Urban land use transport integration and the vital role for Australia’s forgotten inner/middle suburbs
Policy Paper 5
Urban land use transport integration and the vital role for Australia’s forgotten inner/middle suburbs

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Forward

This research Policy Paper is part of a series of publications aimed at decision and policy makers, academics and students.

This Policy Series focuses on land transport, land use, integrated planning and urban development challenges in Australia. The Policy Series has been developed by the Bus Industry Confederation (BIC) of Australia and the Institute of Transport and Logistics Studies, Business School, University of Sydney, and addresses specific subject matters and issues raised in the BIC’s previous reports: “Moving People - Solutions for a Growing Australia” and “Moving People - Solutions for a Liveable Australia.” Both publications are available at www.ozebus.com.au.

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Executive Summary

Purpose

The productivity of Australia's cities is a key determinant of national economic performance and of associated citizen well-being. The way our cities are structured, and how transport infrastructure and services support this structuring, is an important influence on city productivity outcomes and on how the benefits from productivity growth are shared among residents across the city. This Paper examines how strategic land use transport policy in our major cities can be shaped to both promote productivity growth and better share the benefits from this productivity growth more widely among city residents.

The important inner/middle suburbs

The transport policy focus in Australia's major cities has primarily been on access to/from the CBD, on a small number of major road/PT projects and on meeting access requirements in fringe growth suburbs, where backlogs are common. This Paper seeks to redress the balance somewhat, by highlighting the vital role that can be played by the inner/middle suburbs in enhancing the sustainability of our cities. It suggests that these areas have a key role to play for jointly achieving productivity growth and better sharing of the benefits from this productivity growth across the city, while also supporting reduction of the unwanted external costs of motorised traffic (costs such as congestion, greenhouse gas emissions, air pollution, social exclusion, health costs and accidents). The accessibility of inner/middle areas is fundamental to their capacity to best perform such roles.

Inner/middle urban areas already play a major role in housing, and providing jobs for, people who live in Australia's largest cities. High tech/knowledge-based industries are vital to urban economic growth, job growth and to national economic performance. The centralising tendencies of these sectors means that growth in the knowledge economy is placing pressures on job opportunities accessible to outer urban residents, which are not being offset by opportunities in sectors such as manufacturing. A planning challenge is how to maximise the productivity benefits that are available from expansion of high tech/knowledge-based activities, while ensuring that these benefits are more widely spread across the metropolitan area, including to residents of the growing outer suburbs. Land use transport policy with respect to the inner/middle suburbs is crucial for a better response to this challenge, supporting growth opportunities for high tech/knowledge-based economic activities.

High tech clusters and transit corridors

Our analysis of the drivers of regional economic performance in our largest cities suggests the following conclusions.

1. Regional (city) economic performance, as measured by productivity and access to employment opportunities, can be improved by effective policy and planning, particularly focused on various levers that can support development of high tech/knowledge-based industry clusters, including access thereto.

2. The range of policy areas that interconnect to affect outcomes mean that the use of policy and planning instruments needs to be part of an integrated planning blueprint to achieve desired outcomes.

3. In terms of productivity growth and sharing the benefits from this growth, policy instruments should be utilised which directly and/or indirectly influence:
   - the types of industries that are developed (particularly high tech/knowledge-based industries)
   - where industries are located and their scale
   - the spread and intensity of compact, mixed use, transit oriented developments (around nodes and along major connecting trunk transit corridors)
   - transport system capacities and travel times, particularly to/from and within a small number of inner/middle urban high tech/knowledge-based employment clusters, as well as to the central area and outer suburbs. This needs investment in high quality public transport
   - workforce skills, particularly skills needed to support high tech/knowledge-based industry development
   - social, cultural and community infrastructure provision, which is important in attracting skilled labour and in sustaining liveability more broadly.

4. Policy instruments should be used to influence the capital stock and its distribution across the region, to reinforce desired development patterns and help share the benefits of productivity growth to residents across the wider city. Transport, social and community infrastructure investment are vital in this regard.

5. Policy instruments must continue to support growth of the central/inner activity region and surrounds, which is the core for high tech/knowledge-based industry growth. While the central areas of our cities will remain paramount for high tech/knowledge-based economic activities, the inner/middle suburbs stand out as the best opportunity for accelerated development of a small number of high tech/knowledge-based clusters, based around (for example) leading universities, medical research institutes (sometimes known as ‘eds and meds’) and/or advanced manufacturing. These areas are located sufficiently close to the central area to deliver strong productivity levels and can be connected to outer suburbs by high quality transport links, to enable better sharing of the high end employment opportunities they create and of associated service sector job opportunities.

Circumferential movement to/from these clusters is important to ensuring their vitality, because their catchments will be much wider than can be adequately served by only major radial links. Strong transport links to the centre are also needed. Good connectivity to outer suburbs is important for sharing the productivity benefits from clusters. The major linking transit corridors should become a focus for more intensive transit oriented development. Our major cities already contain some of these clusters (e.g.
Monash precinct in Melbourne; Parramatta in Sydney) and growth of some others should be supported.

From a transport perspective, the heightened focus on clusters in the inner/middle suburbs and on access thereto, including from outer areas, implies a need to ensure that high quality (mainly arterial) road capacity exists to support circumferential operation of cars, trucks and road-based public transport (PT) systems, providing this PT with on-road priority wherever possible, in and through inner and middle (and parts of outer) suburban areas, crossing and supporting radial rail lines (if they exist) and linking with other activity centres.

Vancouver’s experience demonstrates how urban infill in areas close to frequent transit services can be very effective in catering for urban population growth, when planning policies are supportive. A transit oriented development pattern can then create opportunities for value capture, which can be used to support public transport service improvements that help to sustain the development direction. The variability of the likely impacts of improved public transport projects on land value uplifts suggests that annual value capture charges, set at a low rate on all properties across an entire city, may be a good way to pursue value capture associated with a more compact urban structure. The metropolitan improvement levy suggested in the BIC’s Policy Paper 3 fits this purpose well.

Taking the preceding considerations into account, the desirable strategic land use development direction for our largest cities then becomes one seeking more compact settlement patterns, anchored by:

> the CBD and close surrounds
> a small number of high tech/knowledge-based clusters (which should form the basis for a polycentric city and focal points for inner/middle urban area growth)
> major transport corridors that link these core nodes to the centre, to each other and to outer areas
> a series of constituent 20 minute cities (see BIC Policy Paper 4. Increasing densities and improved accessibility of such areas was a theme of that Paper).

This land use development direction should be embedded in integrated strategic long term land use transport plans for our major cities, recognising the need for local nuance. It will support urban productivity growth and better sharing of the benefits of this growth, while helping to reduce the external costs of motor vehicle use in our cities. Appropriately handled, it should also help in the challenge of providing more affordable housing in our cities. Our forgotten inner/middle suburbs have a major role to play in delivering this more sustainable set of urban outcomes.

Supportive strategic transport directions are an essential part of integrated long term land use transport plans. These transport directions include ensuring strong radial public transport to the centre of our cities, good arterial roads across the entire city, fast and frequent trunk public transport services supporting inner/middle urban nodes, particularly for circumferential movement, linked to the cluster (node)/transit corridor development focus, and better public transport connections from outer suburbs to areas of employment/activity concentration, particularly the high tech/knowledge-based clusters. Local public transport access must also be supportive, through delivery of the 20 minute city. Walking and cycling should be accorded higher priority throughout the whole of our cities.
1. Context

1.1 Urban goals and land use transport implications in Australian cities

The preceding four Papers in this BIC series, together with two precursor BIC Moving People reports (Stanley and Barrett 2010; Stanley 2012), have generally started from the value position that a city, or other region, whose land use and transport systems support the following goals is likely to become more sustainable over time.

Goals

1. Increases economic productivity - Increased Gross Domestic Product per capita is the usual indicator, albeit an imperfect indicator of human needs and their satisfaction

2. Reduces ecological footprint – in terms of the concept of passing on a stock of natural assets that will assist future generations to meet their own needs, however conceived at the time

3. Increases social inclusion and reduces inequality – this is about ensuring that all people (in the region) have the opportunity to live a good life

4. Improves health and safety outcomes – an essential part of living a good life

5. Promotes intergenerational equity – this goal is likely to be achieved if the preceding goals are met

6. Engages its communities widely in development and delivery of land use transport plans and policies. Seen as an essential ingredient in social sustainability and a matter of rights

7. Pursues integrated land use transport plans/ policies in the widest sense (e.g., across sectors, levels of government, modes, etc). This is primarily about the means of pursuing goals 1 to 5. It is included as a sustainability dimension in its own right because it is so fundamental to achievement.

Goals 1 to 5 in this list relate to outcome goals, while 6 and 7 relate to complementary process goals for sustainability. With the outcome goals in focus, the BIC’s research has argued that urban transport system development directions for moving people in Australian cities should generally focus on:

- ensuring that adequate trunk public transport (PT) capacity is available to facilitate growth in our central city areas and to support movement around these areas, with complementary walking and cycling opportunities being an important part of this policy bundle. This transport direction is primarily about sustaining the agglomeration economies that are strong in central/inner locations
- giving road use priority to the low impact modes of light rail/tram (where they exist or are being developed) and bus, plus walking and cycling, in central/inner suburbs
- providing sufficient high quality road capacity to adequately support high frequency circumferential operation of road-based PT systems in middle and outer suburban areas, crossing radial rail lines (where these exist) and joining up activity centres/clusters. High quality opportunities for walking/cycling should be provided within and to/from activity centres and clusters
- providing local PT services within neighbourhoods and to/from transport nodes/activity centres at a frequency that helps to facilitate social inclusion. The BIC’s Policy Paper 4 on the 20 minute city explored this area in some detail
- prioritising walking/cycling within neighbourhoods, to support development of more compact settlement patterns (also discussed in Policy Paper 4)
- providing high quality trunk PT services between outer suburbs and the central area as well as to the most proximate employment hubs, ensuring that high quality road/rail capacity (as appropriate) and public transport service levels are in place
- achieving no, or very little, growth in private Vehicle Kilometres of Travel over the long term (the BIC’s Policy Paper 2 explored this point).

The transport policy focus in our cities, however, is typically much narrower, concentrating heavily on access to/from the CBD, on a small number of major road/PT projects and on meeting access requirements in fringe growth suburbs, where backlogs are common. This Paper seeks to redress the balance somewhat, by highlighting the vital role that can be played by inner/middle suburbs of our major cities in enhancing the sustainability of those cities. It suggests that these areas have a key role to play for jointly achieving productivity growth and better sharing of the benefits from this productivity growth across the city, supporting achievement of outcome goals 1 and 3 respectively. This approach will also support reduction of the unwanted external costs of motorised traffic (costs such as road congestion costs, greenhouse gas emissions, air pollution, social exclusion, health costs from a lack of exercise and accidents). In so doing, it primarily provides support for transport development goals 3, 4 and 6 but is also supportive of goals 1, 2 and 7, complementing the support that the BIC’s Policy Paper 4 on the 20 minute city provided to goals 4 and 5. Policy Paper 4 was a bottom up view of urban land use transport policy. This Paper is more top down.
1.3 Report structure

Section 2 of this Paper provides some summary information on the importance of the inner/middle suburbs in our largest cities, in population and employment terms, importance which seems to have been lost in many policy and planning circles. Building the case for the very important role that these areas need to play in coming years, to improve the sustainability of our cities, then requires introducing some macro and micro economic argument. The macro argument is about urban productivity and the differential productivity performance between different parts of our cities, with associated equity implications. Section 3 explores these matters. It does so primarily by drawing on research undertaken by the National Institute of Economic and Industry Research (NIEIR) for Melbourne and Sydney, as part of the strategic land use transport planning being done for those cities. The research suggests ways to enhance our urban productivity and how the benefits of this productivity growth can be shared more widely across our cities.

Section 4 presents a summary micro-economic focus, drawing on the preceding BIC Policy Papers and Moving People Papers and on a recent transport policy textbook co-authored by one of us (Stopher and Stanley 2014). The argument highlights the wide range of market failures associated with urban transport. These market failures include the positive externalities associated with urban productivity growth, which is the subject matter of Section 3. Section 4 talks, in very summary form, of some of the wide range of negative external impacts commonly associated with urban transport, particularly motorised transport, and draws out the main strategic implications for land use transport policy and planning in Australian cities from the analysis. Section 5 presents the report’s conclusions.
2. A spatial challenge linked to the emerging economic geography of Australia's capital cities

2.1 The spatial distribution of population, jobs and productivity growth

Inner/middle urban areas in Australia's major cities play a vital role in housing, and providing jobs for, people who live in those cities. Appendix A provides some data to indicate this importance, using Sydney and Melbourne as reference points. It shows, for example, that while the central area in Sydney, as defined in the Appendix, had almost 20 per cent of Sydney's total population in 2011, the inner/middle and outer areas each accounted for 40 per cent. Melbourne had a much smaller population share in the central area, reflecting Sydney's earlier shift to higher density living close to the centre, but a much bigger share in the inner/middle suburbs, partly reflecting the generally good accessibility of these locations in Melbourne.

Overall, Sydney and Melbourne had almost identical ratios of jobs to population numbers in 2011 (at about 540/1000) but there were some differences in where these jobs were located between the two cities. Sydney's central area (as defined) had over 38 per cent of the city's total jobs, the inner/middle municipalities 35 per cent and 27 per cent were in outer suburbs. Melbourne had a slightly lower share of its jobs in the defined central area but a considerably larger share in the inner/middle suburbs and much lower share in the outer suburbs.

Melbourne's inner south, east and north regions all increased their numbers of jobs relative to population (job density) over the two decades to 2015. The outer south, outer east and west were all fairly stable over the period, with relatively low levels of job penetration, but the outer north lost jobs relative to population, rapid population growth exceeding job growth. Sydney data shows a similar picture, the central/inner area having strong increases in the relative rate of job availability, compared to population. The Sydney Inner Eastern Beaches region also had solid growth in its jobs/population ratio, although this region only accounted for a little over 100,000 jobs in total. Some Sydney regions had substantial declines in the availability of jobs relative to population numbers, particularly Parramatta-Bankstown and Northern Beaches. Parramatta-Bankstown's job growth over the two decades was about ten percentage points slower than its population growth.

The valuable State of Australian Cities 2014–15 report (DIRD 2015) points out that productivity levels generally decline with increasing distance from the centre in Australian cities, reflecting structural economic changes and the varying location patterns of different industry sectors. DIRD points, for example, to the strong growth in business services and long term decline in manufacturing, the former supporting strong central area job growth and high productivity levels, while the latter reduces employment opportunities accessible for outer urban residents. This pattern of declining productivity with increasing distance is shown for Sydney and Melbourne in Figure 3.4 later in this Paper.

Significantly, the gap between the productivity levels in inner and outer areas of Sydney and Melbourne has widened in each city over the two decades to 2012, suggesting increasing inequality. Figures 2.1 and 2.2 illustrate this widening gap. The figures show how productivity levels in each city, where productivity is measured as $Gross Regional Product/hour worked, have changed over the two decades, relative to the median rate of change for the city, with outer areas faring worst. The fastest rates of productivity increase have been in places where high tech/knowledge-based economic activities are increasingly concentrating. Some parts of the outer areas in each city have achieved increases in productivity levels that are in line with the median rate for the city as a whole but most have not.
Figure 2.1: Sydney: Change in deviation about the mean 1992 to 2012 for headline GRP per hour worked

Source: NIEIR
Figure 2.2: Melbourne: Change in deviation about the mean 1992 to 2012 for headline GRP per hour worked

Source: NIEIR
2.2 The important role of high tech/knowledge-based sectors

High tech/knowledge-based industries are those that create, design or utilise complex technologies embodied in capital equipment (such as advanced electronics, computing, robotics or pharmaceuticals) and/or utilise high level skills, with high tech knowledge-based service industries employing a high proportion of professional skills (e.g., financial services, engineering, architecture, software development, tertiary education, health services). Appendix B shows the NIEIR estimate of which Australian industry sectors are predominantly high, medium or low tech. Based on these definitions, NIEIR has estimated the 1992 share of high technology industry value added at factor cost (in total industry value added) in Sydney was 35 per cent, which increased to 43 per cent by 2012. The corresponding figures for Melbourne were 34 and 41 per cent respectively. Assuming a modest multiplier impact from high technology industry activity, in terms of spillover benefits on medium and low technology industry, the total impact of Sydney’s high technology industry growth between 1992 and 2012 is estimated by NIEIR to account for nearly 70 per cent of total Sydney metropolitan area growth in value added. The outcome for Melbourne is similar, where high technology industry employment growth is estimated to explain over 60 per cent of total regional growth between 1992 and 2012. These numbers underline the importance of understanding, in particular, the location determinants of high tech industries and the way planning, infrastructure and other policy levers can be used to promote their development.

While a proportion of high tech/knowledge-based jobs will always be found in outer areas, the benefits of clustering that characterise such jobs means that they will tend to concentrate in the central area, close thereto or in a small number of suburban clusters. The inner/middle suburbs are crucial in responding to the city-wide productivity/equity challenge, as elaborated in Section 3. A related planning challenge, dealt with in the BIC’s Policy Papers 2 and 4, is how to slow the growth of outer suburbs, to minimise risks associated with relatively low job availability in those areas, particularly availability of high productivity jobs, and with the costs of urban sprawl.

2.3 An urban planning challenge

The data presented in Section 2.2 (and elaborated somewhat in Appendix A) reflects, inter alia, the importance of growth in the high tech/knowledge-based economy, the centralising tendencies of many jobs in those sectors, the impact of declining availability of manufacturing jobs in outer areas, the continuing tendency for high population growth in outer areas but a relative increase in the role of inner/middle suburbs in catering for population growth. The latter change improves the jobs/population balance in many parts of our cities but the continued strong growth on the fringe, particularly in Melbourne, remains of concern, given relatively low job availability and low productivity growth in outer areas. Job availability is under pressure in outer urban areas but growing strongly in central and some inner areas.

High tech/knowledge-based industries are the key to urban economic growth and to national economic performance, as outlined in more detail in Section 3. A key urban planning challenge for our cities is how to meet the twin goals of (1) maximizing the productivity benefits that are available from expansion of high tech/knowledge-based activities, while (2) ensuring that these benefits are more widely spread across the metropolitan area, including to residents of the growing outer suburbs. This is the main focus of this Paper, with particular attention to the crucial role of transport system development.
3. The productivity challenge

3.1 Productivity growth

Productivity growth is a major concern for many developed countries. Table 3.1 shows how growth in multi-factor productivity has slowed in Australia, Canada, the UK and the US over the past two decades, with DIRD (2015) reinforcing this point for Australia.

Table 3.1: Average annual growth in multi-factor productivity: 1995-2012 (% p.a.)

<table>
<thead>
<tr>
<th>Period</th>
<th>Australia</th>
<th>Canada</th>
<th>UK</th>
<th>US</th>
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<tbody>
<tr>
<td>1995-2000</td>
<td>1.70</td>
<td>1.13</td>
<td>1.63</td>
<td>1.22</td>
</tr>
<tr>
<td>2001-2006</td>
<td>0.77</td>
<td>0.62</td>
<td>1.48</td>
<td>1.47</td>
</tr>
<tr>
<td>2007-2012</td>
<td>0.03</td>
<td>-0.52</td>
<td>-0.5*</td>
<td>0.83</td>
</tr>
</tbody>
</table>

Note: UK data for this period is for 2007 to 2011.


An extensive body of literature explores links between infrastructure investment and economic output (productivity). Reviewing this literature to 2009, Gwee (2010) concluded that studies generally suggest that a 1 per cent increase in public capital investment is associated with a 0.03 to 0.56 per cent increase in economic productivity (i.e., an output elasticity of 0.03 to 0.56), although some (fewer) studies suggest a weaker relationship and a few suggest higher responsiveness. Recognising this link, many countries are looking to infrastructure investment, particularly transport infrastructure, as one way to stimulate productivity growth. The International Transport Federation recently reported, however, that (ITF 2015, p.1):

... continued economic crisis has had an impact on transport infrastructure investment

*Investment in inland transport infrastructure, as a share of GDP, has declined from a peak in 2009 to a record low (0.8%) in the OECD while the volume of investment has fallen back to 1995 levels.

Deteriorating infrastructure condition, linked to relatively low investment levels, is a likely contributory factor to slowing productivity growth rates.

In Australia, since financial deregulation, there has been a significant decline in transport infrastructure capital stock installed relative to GDP and to non-mining business capital stock. In the mid 1980s, transport infrastructure capital stock, as a ratio to national GDP, was 24 per cent. By the turn of the century it had fallen to 17 per cent and remained at that level until a recovery to 18 per cent in 2012 due, in part, to temporary stimulus expenditures induced by the Global Financial Crisis. This was the average level for the 1990s and 2000s. NIEIR has estimated that, had the transport capital stock to GDP ratio been maintained at mid-1980s levels, $115 billion of additional capital stock would have been installed. With flow-on effects, NIEIR has estimated that this would have increased the annual GDP growth rate by about 0.3 per cent.

Australia’s infrastructure backlog has been estimated at ~$100b by Watt (2014) and ~$150b by Brain et al. (2014). Regional infrastructure shortfalls were also estimated by Brain et al., their analysis suggesting a shortfall of over $50b in each of Sydney and Melbourne, with a small shortfall in Brisbane and Adelaide, relative to both domestic and international best practice. DIRD (2015) points out that metropolitan Sydney and Melbourne are below international levels of labour productivity for similar sized cities. Infrastructure backlogs may be part of the explanation.

An increased infrastructure investment share should be one important part of a strategy to lift Australia’s economic productivity. The way we choose to invest in improving the infrastructure base of our cities will be crucial to outcomes in this regard.

3.2 The ‘Rules’ of Australian capital city economic development

To help ensure that additional infrastructure investment drives better productivity outcomes, with a fair distribution of the benefits associated therewith, it is important to understand (inter alia) the links between such investment and city/region economic performance. This is ultimately about effective project selection. International experience is varied (David et al. 2013; Yang et al. 2015), emphasising the importance of local understanding. In this regard, important LGA level research by Dr Peter Brain and colleagues at NIEIR, summarised below for Sydney and Melbourne, is showing how understanding of the way structural economic changes are affecting Australian urban development patterns can be used to inform better project selection, to support productivity enhancing structural changes. The research is useful for suggesting how our cities can pursue the dual goals of (1) boosting productivity growth and (2) sharing the benefits of this productivity growth more broadly amongst urban residents. The following discussion highlights the main findings from the research. Appendix B provides some brief supporting information.

Rule 1

There is increasing inequity in regional economic performance in Australian cities, with fringe urban areas being at an increasing disadvantage. The greater the distance a sub-region is from the central LGA (of the City of Melbourne or Sydney), the greater the increase in inequality.

Section 2 (Figures 2.1 and 2.2) showed that growth in Gross Regional Product per hour worked has increased much faster in inner Sydney and Melbourne municipalities than in fringe municipalities in those cities and the that gap
has increased with increasing distance from the centre, suggesting relatively declining access to high productivity employment and, in some cases, declining access to hours of work in outer areas. This suggests increasing inequality.

**Rule 2**
The greater the level of economic activity located within a region's catchment, the greater the economic benefit to residents within the catchment.

This ‘rule’ is based on the idea that the level of income received by a region’s households from work is determined by the level of economic activity generated in the region’s catchment, as determined by acceptable travel times. Examination of the relationship between industry economic activity and resident economic activity supports this proposition, the two being highly correlated for both Sydney and Melbourne (Figure 3.1), suggesting that allocating investment to specific regions can be effective in stimulating economic activity in the targeted regions. This suggests that if resident employment is deficient in a given sub-region, then a solution is to either increase employment opportunities within the catchment of the LGA and/or to widen the catchment size, by investing in transport infrastructure to reduce travel time.

**Rule 3**
Cumulative regional investment (the capital stock per capita installed in a region) is a fundamental factor that determines the level of economic activity.

Figure 3.1 demonstrates the strong relationship between construction capital stock installed in an LGA catchment and catchment level of economic activity. Infrastructure investment is thus a core regional development issue. To grow employment and real incomes, regions must grow their capital stock. This suggests potentially high effectiveness of planning instruments that allocate public sector capital directly to regions, using this to influence private sector investment decisions.

**Rule 4**
Increasing the scale of the Metropolitan Area will increase the opportunities to increase overall productivity.

There is vast literature that examines links between city size and productivity. For example, a recent OECD study by Ahrend et al. (2014) suggests that a doubling in city size is associated with a productivity increase of between 2 and 5 per cent. Links have also been demonstrated between urban employment density and productivity. NIEIR has examined the empirical relationship between metropolitan-wide productivity and city size for a number of international cities of up to about 6 million people (Figure 3.3) and for Australia’s capital cities, finding productivity gains towards the high ends of the usual reported range, although the Australian sample size is obviously small. However, the extensive international evidence is strongly supportive of rule 4.

Figure 3.1: Sydney and Melbourne Headline GRP versus resident GRP – LGA Catchment analysis

Source: NIEIR
Figure 3.2: Sydney and Melbourne: Capital stock versus economic activity – 2012: Catchment outcomes on both axes

Source: NIEIR

Figure 3.3: The relationship between city scale and productivity

Source: NIEIR
Rule 5
If the metropolitan area of a major city is to maximise the increase in its productivity, the scale of the central region will have to increase, at least proportionally to the overall increase in Metropolitan scale.

Figure 3.4 shows that the Central City LGAs in Sydney and Melbourne have the highest productivity and that LGAs close to the centre are also generally high in productivity terms. The Central City region in both cities is by far the most important in generating export activity, the core proximate driver of growth. Data for high-tech sectors alone shows a similar pattern (not shown in figure format here). This suggests that urban policy and planning mechanisms designed to allocate economic activity closer to the fringe regions, in terms of sharing the benefits of growth, should take care not to undermine growth in the central region in the process, if the metropolitan area as a whole is to maximise its economic performance. This requires careful balancing. It draws attention to the potentially important role of high tech/knowledge-based clusters in middle suburbs as a means of both lifting urban productivity and better sharing its benefits, provided these clusters have good accessibility to the rest of the city, including outer suburbs.

Rule 6
The capacity to export out of a region is the core proximate driver of economic activity.

There is a strong positive correlation between a region’s share of metropolitan exports in Sydney and Melbourne and its share of economic activity, with the central region being an outlier in both cities. The strong relationship holds even when the central city regions are excluded (figures not included). If this relationship did not hold, then planning strategies to impact development locations would not have much impact, local demand formation being the key mechanism for determining regional development. The relationship suggests a role for planning strategies in influencing the productivity of sub-regions.

Rule 7
The skills of households within each region’s catchment are core drivers of the region’s economic performance.

This point is demonstrated by examining the relationship between the regional concentration of high skilled households and regional economic performance. Regions with a higher level of skilled workers are more productive. The relationship holds for all industries but is particularly strong for high-tech sectors, as shown in Figure 3.5. Improving economic outcomes for residents in part, therefore, requires increasing the skilled household share. If a city is pursuing a polycentric development pattern, based on high-tech/knowledge-based clusters, then skilled residents must be willing to move into the labour market catchments of those clusters if the strategy is to succeed, otherwise it will be difficult to exploit economies of scale and scope to improve living standards.

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2 This has a focus on developing activity densities in a number of major nodes within the metropolitan area, as distinct from a mono-centric development pattern, where the centre is the sole focus for developing an intense activity zone.
Figure 3.4: Sydney and Melbourne productivity versus travel time to Central Sydney in minutes – Individual LGA – 2012

![Graph showing productivity versus travel time to Central Sydney in minutes for Sydney and Melbourne.]  
Source: NIEIR

Figure 3.5: Sydney and Melbourne: Catchment skilled household availability versus high technology industry activity

![Graph showing catchment skilled household availability versus high technology industry activity for Sydney and Melbourne.]  
Source: NIEIR
**Rule 8**
Different industry types have different multipliers (or flow-on impacts) for expansion: high-technology industries have the largest multipliers and, therefore, the greater the concentration of high-technology industry in a region, the better the relative economic performance.

If high-technology industry concentration was not associated with superior regional economic performance, there would be no point in targeting high-technology industry, through a polycentric development approach, to improve a city’s economic performance. Figure 3.6 shows a strong relationship between the economic performance of a region and high-technology industry concentration. If high income employment is to be accessed, residents must have good access to high technology industry employment.

**Rule 9**
High-technology industries require the concentration of high-skilled households within their labour market catchments.

This point is shown by the relationship between household skills available within a labour market catchment of a region and the concentration of high technology industry. Figure 3.7 demonstrates strong empirical relationships for both Sydney and Melbourne. This rule complements Rule 7. If Rule 7 is valid, then the validity of Rule 9 indicates that a mechanism to improve the concentration of skilled households in a region is to encourage high-technology industry activity within the labour market catchment.

**Rule 10**
The main reason why high-technology industries have high multipliers is the importance of scale and scope to productivity in these industries and hence profitability and the capacity to expand. Therefore, the Rule is the greater the scale of high technology industries, the greater will be the productivity.

This Rule complements Rule 8. The positive relationship between productivity and scale is particularly strong for high technology industries, as Figure 3.8 indicates. The validity of Rule 8 helps to establish that high technology industries have relatively high multipliers. The validity of Rule 10 reinforces this by establishing a link between the expansion of high-technology industry and increases in the productivity and profitability of other, and in particular high technology, enterprises within the region and surrounding regions.

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**Figure 3.6: Sydney and Melbourne: Local gross resident product versus high technology employment share – 2012**

Source: NIEIR
Figure 3.7: Sydney and Melbourne: Catchment skilled household availability versus high technology industry activity

Source: NIEIR

Figure 3.8: Sydney and Melbourne: Productivity versus scale for high technology industries – 2012 (Catchment on both axes)

Source: NIEIR
Rule 11

High-technology industries need to cluster in and between regions. Hence, the Rule is that the share of high-technology industry in a region’s economic activity will diminish with distance from the central activity areas of Australia’s major metropolitan areas.

The relationship between the distance of a region from the central activity area of major metropolitan regions such as Sydney and Melbourne, and industry productivity, supports this proposition. Figure 3.4 shows that this relationship is strong for all industries and a similar analysis for high technology industries (not shown) shows the same pattern of declining high-tech activity as distance from the centre increases. In general, the closer a location is to the central region, the higher its productivity. Planning policy needs to ensure that any policy of decentralising (within the city) high-tech/knowledge-based industry away from central regions should be done in such a way that does not undermine the benefits from the continued development of existing high-technology industry clusters and their growth potential.

Rule 12

High technology industries require sustained innovation to be competitive. High-technology industries will prefer to locate where there is strong knowledge-creation infrastructure within a region’s catchment.

This point is demonstrated by the relationship between high-technology industry concentration and the availability of tertiary education, advanced health and advanced business services. This strong correlation is evidenced by Figure 3.9. The Rule is very important for the application of policy instruments because the location of supporting knowledge creation infrastructure involves a number of resource allocation decisions that are under the direct control of the public sector. Thus resource allocation decisions for knowledge-creation infrastructure (e.g., where universities, hospitals, research institutions are placed and their rate of expansion) can help facilitate the concentration of high technology industry activity within a region and positively impact on regional economic outcomes, within the context of the requirements for high tech clustering to realise productivity benefits.

Rule 13

Skilled households locate in regions where strong cultural and community infrastructure is available within the region’s catchment. The thesis is that high-technology industry has to locate within the catchment of where high-skilled households want to reside.

Figure 3.10 shows good correlations between community and cultural infrastructure services and the regional concentration of skilled households. As a consequence, planning instruments that influence the distribution of community (health, education) and cultural (entertainment, recreation) infrastructure services, should also be able to influence the location and scale of high-technology industries, subject again to the need for these sectors to cluster.
Figure 3.9: Sydney and Melbourne high technology industry activity versus knowledge creation industry capacity – 2012

Source: NIEIR

Figure 3.10: Sydney and Melbourne: Skilled household availability versus community and cultural service availability

Source: NIEIR
In summary, then, this analysis suggests the following conclusions.

1. In the absence of policy/planning intervention there is a tendency for increasing inequality between regions, especially between urban fringe regions and regions closer to the centre. The data in Sections 2 and 3 suggests that trends between inner and outer metropolitan Sydney and Melbourne are reflecting this proposition.

2. The scale of the metropolitan region, either as measured by population size or the scale of labour market/ economic catchment of individual sub-regions, as determined by travel times, is a key driver of productivity and the ability of residents to capture hours of work.

3. Some industries are more important and effective, per $m value-added, in driving regional economic development than others. High tech/knowledge-based industries have particular importance, in part because of the importance of economies of scale and scope in driving productivity and profitability and in part because they are innovation-intensive industries, whose innovations tend to benefit a much wider circle of firms and industries than just the businesses undertaking the initial innovation (including firms in other industry sectors).

4. Because of the importance of economies of scale and scope and the indirect benefits which can be captured from innovation by others, high tech/knowledge-based firms want to cluster together, either in the central region or regions close thereto.

5. As a result, if outer regions have poor economic outcomes in terms of hours of work available per working age resident and/or dollars earned per hour of work (as is the case in Australian cities, in relative terms), one important reason for this will be a lack of high-tech/knowledge-based employment opportunities within the labour market catchments.

6. If Point 5 is empirically valid, a plausible strategy to improve the economic performance of outer regions is to enhance and expand high value adding employment precincts within commuting range of these regions, and/or increasing catchment diversity, by reducing travel times and/or increasing catchment population densities (especially in those catchments with the best characteristics in terms of scale and high technology industry activity).

7. The enhancement of high-tech/knowledge-based industry capacity further away from the central area should not come by redistributing activity away from existing or developing precincts. Compared to major cities overseas, the existing high tech/knowledge-based clusters found in Australian cities are of a relatively small scale. It is therefore important that existing clusters, including the central region, are encouraged to expand.

8. A core task of policy and implementation, aimed at increasing productivity and better sharing its benefits among residents across the city, is therefore to implement strategies that will enhance the development of high tech/knowledge-based clusters in the inner/middle regions with net additional resources that do not detract from the growth of the centre and with good accessibility to outer urban regions. This does not deny the importance of local employment creation on the fringe but suggests that this will largely be population serving.

9. For the Rules to work, capital expenditure is the enabler that is necessary to realise the benefits of economies of scale and scope. Transport infrastructure is vital in affecting catchment area productivity and accessibility. Social, community and cultural infrastructure are also vital, for attracting the talented people who work in high tech sectors.

The ‘Rules of Australian capital city development’ are at their strongest when applied at the disaggregated industry level and, in particular, at the high tech/knowledge-based industry level, which are core drivers of regional growth. The local capacity to create high value, knowledge intensive goods and services that are able to export and/or out-compete imports in local markets is a primary driver of local prosperity. The growth of such industries depends on:

- labour catchment reach, with catchment size determined by the quality and quantity of installed transport infrastructure and catchment yield, determined by the skilled households within the catchment
- supporting skills creation and knowledge creation in the catchment (universities, training, research, quality business services)
- the scale and scope of nearby supporting general goods and services industries
- the quality and quantity of supporting commercial infrastructure
- the diversity of life-style and cultural choices, to ensure the long-term commitment of highly skilled workers to the labour market catchment, and
- global connections, both for the export of the product and the maintenance of the knowledge base that goes into continued product development.

The planning instruments by which increases in high tech/knowledge-based activities (leading to increased regional exports) may be pursued include:

- transport infrastructure investment, especially as it affects labour catchment size for a given region
- development of government allocated high tech/ knowledge-based industry capacity (health, education, research), and
- upgrading of the skills of the workforce.

### 3.3 Implications for land use transport policy

The BIC’s Policy Paper 2 (Stanley 2014a) summarises current best practice thinking on land use transport integration, namely that the process should start with a vision of the kind of city that is desired and that transport infrastructure (and services) should then be used as
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one means of helping to assure delivery. Based on the preceding analysis, an efficient strategy to promote the twin goals identified in section 2, of (1) increasing urban productivity and (2) sharing the benefits of this increase more widely among residents across the whole city, given the location determinants of the critical high tech/knowledge-based sectors, seems likely to be one that supports:

- selective support for development of a small number of high tech/knowledge-based clusters in the middle suburbs of our major cities, complementing continued growth of central/inner clusters (i.e. a polycentric city)
- improved connectivity (or accessibility) of these high tech/knowledge-based clusters to each other, to the central/inner area and to outer suburbs. This improved connectivity flows from improved transport infrastructure
- increasing population densities in inner/middle and outer areas and
- supportive provision of social, community, educational, health and cultural infrastructure.

This will both support productivity growth from agglomeration and increase the possibilities for infrastructure savings, by more efficient use of existing infrastructure. This needs case-by-case demonstration to identify the most effective locations for such densification.

The NEIR analysis suggests that there may well be another rule of Australian metropolitan development: that the number of strong high tech/knowledge-based clusters that an Australian metropolitan area should possess for sustainable development is approximately one per million people. If true, there would appear to be little case for Adelaide at present to have more than one strategic node, the CBD. There is a case that Sydney should have at least four, with an additional node established in the South West, and there is also a case for Melbourne to possess four, with growth supporting additional such nodes. This conclusion needs substantiation by further research.

It was suggested earlier in this section that the approach taken by particular cities to meet the twin goals of maximizing productivity growth and sharing the benefits of this growth more widely across residents of the city will differ from city to city and that policy approaches need to be based on city-specific evidence. Recent discussions held by one of the authors in London have highlighted this point. London has examined the case for selective development of additional high tech/knowledge-based clusters outside the central city area but decided against this approach, on grounds of relative cost-effectiveness. Central clusters remain London’s orientation. This difference to the Australian approach suggested above seems likely to be linked, in part, to the spatial spread of disadvantage in London being different to that in Australian cities. Whereas disadvantage tends to increase with distance from the centre in Australian cities, London has large areas of disadvantage in relatively close proximity to the centre, particularly to the east. This is likely to mean the centre will need to play a relatively stronger role in London, in terms of meeting the twin goals. It serves as a warning for Australian cities, however, in terms of the risks of developing non-central high tech/knowledge-based clusters and the importance of understanding your city.

3.4 Polycentric clusters and transit corridors

The idea of the polycentric city as a model for urban development has been around for some time, being recognised (for example) in Sydney’s City of Cities approach. Australian delivery, however, has not been strong, as reflected for Sydney and Melbourne (for example) in maps 4.7 and 4.8 of DIFRD (2015), which show very limited development of major non-central nodes. Also, the basis of the case for an Australian polycentric model, thus far, has not been linked to non-central growth in high tech/knowledge-based clusters so much as to developing and providing access to more general higher order commercial/retail activity centres. The productivity-based argument developed in this Paper adds an important productivity dimension to the existing case for polycentric development.

Vancouver has developed the idea of a polycentric city with a strong focus on transport accessibility but without the high tech/knowledge-based focus proposed above for Australian cities. Nevertheless, Vancouver’s experience is helpful for thinking about Australian land use transport planning strategy. Metro Vancouver’s transport planning agency, Translink, has noted how the city aims to concentrate growth to improve regional accessibility and to do this, inter alia, by clustering origins and destinations in centres (Translink 2010). It points out that such localised density is most effective when well connected to other parts of the region and there is good proximity, or accessibility, between jobs and housing. High density employment clusters with low levels of parking and a good mix of uses, well served by frequent public transport, have been shown to be good for public transport patronage. Translink (2010, p. 4) concludes that:

The strong, clear relationship between employment density and mode choice found in the literature supports the effectiveness of a limited number and efficient distribution of employment clusters for improving metropolitan transit mode share. Regions that generate the highest commuter ridership have a high percentage of regional jobs accessible by frequent transit.

The idea of focusing urban employment growth in clusters is thus good for public transport use, which will help reduce the external costs of car use. The present report has added the important identification of high tech/knowledge-based clusters as a foundation for more self-sustaining polycentric growth in an Australian urban setting. Not all urban employment clusters will be founded this way, of course, many being essentially service centres that are needed for an efficient and equitable city.

Connecting urban employment clusters by frequent public transport, to help extend the productivity benefits to residents more broadly across a city, brings in the idea of increasing densities along those frequent transit corridors, which will increase the numbers of residents with good access to the major clusters, boost public transport use and lower the external costs of car use. This thinking draws on a number of the key built form variables that have been shown to reduce vehicle kilometres of car travel (VKT), as discussed in the BIC’s Policy Paper 2, particularly destination accessibility, density, distance to transit, diversity of land uses, design (for connectivity in the preceding discussion but also for a high quality public realm, suited to walking...
to public transport, as discussed in the BIC’s Policy Paper 4) and demand management (limiting parking supply in the employment clusters and in transit-accessible residential areas). Threshold public transport service levels in the relevant transit corridors will need to be 15 minutes, or preferably shorter, for most of the day (and evening).³

Ontario’s Transit-Supportive Guidelines (OMOT 2012, p. 16) reinforce this point:

Major transit corridors should be planned and developed as medium and high density corridors. They are places to concentrate growth and intensification in immediate proximity to transit.

The idea of complete streets, sometimes called smart streets, has emerged in response to the need to deal with some difficult trade-offs in planning such transit-supportive corridors, which will usually be located along or adjacent to existing arterial roads. Transit supportive development must be both friendly to public transport and pedestrians, must recognise the need for access to existing land uses along the corridor (e.g., for freight deliveries) and deal with road traffic and must include planning for affordable housing. Planning for the corridor should strengthen connections between surrounding areas on either side of the corridor and PT services, while development densities should generally increase as distance to the trunk public transport service(s) reduces. Corridor boundaries would normally be based on a 10 minute walk from PT stops, given that the PT service will be a frequent trunk service (~800 metres), although many transit-friendly cities aim for 500m access limits to frequent services. Section 4.2 includes some additional discussion about transit corridors.

3.4 Implications

Our Analysis of the drivers of regional economic performance in Australia’s largest cities suggests the following conclusions.

1. Regional (city) economic performance, as measured by productivity and access to employment opportunities, can be improved by effective policy and planning, particularly focused on various levers that can support development of high tech/knowledge-based industry clusters and can improve the access thereto.

2. The range of policy areas that interconnect to affect outcomes mean that the use of policy and planning instruments needs to be part of an integrated planning blueprint to achieve desired outcomes.

3. In terms of productivity growth and sharing the benefits from this growth, policy instruments should be utilised which directly and/or indirectly influence:
   - the types of industries that are developed (particularly high tech/knowledge-based industries)
   - where industries are located and their scale
   - the spread and intensity of compact, mixed use, transit oriented developments (around nodes and along major connecting trunk transit corridors)
   - transport system capacities, travel times and frequencies, particularly to/from and within a small number of inner/middle urban knowledge-based employment clusters, as well as to the central area and outer suburbs. This needs investment in high quality public transport
   - workforce skills, particularly skills needed to support high tech/knowledge-based industry development
   - social, cultural and community infrastructure provision, which is important in attracting skilled labour and in sustaining liveability more broadly.

4. Policy instruments should be used to influence the capital stock and its distribution across the region, to reinforce desired development patterns and help share the benefits of productivity growth to residents across the wider city. Transport, social and community infrastructure investment are vital in this regard.

5. Policy instruments must continue to support growth of the central/inner activity region and surrounds, which is the core for high tech/knowledge-based industry growth.

While the central/inner areas of our cities will remain paramount for high tech/knowledge-based economic activities, the inner/middle suburbs stand out as the best opportunity for accelerated development of a small number of clusters, based around (for example) leading universities, medical research institutes (sometimes called ‘eds and meds’) and/or advanced manufacturing. These areas are located sufficiently close to the central area to deliver strong productivity levels and can be connected to outer suburbs by high quality transport links, to enable better sharing of the high end employment opportunities they create and associated service sector job opportunities.

Circumferential movement to/from these clusters is important to ensuring their vitality, because their catchments will be much wider than can be adequately served by only major radial links. Strong transport links to the centre are also needed. Good connectivity to outer suburbs is important for sharing the productivity benefits from clusters. The major linking transit corridors should become a focus for more intensive transit oriented development. Our major cities already contain some of these clusters (e.g., Monash precinct in Melbourne; Parramatta and Macquarie Park in Sydney) and growth of some others should be pursued. Appropriately managed, the associated transit corridors and nodes can also form a useful component of a strategy to provide more affordable housing in our cities (e.g., if linked to measures such as inclusionary zoning and floor space ratio bonuses).

³ Cities such as Malmö in Sweden and Freiburg in Germany, with populations of about 300,000 and 200,000 respectively, and larger Canadian cities such as Vancouver (2.4m population), operate public transport frequencies over much of the day that are much better than this, supported by the more dense settlement patterns proposed in BIC Policy Papers 2 and 4.
4. Developing an integrated transport response for the middle suburbs

4.1 General directions

The urban economic analysis of Section 3 is a story about positive externalities, in economic jargon. For integrated urban policy development, this needs to be complemented by an analysis of the more traditional micro-economic challenges facing our cities, particularly transport challenges in terms of the focus of this Paper. This is primarily about dealing with negative external costs of urban transport, such as congestion, greenhouse gas emissions, air pollution, accidents, obesity, energy security, and also the distributional consequences of transport, particularly as this relates to social exclusion. These negative external costs have been discussed at some length in prior BIC publications, such as Stanley and Barrett (2010) and Stanley (2012), so are not discussed in detail here.

Transport policy responses to these external benefits and costs, within a goal framework as elaborated in Section 1, are increasingly looking to long term land use based solutions, not simply transport responses. In this context, the analysis in Section 3 supports the idea of our largest cities pursuing a polycentric development pattern, founded on high tech/knowledge-based clusters that are well served by trunk transit corridors. The BIC’s Policy Paper 4 argued that, at a neighbourhood level, the ideal should be for our large cities to consist of a series of 20 minute cities or neighbourhoods. The desirable land use pattern for our largest cities then becomes one seeking more compact settlement patterns, anchored by:

- the CBD and close surrounds
- a small number of inner/middle urban high tech/knowledge-based clusters (the basis for the polycentric city and the focal points for inner/middle urban areas)
- major transport corridors that link these core nodes to the centre, to each other and to outer areas
- a series of constituent 20 minute cities (see the BIC’s Policy Paper 4. Increasing densities and improved accessibility of such areas was a theme of that Paper).

Major interstate/international air and sea ports are also very important anchors and, at the next level down, major commercial/retail activity nodes will remain significant. The major associated strategic land use transport development directions are summarised below, drawing partly on research by Ewing and Cervero (2010), Cervero (2014) and on the preceding BIC Policy Papers.

Promotion of agglomeration economies in the CBD/surrounding inner city – this is vital in a global economy, because of the productivity and employment benefits associated therewith, understanding of which has increased substantially in recent years with the growing body of research on wider economic benefits (see, for example, Graham 2007). Section 3 has argued that these productivity benefits are so significant that assuring continued growth in the central/inner core of our cities is vital for the whole city and, by implication, for the wider national economy. In transport terms, supporting the achievement of this land use direction is primarily about ensuring adequate radial trunk public transport capacity available to facilitate activity growth in the central/inner areas and that walking, cycling and public transport supports movement within central/inner areas. Radial road capacity can never hope to adequately serve more than a minor part of the trunk travel demands to the central/inner city efficiently and effectively.

Developing a small number of high-end/knowledge-based clusters (e.g., the Monash cluster; Parramatta; Macquarie Park), to form the nucleus of the non-CBD part of the polycentric city (although knowledge clusters are still, of course, part of the central area, such as the Parkville cluster in Melbourne and Sydney University cluster). To both promote productivity growth and share its benefits across the city, Section 3 has suggested that the successful polycentric knowledge clusters will need to be mainly in the inner/middle suburbs (and, of course, in the central area). Infrastructure NSW has recommended $600m be provided for urban public transport upgrades to improve connectivity to Parramatta and Western Sydney, in addition to $400m provided in the 2014 NSW State Budget (INSW 2014) and PlanMelbourne has designated the Monash Cluster, Latrobe Cluster, Sunshine Cluster and South Dandenong Cluster as National Employment Clusters, the latter drawing partly on NIEIR’s research (DTPLI 2014).

Supporting precinct scale urban renewal – this is focused on increasing the rate of urban infill more broadly than is implied in the preceding point, particularly by unlocking capacity in the most accessible parts of the inner and middle suburbs, such as areas around railway stations, in other inner/middle urban locations where precinctual opportunities exist and/or are likely to arise and along trunk corridors used by the main road-based public transport services. Section 4.2 includes a short discussion of the importance of such corridors.

From a transport perspective, the previous two land use development directions imply a need to ensure that high quality (mainly arterial) road capacity exists to support circumferential operation of cars, trucks and road-based public transport (PT) systems, providing this PT with on-road PT priority wherever possible, in and through inner and middle (and parts of outer) suburban areas, crossing and supporting radial rail lines (if they exist) and linking activity centres. Rail level crossing abolition in Melbourne, for example, is critical to achieving this improved circumferential accessibility, the absence of which would slowly suffocate middle Melbourne’s economic vitality. High frequency trunk PT services should be provided to the polycentric nodes and along circumferential corridors. High quality opportunities for walking/cycling should be provided within and to/from the major nodes. Development density targets should be set for inner/middle urban nodes and transport corridors, as in Toronto, to provide guidance on development intentions.

Planning for a low share of growth on the fringe and providing infrastructure and services in these areas in a timely manner – the larger the city, the smaller the share of population growth that should be on the fringe. Land release needs to be managed in a way that supports early achievement of higher outer area density levels, easing pressure on household budgets for residents who have
lower household incomes, promoting social inclusion, supporting stronger communities and enhancing wellbeing, while lowering the wider community costs of car use, such as congestion, greenhouse gas emissions and accidents.

Improving accessibility for outer urban residents, particularly in growth corridors, to areas of employment concentration and particularly to high tech/knowledge-based opportunities, is vital for the sharing of the opportunities provided by the city. For person movement, this means providing adequate arterial road capacity and high quality trunk PT services between outer suburbs and proximate employment hubs. This will particularly mean improving trunk PT service between outer suburbs and inner/middle suburbs, including the major polycentric nodes, where jobs are most readily available, while also seeking to increase the availability of local services and jobs in growing outer suburbs, to reduce the need to travel. It also requires good local public transport opportunities to link with trunk services, as argued in the BIC's Policy Paper 4.

** Provision of neighbourhood level mixed use activity centres –** this is an issue across the entire city but particularly in outer areas, where lower development densities make achievement of a wide range of local services and other opportunities more difficult to achieve. Higher densities will support increased local activity levels, which will help to facilitate local employment opportunities, social inclusion and stronger local communities. Welcome to the 20 minute city!

As argued in the BIC's Policy Paper 4, a 20 minute city needs to offer most of the services, activities and social infrastructure required to meet essential needs: social inclusion, personal wellbeing, mental health and social equity; a sense of place and belonging; participation and choice; the ability to successfully adapt to external challenges; and the provision of some local employment opportunities. This means aiming for a wide range of activities and land uses within local activity centres, including medium to high-density residential (how high depending on centre size), institutional land uses (e.g., community facilities), entertainment, offices, educational facilities, personal services, social services, recreational facilities, retail and faith-based uses.

Achievement requires integrated approaches to service delivery at local level across a range of sectors, such as education, health, social and community services. It also requires supportive densities. A density level of about 50 residents plus jobs per hectare, or more, will be needed to support achievement of this range of activities within a 20 minute public transport, walking and cycling catchment, and these mode choice opportunities must be available locally. Ontario, for example, has adopted this density target for greenfield development in Toronto.

In the smaller capital cities, radial movement will be relatively more dominant but there is a need to plan for development of future clusters as the city grows, since this does not happen overnight. Circumferential movement upgrades are part of this process, though with less significance than in the largest cities.

**4.2 The important role of transit corridors**

BIC Policy Paper No 2 (Stanley 2014a) argued that increasing density in inner/middle suburbs is a key ingredient in achieving more sustainable Australian cities. This Paper has reinforced that argument. A recent review of population and housing developments in Vancouver and Toronto over 2001-11 is helpful for thinking about how to accomplish such an increase in Australia (Burchfield and Kramer 2015). Both cities have been pursuing urban intensification over this period, one being very successful but the other much less so. Table 4.1 shows that both cities grew strongly over the decade, Toronto adding a million people (+18 per cent) and Vancouver 323,000 (+16 per cent). However, only 14 per cent of Toronto's population growth was in the form of urban intensification (essentially increasing density in existing developed areas), compared to 69 per cent for Vancouver. While 46 per cent of the increase in dwellings in Toronto was in intensification areas, lower dwelling occupancy rates and loss of population in some parts of the intensification areas meant that a very high 86 per cent of Toronto's population growth was in greenfield settings. While there was good growth in dwelling numbers near the frequent transit network (+37 per cent), low dwelling occupancy rates meant that this only accounted for 18 per cent of population growth, some of which is outside the intensification areas (the GO transit network extends to the edge of metro Toronto). Urban centres accounted for a further 13 per cent of population growth.

In contrast, 69 per cent of Vancouver's population growth and 76 per cent of its dwelling growth was in the form of intensification. The similarity between these proportions indicates that dwelling occupancy rates are much closer between intensification and greenfield areas in Vancouver, where there has been greater growth in housing diversity. 50 per cent of Vancouver dwelling growth through intensification was attached, 27 per cent was in apartments of 5 storeys or more and 23 per cent in apartments under 4 storeys. Urban centres added 83,000 people in Vancouver but an additional 352,000 people were accommodated close to the frequent transit network. In short, almost half the population increase in Metro Vancouver, and a little over half the growth in dwelling numbers over the decade, was located close to the frequent transit network (defined as within a 500 metre buffer of local bus and streetcar routes and a kilometre of rapid transit).

Burchfield and Kramer (2015) attribute Metro Vancouver's strong performance in intensification, particularly around the frequent transit network, to factors such as a long history of land use transport co-ordination, including an urban containment boundary and complementary focus on transit corridors and urban centres for growth, and greater alignment between regional priorities and those of local government, because of the governance arrangements in place in the region. Such arrangements support investment and services being located to help facilitate intensification. The Cambie Corridor in Vancouver is a notable addition to the city's transit corridor focus.

Conversely, Toronto's lack of focus on intensification within frequent transit corridors is apparent. While density targets were set for activity centres and greenfield areas in Toronto, to lift densities in those areas, there was not sufficient focus on intensification of transit corridors to achieve a substantial lift in the share of the overall population growth being accommodated in infill locations.
Table 4.1: Comparison of Growth Metrics for the Greater Toronto Area and Hamilton and Metro Vancouver, 2001-11.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Greater Toronto Area and Hamilton</th>
<th>Metro Vancouver</th>
</tr>
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<tbody>
<tr>
<td>Population growth</td>
<td>1,002,050 (+18%)</td>
<td>323,360 (+16%)</td>
</tr>
<tr>
<td>Dwelling growth</td>
<td>461,590 (+23%)</td>
<td>163,290 (+21%)</td>
</tr>
<tr>
<td>Urban area growth</td>
<td>14,990 (+10%)</td>
<td>2,540 (+4%)</td>
</tr>
<tr>
<td>Intensification share</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Population</td>
<td>14%</td>
<td>69%</td>
</tr>
<tr>
<td>- Dwellings</td>
<td>46%</td>
<td>76%</td>
</tr>
<tr>
<td>Urban Centres</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Population</td>
<td>134,560 (+13%)</td>
<td>82,610 (+25%)</td>
</tr>
<tr>
<td>- Dwellings</td>
<td>91620 (+20%)</td>
<td>43,890 (+26%)</td>
</tr>
<tr>
<td>Frequent Transit Network</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Population</td>
<td>181,390 (+18%)</td>
<td>151,530 (+46%)</td>
</tr>
<tr>
<td>- Dwellings</td>
<td>172,820 (+37%)</td>
<td>86530 (+53%)</td>
</tr>
</tbody>
</table>


The relative experiences as between Vancouver and Toronto suggest that transit corridors should be an integral part of the process of urban intensification (increasing densities in existing built-up areas) in Australian cities, as argued in Section 3 of this Paper. Sydney and Melbourne, for example, both have strategic transit networks, in which the inner/middle suburbs feature prominently. Parts of these networks should be designated as key targets for transit oriented development. Particular priority should be given to trunk radial and circumferential transit corridors that connect major knowledge-based clusters, join such clusters to the central city and/or join the clusters to growth corridors, as well as to transit corridors that are already showing strong characteristics of transit oriented development.

4.3 Euclid Corridor

If trunk corridor based transit oriented development (TOD) is to become an increasingly important foundation for the development of more compact Australian capital cities, what do we know about development opportunities that might be associated with such a land use development direction? TOD corridors should support development of the polycentric nodes that they serve but they are also intended to create development opportunities along the trunk corridor. Do they achieve this outcome? With bus rapid transit being the main mode likely to provide trunk public transport in inner/middle areas, particularly circumferential transport, we focus on that mode.

Curitiba, Brazil, is perhaps the polar extreme in such development opportunities, being a linear city dependent on high speed Bus Rapid Transit (BRT), the first systemic application of this technology worldwide. Curitiba’s city-wide linear development model is unique and of little relevance to Australia, where a polycentric focus is generally being pursued. However, development of the Curitiba system did make effective use of development rights bonuses to foster greater density along the BRT corridors, a useful idea for Australian application.

The Euclid Corridor Transportation project in Cleveland, Ohio, is of more relevance to Australia. With a total of 9.38 miles of improvements, the project connects the region’s two largest employment districts, the downtown central business district and University Circle, to the Windermere Rapid Transit Station in East Cleveland. Capital cost was $US200+m and the line opened in 2008. The service provides the usual BRT qualities: increased service frequency, reduced travel time and significant customer amenities. Bike lanes are part of an integrated corridor-based approach. The project includes almost 4 kilometres of bus-oriented street improvements.
in a “transit zone” within downtown Cleveland. The design and construction of the BRT component of the project resulted in the rebuild of the street and sidewalks in areas of operation. Low emission diesel-electric vehicles are used.

This project has stimulated over $US4 billion regeneration along the corridor (together with planting of an additional 1,500 new trees). Reflecting this economic development focus, the BRT component of the project operates as “The HealthLine”, after the purchase of naming rights for 25 years by a consortium of the Cleveland Clinic and University Hospitals, two major health care institutions in the Euclid corridor.

Australia has a number of BRT, and BRT-lite, services already in operation, such as Brisbane’s world-class BRT, Adelaide’s pioneering O-Bahn, Sydney’s transitway services and Melbourne’s SmartBus services. A Cleveland value-add has been an explicit focus on corridor economic development opportunities, linked to high quality bus service between the city’s two major employment nodes, and being able to link this with revenue from the sale of naming rights. Such thinking should be part of the promotion of TOD along Australian trunk transit corridors.

4.4 Value capture opportunities

Focusing urban development increasingly around intensification, within a polycentric/transit corridor framework, opens up opportunities for value capture to help fund PT service improvements. A number of studies have examined links between public transport service provision and property values. Mohammad et al. (2013) present a meta-analysis of studies looking at the impact of rail projects on land and property values, showing that the result depends on a range of factors, such as type of land use, type of rail service, rail system life cycle maturity, distance to stations, geographical location, accessibility to roads, data specification, methodological characteristics, together with whether the affected entity is land or property. While the mean value impact they identified was an 8 per cent gain, these influencing factors mean that there is a large variation in the range of impact values. Some of their findings include the following:

- impacts on land prices tend to be relatively larger than on property prices
- commuter rail has a higher impact than light rail
- value changes tend to be highest at distances from 500-800 metres of a station and may extend to 1000 metres for residential areas and sometimes even further
- closer than 500 metres, negative effects such as noise, pollution and perceived risk of crime offset potential value increases
- impacts extend over shorter distances in commercial areas
- value gains are weaker, or non-existent, when there is a good car alternative (being correspondingly higher in more congested areas).

This work suggests a value capture opportunity but also indicates that it requires a nuanced approach to identify areas where value increases will be achieved and to estimate the likely scale of impact.

Studies on property/land value changes associated with improved bus services in developed countries are relatively rare. Dube et al. (2011) summarise a few relevant analyses and present their own research on a bus rapid transit service in Quebec City. They find that properties in areas of higher residential density, located within walking distance, and far enough away to avoid adverse local amenity impact (as with the findings from rail studies), experienced a significant lift in sale price. Importantly, they found that this lift in value exceeded project cost and that increases in local government revenues on the higher property values were significant. The increases in property values that they measured ranged from 2.9 to 6.9 per cent.

Closer to home, Mulley (2014) has looked at the impact of Sydney’s Liverpool to Parramatta Transitway (LPT) on property values. In terms of improved employment accessibility, Mulley found that, at the mean, a one minute saving in travel time to a local shopping or employment centre added about $1590 to the mean house price across the corridor (0.7 per cent of the mean house price), with localised effects of up to 2.9 per cent. For housing within 100 metres of the transitway, she found a statistically significant reduction in house prices. Overall, her results are slightly smaller than those found for Quebec by Dube et al., Mulley suggesting that the different locations of the respective facilities within their respective cities may have contributed to this result (the LPT being in suburban Sydney but Quebec’s facility serving the central metropolis). Mulley’s localised analysis of impacts shows the difficulty of striking a single charging rate to capture some of the value uplift associated with an improved bus rapid transit service. This perhaps suggests that annual value capture charges, set at a low rate on all properties across an entire city, may be a better approach to value capture than an approach that targets particular individual major projects. The metropolitan improvement levy suggested in the BIC’s Policy Paper No. 3 fits this purpose well (Stanley 2014b).
5. Conclusions

Australia’s capital cities are all seeking to achieve more compact settlement patterns, as an essential element for improving their long term sustainability. The inner/middle suburbs are vital to successful outcomes. This is where most urban Australians live and work but surprisingly little policy focus has been accorded to these suburbs.

This report has argued that polycentric city development, based on further development of a strong central city and small number of inner/middle urban high tech/knowledge-based clusters, supported by strong trunk transit corridors and strong neighbourhoods (the 20 minute city), is the most suitable urban form for our largest cities. Transit oriented development should be focused in these corridors, including around major transit stops. This urban form should deliver significant productivity dividends for our cities, states and nation, and enable better sharing of the benefits of this productivity. It should also reduce congestion costs, deliver a lower ecological footprint, promote social inclusion and provide an opportunity for value capture to help fund associated public transport improvements. An on-going low rate metropolitan improvement levy might be well suited for this value capture purpose.

Supportive transport policies and programs are vital for outcome achievement. This requires strong radial public transport to the centres of our cities, good arterial roads across the entire city, fast and frequent trunk public transport services supporting inner/middle urban nodes, particularly for circumferential movement, linked to the cluster (node)/transit corridor development focus, and better public transport connections from outer suburbs to areas of employment/activity concentration, particularly the high tech/knowledge-based clusters. Local public transport access must also be supportive, through delivery of the 20 minute city. Walking and cycling should be accorded higher priority throughout the whole of our cities.

Vancouver’s experience suggests that governance arrangements, particularly between local governments and between local and state (provincial) government, are crucial to achieving the degree of land use transport integration required to deliver intended land use transport outcomes. Such governance arrangements will be the subject of the BIC’s Policy Paper No. 6.
References


Ontario Ministry of Transportation (2012), Transit-Supportive Guidelines,


Translink (2010), Transit-Oriented Communities: A literature review on the relationship between the built environment and transit ridership, Vancouver: Translink, September.


Appendix A: What’s happening to population and job availability?

The significance of any particular segment of our cities is partly an arbitrary outcome of the way those areas are defined. For the purposes of the initial analysis in this Paper, the following definitions are used:

Central municipalities: Sydney = Sydney City, Woollahra, Waverley, Randwick, Marrickville, Leichhardt, North Sydney, Mosman, Willoughby, Manly; Melbourne = Melbourne, Port Phillip, Maribyrnong, Yarra, Glen Eira.

Inner/middle municipalities are defined those that are located between the preceding group and about 30 kms from the centre: Sydney = Ashfield, Canada Bay, Burwood, Strathfield, Lane Cove, Kuring-Gai, Hunter’s Hill, Ryde, Parramatta, Holroyd, Auburn, Fairfield, Bankstown, Canterbury, Rockdale, Botany Bay, Hurstville, Kogarah; Melbourne = Banyule, Stonnington, Boroondara, Bayside, Brimbank, Darebin, Frankston, Greater Dandenong, Hobsons Bay, Manningham, Moonee Valley, Moreland, Nillumbik, Kingston, Knox, Maroondah, Monash, Whitehorse.

Outer municipalities are defined as those on the edge of the city: Sydney = Pittwater, Warringah, Hornsby, Baulkham Hills, Blacktown, Liverpool, Camden, Campbelltown, Sutherland; Melbourne = Cardinia, Casey, Hume, Melton, Mornington Peninsula, Wyndham, Whittlesea, Yarra Ranges.

Figures A.1 and A.2 show the proportion of Sydney and Melbourne’s population and jobs in 2011 that were located in each of these broad areas. The central area in Sydney, as defined, had almost 20 per cent of Sydney’s total population, with the inner/middle and outer areas each accounting for 40 per cent. Melbourne had a much smaller population share in the central area, reflecting Sydney’s earlier shift to higher density living close to the centre (and a slightly larger defined central area in Sydney), but a much bigger share in the inner/middle suburbs, reflecting the generally good accessibility of these locations in Melbourne (and the defined boundaries of the area). Sydney’s outer area share of population is larger, partly because the municipalities in outer Sydney, as defined, are large.

In terms of jobs, Sydney’s central area had over 38 per cent of the city’s total jobs in 2011, the inner/middle municipalities 35 per cent and 27 per cent were in outer suburbs. Melbourne had a slightly lower share of its jobs in the central area, as defined, but a considerably larger share in the inner/middle suburbs and much lower share in the outer suburbs. The central and inner/middle parts of both cities are thus very important for housing each city’s residents and for providing them with job opportunities.

Overall, Sydney had about 540 jobs per 1000 residents in 2011, as did Melbourne. Figure A.3 shows that Melbourne’s central area was more dominant in employment terms, relative to its considerably smaller population living in that area, but jobs/1000 population ratios across the inner/middle suburbs were strikingly similar in both cities, as they were in the outer suburbs, Sydney having slightly higher ratios in both locations.
Figure A.2: Population and jobs shares in Melbourne by broad area: 2011
(Source: NIEIR data bank)

Figure A.3: Jobs per 1000 population in Sydney and Melbourne: 2011 (Source: NIEIR data bank)
At an individual LGA level, the areas of Sydney’s greatest job concentrations outside the central area, relative to population, were in Botany Bay (1464 jobs/1000 residents), Ryde (810/1000), Strathfield (707/1000) and Parramatta (680/1000), although Parramatta LGA had the largest absolute number of jobs outside the central area (~120,000), about one third higher than Ryde and twice the number in Botany Bay. It is noteworthy that Infrastructure NSW (2014) has proposed investing considerable sums in infrastructure development in the Parramatta area, to promote growth in Sydney’s second city and in the west more generally.

In 2011, the strongest areas for employment in Melbourne’s inner/middle area, relative to population numbers, were Greater Dandenong (732/1000), Monash (662/1000) and Stonnington (607/1000), well above the average ratio of 448 jobs per 1000 residents across all the inner/middle suburbs. PlanMelbourne, the city’s long term land use plan, has designated Monash and Dandenong as two of six proposed National Employment Clusters, which will form core hubs for future growth in employment opportunities (DTPLI 2014). Dandenong has been a major manufacturing hub for many years and Monash is the heart of the south-eastern knowledge economy.

Sydney’s outer area jobs/population ratios in 2011 were a little stronger than Melbourne’s in that year, no outer Sydney LGA having less than 300 jobs per 1000 residents but three Melbourne LGAs having ratios less than 300. Melbourne’s population has been growing by about 80,000 to 100,000 people a year in recent years. Even though their local jobs are relatively scarce, the outer suburbs continue to absorb large numbers of new residents, albeit that the share of growth occurring in these areas has started to decline. However, that declining share still remains a very large number of people needing infrastructure and services, given the high rate of population growth. Melbourne’s inner plus middle suburbs, which in combination are similar to the definitions in this Paper, have started to play a stronger role, reflecting a pattern that occurred earlier in Sydney. Between 2002 and 2004, the percentage share of population growth locating in these areas was in the mid teens but is now about twice that share (30+ per cent).4

Figure A.4 shows the ratio of jobs/1000 residents for Melbourne from 1995 to 2015, using data and regional definitions from NIEIR. The City of Melbourne scale is the right hand side and other regions are scaled on the left hand side. The sharp fall in the Melbourne City ratio over this period mainly reflects the rapid growth in numbers of people living in the City. Job numbers more than doubled over the 20 year period but population trebled, hence the declining jobs to population ratio. This is a reflection of a more balanced central city structure. The three inner regions (south, east and north) all increased their relative job density over the two decades but the ratio has fallen more recently in the inner south, again mainly due to rapid population growth. This again reflects an improved activity mix, with people moving closer to jobs and other urban activities. The outer south, outer east and west were all fairly stable over the period but the outer north lost jobs relative to population. This is also an area of rapid population growth, population numbers increasing by almost two-thirds but jobs growing by about 7-8 percentage points less over the two decades. All outer areas had relatively low levels of job penetration throughout.

4 https://chartingtransport.files.wordpress.com/2012/04/
Figure A.4: Jobs/1000 residents: Melbourne

Source: NIEIR data bank

Figure A.5: Jobs/1000 residents: Sydney

Source: NIEIR data bank
Table A.1 shows that Melbourne’s productivity levels (measured as $/hour worked) were strongest in Melbourne City and in the three inner areas, underlining the importance of the knowledge-economy in these locations. The pattern is similar in Sydney but with Sydney’s levels generally being a bit higher than Melbourne’s. Melbourne’s Outer South, Outer East and West had the lowest productivity levels, while in Sydney the Outer West had the lowest productivity level but this was still higher than the average for most Melbourne regions.

Table A.1: Labour productivity ($/hour worked) in Sydney and Melbourne regions

<table>
<thead>
<tr>
<th>Region</th>
<th>$/hour worked</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2000</td>
</tr>
<tr>
<td>Sydney Central</td>
<td>70.2</td>
</tr>
<tr>
<td>Sydney Eastern Beaches</td>
<td>55.9</td>
</tr>
<tr>
<td>Sydney Northern Beaches</td>
<td>53.5</td>
</tr>
<tr>
<td>Sydney Old West</td>
<td>48.3</td>
</tr>
<tr>
<td>Sydney Outer North</td>
<td>54.0</td>
</tr>
<tr>
<td>Sydney Outer South-West</td>
<td>47.4</td>
</tr>
<tr>
<td>Sydney Outer West</td>
<td>49.0</td>
</tr>
<tr>
<td>Sydney Parramatta-Bankstown</td>
<td>49.5</td>
</tr>
<tr>
<td>Sydney South</td>
<td>50.0</td>
</tr>
<tr>
<td>Melbourne City</td>
<td>60.5</td>
</tr>
<tr>
<td>Melbourne Eastern Inner</td>
<td>44.9</td>
</tr>
<tr>
<td>Melbourne Eastern Outer</td>
<td>39.9</td>
</tr>
<tr>
<td>Melbourne Northern Inner</td>
<td>41.7</td>
</tr>
<tr>
<td>Melbourne Northern Outer</td>
<td>41.2</td>
</tr>
<tr>
<td>Melbourne Southern Inner</td>
<td>44.7</td>
</tr>
<tr>
<td>Melbourne Southern Outer</td>
<td>39.7</td>
</tr>
<tr>
<td>Melbourne West</td>
<td>46.9</td>
</tr>
</tbody>
</table>

Source: NIEIR data bank.

The State of Australian Cities 2013 report (DIRD 2013) notes falling manufacturing employment in outer suburbs of major Australian capital cities (defined more broadly than in the current report and thus including part of what this report calls middle suburbs), pointing out that this has not been offset by increases in other types of jobs that are traditionally found in these areas (retail, construction and transport and logistics). The data set out above confirms this for Sydney and Melbourne. DIRD makes the concerning observation that, between 2006 and 2011, there was virtually no net growth in private sector employment in Western Sydney, job growth being almost exclusively in the public sector (mainly in the health and community services industry). It further indicates that this changed trend in terms of jobs in middle and outer suburbs has not been accompanied by a change in the trend of settlement patterns in Australian major cities, population growth continuing to remain strong on the edges of most cities. The Melbourne data summarised above reflects this conclusion but is a little more optimistic, in terms of the stronger role now beginning to be seen in inner/middle suburbs for population growth.

The summary data presented above reflects, inter alia, the importance of growth in the knowledge-based high tech economy, the centralising tendencies of many jobs in those sectors, the impact of declining availability of manufacturing jobs in outer areas, the continuing tendency for high population growth in outer areas but a relative increase in the role of inner/middle suburbs in catering for population growth. The latter change improves the jobs/population balance in many parts of our cities but the continued strong growth on the fringe, particularly in Melbourne remains of concern, given relatively low job availability. This is a reason for pursuing higher rates of urban infill as a policy objective. The present report sees the inner/middle suburbs as crucial to easing such emerging growth pressures.
Appendix B: Data used in NIEIR modelling

All data for Sydney-Melbourne is Local Government Area (LGA) based. The headline gross regional product (GRP), productivity (or GRP per hour worked) and industry employment indicators all apply to the level of economic activity generated within an LGA boundary. The word ‘resident’ applied to the same indicators represents the capture of the indicator by the residents of an LGA, irrespective of source. Clearly, employment and hours of work achieved by residents of an LGA will be sourced from across a number of LGAs.

From the resident perspective, what is important is not so much their own LGA so much as those LGAs that the resident can effectively access, represented by the labour market and economic catchment of the residents of a given LGA. For a given LGA the catchment is defined in the present paper terms of the following. Those LGAs that can be accessed within a 20 minute travel time receive a weight of 1. Those LGAs that can be accessed within a 20 to 70 minute travel time receive a weight which declines in accordance with the pattern in Figure A.1.

Figure B.1: Catchment weights

The NIEIR database contains 2-digit ANZSIC industry series for employment hours of work, sales, exports, gross product, etc. In terms of the indicators presented in this study, the industry classification is either ‘high technology’ or ‘all industry’. Table A.1 classifies the list of 2-digit ANZSIC industries as either high technology, medium technology or low technology industries. The indicators presented for high technology industries are the result of summing the individual 2-digit high technology industries. The central region referred to is the City of Melbourne or Sydney LGA.
Table A.1: The grouping of industries into low, medium and high technology

<table>
<thead>
<tr>
<th>Industry</th>
<th>Tech classification</th>
<th>Industry</th>
<th>Tech classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>M</td>
<td>Accommodation</td>
<td>L</td>
</tr>
<tr>
<td>Aquaculture</td>
<td>M</td>
<td>Food &amp; beverage services</td>
<td>L</td>
</tr>
<tr>
<td>Forestry &amp; logging</td>
<td>L</td>
<td>Road transport</td>
<td>L</td>
</tr>
<tr>
<td>Fishing, hunting &amp; trapping</td>
<td>M</td>
<td>Rail transport</td>
<td>L</td>
</tr>
<tr>
<td>Agriculture, forestry &amp; fishing support services</td>
<td>H</td>
<td>Water transport</td>
<td>L</td>
</tr>
<tr>
<td>Coal mining</td>
<td>M</td>
<td>Air &amp; space transport</td>
<td>L</td>
</tr>
<tr>
<td>Oil &amp; gas extraction</td>
<td>M</td>
<td>Other transport</td>
<td>L</td>
</tr>
<tr>
<td>Metal ore mining</td>
<td>M</td>
<td>Postal &amp; courier pick-up &amp; delivery services</td>
<td>L</td>
</tr>
<tr>
<td>Non-metallic mineral mining &amp; quarrying</td>
<td>M</td>
<td>Transport support services</td>
<td>M</td>
</tr>
<tr>
<td>Exploration &amp; other mining support services</td>
<td>H</td>
<td>Warehousing &amp; storage services</td>
<td>L</td>
</tr>
<tr>
<td>Food product manuf.</td>
<td>M</td>
<td>Publishing (except internet &amp; music publishing)</td>
<td>H</td>
</tr>
<tr>
<td>Beverage &amp; tobacco product manuf.</td>
<td>M</td>
<td>Motion picture &amp; sound recording activities</td>
<td>H</td>
</tr>
<tr>
<td>Textile, leather, clothing &amp; footwear manuf.</td>
<td>M</td>
<td>Broadcasting (except internet)</td>
<td>H</td>
</tr>
<tr>
<td>Wood product manuf.</td>
<td>M</td>
<td>Internet publishing &amp; broadcasting</td>
<td>H</td>
</tr>
<tr>
<td>Pulp, paper &amp; converted paper product manuf.</td>
<td>M</td>
<td>Telecommunications services</td>
<td>H</td>
</tr>
<tr>
<td>Printing (including reproduction of recorded media)</td>
<td>M</td>
<td>Internet service providers, web search portals &amp; data processing services</td>
<td>H</td>
</tr>
<tr>
<td>Petroleum &amp; coal product manuf.</td>
<td>H</td>
<td>Library &amp; other information services</td>
<td>H</td>
</tr>
<tr>
<td>Basic chemical &amp; chemical product manuf.</td>
<td>H</td>
<td>Finance</td>
<td>H</td>
</tr>
<tr>
<td>Polymer product &amp; rubber product manuf.</td>
<td>H</td>
<td>Insurance &amp; superannuation funds</td>
<td>H</td>
</tr>
<tr>
<td>Non-metallic mineral product manuf.</td>
<td>M</td>
<td>Auxiliary finance &amp; insurance services</td>
<td>H</td>
</tr>
<tr>
<td>Primary metal &amp; metal product manuf.</td>
<td>M</td>
<td>Rental &amp; hiring services (except real estate)</td>
<td>L</td>
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<tr>
<td>Fabricated metal product manuf.</td>
<td>H</td>
<td>Property operators &amp; real estate services</td>
<td>L</td>
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<tr>
<td>Transport equipment manuf.</td>
<td>H</td>
<td>Professional, scientific &amp; technical services (except computer system design &amp; related services)</td>
<td>H</td>
</tr>
<tr>
<td>Machinery &amp; equipment manuf.</td>
<td>H</td>
<td>Computer system design &amp; related services</td>
<td>H</td>
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<tr>
<td>Furniture &amp; other manuf.</td>
<td>M</td>
<td>Administrative services</td>
<td>M</td>
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<tr>
<td>Electricity supply</td>
<td>M</td>
<td>Building cleaning, pest control &amp; other support services</td>
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<td>Gas supply</td>
<td>M</td>
<td>Public administration</td>
<td>M</td>
</tr>
<tr>
<td>Water supply, sewage &amp; drainage services</td>
<td>M</td>
<td>Defence</td>
<td>L</td>
</tr>
<tr>
<td>Waste collection, treatment &amp; disposal services</td>
<td>M</td>
<td>Public order, safety &amp; regulatory services</td>
<td>L</td>
</tr>
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<td>Building construction</td>
<td>M</td>
<td>Preschool &amp; school education</td>
<td>M</td>
</tr>
<tr>
<td>Heavy &amp; civil engineering construction</td>
<td>M</td>
<td>Tertiary education</td>
<td>H</td>
</tr>
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<td>Construction services</td>
<td>M</td>
<td>Adult, community &amp; other education</td>
<td>H</td>
</tr>
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<td>Basic material wholesaling</td>
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<td>Hospitals</td>
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</tr>
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<td>Machinery &amp; equipment wholesaling</td>
<td>L</td>
<td>Medical &amp; other health care services</td>
<td>M</td>
</tr>
<tr>
<td>Motor vehicle &amp; motor vehicle parts wholesaling</td>
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<td>Residential care services</td>
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</tr>
<tr>
<td>Grocery, liquor &amp; tobacco product wholesaling</td>
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<td>Other goods wholesaling</td>
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<td>Sports &amp; recreation activities</td>
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<td>L</td>
<td>Gambling activities</td>
<td>L</td>
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<tr>
<td>Food retailing</td>
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<td>Repair &amp; maintenance</td>
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<tr>
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<td>Personal &amp; other services</td>
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<td>Non-store retailing &amp; retail</td>
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<td>Private households employing staff &amp; undifferentiated goods</td>
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<tr>
<td>commission based buying</td>
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Policy Paper 5
Urban land use transport integration and the vital role for Australia’s forgotten inner/middle suburbs

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