seai SUSTAINABLE ENERGY AUTHORITY OF IRELAND

Switching to Electric Vehicles

A Guide for Businesses

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About SEAI

SEAI is Ireland's national energy authority investing in, and delivering, appropriate, effective and sustainable solutions to help Ireland's transition to a clean energy future. We work with Government, homeowners, businesses and communities to achieve this, through expertise, funding, educational programmes, policy advice, research and the development of new technologies.

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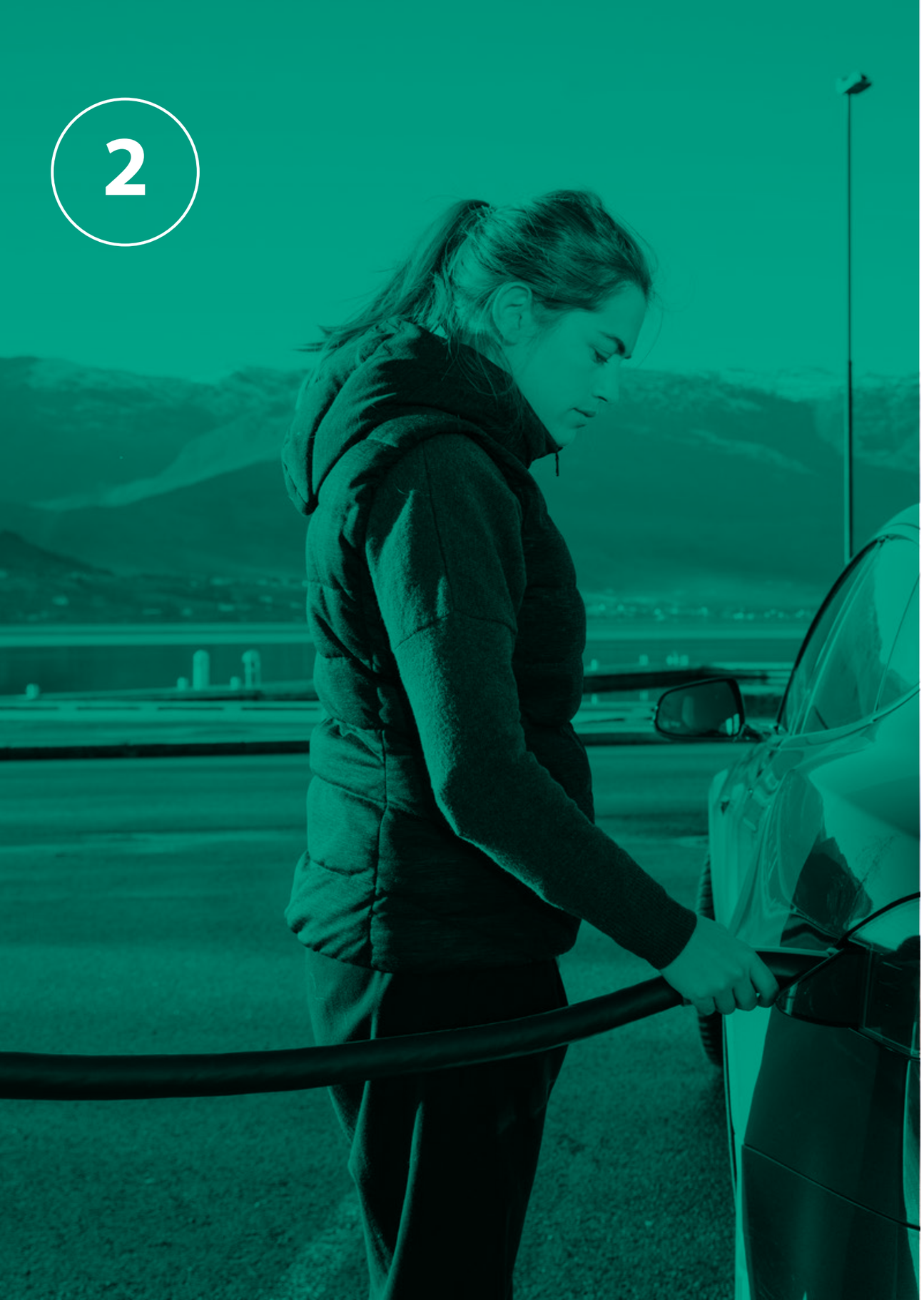
Introduction

Electric vehicles are increasingly common in business fleets, providing businesses with the opportunity to save money, improve their environmental footprint, and enhance their clean brand image.

As we prepare for the switch to electric vehicles, we are presented with some new concepts and challenges which, when approached correctly, will maximise the potential of this technology. If you are responsible for your business fleet, you may also be interested in the practical, technical, and economic considerations of converting your fleet from conventional petrol or diesel vehicles to electric:

- How will electrification of your fleet benefit your business?
- What type of electric vehicles will meet your business requirements?
- What charging infrastructure is required?
- What are the ongoing management and maintenance requirements?
- How does the cost compare to your current fleet?
- What supports are available to assist in the transition to electric?

This best practice guide will help your business through the key considerations for switching your business vehicles to electric. Whether you are a financial controller, fleet manager, facilities manager or are responsible for energy and environmental management, this guide will help you understand the multiple benefits of this rapidly advancing technology and how best to adopt it for your business needs.



2 Why go electric?

Over the last number of years, electric vehicle technology has evolved. Driving ranges have improved, there is a growing network of charging infrastructure, and costs of vehicles are falling.

Switching your business fleet to electric vehicles can help your business to reduce its carbon footprint and over time this will improve as more renewable electricity comes onto the grid.

Electric vehicles have lower running and maintenance costs than their petrol and diesel equivalents. With a range of incentives available to those purchasing electric vehicles, now is a good time to take stock of the changes.

Due to advances in the technology, increasing market adoption, and availability of information, it is now easier than ever before to assess the suitability of electric vehicles for your business fleet.

2.1 Reduce energy cost

For many fleet managers, the rising cost of fuel is a significant challenge. Many of those operating fleets see the cost of fuel as a significant factor when trying to maintain a competitive edge. While combustion engines have become somewhat more efficient, even these gains do little to combat the upward trend and uncertainty of fuel prices. Electric vehicles offer an opportunity to make cost and energy savings.

> The majority of electric vehicle charging occurs at night. During this time, the cost and carbon intensity of the electricity supply is generally at its lowest.

Fuel consumption varies from vehicle to vehicle as well as from driver to driver. Studies show that the running costs of an electric vehicle can be as little as 20% of the cost of a similar size diesel engine (Green eMotion, 2015). Recharging of vehicles on night-rate electricity tariffs, with electricity rates close to half of a standard daytime rate, ensures you maximise the savings.

Table 1 compares the energy consumption of a typical diesel and electric vehicle showing a 76% energy cost saving.

Table 1: Simple fuel cost comparison

Engine type	Advertised energy consumption	Cost per unit of energy	Cost per 100km
Diesel	6.0L/100km	€1.30/L	€7.80
Electric	16kWh/100km	€0.12/kWh*	€1.92

**Based on a blended rate of 60% night-rate electricity and 40% daytime electricity (Band IB: ≥20<50 MWh per annum) using SEAI Commercial Fuel Cost Comparison, 01 April 2020.*

Top tip

The compare and calculate tool on the SEAI website allows you to select different vehicles for comparison: https://www.seai.ie/EVcalculator

2.2 Reduce vehicle service costs

Electric vehicles have lower service costs than vehicles with an internal combustion engine. Battery electric vehicles have far fewer moving parts than an internal combustion engine to wear out, and there are no timing belts, fuel filters, or engine oils to replace. Regenerative braking systems reduce wear on brake pads by using the motor as a generator when the brakes are pressed. As a result, the amount of friction braking required is very little compared to internal combustion engine vehicles. It is not unusual to see electric vehicles with an excess of 100,000km using the original brake pads. This is particularly good news when vehicles are being used around urban areas where brake pads tend to wear very quickly.

Table 2: Vehicle maintenance checklist comparison

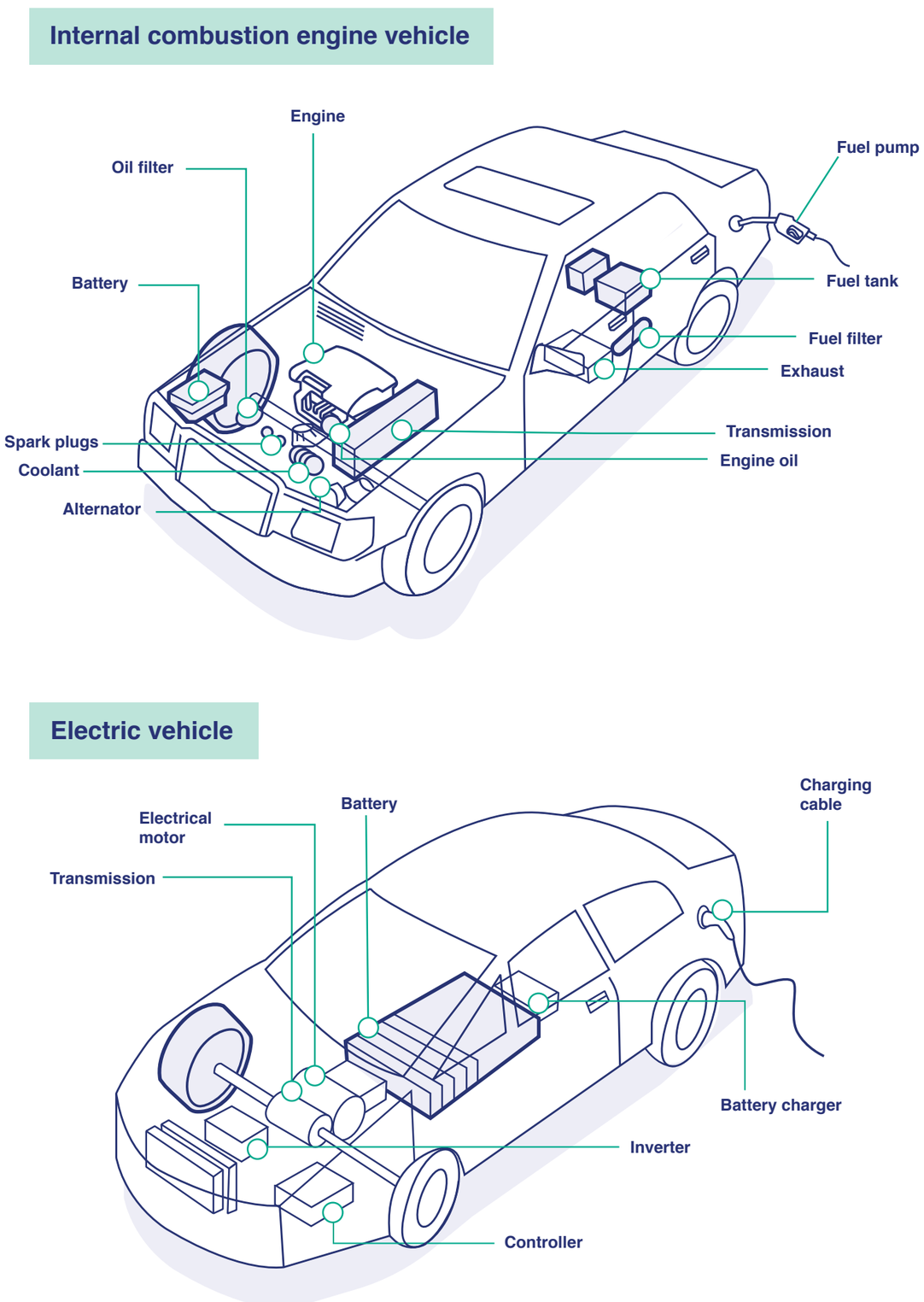
Service parts	Battery electric vehicle	Internal combustion engine
Engine oil	None	Yes
Oil filter	None	Yes
Fuel filter	None	Yes
Spark plugs	None	Yes
Air filter (engine)	None	Yes
Pollen filter	Yes	Yes
Brake fluid	Yes	Yes
Coolant	None	Yes
AdBlue	None	Yes
Brake pads	Yes	Yes
Brake disks	Yes	Yes
Tyres	Yes	Yes

Each oil change can take between four and six litres of oil

Very low wear on electric vehicle due to regenerative braking

Driving in eco mode reduces tyre wear

Figure 1: Maintenance in internal combustion engine and electric vehicles



2.3 Lower harmful emissions

In Ireland, transport dominates as the largest energy consuming sector, accounting for 42% of energy related greenhouse gas emissions (SEAI, 2019). Year on year, Ireland's electricity supply is becoming less carbon intensive. Switching to electric vehicles can help your organisation to decarbonise its transport-related energy emissions, unlocking improvements in environmental performance year-on-year as more renewable sources of electricity come online.

Improve air quality

In addition to carbon dioxide, combustion engine vehicles generate other tailpipe emissions that are harmful to human health, including particulate matter, nitrogen oxides, sulphur oxides, volatile organic compounds, and ozone. This is particularly relevant in urban centres, where people are in close proximity to a high density of vehicle tail pipes. Approximately half of premature deaths resulting from local air pollution are attributed to transport (EEA, 2018). Several cities in Europe, such as London, Oslo and Paris, are introducing bans or charges for certain internal combustion engine vehicles within urban zones. Converting to electric vehicles may future-proof your business for city operations, while demonstrating commitment to a cleaner, healthier environment for your customers.

Reduce noise

While we don't always consider noise as a pollutant, it impacts greatly on quality of life, particularly in cities. Noise pollution has adverse impacts on the well-being of human life and affects the health and distribution of wildlife (EEA, 2014). As with most vehicles, the noise we hear at speeds above approximately 40kph is generally road noise from the tyres. Electric vehicles emit very small levels of noise, particularly at low speeds. With lower noise emissions, electric vehicles are particularly suited to companies operating in residential areas at night.

The Global Logistics Emissions Council Framework (GLEC) can help your business reduce its greenhouse gas emissions

Does your business work in the logistics industry or do you require logistics services to meet customer needs? Do you want to reduce your business fleet's emissions and demonstrate to your stakeholders that you are a leader in sustainability?

The Global Logistics Emissions Council (GLEC) Framework is the global methodology for calculating and reporting logistics emissions. Based on the Greenhouse Gas Protocol, UN Global Green Freight Action Plan and reporting under the Climate Disclosure Project, the framework can help your business measure and report your logistics and freight-related greenhouse gas emissions.

The framework will help your business to:

- Manage your fleet's energy performance more effectively;
- Understand your transport energy use and identify hotspots in your supply chain;
- Set emissions reduction targets and develop an emissions reduction plan;
- Evaluate the impact of energy reduction measures;
- Ensure you are meeting regulatory requirements; and
- Make positive change by building the evidence base for effective decision-making.

Note for Public Sector

For Public Sector organisations, transport energy use is required to be monitored and reported through SEAI's Monitoring and Reporting online platform. This tracks performance towards an overall target of 33% energy efficiency improvement by 2020. From 2021 onwards, this reported data will track towards an increased (50%) energy efficiency target for 2030, and a new energy-related greenhouse gas emissions target. The methodology for tracking the greenhouse gas emissions target, based on international best practice, is currently in development.

2.4 Enhance your brand image

As businesses and individuals, we all have a collective responsibility to protect our environment. At a time when more and more citizens and potential customers are paying greater attention to the consequences of their actions as consumers, it is also important that suppliers and service providers demonstrate their efforts to reduce their business's environmental impact and offer sustainable solutions to modern challenges. Studies have shown that a vast majority of consumers are more likely to buy from a company that engages in activities that support the community (Clutch, 2019).

As company vehicles influence a brand image, migration to electric vehicles can offer a strong message to customers that you are taking your responsibilities seriously. An electric vehicle is a statement of your organisation's commitment to being energy efficient, reducing emissions and building a more sustainable future for this generation and the generations to come.

Organisations are not only looking to decarbonise their own operations but are looking to their suppliers and service providers across their supply chain to follow suit. Requests for tenders are increasingly emphasising the importance of sustainability[1] in their selection criteria. Demonstrating the sustainability of your fleet can present an opportunity for your organisation to gain an edge over your competitors.

Top tip

Promote your company's move to electric and green energy ambitions by incorporating a 'driving electric' message into your vehicle branding.

Green procurement can reduce the environmental impact of your business's transport needs

The Smart Freight Procurement Guidelines provides guidance for organisations of all sizes on how they can leverage sustainable procurement practices to reduce the environmental impact of their freight transport and logistics supply chains. The guidelines were developed by the World Business Council for Sustainable Development and the Smart Freight Centre.

Based on the principles of transparency, collaboration and innovation, the guidelines can help your business to develop procurement policies and procedures which will reduce the greenhouse gas emissions and air pollutants associated with your business's logistics and freight demands.

Note for Public Sector

Check out the Environmental Protection Agency's (EPA) new guide 'EPA Guidance on Green Public Procurement (2020)' for guidance on electric vehicle procurement. The guide is available for download on the Department of Environment, Climate and Communications and EPA websites.

1 Green public procurement rules for vehicles and transport services include scoring for energy efficiency and many of the environmental impacts mentioned under service costs.

3 Switching your fleet to electric

Fleet managers have a wealth of experience when it comes to internal combustion engine vehicles. There are ample sources of information about vehicle performance, load capacity and comfort features. Fleet managers considering the move to electric vehicles will have some new considerations in assessing the suitability of this technology for their business requirements. Vehicle availability, battery capacity and an assessment of the suitability of electric vehicles to meet your business needs are discussed in this section to guide you on the basic considerations for switching your fleet.

3.1 What types of electric vehicles are available?

The number of electric vehicles on the market is growing rapidly and there is a wide offering of vehicle types available to suit your business needs. The greatest increase in offerings is in the vehicle category M1 (cars) with new models regularly being announced. Category N1 vehicles (vans up to 3.5 tonnes) are now available across a number of manufacturers. There is also a growing number of category N2 vehicles (3.5 to 12 tonnes) on the market.

Top tip

The Government offers a variety of supports and financial incentives to help businesses transition to electric vehicles.

Check https://www.seai.ie for the most up-to-date information on electric vehicle supports for your business.

Electric cars range from a typical five-seat saloon or hatchback to seven-seat vehicles and can also come in a 'commercial configuration' with only two front seats. Vehicle specifications are similarly diverse, with comfort levels ranging from modest to luxury. With the increasing number of brands supplying electric models, it is quite likely that your preferred brand has something to suit your needs.

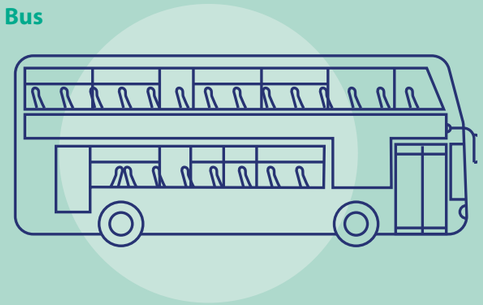
Small to medium size electric vans also come in a variety of makes, models and configurations. There are short and long wheelbase options as well as standard and high roof vehicles. Whether you need a vehicle to transport euro-pallets or one with an open bed cargo area, there are models available. Similarly, vehicles can be configured with two and three passenger seats or with a crew cab. A range of utility vehicles are also available, suitable for general maintenance, gardening or waste management on campus.

Figure 2: A variety of electric vehicles

1. Compact car

2. Medium car

3. Bus



4. Van

5. People carrier

From compact cars to buses, electric vehicles are driving forward.

3.2 Battery capacity

As energy storage in batteries improves, so too does the distance the vehicle is capable of traveling on a single charge. As with any fuel type, the achievable range is dependent on the driving style, weight of vehicle and goods, as well as the weather conditions. More and more vehicles are equipped with batteries that can achieve over 400km of driving on a single charge.

One of the most significant changes in electric vehicles has been the advancement in battery chemistry. Improvements in battery energy density and reductions in the production costs have enabled better energy storage capacity and the design of smaller, lighter batteries.

The standard battery capacities have almost doubled from approximately 24kWh to 40kWh. Depending on the vehicle, models are available with 60kWh, 80kWh, and above.

Energy storage capacity is measured in kilowatt hours

One litre of diesel = 10.169 kWh of energy

Alternative battery chemistry to those used in previous generations of vehicles has resulted in greater life expectancy as well as lower maintenance costs.

The future of batteries is fast evolving

With growing demand for batteries, both in our vehicles and for other applications, there is increasing global ambition to find breakthroughs to the next generation of battery.

There have been a number of promising announcements in the fields of solid-state batteries and nanotechnologies that are positive for the future. Ireland is active in some of this research, having recently made a breakthrough in the area of nanofilms for use between battery layers.

3.2.1 What happens when the battery reaches the end of its useful life?

Battery health is often a key consideration for those who are new to purchasing and using electric vehicles. Batteries are very durable and there is a lot of life in an electric vehicle and its battery before it reaches end of life.

When a battery does reach its end of useful life as a vehicle traction battery, typically around 70% of its original state of health, it still has much residual value. From home and industry, to backup power and renewable energy integration, there is a growing market for battery technology. Vehicle manufacturers are working hand-in-hand with a range of industry partners on developing second-life markets and energy storage projects aimed at maximising the usefulness of electric vehicle batteries after they are removed from the car or van. This will maintain the value of the batteries long after they have been removed from the fleet.

Although the market for battery replacement is still developing, it is anticipated that motor service centres will offer you one of a number of options when your battery does reach the end of its serviceable life:

- the battery will be replaced for a new battery, where you receive a credit for your old battery.
- the battery will be replaced with a reconditioned battery with a guarantee.
- the battery will go through a diagnostic check where the least healthy modules will be identified allowing them to be replaced and bring your battery back to a sufficient level.

Figure 3: Energy storage from second-life electric vehicle batteries

End of life requirements under the WEEE Directive

There are no special requirements for electric vehicle owners when reselling an electric vehicle. Under the **Waste, Electrical and Electronic Equipment (WEEE)** Directive, vehicle manufacturers and distributors have a responsibility for battery recycling and battery end-users can dispose of spent batteries by returning them to any retailer selling equivalent batteries.

For further information on the recycling of batteries consult the batteries section of Environmental Protection Agency's website: https://www.epa.ie/enforcement/weee/batteries/.

3.3 Understanding the electric vehicles needs of your business

When deciding on a new vehicle, many of the considerations are the same regardless of whether you are considering fossil fuel or electric vehicles.

Probably the most important single difference is the lower driving range offered by electric vehicles compared with a full tank in an internal combustion engine vehicle. For many users this need not present a problem – as driving ranges have increased, more and more users can complete all the standard travel requirements on a single charge.

An early indicator of suitability relates to the type of route the vehicle encounters each day. Where vehicles are on fixed routes or operate within specific geographical regions, it should be possible to calculate average daily distances. When the distances encountered are reasonably stable across the working week or month, it should be straightforward to decide if an electric vehicle is suitable.

Top tip

The electric vehicle market has seen rapid technology advances over a short period of time.

If your company undertook a feasibility study for converting your business fleet to electric in the last couple of years it is recommended to revisit and update this before final purchasing decisions are made.

Load dimensions and weight are also important considerations when selecting a suitable electric vehicle for your business needs. Modest loads are easy to handle in most electric vehicle models. Larger loads may limit your choice, however a number of larger electric vehicles have come to market or are due in the coming months.

Be aware of the impact of heavy loads on driving range. It is well worth trialling a vehicle before purchasing, as this will give you the opportunity to assess the real-life driving ranges under conditions encountered at your workplace.

Use the checklist below when testing an electric vehicle's suitability to meet your business needs.

Table 3: Fleet migration checklist

Checklist	Fleet migration checklist	YES	NO
	Customer approval	✓	
	Sufficient driving range		
	Sufficient load capacity		
	Suitable vehicle type / format		
	Accommodates auxiliary equipment, e.g. cooling		
	Tested under real life conditions		
	Charging facilities available / possible		

Top tip

Take a vehicle for a long test drive where you can get a feel for the real driving range. Maybe load the vehicle with a pallet of goods to assess real-life conditions.

4 Recharging fleets

Fuelling petrol or diesel vehicles is a familiar task. Recharging electric vehicles requires somewhat new approaches for fleet managers. This section provides guidance on recharging and will help you to align the needs of the fleet with those of the energy manager, the facilities manager and the financial controller.

4.1 Where to recharge your fleet

For most organisations, the majority of your charging will happen on-site at the fleet yard, overnight while the vehicles are parked. The biggest advantage to overnight charging is the opportunity to use night-rate electricity at lower tariffs. This can help your business maximise the fleet fuel savings and improve the payback of the vehicles.

Charging on the go at public or destination charging stations

While many fleet vehicles will not require a top-up during the average working day on occasion it may be necessary to recharge to extend the range of the vehicle. This may be part of a planned route or due to unforeseen circumstances.

Ireland has a comprehensive and expanding network of public and destination charging which can facilitate these top-ups. Public charging relates to charge points in publicly accessible areas such as fuel forecourts, motorway service, or on-street locations. Charging at hotels, shopping centres, and restaurants is often referred to as destination charging. Charging at public and destination locations typically requires a payment to be made for energy consumed.

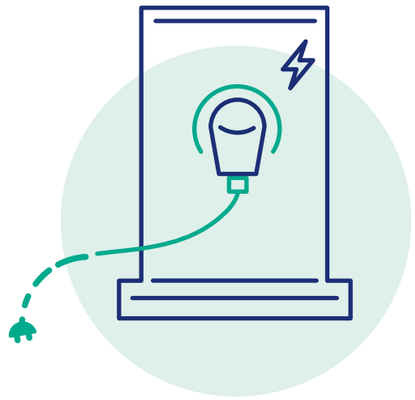
In addition, there are more and more fast charger installations coming onto the network and, as technology advances, the speed of charging is increasing.

Charging at home

It may be necessary for some fleets to be charged overnight at the homes of staff members. This involves installing smart home charge points that transmit the charging records to a back-office system. The staff member is then reimbursed for electricity consumed by company vehicles. The company can maintain a full record of energy consumed and this can be integrated with the central fleet management system.

Top tip

Aim for overnight charging where possible. Slower charges place less stress on available power supplies. Fast charging is great when you need a quick turnaround of a vehicle, however the equipment is more expensive.



4.2 Types of recharging infrastructure for your business

Charge points come in a range of sizes and formats, from 3.6kW to 50kW and greater. There are three common divisions of charge point:

1

1. SINGLE-PHASE AC CHARGING (UP TO 7.2KW)

- Single-phase AC charging is the most common and universal method of charging vehicles.
- 7.2kW is most common in businesses and domestic settings. Lower outputs are normally only chosen where the electrical connection to the building is limited.
- A vehicle left to charge for 10–12 hours overnight can be charged to 300-400km range by the morning.
- Even when a vehicle has the capability to charge at higher levels, it will still be able to charge from a single-phase charge point.

2

2. THREE-PHASE AC CHARGING (11-22KW)

- As a rule of thumb, a three-phase charger offers three times the output when compared against a single-phase equivalent.
- The number of vehicles with three-phase capability available in Ireland is currently very small - DC technologies are most prominent at the upper end of the charging scale.
- Remember that the charge capacity is limited by the charger itself and the car type. For example, an 11kW charge point will deliver 3.6kW to a single-phase vehicle.
- While it is technically feasible to provide 43kW charging using three-phase AC charging, this charging level is not supported by any current models available on the market.

3

3. DC CHARGING (UP TO 50KW)

- DC charging is normally the most powerful and the main advantage is the speed of recharge.
- It is commonly configured for up to 50kW, however higher power ratings are now available.
- The economics of installing a higher power charge point is not limited to the cost of the charge point, but also to the additional connection costs and standing charges for the electricity supply.
- The power supplies required for these fast chargers are large and many need an upgrade to the building's electrical system.
- DC charging can be delivered with output levels of circa 20kW, so this may be an option when you need to turn a number of vehicles around in a short time window. The available electrical supply can be shared amongst a number of lower power units.

While a higher power output will charge your vehicle faster, it is important to remember that the majority of charging will occur overnight and there are significant economic advantages to choosing single-phase AC over other faster charging types.

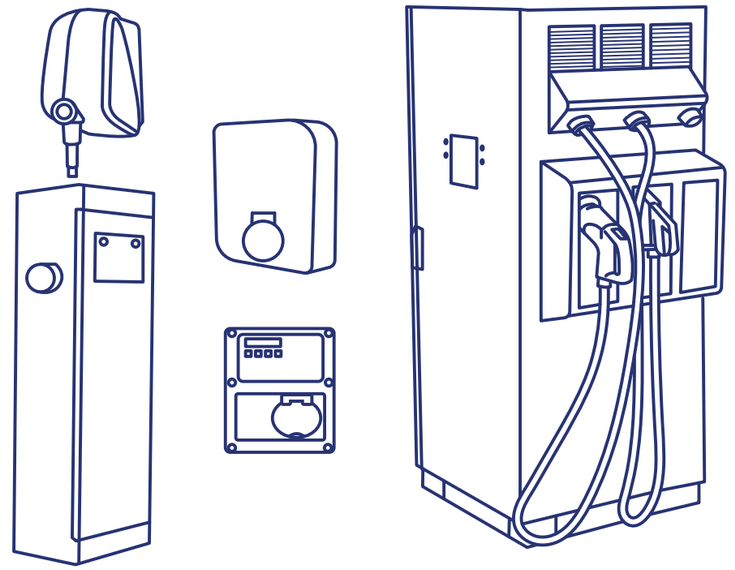
It is most common to charge with an AC charger as these can be easily installed at a workplace or home. DC fast charging is generally only used when a quick top up is required. The power supplies required for these fast chargers are large and many need an upgrade to the building's electrical system.

Electric vehicle driving range, and hence cost and time to fully charge your vehicle, is dependent on the battery size. A 30kWh battery with 80% charge will provide much less range than a 60kWh battery with the same percentage. When evaluating what charger is suitable for your business needs, it is helpful to consider charging in terms of driving distance rather than percentage of charge. 100km of range is constant regardless of the percentage of battery charge. Table 4 gives an indication of what you can expect from the charging power level and the time it takes to provide 100km of range.

Table 4: Charging level comparison

Charge type	Power	Voltage	Current rating	Charging time for 100km driving range
Single-phase AC	3.6kW	230V	16 amps	6–8 hrs
Single-phase AC	7.2kW	230V	32 amps	3–4 hrs
Three-phase AC	11kW	400V	16 amps	2–3 hrs
Three-phase AC	22kW	400V	32 amps	1–2 hrs
DC	50kW	~400V (DC)	~125 Amps	20–30 min

Figure 4: A variety of chargers



4.2.2 Charging connectors

In the earlier years of electric vehicles, a small number of differing connectors were adopted. European standards have now been adopted for charging connectors, which has helped to reduce compatibility issues.

AC charging connectors

In the category of AC charging, sockets on all home and business chargers are the same, while the connector on the vehicle side may differ. Vehicles are normally supplied with an AC charging cable, in which case the charge point side of the cable is a standard cable known as Type 2.

AC charge points are sometimes offered with the cable tethered to the charge point. The advantage of this is that the driver doesn't need to take the charging cable in and out of vehicle storage. However, vehicles with the older type of connector may not be able to charge on newer charge points and vice versa. If your fleet has vehicles with both older Type 1 connectors and newer Type 2 connectors, it is recommended to install charge points with sockets rather than with tethered cables.

DC charging connectors

Connectors used for DC charging are also covered by European standards and regulation. The first vehicles delivered with DC charging adopted a specification known as CHAdeMO. As the industry evolved, a combined charging system, commonly known as CCS or Combo, was adopted as a European standard and is used in the majority of the vehicles on the market today. Public and destination fast charge points are normally equipped with both connectors, allowing any generation of vehicle to charge.

If you are considering DC charging for your private fleet, it is wise to equip the charge point with both connectors. As the power electronics stays the same, the additional cost should be small and the equipment more versatile.

Figure 5: Electric vehicle charge point socket – AC Type 2

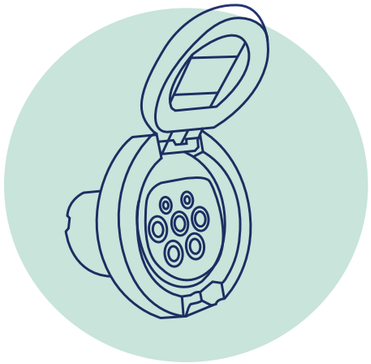


Figure 6: DC fast charger connectors

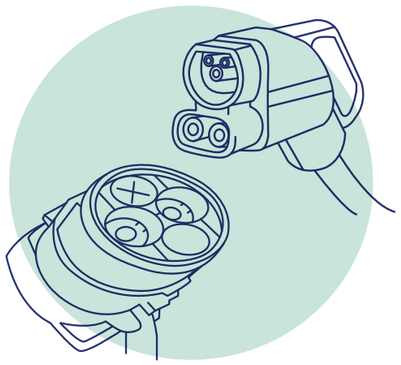
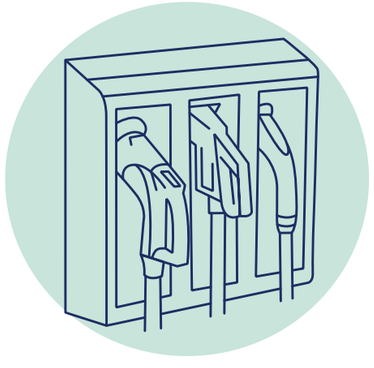


Figure 7: Multi outlet fast charger



Considerations for public and destination charging

There is a wide variety of charging connectors (Type 2, Combo, CHAdeMO) and charging levels (ranging from 3.6kW to more than 50kW across the public and destination charging network. If your business fleet requires top-ups on its journeys check out the website of different charge point operators to plan your route. Don't forget to bring your charging cable with you!

4.3 Infrastructure planning

The first step to planning infrastructure is to assess your requirements. You should consider the number of vehicles, their usage profile, and the period in which they will be parked and available to charge. In some cases, a vehicle may travel routinely between two or more of your organisation's locations and it can be recharged at a convenient time during the day. Charging requirements, tracking of energy consumption, and infrastructure location are all critical to planning your charging network.

Charging needs

A common mistake is to assume that a more powerful charge point is more efficient. This is often not the case. Where vehicles have ample opportunity to charge overnight, a 7kW single-phase charge point may be adequate, without over-stressing the available electrical connection. See section 4.2 for further information on charging point types and power options.

Fast charge points of typically 50kW output are very effective when you need a fast turnaround of a vehicle. These charge points require a large power supply and for most business it makes sense to undertake these charging events at public or destination charging stations.

Another important point is that a fast charge point will normally stop charging somewhere between 80 and 90%. This is to mitigate against the effects of high-power charging on the battery.

Energy management and tracking

In most cases where multiple vehicles are in operation, the organisation will want to monitor fuel consumption. For electric vehicles monitoring your consumption requires installation of a charge point management system. When selecting your charging infrastructure make sure it is compatible with connection to a charge point management system.

Charging location

Consider the locations where vehicles will regularly be parked and where in the car park they are normally located. If the vehicles you are migrating to electric are spread out across the site, consider ways to group them together. This may assist later with sharing infrastructure and managing energy at available connection points.

Here are items to consider when planning your EV charging infrastructure:

Table 5: Charge point requirements checklist

Checklist	Have you thought about these charge point requirements?	YES	NO
	Number of electric vehicles	✓	
	Depot overnight charging		
	Home parking / charging		
	Number of charge points		
	Duration vehicles parked and available for charging		
	Available power at charging locations		
	Amount of energy required by the vehicle each day / shift		
	Choose power output		
	Wall mounted / ground mounted		
	Ground works required		
	Safety bollards required		
	Connection to management system		

Regulatory requirements for electric vehicle charging infrastructure

The Energy Performance of Buildings Directive 2010/31/EU and Amending Directive 2018/844 – Article 8 sets down requirements for the installation of charging infrastructure in new builds, buildings undergoing major renovations, and existing buildings.

For new buildings and buildings undergoing major renovation:

- Non-residential buildings with more than ten parking spaces must ensure the installation of at least one charging point and ensure that ducting infrastructure for at least one in five parking spaces is installed.
- Residential buildings with more than ten parking spaces must ensure the installation of ducting infrastructure for every parking space.

From 2025 for existing buildings:

- EU member states must set down requirements for the installation of a minimum number of charging points for all non-residential buildings with more than twenty parking spaces.

Full details of the changes to Part L of the building regulations for electric vehicles are available in the public consultation documents on the Department of Housing, Planning and Local Government website. These regulations are due to be enacted shortly.

4.3.1 Controlling installation and operating costs

There are a couple of pitfalls that can increase the cost of installing charge points. In some cases, it will be difficult to avoid them, however, often you will be able to plan around them.

When installing charge points as part of a larger construction or development project, the cost of ground works may be marginal and not so important. Whereas, excavating trenches and foundation bases afterwards can be quite costly, so avoiding this is important. Where cables can be routed along a perimeter wall or appropriately buried under soft margins around the perimeter, this can greatly help to reduce costs. In addition, if charging bays are located along a wall, there may be an opportunity to mount the charge points on the wall, avoiding the need for a foundation base.

Installing charge points back to back can also reduce installation costs by allowing charging posts to share a foundation base and ducting. This can work well where vehicles are parked back to back along a centre aisle, such as a grass border. Be sure to check that this doesn't hinder maintenance access to the charge point.

Cable runs can also increase the cost of an installation. Longer cable runs are more expensive. Moreover, if a cable is longer, the cable cross-section or thickness may also increase to avoid voltage drops. This means the copper in the cable – and therefore the cost per meter – increases. If large cables are required, the cost may need to be revised at the time of works as prices vary with copper supply and demand.

If it is feasible, you should consider installing multi-socket outlets. As a rule of thumb, installing a charging post with multiple outlets is often cheaper per socket than installing single points. These can be dual outlet or even quadruple. While it will depend on the product and supplier, multi-socket charge points also offer cost efficiencies with respect to enclosure and the communications board (it is generally cheaper to buy one multi-socket system than multiple single socket systems). Be sure if you are installing multi-socket outlets avoid creating trip hazards with the charging cables.

Top tip

Avoid long cable runs where possible. The longer the cable, the larger it will need to be, consequently increasing the cost. Also, if the cable needs to be buried, the ground works will be more expensive on long runs.

Maximum import capacity

Facilities managers and energy managers will generally be familiar with the term Maximum Import Capacity, or MIC. This relates to the contract that exists between the electricity network operator and the customer. The more power you demand, the greater the MIC required. Your MIC is reflected in the standing charges on the bill provided by your electricity supplier.

Some charge point solutions provide an energy management function that helps to control peaks in power demand. This assists in keeping the overall demand below the MIC level, avoiding penalties. Energy management allows a number of charge points to share the available power over the charging period. For example, if the spare capacity is sufficient for four vehicles at full power, then when a fifth vehicle plugs in all vehicles will receive a slightly reduced rate. When one of the vehicles has finished charging, the spare capacity can be shared amongst the remaining vehicle.

4.4 Charging facilities for staff and customers

Many organisations want to provide charging facilities for staff or customers. Providing charge points for non-fleet use can be straightforward and may allow for the generation of revenue over time. To facilitate this, staff can be provided with radio frequency identification (RFID) card or similar authorisation method to gain access to charging.

Customer parking is often separate to company vehicle parking, reducing the practicality of using existing charge points. Additional charge points may be connected to the same management system as the fleet chargers or may be connected to a third-party system allowing interoperability with public charging networks. When connecting to third-party access systems, the user will be charged a fee for the service by the operator and energy costs are reimbursed to the host site.

As the migration to electric vehicles continues, it is important to have smart, connected charge points to facilitate cost recovery. Integration into the network of a third-party operator can remove the administration of accounts from your organisation.

Top tip

Record staff energy usage separately to company vehicles.

4.5 Future-proofing your business

It is expected that future developments in electric vehicle technology and the charging infrastructure network will enhance the potential for integrating electric vehicles into our fleets and normal business operations. With this in mind, it is important to consider the future when undertaking works today.

While it may not be wise to install more charging points than you require, it is certainly worth considering the future when you are installing the infrastructure that will feed your charge points. Distribution boards can be equipped with large enough switchgear to prepare for the short- or medium-term needs. A large enough cable to allow for expansion can feed a sub-distribution board, or cable ducts can be sized to allow installation of additional cables in the future.

When preparing for development or construction works at your organisation, ensure that you consider the likely take up of electric vehicles across your fleet. A marginal cost today may save you money and headaches in the future.

Consider the following points when assessing the future proofing of your operations:

- Design electrical incomers with electric vehicle charging in mind.
- Leave space in electrical distribution boards.
- Identify spaces for immediate and future electric vehicle charging.
- Install local distribution board for charge points.
- Install cable ducts along the electrical route to future charging points.
- When installing the first charge points, oversize the main supply cable to prepare for the future.

4.6 What is involved in installing a charging point?

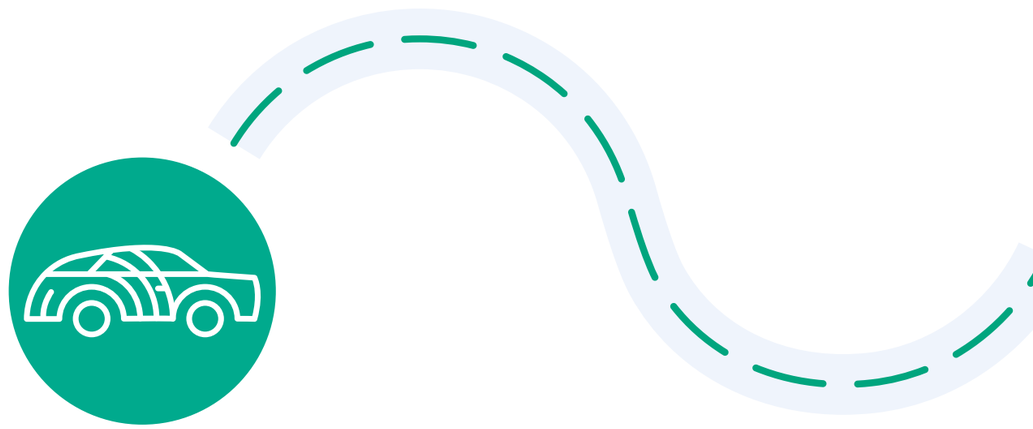
Now that you understand the considerations for recharging your fleet, let's see what steps are required to install a charging system that will meet your business needs.

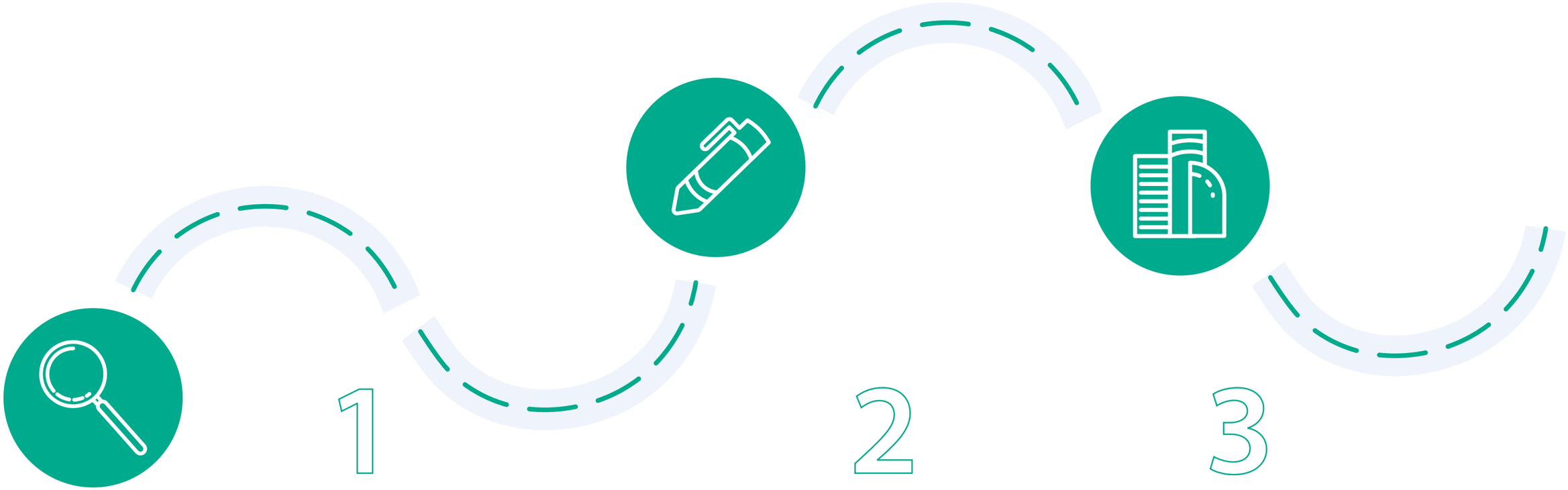
Installing a charging point requires careful planning and you will need to have a good understanding of your requirements to engage effectively with equipment suppliers.

It is advisable to use an independent and competent consultant who is experienced with the right technologies when planning for electric vehicle charging, particularly for larger fleets.

Typically, installing a charge point requires you to:

1. IDENTIFY THE LOCATION
2. DETERMINE THE POWER REQUIREMENTS
3. IDENTIFY ELECTRICAL CONNECTION POINT
4. PROCURE CHARGE POINTS
5. ROUTE CABLES
6. INSTALL THE CHARGE POINT
7. CONNECT THE SUPPLY





1

IDENTIFY THE LOCATION

To pick a location for your chargers, you will need to consider parking convenience, business logistics and the proximity to available power supplies. Shorter cable runs may reduce installation costs, however, there may be logistical reasons why a vehicle must park and charge in a particular location further away from the power supply. If you require multiple charge points in one area of the site, it is worth considering the installation of a sub distribution board in the area of the charging bays.

Another consideration is whether you need wall-mounted or ground-mounted charge points. Wall-mounted points are typically easier to install, and they reduce the cost of the installation through not needing foundations and ground works.

2

DETERMINE THE POWER REQUIREMENTS

Determining the power of the charge points requires a review of what energy needs a vehicle is expected to have each day or over a shift, as well as when, where, and for how long you will be charging the vehicles.

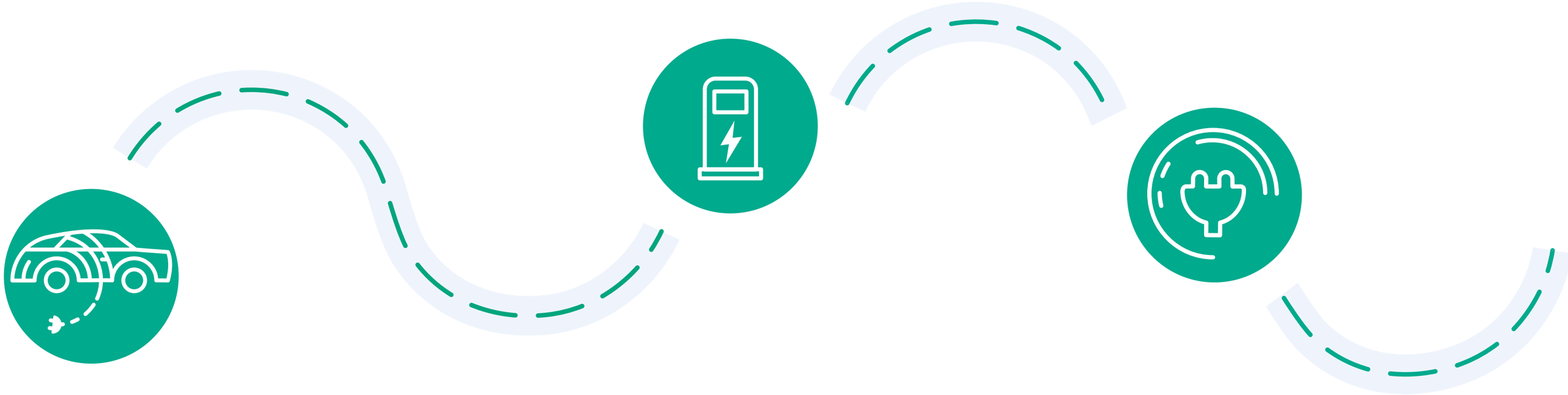
Reasonable contingencies to allow for less typical occurrences, such as an unplanned diversion in the vehicle's daily routine should also be considered. Take a risk-based approach to this – bear in mind that if the likelihood is very low and the resultant negative impact is very low, it may not make sense to invest in contingency measures. While fast charging may add a nice safety net, it may only be required from time-to-time and using public fast chargers as an alternative for these occurrences may be a more economical approach.

Remember: installing higher power charge points is not a guaranteed means of future-proofing your installation. Refer to section 4.5 for considerations on optimising your design for future requirements.

3

IDENTIFY ELECTRICAL CONNECTION POINT

Once you have calculated the electrical requirements, you will need to identify where you can connect them. In some cases, the first preference connection point may not be sufficient to supply the required power. If you are looking at a large fleet of electric vehicles, you may need to consider an upgrade to your supply or a new connection.



4

PROCURE CHARGE POINTS

Having worked out the power requirements from the charge points you will need to procure them, make sure that the charge point is equipped with any accessory required for controlling it and that you can measure how much energy it uses. Charge points should be equipped with sufficient electrical protection and must meet the latest electrical installation regulations at a minimum. Be clear about what you require from a charge point supplier. As with most products, if the price from one supplier is drastically different to another, then you should assume the product offerings differ in their function or build. Investigate why the difference is occurring.

5

ROUTE CABLES

Routing cables to the charge points is fairly straightforward. In some cases, you need to choose between excavating a trench directly to the area of the charge points or following the perimeter with a surface mounted cable in suitable containment. Longer cable runs typically require larger cable diameters, increasing the cost. Excavations can also be expensive, particularly where the excavation is in concrete or tarmac. Your electrical installer will be able to advise on the cable sizes and a ground works contractor will be able to advise on trenching and ducting costs.

6

INSTALL THE CHARGE POINT

Installing charge points is much the same as installing most other electrical equipment. As charge points will generally be installed outdoors, you should ensure that they meet a sufficient IP (ingress protection) rating for the environment. This typically requires a rating of IP54 or better. In addition, it is advisable to include bollards or rubber bump strips to protect the charge point from collision. These can usually be provided by the installer or the ground works contractor.

7

CONNECT THE SUPPLY

When the equipment is in place, your electrician or suitably certified installer will need to connect the power supply to the charge point. This should be carried out in accordance with the electrical installation regulations. Cables should be tested prior to connection and, once connected, the circuit should be tested for both electrical safety and charge point function.

5 Fleet management

Over the years, fleet managers have honed techniques and acquired tools to assist them with the task of managing fleets of all sizes. However, the basic principles of managing a combustion engine fleet still apply for electric vehicles. In addition, the charge point back-office systems and vehicles can assist in tracking data required to efficiently manage your fleet. This section will focus on methods of monitoring energy usage and managing fleet recharging for each vehicle.

5.1 Best practice infrastructure management

When installing a single charge point for a single vehicle, for example at an employee's home, you may not need communications and authentication functionality. A simple energy meter connected in line with the power supply to the charge point will often suffice to allow tracking of energy in the vehicle. It is reasonably straightforward to ensure that one vehicle is charged each time it is supposed to be, as the person responsible doesn't need to monitor multiple vehicles.

Managing multiple vehicles and charge points across different locations in your business can be more complex and a central charge point management system may be more suitable for tracking activity. Generally, the considerations of most interest to businesses regarding charge point management are:

- What vehicles are being used, where and when;
- How much energy is being used (by each vehicle and overall); and
- If a charge point is available for charging or in-use.

5.2 Energy monitoring

Keeping track of the fuel consumed across fleet vehicles has always been important. Moving to electric changes the fuel, but not the importance of tracking it. Traditionally, fuel cards have been used along with odometer readings and sometimes vehicle tracking to assess the usage. With electric vehicles, we can use all of the same tools, but this time recharging will take place mainly at our place of work or at staff homes.

Publicly accessible charge points will usually include energy metering. Moreover, the amount of energy consumed should be displayed as part of your statement of transactions. When it comes to workplace and home charging, the solutions will need to be specified by the organisation at the time of procuring charge points.

In order to be able to report energy, an energy meter should be installed in the charge point. This should be integral and should communicate its readings to the charge point controller. Most good quality products will be accurate enough to present good energy data. However, where customer or resale transactions are involved, Measuring Instrument Directive (MID) grade meters should be used.

Figure 8: Sample applications and software

5.2.1 Vehicle energy tracking

It is important to be able to track and monitor energy use for each vehicle within your fleet. To achieve this you will need to be able to identify each vehicle. The most common approach for vehicle identification is to associate a radio-frequency identification (RFID) tag with each of your vehicles. To achieve this, the charge point must have an integrated RFID reader. These tags store a small packet of information which includes a unique identifier read by the charge point, identifying which vehicle is responsible for the energy consumed.

Radio-frequency identification tags can be in the format of a card just like a bank card or they can be integrated into a key ring fob. The key ring fobs are particularly useful when you need to track the usage of a vehicle as they can be attached to the key of the vehicle. In some cases, there are multiple keys for a vehicle, so each can have its own fob. Don't forget to keep a record of which fob relates to which vehicle.

Top tip

Use one radio-frequency identification tag per vehicle, not per driver. It is the performance of the vehicle that matters. Attach the RFID tag to the vehicle keys.

Figure 9: Authentication and authorisation

How do I track my vehicles using the public or destination charging network?

If the vehicle is being charged at public charge point, you will be able to review your transactions and fees through an account or using individual transaction receipts. Depending on which charge point management system you choose, it may be possible to record all transactions using the same radio-frequency identification tag and report all usage through one central point.

5.3 ICT solutions

Back office systems, known as charge point management systems, are used to collect data from charge points. They can report charger use, notify changes in status, and check if the charge station is still communicating. Charge point management systems can be used with as many or as few charge points as you need. The level of functionality offered can vary from supplier to supplier. A system with basic functionality may be sufficient for low numbers of charge points and users.

The charging transactions are recorded by the charge point and logged on the system in the form of a charge detail record. This record contains the start and finish times of a charging session, the unique identifier used to start it and the amount of energy consumed during charging.

With ICT solutions, you can view the data in real time and download it for record keeping. This is particularly useful for energy or fleet managers. Moreover, the systems will usually allow the user to create reports according to your data management needs, for example, according to the vehicle ID, distance range, date ranges (weekly, monthly, annually or specified start and finish dates) charger number, etc.

Table 6: Sample charge detail record

ID	Name	Socket No.	Card Start	Card Stop	Start Date	End Date	Total Duration	Start kWh	End kWh	Total kWh
1	Fleet Charger 1	1	AB12DE34	AB12DE34	2018-06-13 *17:23:40*	2018-06-13 *19:23:01*	0d, 1h, 59m, 21s	3409	3420	11
2	Fleet Charger 3	2	AB12DE34	AB12DE34	2018-06-04 *12:25:25*	2018-06-04 *13:43:54*	0d, 1h, 18m, 29s	14621	14630	8
3	Fleet Charger 1	2	AB12DE34	AB12DE34	2018-06-01 *16:32:35*	2018-06-01 *19:53:42*	0d, 3h, 21m, 7s	4591	4602	11
4	Fleet Charger 2	1	AB12DE34	AB12DE34	2018-05-27 *08:06:22*	2018-05-27 *10:33:26*	0d, 2h, 27m, 4s	3302	3311	10

What about ICT solutions for public and destination charging infrastructure?

In general, if you intend your business vehicles to charge at a public or destination charge point, you will need to set up an account with the charge point operator. This will normally be facilitated via a customer web portal where you can view and download the usage data for your fleet. Typically, the data can be exported as a .csv file.

5.3.1 Communications protocols

Charge points use a communications protocol to connect to a back-office system or charge point management system. This protocol can be based on a closed (proprietary) format or an open format compatible with multiple equipment and service providers. Remember, if you are buying hardware from multiple manufacturers, ensure that they are all compatible with the operating system.

If you require a small number of charge points at a single location, open protocols may not be an essential requirement. Proprietary systems can offer all the functions required for a small installation.

Installation of larger numbers of charge points, particularly when installed across a wide area, will often necessitate use of an open protocol. This ensures that there is flexibility to change vendor as required, and is particularly relevant if you plan to expand your charging infrastructure in the future. If you have a significant network of charge points and do not use an open protocol you may end up being tied to a single vendor or having to install multiple management systems which are incompatible with each other.

The most prominent open standard in the electric vehicle charging industry is the open charge point protocol (OCPP). It has been developed by the Open Charge Alliance and includes a wide range of stakeholders from across the industry. The open charge point protocol is regularly updated to include new functionality and better performance.

Top tip

Where large numbers of charge points are expected, use an open standard communications protocol such as the open charge point protocol. When the time comes to expand your charging network, you won't be tied to one vendor.

5.4 Measuring and verifying savings

To fully understand cost, energy and carbon savings related to your business fleet it is important to develop a measurement and verification (M&V) plan.

For large fleets or projects, these plans are usually prepared by certified measurement and verification professionals (CMVP). However, for small numbers of vehicles you can calculate savings very simply, as demonstrated in Table 6.

Table 7: Measurement and verification example comparing electric vehicle against ICE vehicle[2,3]

Vehicle Type	Typical annual mileage	Litres to kWh	Energy consumption in kWh	Conversion factor[2,3]: kWh to CO_2	kg CO_2	Cost
Internal combustion engine	30,000km *@5.0L per 100km*	1,500L X 10.169	15,254	0.264kg/kWh	4,027	€1,950 *@ €1.30 per litre*
Electric vehicle	30,000km *@5kWh per 100km*	n/a	4,500	0.331kg/kWh	1,490	€540 *@ €0.12 per kWh*
Savings per year by switching to electric:					**2,537**	**€1,410**

2 Get up to date conversion factors at https://www.seai.ie/resources/seai-statistics/conversion-factors/
3 The electricity grid becomes less carbon intensive each year. Be sure to get the latest conversion factor on the SEAI website (the one used in the calculation here is SEAI's provision figure for 2019)

There are several ways to get your vehicles' energy use data (L/100km for ICE vehicles and kWh/100km for electric vehicles):

Electric vehicle

KWH/100KM

You can also find the kWh/100km on the dashboard. Electric vehicles often come with apps for your phone or even online fleet access to the performance data. As with L/100km, the longer the period or distance covered the better; just like internal combustion engine vehicles, electric vehicles need to be run in, so even if you do these calculations early in the vehicle's life, do them again when you have 10,000+km to be sure of the savings.

Internal combustion engine vehicle

FUEL CARD

If you have a fuel card look up the L/100km in the online account, this can also come in handy if you have let the vehicle go back to the dealer, as your fuel records should still be online. If in doubt, ask your fuel card account manager for help to get the odometer readings which are usually requested at the till. Take any two good km readings, as far apart as possible, and the fuel dispensed in litres to calculate the L/100km (Litres ÷ (km ÷ 100) or 1500L ÷ (30,000 ÷ 100) = 5.0L/100km).

TRIP COMPUTER

With the key, go to the vehicle and turn on the ignition, look for an LCD display, often showing the outside temperature. Use the controls (usually on the steering wheel or one of the wands to either side) to access the average fuel use. It will read something like ø 5.0L/100km (or in MPG 56.5mpg[4] (look for the ø). Ideally, the average fuel use will be for several thousand kilometres perhaps even the life of the vehicle – the longer the sample period the better.

4 To convert MPG to L/100km and vice versa simple key 282.5 into your calculator and divide by what you have to see the reciprocal. For example 282.5 ÷ 5.0 = 56.5 and 282.5 ÷ 56.5 = 5.0 . For more accuracy use 282.4859.

Figure 11: Vehicle trip records

How do I ensure consistency in tracking my business vehicle's energy data?

You may find there is discrepancy between what the fuel card shows and what it says on the dashboard. This is normal. The dashboard is displaying fuel burned by the engine and the fuel card is representative of fuel dispensed at the pump (most accurate). Choose one or the other, do not mix figures from trip computers and fuel pumps.

The same applies to electric vehicles. As there are small losses in charging and the drivetrain, use either the kWh/100km displayed on the dash or the kWh and distance from the charge point management system – but do not mix the two.

Appendix

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Notes

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