How-To Series

A **Roadmap** to Fleet **Electrification**

LION ELECTRIC

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So, you've decided the time has come to **bring electric vehicles into your fleet.**

Congratulations on your move to sustainable transportation!

As efforts and mandates to decarbonize transportation continue to grow into the future, the experience gained as a leader will give valuable experience and insight that will benefit your operations and bottom line, in addition to enhancing your company's reputation and commitment to sustainability. In order to help with this process, we've assembled a checklist of considerations you'll want to make sure you've addressed to make this journey as seamless as possible.

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Make sure you select the **best use case**.

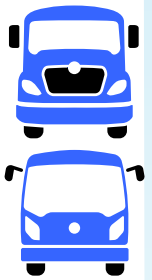
Perhaps the most important first step is to consider which area of your business is best suited to electrification. Which routes have a high number of stops, or exist in stop-and-go environments, and have an appropriate range? Where do your drivers see the worst fuel economy? Which vehicles in your current fleet require the most maintenance? Are there routes or communities that will benefit from vehicle noise reduction?

These are just a few examples of questions to consider. Identifying the ideal operational parameters that will benefit the most from electrification will allow you to maximize the many benefits of going electric. Below, we will outline important considerations to help with your evaluation.

Generally speaking, there are five areas of focus to consider.

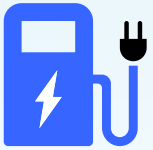
These include the following, though not necessarily in this order.

What's next for your EV fleet?



What to buy?

What service and maintenance is needed



How to charge vehicles?

How to plan for routes and training?

Note that while it may be tempting to begin **with the vehicle acquisition process,**

planning for charging infrastructure readiness should happen concurrently with vehicle acquisition as these two will need to be closely coordinated. Having the right infrastructure in place on day one will be essential to having your new vehicles up and running as soon as possible. But don't forget, the routes and vehicles you choose will influence infrastructure.

In addressing the items below, it's often a good idea to have a resource specific to heavy-duty zero-emission transportation standing by to help with questions and concerns as they arise. Industry organizations can be helpful, however it is wise to choose a vehicle manufacturer who will work with you directly to integrate its vehicles into your fleet.

Factor **no. 1**

Charging Infrastructure **Readiness**

As mentioned, charging infrastructure is one of the major components to a smooth and successful transition to electric. Identifying the correct charging solution for your specific needs is critical, as there are many options available on the market and costs can vary dramatically – in some cases, it can be tempting to over-upgrade when in fact it would be costly and unnecessary to do so. Therefore, we strongly recommend working with a vehicle manufacturer or subject matter expert who can evaluate your site scale and design, and ensure compatibility with the vehicle. Some charging providers may not have had significant experience with heavy-duty EVs and fleets, so working with the vehicle manufacturer directly or seeking qualified referrals can help to ensure compatibility.

Here are some **key considerations to take into account** when evaluating charging infrastructure:

Will all vehicles be charging simultaneously at night or will vehicles operate in 24-hour shifts?

While charging at night can offer reduced rates, and for this reason, is generally preferred for EVs, it also means that potentially all of the pilot fleet vehicles will be pulling current at the same time – which can result in demand charges, so it's important to consider utility rates and structures in your planning process.

Will Level II AC charging be sufficient, or do you need DC fast (Level III) charging?

Level II charging is generally acceptable for vehicles parked all night which will not need to recharge during the day. However, DC fast charging delivers much higher power levels resulting in shorter intervals between charges.

The difference in charger costs and site upgrades can be significant – generally AC charging is lower cost and easier to install. However, a DC charger means a vehicle does not need an onboard charger to convert the current, which will lower the vehicle cost sum. So, in some instances the costs can end up similar, especially when available incentives are taken into account (see next point).

Consider installing your chargers on a separate circuit from your building.

This can lead to reduced costs if your utility has an EV specific plan, and some utility EV subsidy programs may require this so that they can properly monitor charging data. However, if you are installing just one or two AC chargers, it may not be necessary.

Are there potential site upgrades?

Including not just electrical readiness, but service level, site design and optimization.

Note that site readiness can take months depending on whether the location is set up for significant power draw from the grid. On top of service upgrade costs, permits and/or a backlog of other projects could lead to a scenario where pilot fleet vehicles arrive weeks, or in some cases, months ahead of site readiness. For this reason, it is always important to schedule these concurrently.

What incentives are available in your area?

Many utilities and municipalities have programs in place that partially cover charger costs and/or installation costs. These can differ depending on charger type.

Understand the time-of-use rates and demand charges posed by your utility.

Scheduling charging around when electricity rates are lowest is ideal, but may not always be possible depending on your use case. There are smart chargers on the market which can be programmed to schedule around these rates and automatically begin or stop charging, however this software may already be installed on the vehicle itself making a smart charger unnecessary.

Remember, a trial program **is just that – a trial program.**

If successful, the site needs to be able to handle the equivalent of a full phase out of internal combustion engine (ICE) powered vehicles. It is important to ensure that all upgrades account for future increased capacity whenever possible.

Batteries can be installed in tandem with solar to capture energy during the day as well. Energy captured through solar during the day, and then stored on-site in back-up batteries to be used when electricity rates are at their highest. Batteries can also provide a carbon free, quiet, and reliable source of energy, even at night.

Factor **no. 2**

Vehicle **Acquision**

Heavy-duty electric vehicles are fairly new to the market, and the technology is advancing rapidly. Understanding the technology behind the product is important in choosing what is right for you.

For example, it may be tempting to buy the model of vehicle with the highest available range – which is typically how consumer EVs are purchased. But is it necessary for your routes? The battery pack is the most expensive component in an EV, so it is important to take your route needs into consideration.

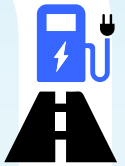
As such, **it is important to understand the vehicle technology** as well as the experience, reputation and support offered by the manufacturer when evaluating EV options. Below are some considerations to take into account.

- First make sure you select a vehicle that is purpose-built to be electric, rather than retrofitted. This results in a more optimized product and experience with fewer design compromises, which can create complications.
- What is the manufacturer's experience in your intended fleet applications? Consider reviewing case studies, asking for referrals and contacting the manufacturer directly.
- How many vehicles does the manufacturer have in operation? The more of their platforms that are in service, the more likely it is they have gathered feedback and implemented improvements into the product.
- What warranty does the manufacturer offer? The battery is typically the most important warranty component, and coverage for other components may differ.
- Does the manufacturer have a service to aid in charging infrastructure installation? This will ensure compatibility and proper site design.
- Make sure the manufacturer offers adequate support to augment your service teams, no matter your location.
- What is the manufacturer's ability to scale up as needed to meet additional demand beyond the pilot program?
- What training programs are offered by the manufacturer? Both for drivers and technicians.
- What other services are offered? This can include telematics and energy management software for chargers. Telematics are powerful tools in analyzing energy use. Telematic systems have the potential to help dial in the vehicle, and as an extension, fleet performance and a prospective vehicle manufacturer should both recognize the value of gathering vehicle telemetry data and provide this as part of their offering.
- What is the manufacturer's experience with purpose-built EVs and battery tech? A manufacturer dedicated solely to electric vehicles has fewer conflicts of interest and more specialized expertise in battery systems, thermal management systems and knowledge of how to integrate EVs into an existing fleet.
- Are the vehicle batteries thermally optimized? Thermal management systems are key to keeping battery performance optimal in all weather conditions, including extreme heat or cold. This often requires liquid cooling and active temperature management.

There are also the more obvious operational needs to take into consideration, which will be more familiar to operators.

These include:

Routes well-suited to electrification
(urban routes, ease of return to base)



Range requirements fully laden

Overnight/off-shift charging times

Don't forget the incentives available, **as these can be significant!**

These can include sources like HVIP in California, VW settlement funding, CARB discounts (in California), as well as regional, industry, and utility programs to name a few. Note that many of these can be combined, in some cases cutting the cost of the vehicle by half or much more. There may also be incentives that apply towards retiring ICE vehicles which may be available from local air districts or state programs. Keep in mind that these incentives are likely to diminish over time, meaning acting now may save in the long run.

Factor **no. 3**

Route **Planning**/ Operator **Training**

EVs tend to be easier to drive than their ICE counterparts – primarily as there is no transmission – but due to the lack of a heavy diesel engine, there is drastically reduced vibration and weight distribution is more centralized.

But there are some adjustments in routine that should be understood.

Nearly all EVs feature regenerative braking in addition to traditional mechanical brakes, and in many cases, the amount of regen assist is adjustable either by the vehicle manufacturer and/or driver.

This method allows a vehicle to quickly coast to nearly a stop, or in some cases, a full stop, without needing to apply the brake pedal. While nearly all drivers find this feature a convenience, in particular for vehicles that make frequent stops, it does take some familiarization before it becomes second nature. Once mastered, use of regenerative braking can optimize range. Similarly, the amount of accelerator pedal travel can differ between internal combustion and electric powered vehicles.

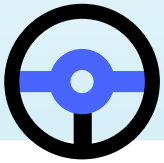
EVs and telematics systems, even more so than combustion vehicles, often go hand in hand.

Part of this is because range and battery usage need to be tied closely to route planning, and because the depth of data available through most fleet EVs is more robust than that of their combustion engine powered counterparts. Operator training around the use of telematics systems and energy management software for chargers is important to ensure the seamless integration of these systems as well as to maximize ROI by carefully watching energy costs and adjusting accordingly.

Many fleet vehicles are also charged on shift by their operators.

As EVs don't require fuel stops during shift operation, this represents a potential increase in productivity, but equally, a loss of a routine bathroom break or break for many drivers. Equally, drivers of combustion engine powered vehicles aren't accustomed to ensuring that their vehicles are placed on a charger at the close of their shift, so this is a variation to their routines that needs to be accounted for.

Over time, many drivers establish a preference for the relatively smooth, quiet operation of EVs and the driving style that they provide.



While it is true that drivers migrating to the pilot vehicles is generally the desired outcome, be aware of the implications this has to the combustion vehicles as they fall out of favor. You may also want to plan to maximize EV uptime for this same reason.

Factor **no. 4**

Service/ Maintenance **Considerations**

Generally speaking, EVs require significantly less service and maintenance compared to ICE powered vehicles. Keep in mind that a diesel drivetrain contains thousands of parts, while an EV drivetrain contains dozens. With no belts, hoses, plugs, exhaust systems, oil changes, and other serviceable parts, their down time is minimal. Even brakes are serviced and replaced much less frequently owing to regenerative braking taking on the majority of a vehicle's braking needs, and surprisingly tires can last longer. As a result, maintenance costs are much lower, and operators typically experience up to 60% maintenance savings.

That said, as with any vehicle, there are tires, suspension, wiper blades, coolant, lighting systems, and other component parts that both categories of vehicles have in common – even if they aren't all serviced on the same schedules. Fleet managers should be trained to recognize and schedule service according to the differing needs of electric vehicles vs. their traditional counterparts – including ordering fewer consumables for fleet maintenance.

Most of the routine service and maintenance can be done by technicians without any special training, tools or expertise – a lot of the parts are the same or similar to combustion engine powered vehicles, including differentials, suspension components, etc. It is when it comes to high-voltage systems that you'll want to seek support from the manufacturer's training and service department. That said, basic technician training should also be taken into account. Electric vehicles run on high-voltage electricity. For this reason, it's important that both operators and service staff are trained on safety related concerns insofar as these differ between vehicles that run on liquid or compressed gas and fuel as opposed to those that run on electricity. Training around where high voltage disconnects are, how to operate them, and the differences between extinguishing electrical vs. fuel fires is an important part of EV fleet preparation.

Factor **no. 5**

Extending Service **Life**

The service life of a typical combustion engine powered vehicle and an electric vehicle can be very different in terms of years/hours of operation before overhaul, and what overhaul actually consists of. It can also mean there are variances in the value of vehicles as they near end of service life.

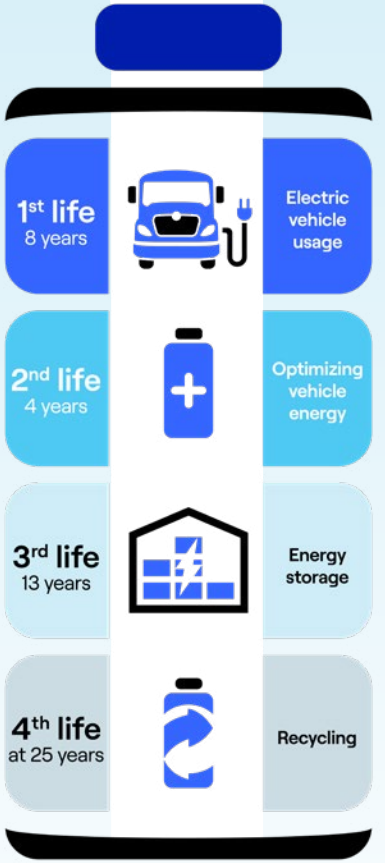
Battery **Cycle Life**

Typically, combustion engine powered vehicles become less reliable as mechanical components wear out over time. Impending engine and transmission failures are often the big-ticket expenses that signal when it is time to plan for vehicle retirement.

By contrast, electric vehicles have nearly no degradation curve associated with major mechanical parts. However, when their battery packs are at the end of their useful life, the degradation of their range can render a vehicle no longer able to cover its intended range. Note that this process can take well over a decade. For this reason, planning for pack upgrades and/or replacements in advance should be taken into consideration. The good news is that with proper planning, an EV can outlast (in some cases, several times over) the effective service life of its traditional ICE counterparts.

Looking beyond the scrap value of the vehicle bodies themselves, there is often relatively little meaningful scrap value in worn engines, transmissions, or differentials from combustion engine powered vehicles.

By contrast, for EVs, even a vehicle whose battery pack has fallen below its useful service parameters still has value. In fact, there are four distinct lives to battery packs. These include not only their initial value as healthy, new batteries that come equipped in vehicles, but a second life where they are repurposed to support vehicles with lower range needs once they no longer operate within originally specified parameters (this stage comes well after a decade into service). After they no longer suit that need, they enter their third life, as static energy storage (for example, the battery back-up systems recommended above as a site upgrade). From there, a battery pack's fourth life is in being recycled into new batteries so that the four-stage process can repeat anew.



For more info on the four lives of batteries **click here**.

Summing it Up

Getting started with an EV program is not as complex as it first may seem. By breaking down the steps and understanding each, it should be relatively easy to prepare a checklist to get your EVs up and running effectively and efficiently. Furthermore, finding the right vehicle partner who has expertise in all these areas can help guide you to decisions that fit your unique operations, in addition to making the process simpler and more efficient.

With these considerations in mind, you'll be empowered to take a holistic approach to adopting fleet electrification including asking the right questions, planning with the appropriate timeline in mind, and ensuring that you have the necessary roadmap to success when embarking down the road of transitioning to an EV fleet.

Ready to get started on your electrification journey?

Discover more valuable information at **www.thelionelectric.com**
or email us at **info@thelionelectric.com**!

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