

POWER UP

NORTHERN RIVERS
ELECTRIC VEHICLE STRATEGY

*Jointly prepared by Byron Shire Council
and Tweed Shire Council*



TWEED
SHIRE COUNCIL



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Executive summary

This strategy provides a thorough introduction to the benefits of EVs and charging technology. It analyses the key challenges and solutions to enable further uptake of EVs in the Northern Rivers, providing clear actions that local government and business can take to encourage EV use as part of a sustainable transport future.

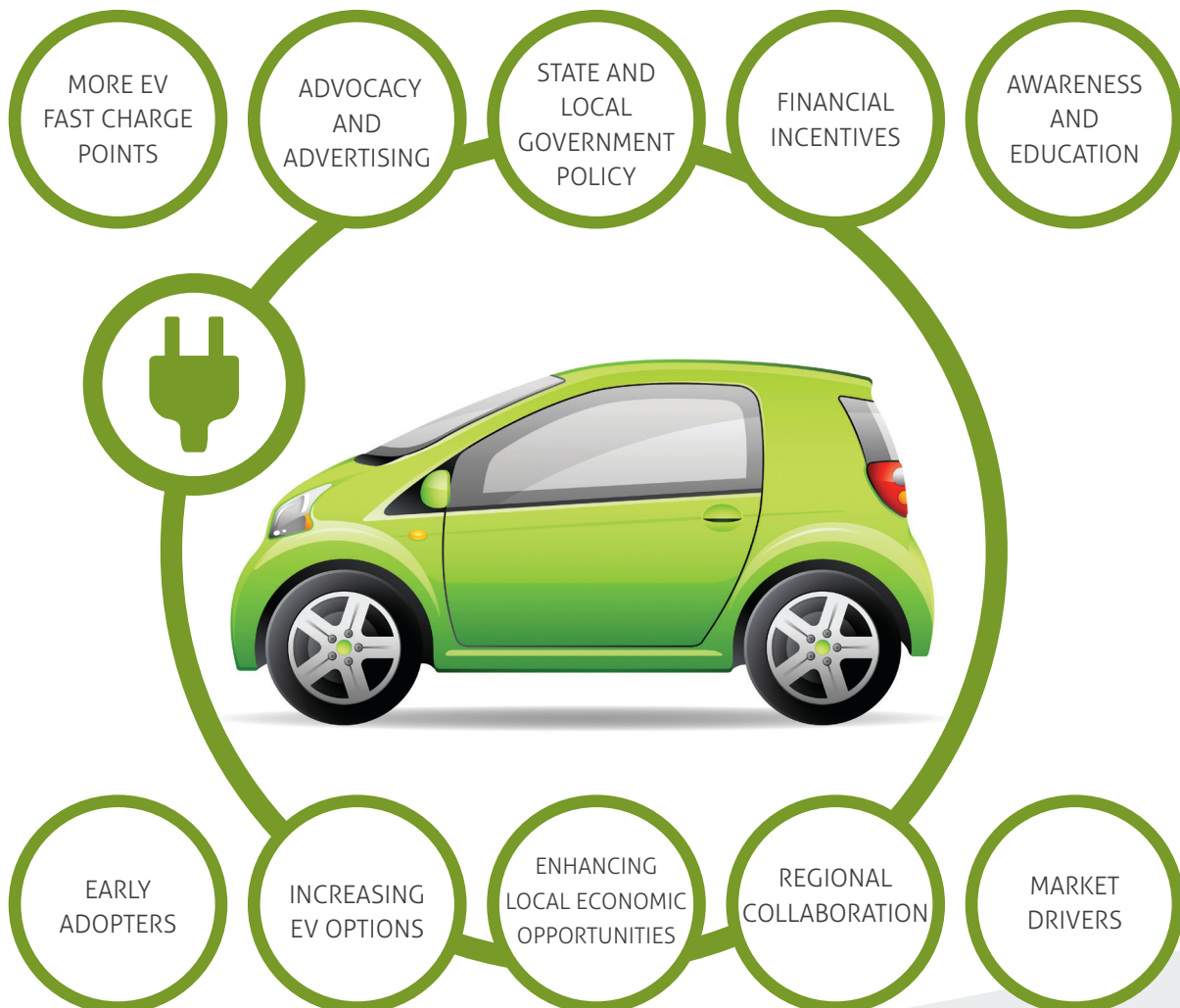
There are a number of barriers to the uptake of EVs in rural areas. One of the most significant is the lack of charging infrastructure in major regional towns thereby producing 'range anxiety', a feeling that the EV will not be able to complete the trip without running out of battery charge

Research has shown that publicly available fast charge stations are vital to enable electric vehicles to travel long distances. Installing fast charge stations

in the Northern Rivers region will be key to attracting tourist EV drivers, supporting the region's eco-tourism reputation, and removing a barrier to greater EV use by local residents.

To complete a primary network of fast charge stations in the Northern Rivers region, installations at Tweed Heads, Nimbin, Lismore and Ballina would enable EV users to have full accessibility throughout the region. A secondary network of charge stations at other key commuter and tourism centres is also recommended, adding infrastructure at Murwillumbah, Mullumbimby, Tyalgum, Uki, Casino, Bangalow and Lennox Head.

A comprehensive network of charge stations in our region will ensure EV travelers have confident access to charge opportunities in the Northern Rivers region. Addressing regional gaps in EV charge stations will support the region's community, economic and environmental ambitions for a zero emissions future.



¹ Find out more about Byron and Tweed Shire councils strategic drivers and achievements in Appendix One

² Find out more at www.sustainnorthernrivers.org/sustain-energy/

About this strategy

This strategy has been prepared jointly by Byron and Tweed Shire Councils in response to local climate action plans, transport strategies and economic strategies for our region¹. The strategy also addresses a priority task identified in the Sustain Northern Rivers Energy Working Group strategic plan².

Councils play a significant role in making low-carbon transport options more convenient. Land use planners, transport planners, economic development officers, social planners and sustainability officers, their managers and elected officials make decisions and can advocate for outcomes that promote public transport, walking, cycling and other forms of electric personal

mobility (such as bicycles and scooters), combined with increased access to car-share and ride-share schemes in their areas.

The strategy aims to inform local decision-makers about the current and emerging EV scene in the Northern Rivers, Australia and globally.

It draws on local experiences and case studies, domestic and international analyses and industry submissions, along with expert peer review.

It also provides a comprehensive review of all aspects of EV use, and outlines a set of actions that local and state governments can take to encourage EV use in the Northern Rivers.



Electric vehicles explained



Electric vehicles (EVs) are defined in this report as passenger vehicles powered by electricity and requiring charge facilities to extend their range.

Battery EVs (BEVs) use chemical energy stored in rechargeable battery packs. BEVs use electric motors and motor controllers instead of internal combustion engines (ICEs) for propulsion.

Plug-in hybrid electric vehicles (PHEV) combine a gasoline engine with an electric motor, which captures energy from braking. They also have the additional capacity to charge via electricity outlets.

Hybrid electric vehicles (HEV) combine a gasoline engine with an electric motor, which captures energy from braking. They are not a focus of this report as they do not require charge facilities.

Why choose an electric vehicle?

Electric vehicles offer a range of benefits, especially when compared to conventional internal combustion engine (ICE) vehicles. Some of the benefits include:

- **Zero greenhouse emissions:** EVs powered by 100 per cent renewable energy do not emit any greenhouse gases from the tailpipe. In Australia, car travel contributes 8 per cent of national greenhouse gas emissions. This means that a shift to EVs will make a large contribution to reducing emissions.
- **Increased economic benefits and opportunities:** EV charge stations can be economic generators for their hosts. As a local example, Byron Bay Woolworths shopping centre is currently looking to install two Level 3 fast charging stations, as a way of attracting customers.

Increased uptake of EVs within Australia and in the Northern Rivers Region has the potential to increase local employment opportunities through charging infrastructure manufacture and deployment. Furthermore, there can be potential opportunities to create new manufacturing and jobs, such as Avass building EV Buses, and locally made charging infrastructure technologies, such as Brisbane based Tritium.

EVs powered by 100 per cent renewable energy do not emit any greenhouse gases from the tailpipe.

The demand for green energy for EVs can also represent new economic opportunities. The establishment of solar power plants and solar infrastructure where the charging stations are to be located within the Northern Rivers has the potential to increase employment in the region, and at the same time, replace the predominantly imported petroleum-based fuels to locally sourced solar energy.

EV car sharing appears as another possible economic opportunity. The car sharing of EVs in the region depends on the availability and interest of any private car sharing company to implement

an operation in the Northern Rivers. Some benefits could be outlined from this, such as, the possibility to bring more tourists and jobs to the region; diversifying its economic profile. Recent trends in peer to peer car sharing show that there is already a blossoming private EV car share network kicking off as interest in EV's grows.

For example, the creation of the "Green Way" to complement the already existing "Rainforest Way" – a road that tourists can travel on to see the sites of the area- in an EV and recharge at all the main towns fast charging stations. In the medium/ long term another possible economic prospect is the opportunity to implement electric public transport in the region. Electric buses have already been showcased as interesting opportunities. For example, Adelaide has a solar powered electric bus.

- **Lower operating costs:** EVs are much cheaper to operate than normal cars, costing \$0.03 per km versus \$0.10 per km for ICE vehicles and even less if charged from a consumer's own renewable generation - such as solar photovoltaic (PV). Electricity, including renewable, is also less expensive per kilometre than liquid fossil fuels making EVs a sure economic winner. Servicing needs also reduced due to no longer needing 6 or 12 monthly replacement of engine oil, filters, plugs etc.
- **Air quality improvements:** EVs do not produce typical tailpipe emissions including CO₂, non-methane volatile organic compounds, nitrous oxides and particulate matter. These emissions contribute to urban air pollution and accumulate in soil and water, negatively impacting on human health and degrading the quality of the natural environment. While EVs still produce some emissions from brake and tyre wear, this is relatively minor in comparison.
- **Reduced Waste:** No creation of chemically hazardous waste oil and oil filters, reduced waste streams of air filters, spark plugs, etc.

- **Higher efficiency:** the average efficiency of EVs in the Ausgrid Smart Grid Smart City trial was 187 kWh/km, or the equivalent of around 1.97 L of petrol per 100km.
- **Reduction of traffic noise:** As EVs are near silent, they help to reduce the negative human impacts of noise and car vibration on health and transform our roads into being a more pleasant space to be.
- **Increased electricity grid stabilisation:** Emerging vehicle-to-grid technology being trialed in Asia and Europe could enable EVs to supply, as well as consume, electricity. It could also become a niche tool for disaster recovery. This could allow EV owners to purchase electricity cheaply when demand is low and sell it at a higher rate when demand rises. Once large numbers of EVs are supplying electricity, they could significantly reduce electricity generation requirements during periods of peak demand, therefore helping to stabilise the grid. ⁱⁱⁱ
- **Pleasant driving experience:** Participants in a Victorian Electric Vehicle Trial reported positive attitudes towards EVs, easily adopting the trial vehicles into their normal travel patterns and were found to use the EV as their first-choice for vehicle travel. EVs usually have high acceleration (Nissan LEAF can accelerate from 0-60km/hr in 4.2 seconds and from 0-100km/hr in 9.7 seconds). Having a lower centre of gravity due to battery weight enables better handling compared to conventional cars.



Electric vehicles - the changing scene globally

Internationally the electric vehicle revolution is rapidly following the transformation we have recently seen with rooftop solar and is closely tied to the battery revolution occurring at the same time. The latest EVs being manufactured in both the US and Europe are substantially cheaper than earlier models, and have the added benefit of increased travel range as well. Car manufacturers such as Chevrolet, Mercedes, Volvo, Renault, Nissan, BMW, Kia and many other Chinese makers already offer pure EVs in their lineups, and most of these have announced plans to match the 300+km range of the Bolt and Tesla Model 3. Jaguar and Volkswagen have also announced plans to heavily move into electric vehicle production.

Overall, the trend towards less polluting vehicles continues with a US Financial Times article in August 2016^{iv} reporting 1.2m electric vehicles on-road across 40 countries in 2015, with 850,000 EVs and PHEVs sold in 2015 globally. Analysts note the impact of battery costs on high EV purchase prices at the moment, however EVs are expected to reach cost parity with internal combustion engines in Europe by 2021 and in China by 2025.

EVs represent more than 1 per cent of total new car sales in the Netherlands, Norway, Sweden and the USA (closer to 20 per cent for Norway). And in China, 2014 saw 230 million e-bikes, 83,000 electric cars and 36,500 e-buses hit the road.

Tesla received deposits equating to \$A13 billion in April 2016 from nearly 200,000 keen potential buyers of the Tesla Model 3. Deposits currently total nearly 400,000 and Tesla have plans to rapidly ramp-up production of the Model 3 to 500,000 units a year after its planned release date of late 2017. Moreover, Tesla is expanding its network of captive service and charging infrastructure which is understood to be critical to prompting this change from ICVs to EVs. 2016 saw the first Tesla Model S travel from Sydney to Broome.

EVs are expected to reach cost parity with internal combustion engines in Europe by 2021 and in China by 2025.

Electric vehicles in Australia

**At least 3,500 electric vehicles are currently registered in Australia.^v
An estimated 40% of those are based in the NSW and Queensland.^{vi}**

Anecdotally there are at least 20 EVs owned by residents in the Northern Rivers region, with Byron Shire Council and Lismore City Council both having one fully electric car in their fleet.

Compare to the variety of EV makes and models available in other countries, a small number of commercial EV/PHEV models are available here.

Entry level compact EVs such as the Nissan LEAF have a stated range of around 130-170 km per charge. A larger vehicle such as the Tesla Model S sedan has a stated range of up to 550 km per charge. Range performance decreases when vehicles travel over 100 km/h and with air conditioning use, both relevant factors for drivers in the Northern Rivers region. While detailed information about passenger vehicle trip distances in the Northern Rivers is limited, it is estimated that the majority of commutes are less than then 170km return a day hence within range of the smallest EV on full charge. Providing charging at work and other public charging infrastructure in each major town in the Northern Rivers as well as key tourist destinations would definitely assist EV owners and hire cars owners to better use their cars and further reduce greenhouse gas emissions.

New electric vehicle (EV) and plug-in hybrid electric vehicles (PHEV) currently available in Australia.

MANUFACTURER	MODEL	EV	PHEV	RANGE	COST (APPROXIMATE)
Audi	A3 Sportsback e-tron		✓	50km	\$60,000
BMW	i3	✓		160km	\$72,000
	i3 Rex		✓	160km	\$80,000
	i8		✓	37km	\$300,000
	x5 xDrive40e		✓	30km	\$120,000
Mercedes	C 350 e (sedan and wagon)		✓	31km	\$80,000
	GLE 500 e SUV		✓	30km	\$125,000
	S 500 e SUV		✓	33km	\$320,000
Mitsubishi	Outlander		✓	50km	\$45,000
Telsa	Model S	✓		300-500km ²	\$122,000 (300KM) \$215,000 (500KM)
	Model X	✓		300-500km ²	\$123,000 (300KM) \$220,000 (500KM)
Volvo	XC90 SUV		✓	40km	\$100,000

Source: Renew Issue 137, page 27

Case study: Newcastle Smart Grid Smart City trial



The 2014 Ausgrid trial of 20 vehicles in fleet and home settings in Newcastle in collected valuable data about EV use over 420,000 kilometers travelled during the 30 month trial.

On average, each trip in both the Fleet and Home Trial used around 14 per cent of the vehicle's charge, suggesting that most trips were relatively short. The median trip used 9 per cent of their charge and very few trips used more than 30 per cent of the charge.

Target customers

Market research by CSIRO suggests some demographic and geographic factors that align with EV ownership:

- higher household income and education levels
- proximity to large urban centres
- availability of off-street parking and more than one car per household.

Urban centres are projected to grow at faster than state average rates in the Northern Rivers. The dominance of environmental themes in community strategic plans across the region indicate a high level of environmental education and awareness. High numbers of tourists visiting the region each year provide great potential for EV tourist infrastructure such as taxis, tour buses, hire cars and car share programs.

Future projections

CSIRO collated recent projections about the potential share of EVs in the Australian fleet, and how the mix of EVs in the national fleet might respond to carbon policy incentives. There was a cluster of projections that suggest up to 15 per cent of the Australian fleet could be EVs by 2030.

The Zero Carbon Australia Electric Vehicles report by BZE's shows that the shift to 100 per cent electric vehicles in Australia within ten years is both feasible and affordable, and provides a range of environmental, health and other benefits to the economy.

As the predicted trend towards EVs takes hold, the expectation on all levels of governments and business to provide fast charge infrastructure will increase.

The Zero Carbon Australia Electric Vehicles report by BZE's shows that the shift to 100 per cent electric vehicles in Australia within ten years is both feasible and affordable.



Test drives of the BMW i8 PHEV were a popular feature of the 2016 Tweed 'Living for the Future' Home Expo

Charge stations explained

There are four levels of charge technology available to provide EV users with charge opportunities in public locations.

LEVEL 1 "SLOW": AC CHARGING

- 15 or 10 Amp outlet (depending on manufacturer's supplied vehicle EVSE lead requirements)
- adds 3 to 8 kilometers of range per hour of charging
- installation costs approximately \$300-\$1,500 (standard electrician)
- can take 5 - 12 hours to fully recharge

LEVEL 2 "MEDIUM": AC CHARGING

- 30 Amp
- adds 16 to 33 kilometers of range per hour
- can take 2-4 hours to fully recharge
- installation costs approximately \$1,000-\$2,000 (suitably certified electrician)
- known as destination charging or top up

LEVEL 3 "FAST": DC FAST CHARGERS

- 50kW - 3 phase power
- 80 per cent battery capacity in 30 minutes
- costs approximately \$40,000 + \$5,000-\$25,000 installation costs (depending on site specifications)
- 7-10 year expected lifetime
- consumer resource, point of sale potential
- designed to keep drivers 'topped up'

Installation of fast chargers can create a large spot load on the local transmission network, which in many cases can be accommodated without the installation of a dedicated distribution transformer or by upgrading low voltage mains and switchboards.

INDUCTIVE OR WIRELESS CHARGING

- Up to 7.2kW (30A)
- can take up to 8 - 12 hours to fully recharge
- charge plate fixed to ground and car charged wirelessly
- Not yet available in Australia however recently released in the USA – www.pluglesspower.com

Charging connectors are not uniform across EV makes and models, however charging station providers are able to accommodate most types of vehicle manufacturers' charging requirements, or adapters can be purchased by EV owners.

The Energy Supply Association of Australia 2013 discussion paper suggested that due to the limited number of EVs on the road in Australia, there is at present no guaranteed income for charging infrastructure providers. Accordingly, to support investment in charging infrastructure, government support for upfront capital or fixed revenue agreements are needed to ensure infrastructure providers have the incentive to enter the Australian market.

Charging technology and costs

Power sourced from solar panels can provide a free source of renewable energy for EV charging. For power purchase costs from the national energy market, assuming an 8c/kWh cost for 100% GreenPower on top of an average energy cost of 25c/kWh, charging a 24kW battery in an EV will cost \$7.50, the equivalent of 4c/km travelled.

The majority of EVs are likely to be charged at home when they are parked overnight in an urban area via Level 1 or level 2 charging. Level 1 and Level 2 charging involves charging equipment within the EV converting AC power to DC to recharge the car's battery. EV owners are encouraged to install home EV supply equipment to supply 240 volt power. Solar power at EV owners' homes can be directly used to charge EVs via programmable relays, or GreenPower can be purchased to provide a carbon zero or carbon neutral charging solution. Smart Grid Smart City participants tended to charge their vehicles using home chargers.

Work charging was the second most popular option for Smart Grid Smart City EV drivers. 53 per cent of participants involved in the trial agreed that roaming charging, using the charging cable provided in any typical domestic wall socket, was sometimes, often or very useful and in general more useful than public charging points.

However, as most commuters in the Northern Rivers drive at least 21kms per day, home charging alone may not be sufficient for these rural car users. They would require level 2 and 3 charging stations available in major towns and workplaces, to ensure they have easy access to a reasonable range of travel distances.

Climate Works highlighted similar findings from US research, and concluded that there should be consideration going forward to ensure that all new multi dwelling buildings, apartments and office buildings have electric vehicle charging planned and built in from construction. The report also described the merit of targeted programs aimed at encouraging workplace and home charging to benefit EV drivers.

The Climate Works report concluded that public charge stations are still required to provide a network of opportunities for EV drivers to fast charge their vehicles.

User pays

The option to impose a fee on consumers to charge their vehicle at a public charging station will require further investigation. Becoming an energy retailer by generating and selling energy to charge consumers to recharge their EV has significant regulatory controls.

Companies like Charge Point and even car companies are working on high tech charging systems and alternative ownership models. Renault for example are talking about selling the car but leasing the battery to customers. It may also be possible to create alternative systems, with a greater level of local economic, and energy independence, using locally generated renewable energy and locally owned charging infrastructure.



Charging stations in the Northern Rivers

At present there is a range of charging options available for the general public use. These include:

- ✓ Byron Bay Library, Byron Shire Council – Level 3 fast charging station is provided free of charge for public use. This is the only Level 3 fast charge station in the Northern Rivers to be accessible by any EV (Tesla needs an adaptor to use) and is run on 100 per cent renewable energy from the local community owned energy retailer, Enova Energy.
- ✓ Macadamia Nut Castle – Level 2 charging is provided using the CT 4000 charging station. It is managed by Charge Point and is compatible with most electric cars available in Australia. It uses a J1772 plug. Currently the use of the charging station is free. They have also recently installed 6 Tesla Super Charger stations for exclusive use by Tesla cars.
- ✓ Byron Eco Park – Level 2 charging station for public use.

Other charge stations provided for specific customers or employees include:

- ✓ Brunswick River Inn – Level 2 Tesla only charging points are available for customer use.
- ✓ Byron Shire Council Works Depot, Byron Bay – Level 1 charge station for staff use only.
- ✓ Lismore City Council Waste Facility - Level 1 charge station for staff use.
- ✓ Byron at Byron, Telstra S&X Models.
- ✓ Ballina, 16 Tamar St Telstra S&X Models.
- ✓ Rainbow Power, Nimbin – Level 1 for public use.
- ✓ Kyogle Caravan Park – Level 1 for public use.

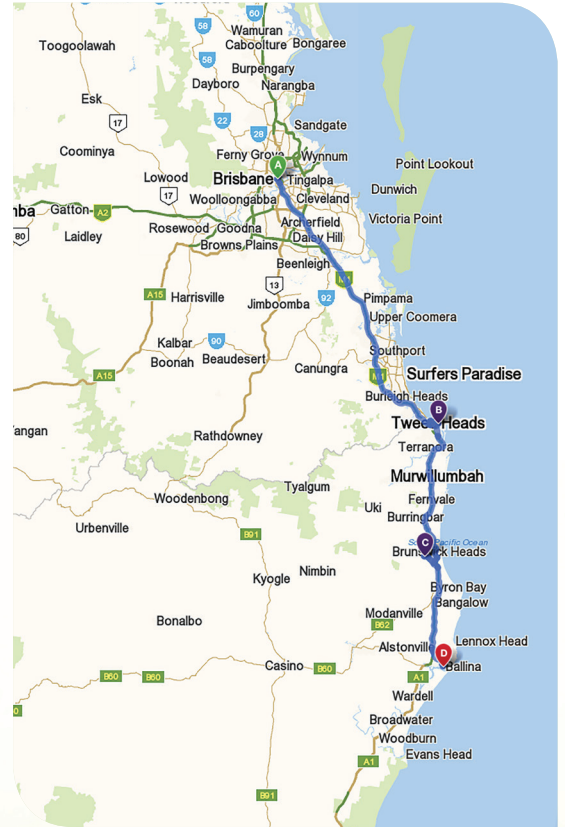
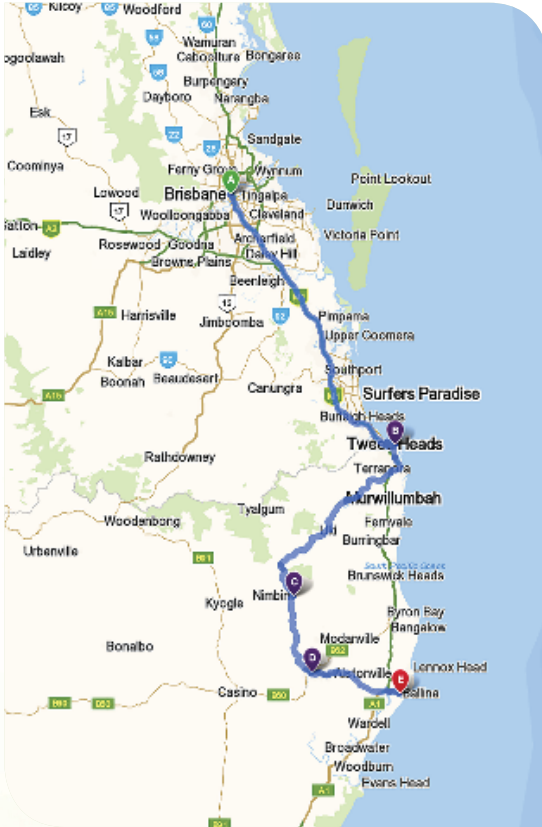
Future plans for more charging stations in the region include:

- ✓ Level 3 and level 2 charging stations for the underground car park at Byron Bay Woolworths.
- ✓ 1x Level 3 and 2x Level 2 charging stations along with a solar roof for the Mullumbimby Council car park for general public use.
- ✓ Byron West Shopping Centre – charge station for public use.
- ✓ The Farm - charge station for public use.



Northern Rivers Charge Stations

- ✓ To complete a primary network of fast charge stations in the Northern Rivers region, installations at Tweed Heads, Nimbin, Lismore and Ballina would enable EV users to have full accessibility throughout the region. A secondary network of charge stations at other key commuter and tourism centres is also recommended, adding infrastructure at Murwillumbah, Tyalgum, Uki, Casino, Bangalow and Lennox Head.



INLAND ROUTE		
	Destination	Distance Between
A	Brisbane (existing)	
B	Tweed Heads	103km
C	Nimbin	48km
D	Lismore	31km
E	Ballina	35km

COASTAL ROUTE		
	Destination	Distance Between
A	Brisbane (existing)	
B	Tweed Heads	103km
C	Mullumbimby (in development)	52km
D	Ballina	41km

Further analysis on inter and intra-regional travel will help inform how many charge points and types to install at each location. This could be done by understanding the travelling profile in the region and also gathering data from EV purchase in the region from local dealers.

Charge station site selection criteria

The Ausgrid Smart Grid Smart City initiative in Newcastle established basic criteria for charge point sites:

- Adequate lighting and security surveillance: people need to be and feel safe when charging their EVs. Lighting should be sufficient to easily read associated signs, instructions, or controls on the EVs, to provide sufficient lighting around the vehicle for all possible EV inlet locations and for charging cable visibility to reduce the risk of trips.
- free-of-charge access
- accessible 24/7
- dedicated parking bays
- for fleet vehicles, charge point locations must meet the likely travel needs of employees
- compliance with relevant Australian Standards and Regulations for OH&S.

The Electric Highway Tasmania Project notes the importance of sites that are designed for disabled access, and encourages consideration to sharing increased patronage amongst local businesses. International examples remind us to factor future battery storage options into site and technology selection.

Any public charging station will require appropriate signage and compliance to ensure optimum usage. Willoughby City Council has implemented the required compliance methods and will supply all relevant background. The signage is important to ensure that designated parking spots for EV charging are used for the purpose of EV charging.

The specific requirements for sites for the fast charge points along M1 Motorway between Sydney and Newcastle were:

- All fast charge points must not be more than 4 to 5 minutes drive from the M1 Motorway and close to exits

- All fast charge points must have access from both the north bound and south bound lanes of the M1 Motorway
- All fast charge points must be located no greater than 70km apart along the M1 Motorway.

Where hosting arrangements are required, Ausgrid mapped out the following four key steps to reach a hosting agreement:

Step 1: Identify an internal champion and support that individual in building consensus internally within the property owner's organisation

Step 2: Assess the technical feasibility of the various parking bays proposed and identify the preferred sites

Step 3: Assist with legal sign-off on the site access agreement

Step 4: Address financial approval for any investment by the property owner (if any).

Benefits of charging stations

The key benefit that public charging stations provide is that they reduce the amount of 'range anxiety' EV drivers feel when worried that they may run out of charge.

Charge stations located in workplaces, shopping centres, public car parks and on roadsides, enables EV owners to 'top up' their charge level while they shop or go about their daily activities.

Installing fast charge stations close to major highways enable continuous travel and allow users that drive throughout the day to take regular breaks. The spacing of Tesla's charging stations is intended to allow users travelling between cities to top-up their charge at about the same frequency that a typical driver would want to pause their drive for a short rest, in line with road safety guidelines.^{vii}

The Ausgrid Smart Grid Smart City project found that site owners of potential charge stations were unsure or reluctant to have infrastructure installed due to limited understanding about the vehicles, charge station technology, economics and low numbers of EV ownership.

Site owners with access to EVs were more likely to consider the installation of charge stations. Stakeholders who agreed to install charge points also valued:

- alignment with long-term strategic interests in EVs
- strategic partnerships with project partners
- multiple assets with an opportunity to form a network of sites for the property owner

Ausgrid reported a short process for site inspection and approval of final drawings (15 days at their own depots), with civil and electrical works, installation and commissioning of chargers complete in 11 days.

Charging station energy sources

The power source used to charge an EV can substantially influence an EV's emissions profile. Taking account of the higher emissions from manufacturing (largely because of lithium-ion battery manufacturing), an EV charged with renewable energy has significantly lower emissions over its lifetime compared to its petrol counterpart. ^{viii}

For renewable energy supply to charge stations, operators can:

- locate charge stations at sites with significant solar, and preferably battery, installations. For example, the 45kW solar car park at The Macadamia Castle at Knockrow can generate enough power to fully recharge the 24kW battery in a Nissan LEAF in just over 30 minutes when UV levels are high.
- purchase 100 per cent accredited GreenPower to ensure the power demand from the charge station results in more renewable energy being added to the national electricity grid, as is the case for the Level 3 fast charge station at Byron Bay.

Dr Liam Wagner, an economist at the Griffith University Business School, says that when EV uptake does increase there was potential for significant consequences on Australia's electricity network, if it was not controlled. ^{ix}

Conversely, other commentators such as the Energy Supply Association of Australia suggest that controlled charging of EVs could improve the efficiency of the overall electricity supply system. Increasing sophisticated vehicle to grid technology will potentially allow EVs to become part of grid stabilisation solution.

For households, integrating EV charging and battery storage with 'smart' appliances could soon become a reality. With the purchase of SolarCity, America's largest solar installation company, Tesla looks set to combine technologies for generation, storage and vehicle energy consumption which offers exciting prospects for truly integrated systems and a very minimal household carbon footprint. ^x

Even using fossil fuels In South Australia and Western Australia, EVs using grid energy will deliver emissions reductions right now. In Tasmania, which uses predominantly hydro-electricity, EVs may actually provide 'zero emissions' driving.

Commuting

It is important to understand travel patterns within the region when considering EV usage.

The Victorian Integrated Survey of Travel and Activity includes data on 72,000 car trips taken over a one year period. From this data facts emerge:

- 1) Australians make a lot of short car trips and
- 2) long car trips are relatively rare.

This suggests that most EVs available have sufficient range to cover the majority of trips taken by typical urban users.

Northern Rivers commuters

North Coast Commuter mapping was a novel method to map commuter flows via collaboration of 16 large organizations with multiple work sites. It is an aggregation of data from large employers and education providers to inform transport planning and enable local governments and the major educational institutions to develop strategies to increase active transport whilst supporting existing public transport services to meet commuting needs of staff and students. It gives amongst other aspects, information on commuter distances which tends to mirror the national understanding for smaller regional centers.

Byron Shire Council Staff Commuting Report

Of those surveyed from Byron Shire work sites, 61 per cent travel more than 21kms to reach their workplace. Almost half of these people live outside Byron Shire and data shows Byron Shire Council employees are very car-dependent. ^{xi}

Ballina Shire Council Staff Commuting Report

A quarter of those surveyed from Ballina Council staff, travel more than 21km to get to work. Most live within Ballina LGA and the majority from outside the Shire, travel from Byron or Lismore Local Government Areas LGAs. ^{xii}

Tweed Shire Council Staff Commuting Report

The Tweed LGA survey showed that 71.5 per cent of respondents live within 30kms and 28.6 per cent greater than 30km from their work site. Significant numbers commute to Murwillumbah and Kingscliff.

Lismore Council Staff Commuting Report

Lismore's survey undertaken in 2009 had 45.4 per cent of respondents living more than 21kms from their work/study site. Commuter patterns for Lismore show flows between Lismore and Ballina catchments, followed by Byron, Casino and Lennox Head.

In summary distances travelled in the rural Northern Rivers are longer than more urban cities however a rough estimation is that the majority of commutes are less than 170km return a day hence within range of the smallest EV on full charge. Further surveys need to be conducted to obtain an exact figure.

Providing charging at work and other public charging infrastructure in each major town in the Northern Rivers as well as key tourist destinations would definitely assist EV owners and hire cars owners to better utilise their cars and further reduce greenhouse gas emissions.



Challenges to the uptake of electric vehicles

There are significant barriers to EV uptake including:

- High vehicle purchase cost: The Ausgrid Smart Grid Smart City EV trial in Newcastle found that from a lifecycle perspective, electric vehicles were still more expensive than popular small cars (eg Mazda 3) and high efficiency cars.
- Lack of driving range: The cheapest EV, the Nissan LEAF, has a maximum range of 170km on full charge.
- Limited range of models available: There are only 4 new battery EV models currently available to the public in Australia (BMW i3, Nissan LEAF, Tesla Model X (can order) and Tesla Model S). Although there are new models due soon such as the Renault Zoe and Kangoo ZE, this limited choice and competition discourages a competitive market and keeps costs high.
- Lack of consumer knowledge and awareness
- Lack of vehicle charging network: Within a regional and rural center area such as the Northern Rivers, EV use will be restricted without the availability of either level 3, fast charging stations, battery exchange points and electrolyte exchange systems or similar that is akin to refueling a petrol or diesel vehicle.
- Lack of travel profiles: It is also important to understand the travel profile of the region and the most significant points of interests, in order to properly plan for the charging infrastructure location.

Solutions to increase electric vehicle uptake in the Northern Rivers

There are a number of major factors impacting the planning and provisioning for the likely increase of EV usage.

Australian EV Industry representatives prepared 'The Path Forward for Electric Vehicles in Australia' with recommendations to support the uptake of EVs in Australia including. The four main areas relevant to local government are:

1. Incentives for vehicle manufacturers to increase the diversity of EV models available
2. EV operating incentives to be provided across all levels of government e.g. reduced parking fees, priority lanes
3. Support local businesses providing innovation in charging infrastructure and locate government fleet charging infrastructure in publicly accessible areas.
4. Require government fleets to develop a plan to reduce fleet emissions and prepare annual reports of their progress

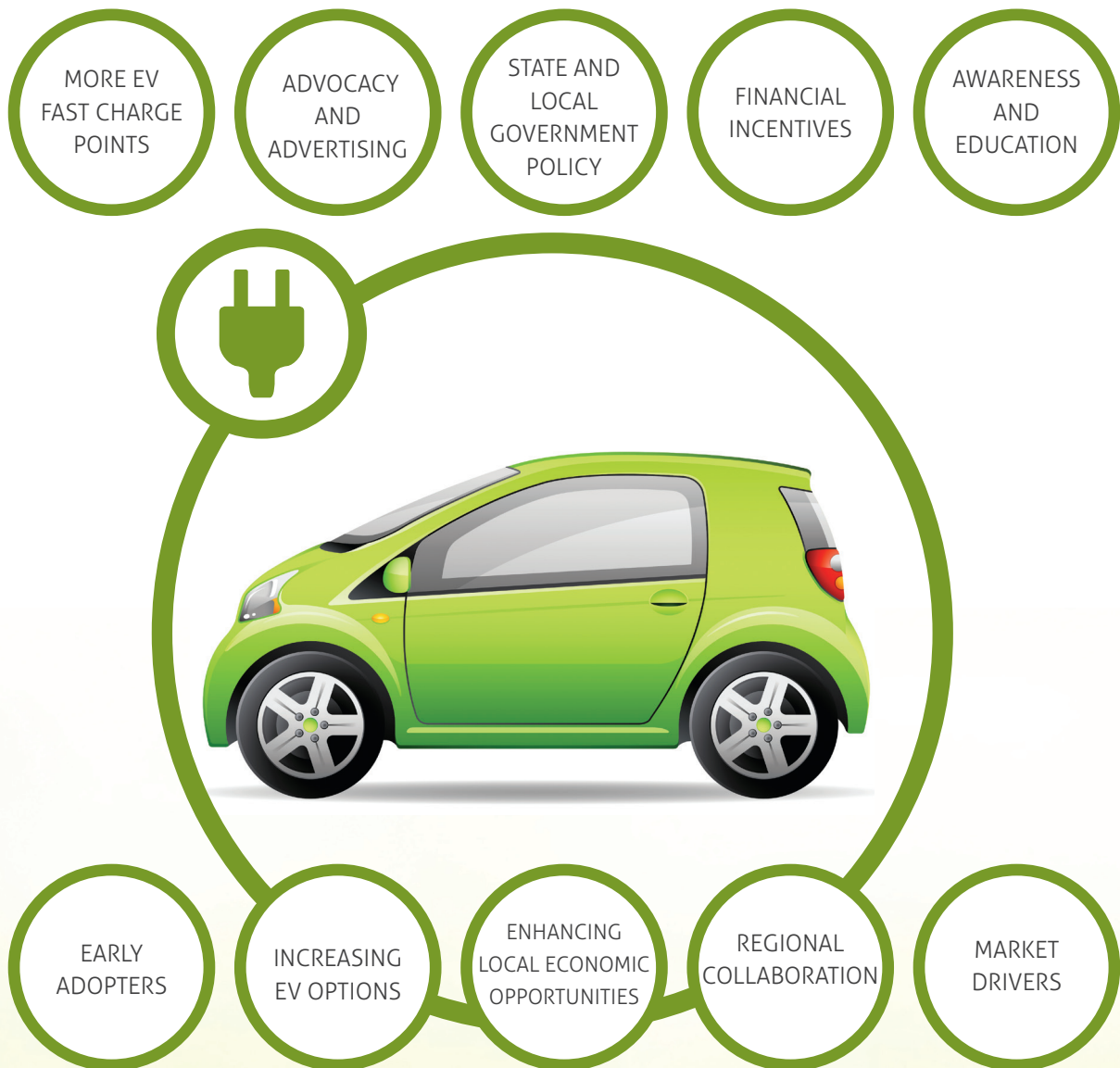
Key solutions to greater EV use in the Northern Rivers region are outlined below.

Within a regional and rural center area such as the Northern Rivers, EV use will be restricted without the availability of either level 3, fast charging stations, battery exchange points

Case study: Brisbane City Council



Brisbane City Council has eight fully electric vehicles in its fleet. These EVs are charged with 100 per cent carbon-free, renewable energy. Additionally, Brisbane City Council has just implemented an EV charging station pilot project in King George Square car park. It provides Brisbane's EV drivers with free charging and half price CBD parking and is sponsored by national business energy retailer ERM Power and GE International Inc. This project will be used as a case study to advise some of Australia's largest corporate, industry and government electricity customers. It will also provide insight into the behaviour of EV drivers and how Brisbane can capitalise on the emerging EV industry.



More EV fast charge points

Providing fast charge infrastructure is a necessity in the Northern Rivers region to influence and support EV use. Owning or promoting public charging infrastructure in major villages, towns and at Council premises is an important role for local government.

A preliminary study has been completed to assess the number of charge stations that would be required. This Strategy is supporting the installation of six charge stations in Murwillumbah, Mullumbimby, Tweed Heads,

Ballina, Lismore and Nimbin. A secondary network of charge stations at other key commuter and tourism centres is also recommended, adding infrastructure at Tyalgum, Uki, Casino, Bangalow and Lennox Head.

Further analysis on inter and intra-regional travel will help inform how many charge points and types to install at each location. This could be done by understanding the travelling profile in the region and also gathering data from EV purchase in the region from local dealers.

A range of potential options are available to resource infrastructure:

- self-funded: willing land owner with a suitable site provides the upfront capital and covers ongoing operational costs
- partnership: land owner partners with EV and/or charge station manufacturers for subsidised charge station technology
- grant funding: land owner seeks infrastructure funding from federal and/or state governments or other grant sources
- user-pays: land owner/charge station provider evaluates pricing options to recoup capital and operational costs via customer tariffs.

Advocacy and advertising

Local governments, agencies and industry groups have a significant role to play in advocating for opportunities that will maximise EV use and EV visitors to the region:

- Encouraging reviews of energy supply and distribution systems to enable flexible responses to local renewable energy generation and sharing, including provision for the role of EVs in storing and contributing energy to local energy supply systems
- Encouraging local EV suppliers to promote the availability of EV models in their product lines, and promote easy access to service these models
- Working with EV manufacturers to partner in the provision of EV fast charging infrastructure

Promoting opportunities to charge batteries and other incentives such as parking privileges would draw city EV drivers to regional areas and promote intra-regional travel across the Northern Rivers.

Branding EV vehicles in commercial fleets will assist in promoting the functionality and availability of EVs. For example, Byron Shire Council has a highly branded EV as its pool car, drawing attention and providing education about zero emissions transport wherever it goes.

State and local government policies

Numerous policy initiatives have been tried and tested overseas and are applicable to challenges in the Northern Rivers:

1. Develop a low carbon transport policy to inform rural and urban planning policies and development processes.
2. Requiring new car parks and apartment buildings to be designed in "readiness" for EV charging infrastructure (eg through inclusion of appropriate conduits). For example Byron Shire Council encouraged the installation of two fast charge stations in a recent development application for a major car park.
3. Design low-carbon fuel-efficient commercial fleet policies, as described in Byron Shire Council's Low Carbon Strategy, to provide a financial incentive for staff to choose a low carbon car as the cheapest leasing option. Use of EVs in commercial fleet is considered vital to the subsequent introduction of second-hand EVs into the wider vehicle market, reducing the barrier of high upfront capital for EV purchase.
4. Supporting EV use in parking policies by, for example, providing free annual parking permits for local residents in the first year of purchasing their EV.
5. Providing benefits to private businesses that provide public charging infrastructure.
6. Fleet vehicle policy restricting where fuel and diesel vehicles can be driven. Byron Shire Council is looking at the use of route mapping for fuel efficiency via in vehicle GPS in Council's fleet as well as providing staff training on fuel choice and efficient driving tips.
7. Eco friendly priority parking: Implement priority/ designated car parking spaces for carpooling, EVs and hybrids.
8. Promoting and supporting car share schemes (such as Go-Get, CarNextDoor, and Flexicar). Councils can support by providing dedicated parking spaces and facilitating the installation of charging stations for those spaces. Moreland Council has created their own Council-run car share scheme with a hybrid being available for both Council officers and the community to use.

9. Educational programs and fleet trial programs to raise awareness of all the benefits as well as provide an opportunity for staff and community to test drive the car. For example Byron Shire Council is currently using it's EV as a staff car pool car to allow as many different staff as possible to try it.

Financial incentives

Well-designed financial incentives for EV consumers at the national and local levels are lowering upfront costs, increasing sales and EV infrastructure deployment in a number of global markets. These types of incentives are not only of benefit to early adopters, but also give car manufacturers and other consumers' confidence in market development. ^{xiii}

1. Upfront rebates or tax credits on the purchase of EV.
2. Lower or no registration fees for EV. The ACT government has adopted an EV strategy including a stamp duty reduction for EV purchases. The Victorian government offers a \$100 reduction in registration fees for EVs and Hybrids
3. Discounted tolls and parking fee.

International examples include Paris, where cars manufactured before 1997 were banned from the

city centre on Wednesdays. The French Government dropped all subsidies for diesel. England has extended its incentive scheme (a £4500 grant) for plug-in vehicles until 2018. ^{xiv}

Non-financial incentives have also benefited increased EV deployment. Priority road and parking use has impacted uptake of EVs in high congestion areas. Utilities are demonstrating support through off-peak energy rates. Governments are pursuing fleet acquisitions and partnering with the private sector on mobility initiatives. Introduction of progressively stringent car emission standards will be important non-financial incentives for EV uptake.

Awareness and Education

Launching fast charger stations with some fanfare, combined with a program of continual promotion through businesses and Council communication tools, such as social media, will demonstrate leadership and normalize EV use.

Having clear and visible signage so that people can easily locate the charge station is also essential. Creating or contributing to the growing number of online EV charge station maps is also a good way to encourage visiting EV drivers to the area.

EV use: Government Leadership



In addition to the Brisbane, Byron and Willoughby local government examples of leadership in EV uptake featured in this report, government agencies across Australia are showing leadership in the uptake of EVs:

- In 2012, the ACT government has rolled out 10 EVs across its fleet
- The Victorian Government Electric Vehicle Trial involved over 80 organisations, and found that local government is the primary source of interest in EVs across key sectors
- Moreland City Council is now integrating EVs into its own fleet operations to reduce its carbon emissions and operational costs. An electric vehicle feasibility study and feasibility analysis in 2014 confirmed the operational cost and environmental benefits of moving to EVs.
- Lismore City Council purchase a Nissan LEAF, which runs on lithium-ion batteries and can travel up to 170 kilometers on a full charge. Lismore's car is recharged at the Lismore Recycling and Recovery Centre, using power from the roof-top solar panels.
- In January 2017, Rockhampton Regional Council received an EV for its fleet as part of its Smart Regional City initiative and to foster innovation in the region.
- Whitehorse City Council added four electric vehicles (EVs) to its fleet in April 2016 as part of a broader Sustainability Strategy at the Council which aims to reduce greenhouse gas emissions. Green power will be used to offset emissions generated from electricity consumption by the EVs.

Early adopters

For state and local government, having EVs as part of the fleet package has become commonplace. This, in addition to the impressive business case to incorporate EVs as a fleet solution places substantial pressure on local governments to consider this option.

Other pressures will be applied from the community on a number of levels. The expectation that governments demonstrate best practice, make the most efficient use of funds and consider potential post-fossil fuel options will influence decisions.

For local businesses, installing an EV charger could provide a competitive edge for organisations committed to maintaining an edge in the “green” economy.

Enhance consumer options

Australia has limited models of EVs currently available. This limited choice and competition discourages a competitive market and keeps costs high.

Encouraging businesses and councils to purchase low (hybrid) or no (EVs) emissions cars within their fleet will help to create a demand for the wider variety of makes and models available in other countries.

Establishing a bulk buy campaign for both business and councils could assist in introducing more cost effective EVs in the area as well as creating a secondhand market as Council fleet rotation is usually 3-5 years.

Tourism and economic opportunities

EV hire cars

Trying out an EV while on holidays could be an attractive proposition for prospective EV buyers. The Northern Rivers is an iconic holiday destination with a strong green image that attracts environmentally aware visitors. Some of these are likely to be early adopters of EVs. This also could be further enhanced with the possibility of EV car sharing in the region.

An earlier concept to support holiday accommodation providers and car hire businesses in the Byron area to use and supply EVs to tourists had interest from the Byron Holiday Letting Organization (HLO).

Holiday accommodation providers and hire car businesses could encourage tourists to hire EVs rather than conventional vehicles.

Interested holiday accommodation providers, would then be encouraged to provide suitable charging facilities for these vehicles. The Byron Visitors Centre, Destination Byron and the Brunswick Heads Visitors Centre could also be an important industry partner in this initiative.

Nimbin Neighbourhood and Information Centre (NNIC) is interested in working with partners to attract funds or in-kind investment into a project such as a fleet of

EV vehicles linked to tourism providers and available for hire for regional green tours, say, between Byron, Lismore, Nimbin, Tweed and back to Byron. The ultimate aim is to charge vehicles on 100 per cent green energy along the way at strategic tourist facilities/ opportunities. NNIC would aim for fast chargers that could hook directly into solar arrays behind the meter.

Car and ride sharing

EV sharing systems are considered to be a great way to boost EV usage and experience. EVs, in the present day, can be unaffordable to the majority of the population; nonetheless electric car sharing systems can create affordable access to zero-emission driving.^{xv} Car-share and ride-share schemes help to break the link between private vehicle ownership and use while also enabling more households to live with fewer vehicles.

Research suggests that when confronted with these costs, many people respond by reducing both their levels of vehicle ownership and also their demand for vehicle travel.^{xvi} Moreover it could be a great opportunity for regions with limited public transport options, to decrease their emissions from the traditional internal combustion vehicles (ICVs) driver-only car usage patterns.

Many cities internationally are increasingly grasping the wider benefits of car-share and ride-share services. In New Zealand Auckland Transport has recently invited tenders for the delivery of a car-share scheme which they would support by providing convenient on-street dedicated parking. They have also expressed a preference for an all-electric car share scheme, where re-charging occurs by way of public on-street charge points.

Due to the lack of population density in rural areas, encouraging existing car-share schemes such as Go-get, CarNextDoor and Flexicar, is difficult as the economic viability is lower.

Peer to peer car sharing schemes specifically for EVs are starting with Sydney-based company Eveeh signing up 15 owners of Tesla Model S vehicles and Nissan LEAFs and is looking for at least another 10 to launch the car-sharing service. The EV owners are motivated by the need to help pay for their vehicles – the Model S starting price is around \$120,000 – or simply to “share the love” of driving an EV.

EVs have a high up-front cost, but much lower running costs. That provides a greater incentive to use the car more often rather than leaving it in the garage. The idea behind car-sharing – and many predict that this is the future model of car ownership – is to maximise the use of the asset.

The other attraction is that EVs have much fewer moving parts and so less wear and tear, so the idea of renting out the vehicle is more attractive.

Regional collaboration

Just as this strategy has been written as a regional collaboration, there may be future benefit in maintaining a regional approach as a way to apply for funding and combine forces on various initiatives to increase the uptake for EVs.

The sustainable Nimbin Community Plan has very strong interest in initiating a local EV project. Nimbin Neighborhood and Information Centre NNIC (owner and

operator of the 45kW community solar farm) wants to investigate EV fast charge stations to connect to at least one of the 10kW arrays on completion of the feed in tariff in December 2016 and is looking for partners.

Counties in the USA (Boulder, Adams and Denver) have commenced pooled purchasing programs for EVs using a similar approach to that of the successful purchasing programs for residential rooftop solar. This programs does not involve tax credits or subsidies but reduces the cost of the Nissan LEAF on a business case for those involved. Since commencement of this program, LEAF sales at Boulder Nissan have increased almost 300 per cent.^{xvii}

The success of this program is attributed to the public-private relationships of unlikely partners and has the potential to be replicated.

Market drive

Not only is consumer-driven purchases of EVs demonstrating a change. Big energy utilities are also moving in new directions. For instance, Origin Energy is one of Australia’s largest utilities and has signaled that Australia could potentially lead the solar-powered market.

Origin Energy has flagged a range of policies and incentives aimed to increase demand for EVs.^{xix}

- support for fleet purchases
- infrastructure such as charge points
- reductions for stamp duty and registration
- Preferential parking and traffic lanes treatment.



Conclusion

EVs are a zero emissions transport technology. Charged from renewable energy and with no tailpipe emissions, EVs are a personal transport solution that can help address climate change while also delivering a range of benefits.

EV technology, especially batteries, is advancing rapidly and prices continue to fall. We are rapidly approaching a cross-over point where the lifetime costs of fossil fuel cars are greater than that of EVs.

There are more and more EVs on the market, such as the Tesla Model X and S and the Renault Zoe (passenger sedan) and Kangoo ZE (van), which can easily handle all commuter trips in rural areas. Coupled with comprehensive public and private charging infrastructure, EVs are capable of providing the same level of convenience that we currently enjoy or better.

Barriers to uptake exist however international and interstate solutions have been found and are already working. In the Northern Rivers, addressing the main barrier of range anxiety by providing inter and regional

charging stations, is critical in enabling EV uptake in the area.

State Government, local council and businesses have an important role to play in reducing the carbon intensity of transport in their regions. While Byron Shire now has the first fast charging station in the Northern Rivers, through implementing the actions outlined in this strategy, a network of charging stations can be established and the issues of range anxiety can be eliminated from the area.

There are also significant economic and environmental benefits to the Northern Rivers being known as the "green drive" and through the strategies outlined above, a clear set of actions remain to ensure that a future of sustainable transport becomes a reality.

A comprehensive network of charge stations in our region will ensure electric vehicle travelers have confident access to charge opportunities in the Northern Rivers region. Addressing regional gaps in EV charge stations will support the region's community, economic and environmental ambitions for a low emissions future.

National case studies: Willoughby City Council case study



Willoughby City Council has purchased electric vehicles with a view to buying more at the time of replacement for the use by officers undertaking Council duties.

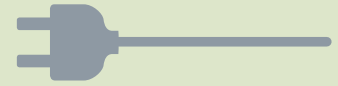
In anticipation of increasing ownership and use of electric cars in Chatswood, chargers for electric cars have been installed in the Council owned Westfield car park. This strategy is consistent with Council's policies with regards to sustainability and demonstrating good practice in resource efficiency, particularly as technology advances for electric cars and charging are becoming more affordable.

Council's Nissan LEAF electric vehicle used by Council Rangers for compliance patrol has the following attributes:

- all kWh used is offset

- stated range is 170km (dependent on many factors)
- has a practical range of 150 km
- power used is 100 per cent Green Power
- \$150 in fuel costs savings in first month
- estimated 210kg of diesel / CO2-e emissions avoided
- anticipated financial savings (accounting for all costs) over 100,000km
- expect to save over 4 tones of CO2-e emissions per year

Case study: Local Byron Bay fast charge station



The first green powered, electric vehicle fast charging station in Byron Bay.

Executive Summary

This case study outlines the challenges and solutions created to enable the first renewable energy powered fast charge station in Byron Bay. Challenges included finding a suitable site that could facilitate the high voltage required as well as being central and accessible in Byron Bay as well as sourcing renewable energy to power the station. A suitable site was found at the Byron Bay Library car park and the best option to power the charge station was to purchase 100% Green Power from local energy retailer Enova Energy. The fast charger is now installed and free for the general public to use courtesy of Byron Shire Council.

Challenges

There were three main challenges to the project;

1. Finding a highly visible and accessible site in Byron Bay CBD
2. Choosing the most efficient way to power the fast charge station with renewable energy.
3. Deciding whether to charge for public use



Electric vehicle models attracted interest at the 2016 Tweed 'Living for the Future' Home Expo

Solutions

This is the first fast charge station in the Northern Rivers and as it has a large energy demand at any one time, it requires a substation large enough to accommodate that. Ideal site location was in the main street of Byron Bay so as to make it as accessible and visible as possible. A number of sites were submitted to Essential Energy, with the initial connection applications being rejected on the basis that there was no future energy capacity in the Byron Bay CBD area for such high demand. However on further investigation it was decided that the Byron Bay Council Library Car park location could handle the fast charger and a new connection was installed.

Further technical challenges arose on the site as the central main switch board was located inside the building within the Library tenancy, making it difficult to manage outages or issues should anything go wrong. Electrical contractors devised an alternate located for the new mains switchboard, separating the fast charge from the original library switchboard and locating it outside close to the station.

The second challenge was how to power it with renewable energy. A solar feasibility study of the site was conducted and it found that it would be far cheaper and more efficient to purchase 100% Green Power from local energy retailer Enova Energy than install solar and batteries.

In addressing the third challenge, after considering the relatively small number of EVs in the Northern Rivers and that price could be a barrier to EV uptake it was decided to offer the charge station free of charge for 1 year, with a review of cost after that. The technology of the Tritium charge station was able to facilitate a free or paid option.

Results

The fast charge station was recently launched and is now in use by public and Council fleet, running on 100% renewable energy.

Appendix One: Drivers for low carbon transport in the Northern Rivers

Local government and low carbon transport

Councils play a significant role in making low-carbon transport options more convenient. Land use planners, transport planners, economic development officers, social planners and sustainability officers, their managers and elected officials make decisions and can advocate for outcomes that promote public transport, walking, cycling and other forms of electric personal mobility (such as bicycles and scooters), combined with increased access to car-share and ride-share schemes in their areas.

Byron Shire Council

In 2008 Byron Shire Council launched a Greenhouse Action Strategy consisting of 29 actions to reduce carbon emissions in the Shire. In 2014 Byron Shire Council prepared the Low Carbon Strategy, consisting of 86 actions to reduce carbon emissions by 30 per cent from the 2003/2004 levels by 2020, including any actions that were not completed in the prior strategy.

This included a number of specific low carbon transport options such as;

- EV public infrastructure: Install electric vehicle fast, medium and slow charging infrastructure for free/reduced rate, investigate opportunities for an integrated charge station network for the Byron Shire
- Public transport: Implement priority/designated car parking spaces for carpooling and electric/hybrid vehicles, introduce 'park and ride' systems, promote shuttle services to key attractions
- Low carbon policy: Develop Fuel Efficient Fleet Policy including route mapping via GPS in fleet, financially incentivize EVs /hybrid car for staff car leases and provide education for staff to use EV/hybrid pool cars
- Alternative fuels: Investigate opportunities for the use of biogas/bio-diesel in Council fleet and encourage local biofuels industry

- Active transport: Investigate public bike hire scheme, review bike plan and identify funding for implementation, install and extend bike paths
- Traffic: reduction targets, reduction in trips and trip length
- Education: Encourage and promote low carbon transport options to staff and community such as school bus network and Northern Rivers Carpool

In 2015, Council supported the first Australian Zero Emissions Target for the whole community by 2025. This includes an Emissions Reduction Transport Plan which will outline which projects will enable the Byron Shire to be 100per cent zero emissions in ten years' time. This plan is currently being developed and will be released in 2017.

In February 2017, Council installed a 100per cent renewable energy powered fast charge station at Byron Bay Library, powered by local community owned energy retailer Enova Energy. It was the first fast charge station in NSW accessible by any type of electric vehicle and will be free for public use for one year.

Tweed Shire Council

In response to the Cities for Climate Protection Program, Tweed Shire Council prepared a Greenhouse Gas Reduction Local Action Plan 2003. Transport emissions made up 12 per cent of Council's own carbon footprint for the 1996 baseline year, and nearly 30 per cent of community emissions, with a projected increase to nearly 40 per cent of community emissions by 2010. The plan set a target of reducing Council's corporate and Tweed's community emissions by 20 per cent of 1996 levels by 2010.

Transport-related actions included:

- Public transport: Development strategy, improve services, develop incentives, introduce 'park and ride' systems, promote shuttle services to key attractions
- Traffic: Reduction targets, reduction in trips and trip length
- Active transport: Install and extend bike paths and negotiate the provision of cycling and walking facilities with developers
- Education: Make people more aware of the environmental impacts of their transport decisions

Appendix Two:

Online Resources

myelectriccar.com.au

onestepoffthegrid.com.au

electricvehiclecouncil.com.au

therevproject.com

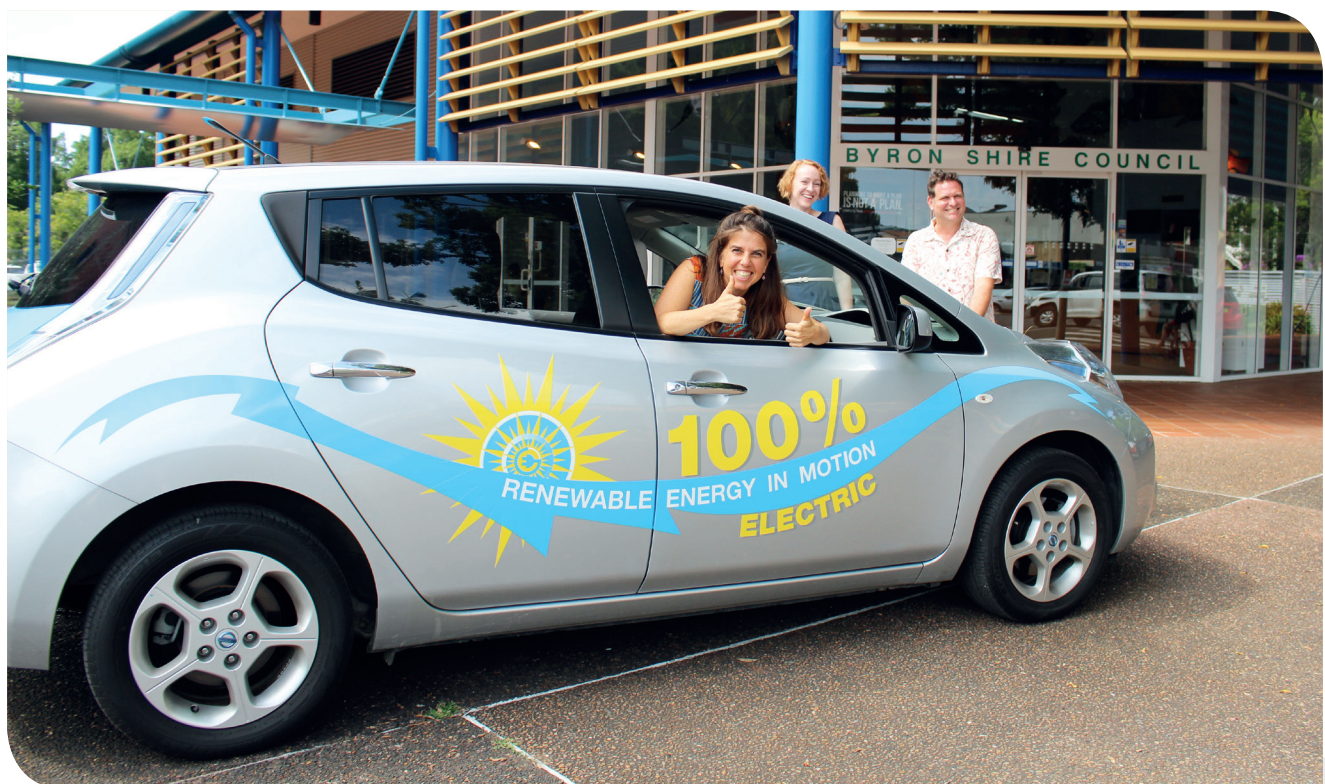
<https://www.eveeh.com.au>

<http://aeva.asn.au>

<https://www.plugshare.com> (EV charger station map).

References

1. Canals Casals, Martinez-Laserna, Amante García, & Nieto. (2016). Sustainability analysis of the electric vehicle use in Europe for CO2 emissions reduction. *Journal of Cleaner Production*, 127, 425-437. <http://blog.ucsusa.org/josh-goldman/comparing-electric-vehicles-hybrid-vs-bev-vs-phev-vs-fcev-411>
2. Energy Supply Association of Australia, Sparking an Electric Vehicle Debate in Australia, Discussion Paper November 2013
3. Nuri Cihat Onat, Murat Kucukvar, & Omer Tatari. (2014). Towards Life Cycle Sustainability Assessment of Alternative Passenger Vehicles. *Sustainability*, 6(12), 9305-9342.
4. Transport Victoria 'creating a market' Victorian Electric Vehicle Trial, Mid Term Report 2013.
5. Tweed Community Greenhouse Gas Reduction Local Action Plan 2003
6. http://sydney.edu.au/business/__data/assets/pdf_file/0017/225251/stepheng-seminar.pdf
7. <http://reneweconomy.com.au/2016/tesla-motors-elon-musk-just-killed-the-petrol-car-72847> accessed 10.4.16
8. <http://reneweconomy.com.au/2016/five-reasons-why-australia-should-accelerate-uptake-of-electric-vehicles-18706>
9. <http://www.echo.net.au/2014/12/electric-vehicle-charging-station-opens/>
10. <http://www.byronnews.com.au/news/inn-set-for-tesla-and-a-solar-future/2752360/>



Footnotes

- i Beyond Zero Emissions – Zero Carbon Australia, Electric Vehicles
- ii Beyond Zero Emissions – Zero Carbon Australia, Electric Vehicles
- iii Beyond Zero Emissions – Zero Carbon Australia, Electric Vehicles
- iv <https://www.ft.com/content/31d68af8-6e0a-11e6-9ac1-1055824ca907>
- v https://en.wikipedia.org/wiki/Electric_car_use_by_country#Australia
- vi Based on the current distribution of 'other fuel type' vehicles in the Motor Vehicle Census, Australia, 31 Jan 2016
- vii Beyond Zero Emissions – Zero Carbon Australia, Electric Vehicles
- viii Rachael Nealer on 1 December 2015 RenewEconomy
- ix <http://www.smh.com.au/business/consumer-affairs/electric-vehicle-uptake-in-australia-held-back-by-price-infrastructure-20160610-gpgkn6.html>
- x "electric Vehicles on the move – the market in Australia and overseas", Bruce Gatton, Renew Economy Issue 137
- xi North Coast Area Health Service (NCAHS) North Coast Health Promotion for SUSTAIN NORTHERN RIVERS, 2008, Byron Shire Council Staff Commuting Report
- xii North Coast Area Health Service (NCAHS) North Coast Health Promotion for SUSTAIN NORTHERN RIVERS, 2008, Ballina Shire Council Staff Commuting Report
- xiii 62 International Council on Clean Transportation (2015) 23
- xiv "electric Vehicles on the move – the market in Australia and overseas", Bruce Gatton, Renew Economy Issue 137
- xv Jeff St John, July 2015, <http://reneweconomy.com.au/2015/how-ev-chargers-and-energy-storage-can-make-good-grid-partners-27483>)
http://www.adelaidecitycouncil.com/assets/documents/0The_path_forward_for_electric_vehicles_in_australia_-_submission_to_the_federal_government_vehicle_emissions_discussion_paper_0.pdf
- xvi BZE – 38 reference
- xvii Beyond Zero Emissions – Zero Carbon Australia, Electric
- xviii (Klock-McCook and Matsuo, 2015) <http://reneweconomy.com.au/2015/what-electric-vehicles-can-learn-from-the-solar-market-65696> (accessed 17.4.16)
- xix <http://reneweconomy.com.au/2016/utilities-say-australia-could-be-world-leader-in-solar-powered-electric-vehicles-74096>





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