Transport disadvantage and low-income rental housing

authored by
Terry Burke and John Stone
with Stephen Glackin and Jan Scheurer

for the
Australian Housing and Urban Research Institute
at Swinburne University of Technology

March 2014

AHURI Positioning Paper No. 157
ISSN: 1834-9250
ISBN: 978-1-922075-49-9
<table>
<thead>
<tr>
<th><strong>Authors</strong></th>
<th>Burke, Terry</th>
<th>Swinburne University of Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stone, John</td>
<td>Swinburne University of Technology</td>
</tr>
<tr>
<td><strong>Title</strong></td>
<td>Transport disadvantage and low-income rental housing</td>
<td></td>
</tr>
<tr>
<td><strong>ISBN</strong></td>
<td>978-1-922075-49-9</td>
<td></td>
</tr>
<tr>
<td><strong>Format</strong></td>
<td>PDF</td>
<td></td>
</tr>
<tr>
<td><strong>Key words</strong></td>
<td>housing, rental, low-income</td>
<td></td>
</tr>
<tr>
<td><strong>Editor</strong></td>
<td>Anne Badenhorst AHURI National Office</td>
<td></td>
</tr>
<tr>
<td><strong>Publisher</strong></td>
<td>Australian Housing and Urban Research Institute Melbourne, Australia</td>
<td></td>
</tr>
<tr>
<td><strong>Series</strong></td>
<td>AHURI Positioning Paper; no. 157</td>
<td></td>
</tr>
<tr>
<td><strong>ISSN</strong></td>
<td>1834-9250</td>
<td></td>
</tr>
</tbody>
</table>
ACKNOWLEDGEMENTS

This material was produced with funding from the Australian Government and the Australian state and territory governments. AHURI Limited gratefully acknowledges the financial and other support it has received from these governments, without which this work would not have been possible.

AHURI comprises a network of university Research Centres across Australia. Research Centre contributions, both financial and in-kind, have made the completion of this report possible.

DISCLAIMER

AHURI Limited is an independent, non-political body which has supported this project as part of its program of research into housing and urban development, which it hopes will be of value to policy-makers, researchers, industry and communities. The opinions in this publication reflect the views of the authors and do not necessarily reflect those of AHURI Limited, its Board or its funding organisations. No responsibility is accepted by AHURI Limited or its Board or its funders for the accuracy or omission of any statement, opinion, advice or information in this publication.

AHURI POSITIONING PAPER SERIES

AHURI Positioning Papers is a refereed series presenting the preliminary findings of original research to a diverse readership of policy-makers, researchers and practitioners.

PEER REVIEW STATEMENT

An objective assessment of all reports published in the AHURI Positioning Paper Series by carefully selected experts in the field ensures that material of the highest quality is published. The AHURI Positioning Paper Series employs a double-blind peer review of the full report, with strict anonymity observed between authors and referees.
LIST OF TABLES

Table 1: Rent differential by quality of public transport accessibility disadvantage, houses and flats, Melbourne, 2012 ................................................................. 26

Table 2: Percentage of private rental dwellings in each category of public transport accessibility, Melbourne, 2012 ................................................................. 26

Table 3: Percentage of public rental dwellings in each category of public transport accessibility, Melbourne 2012 ................................................................. 28

Table 4: Percentage of private rental dwellings in each category of public transport accessibility, Sydney; compared with Melbourne, 2012 ........................................ 29

Table 5: Percentage of public rental dwellings in each category of public transport accessibility, Sydney; compared with Melbourne, 2012 ........................................ 31
LIST OF FIGURES

Figure 1a,b: Bid rent functions for different housing markets .................................................. 5
Figure 2: Melbourne and Sydney, public transport patronage: 1900–2010 ........................ 11
Figure 3: Median suburban rents by distance from CBD, Eastern Corridor of Melbourne (constant 2012 dollars) ................................................................. 14
Figure 4: Distribution of low cost private rental accommodation, Melbourne 2012 .... 15
Figure 5: Distribution of low cost private rental accommodation, Sydney 2012 .... 15
Figure 6: Accessibility by public transport, Melbourne ......................................................... 25
Figure 7: Percentage of private rental flats in each accessibility category, Melbourne, 2012 .................................................................................................................. 27
Figure 8: Percentage of private rental houses in each accessibility category, Melbourne, 2012 .................................................................................................................. 27
Figure 9: Percentage of public rental dwellings in each accessibility category, Melbourne, 2012 .................................................................................................................. 28
Figure 10: Percentage of private rental flats in each accessibility category, Sydney 2012 ......................................................................................................................... 30
Figure 11: Percentage of private rental houses in each accessibility category, Sydney 2012 ......................................................................................................................... 30
Figure 12: Percentage of all private rental dwellings in each accessibility category, Sydney 2012 .................................................................................................................. 31
Figure 13: Percentage of all public rental dwellings in each accessibility category, Sydney 2012 .................................................................................................................. 32
Figure 14: Percentage of all public rental dwellings in each accessibility category, Sydney compared with Melbourne .............................................................................. 32
Figure 15: City of Maroondah. Location of low-cost rental housing in relation to local area transport advantage, 2012 ................................................................. 33
Figure 16: Percentage of jobs accessible within 60 minutes by public transport, Melbourne ......................................................................................................................... 35
Figure 17: Percentage of jobs accessible within 30 minutes by car, Melbourne .......... 36
Figure 18: Public transport mode share for journey to work vs urban density .......... 39
Figure 19: SNAMUTS composite index for public transport accessibility, Vancouver 2012 ......................................................................................................................... 40
Figure 20: SNAMUTS composite index for public transport accessibility, Melbourne 2011 ......................................................................................................................... 41
ACRONYMS

ABS Australian Bureau of Statistics
AHURI Australian Housing and Urban Research Institute Limited
DPCD Victorian Department of Planning and Community Development
DoI Victorian Department of Infrastructure
DoT Victorian Department of Transport
FaCSIA Australian Government Department of Families, Community Services and Indigenous Affairs
IRSAD Australian Bureau of Statistics Index of Relative Socio-Economic Advantage/Disadvantage
NAHA National Affordable Housing Agreement
SNAMUTS Spatial Network Analysis for Multimodal Urban Transport Systems
EXECUTIVE SUMMARY

Despite the plethora of rental research, a significant gap remains in understanding the relationship between rental housing and ‘transport disadvantage’. This project analyses the changing spatial concentration of lower-income renter households in Melbourne and Sydney and connects this with changes in transport opportunity. Extending previous research beyond affordable housing to affordable living, it addresses the question: Do lower-income renters, in being constrained to live in more outer-urban sub-markets, face significantly greater risks of transport disadvantage thereby potentially weakening employment opportunity and other life chances? The use of the term constrained is a deliberate albeit qualified one. It is used in recognition that there is an income constraint and, with limited incomes, the rental choices of low income households are increasingly limited to outer-urban markets. However, it is important to acknowledge that these outer areas also have newer and larger dwellings and some households may be choosing these areas for housing quality reasons as much as income constraints.

For much of the history of Sydney and Melbourne the relationship between housing, public transport, and employment has been one in which lower-income households have been reasonably well served. Lower-cost rental housing (on which low-income households depend) was reasonably well located with respect to appropriate employment markets. The remaking of labour market and housing markets, combined with strategic planning to accommodate the motor vehicle and disinterest in new public transport infrastructure investment or service patterns, has forced many lower-income households to confront new forms of financial hardship and disadvantage.

A transport system creates disadvantage if it limits individuals or households’ mobility in such a way to obtain employment, or access educational and health resources. A transport system can do this in a number of ways including poor availability, limited accessibility, lack of timeliness, cost and lack of flexibility with these attributes varying between the different modes of public transport, that is train, tram and bus. This ‘transport disadvantage’ is recognised as a contributing factor to the problem of social exclusion, which has been central to social policy-making in Australia in recent years (Hayes et al. 2008). It has been used to draw attention, first, to the complex individual and structural causes of poverty and, second, to wider economic and social impacts that go beyond the personal experience of hardship. Like many social concepts, there is considerable argument over its definition (Arthurson & Jacobs 2004). However, a formulation that captures key elements of social exclusion is:

Lack or denial of rights, goods and services, and the inability to participate in the normal relationships and activities available to the majority of people in a society, whether in economic, social, cultural or political arenas. (Levitas et al. 2007, p.9)

Transport systems can be seen to create social exclusion through the processes by which people are:

Prevented from participating in the economic, social and political life of the community because of reduced accessibility to opportunities, services and social networks, due in whole or part to insufficient mobility in a society built around the assumption of high mobility. (Kenyon et al. 2003, p.318)

As an example, a transport system creates disadvantage if it limits individuals or households’ mobility in such a way to obtain employment, or access educational and health resources. A transport system can do this via the ways outlined above that is availability (it is simply not there), accessibility (it is there but getting to it can be
difficult), *timeliness* (not running at times needed or with required regularity), *cost* (too expensive to access) and *flexibility* (it is inflexible to the mobility needs of users). Linking these elements of disadvantage to the previous discussion of housing and urban form it can be seen that the symbiotic process of urban growth and restructuring of housing markets that Sydney and Melbourne have seen potentially means that these elements of transport advantage or disadvantage have become more important for lower-income households. This is because they are now increasingly constrained, or choose, to rent in outer urban locations where transport systems are weak compared to the inner city. The latter has been the historical housing base for many low-income renters and had very good availability, accessibility, timeliness and affordability of public transport and relatively good flexibility.

Transport disadvantage may, however, have different meanings for different household types. A single adult person faces fewer challenges in getting around a city than a family. A family with multiple members has to manage getting family members to different places and at different times and may have teenage children who are independent in most respects but are unable to drive. Balancing these needs with even one car can be difficult within areas of transport disadvantage; without a car it must be an enormous and, at times, an insurmountable challenge.

While often not explicit, there has been recognition of the need to have transport policies that respond to disadvantage. Such recognition is a principal justification for the high levels of state government subsidies for the operation of a rudimentary ‘safety net’ of fixed route, fixed schedule public transport services. Housing agencies attempt to address transport disadvantage through recommendations about locating new housing in areas with higher levels of transport service. However, due to weak planning controls and the structural economic pressures that have led to rapid rises in prices for housing in areas of comparative transport advantage, these recommendations are more often statements of intent rather than of action.

We use an accessibility model, Scheurer’s Spatial Network Analysis for Multimodal Urban Transport Systems (SNAMUTS 2009), to provide a composite indicator of public transport accessibility that measures the performance of existing public transport networks as a means to access jobs and services and social supports. This data is overlaid on the locations of public housing and low-cost private rental housing derived from 2011 Census and from 2012 Rental Bond Board data.

This analysis shows in detail how, to varying degrees, all classes of public and private housing available to people on low incomes are over-represented in areas of poor to non-existent public transport accessibility. This clearly shows that a marked restructuring of the low-cost private rental housing market has taken place in Melbourne and Sydney over the last three decades or so and the effect has been to locate many lower-income households in areas where they suffer significant transport disadvantage. This process is likely to become more marked as the years progress as there is little likelihood of inner city areas becoming more affordable. The necessary policy responses are complex and are a mix of housing and transport initiatives with the emphasis on the latter.

The transport initiatives to tackle transport disadvantage should be based on recent research which shows that, in the ‘dispersed’ cities of North America and Australia, residential density is less important as a determinant of public transport performance than the design ‘philosophy’ of transport planners (Mees 2010; Stone & Mees 2010). Instead of incremental investment in new services in a fundamentally inefficient system of wandering, irregular and disconnected bus routes, significant benefits in service quality and operational efficiency can be achieved if new investment is
coupled with the re-organisation of existing services into a coherent 'network'. Such networks are at the core of public transport success in Canada and Europe, and have been employed in parts of Perth, with clear evidence of improved efficiency and occupancy (Mees et al. 2010; Stone 2011).
1 INTRODUCTION

The rental sector is arguably Australia’s problem housing arena. The private sector is characterised by major affordability problems, lack of tenant security, tenant-landlord disputation and low-end supply shortfalls (Hulse et al. 2011, 2012; Randolph & Holloway 2007; Wulff et al. 2001, 2011). The public sector is constrained by severe need, its funding environment and stock built and located at a different time and for a different purpose (Hall & Berry 2007; Jacobs et al. 2010).

Despite the plethora of rental research, a significant gap remains in understanding the relationship between rental housing and transport accessibility and particularly the notion of ‘transport disadvantage’ whereby lower-income households, predominantly renters, are constrained to locate in areas where there is poor transport access and availability. Thus, this project analyses the changing spatial concentration of lower-income renter households (in Melbourne and Sydney) and connects the process of concentration with changes in transport opportunity. Extending previous research beyond affordable housing to affordable living, it addresses the question: Do lower-income renters, in being constrained to live in more outer-urban sub-markets, face significantly greater risks of transport disadvantage thereby potentially weakening employment opportunity and other life chances?

The relationship between housing and transport is fundamental yet rarely does housing research pay much attention to transport issues or planning and vice versa. There are, however, two typical ways in which the relationships are explored albeit somewhat tenuously.

In the first case, they are woven together through the relationship between urban density and transport mode choice with ‘low-density suburbia’ used as shorthand for the dominance of detached housing and higher density meaning various forms of multi-unit housing. Typically, it is assumed that the residential density of the Australian suburbs is too low for viable public transport and that car dependence is inevitable. The corollary is the belief that higher density housing is the essential prerequisite for improved public transport. This is most powerfully expressed in the works of Peter Newman and Jeff Kenworthy (Kenworthy & Laube 1999; Newman & Kenworthy 1989, 1999) and has been uncritically adopted by the authors of most urban planning strategies in recent decades. It is an important rationale (although not the only one) behind metropolitan planning strategies that recommend greater urban consolidation and particularly the provision of multi-unit housing around public transport nodes and routes (DPCD 2013b).

While this is an important solution, it is problematic particularly in terms of affordable housing (see Section 3.4). Mees (2010, 2000) has clearly shown that much more effective and efficient public transport is possible in the low density suburbs of Australian cities, and the implication of this insight for housing policy is a key theme of this AHURI study.

The second way in which the housing and transport relationship is explored is through the urban economics literature on land usage and locational decisions of households (or firms) (Alonso 1964). This is typically explored through a model based on certain assumptions of the relationship between transport costs and locational decision-making and is diagrammatically represented in a ‘bid rent’ diagram (see McDonald & McMillen 2007, chs. 5 & 6). This recognises that land is in fixed supply and that households will be willing to pay a premium in rent or purchase price for land that is particularly important (e.g. a central business area where most employment, recreation and retailing activity is located). Households situated at greater distances
from these important locations will have to spend more time and money to get there. So, the performance and cost of available transport systems affects what households are willing to pay for certain locations. Thus, Figure 1a below illustrates, on the most basic assumptions, a typical bid rent curve whereby the greater the distance from the CBD the less households are willing to pay for rental of a dwelling. However, if commuting costs are improved through quicker or cheaper transport the bid rent curve is changed and households will be willing to pay more for a given distance from the CBD and, in some cases, as was the situation in Sydney and Melbourne in the 1950s and 1960s, the bid rent curve would be more like Figure 1b where rents were more expensive in the suburbs than the inner city as the car become predominant and the inner city become associated with urban decline. In addition rents for suburban locations were also paying for a higher quality and in most cases a larger dwelling than in the inner city.

Figure 1a,b: Bid rent functions for different housing markets

For public rental housing such analysis is not relevant as public housing is (1) not rented on a market relationship but on a household rent, that is as a percentage of income, and (2) not allocated to households on a ‘willingness to pay’ basis but on a bureaucratic wait list system.

Both these approaches underplay the complexity of the housing-transport relationship and also obscure or divert attention from other issues relating to the relationship between transport and housing, although they still have importance for broad levels of understanding.

This is the first AHURI study looking at the housing transport relationship but does so with a specific focus. The project is designed to investigate ‘the degree to which low and lower-income renters face significantly greater risks of transport disadvantage thereby potentially weakening employment opportunity and other life chances’. The study is premised on the assumption that lower-income renters are increasingly being pushed to more outer urban areas where access to public transport is not as good and where there is greater car dependence. This research will be tackled through five questions that will lead to empirical measures of the problem and its effects and to analysis of possible policy interventions.

1. What is the evidence of increased spatial concentration of lower-income households in outer urban areas of Sydney and Melbourne?
2. How is transport disadvantage conceptualised?
3. To what degree have restructured rental-housing markets created or exacerbated transport disadvantage over the last decade?
4. Are there differences in transport accessibility between lower-income private and public renters and more affluent households?
5. What policy interventions might address transport disadvantage and what are the impediments to reform?

Transport disadvantage is an issue for most countries but has a particular resonance in countries where the dwelling stock is predominantly detached housing and urban densities low. Australia shares this attribute with much of the USA and Canada, but in terms of low-income households Australia appears to have its own twist on the problem, notably that relatively few low-income earners live in the inner city which is where a good proportion of the urban poor live in the USA or Canada. For example, Blumenberg and Manville (2004) in a review on transport’s relationship to poverty drew attention to a problem which is in effect the inverse of Australia; that the best paying employment in many US cities are in the suburbs and with the poor disproportionately resident in the inner city there is major accessibility and costs barriers to accessing such employment.

Another study of transport disadvantage in relation to employment opportunity in Boston found that accessibility differentials between transportation modes were highly important (Qing Shen 2001). For low-income, low-educated job seekers who could travel by car, the majority of residential locations allowed access to labour market areas, but for those who depended on public transit very few residential locations, including inner areas, allowed above-average access to employment. In a qualitative study of 73 low-income welfare dependent households in Los Angeles, Agrawal and Blumenberg (2011) looked at low-income and welfare dependent households in Los Angeles. Unlike this study, theirs was a qualitative study of 73 households in one area (San Jose) and found that transport disadvantage was a major hardship requiring adaptive behaviours to cope with the cost and lack of access.

This paper has four parts. The first provides a brief historical overview of transport provision in Sydney and Melbourne and discusses this in relationship to the changing nature of lower-income rental housing markets. The second part provides a discussion of the concept of transport disadvantage and explores its relationship with housing disadvantage. The third part maps both Melbourne and Sydney using a composite indicator of public transport accessibility that measures the performance of existing public transport networks as a means to access jobs and services and social supports. This data is then overlaid onto location of low-income rental housing to identify the proportions of people in this category who are experiencing transport disadvantage. The final section draws out the policy implications of the findings with the emphasis being on transport rather than housing solutions given the constraints on housing and planning policy to deliver in this area.
2 HISTORICAL CONTEXT

By the international standards of the early to mid-twentieth century, Sydney and Melbourne had among the largest public transport systems in the world and they served their respective cities well. In the nineteenth century, when the Melbourne and Sydney systems were formed, Australia was one of the most affluent countries in the world at that time and could afford extensive urban infrastructure. Moreover, the undeveloped green field nature of Australian cities meant that transportation systems could be established without the impediments of an existing built form.

The twentieth century saw continued growth in Australia’s affluence but this growth increasingly manifested itself in a private rather than public response to transport mobility; more and more households turned to the private car and the public transport system stagnated. Population and urban growth did not stagnate however and the boundaries of Sydney and Melbourne pushed out dramatically with households living in these new areas becoming almost solely car dependent for mobility.

2.1 Melbourne 1850–1960

Melbourne was founded in 1835 and, with discovery of gold in the 1850s, grew rapidly such that it could no longer be a walking city. The first forms of public transport were horse-drawn omnibuses and cabs, and a regular fleet service serving inner-city markets was in place by the late 1860s. The first train line opened in 1854 and ran between Flinders Street to Sandridge (now Port Melbourne) and routes to St Kilda (1857), North Brighton (1859), Hawthorn (1861) and Essendon (1860) quickly followed (Davison 1978). For the next 30 years, railway lines were extended beyond the edge of the city in a speculative suburban housing boom (Davison 1978, pp.156–74). Timetables and ticket pricing were aimed at middle-class commuters and the housing built along most lines was largely detached dwellings with gardens thus giving Melbourne its strong suburban character. While some poorly performing orbital and spur lines have been closed, the rail system of 2013 is very similar to that which was in place by the 1890s. These suburban railways were largely developed independently of the freight and passenger networks used to serve regional markets.

In the 1880s, cable trams began to replace horse-drawn services in the inner suburbs and new lines were built to compete with the railways in the middle-class suburbs to the south and east. At the same time, the railways began to compete for the working-class travellers in the inner and northern suburbs, setting up a 'fever of perverted competition' between the two modes (Davison 1978, p.164). This competition reinforced the speculative boom in housing development driven directly by the extension of public transport services. The property market finally collapsed in the late 1880s as houses were built greatly in excess of demand and remained unsold. Some tram and train lines were closed but political pressure kept most open, but now Government owned (Davison 1978, p.170), leaving Melbourne with a positive legacy of public transport infrastructure and a history of antagonism between public transport operators that still hampers development of effective services today.

While many of the horse-drawn buses of the mid-nineteenth century evolved into the tram system, the motorised bus emerged in the early twentieth century to fill many of the route gaps missed by trains and trams. The bus system expanded rapidly after World War I, when ex-servicemen who had acquired transport experience during the war began privately running buses on any route they thought would provide patronage. Longer radial routes, with destinations in the CBD, were typically operated by the Melbourne Metropolitan Tramways Board—a state agency—but competition on the private buses was fierce: the right to operate the most profitable routes being
sorted out with bottles and fists (Maddock 1992, p.9). The routes shaped by these basic market forces tended to be indirect and disconnected and, without unified timetables or marketing, they did not perform well in later competition with the car. Only the introduction of the multimodal ticketing system in the late 1970s saved the private operators from complete collapse, but they used the courts to resist an attempt to rationalise bus operations in the 1980s, and there has been no political will for a second attempt.

The public transport system enabled two housing submarkets to coexist and develop in a pattern that remained in place to a great extent right up to the 1970s. The inner city, at the end of the nineteenth century and for much of the twentieth, not only encompassed much of the commercial and retail activity of Melbourne but it was also the location of port facilities and of manufacturing including many noxious industries such as abattoirs, dying and leather making. The lower paid unskilled and semiskilled workforce for these industries was also accommodated in the inner city in cheaper, lower quality, and higher density housing. Many of the new suburbs built between 1880 and 1940 contained minimal employment opportunities apart from local retailing. There was no requirement for industry to move to the suburbs. The quality of the rail system that radiated out from the CBD and inner city enabled white-collar employees to commute to inner-city professional and commercial jobs from middle and high income households in detached suburban houses.

This economic pattern of an inner city industrial heartland and radial residential commuter corridors along the train lines remained largely in place until after World War II when much of the manufacturing industry began to relocate to outer urban areas such as Dandenong, Broadmeadows, Deer Park and Altona. Nevertheless, the image of the inner city as a less than attractive place to live endured for some decades after its blighting industries had gone with the population of inner Melbourne continuing to decline despite new flat construction up to the 1970s (Neutze 1977 p.71). This kept house prices and rents low relative to the rest of Melbourne while a post-war boom in flats (‘the six packs’) largely built for the rental market compounded the role of the inner city as a location for affordable housing in the early post-war decades (Burke et al. 1985, Section 3.1–3.4; Kendig 1979, pp.24–26).

For almost 100 years from the 1870s to 1970s, the inner city provided affordable, although often poor quality, housing for large numbers of low-income households. At the same time, it provided these households not only with very good access to city resources because of the public transport legacy, but also with good employment access even without public transport because the concentration of economic activity in the inner city meant that many workers could walk or cycle to work. Even beyond the inner city, the close relationship between suburban housing development and the railways meant that households in suburban locations had good access to the labour markets of the inner city.

2.2 Sydney 1850–1960

Sydney’s train system has a distinctively different history to that of Melbourne and one where the housing-transport relationship is less direct.

From its beginnings, with a line between Sydney and Parramatta in 1855, the initial function of the New South Wales rail system was to bring rural resources to the port and central Sydney. Rail services for Sydney’s residents were more closely linked with this rural system than was the case in Melbourne and there were fewer suburban as distinct from regional to city lines built. This was, in part, because both freight and passenger services were developed by the government, while Melbourne’s suburban passenger rail was initiated by private investors.
While some suburban passenger rail services were opened between 1880 and 1920, by Melbourne standards they were small and historically late. There were several reasons for this. First, Melbourne’s simpler geography made rail development much easier, and Sydney’s city rail terminus was less central than Flinders Street in Melbourne, so railway commuting to the CBD was less attractive. Second, Sydney's inner city was already served well by trams.

Sydney’s train system did not take its recognisably modern form until the 1930s, and the linking of the two major CBD lines via the construction of the Circular Quay viaduct was not completed until 1956. This pattern and later staging of development meant that the train system was never central to speculative housing development as it was in Melbourne.

Ironically, considering that it was dismantled in the 1950s, Sydney’s tram system initially played a more dominant role in the city’s development. In Melbourne in 1907, the ratio of train to tram travel was 1:1 (both carried 60 million passengers per annum). By contrast, in Sydney in the same year, trams carried 3.6 times more passengers (Lee 2010, p.210).

As in early Melbourne, horse-drawn buses and trams gave way to a mechanised system in the later nineteenth century. However, Sydney opted for steam-powered vehicles, rather than the more efficient cable system in which the power source was stationary. These in turn were electrified by the early twentieth century. Because of Sydney’s challenging topography, the tram system emerged as a set of separate largely unconnected lines. Though a larger system than Melbourne—(290 kilometres in 1933, Simpson 2004), the inability to link one line with another, or in some cases with the train system, meant that they found it difficult to connect with either the emerging bus system, or with the railway system when it expanded and electrified in the 1920s and 1930s. In the early post-war years, the growing voices of motorists wanting more road-space, the cost of replacing the ageing fleet of ‘toast-rack’ trams, and the lack of clear champions in government all contributed to a sense of inevitability in the decision to replace trams with buses across the city in 1957 (Manning 1991). This new bus system was government run, and even to the present day, performs better than the private companies that supplied bus services in the growing western suburbs on a similar model to that found in Melbourne.

As in Melbourne, inter-modal antagonisms and institutional inertia have prevented coordination of trains, buses and ferries into a single network. Even the newly promised ‘smart ticket’ will still charge users a separate fare for each section of a single multi-modal journey. Sydney is now the only Australian capital city without a multi-modal public fare system.

As we saw earlier, it is possible to argue that, in Melbourne, the historical developments of housing and the dynamics of housing submarkets are directly linked to the accessibility provided by public transport, but the relationship in Sydney is not quite so clear. Geographical features have played a much more important role than transport in shaping housing markets. Thus, some of Sydney’s affluent commuter areas, such as the North Shore, developed with relatively weak public transport, although ferries provided good links to the CBD. And, while most of Melbourne’s inner urban area was made up of industry and relatively low-cost housing, parts of inner Sydney, for example, Potts Point and Woollahra, have, by virtue of the attractiveness of a harbour location, quite large areas of high-cost housing. Nevertheless, until the 1960s, inner Sydney contained a disproportionate share of Sydney’s ‘heavy’ industries and the workforce for these industries lived nearby and could use public transport to get to work.
2.3 The housing-public transport disjuncture 1960–2013

Up until World War II, economic activity in both Melbourne and Sydney was concentrated in the CBD and inner city and, most of the dwellings in the surrounding commuter suburbs were on the train, tram or ferry routes. For example, in Sydney in 1945, 55 per cent of all employment was in the CBD and adjacent fringe. This rose to 74 per cent for the inner city as a whole (Neutze 1977, Table 4.8). Either by living and working in the inner city, or by commuting to it, there was a strong relationship between housing, public transport and labour markets.

After World War II, the relationship between public transport and housing markets weakened and then broke down almost completely. In the last decade, there has been some restoration of this relationship, but in a somewhat problematic way.

The three decades after World War II were known as the ‘long boom’ and were characterised by full employment and strong income growth. This enabled a symbiotic relationship between home ownership and car purchase to emerge in such a way that most newly-forming households could buy both a car and a new house. For most households, this was their first experience of both and the ownership of a car meant greater housing choice. No longer was there a need to purchase or build within walking distance of public transport. The freedom of movement enabled by the car allowed developers and builders to open up new estates some distance from public transport without fear that they would not sell. Moreover, the estates and the houses on the estate began to be designed for the car with far larger blocks than hitherto the case and layouts that deterred walking and encouraged car use.

The ability of households to be spatially footloose was paralleled by that of industry. As trucks came to dominate freight transport, manufacturing and warehousing could move to new industrial estates on the urban fringe. They had no trouble attracting labour, as workers could drive to their place of employment. Where historically housing markets, labour markets and public transport had enjoyed a close relationship, the motor vehicle created a disjuncture between them. To illustrate the degree of change, the percentage of employment in the Sydney CBD and adjacent fringe in 1971 had fallen from 55 per cent of total to 34 per cent, while the outer ring of that time went from six to 19 per cent (Neutze 1977, Table 4.8). The car enabled people to connect quickly and comfortably to their place of work and place of home therefore decoupling the historic geographical relationship between labour markets and housing markets. As a side effect, public transport became increasingly irrelevant to the degree that, as Figure 2 below shows, both in Sydney and Melbourne there was a steady erosion of public transport usage from its peak in 1945 to its trough in the early 1980s.
Not everybody owned a car and could live in a detached dwelling in the suburbs in the early decades after World War II. Many lower-income households still lived in the inner city, and those without cars were dependent on public transport, walking and cycling. After wartime rent controls were removed in the early 1950s, the inner city became the location for large-scale flat development, most initially designed for rental purposes. This reinforced the image of the inner city as the location for those seeking more affordable dwelling either because of low income or because they were young households using rental accommodation as a staging point before moving to ownership (Lewis 1999, ch.4). In 1971, for example, Melbourne inner city and the immediately adjacent areas of Hawthorn, Footscray, Caulfield Malvern and Northcote, while having only 9 per cent of all housing stock, accounted for 50 per cent of all rental stock with much of this being cheaper stock (Burke et al. 1985, Section 3). By contrast, many of the new suburbs based around the growth of car had virtually no flats and were largely owner-occupied detached houses. Thus, in 1971, outer and fringe ring suburbs contained only 15.8 per cent of Melbourne’s entire rental stock, despite having half as much housing stock again as the inner city (Burke et al. 1985). This pattern was even more pronounced in the 1950s and 1960s, with the effect that a disproportionate number of lower-income households in Melbourne lived in the inner suburbs. In 1966, a Survey of Living Conditions in Melbourne found that while 7 per cent of Melbourne’s population lived below the poverty line, the figures for Richmond, Collingwood, South Melbourne and Port Melbourne were over 30 per cent and Prahran was over 20 per cent (Burnley 1980, p.231).

Sydney was somewhat different. The inner area of Sydney had even higher concentrations of rental property (73% of all stock) (Kendig 1979, Table 3.3) although, unlike Melbourne, rents were not cheaper than the metropolitan average suggesting that residents lived there because it was closer to work and they could avoid travel costs and time. The inner city had high concentrations of poverty in areas such as Redfern, Darlinghurst and Newtown where poverty rates were in excess of 30 per cent (Burnley 1980, p.233). But, outer south-west suburban Sydney also had high concentrations of lower-income households (Kendig 1979, p.43) with much of this related to the scale of public housing provision (see Section 2.4 below). Much of this development was not near public transport.
From the late 1940s until sometime in the 1970s or 1980s, the synergy of home and car ownership worked well for those with access to a car. People could travel between work and for other purposes with relative ease. But, as both the population and the rate of car ownership per household grew, and public transport use fell in response to a downward spiral of service cutbacks, the problems of congestion became worse. In 1950, there were only 269,000 cars in all of New South Wales (one car for every 12.2 people) compared to 3.9 million in 2012 (one car for every 1.9 people) (ABS 2012; Lee 2010, p.241). With so few cars on the road, it is not difficult to image the freedom of movement experienced by car owners in the 1950s and 1960s, or to understand why a new home in the suburbs—with the associated drive to work—was so attractive.

The growth of the motor vehicle and the urban development around it engendered a US rather than European policy response. This was essentially about accommodation to the motor vehicle: a process still largely operative today. In Melbourne, public transport fell further and faster than any other western city apart from Auckland (Mees 2010), and there are now more cars on the road transporting people to work in Melbourne than in Sydney, despite the latter’s much larger workforce (Mees & Groenhart 2012). A few urban plans, such as the 1954 Melbourne Metropolitan Planning Scheme, did argue that both an expanded and coordinated public transport system and new roads were required to meet future transport needs (MMBW 1954), but governments chose to deal with transport problems almost exclusively through the construction of freeways, building more lane-kilometres than any other Australian city. The 1954 MMBW Scheme had suggested that intermodal coordination was 'serious and vital' and asserted that 'it should not be beyond the imagination of the appropriate authorities to devise suitable and adequate machinery' (MMBW 1954, vol.2, p.105). However, this assertion proved false. Widespread community opposition to freeway plans in the 1970s and to public transport cuts in the 1980s led to changes in government rhetoric but little change to transport policy or practice (Stone 2009).

Public transport use fell less rapidly in Sydney than it did in Melbourne, and has maintained somewhat higher share of travel for the journey to work (23.2% vs 16.1% at the 2011 census). Sydney’s somewhat stronger performance is partly the result of transport policies of past decades, particularly the strong pro-rail stance of the Wran ALP Government that followed community opposition to freeway plans in the late 1970s and early 1980s. Line extensions and modernisation works stemmed the decline in rail patronage and even lifted its mode share (Mees & Groenhart 2012). Since then, rail services have deteriorated and there has been a large program of road construction. Substantial declines were only prevented by the city’s historical strengths of an extensive rail system, high population densities and relatively high employment in suburban centres with rail access. Public transport management in Sydney continues to take a fragmented and narrow approach to service planning (Mees 2000), and the processes of regulation are labyrinthine. Nearly 50 years ago, the authors of the Sydney Region Outline Plan lamented that ‘there is virtually no bus–rail coordination’ (State Planning Authority of NSW 1968, p.43). Unfortunately, little has changed, although the reforms initiated by the current Liberal Minister for Transport, Gladys Berejiklian, are attempting to address some of these issues.

Over the five decades from 1950, urban road users fell victim to the tragedy of the commons. The roads, as a resource held in common for use by all, were ultimately ‘destroyed’ by more and more people wanting to use them. The sheer scale of automobile growth from the 1950s onward, with the side effects of congestion, pollution, and infrastructure demands that were unanticipated or ignored by the proponents of freeway-building, not only challenged planners and policy-makers but also car owners whose car-based ‘freedoms’ were watered down by traffic jams and
rising fuel costs. Slowly, public transport has become more attractive for those whose travel demands still fitted into the reduced scope of twenty-first century service patterns.

Public transport use for the journey to work is growing again (Mees & Groenhart 2012; Mees et al. 2008), but public transport managers are struggling to capitalise on these trends. In neither Melbourne nor Sydney, can public transport authorities articulate a vision or demonstrate a blueprint for public transport that can persuade any decision-maker that successful competition with the car was possible. In fact, in Melbourne, government analysts (Gaymer & Kinnear 2009) accept that reasons for recent patronage growth are external to the management of the system itself, and senior planners, for some time, advised their minister that the positive trend would not continue (Stone 2010). Expensive plans for new rail investment in Melbourne contain little justification of their superiority over cheaper options, and in Sydney, plans have been announced and cancelled in a seemingly endless succession.

It was not surprising that the three decades from 1950 onwards that saw the suburbanisation of the people, housing, and industry created what people would now say was a context of path dependency. For a short while in the 1970s, there was growing concern that Australian inner cities would follow the pattern seen in the USA and become ‘Doughnut Cities’ with the flight to the suburbs leaving massive disadvantage and social unrest at the core (DoI 1998). The expectation was that with car dependence, more and more of new economic activity would be located in the suburbs including the growth of edge city developments like the build around the freeways as had occurred in the USA (Garreau 1991). But Melbourne and Sydney did not follow the USA model with the result that a new housing and public transport relationship has emerged.

The inner suburbs of Melbourne and Sydney did experience an absolute reduction in employment and rising unemployment (Neutze 1977) in the 1960s and 1970s, but the decline was short-lived. Over the next four decades, their economies and labour markets were rebuilt to become the heartlands of the new ‘knowledge economies’ of the two cities with a very different lifestyle to that of a working class manufacturing economy (Dingle & O’Hanlon 2009). Financial services and professional services grew rapidly and, by the 2000s, a disproportionate share of high-income jobs was in the inner city, while less well-paid employment became concentrated in the outer areas. The latter was partly related to the decline of manufacturing and the replacement of employment in this sector with industries such as wholesaling and lower-end retailing. When combined with congestion cost and higher costs to own, run and park a car, the centralisation of high-income employment attractiveness had two major effects. First, it made the inner city a much more desirable place to live, igniting a cycle of gentrification and rising house prices and rents (Logan 1985). Second, it encouraged more people back on to public transport, because many of the newly created jobs were in the CBD and inner city that are better served by the public transport system, which had survived the years of decline. As Figure 2 shows, public transport patronage after a bottoming out in the 1980s has increased markedly, although it should be noted that in per capita terms public transport trip-making is very much lower than in past decades. The effects of the rediscovery of public transport on lower income households and particularly rental housing has been dramatic. Figure 3 below shows a rent bid curve as discussed in Chapter 1 for one geographical corridor of Melbourne and illustrates how the rental market has changed over the last forty years. The 1971 rent is very similar to that of Figure 1b reflecting in that era how a suburban rent would get a household a larger higher quality property, greater amenity than then provided by the inner city, and the freedom to own and use a car. By 2012 rents are much lower the further from the CBD despite the fact that for inner city areas
even in the 2000s most of its stock was inferior in size to the outer suburbs (although quality has dramatically improved). The inner city could now receive a large rent premium for its accessibility and attractiveness with the difference between the 1971 and 2012 median inner-city rents ($420 a week in Richmond) highlighting the degree to which lower income households have little choice but move to outer areas.

**Figure 3: Median suburban rents by distance from CBD, Eastern Corridor of Melbourne (constant 2012 dollars)**

Source: 1971: Burke et al. 1985, Melbourne Housing Indicators, Real Estate Agents Board, Table 3.3. This data used advertised rents from The Age newspaper classifieds, 2012: Rental Bond Board data from DHS Rental Report (DHS 2012)

Figure 3 shows the median rents in 1971 and 2012 in constant 2012 prices for the Eastern Corridor of Melbourne going out for some 25 kilometres from the CBD. In 1971, Richmond, adjacent to the CBD, was by far the cheapest place to rent and Ringwood, 25 kilometres from the CBD, the most expensive. In 2012, the situation had been reversed; Richmond was now the most expensive and Ringwood the cheapest. By 2012, the rental market had restructured in such a way to place a much greater value on accessibility than it had four decades earlier. Rent for a two-bedroom flat of the order of $500 a week, as in Richmond, is not affordable for a lower-income single or coupled household. This would be even worse for a family seeking a three-bedroom house in the same area: the rent for such a dwelling in 2012 was $660 per week compared with $360 per week in Ringwood (DHS 2012, Table 11). The market has responded to (or driven) these changed market dynamics by a remaking of where the low cost rental supply is now located. This is no different for Sydney.

As Figure 4 (Melbourne) and Figure 5 (Sydney) show, inner areas, which have historically been the major location of low-cost rental supply, no longer serve that role. Low-cost rental housing (defined as stock renting for 20 per cent or more below the median for the relevant dwelling type and bedroom size) is now concentrated in the outer and newly developing fringe suburbs.
Figure 4: Distribution of low cost private rental accommodation, Melbourne 2012

Source: Unit record files from Rental Bond Board data: properties rented out and bond paid in 2012

Figure 5: Distribution of low cost private rental accommodation, Sydney 2012

Source: Unit record files from Rental Bond Board data: properties rented out and bond paid in 2012
Thus, by the 2010s, a housing-public transport relationship that had for many decades been ruptured by the motor vehicle was being restored, but in a different way prior to the motor vehicle. Affluent households were willing to pay a premium for locations that were better served by the remnant public transport services and conversely areas with worse or no public transport were devalued. This has meant that more affluent households are building a closer relationship between housing location and public transport availability while the opposite appears to be occurring for low-income households; the changing housing market dynamics has meant a displacement of lower-cost rental housing to areas of poorer public transport. If this is the case, there are potential major costs to occupants of such housing who are seeking access to key services and labour market opportunities: they face either higher living costs associated with greater car dependence or greater isolation caused by dependence on buses with limited services and often-poor connectivity. This is not to say, however, that lower-income households including renters want better access to the labour markets of the inner city. The employment needs of the inner city may not mesh with the skills and education of lower-income households whereas those of more dispersed outer urban areas may. But getting to these may be as problematic as to the inner city if the public transport system is too geared to fixed line suburb-to-central city provision. While policy and media debate focus around expansion of rail and tram systems these will always be limited in coverage and it is the bus system that has the capacity to bring access and flexibility to poorly served areas in which lower-income households live.

2.4 Public housing

The previous observations about changing spatial distribution of lower-cost rental housing refer to housing provided by the private market. Social housing in Australia is provided predominantly in the form of public housing and its supply is driven by a different set of factors including greater ability to plan housing provision in relation to public transport.

Public housing, although funded by the Commonwealth, is a state responsibility. So, the history of public housing in Sydney and Melbourne has followed somewhat different trajectories with implications for the housing-transport nexus.

In the early post-war years, there was considerable concern about inner-city slums in both cities. The use of public housing as a mechanism to eliminate such slums appears to have been taken up with much greater enthusiasm in Victoria than in New South Wales. Thus, much more of Melbourne’s so-called inner-city slums were demolished and replaced with high-rise housing and walk-up flats than was the case in Sydney (Tibbits 1988). However, even in this era, not all public housing was built as slum replacement and a number of new estates of detached and semi-detached housing were built in Sydney and Melbourne between the 1950s and the 1970s. In Victoria, a number of these estates were built alongside emergent manufacturing areas, such as Doveton and Broadmeadows, with the tenants providing the workforce for the firms in these areas (Bryson & Thompson 1972). Other new estates were built on undeveloped land not far from the CBD. These included Ashwood (12 kilometres from the CBD) and Heidelberg (10 kilometres from the CBD). This construction of public housing in more accessible metropolitan locations was less practicable in Sydney because of higher land costs. In 1971, land prices for an average block of land in Sydney were 2.2 times that of Melbourne and 3.1 times that of Adelaide (Advisory Council for Inter-governmental Relations 1985, Table B.7).

It is not surprising, therefore, that much of the new public housing built in Sydney, particularly in the 1970s, was on the very fringes of the urban area where land was
cheapest. Thus, areas of Liverpool and Campbelltown were chosen for large public housing estates (e.g. at Macquarie Fields). Many of the new tenants had been displaced from inner Sydney by the slum clearance programs. Liverpool is some 32 kilometres from the CBD and, in the 1950s, was largely an agricultural economy as it had been for the previous hundred years. Campbelltown was even further out (more than 45 kilometres) and it also had a very poorly developed local economy.

Although manufacturing, and later a service industry economy, did emerge in Sydney’s outer west, the local economy was never of sufficient size (either then or now) to employ public tenants on any great scale. There are some local rail stations with connecting, but not necessarily regularly timetabled, bus services to these outlying estates, but it remains a long and slow trip to those parts of Sydney with stronger labour markets.

2.5 The urban development and public transport challenge

Urban strategic planning in Melbourne and Sydney over the past 50 years has been largely based on accommodating the motor vehicle. Few restrictions have been placed on the ability of industry and commercial and residential property developers to make locational choices for reasons of profit or personal wellbeing taking into account individual land and housing costs and associated transport costs. Labour markets are now highly dispersed, particularly for many of the jobs sought by people whose educational, English language and employment skills are limited.

The CBD and adjacent suburbs agglomerate jobs to a much greater degree than outer areas such that the density of jobs is much greater. This, combined with a CBD-focused public transport system, more so in Melbourne than Sydney, means that 63 per cent of commuter mass transit usage in Melbourne involved travel to a workplace in central Melbourne and 56 per cent in inner Sydney (Stone & Mees 2011). The type of work in the inner city and the location of work is not necessarily of the type required or desired by people on lower incomes. These people, more commonly, find employment in wholesaling, transport and storage, and retailing: employment sectors that are now dispersed across the middle and, more substantially, the outer suburbs of Melbourne and Sydney. Similarly with other key services to which transport is required. Within middle and inner ring suburbs that were built pre-car, shops and services were provided adjacent to housing and along public transport routes (the strip shopping centres), but post the motor vehicle retail and service areas were built around various forms of standalone malls surrounded by car parks and within walking distance of very little housing.

The argument to this point is, in summary, that for much of the history of Sydney and Melbourne the relationship between housing, public transport, and employment has been one in which lower-income households have been reasonably well served. For a good part of that history, lower-cost rental housing (on which low-income households depend) was reasonably well located with respect to appropriate employment markets. The remaking of labour market and housing markets in the last three of four decades, combined with strategic planning to accommodate the growth of the motor vehicle and disinterest in new public transport infrastructure investment or service patterns, has forced many lower-income households to confront new forms of financial hardship and transport disadvantage.

Private renter households can potentially adapt to housing and transport disadvantage in a number of ways. In the context of ever increasing differences between inner city and outer urban rents the housing adaptations are limited, particularly for families. Singles and couples may be able to find a smaller dwelling but there are limits to how far a family can downsize without risking overcrowding. Consequently, the most likely
adaptations are around travel behaviour. These include (1) shifting travel to other, less expensive transportation modes, for example, car to public transport or public transport to cycling or walking, (2) reducing the total amount of times they travel, and (3) reorganising their travel to increase cost efficiency including car sharing and ‘trip chaining’, that is organising what would have been multiple trips (shopping, doctor, meeting friends, etc.) into the one, (4) combinations of these three (Agrawal et al. 2011). Some of these are more appropriate for some activities, for example shopping, than others, for example getting to work. While others are person dependent in that a person with some physical problems could not try cycling or a person with limited connecters could not organise car sharing. Others are constrained by the problems of some outer areas, for example lack of bike paths, estates designed to limit walking, or simply the lack of alternatives, for example any public transport, to enable adaptations.

While new fixed rail infrastructure will be needed to bring effective public transport to areas of lower-cost rental housing, and with it affordable access to labour markets and essential services the immediate challenge is to create new service patterns for the suburban bus systems of Melbourne and Sydney, something that has historically received very little policy attention in Australia. In terms of the criteria of effective transport system availability, accessibility, timeliness, cost and flexibility only buses have the capacity to bring these criteria to outer suburbs where the population is widely dispersed and low density housing predominant. However, this is not the only potential policy response and as (and if) the low-income transport disadvantage problem worsens over time options such as offsetting the costs of car usage, providing incentives for car sharing, and more and/or different targeting of subsidies for low-income transportation usage, for example large families, the disabled etc. The policy options are discussed in more detail in Chapter 4.

2.6 Australian approaches to alleviating transport disadvantage

Australian public transport agencies in Australian cities typically operate within a rather narrow definition of transport disadvantage that is more about the constraints of physical disability than spatial access and flexibility. For example, the New South Wales Department of Transport (2013), in its Community Transport Program, defines transport disadvantage as circumstances that:

… leave those that are affected by it in a situation where they have limited or no access to private transport and they have difficulty in gaining access to conventional transport systems (www.transport.nsw.gov.au/content/nsw-community-transport-program-ctp).

This definition includes those for whom limits to mobility and access are imposed by physical disability. These people do require specific attention from transport planners, however it is not the focus of this paper which is about transport services designed for people who are sufficiently able-bodied to allow them to reach public transport services on foot (within a notional pedestrian catchment of around 500 metres).

Nevertheless, while not necessarily using the term ‘spatial transport disadvantage’, there has been recognition of the need to have transport policies that recognise the constraint of distance and the inequities and inefficiencies that might create. Such recognition is the principal justification for the high levels of state government subsidies both direct and indirect that funds the operation of a rudimentary ‘safety net’ of fixed route, fixed schedule public transport services of trams and trains. Bus routes which, in principle, provide the greatest opportunity for addressing spatial disadvantage have been much more difficult to subsidise and regulate in a way that
can lead to reform of the historical pattern of low frequencies, slow and circuitous routes, and poor or non-existent evening and weekend coverage.

From 2006, the ALP government in Victoria promised a significant increase in funding for higher service levels on many conventional bus routes with the express intention of addressing social disadvantage. The first commitment was for $650 million over 10 years in recurrent funding for improved frequency and hours of operation on 250 routes (DoI 2006). This was re-announced, two years later, in the Victorian Transport Plan as $500 million over 12 years for a Metropolitan Bus Upgrade (DoT 2008).

Despite this welcome intervention, one of its principal proponents, Professor Graham Currie from Monash University, has pointed to a continuing mismatch between supply and need (2010) and other research on patronage changes following this new investment concluded that to achieve patronage growth ‘routes must operate seven days a week with half-hourly or better service frequencies’ (Loader & Stanley 2009, p.113).

Apart from the fixed route ‘safety net’, the typical policy response of state transport agencies to transport disadvantage is some form of demand-responsive service.

The most common form is ‘Community Transport’. Typically, this is funded by Transport or Community Service Departments with small grants to local governments and community organisations that provide, often with volunteers, ad hoc ‘community buses’ linking residential suburbs and settlements to retail and medical services.

Financial support for such programs is minimal. The Victorian Government Transport Connections Program in 2012 allocated $3.5 million to 88 projects across the state—and many of the funded projects were simply to provide information about existing transport services or training for volunteer drivers. In New South Wales, the 2011–12 state budget announced an increase of $12 million over four years for the Department of Transport’s Community Transport Plan, but the base level of funding was not easy to find.

At the Commonwealth level, ‘transport disadvantage’, in some form, is becoming a mainstream issue. Speaking at the National Press Club in January 2013, the then Prime Minister, Julia Gillard, made specific mention of failings in urban transport systems as a significant cause of increased stress in Australian city life. Although this speech did not include any indication of the Commonwealth’s intentions regarding policy responses, the use of increasing travel times for the journey to work to illustrate the stresses of modern urban life probably indicates the prevalence of this issue in focus groups.

Since the Commonwealth's re-entry into the urban transport arena after 2007, its funding and programs have been largely geared towards construction of new infrastructure on the recommendations of state agencies. This is despite acknowledgment by Infrastructure Australia that this is not the whole story:

> Simply investing in more capacity is not the only requirement ... Public transport is not administered and managed in Australian cities as well as in many cities overseas ... governments need to ensure that public transport meets best practice and is as efficient as possible. ... Public transport administration in Australia could benefit from a more outward looking approach ... now is the time for nationwide reform to improve public transport governance. (IA 2008, p.45)
2.6.1 Housing and transport disadvantage

Public policy linking housing and transport to address spatial disadvantage has never been strong in Australia. If we are looking for reasons for this it may be due to the fact that up to the sixties it was not a major problem given, as discussed in Chapter 2, the historical process of housing and transport development was one which by accident rather than intent located a good proportion of lower-income housing in areas of good transport provision. And it has taken some time for it to be recognised as a problem as the remaking of housing markets and the growing spatial segregation of Australian cities has not been a focus of much urban research nor has it emerged as a political issue forcing a policy response.

State planning and less often housing agencies have developed their own transport recommendations about locating new housing in ways that reduce disadvantages associated with poor transport provision. However, these are more often statements of intent rather than action. Thus, in Victoria, the planning strategy outlines the intent to:

... locate a substantial proportion of new housing in or close to activity centres and other strategic development sites that offer good access to services and transport (DPCD 2013a, Section 1.1).

While that of New South Wales Housing states that:

... housing should either be concentrated in areas close to commercial or employment centres or major transport nodes or should be serviced by regular and efficient public transport (Housing NSW 2013).

In both Sydney and Melbourne and Australia more generally there is limited capacity through the planning system to locate privately provided housing in a way that can address transport disadvantage. One of the most common planning responses as to where housing should be in relation to public transport is to push for the intensification of residential development along major public transport services with the intent that this will provide opportunities for more affordable housing (DPCD 2013a, p.17). This planning principle suffers from three problems. The first is that there are few mechanisms in the planning act to enforce developers to locate along such routes or around activity centres or employment nodes. As illustrated by Newton et al. (2011), developers go where the low hanging fruit is, not to areas where there are difficulties of land assembly and higher land costs. In a case study of Monash, a local Government area of middle ring Melbourne, they found that despite the intent of Melbourne 2030 most new residential development was scattered throughout the suburbs with most being nowhere near public transport or an activity centre.

The second is that even if development did concentrate in such areas the pressures on land values as a result of the intensity of development require the construction of dwellings of a form that maximise yield (one and two-bedroom units) and at a price or rental return that can no way approximate affordability. As argued by Burke and Hayward (2001, pp.301–2) at the time of the implementation of Melbourne 2030, intensification of residential development can undermine rather than be the solution to housing affordability. The outcome of residential intensification is therefore likely to be opportunity for higher-income households to have better public transport access (as they can buy into such areas) but not so lower-income households, and certainly not for families as very little new family accommodation is provided in areas of residential intensification.

The third problem is that location near fixed line public transport does not solve the problem of continued growth on the fringe. While it takes some pressures off such
development a good proportion of new residential development, particularly for families in Sydney and Melbourne, will still be on the fringe and much of it as this paper suggests will be for low to moderate income purchasers and rental. And there is nothing in Australian planning systems to mandate affordable housing in areas of transport accessibility. And, importantly, most rental investment on the fringe is by small investors buying an existing property and for them the investment decision is guided by cost relative to anticipated yield not the wellbeing of tenants.

For social housing provision and affordable housing funded under the National Rental Affordability Scheme (NRAS) the ability to locate housing with reference to transport access is better than for the private sector albeit still constrained. For public housing, that is state-owned and managed social housing, they have the advantage of land ownership accumulated in the growth stage of the 1940s to 1970s and, as Chapter 4 shows, with a sizeable proportion of it in areas of very good to good transport advantage. Most of this land is built on in a dwelling form that does not maximise yield, that is the detached or semi-detached house giving housing agencies potential to substantially increase stock numbers in areas of transport advantage (Murray et al. 2013). Moreover, public housing agencies, as with community managed providers of social housing, tend to be guided by community service obligations in choosing new development sites, one of which is an obligation is to ensure transport accessibility for clients. For example, with respect to the social housing stimulus package introduced to address the global financial crisis the Housing Ministers agreed on a requirement of ‘… locating housing closer to transport, services and employment’.

However, not all social housing providers have land stocks and not all existing social housing land is appropriate for new development, and here social housing agencies face the constant of having to purchase on the open market if they are to grow. And the sites that are best located to public transport are often priced at a premium limiting the potential to facilitate better social and economic participation for tenants through good transport access. Most importantly in a climate of fiscal constraint the amount of new social housing that can be provided will struggle to be of sufficient weight to counter the wider economic forces that shape the location of new low-cost suburban housing development in areas that reinforce transport disadvantage.

### 2.7 New transport policy options

Responses to financial pressures on discretionary spending can lead to changes in travel behaviour. These changes include:

- Shifting travel to cheaper modes, for example, car to public transport or public transport to cycling.
- Reorganising travel to increase cost efficiency including car sharing and ‘trip chaining’ (combining multiple destinations in a single journey).
- Avoiding some trips altogether (Agrawal et al. 2011).

Some of these strategies are more appropriate for some individuals or some trip purposes than for others. For example, disability may restrict the potential for cycling, while limited social connectedness might be a barrier to organising car sharing.

For households in outer suburbs, limiting factors include absence of safe cycling routes, estates that limit walking, or simply the lack of public transport.

It is likely that the problems of low-income transport disadvantage will worsen over time. Potential policy responses will need to be geared to increasing affordable access to labour markets, essential services and social networks for people living in dispersed suburban locations. Some options include financial support for the costs of
car usage; incentives and support for car sharing; and increased or improved subsidies for the transport costs of large families and the disabled. Such social policies are not the focus of this paper. Instead, we wish to bring to the attention of social planners recent research that demonstrates the potential for greatly improved bus services in the suburbs of Melbourne and Sydney.

In the medium to long-term, new fixed rail infrastructure will be needed to bring effective public transport to areas of lower-cost rental housing, but the immediate challenge is to create new service patterns for the suburban bus systems of Melbourne and Sydney, something that has historically, received very little policy attention in Australia.

In terms of availability, accessibility, timeliness, cost and flexibility—key criteria for an effective transport system—only buses have the capacity to bring these criteria to suburbs where densities are relatively low. This theme is explored further in Chapter 4.
3 MEASURING TRANSPORT DISADVANTAGE

3.1 How can transport disadvantage be measured?

Given the many factors that contribute to transport disadvantage and transport poverty, it is difficult to construct a simple measure for these concepts. For example, a Swiss review notes that an individual calculates the cost of travel in terms of both money and time, using factors such as location of desired destinations relative to transport services, relative speeds of public transport and car travel, and the relative cost or availability of a car or a public transport service. An individual is less likely to travel, and so potentially to be at risk of social exclusion, if they score higher on a ‘psychologically weighted sum of travel time, out-of-pocket costs and comfort relative to population average’ (Schoenfelder & Axhausen 2003, p.273). While at one level this conceptualisation sharpens our understanding of travel cost, it is obviously difficult to provide robust values for such a complex measure.

However, better information systems and databases has enabled improved measurement of the costs of spatial segregation. A number of methodological approaches, reflecting the differing backgrounds of researchers, have been used to describe and analyse the processes of socio-spatial segregation and their impacts on disadvantaged groups. Dodson et al. (2006) identified the most important of these as modelling (within the framework of mainstream transport planning); socio-spatial analysis using GIS; and qualitative analysis typically based on surveys and interviews with households and planners.

In Australia, mainstream transport modelling had been used to explore social needs for public transport services, while GIS-based socio-spatial analysis is becoming more widespread. Some qualitative analysis has also been undertaken recently by Delbosc and Currie (2011). This work used a transport model that weighted its ‘origin zones’ by the social characteristics of the population and evaluated ‘need’ in relation to the supply of public transport services. Here, ‘need’ was derived from a combination of the Australian Bureau of Statistics Index of Relative Socio-Economic Advantage/Disadvantage (IRSAD) and a ‘transport needs index’ that combined census data on age, employment and income status and car ownership, and a rough measure of locational disadvantage based on distance from the CBD. Public transport supply characteristics included service frequency (measured in vehicle trips per week) and walking distance to stops or stations. This paper uses a similar methodology but more nuanced in that it focuses on low-income renters, and more importantly, distance is not measured by distance from the CBD (many households work in retailing and service needs that are not in the CBD), but distance to, and frequency of, the nearest accessible transport route.

In this project, a model called Spatial Network Analysis for Multimodal Urban Transport Systems (SNAMUTS), developed by Scheurer (2009), is used to provide a composite indicator of public transport accessibility that measures the performance of existing public transport networks as a means to access jobs and services and social supports. This is then overlaid on locations of public housing and low-cost private rental housing derived from census data in the case of public housing, and from Rental Bond Board data in the case of private rental. The latter is unit record file data from which properties can be located to the address level while the former uses ABS Census Collection Districts to identify areas of high public housing concentration.
3.2 Mapping transport disadvantage: Melbourne and Sydney rental housing—2011

To date the paper has largely been about context. This section provides data to test the question posed in Chapter 1: ‘To what degree have restructured rental-housing markets created or exacerbated transport disadvantage?’

The method, as briefly stated earlier, was to map relative levels of access by public transport in Melbourne and Sydney using the SNAMUTS model (Curtis & Scheurer 2010). This mapping was overlaid on the locations of public housing and low-cost private rental housing derived from the 2011 ABS Census and from 2012 Rental Bond Board data respectively. The former uses ABS Census Collection Districts to identify areas of high public housing concentration, while the latter is based on unit record files from which private rental properties can be located at the address level.

SNAMUTS is a GIS-based tool designed to measure the accessibility provided by existing or proposed urban public transport networks. Accessibility is a multi-faceted concept, not readily packaged into a single indicator. SNAMUTS uses a range of measures, each of which provides ‘insights with which to assess the performance of a public transport network and its correlation to the land-use structure and the geographical distribution of activities’ (Curtis & Scheurer 2010). The measures that are included in SNAMUTS can be varied depending on the research focus and the urban form being looked at. Thus a smaller city or one where the emphasis is on future transport planning will have a different set of component variables and associated metrics.

The composite indicator, used in this research, has three principal components:

- The numbers of transfers, the travel time and the service frequency of existing public transport services required to reach one node in the network from all others.
- The competitiveness of public transport compared with travel by car in congested traffic conditions to and from each node.
- The numbers of residents and jobs within a 30-minute travel time by public transport for any point.

For more details on the structure of the SNAMUTS model and examples of different uses, see Curtis and Scheurer (2010) and Scheurer (2009).

The composite SNAMUTS indicator of accessibility in this study is measured on a scale from 0 to 36. The score for areas for which public transport is not at least at a frequency of 20 minutes on weekdays and 30 minutes at weekends (using the timetables that were current in 2011) is zero. This reflects the inadequacy of public transport services below this level to provide any meaningful access to employment and services. Anything on the scale below five represents poor access, both in terms of the distance from centres of employment and the ability to reach these locations by public transport, 5–15 is marginal, 16–20 is good and anything above 20 is very good.

Appendix 1 describes the principles, assumptions and metrics built into the SMANUTS model.

3.3 Melbourne

Figure 6 below shows the areas of poor accessibility (grey tone) through marginal (light pink), good (dark pink) to very good (bright red) for Melbourne. It broadly shows that the concentration of higher accessibility is in the inner city, but it is worth noting how quickly the level of access falls away, even within the areas served by the pre-war tram network. The radial focus of the public transport system often means that
destinations in adjacent, but tangential, suburbs can be difficult to reach without a car. The fingers of marginal to good access extending into the suburbs generally follow train lines and the recently developed ‘Smartbus’ routes.

**Figure 6: Accessibility by public transport, Melbourne**

Rental Bond Board data overlaid on the SNAMUTS maps of public transport accessibility enables us to identify the degree to which transport advantage is factored into rents. Table 1 shows, for flats and houses of varying size, average rents within each of the SNAMUTS zones.

The association between transport advantage and rents is very strong. For two-bedroom flats (the most common form), the difference between very good transport advantage and poor is $223 a week. For a three-bedroom house, the difference is $335 a week. As there is little difference across Melbourne in terms of quality of construction and dwelling size, the bulk of this difference is explained by transport advantage. Even in inner area and middle rings areas where overall advantage is good to very good there are still significant numbers of properties with poorer access and these suffer the same fate; they are much cheaper than dwellings in locations of transport advantage. These are huge differences, and it is easy to see why lower-income renters are constrained to locate in areas of transport disadvantage.
Table 1: Rent differential by quality of public transport accessibility disadvantage, houses and flats, Melbourne, 2012

<table>
<thead>
<tr>
<th>Public transport accessibility</th>
<th>Flats</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 Bed</td>
<td>2 Bed</td>
<td>3 Bed</td>
<td>4 Bed</td>
</tr>
<tr>
<td>Poor (&lt;5)</td>
<td>200</td>
<td>270</td>
<td>320</td>
<td>370</td>
</tr>
<tr>
<td>Marginal (5–14.9)</td>
<td>260</td>
<td>330</td>
<td>400</td>
<td>520</td>
</tr>
<tr>
<td>Good (15–19.9)</td>
<td>289</td>
<td>395</td>
<td>525</td>
<td>667</td>
</tr>
<tr>
<td>Very Good (20+)</td>
<td>340</td>
<td>493</td>
<td>685</td>
<td>820</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Public transport accessibility</th>
<th>Houses</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 Bed</td>
<td>2 Bed</td>
<td>3 Bed</td>
<td>4 Bed</td>
</tr>
<tr>
<td>Poor (&lt;5)</td>
<td>230</td>
<td>280</td>
<td>315</td>
<td>360</td>
</tr>
<tr>
<td>Marginal (5–14.9)</td>
<td>250</td>
<td>370</td>
<td>380</td>
<td>495</td>
</tr>
<tr>
<td>Good (15–19.9)</td>
<td>291</td>
<td>480</td>
<td>600</td>
<td>752</td>
</tr>
<tr>
<td>Very Good (20+)</td>
<td>350</td>
<td>500</td>
<td>650</td>
<td>820</td>
</tr>
</tbody>
</table>

Source: (1) Unit record files from Rental Bond Board data, properties rented out and bond paid in 2012; (2) SNAMUTS (see Section 3.1)

Using the same method, we can calculate the proportions of private rental dwellings with poor to good transport access for both flats and houses.

Table 2 below summarises the results for all Melbourne and highlights that flats compared to houses have much greater transport advantage with 29 per cent of all flats having very good access but only 5 per cent of all houses. However, reflecting the market shift of low-cost rental dwellings from inner to outer Melbourne, only 10.1 per cent of low-cost flats and 1.6 per cent of low-cost houses have very good transport access. Looked at another way, 42.6 per cent of low-cost flats have poor access, and 77 per cent of houses. It is not surprising, that houses experience a much worse outcome given that most suburban development after 1950 was houses and they were built in the expectation of car use, with no matching public transport service. What is of concern is that the bulk of low-cost rental stock built in the last decade is detached housing and provided in the growth suburbs, where there is effectively zero public transport. The problem of low-income transport disadvantage is a worsening one. Figures 7 and 8 give a visual representation of these findings.

Table 2: Percentage of private rental dwellings in each category of public transport accessibility, Melbourne, 2012

<table>
<thead>
<tr>
<th>Public transport accessibility</th>
<th>All flats</th>
<th>Low cost flats</th>
<th>All houses</th>
<th>Low cost houses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor (&lt;5)</td>
<td>21.2%</td>
<td>42.6%</td>
<td>63.5%</td>
<td>77.1%</td>
</tr>
<tr>
<td>Marginal (5–14.9)</td>
<td>18.0%</td>
<td>23.0%</td>
<td>17.5%</td>
<td>14.4%</td>
</tr>
<tr>
<td>Good (15–19.9)</td>
<td>31.8%</td>
<td>24.3%</td>
<td>14.0%</td>
<td>6.9%</td>
</tr>
<tr>
<td>Very Good (20+)</td>
<td>29.0%</td>
<td>10.1%</td>
<td>5.0%</td>
<td>1.6%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Source: (1) Unit record files from Rental Bond Board data, properties rented out and bond paid in 2012; (2) SNAMUTS (see Section 3.1)
Table 3 and Figure 9 below show the results for public housing in Melbourne and shows that 41.5 per cent of public housing has very good to good access and 39.4 per cent is poor. This is much better than equivalent low cost private rental (10.1% and 42.6%) and is only slightly different to that of all dwellings irrespective or rent. This finding would reflect the fact that the bulk of public stock was built in the 1940s through to the 1970s when it was still possible to find land in reasonable proximity to transport.

There is a real dilemma for public housing, indeed social housing agencies generally, in terms of what these finding represent. Strapped for funds by (a) a funding formal
the national affordable housing agreement (NAHA) that bears no relation to the capital needs of social housing and (b) ever tighter targeting which ratchets up costs. Public and community housing agencies have hard decisions to make in terms of new stock provision. A client-needs model would identify a high number of low-income households in outer areas suffering housing affordability stress. A financial planning exercise would identify that more dwelling can be provided in outer areas as the purchase of construction cost is much cheaper. But, both the client-needs analysis and financial planning are problematic. The client-needs model is tautological in the sense that potential social housing clients are only in these locations as they have little choice about locating anywhere else. The lowest cost provision model does not factor in the fact that purchase of construction in these areas may be imposing higher living costs, notably private transport costs, on households and weakening their ability to seek employment. It is not clear what the right asset strategy for social housing should be in this context!

Table 3: Percentage of public rental dwellings in each category of public transport accessibility, Melbourne 2012

<table>
<thead>
<tr>
<th>Public transport accessibility</th>
<th>All housing</th>
<th>Public housing</th>
<th>All low-cost properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor (&lt;5)</td>
<td>38.8%</td>
<td>39.4%</td>
<td>54.7%</td>
</tr>
<tr>
<td>Marginal (5–14.9)</td>
<td>19.1%</td>
<td>20.2%</td>
<td>20.3%</td>
</tr>
<tr>
<td>Good (15–19.9)</td>
<td>25.6%</td>
<td>26.9%</td>
<td>18.1%</td>
</tr>
<tr>
<td>Very Good (20+)</td>
<td>16.5%</td>
<td>13.6%</td>
<td>7.0%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>100%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Source: (1) ABS Census (2011a) for SLAs with high concentrations of public housing; (2) SNAMUTS (see Section 3.1)

Figure 9: Percentage of public rental dwellings in each accessibility category, Melbourne, 2012

Source: (1) ABS Census (2011a) for SLAs with high concentrations of public housing; (2) SNAMUTS (see Section 3.1)
3.4 Sydney

In Sydney, the pattern of transport disadvantage for both low-cost private dwellings and public housing is slightly different to Melbourne, although the broad pattern is similar. Table 4 below shows that there is significant transport disadvantage for all low-cost accommodation (31.9% of low-cost flats and 80.2% of low-cost houses are in areas of poor accessibility). But, in the case of low-cost flats, the situation is actually considerably better in Sydney than in Melbourne, where 42.6 per cent of these dwellings are in areas of poor accessibility.

In Sydney, 52.1 per cent of all low-cost rental flats are in areas of good to very good accessibility, while in Melbourne the figure is much lower (34.4%). The better Sydney outcome is probably related to the greater density of flat development in Sydney, much of it built in the 1950s and 1970s in the better-located suburbs. By contrast, the situation with low-cost houses is marginally worse in Sydney than in Melbourne (80.2% of these dwellings are in poor locations in Sydney, compared with 77.1% in Melbourne. This is likely explained by the fact that much of the development of new houses in Sydney has been pushed even further out from the CBD and major transport routes than in Melbourne. Figures 10, 11 and 12 below show the data for the respective dwelling types for Sydney in graphic form.

Table 4: Percentage of private rental dwellings in each category of public transport accessibility, Sydney; compared with Melbourne, 2012

<table>
<thead>
<tr>
<th>Public transport accessibility</th>
<th>Flats</th>
<th>Low-cost Flats</th>
<th>Houses</th>
<th>Low-cost houses</th>
<th>All low-cost properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>SYDNEY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor (&lt;5)</td>
<td>18.2%</td>
<td>31.9%</td>
<td>63.3%</td>
<td>80.2%</td>
<td>47.1%</td>
</tr>
<tr>
<td>Marginal (5–14.9)</td>
<td>18.9%</td>
<td>16.1%</td>
<td>12.9%</td>
<td>9.6%</td>
<td>14.5%</td>
</tr>
<tr>
<td>Good (15–19.9)</td>
<td>31.2%</td>
<td>36.5%</td>
<td>16.7%</td>
<td>7.3%</td>
<td>26.9%</td>
</tr>
<tr>
<td>Very Good (20+)</td>
<td>31.7%</td>
<td>15.6%</td>
<td>7.1%</td>
<td>2.9%</td>
<td>11.4%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Public transport accessibility</th>
<th>All flats</th>
<th>Low-cost flats</th>
<th>Houses</th>
<th>Low-cost houses</th>
<th>All low-cost properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>MELBOURNE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor (&lt;5)</td>
<td>21.2%</td>
<td>42.6%</td>
<td>63.5%</td>
<td>77.1%</td>
<td>54.7%</td>
</tr>
<tr>
<td>Marginal (5–14.9)</td>
<td>18.0%</td>
<td>23.0%</td>
<td>17.5%</td>
<td>14.4%</td>
<td>20.3%</td>
</tr>
<tr>
<td>Good (15–19.9)</td>
<td>31.8%</td>
<td>24.3%</td>
<td>14.0%</td>
<td>6.9%</td>
<td>18.1%</td>
</tr>
<tr>
<td>Very Good (20+)</td>
<td>29.0%</td>
<td>10.1%</td>
<td>5.0%</td>
<td>1.6%</td>
<td>7.0%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Source: (1) Unit record files from New South Wales Rental Bond Board data, properties rented out and bond paid in 2012; (2) SNAMUTS (see Section 3.1)
Figure 10: Percentage of private rental flats in each accessibility category, Sydney 2012

Source: (1) Unit record files from Rental Bond Board data, properties rented out and bond paid in 2012; (2) SNAMUTS (see Section 3.1)

Figure 11: Percentage of private rental houses in each accessibility category, Sydney 2012

Source: (1) Unit record files from Rental Bond Board data properties rented out and bond paid in 2012; (2) SNAMUTS (see Section 3.1)
In public housing, as Table 5 and Figure 12 below show, both Sydney and Melbourne have around 40 per cent of public stock in good to very good locations. But, in Melbourne, this outcome is only marginally worse than the situation for all dwellings (of which only 42% have a good/very good result). In Sydney, 50 per cent of all housing is in the good/very good category.

**Table 5: Percentage of public rental dwellings in each category of public transport accessibility, Sydney; compared with Melbourne, 2012**

<table>
<thead>
<tr>
<th>Public transport accessibility</th>
<th>All housing Sydney</th>
<th>Public housing Sydney</th>
<th>All housing Melbourne</th>
<th>Public housing Melbourne</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor (&lt;5)</td>
<td>33.5%</td>
<td>41.6%</td>
<td>38.8%</td>
<td>39.4%</td>
</tr>
<tr>
<td>Marginal (5–14.9)</td>
<td>16.9%</td>
<td>18.8%</td>
<td>19.1%</td>
<td>20.2%</td>
</tr>
<tr>
<td>Good (15–19.9)</td>
<td>26.6%</td>
<td>26.9%</td>
<td>25.6%</td>
<td>26.9%</td>
</tr>
<tr>
<td>Very Good (20+)</td>
<td>23.1%</td>
<td>12.8%</td>
<td>16.5%</td>
<td>13.6%</td>
</tr>
</tbody>
</table>

Total 100% 100% 100% 100%

Source: (1) ABS Census (2011a) for SLAs with high concentrations of public housing; (2) SNAMUTS (see Section 3.1)
Figure 13: Percentage of all public rental dwellings in each accessibility category, Sydney 2012

Source: (1) ABS Census (2011a) for SLAs with high concentrations of public housing; (2) SNAMUTS (see Section 3.1)

Figure 14: Percentage of all public rental dwellings in each accessibility category, Sydney compared with Melbourne

Source: (1) ABS Census (2011) for SLAs with high concentrations of public housing; (2) SNAMUTS (see Section 3.1)
3.5 The potential of SNAMUTS

SNANUTS and Rental Bond Board data has so far been used at aggregated level to draw out broad patterns of transport accessibility for Melbourne and Sydney. However, it can be taken down to much finer levels where its potential to assist in better urban planning and transport decision-making can be seen. The map in Figure 15 below provides a case study municipality of Melbourne (Maroondah, 25 kilometres east of CBD). It shows the location of every single low-cost rental property in that municipality against the index of transport accessibility. While a good number of low-cost rental properties are in the very good to good areas the bulk are scattered throughout the marginal to poor zones. Such data, in principle, could guide state and local governments to encourage/facilitate the development of affordable housing in areas of very good to good transport access, or be used to provide information about appropriate bus routes, particularly if overlaid, as is possible, with information on access to and location of primary and secondary schools, shopping centres and other key services such as health and child care.

Figure 15: City of Maroondah. Location of low-cost rental housing in relation to local area transport advantage, 2012

Source: (1) Unit record files from Rental Bond Board data, properties rented out and bond paid in 2012; (2) SNAMUTS (see Section 3.1)

3.6 Implications for low-income renter households

The implications for low-income renter households have not been explored directly in this paper although some of the obvious implications are likely to be:

→ Reduced employment opportunities.

→ Increased travel costs and accentuation of financial hardship.

→ Potential for increased social disconnectness particularly for non-car-using persons or households.
Reduced access to support services (1) because many are disproportionately located in the inner city and (2) even when in outer areas they are harder to access.

Recent statistical analysis of Melbourne by SGS Planning throws light on the scale of the employment opportunity issue.

Figure 16 below identifies the percentage of jobs accessible within 60 minutes of a public transport trip and shows that in the outer areas where low-income renters concentrated, relatively few jobs are accessible within the 60-minute metric. Within a 45-minute catchment, job accessibility is reduced even more dramatically. Despite the potential costs, even low-income households will choose or be constrained to use a motor vehicle in the absence of public alternatives, but the mismatch between labour markets and residential growth in Melbourne means that even this is problematic.

Figure 16 below shows employment accessibility for motor vehicles using a 30-minute time frame. It shows considerable improvement over public transport but even so, the percentage of jobs available is in the range 0 to 30 per cent compared to 60 per cent in the inner and middle rings suburbs. And for lower-income renters, not all may have access to a car or be able to afford the use of a car. No equivalent data was available for Sydney.
Figure 16: Percentage of jobs accessible within 60 minutes by public transport, Melbourne

Source: SGS Planning & Economics (2012), Yarra Business and Industrial Land Strategy, Background Report, Yarra City Council, using travel time matrices from 2011 ABS census
Figure 17: Percentage of jobs accessible within 30 minutes by car, Melbourne

Source: SGS Planning & Economics (2012), Yarra Business and Industrial Land Strategy, Background Report, Yarra City Council, using travel time matrices from 2011 ABS census
4 TACKLING TRANSPORT DISADVANTAGE

4.1 Limits to locating more low-income housing in areas now offering ‘transport advantage’

The data presented here shows that a marked restructuring of the low-cost private rental housing market has taken place in Melbourne and Sydney over the last three decades or so. The effect has been to locate many lower-income households, particularly in the private sector, in areas where they suffer major transport disadvantage. The broad findings of the research are not new although the focus on renters is. It reinforces, using different data and method, the growing number of studies pointing to the problematic nature of Australia’s outer and fringe areas most of which relate to issues of accessibility. (see Dodson et al. 2006; Hurni 2007; Currie et al. 2009; Delbosc & Currie 2011) The implications of transport disadvantage for lower-income households have been only briefly touched on in this paper. However, the long-term social inclusion consequences of limited access to employment, education and social networks, as well as the costs of ‘forced car’ ownership, are largely self-evident. Current public housing tenants are somewhat better located in relation to access to public transport. However, given the fiscal constraints that public housing agencies are under, the capacity to provide future public housing (or social housing more generally) in areas of high public transport advantage is increasingly limited. This creates a strategic asset management problem for public housing agencies.

Both the pressures of housing market dynamics for the private rental sector and financial constraints on social housing suggest that practical policy solutions, if they exist, lie less in housing interventions than in improving the affordable and accessible transport options in large areas of the outer suburbs of Melbourne and Sydney. As discussed below, recent international experience points to some positive directions in public transport planning that could enable significant improvements in access to jobs, services and social networks at affordable costs primarily through re-structuring of bus routes and schedules.

This suggests that practical policy solutions, if they exist, lie in improving the affordable and accessible transport options in large areas of the outer suburbs of Melbourne and Sydney. Recent research points to some positive directions in public transport planning that could enable significant improvements in access to jobs, services and social networks at affordable costs primarily through re-structuring of bus routes and schedules.

4.2 Better transport options in the suburbs?

As we outlined in Section 2.6, the purpose of this paper is to consider the options for improving public transport as a key means to tackle the twin problems of suburban financial and transport disadvantage. This focus recognises that, even with supportive social policies, many affected households will be unlikely to ever have the resources for the multiple car ownership that is required for full mobility under current transport arrangements, and that distances to services mean that walking and cycling can only be a partial solution.

Internationally, transport planners suggest several options for improving public transport access to jobs and services for people in the suburbs of car-based urban regions (Vuchic 1999). There is a spectrum of alternatives ranging from ‘community transport’ organised largely by social-support agencies to fill gaps in formal public transport services; through ‘demand-responsive’ services such as ‘Dial-a-Bus’, that
are operated by regular public transport providers or taxi companies outside the formal timetable services; to formal ‘route-based’ services.

The scarce resources available in the welfare sector limit opportunities for significant expansion of ‘community transport’ while evaluations of demand-responsive’ services, which are often promoted as an effective alternative in dispersed suburban areas (Cervero 1997; Mageean & Nelson 2003), have demonstrated that they can serve only small niche markets and are rarely cheaper than conventional public transport. (For a detailed analysis of this approach, see Petersen 2011, pp.51–68.)

In Melbourne attempts to tackle transport disadvantage by providing additional bus services in suburban Melbourne have not been encouraging as there has been a fall in average occupancy rates across the whole bus system. However, it is important to note that the new funds for services were used, for the most part, to increase frequency and coverage on disjointed and circuitous routes: an approach that ignored the key elements in the practice used in other cities to improve both efficiency and ridership of suburban bus services.

Understanding the potential for significant but affordable improvements to bus transport in the middle and outer suburbs of Melbourne and Sydney requires a re-assessment of the received wisdom that residential densities in these areas are too low to support anything but sparse and infrequent bus services. The idea that it is impossible to provide attractive public transport at an affordable cost in areas of low residential density took hold in the early 1960s through the influential Chicago Area Transportation Study—the forerunner of the ubiquitous computer-driven urban freeway plans of this era in North America and Australia. (The Chicago Area Transportation Study 1959) This study claimed that it was not possible to cover the costs of bus operations unless net residential densities were above 96 persons per ha. (The Chicago Area Transportation Study 1959, pp.70–71). However, most bus trips in the Chicago urban region were made in a handful of inner suburbs and almost none in other suburbs so that the data misrepresented the city-wide pattern and in fact residential densities across the whole of the Chicago region were mostly well under this supposed minimum. The reality was the spatial disparity in the distribution on bus ridership in Chicago had nothing to do with density and more with political decisions that confined the bus system to the inner city and left the suburbs for motor vehicle use. In keeping with the times, an apparently ‘scientific’ justification for rejecting public transport in favour of the automobile faced no challenges in technical and political circles and this has become part of accepted wisdom in the USA and Australia (Mees 2010, pp.29–31).

Clearly, it is easier to provide effective public transport services when both population density and the density of jobs and other ‘trip attractors’ are high—this is the relationship powerfully illustrated by the hyperbolic curve popularised by Newman and Kenworthy (1999, p.101). But, within the residential densities found across the urban regions of cities in North America and Australia, statistical analysis shows that, despite the received wisdom on the subject, density does not provide a complete explanation for the observed variation in public transport’s share of travel. Figure 18 below shows, for a number of US and Australian cities, the relationship between population density (horizontal axis) and public transport share of all transport modes (vertical axis), and highlights the fact that differences are so great that other factors in addition to density must be important in travel mode. Despite the lack of solid evidence on the relationship, the idea of ‘density as destiny’ has had such a tight hold on policy-makers that there has been limited effort to create public, that is bus transport, that competes with the car in the suburbs of a dispersed city.
Vancouver is, however, one ‘dispersed’ city where politicians and planners have tried over a long period to win back the suburbs from the car with a combination of expanded train and bus provision, but within what is called a network model of provision (Stone 2013). While still a ‘work in progress’, Vancouver’s efforts have borne fruit, and provide some important lessons for Australian cities.

The SNAMUTS model can be adapted to provide some evidence of the effectiveness of Vancouver’s public transport system. Figures 19 and 20 below using the SNAMUTS model show the benchmarking ‘composite index’ of accessibility for the Vancouver and Melbourne urban regions. Both Melbourne and Vancouver results show that the highest levels of accessibility are along rail corridors, but Vancouver achieves ‘average’ and ‘above average’ results in large areas (the bright green areas) at some distance from the railways, largely because of more effective bus provision. And, even in Melbourne’s ‘transport rich’ inner suburbs, accessibility is much lower than many parts of Vancouver’s inner and middle suburbs. It is also instructive that areas of high accessibility in Vancouver do not necessarily correlate with areas of higher residential density and in Melbourne, the majority of the suburban areas that fall below the SNAMUTS minimum service standards have residential densities in density ranges that should provide for viable levels of public transport provision.
Figure 19: SNAMUTS composite index for public transport accessibility, Vancouver 2012

Source: Scheurer 2009
Planning documents from Vancouver show that the key to achieving these enviable results is the explicit intention of planners to exploit the benefits of what is known as the ‘network effect’ (Mees 2000; Nielsen & Lange 2005). The ‘network effect’ is a transport-planning concept that explains the critical non-linear relationship between public transport supply, budget outlay and ridership that we can see in cities like Vancouver.

4.2.1 The ‘network effect’

Public transport is increasingly called on to serve diverse objectives—ranging from providing mobility to the disadvantaged through to alleviating traffic congestion—while making efficient use of financial resources. The challenge for public transport seems daunting. It must cater for travellers with very different needs, ranging from peak-period access to the CBD to all-day access to local shops and community centres. It also needs to provide attractive service frequencies and operating hours for multiple destinations, while maintaining high occupancy rates. Some observers have argued that these trade-offs present an insoluble problem (Roth & Wynne 1982), but the public transport systems of a growing number of cities, including Vancouver, demonstrate that this is not the case.
The essence of public transport, reflected in its name, is carrying people with different trip origins and destinations in the same vehicle. These travellers can then be transported with lower economic and environmental costs than if they travelled separately. This is public transport’s strength, but also its weakness, because people do not all have the same trip origins or destinations.

One approach to diverse travel patterns is to provide separate services for different markets: express buses and trains for peak commuters; regular buses for local trips along busy corridors; ‘demand responsive’ paratransit for low-demand corridors and times. The problem with this approach is that the more public transport becomes tailor-made, the more it surrenders its environmental and economic advantages. A public transport system offering a direct service between every origin and destination would have low frequencies, low occupancies, high costs and high greenhouse emissions per passenger.

The alternative is networks. This approach enables ‘anywhere-to-anywhere’ travel while keeping occupancy rates high, by carrying different kinds of travellers on the same services. Transfers are integral to a public transport system that offers access to a large number of potential destinations at an affordable cost to the operator (Mees 2000; Nielsen & Lange 2005). Traditional public transport planning (in the English-speaking world, at least) has treated transfers as an inconvenience to be avoided at all costs (Balcombe et al. 2005; DfT 2006), but the network approach makes them the building blocks of a multi-destinational system.

Two US researchers have commented on the importance of transfers:

Surveys asking what passengers … dislike about transit find that transferring is at or near the top of the list … (So, traditionally), transfers are avoided, but at the cost of limiting opportunities for travel to non-CBD destinations. In contrast, the multi-destinational approach uses transfers to open travel paths to … destinations that are reachable in radial systems only by lengthy and circuitous travel. (Thompson & Matoff 2003, p.298)

Creating effective transfer-based public transport systems requires careful planning to ensure that the inconvenience is reduced to the minimum possible.

Four key elements underpin the creation of high-quality, transfer-based networks:

1. A simple line structure: simplicity makes the network easier for passengers to understand, and minimises the resources that an operator must provide.

2. Stable line and operating patterns: as well as being simple, a network must also be stable. The idea is to provide a consistent, high-quality service across the network all day, rather than operating different service types in peak, off-peak, night and weekend time periods. Regular feeder services to nodes on trunk routes are a key feature of successful networks, and the spacing of stops is also considered in the technical literature (Nielsen & Lange 2005).

3. Convenient transfers: easy transferring requires attention to timetables and physical facilities. ‘Random’ transfers are possible when all lines serving an interchange point operate frequently, generally every 10 minutes (six departures per hour) or better. ‘Timed’ transfers are needed when services are less frequent, and the timetables for connecting lines must be coordinated (Mees 2010, ch. 8; Nielsen & Lange 2005).

4. Appropriate institutions and fare systems: fare systems must allow free transfers. The pooling of fare revenues is essential for this; and to allow cross subsidies. Melbourne has such a system, while Sydney has struggled over many decades to turn intention to reality (Mees & Groenhart 2012).
Planning on a whole-of-system basis seems to require a single responsible regional agency. A combination of regional planning by a public agency and competitive tendering for services has achieved positive results in London, Copenhagen and Swedish cities. In Australia, these institutional arrangements are in place in Perth, where public transport patronage has grown steadily since the early 1990s (Stone 2009). New agencies established in both Melbourne and Sydney in recent years are steps in the right direction.

In short, planning to create effective networks allows public transport to operate with very much greater elasticities of demand than traditional transport planning would predict. It is this efficiency in the use of scarce resources for public transport service supply that makes it possible for affordable public transport access to be provided in the suburbs of dispersed cities.

4.3 What ‘network planning’ can offer Australian suburbs

Opportunities to implement network planning principles in Melbourne and Sydney have been hampered by decades of perverse competition and poor cooperation between the institutions responsible for different modes, fragmented and largely unregulated private bus operations, and, in Melbourne, the additional distraction of the franchising of train and tram operations in 1999.

Instead of repeating the incremental investment in a fundamentally inefficient system of wandering, irregular and disconnected bus routes (as was done in Melbourne after 2006), significant benefits in service quality and operational efficiency can be achieved if new investment is coupled with the re-organisation of existing bus services into a coherent ‘network’. This network is the best way to support the patronage growth that will, in turn, provide the economic and political case for expansion of the rail system.

It is this practice that offers real hope for reducing transport disadvantage in the suburbs of Melbourne and Sydney. Recent reforms to the public transport agencies in both cities have created the conditions under which new service planning paradigms could flourish.

4.4 Other policy options

Bus network planning is not, however, the only policy response and as (and if) the low-income transport disadvantage problem worsens over time options such as offsetting the costs of car usage, providing incentives for car sharing, and more and/or different targeting of subsidies for low-income transportation usage, for example large families, the disabled, etc., may have to be considered.

The housing, as distinct from transport, policy options are constrained by the limited capacity of the planning system to locate privately provided housing in a way that can address transport disadvantage. As discussed in Section 2.6 one of the most common planning responses as to where housing should be in relation to public transport services is to push for the intensification of residential development along major public transport services with the intent that this will provide opportunities for more affordable housing (DPCD 2013a, p.17). However, this planning principle tends to be undermined by lack of enforcement mechanisms and the fact that designating an area for residential intensification has the effect of pushing up land values such that affordable housing is increasingly precluded. The only apparent way to address these twin and interrelated problems would appear to be some form of mandatory inclusionary zoning requiring developments along public transport routes to include some proportion of affordable housing with the term affordable housing given explicit meaning to prevent it being met by cheaply built studio apartments and/or one-
bedroom flats. Such a focus would mean as suggested by Gurran et al. (2009, p.100) ‘extending Australia’s existing planning reform program beyond its current focus on ‘red tape’ and land release towards a far more explicit agenda for affordable housing inclusion’ in this case as it related to public transport access.

The problem with an inclusionary zoning system, given the fragmented land ownership in Australian cities, is that many sites would not allow for enough units per site for a financially viable inclusionary scheme. For example, a one in 10 inclusionary zoning requirement would exclude developments under 10 units but may also be difficult to achieve for sites in excess of 10 units by virtue of the attributes of the development. One way around this would be to have an affordable permits trading scheme for designated transport access locations whereby every development from two-unit upwards has to purchase from a council a ‘permit’ based on the land value per hectare, for example equivalent to say 10 per cent of the land value and this becomes part of the cost structure of the development. Councils would then build up a bank of permits that could then be given to developers who are committed to building a certain number of affordable units in the designated transport access zone.

Any such scheme, however, would only deal with new builds and the problem with low-cost rental stock is that the investment is mostly made in existing stock not new purpose build investment stock. As the rental yields tend to be higher in more outer areas they are attractive for many investors, hence the growth of rental stock generally and of low-cost stock specifically in such areas. However, it is difficult to think of policy options whereby investors could be required to internalise some of the transport externality costs they are indirectly creating.
5 CONCLUSION

The data presented here clearly shows that a marked restructuring of the low-cost private rental housing market has taken place in Melbourne and Sydney over the last three decades or so and the affect has been to locate many private rental lower-income households in areas where they suffer major public transport disadvantage. Public housing is somewhat better positioned, but given the fiscal constraints that public housing agencies are under the capacity to provide public housing (or social housing more generally) in areas of high public transport advantage is increasingly limited. This creates a strategic asset management problem for public housing agencies (and social housing agencies generally) in that where opportunities to maximise housing outcomes are the greatest, that is where land costs are the lowest, are in those outer urban areas where transport disadvantage is the greatest.

Where for most of Melbourne and Sydney's urban history the poor and lower-income households were located in inner urban areas they are now disproportionately in more outer suburbs. The advantage of such inner urban location was that this was where the transport system was ‘thick’ in both time and space. Where they might have suffered income poverty in these earlier eras they did not suffer significant transport disadvantage. Now they are likely to suffer both income poverty and transport disadvantage and create new areas of spatial disadvantage of a form previously rare in Australia.

The implications for low-income renter households of transport disadvantage have not been explored directly in this paper although some of the obvious implications are likely to be:

- Reduced employment opportunities.
- Increased travel costs and accentuation of financial hardship.
- Potential for increased social disconnectedness particularly for non-car using persons or households.
- Reduced access to support services (a) because many are disproportionately located in the inner city and (b) even when located in outer areas they are harder to access.

The policy responses to this problem are complex and require new paradigms of thought notably around transport provision. First, they require recognition that the major solutions are not with fixed rail or tram systems which although important do not have the flexibility of buses and therefore it is to buses that we must look to for reform. Second, it requires a re-assessment of the received wisdom that residential densities in outer areas are too low to support anything but sparse and infrequent bus services.

Recent research shows that, in the 'dispersed' cities of North America and Australia, residential density is less important as a determinant of public transport performance than the design ‘philosophy’ of transport planners (Mees 2010; Stone & Mees 2010). Instead of incremental investment in new services in a fundamentally inefficient system of wandering, irregular and disconnected bus routes, significant benefits in service quality and operational efficiency can be achieved if new investment is coupled with the re-organisation of existing services into a coherent ‘network’.

Bus network planning is not, however, the only policy response and as (and if) the low-income transport disadvantage problem worsens over time, options such as offsetting the costs of car usage, providing incentives for car sharing, and more and/or different targeting of subsidies for low-income transportation usage, for example, large families, the disabled etc. may have to be considered.
The housing policy options are more limited than those of transport largely because of a residential planning regime that is limited in its capacity to deal with affordable housing and transport disadvantage let alone the relationship between the two.
REFERENCES


Agrawal, A et al. 2011, *Getting around when you’re just getting by: the travel behavior and transportation expenditures of low-income adults*, Mineta Transportation Institute, College of Business, San José State University, San José.


Blumenberg E and Manville M 2004 ‘Beyond the spatial mismatch: Welfare recipients and transportation policy’ *Journal of Planning Literature Vol 19 no 2*


DoI 1998, *From doughnut city to cafe society*, Government of Victoria, Department of Infrastructure, Melbourne.


—— 2013b, *Melbourne 2030. A planning update: Melbourne @ 5 million*, Department of Planning and Community Development, Melbourne.


Housing NSW 2013, NSW local government housing kit, viewed 11 April 2013 http://www.housing.nsw.gov.au/Centre+For+Affordable+Housing/NSW+Local+Government+Housing+Kit/.


IA 2008, A report to the Council of Australian Governments, Infrastructure Australia, Canberra.

Jacobs, K et al. 2010, What future for public housing? A critical analysis, AHURI Final Report no.151, Australian Housing and Urban Research Institute, Melbourne.


Lewis, M 1999, Suburban backlash, Blooming Books, Burwood, Australia.


Logan W 1985 The Gentrification of Inner Melbourne, University of Queensland Press, Brisbane


Murray, S et al. 2013, Design innovations delivered under the nation building economic stimulus plan—social housing initiative, AHURI Position Paper, Australian Housing and Urban Research Institute, Melbourne.


Newton, P et al. 2011, Towards a new development model for housing regeneration in greyfield residential precincts, AHURI Final Report no.171, Australian Housing and Urban Research Institute, Melbourne.


OECD 1979, Transport services in low density areas, OECD, Paris.


Randolph, B & Holloway, D 2007, Commonwealth rent assistance and the spatial concentration of low income households in metropolitan Australia, AHURI Final Report, No 101 Melbourne.

Roth, J & Wynne, G 1982, Free enterprise urban transportation, Transaction, New Brunswick, USA.


SGS Economics & Planning Pty Ltd 2012, Yarra business and industrial land strategy, Background Report, Yarra City Council, Melbourne.


—— 2010, 'Turning over a new franchise: assessing the health of public transport management in Melbourne', 33rd Australian Transport Research Forum, Canberra, ATRF.


—— 2011, 'Spatial distribution of the journey to work by sustainable modes in Australian cities', 34th Australasian Transport Research Forum, Adelaide, ATRF.


The Chicago Area Transportation Study 1959 The Chicago Area Transportation Study final report in three parts Volume 1 pp.70–71 State of Illinois


Victorian Auditor-General 2013, Developing transport and infrastructure services for population growth areas, Victorian Government Printer, Melbourne.

Vuchic, V R 1999, Transportation for livable cities, Rutgers University Press, New Brunswick, NJ.
Wulff, M et al. 2011, Australia’s private rental market: the supply of, and demand for, affordable dwellings, AHURI Final Report no.168, Australian Housing and Urban Research Institute, Melbourne.

APPENDIX: ATTRIBUTES OF SNAMUTS

SNAMUTS is a GIS-based tool to assess the relationship between public transport network configuration, performance and service standards on the one hand, and the geographical distribution or clustering of land use activities across a metropolitan area on the other hand. It is based on a supply-side analysis of the land use-transport interplay and designed to facilitate discussions and decision-making about public transport service and infrastructure improvements as well as about the location and configuration of land use intensification measures.

SNAMUTS breaks down the land use-transport system into a set of activity nodes and route segments derived from the hierarchy of activity centres identified in strategic planning documents, and the location and service standard of public transport routes. In particular, SNAMUTS makes the following definitions:

Minimum service standard: SNAMUTS defines a minimum standard for inclusion of a public transport route into the analysed network. This threshold is based on service frequencies. The SNAMUTS 20 standard requires a service frequency of 20 minutes (or better) during the weekday inter-peak period (about 10.00 to 15.00) and 30 minutes (or better) during the day on Saturdays and Sundays. The SNAMUTS 30 standard requires a service frequency of 30 minutes (or better) during the weekday inter-peak in combination with the operation of the line or route segment in question seven days a week. These levels have been chosen as they reflect the minimum for public transport to be perceived as having a full-time presence and attracting usage for a variety of both planned and spontaneous journey purposes.

Travel impediment: SNAMUTS measures spatial separation, or spatial resistance (a proxy value for distance) by relying on the units that are closest to the public transport user experience, namely travel time and service frequency. Each route segment is labelled with an impediment value consisting of the average travel time divided by the square root of the number of services per hour, separately for each direction, and multiplied by a factor of four to arrive at more readable numbers. The travel impediment (proxy distance) between any two activity nodes on the network is thus made up of the sum of the impediment values on each route segment passed along the path.

From these definitions, SNAMUTS builds a set of six indicators (see Curtis & Scheurer 2010), including:

- **Closeness centrality** describes the ease of movement along the public transport network, in terms of speed and service frequency.
- **Degree centrality** describes the directness of journeys along the public transport network. It is a topological network indicator, measuring the minimum number of transfers between each pair of activity nodes.
- **Contour catchments** measure the combined effect of public transport speed and land use intensity. This index determines the number of residents and jobs within the walkable catchment areas of activity nodes that can be reached within a public transport travel time of up to 30 minutes from the reference node.
- **Speed comparison** measures the competitiveness of public transport against the car. The index determines the travel time ratio between public transport and road travel (in typical congested conditions) for the path between each pair of nodes.
- **Betweenness centrality** captures the geographical distribution of attractive travel paths between each pair of nodes across the network. It shows concentrations of ‘movement energy’ generated by the travel opportunities the network provides, or
in other words, to what extent an activity node is located ‘at the crossroads’ of public transport supply. It essentially identifies those transport routes that will be traversed the most (cumulatively) by journeys between different pairs of centres after all potential journey combinations are considered.

- **Nodal connectivity** measures the strength of each activity node for (multimodal) integration of services. It captures the suitability of activity nodes for making transfers or breaks of journey with minimal disruption to the flow of movement.

- **A composite index** for overall public transport accessibility is compiled from the figures for each of the above six indicators. They are converted to a scale from approximately 0 to 10 to afford them roughly equal weighting. Higher values indicate greater accessibility. The composite index is commonly visualised on a scale map of the metropolitan area, highlighting the geographical catchment areas of each activity node in traffic light colours according to their composite score.
AHURI Research Centres

AHURI Research Centre—Curtin University
AHURI Research Centre—RMIT University
AHURI Research Centre—Swinburne University of Technology
AHURI Research Centre—The University of Adelaide
AHURI Research Centre—The University of New South Wales
AHURI Research Centre—The University of Sydney
AHURI Research Centre—The University of Tasmania
AHURI Research Centre—The University of Western Australia
AHURI Research Centre—The University of Western Sydney