Alternative personal transportation: Bridging the gap between cars and sustainable transport

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ABSTRACT

It is clear that we are reaching a tipping point in terms of the ability of the automobile to sustainably fulfil its function as a primary provider of personal powered mobility. There is a large gap however, between other forms of more sustainable transport, such as walking, cycling and public transport, and the affordances provided by the car. For a culture accustomed to the conveniences of automobility, it will be difficult to find a direct replacement that provides the speed, carrying capacity, comfort, weather protection and personal safety of a car. Nevertheless, an increasingly diverse range of alternatives are becoming available, promising to provide more diverse transport opportunities.

Alternative vehicles have been developed and produced by niche manufacturers for decades, but have not enjoyed mainstream popularity. This is likely to change in years to come, given the climatic, social and financial issues facing society. Until recently, the major automotive Original Equipment Manufacturers (OEMs) have not demonstrated a clear ambition to design and manufacture alternative vehicles, but new trends are emerging in the concept vehicles at the major international motor shows. This paper provides an overview of some of the issues likely to impact on the personal transport sector and summarises how the major automotive OEMs have been approaching the development of alternative vehicles in recent years.

Keywords: Alternative vehicles, concept cars, vehicle design, sustainable transport, future design, microcar, personal mobility device.

INTRODUCTION

Australia, like many other developed countries, relies heavily on motor vehicles for social and economic functionality. The motorcar underpins labour force mobilisation, accessibility to essential goods and services and the urban development and lifestyle choices we've grown accustomed to. Currently, up to 80% of 'car as driver' trips are catered for by the car (Khan , Kruger, Travedi 2007), with many individuals considering it as a means of creating personal space, maintaining autonomy and serving identity functions (Mann & Abraham, 2006). It is well publicised, however, that we are reaching a tipping point for sustainable automobile use, with many issues threatening the cars' autonomy, such as:

1. Peak oil concerns and rising fuel prices, which are increasing not only the cost of vehicle usage, but also the price of food, services and commodities (see, for example; Garnaut, 2008; Hirsch, Bezdek, Wendling 2005; Deffeyes 2005; Monbiot 2006; Moriarty & Honnery 2007);

2. Legislation by governing bodies to reduce carbon emissions and other factors concerning climate change (see, for example; Garnaut 2008; Johnston 2007);

3. Strategic planning by local councils and communities to increase alternative transport modes in their municipalities (see, for example; City of Moreland 2008; Department of Urban Affairs and Planning 2001);

4. Growing public perceptions linking our current internal combustion vehicles with climate change, health issues and the inefficient consumption of energy (see, for example; Australian Greenhouse Office 2005; AAA 2008).

5. Increasing congestion and parking limitations (see, for example; Shoup 1999; Litman T., 2001; BTRE 2007)

This being the case, many Australian commuters consider themselves to be locked into using motor cars for primary transport. When faced with the choice, trips by train, tram, bus and motorcycle do not singularly provide the flexibility, carrying capacity or convenience of the car. Regardless, public transport systems in some of Australia's largest cities are already struggling to cater for demand (Fyfe & Sexton, 2008), being neither widely distributed nor densely populated enough to provide adequate coverage (Currie & Senburgs, 2007), and motorcycles are seen as an unsafe option. These modes of transport are not likely to fully alleviate vehicle emissions concerns either, as even a full shift would not meet carbon emissions reduction targets (Moriarty & Honnery, 2007).

On the other end of the spectrum, human powered mobility such as cycling and walking are energy efficient, but have their own limitations. Both are comparatively slow, they limit the distance of comfortable travel, they do not provide weather protection nor do they account for physical safety. Individuals with physical impairments are also excluded from these modes.

Other low impact alternatives such as electric pedal assist bicycles, electric powered 3 wheeler cars, mopeds and small cars, if readily available, could offer viable solutions to some of these issues. If they were to gain popularity, it could be important to inclusively consider these alternatives as a means to encourage the growth of environmental and socially sustainable transportation and system efficiency (Rose, 2008).

This paper begins by considering the motor car in objective terms, giving an overview of its inefficiencies and goes on to suggest the there is a need for personal mobility products that fill the gap between the car and human powered modes. The paper then goes on to discusses the current trend towards smaller, lighter, more efficient vehicles, summarising products from recent international motor shows by the major automotive OEMs. It concludes by speculating that there still needs to be further innovation in this area to meet the global challenges we are facing.

THE MOTOR CAR IN OBJECTIVE TERMS

The motor car is an iconic product that provides us with superhuman payload capacity and speed. Its long modern history can be easily understood within the context of twentieth and twenty-first century society and urban landscapes. The automobile has been intrinsic in the formation of our cities and townships and highly instrumental in communication, translocation and social integration. Cars have been embedded in our culture, psyche and egos for so long now that they are unconsciously considered to be part of the landscape.

At a time when efficiency is becoming increasingly important, however, the inefficiencies of the motorcar are becoming more apparent. Vehicle occupancy on average in Australia for instance, stands at 1.12 occupants per work trip and 1.66 for non-work trips. Additionally, the average daily distance travelled per vehicle is 35 kilometres and the average trip is 9.44 kilometres (Transport and Population Data Centre, 2004). Given most usage is to transport one person in urban environments where speeds cannot exceed 80kmh (excluding freeways where speeds of over 100kmh can be reached), the motorcar has excessive capabilities – delivering top speeds over 140kmh, accelerating from 0-100kmh in 14 seconds or less, and providing a potential payload of 5 people plus luggage. The ability to occasionally carry up to four additional passengers also means that motor vehicles require a greater spatial footprint and considerably more structural strength and weight than is necessary for the majority of trips. Consequently, the common vehicle payload is disproportionate to the amount of land area it occupies – whether that is street, highway or driveway – which is a considerable misappropriation of valuable urban space (Adams & Brewer, 2004).

Crashworthiness is also more difficult to achieve when vehicles are heavier and capable of higher speeds. Cars continue to evolve to meet improving safety regulations, using both passive and active systems such as; crumple zones, seat belts, pre-tensioners, airbags and side intrusion beams. In many cases this results in the addition of weight and volume, compounding, safety, efficiency and spatial issues.

When the motor car is considered objectively, there is a strong case for developing energy, space and payload efficient vehicles; but, the case is even stronger when environmental, social and financial issues are taken into consideration. The following section outlines some of these concerns, suggesting that they are likely to threaten the autonomy of the traditional motor car.

BRIDGING THE GAP

Urban environments, transport systems and vehicle designs will require greater efficiency, diversity, eco awareness and social inclusion to become more sustainable. At present, social financial and environmental imperatives do not appear to be dire enough to encourage the general public to take up the many alternative vehicles on offer. Neither, arguably, has the products themselves been appealing enough. One reason for this could be the lack of design development of alternative vehicles by major OEMs over previous decades. Traditionally, these companies have invested heavily in their design facilities and have honed their design expertise. They also have broad market reach, greater capital investment abilities and more robust infrastructures than niche producers. Recent years however, have seen a marked shift from some OEMs towards sustainable product development, and a move to fill the gaps in the market between human powered transport and high payload vehicles. This could result in a shift in the acceptance levels of these vehicles over the coming years. The next section surveys the alternative vehicle concepts shown at recent international motor shows and reviews the trends.

EMERGING TRENDS IN ALTERNATIVE VEHICLES

Broadly speaking, the term ‘alternative vehicle’ in the context of this discussion refers to vehicles that bridge the gap between human powered transport – such as walking and cycling – and the motor car. This vehicle segment can be broken down into a number of more specific categories: Personal Mobility Devices – (PMDs) such as the Segway (figure 1a) – Motorised Mobility scooters (MMS) – such as the Pride Colt XL8 (figure 1b) – Power Assisted Bicycles (PABs) – bicycles that have motor assisted pedalling such as the SANYO eneloop bike (figure 1c) – Velomobiles – usually 3 wheeled, covered, pedal or pedal assist vehicles such as the Velocipede (figure 1d) – three wheel motorised vehicles – such as the Aptera 2e (figure 1e), Twike (figure 1f), Carver (figure 1g) and Harvey Coachworks BugE (figure 1h) – and microcars – small footprint cars usually with 4 wheels and under 3 metres in length such as the Smart Four-Two (figure 1i).[1] To date, these vehicles have been produced largely by cottage industries, coach builders, bicycle and motorcycle manufacturers and, due to their niche market reach and limited production capabilities, the uptake has been slow.

This paper, however, will focus on the concept vehicles that have been recently shown at international motor shows by the major OEMs; given these companies are well placed to design, mass manufacture and distribute new vehicles to a broad consumer base. As a

[1] Explanations of these vehicle types are discussed in greater detail in previous publications by Rose and Richardson (2008; 2009)

general rule, concept vehicles serve a number of purposes: first, for a company to project an intended future design direction; second, to gauge customer acceptance prior to a new model release; and third, to explore innovative designs without committing to mass production. For this reason, the paper will use these advanced models to gauge the types of alternative vehicles that are likely to be mass produced by OEMs.

Figure 1 – Range of alternative vehicle types

Recent alternative vehicle concepts

Recent international motor shows have demonstrated a shift towards smaller, lighter, more efficient vehicles; the most surprising being the 2010 North American International Auto Show. The debut of 'Electric Avenue' sponsored by The Dow Chemical Company – an 11,000 square metre public test-driving track for electric vehicles (NAIAS, 2010a) – represents an attitudinal shift to more eco-considerate forms of transport by one of the globes highest polluting countries. The Avenue showcased a range of both large and small electric and hybrid vehicles, including vehicles produced by cottage industry manufacturers such as the Commuter Cars Corporation Tango, Harvey Coachworks BugE, Edison2, ZAP Alias and the Green Vehicles Triac (NAIAS, 2010b). The major American OEMs, however, contributed mainly large electric 4WDs, indicating that while they are trending towards smaller, lighter vehicles, they are moving in that direction slowly.

The development of electric and hybrid/electric drive systems is one of the most significant contributors to the development alternative vehicles. These systems offer spatial benefits to vehicle package, opportunities to change vehicle infrastructural and can afford significant reductions in weight. At present, these systems are not being utilised to their full potential, as many OEMs have merely installed dedicated electric or hybrid electric systems in existing body designs; however, there are some examples of electric systems being used in innovative package layouts to save space and weight. Proportionally, while these vehicle concepts are few, they appear to be increasing in number. Generally speaking, two types of alternative vehicles that use these technologies are better represented by the major OEMs at international motor shows than the others – PMDs and microcars.

Personal Mobility Devices

The category of PMD relates to two, three and four wheeled, single occupant, low speed, small-footprint electric vehicles that can be used, subject to local regulations, on footways and in public areas. The segment includes products like the Segway, T3 motion (**Error! Reference source not found.**2a.) and Motorised Mobility Scooters (MMS). Their low speed and high manoeuvrability offer a comfortable alternative to walking and have been in relatively limited use as tourist, law enforcement and disabled/aged mobility aid devices (Rose, Richardson, 2008). While these vehicles have shown limited market penetration to date, there has been a noticeable increase in the number of similarly designed concepts unveiled by OEMs at recent motor shows.

Figure 2 – PMDs

The GM PUMA (Personal Urban Mobility and Accessibility) (**Error! Reference source not found.**2b.) concept is a direct descendant of the Segway[2] – a two wheeled, gyroscopically self balancing, low speed electric urban transporter. The concept resulted from collaboration between General Motors and Segway and an early prototype was unveiled at the 2009 New York motor show. While it was neither road nor footpath legal, it had the aim of influencing future legislation with respect to these types of vehicles (CDN, 2009a). The design provides energy efficient transport for trips up to 20km for two people, bridging the gap between the Segway – which provides up to 10km of travel for a single person – and a car. GM has recently released three 'styled' versions of the concept which have been on display at the Shanghai Expo 2010. The three versions of the EN-V (Electric Networked-Vehicle) were designed in three separate studios around the world – Jiao (Pride) (Figure 3a) at GM Europe, Miao (Magic) (Figure 3b) at the General Motors Advanced Design Studio California and Xiao (Laugh) (Figure 3c) at GM Holden in Australia. EN-V concepts are two-seat electric vehicles that respond to concerns about traffic congestion, parking availability, air quality and affordability (General Motors, 2010).

Honda has developed a suite of alternative vehicles. The Honda u3-x (**Error! Reference source not found.**2c) is the smallest of the group and is another Segway derivative. The u3-x has been developed alongside the EV-Cub (**Error! Reference source not found.**2d), EV-Monpal (**Error! Reference source not found.**2e) and EV-N (**Error! Reference source not found.**4e). The main innovation of the concept is its single multi-roller wheel – called the HOT Drive System (Honda Omni Traction Drive System) – that allows omni-directional movement i.e. forward, backward, lateral and diagonal. The rider sits astride the vertical figure 8 shaped body (which is about the size of two tennis racket heads end to end) and uses their body weight to direct the vehicle. Honda claim that the movement afforded by the u3-x is somewhat akin to walking. It has also been designed into integrate into the door trim of the EV-N microcar, which is discussed in the following section (Honda, 2009a).

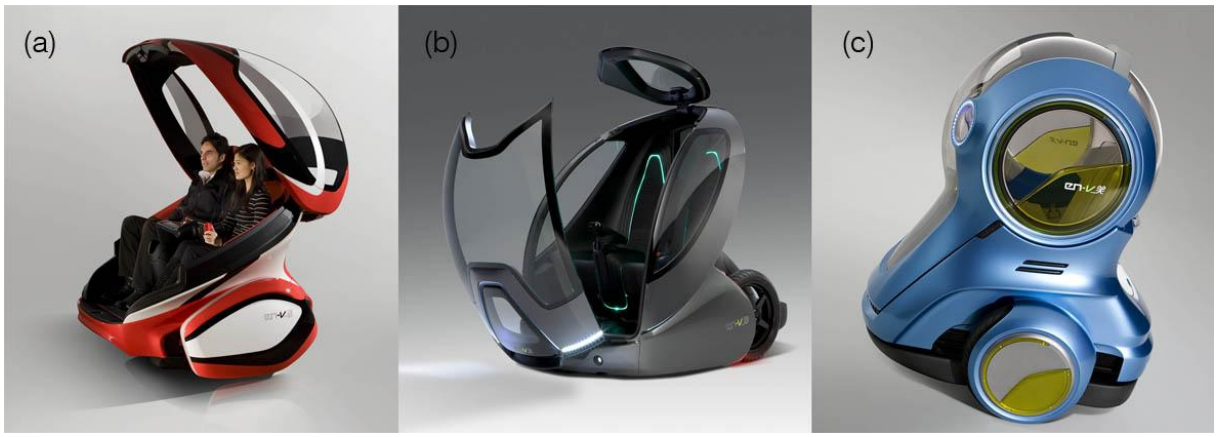

Figure 3 – GM EN-V

The EV-Monpal is a four wheel MMS primarily for those who are mobility impaired. The aim of the design was to engender pride in, and a relationship with, the vehicle through both

[2] The Segway itself has prompted a clear paradigm shift in personal transportation. It was first unveiled in 2001 and has influenced many PMD concepts since then.

recognisable animalistic visual traits – such as 'cute eyes' as headlights "creating a loveable animal face" (Honda, 2009b) – and an intuitive user interface. The design has clearly been developed using automotive design cues, with sophisticated surface detail and car-like headlamp features. Typically, products in this market are visually challenging and the EV-Monpal apparently aims to capture a market share through its styling.

Another Honda innovation – the Walking Assist Device (**Error! Reference source not found.**2f) – is aimed at the tourist, mobility impaired and workplace safety markets. This device has no wheels, but instead uses two robotic leg structures for bodyweight support, reducing the load on the legs while walking. It weighs only 6.5kg including the battery, shoes and twin motors (Honda, 2009c).

Toyota claimed that 2009 saw a marked shift in the car market towards small vehicles (Toyota, 2009a) and has been developing a range of products in response. The company is developing a range of robotic 'partner tools' The Winglet (**Error! Reference source not found.**4a) is the smallest, and aims to fill the 'short distance' vehicle niche (Toyota, 2008). The device is a two wheeled gyroscopically controlled transporter – again very similar in operation to the Segway – but with a footprint much smaller in size. The user stands on footrests that are positioned above small wheels and clasps the device between their ankles, knees or in their hands, dependent on which of the three models is being used. To move, the operator leans in the desired direction. The three models are simply called "S", "M" or "L" and, due to their small size, can be easily stowed in a car, bus, tram or train (Toyota, 2009b).

Figure 4 – Personal Mobility Devices

Other alternatives by Toyota include the Mobiro (**Error! Reference source not found.**4b) and i-REAL (**Error! Reference source not found.**4c). The Mobiro is a single seater, battery operated two wheeled device that is being pitched as a robotic wheelchair. It uses dynamic suspension to raise and lower the vehicle for ease of access to the seat and to maximise the ride smoothness. It also allows the operator to travel at a raised height, which is beneficial for both driving visibility and physical presence. The vehicle is capable of travelling at 6km/h for 20km, can independently avoid obstacles and travel autonomously to remote locations (Hayashi, 2007). According to Toyota (2009b), field testing of the Mobiro is currently under way at a number of medical care facilities in Japan.

The i-REAL – released at the 2007 Tokyo Motor Show – is the fourth generation of Toyota's single occupant vehicle concepts, following the PM (**Error! Reference source not found.**4d), i-unit (**Error! Reference source not found.**4e) and i-swing (**Error! Reference source not found.**4f). Its footprint is little bigger than a lounge chair and operates on three wheels – two at the front, one at the back. A pivot between the wheels dynamically alters the wheelbase relative to its speed; shortening to create an upright stance at low speed, and lengthening to lower the centre of gravity for greater stability at higher speeds. The extra height at low speeds allows the operator to be at eye level with the surrounding walking traffic. The i-REAL also has proximity sensors for collision alerts and can communicate to those around it with a light display (Toyota, 2007).

Another similar product at the 2007 Tokyo Motor Show was the Susuki PIXI (**Error! Reference source not found.**4g). It is a fully enclosed single occupant vehicle – similar to the 2005 Toyota i-swing – that has been designed to dock in tandem with a second PIXI in an SSC unit (Suzuki Sharing Coach – shown in figure 4h) for shared trips. The power for these vehicles reportedly comes from hydrogen and sunlight, and solar energy could be used to fast charge their capacitors (CDN, 2007a).

The VW "future of the Car" concept projected for 2028 includes a line-up of a number of vehicle types; a people mover, a two seater sports vehicle, and the on-"e" (fig 4i) – a three wheel, single seat urban vehicle designed to 'platoon' with other similar vehicles to become a road train during peak hour traffic. Like the i-REAL it has three wheels, but in a reverse configuration – one at the front and two at the back. The wheelbase is also dynamic to provide stability at speed and minimise its spatial footprint when parking (Volkswagon, 2008).

While the number of PMD concepts by major OEMs is increasing, to date, very few have actually made it to production. Toyota and Honda have shown the most willingness to extend their product portfolios to include these vehicles, and if successful we may see others follow suit. At the moment it is difficult to see a justification for vehicles such as the u3-x and the winglet beyond recreational use; however the PUMA and i-REAL concepts provide greater versatility and speed, making them ideal for short commutes. At present, they require changes in legislation and road infrastructure for safe on-road use.

Microcars

The term 'microcar' describes a very small class of car, generally two-door, two-seater and less than 3 metres in length. The vehicle class – which also includes Low Speed Vehicles (LSV) and quadricycles – have a number of benefits that could counter many of the issues outlined in section 2:

1. they are usually lightweight and deliver greatly improved fuel/energy efficiency over regular cars, resulting in cheaper running costs;
2. they have a greatly reduced spatial footprint allowing a higher vehicle density on the road, reducing congestion;
3. they are easy to park in tight spaces;
4. they have greater environmental credentials than regular cars (many microcars have electric drivetrains which eliminate tailpipe emissions, and those that don't, greatly reduce carbon emissions due to their lightweight and efficiency);
5. they are more likely to be exempt from government taxes such as congestion charges, high parking tariffs and carbon/pollution taxes;
6. they have some load carrying capacity;

7. they can usually carry at least one passenger;

8. they can travel a relatively long distance between charges;

9. they afford the same weather protection as a regular car.

Some of these vehicles can be driven by both car and motorbike licence holders and, in the UK, are free from the London congestion charge. In Paris, plans to implement an electric microcar car share system to augment the Velib bicycle share infrastructure has been recently publicised (Chapa, 2008). 'Autolib' combines the convenience of a bicycle share system with the carrying capacity of a small electric car.

The first vehicle in this class to capture a high profile was the Mercedes Benz SMART; a vehicle whose length makes it possible to park perpendicular to the curb and remain virtually within in the width of a normal parking space. Similar vehicles have been produced commercially in small numbers by niche manufacturers, with products such as the ZENN Electric NEV (**Error! Reference source not found.**5a), Venturi Eclectic (**Error! Reference source not found.**5b) and Reva NXR (**Error! Reference source not found.**5c). Vehicles in this category are powered by either internal combustion or electric motors and in Europe some are limited to low speed zones. Microcars also have a potential application as station cars where they are intended for travel from a suburban home to bus or rail transit for city commuting and may involve pooled rather than individual ownership (Rose, Richardson, 2008). The major OEMs have been slow to develop their own production versions, but a number of concept vehicles have emerged recently, such as Chrysler (GEM) Peapod (**Error! Reference source not found.**5d), Honda EV-N (**Error! Reference source not found.**5e), Nissan Nuvo (figure 5f) and the Peugeot bb1 (**Error! Reference source not found.**5g).

The Honda EV-N is the largest in Honda's family of small EV concepts, which include the previously discussed u3-x, EV-Monpal and EV-Cub. The retro styling is reminiscent of the Honda N360 – a strong link with Honda's heritage. The EV-N has an all electric drivetrain and sources some of its energy from the solar cells embedded in the roof (Bird, 2009). The interactive black grille provides a means of communication with the surrounding traffic, able to display messages and flashing lights across it (CDN, 2009b). The weight reduced interior has lightweight mesh seats (Toyota, 2009c) and cleverly incorporates a u3-x into the door trim for short trips after the car is parked. These touches indicate a more 'systems' thinking approach to the design, recognising that commuting efficiency can be improved by increasing the range of modal options.

Figure 5 - Microcars

The Nissan Pivo 2 concept (**Error! Reference source not found.**5h) is one of the more adventurous microcars to be unveiled at the 2007 Tokyo motor show. The centre pod of the vehicle is able to rotate 360°, enabling it to travel both forwads and backwards without turning the whole vehicle around (CDN, 2007b). Access is via a full length front hatch that has the instrument panel and steering wheel attached. The rotational functionality is ideal for driving in a congested city, but this concept is unlikely to see production in coming years. The Toyota IQ (figure 5i), however, is one of the few microcar concepts to make it through to production to date. The initial concept (figure 5j) was unveiled at the 2007 Frankfurt show, with the production version subsequently released at the 2008 Geneva motor show. It is in a similar class to the Smart four-two but has the additional seating capacity of a 3+1 seating package (three primary seats with an occasional fold-away fourth child seat (CDN, 2008c).

Of great interest to the microcar market is the SAIC YeZ concept (Figure 6), released at the SAIC-GM Pavilion at Expo 2010 in Shanghai. The two-seater vehicle extrapolates the idea of eco-motoring further than the other vehicles discussed in this paper. It has a number of energy collecting methods; such as, rotational tracking solar cells in the large green leaf on the roof, wind generators in the four wheels, and it claims that the skin of the vehicle absorbs CO2 and converts it to electric energy via the processing powers of microorganisms. SAIC claims that these technologies will allow it to operate as a “negative emissions” vehicle (SAIC Motors, 2010). Given the YeZ is a only concept at this stage; it will need to undergo some modifications before it would be market ready. For instance, while the design is innovative in its surface execution, the open exterior and lack of a windscreen will make it inappropriate for daily commuting.

Figure 6 – SAIC YeZ

Another adaption of the microcar have been narrow-track, tandem two seater vehicles, such as the Commuter Cars Corporation Tango3 (**Error! Reference source not found.**7a) or the City El. These demonstrate greater spatial efficiency on the road than other microcars, given their ability to lane split. This provides a 15-fold improvement in the volume of people able to be moved through road systems (Adams & Brewer, 2004).

Of particular note is the Nissan Land Glider (**Error! Reference source not found.**7b) which was unveiled at the 2009 Tokyo Motor Show. The tandem, two seater, four wheeled, narrow-track vehicle is a sophisticated representative of the vehicle segment. The concept, which is only 3100mm long, 1100mm wide and 1415mm tall, offers motorbike-like ride dynamics, being able to lean up to 17 degrees to assist with cornering. The vehicle is reminiscent of past 'lean machines', such as the GM Lean Machine, the Mercedes F300 Life-Jet and the Carver. The Land Glider's wheels are encased in tilting body panels that are separated from the main body. It has duel electric motors that are powered by lithium ion batteries positioned under the floor and are configured for wireless induction plate refueling (Winsor, 2009).

VW and Renault have also released narrow-track vehicle concepts as part of projected future fleet line-ups. The VW L1 (Figure 7c), which was unveiled at the 2009 Frankfurt Motor Show, is a revised version of the 1L which was released in 2002. While at 3.8 metres it is technically longer than most microcars, the width remains at only 1.2 metres. The focus of the vehicle engineering was to maintain fuel efficiency. This is has been achieved by the 124kg carbon fibre reinforced plastic body and an aerodynamic form that delivers a Cd (coefficient of drag) of 0.195 (Volkswagon 2009). VW have indicated their intentions for its commercial release. The Renault Twizy Z.E. (**Error! Reference source not found.**7d) is perhaps the smallest of the OEM produced microcar concepts, and borders on PMD size. Renault has indicated that a production vehicle similar to the Twizy Z.E. will be released complete with a tandem rear passenger seat in the coming years (Renault, 2009).

[3] The Commuter Cars Corporation Tango is an ultra-slim, electric, tandem two seater with the spatial footprint of less than half a regular family sedan. The vehicle has been commercially available for a number of years, is one of the more recognizable examples of this vehicle type. As a niche market product though, it has seen limited production at high retail prices – US$108,000 with a $10,000 deposit for the T600 kit (Commuter Cars Corporation, 2008) – which has limited its market penetration. Over the past few years, however, some of the major automotive brands have demonstrated moves to develop similar vehicle concepts which may improve accessibility to vehicles of this type in the future. The Tango, while not being part of an OEM line-up, has been a benchmark for recently unveiled narrow track urban vehicles.

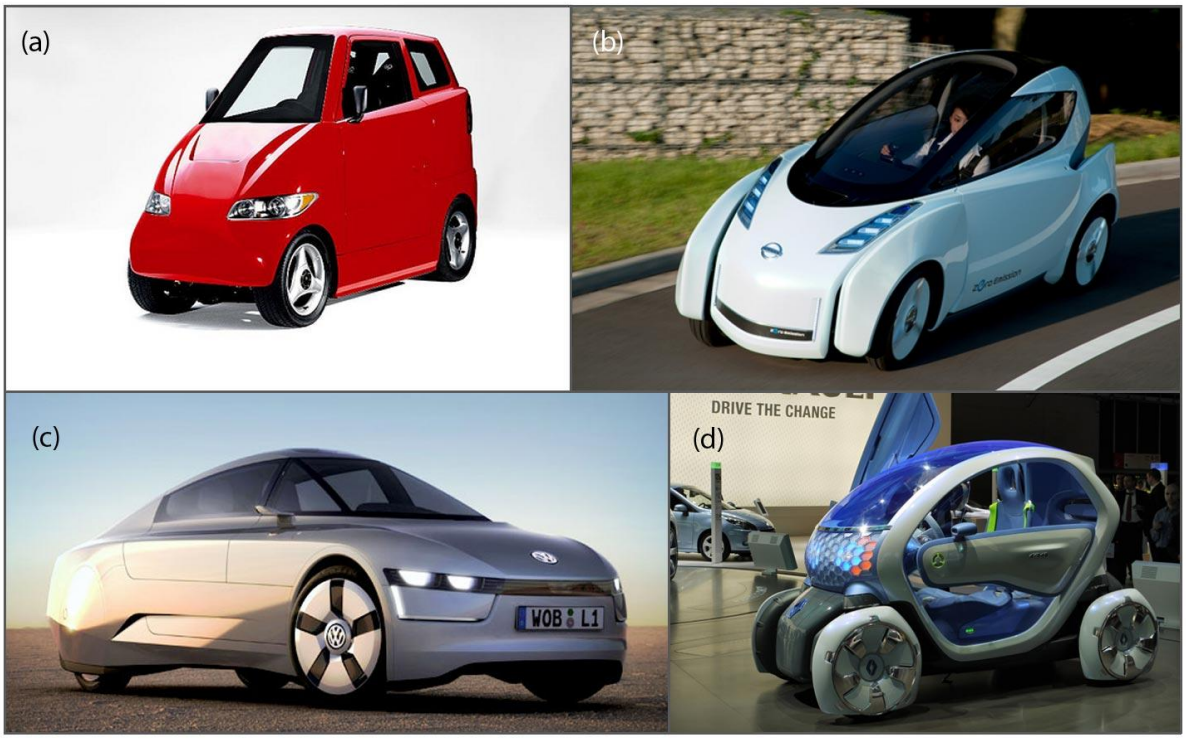

Figure 7 – Narrow-track microcars

Discussion

PMDs are designed to replace walking and cycling trips, allowing users to reduce the effort required for short distance commutes. While quite a number of examples have been shown, few major OEMs – other than GM, Toyota and Honda – are making the great inroads. The Honda u3-x is perhaps the most versatile of the concepts, being designed into interface with the EV-N microcar. It allows the user to park-and-ride and is small enough to be taken on public transport. The efficiency of these products is debatable, given they replace two of the most energy efficient human powered modes – walking and cycling – however, they may persuade commuters to consider alternatives to car trips. The PUMA however, offers a serious alternative to the car for short to medium length commutes, and provides the option of carrying a passenger. If vehicles like it are to become part of the on-road mix, changes to legislation will be required before widespread use can be implemented.

Microcars are perhaps the most likely type of alternative vehicle to be seriously produced by the major OEMs, given they are closest to the traditional car package. The narrow-track tandem seat vehicles are the most adventurous of the concepts, and provide the greatest spatial efficiencies of the segment. While these types of vehicles will relieve road congestion in the short term and allow higher vehicle densities, they still confine commuters to the current road system for the daily commute unless governments address road infrastructures and implement vehicle concessions.

It is interesting that most major OEMs have not expended as much energy in developing other types of vehicles in the alternative vehicle segment, such as PABs, electric bikes,

Velomobiles and three wheel motorised vehicles, as they have on PMDs and microcars. There are a number of exceptions to this, such as the Lexus Hybrid Bicycle Concept[4] – a 17kg, carbon fibre electric pedal-assist bicycle; the Volkswagen Bik.e[5] – a folding, fully electric bike; the Honda 3R-C[6] – a single seater 3 wheel vehicle; the Volkswagen GX-3[7] – a three wheel, open cockpit, internal combustion powered sports vehicle; The BMW Simple[8] – a fully enclosed three wheel lean machine; and the Peugot HYmotion[9] – a three wheel 1+1 seater scooter with a rollover bar. These types of vehicles however, are in proportionally limited development to PMDs and Microcars. Given the equivalent energy expenditure on developing and promoting these vehicle types, it would be interesting to gauge any shifts in market acceptance.

CONCLUSION

Growing concerns over climate change, fuel price rises, congestion, vehicle storage, and household financial constraints are putting pressure on vehicle manufacturers to reconsider their product portfolios. Additionally, many new initiatives, networks, industries and products are emerging which offer efficient and cost effective modes of transport. Community based projects and government initiatives designed to counter the need for large car ownership are likely to encourage individuals to consider using smaller, lighter, more efficient forms of personal transport for daily short to medium distance commuting.

The privately owned conventional motor car, in broad objective terms, will likely come under greater scrutiny. Aside from the obvious pollution concerns, current vehicle platforms are limited in spatial and functional efficiency, as they are built to cater for a wide number of tasks for the broadest possible market reach – a one size fits all approach. A broader system of transport options, however, can provide considerably more when designed to do so. Car-share systems could potentially offer the individual access to a range of vehicles with different seating capacities and functional capabilities, and open a niche for smaller alternative vehicles to be used on a daily basis.

This paper has scoped a broad range of literature to gain a sense for the trends developing in the alternative passenger vehicle segment. While a large number of alternative vehicles are being manufactured worldwide, relatively few of them have been developed by the major OEMs. Recent international motor shows however, have demonstrated a marginal increase in OEM alternative vehicle concepts that are trending towards two vehicle types: PMDs and microcars. PMDs are limited in their functional attributes and are unlikely to replace car travel, given they have minimal range, low speeds and very little carrying capacity. Other vehicles in the alternative vehicle range, such as PABs, velomobiles and powered 3 wheel vehicles, if well designed, may have greater promise.

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[4] See image at http://www.lexus.com.au/news/2010/12962414/LEXUS-HYBRID-HITS-TWO-WHEELS/
[5] See image at http://www.gizmag.com/volkswagen-folding-bike-concept/14949/
[6] See image at http://www.cardesignnews.com/site/home/new_cars/display-item/store4/item187028/
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Microcars are the most likely short term alternative vehicle variant to be produced in great numbers by the major OEMs. They address many of the issues outlined in section 2, providing a small spatial footprint to ease congestion and parking concerns, greater fuel efficiency, weather protection and some luggage capacity. From a market perspective, they are a familiar entity and are likely to be accepted easily. However there are still many opportunities for vehicles that fit somewhere between walking and cars that would be more sustainable transport options. It remains to be seen whether OEMs will take the opportunity to diversify their product portfolios and include them.

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