ENCOURAGING E-BIKE USE: THE NEED FOR REGULATORY REFORM IN AUSTRALIA

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Encouraging E-bike use: the need for regulatory reform in Australia

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Authors: This report is based, in part, on research undertaken by James Belias, Pyrou Chung, James Macdonald and Adam Smith as part of their studies at Monash University. The report has been compiled by Geoff Rose and Peter Cock who were the supervisors of the student’s projects and it draws material from the original student reports.

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Abstract: This report examines the regulation of power assisted bicycles in Australia and overseas. The current regulations are reviewed and reasons for revising the regulations in Australia are outlined. Recommendations are made on key features for revised regulations.

Keywords: Power assisted bicycles, powered bicycles, vehicle standards, regulations, sustainable mobility
EXECUTIVE SUMMARY

The Institute of Transport Studies and the Graduate School of Environmental Science at Monash University have initiated a collaborative research program focussed on power assisted bicycles, with a particular emphasis on those powered by electricity. The research, which has received initial support from the Cycling Promotion Fund and Giant Bicycles, has been progressed through a series of student projects in 2003. This report is based on the work undertaken in those initial student projects.

This research was initiated to provide a contribution to the debate about the regulation of power assisted bicycles in Australia. The aims of the research were to:

- investigate the current situation relating to power assisted bicycles in Australia and comparable overseas countries,
- explore the issues of relevance to the framing of regulations covering these vehicles, and
- identify any actions needed to enable these vehicles to make a larger contribution to the urban transport task.

Current Situation

The Australian Vehicle Standards do not apply to vehicles propelled by a motor with a maximum power output of less than 200W. Bicycles and scooters meeting this power limit are therefore able to be ridden on public roads without a licence. The Regulations governing the use of vehicles meeting this power limit vary across Australian states. In Victoria, vehicles with a motor less than 200W are classified as a bicycle and therefore subject to bicycle regulations.

It is important to distinguish between whether power assistance is only provided when the rider is pedalling (technically termed Power Assisted Bicycles or PAB’s) as opposed to Powered Bicycles (PB’s) which operate with a throttle and so can provide power assistance without any pedal action. The term E-Bike is used to distinguish electric PAB’s from those powered by internal combustion engines (IC-PBs or IC-PABs). The lack of any distinction between powered scooters and bicycles has increased interest in powered scooters since riders do not require a licence and the vehicle does not need to be registered. The powered scooters which are being sold and operated as bicycles clearly require no pedal assistance and could not therefore be classified as PAB’s. It is more difficult to mechanically govern the output of scooters powered by internal combustion engines and some being ridden on public roads have maximum speeds above 40 kph. Powered scooters produce considerable noise impacts, against which greater community opposition can be expected, and the two-stroke internal combustion engines which are common on many models perform very poorly in terms of air pollution.

Overseas there has been significant development of E-Bikes or electric bikes with Canada, the EU and the USA recently amending regulations to facilitate greater use of these vehicles. Those countries now allow higher power limits than in Australia. Canadian Legislation (amended late 2002) specifies a maximum power output of 500W, maximum assisted speed of 32kph, and a stipulation that the motor not be engaged until a speed of 3kph is attained. The US Legislation (amended May, 2003) specifies a 750W power limit,
a 20mph (32kph) assisted speed limit and functioning pedals. Finally, the EU Legislation (amended May 2003) stipulates that E-Bikes must have a maximum continuous power output of no more than 250W, that this assistance progressively decreases to nil at 25kph, or as soon as the cyclist stops pedalling.

Feedback from the bicycle industry suggests that existing users of PBs and PABs in Australia are predominantly males aged over 50 years. It is likely that these older riders will represent a growing market particularly as mobility issues for older drivers are magnified with the ageing population. However a higher power limit coupled with the evolving technology will improve the performance of these vehicles to the extent that they will offer an alternative to the car for some trips. For some older riders, for whom the car is not an option for either financial or health reasons (i.e. no licence), these vehicles will provide a primary means of independent mobility.

Reasons why the Australian Regulations need revision

• The lack of clear guidance on how the power output should be measured under the existing Australian regulations has resulted in some importers deciding not to bring E-PAB’s into Australia because of liability concerns if their vehicles are subsequently found to exceed the power limits.

• The amendments to legislation in Europe, Canada and the USA is stimulating technological innovation which is producing lighter E-PAB’s with greater consumer appeal. The low power limit currently applied to this class of vehicles here means that Australian’s are denied access to the latest technological advances in E-Bikes. The extent to which these vehicles are able to offer transport and mobility choices is therefore restricted.

• E-Bikes have a potentially valuable role to play in the context of sustainable transport since they could substitute for car trips (when a conventional bicycle would not have been used). They are particularly relevant to older people where E-PAB’s would enable them to be active as part of their daily life, increase their mobility, reduce isolation and improve health. Initial research conducted at Monash University has confirmed that E-PAB’s can still provide health benefits to riders.

• The current approach to regulating these vehicles is inconsistent with the increased use of Performance Based Standards (PBS) for other vehicle types. Dimensions of a PBS for E-Bikes could include:
  
  ➢ A requirement that the vehicle be a PAB, requiring active pedal power, to be a key determinant of the vehicle being classified as a bicycle
  ➢ Maximum speed at which the power assistance should cut out
  ➢ Weight limits reflecting the momentum of the vehicle and the implications of that for safety
  ➢ Braking capacity may require attention depending on the weight and speed limits.
Recommendations

- Regulations governing power assistance on bicycles need to be revised in all Australian States and preferably specified in terms of a performance based standard.

- It is desirable that any regulatory change not affect vehicles which are currently legal and so a pedal cycle to which is attached one or more propulsion motors having a combined maximum power output not exceeding 200W should continue to be defined as a bicycle. However, the regulations should be amended to allow for a higher power limit of 500W for vehicles which are electrically powered provided that the power assistance cuts out at 30 kph.

  - This would be consistent with the new Canadian standard, would sit between the American and the European regulations and ensure that these vehicles would not exceed speeds which can be achieved on a conventional bicycle.

  - The use of the term ‘propelled’ in the definition is important since it can be interpreted to cover both ‘powered’ and ‘power assisted’ operation.

  - Vehicles meeting the above limits would continue to be classified as a ‘bicycle’ and require no registration or driver licensing while vehicles which do not meet the above performance standards would not be classified as ‘bicycles’ and therefore would be subject to specific regulations.

- Additional research is required on issues which could not be covered in depth in this initial review.

  - Research similar to Canada’s “Electric Bike 2000 Project” or the European equivalent (E-tour) should be commissioned to addressing operational issues for these vehicles in the Australian context and explore the potential health and mobility impacts of E-Bikes in comparison to conventional bikes.

  - Overseas experience with potential pedestrian conflicts on shared use paths and footpaths should be monitored.

  - An assessment should be made of the feasibility of introducing a system of government rebates to stimulate E-bike use. This would involve a closer examination of the experience in Switzerland, where a rebate on E-bike purchases is available through the government, and also initiatives in Japan where solar panels are used for recharging E-bikes. A combination of these initiatives would be consistent with Government actions in some Australian states to stimulate use of solar hot water systems and water saving devices (rainwater or grey water tanks, low flow shower heads etc.) through provision of rebates on the purchase price of the equipment.
GLOSSARY

E-Bike – a generic term for a bicycle that in addition to pedals has a small electric motor for propulsion. E-Bikes come in two forms: EAB and EPB.

EAB – Electric Assisted Bicycle - An E-Bike where motor assistance is provided in proportion to input from the pedals. The rider must pedal for the motor to operate.

EPB – Electric Powered Bicycle - An E-Bike where motor assistance is provided on command via a switch or lever. It is not necessary to pedal for the motor to operate.

PAB – Power Assisted Bicycle – A generic term for a bicycle that makes use of a small motor or engine to reduce the effort required by the rider. Can be powered by either an internal combustion engine (IC-PAB) or an electric motor (E-PAB).
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1. INTRODUCTION

Cities throughout the world are grappling with the challenge of improving the sustainability of their transportation systems which have developed to be heavily dependent on the private motor vehicle. Those same cities face the added challenge of catering for the mobility needs of an ageing population, many of whom have become accustomed to the independent mobility provided by the car. Beyond the mobility needs of that older cohort, there are added issues of health and wellbeing for which maintenance of physical activity is increasingly seen as a key.

The bicycle has the potential to play an important role in addressing the problems outlined above. However, the performance of the bicycle, in relation to other modes, depends on the physical ability of the rider and the rider’s willingness to provide all the energy needed to reach their destination. The provision of power assistance to the rider therefore has the potential to expand the role of the bicycle in urban transport. Bicycles which provide some form of power assistance are available in a variety of models as shown in Figure 1.

The Institute of Transport Studies and the Graduate School of Environmental Science at Monash University initiated a collaborative research program focussed on power assisted bicycles, with particular emphasis on those powered by electricity. The research, which has received initial support from the Cycling Promotion Fund and Giant Bicycles, has been progressed through a series of student projects in 2003 (Belias, Chung and Macdonald, 2003; Smith 2003). This report has grown out of those initial student projects. It is important to emphasise that this is an initial, exploratory study. The emphasis has been on collecting information on current regulations and issues which are relevant to the review of those regulations.

The research reported here was initiated to provide a contribution to the debate about the regulation of power assisted bicycles in Australia. The aims of the research were to:

- investigate the current situation relating to power assisted bicycles in Australia and comparable overseas countries,
- explore the issues of relevance to the framing of regulations covering these vehicles, and
- identify any actions needed to enable these vehicles to make a larger contribution to the urban transport task.

The structure of this report is as follows. Chapter 2 reviews the terminology and technology related to power assisted bicycles. Chapter 3 reviews the current regulation of these vehicles in Australia and overseas. The present and future market is considered in Chapter 4. Safety and health issues are then canvassed in Chapter 5 before the conclusions and recommendations of this study are presented in Chapter 6.
Figure 1: Examples of Powered/Power Assisted Bicycles
Encouraging E-bike use: the need for regulatory reform in Australia

2. POWER ASSISTED BICYCLES: TERMINOLOGY AND TECHNOLOGY

It is appropriate to begin by distinguishing between powered bicycles and power assisted bicycles. On Powered Bicycles (PBs), the engine/motor operates with a switch or throttle and so provides power assistance without any pedal action. In contrast, on Power Assisted Bicycles (PAB’s) the power assistance is only provided when the rider is pedalling.

Power Assisted Bicycles (PABs) have been in existence since the beginning of last century when the Singer Company in Britain began manufacturing motorized back wheels that could be fitted to existing heavy-duty bicycle frames (Parker, 2002b). These units were powered by a small 2-stroke engine, similar in concept to modern Internal Combustion Power-Assisted Bicycles (IC-PABs). Development of lighter models that could be attached to any bicycle occurred after World War II leading to an increase in their popularity, with an estimated 15 million of them in use throughout Europe by 1965 (Parker, 1999).

Following this period, the increasing popularity and affordability of motor cars saw a decline in usage of IC-PABs throughout Europe. At this time there were also a few Electric PABs (E-Bikes) in use, but the weight and bulk of early batteries and motors, coupled with a dangerous front wheel drive arrangement meant that they never became popular (Parker, 1999).

The modern E-Bike, originated in Japan in the early 1980s, where the intent seemed to be to make cycling easier for the elderly. In 1989 Yamaha released a second generation E-Bike with a 235W motor connected to electronic torque sensors in the crank. Power was delivered only when the bicycle was being pedalled and only in direct correlation with the power exerted by the rider. From these beginnings the world market has expanded, particularly in Europe and Asia, with about 90 companies now producing E-Bikes with over 1 million sold between 1997 and 2001 (Parker, 2002a).

Currently the biggest market for E-Bikes exists in countries such as China, India, Vietnam and Japan which already have a major segment of their transport needs provided by small 2 or 3-wheeled vehicles. By 2001, over 900,000 E-Bikes had been sold in Japan and while statistics are difficult to obtain for other Asian nations an idea of the potential market is given by the enormous number of two wheeled IC vehicles (IC assisted bicycles, mopeds and small motorbikes) produced in Asia each year (about 25 million) (Parker, 2002b).

While factories in Taiwan and China are tooling up to mass-produce E-Bikes for the local market, it is unlikely these will have a great effect on the Australian market. Though bikes from this region are very cost competitive, the standards to which they are designed and built are not usually as high as Australian consumers may expect and might not meet Australian Design Standards.

The EU, Canada, USA and Japan, while not having the same potential market as greater Asia, produce high quality bikes and historically are far more influential on Australian rules and regulations.
Encouraging E-bike use: the need for regulatory reform in Australia

Electric bicycle usage is currently strongly supported within many Asian nations to reduce automobile usage and exhaust emissions. In Shanghai and Beijing, the Chinese government won’t issue new licenses for IC-PAB due to their high pollution rate, but rather only for E-PABs (Parker 2002b). The production of E-Bikes within China was forecast by the Bicycle Industry Information Centre to increase to 500,000 by 2002 and reach 1.5 million in the near future (Parker 2002b). Since signing the Kyoto Protocol in 2001, Japan has become interested in schemes to replace the car with E-PABs as a way of reducing greenhouse emissions (Parker 2002b). The Japanese government is also trialling the use of renewable energy sources (e.g. solar panels) to recharge the bicycles.

E-Bike components can be split into 4 main groups: bike parts, motors, electrics and batteries. All of these components have been the focus of a great deal of research and development, both as they apply to E-Bikes and separately. As the E-Bike currently stands the motors, electrics and standard bike components are all of a high standard and provide no real hindrance to the expansion of their market. The batteries however currently pose a significant technical hurdle. This is where research is being focussed, so that E-Bikes can reach their full potential.

Batteries have two main impacts on the E-Bike’s ease of use: their significant weight and the limits they impose on assisted range. These factors are inextricably linked, as the more energy storage there is (battery capacity/size) the greater the distance it is possible to travel with power assistance. So it would follow that it would be desirable to have as much battery capacity as possible. However, increased weight has two major effects. First, it makes the bikes far more difficult to handle when not under power. This is relevant when being ridden, since the rider has to exert a lot more effort to propel a heavier E-Bike once the battery is flat, as well as when putting them onto bike racks or manoeuvring them in and out of storage. Second, it adds significantly to the inertia of the bike when in use and therefore adds to the safety risk when the vehicle is involved in a crash. Thus it has been necessary to find a compromise between these two factors and to date this has not been done to the total satisfaction of either criterion.

The majority of E-Bikes and DIY kits come standard with a Sealed Lead-Acid (SLA) battery. These batteries are cheap and reliable and have a long life, but have the major drawback of the having the lowest energy density (30Wh/kg) of all rechargeable batteries (Jaycar Electronics, 2001). This has meant that for most E-Bikes range is limited to 20-30kms per charge and around 10-12kg (30-40%) of their weight is the battery.

There are several alternatives to SLA batteries on the market at the moment, but most of them have intrinsic characteristics that make them unsuitable for use with E-Bikes. US Pro-drive offers a kit with a Nickel Metal Hydride (NiMH) power pack, offering increased range (an extra 25-30%) and reduced weight (5kg lighter), but these batteries have a relatively short life span and are quite fragile making them less than ideal for use with E-Bikes. Lithium Ion (Li-ion) batteries are currently the most promising energy storage system, their only drawback being their currently very high cost (3-4 times more than SLA). These batteries have a similar life span to that of SLA’s, provide better performance and have an energy density of 140Wh/kg, meaning that they can provide the same range as current SLA batteries at about 20% of the weight (Jaycar Electronics, 2001).
Thus it would be possible with a Li-ion battery pack to overcome both the major problems currently posed by existing energy storage units, doubling the range per charge (to 50-60km) and still reduce battery weight by 55-60%. For these batteries to have market appeal, however, the price would need to decrease significantly. This could potentially be encouraged by increased production and competition, and/or through government subsidies. Other important areas for technological innovation, which are likely to be fuelled by the growing market for these vehicles, include systems which recharge the batteries while riding, perhaps through regenerative braking systems which use some of the energy dissipated through braking effort to re-charge the battery.

2.1 Products Available on the Australian Market

As part of this study, a number of companies were contacted to develop an appreciation of the products currently offered on the Australian market. The companies contacted as part of this review had an operating history of between two and four years and many had been operational in other areas of the bicycle industry prior to introducing E-Bikes to their range. One company no longer imports E-Bikes as they felt that the market was too small, and restrictive legislation made it impractical to operate profitably.

The product range varied between distributors and this review focuses on electric power assistance. The total range is limited in comparison to what is available on the world market. Most companies currently sell between one and four E-Bike models (bicycles and tricycles); some companies supplement this range with several scooter models. Do It Yourself (DIY) kits, imported from the US, Germany, and Asia are popular as they can be fitted to most existing bike frames, thus allowing the consumer to modify their bicycle to suit their needs. One popular electric kit currently on the Australian market is the US designed, US-ProDrive (Figure 2). This provides an average range of 20 - 30km and a maximum speed of just over 25kph.

Another company rated an E-tricycle as its best seller (see Figure 1), attributing this to its being a very practical form of transportation, with unrivalled stability, ease of use and a large carrying basket. It is described as being ideal for elderly riders. This model is powered by an onboard lead-acid battery of 24 volts and claimed to give an assisted range of 20-30km on a single charge.
E-Bikes range in price from $1,000 to $4,500. The more expensive E-Bikes generally incorporate more advanced technology, but the features do not vary greatly between the models.

The distributors all commented that E-Bike maintenance is as simple as that for a conventional bicycle, as all motor components and batteries are fully enclosed. When faults occur, generally the whole unit requires replacement. Warranty periods and after care service varies from company to company. The frame, motor and electronics all have distinct warranty periods owing to the varying fragility of the components. Most companies will service bicycles ‘in-house’ although those who sell through retailers expect the retailer to offer servicing, and will intervene only in the event of a manufacturing fault.

The companies contacted as part of this review were all small in terms of infrastructure and staff size. A reflection of this is that only three of the six companies which responded had made sales of more than 2000 units since commencing operations. The uneven distribution of sales between distributors is heavily influenced by the number and style of E-Bikes offered.
3. REGULATION OF POWER ASSISTED BICYCLES

3.1 Australian Regulations

In Australia, an important and overarching piece of legislation is the Australian Vehicle Standards (1999) essentially regulate the supply of vehicles into the Australian market. Part 2, Section 10, of those standards state that they do not apply to:

\[ a \text{ vehicle propelled by a motor with a maximum power output of not over } 200 \text{ watts.} \]

Importantly, this definition does not distinguish between a powered vehicle or a power assisted vehicle since the reference is only to the vehicle being propelled by a motor.

In Victoria, vehicles with a motor of less than 200W are classified as a bicycle and therefore subject to bicycle regulations. As such, the vehicle does not need to be registered nor the rider licensed. Since no distinction is drawn between a PB and a PAB, any of the vehicles shown in Figure 3, so long as their motor meets the 200W limit, could be classified as a bicycle. The definition encompasses a range of vehicles and attachments and all are currently legislated by the same basic limit of 200W. This includes electric kits that can be attached to almost any conventional bicycle and a range of powered two wheeled vehicles including purpose designed E-PABs, small kick-style scooters and large scooter-styled mopeds.

![Conventional Bicycle](image1.png) ![E-PAB](image2.png) ![Electric Scooter](image3.png)

Figure 3: Vehicles classified as bicycles under the 200W rule in Victoria

Regulations governing the use of these vehicles are not consistent across Australian states:

- **Northern Territory:** differentiates between bicycles and scooters requiring that to be classified an E-Bike the cycle must have functioning pedals.
- **Queensland:** regulations stipulate, “a PAB may not be ridden on a bicycle path or shared footway when the power source is operating”.
- **Tasmania:** unrestricted cycling on shared pathways, unless indicated.

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2 See the Reference List (pp.26) for a comprehensive listing of web sites accessed to obtain information on current regulations.
The lack of any distinction between powered scooters and bicycles has increased interest in powered scooters since riders do not require a licence and the vehicle does not need to be registered. The powered scooters which are being sold and operated as bicycles clearly require no pedal assistance and could not therefore be classified as PAB’s. It is more difficult to mechanically govern the power output of scooters powered by internal combustion engines and some being ridden on public roads have maximum speeds above 40 kph. Powered scooters produce considerable noise impacts, against which greater community opposition can be expected, and the two-stroke internal combustion engines which are common on many models perform very poorly in terms of air pollution.

The Melbourne Herald-Sun’s front page head line story ‘Booze Scooters’ (C. Smith, 2003) has placed powered scooters firmly into public debate. That article highlighted that a growing market for these vehicles is individuals who have lost their drivers licence for driving under the influence. The power and speed of illegal scooters means that it is probably only a matter of time until a fatal collision again focuses the public spotlight on them. When issues are left until there is a crisis there is a risk of a legislative over reaction. Addressing the scooter ‘problem’ may pull E-Bikes into the net and impose regulations on E-Bikes which further restrict their ability to contribute to the urban transport task.

Another problem with the power assisted bicycles in Australia relates to the interpretation of how the 200 W power limit should be measured. That is, should it be measured with the motor off the bike, on a test bed, or should the motor be fitted to the bike and the power measured at the rear wheel? One leading importer (Giant Bicycles) has indicated that they cannot obtain clear guidance on how the 200W power limit is to be measured (West 2003). As a result of being unable to clarify this issue, Giant does not import its E-Bikes into Australia even though they get regular approaches from consumers here who have seen the products on the firm’s overseas web site and wish to purchase one (West 2003).

In 1999 a uniform set of road rules was established in Australia. Responsibility to enact the rules fell on each state through the revision of their own legislation, which meant there was no mechanism for national legislation. However, it was recognised that uniform road rules would require future amendments and so an Australian Road Rules Maintenance team was established, which includes representatives from each state. Individual jurisdictions are able to identify concerns (ranked as high, medium and low priority). These are then discussed at the Australian Road Rules Maintenance team meeting. Following consensus, decisions and an amendment package are developed which includes model legislation. This is then sent to the Australian Transport Council (National Committee of State Transport Ministers) for approval. Finally, the amendment package is sent to the states for action. This process is quite lengthy and the first amendments took around four years to get through this process. The National Road Transport Commission (NRTC) has indicated it hopes to resolve future amendment packages on a 12-18 month basis.

The definition of power assisted bicycles is likely to be addressed by the NRTC/National Transport Commission (NTC) as part of the regular review of Australian Road Rules. While it is understood that a review on this issue has been called by one state, the large agenda before the road rules committee has meant that the issue is yet to be discussed.
3.2 Overseas Regulations

In this section, a number of overseas examples of regulations governing powered, or power assisted, bicycles are reviewed. Japan is considered first before attention is turned to a group of countries which have recently amended their regulations, namely, the European Union (EU), Canada and the USA.

Japan
As noted earlier, the Japanese were early innovators with E-Bikes and their regulations are perhaps the simplest of all:

any bike with a maximum powered speed below 30kph is exempt from licensing and registration.

Importantly, this is framed without reference to motor power and could be considered a performance based standard since it focuses on a key performance criterion, namely the maximum speed.

European Union
In 2002, the European Union updated a 10-year law, that was causing confusion regarding power ratings, licensing and insurance requirements (Oxer 2002). The new Framework Directive specifies that:

Pedal assisted electric bicycles have been exempted from the Directive with three conditions:

• speed limit of 25 Kph under power
• limit of 250 watts output
• the auxiliary electric motor must be integrated so that output is progressively reduced and finally cuts off as the vehicle reaches a speed of 25 Kph or as soon as the cyclist stops pedalling.

After the Electric Bike 2000 study, Canada amended its regulations for power-assisted bicycles. These included “a maximum of three wheels, an electric motor that can assist the cyclist up to a speed of 32km/hr and that does not exceed 500 watts and an on/off switch or mechanism that prevents the motor from being engaged until the bicycle reaches a speed of 3km/hr” (Transport Canada, 2002).

United States of America
In December 2002, the US President George W. Bush signed legislation H.R 727, amending the Consumer Product Safety Act to define a low speed electric bicycle as follows:

For the purpose of this section, the term `low-speed electric bicycle' means a two- or three-wheeled vehicle with fully operable pedals and an electric motor of less than 750 watts (1 h.p.), whose maximum speed on a paved level surface, when powered solely by such a motor while ridden by an operator who weighs 170 pounds, is less than 20 mph.
3.3 The Future of Regulation: Performance Based Standards

When government and industry representatives were interviewed for this study, a common suggestion was that the regulation of E-Bikes should move towards a performance based standard framed in terms of a restriction on speed. The industry representatives suggested that this could be done by:

(a) Electronically programming a maximum cut off speed, so that once the motor reaches this speed the bicycle would receive no further power assistance, and

(b) Incorporating a compromise between power output and gearing. This would allow greater assistance when travelling up steep gradients or against head winds.

While government representatives, could see a need for performance-based standards, they were concerned about the enforceability of such standards, given that the machines are easily tampered with. They considered the issue with illegal powered scooters as analogous, given the dilemmas regarding roadside enforcement. Among the industry itself, lack of uniformity has caused many suppliers to question the legality of current products on the market. Some currently imported electric vehicles are understood to be above the wattage limit, but they have been fitted with a “resistor” that restricts the power output to 200 watts. By implementing speed restrictions and performance based standards, the need for that modification could be minimised.

Only one company contacted stated that speed was not an issue because bicycle power and speed were limited by battery technology. They argued that the greater the wattage limit of the bicycle the more power it will drain from the battery, thus limiting the speeds it can reach. As many of the Australian imports rely on lead acid batteries, excessive speed would drain the battery so rapidly that distance range would be heavily reduced. Ultimately this form of speed restriction would make the bicycle impractical for even short travel.

3.4 Summary

In relation to the current regulatory environment for power assisted bicycles, it is therefore clear that:

- Current Australian legislation does not clearly distinguish between powered or power assisted vehicles or between bicycles and scooters
- Regulations are not consistent across Australian states
- Australian regulations are no longer in line with recent regulatory reforms in comparable overseas countries, specifically the EU, Canada and America
- Current Australian regulations are more restrictive than those which apply overseas (specifically in relation to power limits) and consequently many products being sold overseas are not available to Australian consumers because they do not conform with the Australian regulations
- Moving to a regulation that includes a maximum speed for power assistance would have merits.
4. PRESENT AND FUTURE MARKET

When discussing the present market in Australia, it is important to keep in mind that the market is largely defined or limited by the current power limit. However, this section includes a review of overseas studies which have sought to explore the market for E-Bikes with more generous power and speed limits.

4.1 Consumer Demographics and Product Reactions

The demographic information available from current suppliers was not solely specific to E-Bikes, but it does isolate consumer groups and gives a strong indication of current overall market trends. While the information tended to be fairly general, it was nevertheless, very similar for all respondents. Those groups mentioned by all participating companies as making up the market for E-Bikes are listed below, in order of largest to smallest market segment:

(a) Retirees (55 plus) - primarily as a form of mobility/transport
(b) Disabled - primarily as a form of mobility/transport
(c) Those ineligible or who have lost their license for road violations – as primary transport
(d) Commuters - as a form of transport
(e) Recreational market, with large potential in the tourism market – as an alternative to walking within parks and around local tourist venues
(f) Hirers - as optional hire for those renting motor homes or boats, used by the hirer to travel short distance, whilst on holiday
(g) Youths (14-20) - as recreational vehicles and transport (mainly scooters).

Those companies who noted a gender distinction said that the Australian clientele was approximately 80% male. Interestingly, this is a direct contrast to the Japanese market where the majority of users are elderly women (Parker, 2002b). The design and style of E-Bikes are significant influences on their relative appeal to each of the demographic groups listed above. The conventional step through design of most E-Bikes makes them appealing to elderly, disabled and female riders, but is likely to appear unfashionable to youth markets.

Appendix 2 contains a number of rider testimonials, including feedback from the testing of two current model Giant E-Bikes. Common user compliments include:

- Viewed positively by a user with an arthritic hip which made it difficult for him to ride a conventional bike
- Braking systems were judged to be adequate
- Older rider who had difficulty getting up a slight incline found the electric bike provided the necessary assistance
- Two riders who tested a 400W model felt that if it were available for their regular commute (12 km each way) it would reduce the effort of riding to the extent that they might not need a shower at the end of the trip. That would be an added convenience, saving time and encouraging them to ride more frequently instead of driving a car.
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The four main concerns expressed to the industry by consumers are:

(a) Weight of the E-Bikes  
(b) Range of the E-Bike on a single charge  
(c) Perceived high price  
(d) Expectation of better performance (largely as a result of the current 200W power limit)

Government and industry representatives contacted as part of this study agreed that the elderly and disabled people were the primary users of E-Bikes, with daily commuters representing a secondary market. Four government officials agreed that it was highly likely that these groups of people would enjoy increased mobility through the use of E-Bikes. This was also reflected in the industry responses, where many of their consumers listed the following as positive lifestyle consequences of the technology:

- Fun and easy to use, with little noise
- Gave them greater independence
- No need for licences or registration
- Affordable and cost effective
- Healthier lifestyle

Despite statements such as these, one government official questioned whether the proliferation of E-Bikes would impact upon the net rate of community activity. It was suggested that it is unlikely that there would be any community benefit, and that E-Bikes might decrease the overall level of physical activity within the community.

One respondent suggested that the variable power issue of E-Bikes might be an equity issue. Denying disabled peoples access to E-Bikes with adequate power would restrict their mobility choices. This could be overcome by bringing Australian legislation into line with overseas regulations. Another issue raised in relation to the elderly and disabled market segment is the importance of the vehicle being powered rather than power assisted. It is understood that many existing owners of E-Bikes from this market segment have specifically sought a vehicle that they do not have to pedal.

Another major community benefit that was recognised by government and industry was the ability of E-Bikes to reduce traffic congestion and pollution in inner cities. However, both sets of interviewees recognised that further infrastructure would be needed to expand the market of cycling.

The community must face the challenge of balancing the twin objectives of providing maximum mobility for older people, and achieving desired road safety objectives/standards. Many older people are no longer able or wish to drive, but still want to be active in the community and need to have other travel options available to maintain mobility. In 1997, the participation rate in sport and physical activity for older people (aged 65 years and over) was only 21.6% compared with the national average of 47.8%. Enabling older people to be active as part of their daily life increases their mobility, reduces isolation, improves health and well being and reduces the risk of injuries and falls (Comm. Dept. Veteran Affairs, 2000) and in this context E-Bikes have a potentially important role to play.
4.2 Overseas Market Research and Initiatives

In parallel with the research being undertaken by individual manufacturers to improve their products, two major overseas studies have sought to examine the potential for E-Bikes to make a greater contribution to the urban transport task.

The largest electric bicycle study to date was undertaken by the Centre for Electric Vehicle Experimentation in Quebec (CEVEQ) in 2000. This study was undertaken to promote the usage of electric bicycles and to document their performance to assist the federal and Quebec governments as they prepared regulations for this mode of transport (Lamy, 2000). The study built on the 1999 Electric Bicycle Evaluation Project conducted in Montreal that tested 120 cyclists over a four month period (Lamy, 2000). The 1999 Electric Bicycle Evaluation Project found that the bicycles tested could “meet the needs of a clientele of moderately physically active working people travelling a distance of less than 20km, but were not suited to the needs of a clientele of regular cyclists because their speed limit was restricted to 24km/hr” (Lamy, 2000). The following year, the study focussed on how more advanced technology could assist those regular riders who needed higher speed assistance.

Electric Bike 2000 selected a total of 369 participants, all of low or moderate levels of fitness, and who had a travelling distance of between 5-20km from work to home. Priority was also given to those currently using cars to commute to work (Lamy, 2000). Fifty-five electric bicycles were deployed in the test, both power assisted and power propelled (Lamy, 2000). Fifteen electric bicycle models were used, with power assistance between 200 watts and 750 watts. Data was compiled through a questionnaire completed by all participants (Lamy, 2000).

A total of 25,205km were travelled during the testing. Nearly two thirds (64%) of Quebec participants said they were prepared to use E-Bikes as a mode of transport to commute, while 44% of participants said E-Bikes were well suited to commuting to work (Lamy, 2000). Nearly all participants (94%) felt E-Bikes belonged on bike paths and, interestingly, about three quarters of them (70%) felt their speed on a bike path was equal or lower to that when they were riding a conventional bicycle (Lamy, 2000). The study noted that 83 per cent of respondents felt as safe on an E-Bike as on a conventional bicycle, with 95 per cent feeling that they had complete control of the bicycle when the motor was running. Some respondents noted a feeling of additional safety because of the availability of increased start-up power which helped riders react more quickly and satisfactorily in traffic. Some respondents even went as far as to suggest an increased tendency to obey road rules (specifically relating to mandatory stops) because of the motor assistance available to help with the standing start.

Another major research project, called E-tour, is underway in Europe (http://www.etourproject.org/). That project aims to demonstrate, evaluate and promote the advantages of electric two-wheelers as a contributor to sustainable mobility in urban areas. The study involves the introduction and testing of over 1,300 electric two-wheelers in 10 European cities/islands in order to obtain a modal shift towards two-wheelers. The project is specifically examining the use of electric bicycles and is aimed at increasing the distance ridden as well as the range of user groups. Results of E-tour are currently being reviewed and will be considered in latter stages of this research project.
To promote use of E-bikes, Switzerland has introduced a rebate scheme to reduce the purchase price of E-bikes for consumers ([http://www.newride.ch/](http://www.newride.ch/)). The rebate is on the order of 20 per cent of the purchase price and covers a range of E-bike models which provide riding ranges from 20 to 50 km with one model offering a top power assistance speed of 40 kph.

Japan has been experimenting with the use of solar panels to recharge E-bikes (Parker, 2003). The Giant LaFree used on private property as part of this study was also charged with solar power. There would be merit in an assessment being made of the feasibility of introducing a system of government rebates to stimulate E-bike use. This could involve a closer examination of the experience in Switzerland with their rebates and also the Japanese initiatives focussed on solar recharging. Parker (2003) proposed that the NZ Energy Efficiency and Conservation Authority should create incentives for purchase of E-bikes as part of a package which included a recharging system based on solar panels. A similar initiative in Australia would be consistent with Government actions in some Australian states to stimulate use of solar hot water systems and water saving devices (rainwater or grey water tanks, low flow shower heads etc.) through provision of rebates on the purchase price of the equipment.
5. SAFETY AND HEALTH ISSUES

As part of this study an initial exploration of safety and health issues associated with E-Bikes was undertaken.

5.1 Safety Issues

Three government officials contacted as part of this study openly declared that speed was the major safety issue, rather than power, and so performance based standards would be useful in addressing safety concerns. Their concern was that if power ratings were increased, this would increase the risks of cycling to both cyclists and pedestrians on shared walkways. One respondent suggested that a possible solution was to limit the motor from engaging only after a speed of 3 km/h is reached. All other respondents indicated the only major benefit of this would be to reduce engine wear and that it would only disadvantage disabled riders further. Government representatives predominantly expressed the view that any dramatic increase in allowable wattage needed to be concurrent with performance based speed restrictions.

In response to suggestions that E-Bike riders were more vulnerable in collisions than riders of conventional cycles, it is relevant to consider the E-Bike 2000 Project in Canada, which concluded that E-Bike riders were as safe as conventional cyclists. As noted earlier, 83% of all users involved in that study felt as safe on an E-Bike as a conventional bicycle. Many website testimonials also demonstrate that E-Bike riders feel that they have more control in traffic situations than on conventional cycles. E-Bikes are also thought to be safer in regular traffic conditions, as cyclists on E-Bikes report being more “obedient” as assisted acceleration makes standing starts (e.g. from STOP signs), and avoidance of accidents, easier (Lamy, 2000).

The major problem with weight is the greater inertia of an E-Bike compared with conventional cycles. Heavier E-Bikes are more difficult to stop and may do more damage in a collision. Two main solutions are possible to counter this problem. Firstly, it is possible to reduce the weight by using different battery materials and improving bike designs, and secondly the braking systems on E-Bikes could be upgraded. Disc brakes are currently available for bicycles and would contribute to counterbalancing the problems associated with increased weight.

Along with these intrinsic speed limitations it is common practice in newer E-Bikes to control motor output electronically. As the bike increases speed, the motor proportionally reduces its assistance, up to a pre-determined limit (25-30kph) where no assistance is provided. Here the extra weight of the E-Bike works to regulate speed further, as their greater weight makes them quite difficult to propel using pedal power alone. As Smith (2003) noted “The rider is more fatigued maintaining a higher speed, such as 25km/hr, up a hill with a power assisted bicycle than with a conventional bicycle.”

The weight factor also has potential ramifications for the safety of pedestrians on shared bike paths. A collision between an E-Bike and a pedestrian could result in greater injury to a pedestrian compared to a collision with a conventional bike. However it is important to keep in mind that very few riders, and particularly not the elderly or disabled, would be
travelling at speeds greater than the electronic speed restriction as it is more difficult to cycle beyond this speed due to weight (Lamy, 2000, Parker, 2003). Furthermore, the speeds reached by fit riders on a conventional bicycles are greater than the speeds obtained on E-Bikes, and conventional bicycles are widely used on shared pathways. Parker (2003) notes that new E-bikes available in Japan are only 2/3 the weight of the Giant LaFree tested as part of this study. Clearly, technology innovation has the potential to dramatically reduce the weight differential between E-bikes and conventional bikes.

Performance-based standards addressing high speeds would restrict riders from reaching speeds that may increase the likelihood of pedestrian E-Bike accidents. The fact that E-Bikes are not designed for speed, but to provide an initial power-assist, means that the rider also has more control over the E-Bikes whilst exerting less physical effort. Thus, it is hypothesized that the risk of collisions between E-Bike riders and pedestrians is as low if not lower than with riders of conventional bicycles. Suggestion that pedestrians are unwilling to share so-called ‘shared paths’ with riders of E-Bikes has not been evident in the literature. Given the low noise level that E-Bikes generate when the motor is generating power, it is unlikely that pedestrians could be alarmed by the sound of E-Bikes.

Importantly the Australian Pedestrian Council has indicated it is prepared to support the proposal to allow higher power limits on E-bikes in Australia (Campbell, 2003). Feedback from the US Federal Highway Administration (Fegan, 2003) suggests there has not been any noticeable increase in bicycle pedestrian conflicts because of the change to the US legislation which has allowed higher power limits for E-bikes.

5.2 Health Issues

In the long-term, this project hopes to collect and analyse data comparing the electric power assisted bicycle with a conventional bicycle and car. One dimension of that comparison is the health benefits of each mode of transportation. Although it is obvious that the bicycle provides a significantly larger health benefit than the car, no scientific research has identified the comparative health benefits that the electric bicycle provides relative to those other modes of transport.

As this is the first stage of this research, the focus is on identifying potential issues with equipment and conducting initial analysis to ensure different forms of information can be synthesized. The primary data collection unit employed in the research described here was a Polar Heart Rate monitor, which collected information on heart rate, speed and cadence (pedal revolutions per minute). A GPS receiver and data logger was included to collect data on position and speed. The GPS equipment consisted of a 15cm X 4cm X 4cm rectangular battery, small GPS data logger and a receiver. The unit is lightweight and fits into a small backpack that is worn by the rider. The GPS receiver was positioned on the outside of the rider’s backpack to ensure clear line of sight for the satellite signals.

Tests were conducted with a conventional bicycle, electric power assisted bicycle and a car. The conventional bicycle used was a Haro 24 speed mountain bike. The electric bicycle, a Giant LAFree Lite (See Figure 4) is similar in appearance to a conventional bicycle. The bicycle weighs approximately 30kg, has 4 gears and is classified as a Power Assisted Bicycle (E-PAB). The car used in the test was a Holden Commodore VS.
The same route was used to test all three modes of transport. Various routes were considered, but the route chosen was approximately 5km around Monash University, Clayton. This route can be seen in Figure 5. The route offered a range of riding conditions including quiet streets, busy roads and a variety of grades. The route began and finished on a relatively flat surface and moderate changes in altitude occurred during the middle stages of the test. In total, a 28m change in altitude occurred along the route. The route started within Monash University near Bayview Avenue and proceeded in an anti-clockwise direction south down Koonawarra Street. The steepest incline occurred on Blackburn Road from approximately midway along Monash University, north to Normanby Road.

The speeds of the conventional bicycle and power assisted bicycle were relatively similar. When travelling down hill, the bikes are capable of maintaining similar speeds, but a more significant difference occurs when travelling uphill or when fatigued. Comparison of speeds along Blackburn Road towards Normanby Road showed that the conventional bicycle maintains a higher speed than the power assisted bicycle which may be a result of better gearing.
Although subjective, the rider felt the battery motor powering the power assisted bicycle offers more assistance at low speeds. Due to the increased weight of the bicycle, in addition to the lower power rating, travelling up an incline takes a significant amount of energy for the rider to maintain a high speed on an electric bicycle. The rider was more fatigued maintaining a higher speed, such as 25km/hr, up a hill with a power assisted bicycle than with a conventional bicycle. However, allowing the speed to decrease, increased the degree of assistance provided by the motor and eventually a comfortable speed was reached where the motor was providing maximum assistance and the rider was only required to input a minimal amount of energy. Therefore it was regarded as understandable that speeds are lower on the power assisted bicycle than a conventional bicycle.

Heart rate data was analysed using both the Polar software output and a Geographic Information System (GIS) mapping system (Smith, 2003). Both these methods allow a comparison between the car and bike modes. Heart rate (in beats per minute abbreviated as bpm) versus time for the all three modes of transport can be seen in Figure 6.
Figure 6: Heart rate for all modes of transport

The initial heart rate on the conventional bicycle was 103 bpm and this increased to a peak of 181 bpm. The average heart rate for the duration of the test was 159 bpm. It can also be seen that the after the heart rate initially increased, it rarely decreased to under 140 bpm for the remainder of the test. The data above also shows that the initial heart rate for the power assisted bicycle was 112 bpm and this increased to a maximum of 166 bpm. An average heart rate of 146 bpm occurred over the duration of the power assisted bicycle test. As expected, a substantially lower heart rate was observed when driving the car, with a maximum of 84 bpm and a minimum of 65 bpm. Overall, the average heart rate during the car testing was 73 bpm.

It can be seen from Figure 6 that the trip times were virtually identical for the power assisted bicycle and the conventional bicycle, with both taking approximately 14.5 minutes. Using the car more than halved trip time at approximately 7 minutes.

It can be seen that there is a relatively strong correlation in the measured heart rates for the electric bicycle and conventional bicycle. There were three sections of the test where trends did not follow and the heart rate dropped significantly on one bike without being matched by the other. A decrease in heart rate when on the conventional bicycle occurred at the 5-minute mark, while decreases occurred at the 6-minute mark and 10-minute mark on the power assisted bicycle. These unexpected changes occurred because the rider was forced to stop the bicycle, and therefore the rider’s heart rate had the opportunity to decrease. The decreases at the 5-minute and 6-minute marks occurred on Wellington Road at the traffic lights into the bus bay at Monash University and main entry to Monash University respectively. The decrease at the 10-minute mark occurred due to a delay at the intersection of Blackburn Road and Normanby Road.
The Polar Heart Rate software also produces data displaying the percentage of time spent exercising within certain heart rate zones. For the purpose of this preliminary study, the heart rate zones were kept at their default values. These are as follows:

**Table 1: Heart Rate zones**

<table>
<thead>
<tr>
<th>Definition</th>
<th>Description</th>
<th>Heart range</th>
<th>Rate</th>
<th>% Max Heart Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Above maximum</td>
<td></td>
<td>&gt;180</td>
<td>&gt;90%</td>
<td></td>
</tr>
<tr>
<td>Above target</td>
<td>Heavy to maximal intensity</td>
<td>153-180</td>
<td>77%-90%</td>
<td></td>
</tr>
<tr>
<td>In target</td>
<td>Moderate to heavy intensity</td>
<td>126-152</td>
<td>64%-77%</td>
<td></td>
</tr>
<tr>
<td>Below target</td>
<td>Light to moderate intensity</td>
<td>108-125</td>
<td>55%-64%</td>
<td></td>
</tr>
<tr>
<td>Below minimum</td>
<td></td>
<td>≤107</td>
<td>&lt;55%</td>
<td></td>
</tr>
</tbody>
</table>

The zones listed in Table 1 provide an indication of the level of exercise undertaken by the rider. As the level of exercise increases, riders must be of a higher level of fitness or higher levels of fatigue will result.

Each zone also corresponds to a percentage of the rider’s maximum heart rate. As the rider in this test was 22 years old, the maximum heart rate is estimated at 198 (220 – age). When exercising at an intensity above 85%, the body cannot supply oxygen to the muscles at a high enough rate, and therefore energy is supplied via an anaerobic system. This system uses carbohydrates as fuel and produces lactic acid as a by-product. Exercising at a heart rate intensity between 65% and 85% allows the body to use oxygen and a combination of carbohydrates and fats in the energy production process. A heart rate intensity of 75% is considered the most efficient. Low intensity workouts use both carbohydrates and fats, but there is very little cardiovascular benefit.

Figure 7 clearly shows the different cardiovascular effects resulting from different modes of transport. Using a car results in a heart rate below the target rate for 90% of the time. Therefore no exercise benefit is gained from driving a car. When riding the power assisted bicycle, 93% of the trip is spent within the target heart rate zone. The remaining 7% is above the target heart rate zone. This differs to the conventional bicycle, where only 48% is in the target zone, with an additional 48% being above the target zone and the remainder over the maximum.

These results highlight that the power assisted bicycle maintained a heart rate intensity that is predominantly in the target range where cardiovascular benefit is gained, fats are used in producing energy and no lactic acid build up occurs. In contrast, the conventional bicycle provides the strongest cardiovascular and fitness workout, however the intensity is often so high that carbohydrates are used for energy and a significant lactic acid build up occurs.
Figure 7: Heart Rate zones

These results have implications with regard to the suitability of power assisted bicycles compared to a conventional bicycle and car. While driving in a car offers no exercise potential, the power assisted bicycle tested here provides a moderate level of exercise which does provide a cardiovascular workout and uses fat as an energy source. Riders are unlikely to be overly fatigued after riding, presenting this as a viable alternative for people wanting to ride to work, the elderly or those who are not fit.
6. CONCLUSIONS AND RECOMMENDATIONS

This research has revealed that current legislation is restricting current market expansion of E-Bikes within Australia. The Australian Vehicle Standards do not apply to vehicles propelled by a motor with a maximum power output of less than 200W. Bicycles and scooters meeting this power limit are therefore able to be ridden on public roads without a licence.

The current Australian regulations are:

- not consistent across Australian states, and
- are more restrictive (specifically in relation to power limits) than the recently revised regulations in comparable overseas countries, specifically the EU, Canada and America.

Consequently many products being sold overseas are not available to Australian consumers because they do not conform with the Australian regulations.

It is appropriate for Governments to revise the regulations so that E-Bikes can provide greater mobility choices. While this is relevant given the current challenge to make urban transport systems more sustainable, an equal, if not more pressing challenge is to meet the independent mobility needs of an ageing population.

Following the review reported here, there was healthy debate within the research team about the formulation of a set of recommendations. Issues debated included the extent to which only power assisted operation should be allowed, the need to specify any maximum power limit on the motor and whether the definition of a pedal cycle needed to be revisited. The research team was also cognisant of the fact that evolutionary rather than revolutionary changes to the current regulations have a much better chance of being implemented in the short term.

Considerable discussion focussed on the definition of a bicycle and the view that the definition should rest on the requirement for active human effort in the form of pedalling. From that definition it was suggested that only ‘power assisted’ operation should be allowed under the regulations. Importantly, the current regulations do not distinguish between PABs or PBs and it would be an added complication to introduce that distinction. It could also cause difficulties for enforcement since it would be necessary to verify, possibly in the field, whether the vehicle operated in a powered or power assisted mode. In addition, at least one industry representative was strongly of the view that the existing market for older and disabled riders would evaporate if only a ‘power assisted’ operation was mandated. Consequently the recommendations which follow do not distinguish between PABs and PBs. The recommendations therefore provide flexibility for the import or manufacture of either powered or power assisted vehicles to meet the needs of different market segments.

Another important issue, which was considered in formulating the recommendation, was the extent to which it was necessary to nominate any power limit on the motor. A move to a truly performance based standard would make the specification of a maximum motor output superfluous. However, reflecting the comment made above, it was felt that an
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An evolutionary rather revolutionary approach to the regulations was more realistic and so the recommendations are framed in terms of a maximum motor output and a maximum speed above which the power assistance is designed to cut out.

The final recommendations are summarised as follows:

- Regulations governing power assistance on bicycles need to be revised in all Australian states and preferably specified in terms of a performance based standard.

- It is desirable that any regulatory change not affect vehicles which are currently legal and so a pedal cycle to which is attached one or more propulsion motors having a combined maximum power output not exceeding 200W should continue to be defined as a bicycle. However, the regulations should be amended to allow for a higher power limit of 500W for vehicles which are electrically powered provided that the power assistance cuts out at 30 kph.
  - This would be consistent with the new Canadian standard, would sit between the American and the European regulations and ensure that these vehicles would not exceed speeds which can be achieved on a conventional bicycle.
  - As in the current regulations no distinction should be drawn between ‘powered’ and ‘power assisted’ operation.
  - Relaxing the regulation solely for electrically powered bikes is justified on environmental grounds since two stroke internal combustion engines are highly polluting and their use should not be encouraged.
  - Vehicles meeting the above limits should continue to be classified as a ‘bicycle’ and require no registration or driver licensing while vehicles which do not meet the above performance standards would not be classified as ‘bicycles’ and therefore should be subject to specific regulations.

- Additional research is required on issues which could not be covered in depth in this initial review:
  - Research similar to Canada’s “Electric Bike 2000 Project” or the European equivalent (E-tour) should be commissioned to addressing operational issues for these vehicles in the Australian context and explore the potential health and mobility impacts of E-Bikes in comparison to conventional bikes.
  - Overseas experience with potential conflicts on shared use paths and footpaths should be monitored.
  - An assessment should be made of the feasibility of introducing a system of government rebates to stimulate E-bike use. This would involve a closer examination of the experience in Switzerland where a rebate on E-bike purchases is available through the government and also initiatives in Japan where solar panels are used for recharging E-bikes. Linking these initiatives (i.e. a rebate on E-Bikes with a solar panel recharging kit) would be consistent with Government actions in some Australian states to stimulate use of solar hot water systems and water saving devices (rainwater or grey water tanks, low flow shower heads etc.) through provision of rebates on the purchase price of the equipment.
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Parker A.A. (2002a) The Electric Powered Assisted Bicycle; a clean vehicle to enhance the mobility of the elderly, the lame and the disabled. Unpublished.
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**Internet sources for regulatory information:**

All websites were accessed between March and June 2003, and were functional and accurate at the time of printing.

**Australian Road Rules:**


**Western Australian regulations:**


**Victorian Regulations:**


**Queensland Regulations:**


**New South Wales Regulations:**

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Northern Territory Regulations:
\[\text{http://www.nt.gov.au/ipe/dtw}\]

South Australia Regulations:

Tasmania Regulations:

ACT Regulations:

US regulations:

EU Regulations:
\[\text{http://www.velovision.co.uk/}\]

Canadian Regulations:
\[\text{http://www.tc.gc.ca/mediaroom/backgrounders/b01_050e.htm}\]

Other sites with useful information on products and regulations:

- \[\text{www.bfa.asn.au}\]
- \[\text{www.currietech.com.au}\]
- \[\text{www.ecowheels.com.au/}\]
- \[\text{www.electricbicycle.com.au}\]
- \[\text{http://www.electric-bikes.com/future.htm}\]
- \[\text{www.extraenergy.org}\]
- \[\text{www.ezeebike.com}\]
- \[\text{http://groups.yahoo.com/group/power-assist/}\]
- \[\text{www.moped.com.au}\]
- \[\text{www.rotarybike.com}\]
- \[\text{www.scooterman.com.au}\]
- \[\text{http://www.scootersaus.com.au}\]
Appendix 1: Stakeholders Approached For Interviews

The Electric Bicycle Industry:

The following companies were approached as part of this study:

- Advanced Traders
- Currier Technologies
- Ecowheels
- Ezeebike Australia
- Motorised Bicycle Australia Pty Ltd
- NavTrak
- Power-Ped
- Rotary Australia
- Scooter Man
- The Electric Bicycles Company

Out of the 10 companies contacted, six responded, two were not contactable and one declined to comment. One company contacted had just recently established the business and had not yet begun trading. Inconsistency in responses coupled with the lack of data monitoring on behalf of the companies resulted in responses that were not as accurate as they could have been in regards to sales records and demographics of consumers. These suppliers dominate the Australian market as there is limited competition between the states and many consumers would find it difficult and costly to import a singular E-Bike individually. While the companies listed are the leading traders, the market is not limited to these outlets, as “online shopping” expands the market further.

Government Officials:

The following Government departments were contacted for comments on the issues surrounding the E-Bike:

- Australian Greenhouse Office
- Council for Ageing
- Department of Infrastructure / Energy Tasmania
- Department of Infrastructure / Planning NT
- Department of Infrastructure / Planning WA
- Department of Transport and Regional Services
- National Road Transport Commission
- Queensland Transport
- RTA Cycle Unit
- Transport SA
- Vehicle Safety Standards
- VicRoads
It should be noted that Government representatives clearly reflected the position of their own state Governments. However, respondents were asked to provide personal comment on some of the issues, thus adding useful insight into the discussion.
APPENDIX 2: User Testimonials

Field testing of Giant E-Bikes

_Giant Australia_ provided the two bikes pictured below for testing in this project. These bicycles are currently not on the Australian market. The _LAFree Sport_, with a motor of 400-watt was clearly illegal for use on public roads and bike paths in Australia, along with the _LAFree Lite_ at 250-watts. For this reason, both bikes were tested on private property on Mt Toolebewong amongst an eco-village community of 50 people. A total of 12 people tried the bicycles.

![LA Free TM LITE Panasonic 250 watt](image)

![LA Free TM SPORT 400 watt](image)

Interested parties were informed of the nature of this study and were invited to test the bicycles while observing safety recommendations and regulations. Initial scepticism was soon overcome and enthusiasm followed. Despite the obvious differences with conventional bicycles, the E-Bikes were viewed as variants. While heavier, they could be pedalled without power, physically lifted and put on a bike rack.

‘Rail-trail’ test:

The 250W _LAFree_ was also tested on the new unfinished ‘Rail-trail’, a path stretching 10km between Kilunda and Wanthathi. The rider, a man in his late 50’s, had an arthritic hip and was reliant on the power-assist to participate comfortably with his family. Concern was expressed over the longevity of battery power and its reliability. The rider knew little about the maintenance of the bike, and suggested that the more complicated the machine, the more vulnerable the user would be should it break down. This highlighted the need to educate users about basic maintenance.

The larger 400W machine was tested at the cooperative site on a mountain to see if it could handle the slopes. Its wider tyres were far more suited to unsealed roads and the machine’s throttle added a power burst to supplement pedal power and give the rider a ‘push’. The 250W bike required significant power from the rider to traverse any real incline.
The following is the personal account given by two of the authors of this report about their use of the 250 watt LAFree Lite along with observations and other reviews found on various web sites:

**Pyrou Chung, 25** – Being a keen cyclist who cycles daily to and from work the idea of having an electric boost when cycling up steep gradients was appealing. However the rider being of a small stature found it difficult to lift and manoeuvre the bicycle when stationary. The rider also found cycling difficult due to the fact that the frame size was inappropriate for her height. For instance, to conserve battery power the rider only used the motor when travelling up hills however on the flat she found it more difficult to cycle or gain substantial speed due to the sheer weight of the bicycle. The fact that the rider is normally able to cycle faster than the LAFree allowed her was disappointing. She feels that there is a niche for a clientele that has limited mobility, or those with no other means of transportation.

**James Macdonald, 25** – As a regular recreational cyclist I was very keen to try the LA Free for myself. I was pleasantly surprised at the power boost given at take off and found this to be of great benefit in conserving my energy. Without attempting any major hills I cannot comment on the E-Bikes level of assistance in this situation, but did notice that the vast majority of assistance was provided at low speed. As I normally ride quite fast (30-35kph) on my conventional bike I feel that something like the LAFree would not be suited to my needs, as it would restrict my speed. For an older or more sedate cyclist however, something like this bike would be ideal; it makes take off easy, and according to others I have spoken to provides good assistance on slight hills at low speeds. On the issue of the increased weight, I found that the bike was quite awkward to manoeuvre into the back of my car for long distance travel, and can imagine that for the target population this would be even more of a problem. On safety, I felt the braking system was perfectly adequate, stopping me equally as quickly as on my conventional bike. The added weight did not hinder manoeuvrability when riding and the extra burst of power at low speeds meant that it was actually easier to ride in confined conditions than my normal bike.

**Ed Benjamin** – a partner with Cycle Electric International Consulting Group, which tracks the electric vehicle industry from its offices in Pocatello, Idaho (USA):

“The LA Free was awarded recognition as the best electric bike tested by Extra Energy V.i.G. A solid, well-thought-out bike by one of the world's best bike builders, it incorporates a 400W continuous (about 900W peak) DC motor, 24V/12AH (gel-cell/lead acid/quick-release) battery pack, and smart 1-3A charger. The LA Free is of a ground-up design, a "pedelec" (i.e. primary power control is through the pedals) that weighs 70 lb. It comes in standard (or slope) frame, and step-thru models. Torque/speed sensors allow the motor to match the rider's input. If the rider is willing to pedal briskly, he or she can travel fast with great range. Another mode is achieved with the LAFree's twist grip Variable Power Control, which progressively shifts the burden away from the rider and on to the motor. Efficiency, hill climbing ability, and motor protection are all enhanced with the motor actually driving the rear wheel through seven gears. The motor assists up to 20 mph (maximum legal speed). Many comfortably ride 10-15 miles (including hills), and some report up to 30 miles on leisurely rides (on flat terrain) per full charge.
Testing Other E-Bikes

Elderly Commuter Comments – (c/o The Electric Bicycle Co.)

Mr Donaldson - "81 yrs young" - Wentworthville, NSW.

"Dear Sir,
What a wonderful electric bicycle you have created. I am almost 81 years and I do have great trouble in walking. I do have a standard bicycle and have done for most of my life, but in the latter years I found I had to walk my bicycle up every small hill. Not now. Thanks to you I ride!!"

Ms Mardy Urquart - "a mature lady" - Doveton, VIC.

"I had not ridden a bicycle for 30 years but a recent accident had decreased my walking ability. Not owning a car I was determined to maintain my mobility and independence - so I bought an Electric Bicycle. I learnt to ride again without using the motor first then graduated to full power within weeks. It was much easier than I thought and now I am always first to the bowling club and last to leave".

Eunice and Dave Paton - "older but still alive" - Parramatta, NSW.

"We wanted something to do together and our electric bicycles mean we can have fun and exercise together. The 'unisex' step-thru frame design means we can also invite our friends to join us - male and female - and share the bikes so we all get to enjoy them.
These bicycles are easy to get on and off, easy to ride, and we can even take them inside for increased security. We are planning to take them on a long train trip soon and ride them at the other end - we think they make us feel 10 years younger".

Hanz DeBeer - "I never believed these could be so good" - Fitzroy, Vic

"My son said I should try these bicycles after I lost my license. I rode motorbikes in Germany and did not think much of the idea of electric bicycles. Now I am totally converted. No pollution, no noise - just fun and convenience. The service I received from the suppliers was fantastic - they went out of their way to ensure the bicycle suited my requirements".

Lyn Clark – Ringwood, Vic

Lyn was asked on behalf of the group to test ride The Electric Bicycle Co. Folding model. Lyn is an elderly lady who has not ridden a bicycle for sometime. This bicycle was chosen due to its ease of transportation in a motor vehicle. The following is what Lyn observed:
“Not being a confident rider I was hesitant at first to get started. The initial impression of the bicycle before even mounting it was the weight. It was enormously heavy for me to manoeuvre when not in motion and the geometry of the weight distribution also seemed to be inappropriate thus adding to handling difficulties. The ride itself was pleasurable once moving at a constant speed. The lack of cycling experience I possess meant that I did not travel far distances or over a varying terrain. It was clear that this product could have the potential to improve standard of living for those with limited mobility however is not an appropriate model for my lifestyle. The ease and convenience of this product has convinced me that I would convert to this mode of transportation should my circumstances change and I was no longer able to drive.”

US ProDrive - by Scott Aikins

Before purchasing the Currie Technologies U.S. Pro-drive, I looked at most all the other offerings. I liked the instrumentation on the ill-fated EV Warrior, but not its weight and friction drive. Although every manufacturer had its advantages and disadvantages, I felt nothing was comparable to the US ProDrive. The reduction chain direct drive, brushless DC motor, its amazing torque, precise control, and clutch which allows the bike to freewheel so normal pedalling is a breeze. I use the System more as an assist to my pedalling versus an electric powered two-wheeler. After riding about 25 miles, I've never run out of battery power. This also includes heavy assist up a 6% grade for 4 miles.

The finest praise I can offer is the experience I had with an unforeseen problem with the bike. The bike started cutting out under load. The folk at Currie Technologies had me mail them the motor so they could confirm that it met their stringent torque requirements. Then they sent me a new motor, battery pack, and charger even though the motor actually checked out fine. They didn't even pro-rate the battery pack since they felt I shouldn't have failed. I would highly recommend Currie Technologies U.S. ProDrive system. Today, it is very difficult to find superior customer service. Currie's service is absolutely tops. The employees at Currie are very enthusiastic about their product, polite, sincere, and really care about customer satisfaction. It just doesn't get and better than that!