Technical advice note

Using data to inform the transition to electric vehicles

Background

Transitioning from internal combustion engine (ICE) vehicles to battery electric vehicles (BEV) is a significant, but vital, undertaking, and the transition can be made easier if reliable data on current vehicle use is available. Electrified transport produces no harmful tailpipe emissions, reduces carbon emissions, and can be zero-emission when powered from renewable energy. Even with the UK grid as it is, a switch to electric vehicles can immediately reduce carbon emissions by approximately two thirds (including battery production), and this will continue reducing as the grid decarbonises. It is also possible for an organisation to generate their own renewable energy, and if aligned to the amount of energy the fleet needs, then electrified transport can be net zero.

Switching to an electrified form of propulsion requires more than simply buying different vehicles. The whole system is different, and it needs to be thought about holistically. Vehicles with appropriate battery sizes for the job need to be procured, the electric vehicle charging infrastructure (EVCI) needs to be installed, a charging regime implemented, and all this needs to be integrated with the rest of the site's energy use and capacity. This is a significant undertaking. Fortunately, it is possible to create certainty using existing data to estimate what the energy requirements of a fully electric fleet would be – and from this the EVCI, site capacity requirement (kVA), charging regime and interactions, can all be estimated. It is therefore crucial to record data about the current fleet exactly.

Good data collection

To use ICE fleet vehicle data to determine the energy use of an all-electric fleet, the data needs to be reliable and robust. This means having accurate mileage recordings and accurate fuel use, for each vehicle used.

In practice, this means diligence when refuelling the vehicles and recording vehicle registration marks and odometer readings, whether that is using fuel cards or on-site bulk storage. Any fuel drawn for use in ancillary equipment like mowers must be identifiable and recorded separately. It could also mean implementing a regular process to record odometer readings and matching this to fuel purchased.

Systems are available to accurately monitor energy use, recording mileage, litres and purchase of fuel. They can also manage fleet workshops, manage the fleet itself, track all vehicle movements and report data from the vehicle's internal information network (the CAN bus). It is critical that these systems are fully integrated and that the best quality data from all the different sources is used. For example, combining accurate distance travelled or hours worked from CAN bus-linked tracking data with actual fuel purchased from fuel cards, to give accurate energy efficiency (mpg, miles/kWh, Wh/km).

Using the data

If fuel use and mileage are known, it is simple to work out the energy efficiency for each vehicle. This could be in miles per gallon (mpg) but can also be in kilometres per kilowatt-hour (km/kWh) – indicating the amount of distance available from a given amount of energy, or kWh/km – indicating the amount of energy to travel a given distance.

Unit conversions	
0.22 gal/L	4.55 L/gal
0.62 mile/km	1.61 km/mile
9.5 kWh/L petrol	10.6 kWh/L diesel

$$miles \div (fuel\ L \times 0.22\ gal/L) = mpg$$

$$km \div (fuel\ L \times 10.6\ kWh/L) = km/kWh\ (diesel)$$

$$(fuel\ L \times 10.6\ kWh/L) \div km = kWh/km\ (diesel)$$

Due to the significantly higher efficiency of BEVs over ICE vehicles, a BEV can be typically expected to use between 25-35% of the energy used by the ICE vehicle. This gives an indication of the battery size needed for the replacement BEV and, therefore, whether a suitable vehicle is available. It also gives an estimation of the amount of energy required for the BEV, and how often it would need recharging.

Have efficiency in kWh/km from previous
BEV energy = 25-35% ICE energy

$$ICE\ kWh/km \times 30\% = BEV\ kWh/km$$

$$BEV\ kWh/km \times daily\ km = daily\ kWh$$

$$BEV\ kWh/km \times annual\ km = annual\ kWh$$

Estimating this information for the whole fleet gives a solid basis from which to determine the EVCI and site energy a fully BEV fleet would require. With telemetry data, this can even be estimated on a daily basis, to illustrate site interactions, such as the maximum energy draw on a single day. This then provides information about the amount of capacity required at the site, the amount of energy needed if installing solar power, how these would interact with other site activities, and what changes need to be made to secure a net-zero carbon organisation, both in transport and energy.

Producing and using this information on BEVs creates greater certainty in a radical change which is inherently uncertain, but the main issue with this approach is that it relies on past performance to predict future use. There may be opportunities to reduce fuel/energy use altogether, such as through more economical driving behaviour (which would also benefit the switch to BEV and may reduce range concerns), downsizing the fleet, or through more effective road transport use. There may also be changes to the organisation's transport use, for example changes to refuse collection rounds.

Accurate data

The accuracy of energy efficiency estimates depends on having reliable data, and without this the best alternative is to base estimates on expected UK or fleet averages. Averages can provide an indication of the energy use of a BEV fleet but will not take into account the specific operating environment of the fleet vehicles – for example if vehicles run hilly rural routes, or mostly motorway or urban conditions, or if the vehicles have an irregular usage pattern – these all have a significant impact on energy efficiency and daily energy requirements. This could lead to erroneous conclusions about the capacity of BEVs to replace an ICE vehicle.

For example, a 2.5 tonne van uses 18 L of diesel to travel 120 miles daily, giving an efficiency of 30 mpg, or 0.99 kWh/km.

A BEV would be expected to use around 30% of the energy of the ICE, giving a real efficiency of 0.30 kWh/km.

With all or part of the data missing, we would assume a standard efficiency of 40 mpg, or 0.75 kWh/km, which gives a BEV efficiency of 0.22 kWh/km.

If we wish to work out the energy use for a known route length of 80 miles (130 km), the two efficiencies give different energy values:

- *Real: 38 kWh*
- *Assumed: 29 kWh*

With a large fleet, even small differences can compound, which can lead to under or overestimation of the EVCI required resulting in insufficient or excess capacity. In a worst case on a constrained site for example, this could mean success or failure of a fleet transition to BEV if average data concludes that the site has sufficient capacity but in practice it does not, and a new site or connection must be installed.

In worst cases, the data can show a significant amount of fuel that is wrongly or not allocated to any vehicle, meaning the data for each fleet vehicle may not be reliable at all.

Find out more about how the Welsh Government Energy Service can help your community enterprise or public sector organisation:

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