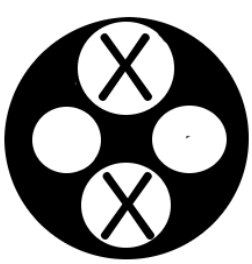
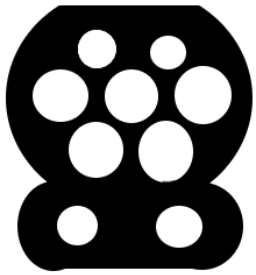
SO, YOU'VE GONE ELECTRIC!

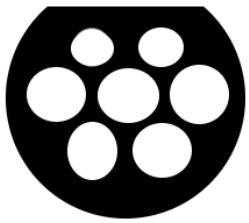
By Gary Comerford



Chademo



CCS



AC

Version 1.0

INTRODUCTION

SO. YOU'VE GONE electric and bought an EV.

Congratulations. You are probably excited about your new purchase and want to get out and see what it can do.

But that's probably not why you bought your EV, right?

- You're an early adopter and you wanted to see what all the fuss is about.

- Or maybe you are environmentally minded and wanted to save the planet by helping decrease our reliance on fossil fuels, reducing our carbon impact, and removing particulate matter from the air we breathe.

- Or maybe you are, indeed, fiscally minded and wish to save money on fuel and servicing (and car tax and the congestion charge).

Whatever the reason welcome to the wonderful world of electric vehicles.

In this short document I'm going to assume you have no idea about how to drive your electric vehicle. I'm going to discuss thing such as charging it, choosing an electric supplier and how to drive your EV in such a way that it works the best for you as well as the environment.

Note: Feel free to pick and choose different parts of this document to read. Although I've tried to put together a sequence that I feel is appropriate for someone who has never driven an EV before, it doesn't need to be read in sequence. But if you feel comfortable on, for example, pre-conditioning your car then feel free to skip that chapter. Likewise if you don't live in a flat or are never going to use a rapid charger.

The Technical Bit

There are a number of small sections marked like this. These are slightly more in-depth discussions about certain technical aspects of EVs such as charging speeds, regenerative braking and charge profiles. If you don't want to read them, or aren't interested, then just skip 'em. I'm not going to feel bad.

WHO IS THIS FOR?

IN THE WORLD of Electric Vehicles there are numerous 'flavours'.

Full Electric BEV: - If your car only runs on batteries and can only be recharged by plugging it into an electric source then you have a BEV (Battery Electric Vehicle). This document is for you.

REX: If your car runs on an electric battery which you charge by plugging in but it also has a small internal combustion engine in the back that switches on when the charge is low and recharges the battery then you have a REX or Range Extender. This document is also for you.

PHEV: If your car has both a battery AND a full Internal Combustion Engine and the battery is charged via a plug BUT the car will run on petrol without you needing to use the battery then you have a PHEV (Plugin Hybrid Electric Vehicle). Parts of this document are for you.

Hybrid: If you have a car with a battery under the bonnet but the only way of refuelling the vehicle is by adding fossil fuels to it then you have a hybrid. If you have a hybrid then pat yourself on the back for taking baby steps towards helping the planet but return this document to wherever you found it because there is nothing in here for you. Furthermore, if you bought your car because you swallowed all that marketing hype about *'Self Charging Hybrids'* then should probably go back to the dealer who sold you the car and tell him you think he misled you into believing this car was an electric car you didn't need to plug in. It isn't. It's a fossil fuel car.

Regardless of which flavour of EV you have (or are considering) there should be something in this document to help and inform you.

- Perhaps you're looking to understand how charging works? - there's a chapter on that.

- Maybe you're looking at planning a trip that will go past the range of your battery - there's a chapter on that, too.

- Or you might just want to understand what all the different charge networks are and how to use them - I can certainly help you there.

Whatever reason you have for reading this I hope there's something you find useful in it.

THE BAD PRESS

EV'S DON'T WORK! They're awful! Why are we going down this path of making everything electric!

I'm sure you've heard or read the news articles - usually in some right wing rag such as the Daily Mail. The story is depressingly familiar: A journalist (*someone who normally writes about cooking or show business in most cases*) is loaned an EV for a couple of days to see what they're like in 'The Real World'. Two days later they find themselves calling the AA or RAC to take them home on the back of a flatbed after they've run out of charge by the side of the A1. Their conclusion is that the world isn't ready for EV's or the infrastructure isn't in place and we should forget about the whole thing.

But when you look into the detail behind these stories you will usually find a couple of key points that would make all the difference. Phrases such as *'I didn't fully charge the vehicle over night so when I left we only had 60% charge*', or '*I went to the nearest charger but it required an RFID card that I didn't have so I couldn't use it.'*

These may look like pretty insignificant things but when you're using an EV at the moment they are key.

In the not too distant future there will be many, many, thousands more chargers than there are now. They will all be able to charge any EV (more or less) and they will all be able to be used by anyone with a credit or debit card.

Right now that is not the case.

At the moment you need to do a little research and a little preparation before you head out in your EV. It doesn't mean you need to learn something akin to a new language to be successful. But it does mean that you need a slightly different mindset.

It's not difficult and this document will show you all you need to know.

PREPARATION

THE FIRST THING you need to remember when you've just bought your electric vehicle is that even though it looks pretty much like the old Honda Civic/Toyota Aygo/BMW 320/(fill in your old car here) that you used to drive, it **isn't** the vehicle you used to drive.

It is quite different.

But it's also fundamentally very much the same. You make it go faster using the pedal on the right and you make it go slower using the other pedal. It has lights, a steering wheel, air conditioning/heating and lots of things that your old ICE (Internal Combustion Engine) vehicle had.

But that doesn't mean it is completely the same.

I'm going to go through the differences and explain what you need to do to have the best EV experience.

NOTE *This doesn't mean you can't just get in, fire it up and start driving. Of course you can. But it does mean that the mindset you had when driving your old ICE car will not work as effectively with an EV.*

Luckily the differences are minor enough that you won't have to worry about relearning everything. But they are major enough to mean that if you try and drive your EV like your old ICE you're not making the most of it.

The key is preparation. That's the title of this section and this is key to understanding the differences between EVs and ICE vehicles.

First and foremost it is important to understand that the fuel model for EVs and ICE vehicles is completely different. In an ICE vehicle you HAVE to go to a petrol station to refill your car. Because you HAVE to go to a fuel station to refill you want to spend as little time as possible there. This is also the reason your ICE vehicle needs a large tank with a range of 300, 400, 500 or even 600 miles : **there is no other source of fuel for your ICE vehicle**.

With EVs it's totally different. EVs generally start with a full 'tank' of energy every day. They do this because you have a source of energy in your home that can go directly into the battery : electricity from a 3-pin plug. Because of this they don't need the huge tanks and long range of ICE vehicles. The average journey in the UK per day is (variably) less than 20 miles. That is well within the reach of **every single EV on the market** at the moment.

Because you don't need to stop at a petrol station to refill your EV the range doesn't have to be as big. You also don't need to have the ability to fill up in 3 minutes (*or however long it takes to put the diesel into your 12 mpg Range Rover*). The car refuels when you are not using it.

So that's your starting point. Don't think of an EV as something you can 'only' run for 100 miles when your old ICE car ran for 500 before needing refilling. It's a different mindset. Your ICE car needed that range so you didn't spend all your time looking for petrol stations. Your EV doesn't need it because there's *always* a plug somewhere.

Will you ever need to go farther than the range of your battery? Of course you will! We'll look at how you deal with that later.

Will there be EV owners who don't have the ability to charge their EVs from a socket in their house? Of course there will. We'll talk about those later, too.

DRIVING YOUR EV

SHALL WE GET in and drive?

Of course if you want to drive it like you stole it and forget the fact that it's an EV there's absolutely no problem with doing that. You'll find they're quite nippy and a lot of fun to drive.

But that's not the ideal way to drive it. There is an art to these things.

The reason there's an art is because you need to balance two competing factors against each other: You want to drive to the point where you don't need to worry about the fact that it's an EV and try and treat it in a similar way to an ICE vehicle vs the fact that you need manage the battery to ensure you get the best range from the charge you have in the vehicle.

So here's how you do it:

When you get in you'll see that pretty much every EV has a little display showing how many miles it thinks you can get out of the charge that's left in the battery. This display is called the **GOM**. It stands for Guess O' Meter and is - as the name suggest - purely an estimate.

Different vehicles have GOM's that are more, or less, accurate. The early Nissan Leafs were known to be little optimistic with their figures (it says you have a longer range than you actually do). The Kia Soul is pessimistic (you usually have more range than it says you have) and a lot of the other vehicles are somewhere in the middle. The key thing to remember is not to trust the figures at all. The reason why is very simple: They can change every few minutes.

If you're driving along a flat road in nice, warm, weather the GOM might say you have 100 miles left. Suddenly you find that the road has started to climb and you're going up a fairly steep hill now. The GOM has - within a mile - lost about 10 miles of range. At the top of the hill you realise that there's a headwind. The car is pushing against it. The GOM has lost another 4miles. Then it starts to rain. Suddenly there is rolling resistance on the road. The GOM loses another 3 miles. Within 5 miles of having a 100 mile range you now have 78 miles left.

Disaster!

Ironically it isn't. The same thing happens with ICE cars. The difference is they don't tend to have a display right in the middle of the dashboard showing how many miles you're losing. With the EV this becomes a little more noticeable.

But it works the other way, too. You can be driving along a nice, flat road with your GOM showing 100 miles left in the battery. Suddenly you find yourself descending a hill. You drop down for about 5 miles and hit the flat part at the bottom. Then you look at the GOM and find that even though you've covered five miles of distance on the road you now have 103 miles of range on the GOM! This is

regenerative braking playing its part (See below for more on regenerative braking).

The other thing to remember about the range is that if it gets cold and you start to put the heater on this can sap the remaining distance very quickly. EVs don't have a hot engine under the bonnet to channel warm air into the cabin. They have to produce heat from a specific heat element in the car. In a lot of cars this takes a large amount of energy. The range is therefore reduced. Many EVs have a heat pump built into them instead. They are far more efficient and will heat the cabin up quickly without losing too much range. (5 miles, perhaps).

Additionally the internal chemistry of an EV battery doesn't work as efficiently with cold weather so that will affect your range.

Your EV will usually also have some sort of indication about how much energy it is using to power the car. This is usually displayed in the form of Miles per kWh or kWh/100 miles (or kWh/100kms depending on which country the car is registered in). This is analogous to the mpg (or litres/100km) measure that fossil fuel vehicles use.

It is difficult to say what is deemed 'good or 'bad' with these measures. Obviously higher values are good if you're working in m/ kWh, low values are good if you're working in kWh/100 miles. Some cars are really efficient and can get over 5 Miles/ kWh in summer. Some are a little less efficient and get 2.5 miles/ kWh in winter. (Or to put it another way anywhere between 20.0 kWh/100miles and 40.0 kWh/100miles). The actual value isn't relevant, it's the relative values which are. If your vehicle regularly returns, say, 3.5 m/kWh in most weathers that's a dependable value that you can work with. If it see-saws between 5 and 2.5 m/ kWh it makes calculation and estimation more difficult.

When you've had your EV for a while you'll understand what a 'good' value is for this reading and what a 'bad' value is. But knowing these values means you can monitor the rate at which energy is being taken out of the battery. This will give you a better indication of remaining range than the GOM.

So now that you know how different things can affect your range what should you do?

Ignore them.

All you need to do is focus on driving as efficiently as you can in the conditions that are around. This consists of being aware of two things :

1) The speed at which you accelerate.

2) The rate at which you brake.

EVs have a very linear power band. This means when you put your foot down in an EV you get all the power of the motor instantly. No delay, no ramping up, no changing gears. Just bam! and you're gone.

This is, undoubtedly, a lot of fun. Anyone who has ever been in a Tesla with Ludicrous mode enabled will attest to the fact that it is a fabulous feeling. 0-60 mph in a little over 2 seconds in a vehicle that weighs several tons. There is nothing like it on the planet.

The problem is it uses a lot of energy. It also wears the battery by heating it up excessively.

That means if you want to make your battery last a long time you need to drive a little more sedately. That doesn't mean you need to pootle along at 50 mph on the motorway. What it means is you should accelerate carefully to get to the speed you want.

Most EVs have a power meter on their dashboard. It shows how much power you are sending to the wheels from the battery. Usually the power meter has an area on the display marked as 'Eco'. This is the power range which will give you the best battery life and range. If you keep the power within the Eco level on the meter you will use the smallest amount of power to get to the speed you wish.

Then you need to be aware of braking. Which brings us to the wonderful topic of Regenerative Braking.

The Technical Bit - Regenerative Braking

Because EVs use an electric motor to charge the wheels they can benefit from a law of physics which means that a motor that is spinning without power being added to it will generate an electric current itself. When you drive you are putting power through the motor. But when you take your foot of the accelerator pedal and let the vehicle 'coast' the spinning motor will actually produce electrical power that can go back into the battery. The secondary effect of this is that the rotating motor will slow the vehicle down without using any of your mechanical brakes. This also extends the life of your brake pads.

Regenerative Braking (or 'regen') is one of the unique selling points of EVs. It means that you can use the speed the car has to actually recharge your engine without being plugged in and you can let the motor slow the car down without using the mechanical brakes.

Some EVs have implemented this to such a degree that you can actually completely drive the car using just the accelerator pedal. Pushing the pedal speeds you up, lifting your foot slows you down to the point where the vehicle will come to a complete stop. Nissan have patented this technology and called it the E-Pedal. BMW have similar technology. It makes driving an EV very relaxing.

So how should you drive? The key is looking ahead. Accelerate carefully and within the Eco range until you reach the desired speed. If you see that there are traffic lights ahead take your foot off the accelerator and let the regen braking slow the car down. Once you're used to it you can time this to the point where your vehicle is almost at a dead stop by the time you arrive at the lights. A simple tap on the brakes (for those cars without an E-pedal) will stop you completely.

The other factor that plays into the range of an EV is the physical top speed you are driving at. Unlike ICE vehicles which have an efficiency curve that peaks around 55 mph, with an EV the slower you drive the further you will travel on one charge. Around town - where your speed might average about 20mph - the highest range can be achieved. Driving 70mph on the motorway will sap your range very quickly. Experience has taught that the optimum speed for motorway driving is around 60mph in an EV. It's fast enough to not be slowing other traffic down but slow enough to maximise the range of your battery.

PRE-CONDITIONING

REMEMBER WHEN YOU had your old ICE vehicle and it was a cold and frosty morning? Remember how you had to spend a few moments deicing the car, scraping the windscreens and waiting for the engine to warm up so you could get the heat running inside?

That's a thing of the past with an EV thanks to preconditioning.

Preconditioning is where you set your EV to start heating before you actually need to get in the car.

Because there is no ICE in an EV there is no issue with having the battery warming the vehicle up. The engine isn't idling and it isn't kicking any harmful toxins out of the back of the car. Which means you can precondition while the EV is in your garage.

So how do you precondition?

There are three methods of doing this and you can choose whichever one is most convenient depending on which vehicle you are using.

1) Scheduled heating

Most EVs will have some sort of software within the car that will allow you to set charging times. This allows you to let the car charge overnight. Alongside this software there is usually a function that allows you to control the preconditioning. All you do is tell the car what time you are going to be leaving in the morning and at what temperature you wish the vehicle to be and the preconditioning software will do the rest.

2) Through the App

A lot of EV's (but by no means all of them) have an associated app. Nissan, Tesla and BMW all have them at the moment and I believe Jaguar and Audi will also have them. The app allows you to communicate remotely with your vehicle and switch on the preconditioning. You can be sitting in your kitchen having breakfast, or on the train home from work, and you can start the heating going remotely. When you've finished your breakfast - or your train has arrived at your local commuter station - you can drive off in a nice, warm, car.

3) By doing it manually

If you haven't set the scheduler and you don't have an app you can always get into your car, start the engine and switch the heating on. You can head back inside where it's warm and wait for the car to heat up.

Timing differs in all cars but I usually allow at least 15 minutes to get the car to a nice internal

temperature.

Of course preconditioning works the other way, too. If the weather is expected to be really warm you can set the preconditioning to cool the car rather than warm it.

TOP TIP *Preconditioning will ALWAYS drain energy from the battery. Some cars won't let you schedule preconditioning unless the car is plugged in to a charger. If you're charging from a wall charger or a rapid charger this isn't an issue. If you're charging from a granny cable the energy requirements of the heater can be more than the granny charger provides to the battery so you will be losing charge. It's not a lot but it will be there.*

PLANNING A LONGER DRIVE

ONCE YOU'RE USED to your EV you'll probably feel relaxed about driving it to and from work. Or down to the shops. Or for a night out to the movies or a meal.

All the time you'll be looking at it thinking *'Can I go for a longer trip? Can I go for a journey that will take it beyond the range of the battery?'*

Of course you can!

Many people have done this. Jonathon Porterfield - an EV specialist - regularly picks up EV's from Leicester and further South and drives them back to Orkney - a journey of 400 miles or more. And these are not to top of the range Teslas, Konas or E-Niros. These are 24 kWh and 30 kWh Nissan Leafs with battery ranges of 60 - 120 miles.

So how is it done?

The answer can be summed up in one word:

Planning

Almost without exception wherever you are travelling in the UK (and, indeed Europe) there will be a rapid charger you can use to help you continue your journey.

The key is knowing where these chargers are and what to do if there is an issue.

…And there may well be issues, unfortunately.

Sometimes your chosen charger won't be working. Sometimes it will be working but some thoughtless person has parked their ICE car in the way so you can't get to it. Sometimes it will be working but there might be a couple of cars in the queue ahead of you waiting to charge. Sometimes it will be working but the connector that your vehicle uses is broken; somebody in a different car can charge but you can't.

All these things happen. It's one of the problems with an immature charging infrastructure. But with a bit of thoughtful planning you can work around it

(*These things also happen with ICE vehicles. How many times have you pulled up at a petrol station to find a long queue of people wanting to fuel up? And how often do you find one of the pumps out of order when you get there? On top of that you can add the fact that not all petrol stations are open 24/7. All public chargers are.*)

To start you'll need a map of where all the chargers are. There are several sites that can provide this. The two most common are Plugshare and Zap-map. (These both have apps for iOS and Android as well as full websites.)

Each of these has a route planning function. This is perfect for working out where your charge stops will be.

The first thing you need to remember is that just because your car can do 150 miles on a charge (or 200, or 300, or even 350 miles) does not mean that should be the distance you plan to drive between charges. As a general rule of thumb, to keep the battery in tip-top condition you can start your journey with 100% charge, drive until you are down to 15 or 20%, recharge to 80% and continue. So if you do the maths with a car that gets 100 miles per charge: Your first charge should be 80/85 miles from the start and then each subsequent charge should be within 60/ 65 miles of the last. For a car with 200 miles of range your first charge should be 160/170 miles from the start with each subsequent charge 120/130 miles from the previous one.

This isn't a hard and fast rule, of course. But to ensure you have some contingency, and to allow for GOM issues and keep the battery in tip top shape, that's what's recommended.

Many drivers have run their cars down to almost empty before recharging. Manufacturers know this and generally have an amount of 'spare' capacity in the battery to allow this to happen. This is known as a 'buffer'. (In a 40 kWh Nissan Leaf, for example, when the battery is 'empty' according to the GOM there is still around 10% buffer left in the battery.)

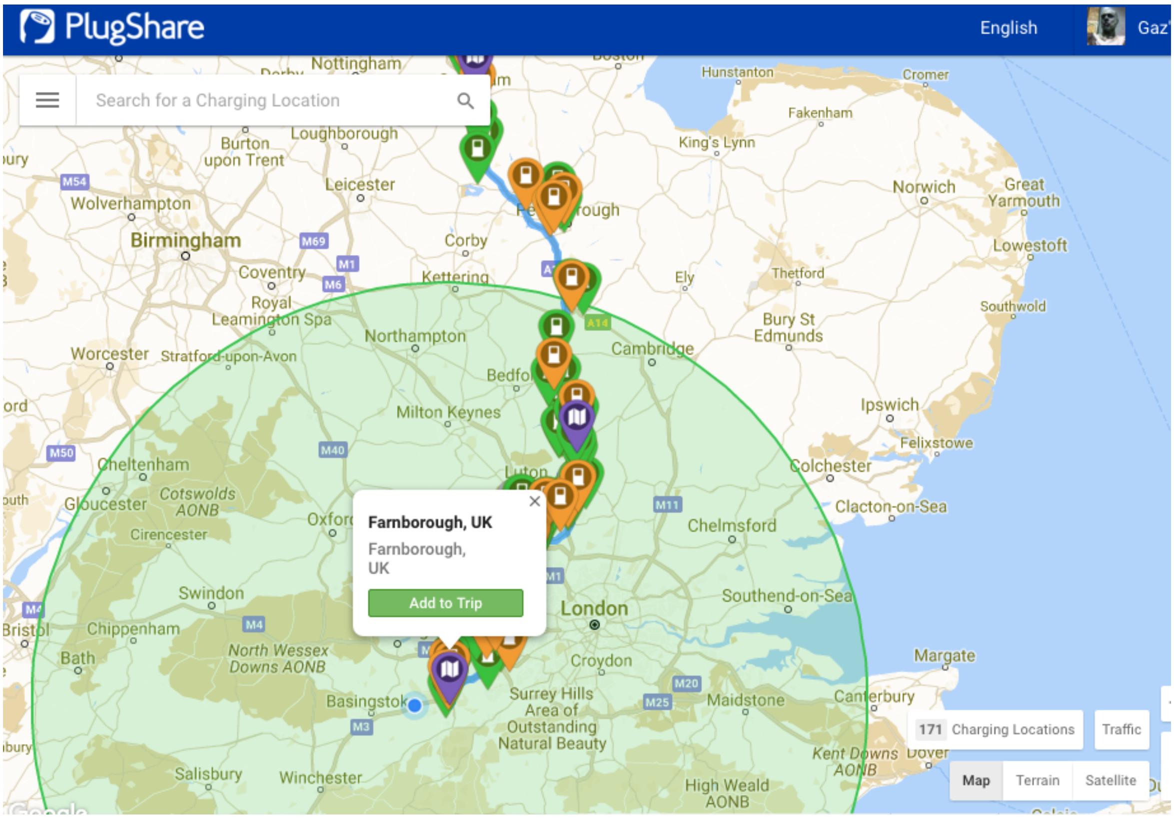
If you get into an app such as Plugshare you can tell it you are in a vehicle with an 80 mile range. It will ask you for a starting location and an ending location. Then it will calculate a route for you. Along that route it will show you all the chargers your vehicle can accept (*it's no use showing Instavolt chargers, for example, if you're driving a Renault Zoe - they are not compatible*). From your starting position it will draw a green area with a radius equal to the distance you can travel on the current charge. You need to find a charger which is close to the edge of that circle.

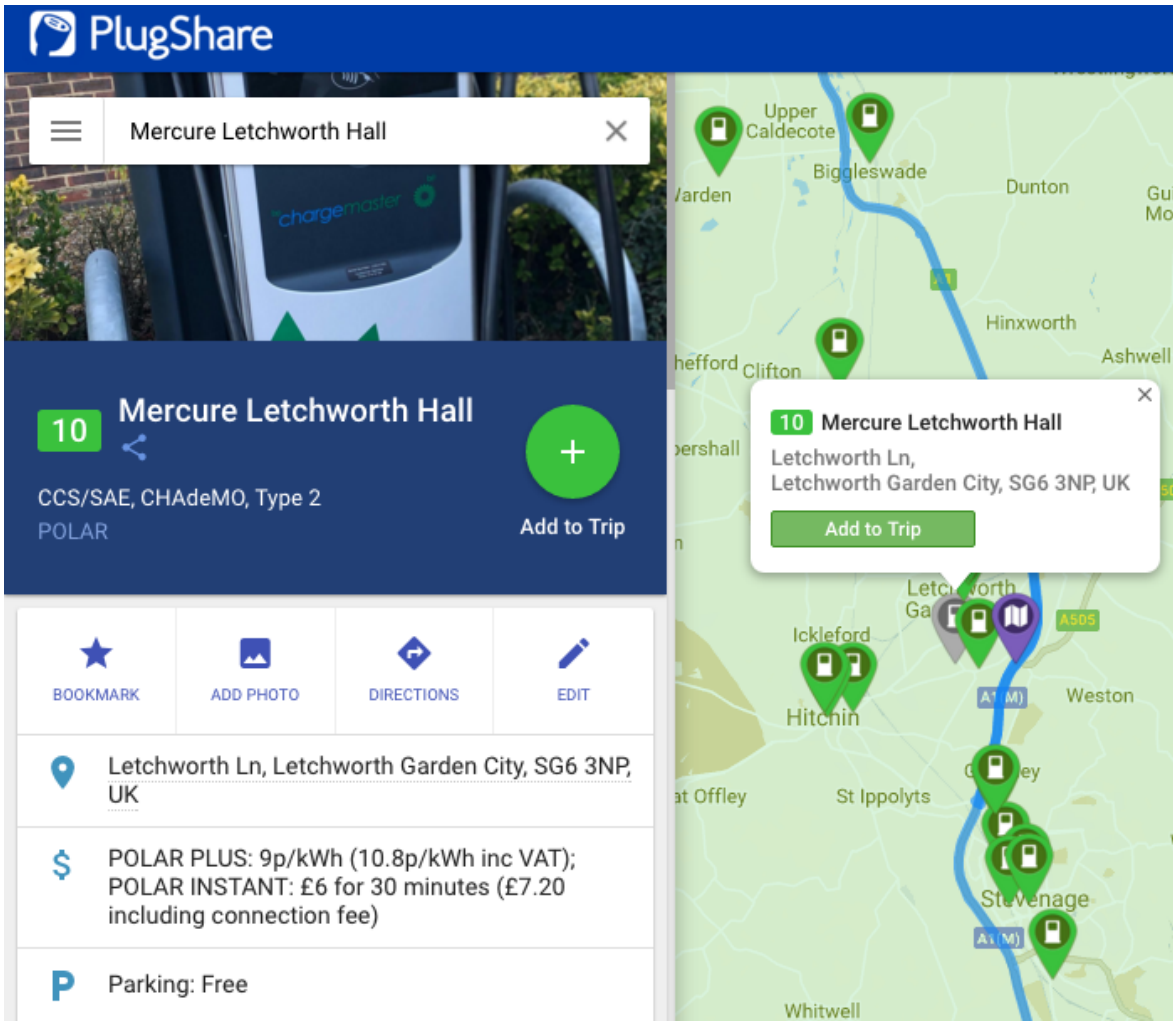
TOP TIP: *Don't choose the last charger at the edge of the circle. Choose the one before. That way if it's out of order you can still continue to the last one without running out of charge. Always have a back-up!*

Now add a second stop to your journey. This will display another green circle and allow you to show another charger that's near the edge (See the top tip above).

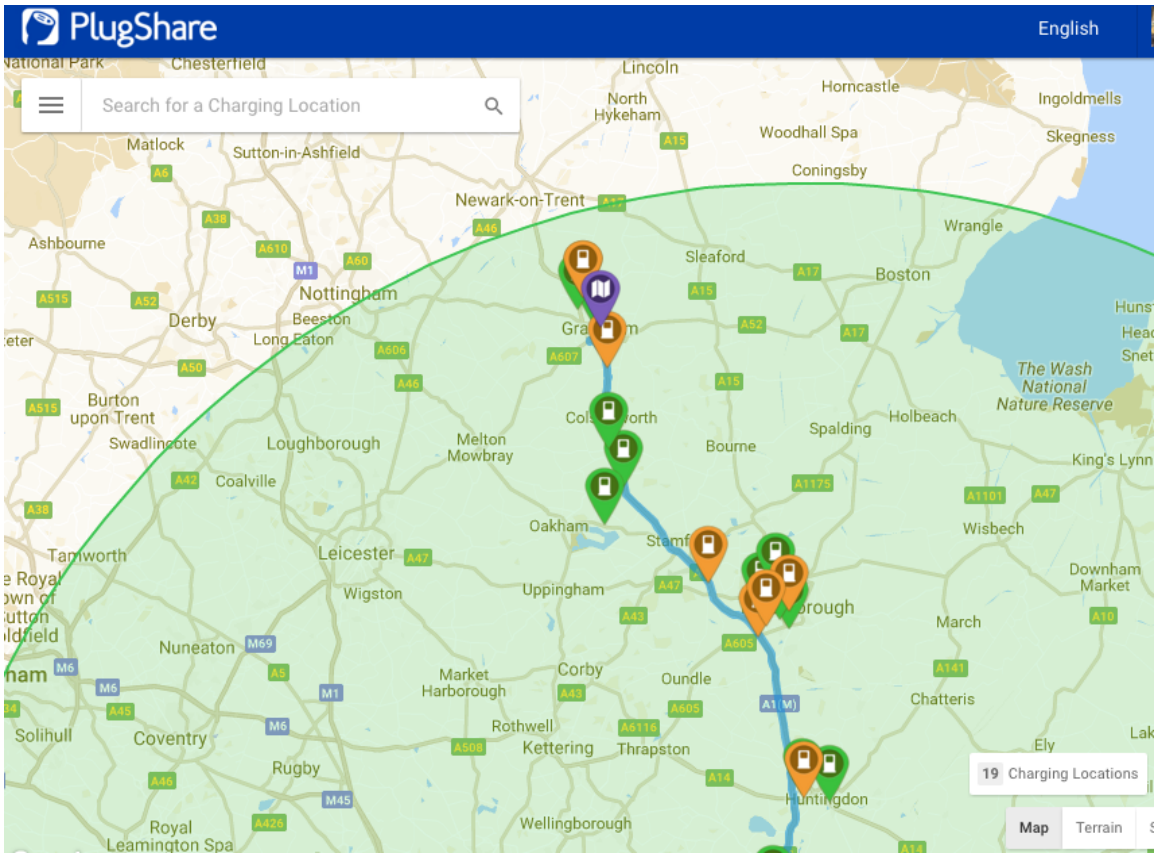
Continue doing this until you have identified all the chargers (and backups) you need to complete your journey.

Let's assume I wanted to go from Farnborough in Surrey to Grantham in Lincolnshire. The total distance is 150 miles. I might be in a Nissan Leaf 30 kWh with a max range of 100 miles. If I plug these figures into the route planner it will show me that within 80 miles of the start there is a charger at Letchworth I can use (Mercure Letchworth Hall) which is 75 miles away. If that one is not available I have an alternate option outside Bedford which is another 15 miles away.


PlugShare
English
Search for a Charging Location
Farnborough, UK
Farnborough,
UK
Add to Trip
171 Charging Locations
Traffic
Map
Terrain
Satellite
Nottingham
Loughborough
Burton upon Trent
Leicester
Wolverhampton
Birmingham
Coventry
Royal Leamington Spa
Corby
Kettering
Northampton
Worcester
Stratford-upon-Avon
Milton Keynes
Cheltenham
Gloucester
Cotswolds AONB
Cirencester
Swindon
Chippenham
Bath
North Wessex Downs AONB
Basingstoke
Salisbury
Winchester
London
Croydon
Surrey Hills Area of Outstanding Natural Beauty
Maidstone
High Weald AONB
Kent Downs AONB
Canterbury
Margate
Southend-on-Sea
Chelmsford
Colchester
Clacton-on-Sea
Felixstowe
Ipswich
Cambridge
Ely
Thetford
Bury St Edmunds
Southwold
Lowestoft
Great Yarmouth
Norwich
Fakenham
King's Lynn
Hunstanton
Cromer



I can add a second stop just outside Peterborough (45 miles away) where there are 3 rapid chargers within 4 miles of each other. That will give me plenty of charge to get to Grantham.



Depending on the weather, the speed I travel and the inclines I have to go up and down these stops can be changed on the fly if I find I have a greater, or lesser, range than I had anticipated.

The key thing is that I allowed for a contingency and I planned in advance.

Once I know which chargers I am heading for I can check that I have the right cards or apps and I'm all set.

CHARGING

ALL ELECTRIC VEHICLES work on exactly the same underlying principle when it comes to charging: You find a source of electricity and you divert that into the battery via a connector on the EV somewhere. The ICE analogy for this is that all ICE vehicles need a source of fossil fuels which you divert into the petrol tank via a filler.

Where EVs differ is that whereas fossil fuel can only come from a limited number of places (petrol stations, usually), EVs can accept electricity from just about anywhere. All you need is the right connector.

Your EV will have been provided with at least one, basic, charging cable. If you are lucky you will have been given two cables. We'll come back to the second cable in a moment. But for now we'll look at the basic cable. The basic cable is one which has a 3-pin plug on one end and some sort of fancy connector on the other. This is what's known as a **Granny Cable**. The idea is that this can be plugged into any socket anywhere in the world and it will provide power into your EV battery. It's so easy you can use it anywhere - even at your granny's house.

This is good news for people who were concerned about running out and not having anywhere to charge. If you can find a 3-pin plug (*and I have 8 of them within fifteen feet of where I am standing*) you can get energy into your battery.

The downside of this is that the power is restricted by the electrical circuit of the location you are charging from. Normal household circuits provide a fairly low voltage. This is why when you load the microwave, dishwasher, iron, TV and computer up then switch on the kettle to make a cup of tea your main circuit breaker will trip.

From a normal household plug it can take anywhere up to 24 hours to completely fill your EV battery from empty. Obviously this depends on how big the battery is. Smaller batteries will fill quicker, bigger ones slower. (*In fact there is a school of thought which says that sometimes charging a smaller battery more often is quicker than charging a larger battery fewer times. The overall travel time on a long journey can be reduced as a result. Norwegian Tesla owner and EV vlogger Bjorn Nyland ran a Jaguar iPace with a 90kWh battery against a Kia Soul with a 30kWh battery on a 1000km journey and the Kia won. This was because it stopped more times but spent less time charging overall because it charged quicker than the iPace*).

If you're at home and the car isn't doing anything that's not a problem. It will charge in the background while you're doing something else. I ran my first EV for several months using just the granny cable without any issue. It charged overnight and was sufficiently charged when I started in the morning.

The Technical Bit - Charging current

EV batteries provide Direct Current (DC) to your vehicle. This is what is stored in the battery. Your house will provide Alternating Current (AC) to your granny cable. In order for the AC to go into the battery it has to go through a charger which is built in to your vehicle. This charger takes AC and turns it into DC which it can then store in the battery. For most cars there is a maximum amount of energy that can be sent through a charger in a given time. Each vehicle is different but this limit will dictate the maximum speed at which your car can charge when using AC. 6 to 7 kW is a reasonable figure for an onboard charger using AC. This means in a given hour your car charger can convert around 7 kWh of energy and store it in your battery. If your battery is 30 kWh capacity it should take somewhere in the region of 5 hours to charge it to the maximum allowing for charging losses.

Your vehicle will have a charge port somewhere on it. For some cars it is under a flap at the front (Nissan Leaf, Kia Soul, Hyundai Kona, Renault Zoe) for others it is at the side (VWs, Jaguar, Hyundai Ioniq, BMW i8 and Outlander PHEVs etc.) The design of the actual socket will differ depending on who made your car.

At the time of writing all vehicles use a very similar plug for charging from a granny cable. This is known as a type 2 plug, also known as a Mennekes plug . (*There is also an earlier version of the type 2 plug called a type 1 plug. Early Kia Souls use this. It's basically the same as a type 2 but smaller.*)

If you are charging at home your granny cable will have a household plug on one end and a type 2 plug on the other end. That is all you need to charge your car anywhere you can find a socket.

If you are out and about you'll probably want to find somewhere to park that's close to a socket. Run your cable from the charge port to the 3-pin plug and you are good to go. This is handy if you're visiting friends or relatives. (*but if you're using an extension lead make sure it is rated to 13A and is fully unwound when attached to your Granny cable*).

But what if you're somewhere that doesn't have convenient access to a charge point, say a cinema or restaurant?

That's where your other cable comes in handy.

This is the type 2 cable. It's used for connecting type 2 chargers to your vehicle.

The Technical Bit - Charging types

Chargers can be split into various 'types'. The charger which works with your granny cable is usually called a slow charger. It'll max out at about 3.5kW charge speed.

The next step up from this is a home charger. These usually max out at around 7kw. To use one of these you will need a type 2 cable. This is the second cable that may have come with your vehicle. It will have a type 2 connector on one end and a type 2 (or type 1) connector on the other.

One level above this is the 'fast charger'. These are fast in name only. They max out at 22kW and usually also use the type 2 connector you may have received with your vehicle.

If you really want 'fast' charging you need to go to the next level up which is 'Rapid Chargers'. These are the big, hulking machines you see at motorway service stations. They usually have several tethered cables attached to them and can provide a charge lasting around a maximum of 1 hr to get you almost completely full.

There are also different levels of Rapid Charger. This is driven by the speed of the charger. 50kW is a typical speed for a charger. This means in 1 hour it will pass a theoretical maximum of 50kWh of charge to your vehicle (although in reality it will be less than that due to inefficiencies in the charger). Newer chargers are coming on line that can pass up to 350kW to your car. These are known as HPCs (High Powered Chargers). If your car can accept this then that's great. Not many can at the moment, though. But it will improve.

It can get complicated when you are working with different types of chargers. The simple way to remember them is by looking at the cables. If the charger does **not** have a cable attached to it the chances are it is not a rapid charger. You will need to attach to it using the second cable you received with your car (or purchased separately as the case may be). If you are out in the wild and you find a charging post with a socket but no cable, chances are it is a 7kW charger. These are typically found in places where you will be expected to stay for an hour or longer. Examples include car parks in the

centre of town, cinemas and some grocery stores such as Asda, Lidl and Tesco.

To use these chargers stick one end of your cable into the charger and the other end into your vehicle and follow any instructions that are on the unit. A large proportion of these chargers are completely free. Once you have started charging your car will lock the cable in place so that nobody can remove it and stop your charge (or steal your cable).

If you are at a charger and it has thick cables permanently attached to it chances are it is a Rapid Charger. These are known as tethered chargers. You do not need your own cable to use these. Once again, however, when the system is charging the car will usually lock the cable into the car so it can't be disconnected.

The other thing you'll notice about these Rapid Chargers is that they will have several cables attached to them. Most will have 2 cables and some will have 3 cables. Does this mean a charger can charge more than one vehicle at a time? Usually (but not always) the answer to that question is 'No'. So why do they have more than one cable? That's because Rapid Chargers fall into three charging standards:

Chademo, CCs and AC:

Chademo is the standard used by Nissan and the early model Kia Souls. It was designed by Nissan and is generally used in Japanese manufactured cars

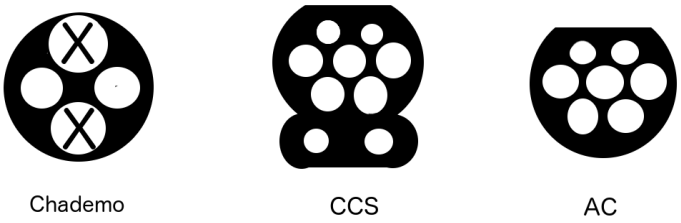
CCS is the 'other' standard. It is used in any car not using Chademo.

AC The exception to this is the Renault Zoe which has what's called a chameleon socket that can be charged using high voltage AC current on a Rapid. This is usually restricted to 43kW maximum speed.

If you want to think of it in terms of ICE refuelling imagine the different sockets equate to Unleaded, Diesel and 4-star. They all power vehicles but you want to ensure you get the right one for the vehicle you're in. The difference between EV and ICE in this regard is that all connectors actually provide the right fuel - electricity - so there is never a chance of putting the wrong stuff in. (*Unlike an ICE vehicle where you can put diesel in your petrol engine and vice-versa*)

The good news with Rapid Chargers is that it's extremely difficult to connect the wrong charger into your car. The three connectors are completely different and mixing them up is almost impossible.

Chademo tends to be a circular adaptor with two large 'pins' in the middle. CCS tends to be shaped a little like a type 2 charger standing on a plinth with two holes in the front of the plinth, and AC looks a lot like your type 2 charger.



If your car has a CCS connector you will usually find that it is co-located with your type 2 socket on the vehicle. The type 2 socket is the top part of the CCS connector and the 'plinth' part usually has a separate cover on it to protect it. Pull that cover off and it will expose the sockets for the lower part of the CCS connector.

So now you know what the different types of chargers are. You also know what the different connectors are.

It might be time to move on and actually look at doing a proper charge.

USING A RAPID CHARGER

YOU PULL UP to a rapid charger. It could be at a motorway service station, a Holiday Inn, a main car park, or anywhere an operator has chosen to install one of these large machines.

(This is a Polar Rapid charger in a hotel car park. Note the three tethered cables: AC, Chademo and CCS)

How do you charge your car?

Well the first thing you do is decide whether you are driving a PHEV.

WARNING WARNING Controversial opinion ahead. WARNING WARNING

If you are charging a PHEV then you should seriously consider whether you should be using a rapid charger. Your vehicle will not rapid charge (although there are exceptions such as the Mitsubishi Outlander PHEV). It is limited to the speed of the on-board charger and that will top out at around 7KW. Using a rapid charger for your PHEV is the same as using a fire hose to fill a swimming pool with water but having a narrow garden hose attachment on the end : it'll get there eventually but you're probably better served finding a normal garden hose.

There are exceptions to this. If there is nobody on or waiting to use the rapid charger AND there are no stand-alone AC chargers nearby AND you are happy to wait by your vehicle then there is no reason you cannot use the rapid. But, please, stay with your vehicle at all times. There is nothing worse than an EV driver pulling up to a rapid charger and finding it occupied by a PHEV and the driver is nowhere to be found. Remember you bought a vehicle that uses fossil fuels as a back-up. There's no reason you shouldn't avail yourself of this back-up wherever possible.

WARNING WARNING Controversial opinion completed. WARNING WARNING

So how do we charge on a rapid?

First things first: open your charge port. Some cars require you to press a button inside the car. Others allow you to open the flap from outside. Whichever one it is open the flap and go to the charger itself.

Initiate the charge: This is the most complex part of the process. You will need to pay for the charge (or at least show that you have the means to pay for it at the end). Depending on who owns the charger this might involve opening an app on your phone, swiping an RFID card or waving a payment card at it. Most rapid chargers have a card reader attached somewhere. This is what you wave your card at.

The small screen will then lead you through what you need to do next.

This is usually asking you to select which type of charging cable you will need. By now you should know the types of charger your vehicle needs (CCS, AC or Chademo). Select the appropriate type.

Take the charger out of the socket on the machine and affix it to your vehicle charge port. There should be a clunk as the charger locks into place.

The charger will then do some complicated technical stuff where it checks the integrity of the cable, the charger, the connector and the battery. If it thinks everything is fine the charge will start. The screen will change to indicate it is charging and inside your vehicle you will be able to see that the vehicle is charging.

But.. but… but..

… It didn't work!

This happens sometimes.

- There might be a problem with the charger.

- There might be a problem with the connector.

- There might be a communication problem with the actual network running the system.

Any of these can cause the charge not to start.

(*Furthermore if you are a CCS user on the early DBT chargers Ecotricity have used you may still find general incompatibility issues between your charger and your vehicle*).

If any of these occurs stop the charge, disconnect the charging cable and start again.

If problems persist with public chargers they all have a contact number on them that you can call for

customer support. 99% of the time the customer support rep will reboot the machine remotely and the problem will go away. This usually takes 3 – 5 minutes.

While your car is charging.

Once the current is running in to your battery you'll have a little bit of time to kill. There are, basically, three things you should look at doing while this is happening :

1) Update Plugshare and/ or Zap-Map.

2) Calculate your charge speed to ensure you're not running slow.

3) Work out how much charge you need and where your next stop will be.

1) Update Plugshare and Zap-Map.

Plugshare and Zap-Map are two apps that allow users to locate chargers across the UK (and, with Plugshare, across the rest of the world). They are very similar in their functionality. I find the Zap-Map user interface to be a better design but Plugshare has better functionality. As you are charging open either (or both) of these apps, select the charger you are at and 'check in' to the charger. Write a little something about what happened. If there were no problems let users know. If there is an issue with the charger add that to your check in. Plugshare uses these to put a rating on each charger. The higher the rating (1 - 10) the more chance there is that it works well and will be available.

If you arrived at the charger and an ICE vehicle was blocking the charger making it difficult or impossible to charge you can also report that on Plugshare and ZapMap.

As both of these apps rely on user input to improve their service it is vitally important you keep them updated. This allows other users to see a) whether a charger is in use and b) If there is a problem, or potential problem, if they wish to use it.

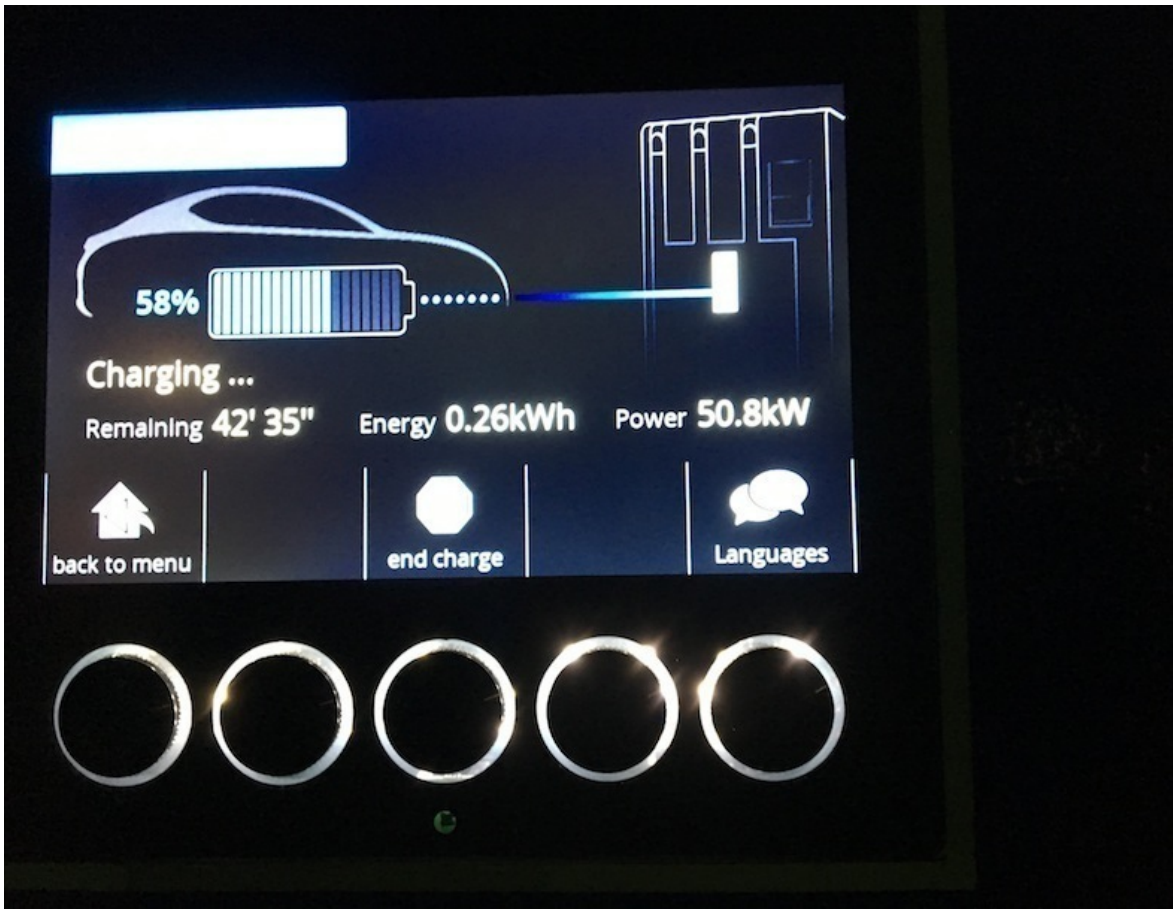
2) Calculate your charge speed.

The fastest chargers in the country will never charge your car at the fastest speed they can achieve for the whole of your charge. The reason for this is twofold: a) Charging a battery to 100% at full charging speed will degrade the cells and shorten its life. b) Battery management systems in EVs control the rate at which current is received according to factors such as how warm the battery is and what percentage charge your battery is currently at.

Many of the more modern EVs have a display on the dashboard that will show the exact charge speed your car is getting. You can monitor this and decide when is the best time to leave (See below re: charge rates).

But if you don't have that display, you will need to calculate the charge speed yourself.

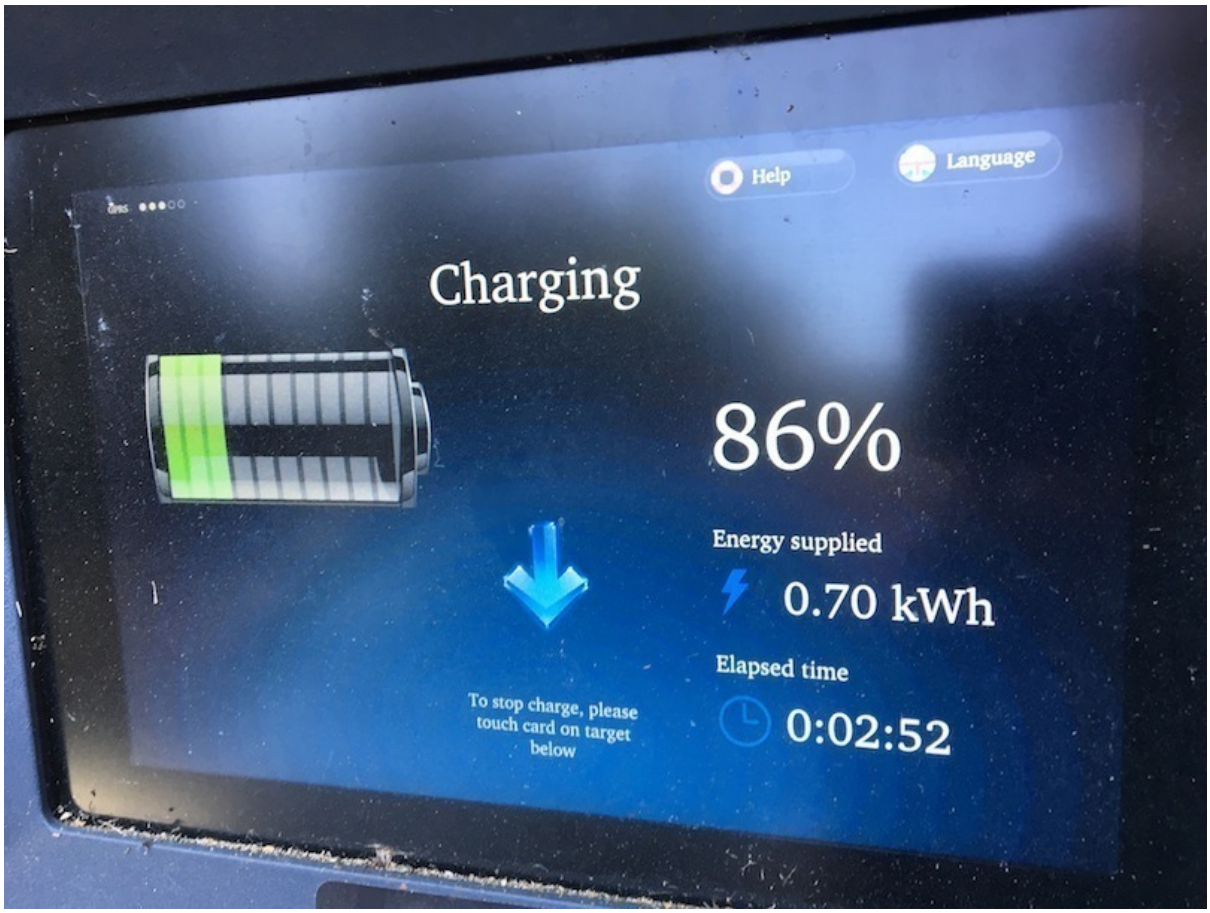
The easiest way to check your charge speed is to read the display on the charger. It may give a voltage and an amperage (e.g. 220v, 198a), It may give an actual charge speed (as in the Alfapower display below) or it may give a number of kWhs delivered and a time.



To work out the charge speed open the calculator function on your phone and do the following:

- For chargers that display the **voltage** and the **amperage** just multiply the two together and divide by 1000 to get the kW speed. In the example above 220v and 198a gives 43,560 watts = 43.5 kW.

- For chargers that display **kWh delivered** and **time readout** (such as with the Polar Rapids) the calculation isn't as accurate but it gives a rough indication. Divide the time into 60 and multiply by the charge that has been delivered. So if you have been charging for 6 minutes and you have received 4.5 kWh of energy divide 60 by 6 (= 10) and multiply this by 4.5 to give 45 kW of charge speed. If the time is 15 and the charge delivered is 8 kW then the calculation is (60/15)* 8 = 32kW charge speed. This is, however, just an average for the whole charge.



Monitor this speed. As the battery gets fuller and fuller the charge speed will start to drop. At some point it is not worth staying on the charger as the speed is so slow. Most chargers start to drop off somewhere around 75 – 85% full. This is the battery management system protecting the battery. If you really need a higher charge than that then by all means stay on. But the last 20% of charge can take as long as the first 80%. In the example above the vehicle is charging at 19 kW. Time to go!

TOP TIP: If your speed has dropped off and there is a 'fast charger' (22 kW) nearby, it is often worth finishing your rapid charge and moving to the 22 kW charger. The cost will often be a lot less and it will free up a rapid charger for another vehicle to use.

3) Work out how much charge you'll need.

If you're on a long journey then the charge time is an excellent opportunity to do some forward planning. Look at where you need to get to for your next rapid charge. Calculate the distance. Work out how many kWh of energy you need to make that distance (assuming a modest contingency). Is there a back-up charger at our next destination in case there's an issue or a problem? Once you know this you can work out how long you need to stay at a charger.

As a general rule don't stay at a rapid charger longer than you really need to. If you absolutely HAVE to charge to 100% to make it to the next Rapid then by all means do so (But see my point about about using a 22 kW charger once you've hit a high state of charge percentage.)

You'll find that once you've checked in at a charger, calculated the charge speed, worked out your

route and next charge point, and been to the toilet/grabbed a coffee/ stretched your legs it'll usually be almost time to head off to your next leg of the journey anyway.

Many times while you are at a charger you will find someone else comes up and chats with you about your car. This might be a member of the public or it might be a fellow EV owner waiting to charge.

Likewise you may turn up at a charger to find someone is already using it. Take time to say hello. Ask them how long they anticipate being there. If you can't wait head off to your alternate charger location (You do have an alternate charger, location, right?). If you're happy to wait most EV owners are happy to chat with you.

There will always be familiar topics of conversation in the EV world. Typical examples include:

1) The state of the charging network.

2) PHEVs hogging chargers (*or, if you are driving a PHEV, you'll be discussing how inconsiderate EV drivers are towards PHEV drivers*).

3) Regular chargers you use and how reliable they are.

4) The different charging networks and their apps/RFID cards.

5) The state of The Electric Highway from Ecotricity.

6) Your EV and what you like and don't like about it.

7) Your next EV and what new ones are due for release.

Work your way through couple of these topics and you'll find the time just flies by.

TOP TIP If you plan on leaving your vehicle charging (such as when you're at a service station and want to head off to grab some food or similar) it's a really good idea to either leave your telephone number on the dashboard so that other users can contact you if there is an issue. In Scotland the government provide discs that can be placed on the dashboard with a phone number and code. Text the code to the phone number and the driver is notified automatically.

The Technical Bit - Charging profiles

One of the quirks of recharging a battery is that the battery itself doesn't accept the highest speed right the way throughout the charge. It starts off slow, speeds up to the maximum rate, then slows down towards the end. Think of it using the Football Supporters At The Stadium analogy: If the stadium accepts 100,000 people the first 60- to 70- thousand people will be able to file in, find

a seat, and sit down quite quickly. But once you start to get towards 80,000 people in the stadium finding the remaining 20,000 empty seats is not as easy. It can take as long to fill those final 20,000 seats as it did to fill the initial 80,000 seats. It's the same with a battery. You can get the first 60 - 70% filled up relatively quickly. Then the speed slows down as the remaining capacity gets smaller and smaller.

On top of this the systems that manage battery charges ('The BMS' - Battery Management Systems) are designed to ensure that the charging does not produce excessive amounts of heat that can damage the battery.

As a result of this each vehicle type will have a distinct battery charging profile. There is a percentage range at which it will receive the maximum amount of power the charger can produce. Then there is a point at which the power will be reduced to preserve the battery. As an example: The Nissan Leaf (40 kWh battery) will charge at maximum speed until it gets to about 70-75%. On a 50 kW charger this can be at speeds of around 44 or 45 kW. Once it reaches 70-75% it will start to slow down to around 35kW reducing gradually to around 20kW as the battery approaches 100% capacity. All EVs have a profile for charging. Know what your vehicle's is and keep a track of it. What this means is that once the charge rate hits this drop-off staying any longer at a charger is wasting time unless you ABSOLUTELY need more charge.

WHEN YOU'VE FINISHED

AT SOME POINT you'll decide you have enough charge to continue your journey. You'll need to stop the charger.

DO NOT PRESS THE EMERGENCY BUTTON TO STOP THE CHARGE!

The red emergency button is for exactly that - an emergency. There are other ways to stop the charge.

- If you have used an RFID card to start your charge you will usually have to present the same RFID card to the machine to allow it to stop.

- If you've started the charge with an App you'll usually have an option to stop the charge early on the app.

- Some chargers and networks limit the length of time you can charge and will stop the charge once the time limit has been reached. Ecotricity is an example of this.

However you do it, stop the charge, Wait for the display to tell you the charge has stopped then unplug your charger.

That's all you have to do.

Congratulations you have performed a rapid charge!

The last thing I want to say about Rapid Charging is this: **Make sure you leave the charger in a good state.**

When the cable needs to be put back, make sure you put it into the holder. ALL rapid charger connectors fit into a slot on the charger itself. **NONE** of them leave the connector hanging out in mid air. Some rapid chargers have a little 'cradle' on the side which looks like it's made for the connector to rest on. It isn't. It's made for the long cable itself to rest on.

Not putting the connector back correctly will lead to issues over time where the charger will not be able to initialise due to broken hardware. You don't leave petrol pump nozzles on the floor so don't leave chargers there either!

(*In the photo above the AC connector is sitting snugly in its slot and the slot above and to the left of it is awaiting the return of the Chademo adaptor after use.*)

If you have pressed the emergency stop button (for whatever reason) make sure you don't leave the charge like that. If you can pull the stop button out, do so. If you can't then contact the operator and ask for the charger to be rebooted. All operators can reboot their rapid chargers remotely. This will ensure the charge is ready for the next customer.

Charging operators

Imagine, if you will, a situation where you go to an Esso garage in your ICE vehicle. You want to fill up with unleaded. But, in order to do that, you need to use a special app on your phone or purchase a special card that can be read and recognised by a reader on the pump.

Now imagine you want to Shell. They also needed an app or a card. But not the same one as Esso. BP also have their own proprietary app, as do Texaco.

That would be ridiculous, wouldn't it?

Unfortunately that's the situation with EV chargers at the moment. There are a handful of companies that have invested money into putting the charging infrastructure in around the UK (or indeed the world). But to recoup some of their investment they're capturing as much information about what their users are doing. In order to do this they've designed phone apps or use RFID cards where the customer has to use create an account on their website etc.

Basically it's a nightmare.

There is good news on the horizon, though. The government are putting in place laws which require all chargers to be able to accept a simple payment card as ID. This card will start the charge and serve as a means of paying for any fees due from that charge.

That's still a little ways away yet.

In the meantime the new EV driver has to identify which of the myriad of charge companies he or she wishes to use and set themselves up with the appropriate app or RFID card.

The other good news is that all the current players in the EV charging market use renewable energy in their chargers. This comes from either solar, wind, biomass or hydro as a general rule of thumb.

Here's a list of the main UK suppliers (with links to their web pages):

POLAR (BP CHARGEMASTER)

POLAR ARE THE largest charge supplier in the UK. They have installed hundreds of fast chargers across the country. They are usually well maintained, high voltage and have all three tethered cables (CCS, Chademo and AC)

Accessing a Polar charger is either via their Polar Plus offering or Polar Instant.

Polar Plus is a subscription service. You pay a set fee per month and - via an RFID card - every charge is priced at 11p per kWh, inc. VAT. That's really good value if you tend to rapid charge a lot.

Their chargers are located all over the place. They tend to install them in hotels - they work closely with the Holiday Inn group - and other town centre places. I've charged with Polar in Harvester restaurant car parks, hotel car parks, Asda stores, Car dealer forecourts, and NCP car parks.

Polar Instant is an App-based offering. You load the app onto your phone and you can use it without a subscription on almost every Polar charger. Because you are not paying a monthly subscription you will pay a higher cost per kWh for any electricity. Polar Instant tends to charge set fees such as £6 for 30 minutes and then add a connection/ admin fee of £1.20 on top. With their Rapid chargers you can get anything up to 20 kWh of charge in 30 minutes which works out at about 35p/ kWh

Here is the link to the Polar site : https://polar-network.com/

ECOTRICITY

BACK WHEN EVS were even more of a rarity than now there were very few rapid chargers anywhere in the country. In order to expedite the rollout of EVs one company took a very bold - and welcome - decision.

Ecotricity (a renewable energy supplier) made a deal to install one or more Rapid Chargers in almost every motorway service station in the country.

A few years later EV drivers found they had a network of chargers they could use for longer distance travels. For many EV drivers these have been a godsend. I know of at least one EV driver who has done trips from the Midlands in England to Orkney in various EVs over 40 times. A large number of his charges have been courtesy of the Ecotricity Electric Highway.

To use an Ecotricity charger you will need their app and an account. Your account will link to a payment card that will deduct the money when the charge is finished.

The Ecotricity Electric Highway is convenient, widespread and mostly seamless.

However it is far from perfect. As part of the deal to implement the chargers Ecotricity were supported by Nissan. (Remember this was the time when the majority of EVs on the road in England were Nissan Leafs). As a result they purchased chargers recommended by Nissan. These chargers worked very well for Chademo users (i.e. The Nissan Leaf), but were a little flaky when it came to CCS users (The BMW i3 and the Hyundai Ioniq particularly suffered with this issue).

In the meantime the chargers have not aged very well. A lot of them have problems. Many don't charge as quickly as chargers on other networks and the connectors can often be broken. The good news is that in many instances when a charger has an issue and loses connection with the Ecotricity HQ it will default to giving a free vend to the user.

Ecotricity have stated that they intend to replace their chargers with newer versions. This would be very welcome as newer chargers would allow more CCS usage and should - in theory - allow charging at higher charge rates when the appropriate vehicles go on sale.

Here is the link to the Ecotricity site : https://www.ecotricity.co.uk/for-the-road

CHARGE YOUR CAR (BP CHARGEMASTER)

CHARGE YOUR CAR (CYC) were purchased by BP Chargemaster who also own the Polar Network. BP Chargemaster is looking to become a major mover in the world of EV charging.

The good news is that if you have a Polar Plus account and card it will work on most of the CYC chargers, too. The additional good news is that your charger will be at Polar Plus rates rather than CYC rates even if you are using a CYC charger which has a higher cost per kWh. This is because the Polar Plus rates are discounted because you pay a monthly subscription charge whereas the CYC rates are not.

To charge at a CYC charger you will need to set up an account and order an RFID card. (As mentioned above, though, if you already have Polar Plus you don't need a CYC account)

Here is the link to the CYC site : https://secure.chargeyourcar.org.uk/weblink-signup

INSTAVOLT

INSTAVOLT ARE BOTH the best and the worst charge network. It depends on which vehicle you drive.

If you drive a car that can charge with CCS or Chademo they are great. You can just rock up at any Instavolt charger, wave your payment card in front of the reader and start charging. There's no app, no RFID card, no account. They charge a fixed rate per kWh - this is usually 35p - but oftentimes their chargers are on free vend which means you still need to wave your payment card at the machine but it won't charge you.

Instavolt are not as widespread as some of the other chargers but they tend to be in interesting places such as the Bannantyne Health Clubs or in the middle of business parks.

If, however, you drive a car that can only charge using AC current on a rapid (at the moment this includes cars such as the the Renault Zoe and the Smart EV range) these chargers are your mortal enemy. There is no cable to allow AC charging on an Instavolt charger.

Here is the Instavolt Web page : https://instavolt.co.uk/

POD POINT

POD POINT ARE a company dedicated to installing chargers wherever they can. Pod Point provide chargers for home use, chargers for company use and public chargers (both slow, fast, and rapid.)

The good news about Pod Point chargers is that a lot of them are free. They will only be slow chargers (7 kW) but they won't charge for then. The also have some fast chargers (22 kW) and this might be 20p/ kWh.

Pod Point also have Rapid Chargers at some locations (and have recently partnered with Tesco to put chargers in their stores) and will charge for these.

To use a Pod Point charger you will need to download their app, make an account and load a payment card against it.

Here is the link to the Pod Point : https://pod-point.com

GENIE POINT

GENIEPOINT ARE A company that have installed a set of Rapid Chargers in various locations around the country. More often than not they are in petrol stations.

Geniepoint work using an RFID card. They can supply one but what they can also do is use an existing RFID card (from, say, another charge company) and log that against your account.

Either way you'll need to create an account and log a payment card against that account.

Once you are set up you can go to a Geniepoint charger and tell it you want to register an existing RFID card from another vendor. It will ask you to swipe and confirm via the web site

Here is the link to the Genie Point site : https://www.cpsgenie.com/ds/Welcome

SHELL RECHARGE / SMOOV

SHELL HAVE EMBARKED on a project to install Rapid Chargers at their service stations. At the moment these are limited to a select few in the South of England - although they say this will expand.

To access a Shell charge you will need a specific app. It is called Smoov and is downloadable from either Google Play or the Apple App store.

You will also need to register with their website and log a payment card against the account.

The app allows you to manage charging and payment directly. Shell Rapids are charged at around 25p per kWh with a transaction fee of 35p.

Here is the link to the Shell web site: https://www.shell.co.uk/motorist/welcome-to-shell-recharge.html

CHARGE PLACE SCOTLAND

IF YOU ARE lucky enough to live in Scotland you can take advantage of Charge Place Scotland.

This is an organisation which is funded by the Scottish government and is devoted to implementing and expanding EV infrastructure North of the border.

They provide charging across the country via an RFID card and provide a unified method of locating, initiating and paying for charging. However a large proportion of the chargers under the CPS scheme are free of charge - even the Rapid Chargers.

Here is their website : https://chargeplacescotland.org/

BUT.. I LIVE IN A FLAT!

EV'S SHOULD BE for everyone.

In the future EVs *will* be for everyone. But at the moment there are several edge cases which will stop people from owning an EV.

- If you absolutely *have* to drive 400 miles in a single day pulling a large caravan or trailer without stopping then you're probably not ready for an EV. Or, more specifically, EVs are not ready for you.

- If you're a sales rep who *has* to cover 300 miles in a day and your patch is central Wales, Devon or the North York Moors where there are very few Rapid Chargers then you're probably not ready for an EV.

But one situation which is often mistaken as an edge case is the user who lives in a flat (or somewhere without off-street parking) and doesn't have a place to charge their car overnight.

Ideally all EV drivers will have access to at least a 3-pin plug for overnight charging. But there are a lot of people who live in flats, or who can only park on the street and are not allowed to run plugs out across the pavement to charge their cars.

It would seem that they can't have an EV.

But that's not the case.

There are numerous cases of people who have EVs and live in either of those domestic situations. They use local charging networks to help them. Their day-to-day commute is within the range of the vehicle's battery and they have found either Rapid Chargers or local AC fast chargers they can use either near where they work or on the way home or back. Because their daily mileage isn't huge they can do a top up charge in about 15 minutes on a Rapid Charger. Is it ideal? No. Will things change in future? Yes. There are already companies that are looking at providing charge points built into street lamps as well as pop up chargers that appear on the pavement at preset intervals along the road. Either of these will help the situation.

Two examples of people who operate EVs under these conditions are El in Dundee (@she_selectric) and Simon in Hertfordshire (@TheEVside). Check out their Twitter streams and Youtube channels for more information on how they deal with this on a day-to-day basis.

It's not there yet. But it will be.

HOME ENERGY SUPPLIERS

IF YOU DO live in a home that has access to a 3-pin plug you'll probably want to make sure you're getting the best electric deal for your money.

Generally speaking (and this is just a generalisation) most EVs charge during the night. There are 2 reasons for this:

1) They're often parked at work all day where they may not have access to a charger.

2) The electric demand is lower at night so there's less load on the network.

That second point is key. Because the electricity network has lower demand at night (Factories aren't always running, TV's aren't on. Kettles aren't being boiled, high demand services such as trains and underground railway services aren't running) the load on the network is much lower. In fact because of the way the electric network operates there is often an oversupply of electricity. If this electricity isn't used it is wasted.

There is, therefore, the opportunity for energy suppliers to reduce their rates in the evening to encourage higher usage. This is one of the reasons the Economy 7 tariff was introduced.

It's also perfect for EV owners.

Several companies have started tariffs which are ideal for EV owners. They combine two things EV owners are looking for: a) Low night time charge prices. b) Renewable energy tariffs.

However these tariffs are not often advertised. The big 6 tend not to go for this (with British Gas being an exception, see below) and it's usually some of the smaller suppliers that provide them.

At the time of writing the main suppliers that cater to EV drivers are

- Ecotricity with their EV bundle
- Octopus with their Energy Go tariff
- OVO with their Energy Everywhere Tariff
- Bulb
- British Gas.

Each of these tariffs has plusses and minuses. If you are wanting the absolute cheapest tariff then Octopus are probably the best. Their tariff can be as low as 5p /Kwh at night. However this is limited to 4 or 5 hours after midnight. If you tend to charge outside those times this might not be the rate for

you.

The other ones have higher rates but give more flexibility.

The Ecotricity bundle also allows half price charging at the Electric Highway chargers they run. It will give you reduced rates on a wall charger at home.

When looking at the costs make sure you check out the standing charge as well as the price per Kwh. If the Kwh rate is low but the daily standing charge is high the savings might not be quite as impressive as they may appear.

HOME CHARGING

AS I HAVE already said it is entirely possible to run an EV using the supplied Granny Cable and charging from a domestic socket in your house. Many people do this without any issue.

However, if you wish to make the best use of limited time night tariffs, or ensure you can charge at the quickest speed possible at home you'll need a home charger.

Home chargers are, basically, the next step up from the Granny cable chargers that use the 3-pin plug. They are a specific set of hardware - usually affixed to an external wall or an internal garage wall - into which a type 2 cable can be attached to charge your car.

Normally for a standard household the Home charger will pass electricity through at a rate of around 7kW. That means that in a given hour your battery will be replenished by 7kWh (*In reality it is less because the chargers are not 100% efficient and some energy is lost through the charger and the cable.*) If your vehicle has a 40kWh battery you should be able to replenish it on a 7kW charger in around 6 or 7 hours.

There are many, many companies that produce home chargers. Some are basic units that literally do what they say - charge your EV. Some are open source so you can decide how the programming works on them. Some link in with wind turbines and solar panels to manage the flow of electricity into your house and car via your renewable home source and the grid.

Whichever one you decide on you may be eligible for a grant from the government to put towards the cost of installation. If you are eligible - and the criteria is quite generous - the overall cost for a standard installation of a basic charger should be somewhere in the region of £200 after the grant. There are cheaper chargers where you will pay less and there are more expensive chargers where you will pay more.

If your installation is not 'standard ' you will have to pay more. This happens in cases where the wiring on your house is old, the circuits can't support the increased current, or you need additional groundworks with new cables being laid at your property. The company installing the charger will inform you of this.

THE MYTHS - DEBUNKED

NOW THAT YOU'VE got your electric car there are going to be a lot of people who'll look at you slightly strangely.

"You mean you paid all that money for a car that won't do 600 miles like my diesel and takes almost an hour to 'Fast Charge'?" (They'll usually use air quotes when they say that)

They'll also trot out all those myths that they hear on Facebook, Twitter and badly researched newspaper articles.

Don't listen to those people.

They're ancient dinosaurs.

And we have answers to all of them :

1) The batteries will need replacing and cost a fortune

There are Teslas on the road at the moment with over 500,000 km on their original battery. CYC Taxis in Cornwall run their Nissan Leafs/ eNV200s for over 150,000 miles before selling them and the batteries are still in good enough state to be used as test beds for things like Vehicle-to-Grid technology.

Data show that an EV will lose about 20% of their state of health only after about 200,000 miles.

Batteries are also plummeting in price. A few years back a single kWh battery would cost up to $1000. Within a few years that same kWh will cost less than $100

2) You can't drive them in the rain.

You can. And put them through the car wash. And drive them through fords and deep puddles.

3) They use coal to generate the electricity so it's no cleaner than using petrol.

Coal accounts for about 6% of UK fuel generation at the moment (2019). This is down from 40% only 6 years ago. Most UK electricity generation at the moment is from nuclear, wind and natural gas. In summer solar is right up there, too. The Northern section of Scotland (from Dundee North) now generates pretty much 100% of its power via renewables and Orkney produce so much renewable power they export some back to the rest of the grid.

Other countries have different ratios of fossil fuels to renewables. In some provinces of Canada, for instance, 98% of the power is generated by Hydro electricity. In others most of it is generated using coal.

But using coal to generate electricity is still more efficient (and cleaner) than using diesel or petrol in an ICE to generate the same power. This is because 1 gallon of petrol has consumed many, many kWh's of electricity to convert it from oil to petrol and it has needed to be transported from a refinery to a petrol station on a fossil fuel powered tanker.

Plus - as the grid gets greener and more and more electricity is generated via renewables - your EV is getting cleaner and cleaner. With an ICE car the fuel is burned, it kicks nasty things into the air, and it is never, ever greener than the day it left the factory.

4) The batteries need precious minerals to be mined to create them.

Yes. That's partially right.

These are exactly the same minerals needed in the batteries your mobile phone uses. Furthermore the biggest mineral used in a battery is Lithium and that is mostly generated from.. seawater.

Cobalt **is** a problem. Most of that comes from places such as The Democratic Republic of The Congo and there are reports that children are used to mine it. But there are other sources of cobalt and battery tech is moving quickly to replace cobalt as an constituent part. If you have problems with batteries in an EV using cobalt but you don't have problems with the batteries in your phone doing the same then, maybe, your issue isn't with cobalt at all.

5) I'll never get an EV until it can do 500 miles and recharge in 5 minutes maximum.

This argument is specious. To understand how specious it is let's go back to the 1900's and listen to a typical New Yorker discussing 'automobiles' ***"I ain't buying one of them new fangled vehicules less I can feed it cheap hay overnight, drive it up over the fields, jump a fence with it and use the droppings to fertilise my roses. Carry around a tank of explosive gasoline in front of me? No way!"***. Can you see how outdated that argument is? But it's a direct parallel to the argument being used today to justify not going to EVs. People are used to working with the ICE model. In that model there is no such thing as the ability to fill up at home. Nobody has a petrol station in their back yard. For this reason - and this reason only - ICE vehicles have to be designed to allow the largest possible range so that people are not heading down to a petrol station every day or so for fuel. And because they need to fill up somewhere other than where they live they don't want to spend all day sitting and refuelling. Which is why petrol stations work on the model they do.

With EVs you charge most of the time at home. There is generally no need to go to a separate location to fill your battery. It charges overnight.

If I told you that you needed to take your mobile phone to some separate location every couple of days to replenish the battery - but you could replenish it in about 5 minutes you would look at me as thought I was stupid and ask why I would need to do that when I can charge anywhere there's a plug, right?

As far as the 500 mile range is concerned I can count on the fingers of a mitten the number of people I have met who drive 500 miles without stopping for a break. In fact it is dangerous to do so. In the break time they could quite easily charge up as they have a toilet break and grab a drink or stretch

their legs.

6) Electric cars are so much more expensive than petrol or diesel cars. I can't afford them

At face value this would appear to be an accurate statement. EVs are, generally, more expensive to purchase at the time of writing (2019). This is mainly due to the cost of the batteries. But as I have already mentioned the unit cost of batteries is decreasing every year.

The other factor that is not taken into consideration is running costs. If an ICE vehicle costs £10,000 to purchase but needs £2000 of petrol every year, £250 road tax, and servicing costs that could run into the hundreds or even thousands, is it actually cheaper over 3 years than an EV that costs £15,000 to buy, has minimal servicing costs, no vehicle excise duty, no congestion charge and electricity costs as low as 2p per mile?

My first EV was bought on a lease. It cost me £9 per day. My electricity was 5p/ kWh at night. It costs less than £2 to fully charge it from absolutely empty, but I generally only needed about 10 kW, or 50p worth, to top it up. I saved £250 per year on road tax, £1000 per year on servicing and I didn't have to pay congestion charges to drive into London. In the first year I also saved almost £2500 in petrol costs.

You do the maths.

7) Don't bother with electric cars - hydrogen is the way forward.

There are a portion of the scientific and manufacturing community that believe the future for motor vehicles is hydrogen. Indeed hydrogen has many things going in its favour - most notably that it echoes the fossil fuel model of '*pull up to a garage and fill in five minutes*'. For larger vehicles such as HGVs, boats and trains, hydrogen is certainly an option to consider. But possibly not for private vehicles.

Hydrogen has many downsides. It is mostly made from fossil fuels at the moment (although this will change over time as alternate generating methods are discovered and brought on line), is very inefficient in the end-to-end generation, storage, and use process (losses of 87% between source and battery are common), is highly explosive, has a very low energy density, needs to be kept under high pressure and - on top of all that - still needs a battery to work with a car.

So why would you use fossil fuels to create a power source that is highly impractical in terms of storage and efficiency and then end up using a battery in your car anyway? Surely the best solution is to take that same energy and drop it right into a battery bypassing the inefficiencies and storage requirements?

Whenever people start to throw some of these old myths and diverting tactics at you just let them know the truth rather than the falsehoods they've picked up from an article they read ten years ago that said EVs would never take off because there's nowhere to charge them.

Or, alternatively, just smile at them and nod politely, knowing that they are living in a world where events will overtake them and they will be forced to buy an EV sooner rather than later if they wish to

drive anywhere.

SUMMARY

THE WORLD OF EVs is the world of the future, but not necessarily the present. At the moment even with the huge numbers of vehicles being produced by the likes of Tesla and Nissan, this technology is still in the early adopter phase. As a result the problems EV drivers are experiencing will need to be addressed to allow wholesale take-up of the technology.

But they will be addressed. At the moment, for example, we are seeing a next generation of EVs with ranges reaching 300 miles on a single charge. This will relieve range anxiety for those unsure of how things work.

As I mentioned earlier the government is also producing legislation requiring chargers to accept contactless payment - easing the way to a simpler method of using chargers.

Finally the charging infrastructure is improving. Polar, Instavolt, Pod Point and Engenie are all embarking on a widespread rollout of chargers. In a short while there will be Rapid Chargers at most large Tesco stores, Marstons pubs and the rest of the Holiday Inn's around the country. There are also cities such as Dundee and Milton Keynes who have embraced EVs and are providing for them in a way which was unheard of as little as five years ago. These two cities have both installed charging 'hubs', which are dedicated spaces containing between 4 and 12 rapid and fast chargers in a single location.

These initiatives, coupled with a growing awareness that Global Climate Change is something that everyone needs to be looking at and helping to reduce, will drive the increase in EV sales across the country and the globe.

The future's bright. The future's electric.

GLOSSARY OF TERMS

HERE ARE A few definitions for those who are interested.

Term	Definition
AC	Alternating current. A charging method using a type 1 or 2 connector.
BEV	Battery Electric Vehicle: Runs only on a battery
CCS	Combined Charge System - A connector and charging standard popular with non Japanese-made vehicles
Chademo	A connector and charging standard popular with Japanese-made vehicles
DC	Direct current. The type of electricity produced by Rapid Chargers and Electric vehicle batteries
Fast charger	Charger delivering between 7 - 22 kW of power
FCEV	A battery powered vehicle that uses hydrogen or similar elements to charge the battery
GOM	Guess-O-Meter; Estimates remaining range of an EVs battery
Granny Cable	A charging cable that can by plugged into a normal wall socket
Heat Pump	A piece of tech that heats an EV more efficiently than the in-built resistance heater
HPC	High Powered Charger - Delivering power at speeds of up to 350Kw
ICE	Internal combustion engine
ICED	When a charger is not accessible due to an ICE vehicle blocking it
kW	The rate at which energy is being provided (Either to or from a charger)

kWh	The quantity of energy either being provided to, or being stored in, a battery
Mennekes	A cable connecter generally using type 2 protocols
PHEV	Plugin Hybrid Electric Vehicle: Has a battery and an ICE. Battery is charged via a plug.
Pre-conditioning	Using the battery (or mains power) to warm your vehicle and battery prior to starting the car on a cold mornings
Rapid Charger	Charger delivering power at up to 100kW
Regen	Regenerative braking. Using the motion of a slowing car to recharge the engine and provide brake function at the same time
RFID	A system used to invoke charging via the use of a card and a proximity sensor
Tethered Charger	A charger which has a permanent cable attached to it.
Type 1	Early connection type to allow AC charging
Type 2	General connection type fitted to almost all EVs to allow AC charging
Untethered charger	A charger which needs a cable supplied to be able to connect to your vehicle.

<<<<>>>>