

Switchon



4 reasons to replace hand-held, petrol-powered tools

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About this document

Title

Four reasons to replace hand-held,
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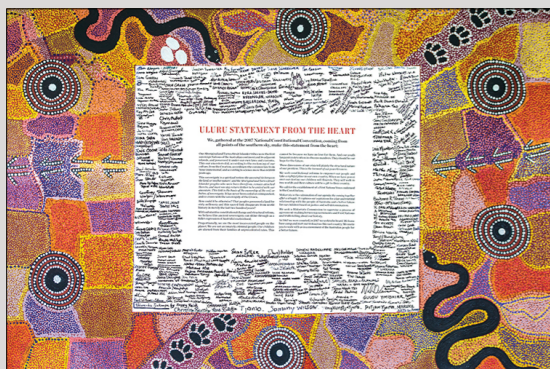
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Introduction

It is now time to rapidly decommission all hand-held, petrol-powered tools and replace them with their electric equivalents.

Petrol-powered tools must be replaced as they are harmful to the operators, are destructive of neighbourhood amenity, increase the burden of disease and accelerate global warming. Hand-held, petrol-powered tools can be decommissioned as practical, low cost, battery-powered equivalents are widely available.

A transition from petrol to battery tool power is underway. In Australia a ban is now in force on the retail sale of new 'non-road', two-stroke motors. In north America, hundreds of municipalities have implemented partial or complete bans on the use of petrol-powered tools.

The pace of this transition is slow. The national retail ban does not address four-stroke motors and, beyond limits on their hours of use, there are in Australia few if any restrictions on the use of hand-held, petrol-powered tools. The slow pace of change is due to several factors, one of which is a lack of information and understanding. This document aims to address this deficit by providing an one-stop introduction to the four reasons for the electrification of hand-held tools.

Another reason the pace of change has been slow is that until now, each of the four 'charges' against hand-held, petrol-powered tools has been heard in a separate 'court'. When considering OHS factors people do not factor in neighbourhood noise or local pollution. Those concerned about the impact of exhaust on worker health, chronic diseases like asthma and global warming do not often sit around the same table even when they belong to the same institution.

Having outlined the four harms, the document introduces the electric alternatives and considers the policies and behavioural programs that might be needed to speed the transition.

It is hoped that the document will alert governments - especially local governments - institutions such as schools, hospitals, and universities, large contracting firms, small landscaping businesses and households to the harm from these tools and the benefits that would flow from electrification.

The early chapters consider each harm in turn:

- The toxic gases that surround the tool operator
- The noise generated around the tool operator
- The local pollution that is generated
- The global warming impact of millions of small, highly polluting motors.

The later chapters provide an outline of:

- The costs and capabilities of electric equipment
- The policy pathways that could be followed in a program of electrification
- The interventions that might be used in a program of electrification.

The document concludes with some notes and a select bibliography.

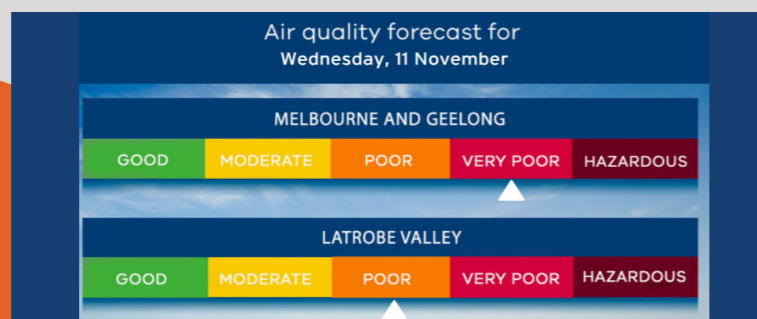
Operator



Local noise



Local smog



Global warming

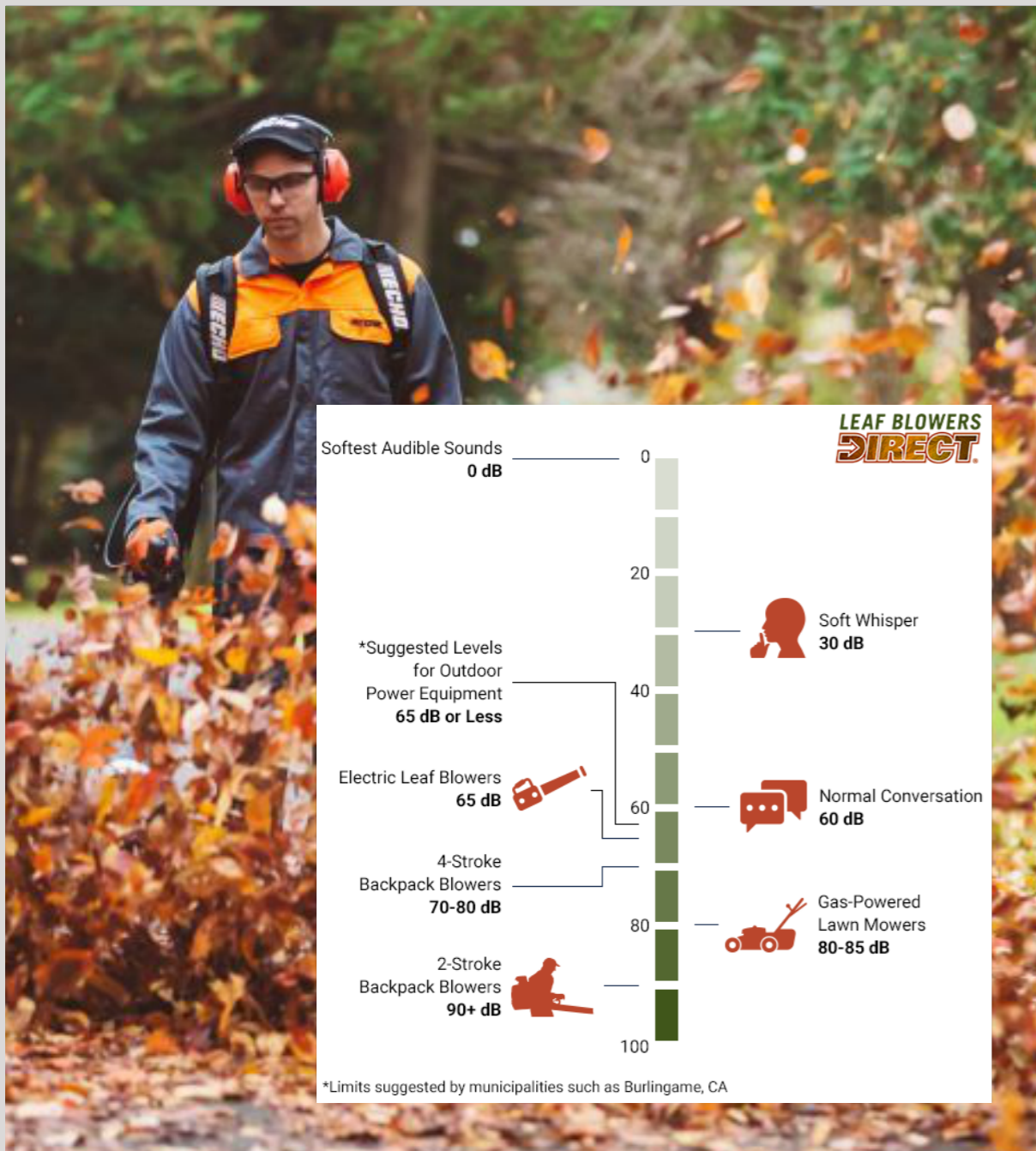


Images: RSEA, Mouldex, EPA Victoria (noise and air pollution), Today Show Channel 9



Operator

1 A dangerously noisy workplace



Ashmore Mower Service Queensland, Leaf Blowers Direct

The health and hearing of operators of petrol-powered tools is at risk from high levels of noise.

Blower operators experience noise levels from 80 dB(A) to above 100 dB(A). Manufacturers specifications say 112 dB(A) can be reached. This level of noise is equivalent to standing a few hundred metres from a jet taking off.

In workplace safety guidelines the lower end of this range of noise (80 - 85 dB(A)) is categorised as 'marginal'. Most of the range is in the 'unsafe' category (>85dB(A)).

The risk to the operator also comes from high levels of noise over long periods of operation. Safework Australia says that over an eight-hour shift, a worker must not be exposed to more than 85 decibels. The safe working limit for 100dB(A) is 15 minutes.

Noise mitigation

The workplace noise can be reduced if the operator wears Class 4 ear protectors in good condition (\$30 - \$50 a pair). This standard of protector can offer 30db(A) of protection. (This would not be enough to bring 110dB(A) noise peaks down into the marginal category.)

For this level of protection to be achieved:

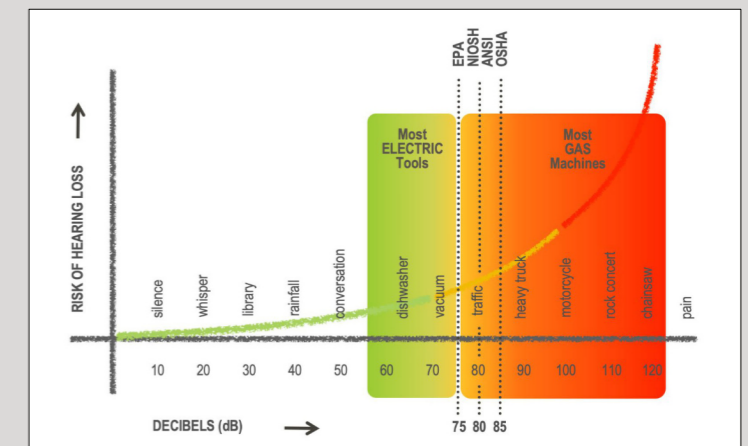
- The ear protectors have to be worn at all times and properly fitted.
- Noise filters need to be cleaned and replaced regularly perhaps as often as every three months
- Risk reduction measures should include training and spot checks.
- The workers hearing should be tested every six months

Noise prevention

Safework Australia says that risks from workplace noise should be eliminated or minimised so far as is reasonably practicable. It notes that one of the most cost-effective and long-term ways of reducing noise at work is to choose the quietest equipment for the job. Worksafe Victoria on the website page Noise: Safety Basics says 'Eliminate the source of the noise. You must always try to do this first.'

The noise range for an electric blower is typically 80 - 90dB(A). The difference between 90 dB(A) and 112db(A) is significant (see Chapter 3.)

At maximum, electric blower noise can still enter the unsafe range but the safe working time for the maximum noise rises to 2 hours and Class 2 ear protection including some types of ear plugs are sufficient to bring the noise into the acceptable band.

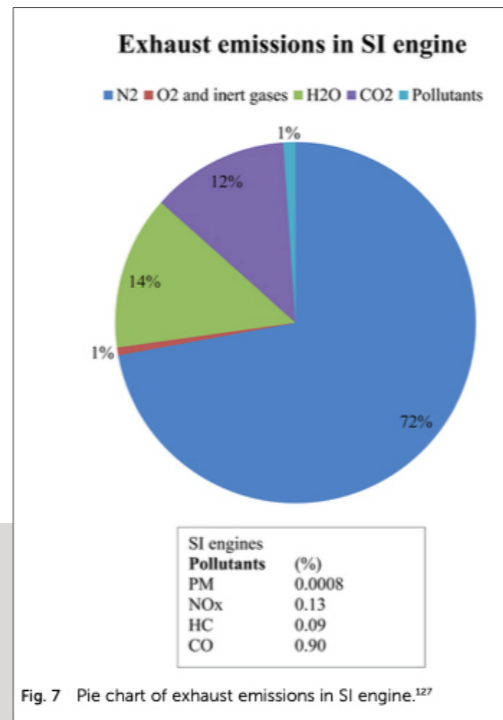
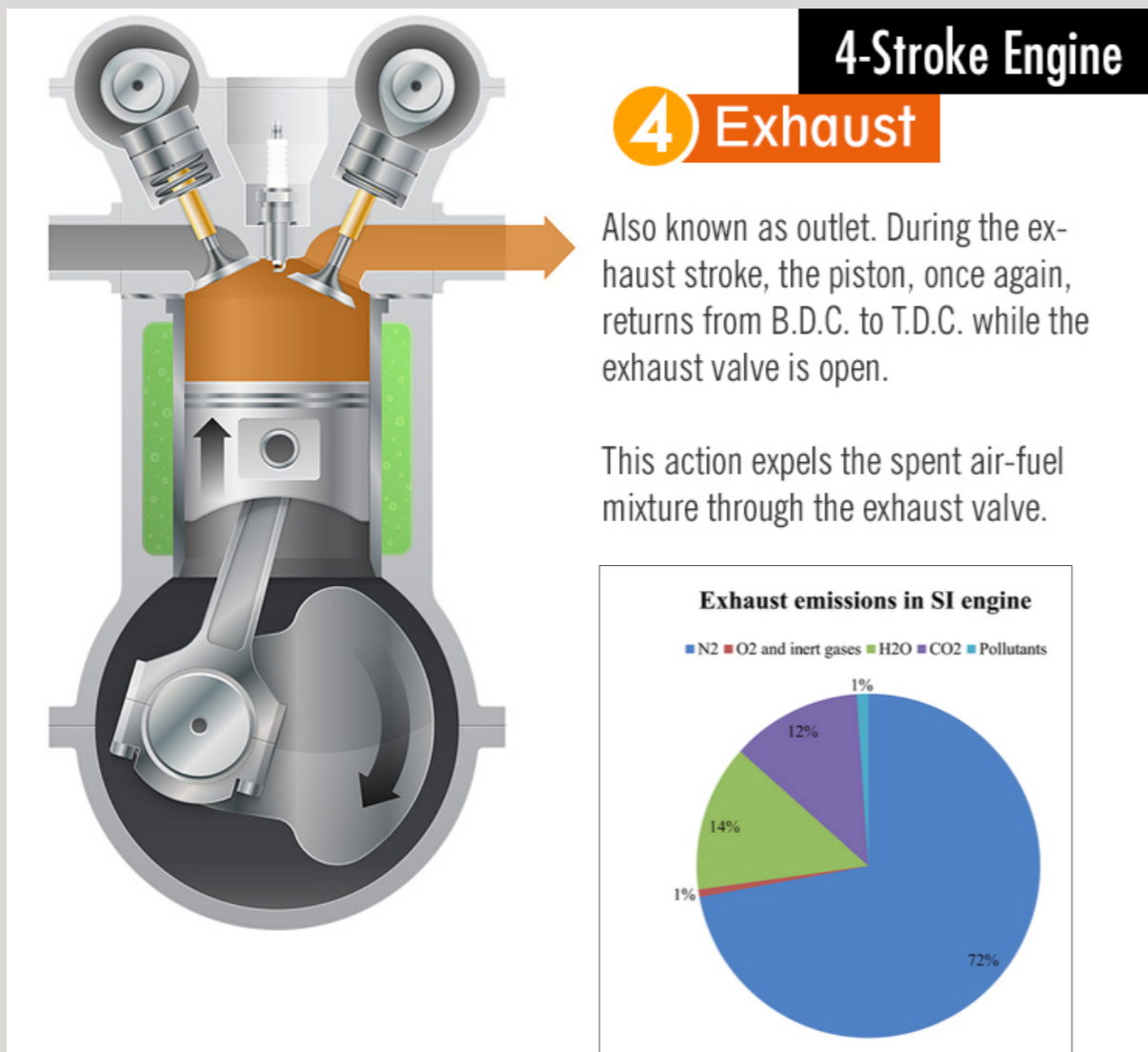


AGZA - American Green Zone Alliance agza.net



Operator

2 Working in a cloud of toxic gas



Operators of petrol-powered tools work in a cloud of toxic exhaust gases.

Two-stroke motors are particularly harmful as this type of motor burns oil as well as petrol. Two-stroke combustion is inefficient, generally only one third of the fuel/oil mix is ignited. As a result two-stroke exhaust combines the harmful gases from burnt oil, burnt petrol as well as vaporised unburnt fuel and unburnt oil.

Petrol motor exhaust includes carbon monoxide - a poisonous gas that can cause illness, permanent neurological damage, and death. Repeated inhalation of low levels of carbon monoxide can generate hearing loss by itself. When combined with noise, inhaling carbon monoxide can trigger hearing loss that the noise by itself would not have generated.

The US workplace safety organisation (NIOSH) recommends that workers are trained in the symptoms of overexposure to CO noting that symptoms can occur within minutes of use. They also recommend warning labels and that tool operators wear personal portable, audible CO monitors. (These devices cost around \$400 each)

The exhaust from hand-held, petrol-powered tools contains several carcinogens including benzo(a)pyrene, benzene and 1,3-butadiene. Other harmful compounds such as formaldehyde, acrolein and oxides of nitrogen oxides can also be present in the exhaust gas. Four-stroke engine exhaust has a high proportion of nitrogen oxides which can be harmful to the blood, immune, nerve and reproductive systems.

Two-strokes in particular generate high levels of soot particles or particulates (PM2.5) which are inhaled by the tool operator. We know that inhaling fine particles damages health. The Australian Institute of Health and Welfare estimated that urban air pollution was responsible for nearly 2,600 premature deaths in 2015. This was twice the number of deaths caused by traffic accidents in the same year. (1,205)

Workers are also exposed to risk from compounds in fuel fumes when handling the equipment or when refuelling.

Mitigation

- Alkylate petrol can be used to eliminate benzene from the fuel. This is required in Sweden. This type of petrol costs \$14 a litre.
- Respirators can reduce exposure to the dangerous gases and compounds in exhaust if they are worn at all times, well-fitted, and in good condition with clean filters.

Replacement

Workplace safety authorities, including those in Australia, recommend substituting petrol motors with less hazardous equipment whenever possible.



3 Aircraft-like noise in the neighbourhood



Hand-held, petrol-powered maintenance tools generate loud, intrusive noise across the neighbourhood.

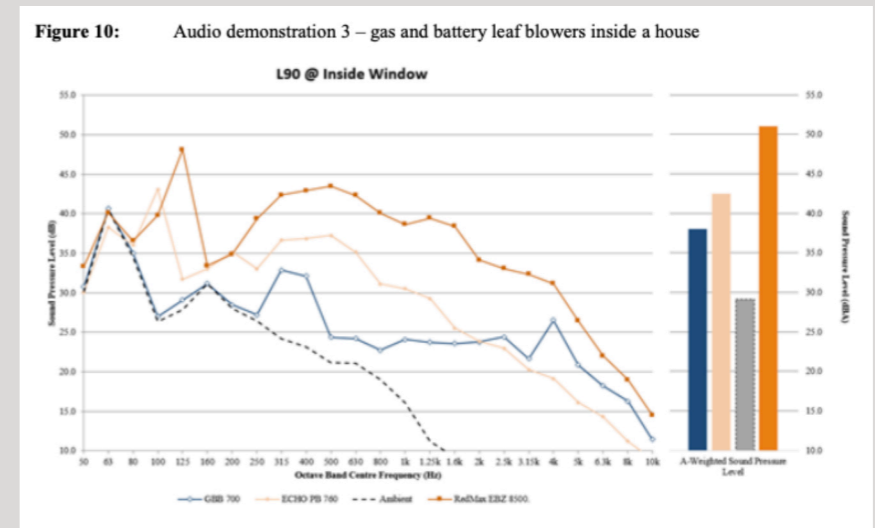
Close to the motor, the noise from hand-held, petrol-powered tools can reach 112 dB(A). Internal combustion engine noise has a large proportion of low frequency sound waves which enables the noise to travel hundreds of meters and penetrate windows to enter nearby buildings. (Aircraft noise has a similar character and penetrative power.)

A blower in operation in public or on-site at a school for example, is probably projecting 65–80 dB(A) for 60m. This level of noise is significantly higher than the daytime sound standards set by the World Health Organisation of 55 dB(A). (An increase of 10 dB(A) means the sound power has increased 10-fold or 1,000% and people will perceive that the sound intensity has doubled.)

Even when not under heavy load, the noise from a motor affects people some distance away. Tests have shown that noise above 55 dB(A) from a petrol blower can be intrusive at 250m.

Both battery and petrol-powered blowers generate high frequency noise as the air ‘whistles’ out of the machine. However battery-powered machines generate less low frequency noise which means that electric blower noise ‘decays’ more quickly and does not ‘reach’ as far. Tests found that the noise of battery powered blowers was significantly lower than the petrol tools at most frequencies at 50m and dropped to or below ambient levels at 120m.

Testers found that inside a building, low-frequency battery-powered blower sound was no higher than the ambient noise and the noise peak was half that of a petrol-powered machine (10dB(A) lower).



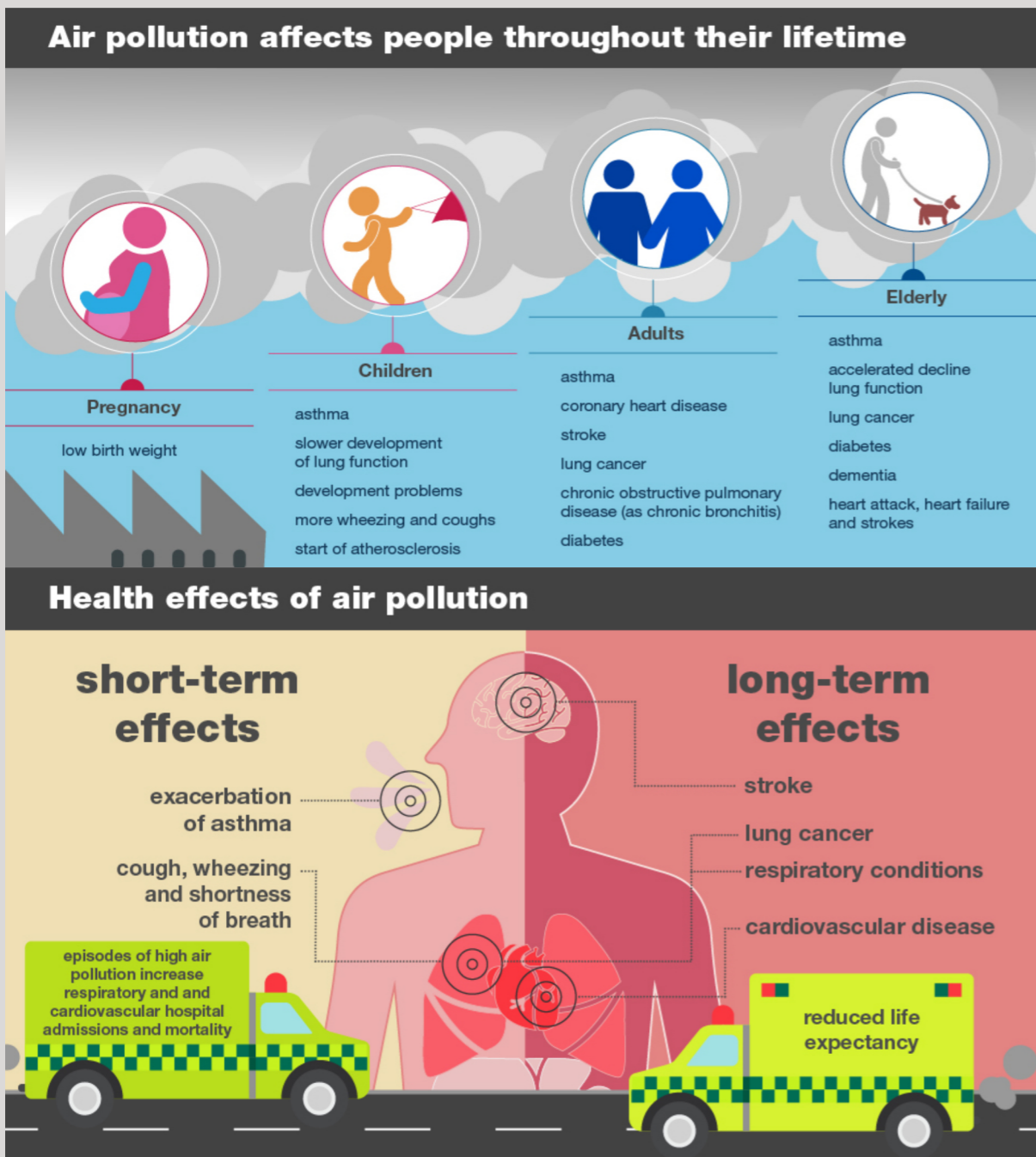
- The gas powered leaf blowers tested all generated more low frequency noise.
- The low frequency noise of the gas leaf blowers transmitted over greater distances and was more readily audible over the longer 400 and 800 foot [250m] measurement distances.
- The low frequency noise of the gas leaf blowers transmitted into a residential house more easily and were louder inside than the battery leaf blowers tested.

Top: EPA Victoria, Left: SGS Engineering, Fox Mowing



Community

4 Premature deaths from pollution



Public Health England

The noise from hand-held, petrol-powered tools signals that harmful local pollution is being generated.

This pollution leads to hospitalisation for childhood asthma, pneumonia and acute bronchitis, cancer and premature death.

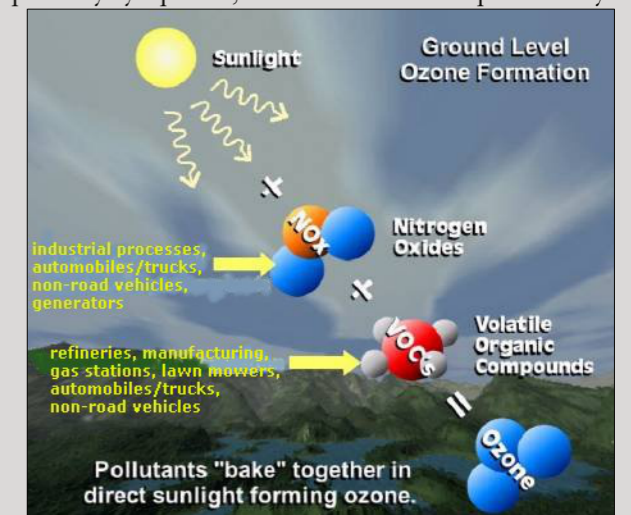
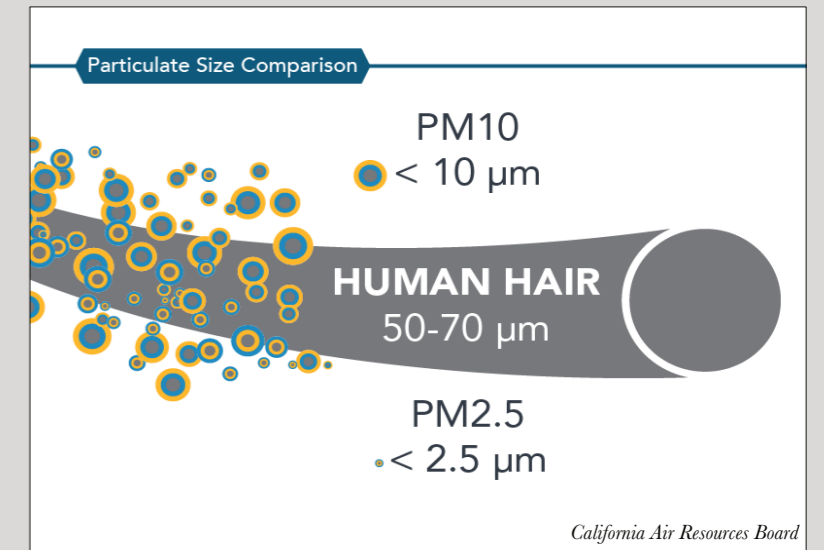
The pollution generated by hand-held, petrol-powered tools can be put in three categories.

The first two categories are inert soot particles (PM2.5) and volatile compounds (VOC). Soot particles are generated when petrol and other fuels are burnt. Other types of burning such as wood fires and bush fires also contribute to airborne particulates. VOCs (compounds that evaporate easily) are generated by petrol motors. Once in the air, they are easy to breathe in.

In the third category are the compounds that form when exhaust gases react with each other or are transformed by heat and sunlight into other gases. Nitrous oxides and VOCs generated by the motors - harmful in themselves - react to form several toxic compounds including ground-level ozone.

None of these emissions and compounds have a 'safe' level at which they do not cause harm. Soot particles are a particular problem. The Australian Institute of Health & Welfare (AIHW), says the fine airborne particles can have both long-term and short-term adverse impacts on human health. These particulates can decrease lung function, increase respiratory symptoms, chronic obstructive pulmonary disease, cardiovascular and cardiopulmonary disease and mortality and decrease life expectancy.

The short term impacts are substantial. Researchers found that in Australia a small increase in PM2.5 had a 'substantial' impact including thousands more hospital admissions and days in hospital and hundreds of premature deaths. The lost life years were valued in billions of dollars. The AIHW estimates that urban air pollution was responsible for nearly 2,600 premature deaths in 2015. This was twice the



Ozone Formation Diagram Harris County Texas



number of deaths caused by traffic accidents in the same year. (1,205)

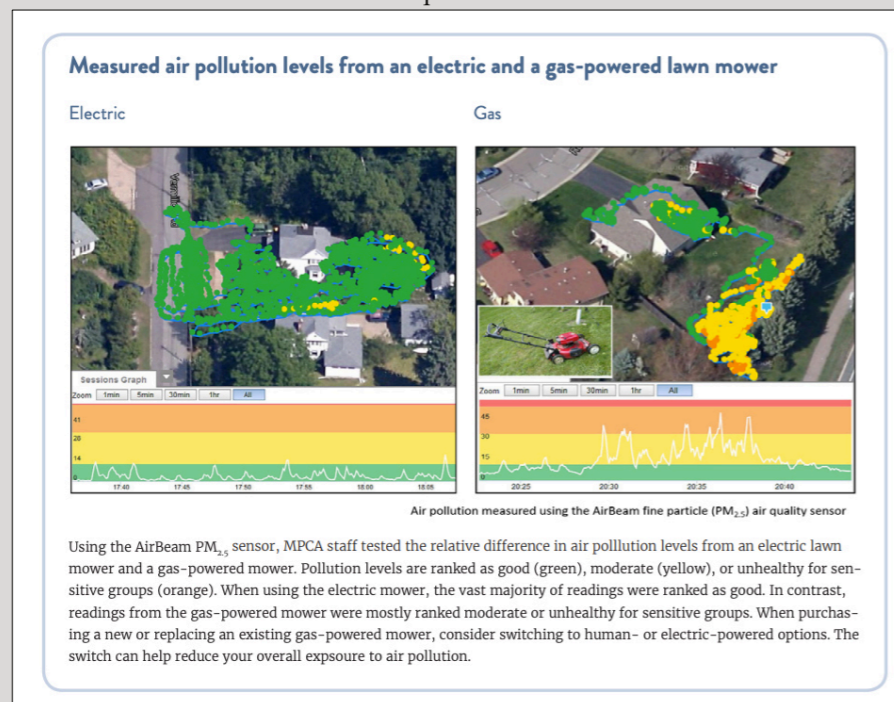
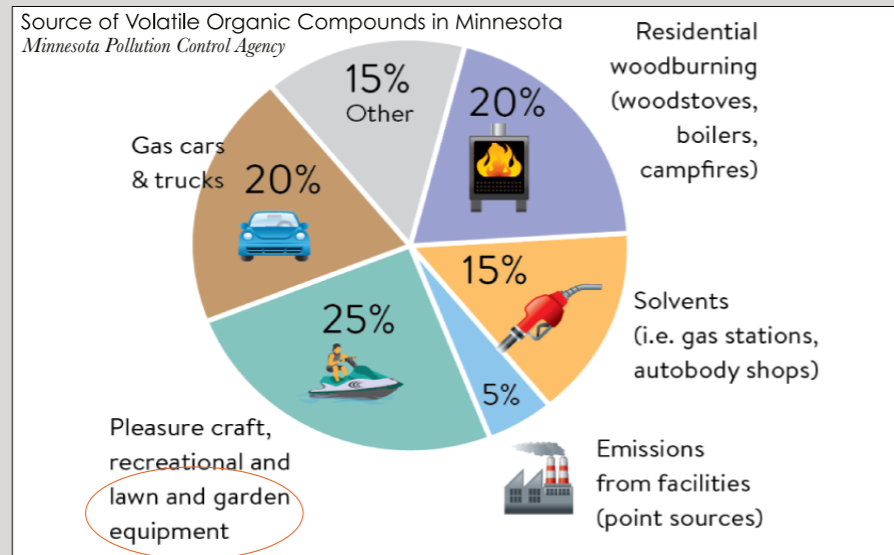
The Commonwealth Government found that in urban environments on a summer weekend day, lawn-mowing and recreational boating activities together contribute about 9%

of total man-made PM 2.5, and 20% of total man-made VOC emissions. At peak times, these motors are estimated to contribute up to 10% of overall air pollutants in Australian urban environments. Higher estimates have been made in other jurisdictions.

The Commonwealth also found that a small reduction in emissions will result in substantial health and economic benefits. It noted that the benefit is higher when outdoor powered equipment is replaced due largely to the significant hydrocarbon emissions from older engines in this sector. The more engines that can be removed from the market, the higher the benefit.

The Government expects the pollutants generated by small motors to increase by 40-80% over period 2015 - 2035, with the majority of the growth attributed to the outdoor powered equipment category. On these grounds in 2020 the Commonwealth banned the importation and sale of new two-stroke engines.

The Regulatory Impact Statement said the much of the cost would be borne by purchasers of the new equipment. While much of the benefit would accrue to the broader community in the form of reduced adverse health impacts from ambient air pollution.



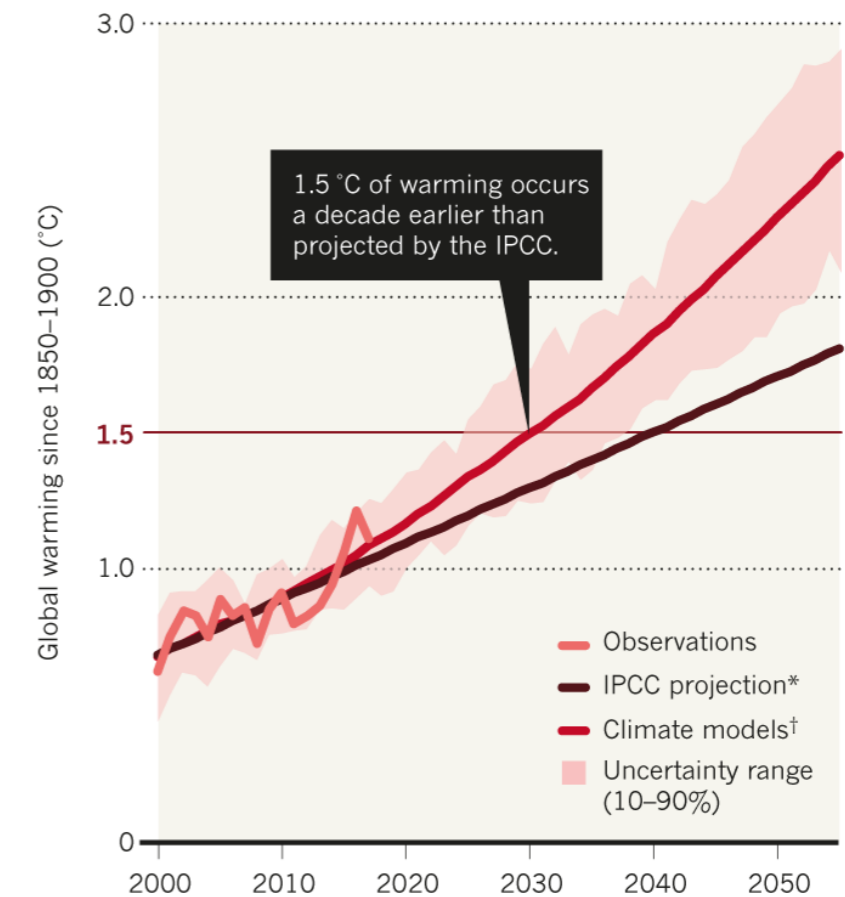
Minnesota Pollution Control Agency



5 Accelerated global warming

ACCELERATED WARMING

Climate simulations predict that global warming will rise exponentially if emissions go unchecked.



*Trend for 2001-15 extended with a constant rate of 0.2 °C per decade, as per IPCC special report. †Ten-year average, 37 climate models for the RCP8.5 scenario (IPCC Fifth Assessment, 2014).

©nature

Global warming will happen faster than we think. Xu, Ramanathan, Victor. Nature December 2018



Petrol-powered tools are powerful contributors to climate change.

1. There are millions of these small engines in use.
2. The gases they pump out are powerful accelerators of global warming.
3. These small motors generate more warming gases every minute than car engines

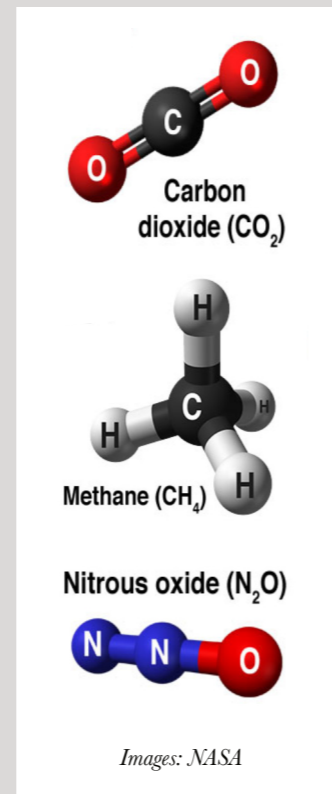
Millions of small engines in use

There are millions of these little engines in Australia. Each year we buy around one million petrol-powered tools and around the same number of cars. There is no national count of petrol-powered tools but we know that in January 2020 there were 20 million cars in use in Australia. This suggests there are a similar number of petrol-powered tools in operation.

The exhaust gases accelerate global warming

Exhaust gases from hand-held, petrol-powered tools include several greenhouse warming gases: carbon dioxide, methane and nitrous oxide.

- Around half the global warming gas from a conventional petrol engine is CO₂. On the warming impact scale (Greenhouse Warming Potential or GWP) CO₂ is rated as one unit of GWP. Atmospheric concentrations of CO₂ last thousands of years.
- Around 3% of the global warming gas from a conventional petrol engine is methane. Methane has a GWP of 28–36 over 100 years. Methane decays after about ten years but absorbs more energy from the sun than CO₂.
- The most potent global warming gas is nitrous oxide. Nitrous oxide has a GWP of 265–298 over 100 years. N₂O emitted today remains in the atmosphere for more than 100 years, on average. It is difficult to pin down exactly how much N₂O emerges from a petrol motor on a hand-held tool as this depends on the motor and how it is being used. N₂O levels are higher when the fuel is not fully burnt (this always occurs in two-stroke motors), when the exhaust is not recycled through the engine and re-burnt (this never happens in hand-held, petrol-powered tools), when there is no catalytic converter, (these are not installed on hand-held, petrol-powered tools) when the fuel has high levels of sulphur (as does the fuel in Australia), during ‘cold starts’ and when the motor is being run hard.



These small motors are more polluting than car engines

To illustrate the global warming impact of hand-held, petrol-powered tools, people have compared hand-held, petrol-powered tool emissions with those from cars.

The motor vehicle engine has been improved over the last fifty years. A key change was the

introduction of catalytic converters in 1986. This reduced emissions of carbon, unburnt fuel and N₂O. Speaking of Europe (which has higher fuel and emissions standards than Australia), the UK Society of Motor Manufacturers and Traders claims: ‘It would take 50 new cars today to produce the same amount of pollutant emissions as one vehicle built in the 1970s.’ The EPA in the United States goes further: ‘Compared to 1970 vehicle models, new cars, SUVs and pickup trucks are roughly 99 percent cleaner for common pollutants (hydrocarbons, carbon monoxide, nitrogen oxides and particle emissions).’

By contrast the motors on hand-held, petrol-powered tools are still in the 70’s. The motors lack catalytic converters and other systems that have reduced motor vehicle pollution:

- The fuel is less well controlled. The fuel systems are not sealed which allows fuel vapour to escape. (When you open the fuel cap on a car, you hear a hiss.) The fuel is not calibrated by the refinery but, in the case of the two-stroke, the proportions of oil and petrol are hand mixed by the operator. This fuel/oil degrades quickly which lowers its efficiency and increases emissions.
- Combustion is less well controlled. The small motors have no sensors or computer controlled fuel injectors to manage the combustion mix. Unlike in a car, the tool operator has a mechanical lever that allows them open the ‘choke’ and leave it on when it is not needed. Unlike in a car, the operator does not see dashboard lights that report when the air filter is blocked or other items need servicing. Poor running is typically solved by ‘revving’.
- In addition, the light, relatively loosely fitting parts (crankcase, gaskets, engine bolts, piston ring(s) and valves (or their equivalents)) wear faster than car motors introducing ‘leaks’ which reduce the already low efficiency of the combustion chamber.
- The motors do not provide feedback on uneconomical ‘driving’ or switch off ‘at the traffic lights’ when they are not needed.



Efforts to compare the output of the two types of motor can draw on substantial evidence on motor vehicle emissions. We have information about each car engine type and know how many kilometres are driven on average in a year (13,400km in Australia). From this we can estimate the global warming footprint of a particular vehicle and of the fleet as a whole.

The same breadth and depth of information is not available for petrol-powered, hand-held tools. This



is partly because the performance of the tool depends on how it is used and how much it is used. However, the following comparisons are available.

The V8 test

A head-to-head test between petrol tools and a 6-litre V8 3-tonne ute by Edmunds found that a four-stroke blower generated 7 times more N²O, 13 times more CO and 36 times as many non-methane hydrocarbons while a two-stroke blower generated twice as much N²O, 23 times as much CO and 300 times more non-methane hydrocarbons.



Ford F150 Raptor V8. Motortrend

The tester found that ‘to equal the hydrocarbon emissions of about a half-hour of yard work with this two-stroke leaf blower, you’d have to drive a Raptor for [6,200 km], or the distance from [Melbourne to Perth and back (6,600km)].’

When the blowers were run on idle, the tester found that emissions were reduced and that the V8 would have to be driven from Melbourne to Shepparton and back (370km) ‘stopping every 505 seconds and doing cold restarts — to emit the same level of hydrocarbons as simply idling the two-stroke leaf blower for less than 10 minutes.’

CARB

The California Air Resources Board has been investigating hand-held, petrol-powered tools for several decades. It introduced minimum standards for these small motors in 1990 which they said reduced their pollution impact by 40 - 80%. CARB is considering tightening these controls as ‘By 2031, small engine emissions will be more than twice those from passenger cars.’

CARB estimates that: ‘operating the best-selling commercial lawn mower for one hour emits as much smog-forming pollution as driving the best-selling 2017 passenger car, a Toyota Camry, about 300 miles – approximately the distance from Los Angeles to Las Vegas (Melbourne to beyond Mt Gambier).

For the best-selling commercial leaf blower, one hour of operation emits smog-forming pollution comparable to driving a 2017 Toyota Camry about 1,100 miles, or approximately the distance from Los Angeles to Denver. (A return trip from Melbourne to Sydney).’

More climate harm than a car

These tests tell us that the climate (and air pollution) damage from hand-held, petrol-powered tools is greater minute-by-minute than a car and over a year can have an equivalent impact to a car engine.

Minute by minute: The tools are more damaging than a car engine minute-by-minute - either 6



times (the lawn mower) or 22 times worse (the blower):

- CARB says one minute of lawn mower use is equivalent to six minutes of driving (assuming the 300m/480km trip is completed at an average of 80km/h).
- CARB says one minute of blower use is equivalent to 22 minutes of driving (assuming the 1,100m/1,760km trip is completed at an average of 80km/h).



2017 Toyota Camry The car connection

Year on year: The annual climate impact of hand-held, petrol-powered tools is as great as an average car.

- Cars are used for around one hour every day. (The average Australian driving year of 13,400km would take around 335 hours at 40km/h.)
- The Toyota Camry described by CARB would travel 300 miles (480km) 28 times in an average Australian driving year.
- If the lawn mower described by CARB is used once a fortnight over the year (26 one-hour sessions) it will generate a similar quantity of emissions to a car. (Jim’s Mowing estimates that around one third of users mow their lawns twice a month.)
- The Toyota Camry described by CARB would travel 1,100 miles (1,760km) 8 times in in an average Australian driving year. If the blower described by CARB is used domestically for 30 minutes every fortnight, it will generate 50% more pollution than the Camry over the year.

These results suggest that, from a climate perspective, hand-held, petrol-powered tools should be replaced before car engines. This is good news as it will be much cheaper and quicker to decommission small relatively cheap motors - perhaps 50 times cheaper. (Assuming an electric car costs \$50,000 and a hand-held, battery-powered tool costs around \$1,000).

The message for households is that those wishing to reduce their impact on global warming should replace their hand-held, petrol-powered tools before they buy an electric car. If the household does not use their car much but does a lot of petrol-powered gardening, this switch is even more important.

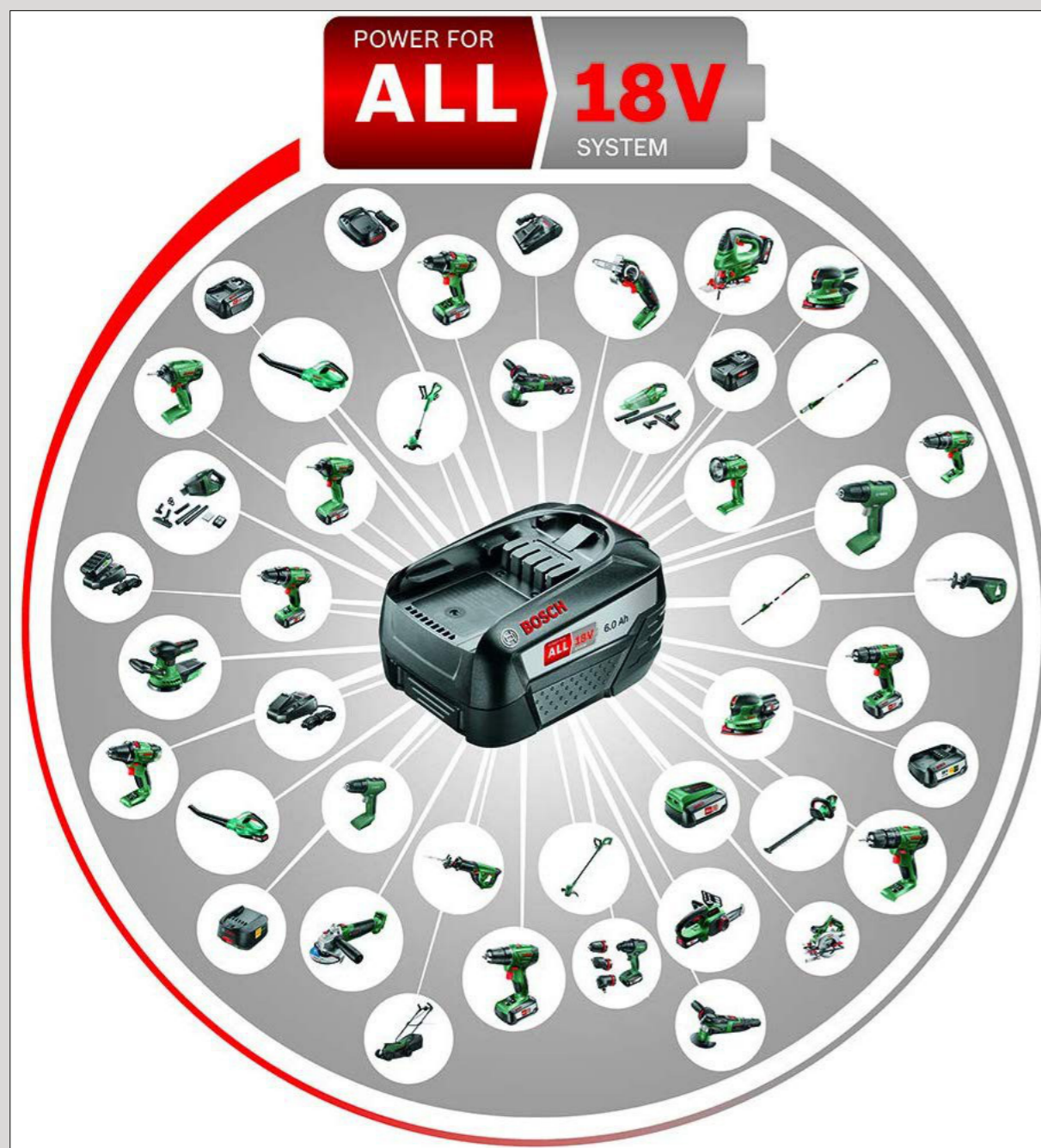
The message for heavy users such as landscaping businesses, institutions and governments is more urgent. Any professional use of hand-held, petrol-powered tools will quickly overtake the annual pollution from a car. A petrol-powered blower used constantly will reach 8 hours of running after one or two shifts. A mower used constantly will reach 28 hours of running inside a working week.

When regular and heavy users switch one petrol tool motor to electric power, it is equivalent to removing the annual climate damage and pollution of fifty or even hundreds of cars.



**Battery
power**

6 Electrification: costs & capabilities



Bosch

The section considers the practical issues of electrification - is it feasible, will it be effective and how much might it cost?

Ten years ago it would not have been realistic to propose the electrification of all hand-held, petrol-powered tools. Battery-powered tools such as drills and screwdrivers were widely available but these discharged rapidly and lacked 'grunt'. Powerful electric tools such as mowers were available but they drew their power from the grid through an extension cord. In the past, to get mobility, convenience and power it was necessary to use a petrol motor.

Improvements in battery technology have triggered a virtuous circle of increasing power and falling cost. Battery-powered tools have become more powerful which has increased sales which has made them cheaper which has made them still more popular. Over the last ten years the cost of the battery cells has come down by 87%. A further fall of 50% in the wholesale cost of cells can be expected in the next couple of years.

Today a bottom-of-the-range line grass trimmer and blower with an interchangeable battery can be bought for less than \$150. A mains-powered, corded lawn mower might cost \$160. A battery power lawn mower with an interchangeable battery might cost \$600.

Costs have been further reduced by designing families of tools around on shared battery. These families of household and garden tools are available from most major manufacturers along with a range of battery capabilities. A full household system might cost up to \$1,000. Stihl and other manufacturers have done the same for heavy-duty use. In the Stihl system a cable from a backpack battery plugs into a range of electric cutters, trimmers and blowers.

Domestic and light-duty use

Battery-powered tools are already capable of replacing petrol-powered tools for light and occasional household use. For bigger jobs, households could share the more powerful and more expensive batteries or could borrow them from hire companies and tool libraries.

Medium-duty tasks

One assessment of electric blowers in the United States says: 'The new breed of commercial-grade battery electric leaf blowers gives operators near petrol-like performance (power, speed, torque, weight, and run-times) while operating at about half the noise level. Furthermore, their electronic throttle controls and turbo modes empower well-trained operators to blow at lower speeds and rely only momentarily on power boosts when necessary. Not only does this further reduce the already lower sound levels it means less airborne dust and particulate matter [blown up from the roadway]'

Based on this review and local experience, it is very likely that tools linked to a 1.5kWh backpack battery can be used for for medium-duty tasks such as scheduled 'sweeping' on a school site or on-the-spot tasks undertaken by Councils such as removing dumped rubbish. These tasks do not require the tools to run for long periods and if the battery has not been charged or runs out at an inconvenient



moment, then a back-up broom can be used or the task rescheduled.

It is likely that many tasks undertaken by landscape contractors would fall into this category. Much of their day would be take up with travelling between sites and then bumping equipment in and out, reducing the working time of the tool.

Heavy-duty use over long periods

A key question is whether the hand-held battery-powered tools can take over all the tasks for which petrol-powered tools are used. For example, could they be used by a Council worker or contractor who runs a blower continuously for seven or eight hours a day.

The review above and analysis of the data published by Stihl - a supplier of 'commercial-grade battery electric leaf blowers' - suggests that they could.

The data suggests that Stihl's most powerful electric blower and biggest battery back pack can run on maximum setting for one and half hours. What this period might translate to in hours in the field is unknown. Neither an electric or petrol powered blower operator is going to run their machine constantly and at maximum power. Field tests would reveal how much of a work shift could achieved with a fully charged backpack battery by an experienced operator.

It seems unlikely that one battery will last a full shift. In which case it may prove necessary to have two or three back up batteries in the support vehicle to complete a full shift.

The data suggests that Stihl's most power electric blower is half as powerful as their top of the range petrol blower. Again field tests would reveal whether the lower maximum force of an electric blower was adequate for the tasks currently performed with a petrol-powered tool. The review suggests they are, although Australian leaves may prove to be tougher to move than those in the United States.

The data show that the cost of electric equipment is higher - roughly double the cost of the petrol-powered equipment. Purchase of multiple batteries would raise the price further. It might cost \$8,000 or more to equip one worker.

Such an investment would provide substantial value - increased workers health and safety as well as reduced neighbourhood noise, local pollution and global warming. However, beyond a trivial reduction in the cost of fuel, the investment would provide no financial return, as all the benefits are 'externalities'.

A comparison of Stihl's petrol-powered and battery-powered hand tools

The largest petrol-powered blower from Stihl (BR 200) costs \$1,100. The petrol-powered system weighs 14kg at the start of a shift (12kg, dry 2kg of fuel). Stihl reports this blower can generate noise up to 114dB(A) and has a blowing force of 41 newtons. The unit would need refuelling every 80 minutes if run constantly at full power.

The top of the range battery-powered blower system has three components: battery, harness and blower tool. The largest backpack battery (AR 3000 L) and the most powerful tool (BGA 200) costs



\$3,250 (\$200 for the harness, \$650 for the tool and \$2,400 for the battery).

The backpack battery unit weighs 10.8kg (9.5kg of battery, harness 1.3kg). This represents a 10% weight saving on the operators back. However the electric tool weighs 3.2kg which is probably more than the tool on the petrol-powered unit. A hip support-clip is available.

Stihl has not reported the run time for the newer and more powerful BGA 200 tool but says that the BGA 100 will run for more than eight hours on the lower settings. On the highest setting it will run for 95 minutes.

The top of the range petrol-powered brush cutter costs \$1,200 and weighs 8kg. Maximum noise is 113dB(A). The battery-powered FSA 130R grass trimmer costs \$700 and plugs into the backpack battery. It weighs 4kg and will run for 2.5 hours. Maximum noise is 94dB(A).



Stihl AR 3000 L battery & BGA 100 blower tool

BLOWER	RRP	WEIGHT	MAX NOISE DB(A)	BLOW FORCE NEWTONS
Stihl BR 800 2-stroke backpack & blower	\$1,100	14kg	114	41
Stihl AR 3000 L battery & BGA 100 blower tool	\$3,250	14.2kg (11kg + 3.2kg)	91	21

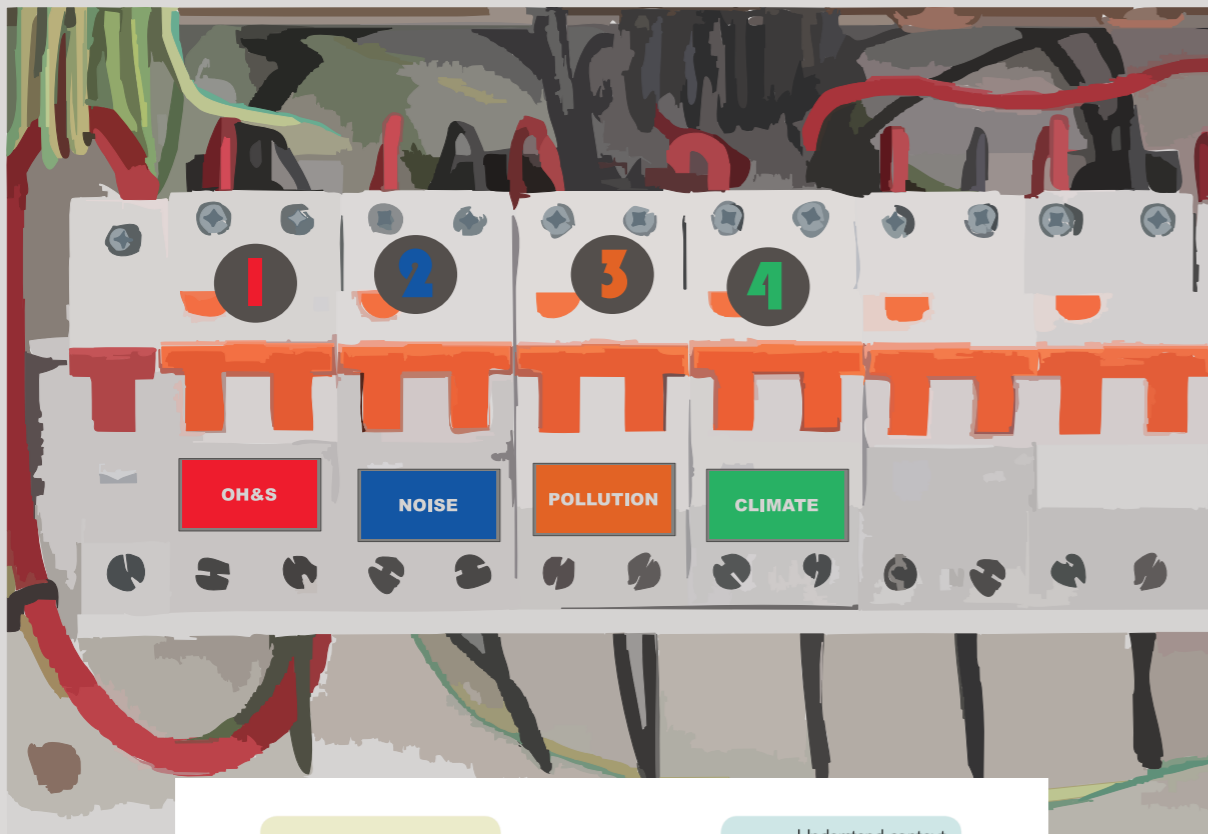
TRIMMER	RRP	WEIGHT	MAX NOISE DB(A)
Stihl FS 260 C-E brush-cutter	\$1,200	8kg	113
Stihl FSA 130R battery grass trimmer	\$700	4kg	94

Stihl Australia website



Rationale

7 Policy & program pathways



City of Glen Eira

This section considers the policies that might underpin programs that lead to electrification of hand-held, petrol-powered tools.

The four harms from hand-held, petrol-powered tools - OHS, noise, local pollution and global warming - are considered against four actors - households, small landscape businesses, institutions and local governments.

Some reasons are more compelling for some actors. Institutions and local government are probably more likely to invest in improved OHS than small businesses and households.

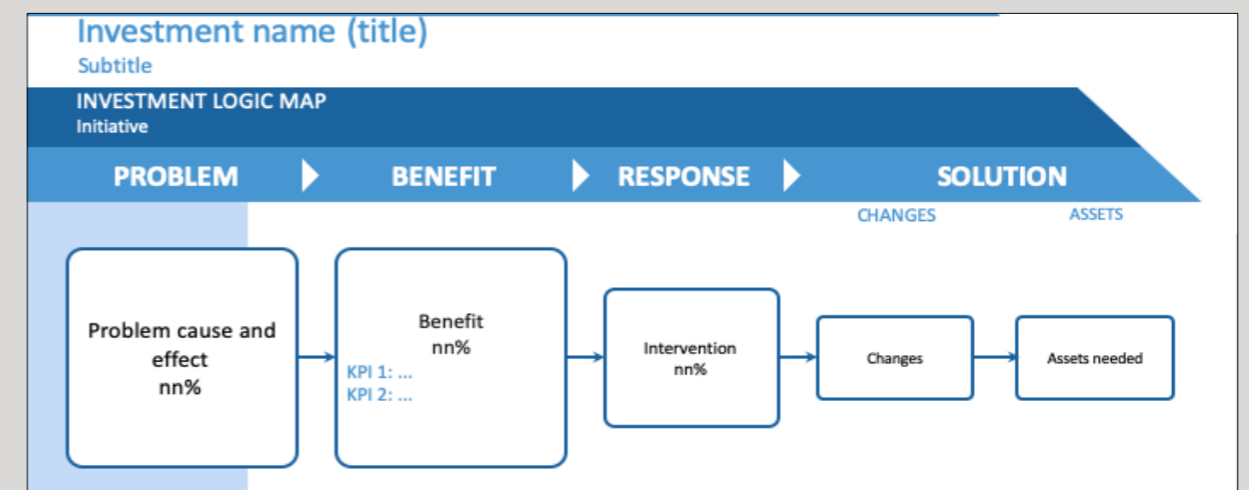
Some reasons are compelling for all actors and may be enough to make the case for electrification on their own. The health case for reducing local pollution may be strong enough on its own. A recent study found three quarters of Australians perceived the air quality as 'average' or less.

Climate change is perhaps the weakest stand-alone reason as the risk sits in an area of perceptual weakness. Unlike the other harms it is not immediate, detectable by the senses or linked to an obvious, single cause.

The reasons are mutually supportive. Those who are motivated to reduce one or two of the harms are likely to feel that the others are additional benefits. Someone with asthma for example, who has a strong view about local pollution is unlikely to withdraw their support for a program that also increases the level of OHS, reduces ambient noise and mitigates global warming.

This suggests that a multi-reason approach is most likely to be effective. A multi-reason approach would enable electrification through several program elements and interventions tailored to the different actors and their priorities. Effectiveness will also be increased by changing the emphasis of the program from community to community emphasising the most compelling reason in that area.

It will also be noted that costs are different for different entities. Heavy users in off-site locations such as small businesses and local government will need to spend more for 'professional' equipment and backpack batteries. Light-duty and occasional users will face lower costs.



Investment logic map, Department of Treasury Victoria



A safer, more pleasant workplace

The electrification of petrol-powered hand tools could be undertaken with the intention of reducing occupational health & safety risks to permanent and contract staff who use petrol-powered hand tools.

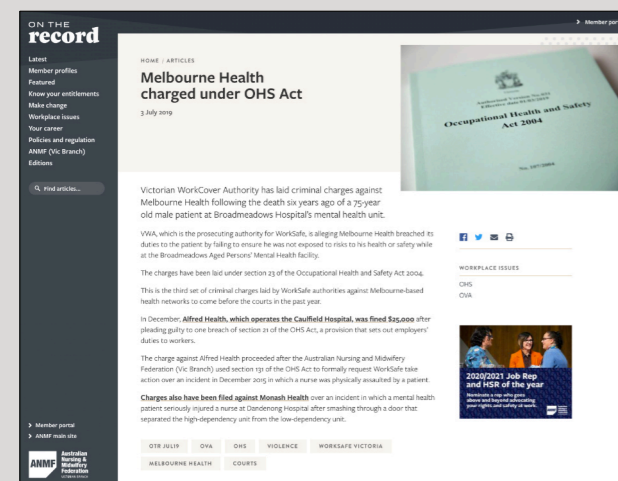
The rationale would be the ethical and legal requirement for employers to exercise a duty of care. In particular, employers have to pay particular attention to risks that are known and have severe consequences that are highly likely.

Duty of care can be demonstrated through policies and procedures. In the case of hand-held, petrol-powered tools, Councils and institutions have demonstrated duty of care in several ways: requiring the use of ear and eye protectors, the use of high visibility and reflective clothing and the employment of a 'spotter' alongside the tool operator. However only one of these interventions addresses the risks from the petrol motors and then only one of the risks: noise.

It may be that the current noise reduction measures are not adequate to protect the user from harm (and the organisation from liability). The motor noise levels are high and can enter the category of 'unsafe'. Ear protection is critical. The ear protection must be of a suitable standard, always worn, properly fitting and the foam inserts need to be cleaned and replaced regularly - perhaps as often as every three months. This is an onerous way to reduce what can be a high level of risk and a method that easily defaults to inadequate protection.

There does not appear to be any effort to reduce exposure of the operator to exhaust from the tool motor. The gases that are exhausted from the small motors are all harmful. In addition, the severity of risks from exhaust and noise rise as the frequency and length of exposure to the noise and uncontrolled engine exhaust increases. It appears that harmful gases and high levels of noise can interact in a way that exacerbates the harm from each source.

An employer that is challenged on the issue of duty of care can raise the defence of 'reasonableness'. Tests of reasonableness include: could the injury have been reasonably foreseen? and reasonably prevented?



Australian Nursing and Midwifery Federation

In the case of harms from petrol-powered hand tools, the harms are well known or at least well documented in the academic literature. The concept of harmful 'secondhand smoke' is widely understood. In addition the Disability Discrimination Act 1992 requires the employer to consider the needs of people with susceptibilities such as asthma.

Most importantly, reasonable prevention of the harms is available through the adoption of battery-powered hand tools.



Turn down the noise

The electrification of petrol-powered hand tools could be undertaken with the intention of reducing neighbourhood noise.

Municipalities have a long history of controlling noise and local pollution. In Victoria, the Environment Protection Act of 1970 provides a framework within which Council can act.

Neighbourhood noise remains a problem. Prior to the revision of the noise regulations in 2018, the EPA published a regulatory impact statement. The statement reported that 'neighbourhood noise' is a major concern equivalent to noise from road traffic and greater than from alarms, construction, dogs and music.

The EPA found that the proportion of people affected by residential noise has almost doubled in recent years. This increase is greater than that experienced for other significant noise sources. Neighbour noise was rated as more annoying than all other types of noise. Neighbour noise is frequently reported to councils and the EPA. The Dispute Settlement Centre of Victoria reports that noise is a common cause of conflict.

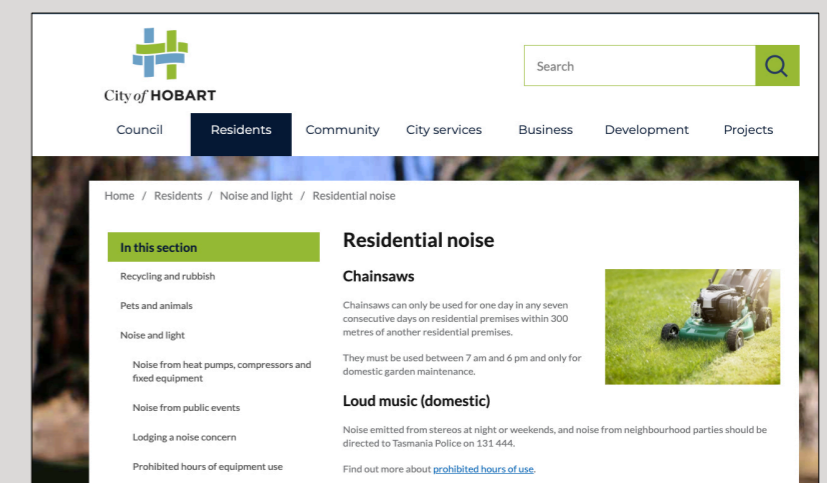
In the Regulations, noise sources are grouped by type. Internal combustion engines including grass cutting with mowers and other devices are in Group One. Electric power tools are in Group Two. These two equipment groups have the shortest period of permitted use 0700 - 2000 on weekdays and 0900 - 2000 on weekends and public holidays.

Rather than using a decibel measure, the EPA regulations define unacceptable noise as 'audible within a habitable room' and 'not unreasonable'. Petrol-powered blowers are certainly 'unreasonable' as the sound travels a long way and the low frequencies in particular easily penetrate windows.

The states that use a decibel measure define the maximum noise in the 'daytime' as 52 dB(A) and 45dB(A) at night. Blowers can reach 112 dB(A) and as we have seen an increase of 10 dB(A) means the sound power has increased 10 -fold or 1,000% and people will perceive that the sound intensity has doubled.

There are strong grounds for Councils to begin a community conversation and develop a community agreement on the reduction of 'neighbour noise' through the replacement of petrol-powered hand tools.

The conversations will develop in different ways in different areas but several pathways are likely. Small scale trials could be



City of Hobart



agreed in some neighbourhoods and then, if successful extended to other areas. Initially, the quiet periods could be for part of the day and part of the week. If successful, the periods could then be extended until at an agreed stage the whole week was ‘quiet’.

A first step could be to reduce the permitted operating hours of petrol devices to ‘mornings’: 0700 - midday on weekdays and 0900 - midday on weekends and public holidays. This would provide ‘quiet afternoons’ that would suit sleeping babies and the sleep pattern recommended for night shift workers. (For a worker starting work at 2300, it is recommended that they sleep from 1300 to 2100.) Under this approach people could still work on their gardens in the afternoons if they use electric and battery-powered tools.

‘Quiet afternoons’ would require petrol-powered landscape businesses to choose to avoid bookings in the afternoon or acquire electric tools for afternoon work. Council could support this equipment changeover with scrappage schemes for small businesses and households (see Interventions below) and the promotion of all-electric landscaping business. A further step could be to introduce ‘quiet weekends’ for example.

A breath of fresh air

The electrification of petrol-powered hand tools could be undertaken with the intention of reducing local pollution - an effort in which local governments have traditionally played a leading role.

Incinerators

Council late last year passed a By-law to govern the use of fires in the open incinerators and barbecues. 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 barbecues 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



bans on Fridays and Mondays were introduced in part because people wanted to be able to hang out their washing without it getting covered in ash or have it smelling of smoke.

Our understanding of the health impacts of air pollution is greater today (but perhaps not complete). The research is definitive that airborne particles can have long-term and short-term adverse on human health even when the smoke is ‘natural’. This was demonstrated during the 2019 - 2020 bushfires. Over the five months of the fires, the bushfire smoke was responsible for 417 excess deaths; 1,127 hospitalisations for cardiovascular problems; 2,027 hospitalisations for respiratory problems; and 1,305 presentations to emergency departments for asthma across NSW, Queensland, Victoria and the ACT.

The local pollution caused by petrol-powered tools is far more harmful than bush fire smoke. Both types of pollution enable particulates to lodge in the lungs but the exhaust gas from petrol-power tools also contains a soup of hydrocarbons, carbon monoxide and nitrogen oxides. Research by the Australian Institute of Health & Welfare suggests that hospitalisation for asthma is directly related to the level of NOx and particulates in the air.

On this platform Councils could begin a community conversation and develop a community agreement on the reduction of local pollution by the replacement of petrol-powered hand tools to protect those at risk from poor air quality such as those with asthma, chronic obstructive pulmonary disease, or cardiovascular disease.

Slowing global warming

The electrification of petrol-powered hand tools could be undertaken with the intention of mitigating global warming. This is an emerging role for local government.

Implementation occurs through several channels include strategy statements (such as declarations of a climate emergency), policy content (such as stormwater capture), investments (both direct such LED street lights and solar panels and indirect such as purchasing offsets and selling all fossil fuel-related securities) and initiatives that aim to influence the actions of others (such as messaging and energy foundations). In general, implementation is accelerated and occurs more widely when all possible channels are used in a complementary and integrated approach.

Several principles are emerging around climate investments:

- Time is limited so ‘something is better than nothing’ and ‘available solutions should be adopted’.
- Money, attention and effort are limited, so ‘climate investors’ should look for value and buy the largest quantities of mitigation for the lowest price.
- People’s actions are constrained by ‘bounded rationality’ so investors should look for those that have the lowest ‘effort of change’ or ‘behavioural resistance’.

Council Resolution

City of Darebin

MOVED: Cr. T. McCarthy
SECONDED: Cr. S. Amir

That:

- (1) Council recognises that we are in a state of climate emergency that requires urgent action by all levels of government, including by local councils.
- (2) Council establishes an Energy and Environment Working Group to further develop Council proposals for a Darebin Energy Foundation and a Darebin Nature Trust, as proposed by four elected Councillors during the recent Council elections. The Working Group will comprise the Mayor and all Councillors who wish to participate and will be supported by relevant Council officers. The Working Group will meet on a regular basis over coming months to develop proposals for Council's consideration at a meeting in February 2017.

CARRIED UNANIMOUSLY



Under these criteria, the climate investment case for the switch to battery-powered, hand-held tools is strong.:

- Battery-powered hand tools are widely available today and easily adopted
- The replacement of small, highly polluting motors is cheaper and per hour of use has a greater global warming impact than replacing larger motors with effective pollution controls (such as motor vehicles)

On the other hand, a plan to switch to battery-powered, hand-held tools will have to deal with several behavioural barriers. Owners of functioning tools may underestimate the climate harms of their tool, see the cost of a replacement as 'avoidable' and may be reluctant to replace an existing tool that is 'an old friend' and 'working well'. These barriers are surmountable. In most cases, the cost is not high and the expense can be spread - buying one new tool at a time for example. Social confirmation and constraints on use can be brought in to help stimulate decommissioning.

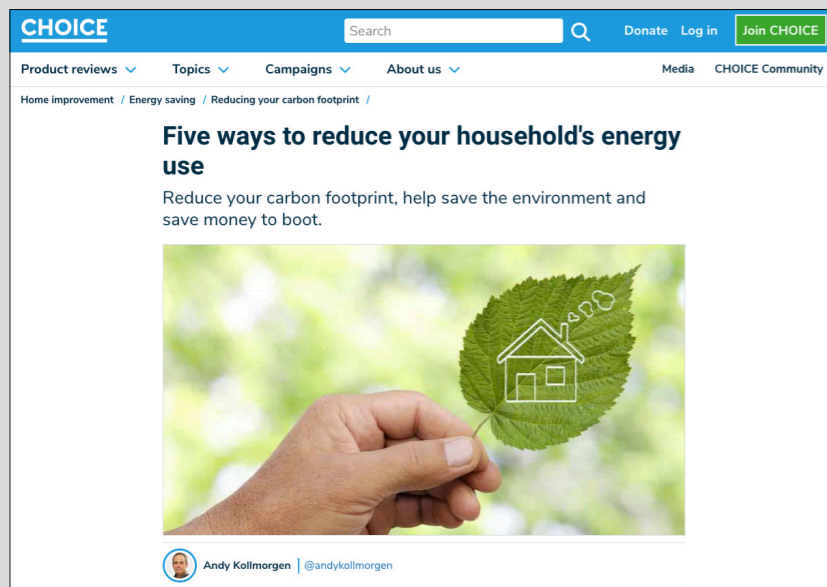
The following sections consider the financial aspect of investments by four actors: households, small business, institutions and community leaders.

A household climate investment

Many household climate investments require large capital sums. Examples include ceiling insulation, double-glazing, heat-pump electrification of hot water, solar panels or an electric car.

A household can probably switch their main garden tools (mower, blower and trimmer) to an 18volt battery system for under \$1,000. The total cost can be staged over several purchases. 'Installation' is easy and the effect is immediate.

The climate impact of this investment would depend on how often the tools are used and for how long as well as how much was spent on the electric tools. For households with gardens this investment will rank as one of the cheapest, easiest and highest-impact household climate investments.



Uptake will be slowed by inertia and lack of a visible, countable 'return'. Unlike a switch to LED lights or solar panels, a tool switch offers no material future financial benefits. Health 'dividends' for those with cardiac or breathing problems could be perceived as material benefits.

Uptake will be accelerated by the actions of 'others'. It



has been found that households are more likely to install solar panels if they see panels on other houses in their neighbourhood. It is likely that a climate investment in battery (or electric) tools would be facilitated by constraints on use and the knowledge that Council, institutions and other households in the neighbourhood were using 'quiet, clean' tools.

A small business climate investment

A climate investment in the electrification of hand-held tools used by landscape services would have a high climate return as these motors run for several hours a day.

Small business investment is a notoriously tricky area. Valuable investments of any type are often overlooked by busy business owners who find it difficult to spend time 'on the business'. Behavioural resistance to climate-related investments has been shown to occur. Small businesses can overvalue the immediate cost of purchase and undervalue running and maintenance costs over the life of the equipment. Even when a small business wishes to make the investment, the capital sums required can threaten all-important cash flow.

Nonetheless, businesses do make climate and climate-related investments. Some businesses intentionally source more expensive inputs including organic, fair trade, low emissions and local products. These climate-related investments are being made by business owners who have 'a purpose' alongside making a profit and are being 'pulled' by customers who are prepared to pay more for a climate-friendly service.

Today, there appear to be few landscaping and garden service providers in Australia that are 'all-electric' or advertise their use of electric tools. This is not because they could not afford to do so. It appears that a single-operator garden service might have an annual gross margin of \$100,000. Promotional material from Jim's Mowing reports that one franchise holder does three times better than that.

A landscaping business can probably switch an operator over to electric tools for less than \$10,000. (A 60cm battery powered lawnmower might cost around \$3,000 while two backpack batteries, a blower and trimmer might cost \$6,000.) For a small business, these expenses could be spread over several years through a business loan or a staged equipment changeover. All costs would be tax deductible. (A \$10,000 loan might cost around \$1,000 over three years.)

The climate benefits of the equipment changeover would be substantial but not necessarily appear in the business's profit and loss. Switching to electric would have some

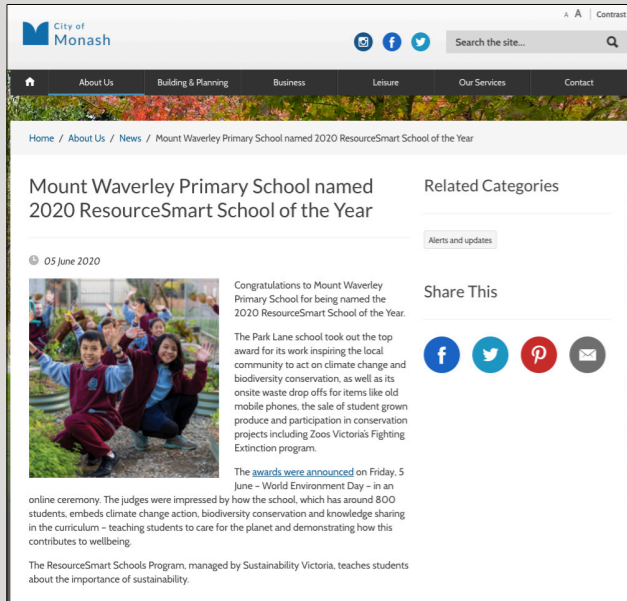
More green businesses than ever

A US study by Office Depot found that almost two-thirds of small businesses are actively trying to go green, and 70 percent anticipate doing more in the next two years. These green businesses are now more likely to be called sustainable because low-waste practices often help reduce costs and boost financial performance.

Sustainability: why should a small business bother?

Sustainable businesses take steps to replace, protect or conserve natural resources. Obviously that can help combat serious environmental issues like climate change and plastic pollution. But there's more to it.

- **Sustainability may lower your costs and increase profitability**
Resources cost money so using fewer of them helps the bottom line. As a result, sustainable businesses often perform better financially according to studies by organisations like the Economist Intelligence Unit, Harvard, and MIT Sloan.
- **Staff, customers and investors are more likely to choose you**
When deciding which brands to engage with, staff, customers and investors all say they care a lot about the societal impact of that business (according to the 2019 Edelman Global Brand Report).
- **Governments care**
Climate disruption has already cut global GDP by 1.6%, according to the DARA Group. That makes sustainability a major concern for governments and they increasingly expect businesses to reduce their footprint.



non-climate benefits for the business. Possibly the ability to start work earlier or finish later, fewer complaints, an easier working day due to lower noise levels and the health benefits from avoiding exhaust smoke. Businesses in the United States report savings in tool fuel and maintenance.

An all-electric business may be able to turn the equipment investment into a marketing advantage. Electrification could enable smaller owner-operator firms and those with strong local identities and connections to offer a point of difference to the big franchises. Constraints on time of use would motivate some firms to purchase battery-powered equipment.

Climate investments by institutions

Another significant user segment are the institutions which use hand-held, petrol-powered tools for on-site maintenance. These include schools and other educational centres, aged care centres, apartment and office buildings, shopping centres and hospitals. Recently St Vincents Health Australia challenged the hospital and aged care sector to ‘do more to reduce your carbon emissions’.

On-site maintenance equipment can be replaced relatively cheaply as a set of smaller, interchangeable batteries can be used and charged several times a day. If all the batteries discharge before the work is complete, the task can be picked up on the following day.

For institutions it is likely that the issues of worker health and safety, noise and local pollution will be salient. Schools which have switched to electric tools for health and safety reasons have found an unexpected benefit in being able to undertake site maintenance

when classes are in session and people are on site during the day. Similar on-site benefits would accrue to many institutional users.

Climate investments by local governments

Commonwealth, State and local government are key institutions as they manage and maintain large areas of land. Local government maintains open space, roadways and footpaths directly and through contractors. Staff performing these functions operate away from base, typically working out of a support vehicle that carries equipment and supplies.

Some maintenance with hand-held, petrol-powered tools is unscheduled and light duty - cleaning up dumped rubbish for example. These tasks can be completed using cheaper electric tools powered by several switchable, small batteries.

A significant proportion of maintenance is scheduled, off-site and heavy duty. Some staff run petrol-powered hand tools all day, day-after-day. As was noted for private landscape contractors, it may cost up to \$10,000 to re-equip each off-site hand tool operator with a full suite of tools powered by a back pack battery. Several large batteries may be needed to complete a full off-site shift.

Councils that have declared climate emergencies are more likely to make - or explore - this relatively cheap and quick reduction in global warming gases. Such a decision is not certain however, as several factors will weigh against it.

Not on the menu

First a switch to battery-powered hand tools is not ‘top of mind’ as a climate solution. For example, the switch to electric tools is not listed by advice organisations focused on ‘energy’ such as the Australian Energy Foundation and the Yarra Energy Foundation. Solutions that are not ‘on the menu’ cannot compete effectively with other climate investments such as solar panels or LED lighting.

Obscured by offsets

Second the need to reduce Scope 1 emissions (those that the organisation is directly responsible for) may be obscured by the purchase of offsets.

Offsets are a necessary part of any global warming mitigation strategy as some emissions are under the control of others. (Scope 2 - emissions are those generated by suppliers to a business and Scope 3 emissions those generated by activities related to the business - for example - customers driving to a business or community centre.) Offsets are the only way to immediately minimise the



City of Monash, KPBS San Diego Public Radio & TV

The crises that occurred under our super-heated atmosphere have led to many people seeking out ways to reduce their own impact. **One topic that is raised time and again by our community is whether, and how, to offset greenhouse gas emissions.**

The answer is more complicated than you would think.

The Climate Council's recommendation on this is based around the following principles:

1. Offsetting greenhouse gas emissions with vegetation projects—for example, by planting trees—is no substitute for preventing the burning of coal, oil and gas in the first place.
2. The most important thing to do is find ways to prevent the burning of coal, oil and gas in the first place.
3. After reducing consumption of fossil fuels as much as possible—and after putting in place plans to reduce their use by more in the future—if you choose to offset fossil fuel use, it is best to do so with projects that avoid fossil fuel use rather than through vegetation-based projects.
4. Restoring Australian landscapes is essential on its own terms, not just for environmental reasons, but also to manage climate change. And vegetation-based offsetting is better than nothing at all.

Taking action on climate change means one thing above all else: Australia, along with every other country, must drastically reduce consumption of coal, oil and gas. The atmosphere is overloaded with heat-trapping gases. **Put simply, to avoid making climate change worse, we must stop adding to the problem.**

The sooner we stop burning fossil fuels, the better it is for the destabilisation of the climate. It is not possible to meet the globally-agreed temperature goals without very deep, urgent and enduring cuts to fossil fuel consumption.



impact of these emissions.

Offsets have a role in the short term for direct or Scope 1 emissions. Here they buy time for the organisation to eliminate the source of the problem. The risk is that, once the offset has been purchased, it is easier to leave the source of the emissions as it is and keep buying the offsets. This risk increases when the offsets are cheaper than the cost of eliminating the source of the problem.

Unfortunately there are many cheap offsets available. The cost to offset a tonne of carbon can be as low as \$3 when sourced overseas compared to a local cost of \$16 in Australia. In Europe a tonne of carbon costs \$50.

The low cost of offsets can be due to several factors. A key one is that in Australia we have not set a date or a quantity target - net zero by a certain year. When a net zero (or other quantity target) is set against a date, then the price of the offset can be linked to the level of permitted emissions. Over time the number of 'permitted tonnes' will steadily reduce and the cost of the offset will steadily rise. As the cost of the offset rises, people can compare the cost of the offset to the cost of eliminating the source and choose the cheapest.

Today the low cost of offsets makes running petrol-powered, hand tools cheaper than purchasing a low-emissions alternative. At \$16 a tonne, a full-time blower operator might generate around \$100 worth of carbon emissions in a year. (This offset would not cover the impact of the motors on the operator or the local noise and pollution.) Over a five-year period the offsets would be equivalent to 15% of equipment capital cost of \$3,000. If the offset costs \$50 a tonne, then over three years the

offset would cost around \$1,000 or one third of the capital cost.

These calculations obscure the main principle which is to eliminate the emissions under an organisation's direct control (Scope 1).

Obscured by electrification of motor vehicles

The other risk to hand tool electrification is that it will be postponed in favour of the electrification of light motor vehicles.

There is no doubt that all internal combustion motors will need to be replaced by battery powered motors. However, today, the electric motor vehicle is an expensive way to reduce emissions.

The likely additional capital cost for an

electric vehicle is around \$15,000. There may also need to be further expenditure on charging infrastructure and possibly electric wiring or rewiring.

Estimates suggest that a private owner can recover the additional capital cost of an electric vehicle through reduced fuel and maintenance costs if their vehicle-kilometres-travelled is double the Australian average - around 30,000km year. However, it is unlikely that a Council vehicle will get this level of use.

Councils could take advantage of the lower maintenance costs and higher resale value of electric vehicles by retaining electric fleet vehicles longer than normal. (The Nissan Leafs in the City of Melbourne fleet are more than six years old.) However, these savings are unlikely to make up all of the additional capital cost.

The other problem with vehicle electrification is that the 'gap' between the relatively efficient new internal combustion engines is smaller than the gap between the uncontrolled hand-held, petrol-powered tool motors and their battery equivalents. A Council that had \$60,000 to spend on a climate initiative could achieve greater climate savings through a tool replacement program that replaced six heavy-use, hand-held, petrol-powered tools than by replacing four cars.

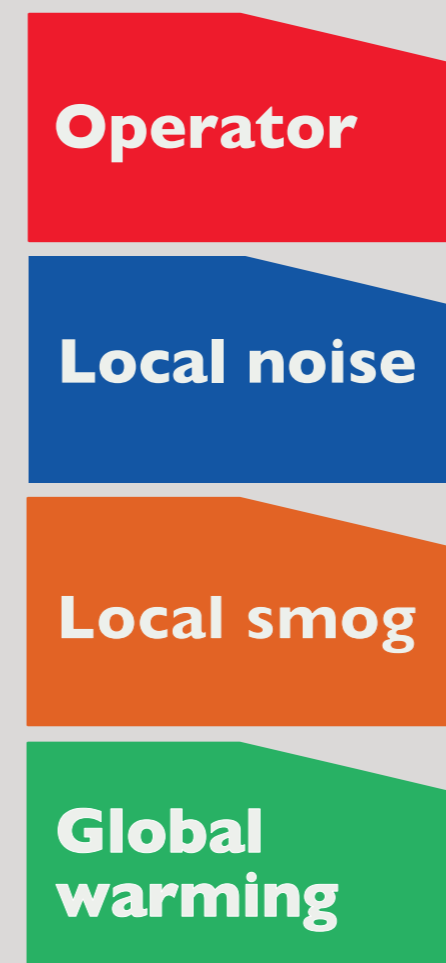
Lake Macquarie council flicks switch on electric vehicle charging strategy, buys four new electric-powered cars
Max McKinney • March 10 2020 - 12:00PM



TRANSITION: Plant and fleet coordinator Glenn Hattander with one of the council's new electric vehicles.

Councillors unanimously voted to adopt the electric vehicle charging strategy on Monday night and on Tuesday the council revealed it had purchased four new electric vehicles for its fleet.

Newcastle Herald

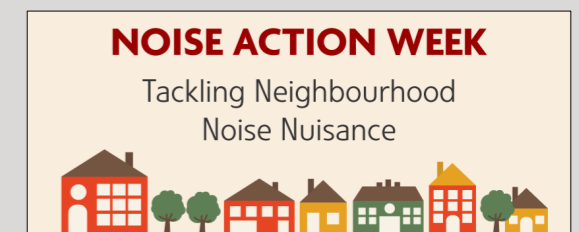


Operator

Local noise

Local smog

Global warming

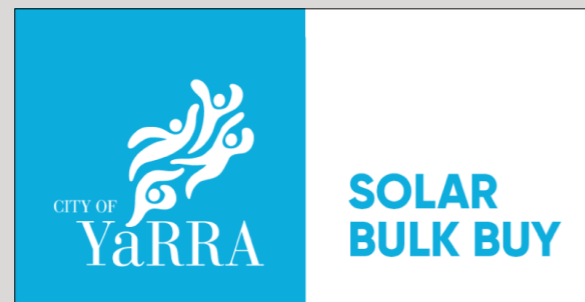
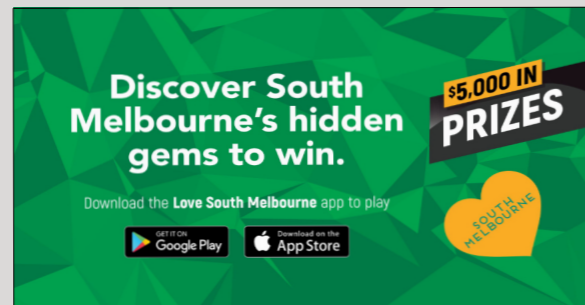
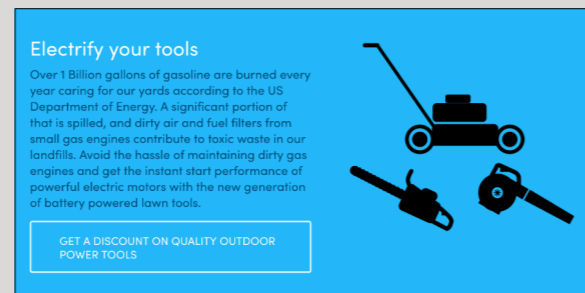


Safework SA, Cirrusresearch.co.uk, World Lung Day, MrBigBear Reddit



Program options

8 Barriers & Interventions



AGZA at Garfield Park South Pasadena, South Coast Air Quality Management District, State of Utah, Communityenergy.org, City of Port Phillip, City of Yarra

This section discusses interventions that could support programs to accelerate the electrification of hand-held, petrol-powered tools.

OHS programs

No new OHS concepts will need to be introduced to support an OHS program that replaces hand-held, petrol-powered tools.

The need to reduce exposure to high levels of noise is well known. Within the tradition of OHS there are many examples of programs that have reduced the inhalation of dangerous substances by workers (and the public). Examples include the identification and then elimination of the risks from asbestos dust, the removal of lead from petrol and smoking. Some Councils are currently in the process of rolling out programs that replace glyphosate to reduce risk to workers and the public. The elimination of dangerous equipment is also standard practice - 'tagging' of electrical cords is an example. Some companies ban the use of widely used and widely available tools such as fixed blade 'Stanley' knives, '9-inch' angle grinders and 'Ocky' straps.

Two barriers to an OHS program can however, be anticipated.

There will need to be a reassessment of the risk profile of hand-held, petrol-powered tools as it appears the OHS risks from hand-held, petrol-powered tools are not fully recognised or underestimated and that the standard control measures are inadequate

One State Government 'Plant and Equipment Risk Management Form' lists the 'Key risks' for a petrol-powered blower as impact, cutting, noise, vibration, ergonomics, fire and explosion and dust. Exhaust gases are not listed as a key risk. Later in this document the risk of toxic gases, vapours or fumes is identified. The risk likelihood is listed as 'possible', the risk consequence 'minor' and the risk level as 'medium'. The control measure is 'to only operate where there is adequate ventilation'. A similar risk assessment is made for noise and the control measure is 'adequate ear protection'. That a regular and heavy user might need Class 4 or Class 5 ear protection (105 - 110 dB(A) eight-hour equivalent continuous sound pressure level) is not identified.

A reassessment of the risks would be likely to lead to the realisation that operator protection will need to be increased including highly effective hearing and breathing protection systems, the introduction of carbon monoxide monitors, health checks and more rigorous compliance checking. Investment in electrification could then be considered as an alternative to investment in increased protection.

Alongside the assessment barrier, an OHS effort to replace hand-held, petrol-powered tools will need to overcome the barrier of 'familiarity'. Today people at work and away from work regularly inhale burnt and unburnt petrol, handle petrol products and experience the noise from combustion motors. This familiarity reduces awareness of the risks and their severity. Familiarity also provides a mental landscape in which the harm can be interpreted as a benefit. Early efforts to reduce drink driving had to deal with the belief among many that they 'drove better drunk'. Recently, prominent regular smokers have claimed smoking would protect them from the COVID-19.



In this context, some effort may need to be made to explain why, from an OHS perspective, the change is being made. It may be useful to emphasise the non-OHS advantages of electrification. The benefit of being able to talk while working, wear lighter (or no) ear protection or ‘gas mask’ may be more salient to tool operators than the health benefits (which they may underestimate). An advantage for supervisors is that they will be able to reduce (or eliminate) health, equipment and safety-equipment compliance checks.

Public surveys & discussion

Local governments in the United States that have reduced or eliminated the use of hand-held, petrol-powered tools have generally started with or been drawn into a public discussion. It does not appear that any systematic process has been followed.

Based on this experience it is likely that some form of community survey would be useful at an early stage. A survey could be used to reveal:

- What people are doing. Studies in the United States have found significant variation in the type of equipment, size, type and age of motor, level of use as well as the months and days of use between different municipalities.
- How well people understand the links between the use of hand-held, petrol-powered tools and personal safety, neighbourhood noise, local pollution and climate change
- How well people understand the availability of alternatives, their cost and capabilities.
- Expressed preference surveys could explore how people would feel about a range of pathways towards electrification (including no pathway).

Based on the survey results, a public conversation could be undertaken to identify a pathway to electrification.

Scrappage schemes

The community conversation could be supported by a voluntary scrappage or ‘amnesty’ program.

Recently the New Zealand police held a successful ‘buy back’ scheme related to the new gun laws. This



scheme linked the scrappage fee to the type and condition of the fire arm. Scrappage fees ranged from \$600 - \$8,000 for one weapon. Two thirds of the registered firearms in the newly prohibited category were recovered.

Hand-held, petrol-powered tool scrappage schemes are being run successfully in the United States. In

one scheme, residents can receive \$250 towards a battery electric mower when they hand in a petrol-powered lawn mower for scrappage. Commercial landscapers, school districts, colleges and non-profits can receive vouchers up to 75% of the cost of electric equipment such as handheld trimmers, chainsaws, pruners, backpack and handheld blowers and ride-on, stand-on, walk-behind and robotic lawn mowers.

In this scheme the rebate that is triggered when (a) the new battery-electric equipment is purchased and (b) an equivalent and operable petrol or diesel powered piece of lawn or garden equipment is handed in and scrapped. (The scheme uses accredited de-manufacture and recycling services to ensure that the recovered equipment is not resold and put back in to use.) Priority access to rebates is given to disadvantaged individuals and communities. The program is supported in part through sponsorship and promotion from wholesalers like Stihl and garden tool retailers.

The scrappage scheme in the US is supported by what Australian farmers call ‘field days’ held in local parks. Field days give people the opportunity to test drive the tools and ask questions before purchase.

Several weaknesses in the US scheme could be remedied.

One weakness is that the rebate is fixed at \$250. This rebate may be too low for some who will choose to retain their old tools. But it will almost certainly be unnecessarily high for others. There are likely to be people who would have switched for a \$100 or \$200 rebate. This can be remedied by introducing an on-line, reverse auction, which allows people to identify the minimum rebate they would accept. The budgeted incentive pool would then be distributed among the lowest bidders allowing more people to benefit and more tools to be scrapped per dollar of incentive.

Another weakness of the US system is that it does not seek to release community contribution and goodwill. It is likely that many people will switch over their tool in return for a ‘thank you’, free ice cream or a shared photo on social media.

Nor does the rebate have to be paid to the ‘switcher’. Successful incentive programs in Australia have directed rebates to good causes. People who know people with asthma may hand in their tools and recruit other ‘switchers’ knowing that the rebates go to a good cause such as a local school or asthma association for example.

Bulk buys

Many Councils have run successful ‘bulk buy’ schemes for solar panels. Some have expanded the schemes to include domestic battery systems. Bulk buys for electric tools could be offered alongside a scrappage scheme.

Different rules for new residents

Many Councils operate kerbside car storage permit systems that provide permits to incumbent households and deny them to those moving into new developments. This approach could be taken with hand-held, petrol-powered tools. People moving in to the municipality could be required to use electric tools and be eligible for the scrappage scheme. As around 17% of the population moves house each



year, the proportion of ‘quiet’ households is likely to expand quickly.

Smog days

Some of the hand-tool electrification programs in the United States restrict the use of hand-held, petrol-powered tools on days of high pollution. Early backyard incineration controls also prohibited burning on ‘days declared to be high pollution’ by the EPA.

High pollution days vary by location. For Melbourne, days when the exhaust from hand-held, petrol-powered tools make a bad situation worse include:

- Seasonal factors:
 - Still days with medium humidity associated with planned bush burning
 - Periods in summer and autumn when higher temperatures facilitate the formation of low-level ozone including multiple days when the maximum daily temperature is greater than 30°C
 - Cool winter days with still conditions when high levels of smoke from wood fire heaters combine with motor vehicle emissions.
 - Days when there are high concentrations of pollen or wind blown dust from farmland or heavily used unsealed roads
 - Peak hospital admission days for asthma (HAADs) occur in in the late-February return-to-school peak, the June viral infection peak and the November allergy peak
- Incident based factors:
 - On days when bushfire smoke is in the atmosphere
 - On days when there is smoke from industrial, chemical or brown coal fires.



EPA Victoria



Further reading

9 Notes & Bibliography

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



Notes

Definition: hand-held, petrol-powered tools

Small internal combustion engines are used for applications across several domains.. Typical applications include transport (motor scooters and motorcycles) and boating (including fishing, water skiing and general recreation), small generators and tools ranging from concrete saws and jackhammers to whipper snippers. For most applications two and four-stroke engines are available - there are two and four-stroke lawnmowers, motorcycles and outboard motors for example.

To conduct research, evaluation or public debate it is necessary to simplify this complex situation. Recent Commonwealth consultation and regulation was based on the concept of ‘non-road’ applications. This included lawnmowers and outboard motors but excluded scooters and motorcycles. Other ways that the ‘pie’ has been cut is to isolate:

- ‘Spark ignition engines’ This excludes diesel engines but includes small inefficient motors with spark plugs as well as large more efficient motors that use computer-based fuel injection and combustion management.
- Two and four-stroke engines. There is a difference in noise and emissions between the two types of motor. However this difference is one of degree - both types of engine are harmful in slightly different ways.
- Lawn and garden equipment. This definition is judged to be vague (are chainsaws included or not?). It also implies a focus on domestic applications whereas the heaviest users (most hours of operation and largest motors) are probably governments and institutions.

This report uses the term ‘hand-held, petrol-powered tools’ as this is judged to be precise and appropriate for a general audience. The definition includes domestic lawn, garden equipment and public space maintenance equipment powered by two or four stroke motors mounted on the tool or carried by the operator.

The definition and this report excludes all other small, petrol-powered, spark-ignition, road- and non-road engines such as motorcycle, outboard motor and generator engines. These applications are not excluded because they are not harmful. Small petrol powered motors are all harmful. However the excluded applications are perhaps not yet ready to be electrified; are less likely to be used by paid staff, some are less likely to be used in built up areas; and are less likely to be used by organisations.

Raised dust

One harm has not been discussed in this document - raised dust.

Public debate and regulations related to blowers used in landscaping in the United States includes discussion of the public health impact of the dust and pollen particles on the ground that are swept into the air by the machines. The harm from raised dust is not discussed in this document as the harm is caused by both petrol-powered and electric tools. The omission of this problem does not mean that it is judged to be trivial.

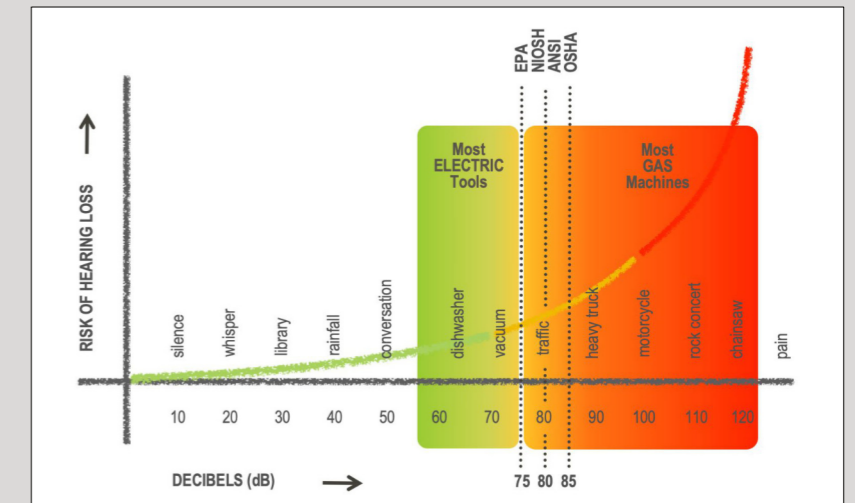


Evidence about Noise

There is plenty of general and in-depth information about noise in the workplace and public noise and how hand-held, petrol-powered tools contribute to that noise.

One of the challenges in understanding for the inexpert reader (and document complier) is that the noise scale is logarithmic. To quote Safe Work Australia. ‘Decibels are not like normal numbers. They can’t be added or subtracted in the normal way. The decibel scale is logarithmic. On this scale, an increase of 3 dB therefore represents a doubling or twice as much sound energy. This means that the length of time a worker could be exposed to the noise is reduced by half for every 3 dB increase in noise level if the same noise energy is to be received.’

The take home message for a general audience is that a few decibels makes a big difference and that there is a significant difference between noise at 75 dB(A) and 85 dB(A).



AGZA - American Green Zone Alliance agza.net

Australia

- Regulatory Impact Statement: proposed Environment Protection (Residential Noise) Regulations 2018 EPA Victoria
- Noise Control Guidelines EPA Victoria Publication 1254 2008
‘These guidelines are primarily intended to be used by municipal officers to assist in the resolution of complaints or to avert a possible noise nuisance. Some guidelines have been prepared so that they could be incorporated into a permit condition of a development or embodied as a local law.’
- Noise Guide for Local Government NSW EPA 2013
(This guide) ‘aims to provide practical guidance to council officers in the day-to-day management of local noise problems and in the interpretation of existing policy and legislation.’

Washington DC and San Clemente City Council

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General

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Exhaust & Emissions

There has been a lot of work on the impacts of toxic gas, 'air pollution' and the emissions that accelerate global warming. Causes such as transport emissions have been thoroughly studied. Some work has been done on small internal combustion engines, mainly in California and in countries with large timber industries.

The main problem with the available evidence is that the emissions from small motors are difficult to predict as it depends how old and worn the motors are, whether they are running cold or hot, the quality and condition of the fuel, how they are used (how clean the air filter is, whether the choke is in or out and how hard the engine is 'revved') and whether the ambient wind and temperature favours smog-forming chemical reactions. It appears the research, which is generally done under controlled conditions, underestimates how 'bad' the motors are.

Hand-held, petrol-powered tools

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the Alert, 'Preventing Carbon Monoxide Poisoning from Small Gasoline-Powered Engines and Tools' Publication No. 96-118a. NIOSH Centres for Disease Control USA

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- Characterization of Emissions from Handheld Two-stroke Engines. Gabele EPA USA
- Comparison of Nonroad Hazardous Air Pollutant Emissions Included in the National Emission Inventory Chang, Billings, and Perez
- Emissions from in-use lawn-mowers in Australia. Priest Williams Bridgman University of Newcastle 2000
- Emissions of Nitrous Oxide and Methane from Conventional and Alternative Fuel Motor Vehicles. Lipman Delucchi Climatic Change 2002
- Feasibility of bioethanol and biobutanol as transportation fuel in spark-ignition engine: a review Yusoff, Zulkiflin et al Royal Society of Chemistry 2015
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Australian Government - two stroke legislation

Retailers are no longer permitted to sell new (non-road) two-stroke engines. This regulation is supported by a regulatory impact statement and other documentation.

Department of the Environment and Energy Australian Government:

- Reducing Emissions From Non-Road Spark Ignition Engines And Equipment Decision Regulation Impact Statement September 2015
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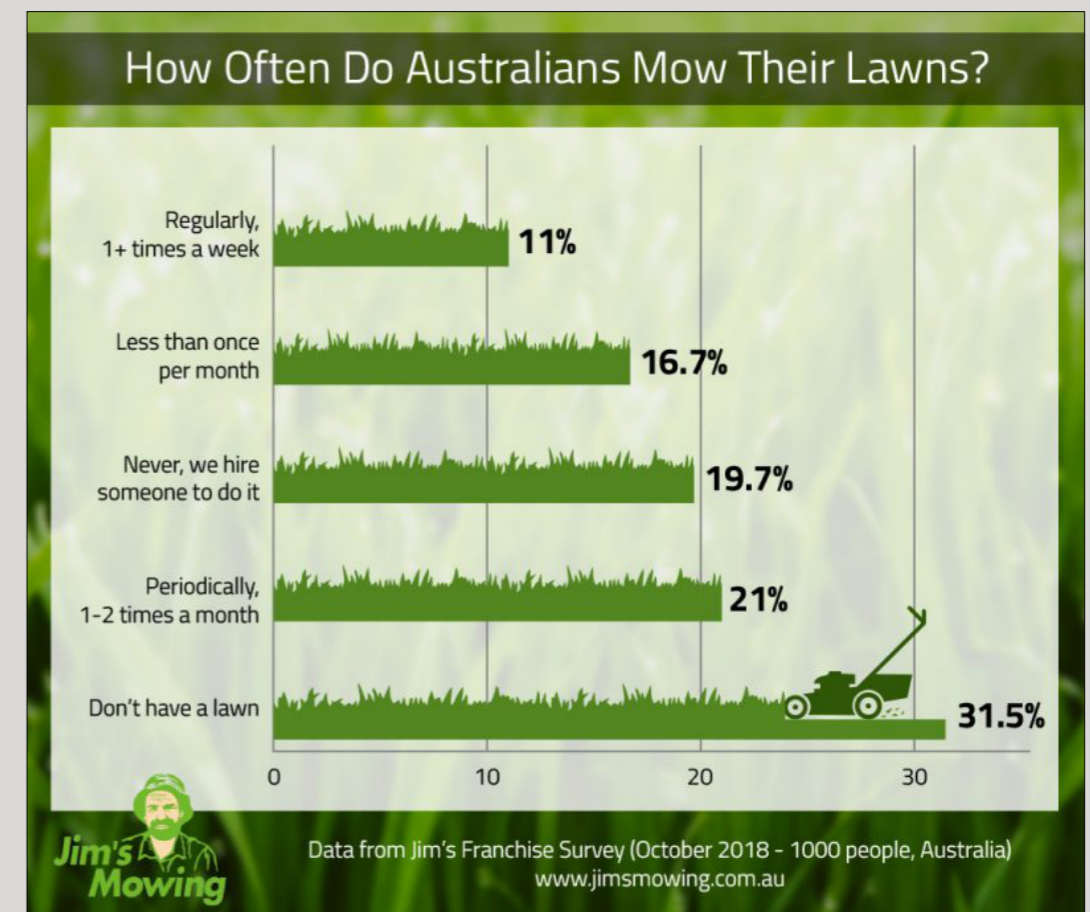
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- South Coast (California) Air Quality Management Board Commercial Electric lawn and garden equipment incentive and exchange program.



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.