

Electric hand tools for municipal tasks



Case Study: City of Yarra

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About this document

Title

Electric tools for municipal tasks
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Switch On

Also available Switch On - 4 reasons to replace hand-held, petrol-powered tools

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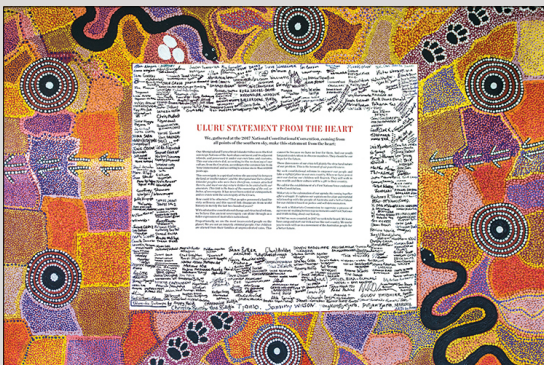
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Uluru statement from the heart

I support the Uluru statement
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Cover

Husqvarna Professional battery-powered tools



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Intro

Summary & findings

Electrification at the City of Yarra

This is a report on progress made by the City of Yarra in the electrification of hand-held, petrol-powered tools used by teams based at the Council depot.

Summary information is provided on the electrification of non-road tools and road-based equipment.

Most hand tools have been electrified

Most of the hand tools based at the City of Yarra depot have been electrified including blowers, hedge trimmers (including an extension trimmer), chain saws (including an extension saw), brush cutters, mower, post-hole auger and backpack spray units.

The changeover to electric hand tools

The investigation found that the category of hand-held tools is 'ripe' for electrification.

- Electrification of Council hand-tools is **feasible**. Today electric tools with petrol-equivalent capability are widely available from reputable manufacturers. Comprehensive and experienced after-sales service is available.
- Council hand-tools **can be replaced 'overnight'**. The City of Yarra has found that a transition period between petrol and electric-powered, hand-tools is not necessary.
- The transition **does not require skills training**. When the power source is changed, the function and operation of the tool remains the same. Skills needed to use battery tools (recharging for example) are familiar and well understood.
- **Staff are enthusiastic** about electric tools. Operators who switch to electric tools report that performance is equivalent. They are enthusiastic about the 'side benefits' of cleaner, quieter equipment. Staff report changing over their garden tools at home based on their experience at work.
- Today **Councils can choose between several reputable manufacturers** that offer a range of suitable tools. This makes brand uniformity possible. However it is likely that most Councils will 'mix and match' brands as each manufacturer's toolset includes superior or unique tools.
- **No additional electric infrastructure is needed**. It is unlikely that any substantial investment will have to be made to the power supply. Some power boards and extension cords may be needed to support convenient charging.



Rationale & benefits

- The changeover to electric hand-tools was **one of a continuing series of clean energy investments** at the City of Yarra
- For depot staff and management the **‘better working conditions’** and the **reduction in OHS risks** were the most immediate, relevant and meaningful advantages of electrification.
- The operational and risk management advantages alone were sufficient reason to implement immediate electrification of hand-held tools.
- The **reduction of neighbourhood noise** was noted as a relevant operational benefit
- The benefits of reduced local air pollution were not mentioned
- Other benefits have flowed from electrification including reduce herbicide use, reduced vehicle inventory and (probably) reduced costs through lower ‘fuel’ prices (including from depot-based solar power) and lower maintenance costs.

Barriers to electrification

- **There are no technical barriers to electrification. There may be ‘human barriers’.** Based on the experience at the City of Yarra, it is likely that in other municipalities, depot and Council staff will not have been exposed to, or have direct experience of, the latest hand-held, electric-powered tools. Other factors such as resistance to change are likely to be obstacles to electrification. City of Yarra staff referred to these as ‘entrenched habits’, ‘traditional decision making’ and ‘what we are used to doing’.
- Both **barriers can be addressed by electric tool demonstrations** which are available from experienced retailers or representatives of the manufacturers.

Purchasing Toolsets

When purchasing toolsets, it is suggested Councils:

- **Operate multi-brand systems** choosing the best tools from reputable manufacturers
- Purchase the most suitable tools even if the batteries cannot be used in other similar tools
- Purchase at least 2 batteries and one charger for each tool.

Cost of electrification

The cost of hand-tool electrification is low. The total replacement cost of the 38-tool inventory used by the City of Yarra is estimated at \$27,000. Most of this cost (65%) was for the batteries. The average cost per tool supported by two batteries and a charger was \$1,700.

A high-value emissions reduction investment

Hand-tool electrification is a high-value emissions reduction investment - significantly cheaper and significantly more effective than purchasing electric cars. Based on data, including from the California Air Resources Board, this report estimates **the replacement of 1 two-stroke blower used for 20 hours a week is equivalent to eliminating annual emissions from 150 average-use motor vehicles.**

Intro

The City of Yarra



City of Yarra depot entrance



The switch to electric hand tools at the City of Yarra

Several years ago the City of Yarra began the journey to electrification across three categories of Council equipment:

1. Hand-held, petrol-powered tools such as blowers, brush cutters, hedge cutters, saws and walk-behind mowers.
2. Non-road tools such as generators, pumps, tractors, ride-on mowers and excavators
3. Road-based equipment such as medium sized trucks (including tippers) and light-duty cars and vans.

The City of Yarra has nearly completed the electrification of the first category - hand-held tools - and is making steady progress in the other two categories.

This report

This report concentrates on the electrification of hand-held tools, summarising progress in the other categories. Information has been sourced from Council, its suppliers, and public information.

The paper is not an official document of the City of Yarra. The views expressed are those of the author and do not necessarily reflect the opinions, policies and plans of the Council.

It is hoped that the findings presented in the paper will accelerate the rate of hand-tool electrification by local governments.



The Renault Zoe electric car at the City of Yarra depot



Hand-held, electric-powered tools at the City of Yarra. Left: Hedge and brush cutters, Centre: Blowers, Right: Electric-pump backpack sprayers



Hand tools

1. Tool changeover

The City of Yarra has equipped two work teams with electric tools.

The Horticulture (parks and gardens) and 'streets' team are both based at the Council depot and both use equipment provided by Council. The Horticulture Team are City of Yarra staff, while the streets team are a contract team working for Elderin.

Two teams - similar toolsets

Each City of Yarra team has its own toolset each with a similar equipment profile. Both teams use blowers, brush cutters and hedge trimmers. The horticulture team toolset includes a mower, chain saws and a post-hole auger as well as an extension hedge trimmer and extension chain saw. The streets team use 15-litre, electric-powered, backpack spray systems (see photo on the previous page and page 13). The total tool inventory is shown in the table below.

'Overnight' changeover

The changeover to electric tools at the City of Yarra was made 'overnight' rather than gradually. The petrol-powered toolset for each team in turn was withdrawn and staff were provided with an equivalent set of electric-powered tools.



Hand-held, electric-powered tools from Stihl



Most of the old hand-held, petrol-powered tools were immediately decommissioned. Some of the petrol-powered blowers have been retained and are used for a couple of weeks in the year as the current electric-powered models are judged not to be powerful enough to move the peak loads of autumn leaves.

The ‘overnight’ changeover was successful. Council found that no new skills need to be learned to manage or use the battery-powered tools. People are familiar with charging batteries and swapping batteries from other contexts and the tools behave in the same way as the petrol-powered equivalents.

Brand continuity across the changeover

The Horticulture team was the first to be switched to electric tools. At the time of the changeover, this team was using petrol-powered tools made by Stihl - a brand with a strong reputation at the City of Yarra and one of the brands endorsed by the Council’s retail provider. At that time, Stihl was one of the few reputable brands that offered a wide range of ‘professional-standard’ electric hand tools. Council grasped the opportunity to maintain the brand when switching tools to electric power. The promise of brand continuity reassured staff that they would not be stuck with tools that ‘could not do the job’.

Staff quickly became enthusiastic

Staff quickly became enthusiastic about the changeover to electric tools. The tools worked well and have proved easy to use. Today the staff who use the tools (and depot management) prefer ‘electric’ would not ‘go back’. Based on their experience at work, some staff have switched their domestic tools to electric power. ‘My petrol blower was just noise on a stick’ said one.

A separate brand for each team

When it came time to change the tools for the ‘streets’ team, the context had changed. Electric tools were now seen by the staff as desirable, while at the retailers, a wider range of reputable toolmakers offering ‘professional’ battery-powered equipment had become available. In this new context, brand continuity was less necessary.

In fact, Council decided to introduce a new brand and link each brand with a team. The streets team were issued with Husqvarna blowers, hedge trimmers and brush cutters. The idea was to eliminate unintentional use of another team’s tools.

Council was unable to completely match ‘brand’ to ‘team’ as, at that time, Stihl was the only company with a backpack battery. As a result, today both teams use Stihl tools. The streets team also uses Milwaukee battery-powered backpack sprayers as this tool is not available from the other manufacturers.

The toolsets from each manufacturer keep expanding and improving. Today, Husqvarna offers a backpack battery and it can be expected that spray units will become available from other providers. The City of Yarra uses a Husqvarna tool with an auger bit. However, Makita have recently introduced the DDG460 tool that could also be used to drive an auger.



Barriers to electrification

Staff reported that the barriers to electrification had two sources:

- What City of Yarra staff called ‘entrenched habits’, ‘traditional decision making’ and ‘what we are used to doing’
- Lack of exposure to, or direct experience of, the latest hand-held, electric-powered tools.

Both these barriers can be addressed by tool demonstrations. Tool demonstrations are available from representatives of the manufacturers or retailers. The latter, of course, can demonstrate tools from several manufacturers.

Since electrification, the depot has held a demonstration day open to local residents, non-depot staff and Councillors. This was successful in raising awareness of the capability of the tools and awareness of the depots efforts towards electrification.

Capital cost of the City of Yarra tool inventory

The table opposite provides an indication of the capital cost that would be incurred through the complete replacement of the City of Yarra’s current tool inventory.

The table reports the tool type, maker and quantity of the current City of Yarra tool inventory. The listed maker is not a recommendation. It is likely today, that equivalent tools will be available from several manufacturers.

The ‘model’ column reports the latest and ‘top of the range’ option for each tool type, (not necessarily the tool in use at the City of Yarra). It has been assumed that each tool is supported by 2 batteries and one charger slot.

Prices are listed recommended retail prices which vary from time to time and between retailers.

The capital cost, is split between the batteries and chargers (65%) and the tool ‘skins’ (35%). Each tool (with 2 batteries and one charger slot) costs on average \$1,700.

Right: A tool demonstration run by AGZA, the American Green Zone Alliance.

The Alliance is a California-based ‘sustainability consultancy’ with the mission of transitioning municipalities, education campuses, commercial property owners, and residents to electric-powered equipment. The Alliance educates, trains and certifies electric-only commercial grounds maintenance crews, commercial land owners (such as golf courses) and municipalities. The Alliance also certifies electric-powered equipment identifying tools that can ‘replace the power and run-times of gas equipment’ and will provide a positive return on investment.





TOOL	MAKER	MODEL	UNITS	RRP	TOTAL
Blower	Husqvarna	530IBX	2	\$769	\$1,538
Blower for backpack battery	Stihl	BGA 200	1	\$699	\$699
Hedge trimmer	Husqvarna	520iHT60	2	\$689	\$1,378
Brush cutter	Husqvarna	520iLX	4	\$549	\$2,196
Brush cutter	Stihl	FSA130	2	\$749	\$1,498
15 litre Backpack spray	Milwaukee	M18BPFPCS-0	4	\$449	\$1,796
Post hole drill (Mud mixer)	Milwaukee	M18FPMC-0	1	\$418	\$418
			16		\$9,523
Batteries	Husqvarna	BL300 (36v 9.4 amp)	20	\$399	\$7,980
Charger	Husqvarna	QC500 (1 slot)	10	\$249	\$2,490
Batteries	Milwaukee	M18HB8 (18v 8 amp)	8	\$209	\$1,672
Batteries	Milwaukee	M18HB5 (18v 5 amp)	2	\$166	\$332
Charger	Milwaukee	M1418C6 (6 slot)	1	\$282	\$2682
Batteries	Stihl	AP300 (36v 6 amp)	4	\$269	\$1,076
Backpack Battery	Stihl	AR300L (36 v 41 amp)	1	\$2,799	\$2,799
Charger	Stihl	AL500 (1 slot)	3	\$139	\$417
			50		\$ 17,330
					\$ 26,853



Hand tools

2. Rationale & benefits

This section identifies the reasons for electrification and project benefits identified by City of Yarra staff.

It can be expected that the rationale for electrification will vary from place to place as each institution will have a different reason for change, a different weighting of the four harms, and a different ranking of the benefits.

At the City of Yarra, the electrification of hand tools is one of many climate-related investments made at the depot and across the Council. For City of Yarra staff, the reduction of OHS risk was front of mind. The reduction of neighbourhood noise was noted as an operational benefit or positive side effect. Reduction of the fourth harm - local air pollution - was not explicitly mentioned.

A continuing series of clean energy investments

In the period before tool electrification, several climate-related investments had been made at the depot. The roof of the depot has been fitted out with a substantial set of solar panels and the panels connected to a wall-mounted Tesla battery. The original battery has been replaced recently by a similar unit with a larger capacity. Council had also purchased an electric car and, in a first for local government in the world, an electric tip truck. The depot is also the site of the Council's 'drop-off' centre for recyclables that are not collected through the kerbside system such as batteries, electronic



Left: City of Yarra depot showing rooftop solar panels. Right: Tesla battery at the depot



equipment, paint and toner cartridges.

These investments and processes provided a supportive strategic and technical context for tool electrification and enabled the changeover to be seen as an extension of normal practices rather than an unusual innovation. When discussing tool electrification with staff it appeared that the reduction of global warming emissions was an important but not an immediate motivation. Staff talked about the need to ‘do the right thing’, ‘get on board’ and ‘being open to change’. One staff member said ‘All councils should follow this lead, for staff first and then for the environment.’

Reduced health risks to operators

The proximate cause of tool electrification at the City of Yarra was a desire to protect the health of staff.

Soft tissue injury. Tool electrification was initially conceived as a way to eliminate the risk of soft tissue injuries from repeated motor ‘pull starts’. Elimination of this risk also improved job satisfaction by eliminating the frustration of unreliable running and repeated ‘starts’. The workplace tools performed so reliably that since the changeover, several staff have switched household tools to electric. Staff reported that any remaining household petrol tools would be replaced when the tool ‘misbehaved’ and was difficult to start.

Fuel storage, handling & mixing. Depot management were also keen to eliminate (or reduce) OHS risks related to fuel storage, handling and mixing. These familiar risks are can be overlooked, but they are substantial:

- Storage. Risks from fuel storage include fire as well as soil and water contamination from spills. Staff time has to be set aside for purchasing and transporting the fuel to the depot - arguably another area of risk.
- Handling. Risks from fuel handling (refuelling) include inhalation and dermal exposure.

Studies find that over the long term, spills and vapour from the infrequent refuelling of a private car or domestic mower carry several health risks including a small cancer risk.¹ These risks are higher for operators of hand-held, petrol-powered tools who might refuel tools several times each day. Other risks from fuel handling including fire when filling a tank on a hot motor or using a mobile phone in a flammable

[Home > Articles & Guides > Garden & Lawn Care > How To Troubleshoot A Non-Starting 2-Stroke Engine](#)

How To Troubleshoot A Non-Starting 2-Stroke Engine

Most petrol hand tools will be powered by a 2-stroke engine and while they are in some ways easier to use and lighter than a 4-stroke engine, they can still give the keen gardener a bit of trouble. One of the most common problems is an engine that won't start. Here are some basic things to check if you are having trouble:

Fuel

As with most petrol engines often the reason for not starting is a problem with the fuel. Check you have fuel in the machine first. If it is old fuel, then it is worth draining and refilling with fresh fuel. Petrol goes off after only a few weeks and engine performance will drop. 2-stroke engines are lubricated by having the 2-stroke oil mixed in with petrol. It is important that this mix is done carefully as an incorrect ratio can lead to engine problems. Always check the manufacturer's guidelines in the manual. Check the fuel lines for wear or kinking to make sure fuel is getting into the engine.

Spark

If fuel is not the problem, then the next thing to check is the spark plug. Usually this is removed by unplugging a rubber cap and then using a spark plug wrench to unscrew it manually. If the business end of the spark plug is dirty, then it will need cleaning or replacing. If the plug is damp then fuel is likely to be getting through. If it is dry then no fuel is getting through and this could be your problem.

Air

Check the air filter. Over time dust and oil particles can build up in the air filter and this can impair the performance of the engine. Usually this is easy to remove and replace. Sponge air filters can be washed and replaced when they are completely dry.

Carburettor

If none of these reveal the problem, then the next thing to check is the carburettor. This small piece of machinery mixes the fuel with air before sending it to the sparking chamber. On older machines this can get clogged with fuel deposits which need to be cleared out. It can be straightforward to do this but if you don't feel confident this is the time to get your local service agent to take a look.

Servicing and Maintenance

As with all petrol-powered machines, you are advised to get it serviced regularly (usually once a year) and keep on top of maintenance. Some machines will have a conditional warranty that requires the machine to be serviced annually. If you aren't going to use the machine for a long period, say over the winter months, then it is best to drain all the fuel out. This will help prevent build up in the carburettor and will ensure you use fresh fuel next time.



atmosphere.

- **Mixing.** Two-stroke motors require fuel and oil to be mixed which elevates the risks from handling.
- **Poor fuel mixing.** In operational practice the risks from repeated pull starts and fuel



Electric backpack sprayers have helped the City of Yarra reduce herbicide use.

mixing are related. It is easy to prepare a sub-optimal mix of two-stroke fuel and poor mixing leads to poor starting and the need for repeated starting.

Herbicide spraying. An improvement in OHS has also been achieved in the use of herbicide. Spray teams used to ride ‘quad’ bikes and distribute the herbicide by hand pump. The new method is to walk and deliver the spray through an electric pump backpack spray unit. This has helped reduce herbicide use by 85% in volume. The elimination of the quad bike motor emissions and reduction in rate of spray will have reduced health risks for the operators and the public.

Overall impact. The City of Yarra OHS-through-electrification project has made an

immediate, relevant and positive difference to the workplace of depot staff. After the changeover to electric tools, staff were enthusiastic about the reduced tool noise and ‘clean hands’ that resulted from electrification. One staffer reported that his wife approved of him coming home ‘no longer smelling of two-stroke’.

This feedback suggests that the health benefits of electrification were appreciated at a practical level even though staff did not specifically mention the harms caused by the noise experienced by the operator or the toxic atmosphere in which the operator of a petrol-powered tool works or the specific chronic conditions (such as asthma) that are exacerbated by tool noise and exhaust.

OHS risks will be further reduced as other petrol motors are replaced. Council retains several petrol-powered blowers for use during the peak autumn leaf periods, continues to use petrol motors on non-road tools such as water pumps used for tree watering and continues to use petrol-powered vehicles.

Reduced neighbourhood noise

The reduction of tool noise on the surrounding area was noted by City of Yarra as an operational benefit of electrification. The external contractor (Spotless) that provides several street services including cleaning up shopping streets in the evening has noted the benefit of using electric equipment ‘after hours’.

The advantages of low-noise tools have been noted in other contexts. Schools that switch to electric



blowers have found that tasks can be done ‘during class’ rather than requiring staff to ‘start early’ or ‘finish late’. A Sydney garden services provider reports on the Husqvarna website that ‘Using battery gear can definitely open up other doorways, if you want to start earlier or work late, or if you work around people’s homes. Some of our customers don’t even know we’ve been there. We can blow or use the lawn mowers while the kids are asleep’.

Benefits that were not highlighted

It is no criticism of the City of Yarra to note that, in discussions with staff, not all harms caused by hand-held, petrol-powered tools were mentioned. Nor did staff feedback identify all the benefits that have been achieved through electrification of hand tools. Some of the benefits that were not front-of-mind for the City of Yarra include:

Strengthened duty of care. The reduction of any OHS risks strengthens Council’s duty of care and reduces related legal and financial exposure. To assist Councils approaching electrification, an initial, non-exhaustive list of known evidence-based risks is provided in a table in Chapter 8.

Reduced risk of tool damage. It is notoriously easy to forget to mix fuel for two strokes. When run on unmixed fuel two-stroke tools quickly ‘seize’, become irreparable and have to be discarded. The City of Yarra’s tool supplier reports that this is the most common reason for petrol tool failure. (Electric motors can also be ruined through operator error. When this occurs, the batteries and charger are usually unharmed and only the tool ‘skin’ has to be replaced.)

Lower running costs. Typically, battery-electric motors have a higher capital cost than petrol equivalents but lower fuel and maintenance costs. Over time the ‘equation’ or total cost of ownership can work out in favour of electric equipment. AGZA makes this claim for hand tools in the USA. No effort has been made to quantify or compare the costs of petrol and electric toolsets for the City of Yarra. However, it is likely that the City of Yarra’s total cost of toolset ownership is now lower.

Cooler running. Operators in other contexts have noted the advantage of handling a cooler tool.

The elimination of tool exhaust. Significant OHS risks for the operator are present in the compounds and particulates that are generated by petrol-powered tool exhaust. The exhaust outputs also worsen local air pollution which in turn triggers medical episodes including hospitalisation and death from asthma and other chronic diseases. The fact these harms were not emphasised in the feedback from the City of Yarra staff may reflect a low level of awareness of the cause-and-effect link these risks in the community or may reflect that we have all become accustomed to breathing exhaust.

Higher emissions and greater local pollution caused by ‘revving’. Hand-held, petrol-powered tools can easily fall into a state of poor adjustment. Poor fuel mixing, ‘dirty’ spark plugs, clogged air filters, poorly adjusted carburettors, imprecise fuel mixing and delayed maintenance can all separately and collectively lead to ‘rough running’ which motivates the operator to ‘rev’ the engine. Both the rough running and the revving increase the quantity of pollutants to which the operator and public are exposed.

1. A screening-level risk assessment of petrol exposures in New Zealand Fowles 2015



Hand tools

3. Brands, tools & batteries

Councils considering the purchase of an electric toolset will face decisions about brands and battery families.

Typically an organisation will avoid running multiple parallel systems and prefer the cost, operational and productivity advantages of a single system. (Virgin Australia decided recently to operate one type of aircraft across all its routes.)

Single systems for electric tools, such as the ‘domestic’ Bosch system illustrated below, are widely available. These systems have the advantage of combining ‘inside’ tools such as torches and drills with ‘outside’ tools such as brush cutters.

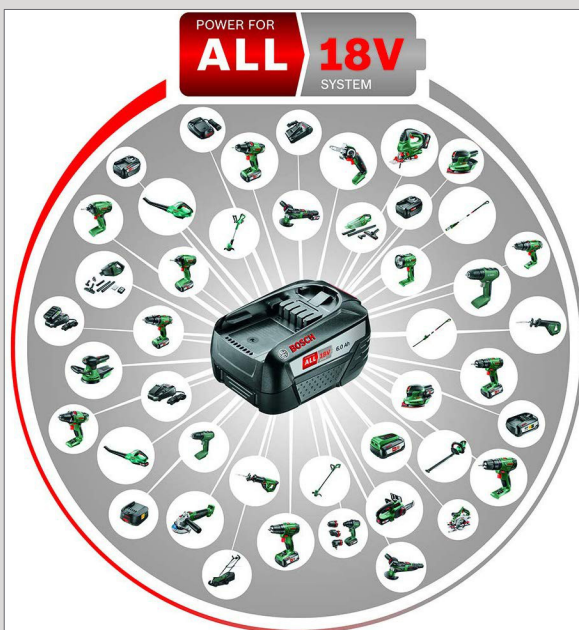
Professional standard battery-powered tools

The option of a single system is not yet available for users of ‘professional’-standard, battery-powered tools. This is because the professional grade toolsets are not yet as complete as the domestic toolsets and within the toolsets on offer, each brand has its strengths and weaknesses. Most brands have a toolset that includes some ‘winners’, tools that are more capable and convenient or easy to use, some average tools as well as some gaps in the range. The City of Yarra report that staff find the Husqvarna blowers noisier than the Stihl units. The reported weaknesses of the Stihl battery range include no in-car charging and a relatively high minimum cut height on the mower. The 6-battery-at-once charger

from Milwaukee compares favourably with the one-battery-at-a-time chargers from the other two brands. Today, Milwaukee is the only brand offering a backpack sprayer. Husqvarna uniquely offers ‘fleet management services’ through an iPad app that include notifications when the electric tools are due for a service.

Cost savings between brands

There do not appear to be any meaningful savings between the brands. Nor are there meaningful differences between the batteries and chargers available from the three brands. No brand holds a significant advantage in battery technology that enables their batteries to deliver significantly more



A domestic single-battery toolset



power or run time or lower cost. Unlike for electric cars, fast charging is not a consideration for a depot-based toolset that can be charged overnight. That said, there is a small saving in space and cost to be had with the Milwaukee six-slot charger.

Several battery families

Were a Council to decide to base their toolset on a single brand, they would still have to run several mutually incompatible ‘battery families’ within that one brand.

One of the great advantages of the systems for domestic users, is that a household only needs one battery to drive all the tools. However the ‘single battery’ system has the disadvantage that the capability of the toolset is limited by the battery. (A battery is at the same time a fuel tank [amp hours measure ‘capacity’], a measure of fuel efficiency [watt hours measure energy ‘distance’] and ‘power’ [volts].)

A domestic user does not need to buy the ‘biggest’, longest-lasting, most powerful battery. Not least because these batteries will be the most expensive (and heaviest). Most of the time the biggest batteries will be more than is needed at home and when there is a big job, the householder can compensate for a battery’s limitations by completing the task over several sessions.

A Council will tend to want big, long-lasting and powerful batteries for municipal tasks. But, like the householder, they will not need the biggest, (\$2,000+) battery for every task as today’s \$200 - \$300 batteries are more than capable, especially if a spare - or even two spares - are carried. Because the operator will be holding the tool, there is also a motivation to keep the in-tool battery smaller and lighter and have a second charged battery on stand-by in their backpack or in the support vehicle.

In addition, some tools are only available with a certain size battery. The standard Stihl hedge trimmer takes a different battery to the telescopic hedge trimmer, for example.

Hybrid toolsets

The current state of brands, tools and batteries explains why

AK 30 Battery

General Technical data Documents



Technical data

Technical data	Value
Weight kg	1.3
Rated voltage V	36
Energy Content Wh ¹⁾	180
Battery cell technology	Lithium-Ionen AK-System

AP 200 Battery

Professional Battery Power at your Fingertips

General Technical data



Technical data

Technical data	Value
Rated voltage V	36
Energy content Wh ¹⁾	151
Battery weight kg	1.3
Capacity ah	4
Battery cell technology	LITHIUM-ION

AP 300 S Battery

Professional Battery Power at your Fingertips

General Technical data Documents



Technical data

Technical data	Value
Battery weight kg	1.8
Rated voltage V	36
Energy content Wh ¹⁾	281
Battery cell technology	LITHIUM-ION
Capacity ah	7.2

Examples of batteries from two Stihl battery families’: AK & AP.

The AK30 is rated at 2.8 amp hours and retails for \$179. An AK20 and AK10 are also available.

The AP200 retails for \$239. The AP 300S, Stihl’s most powerful ‘hand’ battery is half a kilo heavier and retails for \$299. The AP 300S has nearly double the amp hours of the AP200.



the City of Yarra is running at least three battery families within the Stihl brand:

- Tools that can be driven by the more powerful (and longer lasting) backpack battery
- Tools based on the ‘main’ battery family (AP)
- Tools that are only available with batteries from a third family (AK)

The situation is similar with other brands.

It is important to note that, as undesirable as a hybrid system of brands, tools and batteries might seem in theory, in practice it does not seem to have any negative operational impact.

Looking ahead, it is likely that these complexities will be reduced. Batteries will become cheaper, smaller, lighter and, for their size and weight, more powerful. This trend will enable the development of a powerful, long-lasting toolset offering a wide range of tools based on a single, practical battery.

Recommendation

At this stage of electric tool development, it is suggested that Councils:

- Operate hybrid systems based on the best tools from a range of reputable manufacturers
- Purchase the most suitable tools from each brand and battery family
- Purchase at least 2 batteries and one charger for each tool.



Husqvarna (rear), Stihl (white base) and Milwaukee batteries and chargers (red) at the City of Yarra



Hand tools

4. Sales & service

Councils changing over to battery-powered tools will need reliable sales and after-sales service.

Hand-held, battery-powered tools are the norm in the construction industry. Here brands such as Milwaukee and Makita have a strong reputation. In ‘outdoor services’ and Council tasks, other brands such as Stihl and Husqvarna are traditional leaders. Today ‘battery brands’ that have specialised in ‘indoor’ tools are expanding their battery-powered range to include ‘outdoor’ tools. Some traditionally petrol-powered brands, such as Stihl, seem to be swiftly transitioning to battery power. Even traditional ‘petrol’ brands such as Victa offer some electric tools.

This race is going on at a retail level as well. Retailers that have been offering ‘electric’ sales and service for a long time are well placed, while those with deep experience in petrol motors face the loss of their advantage and the need to ‘go back to school’.

Power Tool Specialists

The City of Yarra purchases electric tools from Power Tool Specialists in Bouverie Street Carlton. This store stocks electric tools by Mikita, Milwaukee and Stihl and services clients such as CityWide, Serco and Fire Rescue Victoria (MFB & CFA).

The City of Yarra chose PTS as its supplier for several reasons. A key reason was their ability to provide comprehensive and experienced after-sales service. PTS has a staff of three mechanics and maintains and services tools at the store in Carlton rather than outsourcing to a third party. This has several advantages for the tool owner. Communication around repairs & maintenance is direct and ‘blame shifting’ avoided. As the warranty provider, PTS will have future sales in mind when deciding whether a fault is ‘under warranty’.

PTS has an on-site battery testing unit that can recover battery-use information including whether the



powertoolspecialists.com.au (03) 9347 4888



battery has been dropped, immersed in liquid, the number of charge cycles that remain and so on.

Brand choice

PTS report that there is steady innovation in electric tools and that all manufacturers are introducing or developing products. PTS says that generally construction contractors choose a brand and stick with it so that the tools, batteries, chargers and other equipment are interchangeable. PTS suggests that with the relatively small number of tools needed by Council and the allocation of tools to teams there is less need to stick with one brand across Council.

Charging options

PTS says that in-car charging is not available for all brands and that currently none of the brands offer a larger battery for in-field charging. Battery 'banks' are widely used by vehicle-based campers and are often trickle charged in the field by mobile solar panels. There may be some merit in trialling in-field charging by Council teams but a similar outcome could be achieved more easily by purchasing more in-tool batteries. Some electric vehicles are being advertised as equipped with charging from the main battery - electric tractors that can run a welding unit are already on sale. However, SEA Electric (see below) reports that power off-takes would be a costly accessory to add to an electric vehicle.

Increasing battery power and falling prices

Battery costs have been falling consistently and significantly in recent years and it is likely that this trend will continue. Against that, it is likely that the tool prices will not fall as manufacturers will bring to market tools that deliver more power and run for longer.

From a capability perspective, there is no reason for delay. Almost certainly, future electric hand tools will run harder for longer but the tools on the market today are fully capable for all Council tasks. The exception is the peak autumn leaf season. Councils that deal with heavy loads of autumn leaves can retain some back-up two-stroke blowers for the few weeks of the peak.

Bulk buys

PTS is discussing bulk buys with the central purchasing agency for the fire service. PTS notes that a Council bulk buy would need to consolidate an order of around 1,000 units before the manufacturer would consider offering a discount through PTS. This makes the bulk buy of tools unlikely as Victorian Councils would be unlikely to purchase one thousand tool units (such as chainsaws) as that would mean each Council in Victoria ordering a dozen of one type of tool. A bulk purchase of batteries would be more feasible and relevant. The City of Yarra recently purchased 20 Husqvarna batteries in one order. Since batteries are responsible for most of the cost of the tool, the bulk purchase of batteries by Council groups might be worth exploring.

Demonstrations

PTS is available to conduct on-site tool demonstrations and, unlike the manufacturers, can demonstrate tools from several companies.



5. Power supply

Power supply at the depot

On-site charging of powerful, battery-powered equipment, such as a car, can require a review of the on-site power system. The total capacity of the system needs to be considered and a stand-alone circuit with heavier wiring may need to be installed.

Power constraints at the depot

The City of Yarra depot operates under some power constraints. The connection to the grid is through an 80 amp fuse, the standard connection. This power supply is able to run a rubbish compactor and charge an electric car and tipper truck. However, the system does not have the capacity to handle these two tasks simultaneously. Typically, the compactor runs during the day and the vehicles are trickle charged overnight.

The switch from compactor to vehicle charging is 'manual', that is someone has to remember to switch on the vehicle charging. From time to time the switch over from daytime to nighttime use of the power supply has been overlooked. This has not caused operational problems as the vehicles have enough charge to run for two days. 'Forgetting' for two nights in a row however, would be likely to leave the vehicles undercharged.

Software services are becoming available to take over the task of switching from one load to another including switching between vehicles. These services also reduce plug load - the power that is used when chargers are on but the vehicle or tool battery is not connected or has finished charging.

Council may need to upgrade the power system when additional electric equipment and vehicles are introduced.

None of these considerations apply to the hand-held tools. The charging load on the system is trivial and staff report that no investment has had to be made to the depot power system to accommodate the new electric hand toolsets.

Cost of energy

The cost of the power to charge the tool has not been a consideration. This is probably because the cost per kilowatt hour is lower than petrol and petrol/oil fuels especially when the staff time spent purchasing, refuelling and mixing is considered.

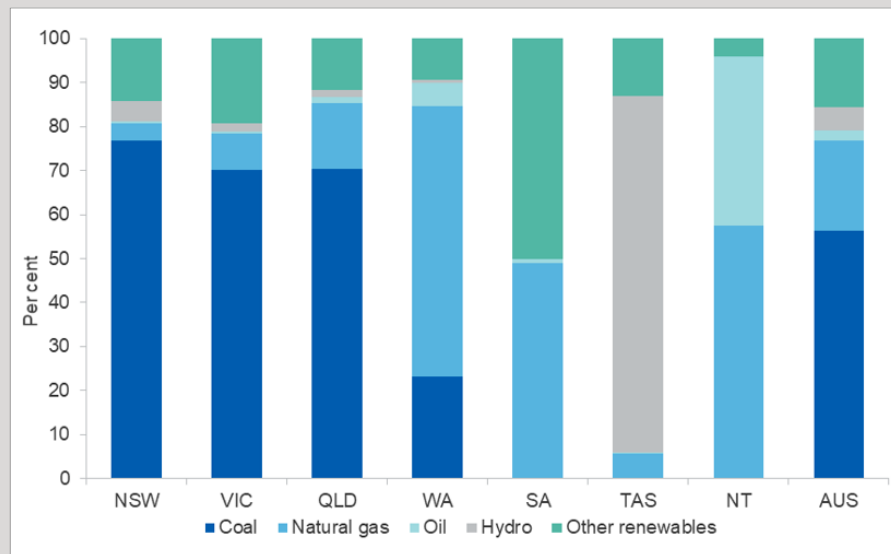


Quality of electricity

The quality of electricity in Victoria is low compared to Tasmania and South Australia. In this state around a quarter of the generation is from renewables with targets of 28-33% by 2025, and 45-50% by 2030 and 100% by 2050.

It was estimated in 2019, that emissions from a typical electric vehicle would have been 20% lower than a typical petrol vehicle.¹ The ‘gap’ would be greater (fewer emissions) for hand-held, petrol-powered tools which do not have emissions controls such as sealed fuel systems or catalytic converters.

The emissions advantage would be further extended at the City of Yarra depot as the tools absorb energy made during the day by the solar panels and stored in the Tesla battery. In addition, a renewable power purchase agreement is in place for all electricity used by Council.



Energy.gov.au

Quantity of power

At the macro level, it is likely that Councils will be able to advance the electrification of tools, non-road equipment and on-road electric vehicles without using ‘more power’.

Councils have many opportunities to introduce large-scale efficiencies in the use of electricity including replacing street lights with more efficient systems and schedules. Warrnambool City Council expects the installation of 900 new street light lamps will save in the order of 275MWh of power each year - around 6% of the Council’s annual power bill (with a payback of eight years).² That quantity of power would fully charge seven vehicles with large (100kWh) batteries every night of the year. A power saving of that scale would probably be enough to run tools, equipment and vehicles at a depot similar to that at the City of Yarra.

When such ‘direct’ efficiencies have been exhausted, further load reduction can be achieved through collaboration with other sites in the municipality. (Many municipalities in California require developers to retrofit existing buildings to generate water savings equivalent to the volume of water that will be used in the new development.) Within this bigger picture, the quantity of power used by the new hand-held toolsets is trivial.

1. *Clean, green machines: the truth about electric vehicle emissions. The Conversation September 2019.*

2. warrnambool.vic.gov.au/news/more-low-energy-street-lights-way December 2020



Non-road equipment

6. Non-road motors

The City of Yarra is pursuing the electrification of non-road motors.

Council's first major item of non-road electric equipment is an electric mini-excavator. Several major manufacturers offer electric-powered versions of their standard excavators including Volvo and Caterpillar. The City of Yarra has chosen the JCB 19C - IE.

The general advantages of electrification apply to this category of tools. The operator does not breathe in exhaust products and has a quieter workplace. JCB claims that the 'noise at the operator station' (sound pressure level or LpA) has been reduced from 68 dB(A) to 58 dB (A). The general rule is that a 3 dB(A) reduction in noise represents a halving of the noise level. On this basis, JCB claim that for the operator, the electric unit is 'five times quieter than the equivalent diesel-powered excavator.'

Those near the machine, including other staff, also benefit from a noise reduction (sound power or LwA) of 6 dB(A). JCB says 'This means contractors can work after normal hours in urban streets without disturbing residents, as well as operating in other noise-sensitive environments including hospitals and schools.'

Electricity North West, a power network distribution company in the UK, has been using these units since 2019. They reported to *Highways Today* that 'Our team finds them more powerful than diesel diggers and another major positive is the reduced noise levels. Power cuts can happen at any time of the day and night and sometimes we're required to dig up roads and footpaths to repair faults. Using the new electric diggers, which have reduced noise levels, means we can work into the night without impacting our customers.'



City of Yarra JCB 19C - IE



JCB 19C - IE



In addition, the City of Yarra can expect to have reduced maintenance and running costs. JCB claims that the fuel cost will be half that of the \$1-a-litre, low-tax red diesel used in the conventional version of the excavator.

JCB says that the unit will run on an overnight charge (6 hours) for a full shift or ‘four hours of extreme duty’.

Construction Equipment Australia

The JCB distributor in Australia is Construction Equipment Australia. CEA have sold six JCB 19C - 1E units with more on order.

Two units were purchased by hire companies who have found they generate a high return. Typically the units are hired by companies completing major projects funded by the Commonwealth or State. The zero-emission excavators enable the contractors to meet the environmental conditions in their contracts.

Three units were purchased by specialised construction companies undertaking projects such as the renovation of hotels or hospital operating theatres. The sixth unit was purchased by the City of Yarra - the first local government in Australia to own such a machine.

CEA says that the purchase price is around 2.5 times more than a conventional unit but ‘you get what you pay for’. They report the operators of the new units are ‘bewildered’ - the user use is identical but there is no noise, no changing of ‘revs’ and no lag from the diesel motor. CEA says the ‘torque rise’ on diesel powered machines is ‘significantly inferior’, while ‘there is no weakness in the electric offer’. Referring to the low noise and emissions they say ‘as a ratepayer, you wouldn’t want anything less’.



CEA reports that many local government buyers are currently undecided, some are even continuing to purchase conventional equipment. However CEA predicts that ‘in three years, one third of all machinery in local government will be electric.’ They also expect that the price of the equipment will fall as volumes increase.

CEA can be contacted on 1300 522 232 or through jcbea.com.au

Petrol-powered motors for non-road applications

The City of Yarra reports that today, not all non-road motors can be electrified. The tree-watering pumps (shown left) are an example of non-road motors that have not been converted to electric power.

How these applications will be electrified is so far unclear. One possible means would be to use an electric vehicle and power the pump from the vehicle battery.



Electric Vehicles

7. On-road vehicles

In 2019 the City of Yarra became the first local government in the world (according to the supplier) to own an electric tipper.

This prototype was based on an Isuzu body fitted with an electric power system known as the SEA-Drive(r) proprietary system. The truck has a 100kWh battery, which the staff report gives the vehicle enough range to do 'two days' work' before it has to be recharged. Typically, the vehicle is charged each night. The vehicle has a range of around 250km and can be recharged to 80% capacity in around five hours.



The City of Yarra's new electric vehicles will be fitted with a SEA-Drive(r) electric motor and battery with DC fast charge.

Peter, the regular driver, is keen on the electric vehicle and eagerly looks forward to its return when he has to relinquish it for the six-monthly service.

The City of Yarra has three electric tippers on order from SEA Electric including a 7-seater crew cab model for one of the depot teams (another first for the City of Yarra). The crew cab unit will enable all the team to travel in one vehicle and will replace two of the Council's current tray back light vehicles.

The new light-rigid class trucks will be 2x 816 and 1x 921 wide-cab models based on the Hino 300 series which conventionally has a 4-litre diesel. The tipper will cost in the order of \$200,000.

Austin Phillips, the Business Development Manager at SEA Electric, says that the cost of ownership will favour the electric version in 3 - 5 years, 'depending on fuel burn rates, service cost savings as well as brake and other maintenance savings associated with an EV truck'. He says the SEA electric vehicles will have a smaller motor and bigger battery than the prototype and will include DC fast charging as well as AC charging.

Phillips said that Parks & Gardens teams in local government typically travel up to 120km each day.



This means a battery-powered vehicle which can travel around 200km on a charge has more than enough range. It also means that regional councils could use the vehicles. Phillips described the City of Yarra as a national leader that was clearly 'leading the charge'.



SEA Electric trucks at the Brisbane Truck Show 2021

Most of Phillips' work is with government and he encouraged Councils considering electric vehicles to get in touch. He said that there are several demo vehicles currently in build for the expanding national dealer network. In Australia, he said, there were electric trucks that had been in service for at least two years and this experience could inform Council decisions.

He emphasised that there are a lot of electric vehicle myths and misconceptions in circulation and that it is imperative to get in touch with the right people early on.

Contact: Austin Phillips SEA Electric Business Development Manager: austin@sea-electric.com

Melbourne council dumps fossil fuels with first electric tipper truck

Bridie Schmidt



Supplied

The first 100% electric tipper truck in Australia has been deployed by Melbourne's Yarra City Council, allowing the exploration of transitioning its garbage and recycling collection fleet away from fossil fuels.

Made by Victoria's Sea Electric, the tipper truck is built on an Isuzu body using a Sea Electric drivetrain and 100kWh battery.

With 108kW maximum power and 1,000Nm torque, the tipper truck has a range of up to 275km and can be recharged using an on-board three-phase charger to 80% in five hours.

Australia's SEA Electric takes massive order for 100 electric trucks

Bridie Schmidt



The Hino 195 EV. Source: Sea Electric

Australian electric truck and bus company SEA Electric has taken its largest order to date from US-based commercial electric fleet provider Zeem Solutions, announcing an order for 100 Hino 195 EVs on Friday.

The Hino 195 EVs, which offer up to 320km driving range, use SEA Electric's 120a SEA-Drive powertrain built onto a Hino 195 medium duty truck body, and will be constructed in the USA by North Carolina-based Fontaine Modifications on behalf of Zeem Solutions.

With 80kW continuous power, 128 kW maximum power and a hefty maximum torque of 1,500Nm, they will be used by Zeem Solutions as part of a turnkey solution for fleet operators.

Articles from *The Driven* thedriven.io: 27 September 2019 (left) 15 November 2019 (right)



Switch On

8. Harms caused by petrol-powered tools



This paper sits alongside the report Switch On 2020

Switch On identifies the four harms caused by hand-held, petrol-powered tools: and outlines the case for the immediate electrification of all hand-held, petrol-powered tools.

The four harms are:

The operator is at risk from:

- Exhaust containing carbon monoxide, carcinogens such as benzo(a)pyrene, benzene and 1,3-butadiene and other harmful compounds such as formaldehyde, acrolein and oxides of nitrogen.
- Noise up to 110 dB(A) well above the 'safe' limit of 85 dB(A).

Tool noise penetrates the surrounding area. A blower can project 65– 80 dB(A) for hundreds of

metres and into buildings. This level of noise is more than double the daytime sound standards set by the World Health Organisation (55dB(A).) Noise that penetrates buildings is rated as 'unacceptable' by the EPA (Victoria).

Local pollution. Small petrol motors can be responsible for up to 10% of urban pollution in summer, 9% of man-made particulates and 20% of total man-made volatile organic compound emissions. These emissions are direct causes of morbidity, hospitalisation and death for people suffering from chronic cardiac and respiratory diseases such as asthma.

Global warming. Small two-stroke and four-stroke motors have more impact on global warming than car engines. One hour's use of a two-stroke blower generates pollution equivalent to that emitted by a medium-sized car travelling from Melbourne to Sydney and back.



An overview of the risks related to the use of hand-held, petrol-powered tools

AT RISK	CATEGORY	NATURE OF RISK
Operator	Noise	High levels of noise
		Elevated noise over time
	Exhaust	Inhalation of carcinogens
		Inhalation of other harmful gases
		Noise & carbon monoxide
		Inhalation of Particles
	Fuel handling	Dermal exposure, inhalation of fumes
	Fuel storage	Fire
		Soil and water contamination
	Soft-tissue injuries	Repeated pull-starts
Neighbourhood	Noise	Outside Noise
		Inside noise
	Air pollution	Inhalation of particles & compounds
Climate		Emissions



Switch On

9. Pollution action

Incinerators

Council late last year passed a By-law to govern the use of fires in the open, incinerators and barbeques. This was done to meet the growing community demand that the use of incinerators should be prohibited on at least two days a week.

The By-law implemented is a fairly tough one. It details the type of material from which an incinerator may be constructed, prohibits the usage of incinerators on three days per week, provides tight restrictions upon burning material on the ground in addition to requiring such burning to obtain a permit, permits the use of gas and electric barbeques at all times provided they are located at a sufficient distance away from property boundaries and totally prohibits the use of incinerators on days declared to be high air pollution potential by the Environment Protection Authority.

The weather conditions prevailing in Melbourne during Autumn and early Winter are conducive to the formation of smog due to low particle dispersion particularly on sunny and still days. Council, in prohibiting the usage of incinerators on the days declared air pollution potential by the E.P.A., is trying to ensure that the quality of air in Ringwood remains at an acceptable level.

In respect of incinerator usage the By-law makes the following provisions:

- i) Usage of incinerators prohibited on Fridays, Sundays and Mondays.
- ii) Usage of incinerators restricted to between the hours of 10 a.m. and 3 p.m. on Tuesdays, Wednesdays, Thursdays and Saturdays.
- iii) Usage of incinerators prohibited on days declared to be high air pollution potential as forecast by the Environment Protection Authority.
- iv) Residents are prohibited from burning waste such as leaves, rubber, chemical, fabric and paint within an incinerator as these matters produce an exceptionally offensive odour.

Any person found contravening the provisions of the By-law may be liable to a penalty of up to \$1,000 (one thousand dollars).

Any resident wishing to discuss the provisions of the By-law or find out further information concerning the By-law should contact the By-laws and Traffic Department on 870-4311.

In summary, burning off is PROHIBITED on –

- Fridays
- Sundays
- Mondays.

Burning off is only allowed on other days between 10 a.m. and 3 p.m.

21

City of Ringwood Information Guide 1985

This response cannot yet be seen in Australia. Even Councils that have declared a climate emergency, have failed to act to reduce or eliminate the use of these small petrol motors.

This inaction can be understood. As with incinerators in the 1980s, it is likely that the harms (separately and collectively) are under recognised and underestimated. It is also likely that many are unaware of the capability of electric tools or the cost of switching to electric power.

Traditionally local governments have acted to eliminate pollution.

Backyard burning of ‘rubbish’ including leaves, paper and plastics was the norm until the 1980s. General bans on the use of backyard incinerators had a significant positive impact on public health and local amenity.

A landmark study in Sydney in 1983 found that 45% of ‘haze’ pollution was caused by incineration of waste - a greater source of smog than motor vehicles (36%).

By 2017 in the United States and Canada, evidence of the harms caused by hand-held, petrol-powered tools had led to bans in at least 136 municipalities across 15 states and provinces.

Monterey bans gas leaf blowers in residential areas

Dennis L. Taylor • September 18, 2020 at 5:17 p.m.



Citing noise and air pollution, Monterey elected officials Tuesday banned gas-powered blowers in residential areas. (Monterey Herald file photo) Pacific Grove elected officials are considering banning gas-powered leaf blowers in the city. (Monterey Herald file photo) Danny Thompson greenskeeper at Monterey Pines Golf Club uses a leaf blower to remove leaves from the course on Thursday, Dec. 8, 2016. (Vern Fisher - Monterey Herald)

Monterey Herald



10. Low-cost, high impact climate action

For Councils that have declared a climate emergency, there is a robust cost-benefit case for immediate hand tool electrification.

Each of the four harms caused by hand-held, petrol-powered tools is worthy of elimination. For Councils that have passed Climate Emergency resolutions, it is likely that one of the salient considerations will be to weigh the cost and ease of tool electrification against the return in emissions reduction. It is hoped that this report has informed the cost and difficulty side of this question. This section considers how the return in emissions reduction can be estimated.

Typical investments by Councils in emissions reductions have included solar panel bulk buys, street light upgrades and the purchase of electric vehicles. The cost of these investments is relatively high in either staff time or capital. On the other hand, the impact of these initiatives has been well studied and well understood, allowing Councils to compare the investment cost with a reliable estimate of the emissions that will be avoided.

The use of hand-held, petrol-powered tools has been well studied, for example to support forestry operations which have traditionally relied on petrol-powered chainsaws. These studies have found that it is not possible to define the emissions from a particular tool, brand or model as the performance depends so much on 'local' factors that cannot be generalised. These factors include the age and 'health' of the tool, the fuel mix, the operator's handling of the tool ('revving' for example), whether the tool is 'cold starting', running evenly or running 'hot' and the weather. On sunny days and in low winds, different compounds will be generated by the tool exhaust and formed in the atmosphere, and then dispersed differently it is a cold, windy or rainy day.



Newcastle Herald

For these reasons, there is no table of emissions that can be consulted to identify the emissions that will be avoided by tool electrification (although manufacturers provide an indicative guide based on a 'workbench' test).

The table of emissions is missing for another reason: hand-held, petrol-powered tools are highly polluting - they could be defined as 'too bad to be worth measuring'. High emissions from tools are caused by their nature (two-stroke engines) and by their lightness and cheapness - none contain catalytic converters for example.

Typically emissions from hand-held, petrol-powered tools are



Two-stroke blower



2017-Toyota Camry The car connection

Over a year, a petrol-powered tool used by staff for 20 hours a week would generate annual emissions equivalent to 150 motor vehicles.

understood by comparing tool emissions to emissions from car engines which are well studied. This research has been done in the United States including by the California Air Resources Board.

Private use generates similar emissions to a car

CARB found that a householder who occasionally uses petrol-powered tools could easily generate more emissions from their tools than from a year's worth of car driving. (US 2017 Toyota Camry.) If a householder uses a:

- Four-stroke tool (mower) once a fortnight for one hour (26 hours over the year), or a;
- Two-stroke tool (blower) once a fortnight for 15 minutes (6.5 hours over the year)

Each tool will emit emissions equivalent to the average use of a passenger car (13,400km in Australia).

Professional use equivalent to 150 cars

The heavier duty cycle of hand-held, petrol-powered tools used by professional landscapers, campus-based institutions and local governments generates more emissions. Council use of a petrol-powered tool may achieve 'equivalent emissions' to the annual emissions of a car inside one working week.

Over a year, a petrol-powered tool used by staff for 20 hours a week would generate annual emissions equivalent to 150 motor vehicles.

When the cost of tool electrification is considered against the return in avoided emissions, it can be seen that petrol-powered tools should be replaced before petrol powered motor vehicles. Electrification of a well-used tool would cost around \$2,000 (with two batteries and charger) and deliver emission savings of around 150 cars, while an electric car would cost \$40,000 and only deliver one car's worth of savings (and only then if was driven 13,400km in a year).

On these grounds, it can be said that there is a compelling climate case for immediate hand tool electrification. When all four harms generated by the tools are considered together, the case for hand-tool electrification is overwhelming.

1

Operator

The workplace health of the operators is at risk.

Harmful noise

The workplace has unsafe levels of noise - loud as a plane taking off.

Toxic gases

They work in a toxic cloud of burnt and unburnt fuel & oil.

2

Neighbour

Airport-like noise penetrates the surrounding streets.

Unacceptable noise levels

The level of noise is more than twice as high as most standards.

Unreasonable intrusion

The strong, low-frequency sound penetrates buildings.

3

Community

The tools generate local pollution which harms health.

Breathing

Breathing disorders are made worse and cancers are triggered.

Health Emergency

Local air pollution increases hospitalisations, hastens death.

4

Climate

The tools generate 22x more emissions per minute than a car

High GWP emissions

Methane & N²O are 30 and 300 times more warming than CO².

Long-lasting

Methane and nitrous oxide last in the atmosphere for 100 years.