CHOOSING A CAR FOR AN EV.

Introduction.

Building your own EV is not particularly difficult, but requires you to make many decisions in order to get the vehicle that suits your needs.

If you do not make the right decisions, you can end up with a vehicle that fails to meet your needs, but costs as much as one that would.

Few people can afford to make this sort of mistake and do it all over again. If you are lucky, you might recoup most of the cost by selling it, but it might not meet other's needs either.

It is critical that you answer the questions that follow honestly.

As you proceed to the next stages of choice of motor and batteries, you will need to revisit your choice of vehicle to ensure that your choices are still valid. For this reason, it is good to have several possible vehicles in mind, and put off purchasing for a short while, while you sort out the other major factors.

Avoid grabbing a vehicle because it is available cheap, or because you might lose the chance to buy. There are plenty of vehicles out there.

The factors influencing your decisions.

The obvious major factors are:

- How many people do you need to carry?
- What is your usual trip distance before you can recharge?
- What is the terrain that you will be driving in? Hills or flat?
- What speeds are appropriate on your usual routes?
- What is your budget?
- Roadworthiness.
- Will everything fit?

Other, lesser issues are:

- What sort of image do you want to project?
- Are there "special" occasional trips that you would like to do?
- Do you want to do everything (or nearly everything) yourself?
- What mechanical backup is available, or needed?

Note that some of these decisions will immediately rule out some vehicles.

Evs must carry their entire energy needs in the form of batteries. These will be a major source of weight, which will need more energy to propel. It is a vicious circle, which can be broken by using more expensive batteries, but can also be avoided by honest answers and modest demands.

The number of people.

If you only need to carry two people, the choice of vehicles is wide open.

You need to allow about 95kg per person over the tare weight of the EV including batteries and all conversion components. ***The tare weight plus the occupants must not exceed the Gross Vehicle Mass (GVM) as shown on the maker's plate.*** If it does, you will have real trouble getting it registered.

You will also need to maintain the overall weight distribution of the original vehicle. You cannot just put all the weight anywhere. This means that the batteries might have to be distributed some fore and some aft.

Small two-seater vehicles like Suzukis, Daihatsus, Subaru Sherpas, Daewoo Matiz and the like are all eminently suitable for conversion. They usually weigh about 600kg in petrol form, and weight around 720kg after conversion. GVM is usually just under a tonne, so all is well in the weight department. A 6.7" DC motor (or equivalent) will usually give about 80-85kph top speed, depending on the gearing, with 72volts.

More than two occupants will require more careful thought. They will need a bigger vehicle, which will need more energy to move it. There will be less room to tuck batteries away, without losing all the stowage space. The tare and GVM will probably be harder to reconcile.

For more than two occupants, it is worth considering a station wagon or hatch. The motor will need to be bigger. Either an 8" or 9" DC motor will be necessary, and voltage will need to be 120 to 192 in order to get the necessary power (65-100kW). All this will be heavy and much more expensive than the previous two-seater, so be sure that you really need it!

Trip distance.

Power is a function of volts times Amps. The higher the voltage, the less Amps are needed to generate a given power.

Once a vehicle is up to speed at 70kph, it only requires about 5kW to maintain it on the flat. That is about 70Amps at 72volts, or 35Amps at 144Volts.

The average battery is rated at about 90-100Ah. That is, about 90-100Amps for one hour. However, this is misleading, as lead/acid batteries start to fade (lose voltage) well before they go flat, which means that they lose performance and the car goes slower. This is usually at about 60% of the nominal charge rating.

With luck, you can limp home at ever-reducing speed. You can certainly get off the road; whereas Lithium ion Phosphate batteries tend to deliver the full charge, then "die" suddenly.

Terrain.

Hilly terrain will require more power than on the flat.

Regenerative power systems will help a bit in hilly terrain, but "regen" is not all that efficient.

Basically, hills are best managed early in the charge of the battery, and are best avoided when the battery is running down. This is not always convenient, and you must consider what battery types and ratings you are going to need if you are planning on working at the limit of your range. Certainly, increasing the voltage should reduce the current draw, but will increase the weight.

The driving style will also influence the range available. If you toddle along, minimising the current draw, you will improve your range, but probably become frustrated (the people behind you certainly will!).

If possible, look at the performance of an existing EV to see how it performs. Then, you can consider how the factors of voltage and current are likely to affect you. This is becoming easier as more member's EVs get onto the road.

It is tempting to put the boot in and use the impressive torque available. You will astonish those people who believe Evs are slow, but you will shorten your range considerably. Accelerate up to speed and back off to conserve power. Practise will greatly improve your technique and range.

Speed.

You must consider the speed limit of the area in which you plan to drive. To drive at 50kph in an 80 zone might conserve power, but will create nuisance and danger as frustrated motorists overtake inappropriately.

If you are to use the EV in a 100kph zone, it should be able to maintain 80kph at least. Otherwise you will be a hazard and nuisance to all.

Higher speeds are quite possible with increases in voltage, and the choice of a car with a fifth gear. As stated previously, once the EV is rolling at speed, the current to maintain it can be quite modest.

Mechanical considerations.

Power brakes, and power steering must be fitted where they were original equipment. The former are easy, but the latter more difficult and costly. It therefore pays to dodge cars with power steering.

Transmissions are also a deciding factor. Automatics sap too much power, and should be avoided. Since EVs do not usually require gear changing once they are moving, there is little point in having a heavy, power-sapping box.

Most EVs can move from standing in top gear, so a gearbox is not necessary unless the motor has very low power and torque (the cheap chinese motor kits probably fall into this category).

Front-wheel-drive cars have the gearbox and differential in a single transaxle, and this means that the gearbox must be retained unless you are to do some serious modifications. Whether you retain or remove the clutch is a matter of personal preference, but if it is removed, the flywheel should also be removed to reduce weight and inertia.

Rear-wheel-drive vehicles can have the motor directly coupled to the tailshaft, with reverse engaged by reversing motor polarity. This saves weight and space, and is quite desirable for larger four/five seater cars with larger motors. The motor can be mounted in the transmission tunnel, leaving the whole under-bonnet area for batteries etc.

Budget.

It is pointless to start a project if you have not got the money to finish it.

If the vehicle is heavy, it will need high voltages and currents to perform, and this will involve expensive batteries, controllers and motors. These items can quickly escalate in price, so be realistic about how much you have to spend, and allow a margin of at least 10%. Unfinished projects are hard to sell, and rarely recoup their cost, so don't go there!

Newer vehicles (and exotic ones) tend to cost more than old "bread and butter" models. Keep in mind that you need to get a good 8-10 years out of your conversion to amortise the costs, so choose a vehicle that will have plentiful spare parts available, and will be easily repaired over the life of your EV. Fancy cars are fun, but can quickly become a nightmare if anything goes wrong.

Roadworthiness.

Once you have completed your conversion, you will need to have it inspected.
The inspection will certainly concentrate on the conversion and its compliance with the bulletin in force at the time, but it will equally concentrate on the condition of the base vehicle.

You should expect that the inspection will cover body defects (particularly rust), brakes, suspension, steering, electrical (lights, horn, etc.). Indeed, anything on the vehicle must work as well as the original.

Power brakes, power steering, demisters, etc must all work as on the original car when new.

If the car of your choice cannot meet the above requirements, don't even think about starting a conversion.

Fitting it all in.

As you choose your vehicle, consider where everything will go. Check that there is room for the motor between the transmission and chassis. Think about how you will mount the controller. Are there convenient flat surfaces? Some vehicles are all curves and angles, which might make them rigid, but also makes mounting bits and pieces a real headache!

This is a good time to plan your basic layout. Try to avoid "building your way out". This is where each stage of construction covers the previous one, so that later repairs can involve dismantling half the vehicle just to get at a component.

Image.

This is an intangible concept, but consider whether you will want to be seen in the car that you choose to convert. If you do not like it, you will not be happy with it, and all your work could be for nothing.

It might be that a paint job could make the car's image suit you, but you should satisfy yourself as to how you feel about the car.

Your EV will probably attract a lot of attention, and you will want to be proud of its appearance.

Special uses.

This can be a minor issue, but you might want a two-seater for 360 days of the year, but something to carry the grandchildren for the remaining 5 days. How important is this to you? Is there another way?

It might well be that you can forego the extra seating, or special long trip, or whatever by simply reorganising how you do things. Selecting a vehicle for what you might *possibly and rarely* want to do is not worth it.

Who will maintain the EV?

Whether you plan to maintain the vehicle yourself, or have it done for you, it will pay to choose a vehicle that is easy to work on.

Some vehicles need special tools and techniques, which can be a real pain when a repair becomes necessary. Keep it simple. What vehicles are in the local wrecker's yard for when you want parts?

Remember that most mechanics have no training in electrical traction, and should have a pretty healthy distrust of high voltages! For this reason, it will be worthwhile to develop a basic understanding of your circuits, or cultivate a friend who does. It is not rocket science!

Where to next?

By now, you should have narrowed your choice of vehicles down to a few. Consider the newest vehicle that you can afford.

It is often worth waiting until you have made the next set of decisions before you actually part with your money.

You now need to select the drive system and batteries, and when this is done, you should re-examine your choice of vehicle to see how it will all go together and how you might expect it to perform.

Choose a vehicle in good condition. It will cost a lot of money to fix up the body, so a bomb is not necessarily a good buy. Remember that the appearance of the vehicle will make a good or bad first impression on the Inspector, and can influence the ease with which you get it through.

If you are satisfied, get on with it.