Welsh Government Zero Emissions Waste and Recycling Programme:

Vehicle Performance Insights: Dennis Eagle eCollect eRCV

21st March 2023

Introduction

This document presents information on the performance of a specific model of electric Refuse Collection Vehicle (eRCV) under different operating situations.

The insights in this report were developed as part of the Welsh Government Zero Emissions Waste and Recycling Project to assist Local Authorities with planning the deployment of zero emission waste vehicles. Data was collected from 24 eCollect RCVs as they were deployed in 5 Local Authorities over a two-year period.

The headline figures in this document help to give a broad idea of the typical range possible under different circumstances with this model of eRCV as observed across several Local Authorities in Wales. A more detailed insight into the variation of vehicle performance can be found by use of the DE 26t eCollect Energy Model Excel Sheet, available on the project website here:

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This model was created to allow a user to input their own route characteristics and get an understanding of the potential performance of an eRCV on their rounds.

Vehicle details

The insights presented in this document are based on data gathered from a single model of electric refuse collection vehicle: the Dennis Eagle eCollect 6x2. While some aspects of eRCV performance will likely be common across different manufacturers and models, the exact trends presented here relate specifically to this model. A summary of details for the eCollect are shown in the table below.

Dennis Eagle eCollect 6x2		
	Gross Vehicle Weight:	26t
	Battery Size:	300kWh (270kWh usable)
	Motor Power:	200kW
	Charging Capability:	50kW 3-phase charger, 6 hour 45 min recharge time (start 25%)
	Typical Range*:	40-80 miles (duty cycle dependent)
*Vehicle range on a single charge based on observed refuse collection routes in Wales. Estimated range was calculated as the miles possible using from 100% to 10% charge based on vehicles' stated battery capacity.		

Vehicle performance window

Data collected from several local authorities showed that the characteristics of the round that an electric RCV is used for will impact the energy consumption and possible range. Here, typical rounds are split into ‘urban’ and ‘rural’ type rounds to illustrate these impacts.

Urban Waste Collection

Urban waste collection is characterised here as having a larger number of bin collections over a shorter distance. Typically in the vehicles observed, these collections covered residential town or city areas.

The graph in Figure 1 shows the estimated full battery driving range of a typical urban collection round of 25 miles, 1000 bin lifts, 8 hours operation at an average temperature of 9°C. A significant variation of the possible range is seen between a typical winter and summer daily temperature. A similar impact is seen by driving in hillier areas, or adopting a more/less aggressive driving style.

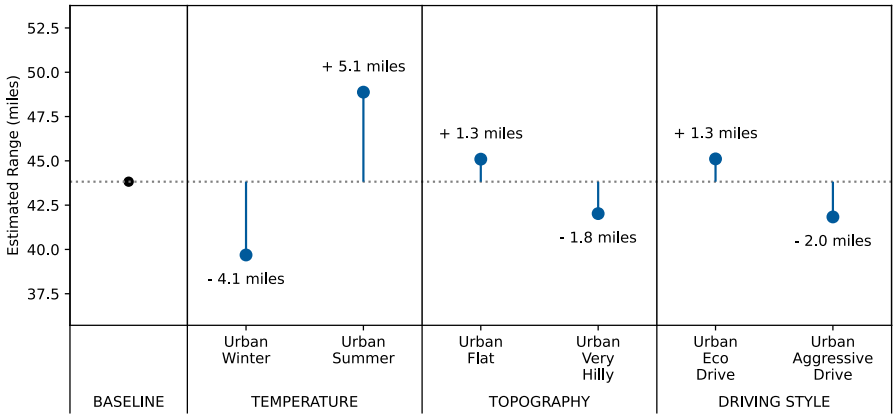


Figure 1: Estimated Impact of Duty Cycle Variations on Vehicle Range during an Urban Route.

Rural waste collection

Rural waste collection is characterised as having a smaller number of bin collections over a longer distance, with a greater average travel distance between lifts.

The graph in Figure 2 shows the estimated full battery driving range of a typical rural collection round of 47 miles, 500 bin lifts, 7.5 hours operation at an average temperature of 15 degrees C. As with the urban rounds, a significant variation of the possible range is observed between a typical winter daily temperature and daily summer temperature. The impact of driving in hillier or flatter areas shows a greater impact on rural routes due to the larger distance travelled. Adopting a more/less aggressive driving style appears to have a smaller, but still noticeable impact on the vehicle range.

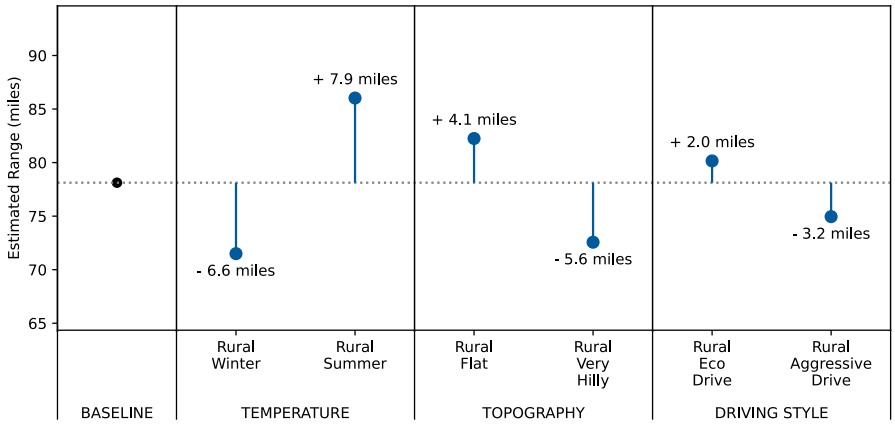


Figure 2: Estimated Impact of Duty Cycle Variations on Vehicle Range during a Rural Route.

Vehicle Planning Model

Model Introduction

The vehicle planning model is a statistical model built from measuring the daily energy use from existing Dennis Eagle eCollect RCVs across different local authorities in Wales. By collecting data from a range of different route characteristics and varying external conditions, the model can build up a more accurate view of how different factors affect the energy use of the vehicle.

This model allows users to explore the estimated energy use and possible range of an eRCV round in more detail than the general performance windows described above.

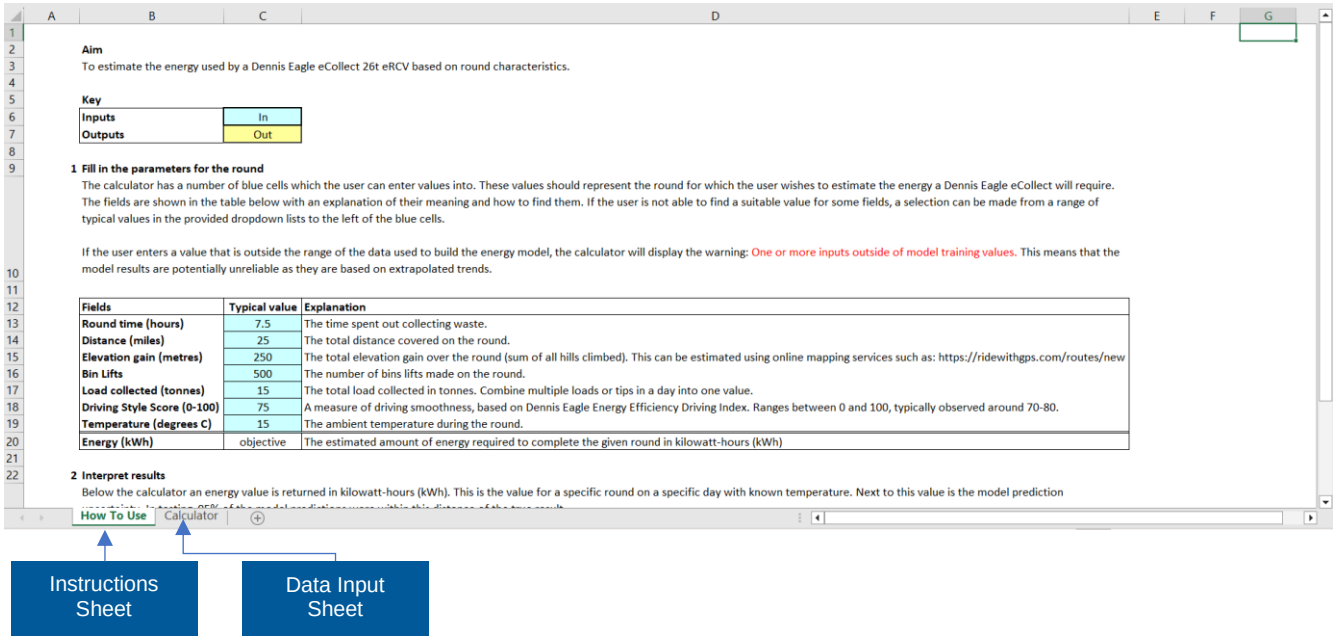
Where to Find the Model

The model can be found on the Cenex project website for the Welsh Government Zero Emissions Waste and Recycling Programme.

Ultra-Low Emission Waste and Recycling Vehicles - Cenex

How to Use the Model

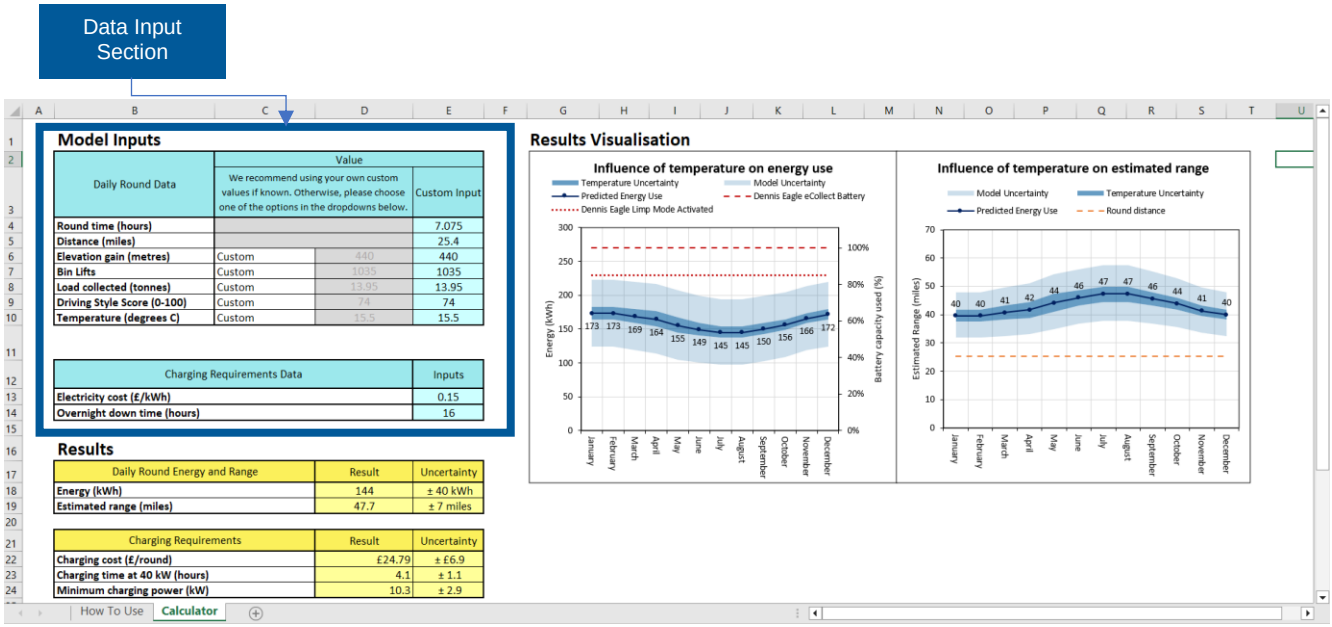
The model can be used by opening the Excel file "**26t Dennis Eagle eCollect eRCV Energy Model**". The first worksheet describes how to use the model, and the second worksheet contains the data input cells and model results.



In the Calculator worksheet, the section for inputting round characteristics is highlighted in blue. Here, a user can input the following characteristics for their daily round:

- Round time (hours)
- Distance (miles)
- Total Elevation Gain (metres)
- Total Bin Lifts
- Total Load Collected (tonnes)
- Driving Style
- Daily Temperature (deg C)

It is preferred that users can provide a specific value for all of the above inputs. However, if some values are not known, estimate inputs are available via dropdown lists to the left of the input cells.



After round characteristics have been entered, the model will update its results and graphics. The model will calculate the estimated total energy used per daily round with the given characteristics. It will also display a measure of the uncertainty of the model. In testing, 95% of the model predictions were within this distance of the true result.

To the right of the results section are graphs showing the estimated variation of the input round over the span of an average year. These graphs use the average temperature for Wales over the year to show the variation in energy required and estimated range as the external temperature changes. Colder months tend to require more energy than warmer months and so the vehicle range decreases. This graph uses the input round characteristics only, and does not take seasonal waste collection trends into consideration.