Transport | Energy Infrastructure | Knowledge & Enterprise

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BETT Quarterly Report Trial Q1: April-June 2022

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Transport Team

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Terms and Conditions

About BETT: the Battery Electric Truck Trial

In June 2021, DAF were awarded funding under the SBRI ZE Road Freight Competition to deploy and undertake research on the performance of 20 DAF LF Battery Electric Trucks.

Cenex, a non-profit research & consultancy organisation focused on low emission transport & associated energy infrastructure, partnered with DAF trucks to lead the study aspects of the research.

A key focus of the research and study aspect is to develop learning materials to promote and educate fleet owners on electric truck adoption. This quarterly report informs on data insights from the trial so far (**April to June 2022**) to help remove barriers to adoption of electric trucks.

Contents

Best of BETT

361 km travelled in one day*

(Vehicle E-2 on 18/05/2022, 103% battery used)

261 kWh used in one day*

(Vehicle E-2 on 18/05/2022, 103% battery used)

06:25 hours worked in one day*

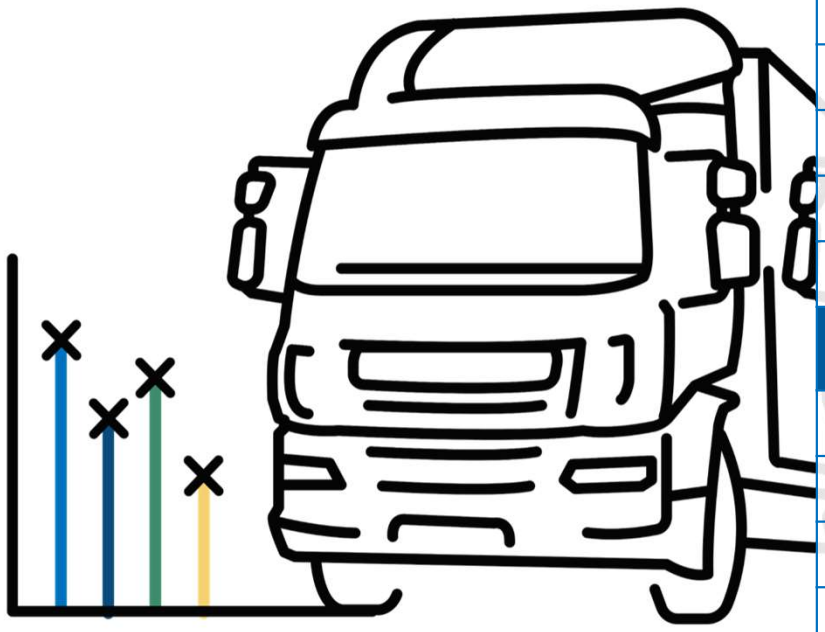
(Vehicle E-2 on 18/05/2022, 103% battery used)

227 kWh charged in one day

(Vehicle E-2 on 18/05/2022, using a rapid charger)

* The vehicle charged once during the day using a rapid charger (see case study in slide 16)

Summary of the Quarter



Summary Stats	
Active Trucks	12
Total Distance	15,932 km
Total Energy	13,764 kWh
Total Number of Journeys	1,268
Total Emissions Savings*	11.5 tCO_2
Real World Range	
Average	305 km
Urban	252 km
Rural	346 km
Motorway	300 km

* Compared to a diesel equivalent truck

Vehicle Activity Summary

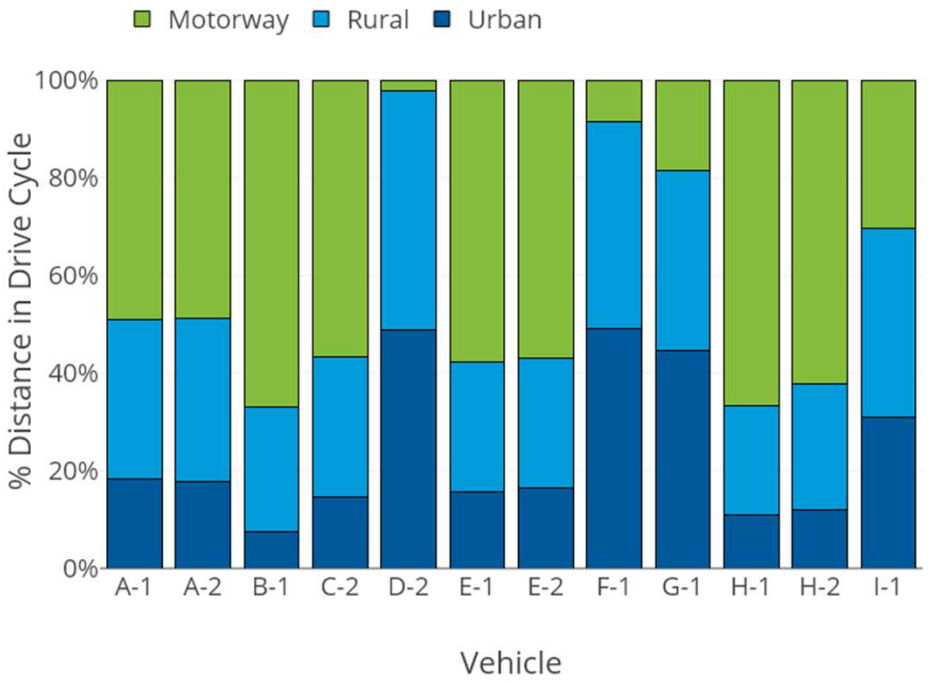
Fleet	Active/Expected	Vehicle	Distance Travelled (km)	Days Driven
A	2/2	A-1	136	3
		A-2	433	4
B	1/2	B-1	364	2
C	1/2	C-2	664	4
D	1/2	D-2	136	2
E	2/2	E-1	2,017	23
		E-2	3,053	23
F	1/1	F-1	436	22
G	1/1	G-1	1,295	36
H	2/2	H-1	4,966	53
		H-2	1,937	25
I	1/1	I-1	495	18
J	0/2	-	-	-
K	0/1	-	-	-
L	0/2	-	-	-
Total	**12/20**		**15,932**	**215**

Drive Cycle

The drive cycles shown on the right describe the type of driving the vehicles exhibit. It is not based on geo-location, but on speed and acceleration statistics. For example, motorway is fast and consistent, whereas urban has more stops and starts.

Most vehicles exhibit a motorway drive cycle for more than half of the distance travelled because although they mostly operate within the cities they are based in, they often use major trunk roads and ring roads to move around.

Conversely vehicles F-1, and G-1 travel to more inner-city locations so have more urban driving. D-2 has very little use so far, so data is not currently representative.



The average for all vehicles is:
Urban 18% | Rural 27% | Motorway 55%

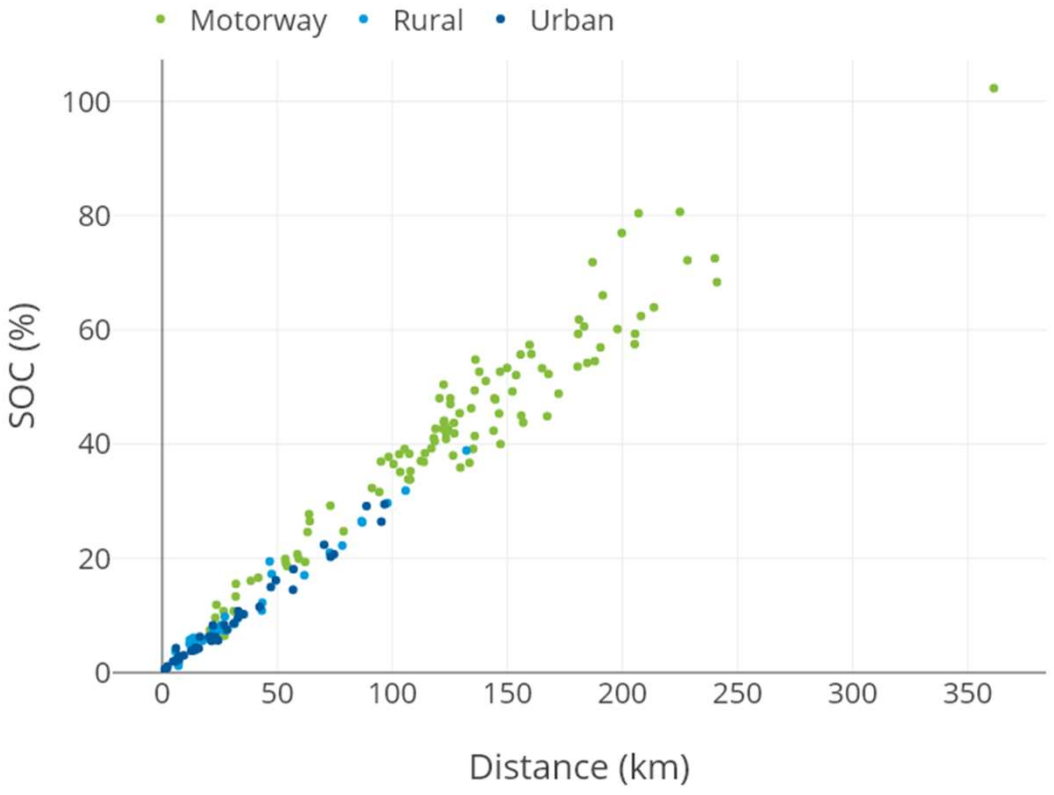
Daily Distance vs SOC

This graph shows how far vehicles travelled in a day, and how much state of charge (SOC) was used*.

Days are colour coded by which drive cycle they mostly drove.

This shows that in a day vehicles can travel about 240 km using 70% of the battery.

The highest distance a vehicle has travelled in one day is **361 km** using just over 100% of the battery, which is possible due to a top-up charge.



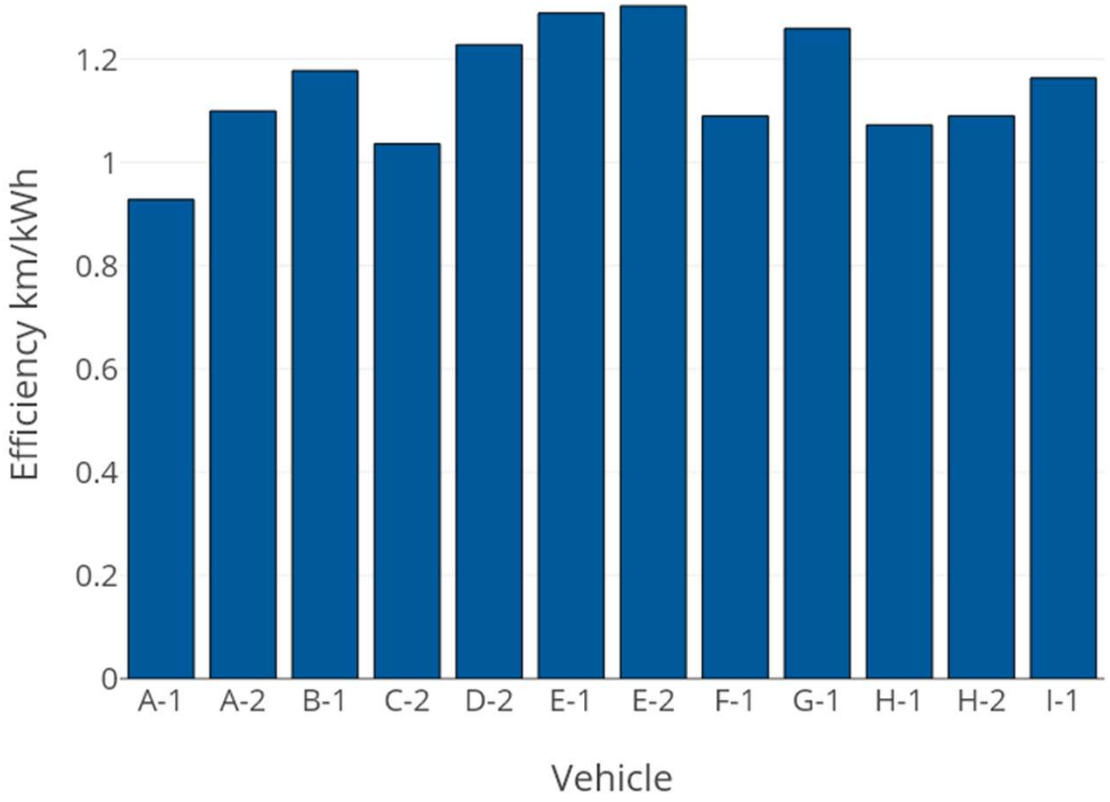
* Only takes into account SOC used for propulsion

Energy Efficiency

The energy efficiency of the trucks across all drive cycles ranges between 0.93 and 1.30 km/kWh.

With a 250-kWh battery, the range of the vehicles would therefore be between **238 km** and **357 km**.

The average real-world range observed during the trial this quarter is **305 km**.



State Duration

A vehicle is in one of four states: Driving, Charging, Idling (e.g., at traffic lights) and Parked.

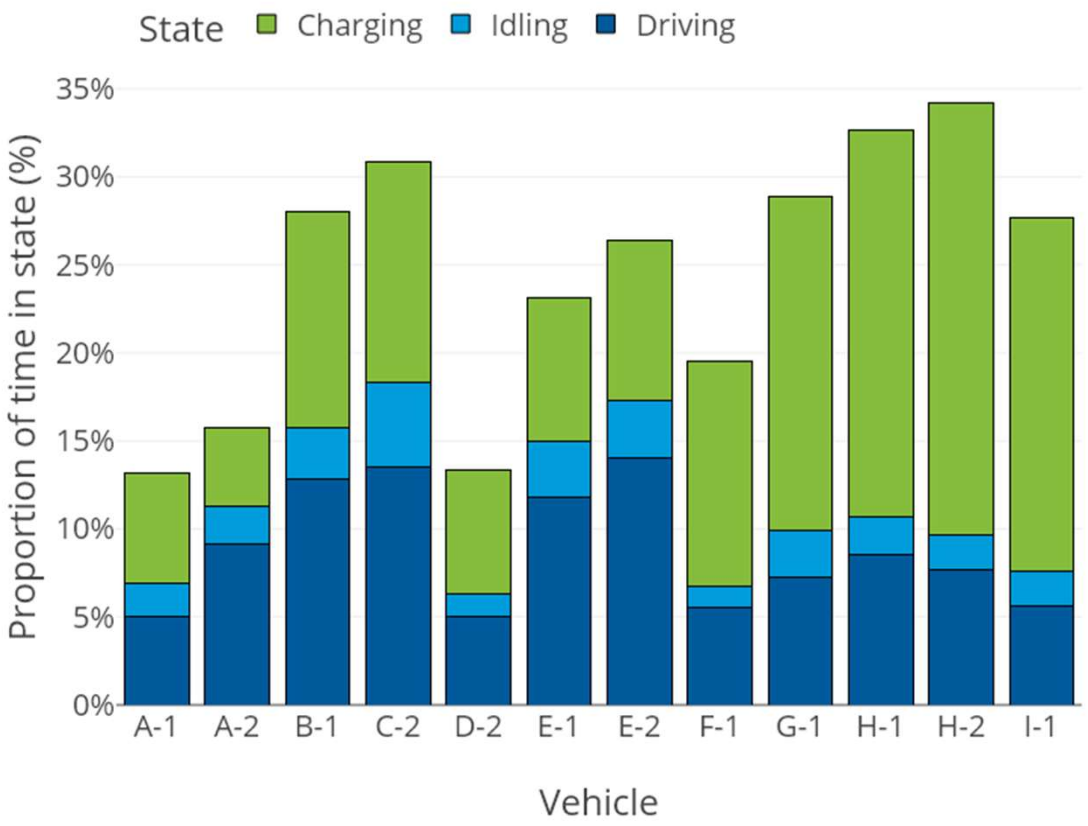
The graph to the right shows how long vehicles are in each state, except for parked, which is the remainder.

As this is the beginning of the trial, fleets are still learning how to use their trucks, so the usage patterns may not be typical of 'normal' usage.

On average vehicles spent:*

- 9% of time driving
- 2% of time idling
- 17% of time charging

*Only uses days where vehicle is in use (driving or charging) for more than 20 minutes

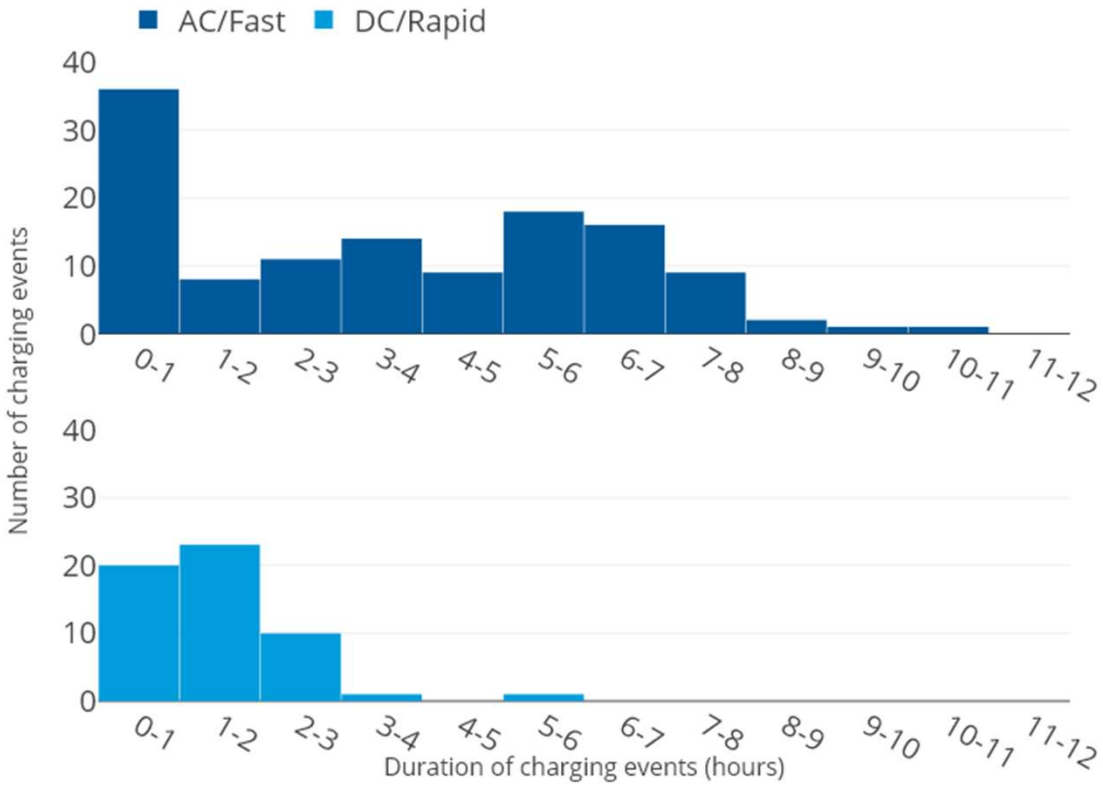


Charging Duration

This graph shows how long vehicles spend charging using AC fast (22 kW) or DC rapid (150 kW) chargepoints.

There is a large number of short AC charging sessions, but this may be due to drivers being trained on how to use chargers (plugging/un-plugging frequently) as this is the start of the trial. The distribution peaks at **5-6 hours**.

DC rapid charging sessions tend to take less than **2 hours**.



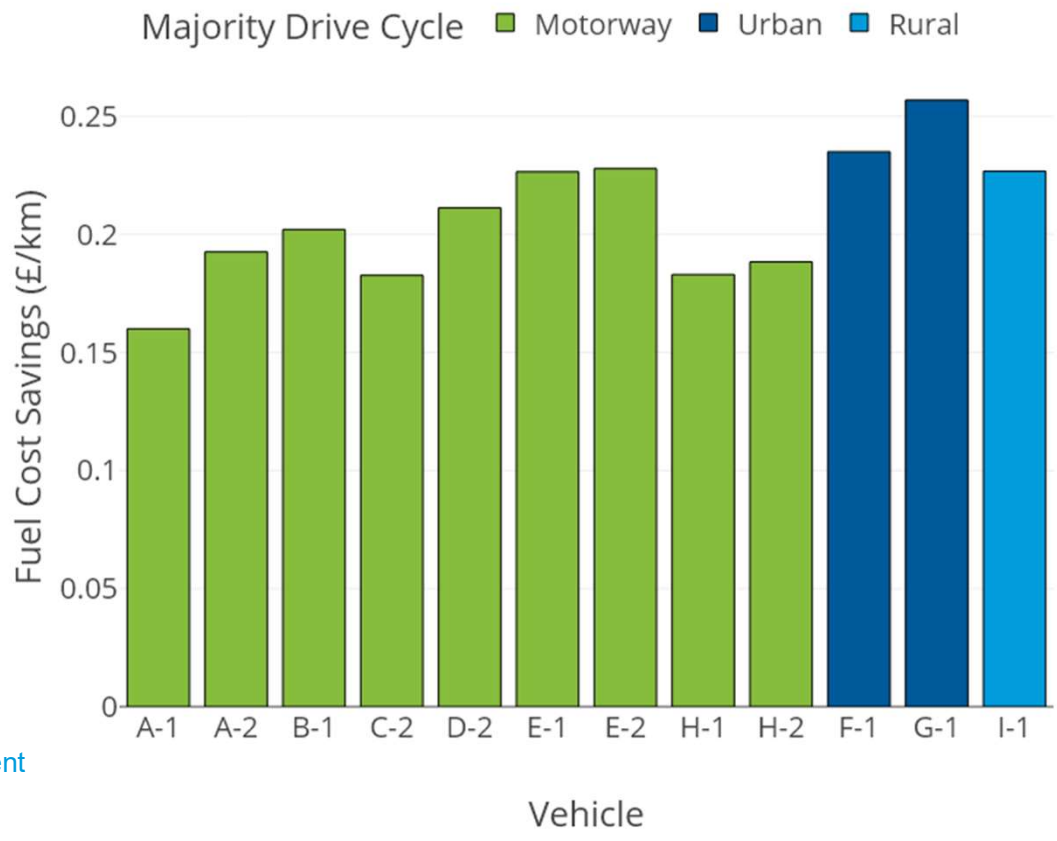
Fuel Savings

This graph shows the average fuel savings per km of each vehicle across the quarter*.

The average fuel savings per km range from £0.16 to £0.26.

The fuel savings for a vehicle driving an annual distance of 50,000 km** would be between **£8,000** and **£13,000 per year**.

The vehicles with the highest average fuel saving are driving mostly in urban or rural environments which shows the relative inefficiency of diesel vehicles in start-stop situations.

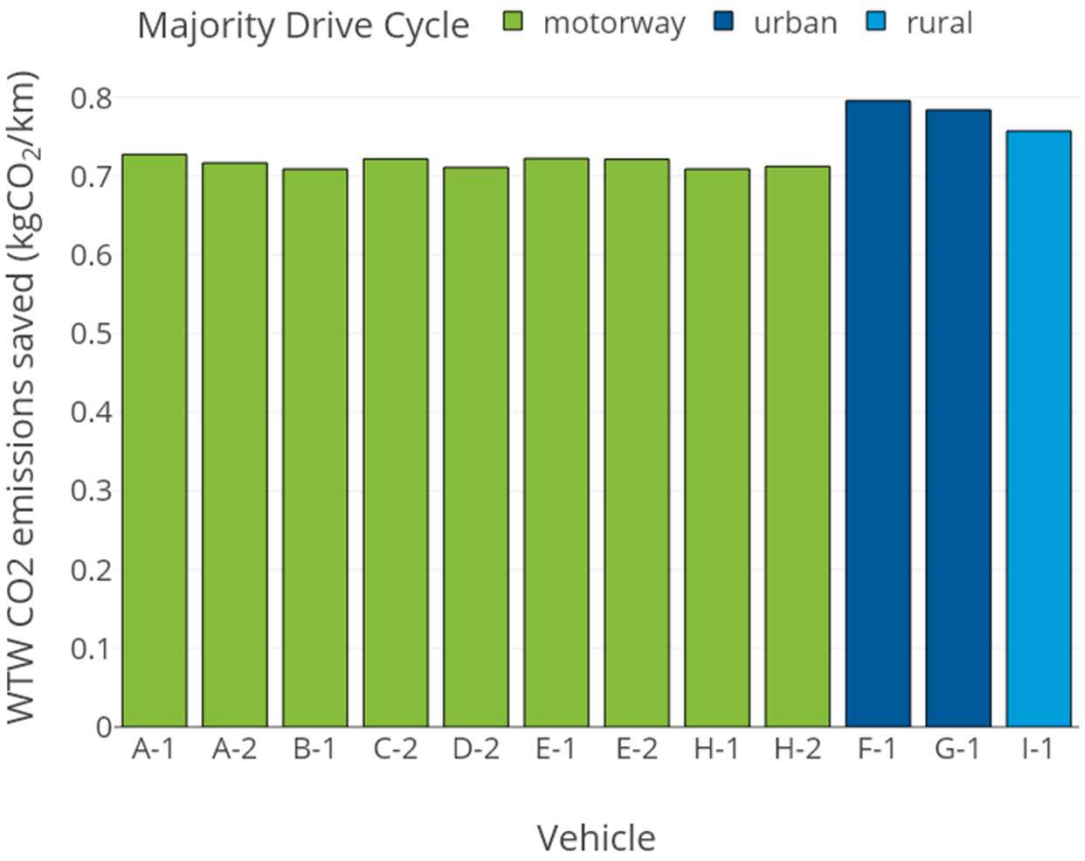


*These figures are generated using £1.75 p/l for diesel on an equivalent diesel truck and £0.23 per kWh for electricity.
**Average annual distance in UK for 17-25t rigid trucks (source: DfT)

Emissions Savings

Emissions savings are calculated as the reduction in CO_2 emitted from 'Well to Wheel' (WTW), which includes the whole life cycle of the fuel/electricity from mining/production through to use in the vehicle.

Emissions saved per km range from **710 to 800 gCO_2/km**. The total WTW CO_2 saved in the first quarter of the trial was **11.5 t**, equivalent to planting just over one football field worth of trees.

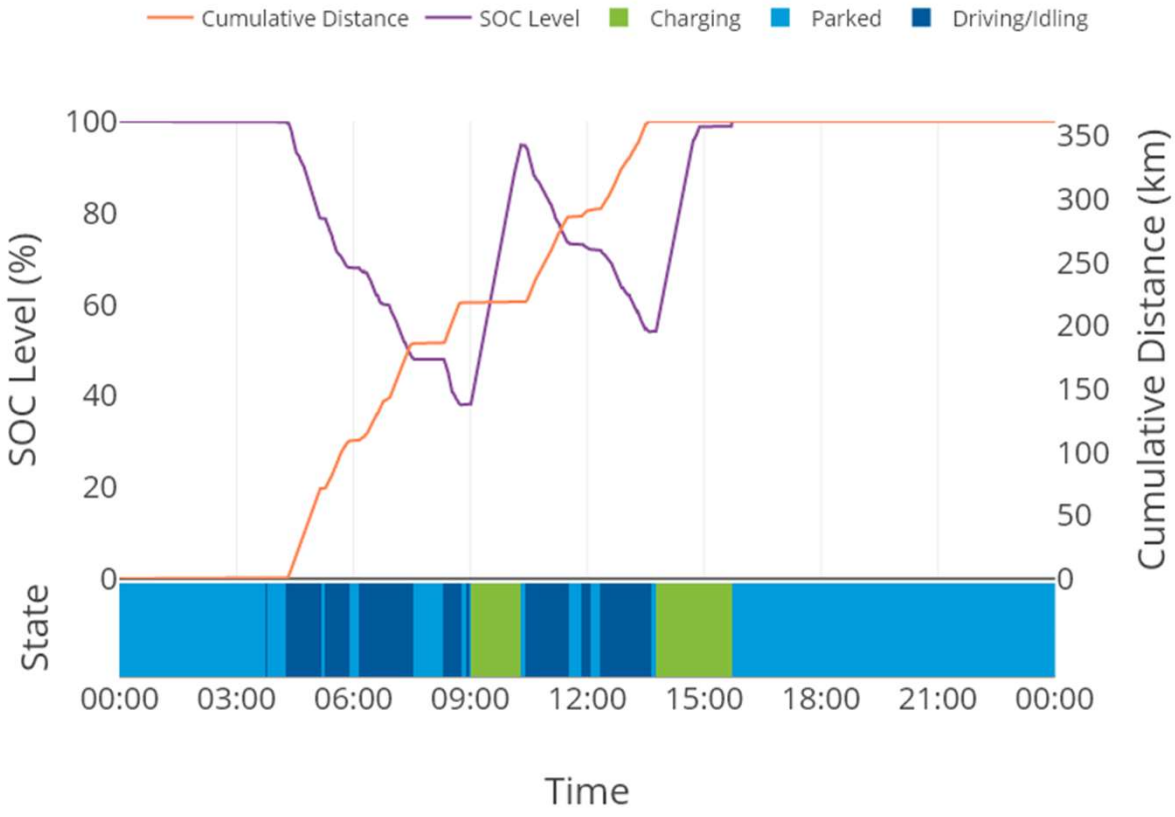


Case Study of Long Distance Day

The furthest distance travelled in a day by a truck this quarter was **361 km**.

The graph on the right shows the battery SOC level and the cumulative distance the vehicle travelled that day.

The vehicle travels 218 km using 60% of the battery before the first charge at 9:00. After 1 hour and 20 minutes it has charged to 95% SOC using a 120kW charger. Then it travels a further 143 km before charging again to 100% ready for the following day.



Glossary of Terms

Acronym/Term	Definition
SOC	State of Charge
WTW	Well to Wheel
Urban	Many stops and starts
Rural	Steady continuous speed
Motorway	Higher continuous speed
BETT	Battery Electric Truck Trial
ZE	Zero Emission

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