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Climate change, peak oil and road safety: finding synergisms to challenge the dominance of speed

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Abstract

Recent critiques of road safety policies argue for a wider cultural change than is found in public education campaigns to change community attitudes to speeding. We argue that a fundamental redesign of cultural arrangements is necessary in order to challenge the "culture of speed". The Swedish Vision Zero policy is often now put forward as a model for progressive shifts in road safety policy and practice. We argue there is also a need to integrate a sustainable transport approach with road safety policy and practice. New cultural arrangements are needed that reconnect road safety to communities that value social connectedness, quality of life and slower ways of being. The multiple health, environmental, economic, transport and community liveability benefits of the slower, active travel modes are now well established. In addition, whether speed, busyness, and "saving time" should be the hallmarks of modern life is as much a road safety issue as an issue for health, climate change and peak oil. Mobility management (also called travel demand management) is currently not integral to road safety considerations. A strong case exists for mobility management strategies being of value in reducing overall crash risk, by reducing per capita vehicle travel (and hence exposure).

1. Introduction

Increasingly in recent years, research and public policy has been pointing to the need for a paradigm shift in the way the Australian community deals with road safety. A publication prepared for World Health Day 2004 by the Australian Transport Safety Bureau (2004) cast the problem of traffic deaths and injuries as a major public health issue. Likewise, McIntosh (2004), although acknowledging the impressive improvements in road safety in the final quarter of the 20th century, points to the need for a new paradigm in order to significantly move beyond the plateau over the last ten years in road deaths and trauma. Among the OECD countries for which 2007 data were available, Australia had 7.6 annual road deaths per 100,000 people, which is just below the OECD median of 7.8. The Netherlands recorded the lowest rate at 4.3 deaths per 100,000 people, and Poland recorded the highest rate at 14.7 deaths per 100,000 people. Other countries at the low end in these terms included Iceland (4.1), Great Britain (5.0), Norway (5.0), Switzerland (5.1), and Sweden (5.2) (Department of Infrastructure Transport Regional Development and Local Government, 2009).

Professor Don Aitkin, Chairman of the NRMA-ACT Road Safety Trust, has emphasised the need for a cultural change in relation to how people consider speed and the use of motor vehicles, in the same way that cultural shifts have occurred in relation to smoking and the issue of AIDS ("Too many crosses to bear on roads," 2005). Yet current road safety programs and thinking are constructed within a paradigm that tends to accept existing cultural arrangements. Typically, programs favouring symptomatic solutions and technical

and/or physical solutions are pursued as a way forward. For example, the above-mentioned report by the Australian Transport Safety Bureau (2004), although recasting road safety within a broad public health framework, still concludes with a chapter on "the future" which focuses on using technology to improve safety, as with the emergence of Intelligent Transport Systems (ITS). We agree with the assessments of those practitioners in the road safety field who consider that large potential gains in road safety depend not on technical fixes, but on changes in social norms, that is in changes in social values, awareness, attitudes and behaviour (Grigg, 2004; Grzebieta, 2005).

Technical innovations such as intelligent speed adaptation (ISA) and pedestrian avoidance technology (Hagon, 2009) are valuable additions for road safety. The range of current car safety features and those under development includes, for example, electronic stability control, adaptive cruise control, ABS brakes, various kinds of airbags, fatigue monitoring and warning systems and lane departure warning systems. Supporting the value of such technical innovations is the finding that the crashworthiness[1] of new cars registered in Australia has progressively improved during the period 1983 to 2006, such that the risk for 2006 cars is about half that of 1983 cars (Newstead, Watson, & Cameron, 2009). On the other hand, such technical approaches are still car-centric in orientation, and the term "risks of safety" has been used to describe the often-repeated pattern of the actual drop in fatalities not living up to the hopes of various safety devices (Vanderbilt, 2008, p. 262). That is, technical improvements are likely to be weakened by behavioural responses that allow motorists to trade off safety benefits as performance benefits (Adams, 1995; Wilde, 2001).

Recent critiques suggest the need for a much wider cultural change than is implied, for example, by just developing public education programs to change community attitudes to speeding. Popular books such as *In Praise of Slow* by Carl Honoré (2004) question whether speed, busyness, and "saving time" should be the hallmarks of modern life. David Engwicht (1999; 2005) likewise promotes the notion of "psychological traffic calming" in his books *Mental Speed Bumps* and *Street Reclaiming*.

The current paper is linked to a report on a holistic approach to road safety prepared for the NRMA-ACT Road Safety Trust (May, Tranter, & Warn, 2010). It addresses questions such as: What is the nature of the cultural shift that is required to overcome death and injury on Australia's roads? How can such a cultural shift be facilitated, both institutionally and in communities? We argue that there is a strong need to integrate a sustainable transport approach with road safety policy and practice. In particular, the combination of two major global issues—peak oil and climate change—is increasingly likely to affect transport and travel behaviour. Although road safety and environmental concerns are both important areas of concern, they are often considered separately with the advocates of each area tending to operate separately. The opportunity and imperative exists to bring sustainable transport and road safety together in a more integrated way in order to facilitate better environmental and road safety outcomes.

2. How deep is the paradigm shift needed?

Challenges to the current paradigm for road safety are coming from a number of directions, including new thinking on health, ecologically sustainable transport, global environmental change, and the "slow movement". The importance of two key drivers of global change—climate change and peak oil—is sufficiently great to devote a separate section to these below. Some general principles are discussed in the current section.

At a more general level when considering change, a distinction can be drawn between "deep" sustainable change, which usually requires fundamental redesign of the systems involved, and our relationships with them, and "shallow" adaptive, substitutive and

[1] Crashworthiness ratings measure the relative safety of vehicles in preventing death or severe injury to their own drivers in crashes.

compensatory change, which usually unintentionally protects and perpetuates the very structures and processes that are the sources of the problems that we are attempting to solve. Hill (1999) uses an "E-S-R" model to distinguish between "efficiency", "substitution" (shallow) and "redesign" (deep) approaches to change. The model was first developed for re-conceptualising pest control, from the inefficient to efficient (E) use of pesticides, to substitutes (S) such as biological controls, to the integrated redesign (R) of complex agroecosystems to favour crops and natural controls and not the pests. Efficiency and substitution strategies may serve either as stepping stones or as barriers to the more fundamental redesign approaches. An integrated, whole system approach calls for redesign and innovation at the industrial and business levels, enabled by supportive changes in institutional structures and processes (at the political and socio-cultural level) (Hill, 2006).

With respect to road safety, Whitelegg (1983) raised similar issues almost three decades ago. He asked to what extent our solutions are locked into a particular view of technology and society, and are therefore tied to producing incremental improvements without any fundamental alteration in the structure of the problem itself. As he put it (p. 153):

> In the case of road safety it can be argued that solutions which build on the acceptance of the motor car as a major and immutable technology will reinforce that position and generate a primary paradox: solutions designed to reduce a major negative effect of motorised transport contribute to the perpetuation of the circumstances which lead to road traffic accidents. The lack of policy suggestions outside of this "predominant technology" leads to great confusion in road traffic accident research.

Whitelegg further considers that the categorisation of people, vehicles and roads as the prime dimensions of road safety policy has created its own difficulties in relation to road traffic crash research. In his view at that time, progress made in road design, vehicle engineering, and studies of driver and pedestrian behaviour had "not been matched by advances in our understanding of the role and function of the transport system as a whole and of the needs and susceptibilities of different groups and individuals for whom movement in cities and elsewhere is an integral part of normal existence" (p. 153). The prevailing approach, he suggests, carries with it the strong implication that the original "design" is without major defects, and the answer to problems within it lies in some aspect of quality control of the component elements, namely people, roads or vehicles.

More recent work, however, on the "politics of mobility" (Vigar, 2002) and the relationships between transport, environmental sustainability and public policy points to a shift beyond a narrowly defined transport policy approach to encompass a much wider set of health, social and environmental concerns. Travel by private vehicle (and also air travel) is widely considered to be more damaging to the environment than by other modes of travel. Motor cars are considered to be less efficient than mass transit both in terms of individual journeys, and in terms of the energy used in their manufacture and maintenance. Consequently, Vigar (2002, p. 190-193) demonstrates how the "predict and provide" paradigm was increasingly questioned during the 1990s particularly in relation to road building, with a gradual perceptual shift occurring from "roads as solution" to "roads as a problem". Thus, where the "predict and provide" model sees "changes in travel demand as an expression of underlying social and market dynamics" and as being inevitable without serious consequences (particularly economic), a "new realist" approach argues that "travel demand can be influenced by public policy" and that travel demand management is an appropriate policy response.

3. Current approaches to shifting the road safety paradigm

In Britain, the call for a paradigm shift in road safety has been highlighted in recent official reports. A House of Commons Transport Committee (2008) report entitled *Ending the Scandal of Complacency: Road Safety Beyond 2010* points out that the deaths of three

thousand people and injuries to a quarter of a million people is a “staggering annual toll to pay for mobility” (p. 3). Further, the committee comments: “It is inconceivable that any transport system invented today would be accepted, no matter what its benefits, if it involved this level of carnage” (p. 3). The report therefore highlights the need for a “step-change in approach”. The following excerpts highlight the need for a new vision integrated with other important policy objectives, and underline the adoption of a systems approach. Consequently, they also emphasise an integrated institutional approach:

> A new vision is needed for road safety in Britain beyond 2010. This should be underpinned by a strategy that explains how casualty reduction, danger reduction and the various other important policy objectives, such as a sustainable transport system, economic efficiency, climate change, social inclusion and physical health are integrated. (p. 34)
>
> The systems approach to road safety, now adopted by the Netherlands, Sweden and elsewhere is different to that pursued by the UK. We believe that it is time for the UK to move towards this more fundamental approach which is accepted for other transport modes. (p. 39)
>
> We … recommend that the Government establishes an authoritative and independent road safety commission that has powers to work across the whole of Government. (p. 42)

The Vision Zero approach in Sweden is a philosophy of road safety that eventually no one will be killed or seriously injured within the road transport system, and assumes that it can never be ethically acceptable that people are killed or seriously injured when moving within the road transport system. The Vision Zero policy requires a paradigm shift in addressing road safety by having fatalities and serious injuries reduced to zero (Tingvall & Haworth, 1999). The policy is radical in its approach as compared with previous initiatives, as shown by its basic strategic principles:

- The traffic system has to adapt to address the needs, mistakes and vulnerabilities of road users
- The level of violence the human body can tolerate without being killed or seriously injured is the basic road transport system design parameter
- Vehicle speed is the most important regulating factor for safe road traffic

The Sustainable Safety approach in the Netherlands likewise adopts a proactive and preventive approach. Examples applicable to both (but expressed here using language typical of Vision Zero) include setting speed limits in accord with the human body’s tolerance against external violence, a road environment with an infrastructure adapted to the limitations of the road user, and road users who are well informed and adequately educated. Specific actions within the safety strategies thus include the use of 30 km/h speed limits in built-up areas, the use of roundabouts rather than traffic lights, and the physical separation of vehicles with major differences in masses, speeds and directions.

The Stockholm Environment Institute (Whitelegg & Haq, 2006) investigated the costs and benefits of adopting a Vision Zero policy in the UK. On the positive side, a vision is something that can be constantly used to inform policy development and thinking. It coincides with a strong interest in Sweden in public health, quality of life, health and safety at work, and an “aviation safety culture” approach in terms of risk. Claes Tingvall (Director of Traffic Safety, Swedish Road Administration) indicated that he “believes Vision Zero has produced a very positive standard of thinking about road safety and has established a high level of consensus and shared values across diverse groups of people including the automotive industry, Volvo, and politicians” (p. 22).

On the downside, some of those interviewed for the Stockholm Environment Institute study, including experts and those in focus groups, consider that the zero target is "idealistic", "unrealistic", and "unattainable", and that a big stumbling block is changing people's attitudes (p. 29). Helmut Holzapfel, Professor of Traffic Planning, University of Kassel believes the concept of Vision Zero is valuable, but considers that Sweden has done little to counter the spread of car dependent lifestyles that result in more kilometres driven (p. 25). He considers that clearly stated intermediate goals are also needed, together with a clear process of evaluation and policy changes to assist in keeping the process on target.

The Parliamentary Advisory Council for Transport Safety (PACTS) in the UK (2007) is another body that called for a more integrated and holistic approach to road safety. It too emphasises the importance of a vision to guide future road safety policy. Additionally, it argues for an engagement plan to involve organisations and policy fields that have not traditionally worked in road safety.

PACTS is supportive of the Swedish Vision Zero policy based on the assumption that no one should be killed or seriously injured in road traffic. This is a "paradigm shift in approach to road safety" (p. 17) as it abandons the traditional economic model where road safety is provided at reasonable cost, and the traditional transport model in which safety must be balanced against mobility.

Importantly, PACTS notes for Vision Zero that *speed is the key factor* for controlling the safety of the system and as a focus for intervention. However, it also draws on an Audit Commission finding that around one fifth of people identified speed and the *volume* of traffic among the issues that most need tackling to improve the quality of life of residents (p. 21).

With respect to integration at an organisational level, PACTS emphasises that "building partnerships between the levels of government and communicating the intersections between road safety and other policy objectives is a specific task and a skill and requires dedicated attention" (p. 26). Thus policies to tackle a variety of social and sustainability agendas such as climate change, social exclusion, obesity and urban renewal can all overlap with the objective of reducing casualties. Therefore PACTS supports the setting up of a high level body or agency to facilitate the greater coordination of road safety issues, with membership including those with expertise in public health, sustainable travel, and attitudinal and behavioural change, to ensure that road safety is considered in its widest context (p. 27).

4. Climate change and peak oil as drivers of change

The combination of two major global issues—peak oil and climate change—is increasingly likely to affect transport and travel behaviour. Peak oil refers to the global peak and subsequent decline in the production of oil. Climate change is increasingly being considered as a major sustainability emergency for humanity (Lovelock, 2009; Spratt & Sutton, 2008). More pragmatically, a wide-ranging report prepared for Brisbane City Council on climate change and peak oil suggests that the Council should call for a sweeping change in attitude and policy by government at all levels, that it should lead by example, and that sustainability should be fully integrated into Council decision making processes at all levels (Maunsell Australia Pty Ltd, 2007). The report is the result of an expert Climate Change and Energy Taskforce set up to advise Brisbane City Council on preparing the city for climate change and peak oil. The taskforce was chaired by Professor Ian Lowe.

Significantly, road safety issues are being linked to the sustainability agenda, including the pivotal issue of climate change, and concerns about sedentary lifestyles and an obesogenic environment (Parliamentary Advisory Council for Transport Safety (PACTS), 2007; Racioppi, Eriksson, Tingvall, & Villaveces, 2004). A report by the World Health Organization demonstrates well how road safety can be integrated with health and environmental concerns (Racioppi et al., 2004, p. 35). A range of road safety related issues including

speed management, traffic calming, reducing transport demand, road pricing, the promotion of safe cycling, walking and public transport, and reducing the power of vehicles have positive and synergistic effects on reducing road crashes, mitigating climate change, promoting physical activity, and promoting community cohesion.

A recent book on resilient cities considers the way in which climate change and peak oil constitute a "double whammy" for resource intensive cities (Newman, Beatley, & Boyer, 2009). The authors argue that there are many reasons—environmental, health, social, and economic—to overcome car dependence. This is best understood in terms of a lack of resilience, with a city needing many kinds of transport and land use options, rather than just one type to be resilient. To emphasise the singular focus on cars, the authors draw on transport planner Eric Britton's reference to the "New Mobility Agenda" of breaking the stranglehold of the single "car-only" option for cities (p. 87).

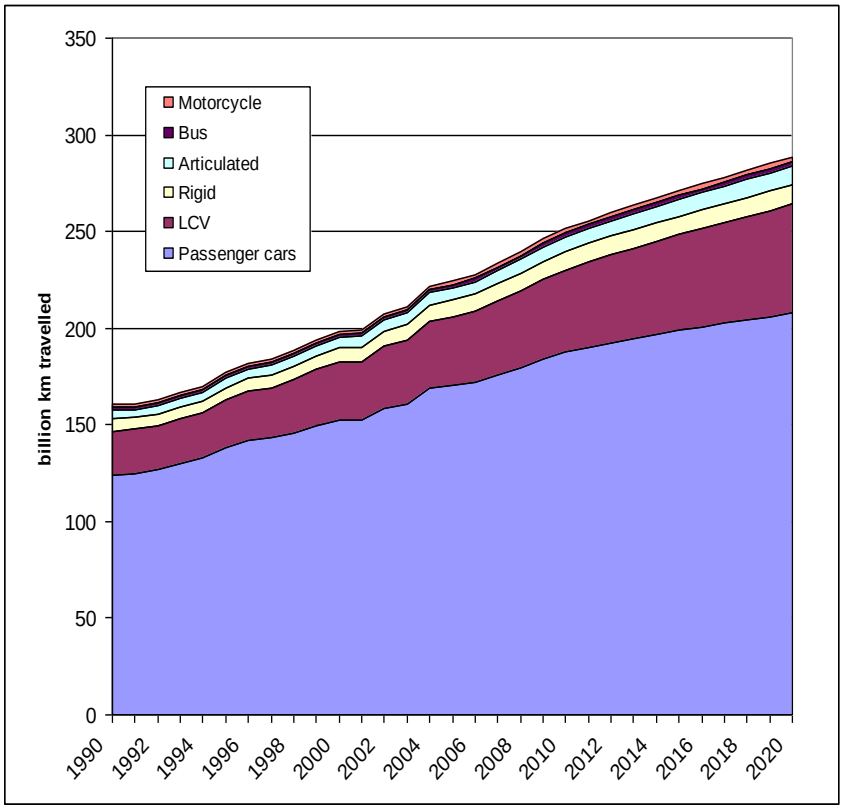
In contrast, the title of another recent book—*Two Billion Cars – Driving Toward Sustainability* (Sperling & Gordon, 2009)—demonstrates the degree to which the car-centric model is embedded in modern societies. The planet has over one billion vehicles today, and is accelerating towards a second billion. By 2020, the authors project that over two billion vehicles will populate the earth, more than half of them cars. The increasing consumption of oil, and the carbon dioxide emissions from it, is the direct consequence of the continuing growth of oil-burning vehicles worldwide. In spite of the widespread concern and discussion about climate stabilisation and the need for deep cuts in emissions, vehicle sales, oil consumption, and carbon dioxide emissions are continuing their strong upward growth. The authors seek to address this unsustainable transport pathway by focusing on the reinvention of vehicles, fuels, and mobility, the latter factor in particular being an acknowledgement of the "spreading hegemony of cars" and a "transportation monoculture" (p. 6).

The contradiction between the need to cut greenhouse gas emissions and road transport's increasing contribution to emissions is demonstrated in more detail by Australian data. The vast majority of domestic passenger and freight trips are undertaken in road vehicles, which account for 75% of transport fuel use. In addition, the demand for transport energy is growing at about 2.4% per year (Future Fuels Forum, p. 12).

In 2007, transport contributed 14.6% of Australia's national greenhouse gas inventory emissions (Department of Climate Change, 2009). Transport emissions are one of the strongest sources of emissions growth in Australia. Road transport was the main source of transport emissions, accounting for 87% of 2007 transport emissions. Passenger cars are the largest road transport source. Emissions from light commercial vehicles (LCVs) and trucks have also grown strongly. Projections forward to 2020 done by the Bureau of Transport and Regional Economics (2005) using base case or business-as-usual assumptions confirm the long-term growth in transport sector emissions flagged in earlier studies. BTRE projections for the road sector have Australian vehicle kilometres travelled (VKT) growing from 222 billion kilometres in 2004 to around 289 billion kilometres in 2020 (an increase of 30% or close to 1.7% per annum) (see Figure 1). If peak oil occurs before 2020, these projections may well prove to be inaccurate estimates.

Another major energy issue with significant implications is the continuing availability of conventional oil (also called "cheap oil"). There is a growing literature pointing to a short to medium term supply problem e.g. Bentley (2002), Heinberg (2003), Deffeyes (2005), Kilsby (2006), and publications from the Association for the Study of Peak Oil (ASPO) such as Campbell (2006). A review of energy futures for Australian transport suggests there is significant risk of a crisis arriving before sufficient preventative action can take effect (Kilsby, 2006). In the above mentioned projections to 2020 for greenhouse gas emissions from transport, the greatest acknowledged uncertainty concerning the projections is whether there will be significant disruptions to oil supply during the forecast period, with consequent increases in fuel prices impacting on transport activity levels (Bureau of Transport and Regional Economics, 2005, p. ix).

Figure 1: Base case projected growth in road vehicle travel for Australia, 1990 – 2020 (Bureau of Transport and Regional Economics, 2005)



Maintaining Australia's resilience in the face of "peak oil" has significant implications in relation to quality of life and mobility, producing food, and meeting energy needs (Cork, Walker, & Buckley, 2008). The addition of diminishing oil supplies as another major global driver of change therefore suggests that communities across the world will increasingly be faced with the need to redesign their transport systems and to modify travel behaviour (Kilsby, 2006). Kilsby suggests that a range of options should be employed in the face of considerable uncertainty. These include, for example, land use and transport integration initiatives, development of better public transport, technological development e.g. more fuel-efficient vehicles and the use of electricity in transport, government intervention via taxation and other pricing policies, and behaviour change via public education campaigns.

The question of how transport's future *could* unfold (rather than its prediction) is also considered by Gilbert and Perl (2010). In their view, two types of transport revolution are possible in coming decades as a result of the peaking of and decline in world oil supply. One revolution is that transport activity could decline substantially, either because of continuing economic recession or because there is little in the way of transport that is not dependent on oil, or for both reasons. The other type of revolution involves maintaining and even raising overall levels of most transport activity but increasingly using means of transport that do not rely on oil. Gilbert and Perl are interested in achieving the second type of transport revolution using technology that does not require oil for propulsion. Thus one scenario given for the USA in 2025 depicts much reduced use of internal combustion engine cars, much wider use of electric personal vehicles that have only electric motors, a declining number of "plug-in hybrids" that can use an internal combustion engine but do so rarely, and the substantial expansion of largely electrified local public transport. Nevertheless, Gilbert

and Perl assert that they cannot predict with any confidence whether this type of revolution will occur, or how, if it occurs, it will unfold.

A CSIRO-led Future Fuels Forum formed in November 2007 similarly addresses the uncertainty over which future technologies and fuels will be commercially available at reasonable cost (Future Fuels Forum, 2008). The Forum states that in the event of a decline in international oil supplies, technology alone will not be sufficient to meet the fuel supply gap. If the oil supply declines slowly then a modest reduction in travel of less than 5% would be sufficient, whereas if the reduction in oil supply is rapid and alternative fuel vehicles are slow to become available, then passenger and freight travel may be reduced by up to 40%. Significantly, the Forum also states (p. 33):

> The choices Australians make about how often, how far and in what mode they travel (public versus private passenger transport) and what size vehicle they need to own are likely to be equally as important as the fuel and technology choices they make in attempting to reduce greenhouse gas emissions and manage their vulnerability to the impacts of higher prices for oil products.

With respect to advancing a sustainability agenda, Lowe's (2008) assessment of energy use and the need to face up to the twin forces of climate change and peak oil, stresses that there must be planning immediately to reduce transport fuel use and to reduce single-person car use for urban trips. Investment in world-class public transport systems and non-motorised forms of 'active transport' such as walking and cycling for all major urban areas is needed. Gleeson and McManus (2008, p. 39) come to the same conclusions when analysing urban settlements. The same authors support urban policies that promote child-friendly cities, which include a wide range of concerns in addition to considerations such as traffic and noise impacts on children. The opportunities for a stimulus for positive changes in society that might be triggered by peak oil (or even by considering the onset of peak oil) are also discussed in relation to child-friendly cities by Tranter and Sharpe (2007).

Prominent medical journals are also increasingly framing the discussion of health in broad cross-sectoral terms. Growth in fossil-fuel based land transport is discussed in terms of its adverse health effects from climate change, road traffic crashes, physical inactivity, urban air pollution, energy insecurity, and environmental degradation. With respect to traffic related injuries and deaths, limiting the speed and volume of motorised traffic is one important prevention strategy.

The key to urban sustainable transport is considered more in terms of the design of local neighbourhoods, well-serviced and easy to navigate by active transport (cycling and walking), supplemented by high quality public transport powered by renewable energy for longer journeys (Woodcock, Banister, Edwards, Prentice, & Roberts, 2007). Similarly, Capon (2007b) discusses changes in cities as an evolutionary process with four distinctive stages I to IV: poverty, industrial, consumption, and sustainable eco-city. The high-consumption lifestyles associated with stage III are characterised by chronic diseases such as obesity, diabetes, heart disease, depression and injury. In contrast with earlier public health interventions based on water supply and sanitation, the reforms associated with ushering in the aspired to stage IV are more likely to be initiatives such as mass transit and safe walking and cycling paths to local shops and services. Systems thinking, and collaborative relationships between urban planners, transport planners, and public health workers, are required.

A recent report with a strong economic and systems focus analyses the way in which the deteriorating quality of Australia's land transport systems increasingly threatens the economic prosperity and quality of life of Australia's major cities (Stanley & Barrett, 2010). It frames its discussion and recommendations around five critical national land transport issues, namely:

- Traffic congestion costing $10 billion annually and rising

- Road transport being the third largest source of greenhouse gas emissions, with emissions growing
- Social exclusion as a result of inadequate transport systems
- Road safety and health, with road deaths and injuries remaining unacceptably high
- Energy security being very significantly threatened as a result of the dependence on fossil fuels

The report's recommendations thus focus on five key strategic outcomes, namely congestion management, environmental improvement (reduced greenhouse gas emissions from transport), social inclusion (adequate accessible public transport for all), transport systems designed to raise community health and wellbeing, and energy security through reduced dependence on fossil fuels. For example, the development of a program for Australia's public transport system is one very important component of a national strategy that cuts across these overarching issues. External benefits provide a policy justification for government supporting public transport services, and include (p. 44):

- Cost savings from reduced congestion
- Reduction in greenhouse gas emissions and other environmental benefits
- Improved mobility opportunities for many people at risk of social exclusion for transport reasons
- Fewer road accidents, with associated health care cost savings and reductions in trauma
- Improved energy security

5. Shallow change and deep change

At the shallow, adaptive level of change, the sustainability agenda discussed above suggests that for car travel, it means travelling less far, in more energy efficient ways, and at slower speeds. Rationalising car design, regulation and driver education should be at the forefront of policies to reduce road transport emissions (Anable, Mitchell, & Layberry, 2006, p. 28). These researchers quote research from the Netherlands showing that a combined approach of downsizing power and speed, enforcing speed limits, and in-car guidance of drivers' behaviour could reduce CO_2 emissions by 50%. Such measures are associated with the term "ecological driving". Johnston (2005, p. 67) notes that many fleet operators are interested in the adoption of more fuel-efficient driving styles and practices, which also happen to be associated with lowered crash risk.

The synergies between road safety objectives and reducing greenhouse gas emissions are supported by research showing that the management of driving speeds in particular is an effective carbon abatement policy (Anable et al., 2006). The authors argue that (p. 31):

> A policy of current speed limit enforcement and, better still, lowering speed limits, would bring significant, certain, immediate, equitable and highly cost-effective reductions in carbon emissions.

The research examines the relationships between reducing speed and a number of other related factors, including reducing casualties, reducing CO_2, reducing travel demand, and improved traffic flow. The researchers suggest that the traffic smoothing effects of a 60 mph limit on motorways in the UK would help to reduce harsh driving styles and overtaking which can cause flow breakdown, disruption, and crashes. Their findings indicate that a properly enforced 70mph speed limit would cut carbon emissions from road transport by nearly 1 million tonnes of carbon per annum, while a new 60 mph limit would nearly double this reduction, reducing emissions by an average 1.88 million tonnes per annum.

Other social benefits flow from reducing speeds. A report on road traffic noise in the UK suggests that road traffic is the biggest cause of noise pollution in the UK, and that reducing speeds and also traffic volumes are effective ways of reducing noise (UK Noise Association - Paige Mitchell, 2009). The report argues that reducing speed, and thus traffic noise, would cut the cost that noise imposes on the economy, and improve the health and well-being of millions of people in the UK.

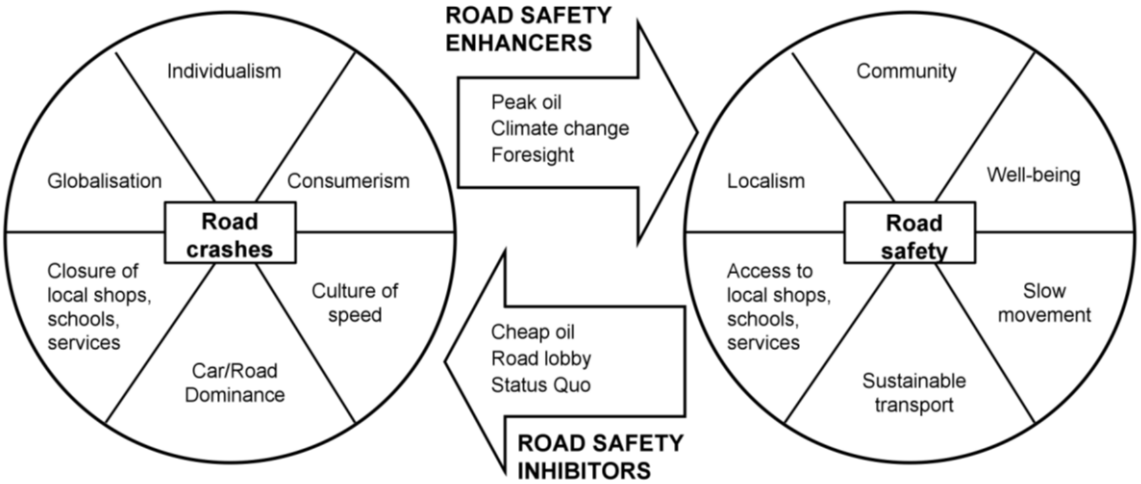
One of the problems in convincing people not to speed is the discrepancy between the perceived individual advantages and the societal disadvantages. A campaign launched by the Dutch Ministries of Environment and Transport brings together the social (especially environmental) and individual advantages of not speeding (European Road Safety Observatory, 2006, p. 29). The emphasis is on increased comfort and saving money for the individual driver, and increased environmental quality and road safety for the society as a whole.

Deep change associated with fundamental redesign can usefully draw on the cross-disciplinary field of social ecology, which focuses on the interrelationships between personal, social, and ecological issues. We consider that this critically based approach is valuable, in contrast with some systems approaches that integrate a range of competing issues, but which are more inclined to accept current cultural arrangements as "given".

A working social ecological model for road safety is shown at Figure 2. Such a model implies the need for a much wider cultural change than just the development of public education programs to change community attitudes to speeding. It contrasts a paradigm linked to car and road dominance and a "culture of speed" with one focusing on sustainable transport and "slow" values. The former is more broadly associated with consumerism, individualism, and globalisation. As Hamilton (2001, p. 190) observes, globalisation depends on more than neo-liberal economic orthodoxy: "It represents the export of a culture and a psychological disposition based on growth, compulsive consumption and the exploitation of the natural world".

A holistic road safety paradigm is associated with characteristics such as localism, community, and well-being. A dynamic component is included in Figure 2 (using arrows), drawing on Lewin's (1935) "force-field analysis" model. It is useful for identifying those forces helping to move towards road safety and those hindering such change. Positive change is facilitated by strengthening and adding to the enhancing forces, and removing and weakening the restraining forces (barriers).

Figure 2: Working social ecological model of road safety (May, Tranter, & Warn, 2008)



6. Deep change and road safety

Deep change is exemplified in the various approaches discussed below including mobility management, the role of active transport and public transport in road safety, and the way time is considered and structured in a society.

6.1. Mobility management

Mobility management (also called travel demand management) is currently not integral to road safety considerations, being usually considered more in relation to congestion reduction, energy conservation and emissions reductions, and improved mobility options for non-drivers. However, Litman (2009) presents a strong case for mobility management strategies that reduce per capita vehicle travel (exposure) being of value in reducing overall crash risk. That is, the *volume* of motorised traffic is a critical factor to consider in addition to speed. He puts the case for change in how road safety is considered as follows (p. 35):

> Current transport planning practices give little or no consideration to safety impacts of changes in vehicle mileage. This tends to overvalue roadway and vehicle improvements that increase vehicle mileage (such as highway capacity expansion which induce vehicle travel on a particular roadway, and vehicle fuel efficiency and safety improvements that increase per capita vehicle mileage), and undervalues mobility management programs that reduce vehicle mileage.

There is acknowledgment of increasing travel as an issue in official documents, but not of travel demand management as a strategy for dealing with the problem. For example, in Australia the *National Road Safety Action Plan 2009 and 2010* (Australian Transport Council, 2008) states (p. 55):

> Australia has had an extended period of economic growth. Studies have shown that increased economic activity and discretionary income are generally associated with higher levels of road trauma due to increased travel, including more travel during high-risk periods in the 24-hour cycle.

The reason that mobility management is given little or no significance according to Litman is that distance-based analysis treats mobility (the amount that people travel) as being outside the scope of policy interventions. In contrast, he makes the case for distance travelled being a significant risk factor, and therefore mobility management being an appropriate way to reduce crash risk. This approach contrasts markedly with the conventional engineering wisdom on the safety benefits of "improving" highway facilities and achieving higher standards of design (Noland, 2003). For example, the Hume Highway is considered as one of the "safest" roads using the RACV's criteria, yet it records high crash rates. This is because it carries high volumes of traffic and consequently has attracted more funding (Public Transport Users Association, 2010).

Further, Litman argues that many experts and individual drivers prefer to focus on reducing the small percentage of high risk driving by other motorists, rather than vehicle travel in general, or their own vehicle travel in particular. While not underestimating the value of "targeted" programs directed at high-risk driving, Litman (2009, p. 5) maintains that the safety value of reducing average-risk travel has been underestimated.

Mobility management strategies are consistent with wider principles adopted for sustainable transport (May, 2006). These include access to goods, services and social opportunities, rather than mobility *per se*, and less movement of goods and services, for example by appropriate urban design and access through telecommunications. Litman (2009, p. 3) uses the following broad categories for various mobility management strategies:

- Improved transport options e.g. transit improvements, walking and cycling improvements, telework, flextime

- Pricing initiatives e.g. congestion pricing, fuel tax increases
- Land use management e.g. smart growth, new urbanism, car-free planning
- Implementation programs e.g. commuting reduction programs, freight transport management, tourism transport management

Litman (2009, p. 35) also comments on how much safety can be achieved through mobility management programs. Examples given include personalised marketing programs towards walking, cycling and public transport that have reduced local vehicle trips by 7 to 14%, with an associated reduction in road crashes of 5-10%. London's congestion pricing reduced crashes within the charge area by about 25%. Residents of smart growth communities[2] tend to drive 15 to 25% fewer miles, and have 20 to 40% fewer per capita crash fatalities than residents of conventional, car-oriented communities. Given that many strategies have synergistic impacts, mobility management programs that use a variety of strategies (e.g. road and parking pricing, improved travel options, and smart growth land use policies) can be expected to reduce per capita crashes by 20 to 30% or more when applied. Significantly, conventional planning tends to overlook the full costs of decisions that increase vehicle travel (such as roadway capacity expansions), and undervalues the full benefits of mobility management strategies that reduce vehicle travel distances.

A related issue concerns the safety of cycling. In spite of the fact that Australia has been seeking to increase cycling to improve the overall sustainability of urban transport, concern about the danger of road cycling is a serious deterrent to getting more people to cycle—particularly for children, women, and older adults. Improving the safety of cycling is therefore important for encouraging its wider adoption. In cases where cyclists and cars cannot be separated, the principle of "safety in numbers" means that cycling becomes safer as levels of cycling increase. The explanation appears to be that large numbers of cyclists are more visible and command more respect from motorists. Further, if an increase in bicycles on roads is accompanied by a reduction in the number of cars, the potential for serious injury from collision decreases (Pucher, Garrard, & Greaves, in press 2010).

6.2. The role of active transport and public transport in road safety

Recent public policy reports on road safety, and those on climate change and peak oil, as discussed above, typically encourage a shift away from default car use to walking and cycling (active transport), as well as to public transport. The active transport modes deserve closer analysis of how they can become part of road safety strategies, how their uptake can be facilitated, and what limitations typically apply. The multiple health, environmental, economic, transport and community liveability benefits of active travel are now well established in the research literature (Garrard, 2008). However, although pedestrians and cyclists are legitimate road users, they are frequently overlooked in transport systems that are shaped by the dominance of car travel, as in Australia.

Active transport and public transport are closely associated with the ways in which the environment is planned and designed. Walkable communities tend to have higher measures of "community health" and well-being, given their higher levels of interaction and "social capital". There are also reductions in damaging vehicle emissions, fewer crashes and greater space for children's play (Cavill, 2001). A review of Central Sydney undertaken for the City of Sydney by Danish urban planner Professor Jan Gehl found it to be dominated by cars, and not geared to the needs of pedestrians (Capon, 2007a; *The Gehl report - a blueprint for greener, more vital, connected CBD*, 2007). Pedestrian walking routes are unconnected, and pedestrians wait too long at traffic crossings.

[2] Smart growth concentrates growth in the centre of a city to avoid urban sprawl, advocates transit-oriented and walkable communities, and has mixed-use development with a range of housing choices.

Encouraging public transport usage is beneficial for the environment and from a safety point of view, whereas freeway expansion is environmentally harmful and likely to be disadvantageous for road safety. Other advantages discussed earlier for public transport include congestion management, social inclusion, and energy security. The Gehl report and a study of work travel modes in Australian capital cities (Mees, O'Connell, & Stone, 2008) both suggest that policy and funding priorities need to be directed away from urban motorways towards more environmentally friendly modes, particularly public transport and walking. There also needs to be a reorientation of road space and road rules to give pedestrians priority over motor vehicles. Mees et al. refer to good international evidence suggesting that walking and public transport complement one another.

The revitalisation of Perth's public transport system through rail expansion and a strong focus on the integration of rail and bus services provides a good model for progressive multi-modal transport planning and implementation (Newman et al., 2009). In addition to Perth, other cities in Australia that stand out at both national and international levels in terms of the growth of public transport, are Brisbane and Melbourne (Stanley & Barrett, 2010, p. 16). Brisbane is rolling out an international best practice example of Bus Rapid Transit. In Melbourne, very strong growth in Business District employment has supported growth in train use in particular. Melbourne, Perth, and Brisbane have all made strong efforts to integrate the various modes of transport, attending to fares, signage, interchanges and timetabling. Forward-thinking political leaders are needed to overcome obstacles in the way of sustainable visions, as well as an aware and politically active citizenry demanding better options to confront climate change and peak oil. Increased funding is necessary to address the requirements of effective public transport such as: a transit system that is faster than traffic in all major corridors; service quality (frequency of service, ease of interchange, comfort, safety); integrated timetabling and route planning; and responsiveness to customer needs. Stanley and Barrett (2010) emphasise the pivotal role of the Federal Government in driving national land transport improvements, especially much increased investment in public transport.

6.3. How time is considered and structured in society

Another example of an issue that has an important bearing on road safety, is the way time is considered and structured in a society. Thus, so-called "time pressure" is emerging as a modern malaise (Strazdins & Loughrey, 2007). It is linked to changes in working life, with longer work hours and faster work pace. In many families both parents must combine working with caring. Time costs shape travel choices and behaviours. Relevant here is the 2005 AAMI survey entitled "Congestion rage: symptoms of a busy, over-stressed society", with 60% of drivers admitting that if they are in a hurry, they are more likely to lose their temper with other drivers. Professor David Hensher considers that "the symptoms of road rage by drivers and passengers are often associated with pressures on their time, given all the competing demands" (AAMI, 2005, p. 6). AAMI's research suggests that traffic congestion is a major source of aggression on the roads. Since 2005, the *AAMI Crash Index* found a more than tripling of the number of drivers who say it takes them thirty minutes or more to drive to work—from 8% in 2005 to 30% in 2009. Moreover, in the same period the research identified an 18% increase in the number of drivers who attribute aggression and road rage to traffic congestion—from 70% in 2005 to 88% in 2009 (AAMI, 2009, p. 5).

Stazdins and Loughrey argue that many public health policy issues have an unacknowledged time dimension, which is vital to consider in bringing about the changes needed. The availability of free time has declined, and if interventions are to be successful, they must avoid adding to time burdens. Policies and interventions in relation to road safety need to take account of this time dimension.

The need for fundamental redesign is reflected in the Slow Cities movement. Surprisingly little attention has been paid to this movement by road safety researchers. Yet it may

provide considerable potential for improvements in road safety. Knox (2005) asserts that globalisation has created a “fast world” with “people and places directly involved, as producers and consumers, in transnational industry, modern telecommunications, materialistic consumption and international news and entertainment”. Countering this trend is the development of the Slow City movement—an ecological and humanistic response favouring local, traditional cultures, a relaxed pace of life and conviviality. Engwicht (2005, p. 159) in discussing such an approach refers to the “Great Civility Outbreak”—a cultural revolution where it becomes the social norm to be ‘civilized’ and ‘a good citizen’.

At the shallow, adaptive level, the use of flextime and telework can reduce peak-period travel by shifting travel time, or reduce commuting trips. At a deeper, more fundamental level, adoption of the slow cities principle promotes a more human, less frenetic way of life. Slow Cities are not just, however, about a fast city slowed down; they are about challenging the dominance of speed, accepting the view that it is OK to be slow (Honoré, 2004). This challenge to the dominance of speed is important for road safety in multiple ways. First, if this is applied to urban speed limits and average driving speeds, there are immediate and clear road safety benefits, as speed is a significant factor in traffic accidents. Second, if the slow cities movement can encourage people to use local public spaces, then one impact of this is reduced traffic levels, as well as more careful driving from psychological traffic calming (Engwicht, 2005). At a larger spatial scale, Slow Cities encourage the use of local materials and foods, reducing the need for transport of goods and materials, particularly by trucks. An additional road safety benefit is therefore achieved by reducing the number of heavy vehicles on streets.

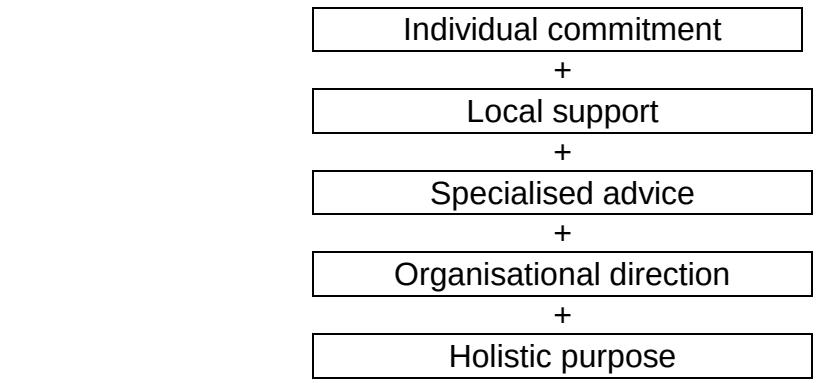
7. Facilitating cultural change for road safety

A recent report commissioned by the Department for Transport in the UK (Broughton et al., 2009) acknowledges the slowing trend in fatality reduction in many countries, and hence the need for a new approach or ‘vision’ for achieving substantive additional reduction.

Broughton et al. (2009) flag the need for road safety policy to be considered in the context of wider policies, such as those linked to climate change, improving people’s safety and health, enhancing quality of life, and promoting greater equality of opportunity. The complexity of the cultural change required with respect to road safety points to the value of holistically oriented management systems. Brown (2008, p. 109) argues for the value of drawing on a range of “knowledge cultures”, which can contribute to collective decision making (Figure 3). These include individual commitment (personal lived experience), community support (mutual place-based experience), specialised advice (from academic disciplines and professions), organisational direction (providing strategic agendas and regulations), and holistic purpose (collective vision and metaphors that span divisions). To achieve whole-of-community change, Brown suggests that rather than focusing on divisions between silos, the ground rules for collective decision-making are best served by integrative webs and networks offering opportunities for synergy and collaborative action.

Nonetheless, with respect to organisational direction and integrative management, policies can frequently fail if responsibility is shared among too many players. As more agencies become involved, the complexity of coordination overwhelms the original policy intent. Successful implementation is therefore associated with a single agency or at least a dominant one (Bridgman & Davis, 2000, p. 117). This observation ties in with recommendations from parliamentary committees in the UK, suggesting that a high level body or independent road safety commission be established to work across the whole of government to integrate efforts from fields such as health, environment, sustainable transport, and behavioural change (House of Commons Transport Committee, 2008; Parliamentary Advisory Council for Transport Safety (PACTS), 2007).

Figure 3: Whole of community change draws on various knowledge cultures (Brown, 2008)



Major factors thus identified as important for the success of road safety initiatives are the necessary political will, proper organisation, and knowledge. Broughton et al. (2009) provide support for such principles by noting that experience in Sweden, the Netherlands and New Zealand underlines the importance of securing parliamentary commitment on grounds that are hard to refute, demonstrating that there are cost-effective measures through which a vision can be pursued, and obtaining the engagement of stakeholders and the public using readily understandable concepts on lines of action. A celebrated example of the importance of political will and commitment was a major initiative by the French President to improve France's safety record compared with other countries. A change in culture and practice of the enforcement of traffic law, using widespread implementation of the speed cameras and also electronic breathalysers, resulted in substantial reductions in fatality numbers.

In addition, of particular relevance for implementation are lessons learned from a case study of road safety in Victoria, undertaken by Professor Ian Johnston for the Federal Highway Administration in the USA (US Department of Transportation: Federal Highway Administration, 2006). A significant element of Victoria's success was the way in which the diversity of institutions involved in implementation came together in an integrated and coordinated way. The catalyst for this came in part from a public outcry over the number of deaths on Victorian roads being 10% greater in 1989 than the levels in 1988 and 1987. As a result, the Minister for Transport demanded action. The key agencies involved in various aspects of road safety—VicRoads, Victoria Police, Department of Justice, and the Transport Accident Commission—were charged collectively with the task of reducing deaths on Victorian roads. Accountability mechanisms for each agency and between agencies were instituted, and cooperative relationships among senior staff in the various agencies were forged. This approach contrasts with the traditional model in which each agency was responsible only for matters under its immediate control.

As well as "top down" reforms, much greater attention and support should also be given to community travel behaviour change initiatives by policy makers. Typically, such programs are rated as being of low effectiveness in the range of possible road safety programs. However, with proper support, TravelSmart travel behaviour change programs and Walking School Bus (WSB) programs have significant value for road safety and deserve to be expanded. Their advantages include modal shifts and reduced car use. TravelSmart programs in particular have the explicit aim at the household level of switching individual travel behaviour from the use of cars to public transport, walking and cycling (Transport WA, 1999), indirectly providing road safety benefits. Professor Peter Newman (2009, p. 111) suggests that the importance of the TravelSmart program in bringing about a transition to

more resilient cities should not be underestimated. In the Travelsmart Belconnen project run in Canberra in 2006-2007, car travel was reduced by 12.7%, in terms of vehicle kilometres travelled (ACT Commissioner for Sustainability and the Environment, 2007). A study of Adelaide in 2005-06 showed even better results. In this case, TravelSmart succeeded in an overall decrease in car travel for participant households on weekdays of about 22% (Stopher, Zhang, Zhang, & Halling, 2009). This is significant in road safety terms when travel demand management is accepted as a valid road safety objective.

8. Conclusion

We argue in this paper for the integration of a sustainable transport approach with road safety policy and practice. In particular, the combination of two major global issues—peak oil and climate change—is increasingly likely to affect transport and travel behaviour. Although road safety and environmental concerns are both important areas of concern, they are often considered separately with the advocates of each area tending to operate separately. The opportunity and imperative exists to bring sustainable transport and road safety together in a more integrated way in order to facilitate better environmental and road safety outcomes.

There are significant co-benefits for road safety, population health, and quality of life through policies to reduce greenhouse gas emissions and to prepare realistically for the consequences of peak oil. At a shallow, adaptive level of change, this is supported, for example, by research showing that the management of driving speeds in particular is an effective carbon abatement policy. However, at a deeper level of change, many of the policies and practices needing to be put in place have very significant positive road safety implications. These include the much wider application of mobility management (also called travel demand management), a strong shift to active travel and public transport, and a reconsideration of how time is structured in society, as with the adoption of “Slow Cities” principles.

Recent road safety inquiries in the UK have recommended that a high level body or independent road safety commission be established to work across the whole of government to integrate efforts from fields such as health, environment, sustainable transport and behavioural change. The complexity of the cultural change required with respect to road safety points to the value of holistically oriented management systems in facilitating whole-of-community change. Vision Zero approaches need to be integrated with a common vision for a sustainable transport system developed in conjunction with energy, transport, health, environment, and education agencies.

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