ASLEEP AT THE WHEEL: OIL ADDICTION IMPLICATIONS FOR URBAN TRANSPORT

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ABSTRACT

This paper assesses the oil addiction implications to urban transport. Two metropolitan areas are compared in terms of urban and regional policy making and actions. The analysis indicates that there may be considerable impacts to well-being, because no specific planning/policy initiatives have been taken to address oil addiction and there is limited knowledge on the potential consequences of oil shortages and/or substantial fuel price increases. There would be various ways to seriously address the oil addiction issue, but it is clear that there will not be any “magic” solutions that will make the problem go away without a long-term vision and coordinated actions from all stakeholders.

Keywords: Peak Oil, Urban Transport Planning

INTRODUCTION

It is well known that our current state of civilisation is heavily dependent on fossil fuel, namely: petroleum. There is very little that exists in today's society that is not produced, distributed or consumed without petroleum (Hirsch et al, 2005). Only remote parts of the planet are not reliant on fossil fuel resources.

Petroleum dependency or addiction is clearly observed in urban areas, where motorised travel is dominant. Even though exact figures are not available for all urban areas around the world, it is not difficult to realise that there is a direct relationship between consumption of petroleum, size and density of urban settlements and motorised travel. Higher densities generate lower vehicle kilometres travelled (VKT) and therefore, exhibit lower energy consumption (Bagley and Mokhtarian, 2002; Newman and Kenworthy, 1999).

Despite general contentment in utilising and taking advantage of numerous qualities of petroleum, there has been a growing concern over the long term implications of such dependency. Various scholarly and governmental reports have indicated that: (a) petroleum reserves are limited (Hirsch et al, 2005; Leggett, 2005); and (b) petroleum-related carbon emissions are affecting the global climate (BTRE, 2002a; Gore, 2006; Stern, 2006). At the urban level, there has been a growing debate on how to consider these issues as part of urban and regional planning, i.e. how development can/should be managed in order to cope with future pressures and resource limitations.

This paper aims to assess oil addiction implications to urban transport. We are particularly interested in examining how different metropolitan areas are subject to eventual constraints in terms of petroleum consumption and/or to substantial increase in fuel prices. Based upon a review of recent studies on peak oil, the urban environment and transport interface and environmental impacts of transport, two metropolitan areas in the Oceania region are compared. Consequences of oil addiction and potential mitigation measures in terms of urban and regional policy making and actions are investigated in order to show how resilient the two metropolitan areas would be in an event of oil shortage. Strengths, weaknesses and potential actions are discussed.

This paper is divided into five sections. After this introduction section, we examine the contextual elements of oil addiction. In the third section, the oil addiction implications to Christchurch (New Zealand) and Sydney (Australia) are presented. The fourth section presents a general discussion on background to current metropolitan planning policies and oil addiction. Finally, the conclusion summarises the key issues in dealing with oil addiction in metropolitan areas.

OIL ADDICTION IN URBAN AREAS

Cheap oil has been a key ingredient to the last 150 years of unprecedented prosperity (BTRE, 2006). Additionally, Hirsch et al (2005, p8) state that "oil is the lifeblood of modern civilization." This is because oil fuels the vast majority of the world's mechanised transportation: automobiles, trucks, planes, trains, ships, farm equipment and the military. Oil is also one of the primary ingredients for many chemicals that are essential to modern life (Hirsch et al, 2005).

Oil addiction in urban travel is the outcome not only of economic advantages. It is also the result of a dynamic process in which urban systems change over time in order to minimise costs and maximise participation in activities distributed throughout the urban area. The following sub-sections examine the principles that explain energy consumption and future prospects in terms of energy availability.

Urban Form, Transport Systems and Energy Consumption

The urban environment has been broadly defined to include land use patterns, the transportation system and urban design features that together provide opportunities for travel (Transport Research Board, 2005). *Land use patterns* refer to the spatial distribution of human activities. The *transportation system* refers to the physical infrastructure and services that provide the spatial links or connectivity among activities. *Urban design* refers to the aesthetic, physical, and functional qualities of the built environment, such as the design of buildings and streetscapes.

Increases in urban density, in conjunction with other land use changes, are often seen as a method of reducing transport and its associated environmental impacts (Maat et al., 2005; Steiner, 1994). Moriarty (2000, p15) has argued that residential density increases should reduce travel in two ways:

> "With higher densities, residents should be closer to destinations such as shopping centres or schools, because these can now be more closely spaced and accessible on foot."
>
> "Higher densities generally mean that road congestion is increased, and ease of parking is reduced, so that the convenience of private travel is reduced compared with less crowded cities."

Overall, existing literature shows that the relationship between urban form and travel behaviour is highly complex, and that different characteristics of the built environment, such as city size, density and urban structure, are interwoven and have a composite impact on travel patterns (Dieleman et al., 2002; Mindali et al, 2004; Naess, 2005).

Work by Buchanan et al (2006) found that distance from the CBD had a stronger correlation with transport patterns in Christchurch, New Zealand, than population density. However, other authors have concluded that previous work has provided little, if any, support that urban design affects travel (Crane and Crepeau, 1998).

Automobile Addiction

Australian cities are highly car dependent, and oil dependent, when compared to many Canadian, UK or European cities (Dodson and Sipe, 2006). The car is used for most trips, both for work and other purposes in Australian cities (Newman and Kenworthy, 1999).

Car dependence is highly unevenly spatially distributed within Australian cities. In general households located close to central business districts (CBD) demonstrate less dependence on automobiles for urban travel than those in middle and outer locations (Dodson and Sipe, 2006).

Growing energy consumption in urban travel is also a major issue in terms of its environmental consequences. There is growing concern about the impact of gases such as carbon dioxide, and the resultant possibilities of climate change and global warming. In particular, there is a growing concern about environmental impacts caused by transportation systems. Rises in energy consumption and the emissions from the automobile are being considered the main contributors to the problem (Mindali et al, 2004). "*The oil crisis and the high proportion of greenhouse gases due to mobility mean that reducing transport fuel should be a high priority for the short and long term future* (Newman, 2006, p6)."

Transport activity accounts for 14 per cent of global greenhouse gas emissions, making it the third largest source of emissions jointly with agriculture and industry (Stern, 2006). In contrast to Stern, Heywood (2006) argues that 25 per cent of worldwide greenhouse emissions are from transport. Three-quarters of these emissions are from road transport, while aviation accounts for one eighth and rail and shipping make up the remainder. Overall, total CO_2 emissions from transport are expected to more than double by 2050 (Stern, 2006).

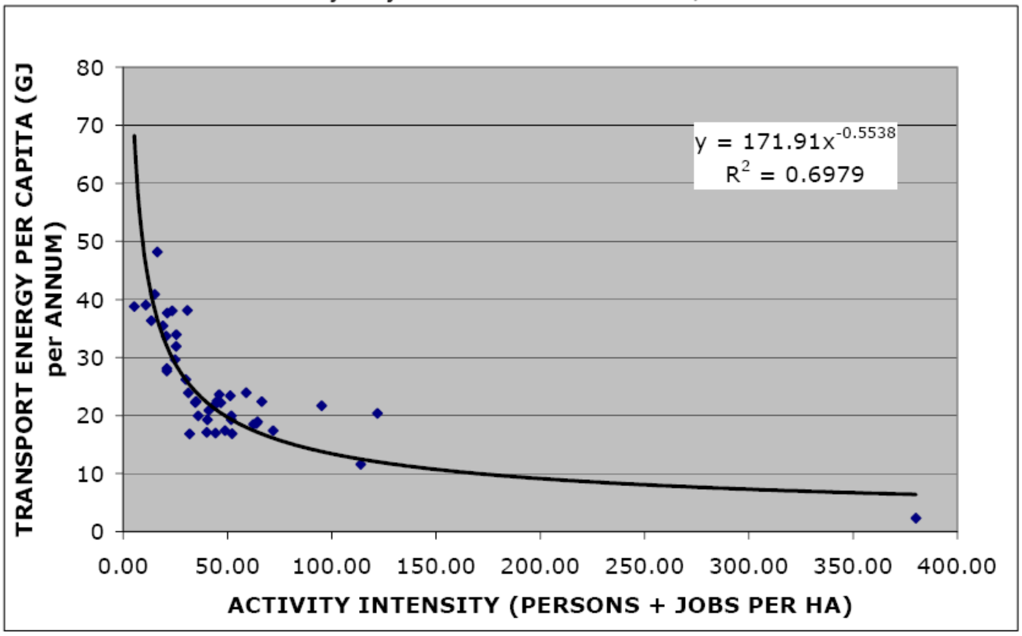
Greenhouse gas emissions from transport are due primarily to the use of fossil fuels – the main transport energy source. Carbon dioxide is the major greenhouse gas produced by transport emissions, with 2.26kg of carbon dioxide being produced for every litre of petroleum consumed by motor vehicles (BTRE, 2002b). CO_2 is estimated to make up around 60 per cent of global warming (Chandra, 2005).

The main environmental challenges facing transport are emissions of greenhouse gases, and local air pollution, especially in large cities (Moriarty, 2000). Different modes of transport have different environmental impacts. For example, public passenger transport is more fuel efficient on a primary energy basis than car travel (Moriarty, 2000). Urban rail transport is over twice as energy efficient as urban car travel. In Australia, approximately 85 per cent of greenhouse gas emissions from the transport sector are due to road transport, of which over half the emissions were due to passenger vehicles (BTRE, 2002b).

Newman and Kenworthy (2006) analysed transport energy use for local government areas in Sydney and Melbourne. The findings for Sydney are discussed here. Newman and Kenworthy (2006) used the combination of population and employment density to produce a measure of overall density, which is called 'Activity Intensity'. The results for Sydney in both 1981 and 2002 showed a sharp reduction in car use and transport energy as density reaches certain cut-off levels.

Figure 1 illustrates the findings for 2002. Figure 1 shows the relationship between per-capita, private-transport energy use and activity intensity in Sydney. The relationship actually changed very little over time, as the two data sets were collected 21 years apart, yet "show an identical relationship between transport and land use intensity (Newman and Kenworthy, 2006, p37). Obviously, density (or urban form) is not the only variable that is associated to energy use. It is actually a consequence of development policies (use of cheap land) combined with energy abundance (cheap oil).

Figure 1 Per Capita Passenger Transport Energy Use versus Activity Intensity in Sydney (2002)



Source: Newman and Kenworthy (2006).

Peak Oil and Shortage Scenarios

Overall, there is no question that world oil production will eventually peak and go into decline (Dantas et al, 2007; Hirsch et al, 2005). However, there has been much speculation as to when. There are two very distinct schools of thought on this (BTRE, 2006). The 'depletionists' argue that half the world's oil supplies have been, or will shortly be, used and oil production has peaked or is about to peak. The counter view, held by 'antidepletionists', is that while there are always uncertainties about reserve estimates, it is likely we have only used around a quarter of world reserves and that the outlook for the next 30 years presents no cause for concern (BTRE, 2006).

What happens to transport when oil starts to decline? One view is that a shortfall of oil supplies caused by world conventional oil production peaking will sharply increase oil prices and oil price volatility. As oil peaking is approached, relatively minor events will have more pronounced impacts on oil prices and futures markets (Hirsch et al, 2005). Another view is that the peak of oil production will signal a short-term crisis across world economies that will cause massive disruptions to daily activities, including transport (BTRE, 2006).

Mitigation of the oil depletion shock will require an intense effort over several decades. This inescapable conclusion is based on the time required to replace vast numbers of vehicles and the time required to build a substantial number of substitute fuel production facilities. Hirsch et al (2005) have found that:

- Waiting until world oil production peaks before taking reactive action would leave the world with a significant fuel deficit for more than two decades;
- Initiating a mitigation program 10 years before world oil peaking would help considerably but still leave a fuel shortfall roughly a decade after the time that oil would have peaked; and
- Initiating a mitigation program 20 years before peaking offers the possibility of avoiding a world fuel shortfall.

Without mitigation, the peaking of world oil production is envisaged to cause major economic upheaval. However, given enough lead-time, problems are manageable with existing technologies. Unfortunately, we as a society are quickly running out of time. New technologies are certain to improve the situation, but not in the short term and there are considerable concerns over their mitigation power in the long term.

OIL ADDICTION IMPLICATIONS

Four main analysis criteria are employed in order to assess the impact of oil addiction on two metropolitan areas for Sydney (Australia) and Christchurch (New Zealand). They are

- **Oil supply scenario analysis**: this involves the description and study of the particular characteristics of the energy supply system in the study areas. All possible sources of energy supply and their respective input/output ratios per sector of consumption and/or activity are listed and analysed;
- **Existing travel demand patterns**: this comprises general travel behaviour characteristics in the two study areas of Christchurch and Sydney. These characteristics are expressed in terms of trip length distribution, modal split and other indicators that represent the overall performance of the transportation system;
- **Initiatives to improve urban resilience to oil addiction**: existing plans to cope with energy constraints are examined. Also, other initiatives such as development of energy supply management systems and community awareness campaigns are analysed in order to verify whether or not future prospects of energy limitations have contributed to high levels of community resilience.
- **Implications**: the implications oil addiction may have on Christchurch and Sydney.

The sub-sections below describe the conditions of the criteria for Christchurch and Sydney as case studies.

Oil Addiction Implications to Christchurch

New Zealand's Energy Profile

New Zealand is dependent on imported oil refined products for all transportation fuels. In 2004, approximately 65% of transport fuel was refined at Marsden Point, New Zealand's only refinery, which is operated by the New Zealand Refining Company. The remaining 35% of transport fuel is imported directly as refined product. MED (2005) indicates that more than two thirds of refined oil products are used exclusively for domestic transportation.

In a recent study, Dantas *et al* (2007) conducted an analysis of the oil supply situation and developed a probabilistic model to estimate shortage events. Given that we know with 100% certainty that a peak in oil production will occur and the majority of oil experts agree that by 2030 the peak will have occurred, so the 100% probability of occurrence is taken as 2030.

A probability distribution of energy shortages was constructed from world oil resource, supply and consumption data by making a histogram of the predicted peak dates.Table 1 summarises the probabilities of oil shortage events of each level of oil reduction. Each scenario refers to the amount of oil that would be available from 2005 to 2030. For example, Scenario Peak Production refers to the current situation in which there is no control over oil consumption plus current trends of oil price increases are continuously observed throughout the years. This is a very optimistic scenario, given that oil peak may lead to exponential growth in prices instead of almost linear increases. On the other hand, Scenario 20% (Ration Enforced Reduction) shows the likelihood of a major cut in available oil stocks, which could be considered a pessimistic planning horizon, which may also occur in a relatively distant future.

Table 1: Peak Event Probability Matrix

		2005	2010	2015	2020	2025	2030
SCENARIOS	Peak Production	0.0%	37.8%	79.2%	94.9%	99.0%	100%
	7% Voluntary Reduction	0.0%	3.5%	52.4%	88.4%	98.1%	99.7%
	10% Ration Reduction	0.0%	0.0%	29.4%	78.1%	95.9%	99.4%
	15% Ration Regulated Reduction	0.0%	0.0%	1.5%	46.1%	86.0%	97.6%
	20% Ration Enforced Reduction	0.0%	0.0%	0.0%	7.3%	59.3%	90.7%

Source: Dantas *et al* (2007).

Overall, these results in Table 1 indicate that New Zealand is very likely to face a considerable reduction in the amount of available oil for transport activities. It is clear that from 2020, the probability increases considerably in the range of 10-20% reduction events. This is rather alarming, because there is no guarantee that worldwide oil reserves would be totally made available to small countries such as New Zealand. Furthermore, it would be expected that only a small part of reserves could be allocated to transportation activities.

Christchurch's Urban Transport Profile

Christchurch is a medium sized city with a population of 372,500 in 2006 (Statistics New Zealand, 2006). Greater Christchurch is the largest urbanised area in the South Island and had an estimated population of 414,000 in 2006, and is the third largest urbanised area in New Zealand (UDSF, 2006a).

According to the Christchurch Transport System model (CCC, 2003) the average travel distance is 7.4 km, which comprises 85% by car; 4% by public transport; 11% by other modes (walking, cycling, etc). It is also estimate that average number of trips per day is 5. Journey to work (JTW) travel patterns for Christchurch show that travel by car is dominant, with 79 per cent of JTW trips undertaken by car in 2001 (Buchanan, 2004). Bicycle and walking trips constituted 7 and 5 per cent respectively, while bus travel was less than 5 per cent in 2001. Overall, the average trip length for the JTW in Christchurch was 7.0 km in 2001 (Buchanan, 2004). Differences were more apparent in separate modes. Car-based travel averaged the longest trip (8km), followed by bus (7km) and bicycle travel (6km). Outer suburbs both generated and received the highest percentage of trips in 2001, indicating circumferential travel rather than a more traditional radial pattern (Buchanan et al, 2006).

Planning Initiatives

Locally, the Urban Development Strategy (UDS) forum has been constituted to discuss, elaborate, assess and communicate a series of planning actions to manage the predicted growth of the Greater Christchurch area. The forum, established in 2005, is part of a multi-organisational participatory planning effort, which comprises representatives from the Christchurch City Council, Selwyn and Waimakariri District Councils, Environment Canterbury (the Regional Council), Transit New Zealand (state highway system) and a cross-section of local leaders drawn from community, business and government organisations (UDSF, 2006b). A high-density development option has been chosen for implementation.

At the regional planning level, the *Canterbury Regional Land Transport Strategy 2005-2015* (RLTS) has been published and disseminated. The RLTS contributes to the national government's overall vision of achieving an affordable, integrated, safe, responsive, and sustainable land transport system. Five sections of the RLTS contribute to achieve the vision. These are in the areas of car-alternative modes, the road network (including safety and environmental impacts), demand management, land use and freight. Therefore, a core component of the Strategy is to increase the proportion of trips made by walking, cycling and public passenger transport, as the RLTS recognises that "it is not possible to build our way out of congestion (Ecan, 2005, p19)."

Future Trends and Implications

Population

The population of Greater Christchurch will change significantly by 2026. By 2026 the number of people living in Greater Christchurch is projected to grow to approximately 500,000, even reaching approximately 550,000 by 2041, if factors such as high migration continue (UDSF, 2004).

Demand for growth is high on the periphery of Christchurch City, in particular for residential development. A new town, Pegasus, north of Woodend is proposed to house 5,000 residents in the next 10 years (UDSF, 2006b). Development to the north-west and south-west will additionally impact on the performance of Greater Christchurch's road network. However, it has been shown that peripheral development in Christchurch leading to unsustainable trends such as high car use and increasing travel distances (Buchanan and Barnett, 2006; Buchanan et al, 2006; Buchanan, 2007).

Vehicle Kilometres Travelled

The growth of travel distance and freight movement in Christchurch continues to increase, even without a substantial growth in population. While vehicle trip growth rates may tend to level off, the consequences will not abate or go away immediately (Douglass, 2003). On present evidence there will be a further doubling in trip making and vehicle travel on the road network by 2050. For the Christchurch urban area this is an increase from 1.05 million vehicle trips (per 24 hour day) in 2000 to approximately 2.0 million trips in 2050. This is a significant increase and challenge, in addition to an increasingly congested network at the current time (Douglass, 2003).

Implications

In order to implement the RLTS, all of the agencies involved with the provision of the regional land transport system need to adopt the RLTS and be proactive in its implementation. However, some difficulties may arise as many organisations have their own implementation plans. This means that they need to work cooperatively with other organisations to integrate various methods and policies to produce "a safe, integrated, responsive and sustainable land transport system that enhances the quality of life for all of the people of Canterbury (Ecan, 2005, p40)."

LTNZ (2006) has established various national-level policies encouraging patterns of development that reduce the need to travel and reduce the length of journeys, but it makes no mention to energy availability and reliance issues. MED (2005) acknowledges the reliance on fossil fuels and proposes significant investments on renewable and clean energy in order to cope with future limitations in petroleum. Nevertheless, it relies heavily on soft measures such as change in travel behaviour in order to minimise future disruptions.

Oil Addiction Implications to Sydney

Australia's Energy Profile

According to the Commonwealth of Australia (2006), Australia is currently almost self-sufficient in the extraction and production of oil. It states "…*Our known oil reserves are significant, but are projected to decline in the absence of new discoveries*…". According to Geoscience Australia (2004) crude oil and condensate remaining economic demonstrated resources at the end of 2004 could sustain production of 34.0 Gigalitres per year for 14 years. This average production level was calculated for the period 1995 to 2004. The projected consumption of crude oil and condensate in 2005 could be sustained by remaining economic demonstrated resources for 9.8 years.

The transport sector is responsible most part of energy consumption in Australia. Petrol and diesel combined account for 41% of total Australian final energy consumption, which is mostly spent on road transport (76%). Future projections indicate that the demand for transport energy will increase by about 50% by 2019–20. Australia's heavy reliance on petroleum fuels for transport is expected to continue because of a lack of competitively priced alternatives, the long life expectancy of existing fuel production and distribution infrastructure, and the stock of vehicles (Commonwealth of Australia, 2006).

Based on Dantas *et al*'s modelling of worldwide energy reduction (2007), it is possible to consider Australia's particular energy supply characteristics and estimate peak event probabilities. The probabilities in Table 2 were estimated from Australia's official data (Commonwealth of Australia, 2006; Geoscience Australia, 2006).

Table 2: Peak Event Probability Matrix

		2005	2010	2015	2020	2025	2030
SCENARIOS	Peak Production	0.0%	19.9%	49.2%	72.1%	86.06	93.3%
	7% Voluntary Reduction	0.0%	3.1%	25.3%	53.31%	74.3%	86.9%
	10% Ration Reduction	0.0%	0.8%	15.9%	43.2%	67.0%	82.6%
	15% Ration Regulated Reduction	0.0%	0.0%	5.5%	26.0%	15.0%	72.5%
	20% Ration Enforced Reduction	0.0%	0.0%	1.2%	12.7%	35.0%	58.4%

Australia's exposure to oil shortages is presented in Table 2. High probabilities of significant shortage events are observed only after 2030. Nevertheless, this does not indicate that Australia is exempted from the global effects of oil shortage events. Furthermore, as observed in New Zealand's case, it is expected that only reduced parts of oil reserves would be made available to transportation activities.

Sydney's Urban Transport Profile

Sydney had a 4,169,000 population in 2004. It is estimated that in 2031 population will reach 5,300,000 people (NSW Department of Planning, 2005).

Over 70% of all trips are undertaken by private automobile (TPDC, 2006). There are approximately 15.8 million trips undertaken each day in Sydney, and vehicle kilometres travelled (VKT) was 80 million kilometres in 2004. VKT in Sydney increased at a rate of 2.3% per annum between 1991 and 2001 (TPDC, 2005). In 2004 the average daily kilometres travelled per person for residents of central Sydney was 19.8km, 23.5km for eastern Sydney residents, compared to between 44 to 48km for those in Sydney's west (TPDC, 2005). The average vehicle travel distance is 20.3 km per person per day. The current mode split is: 69.5% car; 10.4% public transport (train 4.9% and bus 5.5%), 20.1% other modes (walking and cycling 18.6%; light rail and ferry 0.3%; and other 1.2%). The average number of trips per day per person is 3.8 and the average trip length is 9.4 km.

Planning Initiatives

The *Metropolitan Strategy* is the New South Wales Government's long term plan to manage growth in the greater Metropolitan Region of Sydney (NSW Department of Planning, 2005). The *Metropolitan Strategy* envisions six distinct transit cities, each around 20 to 30 kilometres in diameter and each having a major Centre and a series of Local Centres. By focusing the plan on these six areas, it becomes feasible to determine where to direct growth and where new transit infrastructure will assist the development of a more sustainable city (Newman and Kenworthy, 2006).

Overall, the high-level objectives presented in the *Metropolitan Strategy* portray a picture of attempting to achieve a sustainable balance between social, environmental and economic objectives. These include peripheral travel, i.e. not just to the CBD, encouraging sustainable travel through an increase in alternative modes to the car and also targeting implementation through planning, evaluation and funding.

Future Trends and Implications

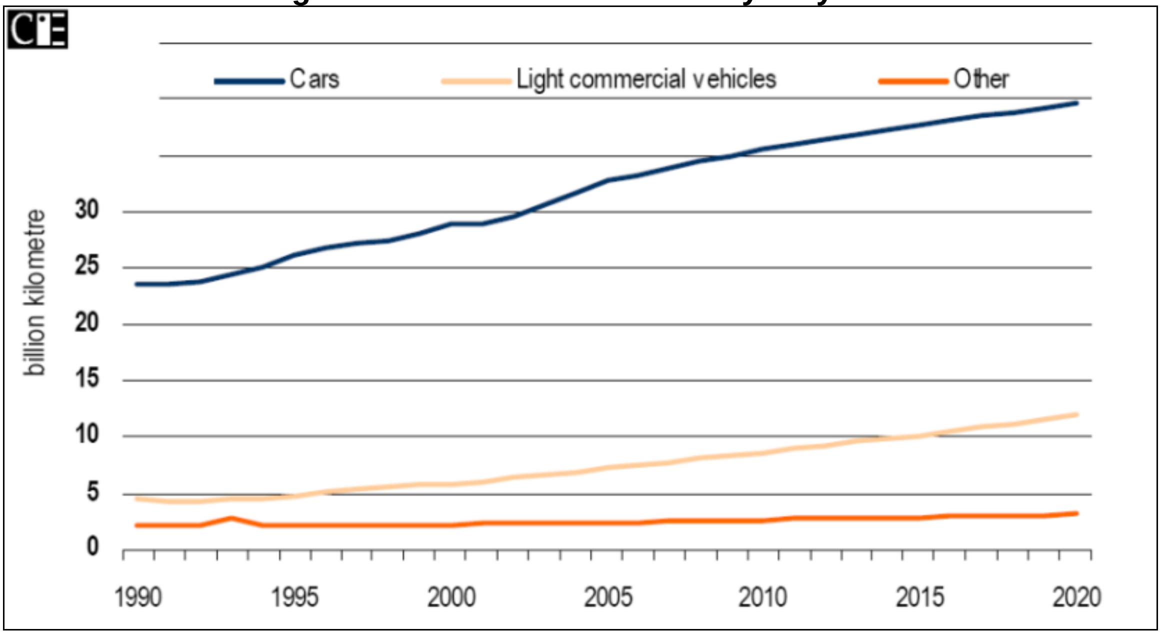
Population

Sydney's population is estimated to reach 5.3 million people by 2031 (NSW Department of Planning, 2005). This population increase will place additional pressure on all facets of transport infrastructure in Sydney, with increased demand for travel by all modes. Under the Metropolitan Strategy, there are to be two growth centres to the north-west and south-west of the city, however, many people will still be employed in the CBD, thus increasing travel distances.

VKT

Extrapolation of current travel behaviour shows that VKT will reach approximately 40 billion kilometres in 2020. If this trend continues or eventuates, increasing demand will be placed upon fuel availability.

Figure 2 Predicted VKT in Sydney to 2020



Source: Gargett and Gafney (2004) from Centre for International Economics (2005).

However, according to more recent travel statistics, VKT shows a large increase in 2002 followed by slowing growth which culminated in a significant decline of 2% between 2004 and 2005, the first negative change in Sydney since 1999 (TDC, 2007). On average between 1999 and 2005 VKT grew by 0.7% annually. This was slightly lower than the average annual population growth of 1% (TDC, 2007).

Implications

Overall, current trends in Sydney seem set to continue, although it is recognised that VKT has recently had a slight decrease. Furthermore, it has been argued that the transport based objectives in the *Metropolitan Strategy* represent an amalgam of various plans and projects, based on trying to adequately cope with current conditions (Bunker, 2007), rather than not looking far enough ahead in the future and how Sydney will acclimatise with less and/or more expensive fuel.

It has been further suggested that the major rail links to serve the new north west and south west sectors are too far into the future and by then travel patterns by car in those areas will already be well established (Bunker, 2007). Indeed, a recent announcement by the State Government of NSW has scrapped the north west heavy rail line and announced a metro-style link.

Discussion

The comparative analysis of the energy, transport and planning situation in New Zealand and Australian metropolitan areas indicates that there may be considerable impacts to well-being in the event of an oil shortage and/or significant increases in fuel prices. Major facts contributing to such a finding are:

(1) Lack of local, regional and national planning/policy initiatives that specifically consider oil addiction as a critical matter in achieving sustainability. Both countries and metropolitan areas have initiated many planning efforts which deal with environmental sustainability, but they fail to adequately and effectively address a critical issue: **private car travel and the dependence of urban development on energy consumption through fuel for private vehicles**; and

(2) Limited knowledge on the potential consequences of a substantial fuel price increase and/or oil unavailability at the levels currently supplied to users. To date, there has not been any effort in quantifying global changes that may occur if petrol prices increase by 100%, 200% or even 300%. It can therefore be argued that world activities would be restructured or rearranged in order to cope with substantially higher transportation costs. Even though the 1970s oil shocks and other temporary disruptions to oil supply generated important data on how society managed to live with less and more expensive fuel, peak oil brings the prospects of a permanent situation which may be extremely different to that currently observed. Policy documents in Australia and New Zealand have not extensively contemplated or addressed such a scenario.

There are many ideologies that underlie the current state of policy making and knowledge. The most relevant to this paper are:

(a) Alternative sources of energy will be created, processed and managed in order to "fill" the gap between what is currently consumed and what can be supplied in term of fossil fuels. For example, many scholars and governmental agencies have claimed that renewable energy sources (solar, wind, ethanol etc) can be employed as a fuel replacement for petroleum;

(b) New oil reserves are being discovered all over the world and they will be sufficient to meet current and future generation needs; and

(c) People's behaviour will change in face of adversity, as previously observed in human kind history.

These ideologies should not and cannot be ignored; therefore policy makers should not rely on them as given scenarios to help deal with potential oil shortages in the future. Various reports have demonstrated that to change current urban forms and the dependence on car travel there has to be a great deal of long term action to address the impacts both for and of contemporary society. Newman and Kenworthy (1999, p51) simply state: "the global peak in oil production will reverberate through our cities." Dodson and Sipe (2005) found that Sydney's urban environment has strong patterns in terms of oil vulnerability (socio-economic impact of rising fuel costs based upon the Socio-economic Index for Areas, household motor vehicle ownership and car use for work journeys).

However, many planners and engineers still assume that the current fuel supply is unlimited (Dantas *et al*, 2007) and have planned accordingly: thus today's cities in the western world are based upon unrestricted travel by the private automobile on expanding highways. Planning authorities also continue to develop transport policies that predict the continuous growth of fuel supplies (Chatterjee and Gordon, 2006).

Unfortunately in the Western world, the cost of transportation goods and services are typically under-priced, as both consumers and producers benefit at the cost to society and the negative externalities that affect the environment, such as air pollution and climate change. The implication for legislative bodies, such as local governments, is that their policies must either prevent the costs from occurring in the first place (*regulatory-based* policies) or recover costs by internalising them in the market price (*market-based* policies) (Bester, 2000). Market-based policies allow market forces to drive the allocation of scarce resources and provide a more equitable way to allocate the cost of using public goods such as air quality. This is because consumers will incur the marginal social cost of market-based policies and not the average social cost in the absence of any policy (Bester, 2000).

Mindali et al (2004) argue that the promotion of policies designed to reduce urban environmental problems through land-use planning are not necessarily feasible. This is because it is almost impossible to recommend a major change to long established practices that promote dispersal into the suburbs due to one criterion. Mindali et al (2004, p147) write that "the urban system is not only the result of the planners' script, but also a mixture of location decisions of firms and households as well as the interaction between these decisions and the transportation system." Any change in urban structure is likely to generate significant changes in the residents' lifestyles, which may not be welcomed by all residents (Breheny, 1997).

Nevertheless, the real cost to society occurs if we fail to change (Litman, 2005). Society will be burdened if we continue to choose to drive inefficient vehicles and choose automobile dependent homes when fuel prices eventually double or triple. There are several ways that consumers can reduce their transportation energy consumption (Litman, 2005):

- *Choose more fuel-efficient vehicles.* The current vehicle fleet averages less than half the efficiency of commercially available hybrid cars.
- *Choose closer destinations and consolidating trips.* About half of daily trips are taken for shopping, errands and recreational trips. People who live in more accessible neighbourhoods drive significantly less for these trips.
- *Shift to alternative modes.* Many consumers can shift a portion of their automobile travel to alternative modes, including walking, cycling, ridesharing, public transport and teleworking.

Another option is to decarbonise transport, however the transport sector is still likely to remain oil-based for several decades (Stern, 2006). The main options for decarbonising transport (other than biofuels) currently being considered are hydrogen and battery-electric vehicles. However, much will depend on transport systems too, including road pricing, intelligent infrastructure, public transport and urban design (Stern, 2006). Attitudes towards change in personal travel will also prove to be very influential – for either good or bad.

Given the high probability levels of peak oil occurrence associated with the likely impacts, the 20-year planning horizon (2010-2030) is a short period to address the oil addition issue and proceed to implementing fundamental changes. Our analysis demonstrates the urgency of matter, which is likely to generate considerable, if not massive, socio-economic problems. Nevertheless, it is also obvious that current policies are not likely to fully address the issue in order to minimize the impacts to society. Clearly, changing the current status of oil addiction is not a simple task and first of all this must be realised sooner than latter.

CONCLUSION

Oil addiction implications to urban transport in two metropolitan areas of Oceania were examined in this paper. It was found that current development trends in conjunction with inexistence of peak oil-oriented policies and lack of knowledge may result in a large variety of impacts to all transport related activities.

In specific, it was found that New Zealand is very likely to face a considerable reduction in the amount of available oil for transport activities. It is clear that from 2020, the probability increases considerably in the range of 10-20% reduction events. This is alarming as it was shown that Christchurch is highly addicted to the automobile, and despite planning interventions, such as the *Greater Christchurch Urban Development Strategy*, current car-based transport trends are set to continue.

On the other hand, Australia was also found to have a high probability of significant oil shortage events from 2030. As for Christchurch, current trends in Sydney seem set to continue, although a recent study reported a slight decrease in VKT for the metropolitan area. The strategic response in Sydney has been the *Metropolitan Strategy*, however, the transport objectives are based on trying to adequately cope with current conditions, rather than setting long-term goals that acknowledge and plan for future oil shortages.

It was presented that there are both technological and behavioural changes required to be made to reduce automobile addiction in our Australasian cities. However, in short, it was found that planning aims in Christchurch and Sydney did not appropriately deal with future oil shortage scenarios. Travel patterns and behaviours need to change in the immediate future, with better facilitation at both the planning and individual level.

Based on the argument and evidence presented, it is clear that a new approach to transport and urban planning and policy making is required to address oil addiction. This pressing issue should be dealt with maximum urgency in order to minimise the extent that daily urban activities and well-being could be affected in its fundamental functions. As part of this, all involved parties from governments to individuals must realise that there is not a single “solution” that will stop our current addiction on cheap fossil fuel and all its related energy sources.

Also, it can be argued that localised or individual actions will not be enough to actually make a global difference. Hopeful wishing and increased public awareness alone are not likely to make travellers or decision makers behave in an altruistic manner. Hard, difficult and complex decisions are required as part of incorporating, promoting and achieving sustainable development. This means recognising that sustainable growth and development does not involve continuous and uncontrolled growth and adjusting our plans, policies and strategies to match.

On the scientific side, it is envisaged that immense resources are needed to actually develop a whole discipline on transitioning from an oil addiction reality to an energy constraint society. Research on all facets of the problem are urgently required, because up to now we are actually in a stage of quasi-null knowledge, which does not help in solving the world's problems. Innovative and productive thinking must be encouraged in order to use the best brains to map solutions and not only discuss the problem, as we have often done in recent years.

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