



CLEAN ENERGY
SNAPSHOT

**AUSTRALIAN
ELECTRIC
VEHICLE**
MARKET STUDY

The CEFC is responsible for investing \$10 billion in clean energy projects on behalf of the Australian Government. Our goal is to help lower Australia's carbon emissions by investing in renewable energy, energy efficiency and low emissions technologies. We also support innovative start-up companies through the Clean Energy Innovation Fund. Across our portfolio, we deliver a positive return to taxpayers. cefc.com.au

Acknowledgments

The CEFC gratefully acknowledges the contributions of Australian Renewable Energy Agency, which jointly funded the *Australian Electric Vehicle Market Study*, and Energeia, which produced the study.

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The Australian Electric Vehicle Market

An Industry Snapshot from the
Clean Energy Finance Corporation

Electric vehicles are central to our clean energy economy



Electric vehicles could represent 90 per cent of all cars and light commercial vehicles on Australian roads by 2050, according to a new study that we commissioned in partnership with ARENA. This exciting prospect would require \$1.7 billion in private investment in new charging infrastructure.

Our new modelling forecasts a surge in electric vehicle sales from as early as 2021, based on the right combination of incentives, models and infrastructure. It also finds that, on current trends, EVs could have the same driving range capabilities as diesel or petrol-fuelled cars by 2024, addressing one of the biggest consumer concerns about EVs.

This important research gives us insights into how we can accelerate our transition to electric vehicles, which is essential to cutting carbon emissions. Australians have traditionally been early adopters of new technology, but we're lagging when it comes to EVs. Our research shows that we can increase the uptake of EVs in a way that benefits drivers as well as the environment. It's about lowering prices, bringing more models to market and creating a charging network.

The reality is that the transition to EVs is inevitable. We're already seeing vehicle makers confirm they will stop producing pure internal combustion engines over the coming years. At the same time, we're seeing dramatic improvements in vehicle charging networks, creating the essential infrastructure to support electric vehicles.

These measures can deliver a material improvement to our greenhouse gas emissions as our vehicle fleet and electricity system evolve over the coming decades.

Right across the clean energy economy, we are seeing dramatic falls in prices as the use of new technologies becomes more widespread and as the private sector responds to new investment opportunities. We can expect to see the same trends in the EV market, with increased sales driving down vehicle purchase costs and private investors financing new charging infrastructure to service this new market opportunity.

We thank Energeia and ARENA for their support in the development of this important research, to help us better understand the exciting potential for Australia's electric vehicle transition.

The CEFC has already invested in a number of projects to encourage the adoption of electric vehicles, including discounted finance options for individual and fleet buyers. Through the Clean Energy Innovation Fund, we are also financing start-up companies targeting the EV market. We look forward to growing this market even further, and lowering our carbon emissions.

A stylized, handwritten signature in black ink, appearing to read 'Ian Learmonth'.

Ian Learmonth
CEO, CEFC

ELECTRIC VEHICLES: AUSTRALIA'S TRANSITION

“

Our transition to electric vehicles is inevitable. It's about lowering prices, bringing more models to market and creating a charging network.

”

Ian Learmonth
CEFC CEO

WHERE WE ARE HEADING

50% new car purchases
are EVs **by 2030**

5 minute
supercharging capability

Matched driving range
with diesel, petrol vehicles



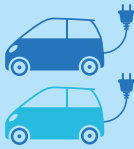
WHAT WILL GET US THERE

POLICY INCENTIVES



Lower
up front
costs

MODEL AVAILABILITY



More
models

CHARGING NETWORK



Home +
public
charging

WHAT WE WILL SEE

2 year

payback on purchase price premiums

20 EV models

on the market in Australia by 2020

28,500

public access fast charging points





Electric vehicles and the Australian market

The CEFC sees the transition to electric vehicles as a critical decarbonisation pathway for Australia. This Industry Snapshot reports the key findings of the *Australian Electric Vehicle Market Study* prepared by Energeia for the CEFC and ARENA.

Transport in Australia produces nearly 100 million tonnes of emissions each year or 19 per cent of national greenhouse gas emissions. Cars and light commercial vehicles together represent more than half of those emissions, and their emissions are projected to increase as the population grows and economic activity increases. Along with decarbonising the electricity sector, electrifying Australia's light vehicle fleet is an important step in meeting Australia's emissions reduction target.

Energeia modelled three scenarios to project the potential uptake of electric vehicles (EVs) in Australia, and the associated requirement for charging infrastructure:

1. *No Intervention*
2. *Moderate Intervention*
3. *Accelerated Intervention*

The study released in June 2018, examined the barriers to uptake, which include the purchase price premium, low EV model availability and limited access to charge points, and also examined trends in other markets.

The CEFC is encouraging the EV transition by providing finance to businesses looking to upgrade their vehicle fleets. The CEFC has financed around 300 EV sales to date and expects to continue to support this growing market. The CEFC is also supporting the EV battery supply chain through an investment in a lithium mine in Western Australia.

Additionally, through the Clean Energy Innovation Fund, a joint initiative with ARENA, the CEFC is encouraging the development and deployment of enabling technologies that will unlock higher EV uptake.

Analysis shows that getting electric vehicles to mass-market penetration needs three things: policy incentives that reduce the payback period for the EV purchase premium, model availability that meets consumers' needs, and charging infrastructure that ensures drivers can recharge away from home.

Energeia modelled EV uptake for Australia in a number of scenarios. It found that with the right combination of incentives, models and infrastructure, electric vehicle sales could surge in 2021, reaching half of new vehicle sales by 2030. In the Moderate Intervention scenario, EVs would reach 100 per cent of sales in 2040 and more than half of all vehicles on the road would be EVs by that time. While the EV market will grow without these supports, sales would not take off until 2027 and would grow more slowly, leaving more internal combustion engine (ICE) vehicles on the road and delaying the task of electrifying the light vehicle fleet.

Energeia's analysis shows that EV charging time and driving range matches internal combustion engines by 2024, and finds that EV charging adds 2.8 GW to maximum electricity demand by 2040, equivalent to around just 10 per cent of average demand today.

Energeia's projections in this modelling see faster growth for EVs than other research on the Australian outlook published to date. That faster growth reflects technology gains and increasing model ranges driven by accelerating policy support in other countries. Gains overseas spill over into lower costs, wider model availability and faster uptake in Australia.

The full report is available at cefc.com.au.

What drives EV uptake?

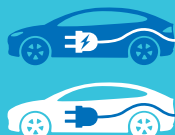
Energeia finds that high EV penetration needs three things: **policy incentives** that reduce the payback period for the EV cost premium, **model availability** that meets consumers' needs, and **charging infrastructure** that ensures drivers can recharge away from home.

FIGURE 1: KEY FACTORS INFLUENCING EV TAKE-UP



The highest impact **policy incentives** identified by Energeia include *upfront financial incentives, government fleet purchases, and changes to the regulation of vehicle emissions, fuel efficiency and vehicle import regulations*. Energeia analysis shows that among these interventions, upfront cost savings have the largest direct impact on sales. In Energeia's model, a

two-year payback —where it takes two years for the EV purchase cost premium to be repaid in operating cost savings — is the tipping point for mass-market uptake. That means that policies to reduce the upfront cost of purchasing an EV are key. Energeia finds that measures that would reduce the upfront cost of EVs in Australia include lower stamp duty, exemption from registration fees, and lower fringe benefits tax or luxury car tax.



Increasing **model availability** allows consumers to find vehicles within their budget that offer features they want. There are currently five EV models available in Australia, and information

from vehicle manufacturers indicates there could be seven models on the market by the end of 2018 and up to 20 by 2020. Energeia finds evidence from overseas that policy incentives drive higher model availability as manufacturers anticipate higher vehicle sales.



Public-access **charging infrastructure** is another key enabler for EV sales: drivers with home charging need public access charging for long-haul trips and occasional top-ups, and drivers without access to charging at home rely entirely on public access charging. Energeia estimates that

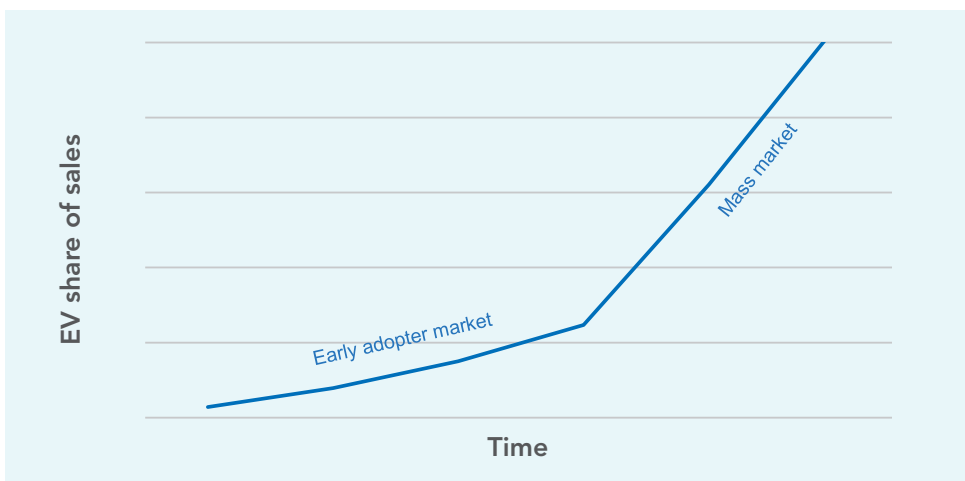
supporting a market where electric vehicles represent all new vehicles sales will require a network of around 28,500 public access fast charging points across the country. Building that network would require around \$1.7 billion of investment.

EVs will help reduce Australia's transport emissions

In 2017, transport accounted for 100 million tonnes of CO₂-e or 19 per cent of Australia's emissions, with cars and light commercial vehicles representing more than half of those emissions. Increasing the share of electric vehicles on the road will translate directly into lower emissions from fuel combustion. EV charging will add to demand for electricity, but emissions associated with charging will also decline over time as electricity generation switches to renewables.

Australia has very low EV penetration among advanced countries. Only 0.1 per cent of new car sales in Australia are EVs, behind the United States at 0.9 per cent, the United Kingdom at 1.4 per cent and well behind global leaders such as California at 3 per cent, the Netherlands at 6.4 per cent and Norway at 29 per cent.

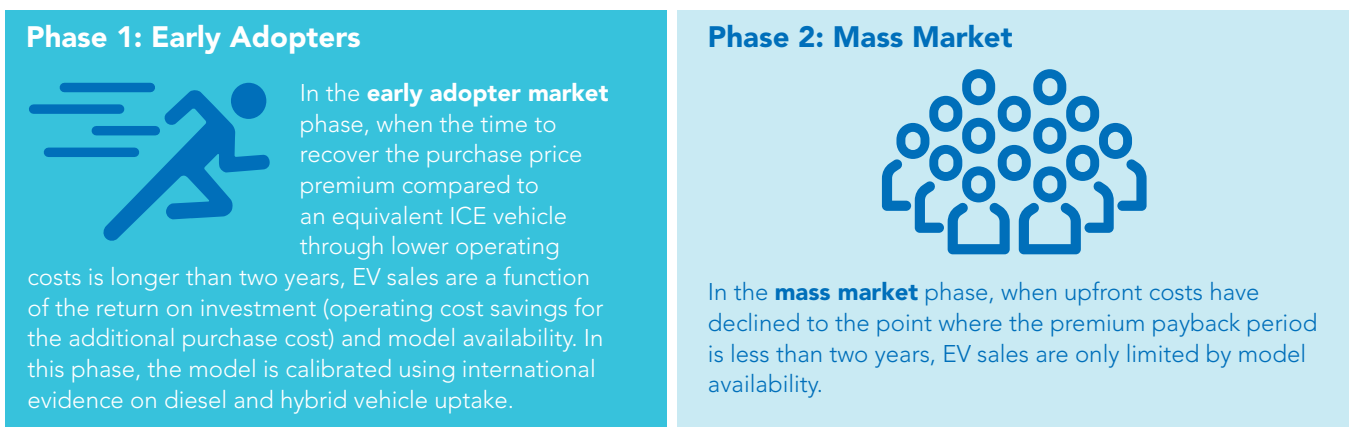
FIGURE 2: EV SALES TAKE OFF WHEN THE PREMIUM PAYBACK PERIOD IS LESS THAN TWO YEARS



The Energeia model forecasts EV uptake in two phases, early adopter and mass market.

Energeia's modelling assumes that battery prices continue to decline. That ongoing price decline in turn drives lower EV purchase costs and better competitiveness with internal combustion engine vehicles, but also allows EV manufacturers to increase driving range, reducing one of the key barriers to EV uptake.

FIGURE 3: EV TAKE-OFF



Accelerating our EV transition

EV uptake – modelled under three scenarios

To forecast the uptake of EVs, Energeia modelled three scenarios:

1. The **No Intervention** scenario assumes no additional action by governments in Australia, with uptake driven entirely by the economics of imported EVs.
2. The **Moderate Intervention** scenario incorporates changes that reduce the EV price premium, support from state and local government procurement policies, relaxed import regulations, access to transit lanes, vehicle registration and toll road discounts and new public-access charging infrastructure, among other quick-win incentives. A wider range of models are available in this scenario.
3. The **Accelerated Intervention** scenario sees the measures in the moderate intervention scenario applied faster and with a higher level of support, and an even wider range of EV models on the market.

EV sales take off in 2021 in the Moderate Intervention scenario

Energeia finds that EV sales grow slowly for the next decade in the No Intervention scenario and do not take off until 2027. But in the Moderate Intervention scenario, EV sales take off in 2021 and reach 50 per cent of new car sales by 2030, taking EVs to over 90 per cent of Australia's fleet by 2050.

FIGURE 4: EV SHARE OF SALES

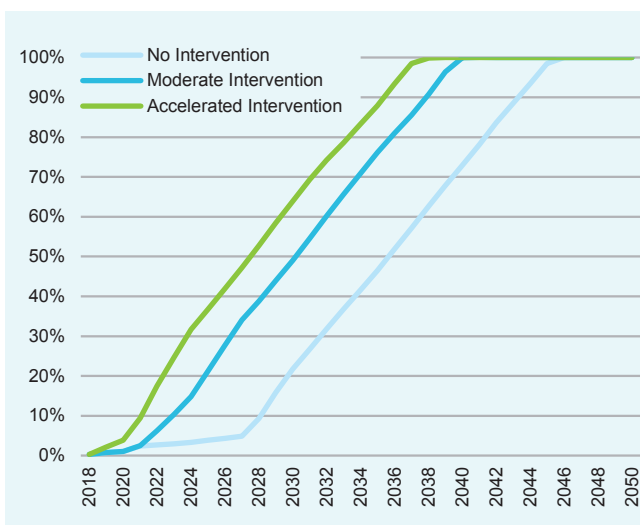
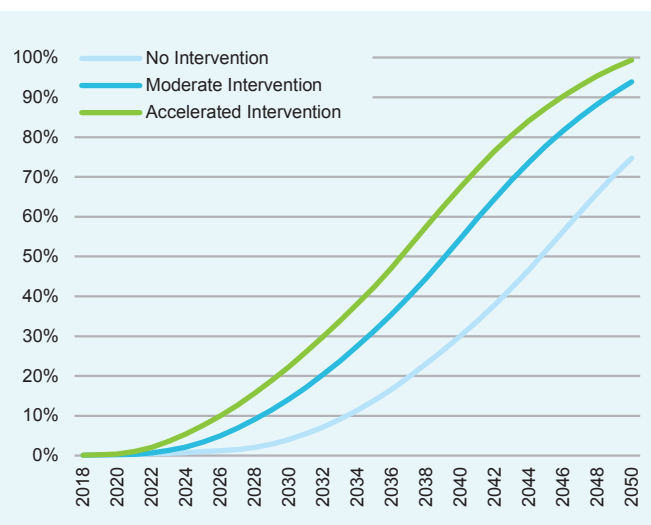


FIGURE 5: CUMULATIVE EV UPTAKE



Source: Energeia

Model availability is driven by policy incentives

A wide range of models allows consumers to find vehicles that meet their needs. International evidence suggests that manufacturers' model import decisions are affected by policy incentives for EV purchases. Energeia notes that California has stronger policy incentives and a wider model range than the United Kingdom, which in turn has more incentives and a wider model range than Australia, which has few incentives and the smallest EV model range.

Recent cost declines in batteries have been significant, and supportive policies in many countries are seeing manufacturers increase their focus on EVs. Several manufacturers have announced that they will no longer develop pure petrol drivetrains after the current model cycle.

There are currently five EV models available in Australia, and information from vehicle manufacturers indicates there could be seven models on the market by the end of 2018 and up to 20 by 2020. The Moderate Intervention and Accelerated Intervention scenarios assume an increase the number of models available in Australia.

Longer range and faster charging on the horizon

To date, range anxiety and long recharge times have been barriers to EV purchases. Energeia estimates that EV driving range and recharge times will reach parity with ICE vehicles by 2024, suggesting those concerns will fall away as impediments to EV uptake.

CHARGING TIME AND COSTS: For mass-market take-up, consumers are likely to expect charging to take not much longer than refilling a fuel tank. Energeia analysis finds that by 2024 EV owners could expect to pay around \$11 to charge their 100 kWh battery at a direct current fast charging point at the local access network charge point in about five minutes or less. The same charge at a dedicated charger at home or work would take four hours and cost \$17-19. Fast charging is expected to be the dominant technology for the public access charging network.

RANGE: Energeia found that more than 99 per cent of car trips are under 50 kilometres, making a round trip well within the range of current EV models. On current trends, Energeia expects EV driving range to reach parity with ICE vehicles by 2024.



Charging networks will require \$1.7 billion in investment by 2040

Energeia identifies two segments in the charging market:

- Around 70 per cent of EV owners will **have access to dedicated charging** at home. This segment depends on public charging for long-distance trips — which represent around one per cent of total distance travelled — and occasional top-up charges via public access charging.
- Around 30 per cent of EV owners who **do not have access to dedicated charging** will require public access charging for all of their charging needs.

The lack of reliable access to public charging infrastructure limits EV uptake to drivers with access to a dedicated parking space. Building a public access charging network to meet the needs of EV owners without dedicated charging at home and for all EV users on long-distance trips is a key enabler of higher EV uptake.

In the Moderate Intervention scenario, a public access charging network that meets the needs of owners without a dedicated charge point at home will require around 28,500 service station-style charge points around the country by 2040.

In Energeia's Moderate Intervention scenario, EVs represent over half of all cars and light commercial vehicles on Australian roads by 2040. Energeia estimates that building a charging network to accommodate that fleet would require around \$1.7 billion in investment over the next two decades, split between \$1.5 billion for local access charge points and around \$200 million for range extension charge points.

FIGURE 6: CUMULATIVE CHARGE POINTS: MODERATE INTERVENTION SCENARIO

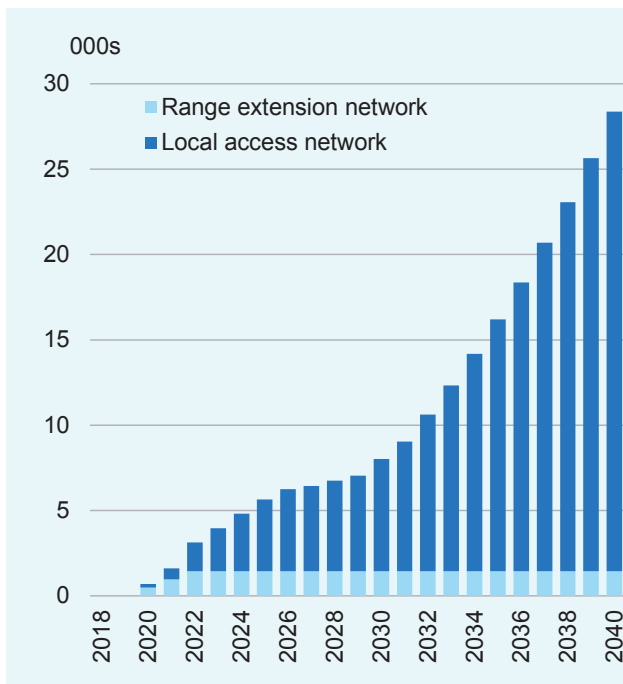
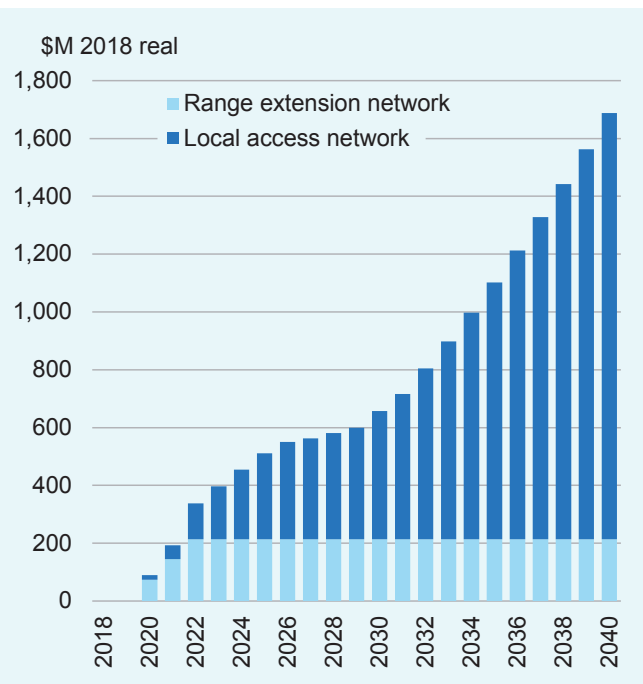


FIGURE 7: CUMULATIVE CHARGE POINT CAPEX: MODERATE INTERVENTION SCENARIO



Source: Energeia

Who will develop the charging network?

Energeia identifies two parts to the public access charging network:

1. A **local access network** with around 27,000 charge points in cities and towns to provide the vast majority of day-to-day charging for EV owners without dedicated a charge point at home
2. A **range extension network** with around 1,500 charge points along regional and rural roads to provide for the small number of trips that are over 150 kilometres.

Energeia evaluated a range of potential charging network developers and concluded that petrol station operators, automotive associations, regulated electricity networks and energy retailers are in the strongest position to deploy a charging network in Australia. Charging network investment may also come from state governments,

such as Queensland's Electric Super Highway, and Australian or international EV charging network developers like Chargefox, ChargePoint and Tritium.

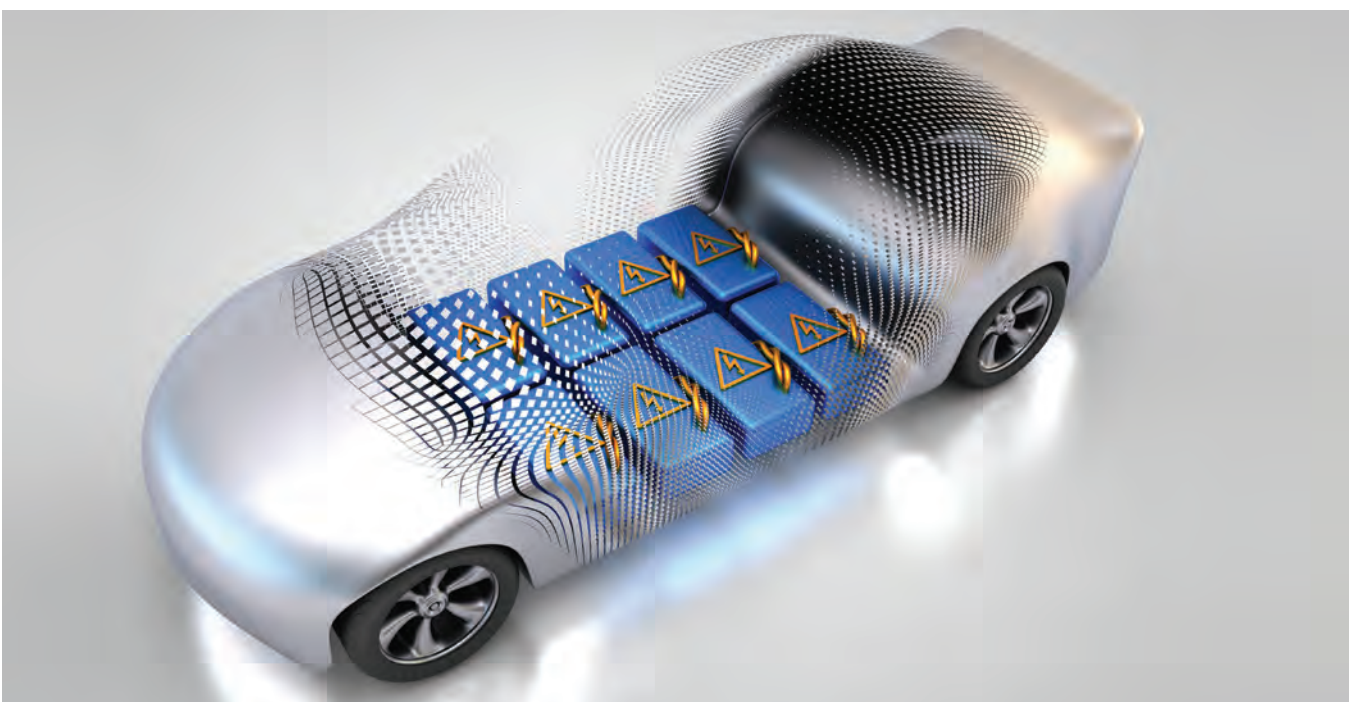
In Europe and the United States, charging networks tend to receive revenue from government subsidies and user charges. To date in Australia, public charging has been funded by vehicle manufacturers (like Tesla's Supercharger network) and by retail businesses offering free charging to attract patrons. Over time, free charging is being withdrawn in favour of a user-pays model such as Chargefox, ChargePoint and Evertly or an 'embedded' revenue model such as the NRMA and RAC (WA) networks.

Potential EV charging network providers are likely to have capabilities in software and hardware, infrastructure development and asset management and will need access to suitable sites.

Policymakers will need to provide a stable and facilitative regulatory framework for EV charging.

Two risks to Energeia's outlook for charging infrastructure include the uptake of fuel cell vehicles such as hydrogen vehicles, which are around 10 years behind EVs on model availability and infrastructure, and wireless charging, which would be more convenient than plug-in charging and could reduce demand for public access charging infrastructure in the long term.

Energeia's full report also explores other related topics including average trip length, the implications of EVs on electricity demand, and future EV model availability and presents the uptake modelling results in detail.



Financing our EV transition

FIGURE 8: CEFC FINANCE FOR ELECTRIC VEHICLES

The CEFC has financed around 300 EVs through our **co-financing arrangements** with banks and other financiers. CEFC financing has been an important part of the emerging EV market. Ensuring steady growth of EV sales during this early phase of EV penetration will help to support model availability in Australia, a key enabler of faster uptake later.



CLEAN ENERGY INNOVATION FUND

\$750K FOR RELECTRIFY TECHNOLOGY DEVELOPMENT



Melbourne-based company **Relectrify** is developing and commercialising control technology that unlocks extra performance in battery systems. Once they are no longer effective as electric vehicle or plug-in hybrid car batteries, Relectrify's technology boosts their second-life storage capability and lifespan. Through the Clean Energy Innovation Fund, the CEFC has invested \$750,000 of equity in Relectrify to help the business with technology development and trials.

The CEFC is working with **EV charging network developers** to support EV charging infrastructure, and support private investors in financing new charging infrastructure to service the new market opportunity.



CLEAN ENERGY INNOVATION FUND

\$5M INVESTMENT



AUSTRALIA'S EMISSIONS CHALLENGE

LIGHT VEHICLES
=10%
EMISSIONS

ELECTRIC VANS
AND TRUCKS

96% COMMERCIAL
VEHICLES USE
DIESEL OR PETROL*

Victoria's SEA Electric has technology that converts express freight, general delivery and waste collection trucks and vans to electric power

Victorian manufacturer **SEA Electric** is drawing on \$5 million in CEFC debt finance through the Clean Energy Innovation Fund to ramp up its conversion of medium-duty trucks and commercial vans to electric vehicles. SEA Electric has developed three electric drive systems that can be fitted to commercial vehicles to allow them to be converted to 100 per cent electric operation. The technology can be applied to express freight, general delivery and waste collection vehicles.

*Australian Bureau of Statistics

