GEOTAB

The Ultimate Guide to Fleet Electrification

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This is your go-to resource for understanding the business case for electric vehicles (EVs) and how implementing them into your fleet can turn into a great investment.

If you own or operate a fleet of vehicles, you may be wondering whether an EV investment is right for your organisation. Or you may be aiming to hit a sustainability target and believe electrifying a portion of your fleet is the solution.

The reality is that EVs are here to stay. It's not a question of if EVs are coming to your fleet, but when. So, where do you start?

From dealing with change-adverse operators to figuring out which vehicles can match their traditional internal combustion engine (ICE) vehicle counterparts, there are many unknowns. We're here to help you solve those challenges and set a smooth course for electrification and EV fleet management.

Ready to get started? Let's dive in.

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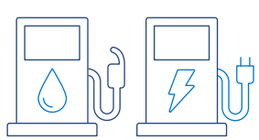
CHAPTER 01

What is an electric vehicle?

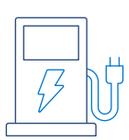
Your neighbour owns one, you see them in driveways and on the motorway – EVs are everywhere these days. But what exactly is an electric vehicle? Let's start with the basics.

What is an electric vehicle?

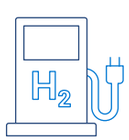
The distinguishing feature of an electric vehicle is its use of a battery and electric motor for propulsion. EVs use a battery pack to power the motor that then has to be recharged by plugging into an electrical source. Battery vehicles continue to gain momentum and while passenger cars have led the way, we're now seeing a variety of sizes and classes including electric vans, HGVs, buses, and even forklifts making their way to the market.



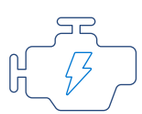
Plug-in hybrid electric vehicle (PHEVs)



Battery electric vehicle (BEVs)



Fuel cell electric vehicle (FCEV)



Hybrid electric vehicle (HEV) (ICE)

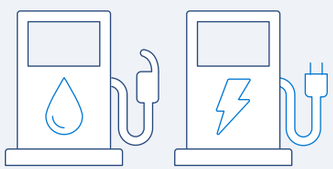
Zero Emission Vehicles

Not included in EV data reporting/monitoring. Does not plug-in to charge.

Types of electric vehicles

Electric vehicles can be generally classified as PHEV, BEV, HEV or FCEV. Let's drill down into the key differences:

Plug-in electric vehicles



Plug-in hybrid electric vehicles (PHEVs)

+ Electric motor that can be charged by plugging in plus an ICE that runs on liquid fuel (that either helps to propel the vehicle and/or powers the battery as a generator).
+ Fuel supplements the battery as a power source, effectively extending the range.
+ Some PHEV models only use fuel when the battery is depleted, as a backup generator.
+ Examples include: Hyundai Ioniq, Toyota Prius, Mitsubishi Outlander, and Volvo XC60.

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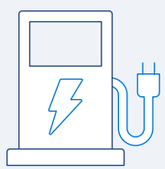


Battery electric vehicles (BEVs)

+ Fully electric vehicles with no petrol or diesel engine.
+ Convert energy stored in battery packs to electricity to power an electric motor and turn the wheels.
+ Can recoup some charge back from regenerative braking, but once the battery has been depleted, it has to be plugged into a charging station or electrical outlet to recharge.
+ Emits no exhaust fumes from a tailpipe. (BEVs don't even have a tailpipe!)

Examples include: BMW i3, Kia e-Niro, Kia Soul, Nissan LEAF, Volkswagen ID.3 Tesla Models 3, X, Y and S.

Other types of electric vehicles

Hybrid electric vehicle (HEV)

+ Not generally considered electric.
+ Small battery and electric motor.
+ Unable to charge from the grid.
+ Can only be recharged by the petrol engine (as a generator) or through regenerative braking during use.

Examples include: Toyota Prius Hybrid, Honda Civic Hybrid and BMW 330e

Fuel cell electric vehicle (FCEV)

+ Use a fuel cell to convert hydrogen storage in tanks, into electricity.
+ Have a small battery pack to increase efficiency.
+ Electricity is used to drive the electric motor.
+ While HEVs and FCEVs are classified as electric vehicles, this document focuses only on plug-in electric vehicles.

What is EV range?

EVs are advertised with a rated range – this is how far a vehicle will travel on a single charge. Real world range will depend on a number of factors including temperature, passengers or load, geographical conditions and driver habits. Electric vehicles come with different battery sizes, or capacity (measured in kilowatt hours: kWh or watt hours: Wh), depending on their make and model. Larger battery packs offer longer range.

TIP

Hot and cold climates can impact an EVs range – this is true for both consumers and of course, fleets. The Temperature Tool for EV Range can help you uncover the impact extreme temperatures will have on your day-to-day range to help you ensure you have the right vehicle for the job.

Understanding the EV battery

Electric vehicles use Lithium-ion batteries of various designs, similar to those used in mobile phones and laptop computers, only on a much larger scale. Lithium-ion batteries have a high-energy density and are less likely than other types of batteries to lose their charge when not being used.

Batteries naturally degrade over time, meaning their ability to store energy and deliver power diminishes. EV batteries are covered under manufacturer warranties, and data to-date shows degradation has on average been minor. For detailed research on battery degradation in EVs, check out our analysis of over 6,300 EVs.

A number of factors can impact the speed of battery degradation:

- **High state of charge (SoC)**
- **High current**
- **High temperatures**
- **Low state of charge (SoC)**
- **Energy cycles**
- **Low temperatures**

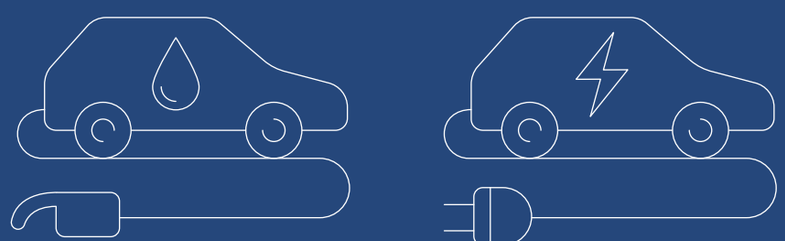
DID YOU KNOW?

Battery-powered vehicles are not a new phenomenon. In fact, electric vehicles have existed as long as petrol-powered cars. What has changed, however, is better battery technology and growing public attention to the many environmental and economic benefits that EVs can provide.

Similarities and differences between petrol vehicles and electric cars

Sitting inside an electric car for the first time, you'll notice that nearly everything is in the same place as it would be in a traditional ICE vehicle.

The accelerator and brake pedals are in the same spot. The gear shifter is located either between the seats or on the steering wheel. But, while they may look similar, there are some key differences in EVs.



1 One-speed transmission

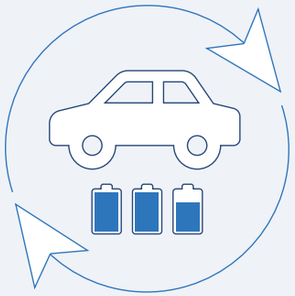
Most electric cars operate only in drive (one-speed) mode. In conventional vehicles, many speeds are needed because the combustion engine can only be operated in a narrow speed band, and the efficiency is highly dependent on the engine speed.

By contrast, electric motors operate over a very wide speed band, and can maintain high efficiency across this band. Electric motors can also provide torque in both directions so a single gear ratio can be used for both forward and reverse, unlike combustion engines.

2 Instant torque

While ICE vehicles take many revs to get to maximum torque, electric cars have access to the majority of torque from a stop. Therefore, EV acceleration is superior to equivalent petrol-powered vehicles.

It shouldn't take long to adjust to the additional power available every time you put your foot down. This rapid acceleration is useful when drivers need to increase speed quickly to enter a motorway.



Energy is captured during regenerative braking and recycled back to the battery.

3 Regenerative braking and Eco mode

Some vehicles will allow you to control how aggressively the car slows down when your foot comes off the accelerator. Regenerative braking can help train vehicle operators to accelerate and stop smoothly, by using a single pedal for most of their driving, thereby conserving energy and range. One-pedal driving is also useful in congested city driving, as the vehicle automatically slows when the accelerator is released, allowing drivers to easily slow down and speed up through traffic, without constantly slamming on the brakes.

4 No engine noise

Perhaps the most obvious difference between ICE and electric vehicles is engine noise. EVs operate on silent electric motors, so you only hear the quiet whirring and tire noise. If a pedestrian or cyclist is not actively watching the road they may not hear a slowly approaching EV.

DID YOU KNOW?

The European Union implemented a regulation requiring new EVs to be equipped with an Acoustic Vehicle Alert System (AVAS) that produces noise when traveling under 20 kmph (12 mph) so pedestrians can hear an EV approaching. This rule goes into effect on July 1, 2021.

CHAPTER 02

Electric vehicle benefits for fleets

Now that you have a better handle on the basics, let's take a look beneath the surface and identify some of the key benefits for fleets considering electrification.

Even though the number of EVs on the road is proportionally small on a global scale, the electric mobility movement is expanding at a rapid pace.

The EV driving model can benefit nearly everybody, including fleets. Operators will benefit from lower running costs while drivers enjoy improved performance in some of the most cutting-edge vehicles on the planet, all while reducing negative impact on the planet's atmosphere.

KEY TAKEAWAY

BloombergNEF predicts that by 2040, there will be over 500 million passenger EVs and 40 million commercial EVs on the road.

Safety benefits

Electric vehicles have additional built-in safety benefits for fleet managers. Let's explore a few of them here.

High safety ratings

EVs must not only undergo the same safety testing and standards requirements as ICEs they must also meet EV-specific standards for limiting chemical spillage from batteries as well as securing the batteries during a collision. Plus, EV carmakers are upping the safety quotient by loading the vehicles with more standard features.

Because BEVs operate without an engine and all associated components, they are structurally safer than conventional vehicles. The space typically occupied by a combustion engine provides a larger crumple zone to absorb energy during a collision and protect drivers and passengers. And, while some collisions may result in a fire in a conventional vehicle, EV fires are extremely rare.

Thanks to the placement of the battery packs, a major benefit of an EV is that most of its weight is low to the ground and distributed more evenly. This helps to prevent dangerous vehicle rollovers, which, according to statistics from NHTSA, are more fatal than other types of vehicle collisions.

It's widely known that the extra money you pay upfront for an EV tends to come back in the form of fuel savings down the road. But those EVs will also pay dividends in fleet safety – which can, in turn, add up to real savings in terms of insurance and collision costs.

DID YOU KNOW?

Electric cars offer more passenger safety than conventional ICE vehicles. With the Nissan LEAF winning a 5-star safety rating in crash tests.

Maintenance benefits

EVs have lower maintenance costs due to fewer moving parts and no particulate buildup. Fewer parts to maintain and repair means a substantial amount of money saved over the vehicle's life, but also can lead to a better safety record. Some known safety hazards of petrol cars include misfiring cylinders, bad spark plugs or damaged timing belts, all of which can be dangerous if they occur while driving. EVs, in contrast, have none of these parts.

Brakes on EVs also end up with less wear and tear. Thanks to regenerative braking systems – which capture and restore energy that would otherwise be lost to friction – EVs end up putting much less strain on their brake pads.

Save on fuel

Swapping out petrol-powered vehicles for EVs can help fleets save money on day-to-day expenses – one of the biggest being fuel. EDF Energy calculates that on average, it costs less than half as much to travel in an EV than a petrol-powered vehicle.

EVs are three to four times more efficient than ICE vehicles at converting energy to motion, and electricity rates are less than average fuel rates across the globe. Additionally, electricity rates tend to be much more stable than petrol prices, meaning budgeting is easier with more predictable operating costs.

DID YOU KNOW?

According to a Direct Line study, EVs cost half as much to maintain as ICEs.

Sustainability

Electric vehicles are a great opportunity for fleets looking for ways to improve air quality to meet organisational goals – and to contribute towards EU climate change goals.

Thanks to their zero-emission design, BEVs directly contribute to better air quality by eliminating the exhaust emissions presented by their ICE counterparts, and reducing total emissions anywhere from 30% to 90%, depending on the energy grid.

As the COVID-19 pandemic brought into sharp focus in 2020, one noticeable side-effect of taking ICE vehicles off the road (due to stay-at-home measures to reduce the spread of the virus) was a major decline in transportation CO2 emissions across the globe.

Fleets can work to maintain at least some level of this decrease in emissions by committing to a transition to EVs wherever possible.

Budgeting

Budgeting becomes much easier with EVs as they have more predictable operating costs. While petrol prices can be highly volatile in any given year, electricity prices tend to be more static, so fleet managers can prepare more accurate budgets.

Incentives are often available for EVs, as governments around the world continue to encourage EV adoption. While some programs target private individuals, fleets can often reap these rewards too. Working with your vehicle suppliers and reviewing incentives sites such as the European Automobile Manufacturer Associations' overview on EV tax and purchase benefits can keep you up to date on all of the possible rebates and credits for your EVs, some of which may be stackable.

Driver satisfaction

While it's normal to be hesitant when trying something new, EVs tend to win drivers over quickly with their fast and smooth acceleration, reduced noise and great handling. EVs also have a pretty good reputation among new owners, many of whom never go back to petrol.

CHAPTER 03

How much do electric vehicles really cost?

It's no secret that electric vehicles carry higher sticker prices than comparable ICE vehicles. Even as the cost of EV batteries continues to fall and EV proponents promote the value of total cost of ownership (TCO), the biggest challenge facing electric vehicles is still affordability.

But, fear not. With EV costs set to keep falling, many industry experts predict that we are approaching a tipping point that would finally see EV purchase costs undercut gas and diesel cars post-2022. In the meantime, it's important to take into account the many financial benefits associated with EVs (refer back to chapter 2 for a refresh on fuel and maintenance cost savings associated with EVs), rather than focusing solely on the upfront costs.

How long does it take to recoup the cost of an EV?

Given that EVs have a higher sticker price out of the gate, the upfront acquisition costs could overshadow long-term gains. You might start to question when the fleet will break even on cost.

The answer really depends on the vehicle, the location specifics of petrol and electricity prices, and how much you put the vehicle to work.

Cost comparison of three popular electric cars

We looked at three electric vehicles and compared them to their closest petrol-fueled equivalents. Using the UK national average electric and petrol prices, we calculated fuel costs per mile for each model and added them to the post-credit MSRP of each vehicle over time – or "miles," as the case may be. Using this simplified approach (and without factoring in maintenance costs), these plug-ins recouped their premium (and then some) during the normal lifespan of a vehicle, with some offering significant cost-of-ownership savings over time.

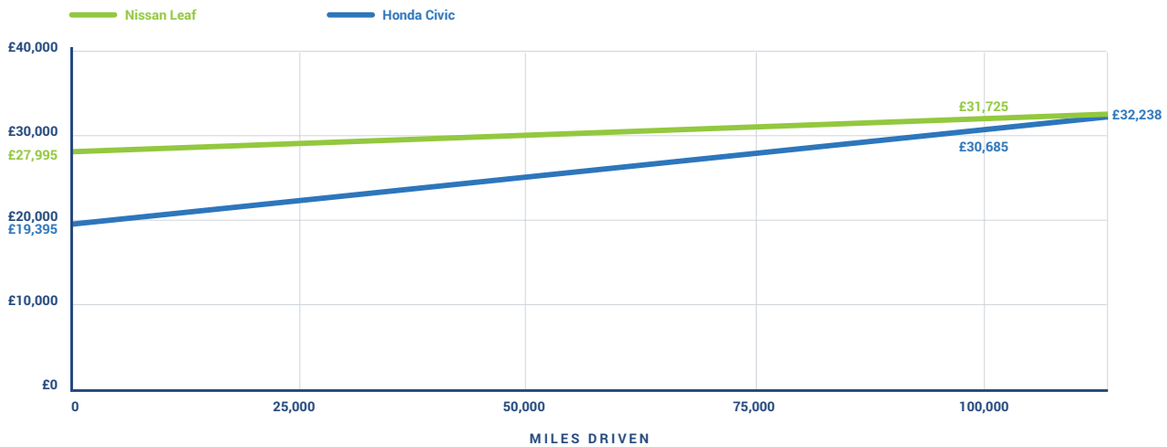
1 2019 Nissan LEAF

(£26,845 *after government grant) vs. 2019 Honda Civic (£21,670)

The base-level 2019 Nissan LEAF is a low-cost compact EV, with a range of 224 miles, on a single charge, to handle the vast majority of daily consumer and fleet demands.

The Honda Civic is one of the most popular and well-reviewed compacts on the market, but it doesn't take long before the LEAF starts paying fuel cost dividends at 103,500 miles driven.

Nissan Leaf vs. Honda Civic

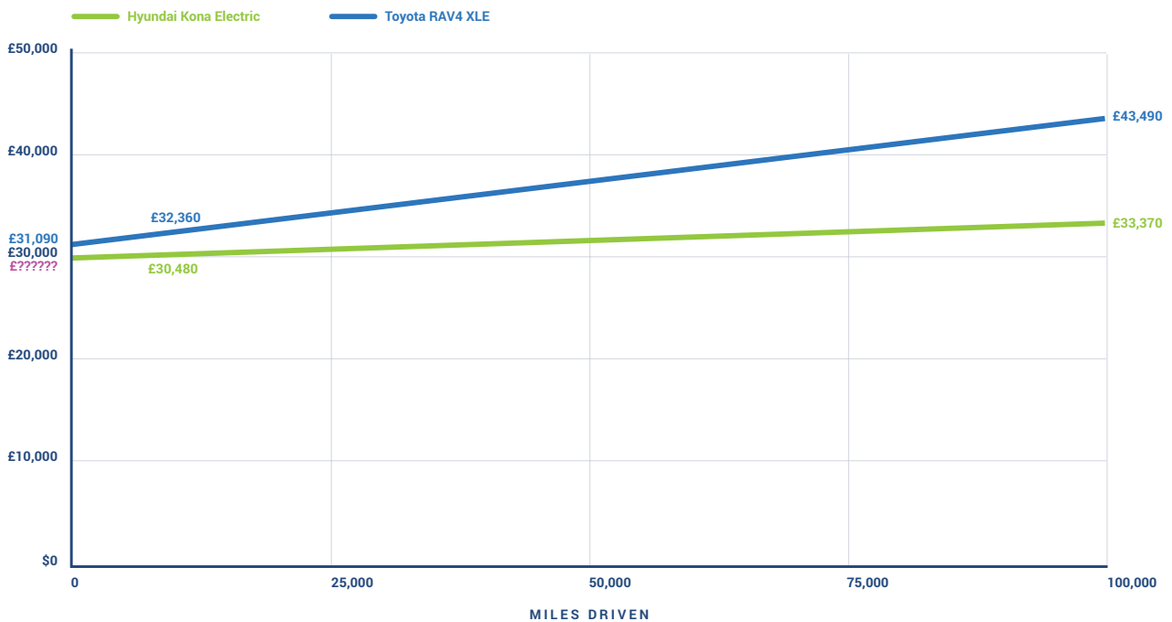


2 2019 Hyundai Kona Electric

(£30,150 *after government grant) vs. 2019 Toyota Rav 4 Icon (£31,090)

The Hyundai Kona Electric with 300 miles of range takes on the popular Toyota RAV4. The Kona Electric has a lower starting price than the RAV4 Icon, making it cheaper even before fuel costs are brought into consideration.

Hyundai Kona Electric vs. Toyota RAV4 XLE

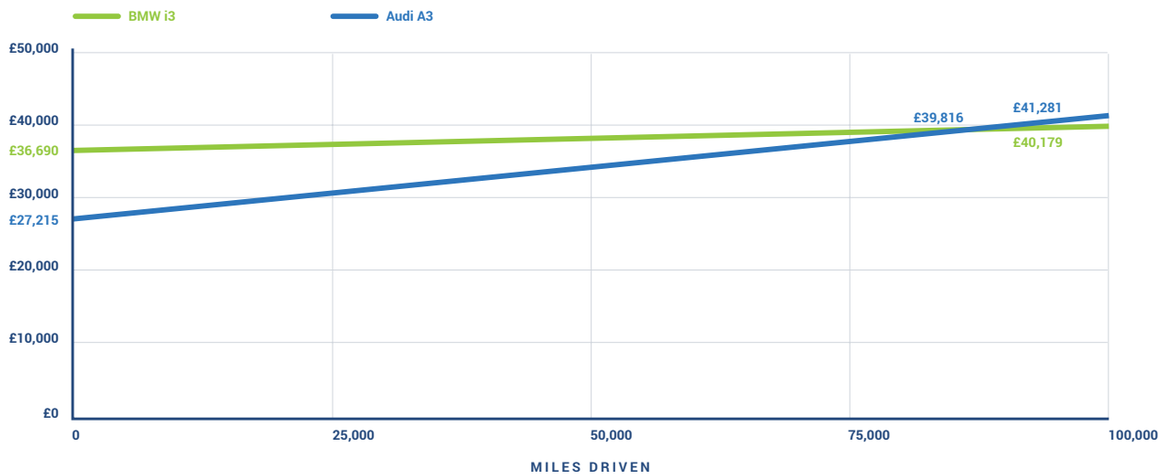


3 2019 BMW i3

(£36,690 *after government grant) vs. 2019 Audi A3 Sportback (£27,215)

The BMW i3 is a small compact electric vehicle with a range of 190 miles. For its internal combustion analogue, we chose the Audi A3, whose mix of stylishness, performance and size appeal to a similar demographic of buyers. The i3 revs its savings engine at 89,500 miles driven.

BMW i3 vs. Audi A3



KEY TAKEAWAY

Over time, EVs will beat their petrol equivalents on total spend, and the more you put your EV to work, the faster you will realise a return on the higher upfront investment. Plus, EVs cost less to maintain and tax when compared with ICE vehicles.

CHAPTER 04

EVs for public fleets

As European governments look for ways to reduce air pollution and combat climate change, all eyes turn to the transportation sector, which accounted for 25% of European greenhouse gas emissions in 2018.

In order to do their part to reduce emissions, local governments can certainly do something about the vehicles employees drive in municipal fleets. Hundreds of thousands of litres of petrol are consumed every year, including from:

- **Police vehicles on patrol duty**
- **Parking authority vehicles circling the streets in search of offenders**
- **Park services vehicles making the rounds**
- **Transportation services for city officials**
- **Street sweepers and waste collection vehicles in public services departments**
- **City and school buses making their stops**

Municipal fleets play a significant part in a city's transportation emissions, and the switch to electric vehicles and hybrids is the easiest way to address the problem. Governments from Swansea to Gothenburg to Marseille have already begun the transition, suggesting the solution will work, no matter what political party happens to be in power.

Many municipalities started with transitioning their passenger car fleets, but now have targets set for all vehicle class sizes. Transit authorities across Europe are also beginning to move their buses to electric.

According to Sustainable Bus, Amsterdam, Rotterdam, Berlin and Gothenburg lead Europe in zero-emission buses (ZEBs). And, because much of the technology used in ZEBs can be used in other types of medium- and heavy-duty vehicles, The ICCT expects delivery vans and other trucks to follow suit.

Motivating factors for government fleets to electrify

Here are four factors persuading governments to shift their fleets to electric vehicles and hybrids:

1 Cost savings

Natural Resources Wales integrated three electric cars into their fleet, and installed six vehicle charging points. Each EV saved the organisation £900 per annum in total compared to their conventional fleet vehicles. By leasing the vehicles, they calculated that replacing 56% of the fleet with EVs would save them £136,000 per annum in fleet costs.

With an average annual mileage of 10,000 miles, they calculated fuel savings to be £500 per vehicle per annum, with EVs fuel costs only 2 pence per mile, compared to 7 pence for a diesel equivalent. Together with fuel savings, they also benefited from reduced servicing requirements, which further reduced costs to the fleet budget.

2 Air quality control

The worst effects of air pollution are invisible, but city residents have palpable trouble breathing when particulate matter is elevated. Anyone living in congested urban areas will notice the smell and oppressive air conditions when city vehicles are idling nearby. This quality-of-life issue can be addressed in every town and city by putting cleaner-operating EVs into service.

Air pollution from idling is of particular concern as an idling combustion engine releases twice as many exhaust fumes as a vehicle in motion. Green transportation initiatives can play a major factor in improving air quality as EVs are idle-free.

3 Smarter budgeting

Natural Resources Wales completed a strategic fleet carbon review, which showed that leasing the vehicles provided the greatest fleet cost savings opportunity. allows municipal budget planners to free up funds for other capital investments. For instance, cities that buy EVs through these financing routes, can use the money they save for infrastructure fixes like potholes or adding more bus routes.

Any city or local authority looking for a way to support and improve infrastructure should investigate the fleet incentives available for leased EVs and plug-in hybrids. Fiscal responsibility and improved public services are popular initiatives in every party and region; it's what voters everywhere expect governments to do competently.

4 Meeting emissions goals

Reducing emissions remains a top priority in many major cities. Eurocities, a network of 190 cities across 39 countries released a position paper in December 2020, calling for the EU 2030 emission reduction target to be revised upwards to at least 60% by 2030. Of their position, Dario Nardella, President of Eurocities and Mayor of Florence said "Europe must maintain its global leadership to reduce greenhouse gas emissions by at least 60% for 2030, laying the groundwork for an inclusive recovery [from the COVID-19 pandemic]."

Here are four examples of cities with ambitious sustainability goals:

+ Lisbon expands its vision of sustainable urban mobility by extending the infrastructure for EV charging with over 516 charging points in the city.
+ As part of the EU's plan to make 100 cities carbon neutral by 2030, Valladolid and Nottingham have been chosen as 'lighthouse cities' to experiment with sustainable innovations and lead the way for others to follow.
+ London aims to completely decarbonise road transport by 2050 through the adoption of Ultra Low Emission Zones (ULEZ)
+ Berlin commits to plans to be carbon-neutral by 2050.

One of the tools that each of these cities plan to use to meet their goals is deploying electric vehicles and hybrids in municipal fleets. In Valladolid, eBuses, private electric vehicles, and municipal car-sharing e-vehicles will be deployed, supported by a network of public charging points. The total impact of the city's sustainable initiatives is a drop in CO2 emissions of 88%.

London Mayor Sadiq Khan set out the capital city's plans for an electric vehicle future, saying "We need to reject the fossil fuels of the past and embrace an electric revolution in London's transport." As of 2019, London had 20,000 electric vehicles, 1,700 electric taxis and Europe's largest electric bus fleet. The Electric Vehicle Infrastructure Delivery Plan intends to make it easier for Londoners to make the switch from diesel to electric cars to reduce toxic traffic emissions and realise the Mayor's ambition of becoming a zero-emission city.

HOW TO MAKE THE BEST GOVERNMENT EV PROCUREMENT DECISIONS

Every municipality hoping to create a better quality of life for citizens should explore the benefits of adding EVs to the fleet mix. Knowing how to access available incentives, budget operating costs and deploy electric models is essential when making the switch. This knowledge is only possible with data from real-world use.

CHAPTER 05

Exploring the EV market

The key to making an educated investment in electric vehicles – one that is almost certain to pay off in the long run – is identifying your fleet's needs and finding the vehicle that best matches them.

+ **How many miles do you drive each year?**
+ **How often do you travel outside of the range capabilities of mid-range EVs like the Nissan LEAF?**
+ **How much does petrol and electricity cost in your area compared to other parts of the country?**

Understanding your fleet's driving patterns and how to maximise operational efficiencies can provide the additional clarity needed to take the EV plunge and reap the rewards of driving petrol free. Without an accurate assessment of your current fleet's typical range and duty cycles, however, it's very difficult to determine if an EV can do the job. Using telematics data to capture existing driving profiles can help establish a baseline for going electric, or not.

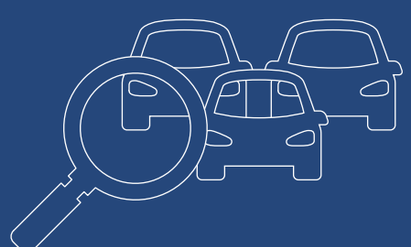
Choices, choices, choices

Given that EV prices are falling, businesses face fewer limitations with plug-in vehicles than they did in the past. Of course, with more options available, deciding on the right EV for your organisation's needs has become slightly more complex.

The steady increase in light-duty passenger EVs is not to be overshadowed, as more choices become available in commercial vans, trucks and buses as well. The race to electrify the medium-to-heavy duty vehicle space is heating up, with traditional OEMs competing with market disruptors like Tesla, Rivian, Chanje and BYD offering exclusively electric vehicles.

Below we've looked at several EV models to determine their best use in vehicle fleets. These vehicles represent a range in size of EV models that could be deployed easily in a fleet.

This is just a small sample of the models to choose from. Here is a complete list of EV models available in the EU and UK.



Hyundai Kona

+ Fully electric
+ 300 miles of range
+ Charge in under one hour with DC fast charger (DCFC)
+ Popular choice for police forces in Europe

Nissan Leaf

+ Top-five ranking in fuel economy
+ 224 miles of range (extended range available in Leaf Plus model)
+ 106.3-inch wheelbase, EPA classified as mid-size car
+ Best for administrative functions with frequent travel, small parcel delivery or utility surveyors traveling short distances

Mitsubishi Outlander PHEV

+ Higher seating, increased head and leg room
+ Flexible interior cargo space
+ Ideal for construction and retail service fleets
+ 4-wheel drive
+ Well suited for wintery conditions
+ 80% charge in just 30 minutes with DCFC

BYD T6

+ 7.5T GVW
+ Load capacity of 4,090kg
+ 17m3 volume capacity
+ 1.3 hour fast charging time
+ 150 mile range with a full load

Volkswagen ABT eTransporter

+ Medium-duty electric panel van
+ 1,001 kg payload
+ 6.7 cubic metre load area
+ 82 miles range on WLTP cycle
+ 37.3kWh capacity battery

Although electric vehicles will not work for all fleets, for many, they do have real advantages over petrol and diesel-powered vehicles. Here's a handy tool for comparing an EV to a similar petrol vehicle.

EVs are the future for last-mile delivery

When looking to identify the use cases where electric vehicles can save you money, don't pass over last-mile delivery. Expectations in the industry are that EVs will transform last mile delivery, as urban driving is seen as the perfect environment to showcase the benefits of EVs.

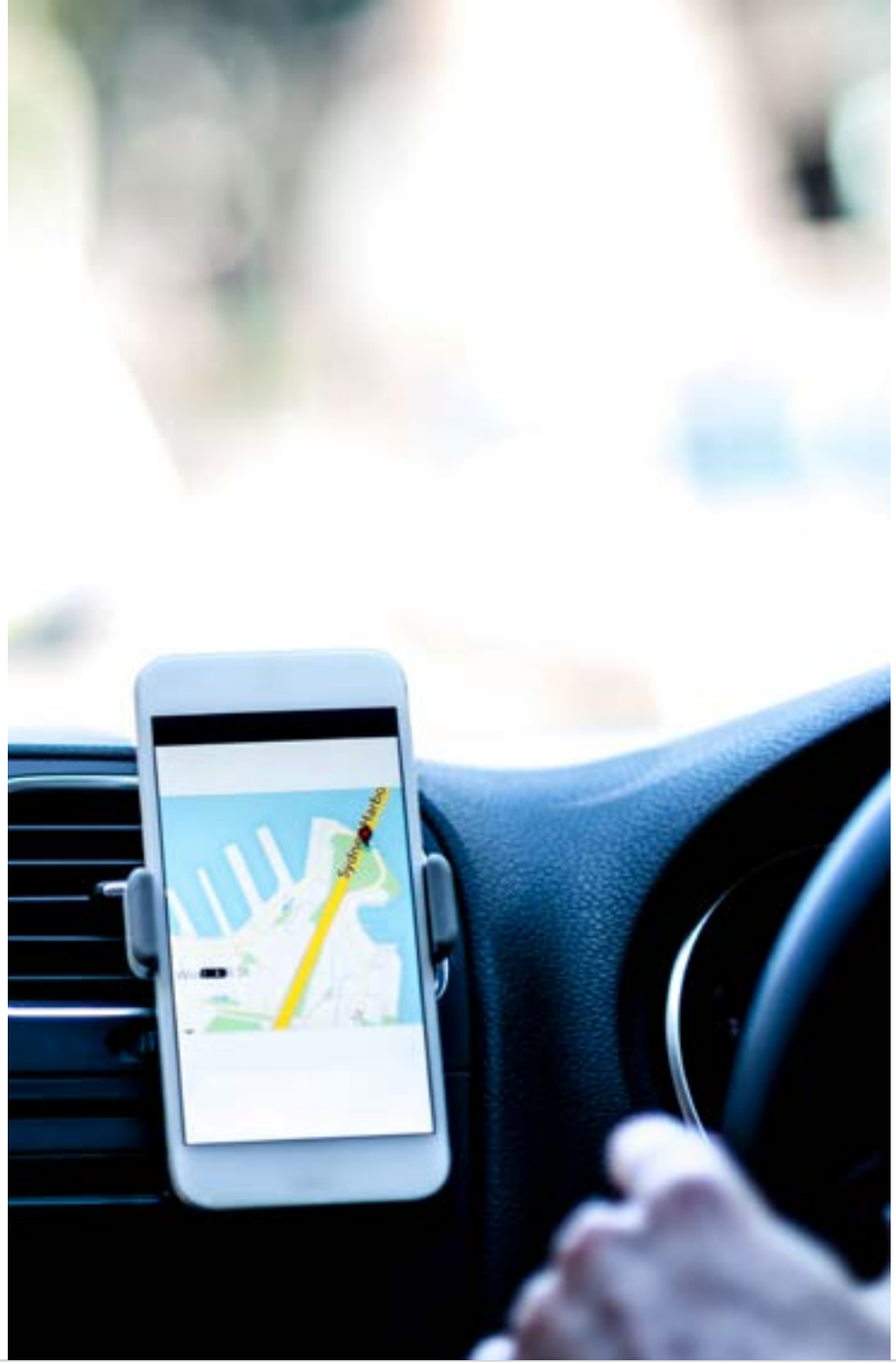
Pressure is rising from cities and their inhabitants for cleaner delivery options. EVs improve noise levels and air quality in city centers where millions of people live and work. Low-emission zones and zero-emission zones continue to emerge across the globe, gradually forcing carriers to move to electric fleets in order to cut costs and continue to serve those regions. Plus, with the growing choice of electric vehicles capable of last mile delivery, fleets are electrifying faster than ever before.

Utility fleets are embracing EVs

With more of their customers making the move to electric, utility fleets are in a unique position to embrace the transition themselves, to better understand their customers needs as well as the added stress to the grid. As an example, EDF Energy believes EVs will play a key role in changing the way power is generated and delivered through their smart grid infrastructure.

Rideshare and carshare companies are jumping into EVs in a big way

Increased pressure from consumers demanding green strategies, including the accelerated adoption of electric vehicles, is propelling rideshare and carshare companies to act quickly to electrify their fleets. Both UBER and Lyft have announced their plans to transition to electric by 2040 and 2030 respectively.



CHAPTER 06

Creating an EV adoption strategy

When beginning your EV adoption journey, it is important to answer three key questions to get a clear understanding of the requirements for new EVs, beyond just matching a vehicle size. Documenting your specific needs is important whether you are switching only one vehicle to electric, or all.

TIP

Looking at usage across all vehicles in a fleet, a savvy fleet manager may reassign vehicles to ensure the right vehicle is used for the right job to optimise the fleet. This way an EV isn't overlooked because of those two long trips it takes a year.

Key questions to ask for your EV adoption strategy

Here are some key questions to ask:

1 What is the maximum distance the vehicle drives in a day?

Determining the maximum range a vehicle completes in one day, you are able to better choose what kind of EV you require. A long-range battery EV can keep up with duty cycles over 200 miles, but you may only need a short-range EV to get the job done.

Analysing the maximum distance driven by a vehicle is a useful first step when considering EV adoption.

2 What are my current costs for running the vehicle?

Electric vehicles are priced higher than their traditional internal combustion engine counterparts, so understanding your current ICE vehicle costs can help you choose an EV that will save you money in the future.

The higher price tag of an EV can be offset when you look at the total operational savings of the vehicle over its lifetime. As we've mentioned before, other than the obvious savings in fuel, EVs are more reliable and cheaper to maintain thanks to having only 20 or so moving parts, unlike an ICE vehicle, which has over 2,000. Plus, EV powertrains can last 200,000 miles, significantly more than that of ICE powertrains.

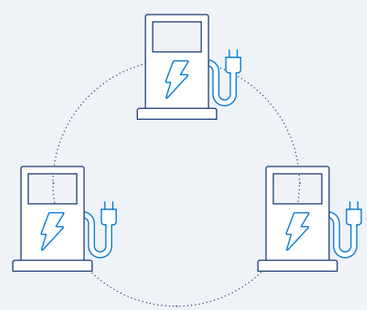
3 Where do they dwell, and for how long?

Figuring out where your fleet's vehicles spend the most time helps to build an effective strategy for deploying charging infrastructure. It will help determine how many stations you need, as well as where it makes sense to place them. This might lead to decisions about whether or not a regular wall outlet can accommodate your first few EVs.

Since each fleet's dwell time and location are unique, it's critical to use your own fleet's data when planning the infrastructure component of your EV adoption strategy.

How to plan EV charging infrastructure

One of the biggest stumbling blocks for organisations interested in adding plug-in vehicles to their fleet portfolio has been planning out EV charging infrastructure. Calculating vehicle costs, fuel savings and suitability become all the more difficult when you don't know where the cars are going to charge, how many stations will be needed and how much those stations will cost to install and use. Planning electric vehicle supply equipment (EVSE) requires examining a number of factors, and often varies widely from one fleet to the next.



Three key considerations for implementing a successful charging program

1 Where will the stations best serve your needs?

Do your vehicles typically park at:

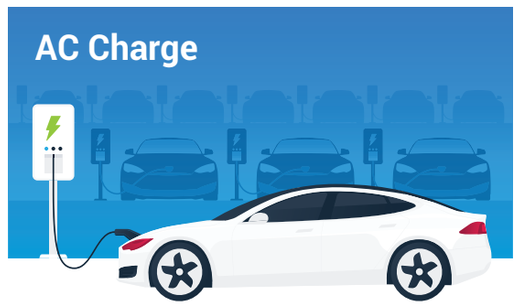
+ Your fleet depot?
+ An office building?
+ Customer facilities?
+ Employees' residences?

Understanding where your vehicles go and what types of trips they make will be your first step in identifying the best locations for charging. Who owns (or has decision-making authority for) those facilities may also impact your charging deployment. Consider existing infrastructure: Is there currently available infrastructure in the areas your vehicles operate? Speak with local planners to find out if and where more stations are going to be installed in the near term.

A site assessment of your preferred locations with an electrician or electrical engineer will determine what electrical capacity is available, or if upgrades may be required. Site-specific considerations may include spacing and orientation of the parking and charging spaces, vicinity to the electrical service and safety features for the operators.

If you're planning a significant EV transition, communicating with your utility provider early is also important, as they may need to be involved in electrical upgrades to your facility, and they can advise on any commercial fleet rates that might be available.

Know your EV charging stations



Voltage
208V or 240V 1-Phase AC

Amps
12 – 80 Amps (Typ. 32 Amps)

Charging Loads
2.5 to 19.2 kW (Typ. 7kW)

Charge time for vehicle
10 – 20 miles of Range per hour

Voltage
208V or 480V 3-Phase AC

Amps
<125 Amps (Typ. 60 Amps)

Charging Loads
>25kW (Typ. 50-100 kW)

Charge time for vehicle
80% Charge in 20 – 30 minutes

2 How many charging stations will you need?

There's no one-size-fits-all formula for determining how many charging stations a fleet will need. A number of considerations come into play, including:

+ The duty cycles of the vehicles at each site
+ The balance of plug-in hybrids vs all-electric vehicles
+ The capacity of the battery packs that will need to be charged
+ Whether the stations will be exclusively for fleet use or open to the public

3 What kind of stations will you need?

If your fleet utilises plug-in hybrids with smaller battery packs, the ability to charge them in as many locations as possible may be crucial to maximising their electric mileage.

Then there's the question of charge speed:

AC charging

+ The most commonly used charge level, delivering 7kW of power
+ Can charge a vehicle fully in around 3-7 hours, depending on model

DC fast-charging (DCFC)

+ Can bring a typical 100-mile EV to around 80 percent in just a half hour

Battery size, duty cycle and vehicle type are crucial factors in choosing between the charging speed of your stations. Most plug-in hybrids aren't capable of DCFC charging, while a small fleet of all-electrics that tend to be in use around the clock (like taxis) may be best served by a shared DCFC station.

The most compelling argument for installing no-frills charging stations is, of course, cost.

AC charging stations can cost anywhere from a few hundred pounds to upwards of £4,000. DCFCs are capable of adding 100 or more miles in less than an hour, but a fully installed rapid charge unit can cost up to £35,000 – depending upon model and installation costs.

The UK government offers organizations and local authorities financial support to install level 2 charge points at their premises under the Workplace Charging Scheme (WCS). The grant provides up to £350 per socket at 75% of the total cost of installation.

Any decisions regarding which models of EVSE to purchase should be grounded in a firm understanding of your fleet's needs. In some cases, there's simply no getting around the need for more expensive charging equipment. If you need to control access to the stations, or want to offer charging for a fee to the public , you'll need a networked charger with RFID-reading capabilities. If you need to top off vehicles quickly for rapid turn-around use, you may decide to spring for a DC fast charger.

There are many reasons why you might decide a fast, top-of-the-line, networked charging station is the best fit. However, bigger isn't always better, and fleets can save money by sizing their equipment to take advantage of the natural dwell time of their vehicles, rather than opting for the speediest, most powerful options.

CHAPTER 07

Choosing the right EVs for your fleet

When it comes time to choose the right EVs for your fleet, your decision should consider whether the EV is capable of completing its daily duties and whether it will save you money over the long term.

When you're ready to take the first step towards procuring EVs, it's important to arm yourself with the most up-to-date information about available EVs and use real-world performance data to help inform your decision.

An Electric Vehicle Suitability Assessment (EVSA) is a tool that helps the fleet manager create a data-driven blueprint for electrification.

The EVSA analyses fleet and vehicle data to make the case for an electric transition in a way that makes sense for the organisation's budget and time frame.

The method for determining what vehicles are suitable to replace with electric can range from manual calculations and estimations in a spreadsheet, to using an automated tool that simplifies data input, all the way to commissioning consultants to prepare a fleet electrification plan tailored to the needs of the organisation.

An EVSA saves fleet managers time

An EVSA saves you time researching EV acquisition options and allows you to be confident in selecting the right vehicles for starting the EV transition.

A key benefit of an EVSA is it that it can save fleet managers time by making it easy to compare EV options based on factors such as:

Retail price

EV type (BEV vs. PHEV)

Battery capacity/range

Local availability

Maintenance schedules

The role of telematics in an EVSA

Telematics solutions provide access to a rich set of data points that can be used to refine the accuracy of an EV assessment.

To start, telematics can provide accurate daily driving distance readings and compare them against the real-world range of EVs available in the market. Vehicle trip data will also highlight optimal charging locations and types, based on where and for how long vehicles dwell.

A more advanced assessment can use location information to get data on the local terrain where vehicles are driven. This data can be correlated to outside temperatures to figure out when to factor in climate control systems when modeling the EV's efficiency and range. With Geotab's support, we can help make your transition as seamless as possible.

Benefits of an EVSA

Operational requirements

Before diving into the total cost of ownership cost analysis, an EV must first and foremost be able to complete the required range. Analysing the maximum distance driven for each vehicle in your fleet and comparing that distance to the real-world EV range provides an immediate pass or fail to help make decisions on an electric vehicle. An EVSA will analyse the daily driving range requirements (over the last 12 months, if possible, to capture business seasonality), to verify that the selected EV can complete its daily tasks on a single charge, to eliminate any concerns over range anxiety.

Financial analysis

After confirming that there are EVs capable of doing the job required, the next step is to understand the financial impact of acquiring EVs. More importantly, an EVSA can also help fleets determine whether a switch to EVs would save the fleet money over the lifetime of the vehicles.

The financial aspect of an EVSA calculates the lifetime cost of replacing a vehicle with an EV and compares it with replacing it with a traditional ICE vehicle. The following cost components are usually considered:

+ Vehicle acquisition costs (whether it is a purchase or lease)
+ Maintenance
+ Fuel and electricity
+ EV procurement incentives
+ Low-Emission Zone charges (where applicable)

An EVSA helps fleet managers understand the changes in the cost structure if they elect to acquire EVs. Typically, EV acquisition costs are higher, but the fleet will make up the difference with operational cost savings on fuel and maintenance.

It is also important to consider any EV government incentives available for the fleet. In some organisations, it is possible to unlock funds from sustainability programs aimed at reducing the organisation's GHG emissions.

These funds, along with government incentives, can play an important role in reducing the total cost of ownership of EVs.

Environmental impact

Electric vehicles provide a great opportunity for fleets to reduce their fuel consumption and carbon footprint. An immediate environmental benefit of using an EV is the elimination of idling emissions.

Going green also has direct financial implications in some areas. In central London, UK for example, EVs are exempt from the Congestion charge, priced at £11.50 per day. Other jurisdictions around the world are considering similar types of low emission and congestion fees.

An EVSA can help quantify the exhaust emissions reduction, fuel cost savings, and any congestion charge savings. Some fleets take a holistic approach to emissions reduction when running EV assessments and identify opportunities to rightsize their fleet.

What do I get in a Geotab EVSA?

The Geotab EVSA draws on the largest dataset for real-world EV performance to offer data-driven recommendations for your fleet. It analyses your fleet's unique patterns to identify the vehicles best suited for EV replacement. The Geotab EVSA also takes into account extreme weather conditions, financials, availability in the local market and more to help make your transition to EVs as seamless as possible.

How to rightsize

Rightsizing includes reducing the number of vehicles based on overall utilisation, as well as the fleet's vehicle class composition. Ask yourself, does your fleet really need multiple SUVs, or would a more cost-efficient vehicle be able to do the job as well? Cost savings realised by rightsizing the fleet are then put towards electrifying more vehicles.

CHAPTER 08

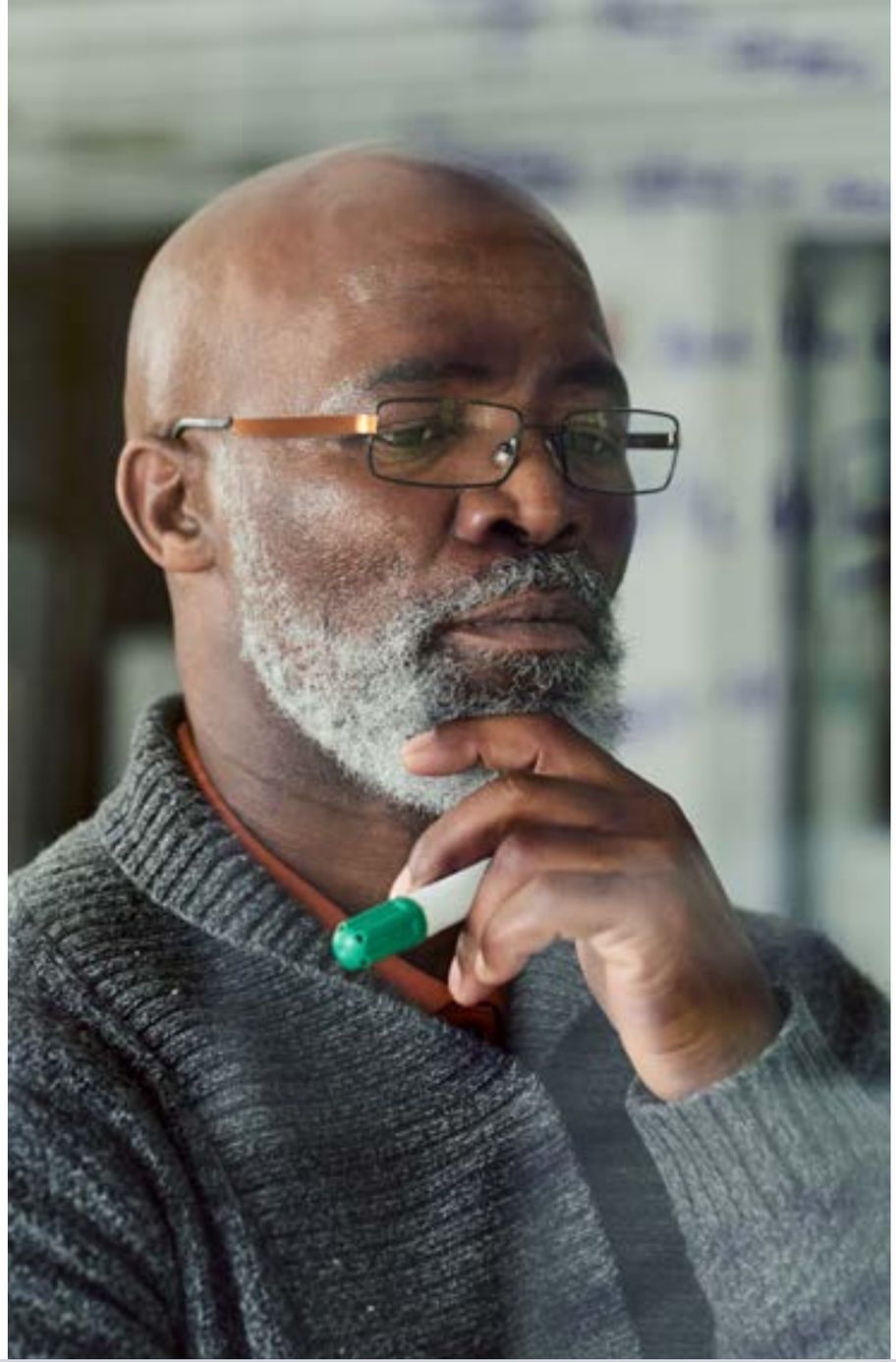
EV fleet manager FAQs

Once a portion of your fleet has electrified, it's time to shift your attention to ensure your EVs are managed effectively.

How do you apply traditional fleet management techniques to monitor performance?

Although electric and traditional fleet management is similar in some ways, there are some critical differences to be aware of. Aside from productivity indicators like utilisation and downtime, EVs use different metrics that operators must understand in order to optimise fleet operations.

These metrics include, state of charge, electric miles versus fuel miles and charging details, like whether or not a vehicle has been plugged in at the end of a shift.



I've switched to EVs. Now what?

A comprehensive fleet management solution should fully support conventional, mixed and fully electric fleets. Integration of the all-in-one platform has demonstrated the ability to increase fuel efficiency, reduce operating costs, improve safety and optimise fleet capacity. EVs have unique metrics that must be properly monitored to ensure performance is optimised, while tracking range and SOC.

Let's take a closer look at some of the questions fleet managers who are in the process of transitioning to EVs should ask themselves before choosing a telematics provider.

Are my EV models supported?

An EV-friendly telematics solution should be equipped to access information for all of the models in your fleet, including EVs. While this may seem like a no-brainer, it's important to understand that EVs do not communicate vehicle-specific data in a standard way (unlike conventional ICEs). That's why it's vital to confirm your telematics provider not only supports the EV models you currently own, but they also have the historic track record and capability to support future models as your fleet expands.

What metrics should I use to monitor EVs in my fleet?

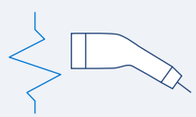
Basic monitoring of your fleet's EVs is vital to ensure you don't end up with stranded drivers. Your telematics solution should report the real-time SOC while EVs are on the road, to help you ensure the most efficient use of your vehicles.

Monitoring real-time SOC in percentage increments on a live map view tells you exactly which vehicles need to charge and how much they require to complete their daily tasks. You should also be able to set alerts for vehicles that should be charging but aren't.

Speaking of alerts, a telematics solution that properly supports EVs should be able to send notifications by email, SMS or web application to either the drivers themselves or to the management team.

Real-time alerts could include conditions like:

Low SOC



Optimised charging (e.g., an EV that wasn't plugged in at the end of a shift)

Charging complete

How do I know how much energy my vehicles are using?

While a conventional fleet uses fuel, EVs measure electric energy in kWh and Wh. Your telematics solution should allow you to monitor and report on the amount of "fuel" used by your EVs. This includes energy consumed while driving, as well as energy added back into the battery from regenerative braking. Monitoring the actual amount of energy each vehicle uses and produces is vital to understanding the true cost and efficiency of your EVs.

It's also important to keep an eye on your electric energy economy – a calculation equivalent to the MPG or L/100km you would track with your conventional vehicles. MPG-e allows you to compare EV and ICE performance in a single fuel economy report, and provides insight into how your EVs are performing, and your typical real-world range.

If you're adding PHEVs to your fleet, you'll want to make sure they're being used correctly and that no PHEV is being operated solely on petrol. Your telematics solution should provide you with a report to show the combined electric energy and fuel consumed by each of your PHEVs over the total distance they've travelled to ensure your fleet is getting the greatest possible electric miles from your plug-in hybrids.

Charging data

The biggest difference between EVs and ICE vehicles is of course, how they "fuel up." Your telematics solution should supply you with an EV charging history log to provide insights into the SOC for each of your EVs, how they got to that charge level and how that helps you fully allocate charging costs to each vehicle. Having a complete charging history that includes where and when the EVs are charging, the length of time the EVs were charging at a specific location and the amount of energy they actually received will help form an optimised charging infrastructure strategy.

TIP

Still have questions about choosing the best telematics solution for your fleet management needs? Check out this handy checklist.

CHAPTER 09

How to optimise EV fleet operations

The EV value proposition for fleets can get somewhat complicated, but there are ways to maximise the technology's cost and emissions savings.

How can fleet managers get more out of their EV investment?

Optimise routes to maximise your electric miles while minimising on-route charging.

Monitor charging and driving energy data to optimise EV use in the fleet.

Train operators on EV charging and driving techniques and improve charging compliance rates (e.g., introduce alerts if a car is plugged in, but not charging).

Increase utilisation to take full advantage of EV range (low-use EVs don't have as fast a payback; they don't save unless you use them).

Introduce technology to share vehicles across staff and/or departments to improve utilisation.

As with every other aspect of fleet planning, knowledge is a fleet manager's best weapon in combating waste with the right-sized fleet for daily vehicle runs. Using fleet telematics to know exactly how EVs are performing is the place to begin.

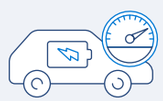
Tips for maintaining the EV battery

We now know that early concerns about battery degradation and range loss tends to have been overblown. Carmakers plan for these factors and design their vehicles to resist them to the greatest extent possible. Nevertheless, there are ways to extend the life of your battery and keep it in the best condition possible.

Some examples include:

Avoid long periods of very high or low SOC

Avoid charging in extreme temperatures



Minimise DC fast charging whenever possible

When an electric vehicle loses energy storage capacity, it could eventually render the car unusable without a costly replacement pack – which will set you back upwards of £4,900 depending on the model. Our analysis has shown that batteries should outlive the life of the vehicle under average usage and conditions.

Monitoring battery health will help you stay on top of any concerning trends. Telematics allows fleet managers to know how their vehicles are being used and even monitor the current health of a battery pack, including how much range has already been lost. It won't always be possible to follow the tips outlined, but creating a solid strategy to encourage EV best practices will prolong the life of your battery and save you money in the long term.

Maximising EV range

An EV's usable range can vary on a daily basis, and will be impacted by:

+ Topography (i.e., hills)
+ Use of climate control – heat or A/C
+ Temperature
+ Speed
+ Driving habits (e.g., aggressive driving)
+ Load (number of passengers or goods)

With the use of telematics and data analysis platforms, fleets can monitor the performance and minimise the impact of many of these factors. This information can help fleet managers support drivers with feedback and general tips for improving performance.

The path to the best battery range is often specific to the vehicle model and how it's used, but in general, there are some foolproof ways to boost your EV battery range.

5 sure-fire tips to start improving EV range

1 Minimise the impact of extreme weather

After analysing nearly 5.2 million EV trips, our data was able to show the ideal temperature for operating an EV is 21°C without impacting range.

Cold weather affects all vehicles, but the impact on EVs can feel particularly intense. Running an EV's heater, especially at full blast, puts a big drain on battery power. In the winter, dial down the climate control and instead rely on the heated seats and heated steering wheel (if your vehicle is so equipped) to keep things toasty, which uses far less energy. Also, preheat your car while it's plugged in so you can use the climate control less while driving.

Operating the air conditioning consumes battery power at a rapid rate as well. Try running only the fan, and not the compressor whenever possible or try rolling down the windows as operating the AC at full chill will drain the battery far quicker than driving with the windows down. Best to pre-cool the car in summer months while it's plugged in to help reduce the need to run the AC once you hit the road and advise operators to choose shade when parked on hot days.

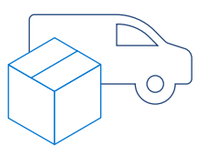
2 Go easy on the accelerator

Time may be money, but so too is electricity. Driving at excessive speeds is far less efficient for your vehicle.

In addition to watching your speed, driving smoothly is an easy way to conserve energy used from your battery so read the road ahead to reduce unnecessary acceleration and braking. An aggressive driving style often leads to heavier braking, which results in regenerative braking not being maximised.

We all tend to drive less efficiently when we're late, even though it tends to save much less time than we actually think. Optimising vehicle use schedules and giving drivers an extra 5-10 minutes to get where they're going can have the effect of lightening his or her right foot – saving battery range and charging costs.

3 Minimise cargo weight



All vehicles lose efficiency the more weight they're carrying. For modest range improvements keep any non-essential weight out of the vehicle when it's in use. This may include passengers, equipment or delivery items. Every little bit counts. And of course, one trip is better than two, so optimise your trips, route and cargo to minimise miles.

4 Practice preventative maintenance

One of the best perks of all-electric vehicles is their relative lack of maintenance demands. However, something as simple as tire inflation can extend a battery's range by several miles per charge. Fleets can use vehicle data to optimise maintenance schedules and keep each EV in optimal shape during use.

5 Push past range anxiety

Studies have found that electric vehicle drivers tend to be overly cautious about running out of range. Educating drivers on how to use an EV's built-in range estimates alongside driving data and familiarity with routes should give them the confidence to get the most out of each charge. Unnecessarily cutting a trip short or delaying service to charge when more juice isn't actually needed can cost valuable time and money.

Conclusion

This guide is meant to serve you on your electrification journey but, as noted throughout, the best route to integrating EVs start to finish is with accurate and timely performance data. We've explored each necessary step to successfully electrify your fleet. As a recap, it's important to consider the basics, like:

+ What benefits do EVs bring to my fleet vs. an ICE?
+ What EV options are available to me and how much do they cost?
+ How will EVs fit in my fleet's driving cycles and where will they charge?

Once you have a solid general understanding of EVs and you're ready to take the next step towards electrification, it helps to create an EV adoption strategy built on data-driven insights to pinpoint the right EVs for your fleet.

And remember, adding EVs to your fleet is only a step toward greening your fleet and saving on fuel costs. A reliable telematics solution is vital to provide you with the data you need to monitor and optimise both the conventional vehicles in your fleet and the EVs. By having all your information in one place, you are optimising the fleet usage, and ensuring that you are getting the maximum return on investment from your electric fleet.

For more information on EV fleet management, please visit us online.

Glossary

Eco mode – An economical mode option available in some plug-in hybrid vehicles. In order to run the vehicle more economically, Eco mode increases fuel efficiency by reducing acceleration levels and can also regulate auxiliary power in the vehicle.

Electric vehicle –A vehicle that uses a motor powered by electricity from a battery.

EV diagnostics – Vehicle system information and fault codes which can be collected via telematics and used to monitor the health of an EV as part of a vehicle maintenance programme.

EVSA – An electric vehicle suitability assessment (EVSA) is a customised Geotab report for fleet and sustainability managers providing a multi-year procurement plan for EVs including ROI and a forecast of emissions reduction.

kWh/100 km – The kilowatt-hours per 100 kilometres (kWh per 100 km) represents how much electricity an EV uses in 100 kilometres driven, indicating its fuel efficiency.

Maximum range – The total number of miles an EV can be driven before it needs to stop and recharge.

MPG-e – Miles per gallon-equivalent (MPG-e) is a metric used to compare the fuel economy of EVs and other alternative fuel vehicles with petrol-powered vehicles.

MyGeotab Rules Engine – A feature of the Geotab telematics platform that allows users to set fleet management rules for drivers such as for maximum speed limit, idling time or EV charging, then monitor compliance in MyGeotab.

Plug-in hybrid – A plug-in hybrid electric vehicle (PHEV) has a two-part drive system, including an electric drive and a small internal combustion engine running on fuel. The two main other types of EVs are hybrid electric vehicles (HEV) and battery electric vehicles (BEV).

Range anxiety – An EV driver's fear of running out of electricity before the end of a trip.

Regenerative braking – The process of converting the kinetic energy produced when brakes are applied in an electric vehicle into usable stored energy within the vehicle's battery.

State of charge (SOC) – The amount of battery power left in an EV, as measured in percentage.

Vehicle dwell – Where a fleet vehicle resides when it is not in use (e.g., a garage).

Zero-emissions – A global movement towards sustainability based on EVs generating lower or zero greenhouse gas emissions and use of other clean, sustainable technology.

About Geotab

Geotab is advancing security, connecting commercial vehicles to the internet and providing web-based analytics to help customers better manage their fleets. Geotab's open platform and Marketplace, offering hundreds of third-party solution options, allows both small and large businesses to automate operations by integrating vehicle data with their other data assets.

As an IoT hub, the in-vehicle device provides additional functionality through IOX Add-Ons. Processing billions of data points a day, Geotab leverages data analytics and machine learning to help customers improve productivity, optimise fleets through the reduction of fuel consumption, enhance driver safety, and achieve strong compliance to regulatory changes.

Geotab's products are represented and sold worldwide through Authorised Geotab Resellers. To learn more, please visit www.geotab.com/uk and follow us @GEOTAB and on LinkedIn.

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