

ELECTRIFICATION OF VEHICLES AND MACHINERY

A PRACTICAL GUIDE

AT A GLANCE

Best suited to:

Businesses relying on light vehicles and shorter travel distances

Main benefit:

Lower operating and maintenance costs

Main barriers:

Upfront capital costs, charging limitations, and the availability of larger electric farm machinery

Good first step:

Determining how to source the necessary power supply

Image: Tropic Wings





OVERVIEW

Electrification of vehicles involves replacing vehicles driven by internal combustion engines with vehicles driven by electric motors. Electric vehicles (EVs) and machinery have batteries instead of fuel tanks.

The purchase of electric passenger and light commercial vehicles in Australia is growing rapidly. A wide range of electric equipment for farms and workshops is also available, with extensive use of forklifts, all-terrain vehicles (ATV), and motorbikes in rural and regional Australia.

Electric tractors are slowly entering the market, especially in the small/medium sizes while heavy duty, high horsepower tractors will emerge as the next frontier.



SUITABLE BUSINESS TYPES

For rural transport and delivery businesses, there are many electric light vehicles (cars and utility vehicles) available on the market – though range anxiety and the availability of charging infrastructure remain big concerns.

Many modern EVs can travel 300–500 km on a single charge, which covers most daily needs. However, long-distance travel requires planning of charging stops, and ensuring availability of compatible charging spots. Charging overnight, using a workplace or depot for charging, or planning routes with fast charging on highways can aid EV use.

For storage, depot, and stationary service styles of business, electric workshop vehicles and forklifts are readily available.

For farming businesses, side-by-sides and utility vehicles, motorcycles, and quad bikes are readily available – and small tractors are increasingly available as well. Intensive operations like dairies, piggeries, wineries, nurseries, and horticulture are highly suitable for vehicle electrification due to the short travel distances, predictable and repetitive vehicle use, and centralised operations (supporting ease of charging).



BENEFITS

There are a number of potential benefits to electrifying vehicles and machinery as they become available. These include:

- Lower operating and maintenance costs compared to diesel or petrol vehicles.
- Reduced exposure to fuel price volatility and supply disruptions.
- Environmental benefits with lower greenhouse gas emissions.
- Opportunity to integrate with renewable energy for greater energy independence.
- Reduced noise and the elimination of exhaust fumes.
- Charging electric vehicles on-site is potentially a flexible load that can be operated during periods of surplus solar generation or times of cheaper grid electricity.



CHALLENGES

Some of the challenges to consider include:

- Higher upfront capital cost for electric equipment and supporting infrastructure.
- Charging time constraints can impact operational flexibility.
- Grid capacity limitations in some regional areas.
- Uncertainty around battery lifespan, replacement costs and resale value.
- Lack of regionally available expertise for repairs or maintenance.
- The need for isolation equipment if grid stability is an issue (i.e. equipment that provides the ability for solar and batteries to operate off-grid and continue to charge vehicles in an outage).



TECHNICAL CONSIDERATIONS

Understanding energy usage

Some matters to consider:

- Energy and load management systems are important to optimise charging times, manage electrical loads and avoid peak demand charges or grid constraints.
- Whether being able to charge vehicles during a grid outage is important to your operations. This may require isolation mechanisms that disconnect the system from the grid so that it can run on solar, batteries, and the generator during a grid outage.
- What charging practices will lead to the most effective load management and the best value for money. Staggered or overnight charging for vehicles can reduce peak demand and infrastructure costs.

Suitable power supply

- You will require a power supply that can provide enough electricity to charge the machines. Consider the power supply requirements of each vehicle, as the speed and frequency of charging will affect the electrical system capacity needed.
- Consider where there is more than one place on the property that charging infrastructure could be installed.
- Consider the time it takes to charge batteries for electric vehicles and how the charging time will fit with the workflow of the business or any anticipated travel.

Infrastructure needed

- Sufficient and reliable power supply must be available for charging. Chargers can range from standard chargers to fast chargers depending on fleet size and usage patterns.
- Electrical upgrades such as switchboards, transformers, wiring, or grid augmentation may be required.
- Potential for EVs to be integrated with renewable energy systems such as solar, battery storage, or bioenergy production.
- Whether off-grid or hybrid systems are feasible when paired with solar and battery storage or bioenergy systems.



IMPLEMENTATION CONSIDERATIONS

Land and space requirements

- Dedicated space is required for charging stations and potential battery storage systems.
- Sufficient area for solar installations (rooftop/ground-mounted or elevated over crops) is required if pursuing off-grid generation.
- Ensuring a safe storage area for electric vehicles and equipment and the associated charging infrastructure might change the way traditional vehicle storage areas are used.

Skills or training required

- Training to help you get the best performance from your equipment, including working out optimal charging times.
- Training for operators and mechanics in the safe use and maintenance of electric equipment.
- Access to energy management and optimisation skills, particularly when integrating renewables.

Automation

- The development of electric equipment and machinery is occurring alongside rapid advances in automation. For example, some electric tractors are being designed with autonomous capabilities, which may reduce the inconvenience of charging times by allowing tasks such as weed spraying to operate continuously, including overnight, without needing an operator.



DECISION FACTORS

When this option may make sense

- Your business has high fuel costs, especially if you have the potential to offset energy purchases with on-site renewable production.
- Solar power is already being exported regularly, which may mean enough spare capacity to charge an electric vehicle, forklift or ATV.

- Vehicle usage is short and predictable.
- There is existing grid capacity to support the increased charging requirements.
- Emissions reduction or sustainability targets are a priority.

When it may not be suitable

- Your farm is large-scale and broadacre, requiring continuous, high-horsepower machinery.
- You're in a remote location with limited grid access and insufficient capital for large amounts of solar.
- Equipment use is highly variable or runs for long durations.

Key decision criteria

Some factors to consider when deciding whether electrification of vehicles and machinery is right for you:

- The most appropriate technology combination to power charging. This could include grid electricity, solar only, solar and battery or hybrid (a mix of solar and grid and diesel backup).
- The presence of constraints such as whether the grid has enough capacity to fast-charge equipment (if necessary) and if not, what the cost of upgrades versus off-grid charging would be.
- Whether there is local access to service, support, and expertise to fix and repair electric equipment, factoring in the lead times for new parts.
- The total cost of ownership (capital versus operating savings) and what financing could be available.
- Whether electric equipment is compatible with existing business systems and workflows.
- Equipment performance requirements (range, power, duty cycle) and whether these can be met through the available or proposed energy supply.
- Whether electrification aligns with long-term business goals, including sustainability and risk management.



CASE STUDY.

TROPIC WINGS BUSES

Tropic Wings, a tourism operator located in Cairns, was the first private operator of an electric bus in Australia, starting back in 2019. In 2023, through an Australian Renewable Energy Agency (ARENA) trial, Tropic Wings introduced a further 12 battery electric buses into its fleet of 34 vehicles. Eleven chargers were also installed at their depot and one of their major tourism destinations, Rainforestation in Kuranda.

For the change to electric vehicles to be successful, the company needed to consider multiple regulatory and technical challenges – from flood-resilient construction to optimising site layout and power flow. To get the help they needed, Tropic Wings worked with their energy retailer to assess grid capacity and design appropriate load-management systems.

In 2024, the company installed a battery energy storage system (BESS) to provide redundancy, minimise grid impact, and reduce operational costs. Currently the company has 19 electric buses, which is 45% of the fleet.

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For more information see: arena.gov.au/assets/2026/05/Tropic-Wings-Sustainable-Transport-in-Tourism-Industry-Blueprint-for-the-Deployment-of-Electric-Buses-by-Private-Operators.pdf

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