CHARGING TOWARDS AN ELECTRIC VEHICLE FUTURE

WORKS VEHICLES AND MACHINERY

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Volvo FL electric truck, the first of its kind in Australia

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2. Introduction

2.1 Executive Summary

According to Hollywood, we were all supposed to have flying cars by now. Or at least hoverboards. This has not materialised, but vehicle technology has advanced in other ways.

Electric Vehicles (EVs) are becoming increasingly common. So too is the expectation that organisations will move away from fossil fuels. Local Government is already being looked to as a change leader in this regard.

Whilst many councils throughout South Australia have started transitioning toward EV fleet vehicles, and certain battery-operated hand tools, uptake of EV works vehicles and machinery has lagged behind. These vehicles include but are not limited to, garbage trucks, street sweepers, ride-on lawnmowers, trucks, vans and earthmoving machinery.

Analysts predict Australian organisations will have the opportunity to transition the majority of these vehicles to EV models within the next five years, and likely by 2024. The South Australian Government's Electric Vehicle Action Plan sets a target of having all new vehicles – including heavy equipment – be electric by 2040.

Councils will need to strategise and budget to take advantage of these new possibilities. Not only will EV machines cost significantly more to purchase, but councils will also have to consider how they can keep everything charged and ready for operation daily. This could include building dedicated charging stations.

Sufficiently prepared councils stand to reap significant benefits. Each EV will save considerable money over their useful lifespan, require far less maintenance than its traditional fossil fuel counterparts, are quieter and therefore more community-friendly, and can help councils play their part in reducing greenhouse gas emissions.

Adequately preparing for the transition of works vehicles and equipment to EV technology is the biggest opportunity facing Local Government in the next five years.

2.2 EV Definition

EVs are defined in this report as battery electric vehicles, plug-in hybrid electric vehicles and hydrogen fuel cell electric vehicles.

Hybrid electric vehicles, which do not require charging from an external electricity supply, are outside the scope of this report. This ensures the report aligns with the South Australian Government's Electric Vehicle Action Plan and the Federal Government's draft National Electric Vehicle Strategy.

3. Current Situation

3.1 Machinery Playing Catch-up to Fleet Vehicles

Councils across South Australia have started making great headway in transitioning to Electric Vehicles.
Several councils have already changed their fleet vehicles to EVs, and a number of those are looking into using EVs for construction vehicles.
Investigations have uncovered that heavy vehicle technology in Australia – whether that is electric or hydrogen – is not quite where it needs to be. It is anticipated that the technology won't be available until 2024 (Australian Local Government Association, 2022).

3.2 Trials for EV Works Machinery

Many councils are using or trialling electric garbage trucks and other specialised equipment, such as cherry pickers.
In the case of garbage trucks, the service and vehicles are provided by contracted refuse operators.
Councils can help lead the transition to EVs by requiring their waste operators to trial or run electric garbage trucks as part of tender processes.

Councils currently trailing EVs include:

- City of Port Adelaide Enfield
- City of Adelaide
- City of Casey
- Yarra City Council
- City of Fremantle
- City of Hobsons Bay
- Blacktown City Council

3.3 Global Outlook Promising

While EV works vehicles and machinery have had limited uptake in Australia to date, the technology does exist elsewhere.
Volvo Construction Equipment is expanding across Europe, Asia and North America.
Electromobility by Volvo CE offers up to an 8-hour working day on a single charge depending on the application, can charge up to 80% in as little as 1-1.5 hours and has zero exhaust emissions from use (Volvo Construction Equipment, 2021).

4. Opportunities Available

4.1 Vehicles/Equipment Available

Whilst EV works vehicles and machinery are still in the early stages of being phased into Australian operations, there are several options already available. Additionally, more are being trialled and this is expected to continue growing the segment.

Vehicles and machinery commonly used in depots which can be transitioned to electric in Australia as of the time of this report (late-2022):

Mid-size	Large size
Ride-on lawnmowers	Garbage trucks
Golf carts	Street sweepers
5-metre trucks	Patching trucks
Utes and vans	Water trucks
Footpath sweepers	
Forklifts	
Elevated work platforms	

Councils with small ratepayer bases and/or vast land masses may find larger EV machines are not affordable or practical.

However, they could still consider transitioning to smaller-scale battery-operated items such as lawnmowers.

For example, an Ego ride-on mower with four batteries plus a charging kit, which can charge all four batteries in two hours, retails at about $9,000, a similar price to comparable petrol models.

The Ego comes with a five-year warranty (three years for the batteries and charger).

However, the Ego can only cut up to three acres on a single charge, with a maximum six batteries in use, so would require recharging every hour and is likely not suitable for vast spaces.

Councils requiring longer-lasting use could purchase extra batteries and rotate from charger to mower – and these batteries can also be used in all other Ego products including blowers, trimmers, saws and more.

Manufacturer	Model	Segment	Range	Cost to Purchase (approx., GST exclusive)	Picture	Notes	Website Hyperlink	Reference
John Deere	TE 4x2 Electric	Gator Utility	7-8 hours	Starting $19k		Every unit comes with an Underwriters Laboratories Inc. (UL) approved onboard charger that lets you to charge your vehicle from anywhere.	https://www.deere.com.au/en/gator-utility-vehicles/traditional-gators/te-utility-vehicle/	(John Deere, 2022)
EGO	Power+ 107cm (42") Z6 Zero Turn Riding Mower	Ride on Mower	2-3 Acres on a single charge	Starting from $9k		Expandable batteries 2hr fast charging	https://www.totaltools.com.au/186594-ego-power-56v-4-x-4-10ah-42-z6-zero-turn-riding-mower-kit-zt4204e-l https://egopowerplus.com.au/zero-turn-riding-mower-zt4204e-l/	(Total Tools, 2022) (Ego Power Plus, 2021)
Dulevo	Dulevo D.zero[2]	Footpath Sweeper	8 hours (full shift)	N/A		2.5hr fast battery charging 80% lower running costs than diesel	https://www.sweeper.com.au/machines/asc-dulevo-zero/	(ASC, 2021)
Dulevo	Dulevo Zero Hydro	Compact Road Sweeper / Washer	8 hours (full shift)	N/A		2.5hr fast battery charging 80% lower running costs than diesel	https://www.sweeper.com.au/machines/asc-dulevo-zero-hydro/	(ASC, 2021)
SEA Electric	300-85 HINO SEA EV	Truck Aluminium Tray	200-300km	$213,534 inc $10,500 for fast charging		8 hour charging time	https://www.sea-electric.com/en_au/sea-300-85-ev/	(ASC, 2021) (SEA Electric, 2022)
Volvo	FE Electric	Waste collection / light construction	200km	Starting from $500k		Fast charging (150kw) 2hr 11hr with AC 22kw	https://www.volvotrucks.com/en-en/trucks/trucks/volvo-fe/volvo-fe-electric.html	(Volvo 2022)
SEA Electric	Isuzu NPR EV	Light construction / tipper	275km	Starting from $500k		Charge Time: Approx. 4 hours up to 80% charge Life Cycle: Up to 10 Years Three-phase 32amp On Board Charger	https://www.sea-electric.com/products/seadrive100/	(SEA Electric, 2022)

4.3 Converting Petrol/Diesel Vehicles

It is possible to take existing vehicles and convert them to EVs.
Almost any vehicle can be converted, although classic cars are presently the most common choices because a conversion can extend their mechanical life, and is simpler due to the less intricate mechanical setups of older vehicles (Morley, 2022).
One Townsville-based EV conversion business reported a 500% growth in enquiries since fuel prices rose in 2021-22 (Toomey, 2022).
According to Tim Harrison, Charged Garage, the most basic conversion on a simple car would easily cost between $15,000 and $20,000 "and the sky's the limit from there".
For that reason, retrofitting vehicles to become battery-powered is only worthwhile financially in limited circumstances at this stage, although that could change as technology continues to advance (Morley, 2022).
Overseas, businesses have begun retrofitting earthmoving equipment such as road graders with batteries, and ongoing efforts should be monitored closely by local councils (MEDATech, 2020).

4.4 Grants/Partnerships

One opportunity available to help the Local Government sector fast-track a transition to EVs is through funding opportunities and partnerships with relevant organisations.
JOLT is partnered with five metro councils – Adelaide City, Charles Sturt, Campbelltown, Marion and Port Adelaide Enfield – to deploy charging infrastructure which provides the following benefits:

- Zero cost for council – City of Adelaide does not need to allocate ratepayer funds
- Free fast charging for the community – helping make EVs more accessible to the public
- The guaranteed revenue stream for council and long-term viability of the model
- 100% renewable energy

Tesla has previously supplied destination chargers throughout South Australia to encourage the uptake of their vehicles.
The chargers were provided for free, although owners – including councils – have to pay for the electricity used (Cars Guide, 2019).

The South Australian Government has partnered with the RAA to construct a 140-site fast charging network across the state.
This $12.4 million initiative aims to reduce range anxiety for EV motorists, a good example of government partnering to improve accessibility for EVs (Ward, 2022).

4.5 Collaboration

Councils in close to proximity to one another could share charging infrastructure, splitting the cost and use of large-scale charging stations for EV works vehicles and machinery.
The economies of scale achieved would save money for the initial construction; for instance, purchasing and installing one large charging shed rather than several smaller ones.
Councils could also attempt to use combined bulk purchasing to negotiate cheaper rates for chargers, as well as for electricity.
Councils could further consider sharing some specialised machinery items which are required but not used regularly.

5. Challenges

5.1 Initial Cost Outlay

EVs remain significantly more expensive to purchase than their traditional counterparts.
Whilst lower running costs can offset this, and often mean electric options are cheaper in the long run (Electric Vehicle Council, 2020), the initial outlay could be off-putting to council staff, Elected Members and ratepayer bases.
Comparison of the same 7,995kg GVM cab chassis depending on how it is powered:

Vehicle	Powered by	Purchase price (approx., inc. GST)
Hino SEA300-85-120-15	Fully electric (battery)	$245,000 (inc fast charger)
Hino 816	Diesel	$73,754

Debt funding for EV plant/machinery would help ensure the cost burden is shared across ratepayers for several years, and therefore no sharp rate rises are necessary.
However, debt funding can be divisive among voters (Australian National University, 2016) and therefore may not be looked upon favourably by Elected Members.

5.2 Lack of Chargers

South Australian councils do not presently have EV charging stations capable of recharging several items of large machinery overnight. Some of these issues could be overcome in the short term for councils that have charging infrastructure available throughout their districts. Country councils face a bigger issue, with only a relatively small number of chargers across often large geographical areas (see case study, 4.6).

5.3 Establishing In-house Charging

For most councils, the only option will be to establish in-house charging, such as a car park or shed with multiple bays allowing vehicles to charge overnight.
This would require a large initial capital outlay, with appropriate chargers costing $1,000 to $1,600 each before extra costs for installation, housing them (which may require purchasing, erecting and concreting a large shed), adding generator back up, plus any desired cost-saving measures such as solar panels (Solar Choice, 2021).
While EV charging stations in private residences are becoming common, on-site commercial charging will need to become a standard building feature in the next 10 years to meet consumer demand (McKinsey & Company, 2021).

5.4 EV Maintenance

EV machinery generally requires less maintenance (Black Ink Technologies, 2022).
However, any that is needed requires the expertise of a specialist. Across the lifespan of an EV, this is covered under warranty, generally for up to eight years/160,000km (Corby, 2022), but EVs would need to be attended to by specialists which could cause delays compared with in-house mechanics employed by many councils.

5.5 Battery Disposal

Only 10% of Australia's lithium-ion batteries, the kind used in EVs, are presently recycled.
The CSIRO estimates each tonne of lithium-ion battery waste could be worth between $4,400 and $17,200 in materials.
But extracting those materials in a pure form is challenging.
"Current batteries are not designed for a circular economy, so they're not designed to be disassembled easily and valuable components recovered," says CSIRO's Dr Gavin Collis (Zhao, Ruether, Bhatt, Staines, 2021).
Batteries ending up in landfill can emit toxins (Morse, 2021) and would risk negative public reaction for councils who had pursued EVs, in part, to achieve a clean, green image.

5.6 Case study – Yorke Peninsula Council

Yorke Peninsula Council (YPC) has only a small number of EV chargers across its 5,834 square kilometres (Yorke Peninsula Council 2022).
To utilise them, YPC works machines would need to travel vast distances to charge, wait for the charging to finish, and then proceed to the job. Only one could charge at a time per site.
Hours of work time would be lost and in some cases, the EV machinery would barely make it from the charger to the work site before needing to turn back and recharge.
A single large-scale charging space would not be adequate.
YPC operates four depots.
If one charging facility was centrally located, in Minlaton, EVs would have to be driven 46 kilometres from the northern depot or 32km from the southern depot to charge each night.
In the morning, operators would have to report to the depot, drive to the charging location and collect the machinery before driving the EVs to their work sites.
To access the YPC's southernmost township, Marion Bay, the EV would have to be driven 83km; for the northernmost township of Port Arthur, 89km.
The operator would have to make a return trip of the same distance, arriving back in time to begin the charging process and then drive back to their depot.
Even if the day's work was much closer than those southern-and northern-most extremes, significant time would be wasted.
The alternative would be to establish charging stations at each depot.
However, this would be far costlier, and the issue of time lost to travel to work sites – whilst somewhat alleviated – would remain unacceptable.

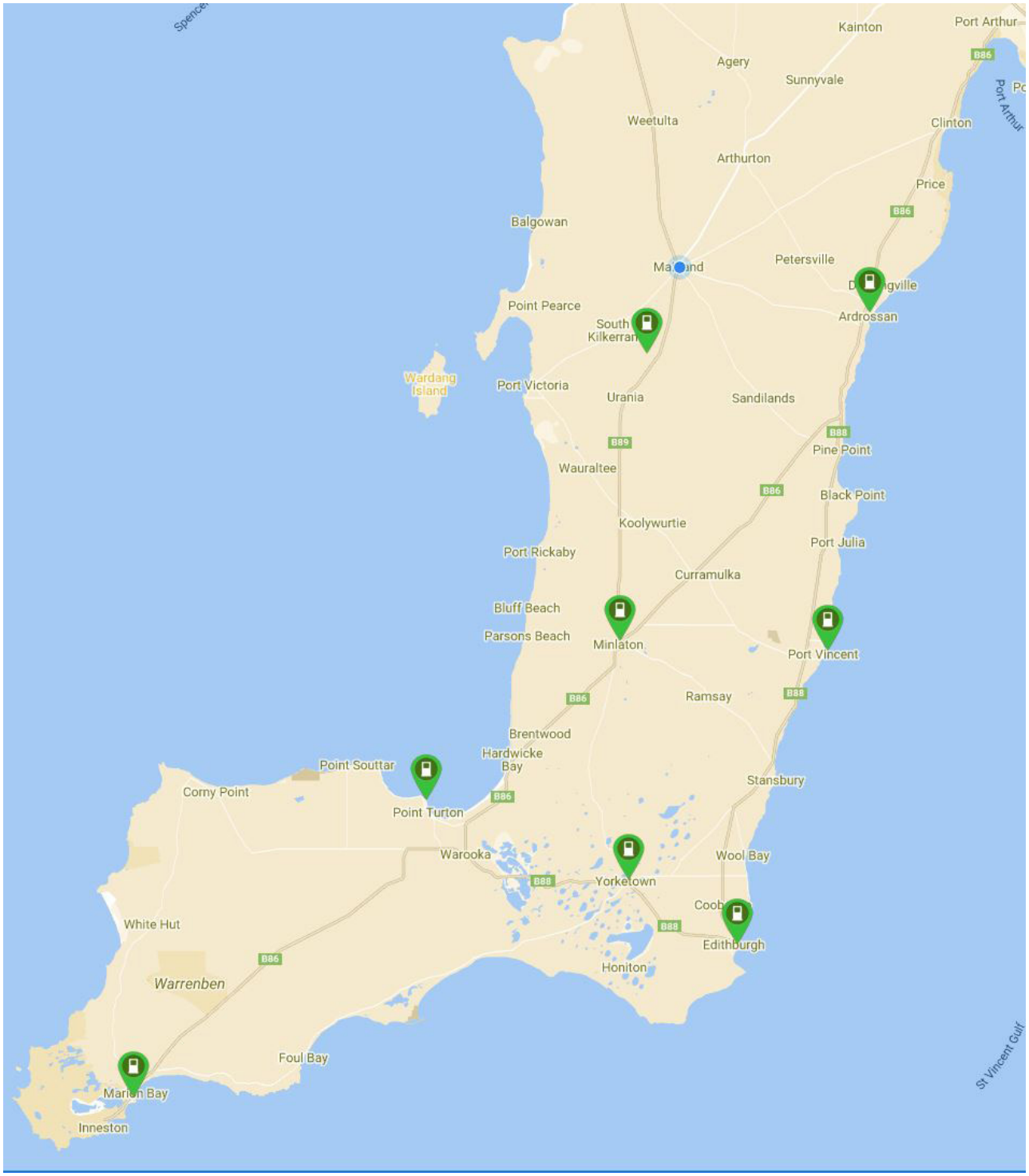

Image: Map showing EV charging stations on Yorke Peninsula (plugshare.com)

6. Benefits

6.1 Long-Term Cost Savings for Councils

EVs could save councils a substantial amount in the long term.
The initial cost of EVs is typically higher than fuel systems; however, EVs have different factors that help companies recoup the loss from purchases in the long term (Waytek, 2022).
By replacing a diesel-fuelled garbage truck with an electric model, General Manager Rob Gregory notes East Waste "conservatively project that our new electric vehicle will save more than $220,000 over the seven-year life of its diesel predecessor. Even with the extra $150,000 purchase price, that is a $70,000 saving" (Electric Vehicle Council, 2020).

Image: First electric-powered waste collection truck for South Australia (East Waste, 2019)

6.2 Reduction in Routine Maintenance

Internal combustion engines have numerous moving parts.
Electric motors have comparatively few, meaning less can go wrong.
EVs break down less frequently and require fewer check-ups.
Construction companies that buy, lease, or rent these will end up spending less on maintenance and will be slowed down less frequently by equipment downtime (Black Ink Technologies, 2022).
Electric systems also require less routine maintenance since upkeep such as changing the oil becomes obsolete (Waytek, 2022).

6.3 Reduction in Greenhouse Gas Emissions

The lithium-ion batteries used in EVs effectively eliminate the need for fossil fuels. This contributes to a more sustainable planet by reducing greenhouse gas emissions (YardLink, 2022).
In general, running electric motors contributes less to pollution than running internal combustion engines, since they do not directly rely on burning fuels (Black Ink Technologies, 2022).
The potential for electrification to reduce emissions continues to be a driving force advancing cleaner technologies. With the trend toward greener technologies advancing rapidly, electric-powered equipment is in a prime position to take off in the coming years (Waytek, 2022).

6.4 Meeting Targets

The South Australian Government has set goals to reduce South Australia's greenhouse gas emissions by more than 50% below 2005 levels by 2030 and to achieve net zero emissions by 2050 (Department of Environment and Water, 2022).
The Australian Government and Australian Local Government Association have also set targets of net zero by 2050 (Australian Local Government Association, 2022).
South Australia's Electric Vehicle Action Plan states EVs should become the "default choice for all new passenger, commercial and heavy vehicle purchases" by 2040. (South Australian Government, 2020)

6.5 Meeting Community Expectations

South Australians are increasingly interested in, and in favour of, EVs.
A 2022 survey of RAA members revealed 62% of respondents would consider an EV as their next car purchase. This represents a significant increase compared with the 42% who made the same claim in 2020.
Rising fuel costs and a desire to lower emissions were the main factors responsible for the increased interest in purchasing EVs (RAA, 2022)

6.6 Quieter Operating Noise

Quieter operating noise is a subtle advantage of electric equipment.
Cities typically set ordinances for permitted construction times and decibel levels.
Some electric equipment has the potential to extend a construction site's working hours beyond typical limits since the machines operate below set maximum decibel levels (Waytek, 2022).
In some jurisdictions, they can possibly allow for night works (Black Ink Technologies, 2022).
"With reduced air pollution comes the removal of noise pollution as the truck travels from house to house on bin collection day. It is almost silent." – Rob Gregory (Electric Vehicle Council, 2020)
Excessive noise is a common complaint. With quieter EVs, construction work can result in fewer complaints and therefore improved community rapport.

6.7 Vehicle Data Acquisition

Electric equipment owners can optimise fleet performance by detecting trends within data.
Battery health, emission volume, overall efficiency and more can be tracked.
Over time, aggregate data gives owners concrete evidence needed to pursue predictive maintenance and prevent bigger issues before they happen (Waytek, 2022).
In the long run, these smart systems can influence expenditures and safety by adding predictive maintenance on top of preventive maintenance (Acre, 2021).

7. Conclusion

7.1 Summary

Electric and battery technology is advancing rapidly in the works vehicle and machinery space.
However, for most items, that technology will remain out of reach for Local Government in Australia for another year or two at least.
This presents an opportunity for councils to trial those items currently available, and to prepare for the transition to EV so they are not left behind once the technology is ready.
All councils would be well served to investigate the possibilities, although councils with smaller geographical footprints and those in the metro regions stand to gain the most benefits.
For these reasons, preparing for an EV future for works vehicles and machinery is the biggest opportunity facing Local Government in the next five years.
Besides, who needs a hoverboard when you can run your works fleet without spending thousands on fuel each year?

7.2 Key Findings

1. **South Australian councils are not currently prepared to move into the EV space for works vehicles and equipment.**
The next few years present an opportunity for councils to take advantge of this looming opportunity, rather than playng catch-up,

2. **Now is the time for councils to start assessing possibilities for transitioning works vehicles and machinery to EVs.**
Whilst some EV machinery can be purchased already, experts predict Australia will have sufficient availability of such items as soon as 2024.
Early adopter councils will be best placed to meet community expectations and State Government targets, which state all new purchases should be EVs by 2040.
EV works vehicles and machinery can save significant money over the course of their useful lives when compared with traditional fossil fuel counterparts.

3. **Even with higher initial purchasing costs, EV options are expected to create long-term savings on diesel and maintenance.**
For example, an EV garbage truck will save an estimated $70,000 across seven years.

4. **Utilising EV works vehicles and machinery will have other benefits for Local Government.**
Not only will establish transitioning to EVs help the sector as a leader in the clean/green space, but it could also lead to benefits on the ground with quieter machinery creating less noise impact on the community.

5. **Appropriate charging infrastructure needs to be planned for and established.**
Large stations capable of charging numerous medium- and large-sized machinery must be built so councils can charge all required EVs overnight. These stations could include solar panels to offset charging costs. Councils would be well served to combine resources and share such facilities when possible.

6. **Transitioning works vehicles and machinery to EVs will be more difficult for regional councils, especially those with large land masses to cover.**
EV technology will have to improve significantly to prove workable for councils with large geographical areas.

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