



**Alternative Technology Association:
Melbourne Electric Vehicle Special Interest Group
Light Electric Transport Sub-group**

Preface

As the public consensus for a transition to a low carbon economy continues to increase, the choice for more sustainable transport options will also be demanded from the community.

Responding to this demand are a number of radical new vehicle designs which come under the heading of Light Electric Transport that are in the prototyping stage or have recently been put to market that conform very poorly, if at all, to the current regulations.

Also, the drafting of legislation for electric bikes, electric scooters and other wheeled devices has been reactive and has become problematic as evidenced by inconsistent rulings across different jurisdictions, both nationally and internationally.

The general approach has been to draft legislation from the perspective of the bicycle which really only caters for those vehicles that resemble a bicycle in design.

If legislation was drafted with the view of embracing solutions for reducing urban transport congestion and de-carbonising the transport sector then a far wider range of vehicles designs could be accommodated for.

Executive Summary

The ATA is a national community-based, not-for-profit organisation representing consumers in the renewable energy and energy efficiency marketplace. The organisation was established in 1980 to empower our community to develop and share sustainable solutions and to promote the uptake of sustainable technologies.

The organisation currently provides service to approximately 6,000 members nationally who are actively engaged with small, medium and large scale renewable energy, energy efficiency, smart meters, electric vehicles and the national electricity market.

This document advocates for a simplification of the Australian State regulations that apply to electric bicycles, motorised scooters and other similar vehicles collectively known as Light Electric Transport, without compromising safety. An overview of the regulations that apply in other countries and the regulatory context for Australia is presented.

A cursory read of the two main rules proposed is likely to see them dismissed as being too radical to warrant further consideration. In reality, these two rules are actually underpinned by existing current regulations for road safety and therefore they deserve support for their introduction.

The recommendation is:

- **That the maximum motor power be set at 750 Watts unless the vehicle is speed limited and;**
- **If the vehicle is speed limited (suggested 32 km/h [20 mph]) then there be no restriction on the motor size;**

These rules are supported with argument and a further five supplementary rules to facilitate the introduction and compliance verification of the two rules above.

The section titled 'Rationale' expands on the arguments that are presented to support the proposals.

The section titled 'Further aspects considered' elaborates on the related issues reflected upon when preparing this document such as;

- merits of a cut-out speed,
- how authorities enforce compliance,
- pedals as a valid criterion for classification,
- how unique designs can be accommodated,
- at what point is a vehicle deemed a motor bike, and
- the momentum of a vehicle.

Introduction

This document advocates for a wider context to be taken when drafting legislation for light electric transport with the aim of increasing the opportunities for innovative Light Electric Transport to assist in reducing the urban transport congestion and de-carbonising the transport sector. Mobility scooters are outside the scope of this document because they have a different user cohort, though they are not precluded from consideration.

Victoria will be used in this document as the primary reference when referring to existing legislation. Essentially, legislation for light electric transport is currently drafted focusing tightly on the bicycle design. Depending on the design, some types of vehicles are legal while others are illegal though having the same functionality. For example, a power-assisted bicycle is legal in NSW while a motorised scooter is not.ⁱ

Overview

Globally, both the maximum motor size and the maximum vehicle speed for motor cutout varies significantly with jurisdictions. Some jurisdictions also have additional requirements where the motor output is progressively reduced to zero at cut-out speed.

Motor Power Size

The maximum motor power allowed varies with jurisdiction. Some jurisdictions add qualifiers such as in the USA where both the rider's weight and a maximum speed of 32 km/h with motor only power across paved level ground is applied.

The actual allowable wattage of the motor varies from 200 watts in Australiaⁱⁱ and the United Kingdom, 250 watts in Europeⁱⁱⁱ, 300 watts in New Zealand^{iv} 500 watts in Canada^v and 750 watts in the USA^{vi}. Two examples of vehicles that are currently excluded by existing legislation in all Australian states are the Yikebike that has a 1000 watt motor^{vii} and the Segway which is apparently 1500 watts .

Cut-out Speed

The specified cut-out speed varies from 24 km/h in the United Kingdom, 25km/h in Europe to 32 km/h in Canada and the United States. In Europe the output is required to be progressively reduced and finally cut off as the bicycle reaches a speed of 25 km/h.

The regulatory context

The current ethos behind the road rules, which is to place minimal restrictions on the vehicle and legislate for sensible use of the road network regardless of the vehicle used, should continue. This ethos needs to be extended to the bicycle path network to resolve conflict issues that currently exist due to cyclists using off-road recreational paths for commuting.

This practice often results in inappropriate high speeds for off-road paths and similar inappropriate speeds on shared paths. This conflict occurs because the route is being used for the mixed purposes of commuting and recreation, a case which is scarcely acknowledged.

Historically, recreational paths were the only option for a commuter cyclist who preferred to opt for a safer ride by avoiding the vehicle traffic of the road network. This is currently in a transition phase to cater for cyclists with some areas improving faster than others. The addition of continuous lanes and coloured demarcation zones at intersections are examples.

This factor, and the emergence of newer electric vehicle designs, has created a need for the entire path/road network usage to be reviewed. In Melbourne, there is the Revised Principle Bicycle Network due to be released about May 2011 which is anticipated to cover routes but is not expected to cover vehicle designs such as cargo bikes and the newer electric-only designs. While drafting legislation from the context of a bicycle results in very restrictive rules, a bicycle does provide a useful reference to inform the decision making process.

The approach recommended is to depart from the bicycle centric context for drafting legislation for light electric vehicles, to instead use the prevailing ethos behind the road rules of acknowledging purpose and route type.

Purpose consists of the following:

- Aspirational cyclists (people who do not cycle or only cycle infrequently and would like to cycle more) including learners and children.
- Local transport cyclists (journeys to and from shops and other local facilities).
- Recreational cyclists (people who engage in the activity for enjoyment/health reasons).
- Commuters (journey to and from work, school or college).
- *Racing and training cyclists* (this category is not applicable to personal electric transport and is included here only to acknowledge this group).

Route type consists of the following:

- Shared pedestrian/bicycle path.
- Dedicated off-road cycle path.
- Dedicated on-road bicycle lane.
- Road network – residential, 50 km/h or less.
- Road network - >50 km/h.

Proposals

Safety is the primary consideration for the road/bicycle network with the following proposals focused on how the paths are used and on the vehicle attributes; focus is not given to vehicle type. The suggested rules and a brief explanation are given in this section with further description given in the section titled 'Rationale'.

1. That the maximum motor power be set at 750 Watts unless the vehicle is speed limited. *Underpinning current regulation* - In Victoria, probationary drivers are limited to a power-to-weight ratio of less than 100kW per tonne^{viii} and motorcycle riders are limited to 150 kilowatts per tonne^{ix}.

By comparison, an 80 kg bicycle rider with a 20 kg 750 watt electric bike is a power-to-weight ratio of 7.5kW per tonne. This is a margin of safety many times more than that required for probationary drivers and riders under current regulations and therefore this rule should be supported.

A nominated maximum power figure is required to make an easy distinction between light electric transport and motor scooters or motorbikes. To simplify distinguishing between the two vehicle categories, the motor maximum power figure should be indelibly marked on the vehicle.

2. If the vehicle is speed limited (suggested 32 km/h [20 mph]) then there be no restriction on the motor power output.

Underpinning current regulation - The current 200 Watt motor power limit for electric bicycles. ***Theoretical bicycle power calculators on various websites^{x,xi} and an anecdotal report^{xii} indicate that the non-peddalling 200 watt motor power only velocity is 30.5 km/h to 31.0 km/h. This evidence indicates that a 32km/h limit is reasonable and therefore should be supported.***

This rule would allow flexibility with motor size to suit vehicle application. For example, tandem bikes, trailer bikes and cargo bikes could be powered by a suitably sized motor for the anticipated application. This would allow design flexibility by removing restrictions of a fixed weight/performance regime. This will also accommodate the newer designed vehicles mentioned above such as the Yikebike with a 1000 watt motor limited to 23 km/h, and the Segway with a 1500 watt motor which is limited to 20 km/h.

3. The weight of the vehicle is limited to a specific maximum. (Further discussion is required to determine and nominate a sensible figure.) This rule is suggested to make a clear distinction between light electric transport and motor scooters or motorbikes for regulatory clarity.

The European Two-wheeled Traders Association, a well represented industry body, suggests an un-laden mass of 25 kg or less^{xiii} United Kingdom legislation stipulates 40 kg or less^{xiv}. The Segway is 47.5 kg^{xv} and the Light Electric Vehicle Association suggests light is 'usually less than 100 kg'^{xvi}. A local retailer^{xvii} has suggested that 40 kg would be a suitable weight limit.

A review of cargo bikes is essential for a sensible figure to be arrived at. One possible approach is to have two weight limits specified, one for freight carrying vehicles and the second for commuter/errand vehicles.

4. That an age restriction is placed on the use. (Further discussion is required to determine and nominate a suitable age.) Consistent with the road rules for WA, the age of 16 is suggested as this is also the age a learner's permit can be obtained and familiarity with the road rules can be demonstrated. This rule is suggested to ensure safe use of light electric vehicles as they will predominately be used for freighting or commuting on the road network.

For shared pedestrian/bike paths and dedicated off-road bicycle paths.

5. A maximum speed is posted. This is suggested to improve safety for all path users. This is also consistent with the existing approach of drafting regulations for the road network. An actual speed figure should be determined in consultation with cycling bodies.

6. A maximum width limit is posted. As paths are usually of restricted width, a maximum specified vehicle width is required so that there is no encroachment on the space of other users. This encroachment could be from cargo bikes, scooters with fairings etc.

A provision should be included to allow relaxation of the above shared path restrictions for special occasions and organised events. The relationship between purpose and route with suggested stipulations is given below in a matrix for clarity.

	Learners, children and novices	Recreational and health reasons	Shopping and other errands	Commuters
Shared path	<20km/h		<20km/h	
Dedicated off-road	<30km/h		<30km/h	
Dedicated on-road	-Posted speed Limit		-Posted speed Limit	
Road - Residential	-Posted speed Limit		-Posted speed Limit	
Road- >50km/h	-Not recommended or prohibited. -WRD ¹ prohibited.	-Not recommended -WRD ¹ prohibited.	-Posted speed Limit - WRD ¹ prohibited.	

¹ **WRD – Wheeled Recreational Device** means a wheeled device, built to transport a person, propelled by human power or gravity and ordinarily used for recreation or play.

Rationale

1. That the maximum motor size be set at 750 Watts unless the vehicle is speed limited.

- There is an erroneous view that safety is directly related to motor size, such as that expressed by the NSW Centre for Road Safety, *'The main objective from a road safety point of view is to limit the power output, not the type of power source'*^{xviii}. This approach is inconsistent with existing legislation as other vehicles are not limited in motor size on the grounds of safety. The restrictions that do exist are power-to-weight ratio limitations, not power only.
- Market opportunities. Setting the motor size limit to the highest figure that is legislated abroad will allow Australians access to the entire range of products that are available from abroad and will therefore not restrict market opportunities. One of these emerging markets is to provide transport for people with limited mobility, but who have sufficient mobility that they can avoid the perceived stigma of using a mobility scooter. Examples are people who have had joint replacements, have limited heart/lung capacity etc - a cohort which will become more prevalent with Australia's ageing population.
- The United States is the more similar to Australia, with regard to geography and distances, than Japan and Europe and therefore it is instructive that the United States have nominated the 750 watt limit.
- Increased power beyond 200W gives much better hill climbing and overall flexibility and convenience but actually gives little extra top speed. This is because of the aerodynamic resistance increasing with the square of speed.
- A healthy adult can generate 200W continuously but will exert significantly more power when starting from standstill or climbing hills. A 200W limited bike will therefore accelerate much slower and be less able to climb steep hills without significant rider effort than a healthy-human powered bike.
A 750W bike would be much closer in performance to a healthy adult since the peak power is delivered at the lower speeds and then reduces at higher speeds due to the inherent characteristics of an electric motor torque curve.

2. If the vehicle is speed limited (suggested 32 km/h [20mph]) then there be no restriction on the motor size.

- A typical healthy adult is able to cruise on level ground at around 32km/h or more.
- This rule will free up opportunities to service niche markets by not being locked into a fixed weight/performance ratio.
- This is a more efficient method to service potential markets as the current process requires expensive approval procedures for each vehicle type. This proposal sets the parameters the vehicle has to operate in and has the advantage that it is proactive in that it can accommodate vehicle designs that have not yet been developed.

3. The weight of the vehicle is limited to a specific maximum.

- This rule is suggested to assist law enforcement to identify precisely what category a vehicle belongs to. All that is required is a set of scales to measure the weight. Again, this is consistent with how the GVM of other vehicles on the road are used to establish compliance with the different vehicle categories.

4. That an age restriction is placed on the use.

- The changes suggested to the road rules will allow younger people more mobility on the road network. This will require a satisfactory level of sound judgement so the age restriction is suggested. As other jurisdictions use the age of 16 as a requirement this precedent is acknowledged and suggested for this application.

5. A maximum speed is posted.

- There is a concern that motorised bicycles will be used at excessive speeds in proximity to pedestrians etc. This case already exists with standard bicycles and pedestrians (as commonly observed at the Southbank promenade-Melbourne due to poor guidance and no enforcement of sensible speeds) therefore posting speed restrictions that apply to all users regardless of the mode of transport will raise the safety level of shared paths above the current existing level. This approach is also consistent with the existing method of posting speed signs for establishing safe speeds for road use.

6. A maximum weight of vehicle to be posted. (The rationale for this point is already covered in Proposals - point six above.)

Further aspects that were considered

Cut-out speed

Some overseas jurisdictions have stipulated that a cut-out speed be applied to all vehicles, either as a maximum motor speed that can be obtained or as a gradually reducing power output from the motor. There has been no evidence found to support the contention that this requirement contributes to safety.

In addition, this approach is inconsistent with the treatment of other vehicles on the road network as the only restriction for personal vehicles is power-to-weight ratios. There are no other legal vehicles with a maximum speed requirement imposed (with the exception of 100km speed limited trucks).

Currently there is no cut-out speed stipulated for use on light electric transport in Australia and a blanket imposition will be an unnecessary added complexity with no gain in safety. (The exception, as mentioned in point 2 above is, if the motor rated power output is above 750 watts, then a speed restriction of 32km/h should apply.)

Pedelecs

Considered, but found to be of no value for safety. It would only serve as another restriction on convenience of use for people with mobility restrictions from joint replacements or strength impairment and limit the choice of product in marketplace.

How do authorities enforce requirements?

Currently, the existence of pedals are used as a point of discernment for distinguishing vehicle classes. Some manufacturers have exploited this aspect by adding token pedals post-design and therefore contributing to the current confusion in the market place.

As stipulated above, electric motors are to be indelibly marked with their rating, which is a long standing industry practice, or a compliance plate permanently fixed to the vehicle to stipulate the precise power rating and at what point this power is measured.

One issue for further consideration is that the same motor can be driven at different power ratings depending on the controller. The rating will need to apply to the whole system - not just the motor.

The second aspect is restricting the weight of the vehicle. This restriction does not contribute to safety however it will assist in assessing compliance by using scales to measure the weight.

Are pedals a valid criterion for classification?

Current legislation refers to the motor “assisting” human effort. This has been interpreted as requiring pedals as a distinguisher for vehicle classification. This has, however been problematic because pedals have been added post-design to vehicles that more closely resemble a motorised scooter in weight and physical size. With the emerging designs due to advances in battery technology and motor application, pedals are becoming redundant as a means of propulsion and should not be used for determining vehicle classification.

How do we accommodate unique vehicle designs?

As the public demands more sustainable transport options, the impetus for more creative designs will increase. Responding to this demand are a number of radical new vehicle designs which come under the heading of Light Electric Transport that conform very poorly, if at all, to the current regulations.

Accommodating these new designs can be achieved by allowing unrestrictive design parameters that either limits the power of the motor with unrestricted speed or a restricted speed with an unrestricted motor power and using total vehicle mass as the definer between light electric vehicles and the standard vehicle classes. This has already occurred in general aviation with weight being the definer between the newer Ultralight class and the more established conventional aircraft .

Setting these minimal design parameters will make it simple to establish compliance and avoid the continued tweaking required with legislative amendments of the road rules to allow these radical designs access to viable markets.

At what point is a vehicle deemed a motor bike?

- If the vehicle’s power output exceeds 750 watts **and** is not speed limited, then it is a motorbike.
- If the vehicle exceeds a specified weight, then it is a motorbike.
- If the vehicle’s motor is 750 watts or less, (not speed restricted) then it is a Light Electric Vehicle.
- If the vehicle is speed limited at or below 32 km/h, then it is a Light Electric Vehicle (unrestricted motor size).
- ***Note – the vehicle mass limit will restrict the actual maximum power output of the motor that can be used due to larger power motors physically weighing more. At some point, the vehicle will exceed the mass limit of the Light Electric Vehicle Category and not comply.***

Australian standards for scooters

After a cursory search of the Australian standards, standards for the quality of scooters appears to not exist. This is an area that will require further work as minimum standards will be required to prevent sub-standard products with potential safety issues entering the market.

Maximum width of vehicle

There should be no width restriction on a vehicle design though such a vehicle may be excluded from shared paths as notified by posted width limits because of encroachment on neighbouring lanes.

The momentum of the vehicle

Often the risks associated with speed are assessed in terms of velocity only, however it is the kinetic energy of the vehicle that causes the potential injury to people. Kinetic energy is a function of the vehicle mass times the square of the velocity. Speed is significant because a doubling of the speed results in increasing the kinetic energy by four times. However, encouraging additional lighter vehicles on the road will reduce the kinetic energy for a given speed, so increasing the safety of the road system.

Surprisingly, a Monash University Report suggests that vehicle geometry such as bull bars and van style vehicles play a more important role in inflicting injury than vehicle mass.^{xix} The geometry of light electric vehicles, together with relatively less kinetic energy due to their smaller mass, suggest that these vehicles would be safer than many other vehicles currently on the road.

How would these changes affect Wheeled Recreational Devices.

It is suggested that there are no changes required (except to be adjusted for consistency with this proposal) to the regulations concerning Wheeled Recreational Devices such as toys, roller blades and skateboards etc. If these devices have motors then they should still be restricted to 200 watts as is currently the case.

References

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- ^x <http://www.oocities.com/mdetting/sports/cycling.html> Accessed on 27-1-2011
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- ^{xii} A 98 kg rider with a combined bike, battery, motor kit and rider weight of 127 kg reports doing 31 km/h on the flat with motor only power. The bicycle was powered by Mark II 200 watt Elation after market kit.

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