# ‘Peak Car Use’: Understanding the Demise of Automobile Dependence

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## Introduction

In 2009 the Brookings Institution were the first to recognise a new phenomenon in the world’s developed cities – declines in car use (Puentes and Tomer, 2009). This paper summarises the recent data covering this new phenomenon of ‘peak car use’ and seeks to understand why it is happening. It first presents the data which are confirming this trend in cities in the US, Australia and eight other nations together with some of the data from our Global Cities Database that were suggesting the possibility of this trend. Peak car use suggests that we are witnessing the end of building cities around cars – at least in the developed world. In the 1980’s we called this kind of city building automobile dependence (Newman and Kenworthy, 1989). The peak car use phenomenon suggests we may now be witnessing the demise of automobile dependence in cities. The paper therefore sets out to examine six possible causes of peak car use before making a general conclusion and setting out some of the implications for the professions who manage our cities.

## The Data on Car Use Trends.

Puentes and Tomer (2009) first picked up the trend in per capita car use starting in 2004 in US cities. They were able to show that this trend was occurring in most US cities and by 2010 was evident in absolute declines in car use. The data are summarised in Figure 1.

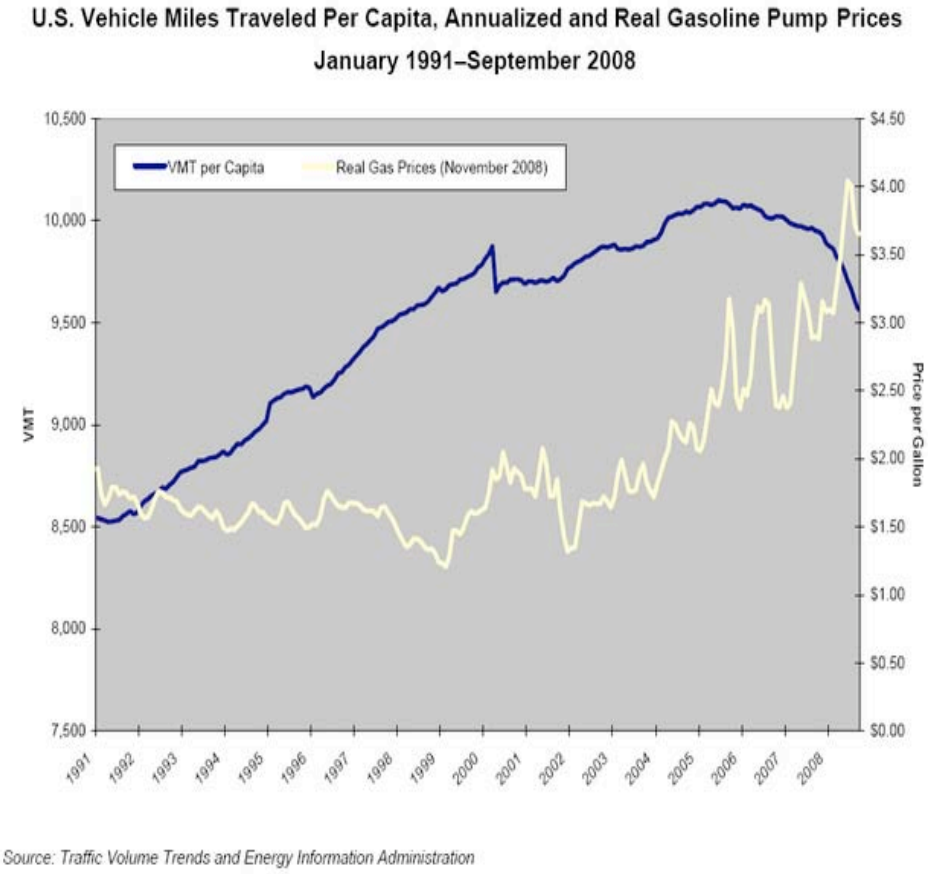



**Figure 1. Peaking of US vehicle miles of travel.**

Stanley and Barrett (2010) found a similar trend was obvious in Australian cities and that the peak had come at a similar time – 2004 - and car use per capita at least

seemed to be trending down ever since. Their data are shown in Figure 2.

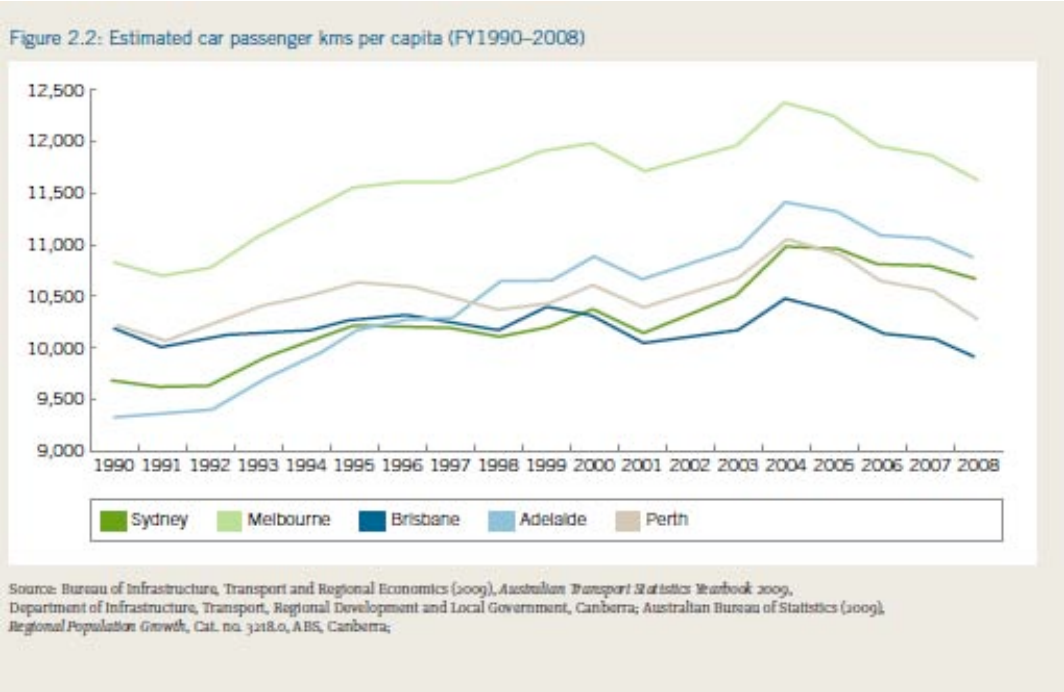



**Figure 2. Peaking of car use in Australian cities**

In a pre-publication paper Millard-Ball and Schipper (2010) examine the trends in eight industrialised countries that demonstrate what they call 'peak travel'. They conclude that:

*'Despite the substantial cross national differences, one striking commonality emerges: travel activity has reached a plateau in all eight countries in this analysis. The plateau is even more pronounced when considering only private vehicle use, which has declined in recent years in most of the eight countries…. Most aggregate energy forecasts and many regional travel demand models are based on the core assumption that travel demand will continue to rise in line with income. As we have shown in the paper, this assumption is one that planners and policy makers should treat with extreme caution.'*

The Global Cities Database (Kenworthy and Laube, 2001; Kenworthy et al 1999) has been expanding its global reach since the first data were collected in the 1970's. While the 2005/2010 data are yet to be complete the first signs of a decline in car use can be gleaned from previous data and were first recognised by us in Newman and Kenworthy (1999) and Kenworthy and Laube (1999) when it was seen that cities in the developed world grew in car use per capita in the 1960's by 42%, in the 1970's by 26%, and the 1980's by 23%. Our new data now show that the period 1995-2005 had a growth in car use per capita of just 5.1%, which is consistent with the above data on peak car use.[i]

Figure 3 summarises the changes in car vehicle kilometres per capita in cities in the developed world over the 45 year period from 1960 to 2005. It shows the percentage growth in four decades for all the cities combined. It is clear that in this sample of cities in the USA, Canada, Australia and Europe that the growth in car use is slowing down and is likely to

continue into the 21st century in developed cities.

In the twenty-six cities that comprise the 1995-2005 percentage increase in car vkt per capita we are beginning to see some cities that have actually declined. Some European cities show this pattern: London has declined 1.2%, Stockholm 3.7%, Vienna 7.6%, Zurich 4.7%. In the US, Atlanta went down 10.1%, Houston 15.2% (both from extraordinarily high levels of car use in 1995), Los Angeles declined 2.0% and San Francisco 4.8%.

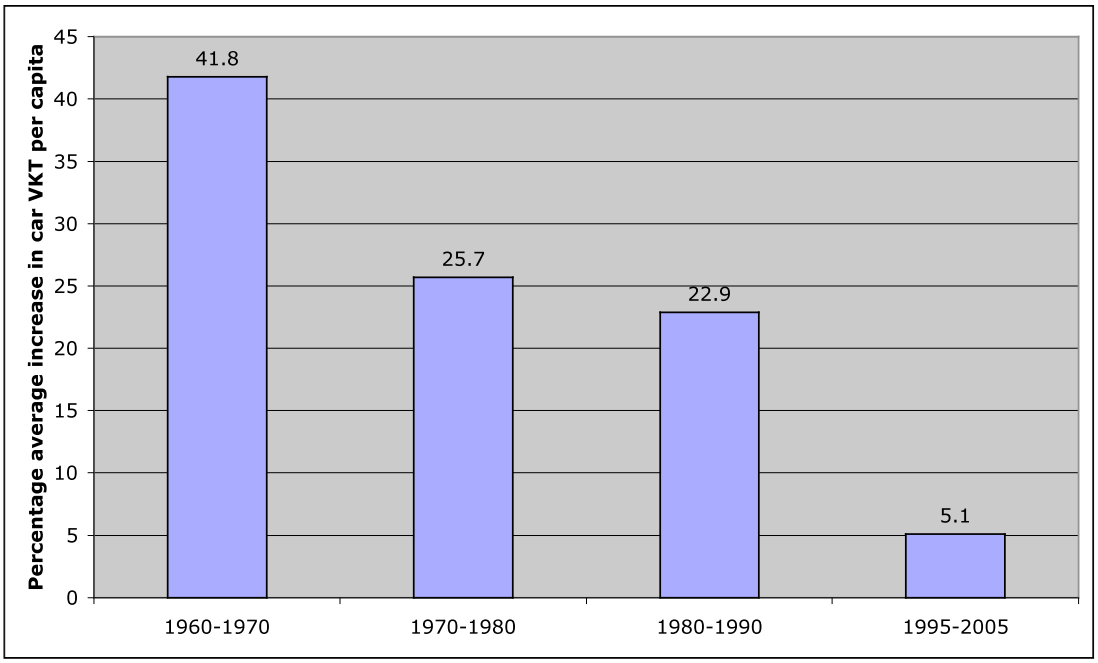



**Figure 3. Car use growth trends in developed cities from 1960 to 2005 using Global Cities Database. (see Endnote 1 for details).**

Peak car use appears to be happening. It is a major historical discontinuity that was largely unpredicted by most urban professionals and academics. So what is causing this to occur?

**The Possible Causes of 'Peak Car Use'.**

The following six factors are examined and then their overlaps and interdependencies are explored afterwards:

1. **Hitting the Marchetti Wall**
2. **The Growth of Public Transport**
3. **The Reversal of Urban Sprawl**
4. **The Ageing of Cities**
5. **The Growth of a Culture of Urbanism**
6. **The Rise in Fuel Prices**

**1. Hitting the Marchetti Wall**

Thomas Marchetti was the first to recognise that all cities have a similar average travel time budget of around one hour (Marchetti, 1994). This seems to be biologically based in humans – they don't like to take more out of their day than an hour just getting to their work and back home. Thus we have applied this to the technology of city building (Newman and Kenworthy, 1999) to show that cities always hit the wall when they are 'one hour wide'.

A Walking City is based around people walking at an average of 5-8 km/h thus in one hour people can walk 5-8 km; therefore a Walking City can expand to 5-8km wide before it becomes dysfunctional

to go any further. A Transit City based on an average speed of 30 km/h for trains can extend to 30 km wide. An Automobile City based on an average speed of 50 km/h in cars can reach out to 50 km wide before the average travel time will be more than is acceptable to most people. As cities have filled with cars the limit to the spread of the city has become more and more apparent with the politics of road rage becoming a bigger part of everyday life and many people just choosing to live closer in. Fast trains have been the only technology to break this car-based limit, though they are limited in their origins and destinations in cities built around cars and soon hit the wall also.

The travel time budget limit is observable in most Australian and US cities where the politics of transport has been based on the inability of getting sufficient road capacity to enable the travel time budget to be maintained under one hour. Thus there has been a shift to providing faster and higher capacity public transport based on the growing demand to go around traffic-filled corridors or to service growing inner area districts. At the same time the politics of planning in the past decade has turned irrevocably to enabling greater redevelopment and regeneration of suburbs at higher densities closer in to where most destinations are located. The Automobile City seems to have hit the wall.

**2. The Growth of Public Transport**

The extraordinary revival of public transport in Australian and American cities is demonstrated in Figures 4 and 5.

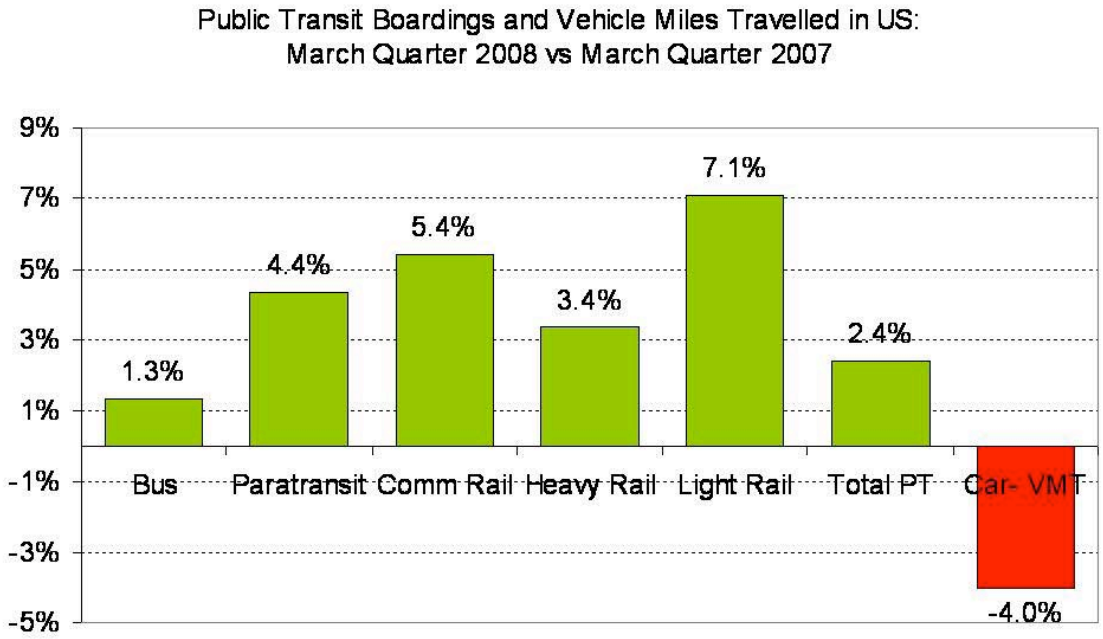
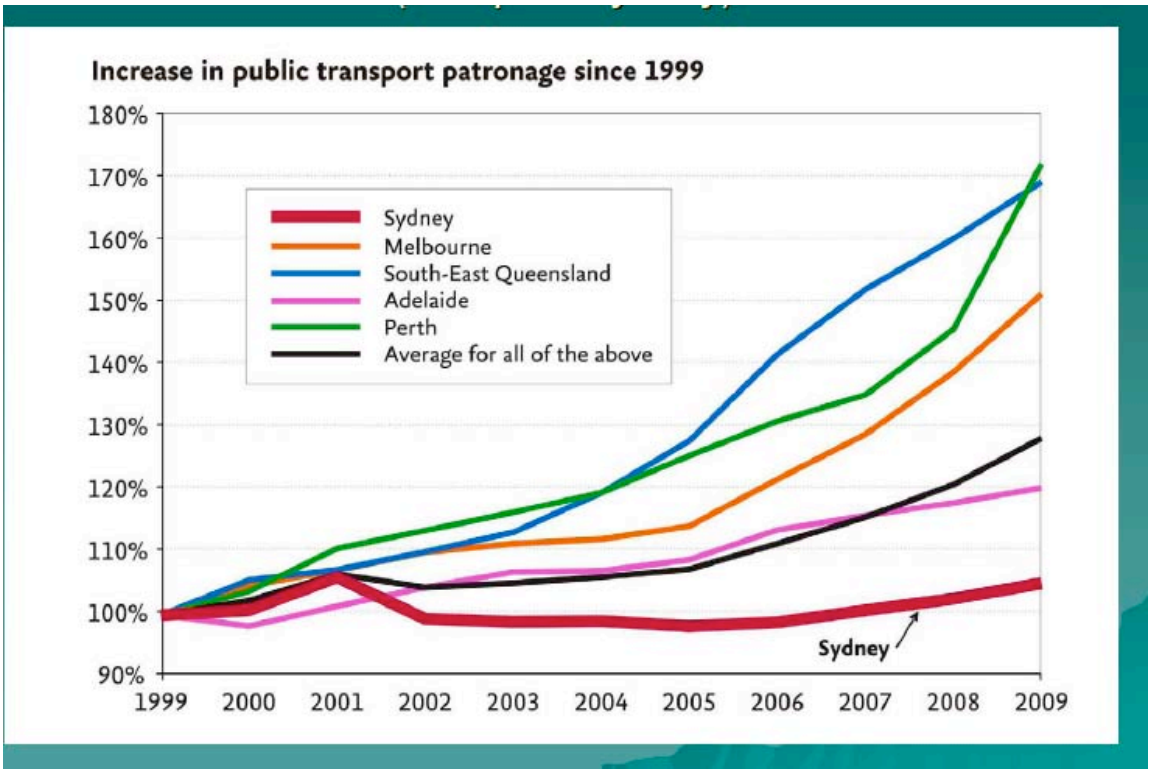



**Figure 4. Recent strong growth in US transit use and declining car use.**

The global cities data currently being updated show that in ten major US cities from 1995 to 2005 transit boardings grew 12% from 60 to 67 per capita, five Canadian cities grew 8% from 140 to 151, four Australian capital cities rose 6% from 90 to 96 boardings per capita, while four major European cities grew from 380 to 447 boardings per capita or 18%. The growth in transit was always seen by transport planners as a small part of the transport task and car use growth would continue unabated. However, the

exponential relationship between car use and public transport use as shown in Figure 6 indicates how significant the impact of transit can be. By increasing transit per capita the use of cars per capita is predicted to go down exponentially. This is the so-called 'transit leverage' effect (Neff, 1996; Newman *et al*, 2008). Thus even small increases in transit can begin to put a large dent in car use growth and eventually will cause it to peak and decline.

**Figure 5. Growth in transit use in Australian cities since 1999**

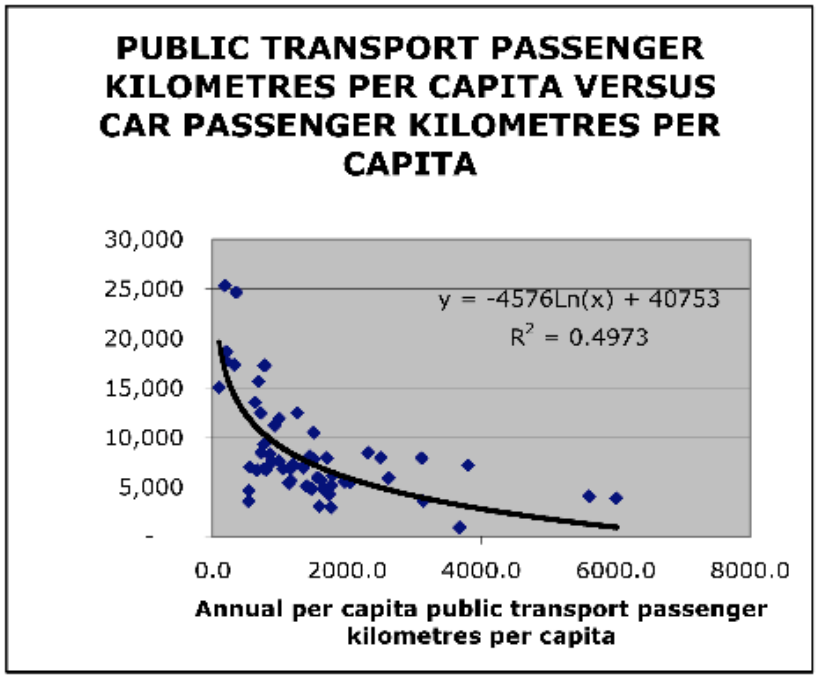



**3. The Reversal of Urban Sprawl**

The turning back in of cities leads to increases in density rather than the continuing declines that have characterized the growth phase of Automobile Cities in the past 50 years. The data on density suggest that the peak in decline has occurred and cities are now coming back in faster than they are going out. Table 1 (p.37) contains data on a sample of cities in Australia, the USA, Canada and Europe showing urban densities from 1960 to 2005 which clearly demonstrate this turning point in the more highly automobile-dependent cities. In the small sample of European cities, densities are still declining due to "shrinkage" or absolute reductions in population, but the data clearly show the rate of decline in urban density slowing down and almost stabilising as re-urbanisation occurs

The relationship between density and car use is also exponential as shown in Figure 7. If a city begins to slowly increase its density then the impact can be more extensive on car use than expected. Density is a multiplier on the use of transit and walking/cycling, as well as reducing the length of travel. Increases in density can result in greater mixing of land uses to meet peoples' needs nearby. This is seen, for example, in the return of small supermarkets to the central business districts of cities as residential populations increase and demand local shopping opportunities within an easy walk. Overall, this reversal of urban sprawl will undermine the growth in car use.

**Figure 6. The transit leverage effect in developed cities, 1995**




## 4. The Ageing of Cities

Cities in the developed world are all ageing in the sense that the average age of people living in the cities has been getting older. People who are older tend to drive less. Cities therefore that are ageing are likely to show less car use. This is likely to be a factor but the fact that all American and Australian cities began declining around 2004 suggests there were other factors at work than just ageing as not all cities in these places are ageing at similar rates. The younger cities of Brisbane and Perth in Australia still peaked in 2004.

**Figure 7. Rapid decline in car use with increasing urban density, 1995**

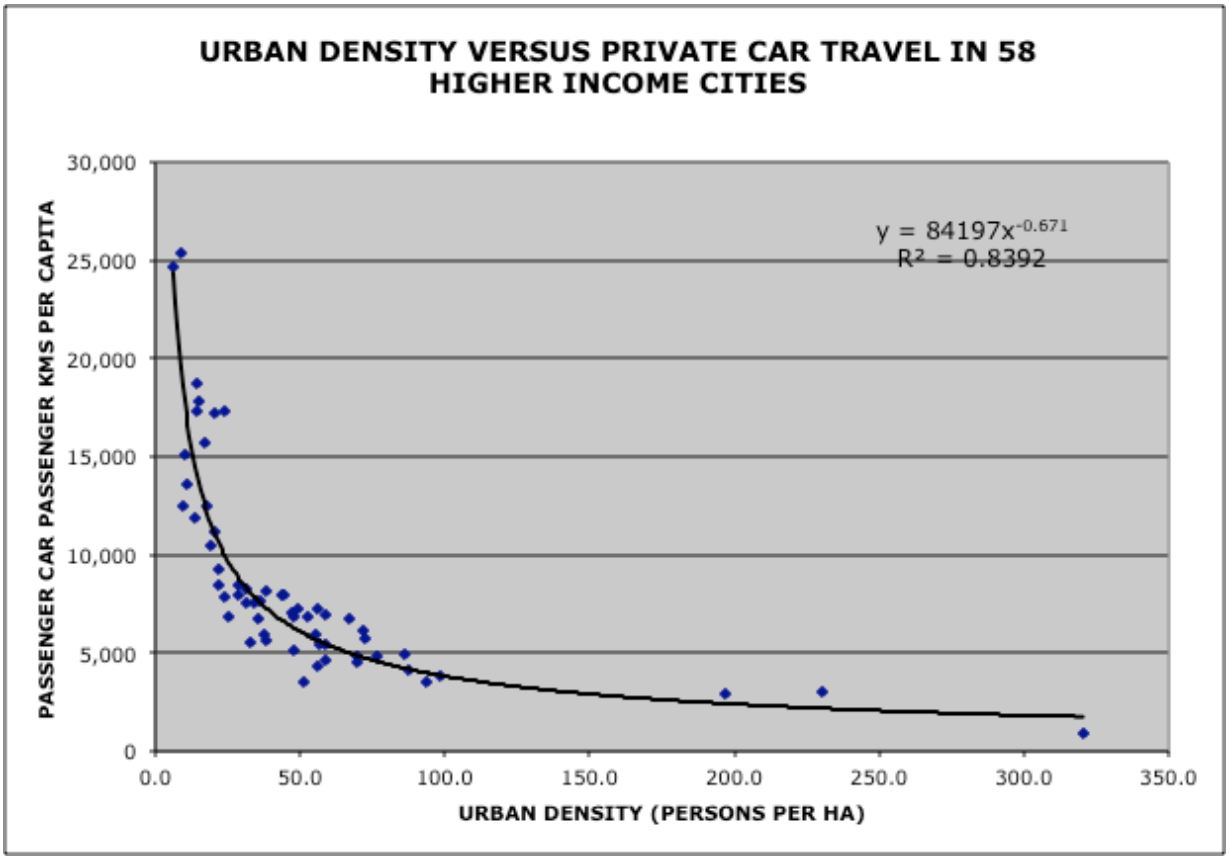


**Table 1. Trends in urban density in some US, Canadian, Australian and European cities, 1960-2005**

| Cities | 1960 Urban density persons/ha | 1970 Urban density persons/ha | 1980 Urban density persons/ha | 1990 Urban density persons/ha | 1995 Urban density persons/ha | 2005 Urban density persons/ha |
|---|---|---|---|---|---|---|
| Brisbane | 21.0 | 11.3 | 10.2 | 9.8 | 9.6 | 9.7 |
| Melbourne | 20.3 | 18.1 | 16.4 | 14.9 | 13.7 | 15.6 |
| Perth | 15.6 | 12.2 | 10.8 | 10.6 | 10.9 | 11.3 |
| Sydney | 21.3 | 19.2 | 17.6 | 16.8 | 18.9 | 19.5 |
| Chicago | 24.0 | 20.3 | 17.5 | 16.6 | 16.8 | 16.9 |
| Denver | 18.6 | 13.8 | 11.9 | 12.8 | 15.1 | 14.7 |
| Houston | 10.2 | 12.0 | 8.9 | 9.5 | 8.8 | 9.6 |
| Los Angeles | 22.3 | 25.0 | 24.4 | 23.9 | 24.1 | 27.6 |
| New York | 22.5 | 22.6 | 19.8 | 19.2 | 18.0 | 19.2 |
| Phoenix | 8.6 | 8.6 | 8.5 | 10.5 | 10.4 | 10.9 |
| San Diego | 11.7 | 12.1 | 10.8 | 13.1 | 14.5 | 14.6 |
| San Francisco | 16.5 | 16.9 | 15.5 | 16.0 | 20.5 | 19.8 |
| Vancouver | 24.9 | 21.6 | 18.4 | 20.8 | 21.6 | 25.2 |
| Frankfurt | 87.2 | 74.6 | 54.0 | 47.6 | 47.6 | 45.9 |
| Hamburg | 68.3 | 57.5 | 41.7 | 39.8 | 38.4 | 38.0 |
| Munich | 56.6 | 68.2 | 56.9 | 53.6 | 55.7 | 55.0 |
| Zurich | 60.0 | 58.3 | 53.7 | 47.1 | 44.3 | 43.0 |

**5. The Growth of a Culture of Urbanism**

One of the reasons that older aged cities drive less is that older people move back into cities from the suburbs – the so-called 'empty nester' syndrome. This was largely not predicted at the height of the Automobile City growth phase nor was it seen that the children growing up in the suburbs would begin flocking back into the cities rather than continuing the life of car dependence (Leinberger, 2007). This has now been underway for over a decade and the data presented by the Brookings Institution suggest that it is a major contributor to the peak car use phenomenon (Puentes and Tomer, 2009). They suggest this is not a fashion but a structural change based on the opportunities that are provided by greater urbanism. The cultural change associated with this urbanism is reflected in the Friends TV series compared to the Father Knows Best suburban TV series of the earlier generation. The shift in attitudes to car dependence is also apparent in Australia (Newman and Newman, 2006).

**6. The Rise in Fuel Prices**

The vulnerability of outer suburbs to increasing fuel prices was noted in the first fuel crisis in 1973-4 and in all subsequent fuel crisis periods when fuel price volatility was clearly reflected in real estate values (Fels and Munson, 1974; Romanos, 1978). The return to 'normal ' after each crisis led many commentators to believe that the link between fuel and urban form may not be as dramatic as first presented by people like us (Newman and Kenworthy, 1989; 1999). However the impact of $140 a barrel oil on real estate in the US dramatically led to the GFC (sub-prime mortgagees were unable to pay their mortgages when fuel prices tripled).

Despite global recession the 21st century has been faced by a consolidation of fuel prices at the upper end of those experienced in the last 50 years of Automobile City growth. Most oil commentators including oil companies now admit to the end of the era of cheap oil, even if not fully accepting the peak oil phenomenon (Newman, Beatley and Boyer, 2009). The elasticities associated with fuel price are obviously going to contribute to reducing car use growth though few economists would have suggested these price increases were enough to cause peak car use that set in well before the 2008 peak of $140 a barrel.

**Interdependencies in Six Factors**

It is not hard to see that the six factors involved in understanding peak car use are all interwoven and interdependent and can result in multiplicative effects that are greater than the sum of the individual parts. For example:

1. The Brookings Institution suggest that the growing price of oil may have been a substantive factor in pushing the trend to reduce cars, though the other structural factors around the culture of urbanism were also pulling the trend along.
2. The reurbanisation of car-based cities and the reorientation of transport priorities around transit, walking and cycling, are policies that feed on each other; once one begins the other tends to follow and together they can set in motion exponential declines in car use.
3. The motivation to move to a more urban location with less car dependence can be a combination of time saved in the travel time budget, fuel saved, a preference for urbanism and even getting older.

The urban planning profession has been developing alternative plans for Automobile Cities in the past few decades with the rationale of reducing car dependence involving all of the above factors; few however would have thought they would be quite so successful, perhaps because each of the factors had such interactivity and reinforcing effects.

**Implications for Peak Car Use**

The reality of declining car use in cities will have big impacts on the professions. The trends suggest they are very different to how they have been trained and how their manuals suggest they should work. Some examples include:

1. **Traffic engineers** will need to fundamentally change their traffic models and their assumption that increasing road capacity is their main raison d'etre. The rationale for roads will shift away from accommodating cars to being much more inclusive of other modes - light rail, buses, cycling and walking. Road diets and traffic calming will become the skill they need to lead with rather than being pushed into. In cases where road capacity has been reduced such as in the demolition of 6 km of high capacity freeway through the centre of Seoul to create an urban stream and boulevarde, average speed across the city actually improved and there were no adverse traffic impacts (www.design-e2.com - Seoul: Stream of Consciousness). This and other similar road diet projects that have been implemented around the world with similar experiences (Schiller et al, 2010), must lead to a change in how the traffic engineering profession conceives traffic, not as a "liquid"

that will flow over everything if space is removed, but as a "gas" that compresses according to the space constraints imposed on it. Peak car use will generate a growing rationale for removal of high capacity roads and conversion of space to support transit, walking and cycling and the urbanism of the new city.[ii]

2. **Town planners** will need to become much more adept at re-urbanising suburbs and centers than in scattering suburbs around the urban fringe (Newton, 2010). The provision of reduced parking will be a tool that can help revitalise urban development. The reduction in road space will now be seen as a positive value for any new development. The automobile city planning norm of minimum parking and maximum density will be reversed to maximum parking and minimum density to suit the new realities. Urban design of the public realm will become a much more critical factor in urban development as it has over many years in the extensive redevelopment and especially transit-oriented development that has shaped cities like Vancouver since the late 1970s.[iii]

3. **Urban financiers** will need to re-evaluate their penchant for financing toll roads and new suburbs on the urban fringe. Many recent toll roads in Australia have gone bankrupt because the numbers of cars have just not materialized in the way the models predicted (Goldberg, 2009).

4. **Urban economists** will need to find a new way of measuring economic progress other than by the number of new cars sold.

**Conclusions**

The phenomenon of peak car use appears to have set in to the cities of the developed world. It seems to be due to a combination of: technological limits set by the inability of cars to continue causing urban sprawl within travel time budgets; the rapid growth in transit and re-urbanisation which combine to cause exponential declines in car use; the reduction of car use by older people in cities and amongst younger people due to the emerging culture of urbanism; and the growth in the price of fuel which underlies all of the above factors. The implications for traffic engineers, planners, financiers and economists is a paradigm shift in their professional understanding of what makes a good city in the twenty first century. It does however point to the demise of automobile dependence.

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**Reference**


Fels, M. F. and Munson, M. J. (1974) *Energy thrift in urban transportation: Options for the future*. Ford Foundation Energy Policy Project Report.

Goldberg, J.L. (2009) The Valuation of Toll Roads and the Implication for Future Solvency with Special Reference to the Transurban Group. *Journal of Business Valuation and Economic Loss Analysis*, 4 (1), Article 2.

Kenworthy, J. (2011) Update of Millennium Cities Database for Sustainable Transport, ongoing. (unpublished).

Kenworthy, J. and Laube, F. (2001) *The Millennium Cities Database for Sustainable Transport,* ISTP, Murdoch University, Perth and UITP, Brussels.

Kenworthy J., Laube F., Newman P., Barter P., Raad T., Poboon C. and Guia B. (1999) *An International Sourcebook of Automobile Dependence in Cities, 1960-1990.* University Press of Colorado, Boulder.

Leinberger, C. (2007*) The Option of Urbanism: Investing in a New American Dream,* Island Press, Washington DC.

Marchetti, C. (1994). Anthropological Invariants in Travel Behaviour. *Technical Forecasting and Social Change* 47(1): 75–78.

Millard-Ball, A. and Schipper, L. (2010) Are we reaching peak travel? Trends in passenger transport in eight industrialised countries. *Transport Reviews*, 2010, 1-22. First published on 18 November 2010 (iFirst).

Neff, J.W. (1996) Substitution rates between transit and automobile travel. Paper presented at the Association of American Geographers' Annual Meeting, Charlotte, North Carolina, April.

Newman, P. (1995) The end of the urban freeway. *World Transport Policy and Practice* 1 (1): 12-19.

Newman P., Beatley T. and Boyer H. (2009) *Resilient Cities: Responding to Peak Oil and Climate Change,* Island Press, Washington DC.

Newman, P. and Kenworthy, J. (1989) *Cities and Automobile Dependence: An International Sourcebook,* Gower Publishing, Aldershot.

Newman, P. and Kenworthy, J (1999) *Sustainability and Cities: Overcoming Automobile Dependence,* Island Press, Washington DC.

Newman, P., Kenworthy J. and Glazebrook, G. (2008) How to Create Exponential Decline in Car Use in Australian Cities. AdaptNet Policy Forum 08-06-E-Ad, 08 July 2008. Also published in *Australian Planner*.

Newman, C.E. and Newman P.W.G. (2006) The Car and Culture. In Beilhartz, P., Hogan, T. (eds) *Sociology: Place, Time and Division,* Oxford University Press, Oxford.

Newton, P. (2010) Beyond Greenfields and Brownfields: The Challenge of Regenerating Australia's Greyfield Suburbs, *Built Environment* 36 (1), (page numbers to come).

Puentes, R. and Tomer, A. (2009) *The Road Less Travelled: An Analysis of Vehicle Miles Traveled Trends in the U.S.* Metropolitan Infrastructure Initiatives Series, Brookings Institution, Washington DC.

Punter, J. (2003) *The Vancouver Achievement: Urban Planning and Design*, UBC Press, Vancouver, BC.

Romanos, M.C. (1978) Energy price effects on metropolitan spatial structure and form, *Environment and Planning A,* 10 (1): 93-104.

Schiller, P.L. Bruun, E.C. and Kenworthy, J.R. (2010) *An Introduction to Sustainable Transportation: Policy, Planning and Implementation*. Earthscan, London.

Stanley, J. and Barrett, S. (2010) *Moving People – Solutions for a Growing Australia*. Report for Australasian Railway Association, Bus Industry Confederation and UITP.

Watt, K.E.F. and Ayres, C. (1974) Urban land use patterns and transportation energy cost. Presented to the Annual Meeting of the American Association for the Advancement of Science, San Francisco

**ENDNOTES**

[i] These data cover 25 cities in the USA (9), Canada (2), Australia (5) and Western Europe (9) for which per capita car kilometres are consistently available for 1960, 1970, 1980 and 1990 (see Kenworthy and Laube, 1999). The trends in each region and for the average for the whole sample are set out in Table 2.

| **Cities** | **1960** | **1970** | **1980** | **1990** |
|---|---|---|---|---|
| American | 5,489 | 7,049 | 8,586 | 10,710 |
| % change | | 28.4% | 21.8% | 24.7% |
| Canadian | 3,482 | 4,386 | 6,096 | 7,913 |
| % change | | 25.9% | 39.0% | 21.3% |
| Australian | 2,910 | 4,466 | 5,748 | 6,536 |
| % change | | 53.5% | 28.7% | 13.7% |
| European | 1,470 | 2,755 | 3,534 | 4,505 |
| % change | | 87.5% | 28.2% | 27.5% |
| All 25 cities | 3,366 | 4,773 | 6,000 | 7,376 |
| % change | | 41.8% | 25.7% | 22.9% |

**Table 2. Car use per capita in cities in different regions from 1960 to 1990 and the percentage changes, 60-70, 70-80 and 80-90.**

*Note:*

For the 1995 data in our global cities database the number of cities being monitored and the cities themselves changed, so it is difficult to continue these trends from 1990. However, the update of the data to 2005, which matches with the 1995 data, so far shows that between 1995 to 2005 car vehicle kilometres per capita in US cities rose by only 2.0%, in Canadian cities by 2.1%, Australian cities by 10.4% and European cities by 5.6%, leading to an overall increase across the sample of 5.1% (Kenworthy and Laube, 2001; Kenworthy, 2011 unpublished).

The same cities comprise the sample in each year as follows:

*US cities:* Boston, Chicago, Denver, Houston, Los Angeles, New York, Phoenix, Portland, San Francisco

*Canadian cities:* Calgary, Winnipeg

*Australian cities:* Adelaide, Brisbane, Melbourne, Perth, Sydney

*European cities:* Amsterdam, Brussels, Copenhagen, Frankfurt, Hamburg, London, Munich, Paris, Stockholm.

[ii] Some data now exist to support the positive effect that a reduction in freeway provision might have in stabilising and reducing per capita car use. There are some signs of the "peaking" of freeway provision in cities of the developed world, suggested by data between 1995 and 2005 in the US and European cities, as well as Singapore.

It has been known for decades how freeways are associated with encouraging greater car use, spreading the city out and undermining transit as well as walking and cycling (Watt and Ayres, 1974). Newman (1995) saw signs of the end of the urban freeway, an important factor in a new paradigm about how to build cities. Evidence was provided about the many negative effects associated with building freeways, including severe economic ones, and how many cities are seeing the need to stop constructing them.

Much of the trend data supports this. Between 1995 and 2005 in the ten major US cities examined, the average per capita provision of freeway remained identical at 0.156 metres per person, with six out of the ten cities experiencing significant declines in freeway provision (Atlanta, Houston, Los Angeles, Phoenix, San Diego and San Francisco). In fact, all the US cities that reduced their car use per capita also reduced their relative supply of freeways (Atlanta, Houston, Los Angeles and San Francisco). In the five major European cities examined the same thing occurred, with average urban freeway provision remaining at 0.076 metres per person over the 10 years. Singapore declined marginally in per capita freeway supply. In the Canadian and the Australian cities average per capita freeway provision did increase, though even here three out of the nine cities involved did decline in per capita freeway provision (Vancouver, Brisbane and Melbourne).

[iii] The quality of the public realm in developments throughout Vancouver at places like False Creek, Coal Harbor, various inner city locations and around Skytrain stations has placed the city in a league of its own and gives it liveability rankings consistently at or near the top of such global indices (Punter 2003). Other cities such as Freiburg im Breisgau, Germany are also leaders in these respects (Schiller et al 2010).

## Corrections to previously published articles in World Transport Policy & Practice

Volume 17.2

Correction to the article by Peter Newman and Jeff Kenworthy in World Transport Policy and Practice, Volume 17, number 2, "Peak car use: understanding the demise of automobile dependence":

The authors wish to sincerely thank the generous support of the Helen and William Mazer Foundation of New Jersey which contributed to the collection of the 2005/6 data reported in this paper.

Volume 15.2

The article by Paul Mees in volume 15, number 2 omitted a reference. The article titled "The density delusion? Urban form and sustainable transport in Australian, Canadian and US cities" refers to Mindali (2004) and the full reference is:

Mindali, O., Raveh, A. and Salomon, I. (2004) Urban Density and Energy Consumption: a New Look at Old Statistics. *Transportation Research A*, 38, 143–162.