# Population growth and infrastructure development in Melbourne

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## Abstract

Melbourne's growth predictions coincide with a global shift in rural and urban populations, expecting a population increase from 4.3 to 6 million people within the next 30 years. This imminent increase places Melbourne in the category of an emerging megacity, which are front-runners in terms of economic growth, urban-development, industrial transformation, lifestyle changes and policy implementation. A common characteristic of an emerging megacity is the deliverance of infrastructure at a slower rate than the growth experienced, and so, cities such as Melbourne face severe societal issues in the near future if proactive planning management does not occur. Transport infrastructure is seen as the biggest infrastructure challenge, being a crucial aspect of employment opportunities, accessibility and ease of lifestyles. Failures in this area therefore have the ability to negatively affect the economy and functionality of a city, the environment and also alienate suburban areas. The potential for urban transport infrastructure projects such as metro, regional rail and tram, to provide a catalyst for the development and redevelopment of urban areas in European cities is examined in this paper. In addition, the successes of a rail transit development in a low density city in Perth Australia is discussed. The paper suggests that there are important lessons to be learnt from the European examples and particularly the Perth Southern railway in designing urban rail systems for making travel in dispersed cities such as Melbourne more sustainable.

*Keywords: infrastructure development, population growth, sustainability, urbanisation, transit-orientated design.*

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## 1 Introduction

The growth of a city is not necessarily a problem unless there is insufficient coinciding growth of infrastructure to support it. Melbourne has just been announced as the world's 'most liveable city' for the third year in a row, an accolade and credit to the government bodies concerned. However, the rapid growth in Melbourne, and the projected population in the next 30 years place severe pressure on the developmental future of Melbourne. Of the top ten most liveable cities, only two are over 2 million and one over 6 million [1]. This reinforces the severity of the situation and highlights the need to anaylse the probable affects the increase in population can have on Melbourne and establish a suitable foresight into the future, to develop strategies and policies that will allow it to maintain its qualities and sustainably provide for its inhabitants. Preparing and providing for the predicted population growth is a highly complex scenario. Of this, transport infrastructure is one of the most critical and difficult forms of development in urban areas, and therefore should be at the forefront of future development decisions in cities. Melbourne's most recent infrastructure development – possibly the most notable development in its history in reference to the total cost of the project – is the East West Tunnel Link. This project is a road development and although is supported by convincing evidence of probable benefits, it prompts investigation as to the viability of road projects as a whole and the role that they play in a city's future. Sustainability is the emphasis of this paper. It aims to investigate the concept of sustainability, how it is associated with the development of Melbourne's transport infrastructure and the benefits available to Melbourne if this concept is used in the planning and development of the city.

## 2 History of population growth and transit

The UN Population Division has demonstrated the global shift in rural to urban environments [2]. This exponential growth in urban areas during the 20th century gave birth to the *age of urbanisation*, an era that reflected the gravitational pull of 'city life'. Many cities generate a large majority of a country's wealth, causing a sense of hope and opportunity to migrants. Migrants were enticed by the assumption of high levels of employment, education, entertainment and access to services otherwise unreachable in a rural setting. This form of migration, known as rural-to-urban migration, is the most influential growth recognised and can pose a serious threat to both rural and urban areas concerned.

Australia's history is young compared to that of European countries and America and has a unique growth generated from higher international and internal migration than any other country. The population growth in Australia's urban areas due to the combination of international and rural settlers leads to a peculiar situation. Australia has one of the most 'residentially mobile populations in the world' and, in 2010, 'recorded 87% of the population to be living in an urban area' [3]. Figure 1 [4] demonstrates Australia's degree of international migration over the recent 30 years, and Figure 2 [3] demonstrates the high level of shift to urban

areas in Australia. The combination of these two representations illustrates Australia's unique migration trends and the severe urban influx that can eventuate from it.

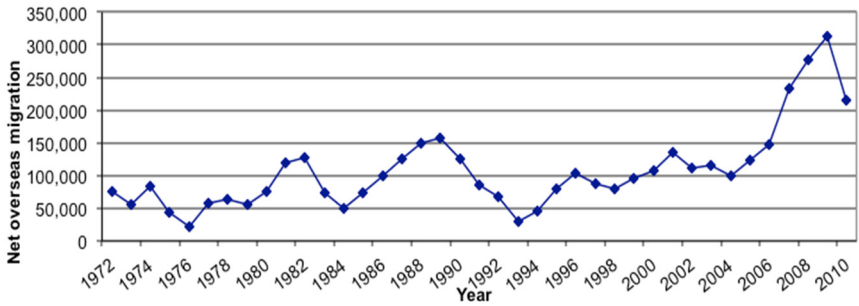


Figure 1: Net overseas migration in Australia [4].

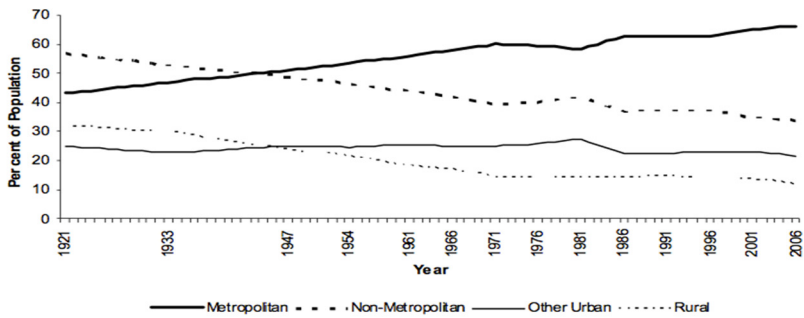


Figure 2: Australia: changing distribution of the population between urban and rural sectors, 1921–2006 [3].

International migration has led to large population increases in our capital cities in recent years, specifically Melbourne, which has doubled in total population in the last 50 years. This growth, and potential side effects is now a heavily debated topic. It is predicted that the total population of Melbourne will be 5 million by 2030, and potentially 6 million by 2040 with, at stages, an increase of 2000 inhabitants per week [1]. In 2010–2011 Melbourne showed a growth rate of 1.6%, becoming the country's fastest growing city. Figure 3 [5] demonstrates the predicted increase in population over the next 30 years, with reference to these growth rates over Melbourne's history.

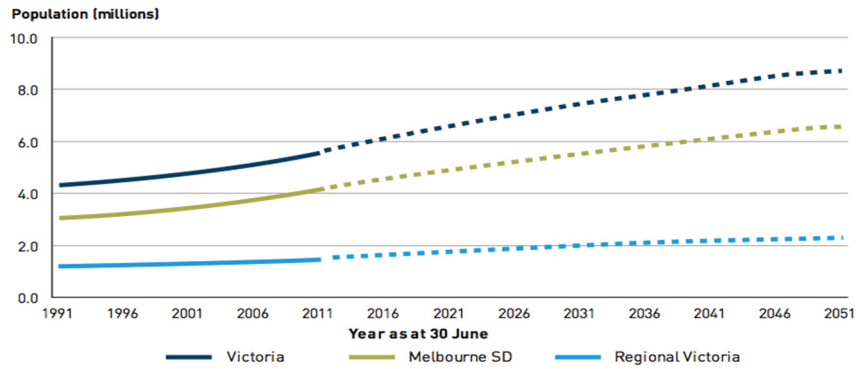


Figure 3: Historical and projected population, Victoria, Melbourne SD and Regional Victoria, 1991–2051 [5].

Coinciding with the population booms discussed, transport operations have evolved, seeing vast changes in the development of transport infrastructure as it adapts to society's needs and the corresponding developments of technology. Newman and Kenworthy [6] establish a concept of the evolving transit operations and the coinciding development to accommodate it. The researchers use the findings of Allen and Unwin who present the idea that people prefer not to travel more than half an hour to work, and divide transport development changes in relation to population growth into three categories; the walking city, the transit city and the automobile city. The latter shows strong correlation with the characteristics of Australian urban areas.

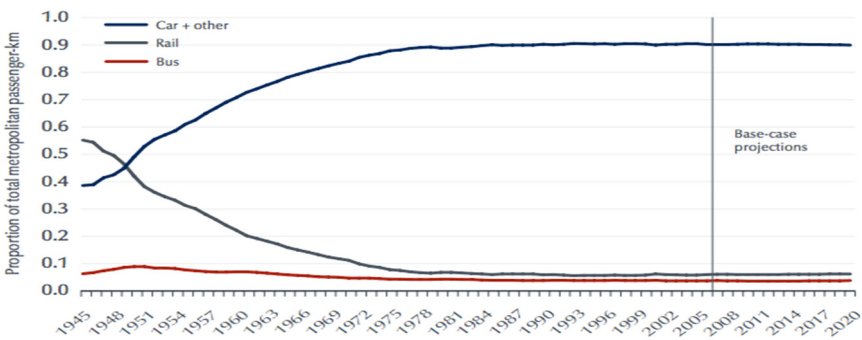


Figure 4: Proportion of passenger-kilometers travelled by motorised vehicle Type: capital cites, 1947–2007 [7].

The almost endless frontier of inhabitancy due to the freedom supplied by automobiles essentially meant that people could move in any direction they wanted and the government had to provide for that. Figure 4 [7] presets the severe change in transport mode over the period of 1947–2007 and reflects the transition

shown in cities from public transport travel to automobile dependency. 'Already, transportation is seen as the single biggest infrastructure challenge by a large margin, and is a key factor in city competitiveness' [8].

## 3 Sustainability issues and considerations

Melbourne's automobile dependency raises numerous environmental, economic and social concerns for a city. Government bodies must develop infrastructure to accommodate the city's population and provide suitable transit options to ensure that the longevity of Melbourne as a highly functional, vibrant and growth stable city is sustained. Alongside critically evaluating infrastructure types, there is an importance in evaluating what these can provide, or in Melbourne's case, maintain.

> '*Melbourne offers an exciting notion of what living in the city is for: phenomenal cultural institutions where one can connect with people from every walk of life, great public life, with an urban 'scene' of popup bars and small scale live performance venues, high quality jobs seemingly aplenty, an endlessly fascinating look and feel where one can connect with the city's history'* [9].

Exemplified are the features and attractions of Melbourne that generate its leading lifestyle, on a global scale. This success however, as previously addressed, is in jeopardy and 'if we cannot muster the courage to think concertedly about the long term future of our cities, we will miss the opportunity to innovate within, rather than waiting for the change to be exposed by external crisis' [9]. Melbourne has numerous vibrant areas surrounding the inner city that can provide the numerous services to the people in the immediate vicinity. Beyond these however, in the increasing suburban areas, long drives over long distances are prominent as houses are widespread and the difficulty in accessing required services is increasing. 'In 2009-10, about 68% of growth occurred more than 20 km from the centre' [10], demonstrating the lack of concern for the urban spread that Melbourne is generating.

Attempts have been made by the Government to reduce the sprawl and increase urban density by setting urban growth boundaries outlined in the Melbourne 2030 framework, which aims to manage growth and change across metropolitan Melbourne. This presents various challenges for the Government including changing the preference many people have for low density communities. For instance, the average number of people in each household is decreasing across Melbourne, yet new houses are becoming larger. This suggests that even as the city's population grows, many Melburnians continue to prefer a low density, high-mobility suburban lifestyle [11].

Kenworthy *et al*. [13] state that 'Rail-orientated transit is highly efficient compared to roads'. Newman identifies the inverted proportion of city wealth associated with rail-orientated transit developments and building roads. The research demonstrated that over time, the proportion of wealth spent on rail-

orientated transit developments decreases, while that of road construction increases [12].

'Road transport is responsible for over 40% of discharges of suspended particles into the atmosphere' [8] and therefore is a large contributor to emissions in cities. The attraction to cars remains large, and governments and industries continue to support it. A debate in city emission schemes is the efficiency of cars. Continually cars are being designed to be more efficient in comfort, fuel use and levels of harmful output. The public, and assumedly governments, are being blindsided by these improvements and are placing the responsibility of air pollution on road congestion. Statements provided by the Nation Association of Australian State Road Authorities and the Royal Automobile Club of Victoria, released in 1981 and 1982 regarding two separate motorway constructions, justify the construction of roads based on the fuel savings and emission reductions produced from the proposed relieving congestion [6]. Luckily, 'the degree of focus on sustainability has varied over the past 3 decades, and strayed far from this mindset into something that concerns all parts of society' [6]. The initial concept that fuel use and emissions by cars is reduced when free flowing traffic exists, is in this exact context, correct.

Research by Kenworthy *et al.* [13] analysed fuel consumption and emissions in Perth and 32 cities around the world. Their findings do agree that efficiency is increased with a higher average speed, however the further the travel, the more fuel is used, hence the more corresponding emissions generated. The greater decreases seen per car in the CBD is due to less use per person living centrally. Outer suburban residents generate the greatest amount of emissions and use more fuel due to their greater travel distance, which inevitably generates a greater value than the reductions proposed from increasing the average speed in the urban area [13].

## 4 Case studies: benefits of public transit, particularly rail, in Europe and Australia

Gospodini [14] researched 'the potential of urban transport infrastructure projects such as metro, regional rail and tram, to indirectly work as a catalyst for the development and redevelopment of urban areas as well as the regeneration of declining areas'. He presented strong evidence from collected hard and soft data supporting the positive catalytic effect of these new infrastructure types from examples within 12 European cities. It can be taken from this research that rather than a 'cat and mouse' game of transport developments trying to catch suburban expansion, similar to the effects insufficient forward planning presented by Holden and Scerri [9], new transport developments can instead become the dictator in establishing the growth in an area. 'Projects of this type have so far played only a limited role in urban policies' [14], however have proven to generate development and redevelopment in cities such as Brussels, Madrid, Valencia and Zurich. In Madrid for example, large investments in urban development and redevelopment commenced during the construction of a new metro line, predominantly on sites where the new train line would access, and produced

corresponding improvements in the areas accessibility and master plan of the area, promoting higher density growth and high-rise buildings [14]. Valencia showed similar positive effects from the construction of a new tramline, however the most predominant change was a transformation of one particular area from a declined and segregated area to a highly accessible area with new service facilities. Zurich's transport infrastructure development, a new S-Bahn, showed that the land use patterns of areas on the new line close to the city had significant changes, seen in Figure 5 [14].

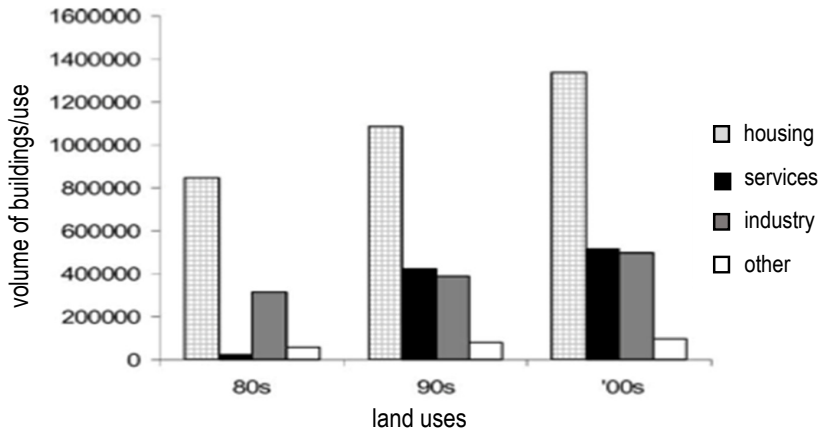


Figure 5: Zurich, Schwerzenbach: land use changes in the last three decades – measured in terms of volume of buildings per use ($m^3$) [14].

Gospodini [14] presents examples of where 'New public urban transport systems, such as metro, regional rail, tram and trolleys, are planned and constructed in European cities and around the world in an effort to increase speed, reliability and effectiveness of public urban transportation, improve accessibility of urban areas, create less-car dependent urban space and improve environmental conditions'. Each example demonstrated unique benefits in terms of growth, and establish an idea that transport infrastructure projects *can* cause positive changes to an area and promote controlled and steady growth by increasing the attractiveness of higher density living arrangements and also causes increases in services available.

As population growth continues in Melbourne it could look to these examples seen in Gospodini for inspiration in public transport planning. Unlike most European Countries however, which are more population dense, one of the major challenges facing sustainable transport in Melbourne is its low population density, particularly in its outer suburbs.

Melbourne's low population density compared with other cities around the world is highlighted in the following statement by Department of Transport Planning and Local Infrastructure [11]. Population density maps of Greater Melbourne are also able to illustrate the dispersing population from the city centre.

The city is shown as predominantly medium density, and becomes less dense further away from the city centre [11].

> '*Melbourne now accommodates around 3.7 million people over nearly 2,000 square kilometres. In contrast, Paris accommodates more than six million people in half that area. Melbourne's population density is not only lower than most European cities, it is also lower than many large American cities (such as Washington, San Francisco and Los Angeles)*' [11].

Traditionally, transport planners consider that rail will not be successful in low density city areas [15]. Furthermore, the delivery of traditional Transit Orientated Development (TOD) principles within a low density urban setting is challenging. The reason is TOD principles are based around high density living. In relation to TOD principles, Curtis and Mellor [16] identify that 'theories about transit-oriented development are based on a basic concept aimed at concentrating urban development (a mix of land uses including high-density residential development and high-intensity non-residential development) around railway stations in order to support public transport use. They also explain the benefits of TOD, stating 'it facilitates sustainable accessibility by providing an alternative to the car and by creating a land-use pattern that facilitates transport choice especially for public transport and non-motorised transport based on resource efficiency' [16].

The Southern railway in Perth Australia, which opened in 2007, is an example of a rail system that has been delivered successfully in very low density urban environments over a sprawling urban corridor [15]. The Perth Southern Railway stretches 72 km from the Perth CBD to Western Australia's second largest city at Mandurah. There was some controversy surrounding the railway as the catchment density is mainly between 6 and 15 dwellings per hectare, which is a very low dwelling density for rail-based public transport services to be considered viable [17]. Another major difference to other public transport systems in Australia is that the public transport system was designed to directly compete in terms of journey time and cost with private vehicle transport [16]. This was due to very high car dependency in the areas where the railway was proposed, presenting a major challenge to the uptake of public transport.

To compete with the car in the low density areas servicing the railway, a transit-transfer model was developed, providing people in surrounding areas with good access to railway stations through high quality bus interchange and good car access and parking [16]. This model for low density areas, whereby masses are brought to the railway through bus and car has been described by Waldock [18, p. 15] as 'a new model for rail which has become a touchstone for the industry nationally'. It differs from the typical public transportation model of mass transit, which achieves mass through penetration into high urban densities [18]. This is also very different from the traditional TOD concepts based around walk on patronage [16]. These station precincts act primarily as a transit interchange (rather than a destination station) aiming to achieve a high level of accessibility by car and feeder bus, with no attempt to develop land use activity to support the station [19].

However, at other stations more traditional TOD models have been adopted; in one case the Government planned for a new TOD community to support walk on rather than car patronage. Other stations sit somewhere between these two extremes. Curtis and Mellor [16] explain these different models, stating that they 'present an opportunity to explore the various ways of integrating the railway with land use and so to test the concept for transit-oriented development in a low-density suburban environment'.

The southern railway has been very successful in terms of patronage, carrying over 70,000 people per day (five times the patronage on the bus service it replaced) and has reached the patronage levels predicted for 2021 a decade ahead of time [17]. A major part of the success of the rail system appears to be the bus interchange model, which transfers patrons from the bus service to rail. This is clear considering 85% of the Southern Rail patrons access the train by a bus service (line to line transfer), whereas around 8% are from the park and ride, and the remainder from pedestrian catchment and kiss and ride [17]. Careful integration of bus services, the use of integrated ticketing and fares without transfer penalties have been crucial to the success of this model, ensuring time and cost remains competitive with the motor vehicle [17]. Another crucial aspect in the success of the railway is the high speed of the system when compared to competing car based trips [17]. For instance, the railway has a maximum speed of 137 km/hr and an average speed of approximately 90 km/hr compared with a typical suburban rail system, which in Australia averages around 40 Km/hr (if stopping at all stations) [17]. The successful interchange model and the high speed nature of the rail service has cut the journey time from approximately 68 minutes to 48 minutes for the journey from Mandurah to Perth when compared to a private car [17, p. 18]. Furthermore, McIntosh *et al*. [17], demonstrates that the public transport trip can provide a lower generalized cost for the trips to the CBD than the private car.

Resembling the European case studies, the Southern Railway has been a catalyst for new development in the railway precincts. Indeed, many property developers chose to promote access to the railway as a key draw card in their development. For example advertising billboards used the railway to promote a new development in Wellard (one of the railway catchment areas) [20]. This included redevelopment opportunities to re-orient existing urban areas toward the station [19]. In new areas, the government and private sector planned for new TOD communities at some railway precincts, thus increasing accessibility and economic opportunity. For example, at Wellard station, located 39 kilometers from the Perth CBD, land was set aside for a TOD community designed on 'new urbanist' and TOD principles [19]. Development of a mixed use main street (including 4070 $m^2$ of retail space) centered on the station surrounded by higher density residential dwellings was planned [19]. A street network supporting a good pedestrian environment and access was part of the design. Construction of the southern railway through the city also proved to be a major catalyst for redevelopment in the city centre, being a major driver for proposals such as the Perth Waterfront and Northbridge Link [15].

Presently there is a dramatic peaking in car use and associated increase in the world's urban rail system, including in the traditional car dependent cities of the US and Australia [21]. Public transit patronage in Australia 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 *et al*. [21] provides new data demonstrating a plateau in the speed of urban car transportation, which he suggests is a major contributing factor to the rise of rail, which can be (as demonstrated in the Perth case study) a faster mode of transport. Newman *et al*. [21] suggests various other structural, economic and cultural changes that are likely to be contributing to the move away from car dependent urbanism. For example, suggests a peak in car use is also due to the growing value of dense knowledge based centres that depend on rail for their viability and cultural attraction [21]. In order for Melbourne to capitalise on this new trend there are important lessons to be learnt from the European examples and particularly the Perth Southern railway in designing urban rail systems for making travel in dispersed cities such as Melbourne more sustainable.

## 5 Conclusion

Since the boom of the post war period, automobile dependency has severely increased and has become a major consideration in determining city land use plans. The rapid growth of Melbourne has caused the city to sprawl, taking with it increased travel times and distances for suburbanites seeking the 'city life' through internal or international migration. With the expansion, roads are continually being built and upgraded, temporarily assisting the growth that is predicted to continue, leading to an endless cycle of road construction trying to *catch* the spread that it itself causes. Research demonstrates the detrimental environmental impacts associated with road use and the wealth consumption caused by continual expansion and proposes recognition of sustainable transportation ideas such as public transit. Numerous case studies support the benefits that public transit can create, including economic benefits through investment, environmental aspects and also societal impacts such as access, atmosphere and safety. The sustainable future for Melbourne requires the consideration of immediate needs and also that of the future population. 'High density cities that have well balanced transport systems have better performing economies' [22]. Australia, and particularly Melbourne, has poor variety in transport systems. This generates grave concern for Melbourne's sustainable future, requiring intensive analysis of the viability and longevity of transport infrastructure projects to maintain its globally leading status in the near, and long term future.

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