -; Water Load -; Hopper Size -	**Bucher CityCat VS20e 4x2**	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 @ 2.5 h
Out Now (2020)	Load 1565 L; Hopper Size 6.5 m³; DC @ 5 h	On Trial (2022)	Out Now (2021)
Bucher CityCat V20e 4x2	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; DC @ 3 h	**Bucher CityCat VR50e 4x2**	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; DC @ 2 h
Out Now (2021)		Out Now (2022)	
Boschung Urban Sweeper 2.0 4x2	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; DC @ 1.75 h		
Out Now (2018)			

[1] Repower of Mercedes Econic.

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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. Pease 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

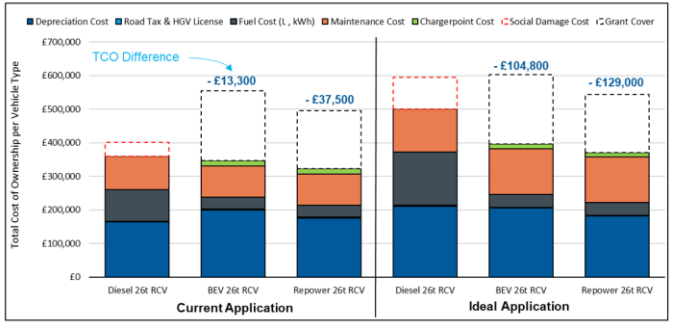
Num	Relevant Steps	Status	Notes
1	Reading this Checklist	✓	Congratulations, you are now part of the change!
2	List fleet vehicle replacement requirements.		
3	Shortlist zero emission vehicle alternatives based on the requirements list.		

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

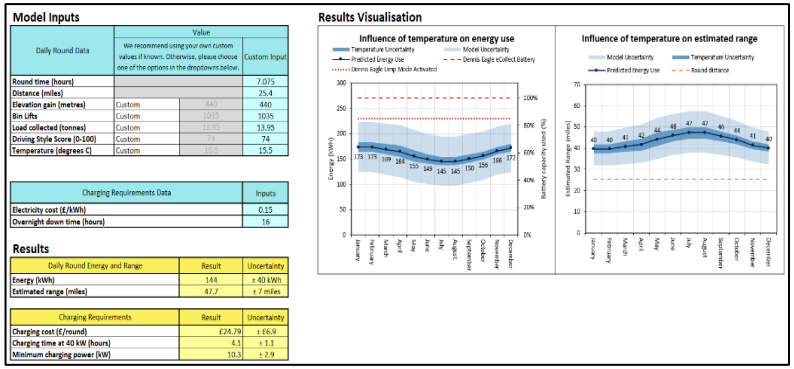
Programme Support

Cenex' Support Tools

Current and Potential eRCV Economic Performance[1]. 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%

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

What support would be useful going forward?

Planned for this year	What support would be most effective?
Development of a project specific website (one-stop-shop) Performance models & insights Quarterly workshops & regular correspondence Advice	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

Andrew Bishop
Waste Strategy Advisor/Cynghorydd Strategaeth Gwastraff
andrew.bishop@gov.wales

Mark Brown
Director - Climate
mark.brown@localpartnerships.gov.uk

Contacts for Planning and Implementation Advice

Vicente Jofré Matamala
Assistant Technical Specialist – Zero and Low Emission Vehicles
vicente.jofre@cenex.co.uk

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Thank you for listening

Steve Carroll

Head of Transport, Cenex, steve.carroll@cenex.co.uk