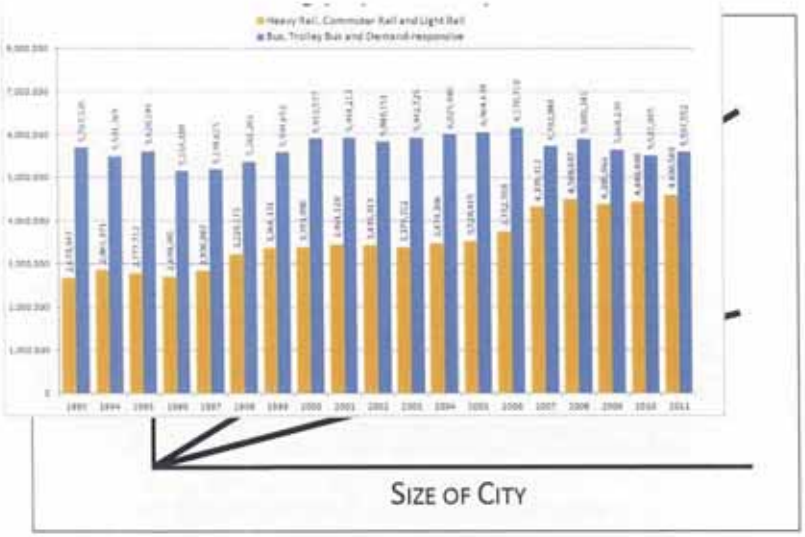
Kacey Cogle

From: Alan Squire <alansquire@bigpond.com>
Sent: Saturday, 24 November 2012 4:18 PM
To: Premier's Office; Public Hazzard's Office Email; Public Berejiklian's Office Email; Public Baird's Office Email; Public Gallacher's Office Email; Public Souris' Office Email; Public Parker's Office Email
Subject: Professors Newman, Glazebrook and Kenworthy Rise and Rise of Global rail to Premier and Ministers pm
Attachments: The Rise and Rise of Global Rail7 TO HIPTI.odt

Premier and Ministers
I enclose article by 3 of Australia's leading transport planners.
It is pertinent to Newcastle's inner city rail issues and points up the value of rail and light rail ,particularly to small cities. Please take it into account in your deliberations on the Newcastle Rail issue.
Would be grateful for your comments.
Alan Squire
Hunter Transport for Business Development
49294898
0408660352



The Rise and Rise of Global Rail: Why this is happening and what it means for large and small cities

By Peter Newman,
Curtin University Sustainability Policy (CUSP) Institute
Garry Glazebrook
City of Sydney and University of Technology Sydney
and
Jeff Kenworthy
Curtin University Sustainability Policy (CUSP) Institute

The 21st century promises some dramatic changes – some expected, others surprising. One of the more surprising changes is the dramatic increase in the world's urban rail systems. This paper will set out what is happening, especially in the traditional car dependent cities of the US and Australia, why this is happening, what can be done to make it work better based on some best practice trends in large cities, and finally what could now make it happen in small car dependent cities.

The Global Rail Revival

There is now a major rail revival around the world, including light rail, metro rail, heavy rail, and high-speed rail. This reflects growing concerns by city, regional and national governments at the need to make their transport systems more sustainable, their cities more livable, and their economies more resilient to future shocks from the peaking of oil supplies and from the need to reduce CO_2 emissions in the face of global warming. The multiple advantages of modern urban rail are clearly one of its great attractions to policy makers. But this has been largely known for some time so the surprise is how dramatically successful these urban rail systems are, with their patronage growth far exceeding expectations in most cases. This appears to be reflecting changes in the structure of cities, individual travel behavior and housing preferences, and the beginning of a shift away from the dominant car-based urban sprawl paradigm of the 20th century. Before describing the probable causes, the trends will be examined first in dense European, Asian and Middle Eastern cities then low density American and Australian cities.

Emerging Rail Trends in Dense Cities of Europe, Asia and the Middle East

1. European Trends

In Europe most cities were built around suburban rail systems which have been retained, though many removed their tram systems in the 1950's and 60's. So the revival of light rail has been a major addition to rail in most European cities. No less than 65 cities built new or expanded light rail systems between 1980 and 2007, bringing the total number of European cities with light rail at that time to over 160 (see Table 1). Further growth in light rail has continued since then, particularly in France, Spain and Portugal.

Table 1. Selected European countries with Light Rail systems (2007)[1]

Source: Konig, Herbert and Heipp, Gunnar (2012): "The Modern Tram in Europe". Municher Verkehrsgesellschaft GMBH. Available at http://reconnectingamerica.org/assets/Uploads/The-Modern-Tram-in-Europe.pdf

In an assessment of the trend to light rail in Europe the following conclusions were made by Glen Bottoms from the US Federal Transit Administration as early as 2003 after a review:

'The trend toward constructing new light rail systems, which had its genesis in France and has continued at a high level in that country, has generally spread throughout Western Europe and the British Isles. Light rail continues to be implemented in progressively smaller cities."

In addition new and expanded metro rail systems have also been added or are under construction in many of the larger European cities, such as Paris, Madrid, Athens, London, Vienna, Stockholm, Munich and Frankfurt. For example, London is currently building Crossrail – Europe's largest construction project – while Paris is completing an orbital metro to

1This table understates the extent of "modern trams". Switzerland has at a minimum 5 cities with these modes.

complement the extensive upgrades made to the radial metro and RER line networks.

Europe has also rapidly expanded its network of high-speed rail lines for intercity travel, with extensive networks in France, Germany, Spain and Italy, and new lines planned or under construction in the UK, France, Turkey, Sweden and other countries.

2. Middle East

In the Middle East a large expansion of rail systems is underway (Middle East Rail Market Report, 2012). For example:

- In Qatar, a four line metro network is about to start construction in Doha, with the first section to be completed by 2018, while additional rail projects include an LRT line, the West Bay People Mover system, and a planned high-speed rail network linking Doha airport, Doha town centre and Bahrain.
- In Saudi Arabia, bidding is underway for construction of a metro network for Riyadh, eventually planned to include six lines totaling 175 km. The Haramain high-speed rail line will be the region's first when opened in 2014. Approval has also been given recently for a major metro system for Makkah, with a planned length of 182 km.
- In Dubai, a 76 km metro is currently open with a plan for 108 km and an integrated light rail and bus system is partly completed. The LRT is under construction and buses are integrated at many stations.
- Other metros are planned for Kuwait where a 69-station system with three lines is due for completion by 2020.
- A 131 km metro system in Abu Dhabi is forecasted for completion some time in 2015.
- A pan-Gulf Cooperation Council (GCC) interlinking rail system is planned, with a current projected cost of about $30 billion. This network will include the first rail line linking all the GCC member states (http://abu-dhabi-metro.com/tag/uae-rail-system). Congestion on road systems joining different Emirates is now legendary (e.g. from Dubai to Sharjah) and is one reason why Abu Dhabi has introduced a new law that to work in Abu Dhabi one must now be a resident. Dubai is set to do the same. The pan-GCC rail system is also met to help address the problem.

3. Asia

The rapid pace of urbanization across Asia has seen major growth in population for numerous cities. Coupled with rising incomes, this has led to an explosive growth of cars and motorcycles and a decline in the use of bicycles and small vehicles. The densities of most Asian cities means that mass transit systems will need to handle an increasing share of traffic in response to congestion levels, and a large number of cities have responded with what is the biggest rail boom since the original railway age in the late 19th century in Europe and America. For example:

- Singapore has built a highly efficient mass transit system encompassing metros and automated light rail feeders, complemented by buses, and carefully integrated with land use planning with major developments concentrated on the rail network.
- Hong Kong has also built a major, high capacity and modern metro network including a high speed metro line to the new airport. It has also built a successful LRT system in the New Territories.
- Kuala Lumpur, Bangkok, Manila, Delhi, Kolkata, Mumbai, Seoul and other major Asian cities have added a variety of rail-based systems including above ground metros or monorails, underground metros and light rail systems.
- India is building Metros in 14 cities.
- China has seen the largest expansion. Shanghai has built some 13 metro lines in the last two decades and now has one of the world's largest systems. 82 Chinese cities are now building Metros. Dozens of cities have added light rail. China has also built the world's largest high-speed rail network in the last fifteen years, adding to the networks in countries such as Japan, Korea and Taiwan.

What is clear from the above trends is that there appear to be multiple advantages that are being found from the development of rail in the world's denser cities in Europe, Asia and the Middle East. At the large end Mega cities are building metros with their ability to manage high capacity mobility in narrow spaces, and at the other end small cities are building light rail at sizes that previously were not seen to be viable.

Emerging Rail Trends in Low Density Car-Dependent Cities

The trend back to rail is perhaps to be expected in the relatively dense cities and countries in Europe, the Middle East and Asia. However, perhaps the more surprising trends have been in the US, Canada and Australia where traditional car dependent cities that were once only considered suitable for bus transit in their suburbs, are now seeing a future based around rail.

In particular, light rail is emerging as the core of the mass transit system in the medium size but relatively low density cities in the US, Canada and Australia, such as Portland (Oregon, USA), Edmonton and Calgary (Alberta, Canada) and the Gold Coast (Queensland, Australia). In larger and higher density cities such as San Francisco, Toronto or Sydney, light rail is emerging as a secondary system to support heavy rail / metro systems, and is particularly suited to shorter distance radial corridors in inner suburbs, to circumferential or ring routes, or to radial corridors to secondary centres.

1. United States

There has been a significant resurgence in mass transit in the United States, with patronage as estimated by APTA (The American Public Transportation Association) now 23% higher than in 1993, and growing faster than car usage. The growth has been particularly strong since about 2003, and has continued since 2008 despite the significant economic downturn in the US since the global financial crisis, which has resulted in declining economic growth, increasing unemployment and significant financial pressures on urban transit systems.

However, it is interesting that all of the growth in patronage since 1993 has been on rail-based modes (heavy rail, commuter rail, light rail). In contrast total patronage on bus – based modes (bus, trolleybus, demand-responsive) have been essentially static in terms of overall patronage (Figure 1).

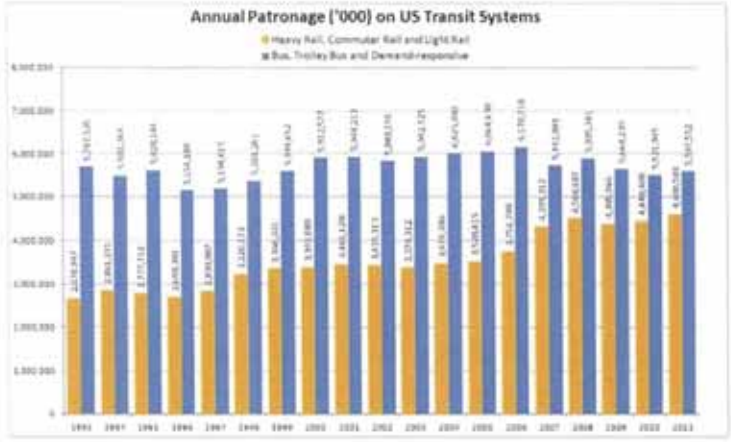


Figure 1. Annual patronage by bus-based and rail-based transit systems in the USA 1993-2011

Source: APTA

As shown in Figure 2, light rail has had the fastest growth rate of any mode, almost tripling patronage between 1993 and 2011, though from a low base.

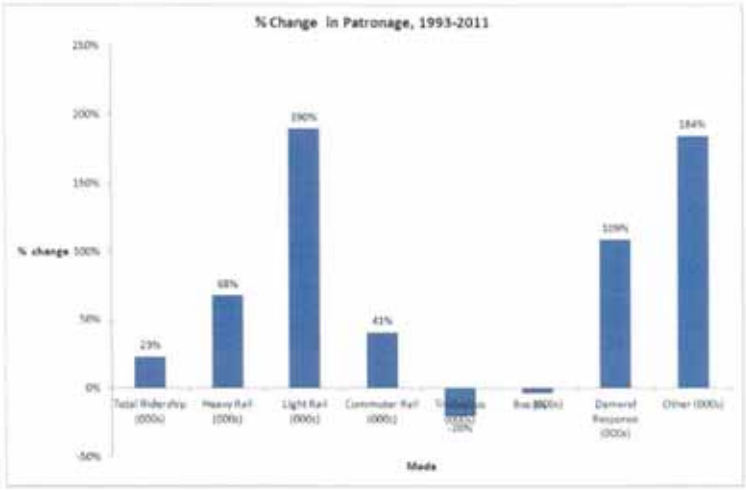


Figure 2. Percentage changes in patronage of transit modes in the USA, 1993-2011

Source: APTA

As a result of the differential in growth rates, rail modes have increased their shares of total patronage, particularly heavy rail (from about 25% to 35% of the total), while the bus share has significantly declined from 65% to 50%. The issue of bus failure is addressed by Bradley and Kenworthy (2012). Here they confront the widespread failure of cities to implement effective congestion measures and provide bus operating environments that can enable buses to beat the traffic instead of being a victim of it, thus also growing their patronage as an effective transport option for mid-level loads.

The patronage on light rail has increase rapidly from a relatively small base of 168 million to 481 million over the same period, passing the patronage on commuter rail (which has also increased relatively rapidly). The number of light rail systems in the US has grown from 15 in 1995 to 29 currently. Figure 3 shows the growth in patronage on individual light rail systems in the first quarter of each year from 1996 to 2012.

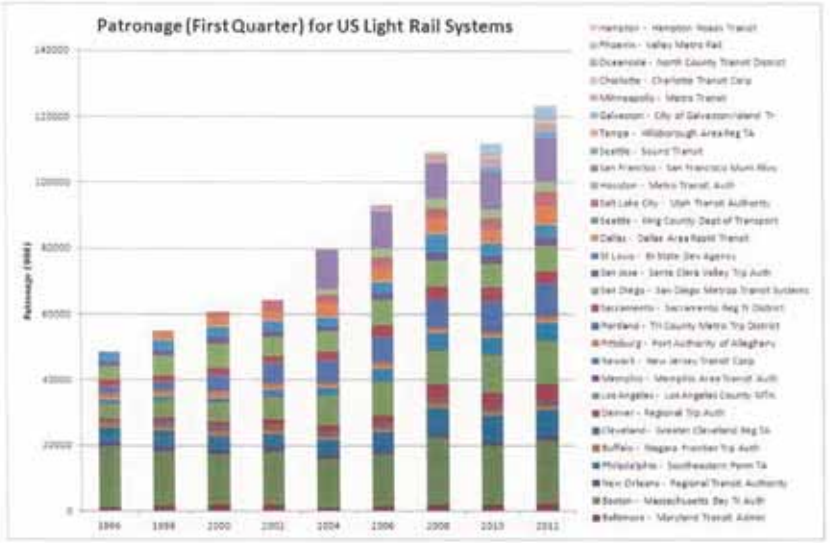


Figure 3. First quarter patronage of US light rail systems, 1996-2012

Source:

Figure 4 breaks these systems into three groups:

- The "Legacy" systems – cities which kept at least part of their original tram / light rail systems, and subsequently built on these (this includes cities such as Baltimore, Boston, New Orleans, Philadelphia, Cleveland and Buffalo)
- Those cities in the early wave of new systems, with their first lines opening by 1990 (this includes cities such as San Diego, Portland, Pittsburg, San Jose, Sacramento and Los Angeles)
- Those cities opening their first light rail lines since 1990 – this includes cities such as St Louis, Denver, Dallas, Seattle and Salt Lake City

As can be seen, the cities with "Legacy" systems had roughly static patronage until 2004, but patronage has grown around 25% since. Those cities which had opened new light rail systems by 1990 saw more than a doubling of patronage since, while further growth has come from the expanding number of cities with light rail, as well as expansion of networks already established.

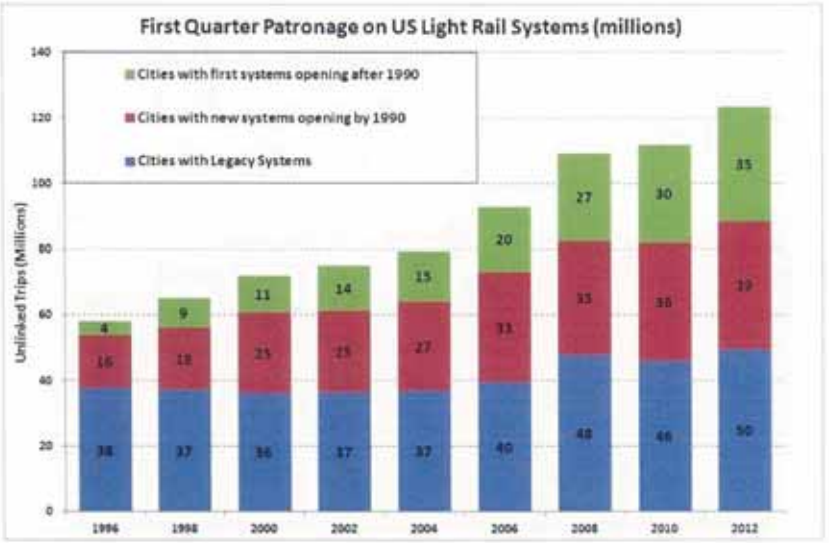


Figure 4. Different types of US light rail systems and their patronage, 1996-2012

Source: APTA

The cities with the fastest growth in light rail patronage are Portland, Los Angeles and Newark with first quarter patronage from 1996 to 2012 shown in Figure 5.

Figure 5. Patronage of LRT in Portland, Los Angeles and Newark, 1996-2012

Source: APTA

Looking at trends in patronage by mode for specific cities, the graph below shows trends for Portland, Oregon, which has had one of the fastest growth patterns in overall public transit use. As is apparent, essentially all the growth in patronage has occurred on light rail, with bus volumes static (Figure 6). The implementation of LRT in Portland in 1986 and the later addition of a Streetcar system, especially through the revitalized Pearl District, were accompanied by dramatic improvements in Downtown and near city street environments with the conversion of parking lots to squares, new farmers' markets, the widening of footpaths, introduction of high quality street furniture and artwork and a revival of downtown residential development. These accompanying changes were part of the reason for the patronage boost shown in Figure 5. People rediscovered

their central city and pre-automobile inner areas using a convenient public transport option. The experience of Portland has thus shown another important qualitative aspect of LRT – it gives the opportunity to radically change the dynamics of street use in favour of pedestrians and cyclists and can be part of a process involving a major upgrading of urban design and livability in the neighbourhoods it serves (Schiller, Bruun and Kenworthy, 2010).

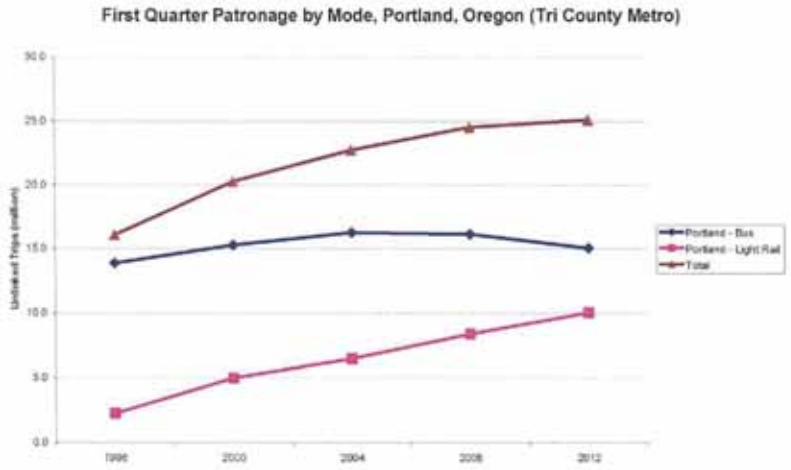


Figure 6. Patronage of LRT and buses in Portland, Oregon, 1996-2012

Source: APTA

Overall, the patronage data from US cities reinforces the growing role of public transport, especially rail-based modes, in handling the urban transport task in the United States, although overall travel remains heavily car dominated. It also suggests that there is likely to be further strong growth in public transport patronage in the future as there are still significant investments occurring in many cities, ranging from upgrades to the metros in New York and Chicago to significant expansions of light rail and other systems in cities from Los Angeles to Houston. It is noteworthy that many of these are continuing to gain voter support, notwithstanding the difficult financial situation facing many city and state governments.

Similar patronage trends are also apparent in other "new world" cities in Canada and Australia, which have historically been heavily car dependent but which are now investing significantly in rail-based (and in some cases bus-based) public transit systems.

2. Australian Trends

There has also been a revival in public transport patronage in Australian cities since the turn of the century. Patronage is growing faster than car usage in virtually every major city in Australia, and car usage per capita is now falling in many cities (Newman and Kenworthy, 2011, and see Figure 7).

The growth in public transport patronage has occurred for all modes, but with the highest growth in suburban rail in Perth, suburban and light rail growth in Melbourne and suburban rail and bus use in Brisbane.

Figure 7. Per capita public transport travel (passenger kilometres) in Australian cities, 1976-2008.

Source: BTRE (2011) Australian Infrastructure Statistics Yearbook.

This reflects similar trends to those occurring in the United States, where urban sprawl has slowed, densities in inner areas are now increasing, and travel behavior has begun shifting from cars to public and active transport modes. Hence the future is not likely to be a linear extrapolation of the post-war period, which for fifty years saw declines in public transport and rapid rises in car use. Another sign of the change has been the financial failure of recent toll roads, including the Cross City and Lane Cove Tunnels in Sydney, and the Clem 7 tunnel in Brisbane, with early signs that the Airport Road Tunnel in Brisbane is also experiencing much lower traffic than forecast (Goldberg, 2012).

Governments are beginning to respond to this shift through moves to enhance public transport, though not all governments have yet realized that the time for major new motorways is coming to a close:

- In Sydney, the Draft Transport Masterplan has committed the Government to two major heavy rail extensions – the South West and North West Rail links, and to extensions of the small light rail system into the inner west, CBD and south-eastern suburbs. In addition a second harbor rail crossing has also been included in the plan, though as yet the funding, timetable and design are not yet clear. Light rail lines in Western Sydney, based on Parramatta, are also under investigation. The heavy rail fleet is being updated and expanded, and a new approach promises much closer integration between rail, bus, ferry and light rail modes.
- In Melbourne there have been incremental extensions to the heavy and light rail systems, some additional trains and buses, and improved bus services in the outer suburbs. However, the improvements have not

kept up with the rapid growth in demand, and there have been significant complaints as to the reliability and quality of services. Planning is continuing for a new heavy rail line through the CBD to provide additional capacity, with a $4 billion price tag shared with the Federal Government and work underway.

- In Perth the rail system has been significantly expanded with the South-West Rail Line of some 74 km, which opened in 2007, extensions on the Joondalup line, which opened in 1993, and increased rolling stock to cope with much higher than expected demand. The original system (three lines) was electrified in 1991, thus also increasing its operating speed significantly. However, rolling stock has just kept pace with the very rapid growth in demand, which has seen rail patronage increase dramatically, as shown in Figure 8. The government has however also announced a start on a $1 billion light rail network for the CBD and inner suburbs, which will help to handle demand from these areas and support more sustainable land use patterns. Figure 8 also shows how rail can stagnate when it is based on a slow diesel service with no expansion, as has been the case in Adelaide until now.

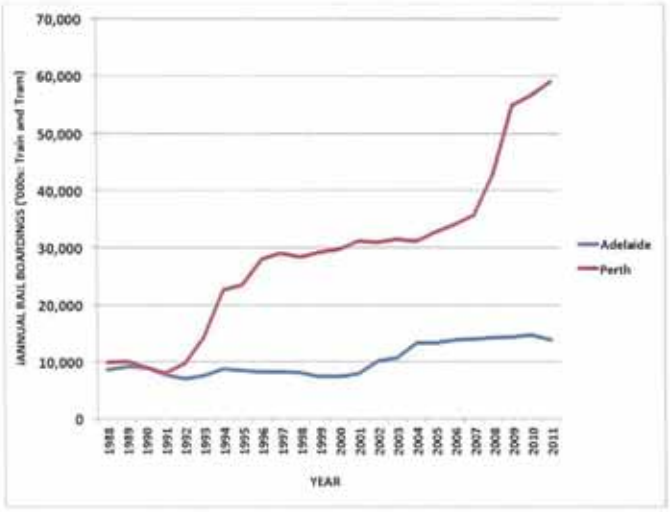


Figure 8. Annual rail boardings in Perth and Adelaide, 1988 to 2011

Source: Compiled from data in the Annual Reports of the rail operators in Perth and Adelaide.

- In Brisbane, there have been some extensions to the rail network (the Gold Coast line and the Springfield line) with more extensions agreed (to Redcliff and potentially the Sunshine Coast). There has also been significant expenditure on a busway network, including an underground link through the CBD for buses, necessitated by the volumes of buses entering the city. Planning for a major new rail line through the CBD – the Cross River Rail link – has been finalized, but as in Sydney, no funding or timetable has been announced.
- In Adelaide, the light rail system has been extended and the heavy rail system is being electrified, although the speed of the program has been cut back recently.
- In the Gold Coast a $1 billion light rail line is under construction which will form the beginning of the mass transit system through the high density coastal strip.
- In Canberra plans for light rail are progressing, though the funding situation remains unresolved. Similar concept plans are under discussion in Hobart, Darwin, Newcastle, Cairns and other smaller cities.

The overall picture is thus encouraging, and governments in all States and of both political persuasions are beginning to recognize the crucial need to further upgrade, expand and extend Australian urban rail systems.

What is behind the trends in urban rail?

The one hundred year growth in the use of the automobile in cities appears to have plateaued and then declined across the world's developed cities (see Gargett, 2012; Newman and Kenworthy, 2011). This set in before the GFC and is approaching a decade with little sign of change. Indeed a report by Davis, Dutzik and Baxandall (2012) on US young people shows that amongst the age group from 16 to 34 years old there was a decrease in car use from 2001 to 2009 from 10,300 miles to 7,900 miles per capita – a 23% decline. At the same time, use of transit went up 100%, walking 37% and biking 122%. These are remarkable numbers and suggest a much deeper transition is happening than simple supply and demand based on previous elasticities. It suggests a combination of factors that are synergizing a major change and the rail growth data are reflecting this as well.

The change in car use in developed cities occurred simultaneously in 2004 when oil reached US $80 per barrel. The plateau then dropped significantly when it went to $140 in 2008 and propelled the world's cities into the GFC. Australian cities were buffered from much of the GFC due to a combination of quick action by the government, well regulated banks and China's continuing demand for resources. Nevertheless, a significant decline in car use per capita continued from 2004 to the present – see Figure 9. And those Australian cities that provided new rail infrastructure grew substantially, and those that did not remained static – (see Figure 8).

Figure 9. Per capita private passenger travel in Australian cities (car, light commercials and motorcycles), by city, 1976-2009.

Source: BTRE (2011) Australian Infrastructure Statistics Yearbook.

Such data suggest that supply of rail options and demand reductions in car use due to fuel prices, are likely to be part of the mix of explanations.

It is also possible to see two other structural matters that are likely to be part of this global phenomenon. One is that the structure of cities began reaching a limit to car use growth and the other that urban culture and economy began to change.

Urban Structural Limits

Cities are structured around their transport priorities. Traditional walking cities were structured around walking and expanded little beyond a half hour radius or one hour diameter (5 km) that walking speeds could reach all destinations. Transit Cities extended this one hour diameter to 20 km or so and Automobile Cities extended this to 50 kms or so (Newman and Kenworthy, 1999). All cities have combinations of these three city types. The last 80 years has seen the growth in transport mostly around cars and the old Walking and Transit City components have been reasonably static. However, in the past decade it would appear that the Automobile City has reached its limits and a new type of city is emerging with a different structure. Despite the difference in city types around the world it seems that the 21st century is where the limits on global car-based urban growth has happened. This will be explained by referring to the two groups of cities outlined above: the denser cities of Europe, the Middle East and Asia, and the low density cities of America and Australia.

The approach taken is built on the above theory of travel time budgets and transport modes developed in Newman and Kenworthy (1999) and the new data from the Global Cities Study which shows that traffic speeds have stabilized in the world's cities (Kenworthy and Laube, 2001; Kenworthy pers. com). General traffic in the world's cities averages 34 kph with dense cities in Europe around 30 kph and Asia around 20 to 30 kph; low density cities in America and Australia are around 45 to 50 kph. The global average speed of buses is 19 kph with most cities unable to get much above this. Rail systems vary considerably but Metros average around the traffic speed at 34 kph and Suburban Rail averages 43 kph. Perth's new rail line to the South averages 88 kph.

The most significant trend to help explain the decline in car use and the increase in rail is that the world's cities all showed a plateau or an increase in the ratio of transit to traffic speeds in the most recent data collection period as shown in Figure 102.

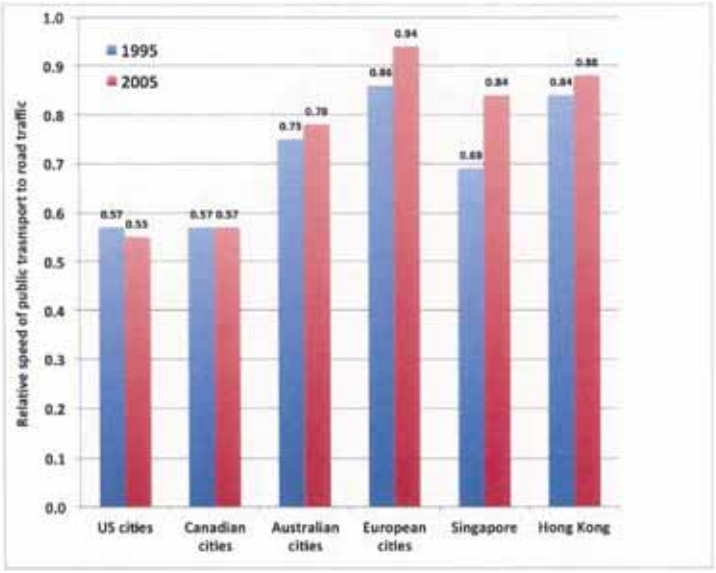


Figure 10: Ratio of overall average transit system speed to general road traffic speed in cities, 1995 and 2005.
Dense Urban Form Cities

European, Asian and Middle Eastern cities did not begin to grow with the car until well after the new world cities of America and Australia. They remained mostly based around their old Walking and Transit City urban form and have had much less car-based urban sprawl. Car ownership

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2The plateau in US and Canadian cities follows a period where significant increases in traffic speeds happened since the 1960's (see Kenworthy and Laube, 2001). In the emerging cities traffic speeds were very slow (around the low 20's km/h) and bus speeds always slower than this. Bangkok had a traffic speed of 14 km/h and a bus speed of 9 km/h. Thus as these emerging cities build rail (often above or below the traffic) the data will be reflected in dramatic transit speed improvements.

continued to grow until recently but has largely plateaued as the streets have filled and other options have been pursued, as set out in this paper. European cities led the way to calm traffic and build extensive cycle-way and transit options as the public chose not to build so many large freeways or to facilitate car use anything like the cities of the new world. Thus peaking of car use and growth of rail has occurred because average traffic speeds have generally stopped growing.

The emerging cities of Asia and the Middle East have had a much shorter period to reach their limits on car use, but perhaps are bound to do so sooner as they are so much denser and the streets have so much less capacity to enable car use growth. They also have hit the wall on their average traffic speeds.

Data on the use of cars in the emerging cities of China and India and the Middle East are not easy to obtain as they are in most developed cities, though car ownership data is known. Most projections of car use suggest that major global growth in car use will occur in these cities. However, it may be that the growth in car ownership will not be reflected in the same trend upwards as has been seen in the developed world. The urban fabric of dense Asian cities is such that little space for car use exists. For example, in Singapore, which does directly control car ownership growth through economic imposts, precisely because of its limited ability to accommodate cars, car ownership in 1995 was a meager 99 cars per 1000 persons and in 2005 it was 100. In Hong Kong likewise, where cars are not controlled so tightly using economic means, still car ownership only rose from a tiny 47 to 57 cars per 1000 persons, a remarkably low car ownership number when compared to any city in the world today (Kenworthy, 2012 – unpublished update of *Millennium Cities Database for Sustainable Transport*). The remarkable growth in urban rail in China and India suggests that these cities may have hit the wall much sooner than occurred in European cities and certainly far sooner than American cities. Daily experience of the streets in these cities suggests that the old Walking and Transit City urban fabric is saturated with cars and from here on the growth will largely plateau. Sprawling car-based suburbs of the very low density found in Australia and the USA are rare in these cities and land constraints, including unsustainable destruction of essential food growing areas, are likely to mean they will largely grow based on Walking and Transit forms.

Based on this analysis, European levels of car use would be the most that would be expected in China and India, more probably with around half the levels of where car use plateaued in Europe.

Low Density Cities

The cities of America and Australia grew mostly in the Automobile City era and as a result are much lower in density (by a factor of ten usually). Thus the space for car use is much more available. Car ownership and car use grew to a much higher level but is now plateauing and declining. They seem to have hit the same wall as the denser cities, but at a much higher level of car ownership and use. However, they have also reached a limit on the growth of freeways and other urban space for cars (e.g. parking is being restricted heavily in most developed cities) and hence average traffic speeds have plateaued or reduced.

The nineteen lower density cities in Australia (4 cities), the USA (10 cities) and Canada (5 cities) for which we have 1995-6 and 2005-6 average road traffic speed data (24 hour/7 days per week), show an overall average road traffic speed in 1995 of 46.8 km/h and 47.4 km/h in 2005. In terms of the regional averages, Australian cities in 1995 averaged 43.6 km/ and declined to 42.8 km/h, the Canadian cities were roughly stable at 44.5 km/ and 45.4 km/h respectively, and the US sample was similar (49.3 km/h and 50.4 km/h).

In terms of parking, between 1995 and 2005 parking supply per 1000 CBD jobs in a large sample of cities mostly declined. US cities went from 555 to 487 parking spaces per 1000 CBD jobs, Canadian 390 to 319, Australian 367 to 298 and Singapore and Hong Kong declined too from 136 to 121 parking spaces per 1000 CBD jobs. In European cities, CBD parking rose a fraction from 224 to 241, but this was largely because of an unavoidable expansion of the definition of the CBD in Berlin which increased the apparent CBD parking supply in that city (Kenworthy, 2012 – unpublished update of *Millennium Cities Database for Sustainable Transport*).

Thus the same mechanism can be understood to have set in over the past decade: the urban structure or fabric of the city has prevented any further growth in car use, congestion has remained totally uncontrolled, and the only way forward was with alternative transport, especially urban rail.

The second perspective on this issue is provided by an understanding of urban culture and economy.

Urban Cultural and Economic Change

The biggest change in the economy during the period leading up to and including the period of car use decline and rail growth has been the digital transformation and the consequent knowledge/service economy. Despite this being global and enabling long distance communication, it has in fact been a concentrating force in terms of city structure and fabric. The knowledge economy and digital jobs are focused in city centres as these are where the creative synergies between people occur (Kane, 2010). Old

CBD's have been transformed back into functional Walking Cities and those which have done this best have attracted the most capital and young talent to work there (Gehl, 2012; Matan and Newman, 2012). Other centres have also done similar transformations and the linkages between them have become the basis for the revival of the Transit City. Universities, health campuses, IT job clusters have created their own centres for jobs and have attracted housing and transit to link them together.

Other parts of the economy such as manufacturing, small and large industry, freight transport and storage, have remained car-based and are outside this new knowledge economy. They will remain so but they are also not where the growth in jobs or the growth in wealth is happening. Thus the Automobile City economy and culture has become somewhat distinct from the new regenerated urban economy of knowledge/services and its basis in Walking and Transit City locations.

An expression of this change can be seen in the way young people are moving to reduce their car use and switch to alternative transport. On transit or walking (and even to an extent while biking) young people are already connected by their smart technology phones and tablets. They are hardly usable while driving a car. The Davis, Dutzik and Baxandall (2012) report shows that the mobile phone is a far more important device than a car for younger people. This is a cultural revolution that underlies the rail revolution. Baby-boomers gained freedom and connection with a car, Gen Y's are not needing one.

The other expression of this change is that younger people are moving to live in the Walking City or Transit City as they more readily enable them to express the kind of urban experience and culture that they aspire to (Florida, 2011). Thus they feed the market that enables the rail revival and city centre renewal to continue.

The rise and rise of rail can be explained by a combination of urban structural limits as well as urban cultural and economic change. However, if a city does not adequately develop or build the rail infrastructure then it can easily miss out on this important social and economic change. The biggest threat is if car dependent cities do not recognize that the golden age of the car is over. Some suggestions for how to make the rail revival happen in large and small car dependent cities are therefore provided as an end to this paper.

What can be done to make rail work better in large car dependent cities?

There are a few emerging trends in best practice for rail that can enable large car dependent cities to capitalize on the opportunities that are now presented by this global new world.

1. **Integration of modes.** The most obvious impact of rail is when it is properly integrated with bus feed-in to enable a broad catchment to be served. This is particularly evident in car dependent cities which cannot be served by just walk-on passengers. This requires ticket integration as well as fast and convenient transfer systems. Perth's Southern Rail illustrates this well with some 80% of the system usage being from bus transfers and only a very small percentage from Park and Ride, despite generous Park and Ride provision (McIntosh, Newman, Scheurer and Wisdom, 2012). Bus right-of-way into stations is a critical part of enabling this integration.
2. **Integration of land use.** Rail will work better if there is a chance to redevelop land use around the stations in order to enable more people to have easy access. Measuring this potential and making it part of the planning process seems to be an emerging standard practice (Renne and Curtis, 2009; Bachels and Newman, 2011). Where Park and Ride is needed, it should be integrated with such attractive higher density, mixed use development and not as vast swathes of bitumen, which destroy station environments (Schiller and Kenworthy, 2011).
3. **Speed.** The value of travel time will not change much in this new world and must be central to how any rail system is designed. Giving reasonably long station distances and right-of-way is critical. Light rail on dedicated right-of-way, rather than on-street tram options will be mostly needed in car dependent cities.
4. **PPP (Private-Public Partnership) Procurement.** The delivery process can enable all of these options to be highlighted if procurement is based on a PPP process, as suggested by many (e.g. Bottoms, 2003; Infrastructure Australia, 2012). The Gold Coast Light Rail provides the best example in Australia of how PPP approaches can be achieved in light rail. The full integration with land use remains to be done and is much more likely if land value capture (see below) is made part of the package.
5. **New assessment approaches for rail.**
   There are two major ways for rail to be improved through the assessment process: recognizing the role of agglomeration economies in a Benefit-Cost Ratio and recognizing the role of avoidable land development costs. Agglomeration economies are being included in transport BCR's since the Eddington Transport Study in the UK (Eddington, 2006). Their application in rail is considerably better than road projects as rail acts as a focusing feature that enables the synergies and clustering of knowledge economy productivity, i.e. the Walking City. Trubka (2012) has outlined the value of agglomeration elasticities for Australian cities. Even more significant (though rarely done) is the use of avoidable costs in assessment of transport. Rail and its focusing ability in land

use can enable reductions in urban sprawl that invariably are heavily subsidized and have many external costs. Trubka et al (2010) have shown considerable cost savings and health benefits from rail-oriented development as opposed to car-based development.

6. **New approaches to funding rail through value capture.** Rail infrastructure increases land value due to its accessibility benefits. This value can be captured and used to help fund the infrastructure. McIntosh et al (2012) have shown that a five step process can work in the following way:

a. Accessibility benefits analysis to demonstrate the land area where owners will benefit from the new infrastructure.

b. Land value data collection of the differential between those areas varying in accessibility.

c. Assessment of the various potential financing mechanisms available in the city through public and private value capture.

d. Economic and financial assessment taking into account all the potential.

e. Delivery through a planning mechanism and a fund established to bring it together, probably in a PPP.

If rail is going to continue to grow and car use to decline then a range of sophisticated value capture mechanisms will be needed for each city to make the most of this opportunity for funding.

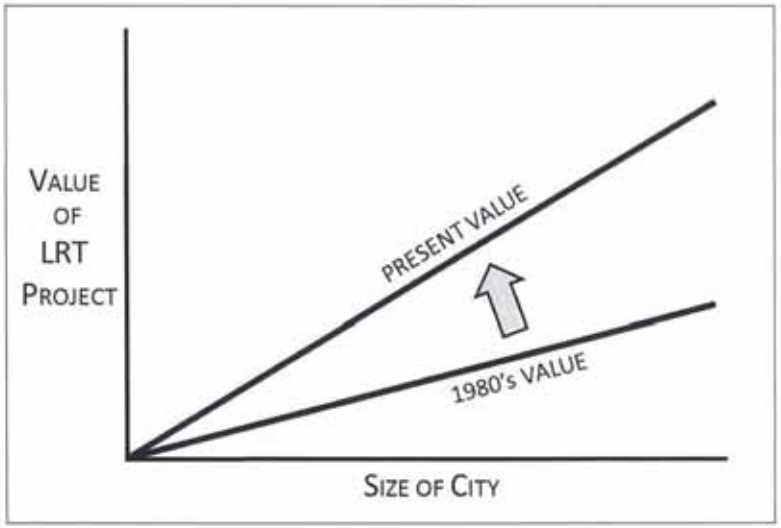
Can light rail work in small car dependent cities?

Perhaps the most significant trend in recent years in Australia (and America) has been the emergence of light rail as an issue in small car dependent cities across the country. Lobby groups in Australia have been actively pushing the political case for light rail in Canberra, Hobart, Bendigo, Darwin, Newcastle, Cairns and Parramatta (although embedded within Sydney it is like a small town, as it would need to be an independent and isolated system servicing a local population, not unlike the other smaller cities). These cities are mostly well under 300,000 people, Canberra being the largest at a little over 300,000.

The question needs to be asked whether this is likely to be a viable option for these small cities as the traditional approach would suggest it was not. Bus options have long been considered the only viable option for small cities. However, the above dramatic turn around in the fortunes of light rail may be indicating that a new era of viability for light rail in small cities is emerging. The case for these cities to be considered is based on an understanding of what is likely to be causing the above trends in traditionally car-dominated cities, as well as some new options for assessing and funding light rail in such cities.

From Wikipedia there are 545 cities with light rail; from this there are now 118 cities with populations under 150,000 that are with light rail or are constructing light rail.
This appears to suggest that a changing appreciation of the value of light rail in small cities has occurred, as shown in Figure 11. The change is probably associated with the shift in value associated with the trends outlined above in peak car use, fuel prices, urban trends and urban economic and cultural changes.

Figure 11. The shift in value of light rail projects in recent decades has made increasingly smaller cities viable for light rail.



The key to whether a small city is ready to take on a light rail option will be whether their economy is sufficiently oriented to the knowledge/services economy that requires strong functioning Walking City centres, linked by transit. It will be a city where traffic is becoming an issue in these centres and where attempts to traffic calm, reduce parking and bring people without cars, is firmly on the planning agenda, thus reducing traffic speeds. It will also be a city where young people are moving to live and to gather in these centres for their cultural life, rather than just driving around suburbs. Such cities will find the addition of light rail an invaluable part of being a small contributor to the 21st century with its reduced car dependence.

Conclusions

The rise of rail in its first incarnation was a major part of the industrial revolution and led to a new kind of urban form. In its second rise rail again seems to be having a structural, economic and cultural change at its heart. The rise is due to limits on car-based cities that have well and truly set in to cities in the developed world and probably have set in to cities in the emerging world. This is good news for matters like climate change and peak oil that threaten to sink the economies of major global cities unless dramatic change occurs. If the arguments in this paper are correct then the structural change we need to enable this dramatic change could well be underway. The need to make the most of this should be high on the agenda of any large or small city.

Application of the new approaches outlined above, especially value capture, may well make these projects viable for many more small cities that are also wanting a way out of their car dependence.

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