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Cities

**Population growth, jobs growth
and commuting flows in Sydney**

Bureau of Infrastructure, Transport and Regional Economics

Population growth, jobs growth and commuting flows in Sydney

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Foreword

This report identifies recent spatial changes in employment and the residential population within Sydney, and investigates how commuting behaviour has responded to these changes. It provides evidence about recent spatial development trends in Sydney, and compares the reality of those trends to the strategic direction for the city's growth set out in the NSW Government's recent Metropolitan Strategies.

The paper is part of a broader research project on population, employment and commuting change in Australia's largest capital cities, being undertaken by the Bureau's Cities Research team. Reports have already been released for Perth and Melbourne. The Sydney report was authored by Dr Catharina Williams, Leanne Johnson, Jack McAuley and Anatoli Lightfoot.

Gary Dolman
Head of Bureau
Bureau of Infrastructure, Transport and Regional Economics
October 2012

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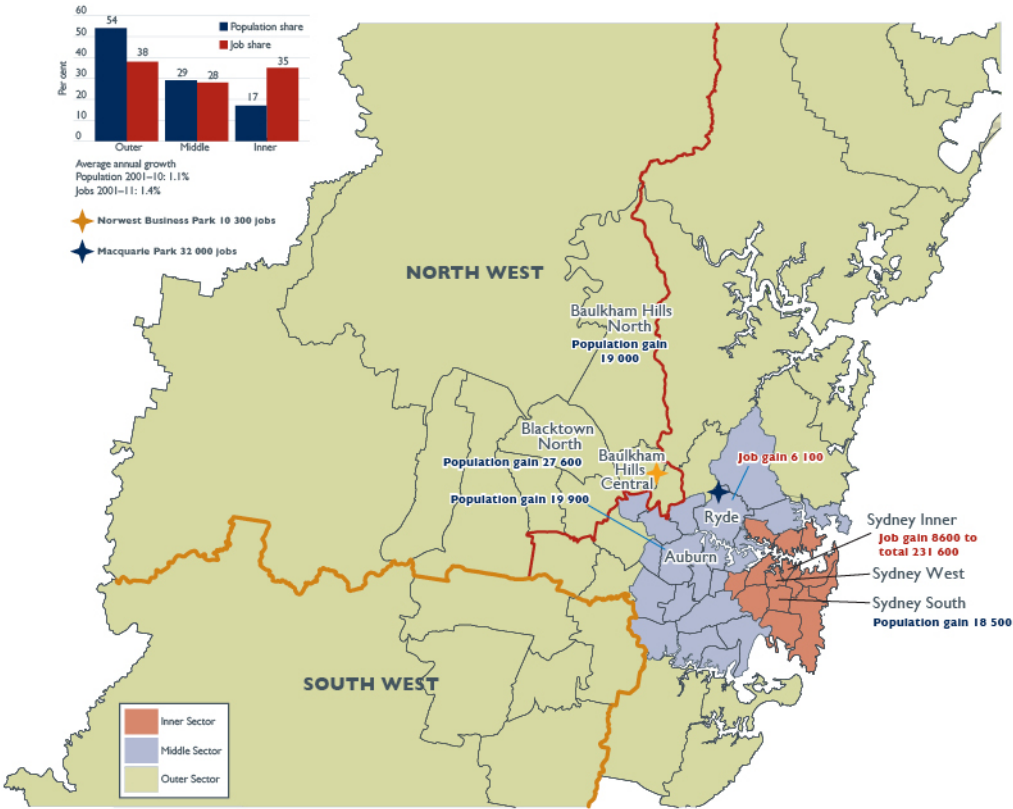
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While BITRE is grateful for the assistance provided by these individuals and organisations, the views expressed in this report are those of BITRE, and should not be attributed to any other individual or organisation.

At a glance

- This report is the third in a series of investigations into spatial changes in population, jobs and commuting in our largest cities.
- Sydney's population grew by 447 000 persons from 2001 to 2010 to reach 4.6 million, at an annual growth rate of 1.1 per cent. Much of the increase occurred in established suburbs, with 81 per cent of new housing development located within the existing urban area. The main growth locations were the Outer sector Statistical Local Areas (SLAs) of Blacktown North and Baulkham Hills North, Auburn in the Middle sector and Sydney South in the Inner sector (the over page map presents sector and relevant SLA boundaries).
- Sydney's employment grew by 1.4 per cent per annum from 2001 to 2011, which was well below the national growth rate of 2.3 per cent. There was a gain of 47 300 jobs in Sydney from 2001 to 2006, with 35 500 jobs added in the Outer sector (including 16 300 in the North West subregion). The key job growth locations of Sydney Inner, Ryde, Sydney West and Baulkham Hills Central, each added between 5000 and 9000 jobs. The specialised centres of Macquarie Park and Norwest also made important contributions to job growth.
- Commutes in an inward direction (38 per cent) dominate those in an outward direction (8 per cent), while 44 per cent of commutes are within the home subregion. Outward commutes grew most rapidly from 2001 to 2006 (1.6 per cent per annum). Inward commutes had subdued growth (0.3 per cent).
- There was little change in the average commuting distance from 2001 to 2010 (+0.3km), and a 1.6 minute rise in the average duration of a commuting trip.
- Gravity model regression analysis reveals that the spatial distribution of residents and jobs explains about 75 per cent of the current pattern of commuting flows between SLAs in Sydney. The spatial growth in residents and jobs explained about 40 per cent of the *change* in commuting flows between 2001 and 2006. Expansions to Sydney's motorway network also explained some of the changes in commuting patterns.
- The NSW Government projects that two-thirds of Sydney's forecast 1.7 million population increase from 2006 to 2036 will occur in the Outer sector; while 52 per cent of job growth will be in the Outer sector. These spatial projections imply substantial increases in Outer sector commuting flows, particularly in flows within the South West and North West subregions.
- The *Metropolitan Plan for Sydney 2036* sets out the strategic direction for the future growth of the metropolitan area. It is an extension and update of the 2005 metropolitan strategy—*City of Cities*—and retains a similar set of objectives. Some progress has been made against most of the relevant strategic planning goals since 2001. For example, there was good progress in increasing residential densities and focusing job growth in strategic centres, and the targets for limiting urban sprawl were exceeded. There was also some progress in increasing the active transport and public transport mode shares of commuter travel. However, there was a shift towards Sydney residents working a little further away from home between 2001 and 2010.

Map of sectors, selected subregions, Statistical Local Areas and centres in Sydney



Note: Population gains for SLAs relate to 2001 to 2010; Job gains for SLAs relate to 2001 to 2006.

Source: BITRE analysis based on 2006 Australian Standard Geographical Classification boundaries, ABS *Census of Population and Housing* 2001, 2006, ABS (2011a, 2011c), TDC (2008b).

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Executive summary

This report is the third in a series of reports which identify recent spatial changes in employment and the residential population within Australia's largest capital cities and investigate how commuting behavior has responded to these changes. The previous reports examined Perth (BITRE 2010) and Melbourne (BITRE 2011).

The principal aim of this study is to identify recent spatial changes in population, employment and commuting in Sydney, with a view to providing a solid evidence base about the trends that have been shaping the city in recent years. A secondary aim is to investigate the extent to which there has been progress in reshaping the city's spatial development and commuting patterns in the direction envisaged by recent Metropolitan Strategies. Understanding change in the spatial form of cities can assist in formulating urban policy and inform infrastructure investment decisions.

The analysis is focused on the Sydney Statistical Division (SD), but also considers the broader Greater Metropolitan Area (GMA), which includes the Illawarra and the Lower Hunter in addition to the Sydney SD. The results presented for 'Sydney' throughout this report relate to the Sydney SD¹. The analysis is presented at a range of geographic scales—including the GMA and the Sydney SD, the Inner, Middle and Outer sectors, the planning subregions, Statistical Local Areas (SLAs), suburbs, census collection districts and travel zones—so as to convey both the overarching patterns and some of the finer detail. The over page maps show the Sydney GMA and SD, and the sectors and planning subregions which are used throughout this report.

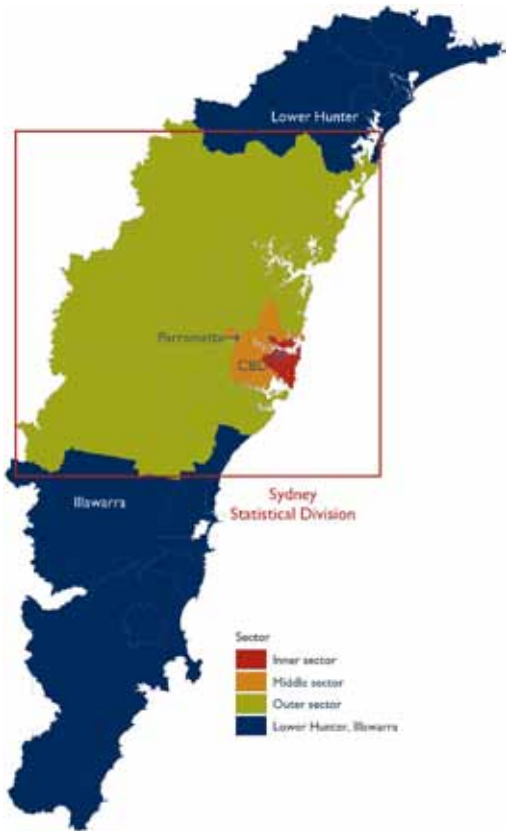
The study focuses on the 2001 to 2010 period (particularly the 2001 to 2006 period for which detailed spatial data is available), but also incorporates information on longer term trends to put current changes into their historical context. The key data sources are the ABS *Census of Population and Housing* for 2001 and 2006 and ABS *Estimated Resident Population* time-series data.² Until the 2011 *Census of Population and Housing* 2nd release data becomes available in October 2012, the 2006 census data represents the latest available data on spatial patterns of employment, industry and commuting within Sydney.

1 Any results relating to the GMA will be specifically described as such.

2 Apart from those instances where a specific source is given, the data presented in the Executive Summary are largely BITRE estimates derived through analysis of these two primary data sources and a range of secondary data sources (e.g. the NSW Government's *Household Travel Survey*, Metropolitan Development Program, Sydney Strategic Travel Model outputs, and spatial population and employment projections). Details of data sources are provided in the relevant chapters.

Maps showing Sydney Greater Metropolitan Area, Statistical Division, sectors and planning subregions

a) GMA and sectors



b) Statistical Division and planning subregions



Note: Shaded area on map b) represents Western Sydney.

Source: BITRE analysis based on 2006 Australian Standard Geographical Classification boundaries.

Residential patterns and trends

The population of the Sydney SD grew from 137 586 in 1871 to 2.73 million in 1971, and by 2010 it had reached 4.58 million. The average annual rate of population growth was 2.3 per cent from 1961 to 1971, but in each subsequent decade growth has averaged around one per cent per annum.

Sydney's Outer sector grew from 0.8 to 2.5 million residents between 1961 and 2010, growing particularly rapidly in the 1960s and 1970s. This gain of 1.7 million Outer sector residents, compares to 371 000 for the Middle sector and 95 000 for the Inner sector. The population of the Inner sector declined in the 1970s, but has been growing solidly since 1991 due to inner city redevelopment.

As of 2010, 54 per cent of the Sydney SD's population lives in the Outer sector, 29 per cent in the Middle sector and 17 per cent in the Inner sector. Western Sydney—which comprises the West Central, North West and South West planning subregions—is home to 43 per cent of

the population. The Sydney SD accounts for 82 per cent of the population of the GMA, which also includes Lower Hunter and the Illawarra.

Sydney's population grew by 447 000 from 2001 to 2010. Eighty per cent of this population growth was due to natural increase and 20 per cent to net migration. The net gains from overseas migration outweighed the migration losses to the rest of Australia.

The average annual population growth rate of 1.1 per cent from 2001 to 2010 was below the national figure of 1.6 per cent. While population growth averaged just 0.7 per cent in Sydney from 2001 to 2006, it rose to 1.7 per cent per annum between 2006 and 2010.

Sydney's increased population was largely accommodated in established suburbs, with 81 per cent of new housing development between 2001 and 2010 occurring within the existing urban area (Department of Planning and Infrastructure 2011h). Around 47 per cent of Sydney's 2001 to 2010 population growth occurred in the Outer sector, 33 per cent in the Middle sector and 20 per cent in the Inner sector. The North West and West Central subregions were key contributors, accounting for 20 and 18 per cent of population growth, respectively.

At the SLA scale, Blacktown North added the most population (27 600 persons), followed by Auburn (19 900), Baulkham Hills North (19 000) and Sydney South (18 500). The Sydney Inner SLA recorded the highest average annual growth rate of 6.5 per cent. Campbelltown North experienced the largest loss of population between 2001 and 2010 (–377 persons).

Sydney is Australia's most densely populated city—its established inner and middle suburbs averaged 3244 persons per square kilometre in 2010, up 13 per cent from 2001. This reflects a shift towards higher density forms of housing, particularly in Sydney's strategic centres. The stock of flats, units and apartments of four or more storeys in strategic centres expanded by over 50 per cent from 2001 to 2006. The largest gains in population density occurred in the City of Sydney subregion (particularly Central Sydney and Green Square) and in the Concord SLA.

Employment and industry

Employment patterns and trends

Up until the 1950s, employment was heavily centralised in the Central Business District (CBD) and inner suburbs of Sydney. There was a strong trend towards suburbanisation of manufacturing and service sector jobs in the 1950s, 1960s and 1970s, which has since moderated (Pfister et al. 2000, Urban Research Centre 2008).

More than half a million jobs were added in Sydney between 1981 and 2006, with the most rapid growth occurring between 1991 and 2001 (TDC 1998, 2008b). Between 1981 and 2004, there was modest job growth in the City of Sydney (0.5 per cent per annum) and Inner West (0.3 per cent), while job growth in the North West, South West and Central Coast subregions exceeded 3 per cent per annum (NSW Government 2005). An important trend over the last two decades is the increasing prominence of office, technology and business parks (SGS 2004).

Sydney's employment is concentrated in the inner suburbs, while population is concentrated in the outer suburbs. In 2006, the Inner sector contained 35 per cent of Sydney's jobs, but

only 17 per cent of its population. The Middle sector contained 28 per cent of jobs and 29 per cent of population, while the Outer sector contained 38 per cent of jobs and 54 per cent of population. Western Sydney contained 34 per cent of jobs and 43 per cent of population.

The 2006 census identifies 1.74 million people with a fixed place of work within the Sydney SD and 2.05 million people with a fixed place of work in the GMA. The City of Sydney subregion employed 357 800 people in 2006, representing 21 per cent of jobs within the Sydney SD. The CBD (i.e. the Sydney Inner SLA) contained 13 per cent of jobs. While CBD employment declined in the 1970s and 1980s, its share of jobs has been rising since 1991. Other major employment centres within Sydney are North Sydney (35 800 jobs), St Leonards-Crows Nest (34 400), Parramatta (34 200), Macquarie Park (32 000) and Sydney Airport (28 200). Forty per cent of jobs are in strategic centres, 20 per cent in employment land precincts and 40 per cent in other locations.

The City of Sydney, Inner North and West Central subregions contain more jobs than employed residents. The South and North planning subregions are the least self-sufficient with respect to employment, offering less than 6 jobs for every 10 employed residents.

Sydney had relatively modest job growth of 1.4 per cent per annum between 2001 and 2011, which was well below the national rate of job growth (2.3 per cent). Comparison of the 2001 and 2006 censuses identifies 47 300 additional jobs with a fixed place of work in Sydney, of which 26 200 were in Western Sydney. Of the 27 000 jobs added in Illawarra and Lower Hunter, 18 100 were in the Lower Hunter.

The Inner sector experienced a 2300 person decline in employment between 2001 and 2006. Employment gains in the CBD and Sydney West were offset by job losses in most of the remaining inner suburban SLAs.

Three quarters of the job growth in the Sydney SD from 2001 to 2006 occurred in the Outer suburbs, with the North West subregion alone contributing 34 per cent of jobs growth. The most rapid job growth occurred in the Central Coast (2.1 per cent per annum), North West (1.6 per cent) and South West (1.5 per cent)—in all three subregions the rate of job growth outpaced population growth.

Two thirds of job growth occurred in strategic centres and 30 per cent in employment lands. The increase in centred employment was due mainly to very strong growth in Macquarie Park, Norwest Business Park and Olympic Park-Rhodes. The increase in employment land precincts was due to strong job growth in several outer suburban industrial areas (e.g. Prestons and Smeatons Grange).

Industry patterns and trends

Sydney's major employing industries in 2006 were Property and business services (14 per cent), Retail trade (14 per cent), Manufacturing (11 per cent) and Health and community services (11 per cent).³ The Property and business services industry is the major employer in the Inner sector, while Retail trade is the major employer in the Middle and Outer sectors. Retail is the main employing industry in 7 of the 11 planning subregions, but Transport and storage is the top employer in the East subregion, Manufacturing is the top employer in West Central, and Property and business services is the main employing industry in the City of Sydney and Inner North. Retail trade employment—along with Education and Personal and other services employment—is well dispersed across SLAs and aligned to the population distribution.

Between 2001 and 2011 (using the ANZSIC 2006 classification), the Health care and social assistance industry contributed 26 per cent of new jobs and the Professional, scientific and technical services industry contributed 22 per cent.

From 2001 to 2006, the main contributors to Sydney's job growth were Health and community services (gain of 27 200), Government administration and defence (17 100) and Education (15 900). Significant job losses were evident for Manufacturing (–19 700 jobs).

The industry drivers of job growth vary across Sydney. Government administration and defence was the main contributor to job growth in the Inner sector from 2001 to 2006, while Health and community services was the main contributor for the Middle and Outer sectors. The four top job growth SLAs had different industry drivers—for Sydney Inner the Finance and insurance industry was the main contributor to job growth, for Ryde it was Wholesale trade, for Sydney West it was Education, and for Baulkham Hills Central the Retail trade industry made the largest contribution.

Transport mode usage: patterns and trends

Private vehicle was the dominant mode of travel to work on census day 2006, with 69 per cent of Sydney SD residents using a private vehicle to commute, compared to the 21 per cent who used public transport, the 5 per cent who used active travel modes (cycling or walking) and the 4 per cent who worked at home. The Outer sector was most car dependent, with 77 per cent of Outer sector residents and 84 per cent of Outer sector employees commuting by private vehicle.

Sydney has a higher public transport mode share than any other Australian city. Inner sector workers are slightly more likely to use public transport (44 per cent) than private vehicle (43 per cent) to get to work. City of Sydney workers are particularly likely to use public transport for the journey to work (59 per cent), while only 5 per cent of Outer sector jobs are accessed by public transport. The majority (73 per cent) of Sydney's commutes by public transport are to a place of work in the Inner sector.

While walking accounted for less than 5 per cent of total Sydney commutes, walking is a common commuting mode for inner city residents, particularly for those who live in the City of Sydney (27 per cent), Inner North (8 per cent) and East subregions (7 per cent). Cycling

³ This section adopts the ANZSIC 1993 1 digit industry classification, except where otherwise noted.

represents less than one per cent of journeys to work, with a higher proportion of inner suburban residents cycling to work. Walking and cycling both increased their mode shares from 2001 to 2006, and these increases were concentrated in the Inner sector.

Over the last decade, Sydney recorded relatively modest growth in public transport patronage compared to other Australian cities (BITRE 2012a, 2012b). While there was a significant decline in the public transport mode share of commuter travel in the early 2000s, following the Sydney Olympics, the mode share has been well above 2001 levels since 2007–08 (BTS 2011).

Between 2001 and 2006, the proportion of Sydney residents commuting by private vehicle rose by 1.1 percentage points, although it fell for Inner sector residents. This increase in private vehicle use was predominantly due to job growth occurring in areas with high rates of private vehicle use, as well as a shift towards private vehicle use to access jobs in employment lands.

Commuting patterns and trends

Commuting flows

In 2006, Sydney attracted around 2.3 per cent of its workforce from outside the SD, mainly from Wollongong and (to a lesser extent) Newcastle. About 1.1 per cent of Sydney's employed residents worked outside the SD, primarily in Newcastle. The Illawarra and Lower Hunter both provide many more commuters to the Sydney SD than they receive in return, although the net outflow of commuters declined slightly for both regions between 2001 and 2006.

Focusing on commutes *within* the Sydney SD in 2006, trips to work in an inward direction dominate those in an outward direction (38 per cent and 8 per cent, respectively), while 27 per cent of all commutes occur within the home SLA and a further 16 per cent are to a different SLA in the home subregion and ring.

About 44 per cent of employed residents work in their home subregion. Consequently, the largest volume commuting flows are commutes within the home subregion, such as the 171 700 North West residents who commute to a place of work in the North West. Self-containment is highest for the Central Coast (65 per cent) and very low for the Inner West and North subregions (25 and 32 per cent, respectively). The Central Coast increased its self-containment rate by 2.6 percentage points between 2001 and 2006, but there was minimal change in Sydney's overall level of self-containment.

The most frequent flows between different subregions are the 66 000 residents of the South subregion who commute to a City of Sydney workplace and the 62 000 North West residents who commute to a West Central workplace. Between 30 and 40 per cent of employed residents of the East and Inner West subregions commute to a City of Sydney workplace, compared to just 5–8 per cent of North West, South West and Central Coast employed residents.

Changes in commuting patterns from 2001 to 2006 were relatively subtle, and Sydney's overall commuting structure remained very stable. Outward flows had the most rapid growth (1.6 per cent per annum), increasing from 7.5 to 7.8 per cent of all flows. Inward commutes recorded subdued growth (averaging 0.3 per cent per annum), declining from 38.6 to 37.7 per cent of all commuting flows.

There were large increases in the number of people commuting within the North West (12 700), Central Coast (8200) and City of Sydney (7100) subregions, as well as from the Inner West to the City of Sydney (2800). The number of Outer sector residents commuting to a place of work in the Inner sector declined by 4200 persons between 2001 and 2006.

The likelihood of commuting to the City of Sydney increased for East, Inner North and Inner West residents, but it declined for West Central, South West and Central Coast residents. The likelihood of commuting to an Inner North workplace declined for a range of subregions between 2001 and 2006.

Commuting distances and times

Job access is one of several key factors—alongside proximity to family and friends, lifestyle and housing cost—that underpin people's choices as to where to live. Average commuting distances are low for Inner sector residents (7.5km), higher for Middle sector residents (11.5km) and highest for Outer sector residents (18.8km). This compares to an average commuting distance within the Sydney SD of 14.6km in 2006. Commuting distances were particularly high for residents of the Central Coast (26.2km) and South West (21.9km). While City of Sydney residents had the lowest average commuting distance (5.9km), those who worked in the City of Sydney travelled an average of 17.5km to work.

Average work trip durations rose more gradually across the sectors of residence, standing at 30 minutes for the Inner sector, 32 minutes for the Middle sector and 35 minutes for the Outer sector in 2007 (TDC 2009d). South West residents had the lengthiest average work trip duration of 38 minutes (TDC 2009c).

Between 2001 and 2010 there was very little change in Sydney's average commuting distance (+0.3km) (BTS 2011), although the average commuting distance of Central Coast residents did decline significantly from 2001 to 2006. There was a modest 1.6 minute rise in the average duration of a Sydney commuting trip between 2001 and 2010 (ibid.). There was also a 4 km/hour decline in morning peak road travel speeds in Sydney between 2001 and 2010, and a much less pronounced decline in afternoon peak speeds (Austroads 2011).

Some drivers of commuting flows

In addition to describing spatial patterns and trends in commuting, this project set out to explore how commuting behaviour has responded to recent spatial changes in population and jobs. Regression analysis was used to investigate this issue.

A simple gravity model explains about three-quarters of the variation in commuter flows between SLAs in Sydney, and the fundamental drivers remained very stable between 2001 and 2006. The number of people commuting between an origin-destination pair tends to increase with the number of employed residents of the origin SLA and with the number of jobs in the destination SLA. For example, rapid population growth in places such as Sydney South and Blacktown North has generated increased commuter flows within the home SLA and to a range of nearby areas.

The number of people commuting between an origin-destination pair tends to decline as the road network distance between the two SLAs widens. Distance is less of an impediment to travel between locations that have a direct rail or freeway connection. Distance tends to impede commuter travel more in Sydney and Melbourne, than in Perth, reflecting the greater density and congestion in the two larger cities.

The spatial concentration of industries also has implications for commuting, particularly where workers have specialised skills that tie them closely to specific industries. The greater the alignment between the skills available in the origin SLA and the skills demanded in the destination SLA, the greater the predicted commuting flows between those two places.

Spatial patterns of growth in employed residents and jobs play an important role in explaining *changes* in commuting flows in Sydney between 2001 and 2006. These two factors alone explain around 40 per cent of the variation in commuting growth rates for origin-destination pairs with non-trivial commuter flows. More distant origin-destination pairs tended to experience lower *growth* in commuting flows between 2001 and 2006. The significant expansions of Sydney's motorway network between 2001 and 2006 (i.e. the M7, M5 East and Cross-city tunnel) also explain some of the *changes* in commuting patterns. Commuting flows between areas connected by the new motorways increased more than otherwise would have been expected given residential and job growth in those areas.

Outlook

Official population projections point to Sydney reaching a population of 7 million by 2056 (ABS 2008). Sydney is projected to increase its population by 1.2 per cent per year, on average, between 2006 and 2056—a lower projected growth rate than Perth, Brisbane or Melbourne, but higher than that for Adelaide (*ibid.*).

The NSW Department of Planning (2010b) projects that two-thirds of Sydney's 1.7 million population increase from 2006 to 2036 will occur in the Outer sector, with 21 per cent in the Middle sector and 12 per cent in the Inner sector. The largest increases are projected for the SLAs of Camden (198 900), Blacktown North (158 500), Liverpool West (125 300), Wyong North East (63 500) and Baulkham Hills North (62 700) (*ibid.*). This population growth will generate demand for around 770 000 new homes in Sydney, mainly in the North West and South West subregions (NSW Government 2010a).

Sydney's employment is forecast to increase by 761 000 workers from 2006 to 2036 (TDC 2009b). The additional jobs are expected to be concentrated in the North West (21 per cent), City of Sydney (19 per cent), South West (14 per cent) and West Central (13 per cent) subregions, and thus nearly half of the new jobs (48 per cent) are forecast to be in Western Sydney. Specific job growth locations include the CBD (which is forecast to add 83 000 jobs) and Liverpool East (30 500). Particularly rapid jobs growth is forecast for the South West (2.0 per cent per annum) and the North West (1.6 per cent), compared to the Sydney-wide average of 1.0 per cent (*ibid.*).

These spatial projections of population and employment growth through to 2036 have implications for future spatial patterns of commuting within Sydney, which in turn have ramifications for future congestion and infrastructure investment. If these projections are realised, a large proportion of the increase in commuting within Sydney will likely be increased

commutes within the North West and South West subregions. This increase in the relative importance of same-subregion flows, together with the modelled reduction in the relative importance of inward commutes, will pose a challenge to growing the public transport mode share. The projected pattern of growth is also expected to involve a small rise in average commuting distances. Scenario modelling suggests the magnitude of these changes will be greater if a larger proportion of residential and job growth occurs on the urban fringe.

Strategic plans

Strategic planning is one of several mechanisms through which governments attempt to influence the spatial allocation of population, jobs and commuting within cities.

Following the change of government in NSW in March 2011, a comprehensive 18 month review of the NSW planning system was announced, which will include the creation of new planning legislation (Hazzard 2011). A new Metropolitan Strategy covering a 20 year timeframe is due for release by the end of 2012 (NSW Government 2012). It will be integrated with the Long-Term Transport Master Plan and State Infrastructure Strategy (ibid).

This BITRE study focuses on the 2001 to 2010 period, in which *Shaping our Cities* (1999), *City of Cities* (2005) and *Sydney 2036* (2010) were the operational strategic plans. The *Metropolitan Plan for Sydney 2036* sets out the overall strategic direction for the growth and development of the metropolitan area over a 25 year timeframe (NSW Government 2010a). *Sydney 2036* is an extension and update of the 2005 Metropolitan Strategy—*City of Cities* (NSW Government 2005). The preceding Metropolitan Strategy—*Shaping our Cities*—consisted of a set of broad principles to guide planning in the GMA, but contained very little in the way of detail or quantifiable objectives.

Both *Sydney 2036* and *City of Cities* promote similar principles—liveability, economic competitiveness, fairness, protection of the environment and improved governance—and primarily represent a program of long term economic development to maintain global competitiveness. The plans structure Sydney as a system of regional cities and major centres which are connected by the rail network, bus corridors and the orbital motorway network. *Sydney 2036* and *City of Cities* have a number of common goals that relate to the spatial distribution of population and employment, or to commuting patterns. These include limiting urban sprawl, concentrating development around centres, growing jobs in Western Sydney, better connecting people to centres, achieving greater use of sustainable transport modes, and ensuring people work closer to home. There were some significant shifts in strategic planning goals and targets over the period, including a lower profile role for corridors in *Sydney 2036* as compared to *City of Cities*.

Past reviews have identified the strengths of Sydney's strategic planning system as being the clearly articulated vision for the shape of Sydney, the comprehensiveness of the planning documentation, and the monitoring system for land supply. The principal criticisms relate to accountability and implementation failures, in terms of both planning priorities and transport infrastructure (KPMG 2010, Bunker and Searle 2007, COAG Reform Council 2012). Thus, a key challenge is to align and strengthen coordination of government decision making to deliver on the stated priorities.

BITRE has analysed the extent to which progress has been achieved from 2001 to 2010 against those metropolitan strategy goals that relate to the spatial distribution of population and employment or to commuting patterns—results are summarised in the table on the following pages. Outcome measures on their own do not provide a reliable indication of how effectively government planning systems are working, due to the many other influences that can impact on outcomes (Productivity Commission 2011), and so this report does not attempt to evaluate the performance of Sydney's strategic planning system. Rather, the purpose of this analysis is to provide evidence about the actual 'on the ground' changes that have been occurring with respect to these strategic planning goals, identifying whether such movements are in the desired direction and progressing at the required pace of change. This evidence about the reality of the trends in Sydney's population, employment and commuting flows can then be used to inform future planning initiatives.

The available evidence suggests that there has been some movement in the desired direction for most of these planning objectives since 2001. The exception is that Sydney's average commuting time has not been heading in the desired direction. Good progress was achieved against several of these objectives, such as increasing residential densities and focusing job growth in strategic centres. More often, evidence is mixed. For example, Western Sydney increased its share of Sydney's employment between 2001 and 2006, but an upturn in job growth will need to occur to meet the longer term targets. While some progress has been made against most of these planning goals, it has been incremental in nature as the accumulated effects of decades of residential and industry development do not reverse in just five to ten years.

There are wide-ranging interconnections, and in some cases tensions, between the different strategic planning goals. For example, the increase in use of active transport modes by inner city residents from 2001 to 2006 arose largely through their reduced public transport use, and these mode shifts in turn had implications for commuting times. Progress against strategic planning goals can also have implications for broader economic, social or environmental policy goals which need to be taken into account. For example, while recent progress in 'limiting urban sprawl' has exceeded expectations, the COAG Reform Council (2012, p.98) notes that the 'goal of a more compact city is a delicate balancing act. Infill development will help Sydney meet sustainability and economic competitiveness goals but may have negative effects on affordability and growth'.

The recent spatial changes in population, jobs and commuting flows in Sydney largely reflect market forces, demography and people's preferences as to where they live, work and do business. Government planning policies and infrastructure provision also play a role, with state and territory governments believing that management of greenfield development, accommodation of population growth, and the transition to higher densities are most able to be influenced by planning (Productivity Commission 2011).

Observed change against urban planning goals for Sydney from 2001 to 2010

Strategic planning objective	Time period to which evidence relates	Extent of progress	Comments
Spatial patterns of residential development			
Limit urban sprawl	2001 to 2010	Over-achieved#	Urban infill development played a much more dominant role in accommodating Sydney's population growth from 2001 to 2006, than it did in either Melbourne or Perth. <i>Sydney 2036</i> 's target for at least 70 per cent of new homes to be located in existing suburbs was met and exceeded between 2001–02 and 2009–10 when 81 per cent of new housing development occurred within the existing urban area. About 33 000 dwellings were added in greenfield areas, representing 19 per cent of new housing development. Since 2004–05 greenfield production has averaged just 2400 dwellings per year. <i>City of Cities</i> had previously envisaged a greater role for greenfield sites, targeting 30–40 per cent of housing development in new land release areas. While the <i>Sydney 2036</i> urban infill percentage target was exceeded and urban sprawl was contained, aggregate dwelling production declined considerably over the period, with implications for housing affordability and for Sydney's growth.
Focus residential development around centres	2001 to 2008	Some	Between 2001 and 2006, the population living in strategic centres has increased at a much faster rate than the rest of the city. While only 5 per cent of Sydney's population lives in existing strategic centres, they accounted for 27 per cent of population growth between 2001 and 2006 and 23 per cent of dwelling completions between 2003–04 and 2007–08. The smaller local centres housed a lower than expected proportion of recent residential development. Even though the strategic centres have grown rapidly, the rate of out-of-centre residential development in established suburbs has been much higher than that targeted by <i>Sydney 2036</i> .
Increase residential densities in centres	2001 to 2006	Good	There was a shift towards higher density forms of housing being built in Sydney's strategic centres between 2001 and 2006. The stock of high rise flats, units and apartments in strategic centres expanded by over 50 per cent, and as a result, the population density of non-specialised strategic centres increased at a much more rapid pace (26 per cent) than the city's overall population density (4 per cent). The density gains were concentrated in a few centres located within 10km of the CBD.
Spatial patterns of jobs growth ~			
Focus job growth in strategic centres	2001 to 2006	Good	From 2001 to 2006 there was an increase of 31 500 jobs in strategic centres, representing 67 per cent of Sydney's job growth. Specialised centres—such as Norwest, Macquarie Park and Olympic Park-Rhodes—were responsible for over half of this growth. Much of the job growth in centres was in the Health and community services and Government administration industries, with Retail and Finance also important to growth. The centred employment share rose from 40.0 to 40.7 per cent, which is consistent with the NSW Government's target to grow the centred employment share by 3 percentage points to 2036.
Enable jobs growth in Global Economic Corridor	2001 to 2006	Limited	The Global Economic Corridor added 6700 jobs from 2001 to 2006, although the northern part of the corridor experienced a net job loss. Its employment share declined from 33.6 per cent to 33.1 per cent. While <i>Sydney 2036</i> did not specify employment targets for the Global Economic Corridor, recent job growth is well below that envisaged by <i>City of Cities</i> which targeted 150 000 new jobs between 2006 and 2031.

(continued)

Observed change against urban planning goals for Sydney from 2001 to 2010 (continued)

Strategic planning objective	Time period to which evidence relates	Extent of progress	Comments
Accommodate about 20 per cent of jobs in employment lands	2001 to 2006	Good	About 30 per cent of Sydney's job growth from 2001 to 2006 occurred in employment land precincts, amounting to 13 900 additional jobs. The job share of employment land precincts rose from 19.4 per cent in 2001 to 19.7 per cent in 2006, which is consistent with the 20 per cent target from <i>Sydney 2036</i> .
More jobs in Western Sydney	2001 to 2006	Some	Western Sydney added 26 200 jobs from 2001 to 2006, mainly in the Health and community services (9400 jobs) and Transport and storage (6500) industries. This job growth involved a slightly more diverse industry mix and an upgraded skills base in Western Sydney. The proportion of Sydney's employment in Western Sydney rose by 0.6 percentage points to reach 34.5 per cent in 2006. The recent creation of 26 200 jobs in Western Sydney is modest compared to the longer term target to create 384 000 new jobs in Western Sydney from 2006 to 2036.
Better align jobs with where people live	2001 to 2006	Isolated	Employment self-sufficiency ratios reveal limited change from 2001 to 2006 in the degree to which jobs are aligned with where people live across Sydney's subregions. The exception was the City of Sydney subregion, where strong population growth reduced the excess of available jobs over employed residents. The City of Sydney and North West subregions experienced the largest increase in residents as well as some of the most substantial employment increases.
Commuting-related objectives			
Greater use of public transport	2001 to 2010	Some	Sydney has the highest public transport mode share of Australia's cities. The public transport mode share of commuter travel declined significantly in the early 2000s, but recovered strongly between 2004 and 2008, before stabilising. It stood at 23.9 per cent in 2009–10, which is about 3 percentage points higher than in 2000–01, suggesting some progress has been made towards the NSW Government's commuter target of 28 per cent by 2016. However, across all trip purposes the public transport mode share was essentially the same in both 2001 and 2010 (i.e. 15 per cent). Sydney's public transport patronage growth over the last decade has been modest in comparison to other large Australian cities.
Greater use of active transport	2001 to 2010	Some	From 2001 to 2006, the active transport mode share increased by 0.5 percentage points to 5.4 per cent of all commutes. Walking and cycling mode shares both increased. These shifts were largely confined to the inner and middle suburbs, with the outermost subregions (i.e. North West, South West, Central Coast) experiencing small declines in the proportion of residents walking to work. More recent data suggest Sydney's active transport mode share continued to rise gradually from 2006 through to 2010.
Better connect people to centres	2001 to 2010	Isolated [^]	From 2001 to 2006, there was a 1.4 percentage point decline in public transport's share of commuter travel to and from Sydney's strategic centres. The Parramatta CBD was an exception, with an increase in its public transport mode share from 2001 to 2006. Over the longer 2001–02 to 2009–10 period, the public transport mode share declined for Liverpool, and while it rose for the Sydney and Parramatta CBDs it remained below the 2016 targets.

(continued)

Observed change against urban planning goals for Sydney from 2001 to 2010 (continued)

Strategic planning objective	Time period to which evidence relates	Extent of progress	Comments
Concentrate development near public transport	2001 to 2010	Some	Since 2000–01, 42 per cent of Sydney's residential development has been concentrated near public transit nodes, and there was a net rise in this proportion over the decade. While 44 per cent of Sydney's 2001 to 2006 population growth occurred within 1km of a rail station, this compares to just 5 per cent of employment growth. Although recent residential development has been concentrated near Sydney's rail network, economic development and jobs growth have not.
People work closer to home	2001 to 2010	Negative	Sydney's level of self-containment remained stable, with 44 per cent of employed residents working in the home subregion in both 2001 and 2006. Between 2000–01 and 2009–10, there was a very small 0.3km rise in the average commuting distance within Sydney and a modest 1.6 minute rise in the average duration of a commuting trip, which reached 34.3 minutes in 2009–10. Since 2001 there has been a shift to Sydney residents working a little further away from home, on both a distance and time basis.

Note: The focus is on the strategic planning goals of *Sydney 2036—City of Cities* objectives that were not pursued in *Sydney 2036* are not considered in the table. Table 2.4 contains details of the relevant strategic planning goals from both *Sydney 2036* and *City of Cities*.

Urban sprawl was contained, but the level of new dwelling production in Sydney declined with implications for affordability and growth.

~ BITRE's employment analysis is based on census place of work data—estimates differ from employment figures in the NSW Government's recent metropolitan strategies, which are modelled estimates that adjust the census data upwards to match ABS Labour Force Survey totals.

^ Assessment of this objective was challenging due to conflicting estimates, changes to the underlying methodologies over time, and concerns about the robustness of estimates.

Source: BITRE analysis—details of assessment and sources provided in body of report.

How does Sydney compare?

The Sydney study is part of a series of investigations of recent spatial change in employment, residential and commuting patterns in Australia's largest capital cities. Some insight into how Sydney compares can be gained from considering the results of this study in the context of our Perth and Melbourne results, in BITRE (2010) and BITRE (2011), respectively. A final comparative report will provide an overview of the relevant statistics for these three cities and Brisbane, highlighting commonalities and differences in the ways our cities are evolving over time and drawing out the implications for urban development and infrastructure policy.

CHAPTER I

Introduction

Key points

- This Sydney study is a part of a series of investigations into the identification of spatial changes in employment and residential patterns in Australia's largest cities and how commuting behaviour has responded to these changes. The previous reports examined Perth and Melbourne.
- ABS *Census of Population and Housing* and *Estimated Resident Population* are the primary sources used in the analysis, which is focused on the 2001 to 2010 period.
- The analysis is presented at a range of geographic scales, including the Greater Metropolitan Area, Sydney Statistical Division, the Inner, Middle and Outer sectors, the planning subregions, Statistical Local Areas, suburbs, census collection districts and travel zones.

Context

This document is part of a set of case studies by BITRE which aims to identify spatial changes in employment and residential patterns in our largest capital cities and how commuting behaviour has responded to these changes. A secondary aim is to investigate the extent to which there has been progress in reshaping each city's spatial development and commuting patterns in the direction envisaged by recent metropolitan plans. Reports have already been completed for Perth and Melbourne (BITRE 2010, 2011), with Brisbane to follow.

These in-depth case studies of the major capital cities will provide the basis for a final comparative report, which:

- provides an overview of relevant statistics for the capital cities,
- pulls out some of the common themes which emerge from the individual city studies, as well as the differences, and
- highlights the implications of the analysis.

The report aims to provide key stakeholders with an evidence base on spatial patterns and trends in population, jobs and commuting flows for Sydney, including the changes that have been occurring with respect to the relevant strategic planning goals. The research is being undertaken in the context of the Australian Government's increased involvement in urban policy and strategic planning issues in recent years, reflected in the establishment of the Major Cities Unit, the release of the *National Urban Policy* (Department of Infrastructure and Transport 2011), and the COAG Reform Council's review of capital city strategic planning systems (COAG Reform Council 2012).

Information sources

The approach followed is based on the previous investigations completed for Perth and Melbourne (BITRE 2010, 2011). This report uses the official population counts as well as detailed data from the Australian Bureau of Statistics (ABS) *Census of Population and Housing* to answer the following research question:

What are the recent spatial changes in major capital city employment and residential patterns and how has commuting behaviour responded?

The period of interest for this study is the period from 2001 through to 2010. While information on post-2006 change has been incorporated wherever possible, in practice much of the analysis relates to the 2001 to 2006 period for which detailed spatial data is available from the ABS *Census of Population and Housing*. Information on longer term trends is also incorporated to put current changes into their historical context.

The datasets used in this study include:

- Estimated Resident Population (ERP) from the ABS' *Regional Population Growth Australia* (Cat. No. 3218.0, March 31 2011 release).
- A range of ABS *Census of Population and Housing* data for 2001 and 2006, including data on employed residents and transport mode from the ABS' *Basic Community Profile* (ABS Cat. No. 2069.0.30.001) and CDATA 2001, and customised unpublished census data on employment, industry and commuting flows.
- Journey to Work (JTW) data and various concordances from the New South Wales (NSW) Bureau of Transport Statistics (BTS), previously known as the Transport Data Centre (TDC). This JTW data for 2001 and 2006 was originally collected through the ABS *Census of Population and Housing*.
- Other NSW Government data, including the *Household Travel Survey*, Metropolitan Development Program, spatial population and employment projections, and modelled estimates of road distance and travel times between travel zones.

Many of the capital city Central Business District (CBD) councils and state governments have undertaken similar, and sometimes more in-depth, analysis of patterns of residential and job growth for their own city. For example, the BTS has published numerous reports which contain spatial analysis of population, employment, transport and commuting in Sydney (e.g. TDC 2008a, 2008b, 2006a, 2006b). BITRE's multi-city study will add value by bringing together the different cities on to a comparable basis and highlighting commonalities and differences in the ways the cities are evolving over time.

While the *Census of Population and Housing* and ERP data are the two main information sources, BITRE's study also uses a range of government and academic literature.

- An overview of the planning system and key strategic plans for Sydney is provided in Chapter Two. BITRE's analysis includes reference to the goals of recent strategic plans and compares the actual outcomes in terms of spatial patterns of population and job growth to the expressed goals.

- The report also makes reference to academic analyses and reviews of strategic planning for Sydney. Some academics are critical of metropolitan plans for paying insufficient attention to the reality of the economic and social trends shaping our cities. This study identifies those economic trends, and their spatial implications, which will be of benefit for future planning initiatives.
- Published material on past and projected population growth, job growth, commuting flows and transport usage is incorporated, where relevant.

Geography

This study adopts two aggregate spatial units—the Greater Metropolitan Area and the Sydney Statistical Division:

- The Greater Metropolitan Area (GMA) consists of the Sydney Statistical Division (SD) plus the Illawarra SD and the Newcastle Statistical Subdivision (SSD), the latter of which is referred to as the ‘Lower Hunter’ in the NSW planning literature. The GMA is the spatial unit covered by the NSW Bureau of Transport Statistics’ population and employment forecasts and its journey to work data. The term GMA is more generally used to study the economic and social links between Sydney’s urban core (with its higher employment density) and the surrounding residential areas. Map 1.1 illustrates the GMA boundary.
- The city of Sydney is defined as corresponding to the ABS Statistical Division (SD) of Sydney. This corresponds exactly to BITRE’s Sydney working zone (WZ), which was defined based on the commuting patterns revealed in the 2006 ABS *Census of Population and Housing* (BITRE 2009a). Data presented for Sydney will relate to the Sydney SD, except where it is specifically noted that the data relates to the GMA.

BITRE’s analysis of commuting flows considers all significant commuting flows into or out of the Sydney working zone, and so captures long-distance commuting such as flows from Newcastle or Canberra to Sydney. There are four other BITRE working zones included in the Greater Metropolitan Area, namely, Wollongong & surrounds, Shoalhaven, Wingecarribee and Newcastle & surrounds. These working zones show relatively strong commuting connections with Sydney, with Wingecarribee having the highest proportion of employed residents commuting to the Sydney working zone (16 per cent) and Wollongong the largest number of commuters (15 600).

Map 1.1 Greater Metropolitan Area, 2006



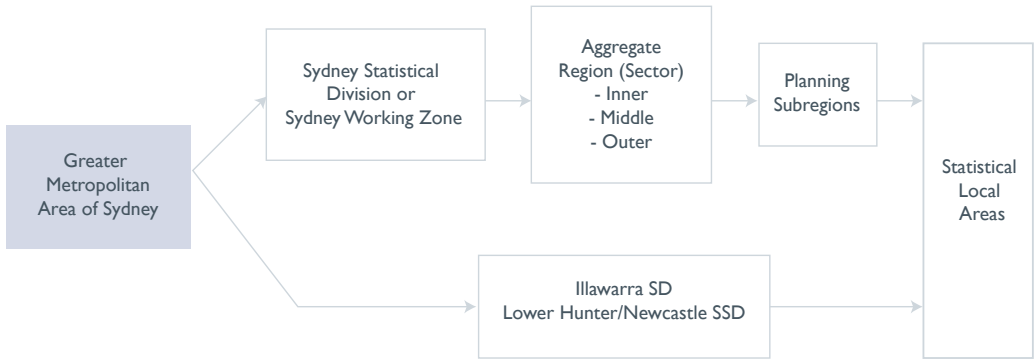
Note: This area covers the Sydney and Illawarra Statistical Divisions and the Newcastle Statistical Subdivision/ Lower Hunter;

Source: TDC (2010),

Figure 1.1 summarises how the Greater Metropolitan Area relates to other spatial units used in this study, such as the Sydney Statistical Division and sectors. The Greater Metropolitan Area can be grouped into three sectors (i.e. Inner, Middle, Outer) and the rest of the Greater Metropolitan Area (i.e. Illawarra and the Lower Hunter). The sectors were established by the NSW government particularly for their planning of transport and other infrastructure. Map 1.2 illustrates the Inner, Middle and Outer sectors and the rest of Greater Metropolitan Area. Full details of the classification of Statistical Local Areas (SLAs) to sectors are provided in Appendix A, but examples of SLAs in each sector are listed below:

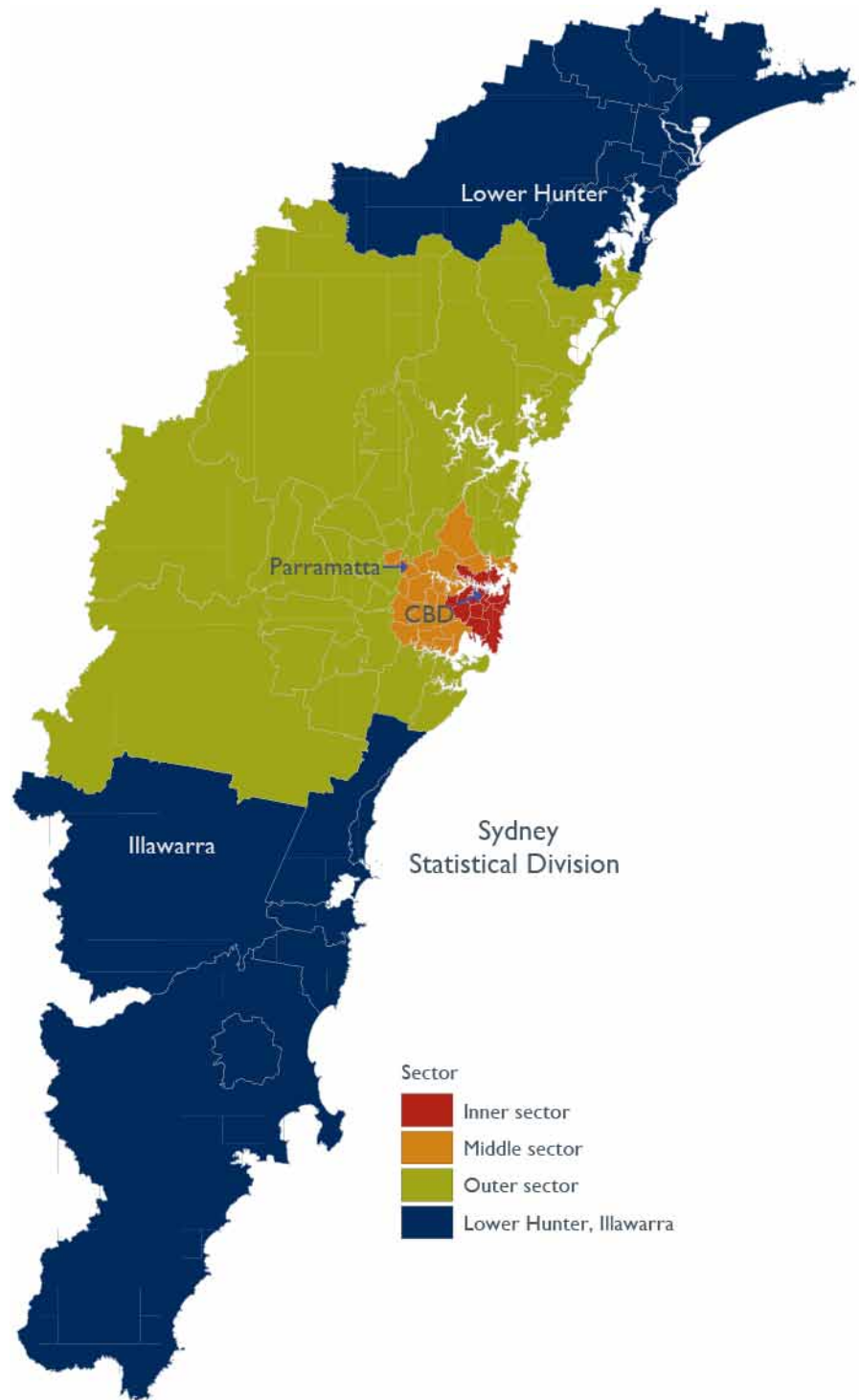
- Inner: Sydney Inner, North Sydney, Mosman, Botany Bay, Ashfield, Marrickville
- Middle: Manly, Ryde, Ku-ring-gai, Parramatta Inner, Auburn, Strathfield
- Outer: Fairfield East, Blue Mountains, Wyong North East, Pittwater, Camden.

Figure 1.1 Spatial units of analysis, Sydney



Source: BITRE analysis.

Map 1.2 Inner, Middle and Outer sectors of Greater Metropolitan Area, 2006



Source: BITRE presentation of TDC 2006 Sydney geography.

This report will on occasion disaggregate the Sydney SD into subregions using the NSW Department of Planning *Subregional planning areas*. Note that this is an entirely separate classification to the 'sectors' classification discussed earlier and the subregions do not aggregate to the sectors. The subregional planning areas, or planning subregions for short, are shown in Map 1.3 and are based on LGA boundaries:

- Sydney City (City of Sydney LGA)
- East (Botany Bay, Randwick, Waverley, Woollahra LGAs)
- South (Kogarah, Hurstville, Canterbury, Rockdale, Sutherland, Marrickville LGAs)
- Inner West (Ashfield, Burwood, Canada Bay, Leichhardt, Strathfield LGAs)
- Inner North (Lane Cove, North Sydney, Ryde, Willoughby, Hunters' Hill, Mosman LGAs)
- North (Hornsby, Ku-ring-gai LGAs)
- North East (Pittwater, Warringah, Manly LGAs)
- West Central (Auburn, Bankstown, Fairfield, Holroyd, Parramatta LGAs)
- North West (Baulkham Hills, Blacktown, Blue Mountains, Hawkesbury, Penrith LGAs)
- South West (Wollondilly, Camden, Campbelltown, Liverpool LGAs)
- Central Coast (Gosford and Wyong LGAs).

Each of the planning subregions has its own population, employment and dwelling targets reflecting the demographic dynamics of the areas. This will be discussed in subsequent chapters.

Some of the analysis is also presented at a more spatially disaggregated scale:

- *For population:* suburbs or census collection districts (CCDs or CDs) as defined in the 2006 ASGC.
- *For employment:* 2001 and 2006 travel zones—as defined by the NSW Bureau of Transport Statistics (previously known as the Transport Data Centre)—and employment lands, defined by BITRE using travel zone boundaries and subregional plans.
- *For population and employment:* strategic centres, with boundaries based on TDC (2008b) plus BITRE analysis of Metropolitan Strategy subregional plans and 2006 destination zone boundaries.

Thus, the spatial analysis in this report is presented at a range of different levels of disaggregation, to convey an understanding of both the overarching patterns and some of the finer detail.

Structure of report

This report begins with an overview of the urban planning system for Sydney in Chapter 2, followed by a spatial analysis of residential growth between 2001 and 2010 in Chapter 3. Chapter 4 focuses on the spatial dimensions of employment within Sydney, while the location and growth of different industries is examined in Chapter 5. Spatial differences in car, public transport and other transport mode usage are then considered in Chapter 6. This is followed by an investigation of existing commuting flows and changes in these commuter flows. Chapter 8 considers the relationship of changes in commuting flows to population growth, job growth and other key drivers. Chapter 9 explores the implications of the available spatial projections of population and jobs for future commuting patterns in Sydney, while Chapter 10 provides an overview of the main findings.

CHAPTER 2

Strategic planning

Key points

- The key players in Sydney's planning system are the Minister for Planning, the NSW Department of Planning and Infrastructure, the NSW Planning Assessment Commission, the Regional Planning Panels and local government.
- Following the change of government in NSW in March 2011, a comprehensive 18 month review of the planning system was announced.
- The most recent strategic plans for Sydney are the *Metropolitan Plan for Sydney 2036* (2010), *City of Cities* (2005), and *Shaping our Cities* (1999). Related documents include the Metropolitan Transport Plan—Connecting the *City of Cities* (2010), and *NSW 2021* (the 2011 state plan).
- *Sydney 2036* is an extension and update of *City of Cities*. Both plans promote similar principles—liveability, economic competitiveness, fairness, protection of the environment and improved governance—and primarily represent a program of long term economic development to maintain global competitiveness. The strategies provide a framework for managing the city's growth over a 25 year timeframe and structure Sydney as a system of regional cities and major centres which are connected by the rail network, bus corridors and the orbital motorway network.
- Recent planning initiatives have emphasised community involvement processes. The evidence suggests this initial consultation was not followed through to the final development phase, which resulted in some initiatives lacking the support needed for successful implementation.
- Reviews have identified the strengths of the Sydney strategic planning system as the clearly articulated vision, the comprehensiveness of the planning documentation, and the monitoring system for land supply. The principal criticisms relate to implementation failures, in terms of both planning priorities and transport infrastructure. Thus, a key challenge is to align and strengthen coordination of government decision making to deliver on the stated priorities.
- *City of Cities* and *Sydney 2036* have a number of common goals that relate to the spatial distribution of population and employment, or to commuting patterns. These include limiting urban sprawl, concentrating residential development and job growth in and around centres, growing jobs in Western Sydney, better connecting people to centres, achieving greater use of sustainable transport modes and ensuring people work closer to home. Where data permits, this study will analyse the actual changes that have occurred against these planning goals since 2001.

The planning system

This section describes the planning system that was in place in Sydney prior to the election of the Coalition State Government in March 2011. The new State Government is in the process of making a range of changes to the NSW planning system, which are summarised in Box 2.1.

The *Environmental Planning and Assessment Act 1979* is the primary piece of planning legislation in NSW—it sets out the rules for assessing development applications and the processes for making strategic plans (EDO 2009). The Act allows for the making of Environmental Planning Instruments (EPIs) which control development and regulate land use (ibid.). There are two types of EPIs, both of which are legally enforceable:

- State Environmental Planning Policies (SEPPs) deal with planning issues of state or regional significance and can either prohibit or facilitate particular types of development. SEPPs set out when development consent is required and identify the decision maker for particular types of development (EDO 2009).
- Local Environmental Plans (LEPs) relate to individual councils and enable management of the way in which land is used in different parts of the local government area through zoning and development controls (Department of Planning and Infrastructure 2011a).

The key strategic planning documents in NSW are the:

- *State Plan*, an overarching strategic document which identifies long term goals and priorities and guides decision making by the NSW Government.
- Sydney Metropolitan Strategy, which outlines how growth and change is to be managed throughout the Metropolitan Region and 'has been given statutory effect through a Ministerial Direction under s 117 of the planning Act' (Productivity Commission 2011, p.66).
- Regional Strategies, which set out a 25 year plan for future land use in a region, and are in place for the Central Coast, Lower Hunter and Illawarra regions within the Sydney Greater Metropolitan Area. While 'not legally enforceable in and of themselves, councils are required to ensure that their draft LEPs are consistent with the relevant Regional Strategy that applies to their local government area' (EDO 2009, p.7).
- Subregional strategies, which translate the Sydney Metropolitan Strategy goals to the ten subregions of the Metropolitan Region and serve as a mechanism for implementing the Metropolitan Strategy.

The NSW planning system is administered at several levels. The following list shows the principal institutions and their roles and responsibilities:

- The Minister for Planning is ultimately responsible for the *Environmental Planning and Assessment Act* and for oversight of strategic planning. The Minister is responsible for making SEPPs and is also the decision-making authority for approval of major projects of state or regional significance (EDO 2009).⁴

⁴ In June 2011, NSW Parliament passed a Bill to repeal Part 3A of the EPA Act and 'replace it with an alternative system for assessing projects of genuine State significance' (Department of Planning and Infrastructure 2011b). The Bill is expected to 'result in around a 50 per cent reduction in the number of projects dealt with by the State, with those that do not qualify as State significant to go to the local council for assessment' (ibid.). The Planning Assessment Commission will have an expanded role in determining State significant projects (Department of Planning and Infrastructure 2011d).

- The NSW Department of Planning and Infrastructure (formerly the Department of Planning, and before that the Department of Infrastructure, Planning and Natural Resources (DIPNR)) is responsible for driving long-term strategic planning, ensuring the planning system is streamlined and effective, and advising the Minister on the approval of major development and infrastructure projects of significance to the State's economy (Department of Planning and Infrastructure 2011c). The Department prepares high-level strategic plans such as the Sydney Metropolitan Strategy, Regional Strategies and Subregional Strategies, seeking input from local government, communities and business (Kübler 2005). It also guides the creation of the more detailed local plans.
- Local Governments are responsible for subdivisions, building regulations and for making decisions regarding development applications, apart from those deemed by the Minister to be of regional or state planning significance (Productivity Commission 2011, Kübler 2005). Councils also prepare Local Environmental Plans based on a standard template, although it is ultimately the Minister for Planning who makes LEPs (EDO 2009).
- Joint Regional Planning Panels are statutory bodies that provide decision making on regionally significant projects and are intended to provide a balance of expertise, independence and local knowledge (Keneally 2009). There are six panels covering all of NSW, and two situated in the Sydney metropolitan region. Each panel consists of three State Government appointed members and two nominees from the relevant local council.
- The NSW Planning Assessment Commission is a statutory body which began operations in 2008 and provides 'an additional level of expert scrutiny in the review or determination of some major development proposals, particularly those where a potential or perceived conflict of interest exists' (PAC 2010, p.5). The Commission determines project applications that are delegated to it by the Minister for Planning, including those within the Minister's electorate and those with a reportable political donation (ibid.). It also provides advice to the Minister on a range of planning and development issues, such as environmental aspects of proposed developments.⁴
- Independent Planning Assessment and Review Panels may be appointed to undertake a strategic inquiry, review particular planning matters or exercise the functions of a local council where performance is unsatisfactory (Productivity Commission 2011).
- *Transport for NSW* is the department responsible for transport policy, planning and coordination functions, as well as oversight of infrastructure delivery and asset management.

The Productivity Commission (2011, p.76) notes that, compared to Western Australia and South Australia, in NSW (and the remaining states) 'decision making is more focused at the local council level'. Nevertheless, there are concerns in local government that planning instruments such as Development Corporations have allowed the State Government to appropriate planning control of particular areas away from local government (Kübler 2005). An example of a Development Corporation is the establishment of the Sydney Metropolitan Development Authority (SMDA) in 2010 to drive housing and employment opportunities in urban renewal precincts serviced by public transport and infrastructure (Kelly 2010). Others have argued that centralisation of planning powers within the state government can provide increased certainty and has been beneficial in attracting investment and development through coordinated macro planning (Williams 2007 in Bunker 2008, p.35). However, a recent survey of businesses judged the NSW planning system as being more difficult to operate under than the planning systems of Victoria and Queensland (Productivity Commission 2011).

Box 2.1 The current NSW Government

The Liberal-National Coalition Government, led by Premier Barry O'Farrell, was elected on 26 March 2011, and is in the process of making a range of changes to the NSW planning system.

During the election campaign, the NSW Coalition signalled their intention to increase the proportion of fringe development in Sydney beyond the existing 30 per cent target specified in the *Sydney 2036* strategic plan (Nicholls 2011, Chancellor 2011). The new government's 100 day action plan, announced in April 2011, contained a range of planning and infrastructure related initiatives, including 'instruct Landcom to target the release of 10,000 housing blocks within four years' (NSW Government 2011a, p.2). In July 2011, the Premier announced the accelerated release of land for 13 000 new homes in the North West and South West Growth Centres (O'Farrell 2011). In early 2012 the Government published a schedule of landowner nominated sites for housing development, many of which are outside the North West and South West Growth Centres. It established a committee, run by the Premiers Department, which is tasked with assessing the developer proposals and identifying sites that could produce housing within the next three years 'at no additional cost to government' (Moore 2012).

An 18 month review of the NSW planning system has been announced, which will set out 'the Government's new framework for the NSW Planning System, including the draft legislation' (Hazzard 2011). In May 2012, a discussion paper was released for the new 20-year Metropolitan Strategy, which will be integrated with the Long-Term Transport Master Plan and the State Infrastructure Strategy, and is due to be finalised by the end of 2012 (NSW Government 2012). The Government will examine giving legislative backing to the new Metropolitan Strategy and will develop 'a clear mechanism to ensure the strategy is properly delivered' (Hazzard 2012 p.1).

Parliament has repealed the section of the EPA Act relating to State significant projects and introduced an alternative assessment system for projects of genuine State significance (Department of Planning and Infrastructure 2011b). These new planning laws limit the Planning Minister's powers to override councils (Salusinszky 2011). The Government also passed legislation to establish Infrastructure NSW (NSW Government 2011b). In the 2011 NSW Budget, \$1.7 billion was committed to the South West Rail Link and a provisional estimate of \$2.5 billion for the North West Rail Link over the forward estimates (ibid.).

The Government also launched *NSW 2021*—a 10-year strategic plan which replaces the previous *NSW State Plan* (NSW Government 2011c). It outlines 32 core objectives for the State, including: invest in critical infrastructure, build liveable centres, improve housing availability, reduce travel times, grow public transport patronage and restore confidence and integrity in the planning system (ibid.).

The strategic planning system

Analysing a capital city strategic planning system is a complex task, as there are a range of planning documents that together may amount to the system (KPMG 2010). The scale and scope of these documents vary, such as state strategic plans, metropolitan strategic plans, regional plans and infrastructure or transport plans. KPMG (2010) note that five key strategy documents encapsulated the Sydney planning strategy as of 2010—the *NSW State Plan* (2010), *City of Cities* (2005), *State Infrastructure Strategy* (2008), *Sydney 2036* (2010) and the *Metropolitan Transport Plan* (2010). Taken together, the plans emphasise efficient use of existing infrastructure and centres policy as the basis for future growth. They also promote jobs closer to home, improved accessibility and efficient public transport.

Kübler (2005) notes that the Sydney metropolitan region has had a strong history of strategic planning documents that have included:

- The *County of Cumberland Plan 1948* was developed by the County of Cumberland Council, an independent Council that stretched from Broken Bay in the north, to the edge of Wollongong in the south, and west to the Nepean River (it covered most of the modern-day Sydney metropolitan area). The Council acted as the link between state and local governments by fitting local planning schemes into the overall plan for the city. The plan was based on land-use and development controls to manage the growth of the city.
- The *Sydney Region Outline Plan 1968* was developed by the State Planning Authority (SPA) who replaced the County of Cumberland Council. It offered strategic guidance in a period of high rates of economic and demographic growth (which the Cumberland Plan failed to sufficiently take into account). The plan identified corridors of growth combined with suburban town centres, complemented by a metropolitan freeway network.
- The *Metropolitan Strategy 1988* was developed by the Department of Environment and Planning (originally the State Planning Authority). It aimed to limit urban sprawl through urban consolidation via smaller lot sizes, increased proportions of townhouses and flats, the promotion of medium density housing and a connected road and rail network.

Following the *Metropolitan Strategy 1988*, Sydney's metropolitan planning initiatives initially shifted away from an outcomes-oriented approach to process-oriented planning with limited spatial content (Kübler 2005). The strategic plans released during this period identified a set of broad principles to guide planning in the Greater Metropolitan Region, but contained very little in the way of detail or quantifiable objectives. These plans represented an attempt to cope with, rather than challenge, the existing housing and employment trends (Gleeson et al. 2004):

- *Cities for the 21st Century* (1994) outlined an integrated urban management plan for Sydney, Newcastle, the Central Coast and Wollongong developed by the NSW Department of Planning. The emphasis was on process rather than fixed proposals (Searle 2004).
- *Shaping our Cities* (1999), prepared by the Department of Urban Affairs and Planning, aimed to create a more compact urban structure, reduce the need for car travel and encourage a shift towards public transport, cycling and walking.

The two most recent strategic plans are much more detailed and reflect the desire to progressively transform the NSW planning system 'from a process driven approach to an outcomes focused service' (Iemma 2006):

- *City of Cities – A Plan for Sydney's Future* (2005) is a planning exercise managed by the Department of Planning. It supports continuing economic growth while balancing social and environmental impacts and is based on anticipated population, economic and demographic trends. The plan aims to enhance liveability, strengthen economic competitiveness, maintain fairness, protect the environment and improve governance. The strategy includes key policies on economy and employment, centres and corridors, housing, transport, environment and resources and parks and public places (NSW Government 2005).
- *Metropolitan Plan for Sydney 2036* (2010) is an update and continuation of *City of Cities*. It builds on the principles of the previous strategy and emphasises Sydney's long term economic development and growth while maintaining its environment (NSW Government 2010a).

Over time the definition of the Sydney metropolitan region has varied. The two most recent strategic plans—*City of Cities* and *Sydney 2036*—relate to all of the Sydney Statistical Division, apart from the Central Coast (which is covered by its own Regional Strategy). These two recent metropolitan strategic plans are discussed in greater detail later in this chapter.

In recent times, NSW has had a state plan—an overarching strategic document which identifies goals and priorities and thus sets the context for the NSW Government's other strategic plans. The initial *State Plan* was produced in 2006 (NSW Government 2006) and was updated in 2010 to respond to new community priorities and needs identified through a consultation process (NSW Government 2010c). The 2010 plan retains about 75 per cent of the priorities and targets from the 2006 version, including the priorities of increasing use of public transport and jobs closer to home (*ibid.*). Two priorities stand out in the context of this study: firstly a stronger economy (supporting jobs and attracting business investment) and secondly an improved transport network which is safe, reliable and accessible. The 2010 *State Plan* has been replaced by *NSW 2021*, which is a 10 year plan setting out the government's agenda for change in NSW. It identifies 32 goals, 180 targets and details the priority actions to support achievement of each target (NSW Government 2011c).

Infrastructure networks form the essential 'connective tissue' of a city and shape urban outcomes. Thus '...unless infrastructure policy is conceived within a clear strategic spatial comprehension of cities it risks creating new urban spatial problems that future spatial planners will be called upon to resolve' (Dodson 2009, p.10). Infrastructure plans—and their alignment with metropolitan strategies—therefore form an important element of Sydney's strategic planning system (Hutchings and Hammetts 2006). Sydney's recent infrastructure plans include:

- The *Integrated Transport Strategy for Greater Sydney 1995* provided a range of broad objectives for transport, highlighting the need to find a balance between efficiency, equity, environmental protection and safety.
- The *Metropolitan Water Plan 2006* detailed how the NSW Government would provide a secure supply of water to meet the long term needs of Sydney. The plan provided a framework for a sustainable and secure water system for people and rivers over the next 25 years. The *2006 Metropolitan Water Plan* was reviewed and updated in the *2010 Metropolitan Water Plan*.

- The *State Infrastructure Strategy 2008* is the second State Infrastructure Strategy to be released, and outlines capital projects in NSW over a ten year timeframe. The Strategy aims to facilitate more effective budget planning and prioritisation of the NSW Government's infrastructure projects.
- The most recent *Metropolitan Transport Plan—Connecting the City of Cities* (2010) emphasises the importance of integration of transport planning with the *Metropolitan Plan for Sydney 2036*. It aims to effectively link transport networks and land use planning and to encourage public transport in order to make Sydney a more connected and sustainable city. The vision is that 'by 2036, Sydney will be more compact, networked city with improved accessibility, capable of supporting more jobs, homes and lifestyle opportunities within the existing urban footprint' (NSW Government 2010c, p.15). The transport plan outlines the NSW government commitment to the delivery of transport that will meet the demand of Sydney's population over the next 10 years, with a funding commitment of \$50.2 billion.

Recent strategic plans—*City of Cities* and *Sydney 2036*

This section focuses on the strategic plans in operation over the 2001 to 2010 period. Prior to the release of *City of Cities* in 2005, *Shaping our Cities* (1999) was the operational strategic plan. *Shaping our Cities* consisted of a set of broad principles to guide planning in the Greater Metropolitan Region, but contained very little in the way of detail or quantifiable objectives. The guiding principles of relevance to this project included:

- Manage the housing supply to create a compact urban structure
- Create opportunities for jobs and business growth in locations that are accessible by public transport and minimise conflict with other uses
- Improve opportunities for walking, cycling and public transport use
- Development decisions should seek to contain the growth of travel demand
- Encourage investment, job creation and business confidence.

City of Cities—A Plan for Sydney's Future (2005) presents the government's vision for achieving a stronger Sydney over the next few decades, which consists of eight key elements (NSW Government 2005, p.8):

- Stronger cities within the metropolitan area
- Strong global economic corridor
- More jobs in Western Sydney
- Contain Sydney's urban footprint
- Major centres will emerge as jobs, service and residential locations
- Fair access to housing, jobs, services and open space
- Connected centres
- Better connected and stronger regions.

The most recent Metropolitan Plan, *Sydney 2036*, draws on the principles of two documents—*City of Cities* and the 2010 *Metropolitan Transport Plan: Connecting the City of Cities* (NSW Government 2010c). *Sydney 2036* represents the first review and update of *City of Cities*. The purpose of this review was to identify and respond to the challenges of the Global Financial Crisis, expected population growth, housing affordability and climate change. It also aimed to address the Council of Australian Governments (COAG) national criteria for capital city strategic planning systems. The principal aims include limiting urban sprawl, protecting resource lands, encouraging development near public transport, reducing the need for car travel and more jobs located near homes. *Sydney 2036* articulates a set of performance measures which will be used to monitor the success of the Metropolitan Strategy, and provides recent benchmarks. An example is provided in Table 2.1.

Table 2.1 Metropolitan Strategy performance: measure of success

Aim	Measure	Benchmark	2010 Metropolitan Strategy Review
Enhance liveability	Quality of living: maintain or improve Sydney's index and ranking of quality of living	In 2005 Sydney ranked 8 out of 260 cities in the Mercer Quality of Living Survey with an index score of 105.	In 2010 Sydney ranked 10 of 221 cities in the Quality of Living Survey with an index of 106.3.
Strengthen economic competitiveness	Contribution to national economy: maintain or increase the proportion and value of Sydney's contribution to GDP	In 1998-99 Sydney produced 23 per cent of Australia's value added.	In 2009 Sydney's contribution to GDP had increased to 24.9 per cent.
Ensure fairness	Access to services: Increase the percentage of the population living within 30 minutes by public transport of a city or major centre	In 2005, 75 per cent of Sydney residents could access a major centre, regional city or Global Sydney within 30 minutes by public transport.	In 2010, 77 per cent of Sydney's residents can access a major centre, regional city or Global Sydney within 30 minutes by public transport.
Protect the environment	Environmental footprint: no increase in environmental footprint per capita	Between 1994 and 1999 the environmental footprint of Sydney residents increased by 16 per cent to 6.78 hectares per person.	From 1999 to 2004, Sydney's environmental footprint increased 6 per cent to 7.21 hectares per person.
Improve governance	Metropolitan Strategy and Infrastructure: identified transport and infrastructure needs to inform the annual State Infrastructure Strategy	Budget Paper 4 responds to transport and infrastructure priorities as identified in the State Infrastructure Strategy.	The Metropolitan Plan integrates land use, transport and infrastructure. It prioritises infrastructure investment and guarantees 10 year funding for transport projects. This is reflected in the State Infrastructure Strategy and Budgets.

Source: NSW Government 2010a, p.247.

Sydney 2036 and *City of Cities* both provide a framework for facilitating and managing the city's growth and development over a 25 year timeframe. The plans identify the extent to which new residential development is expected to be accommodated in either greenfields or established urban areas and the centres that are best placed to cater for future growth. In this respect, the recent Metropolitan Strategies are highly detailed and quite prescriptive (Bunker and Holloway 2006).

Both *Sydney 2036* and *City of Cities* position Sydney as a globalised competitive city, aiming to attract foreign investment and specialised skilled people and professionals from around the world. For example, *City of Cities* highlights the spatial pattern of high skill and knowledge industries which tend to cluster as specialist employment nodes in a 'global economic corridor' linking the central city to inner suburbs to the north and south. There are ideas of strengthening and reaping the benefits of this type of agglomeration to drive innovation and competitiveness (Bunker and Searle 2007). The separation and specialisation of functions and use of space in the city, whilst attracting investment and tourists on one hand, can create fragmentation and polarisation on the other hand (Kipfer and Keil 2002).

The strategies have structured Sydney by a system of regional cities and major centres, networked by rail lines and bus corridors. Both strategies plan for an intensification of suburban densities through higher density housing in and surrounding centres, which can be accessed by public transport.

The remainder of this chapter provides further detail on two key elements of the recent strategies—accommodating future growth and activity centres—before summarising the issues that have been raised by reviews of these strategic plans, with a particular focus on governance issues.

Accommodating future growth

Much of the focus of the recent metropolitan strategies has been on planning for where residents will live and work within Sydney over a 25 year timeframe. *City of Cities* forecasts that Sydney's population will increase by 1.1 million to reach 5.3 million by 2031 (NSW Government 2005). Substantial immigration flows have meant that population growth has been stronger than anticipated in recent years. Reflecting this, *Sydney 2036* reviewed and updated the forecasts of population and the associated demand for housing. By 2036, Sydney is expected to add 1.7 million to reach almost 6 million population, which will require the provision of 770 000 additional homes.

The recent metropolitan strategies seek to limit urban sprawl by accommodating the majority of Sydney's residential growth within the established urban area. *City of Cities* contains a target that 60 to 70 per cent of new housing will be accommodated in the existing urban area, rather than in new land release areas (NSW Government 2005). This urban consolidation is to be achieved by smaller lot sizes, an increased proportion of townhouses and flats, and the promotion of medium to high density housing around centres and in corridors (Bunker and Searle 2009). *Sydney 2036* contained a revised target that at least 70 per cent of new homes would be located within the existing urban area (NSW Government 2010a). Evidence of urban consolidation over the past five years suggests that '...the market signals for renewal and redevelopment are not there in many parts of the city, and without policy intervention, the dwelling targets are unlikely to be met' (Randolph, Pinnegar et al. 2010, p.3).

Employment capacity targets are also presented which are 'closely related to trend based projections, but they recognise that more concerted action may be needed in some areas to stimulate private sector investment and employment growth' (NSW Government 2005, p.14). These targets are intended to ensure that enough zoned land is available to support job growth. Bunker and Holloway (2006, p.6) describe the 2031 employment targets as 'essentially scoping exercises', with realisation dependent on how the private sector and government take

up and support development opportunities over time. The employment capacity target for Sydney in 2036 is 760 000 new jobs (NSW Government 2010a).

The metropolitan targets have been translated into subregional targets of dwellings and employment. Targets were initially produced for 2031 and have since been updated to 2036. The subregional targets for new homes and jobs are presented in Table 2.2. The purpose of the targets is to provide more certainty for investors, but as noted by Randolph et al. (2010), this sense of certainty rarely transpires in reality.

The Metropolitan Strategies also specify employment targets for strategic centres. The relevant population, employment and dwelling targets will be discussed further in Chapter 9 which discusses the outlook for Sydney.

Also of relevance to accommodating Sydney's residential growth is the *Metropolitan Development Program (MDP)*, which monitors and manages housing supply in the Sydney SD and covers major infill sites in existing urban areas as well as the release of greenfield sites. The MDP includes indicative ten year forecasts of dwelling supply (Department of Planning and Infrastructure 2011e).

Table 2.2 Subregional new homes and jobs targets, Sydney, 2005

Planning subregion	Local Government Area	New homes target		New jobs target	
		2031	2036	2031	2036
Sydney City	Sydney City	55 000	61 000	58 000	114 000
East	Botany Bay, Randwick, Waverley, Woollahra	20 000	23 000	17 500	31 000
Inner North	Lane Cove, North Sydney, Ryde, Willoughby, Hunters Hill, Mosman	30 000	44 000	54 000	62 000
Inner West	Ashfield, Burwood, Canada Bay, Leichhardt, Strathfield	30 000	35 000	10 000	25 000
South	Kogarah, Hurstville, Canterbury, Rockdale, Sutherland, Marrickville	35 000	58 000	21 000	52 000
North	Hornsby, Ku-ring-gai	21 000	29 000	8 000	15 000
North East	Pittwater, Warringah, Manly	17 300	29 000	16 000	23 000
West Central	Auburn, Bankstown, Fairfield, Holroyd, Parramatta	95 500	96 000	35 000	98 000
North West	Baulkham Hills, Blacktown, Blue Mountains, Hawkesbury, Penrith	140 000	169 000	90 000	145 000
South West	Wollondilly, Camden, Campbelltown, Liverpool	155 000	155 000	80 000	141 000
Central Coast	Gosford, Wyong	56 000	70 000	55 000	54 000
Sydney Total		654 800	769 000	444 500	760 000

Notes: For 2031 target new homes/jobs were compared to a 2004 base, while for the updated 2036 target, new homes/jobs were compared to a 2006 base.

Source: Adapted from NSW Government (2005)—*City of Cities* and NSW Government (2010a)—*Sydney 2036*.

Activity centres

“Centres and Corridors” is a central instrument in the planning of Sydney to 2031 and is interwoven with, and affects, other strategies concerned with economy and development; housing; transport; environment and resources; and implementation and governance’ (Bunker, Tice and Easthope 2009, p.5).

City of Cities and *Sydney 2036* both emphasise a hierarchy of centres—including Global Sydney (Central Sydney and North Sydney), regional city centres, major centres and specialised centres—which are connected by the railway network, bus corridors and an orbital motorway network (NSW Government 2005). Table 2.3 details the functions of each of these higher-order activity centres, while Map 2.1 displays their geographic locations. The map illustrates the *City of Cities* vision of a spatial economy structured by clearly defined systems of regional cities and major centres within the metropolitan area, joined by rail networks and corridors.

The most significant in the hierarchy are Sydney City and North Sydney forming *Global Sydney*. The concept of Global Sydney was created to reinforce global competitiveness and links to regional economies. It is the major employment centre and economic driver of Sydney and the overall Greater Metropolitan Area. Sydney City is defined as comprising five broad precincts—Sydney CBD, City East, Pyrmont-Ultimo, Sydney Education and Health Precinct, and Redfern Centre.

Table 2.3 Activity centres, Sydney, 2006

Centre type	Concentration of activities in area	Specific centres
Global Sydney	The main focus for national and international business, professional services, specialised health and education precincts, specialised shops and tourism, it is also a recreation and entertainment destination for the Sydney region and has national and international significance.	Sydney City* North Sydney
Regional Cities	With a full range of business, government, retail, cultural, entertainment and recreational activities. They are a focal point for regional transport and jobs.	Parramatta Liverpool Penrith
Specialised Centres	Areas containing major airports, ports, hospitals, universities, research and business activities that perform vital economic and employment roles across the metropolitan area. The way they interact with the rest of the city is complex and growth and change in and around them must be managed.	Macquarie Park, St Leonards, Olympic Park/Rhodes, Port Botany, Sydney Airport, Randwick Education and Health, Westmead, Bankstown Airport/Milperra, Norwest
Major Centres	The major shopping and business centre for the surrounding area with a full scale shopping mall, council offices, taller office and residential buildings, central community facilities and a minimum of 8000 jobs.	Bankstown, Blacktown, Bondi Junction, Brookvale/Dee Why, Burwood, Campbelltown, Castle Hill, Chatswood, Hornsby, Hurstville, Kogarah

Notes: The Sydney activity centre hierarchy also includes towns, villages and neighbourhood centres. Outside Metropolitan Sydney, Wollongong is the regional city for the Illawarra, Newcastle is the regional city for the Lower Hunter and Gosford is the regional city for the Central Coast.

*Sydney City includes the CBD, Sydney Education and Health Precinct, Pyrmont-Ultimo, City East (e.g. Kings Cross, St Vincent's/Darlinghurst Health Precinct) and Redfern Centre.

Source: NSW Government 2005.

Map 2.1 Sydney Metropolitan Strategy: main centres, 2005



Sources: NSW Government 2005, Figure B3.

There are three regional cities in the West of Metropolitan Sydney at Parramatta, Liverpool and Penrith (see Table 2.3), and three in the rest of the Greater Metropolitan Area—Newcastle, Wollongong and Gosford. There are nine specialised centres ranging from Port Botany to Randwick Education and Health. The twelve major centres exercise more generalised functions. The Metropolitan Plan aims to strengthen the roles of these centres so that they are able to increase their share of total employment (Bunker 2007).

Productivity Commission (2011, p.289) points out that 'despite New South Wales claims that out-of-centre developments are actively discouraged, only about 20 per cent of NSW councils reported implementing an activity centres approach (the lowest of any state) and NSW councils reported refusing only two DAs on the basis that they were inconsistent with activity centres policy'. Productivity Commission (2011) also notes that NSW and the ACT appear most susceptible to businesses pushing for special consideration or attempting to locate in out-of-centre locations as a way of circumventing prescriptive activity centre regulations.

Urban governance

In the Australian context, there are three models informing urban governance—governance through hierarchy, through market and through negotiation (Kübler 2005). Sydney's recent strategic plans primarily follow a hierarchical approach to governance that has a structured division of labour with clear hierarchical authority and control at different levels (ibid.). The initial phase of *City of Cities* showed a shift towards governance through negotiation, as evident in the consultation forums that were held with stakeholders in the initial phases of developing the plan (ibid.). This negotiative approach is often useful in mediating and managing expectations

between stakeholders and the state government. However, this approach was not consistently followed through in the later phases of the process—particularly in the decision making stage. The danger of switching from a negotiative to hierarchic form of governance part way through the process is explained by Kübler (2005, p.36):

'one probably ends up getting the worst of both worlds...the final Strategy will either be weak because it avoids the hot issues, or be a strong document that does take clear stances but then lacks the wide support necessary to its successful implementation.'

The final development of *City of Cities* was completed with limited stakeholder involvement and hierarchical governance dominated the ultimate decision making process, with local councils viewed as instruments of implementation rather than partners in governance (Bunker 2008).

City of Cities provides a blue print for the future distribution of population, dwellings and jobs throughout Sydney, identifying targets for subregions and centres. Through the subregional planning process, these targets are allocated to council areas, and are then used by councils to prepare LEPs to a standard template. These targets have implications in terms of environmental and social impacts, traffic generation and infrastructure provision which may only be understood once the detailed local planning is completed. Bunker and Searle (2007) report that many councils argue this detailed planning should be done before the targets are imposed, so the necessary adjustments can be made to arrive at a final target. Despite the strong centralised plan at the State level, there has been a problem of sequencing and translating the plans and targets and efforts of implementation to the local level and as a result, different subregional and local targets lack the community support needed for successful implementation (ibid.).

Kübler (2005) discusses how the split in planning responsibilities has been associated with significant inter-governmental tensions in NSW. During the consultation on *City of Cities*, local governments made many submissions calling for stronger involvement with councils and recognition of their local knowledge. Significant concerns have continued to exist, with the Productivity Commission (2011, p. XXXVI) concluding, based on a 2010 survey of councils, that 'New South Wales and Tasmanian councils seem to have the most difficult relationship with their state government'.

Easthope and Randolph (2008, p.18) point out how 'urban consolidation raises significant economic, political, environmental and social challenges' and presents a challenge for urban governance. In particular, a high density city needs governance in which the implications of regulation, representation, and social and economic forces are clear and properly understood (ibid.).

Thornley (1999, p.13) previously highlighted 'the paramount importance of short term economic imperative' in the government's agenda and the dominance of specific pressure groups, particularly the private sector, as an issue of concern for the urban governance of Sydney. Sydney's recent metropolitan strategies have continued to emphasise economic goals, with Bunker and Searle (2007) noting that, by default, *City of Cities* serves as the economic development plan for Sydney. This economic emphasis is more pronounced for Sydney's strategic planning than for other Australian cities, such as Melbourne and Perth.

Reviews of recent strategic plans

The assessment of Sydney's strategic planning system in COAG Reform Council (2012) was influenced by the transitional status of the NSW planning system at the time of the review, which affected a number of findings. Key findings include:

'The system contains strong planning and policy content, however it lacks the hard-edged accountability, performance and implementation measures to drive these policies.

The drive towards densification and making Sydney a '*City of Cities*' requires a delicate balancing act between affordability and growth, on the one hand, and productivity and sustainability goals, on the other' (ibid., p.4).

KPMG (2010) identify the strengths of the Sydney strategic planning system as including the comprehensiveness of the documentation at different scales (the state, metropolitan and regional based plans), the annual monitoring of greenfield and infill land supply through the Metropolitan Development Program, and the shift to a greater emphasis on integration between the Metropolitan Transport Plan and the Metropolitan Plan.

Bunker and Searle (2007) conclude that Sydney's recent metropolitan strategic planning, in seeking to provide certainty, has been overly detailed and prescriptive. Bunker (2008) highlights gaps in the research basis of *City of Cities*, including a lack of analysis of social equity issues, limited reference to Australian research on urban development, and insufficient appreciation of the complex influences shaping residents' behaviour. The current planning process, with its strongly articulated targets, is not considered to be well suited to an urban environment which increasingly requires flexibility and rapid policy adjustments in the context of major uncertainties (ibid.).

Urban Taskforce Australia (2010) is critical of the failure to implement various aspects of *City of Cities*, such as the corridor initiatives, and highlights the limited progress achieved relative to the stated targets for creating jobs in Western Sydney and delivering additional homes. It is recommended that the 'NSW Government measure its performance based on actual outcomes on the ground, not on procedural requirements' (ibid., p.18).

According to KPMG (2010), differences in the timeframe of transport and infrastructure planning (10 years) and the Metropolitan Strategy (25 years) are a fundamental flaw of the planning system. KPMG (2010) ranked Sydney sixth of the eight capital cities in terms of consistency with the Council of Australian Government (COAG) national criteria for capital city strategic planning systems, due principally to poor implementation. As Bunker and Searle (2007, p.631) point out, 'Sydney has a long history of promised improvements and major projects to strengthen public transport which have not happened.'

KPMG (2010) identifies a continuation of this pattern, citing 'changes in priority to major transport infrastructure projects, such as the North West Rail Link, CBD Metro and West Metro' which indicate 'a lack of predictability and certainty in the way the Sydney strategic planning system operates' (ibid., p.10).

Thus, a key challenge for Sydney is to align and strengthen planning and coordination of government decision making to deliver on priorities. KPMG (2010, p.50) conclude that in addition to strengthening decision making frameworks, there 'are major challenges in terms of linking growth with employment and transport, avoiding further social polarisation and removing obstacles to land supply and development'.

Strategic planning objectives of relevance to BITRE study

This section identifies the strategic planning goals that specifically relate to the spatial distribution of population and jobs and to commuting patterns within Sydney.

The present BITRE study focuses on the 2001 to 2010 period, and for much of this period *City of Cities* was the operational strategic plan. *Shaping our Cities* (1999) was the operational strategic plan prior to the release of *City of Cities* in December 2005, but while it outlined a set of broad principles to guide planning, it contained very little in the way of detail or quantifiable objectives.

BITRE's analysis of strategic planning objectives for the 2001 to 2010 period also considers the *Sydney 2036* metropolitan strategy (which was released in December 2010), and investigates the extent to which the strategic planning goals articulated in *City of Cities* have been retained, changed or elaborated upon within *Sydney 2036*.

The scope of *City of Cities* and *Sydney 2036* extend well beyond the scope of this BITRE study, which is focused on changes in the spatial distribution of population and jobs and on changes in commuting patterns within Sydney. Table 2.4 identifies the detailed strategic planning goals from *City of Cities* and *Sydney 2036* which are of most relevance to the present study, grouping them into 14 broad strategic planning goals that relate to either:

- the spatial distribution of the residential population,
- the spatial distribution of jobs and industry, or
- commuter flows and transport use by commuters.

The two metropolitan strategies also detail dwelling and employment capacity targets for all subregions and strategic centres in Sydney, which are intended to guide the future spatial distribution of employment and the residential population throughout the metropolitan area, and are therefore of considerable relevance to the present study.

A high proportion of the objectives listed in Table 2.4 relate to activity centres—with centres-focused objectives featuring for each of population, jobs and industry, and commuter transport. The strong economic emphasis of these strategies is also evident in the table, with many of the detailed objectives relating to the spatial distribution of employment and industries. Only a handful of the listed objectives include quantitative targets.

Table 2.4 Summary of *City of Cities* and *Sydney 2036* objectives of relevance to BITRE study

Broad objective	Detailed objectives from <i>City of Cities</i> (2005)	Detailed objectives from <i>Sydney 2036</i> (2010)
Spatial patterns of residential development—Chapter 3		
Limit urban sprawl	Contain Sydney's urban footprint by ensuring 60 to 70 per cent of new housing development occurs within the existing urban area (pp.209, 217)	Contain the urban footprint by locating at least 70 per cent of new homes in existing suburbs (pp.6, 44, 114, 249)
Focus residential development around centres	Focus residential development around centres (pp.140–41)	Locate at least 80 per cent of all new homes within the walking catchments of existing and planned centres (pp. 6, 63, 248)
Increase residential densities in centres	Increase residential densities in centres (p.96)	More medium density housing in and around local centres (p.117)
Focus residential development in renewal corridors	Focus residential development in the Parramatta to City renewal corridor (p.112)	None
Spatial patterns of jobs and industries—Chapters 4 and 5		
Focus job growth in strategic centres#	Increase the share of jobs in strategic centres (p.94)	Focus employment in strategic centres (pp.134, 250) Promote economic development of regional cities, including strengthening of Parramatta's role as the premier regional city and second CBD (pp. 6, 38, 248)
Accommodate about 20 per cent of jobs in employment lands	Aim to locate over 100 000 new jobs, and 23 per cent of all employment, in employment lands (pp.60–61)	The share of jobs in employment lands will be maintained at about 20 per cent (p.140)
More jobs in Western Sydney	Accommodate close to half of all new jobs in Western Sydney, particularly in its regional cities and specialised centres (pp.8, 39)	Accommodate half of all new jobs in Western Sydney, focusing on cities and centres (p.6) Increase the diversity of jobs in Western Sydney (pp.148–49)
Enable job growth in corridors	Strengthen the role of economic corridors, including locating around 30 per cent of new jobs in the Global Economic Corridor (pp. 46, 83) Focus economic development in the Parramatta to City renewal corridor (p.112)	Protect commercial core areas in the Global Economic Corridor so there is capacity to attract global businesses and meet employment targets (p.45)
Better align jobs with where people live	Ensure that job growth matches population growth in rapidly growing subregions (p.59)	Ensure more jobs are located closer to home (pp.6, 132)*
Strengthen core functions of centres and corridors	Protect the core functions of specialised centres, economic corridors and strategically located employment lands (pp.61, 101, 46, 83) Cluster business and knowledge-based activities in strategic centres (p.97) Concentrate retail activity in centres, business development zones and enterprise corridors (p.104)	Strengthen clusters of activity in specialised centres and strengthen existing freight and industry clusters (pp.138, 144, 154) Focus commercial and retail jobs in strategic centres (pp.62, 134) Strengthen the city centre's position as a specialised retail and hospitality location (p.50)

Continued over page

Table 2.4 continued

Broad objective	Detailed objectives from <i>City of Cities</i> (2005)	Detailed objectives from <i>Sydney 2036</i> (2010)
Commuter flows and transport use—Chapters 6 and 7		
Greater use of public transport [^] #	Encourage more sustainable travel, with greater use of public transport (p.181)	Increase the public transport mode share (pp.91, 248)
Greater use of active transport [^] #	Encourage more sustainable travel, with greater use of walking and cycling (p.181)	Promote active transport opportunities (pp.97, 251)
Better connect people to centres [^] #	Better connect people to centres, with an increase in the share of trips made by public transport to centres (pp.91, 101, 165)	Ensure key centres are accessible and connected (p.96)
Concentrate development near public transport [#]	Concentrate population and activities near the public transport network (pp.83, 131)	Target development around existing and planned transport capacity (pp.6, 91)
People work closer to home [#]	Reduce average journey to work travel times from Western Sydney and the Central Coast (p.58)	Ensure more jobs are located closer to home (pp.6, 148)* Increase employment self-containment in Western Sydney (p.148)

Notes: [^] NSW 2021 (NSW Government 2011c) provides quantitative targets relevant to these objectives.

[#] These are amongst the stated objectives/targets of NSW 2021 (NSW Government 2011c), which replaces the previous *State Plan*. Note that NSW 2021 makes a firmer commitment to “reduce travel times”, than did *Sydney 2036* and *City of Cities*.

*This detailed objective has been allocated to two broad objectives, as it can be interpreted in two rather different ways, namely as (a) increasing the number of jobs that exist in residentially oriented parts of the city, or (b) ensuring the jobs people actually work in are increasingly located close to their place of residence. While both interpretations are evident in *Sydney 2036*, the first interpretation is more prominent.

Source: BITRE analysis of *City of Cities* (NSW Government 2005) and *Sydney 2036* (NSW Government 2010a).

With the release of *Sydney 2036* in December 2010, all of the previous population, housing and employment capacity targets were updated. While *Sydney 2036* retains most of the broad principles of *City of Cities*, the language used to articulate the objectives and the quantitative targets has been modified. Some particular points of difference include:

- Renewal corridors receive less attention in *Sydney 2036* than in *City of Cities*. The focus shifts to centres within those corridors, rather than the corridor as a whole (NSW Government 2010a, p.61).
- Economic corridors were an important focus of *City of Cities*, but with the exception of the global economic corridor are not discussed in *Sydney 2036*. Similarly, enterprise corridors receive limited attention in *Sydney 2036*.
- Both strategies aim to concentrate employment in strategic centres, but *Sydney 2036* places a greater emphasis on the regional cities, particularly Parramatta.
- *City of Cities* recognised that greenfield development would occur in both the growth centres and in other locations, without providing guidance on the desired mix (NSW Government 2005, p.217), while *Sydney 2036* specifies that greenfield development should be focused in the designated growth centres.
- *City of Cities* gives greater prominence to increasing residential densities in centres than *Sydney 2036*, which shifts the focus to medium density development in local centres.
- There are a range of industry-based objectives in each plan—relating to retail, hospitality, commercial, rural, freight and knowledge-based activities—but these objectives only partially overlap between the two strategies.
- While *City of Cities* and *Sydney 2036* aimed to locate a similar proportion of new jobs in Western Sydney, *City of Cities* did not specifically seek to boost self-containment (i.e. the proportion who live and work in the same region).

These differences largely represent refinements and changes in emphasis, rather than major shifts in direction between the two Metropolitan Strategies. Most of the relevant objectives from *Sydney 2036* are carryovers from *City of Cities*, albeit with slightly different wording and in some cases, updated targets. Several of these objectives also feature in *NSW 2021*, the *NSW State Plan* (2006, 2010) and/or the *Metropolitan Transport Plan 2010*, with the state plans incorporating quantitative targets for public transport use and active travel.

The planning objectives from Table 2.4 will be revisited in the chapters that follow, which will include analysis of the changes that have actually occurred against these objectives since 2001.

In summary

The metropolitan strategic plans provide important context for this study. *City of Cities* and *Sydney 2036* have the following common goals that relate to the spatial distribution of population and employment, or to commuting:

- Limit urban sprawl through urban consolidation
- Concentrate residential development and job growth in and around centres, thus increasing the density of centres
- Grow jobs in Western Sydney and the Global Economic Corridor
- Protect and strengthen the existing economic functions of the different categories of centres and corridors
- Concentrate development near the public transport network
- Better connect people to centres
- Achieve greater use of sustainable transport modes—public transport, cycling and walking
- Ensure people work closer to home.

BITRE's spatial analysis of population growth, job growth and changes in commuting flows focuses on the 2001 to 2010 period. Where data permits, the study will analyse progress against the planning objectives since 2001. However, as *City of Cities* was not released until 2005, these comparisons are not intended to evaluate the success of *City of Cities* or any other strategic plan. Rather, the primary purpose of BITRE's study is to provide evidence about the trends that have been shaping the city of Sydney, which can then be used to inform future planning initiatives.

CHAPTER 3

Residential patterns and trends

Key points

- Around 54 per cent of the Sydney SD's population lives in the Outer sector, 29 per cent in the Middle sector and 17 per cent in the Inner sector. The Sydney SD accounts for 82 per cent of the population of the Greater Metropolitan Area, which also includes Lower Hunter and the Illawarra.
- The population of the Sydney SD grew from 137 586 in 1871 to 2.73 million in 1971 and 4.58 million in 2010. The Outer sector recorded higher growth than the other sectors between 1961 and 2001, growing particularly rapidly in the 1960s and 1970s. The population of the Inner sector declined in the 1970s, but has been growing solidly since 1991 due to inner city redevelopment.
- Sydney's population grew by 447 000 from 2001 to 2010—an average annual growth rate of 1.1 per cent, which was below the national figure of 1.6 per cent. Sydney's population growth averaged just 0.7 per cent from 2001 to 2006, but rose to 1.7 per cent between 2006 and 2010.
- Eighty per cent of Sydney's population growth from 2001 to 2010 was due to natural increase and 20 per cent to net migration. The net gains from overseas migration outweighed the migration losses to the rest of Australia.
- Around 47 per cent of this growth was in the Outer sector, 33 per cent in the Middle sector and 20 per cent in the Inner sector. The North West and West Central subregions contributed 20 and 18 per cent of growth, respectively.
- At the SLA scale, Blacktown North added the most population (27 600 persons), followed by Auburn (19 900), Baulkham Hills North (19 000) and Sydney South (18 500). Sydney Inner recorded the highest average annual growth rate of 6.5 per cent.
- Sydney is Australia's most densely populated city—its established inner and middle suburbs averaged 3244 persons per square kilometre in 2010, up 13 per cent from 2001. The largest gains in density occurred in the City of Sydney and in the Concord SLA.
- There was a shift towards higher density forms of housing being built in Sydney between 2001 and 2006. The majority of this higher density housing was built in strategic centres, where the stock of flats, units and apartments of four or more storeys expanded by over 50 per cent in just five years.

- Since 2001, there has been rapid population and dwellings growth in strategic centres, although the smaller local centres have accommodated a lower than expected proportion of growth. Considerable out-of-centre residential development is occurring in established suburbs.
- Over 80 per cent of Sydney's new housing development occurred within the existing urban area between 2001 and 2010. Housing production in new release areas was well below expectations, so greenfield sites housed much less than the 30–40 per cent share of growth targeted in *City of Cities*.

Introduction

Sydney's recent metropolitan plans endeavour to integrate land use and transport planning to provide a framework for sustainable growth of population and economic development across the city. Within this framework there are broad objectives relating to managing Sydney's population distribution and its growth, including limiting urban sprawl, focusing residential development around centres, and increasing the density of centres.

The chapter starts by providing a snapshot of the distribution of Sydney's population as of 2006—the latest census year was preferred over more recent years, as the census data provides much more spatially detailed information than other sources. This is followed by a discussion of spatial patterns of population growth in Sydney, focusing on the 2001 to 2010 period⁵. The chapter concludes with an analysis of the recent changes that have occurred with regard to the key population-related strategic planning goals elaborated in *City of Cities* and *Sydney 2036*.

Population—2006 snapshot

Population distribution

The ABS Estimated Resident Population (ERP) for the Sydney Statistical Division (SD) was 4.3 million in 2006, up from 4.1 million in 2001. The SD covers a large geographical area of over 12 100 km², containing metropolitan Sydney and urban fringe areas, including the Central Coast. The rest of the Greater Metropolitan Area (outside the Sydney SD) consists of the Lower Hunter and Illawarra, with a total population of 932 200, representing almost 18 per cent of the Greater Metropolitan Area population. The Illawarra and Lower Hunter have strong connections with Sydney, and so are important to understanding the changing nature of demographics for Sydney and the Greater Metropolitan Area as a whole.

A summary of the total population of the Sydney working zone⁶ and Greater Metropolitan Area is in Table 3.1. The table presents population information for the Inner, Middle and Outer sectors of Sydney, the 11 planning subregions of Sydney, and the rest of the Greater Metropolitan Area.

⁵ Based on ABS Cat. 3218.0, March 31 2011 release.

⁶ The Sydney working zone coincides with Sydney Statistical Division (SD), so the terms are used interchangeably. See BITRE (2009a) for the definition of working zone.

In 2006, most people in Sydney lived in the Middle and Outer sectors. The Middle sector had 28.6 per cent of Sydney's population and the Outer sector had 54.2 per cent, representing 23.4 per cent and 44.5 per cent of the Greater Metropolitan Area population respectively. The North West planning subregion was home to 17.8 per cent of Sydney's population, while the City of Sydney planning subregion was the least populous, contributing only 3.9 per cent of Sydney's population.

Table 3.1 Estimated Resident Population by planning subregions and sectors, Sydney Greater Metropolitan Area, 2006

	Estimated resident population, 2006	Share of Sydney SD population (per cent)	Share of Greater Metropolitan Area population (per cent)	Area (km ²)	Population density (persons/ km ²)
Planning subregions					
City of Sydney	165 596	3.9	3.2	27	6 202
East	281 789	6.6	5.4	79	3 545
Inner North	302 948	7.1	5.8	98	3 079
Inner West	227 425	5.3	4.4	60	3 816
South	651 395	15.2	12.5	450	1 447
North	261 911	6.1	5.0	548	478
North East	235 021	5.5	4.5	254	925
West Central	679 565	15.9	13.0	312	2 177
North West	761 078	17.8	14.6	5 253	145
South West	410 516	9.6	7.9	3 376	122
Central Coast	304 744	7.1	5.8	1 680	181
Sydney SD	4 281 988	100.0	82.1	12 137	353
Sectors					
Inner	737 354	17.2	14.1	171	4 307
Middle	1 222 613	28.6	23.4	480	2 549
Outer	2 322 021	54.2	44.5	11 487	202
Rest of GMA					
Illawarra	414 704	n/a	8.0	8309	50
Lower Hunter	517 511	n/a	9.9	4052	128
Total GMA	5 214 203	n/a	100.0	24 499	213

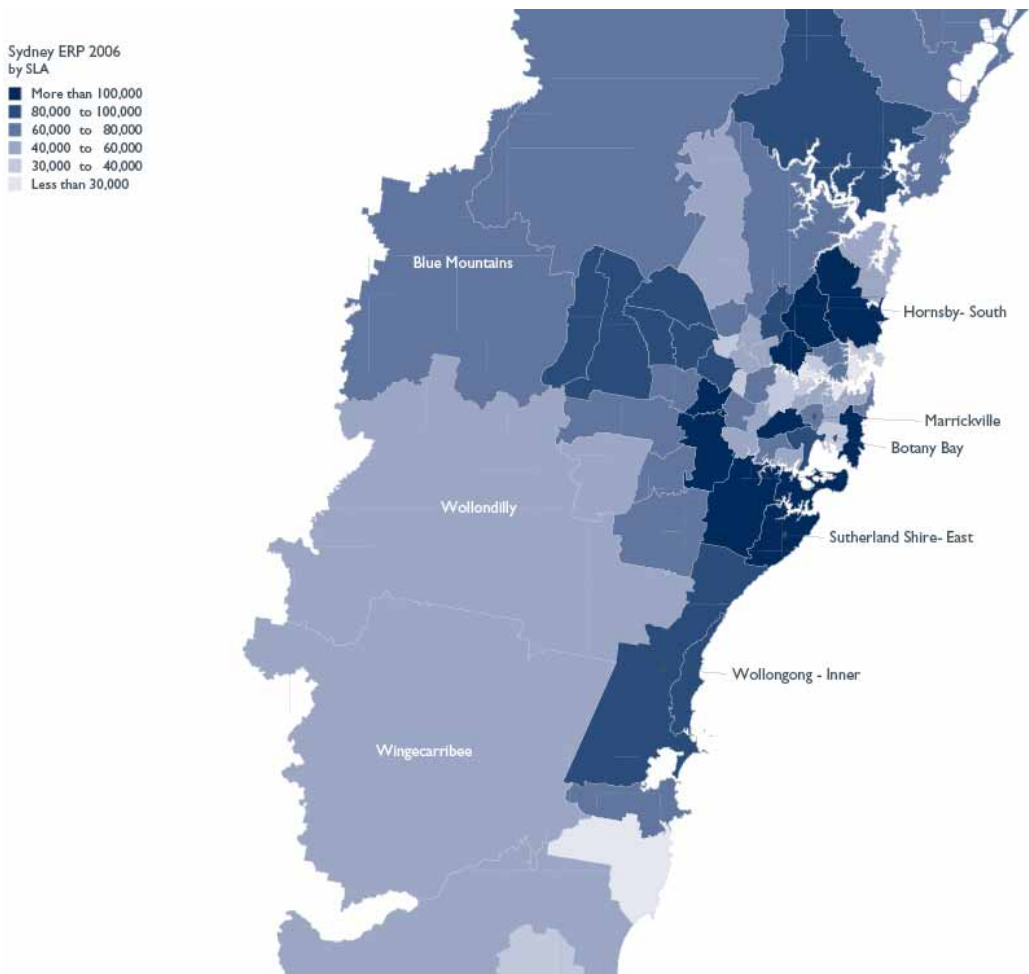
Note: Estimates are based on 2006 boundaries.

Source: BITRE analysis of ABS Cat. 3218.0 Regional Population Growth.

The 2006 spatial distribution of people in Sydney by Statistical Local Area (SLA) is shown in Map 3.1. SLAs within Sydney vary in their population size. In the Inner sector, only the Randwick SLA has a population greater than 100 000, whereas there are three Middle sector SLAs and five Outer sector SLAs with populations greater than 100 000.

The most populated SLAs in the Inner sector were Randwick (126 108), Marrickville (75 546) and Waverley (64 684). The most populated SLAs in the Middle sector were Canterbury (135 605), Ku-ring-gai (105 103) and Ryde (100 962), while Warringah (139 163), Fairfield East (114 616) and Sutherland Shire West (111 465) were the most populous SLAs in the Outer sector. Thus, the most populous SLA in 2006 was Warringah in the Outer sector. In contrast, Hunter's Hill in the Middle sector had just 13 746 residents. The average population size across the 64 SLAs in the Sydney SD was 66 900 and the median was 65 788. Within the rest of the Greater Metropolitan Area, Wollongong Inner (99 304) had the highest population, whilst Kiama (20 007) had the lowest.

Map 3.1 **Distribution of Estimated Resident Population across Statistical Local Areas, Sydney, 2006**



Source: BITRE analysis of ABS Cat. 3218.0 Regional Population Growth.

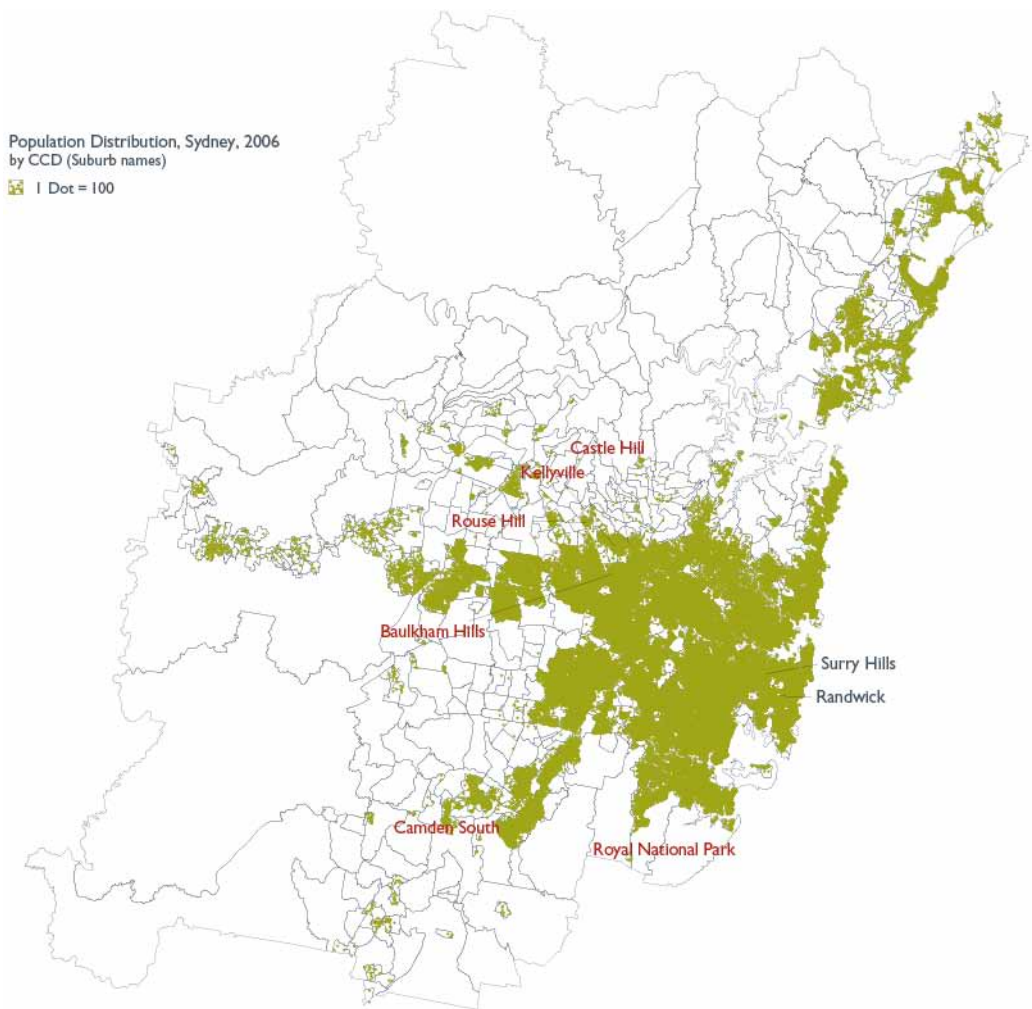
Other more disaggregated spatial units—such as suburbs and census collection districts (CCDs or CDs)—are less variable in terms of population size. These are briefly considered, below.

The average Sydney suburb had a population of 5 100 residents in 2006, with a median of 3400. Some ABS suburbs had low populations with 10 or less people, including Royal National Park in Sutherland Shire East. In contrast, the most populous suburbs were:

- Blacktown which is a part of the Blacktown South East SLA in the North West planning subregion, with 38 906 people.
- Castle Hill, which contains 35 397 people and cuts across the Baulkham Hills Central and Hornsby North SLAs (in the North West and North planning subregions, respectively).
- Baulkham Hills, which contains 34 473 people and cuts across the Parramatta North West and Baulkham Hills Central SLAs (in the West Central and North West planning subregions, respectively).

The CDs are a smaller unit of geography, which in the 2006 census range from a high of 2765 residents to a low of no residents. The average Sydney CD has 600 residents, with a median of 570. Map 3.2 uses the CD data for 2006 to provide a dot density representation of the population distribution within Sydney, in which each dot represents 100 persons. The map illustrates the current pattern of settlement within the Sydney working zone, and highlights the corridors of residential development extending through the Blue Mountains, Central Coast and outer south western suburbs of Sydney.

Map 3.2 Dot density map of population distribution within Sydney, 2006

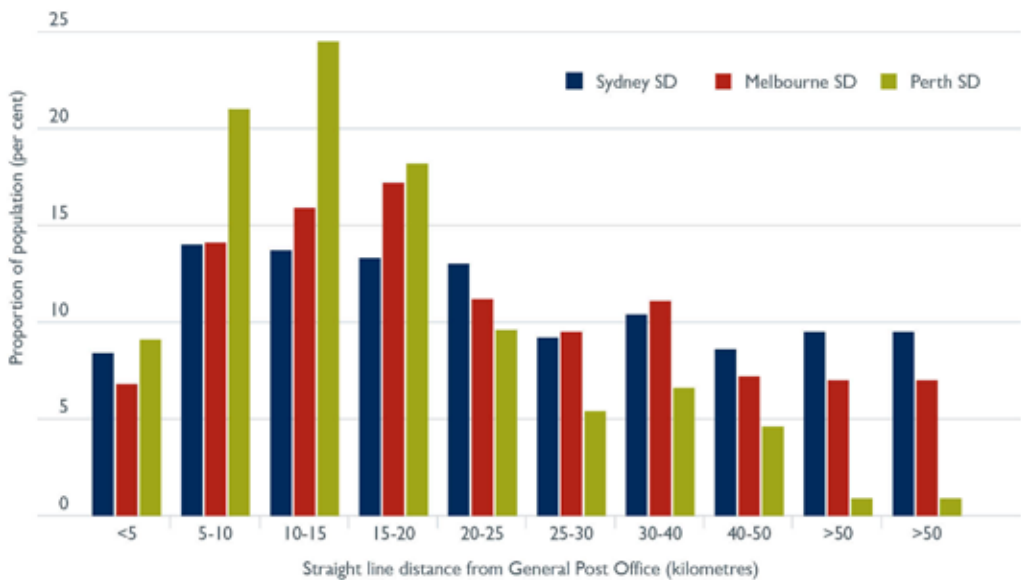


Note: Excludes Illawarra and Lower Hunter.

Source: BITRE analysis of 2006 ABS *Census of Population and Housing* usual residence data at CCD scale.

Figure 3.1 uses this CD data to compare the spatial distribution of population in Sydney in 2006, to that of Melbourne and Perth. In Sydney, 22 per cent of the population lived within 10 kilometres of the Central Business District (CBD), 27 per cent within 10 to 20 kilometres, 22 per cent between 20 and 30 kilometres, 10 per cent between 30 and 40 kilometres and 18 per cent more than 40 kilometres from the CBD. Compared to the other cities, Sydney had a larger proportion of its population living more than 40 kilometres away from the CBD. Melbourne had a smaller share of its population living within 5 kilometres of the CBD. Reflecting Perth's smaller population base, 73 per cent of residents live within 20 kilometres of the CBD, compared to around half of Sydney and Melbourne residents. These patterns reflect the different sizes of the cities, geographic constraints and the accumulated pattern of development over many decades.

Figure 3.1 Proportion of population living at various distances from Central Business District in Sydney, Melbourne and Perth, 2006



Source: BITRE analysis of 2006 ABS *Census of Population and Housing* place of enumeration data for CCDs.

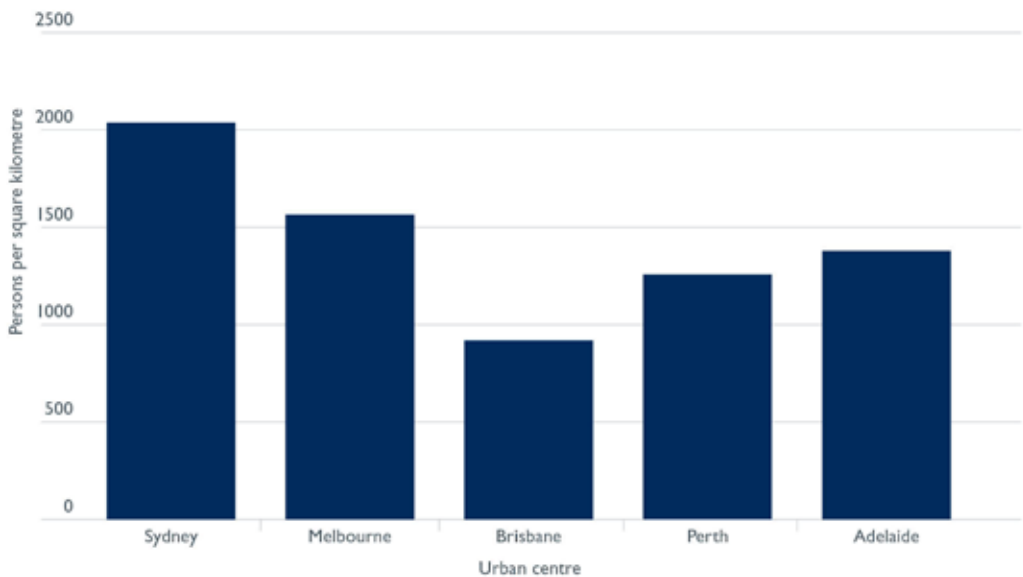
Population density

As shown in Figure 3.2, compared to the other major capital cities, Sydney has the highest population density at 2036 persons per square kilometre for the urban centre.

Population densities vary widely across the Sydney working zone, which includes rural land, nature reserves and industrial areas, as well as residential areas. Sydney's Inner and Middle sectors are relatively densely populated, containing 3011 persons per square kilometre in 2006, compared to 2088 for Melbourne and 1563 for Perth. The Inner sector had 4307 persons per square kilometre and the Middle sector had 2549.

At the planning subregion level, Table 3.1 shows the City of Sydney had a very high population density of 6202 persons per square kilometre, followed by the Inner West at 3816 persons per square kilometre. The Inner North and East were also relatively densely populated, with between 3000 to 3600 persons per square kilometre. In contrast, the South West, North West and Central Coast subregions had the lowest densities (under 200 persons per square kilometre), reflecting the large areas of rural land and/or nature reserves in those subregions. The Illawarra and Lower Hunter also had very low population densities.

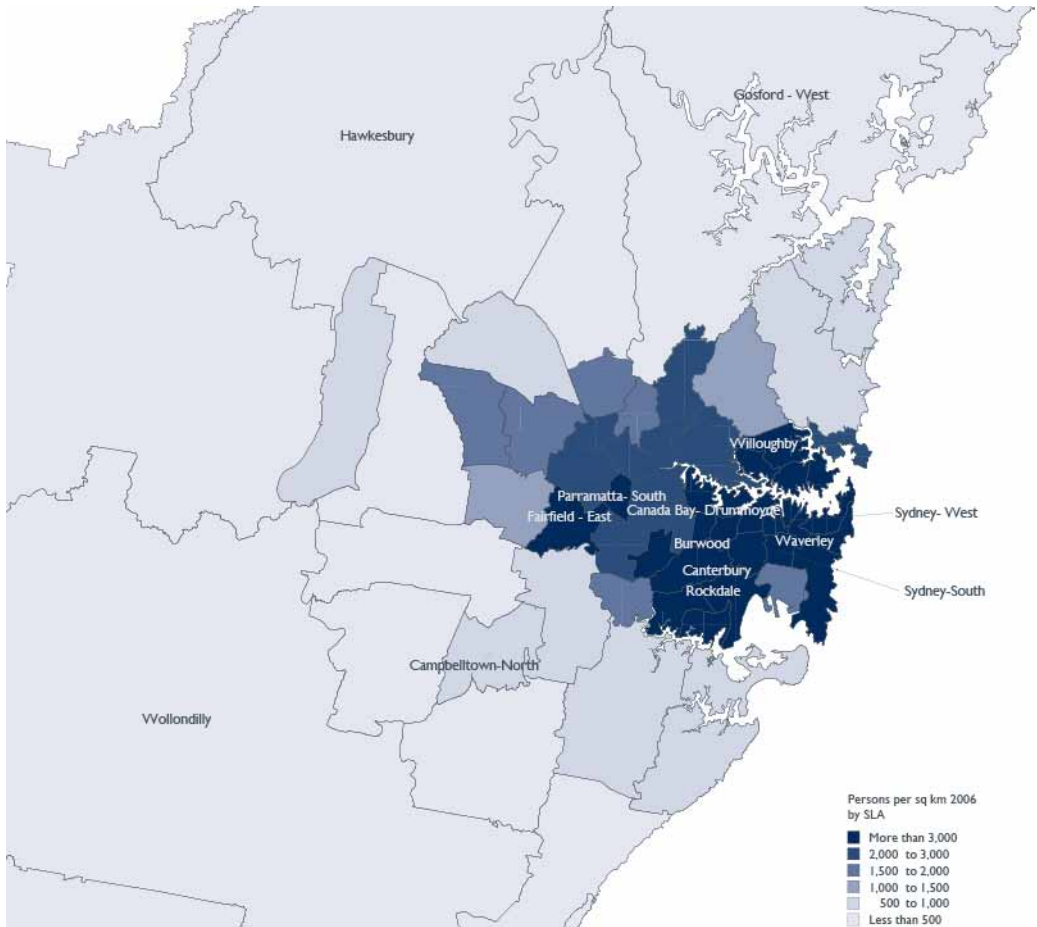
Figure 3.2 Population densities of Australia’s major capital cities, 2006



Note: Based on ABS urban centre boundary.
Source: ABS *Census of Population and Housing* 2006.

The population density of an SLA depends, among other things, on housing density, residential area relative to non-residential area, and household size. Map 3.3 illustrates the varying densities of SLAs within Sydney. The three most densely populated SLAs are in Sydney’s Inner sector—Waverley, Sydney West and Sydney East—with between 7200 to 8400 persons per square kilometre each. A high proportion of the dwelling stock in these SLAs is units and apartments.

There are pockets of high population density in the Middle sector, including Burwood, Drummoyne, Canterbury, Bankstown North East, Kogarah and Rockdale, with 3500 to 4700 persons per square kilometre each. The highest population density SLA in the Outer sector was Fairfield East, with 3100 persons per square kilometre.

Map 3.3 Population densities by Statistical Local Area, Sydney, 2006

Source: BITRE analysis of ABS Cat. 3218.0 Regional Population Growth.

Using census estimates of population, rather than the official ERP data provides a more disaggregated perspective. Table 3.2 lists the highest density Sydney suburbs, which had more than 8000 residents per square kilometre in 2006. All but one of these is located in the Inner sector of Sydney. Suburbs such as Elizabeth Bay, Rushcutters Bay and Pyrmont are located in relatively small areas of less than one square kilometre each and the dwelling stock consists primarily of units, flats and apartments. The only Middle sector suburb with a population density of more than 8000 people per square kilometre was Allawah. This suburb has a population of almost 5000 in an area of 0.59 square kilometres. Over 80 per cent of its dwellings are units, flats or apartments.

Table 3.2 Sydney suburbs with the highest population density, 2006

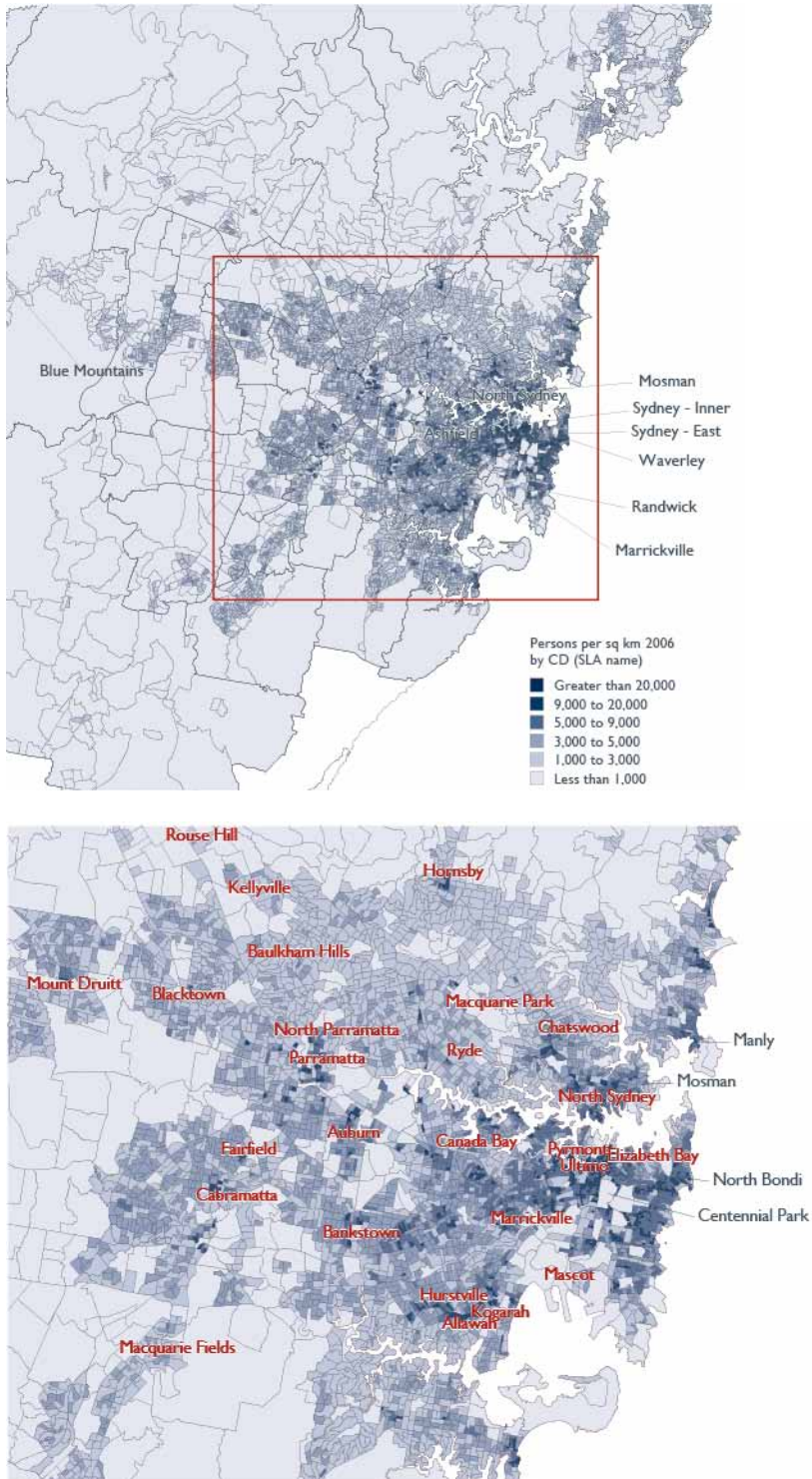
Suburb name	Population, 2006	SLA name	Sector	Area (km ²)	Population density (person/km ²)	Units, flats and apartments as share of total dwellings (per cent)
Elizabeth Bay	4 942	Sydney – East	Inner	0.26	19 171	98
Rushcutters Bay	2 236	Sydney – East	Inner	0.14	16 015	95
Surry Hills	15 048	Sydney – East	Inner	1.23	12 275	70
Pymont	11 097	Sydney – West	Inner	0.96	11 567	94
Potts Point	6 874	Sydney – East	Inner	0.62	11 156	93
Haymarket	4 302	Sydney – Inner	Inner	0.39	11 089	77
Darlinghurst	10 125	Sydney – Inner	Inner	0.96	10 571	73
Bondi	9 373	Waverley	Inner	0.94	10 024	70
Ultimo	5 548	Sydney – West	Inner	0.58	9 608	87
Redfern	11 478	Sydney – South	Inner	1.20	9 527	65
Milsons Point	1 544	North Sydney	Inner	0.17	9 217	99
Bondi Beach	10 406	Waverley	Inner	1.15	9 054	80
Newtown	13 532	Marrickville	Inner	1.57	8 637	34
Hillsdale	4 568	Botany Bay	Inner	0.53	8 567	84
Allawah	4 922	Kogarah	Middle	0.59	8 342	81
Eastlakes	6 612	Botany Bay	Inner	0.81	8 119	69

Source: BITRE analysis of ABS *Census of Population and Housing* 2006.

Map 3.4 illustrates the varying densities of CDs within Sydney. The highest density residential areas are concentrated in CDs within the SLAs of Sydney Inner, Sydney East, Sydney West and Willoughby. These CDs have more than 70 000 persons per square kilometre⁷ and include CDs belonging to the suburbs of Sydney, Haymarket, Pymont and Chatswood. This reflects the presence of high rise units in these areas. Other moderate to high density CDs are visible in Central Sydney (e.g. Elizabeth Bay, Surry Hills), the inner north (e.g. Milsons Point), the eastern suburbs (e.g. Bondi) and along some suburban rail lines (e.g. around Hurstville and Allawah stations on the Illawarra/Cronulla line).

⁷ Note that the high number of residents per square kilometre needs to be interpreted with caution because some CDs cover a very small land area. For example, some of these CDs comprise a mere 0.01 square kilometre area with a population of between 700 and 900 persons.

Map 3.4 Population densities by Census Collection District, Sydney, 2006



Source: BITRE analysis of 2006 ABS *Census of Population and Housing* usual residence data at CD scale.

Population growth

Historic population growth

The population of Sydney grew from 137 586 in 1871 to 2.7 million in 1971 (one hundred years later), and added a further 1.4 million people between 1971 and 2006 (see Table 3.3). Sydney's share of the State's population increased from 27 per cent in 1871 to 59 per cent one hundred years later and further increased to 63 per cent in 2006.

Estimates of city population may vary depending on the boundary drawn, that is how much of the surrounding areas are included in the definition. In 1899, Sydney with its 35 suburbs in 96 000 acres was smaller than Melbourne at 164 000 acres and both were significantly larger than London's 75 000 acres (Weber 1967, quoted in Spearritt 2000). By the 1901 Census, Sydney's urban area (defined as the contiguous suburbs) had a population of 481 830 persons. Within three decades, from 1901 to 1933, the population of Sydney more than doubled to 1.2 million persons and the area increased by 77 per cent (Spearritt 2000). A historical analysis suggests that the perception of competing interests between the urban and rural economies was quite profound, particularly in the early period from 1871 to 1931 when Sydney grew at a higher annual average rate than in more recent years (ibid.).

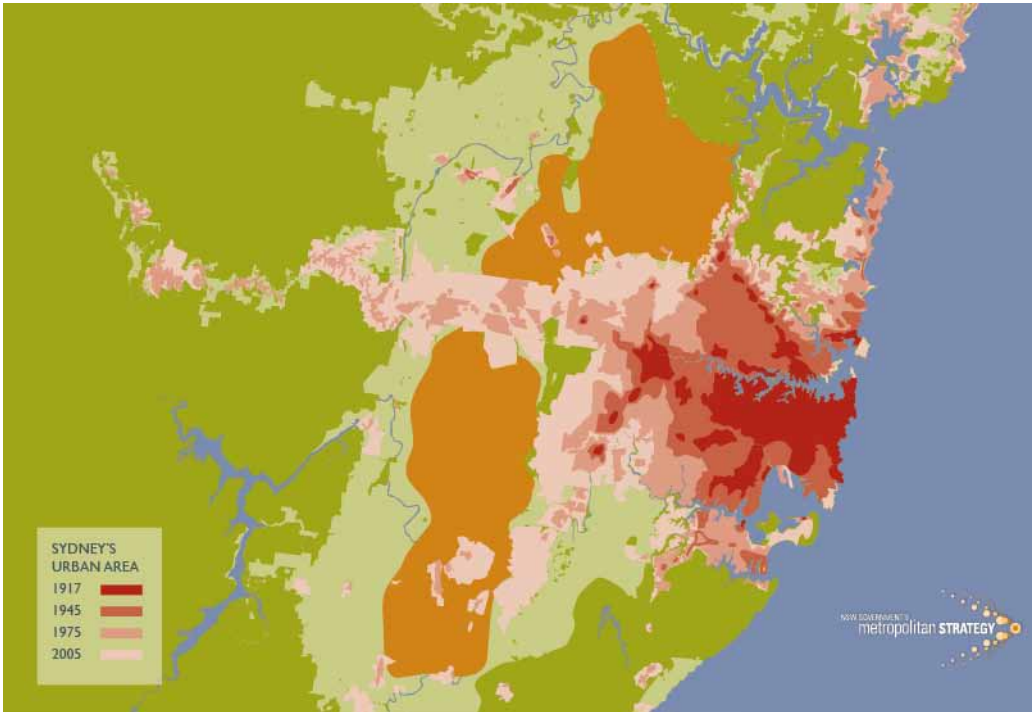
Table 3.3 **Average annual population growth, Sydney, 1871 to 2006**

Year	Population	Sydney's share of NSW population (per cent)	Average annual growth in ten year period (per cent)
1871	137 586	27.4	na
1881	224 939	30.0	5.0
1891	383 333	34.0	5.5
1901	481 830	35.6	2.3
1911	629 503	38.2	2.7
1921	899 059	42.8	3.6
1931	1 200 830	46.8	2.9
1941	1 337 050	47.5	1.1
1951	1 795 010	54.8	3.0
1961	2 193 231	55.7	2.0

Notes: Population figures in this table are census data and are based on boundaries used for statistical purposes at the time. Na is not available.

Source: Adapted from Spearritt (2000).

Map 3.5 presents the expansion of Sydney's urban area at roughly 30 year intervals from 1917 to 2005. It shows that the pattern of development in Sydney in the early 20th century was concentrated around Sydney Harbour and the Parramatta River, and along the rail network (e.g. the North Shore line). The 1970s brought a greater reliance on cars, with new lower density suburbs being established away from the rail network. In the period from 1975 to 2005, the great majority of the expansion of Sydney's urban area occurred to the west of Parramatta, but this encompasses a range of different development fronts (e.g. the Blacktown, Penrith, Blue Mountains, Fairfield, Liverpool, Campbelltown and Camden LGAs).

Map 3.5 Expansion of Sydney's urban extent from 1917 to 2005

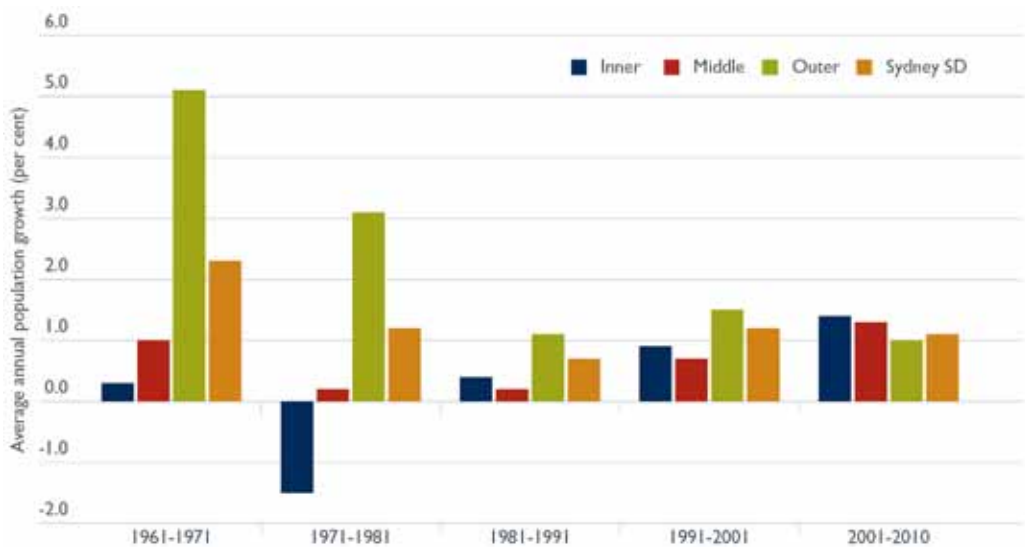
Note: Orange colour represents the anticipated increase in Sydney's urban extent to 2035, if the development pattern of the last 30 years were repeated.

Source: NSW Department of Planning 2005.

Figure 3.3 presents the average annual growth rates of population for Sydney and its sectors from 1961 to 2010, based on decade long intervals. Sydney's population growth averaged 2.3 per cent per annum from 1961 to 1971, but growth was lower between 1971 and 1981 and also 1981 and 1991 and it averaged 1.1 per cent per annum between 2001 and 2010.

The Outer sector recorded the highest rate of growth in each subperiod in Figure 3.3, apart from the most recent one. The Outer sector recorded particularly rapid population growth between 1961 and 1981. Between the 1976 and 1981 censuses, population growth in Sydney displayed a doughnut pattern, with the Outer sector growing faster than the rest of Sydney (Hugo et al. 2000). During this period, many suburbs in the Inner and Middle sectors of Sydney experienced population declines or small growth whilst the Outer sector experienced very strong growth. Population decline was also evident in the Inner suburbs between 1981 and 1986 (ibid.).

Figure 3.3 Average annual population growth of Sydney by sector, 1961 to 2010



Note: Estimates are based on 2006 LGA boundaries, which differ from results using the boundary in the ABS 2008 Cat.3105.0.65.001.

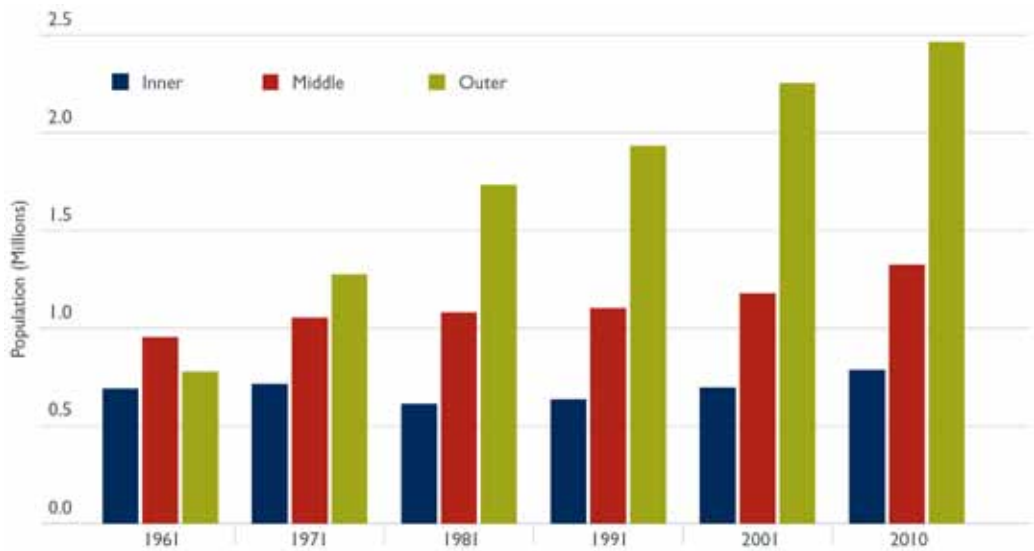
Source: BITRE analysis of ABS Cat 1300.1 New South Wales Year Book (various years); and ABS Cat 3218.0 Regional Population Growth.

While the population of the Inner sector declined notably in the 1970s, it has been growing solidly since 1991. The Middle sector has also recorded solid growth since 1991, following a period of very limited growth between 1971 and 1991. Thus, by the early 1990s, the spatial pattern of population growth had changed. It had become more complex, with suburbanisation and reurbanisation occurring simultaneously in Sydney. Suburbanisation is the growth of areas on the fringes of a city, whilst reurbanisation refers to redevelopment of the existing urban area, particularly in the Inner sector (Hugo et al. 2000). The Outer sector did however grow at a significantly higher rate than the Inner and Middle sectors in the ten years to 2001. The relatively faster rate of growth of the Outer sector reflected the continuing opportunities available for people to secure new housing in greenfields development on the fringe—especially in areas such as Liverpool (DIPNR 2004). A further contributor was the declining trend in the average number of people per household in the established inner and middle suburbs.

The drop in the rate of growth of the Outer sector during the period since 2001 occurred alongside increased growth in the Inner sector (and particularly the City of Sydney). The strong growth of the Inner sector between 2001 and 2006 reflected large scale redevelopment of medium to high density dwellings (DIPNR 2004). The decline in population growth for the Outer sector was particularly pronounced in fringe LGAs and occurred at the same time as there was a substantial decline in greenfield dwelling production (Department of Planning 2010a).

Figure 3.4 focuses on changes in the population size of each sector over time, using the same underlying dataset. The Outer sector grew from 0.8 to 1.7 million residents between 1961 and 1981, surpassing the population of the Middle sector by 1971. Since 1981, the Outer sector has grown at a more subdued pace, with population increasing from 1.7 million residents in 1981 to 2.5 million in 2010. Sydney's Outer sector has added 1.7 million residents between 1961 and 2010, compared to 371 000 for the Middle sector and 95 000 for the Inner sector.

Figure 3.4 Population of Sydney by sector, 1961 to 2010



Note: Estimates are based on 2006 LGA boundaries, which differ from using boundary in the ABS 2008 cat.3105.0.65.001.

Source: BITRE analysis of ABS Cat. 1300.1 New South Wales Year Book (various years); and ABS Cat. 3218.0 Regional Population Growth.

Map 3.6 shows the changes in the location and pace of population growth across the Sydney SD over the last five decades at a more detailed scale. Between 1961 and 1971, population growth occurred across most of Sydney, and was particularly strong in the Liverpool and Baulkham Hills LGAs. However, several inner and middle LGAs experienced population decline (Leichhardt, Sydney and Auburn). Between 1971 and 1981, most inner and middle suburban LGAs experienced a decline in their population (e.g. Ashfield, Marrickville, Sydney and Woollahra), but several urban fringe LGAs grew rapidly (i.e. Campbelltown, Hawkesbury, Blue Mountains). Between 1981 and 1991, the City of Sydney grew strongly in population and there was a tendency for the population of other Inner and Middle LGAs to stabilise. The Outer LGAs continued to grow at higher rates than the rest of Sydney, particularly Campbelltown, Wollondilly and Wyong. From 1991 to 2001, the Marrickville and Ashfield LGAs lost population, the City of Sydney again grew strongly, while the remaining inner and middle LGAs either remained stable or experienced modest growth in population. Between 1991 and 2001, the Camden and Liverpool LGAs grew most rapidly.

Map 3.6 Average annual growth rate of population by Local Government Area, Sydney, 1961 to 2010

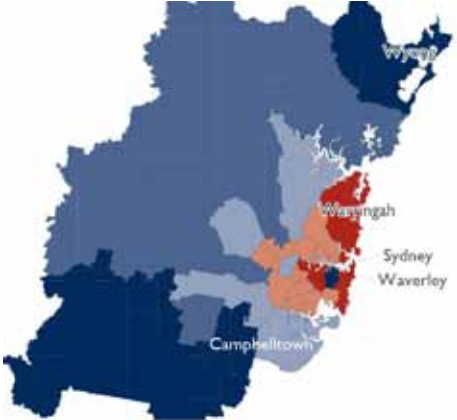
1961–1971



1971–1981



1981–1991



1991–2001



2001–2010



Population Average Annual Growth by LGA
1961–1971 (Per cent)

- More than 8
- 4 to 8
- 2 to 4
- 0.5 to 2
- No significant change
- Below 0

Note: Estimates are based on LGAs (2006 ASGC).
Source: BITRE analysis of ABS Cat 1300.1 New South Wales Year Book (various years); and ABS Cat 3218.0 Regional Population Growth.

Between 2001 and 2010, Sydney recorded a relatively modest rate of population growth, and this was fairly evenly spread across the city. None of the LGAs in Sydney declined and none exceeded more than 4 per cent per annum growth in population. This is quite a contrast to the 1960s and 1970s, when growth rates of over 8 per cent per annum were recorded by several outer suburban LGAs. The pace of outer suburban population growth has been more subdued in recent decades.

A range of factors—including economic opportunity, the city's infrastructure and lifestyle, as well as links to global markets—have created a pull factor or flow of population to Sydney. The city's development as a centre of commerce, industry, transport and government led to Sydney's characterisation as a 'world city'. Sydney has emerged as a focus for some industries including communication, education, entertainment and culture, offering diversified employment (Spearritt 2000). Population growth in Sydney has come not only from people moving from the rural areas to the city but also from new immigrants (*ibid.*). Recent developments in housing and labour markets have resulted in a net internal migration loss to other states, but international immigration has remained strong. These developments will be explored further later in the chapter.

Population change since 2001

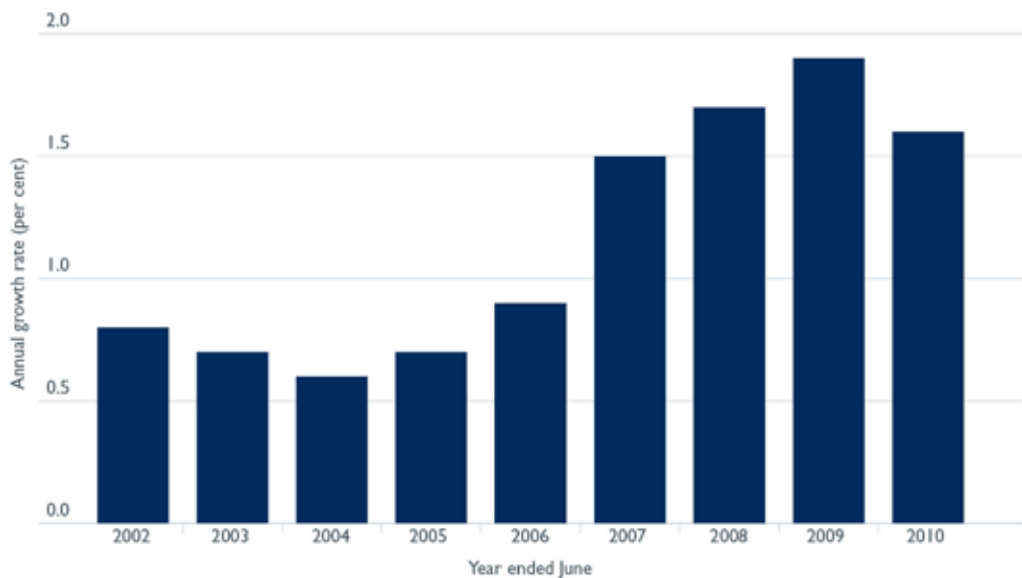
Changes in estimated resident population (ERP), 2001 to 2010

This section provides an analysis of population growth between 2001 and 2010. Note that the 2010 data remains preliminary (ABS 2011a). Sydney SD's average annual population growth over this period was 1.1 per cent. By contrast, the total ERP growth for Australia during this period was 1.6 per cent per annum and 2.3 per cent for the most rapidly growing city, Brisbane.

Figure 3.5 shows that the rate of growth increased over the period, which is a similar pattern to Melbourne's population (BITRE 2011). The years ended June 2008 and 2009 had relatively high population growth rates of 1.7 and 1.9 per cent, respectively. Population growth in the year ended June 2010 was slightly lower, at 1.6 per cent.

The population growth of the Sydney SD was considerably lower in the 2001 to 2006 period (0.7 per cent per annum, on average), than in the post-2006 period (1.7 per cent) (ABS 2011a). This stronger recent population growth has been taken into account in the NSW Government's updated population projections (NSW Government 2010a, Department of Planning 2010b). Further information on population projections for Sydney to 2036 is provided in Chapter 9.

Figure 3.5 Annual rate of growth in Estimated Resident Population, Sydney, 2001 to 2010



Note: 2010 population estimates are preliminary

Source: BITRE analysis of ABS Cat. 3218.0 Regional Population Growth (ABS 2011a).

Table 3.4 summarises the change in ERP for Sydney and the Greater Metropolitan Area between 2001 and 2010. The Outer sector accounted for 47 per cent of the Sydney SD's population growth, the Middle sector for 33 per cent and the Inner sector for 20 per cent. This compares to the Outer sector's share of 61 per cent of growth in the Melbourne SD and 69 per cent of growth in the Perth SD (Major Cities Unit 2011). The Inner sector grew at a slightly more rapid pace than the Middle sector (1.4 and 1.3 per cent, respectively), with the growth rate of the Outer sector and the Illawarra lagging behind (1.0 per cent each).

At the planning subregion scale, the North West and West Central experienced the largest population increases, contributing 20 per cent and 18 per cent of Sydney's growth, respectively (or 16 and 15 per cent of GMA growth). The Lower Hunter region also grew substantially—its increase of 54 239 residents amounted to 10 per cent of GMA population growth. Other significant contributors to growth were the City of Sydney (52 530), the South West (46 484) and the South (41 615) subregions.

Table 3.4 Change in estimated resident population by sector and subregion, Sydney Greater Metropolitan Area, 2001 to 2010

Sector	Estimated Resident Population 2001	Estimated Resident Population 2010	Change, 2001 to 2010	Sector's share of Sydney's population growth (per cent)	Sector's share of GMA population growth (per cent)	Average annual population growth rate (per cent)
Planning subregions						
City of Sydney	129 696	182 226	52 530	11.7	9.8	3.9
East	278 659	299 004	20 345	4.5	3.8	0.8
Inner North	292 978	318 250	25 272	5.7	4.7	0.9
Inner West	213 312	247 832	34 520	7.7	6.4	1.7
South	647 290	688 905	41 615	9.3	7.7	0.7
North	260 855	278 176	17 231	3.9	3.2	0.7
North East	231 230	247 637	16 407	3.7	3.1	0.8
West Central	656 824	738 499	81 675	18.3	15.2	1.3
North West	728 092	815 726	87 634	19.6	16.3	1.3
South West	393 078	439 562	46 484	10.4	8.6	1.2
Central Coast	296 258	319 715	23 457	5.2	4.4	0.9
<i>Sydney WZ</i>	4 128 272	4 575 532	447 260	100.0	83.2	1.1
Aggregate regions						
Inner sector	694 725	786 190	91 465	20.5	17.0	1.4
Middle sector	1 178 256	1 325 003	146 747	32.8	27.3	1.3
Outer sector	2 255 291	2 464 339	209 048	46.7	38.9	1.0
Rest of GMA						
Lower Hunter	492 549	546 788	54 239	na	10.1	1.2
Illawarra	399 987	436 117	36 130	na	6.7	1.0
Total GMA	5 020 808	5 558 437	537 629	na	100.0	1.1

Note: 2010 population estimates are preliminary. Na is not applicable.

Source: BITRE analysis of ABS Cat. 3218.0 Regional Population Growth (ABS 2011a).

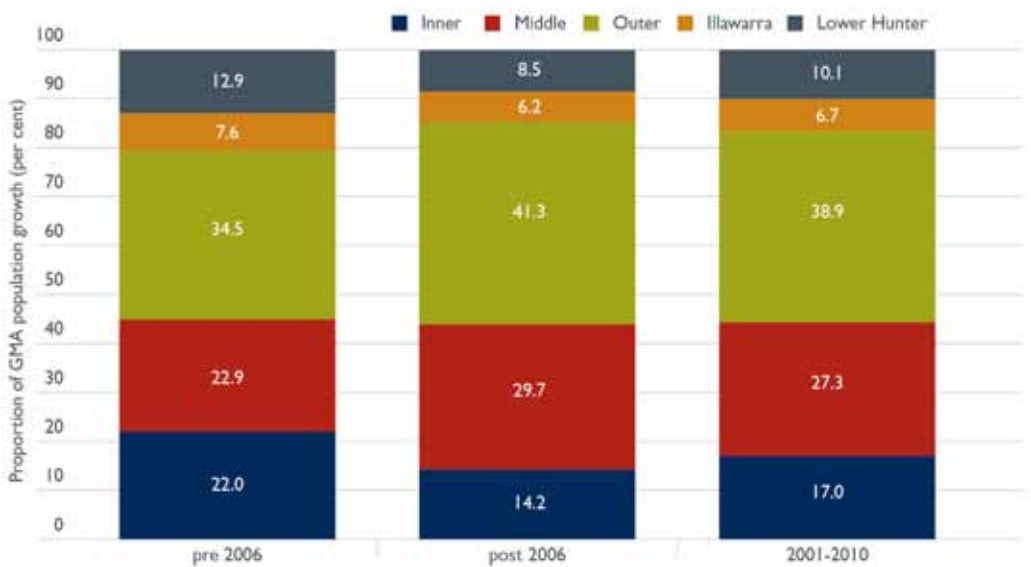
The City of Sydney's average annual population growth rate of 3.9 per cent was much higher than that of the other planning subregions. The Inner West also recorded a higher than average growth rate (1.7 per cent). While the North West and South West planning subregions contain Sydney's main greenfield residential development sites, the growth rate of these two subregions was only marginally above the Sydney-wide average between 2001 and 2010.

Sydney's urban fringe residential developments are contained within the North West, South West, Central Coast and (to a limited extent) North East planning subregions. These four subregions together accounted for 39 per cent of Sydney's population growth from 2001 to 2010. The population growth experienced in these subregions occurred in established suburbs as well as new land release areas. Therefore, the clear majority of Sydney's 2001 to 2010 population growth (at least 61 per cent) occurred within the existing urban area.

As was evident from Figure 3.5, Sydney experienced more rapid population growth in the latter part of the decade. Average annual growth for the GMA roughly doubled from 0.8 per cent per annum between 2001 and 2006 to 1.6 per cent between 2006 and 2010. All sectors and planning subregions, apart from the City of Sydney, had a post-2006 growth rate that was higher than the pre-2006 population growth rate. In the City of Sydney, the average annual growth rate declined from 5.0 per cent to 2.4 per cent, but this still exceeded growth in any other subregion of Sydney between 2006 and 2010.

The pattern of growth differed somewhat between the pre-2006 and post-2006 periods, as can be seen from Figure 3.6. The GMA's population growth was more heavily concentrated within the Inner sector—and particularly within the City of Sydney—between 2001 and 2006 than between 2006 and 2010. The Middle and Outer sectors made an increased contribution to growth in the latter period. For example, the Middle sector recorded the highest growth rate between 2006 and 2010, averaging 2.0 per cent, well above the 0.7 per cent average for the 2001 to 2006 period. The rest of GMA, consisting of Illawarra and Lower Hunter reduced its contribution in the post 2006 period.

Figure 3.6 Proportion of population growth by sector, Sydney Greater Metropolitan Area, 2001 to 2006 and 2006 to 2010

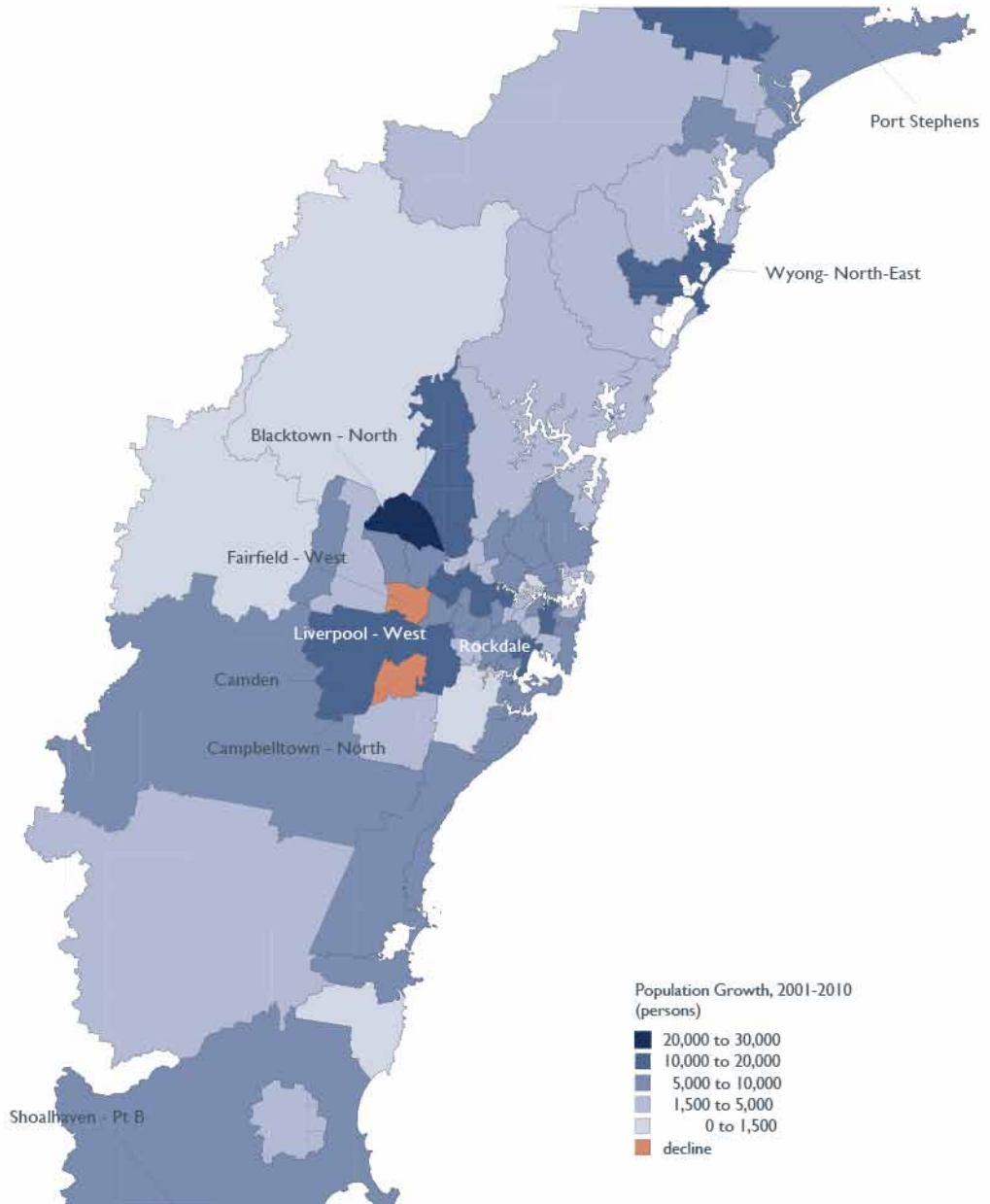


Note: 2010 population estimates are preliminary.
Source: BITRE analysis of ABS Cat. 3218.0 Regional Population Growth (ABS 2011a).

Map 3.7 illustrates the change in population of all Sydney SLAs between 2001 and 2010. Table 3.5 shows the most significant changes in the population by SLA during the period since 2001. Both map and table reveal that many of the SLAs experiencing the greatest population increases were located in the Outer sector; while both of the declining SLAs were also in the Outer sector. The main population growth SLAs do tend to cluster together; but the two declining SLAs are immediate neighbours to SLAs which are experiencing substantial increases in their population.

The Outer SLA of Blacktown North experienced the greatest population increase, adding 27 600 people to its population between 2001 and 2010. Several SLAs added between 15 000 and 20 000 new residents, including Baulkham Hills North and Liverpool West in the Outer sector, Auburn in the Middle sector and Sydney South in the Inner sector.

Map 3.7 Change in Estimated Resident Population by Statistical Local Area, Sydney, 2001 to 2010



Note: 2010 population estimates are preliminary.

Source: BITRE analysis of ABS Cat. 3218.0 Regional Population Growth.

Table 3.5 Statistical Local Areas with largest change in Estimated Resident Population, Sydney, 2001 to 2010

Statistical Local Area	Planning subregion	Sector	ERP 2001	ERP 2010	Change in ERP, 2001 to 2010
Growth					
Blacktown North	North West	Outer	76 850	104 456	27 606
Auburn	West Central	Middle	58 678	78 597	19 919
Baulkham Hills North	North West	Outer	38 937	58 000	19 063
Sydney South	City of Sydney	Inner	40 502	59 000	18 498
Liverpool West	South West	Outer	60 601	76 317	15 716
Sydney West	City of Sydney	Inner	30 654	44 754	14 100
Holroyd	West Central	Outer	89 236	102 188	12 952
Canada Bay—Concord	Inner West	Middle	27 626	40 320	12 694
Wyong North East	Central Coast	Outer	66 804	78 662	11 858
Baulkham Hills Central	North West	Outer	65 386	77 201	11 815
Decline					
Campbelltown North	South West	Outer	79 954	79 577	–377
Fairfield West	West Central	Outer	74 739	74 613	–126

Note: 2010 population estimates are preliminary.

Source: BITRE analysis of ABS Cat. 3218.0 Regional Population Growth.

Table 3.6 lists the SLAs in the Sydney SD that showed the most rapid rate of population growth between 2001 and 2010. The most rapidly growing SLAs were evenly spread across the Inner, Middle and Outer sectors of Sydney. The Sydney Inner SLA grew particularly rapidly, averaging 6.5 per cent annual growth between 2001 and 2010, while two other City of Sydney SLAs also grew at over 4 per cent per annum (i.e. Sydney South, Sydney West). Other rapidly growing SLAs include the Outer sector SLAs of Baulkham Hills North and Blacktown North and the Middle sector SLAs of Concord and Auburn. The rapid growth of a range of Inner and Middle sector SLAs points to the importance of urban infill in accommodating a great deal of Sydney's population growth over the period.

Population growth rates were lower in the earlier part of the decade, with 13 Sydney SLAs recording modest population declines between 2001 and 2006 (e.g. Hawkesbury, Ku-ring-gai, Marrickville, Blue Mountains, Lane Cove). Sydney had many more SLAs with population declines than Melbourne and Perth (BITRE 2011, 2010). However, none of the SLAs in Sydney recorded a population loss between 2006 and 2010, although Blue Mountains and Fairfield West had the lowest growth rate (between 0.6 and 0.7 per cent) and they were among the 13 Sydney SLAs with negative rates of growth from 2001 to 2006.

Between 2006 and 2010, the Concord SLA grew more rapidly than any other Sydney SLA, averaging 5.5 per cent growth per annum, compared to 3.3 per cent growth between 2001 and 2006. The Parramatta Inner and Parramatta South SLAs recorded a similar increase in their growth rates, recording average annual growth of 3.8 and 3.9 per cent, respectively, since 2006. From 2001 to 2006, the Sydney Inner SLA grew most rapidly, averaging 9.2 per cent population growth per annum, but this declined to 3.1 per cent between 2006 and 2010. The Sydney South SLA recorded a similar slowdown in growth in recent years.

Table 3.6 Statistical Local Areas with highest average annual population growth rates, Sydney, 2001 to 2010

Statistical Local Area	Planning subregion	Sector	ERP 2001	ERP 2010	Average annual growth in ERP, 2001 to 2010 (per cent)
Sydney Inner	City of Sydney	Inner	14 618	25 677	6.5
Baulkham Hills North	North West	Outer	38 937	58 000	4.5
Sydney West	City of Sydney	Inner	30 654	44 754	4.3
Canada Bay–Concord	Inner West	Middle	27 626	40 320	4.3
Sydney South	City of Sydney	Inner	40 502	59 000	4.3
Blacktown North	North West	Outer	76 850	104 456	3.5
Auburn	West Central	Middle	58 678	78 597	3.3
Parramatta Inner	West Central	Middle	37 588	49 242	3.0
Liverpool West	South West	Outer	60 601	76 317	2.6
Strathfield	Inner West	Middle	29 433	36 911	2.5
Camden	South West	Outer	45 454	56 809	2.5

Note: 2010 population estimates are preliminary.

Source: BITRE analysis of ABS Cat. 3218.0 Regional Population Growth.

In the 2001 to 2006 period, the Blacktown North and Baulkham Hills North SLAs in the North West planning subregion were the main locations for growth, each housing 4.6 per cent of the increase in Sydney's population. Between 2006 and 2010, Blacktown North contributed 4.8 per cent of Sydney's growth, while the Middle sector SLAs of Auburn (3.5 per cent) and Canterbury (3.4 per cent) were also important locations for growth. Auburn grew strongly throughout the 2001 to 2010 period. Canterbury's population declined between 2001 and 2004, but it has since returned to a situation of positive and, from 2006, increasingly strong population growth. The Baulkham Hills North SLA has grown at a much more subdued pace since 2006, and was responsible for 1.9 per cent of Sydney's population increase between 2006 and 2010.

Key points regarding the spatial patterns of population growth for the entire 2001 to 2010 period are:

- The Sydney SD added 447 000 residents to reach 4.58 million population in 2010, representing an average annual growth rate of 1.1 per cent.
- Around 47 per cent of this growth was in the Outer sector; 33 per cent in the Middle sector; and 20 per cent in the Inner sector.
- The Inner sector experienced the highest average annual growth (1.4 per cent), followed by the Middle sector (1.3 per cent) and the Outer sector (1.0 per cent).
- The North West subregion contributed 20 per cent of population growth and the West Central subregion contributed 18 per cent. The most rapid growth occurred in the City of Sydney, averaging 3.9 per cent per annum.

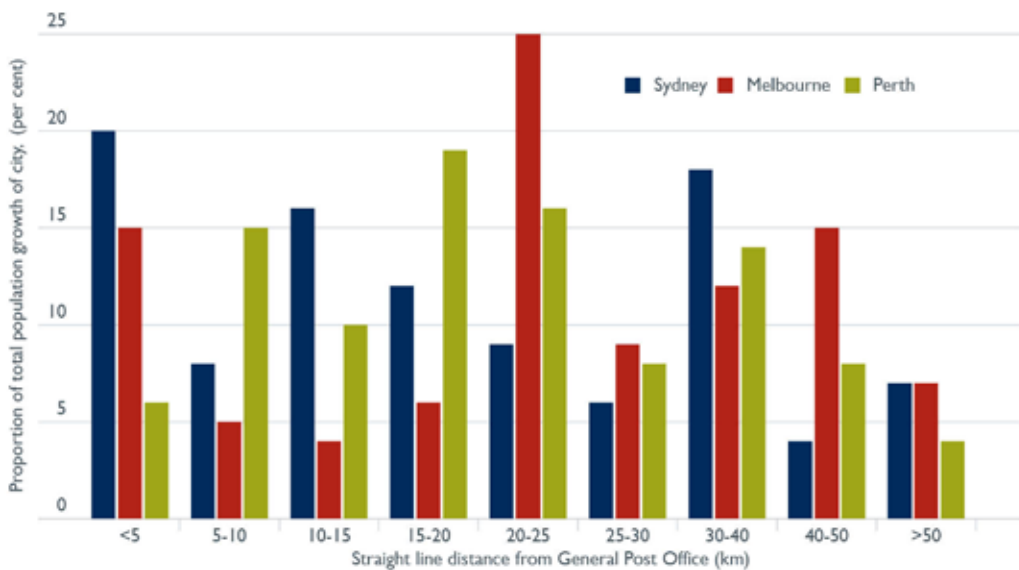
- At the SLA scale, Blacktown North added the most population (27 600 persons), followed by followed by Auburn (19 900), Baulkham Hills North (19 000), Sydney South (18 500) and Liverpool West (15 700). Campbelltown North experienced the greatest population decline.
- The highest average annual rates of population growth were in Sydney Inner (6.5 per cent), Baulkham Hills North (4.5 per cent), Sydney West and Canada Bay–Concord (4.3 per cent each).

Change in population between 2001 and 2006 censuses

A more detailed perspective on where population growth and decline is concentrated within Sydney can be gained by focusing in on the 2001 to 2006 period, using population counts from the ABS *Census of Population and Housing*.

Figure 3.7 summarises the spatial distribution of the 2001 to 2006 population increase, based on distance bands around the CBD. The area within 5 kilometres of the GPO accounted for 20 per cent of Sydney's population increase between 2001 and 2006, compared to 15 per cent for Melbourne and 6 per cent for Perth. The area within 20 kilometres of the GPO accommodated 56 per cent of Sydney's population increase, compared to 51 per cent for Perth and 31 per cent for Melbourne. There was also significant population growth occurring at a distance of 30 to 40 kilometres from Sydney's CBD, which corresponds to the North West growth area (e.g. the Blacktown North and Baulkham Hills North SLAs).

Figure 3.7 Proportion of 2001 to 2006 population increase occurring at various distances from Central Business District in Sydney, Melbourne and Perth



Source: BITRE analysis of 2001 and 2006 ABS *Census of Population and Housing* place of enumeration data for CCDs in respective Statistical Divisions.

Analysis of population and dwellings change by Randolph et al. (2008, p.3) between 2001 and 2006 concluded that '[s]ome parts of the city have changed dramatically: new neighbourhoods have emerged at Green Square and along the Parramatta River in Canada Bay; others have been transformed as new apartments congregate around transport hubs such as Chatswood and St Leonards'.

Table 3.7 lists the Sydney suburbs which experienced the most rapid rates of population growth and decline between 2001 and 2006. Kellyville Ridge in the Blacktown North SLA, with 53 per cent average annual growth, ranked as the suburb with the fastest population growth during the period. The other suburbs with rapid population growth in this SLA were Stanhope Gardens (17 per cent average annual growth), Rouse Hill and Acacia Gardens (12 per cent each). The suburb of Zetland in the City of Sydney—part of the Green Square redevelopment—had the second highest population growth of 35 per cent per annum in the five years to 2006. A majority of the rapidly growing suburbs were located in the Outer sector; while the suburbs with rapid population declines were also located in the Outer sector.

Table 3.7 Most rapidly growing and declining suburbs in Sydney, 2001 to 2006

Suburb name	SLA name	Sector	Planning subregion	2006 population	2001 population	Average annual growth (per cent)
Fastest growth						
Kellyville Ridge	Blacktown–North	Outer	North West	3 957	470	53
Zetland	Sydney–South	Inner	City of Sydney	2 615	594	35
Homebush Bay	Auburn	Middle	West Central	1 306	323	32
Woongarah	Wyong–North East	Outer	Central Coast	3 330	846	32
Wolli Creek	Rockdale	Middle	South	2 646	844	26
Macquarie Links	Campbelltown–North	Outer	South West	911	325	23
Dawes Point	Sydney–Inner	Inner	City of Sydney	769	294	21
Beaumont Hills	Baulkham Hills–North	Outer	North West	5 820	2 352	20
Blair Athol	Campbelltown–South	Outer	South West	2 624	1 124	18
Rhodes	Canada Bay–Concord	Middle	Inner West	1 673	730	18
Stanhope Gardens	Blacktown–North	Outer	North West	4 261	1 962	17
Hamlyn Terrace	Wyong–North East	Outer	Central Coast	3 984	1 873	16
Waitara	Hornsby–South	Outer	North	5 121	2 511	15
Harrington Park	Camden	Outer	South West	6 054	3 009	15
Wadalba	Wyong–North East	Outer	Central Coast	1 245	685	13
Chiswick	Canada Bay–Drummoyne	Middle	Inner West	2 367	1 314	12
Silverwater (Auburn)	Auburn	Middle	West Central	2 891	1 621	12
St Leonards	Willoughby	Middle	Inner North	3 977	2 236	12
Huntleys Cove	Hunter's Hill	Middle	Inner North	700	401	12
Rouse Hill	Blacktown–North	Outer	North West	6 468	3 719	12
Acacia Gardens	Blacktown–North	Outer	North West	3 109	1 799	12
Voyager Point	Liverpool–East	Outer	South West	1 301	774	11
West Hoxton	Liverpool–West	Outer	South West	7 893	4 717	11
Kellyville	Baulkham Hills–North	Outer	North West	18 370	11 083	11
Waterloo	Sydney–South	Inner	City of Sydney	8 500	5 131	11
Fastest decline						
Kariong - Bal	Gosford–West	Outer	Central Coast	168	399	–16
Middleton Grange	Liverpool–West	Outer	South West	280	395	–7

Note: Some of the results may be impacted by changing ABS suburb boundaries, particularly in the Outer sector. The list excludes suburbs with less than 100 population in 2006 and suburbs which were identified to have had a substantial change in boundary between 2001 and 2006.

Source: BITRE analysis of 2001 and 2006 ABS *Census of Population and Housing* place of usual residence data.

Table 3.8 lists the suburbs which experienced the greatest change in the number of usual residents between 2001 and 2006. Kellyville was the standout, adding 7287 residents, while several other North West suburbs also added more than 3000 new residents (i.e. Glenwood, Castle Hill, Kellyville Ridge and Beaumont Hills). Other notable population increases occurred in the suburb of Prestons in the South West subregion, in the suburb of Auburn in the West

Central subregion, and in the inner city suburbs of Sydney, Waterloo and Pyrmont. The Inner suburb of Marrickville recorded the largest decline, with 1 384 fewer residents in 2006 compared to 2001.

Table 3.8 Sydney suburbs with largest population gains and losses, 2001 to 2006

Suburb name	SLA name	Sector	Planning subregion	2006 population	2001 population	Change in population (person)
Largest increases						
Kellyville	Baulkham Hills–North	Outer	North West	18 370	11 083	7 287
Glenwood	Blacktown–North	Outer	North West	13 891	9 311	4 580
Prestons	Liverpool–East	Outer	South West	12 824	8 974	3 850
Sydney	Sydney–Inner	Inner	City of Sydney	13 538	9 861	3 677
Castle Hill	Baulkham Hills–Central	Outer	North West	35 397	31 868	3 529
Auburn	Auburn	Middle	West Central	29 951	26 454	3 497
Kellyville Ridge	Blacktown–North	Outer	North West	3 957	470	3 487
Pyrmont	Sydney–West	Inner	City of Sydney	11 097	7 618	3 479
Beaumont Hills	Baulkham Hills–North	Outer	North West	5 820	2 352	3 468
Waterloo	Sydney–South	Inner	City of Sydney	8 500	5 131	3 369
Chatswood	Willoughby	Middle	Inner North	13 525	10 172	3 353
West Hoxton	Liverpool–West	Outer	South West	7 893	4 717	3 176
Harrington Park	Camden	Outer	South West	6 054	3 009	3 045
Hurstville	Hurstville	Middle	South	23 341	20 347	2 994
Quakers Hill	Blacktown–North	Outer	North West	25 009	22 217	2 792
Parramatta	Holroyd	Outer	West Central	18 435	15 663	2 772
Rouse Hill	Blacktown–North	Outer	North West	6 468	3 719	2 749
Bankstown	Bankstown–North East	Middle	West Central	26 452	23 777	2 675
Waitara	Hornsby–South	Outer	North	5 121	2 511	2 610
Woongarra	Wyong–North East	Outer	Central Coast	3 330	846	2 484
Homebush	Strathfield	Middle	Inner West	7 029	4 710	2 319
Stanhope Gardens	Blacktown–North	Outer	North West	4 261	1 962	2 299
Glenmore Park	Penrith–West	Outer	North West	19 216	16 964	2 252
Hamlyn Terrace	Wyong–North East	Outer	Central Coast	3 984	1 873	2 111
Mount Druitt	Blacktown–South West	Outer	North West	13 598	11 524	2 074
Casula	Liverpool–East	Outer	South West	13 207	11 148	2 059
Zetland	Sydney–South	Inner	City of Sydney	2 615	594	2 021
Largest decreases						
Marrickville	Marrickville	Inner	South	23 150	24 534	–1 384
St Clair (Penrith)	Penrith–East	Outer	North West	20 132	20 942	–810
Macquarie Fields	Campbelltown–North	Outer	South West	12 981	13 764	–783
Villawood	Bankstown–North West	Middle	West Central	5 137	5 853	–716
South Penrith	Penrith–West	Outer	North West	11 559	12 180	–621

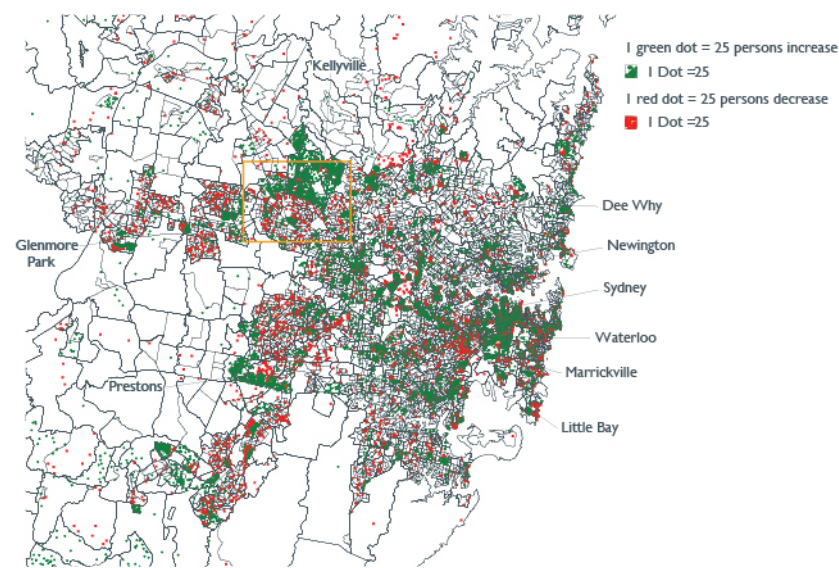
Note: The list excludes suburbs with less than 100 population in 2006 and suburbs which were identified to have had a substantial change in boundary between 2001 and 2006. Some results may still be impacted by changing ABS suburb boundaries, particularly in the Outer sector.

Source: BITRE analysis of 2001 and 2006 ABS *Census of Population and Housing* place of usual residence data.

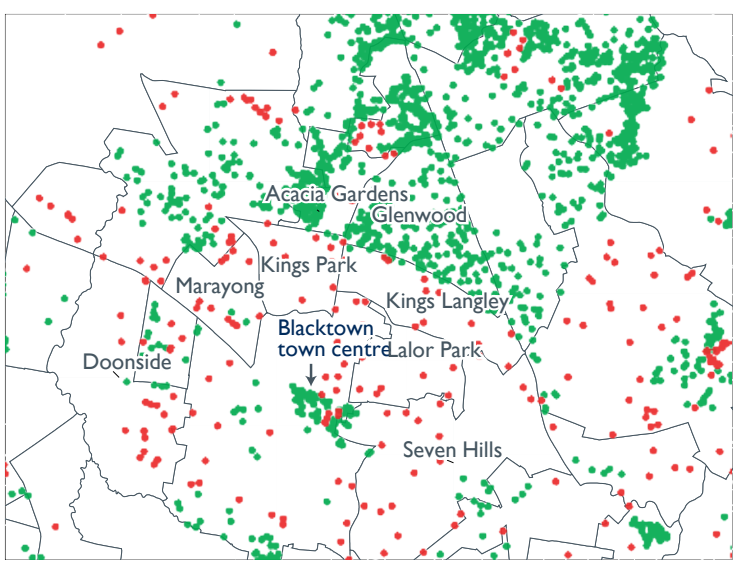
Map 3.8 shows negative and positive change in population at the CD level, highlighting the complex patterns of recent population changes in Sydney. There were pockets of strong growth within Sydney's established urban area, particularly around the CBD and Hurstville, reflecting processes of urban consolidation. The most concentrated area of population decline was around Marrickville, but CDs with population declines were scattered across the urban area, and were often located right next to the growth CDs.

Map 3.8 Dot density map of population change for Sydney, 2001 to 2006

a) Sydney



b) Inset map of Blacktown



Note: While data is for CDs, the labels (and the boundaries on the inset map) relate to suburbs.

Source: BITRE analysis of ABS 2001 and 2006 *Census of Population and Housing* place of usual residence data at CCD scale.

The Outer sector CDs have a mix of growth and decline in the period between 2001 and 2006. The most pronounced areas of growth were around Kellyville, Glenwood and Rouse Hill in the North West and around Prestons and West Hoxton in the South West. The CDs with population loss tended to be located in more established outer suburbs, and reflect demographic forces. Similar patterns of population loss were also evident in Melbourne and Perth's established outer suburbs over this period (BITRE 2011, 2010).

An example can be seen on the inset map, which focuses on the suburbs located around the Blacktown town centre in Sydney's North West. The suburb of Blacktown gained nearly 1400 residents between 2001 and 2006, with population growth concentrated around the railway station and shopping centre. There was a ring of CDs surrounding the Blacktown town centre which lost population, covering the suburbs of Seven Hills, Lalor Park, Doonside, Marayong, Kings Langley and Kings Park. ABS census data reveals that these six suburbs all have an ageing population and experienced a decline in the number of children aged 14 and under between 2001 and 2006. The suburb of Blacktown was much less affected by ageing, recording a 5 per cent increase in the number of children between 2001 and 2006, which matched the 5 per cent increase in the number of residents aged 55 and over. The increase in children reflects a 2 per cent increase in the number of families with children living in Blacktown as well as births in existing family households. Of the six population loss suburbs, all but Seven Hills recorded a decline in family with children households between 2001 and 2006⁸. Thus, the ageing in place of the local population combined with a lack of replenishment of the maturing family households with new young families, is resulting in net population loss in these suburbs. Significant population losses in parts of Blacktown were also identified by Randolph et al. (2008), who refer to a more general pattern of population loss in many of Sydney's established outer suburbs, particularly those built in the 1960s and 1970s.

Returning to the inset map, beyond this ring of population loss CDs, areas of substantial population gain are evident in newly developing suburbs such as Glenwood and Acacia Gardens. These suburbs are characterised by young and growing families, with the number of children aged 14 and under increasing by roughly 50 per cent from 2001 to 2006. These two suburbs are located to the immediate north of the declining suburbs of Kings Langley and Kings Park.

⁸ The increase in Seven Hills amounted to just 11 households, representing a 0.3 per cent increase.

Sources of population growth

The ABS ERP for New South Wales grew by 645 000 people between June 2001 and June 2010 (ABS 2011b). The Sydney SD accounts for 69 per cent of the state's overall increase, with the Lower Hunter and Illawarra at 8 and 6 per cent respectively (ABS 2011a). ABS (2011b) decomposes New South Wales population growth to the following three components:

- Natural increase: 57 per cent
- Net interstate migration: –34 per cent
- Net overseas migration: 77 per cent.

While the ABS does not publish an equivalent decomposition for Sydney, the 2008 MDP estimates that 80 per cent of Sydney's population growth between 2001 and 2010 was attributable to natural increase and 20 per cent to net migration (Department of Planning 2010a). The contribution of net migration was essentially zero for the 2001 to 2006 period, as the net gains from overseas migration were balanced out by migration losses to the rest of Australia. Sydney had a net outflow of people to the remainder of New South Wales, estimated at 49 980 from 2001 to 2006. During this period Sydney also lost population to other states, particularly to Queensland. Since 2006, net overseas migration to Sydney has been high, which 'may be due to larger increases in long term arrivals (particularly overseas students) and the increased return of expats related to the Global Financial Crisis' (ibid., p.81).

The sources of population growth vary for different parts of Sydney. For example, census data for the 2001 to 2006 period reveals:

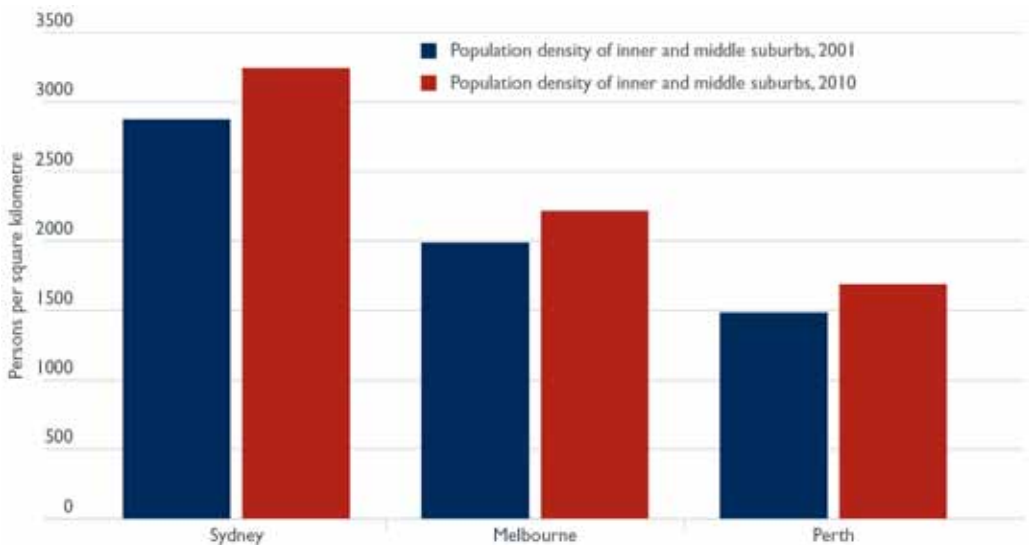
- The arrival of over 244 000 new migrants from overseas substantially increased Sydney's population by about 6 per cent. The SLAs which had a population boost of over 20 per cent from new migrants were Sydney Inner and Parramatta Inner.
- Baulkham Hills North, Wyong North East and Blacktown North all experienced a substantial net inflow of residents from other parts of Sydney between 2001 and 2006, each with over 5 000 people entering the SLAs.
- Six SLAs have residents aged between zero and four that represent 9 per cent or more of the total residents. These include Blacktown (South West, North and South East), Liverpool West, Baulkham Hills North and Camden. This is above the 7 per cent population share of children aged under four for the whole Sydney SD.

Department of Planning (2010a) investigates the migration patterns for greenfield areas on the fringe of Sydney, and finds that almost 70 per cent of those who moved into Sydney's greenfield areas between 2001 and 2006 came from the same LGA or surrounding LGAs.

Changes in population densities

The population growth that occurred between 2001 and 2010 led to increases in Sydney's population density. In 2001, the inner and Middle sectors of Sydney on a combined basis had an average population density of 2878 persons per square kilometre, well in excess of density levels in the inner and middle suburbs of Perth or Melbourne (see Figure 3.8). By 2010, this had increased by 366 to reach 3244 persons per square kilometre. While the absolute magnitude of Sydney's density gain was greater than that in Perth and Melbourne, all three cities experienced a similar percentage change of around 13 per cent.

Figure 3.8 Population density of inner and middle suburbs of Sydney, Melbourne and Perth, 2001 to 2010



Source: BITRE estimates derived from ABS Cat. 3218.0, Regional Population Growth.

Table 3.9 lists the SLAs which experienced density increases of over 500 persons per square kilometre between 2001 and 2010. There are 12 such SLAs in the Inner and Middle sectors in the table, and none from the Outer sector. The top four SLAs are the four parts of the City of Sydney, each with a density increase of over 1400 persons per square kilometre between 2001 and 2010 and each exceeding 5000 persons per square kilometre in 2010. There were also four SLAs in the West Central subregion which recorded a density increase of between 500 and 650 persons per square kilometre, which resulted in densities of between 2000 and 4000 persons per square kilometre in 2010.

Table 3.9 Greatest increases in population density by Statistical Local Area for Sydney, 2001 to 2010

SLA name	Planning subregion	Sector	Area (km ²)	Population density per square kilometre (persons)		Increase in density (persons)
				2001	2010	
Sydney–Inner	City of Sydney	Inner	4.2	3480	6114	2633
Sydney–West	City of Sydney	Inner	5.7	5378	7852	2474
Sydney–South	City of Sydney	Inner	10.8	3750	5463	1713
Sydney–East	City of Sydney	Inner	6.0	7320	8799	1479
Canada Bay–Concord	Inner West	Middle	11.5	2402	3506	1104
Waverley	East	Inner	9.2	6874	7546	672
Parramatta–Inner	West Central	Middle	18.6	2021	2647	627
Auburn	West Central	Middle	32.5	1805	2418	613
Parramatta–South	West Central	Middle	11.0	2890	3477	588
North Sydney	Inner North	Inner	10.5	5592	6171	579
Strathfield	Inner West	Middle	13.9	2117	2655	538
Bankstown–North East	West Central	Middle	16.7	3295	3802	508

Source: BITRE estimates derived from ABS Cat. 3218.0, Regional Population Growth.

Again, a more detailed perspective on changes in density can be gained by focusing on the 2001 to 2006 period for which census data is available. Table 3.10 lists the Sydney suburbs with the greatest population density increases over the 2001 to 2006 period. Consistent with the patterns of density change for SLAs (see Table 3.9), the greatest change in population densities occurred in the Inner sector of Sydney. There are 14 listed suburbs in the Inner sector which recorded a change in density of over 1000 persons per square kilometre, compared to six in the Middle sector and 3 in the Outer sector.

The table provides some insight into the main locations for urban consolidation in Sydney. It was most pronounced in the City of Sydney, with numerous suburbs increasing population densities dramatically between 2001 and 2006 (e.g. Pyrmont, Waterloo, Chippendale, Elizabeth Bay). A range of other Inner and Middle suburbs recorded density gains of a similar magnitude, including:

- St Leonards in the Lane Cove SLA, reflecting new high-rise apartment developments in this established commercial and residential area
- Homebush West in the Strathfield SLA, reflecting conversion of older housing into unit developments
- Liberty Grove in the Concord SLA, reflecting the conversion of former industrial land into a townhouse and unit development, and
- Wolli Creek in the Rockdale SLA, reflecting the conversion of former industrial land to high density residential and commercial use.

The apparent gains in population density for the Outer sector suburbs are largely a result of rapid population growth in new greenfields housing estates. The exception is Waitara in the Hornsby South SLA—an established suburb which underwent significant urban infill between 2001 and 2006. More specifically, census data reveals it went from having no apartment buildings of four or more storeys in 2001 to having 60 per cent of the suburb's total dwelling stock consisting of units in buildings of at least four storeys in 2006.

Table 3.10 Suburbs experiencing density changes of more than 600 persons per square kilometre, Sydney, 2001 and 2006

Sector	Suburb	Statistical Local Area	Density 2001 (persons per square km)	Density 2006 (persons per square km)	Increase in density (persons per square km)
Inner	Pymont	Sydney–West	7 940	11 567	3 626
	Dawes Point	Sydney–Inner	2 008	5 253	3 245
	Waterloo	Sydney–South	4 588	7 600	3 012
	Ultimo	Sydney–West	6 925	9 608	2 682
	Zetland	Sydney–South	741	3 262	2 521
	St Leonards	Lane Cove	2 957	5 259	2 302
	Milsons Point	North Sydney	7 056	9 217	2 161
	Elizabeth Bay	Sydney–East	17 332	19 171	1 839
	Sydney	Sydney–Inner	4 159	5 709	1 551
	Chippendale	Sydney–West	4 464	5 978	1 514
	Ersleville	Sydney–South	4 045	5 490	1 445
	Camperdown	Marrickville	3 184	4 462	1 277
	Millers Point	Sydney–Inner	2 828	4 088	1 260
	Potts Point	Sydney–East	9 953	11 156	1 203
	Surry Hills	Sydney–East	11 287	12 275	989
	Haymarket	Sydney–Inner	10 215	11 089	874
	Rushcutters Bay	Sydney–East	15 170	16 015	845
	Rozelle	Leichhardt	4 847	5 525	677
	Newtown	Marrickville	7 995	8 637	642
	The Rocks (Sydney)	Sydney–Inner	1 931	2 569	638
Middle	Liberty Grove	Canada Bay–Concord	4 145	6 270	2 125
	Chiswick	Canada Bay–Drummoyne	2 623	4 725	2 102
	Wolli Creek	Rockdale	929	2 911	1 983
	Homebush West	Strathfield	2 717	4 221	1 504
	Chatswood	Willoughby	3 489	4 639	1 150
	Huntleys Cove	Hunter's Hill	1 431	2 497	1 067
	Rhodes	Canada Bay–Concord	719	1 648	929
	Meadowbank	Ryde	3 173	4 075	902
	Dolls Point	Rockdale	3 208	4 050	842
	Homebush	Strathfield	1 639	2 446	807
	Hurstville	Hurstville	4 795	5 501	706
	Cabarita	Canada Bay–Concord	1 961	2 651	690
	Rockdale	Rockdale	4 849	5 534	685
Outer	Waitara	Hornsby–South	2 204	4 495	2 291
	Acacia Gardens	Blacktown–North	1 785	3 085	1 300
	Stanhope Gardens	Blacktown–North	888	1 928	1 040
	Glenwood	Blacktown–North	1 861	2 777	915
	Harrington Park	Camden	840	1 690	850
	Parklea	Blacktown–North	1 617	2 330	713
	Blair Athol	Campbelltown–South	500	1 167	667
	Beaumont Hills	Baulkham Hills–North	446	1 105	658
	Kellyville	Baulkham Hills–North	994	1 648	654

Note: Where suburbs are split across more than one SLA, they have been allocated to the SLA that accounts for the largest population share.

Source: BITRE analysis of ABS 2001 and 2006 *Census of Population and Housing* place of usual residence data at suburb and CCD scale.

Households

This section presents a brief overview of spatial differences in average household size and the rate of growth of households, focusing on similarities and differences with the population results presented in the previous section. This analysis has been included to provide some understanding of the connection between spatial change in population, households and demand for dwellings.

Table 3.11 summarises household growth and household size at the planning subregion level for the 2001 to 2006 period, based on ABS' Estimated Resident Households data. The Outer sector had the largest household size in 2006—averaging around 2.9 persons per household. The smallest household size was in the Inner sector with 2.3 persons per household. At the subregion scale, average household size ranged from 2.0 persons in the City of Sydney to 3.1 persons in the South West.

Table 3.11 Household growth and household size by planning subregion and sector, Sydney Greater Metropolitan Area, 2001 to 2006

	Average annual growth in households, 2001 to 2006 (per cent)	Average annual growth in estimated resident population, 2001 to 2006 (per cent)	Average household size 2001	Average household size 2006	Change in household size, 2001 to 2006
Planning subregions					
City of Sydney	4.5	5.0	2.0	2.0	0.05
East	0.4	0.2	2.4	2.4	-0.02
Inner North	0.9	0.7	2.4	2.4	-0.03
Inner West	1.2	1.3	2.5	2.5	0.01
South	0.6	0.1	2.7	2.7	-0.06
North	0.7	0.1	3.0	2.9	-0.09
North East	0.5	0.3	2.6	2.6	-0.02
West Central	1.0	0.7	3.0	3.0	-0.04
North West	1.1	0.9	3.0	3.0	-0.03
South West	1.1	0.9	3.1	3.1	-0.04
Central Coast	0.1	0.6	2.5	2.5	0.06
Sydney SD	1.0	0.7	2.8	2.7	-0.03
Sectors					
Inner	1.4	1.2	2.3	2.3	-0.02
Middle	1.0	0.7	2.8	2.8	-0.03
Outer	0.8	0.6	2.9	2.9	-0.03
Rest of GMA					
Illawarra	0.7	0.7	2.6	2.6	0.00
Lower Hunter	0.6	1.0	2.6	2.6	0.06
Total GMA	0.9	0.8	2.7	2.7	-0.02

Note: The estimated resident population used in the table has been based only on residents of occupied private dwellings. This enables valid comparison with household data.

Source: BITRE analysis of ABS Estimated Resident Household data obtained on request.

The average household size in the Greater Metropolitan Area of Sydney declined marginally from 2001 to 2006. A similar trend was observed in the Sydney SD as well. All the planning subregions in Sydney—except the City of Sydney, Inner West and Central Coast—experienced a contraction in the number of persons per household.

The number of Sydney households grew at an average annual rate of 1.0 per cent, which was about 0.3 percentage points higher than the population growth rate, with the gap reflecting the slight reduction in household size between 2001 and 2006. The lowest household growth occurred in the Central Coast planning subregion, with an average annual 0.1 per cent increase in the number of households during the period. In contrast, the City of Sydney grew at an average annual rate of 4.5 per cent, which was almost comparable to its increase in population in that period.

Between 2001 and 2006, 43 per cent of population growth and 42 per cent of household growth in Sydney occurred in the Outer sector. The spatial distribution of household growth was fairly well aligned with population growth within Sydney. The correlation coefficient was 0.97 at the planning subregion scale and 0.81 at the SLA scale. Analysis of growth in population and households for SLAs shows that the top three growth SLAs on both measures were Sydney Inner, Sydney West and Baulkham Hills North, although the order differed. Overall, there is a close connection between the recent spatial patterns of household growth in Sydney, and the patterns of population growth that were discussed earlier in this chapter.

Progress with regard to Metropolitan Plan objectives

'By 2036, Sydney will be a more compact, networked city with improved accessibility, capable of supporting more jobs, homes and lifestyle opportunities within the existing urban footprint.' (NSW Government 2010a, p.15)

The metropolitan strategic plans provide important context for this study—this section discusses the progress that has occurred with regard to the population-related objectives of Sydney's recent metropolitan strategies.

City of Cities and *Sydney 2036* have the following common goals that relate to the spatial distribution of population:

- Limit urban sprawl and contain the urban footprint by building around 70 per cent⁹ of new housing within the existing urban area
- Concentrate residential development in centres
- Increase residential densities in centres.

In addition, *City of Cities* aimed to focus residential development in renewal corridors (objective B6). With the release of the *Metropolitan Plan for Sydney 2036*, the focus shifted to centres within those corridors, rather than the corridor as a whole (NSW Government 2010a, p.61). The list of 'strategic directions, objectives and actions' for *Sydney 2036* contained no reference to renewal corridors. In light of this policy shift, BITRE chose not to undertake an empirical assessment of the extent to which residential development has been focused in renewal corridors.

⁹ The target was 60 to 70 per cent in *City of Cities* and 'at least 70 per cent' in *Sydney 2036* (see Table 2.4).

BITRE's spatial analysis focuses on the 2001 to 2010 period, and so where data availability permits, the changes that have occurred between 2001 and 2010 will be analysed. However, as *City of Cities* was not released until 2005, these comparisons are not intended to evaluate the success of *City of Cities* or any other strategic plan. Rather, the primary purpose is to provide evidence about the spatial population trends that have been occurring in Sydney in recent years.

Note that the planning objectives are often framed in terms of dwellings. BITRE's analysis is largely focused on the population outcomes, rather than dwelling outcomes, reflecting the purpose of the study.

Limiting urban sprawl

Recent metropolitan strategies have contained a strong focus and expectation that the existing urban areas will accommodate the majority of the growth that occurs in population and dwellings over the next 25 years. In *Sydney 2036* it was argued that containing the city's urban footprint will provide a range of benefits:

- 'a growth path with 50 per cent of new dwellings on the urban fringe and 50 per cent in existing areas has net costs of \$5 billion relative to a growth path of at least 70 per cent built in existing areas and up to 30 per cent in Greenfield areas'
- 'transport modeling indicated potential for more congestion, slower travel times and increasing economic costs if development is not contained within the current footprint'
- 'will also help protect agricultural and resource lands, and areas of high biodiversity conservation values' (NSW Government 2010a, p.158).

However, too much urban consolidation can also impose costs, with *City of Cities* acknowledging that a hypothetical scenario of 90 per cent of new homes in the existing urban area 'would put great pressure on Sydney's existing suburbs and character and would potentially further reduce housing affordability' (NSW Government 2005, p.133).

City of Cities aimed to 'contain Sydney's urban footprint', by ensuring that the North West and South West growth centres and other land release areas will provide for 30–40 per cent of housing development, while '[t]he remaining 60–70 per cent of housing development will occur within the existing urban area' (NSW Government 2005, p.217). The greenfields target was consistent with Sydney's experience in the 1990s, when 33 per cent of housing development related to greenfield sites (see Figure 3.11). The urban consolidation target was raised slightly in *Sydney 2036*, to '[l]ocate at least 70% of new homes in existing suburbs and up to 30% in greenfield areas' (NSW Government 2010a, p.6). *Sydney 2036* also aims to contain Sydney's urban footprint 'by focusing land release in the Growth Centres' (ibid., p.160).

The metropolitan strategies identify a range of mechanisms to achieve this urban containment objective:

- Housing targets are set out for all planning subregions, using a 25 year timeframe. These are translated into housing targets for LGAs in the subregional strategies.
- Councils are required to incorporate the strategic directions and housing targets from the Metropolitan Plan into their Local Environmental Plans (LEPs). The LEPs need to set out the land use zoning pattern to achieve this outcome.

- New land releases by the NSW Government are to be focused in the North West and South West growth centres. Rural settlements outside of these growth centres will be managed through new comprehensive local strategies prepared by councils, with endorsement by the Department of Planning.
- There will be streamlining of the land release process for new release areas to provide greater certainty. *Sydney 2036* proposes that all land supply requests will be considered simultaneously in an annual land supply assessment which determines whether more land should be released.
- Monitoring of housing production against targets will occur through the Metropolitan Development Program, with annual reports (NSW Government 2010a, pp. 114, 160–61, NSW Government 2005, pp. 133–36).

Following the change of Government in NSW in 2011, several policy initiatives have focused on increasing the supply of greenfield land available for housing in Sydney (see Box 2.1). A specific goal of *NSW 2021* was to increase housing affordability and availability, with the following nominated targets:

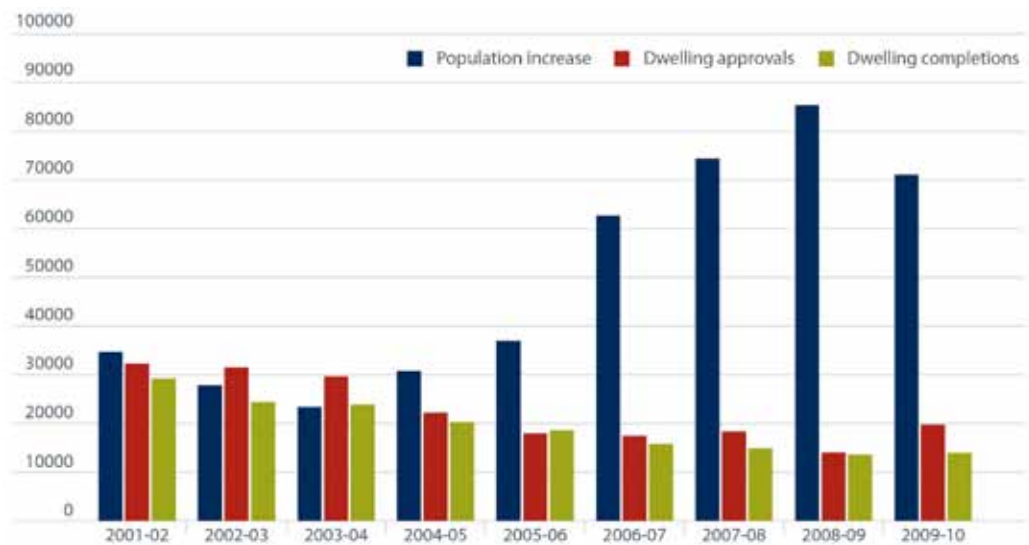
- Facilitate the delivery of 25 000 new dwellings in Sydney per year
- Increase the available greenfield zoned and serviced lots to always be above 50 000 (NSW Government 2011c).

Recent trends in Sydney housing development

Between 2001 and 2010, the estimated resident population of the Sydney SD increased by about 447 000 people. There were 203 000 dwelling approvals over the same period (ABS 2011d). Figure 3.9 illustrates the trends in population additions, dwelling approvals and dwelling completions over the period. Population growth in Sydney averaged around 30 000 a year between 2001–02 and 2005–06, but the city's population has increased by more than 60 000 in each year since 2005–06. Dwelling approvals and completions display a very different pattern, with a declining trend between 2001–02 and 2005–06, followed by a period of relative stability. There are typically more dwelling approvals than dwelling completions in a year, as some approved dwellings experience construction delays or are not followed through on. The more rapid population growth of recent years has had no noticeable effect on levels of dwelling production, suggesting a rise in average household sizes since 2006.

Only 37 per cent of dwelling approvals related to separate houses, compared to 67 per cent in Melbourne and 79 per cent in Perth between 2001 and 2010 (ABS 2011d). Dwelling completions were similarly biased towards multi-unit dwellings rather than detached dwellings, with the latter representing only 30 per cent of dwelling completions between 2001–02 and 2007–08 (Abelson 2010). The high proportion of multi-unit dwellings points to the important role of infill developments in accommodating population growth in Sydney.

Figure 3.9 Comparison of population increase, dwelling approvals and dwelling completions, Sydney, 2001–02 to 2009–10



Note: 2010 ERP data remains preliminary.

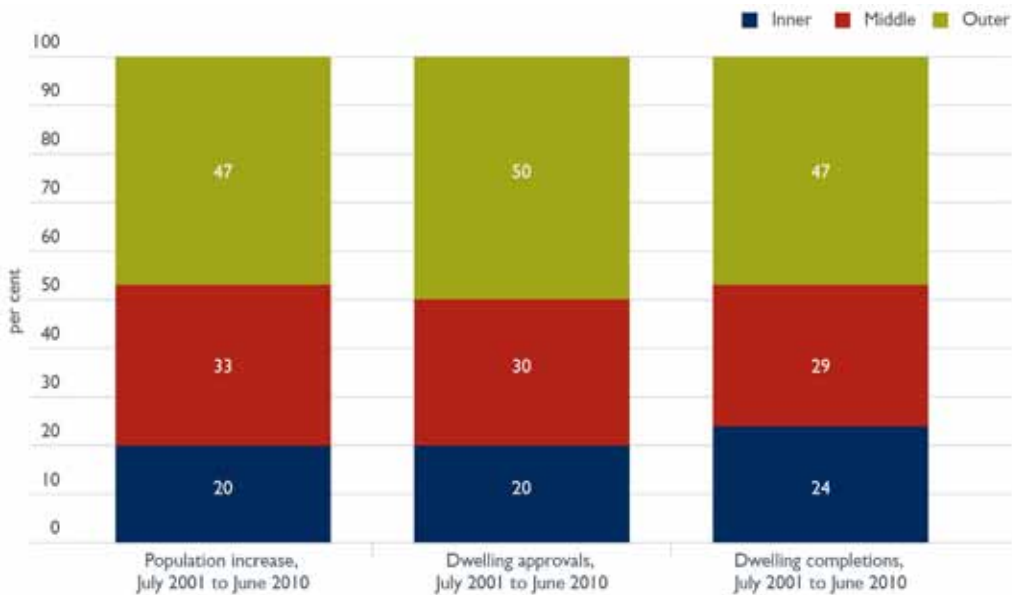
Sources: BITRE analysis of ABS Cat. 3218.0 and 8731.0, NSW Department of Planning dwelling completions data (based on Sydney Water connections) and NSW Department of Planning and Infrastructure (2011h).

Housing development in greenfield land releases

Where in Sydney were these population increases and new dwellings located? Figure 3.10 reveals that the largest proportion of population and dwellings growth occurred in the Outer sector. Between 2001 and 2010, 47 per cent of population growth and dwelling completions and 50 per cent of dwelling approvals related to the Outer sector. The Inner sector accounted for 20 to 24 per cent of the three measures, while the Middle sector accounted for 29 to 33 per cent. Sydney's Outer sector accounted for a considerably smaller share of the city's 2001 to 2010 population increase than did the Outer sectors of the Melbourne statistical division (61 per cent) and the Perth statistical division (69 per cent) (BITRE 2011, 2010).

The population growth in Sydney's Outer sector reflects a mix of growth in established suburbs and greenfield developments. The distinction is not always straightforward, as there can be delays of many years between an initial land release and a suburb being fully populated, and significant new land releases can occur in an established suburb. About 40 per cent of Outer sector dwelling completions between 2001–02 and 2009–10 were classified by the Metropolitan Development Program as occurring in greenfield developments.

Figure 3.10 Proportion of population increase, dwelling approvals and dwelling completions occurring in each sector of Sydney, 2001 to 2010



Note: 2010 ERP data remains preliminary.

Sources: BITRE analysis of ABS Cat. 3218.0 and 1379.055.001, NSW Department of Planning Metropolitan Development Program data on dwelling completions (based on Sydney Water connections), various issues.

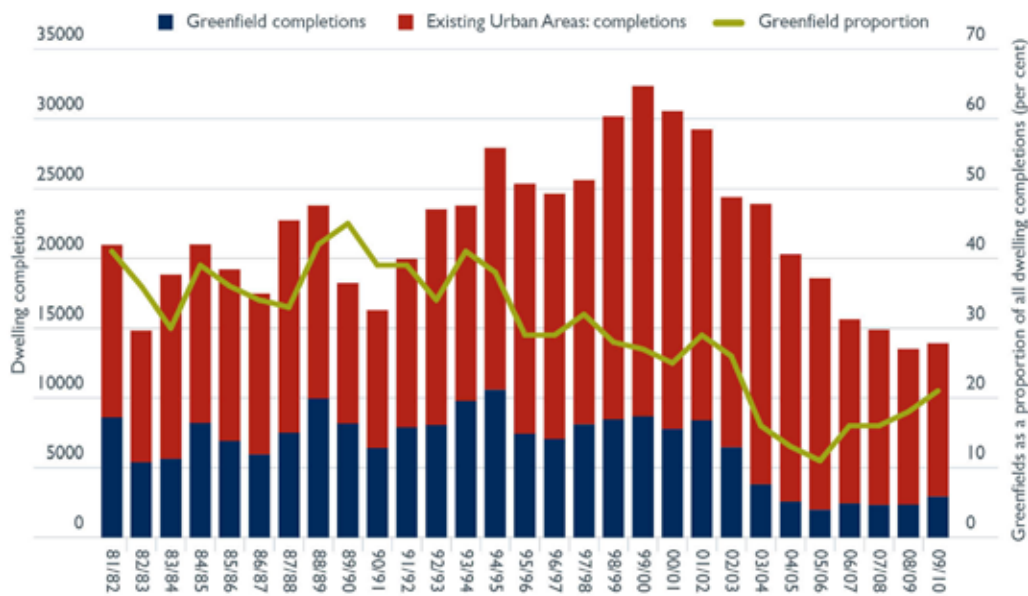
The NSW Government's official data on historical dwelling completions indicates that only 19 per cent of dwelling completions in Sydney between 2001–02 and 2009–10 related to greenfield developments, with the remaining 81 per cent relating to existing urban areas (see Figure 3.11). The greenfield proportion was 29 per cent in 2001–02, but fell to just 11 per cent in 2005–06, before rising to reach 21 per cent in 2009–10. In the five years since *City of Cities* was released, only 14 per cent of the new dwellings were in greenfield developments (NSW Government 2010a).

Dwelling completions in greenfield areas declined substantially in the early part of the decade, and have averaged around 2400 completions per year since 2004–05. Dwelling completions in existing urban areas declined each year between 2003–04 and 2009–10. Department of Planning (2010a) provides the following explanation for the decline in dwelling production:

'The peak in production was related to factors such as high levels of population growth, relatively low interest rates, ready access to finance, the pre GST increase in demand and the Commonwealth Government's First Homebuyers Grant' (p.4)

'The first part of the fall in production can be attributed to factors such as demand being brought forward during the peak levels of production, increasing property prices, falling population growth, rising interest rates and reduced activity by property investors. The later part of the fall in production has been compounded by the Global Financial Crisis with factors such as increasing unemployment and difficulty in access to finance for the development industry' (p.77)

Figure 3.11 Dwelling completions in existing urban areas and greenfield areas, Sydney, 1981–82 to 2009–10



Source: NSW Department of Planning official data based on Sydney Water and Central Coast councils (data on request) and NSW Department of Planning and Infrastructure (2011h).

Thus, for the July 2001 to June 2010 period, the *City of Cities* target that ‘60–70 per cent of housing development will occur within the existing urban area’ has been exceeded, with 81 per cent of dwelling completions occurring within the existing urban area. The realised outcomes are more compatible with the revised *Sydney 2036* target that at least 70 per cent of new homes will be located in existing suburbs, with up to 30 per cent in new land release areas.

Population growth within newly developing suburbs

While the Metropolitan Development Program (MDP) data directly informs questions about the containment of new housing development within the existing urban area, it does not directly provide information on the location of population growth and nor does it support comparison between cities. Census data can provide some information on these matters.

BITRE has developed a census-based methodology for classifying all ABS suburbs within capital city SDs as either a ‘newly developing suburb’ or part of the ‘existing urban area’ for the 2001 to 2006 period. All Middle and Inner sector suburbs were classified as part of the existing urban area, whereas Outer sector suburbs were classified as either a ‘newly developing suburb’

or part of the 'existing urban area' depending on whether certain growth criteria were met.¹⁰ The 'newly developing suburb' category is intended to capture urban fringe locations that have experienced a very rapid increase in the number of dwellings, typically off a low base. Further information on this classification as it applies to Melbourne and Perth is available from BITRE (2011, pp.85–86) and BITRE (2010, pp.44–45).

This methodology has been applied to the Sydney SD, identifying 19 'newly developing suburbs' which are listed in Table 3.12. The MDP identified 18 of the 19 suburbs as containing 'greenfield release areas', but the dwellings growth at Holsworthy was classified as 'transit node' development (rather than infill or greenfield development) because it was near the Holsworthy train station (Department of Planning 2005, 2009).

Table 3.12 Sydney's newly developing suburbs for the 2001 to 2006 period

The following suburbs* were classified by BITRE as newly developing suburbs

South West subregion—Harrington Park, Macquarie Links, Blair Athol, Holsworthy, Voyager Point, Prestons, West Hoxton
 North West subregion—Beaumont Hills, Kellyville, Kellyville Ridge, Rouse Hill, Acacia Gardens, Parklea, Glenwood, Stanhope Gardens
 Central Coast subregion—Hamlyn Terrace, Wadalba, Woongarra
 North East subregion—Warriewood

Note: * Some suburbs have changed their CD composition between 2001 and 2006 and hence their boundaries may also change.

Source: BITRE analysis of ABS *Census of Population and Housing* suburb and CD data on occupied private dwellings for 2001 and 2006, and Metropolitan Development Program Databook and Atlas 2004 and 2006.

Growth in newly developing suburbs provides a conservative guide to growth in greenfield land releases because considerable greenfield development has occurred in suburbs which are not listed in Table 3.12. Examples include Glenmore Park in the Penrith LGA and Castle Hill in the Baulkham Hills LGA—both were relatively established suburbs in 2001 (containing more than 5000 dwellings) and have added many new dwellings, but have not grown rapidly enough since 2001 to meet the BITRE definition of a newly developing suburb.

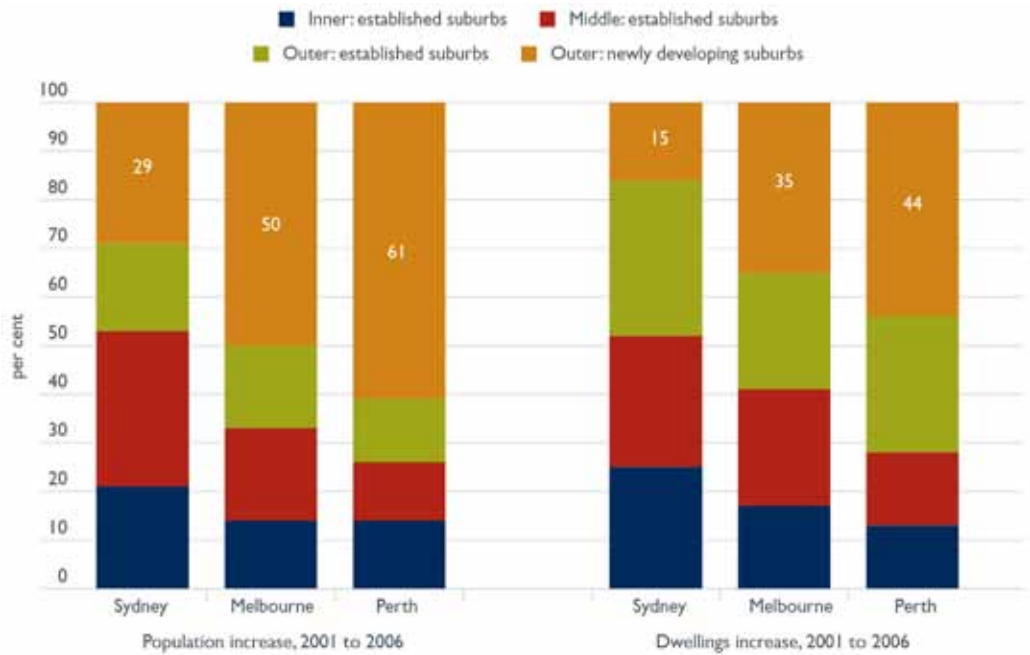
Between 2001 and 2006, Sydney's population and dwellings growth rates were considerably lower than those of Perth and Melbourne. Figure 3.12 compares Sydney, Melbourne and Perth in terms of the proportion of population and dwellings growth that occurred in newly developing suburbs between 2001 and 2006. Sydney had a much lower proportion of its population increase occurring within the newly developing suburbs, at 29 per cent, compared to 50 per cent for Melbourne and 61 per cent for Perth. Sydney also had a much lower proportion of its dwelling increase occurring within the newly developing suburbs.

¹⁰ Specifically a newly developing suburb needed to meet one of the following conditions:

- A suburb located in the Outer sector in which the number of occupied private dwellings increased by more than 50 per cent over the period *and* this involved an increase of at least 100 additional dwellings *and* the growth was fringe development, not urban infill.
- A suburb located in the Outer sector in which the number of occupied private dwellings increased by between 30 and 50 per cent over the period *and* this involved at least 100 additional dwellings *and* at least one CD within the suburb more than doubled its number of dwellings *and* the growth that occurred was fringe development, not urban infill.

The second criterion loosens the growth cutoff a little to ensure the definition is able to capture suburbs which contain some established residential areas, but in which substantial new land releases occurred during or just prior to the period of interest.

Figure 3.12 Distribution of population and dwelling growth in Sydney, Melbourne and Perth, 2001 to 2006



Notes: The analysis relates to suburbs within capital city statistical divisions. Definition of newly developing suburbs is provided in Table 3.12 for Sydney, Table 3.18 of BITRE (2011) for Melbourne, and Table 3.8 of BITRE (2010) for Perth. Results relate to the usual resident population and to occupied private dwellings.

The estimates for Perth and Melbourne differ slightly from those in BITRE (2010) and BITRE (2011), as the population increase and dwelling increase for the statistical division was used as the denominator to enable valid comparisons to be made with the Sydney results (whereas the previous denominator was the sum of growth across suburbs).

Source: BITRE analysis of ABS *Census of Population and Housing* data for 2001 and 2006.

In each city, the newly developing suburbs accommodated a much larger proportion of the population increase than of the dwellings increase. This reflects the larger household sizes and higher birth rates in the newly developing suburbs, compared to the existing urban area.

The Sydney, Melbourne and Perth results in Figure 3.12 are consistent with the NSW Government's conclusion that:

'Sydney is unique among Australian capital cities in that most of its growth are within the existing urban areas rather than relying on outward fringe growth' (Department of Planning 2010a, p.1).

Table 3.13 presents the five newly developing suburbs and existing suburbs that added the most dwellings between 2001 and 2006. The five suburbs that added the most dwellings were all located in the existing urban area of Sydney, with the top three located in the City of Sydney LGA. The three suburbs that added the most population were the newly developing suburbs of Kellyville and Glenwood in the North West and Prestons in the South West.

Most of the newly developing suburbs are located in either the South West or North West planning subregions. The eight newly developing suburbs in the North West accommodated 16 per cent of Sydney's population growth while the seven newly developing suburbs in the

South West accommodated 8 per cent of growth.¹¹ These newly developing suburbs were identified for the 2001 to 2006 period. Consequently, there is only a small degree of overlap with the North West and South West Growth Centres identified in *Sydney 2036* as being the intended focus of future greenfield residential development (i.e. between 2010 and 2036).

Table 3.13 Suburbs adding the most dwellings, Sydney, 2001 to 2006

Newly developing suburbs			Existing urban areas		
Suburb	Dwelling change	Population change	Suburb	Dwelling change	Population change
Kellyville	1379	7287	Waterloo	1949	3369
Prestons	1214	3850	Sydney	1771	3677
Glenwood	1207	4580	Pymont	1672	3479
Kellyville Ridge	1011	3487	Waitara	1665	2610
Rouse Hill	955	2749	Chatswood	1658	3353

Note: Some suburbs have changed their CD composition between 2001 and 2006 and hence their boundaries may also change.

Source: BITRE analysis of ABS Census of Population and Housing suburb data on occupied private dwellings and usual resident population for 2001 and 2006, and Metropolitan Development Program Databook and Atlas 2004 and 2006.

North West and South West Growth Centres

The North West Growth Centre includes parts of The Hills, Blacktown and Hawkesbury LGAs, while the South West Growth Centre includes parts of the Liverpool, Camden and Campbelltown LGAs. Table 3.14 lists the localities that the NSW Government identifies as making up the North West and South West Growth Centres. The location of these Growth Centres is shown on Map 1.3. The South West Growth Centre has the capacity to provide 110 000 new dwellings for about 300 000 people, while the North West Growth Centre has the capacity to provide 70 000 new dwellings for around 200 000 people (Department of Planning and Infrastructure 2011f,g).

Table 3.14 Locations within Sydney's North West and South Growth Centres

Growth Centre	The following precincts were designated by NSW government as part of the respective Growth Centre ^
South West Growth Centre	Edmondson Park, Oran Park, Turner Road, Austral, Leppington North, East Leppington, Leppington, Catherine Fields North, Catherine Fields, Marylands, Rossmore, North Rossmore, Lowes Creek, Bringelly, North Bringelly, Future Industrial, Kemps Creek, Western Sydney Parklands
North West Growth Centre	North Kellyville, Alex Avenue, Riverstone East, Riverstone, Riverstone West, Colebee, Area 20, Marsden Park, Marsden Park North, Marsden Park Industrial, Box Hill, Box Hill Industrial, Schofields, Schofields West, Shanes Park, Vineyard

Source: NSW Department of Planning and Infrastructure (2011f,g) <www.gcc.nsw.gov.au/home-3.html>

¹¹ MDP monitoring reveals that the North West has continued to be more dominant, with 9 per cent of Sydney's dwelling completions between July 2006 and June 2010 relating to new release areas in the North West subregion and 5 per cent to new release areas in the South West subregion (Department of Planning and Infrastructure 2011h).

Overall assessment

MDP data reveals that over 80 per cent of Sydney's new housing development occurred within the existing urban area between 2001 and 2010. New land releases played a relatively minor role, accommodating much less than the 30–40 per cent share of growth targeted in *City of Cities* (which was changed to an 'up to 30%' target in *Sydney 2036*). Census data for 2001 to 2006 confirms the dominant role played by urban infill development in Sydney, and highlights the much lesser role played by urban infill in Melbourne and Perth. This evidence points to strong progress since 2001 against the goal of limiting urban sprawl in Sydney—the specified targets have been met and exceeded.

The target has been exceeded because '[h]ousing production in new release areas has been well below expectations in recent years' (NSW Government 2010a, p.106). Dwelling production within the existing urban area has also been below expectations. For example, the 2004 MDP forecasts total dwelling production of 23 000 dwellings in greenfield release areas and 101 000 dwellings within the existing urban area for the 2004–05 to 2008–09 period (Department of Planning 2005). Realised dwelling production was 50 per cent lower than this for greenfield sites and 29 per cent lower for the existing urban area.¹² In a report for NSW Treasury, Abelson (2010 p.5) concludes that 'slow growth in GSP per capita and population do not fully explain this substantial slow down in residential building activity ... Supply side constraints are responsible for much of the slow down'. The following reasons have been identified for the decline in new house construction on Sydney's urban fringe:

- Due to fractured land ownership on Sydney's western fringe, developers find it hard to acquire commercially viable consolidated land holdings (Abelson 2010).
- Developers regarded new subdivision projects as being financially unviable due to the high asking prices for undeveloped land, which occur either because englobed land owners were unwilling to sell their land below the price benchmarks set during the previous market peak or because they do not want to sell and move (ibid.).
- New house and land packages had become unaffordable for many new home buyers and were not price competitive. In particular, the 33 per cent higher price of new greenfield dwellings compared to the established housing stock in the same area was a major contributor to the weak demand (BIS Shrapnel 2009, as described in Department of Planning 2010a).

Ergas (2012, p.13) argues that '[a]n incoherent policy mix has combined very tight restrictions on land availability at Sydney's urban fringe with capping of local council rates, reducing the incentives of local councils in the in-fill area to accept denser uses whose benefits they cannot appropriate'. This led to a predictable reduction in the availability of low cost housing in Sydney (ibid.).

Sydney's low level of dwelling production has not kept pace with demand, which has broader implications for affordability and growth. Abelson (2010) points out that a low housing completions policy comes at the cost of escalating house prices, and negative impacts on economic growth and incomes. COAG Reform Council (2012, p.98) notes that the focus on infill development in Sydney may have negative consequences for affordability and also has 'implications for Sydney's growth—and given the national economic significance of Sydney—for the nation'.

¹² Based on MDP data from Department of Planning and Infrastructure (2011h) and earlier issues.

Focus residential development around centres

Centres policy has been part of Sydney's metropolitan strategies for at least fifty years (NSW Government 2005), but centre policies have evolved into a more structured form since the release of the 1988 Metropolitan Strategy. *City of Cities* and *Sydney 2036* both emphasise concentrating activity—including jobs, services and housing—within a hierarchy of centres located across the metropolitan area. 'With regard to housing:

- *City of Cities* aims to 'focus residential development around centres' (NSW Government 2005, p.140). Its vision for housing is that '[o]ver three-quarters of new housing will be located in strategic centres, smaller centres and corridors within walking distance of shops, jobs and other services concentrated around public transport nodes. As housing density increases in these places, the character of Sydney's suburbs will be protected' (ibid., p.118). A potential distribution of new housing in centres to 2031 is presented which involves 57 per cent of additional dwellings being built in centres within existing areas of Sydney—21 per cent in strategic centres and the remaining 36 per cent in the smaller town centres, neighbourhood centres and villages. The remaining dwellings would be located in suburban areas that are not near centres (13 per cent) and in greenfield areas (30 per cent).
- *Sydney 2036* 'aims to accommodate 80 per cent of Sydney's new housing within the walking catchments of existing and planned centres', because '[f]ocusing new housing in and around centres helps to make efficient use of existing infrastructure, increases the diversity of housing supply, allows more trips to be made by public transport and helps strengthen the customer base for local businesses' (NSW Government 2010a, p.63).

Defining centres

Measuring the extent of residential development in centres requires a definition of what constitutes a centre. The centres hierarchy has evolved over time, and the number of nominated centres has increased with each successive plan. The following analysis adopts the centres hierarchy outlined in the 2005 Metropolitan Strategy—a listing of strategic centres is provided in Table 2.3 and their spatial distribution is illustrated in Map 2.1.

Measurement also requires centre boundaries to be defined. Two different approaches have been adopted by the NSW Government in recent years:

- The recent Metropolitan Strategies focus on the walking catchment from which people can be expected to walk to the centres' shops, services and public transport. This is measured as a radius from a central point in the centre which is often a public transport hub. The walking catchment radius differs by centre type, being set at 2 kilometres for Global Sydney and the regional cities, approximately 1 kilometre for the specialised centres and major centres, and typically less than this for the smaller local centres (Department of Planning 2010a). The catchment of centres which are located in close proximity overlap (e.g. Parramatta and Westmead, St Leonards and North Sydney), and in this case a boundary split needs to be determined so numbers are allocated to only one centre. The radius approach is most suitable when geocoded address data is available¹³. It is the basis for the MDP data on dwelling completions in centres presented in the following section.

¹³ Producing estimates for centres based on census data requires the radius to be approximated using census collection district or destination zone boundaries.

- Transport Data Centre (2008b) defines the boundaries of strategic centres in terms of 2006 destination zone boundaries and uses this definition to measure employment in centres. The TDC approach has the advantage of alignment with census output boundaries and matches the approach used for centres in BITRE's Melbourne and Perth studies (BITRE 2011, 2010). BITRE has adopted the TDC centre boundaries as its starting point in estimating population and jobs in centres. As not all of the strategic centres (and none of the planned/potential major centres) identified in *City of Cities* were covered by TDC (2008b), BITRE made some modifications to the TDC classification to ensure alignment with the information provided in *City of Cities* and the relevant subregional plans (details in note for Figure 3.13). As of 2012, the NSW Government uses a revised version of the TDC (2008b) classification, which reflects the full set of strategic centres and is similarly based on 2006 destination zone boundaries.

Dwellings

Table 3.15 presents MDP information on the spatial distribution of dwelling production in Sydney in recent years. In the past five years, 50 per cent of total dwelling production has occurred in the vicinity of centres, which is a little below the 57 per cent envisaged in *City of Cities*. However, it exceeds the 42 per cent of dwelling production that occurred around centres in the 1998–99 to 2002–03 period (Department of Planning 2010a).

The MDP data indicates that 23 per cent of dwelling production was in strategic centres between 2003–04 and 2007–08 and 21 per cent between 1998–99 and 2002–03 (*ibid.*). BITRE analysis of census data indicates that 25 per cent of the Sydney SD's increase in occupied private dwellings between 2001 and 2006 related to strategic centres.¹⁴ Thus, the proportion of new dwellings being built in strategic centres roughly matches the 21 per cent envisaged by *City of Cities*.

However, dwelling production in the smaller local centres has been below the 36 per cent share envisaged by *City of Cities*. The smaller local centres accounted for 27 per cent of new dwelling production between 2003–04 and 2007–08 and 21 per cent between 1998–99 and 2002–03.

¹⁴ The MDP figures of 23 per cent between 2003–04 and 2007–08 and 21 per cent between 1998–99 and 2002–03 exclude Central Coast dwelling production, while the BITRE census-based estimate includes the Central Coast's strategic centres.

Table 3.15 New dwelling production by centre type, Sydney

Location by centre type	2003–04 to 2007–08 (dwellings)	(per cent)	2008–09 to 2012–13 forecast (per cent)	City of Cities potential distribution of new dwellings to 2031 (per cent)
Global Sydney, Regional cities, Specialised centres	14 623	15.7	11.5	14.1
Major centres	6 551	7.0	6.5	7.0
Strategic centres	21 174	22.8	18.0	21.1
Smaller local centres: Town centres, villages and neighbourhood centres	25 506	27.4	20.4	35.9
All centres	46 680	50.2	38.3	57.0
Outside centres: suburban areas not near centres	29 910	32.1	36.3	12.5
Total existing urban areas	76 590	82.3	74.6	69.5
Total Sydney dwelling production	93 040	100.0	100.0	100.0

Note: Data for centres and the existing urban area exclude Central Coast dwelling production. Dwelling production data was not presented on a centres basis in the more recent MDP reports.

Source: NSW Department of Planning 2010a (Tables 5.1, 5.2 and 5.4).

Of the new dwellings built within the existing urban area, 39 per cent were built outside of the walking catchment of centres between 2003–04 and 2007–08 (i.e. 32.1/82.3). Similarly, 39 per cent were built outside of centres in the 1998–99 to 2002–03 period (Department of Planning 2010a). Randolph, Pinnegar et al. (2010, p.6) estimate that 53 per cent of the strata units completed between 2006 and 2009 were built outside the specified centres, noting that ‘much of this “non-centre” development is in fact taking place on the margins of the centres, beyond the already more densely developed core areas’. Productivity Commission (2011, p.289) points out that ‘despite New South Wales claims that out-of-centre developments are actively discouraged, only about 20 per cent of NSW councils reported implementing an activity centres approach (the lowest of any state) and NSW councils reported refusing only two DAs on the basis that they were inconsistent with activity centres policy’.

The recent figures for out-of-centre development in the existing urban area are all well above the 18 per cent share (i.e. 12.5/69.5) envisaged by *City of Cities* to 2031, and provide no evidence of any lowering of the rate of out-of-centre development since the release of *City of Cities* in 2005. Instead, in the short term, out-of-centre development is forecast to increase, accounting for 49 per cent of new dwellings built within the existing urban area between 2008–09 and 2012–13 (see Table 3.15). Dwelling production around centres is forecast to decline over this period (Department of Planning 2010a).

Randolph, Pinnegar et al. (2010, p.6) note that ‘[m]any of these centres are already fairly densely built up with commercial cores, making the task of rebuilding to higher densities much more difficult’. They further state that renewal in centres is likely to be ‘high risk, protracted and piecemeal’ (ibid., p.6). They suggest that rethinking of incentives and policy levers is required to bridge the renewal gap (ibid.).

The relatively high ongoing rate of out-of-centre residential development in Sydney's established suburbs is not in line with the stated policy aim of focusing residential development around centres. Achievement of the *Sydney 2036* target (that 80 per cent of new housing be located within the walking catchment of a centre) will be challenging in the face of these recent trends. As acknowledged in *Sydney 2036*, 'a concerted effort will be needed to increase this proportion' (NSW Government 2010a, p.63).

Population

Of particular interest in this study is the extent to which Sydney's population is concentrated within centres, and how this is changing over time. Table 3.16 presents BITRE's estimates of the distribution of the population across the different types of strategic centre, and how that changed between 2001 and 2006. Estimates have not been produced for the smaller local centres.

Table 3.16 Estimated resident population by centre type, Sydney, 2001 to 2006

Centre type	Share of 2001 population (per cent)	Share of 2006 population (per cent)	2006 population (thousands)	Population change, 2001 to 2006 (thousands)	Average annual growth rate, 2001 to 2006 (per cent)	Share of population change, 2001 to 2006 (per cent)
Global Sydney	1.6	2.0	87	20	5.3	13.0
Regional cities	0.6	0.7	29	3	2.5	2.2
Specialised centres	1.1	1.2	52	6	2.6	4.1
Major centres	1.2	1.4	62	11	4.0	7.1
Existing strategic centres	4.6	5.4	230	41	4.0	26.5
Planned and potential major centres	0.5	0.7	28	8	6.6	5.0
All strategic centres	5.1	6.0	259	48	4.2	31.5
Outside of strategic centres	94.9	94.0	4023	105	0.5	68.5
Sydney total	100.0	100.0	4282	154	0.7	100.0

Notes: See Table 2.1 for further information about each centre type.

Sources: Estimated resident population data sourced from NSW BTS online tabulations at travel zone scale. Centre boundaries based on TDC (2008b), BITRE analysis of Metropolitan Strategy subregional plans and 2006 destination zone (travel zone) boundaries.

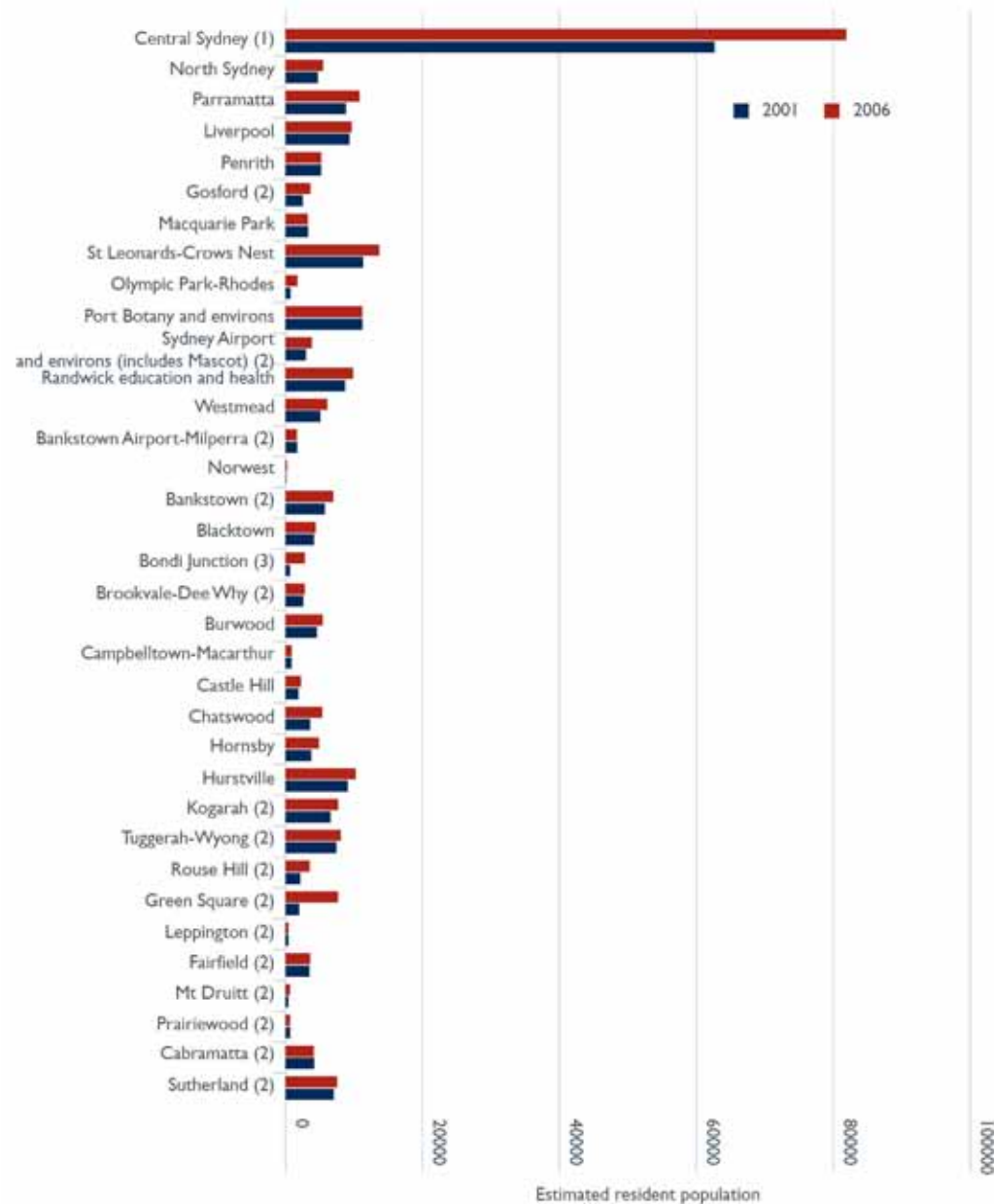
It is estimated that there were around 230 000 residents of Sydney's existing strategic centres in 2006, representing 5.4 per cent of the city's population. If the planned and potential major centres are taken into account, that rises to 259 000 residents and 6.0 per cent. Much of this population lives in Global Sydney (particularly Central Sydney), which was home to over 87 000 residents in 2006. Despite the policy emphasis given to accommodating population in strategic centres¹⁵, they currently play a very modest role with the vast majority (94 per cent) of Sydney's residents living outside of strategic centres.

¹⁵ For example, *City of Cities* specifies a targeted increase of 140 000 (or 82 per cent) in the capacity of strategic centres to house residents between 2001 and 2031 (NSW Government 2005, p.82).

The population of Sydney's strategic centres (including planned and potential centres) is estimated to have risen by 48 000 between 2001 and 2006. This represents an increase from 5.1 per cent of the city's population in 2001 to 6.0 per cent in 2006, indicating a shift towards a greater concentration of population within centres since 2001. Over 30 per cent of Sydney's population growth occurred in its strategic centres, which is a very high concentration of growth in strategic centres, given the 5 per cent population share at the start of the period.

Each of the different types of strategic centres experienced more rapid population growth than Sydney as a whole, with the most rapid growth rates occurring in Global Sydney and in the planned and potential major centres. Figure 3.13 presents the results for individual centres—the greatest population growth occurred in the inner city centres of Central Sydney (19 300) and Green Square (5600), with St Leonards-Crows Nest and Parramatta also experiencing significant growth. Those four centres together accounted for 60 per cent of population growth in Sydney's strategic centres. While population growth was relatively concentrated in the inner city centres, most of the middle and outer suburban strategic centres experienced at least some population growth and none experienced a substantial population decline between 2001 and 2006.

Figure 3.13 Estimated resident population of strategic centres, Sydney, 2001 and 2006



Notes: (1) Comprises the Sydney CBD, City East, Pyrmont-Ultimo, Redfern Centre and Sydney Education and Health precincts. Some parts of the City of Sydney LGA are excluded (e.g. Glebe, Elizabeth Bay, Green Square).

(2) Defined by BITRE using 2006 destination zone boundaries and, where available, relevant information contained in the subregional plan.

(3) The 2001 destination zones are large relative to this centre's boundaries, meaning that destination zone data is unlikely to provide an accurate estimate of the population of this centre in 2001.

Sources: Estimated resident population data sourced from NSW BTS online tabulations at travel zone scale. Centre boundaries based on TDC (2008b), BITRE analysis of Metropolitan Strategy subregional plans and 2006 destination zone (travel zone) boundaries.

The spatial distribution of population in Sydney has evolved over a long period and any attempt to significantly alter the urban form will also take time to materialise. Assuming the number of centres remains similar, by 2036 the proportion of people living in strategic centres is still likely to be under 10 per cent—the TDC travel zone population forecasts from October 2009 predict that around 8 per cent of Sydney's population will live in strategic centres in 2036.

Overall assessment

City of Cities and *Sydney 2036* aim to accommodate a significant proportion of residential growth through renewal and densification of areas in close proximity to centres. Between 2001 and 2006, the population living in strategic centres increased at a much faster rate than the rest of the city. The existing strategic centres accounted for 27 per cent of Sydney's population growth and 25 per cent of dwellings growth between 2001 and 2006, and 23 per cent of dwelling completions between 2003–04 and 2007–08. These shares compare favourably to the 21 per cent of dwellings growth to 2031 envisaged by *City of Cities*. However, the smaller local centres have accommodated a lower than expected proportion of recent dwellings growth in Sydney.

At the same time, a relatively high rate of out-of-centre residential development is occurring in Sydney's established suburbs, which is not in line with the stated policy aim of focusing residential development around centres. In the face of these recent trends, the *Sydney 2036* target—that 80 per cent of new housing be located within the walking catchment of a centre—will be challenging to achieve.

Increase residential densities in centres

This planning objective is closely related to the preceding one, but shifts the emphasis to the density and form of housing built in the vicinity of centres.

City of Cities aims to 'encourage greater housing density in centres', but this is subject to the qualification that residential development must be compatible with achievement of the specified employment capacity targets (NSW Government 2005, p.96). It is argued that increased residential densities will enhance liveability by revitalising services, increasing the liveliness of centres, improving diversity and providing greater opportunities for social interaction (ibid.). However, Bunker, Holloway and Randolph (2005) make the point that building large numbers of attached dwellings in Sydney's existing suburbs risks accentuating existing concentrations of disadvantage.

The density objective in *Sydney 2036* has a narrower scope, aiming for 'more low rise medium density housing in and around local centres' (NSW Government 2010a, p.117). The emphasis is on producing housing that meets the future needs of residents, recognising that ageing and housing affordability pressures favour a shift towards more medium density development and smaller, more affordable dwellings (ibid.).

This section examines the broad aim of increasing residential densities in centres, focusing on the changes that occurred in strategic centres between 2001 and 2006. More recent data on population and the dwelling stock was not available for strategic centres and no analysis is undertaken for the smaller local centres. Centre boundaries were defined using a TDC (2008b) based classification, as described in the previous section.

Population density

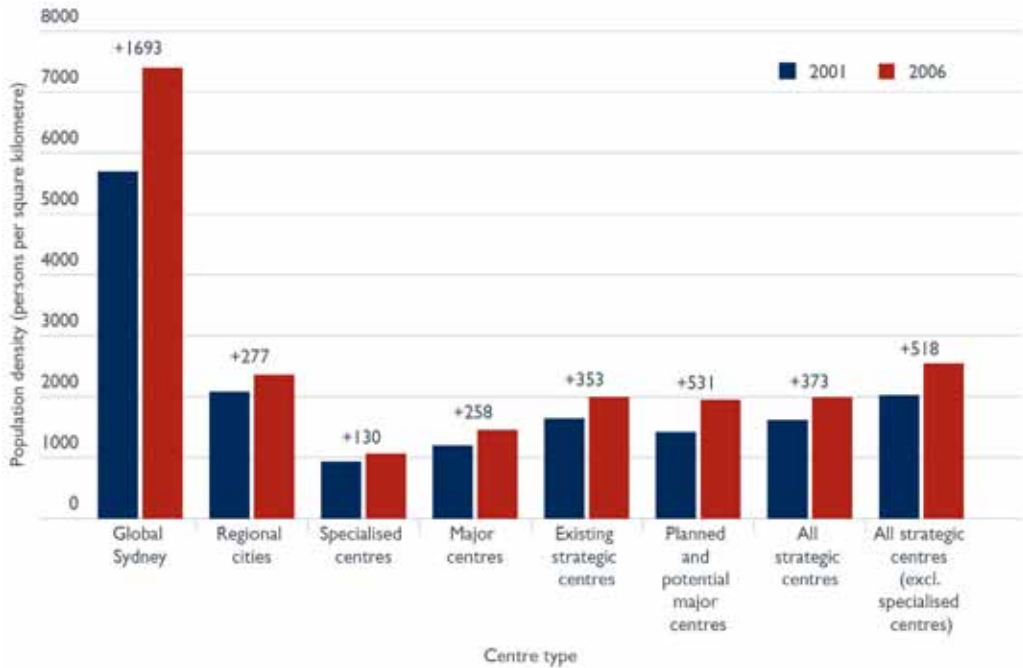
The average population density of Sydney's Inner and Middle sectors increased from 2878 persons per square kilometre in 2001 to 3244 persons per square kilometre in 2010, representing a 13 per cent increase. This density increased by 144 persons per square kilometre or 5 per cent between 2001 and 2006, and 222 persons per square kilometre or 8 per cent between 2006 and 2010.

As a group, Sydney's strategic centres had an average population density of 1991 persons per square kilometre in 2006 (see Figure 3.14). This is lower than the typical population density in established residential areas as the strategic centres contain a mix of land uses, including commercial activity and services as well as residential use. The most densely populated strategic centres were Bondi Junction¹⁶, Chatswood, Central Sydney and Hurstville, all of which had more than 6000 residents per square kilometre in 2006. In contrast, the Leppington, Campbelltown-Macarthur, Norwest, Bankstown Airport and Olympic Park-Rhodes strategic centres have very low population densities of less than 300 persons per square kilometre. The final three of these are specialised centres in which the limited population base is offset by a substantial jobs base.

Given the employment-orientation of the specialised centres, it is appropriate to focus on the remaining strategic centre categories when analysing recent trends in population density. Figure 3.14 shows that the average population density of Sydney's strategic centres (excluding the specialised centres) rose by 518 persons per square kilometre between 2001 and 2006, which is a 26 per cent increase. Population density increased at a much more rapid pace for Sydney's strategic centres than for the city as a whole or its established inner and middle suburbs (which grew at 4 and 5 per cent, respectively).

Global Sydney experienced a much greater density gain than any of the other categories of strategic centre. Individual centres which experienced particularly large gains in density between 2001 and 2006 included Central Sydney, Green Square and Chatswood, which are all located within a 10 kilometre radius of the CBD.

¹⁶ Based on the TDC (2008b) definition the Bondi Junction centre covers the smallest land mass of all strategic centres (32 hectares), which tends to exaggerate its density compared to other more broadly defined centres.

Figure 3.14 Population density by type of strategic centre, Sydney, 2001 and 2006

Notes: See Table 2.1 for further information about each centre type. Specialised centres are employment oriented, and so when considering population density trends, it is appropriate to focus on the remaining types of strategic centre.

Sources: Estimated resident population and area data sourced from NSW BTS online tabulations at travel zone scale. Centre boundaries based on TDC (2008b), BITRE analysis of Metropolitan Strategy subregional plans and 2006 destination zone (travel zone) boundaries.

Higher density forms of housing

Detached houses account for the majority of Sydney's dwelling stock, but their share has been gradually declining from 66 per cent in 1996 to 64 per cent in 2001 and 62 per cent in 2006. Table 3.17 summarises the changes in the dwelling mix between 2001 and 2006. The number of occupied private dwellings increased by 83 000, with an increase of 47 000 flats, units and apartments. High rise flats, units and apartments (i.e. in blocks of four or more storeys) experienced the most rapid growth. Low rise flats, units and apartments also experienced above-average growth. The table reveals a shift towards higher density forms of housing being built in Sydney between 2001 and 2006, but the effect on the overall stock of dwellings is much more incremental in nature.

Higher density forms of housing have continued to account for the majority of additions to Sydney's dwelling stock since 2006:

- Only 38 per cent of Sydney's dwelling approvals for the 2007 to 2010 period related to private sector houses (ABS 2011d).
- Three quarters of dwelling production in Sydney between 2005–06 and 2009–10 was multi-unit dwellings and only 25 per cent was detached dwellings (Department of Planning and Infrastructure 2011h).

Table 3.17 Dwelling type, Sydney, 2001 and 2006

Type of dwelling	Occupied private dwellings 2001 (per cent)	Occupied private dwellings 2006 (per cent)	Average annual growth rate, 2001 to 2006 (per cent)
Separate house	63.7	61.8	0.7
Semi-detached, row or terrace house, townhouse etc	11.4	11.9	2.1
Flat, unit or apartment, block of three storeys or less (includes flats attached to houses)	15.7	16.0	1.7
Flat, unit or apartment, four or more storey block	8.5	9.7	4.1
Other (e.g. caravan, cabin, houseboat, flat attached to shop or office)	0.8	0.7	-3.0
Total	100.0	100.0	1.1

Note: 'Dwelling structure not stated' was excluded when calculating percentages.

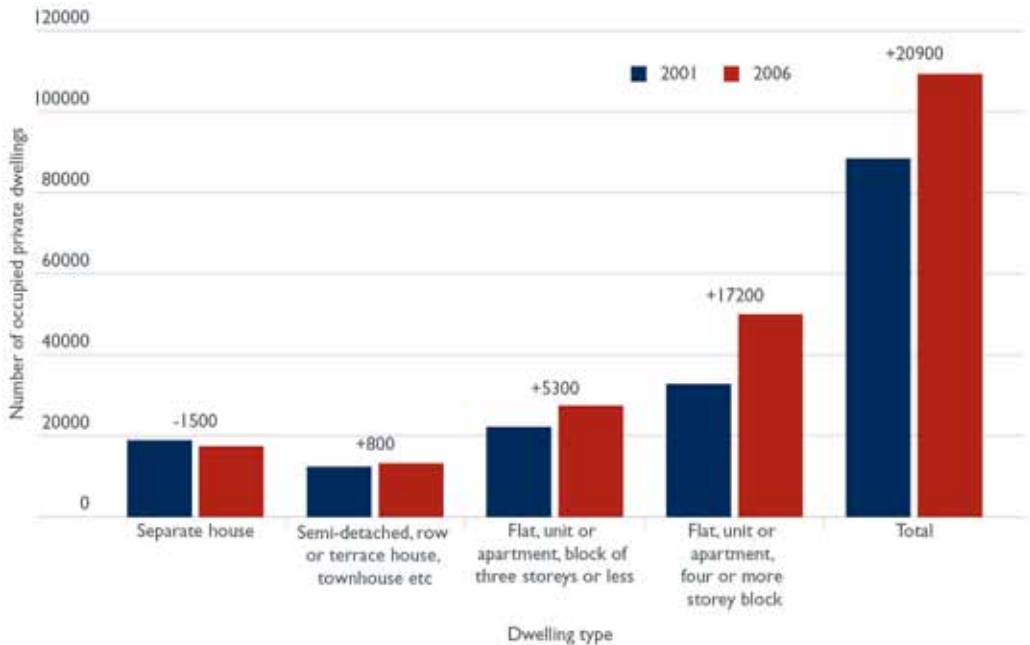
Source: BITRE analysis of ABS Census Population and Housing 2006 time series profile.

How did the Sydney-wide shift towards higher density forms of housing translate to the strategic centres? One-quarter of Sydney's total increase in dwellings between 2001 and 2006 relates to strategic centres. Figure 3.15 makes it clear that the vast majority of the increased dwellings in strategic centres were high rise flats, units and apartments, accounting for 17 200 out of the 20 900 additional dwellings. Sydney contained over 27 000 more high rise flats, units and apartments in 2006 than it did in 2001, and 63 per cent of the increase occurred in strategic centres. This expanded the stock of high rise flats, units and apartments in strategic centres by 52 per cent. There was also a substantial increase in the number of low rise flats, units and apartments in strategic centres, but the number of detached houses declined.

The strategic centres that experienced the largest gains in population density between 2001 and 2006 typically did so by adding a large number of flats, units and apartments in buildings of four or more storeys. Of most note were the increases in higher density forms of housing in:

- Green Square—it had a limited residential base in 2001, but added 2600 dwellings, of which 2300 were high rise flats, units and apartments
- Central Sydney—7200 dwellings were added, of which 5100 were high rise flats, units and apartments.

Figure 3.15 Number of occupied private dwellings in Sydney's strategic centres by dwelling type, 2001 and 2006



Notes: Data relates to all strategic centres, including existing, planned and potential centres. 'Dwelling structure not stated' and 'other dwelling' are not separately presented, but are included in the total. The data labels refer to the change in the number of occupied private dwellings of that type in Sydney's strategic centres between 2001 and 2006.

Sources: BITRE analysis of ABS Census Population and Housing 2001 and 2006 place of enumeration data at CCD scale, Centre boundaries based on TDC (2008b), BITRE analysis of Metropolitan Strategy subregional plans and 2006 destination zone (travel zone) boundaries.

Overall assessment

There was a shift towards higher density forms of housing being built in Sydney between 2001 and 2006, and the majority of this higher density housing was built in strategic centres. The stock of high rise flats, units and apartments in strategic centres expanded by over 50 per cent in just five years. As a result, the population density of Sydney's strategic centres increased at a much more rapid pace than the city's overall population density. The density gains were concentrated in a relatively small number of strategic centres located within 10 kilometres of the CBD.

In summary

This chapter has summarised the population distribution, and how it has changed in recent years, and has also considered the strategies in place for managing spatial aspects of population growth in Sydney.

The Sydney SD added 447 000 residents between 2001 and 2010 to reach a population of 4.58 million. Population growth averaged 1.1 per cent per annum, although growth has been more rapid than this since 2006. The modest growth resulted in the spatial distribution of Sydney's population remaining relatively stable. The principal residential growth location was Blacktown North on the North West fringe, followed by Auburn, Baulkham Hills North and Sydney South.

The great majority of Sydney's new housing development (over 80 per cent) occurred within the existing urban area, reflecting low levels of dwelling production in new land release areas. There was a shift towards higher density forms of housing being built in Sydney between 2001 and 2006, with the majority being built in strategic centres. At the same time, a relatively high rate of out-of-centre residential development is continuing to occur in established suburbs.

CHAPTER 4

Employment location and trends

Key points

- Jobs and economic competitiveness are a main focus of Sydney's recent Metropolitan Strategies. Key aims include concentrating job growth in strategic centres and locating more jobs in Western Sydney.
- In 2006, the Inner sector contained 35 per cent of Sydney's jobs, but only 17 per cent of its population, while the Outer sector contained 38 per cent of jobs and 54 per cent of population.
- The City of Sydney LGA employed 357 800 people in 2006, representing 21 per cent of jobs, with 13 per cent of jobs in the CBD. While CBD employment declined in the 1970s and 1980s, its share of jobs has been rising since 1991.
- Areas with few job opportunities relative to employed residents are Blacktown North, Liverpool West, Baulkham Hills North, Sutherland Shire West, Parramatta North West and Drummoyne.
- Sydney's major employment centres are Central Sydney (300 100 persons in 2006), North Sydney (35 800), St Leonards (34 400), Parramatta (34 200), Macquarie Park (32 000) and Sydney Airport (28 200). Forty per cent of jobs are in strategic centres, 20 per cent are in employment land precincts and 40 per cent in other locations.
- In 2006, 3.8 per cent of Sydney's employed residents worked at home, down from 4.1 per cent in 2001.
- Sydney had relatively modest job growth between 2001 and 2006, and while employment grew at a faster pace between 2006 and 2011, Sydney has continued to lag well behind the national rate of job growth.
- The spatial structure of employment within the GMA was quite stable between 2001 and 2006, but there was a shift in jobs away from the Inner sector and towards the Outer sector and the Lower Hunter.
- Three quarters of Sydney's job growth occurred in the outer suburbs, with the North West sector alone contributing 34 per cent. The most rapid job growth occurred in the Central Coast (2.1 per cent per annum), North West (1.6 per cent) and South West subregions (1.5 per cent)—in all three, the rate of job growth outpaced population growth.
- The Inner sector had 2300 fewer jobs in 2006 than in 2001. Employment gains in the CBD and Sydney West SLA were offset by job losses in most of the remaining inner suburban SLAs.

- Western Sydney grew more rapidly than the rest of Sydney between 2001 and 2006, and contributed 56 per cent of Sydney's total job growth.
- Two-thirds of job growth occurred in strategic centres and 30 per cent in employment lands. The increase in centred employment is due to very strong growth in business parks. The increase in jobs in employment land precincts is due to strong growth in several outer suburban industrial areas.

Context

'Sydney's links with the global economy and the rest of the Australian economy in terms of capital flows, trade, and movement of people and information—along with the generation and application of knowledge—are the city's main drivers of wealth and job creation' (NSW Government 2005, p.43).

The vision of Sydney as a competitive and innovative economy underpins its recent Metropolitan Strategies. Jobs and particularly economic competitiveness within private enterprise are a main focus. Whilst businesses make decisions about investment, location, and factors of production, including workers, the government can influence this through planning, infrastructure investment, and other economic and social policies (NSW Government 2005).

There has been an employment component in Sydney's Metropolitan Strategies for several decades, with the 1988 plan seeking to achieve outer suburban job growth and increased concentration of employment in centres (Searle 2002). The two most recent Metropolitan Strategies are focused on jobs, economic competitiveness and providing greater certainty for private enterprise—perhaps more so than in the other Australian capital cities. Activity centres are the core element of the strategy to support employment growth and a more efficient utilisation of infrastructure and services. Other elements include the policy initiatives relating to employment lands and corridors. The Metropolitan Strategies aim to reshape the spatial distribution of Sydney's employment by locating more jobs in Western Sydney, focusing job growth in strategic centres, accommodating around 20 per cent of jobs in employment land precincts, and better aligning jobs with where people live.

This chapter begins with a snapshot of the spatial distribution of employment within Sydney in 2006, before discussing the changes that have occurred in the location of employment since 2001. The chapter concludes with an analysis of the recent changes that have occurred with regard to the key employment-related goals that were identified in *City of Cities* and *Sydney 2036*.

Because no single data source covers the entire post-2001 period as well as the full range of spatial scales, several different data sources have been used to assess spatial patterns of employment in this chapter. The ABS Labour Force Survey is used to provide a broad overview of employment change between 2001 and 2011 for Sydney as a whole. The spatial analysis is based on ABS *Census of Population and Housing* data for 2001 and 2006, with two slightly different forms of census data being used:

- ABS place of work data (also referred to as Working Population Profile data) is used to build a profile of employment at the SLA, subregional and sectoral scales in 2006

- Bureau of Transport Statistics (BTS) place of work data is used to analyse employment at the finer scale of travel zones in 2006¹⁷ and also to assess the spatial patterns of employment change in Sydney between 2001 and 2006.

Both of these census-based datasets are subject to census undercount. In addition, there are many responses relating to 'no fixed workplace' or where the place of work is inadequately described. Together these issues mean that the census total for those with a known fixed place of work in Sydney is around 20 per cent below the ABS *Labour Force Survey* estimate for the equivalent period. This limitation needs to be kept in mind when using the data presented in this chapter. The ABS and BTS place of work data differs from employment figures presented for Sydney (and its subregions and strategic centres) in the NSW Government's recent metropolitan strategies, which are BTS Small Area Employment Forecasting Model (SAEFM) outputs that adjust the census place of work data upwards to compensate for these issues.¹⁸

Place of work employment—2006 snapshot

There were 1.90 million employed people living in the Sydney working zone at the time of the 2006 census and 2.27 million in the Greater Metropolitan Area (Sydney, Illawarra and the Lower Hunter). Place of work information was available for 95 per cent of employed residents of Sydney and the Greater Metropolitan Area (GMA).

The great majority of employed Sydney residents who provided place of work information worked at a location within the Sydney working zone (1.69 million persons). However, 8800 worked in other parts of the GMA, 4400 worked in regional NSW¹⁹, 11 700 worked in an undefined part of NSW and 6300 worked interstate. A further 79 000 individuals (representing 4 per cent of employed residents) had no fixed work address. This category includes many drivers, labourers and tradespeople (VicRoads 2008), of whom most would probably be based in the Sydney working zone.

The analysis in this section is based on those who reported a fixed place of work in the GMA in 2006, namely:²⁰

- 1.74 million people who reported a fixed place of work within Sydney
- 182 000 people who reported a fixed place of work in the Lower Hunter
- 128 000 people who reported a fixed place of work in the Illawarra.

Of this group, which totals 2.05 million employed persons with a fixed place of work in the GMA, 2.02 million (99 per cent) were residents of the GMA, while 15 200 were residents of regional NSW and 8000 were interstate residents.

¹⁷ The BTS journey to work data is derived from census counts of employed persons, but the BTS (formerly known as the Transport Data Centre or TDC) make a range of adjustments to the ABS' census data. For example, where there was not enough information to assign a place of work in a travel zone, the BTS allocated street and SLA dump code employment to a 'best fit' travel zone and also edited miscodes. However, the undefined, unknown and no fixed workplace employment is not imputed (Transport Data Centre 2008a).

¹⁸ The employment forecasts presented in Chapter 9 are based on SAEFM outputs.

¹⁹ Defined here as NSW excluding the GMA.

²⁰ The place of work analysis therefore excludes those who reported no fixed work address, a place of work in 'Undefined NSW' or did not respond. Due to issues of non-response, undercount and inadequately described place of work, the actual number of people employed within Sydney and the GMA in August 2006 is likely to be around 20 per cent higher than the figures reported here.

Sectoral and planning subregion overview

Table 4.1 summarises place of work information for the planning subregions and aggregate regions. About 29 per cent of GMA employment is located in the Inner sector, although the Inner sector contains only 14 per cent of population. The Middle sector accounts for 23 per cent of employment and population. The Outer sector of Sydney contributes 32 per cent of employment and 45 per cent of population, while Illawarra and the Lower Hunter also make up a greater proportion of the GMA's population than its employment.²¹

The single largest planning subregion in the GMA in terms of employment is the City of Sydney which employs 357 800 people, representing 18 per cent of employment. The West Central planning subregion, which includes Parramatta, also makes an important contribution, employing 266 200 people (13 per cent). Other important subregions in terms of employment are:

- North West (11 per cent)
- Inner North (10 per cent)
- Lower Hunter (9 per cent)
- South (8 per cent).

The stand out in terms of employment density is the City of Sydney which has about 13 400 jobs per square kilometre. The Inner North, East and Inner West planning subregions also have high employment densities with more than 1000 jobs per square kilometre. Employment densities are higher for the Inner sector than the Middle sector, which in turn has a much higher employment density than the Outer sector. The Illawarra has the lowest employment density in the GMA, followed by the South West, North West and Lower Hunter.

The self-sufficiency ratio is the ratio of the number of workers in an area to the number of employed residents. Places with a self-sufficiency ratio well above 0.9²² can be considered employment orientated, while places with a ratio well below 0.9 can be considered residentially orientated.

²¹ If the focus is on Sydney SD, in 2006, the Inner sector contained 35 per cent of Sydney's jobs, but only 17 per cent of its population, while the Outer sector contained 38 per cent of jobs and 54 per cent of population.

²² If 100 per cent of employed people provided valid information on a fixed place of work in the census, the appropriate benchmark would be 1.0. Since only 90 per cent of employed GMA residents could be coded to a fixed place of work, 0.9 is a more appropriate benchmark.

Table 4.1 Place of work data by planning subregion and aggregate region, Sydney Greater Metropolitan Area, 2006

	People who work in area	Proportion of GMA employment (per cent)	Proportion of GMA ERP (per cent)	Employment density (jobs per square kilometre)	Self-sufficiency ratio
Planning subregions					
City of Sydney	357 772	17.5	3.2	13 385	4.62
East	110 197	5.4	5.4	1 385	0.84
Inner North	195 847	9.6	5.8	1 992	1.32
Inner West	82 062	4.0	4.4	1 375	0.75
South	161 088	7.9	12.5	358	0.55
North	68 808	3.4	5.0	126	0.56
North East	72 802	3.6	4.5	287	0.63
West Central	266 218	13.0	13.0	853	1.04
North West	219 643	10.7	14.6	42	0.63
South West	110 236	5.4	7.9	33	0.63
Central Coast	86 038	4.2	5.8	51	0.71
Unknown address	6 096	0.3	0.0	na	na
Total Sydney	1 736 807	84.8	82.1	143	0.91
Aggregate regions					
Inner sector	600 873	29.4	14.1	3 508	1.68
Middle sector	478 055	23.4	23.4	997	0.93
Outer sector	651 783	31.8	44.5	57	0.63
Lower Hunter	181 967	8.9	9.9	45	0.87
Illawarra	128 312	6.3	8.0	15	0.80
Greater Metropolitan Area*	2 047 086	100.0	100.0	84	0.90

Note: The self-sufficiency ratio is the ratio of people who work in the region to the number of employed people who live in the region. The ratio for the GMA is less than one due to non-response and no fixed place of work responses. Na is not applicable.

*Includes unknown address in Sydney.

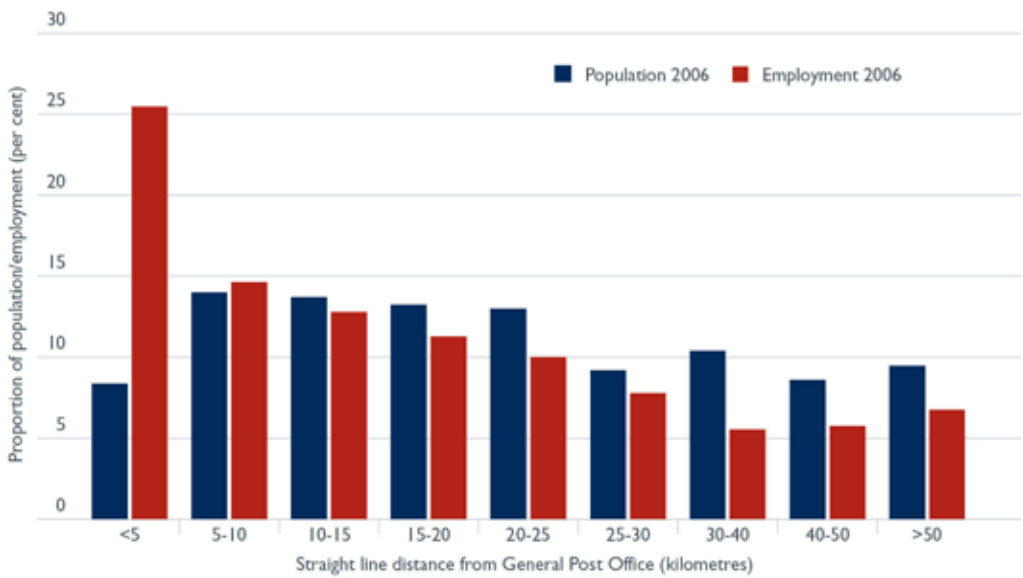
Source: BITRE analysis of ABS *Census of Population and Housing* 2006 place of work data for SLAs and ABS Cat. 3218.0.

Table 4.1 reveals that the Inner sector is very employment orientated, because it has many more jobs than employed residents. In contrast, the Outer sector and the Illawarra are residentially orientated. The Middle sector and the Lower Hunter are in approximate balance.

The City of Sydney is by far the most employment orientated planning subregion within the GMA. The Inner North and West Central subregions are also employment orientated. The most residentially orientated planning subregions are the South and the North. However, all of Sydney's subregions have at least one job available for every two employed residents, which is similar to the situation in Melbourne (BITRE 2011), while in Perth several subregions have self-sufficiency ratios of less than 0.5 (BITRE 2010).

Figure 4.1 presents information on the spatial distribution of jobs by distance to the Central Business District (CBD). The General Post Office (GPO) is used to represent a central point in the CBD. The employment orientation of the inner city is the main feature, with around a quarter of all of Sydney's jobs being located within 5 kilometres of the CBD, compared to 8 per cent of its population. Fifty three per cent of Sydney's jobs are located within a 15 kilometre radius of the CBD. While the areas within 10 kilometres of the CBD are employment oriented, all of the remaining distance categories in Figure 4.1 are residentially oriented. In particular, in the locations which are 30 to 40 kilometres from the CBD the job share is roughly half the population share. This 30 to 40 kilometre radius includes large parts of the Blacktown, Liverpool and Campbelltown LGAs.

Figure 4.1 Proportion of population and employment located at various distances from the Central Business District, Sydney, 2006



Note: The GPO is assumed as a central point of the CBD. Calculation is based on straight line distance from each TZ's centroid to GPO. Analysis relates to Sydney statistical division only.

Source: BITRE analysis of BTS JTW data for travel zones and ABS *Census of Population and Housing* 2006 place of enumeration population counts for CDs.

Statistical Local Areas

Table 4.2 lists the ten SLAs containing the largest number of jobs in 2006. The Sydney Inner SLA is the place of work for 231 600 people, representing 11 per cent of GMA employment and 13 per cent of Sydney's employment. The Sydney Inner SLA corresponds broadly to the Sydney CBD—The Domain, Hyde Park and Wentworth Avenue form the eastern border of the SLA, Eddy Avenue, the southern border (Central station belongs to the Sydney South SLA) and Darling Drive, the western border. Locations within the Sydney Inner SLA include Darling Harbour, Haymarket, Wynyard, Circular Quay, The Rocks, Barangaroo and Walsh Bay. There are nearly 30 times as many jobs as there are employed residents of this SLA, reflecting the CBD's very strong employment orientation. Employment density is extremely high at 55 000 jobs per square kilometre. While employment is heavily concentrated within Sydney

Inner; the remaining 87 per cent of Sydney Statistical Division (SD) employment is fairly evenly distributed across SLAs.

The SLA with the second highest number of jobs is the Parramatta Inner SLA, reflecting Parramatta's status as Sydney's second CBD. Parramatta Inner contains 65 900 jobs, representing just under 4 per cent of employment. Parramatta Inner is also the second most employment orientated SLA, after the Sydney Inner SLA. Parramatta's current status as a major employment centre owes much to the relocation of state and federal government jobs and centres policy support since the late 1960s (NSW Government 2005).

The Inner sector SLAs of North Sydney, Sydney East, Sydney West and Sydney South, the Middle sector SLAs of Ryde and Willoughby, and the Outer sector SLAs of Warringah and Blacktown South East also feature in the top ten. Each contributes between 2.4 and 3.5 per cent of Sydney's employment.

Table 4.2 Top employing Statistical Local Areas, Sydney, 2006

SLA of work	Planning subregion	Sector	People who work in area	Proportion of Sydney employment (per cent)	Proportion of Sydney ERP (per cent)	Employment density (jobs per square kilometre)	Self-sufficiency ratio
Sydney Inner	City of Sydney	Inner	231 562	13.3	0.5	55 003	29.88
Parramatta Inner	West Central	Middle	65 901	3.8	1.0	3 535	3.48
North Sydney	Inner North	Inner	60 047	3.5	1.4	5 719	1.70
Ryde	Inner North	Middle	58 314	3.4	2.4	1 441	1.24
Willoughby	Inner North	Middle	51 426	3.0	1.6	2 285	1.61
Warringah	North East	Outer	45 545	2.6	3.2	305	0.66
Blacktown South East	North West	Outer	43 435	2.5	2.2	734	1.09
Sydney East	City of Sydney	Inner	43 099	2.5	1.2	7 159	1.75
Sydney West	City of Sydney	Inner	41 614	2.4	0.9	7 314	2.21
Sydney South	City of Sydney	Inner	41 497	2.4	1.2	3 839	1.58

Note: The self-sufficiency ratio is the ratio of people who work in the SLA to the number of employed persons who live in the SLA.

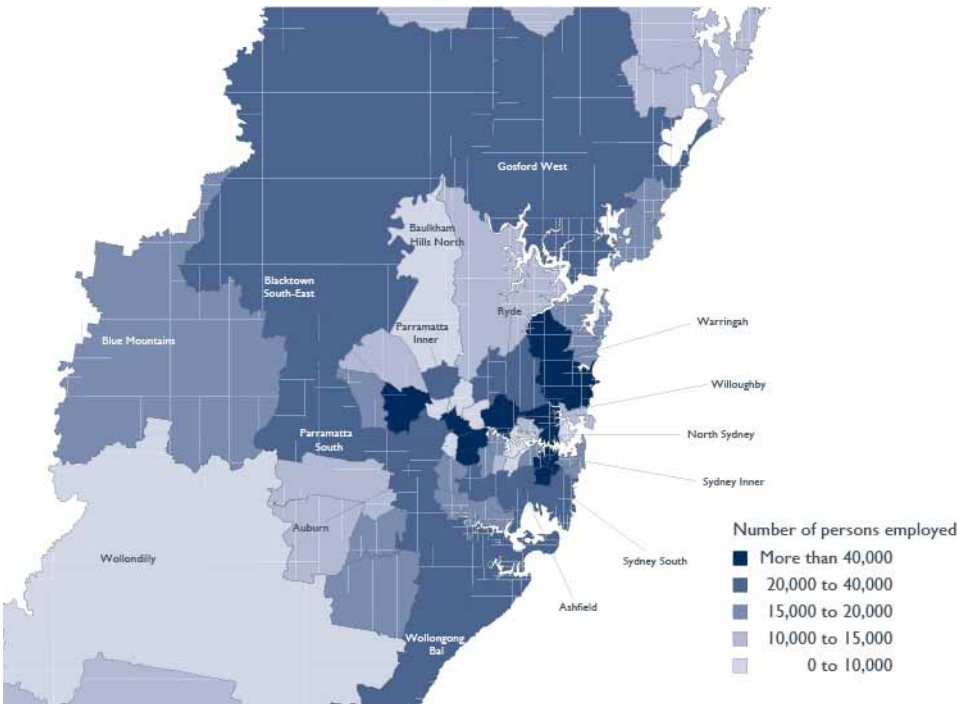
Source: BITRE analysis of ABS *Census of Population and Housing* 2006 place of work data and ABS Cat. 3218.0.

Map 4.1 presents the number of people working in each SLA for 2006. While employment is concentrated in the central SLAs, there is also a number of high employment SLAs in Sydney's western suburbs (e.g. Parramatta Inner; Blacktown South East, Auburn, Holroyd, Baulkham Hills Central).

Within the GMA, employment density is at its greatest in Sydney Inner (55 000 jobs per square kilometre), Sydney West (7300), Sydney East (7200), North Sydney (5700), Sydney South (3800) and Parramatta Inner (3500). Employment density is less than ten jobs per square kilometre for the outlying areas of Shoalhaven Part B, Wollondilly, Wingecarribee, Cessnock and Hawkesbury.

The number of jobs is more than double the number of employed residents in just four SLAs—Sydney Inner, Parramatta Inner, Botany Bay and Sydney West. Botany Bay did not make the top ten SLAs in terms of employment (it was ranked 13th), but is nevertheless highly employment orientated, with 2.4 jobs for every employed resident. This reflects the presence of important employment hubs such as Sydney Airport and Port Botany within the SLAs boundaries. Other SLAs which are self-sufficient in terms of employment are Auburn, Sydney East, Newcastle Inner, North Sydney, Willoughby and Sydney South.

Map 4.1 People working in each Statistical Local Area, Sydney, 2006



Source: BITRE analysis of ABS Census of Population and Housing 2006 place of work data.

Map 4.2 displays the self-sufficiency ratio for each SLA for 2006. A key feature is the highly employment orientated corridor that stretches from Willoughby in the north to Botany Bay in the south and incorporates the City of Sydney—this is referred to as the Global Economic Corridor in *City of Cities*.²³ A second cluster of employment oriented areas is focused around Auburn in the city's west.

There are quite a few SLAs where the self-sufficiency ratio lies below 0.5 (i.e. there is less than one job for every two employed residents). These are Sydney's dormitory suburbs, offering few employment opportunities for local residents. The SLAs with the lowest self-sufficiency ratios are:

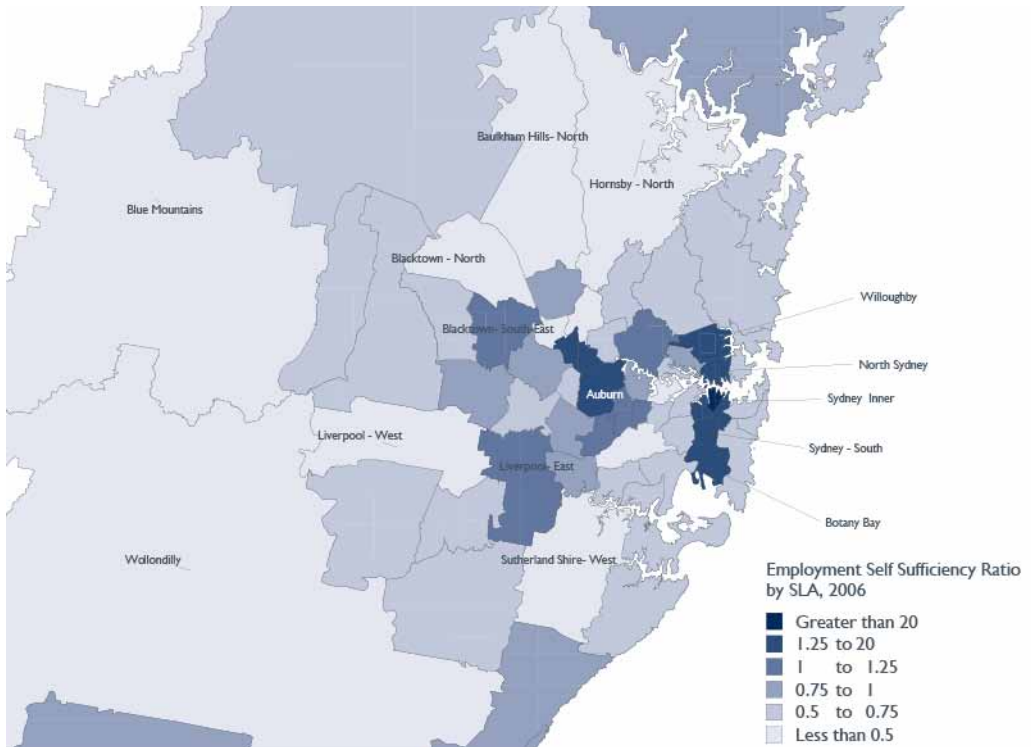
- Blacktown North, Liverpool West, Baulkham Hills North and Sutherland Shire West in the Outer sector
- Parramatta North West and Drummoyne in the Middle sector.

²³ The Global Economic Corridor extends beyond this to include Macquarie Park in the Ryde SLA.

Map 4.2 reveals two main spatial clusters of highly residentially orientated SLAs:

- the outer north (i.e. Hornsby North, Baulkham Hills North, Blacktown North)
- the far west of Sydney (i.e. Liverpool West, Blue Mountains, Wollondilly).

Map 4.2 Self-sufficiency ratios by Statistical Local Area, Sydney, 2006



Note: The self-sufficiency ratio is the ratio of jobs located in the SLA to the number of employed residents of the SLA.

Source: BITRE analysis of ABS *Census of Population and Housing 2006* place of work data and ABS Cat. 3218.0.

In 2006, 3.9 per cent of GMA employed residents worked at home. The North and North East subregions had a relatively high proportion of residents working from home (6.4 and 6.0 per cent respectively), while the West Central subregion had the lowest proportion (2.2 per cent). At the SLA scale, the proportion of residents working from home was greatest in Wingecarribee (8.5 per cent), Pittwater (8.4 per cent), Ku-ring-gai (8.3 per cent), Woollahra (8.0 per cent), Shoalhaven Part B (7.8 per cent), Mosman (7.5 per cent) and Hunter's Hill (7.5 per cent). These SLAs contain many of the most affluent areas of Sydney. A much smaller proportion of residents worked from home in Blacktown South West (1.3 per cent) and Parramatta Inner (1.6 per cent).

According to census data, the proportion of GMA residents working from home has declined marginally from 4.1 per cent in 2001 to 3.9 per cent in 2006, while for Sydney it declined from 4.1 per cent to 3.8 per cent. This decline reflects a general trend that was also evident in Perth and Melbourne (BITRE 2010, BITRE 2011).

Destination zones/travel zones

The place of work data can also be disaggregated to a more detailed scale—destination zones. The spatial information for destination zones²⁴ was obtained from the New South Wales Government's Bureau of Transport Statistics (BTS). The BTS place of work data does not always correspond to the ABS place of work data at the SLA scale,²⁵ although for the majority of SLAs the data is well aligned. The more processed BTS destination zone dataset was preferred over the ABS provided destination zone data, which contained numerous 'dump codes' for employment that ABS was unable to code to a destination zone.

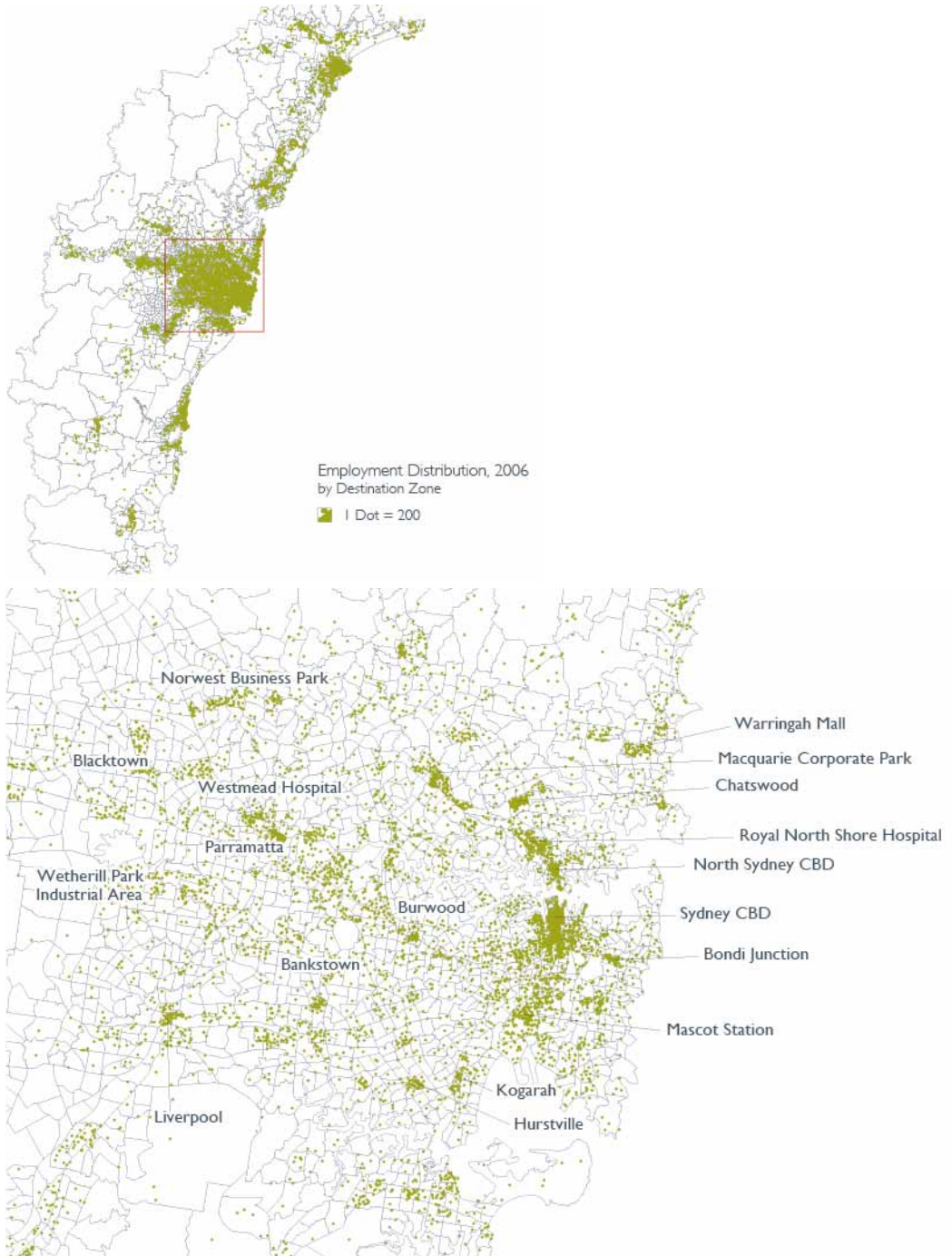
The destination zones in Sydney's Inner and Middle sectors often cover a very small geographic area, whereas destination zones tend to be much larger in the outer suburbs and in peri urban areas.

Map 4.3 plots the distribution of jobs across Sydney, based on the destination zone data. There are very heavy concentrations of jobs throughout most of Sydney's inner suburbs, with the Global Economic Corridor—which stretches from the Sydney Airport and Port Botany in the south, through the CBD and North Sydney to Chatswood and Macquarie Park in the north—being a key feature of the inset map. The employment hubs which are evident in Map 4.3 tend to correspond to specific strategic centres and employment lands, which are discussed in more detail later in the chapter.

²⁴ Referred to by the NSW Government as travel zones (TZ).

²⁵ The key differences occur for the Rockdale SLA (where the BTS estimate is 7 per cent lower than the ABS estimate) and the Botany Bay and Sydney West SLAs (where the BTS estimates are 4 per cent higher than the ABS estimates).

Map 4.3 Dot density map of job distribution, Sydney Greater Metropolitan Area, 2006



Note: Based on 2006 NSW travel zone boundaries.

Source: BITRE analysis of BTS 2006 JTW Table 1.

The twenty highest employing destination zones in 2006 are listed in Table 4.3. Three of these are located in each of Parramatta Inner and North Sydney and two in each of Sydney Inner, Botany Bay, Warringah and Willoughby. Many are centred on a transport hub. The single highest employing area is the destination zone centred around Mascot station, which is dominated by transport-related businesses. Alongside the numerous office and retail based destination zones, two hospitals (Westmead and Royal North Shore), the domestic airport and an industrial area (Wetherill Park) also feature in the top twenty.

While not shown in Table 4.3, which focuses on the Sydney SD rather than the broader GMA, the Wollongong Station (East) destination zone has the second highest number of employed persons in the GMA (11 611), while the Port Kembla Station (6153) and Nowra CBD destination zones (6043) also have substantial employment.

Table 4.3 Top twenty employing destination zones in Sydney, 2006

Travel zone code	Name of travel zone	Statistical Local Area	People who work in zone
404	Mascot Station	Botany Bay	13 666
2360	North Sydney CBD (Northern End)	North Sydney	11 357
2359	North Sydney CBD (Southern End)	North Sydney	11 006
1930	Penrith Station (South)	Penrith West	10 059
1705	KPMG Centre (Parramatta CBD)	Parramatta Inner	9 621
2392	Chatswood Station	Willoughby	9 391
1693	Westmead Hospital	Parramatta Inner	8 810
2411	Royal North Shore Hospital	Willoughby	7 856
1042	Wetherill Park Industrial Area (western)	Fairfield West	7 733
411	Airport - Domestic Station	Botany Bay	7 680
2480	Centrecourt Business Park	Ryde	7 585
2093	Blacktown Station (South)	Blacktown South East	7 005
71	No.1 Martin Place	Sydney Inner	6 988
92	Cockle Bay Wharf	Sydney Inner	6 746
2923	Warringah Mall	Warringah	6 586
224	Pymont Bay Ferry Wharf	Sydney West	6 476
1707	Rydalmere Station	Parramatta Inner	6 436
2354	Monte Sant'angelo	North Sydney	6 282
1288	Campbelltown Station (South)	Campbelltown South	6 179
2909	Forestridge Business Park	Warringah	5 985

Note: Based on 2006 NSW travel zone boundaries.

Source: BITRE analysis of BTS 2006 JTW Table 1.

Map 4.4 shows the employment density (jobs per square kilometre) of the destination zones for 2006. It shows a strip of high employment density stretching from the airport to Circular Quay and across to North Sydney. There are 23 destination zones which have an employment density of more than 200 000 jobs per square kilometre (i.e. 2000 jobs per hectare), and all belong to the Sydney Inner SLA.

Most of the destination zones with job densities exceeding 20 000 jobs per square kilometre (i.e. 200 jobs per hectare) belong to the Inner sector and cover just a few hectares—they include destination zones located within the suburbs of Sydney, The Rocks, Haymarket, North Sydney, Millers Point, Surry Hills, Darlinghurst, St Leonards, Chippendale, Woolloomooloo, Milsons Point, Camperdown and Bondi Junction. Some destination zones within Parramatta, Chatswood, Macquarie Park and Burwood in Sydney's Middle sector have similarly high job densities.

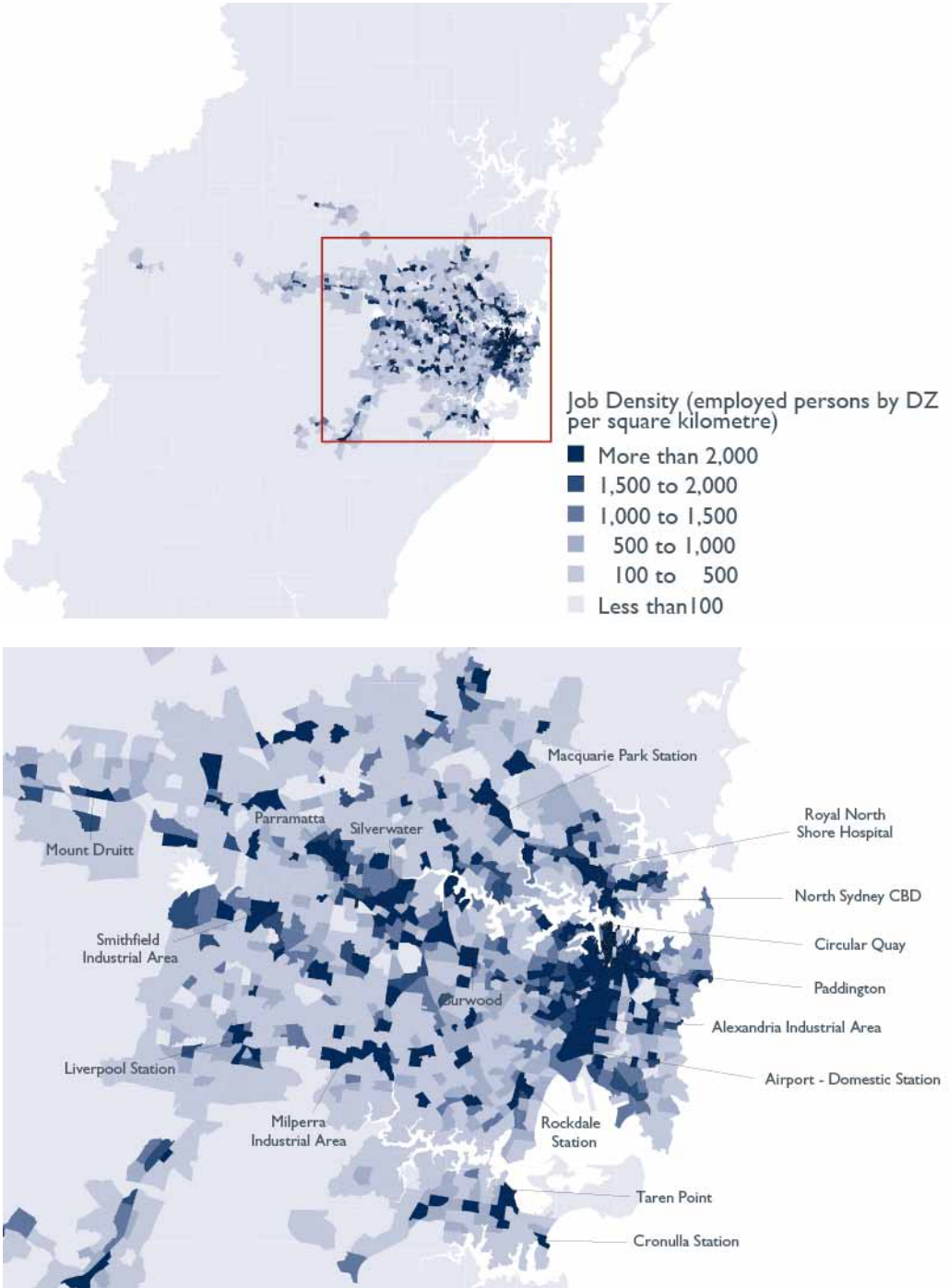
Outside the Inner and Middle sectors, the destination zones with the highest employment density are Civic Station in Newcastle's CBD (16 100 jobs per square kilometre) and Westfield Hornsby (14 600).

Map 4.5 maps the self-sufficiency ratio for each destination zone in 2006, which is calculated as the ratio of jobs to employed residents of the destination zone. Most of Sydney's destination zones have a residential orientation, in that there are considerably more employed residents than jobs located in the destination zone. Very employment oriented clusters (in red) stand out in the CBD, North Sydney, Kingsford Smith Airport, Port Botany, Macquarie Park, Auburn, Parramatta and Port Kembla.

The self-sufficiency ratios can be used to understand the extent to which GMA employment is heavily concentrated in employment focused areas or more dispersed throughout the suburbs. Employment can be split as follows:

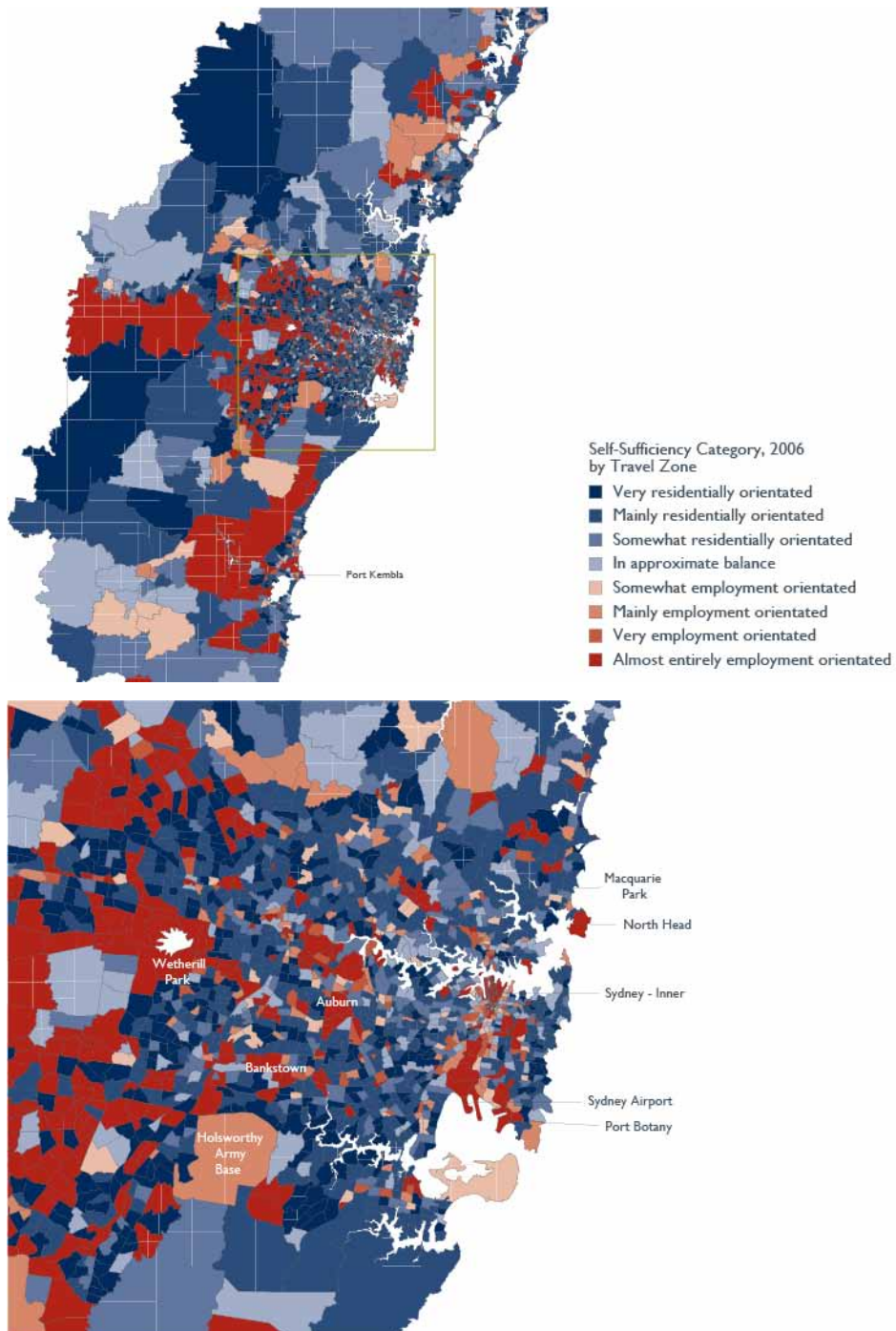
- 59 per cent of workers have a job in an employment focused destination zone, which either contains no employed residents or has at least twice as many workers as employed residents (i.e. the self-sufficiency ratio exceeds two).
- 19 per cent of workers have a place of work in a residentially focused destination zone, which has at least twice as many employed residents as workers (i.e. the self-sufficiency ratio is less than 0.5).
- The remaining 21 per cent of employment is located in destination zones which are 'mixed use' containing more of a balance of residential areas and employing businesses.

Map 4.4 Employment density of each destination zone in Sydney Greater Metropolitan Area, 2006



Note: Based on 2006 NSW travel zone boundaries.
Source: BITRE analysis of BTS 2006 JTW Table 1 and BTS area data.

Map 4.5 Self-sufficiency ratio of each destination zone in Sydney Greater Metropolitan Area, 2006



Note: BITRE assigned the self-sufficiency categories based on the ratio of employed residents to jobs in each destination zone.

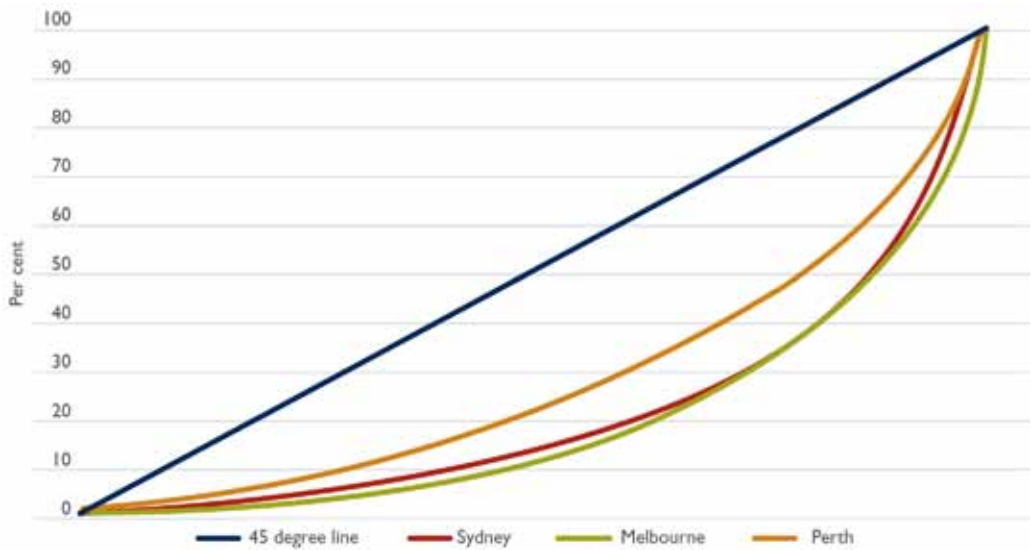
Source: BITRE analysis of BTS 2006 JTW Tables 01 and 13.

Melbourne had a broadly similar distribution of employment across these three destination zone types (BITRE 2011). In contrast, for Perth, a much larger proportion of jobs were located in mixed use destination zones (58 per cent), with only 30 per cent located in employment focused zones (BITRE 2010).

Employment in the Sydney Inner SLA is dominated by employment focused destination zones, which is also the case for Parramatta Inner and Blacktown South East. In contrast, the Hunter's Hill and Drummoyne SLAs contain no employment focused destination zones.

Figure 4.2 presents Lorenz curves that show that Sydney and Melbourne both have a similarly high spatial concentration of jobs, while in Perth jobs are more evenly distributed across the working zone.

Figure 4.2 Lorenz curves for spatial distribution of jobs in Sydney Greater Metropolitan Area, Melbourne working zone and Perth working zone, 2006



Note: The smaller the area between the city's curve and the 45 degree line the more even is the distribution of jobs across destination zones in that city.

Source: BITRE analysis of destination zone data.

The spatial distribution of jobs can be summarised by calculating a Gini coefficient, which potentially ranges between zero and one, with a value of zero meaning that all destination zones have an equal number of jobs while a value of one means all jobs are located in a single destination zone. The Gini coefficients for the three cities are Sydney (0.60), Melbourne (0.62) and Perth (0.46). This indicates Perth's employment is much less spatially concentrated than the two larger cities. One contributor to this result is the different size of the three city centres—the City of Perth LGA accounts for a smaller proportion of working zone employment than the City of Sydney or the City of Melbourne LGAs (BITRE 2010, BITRE 2011). The lack of strict comparability between destination zones for different cities, which is reflected in a higher average employment per destination zone in Perth, may also contribute to the result.

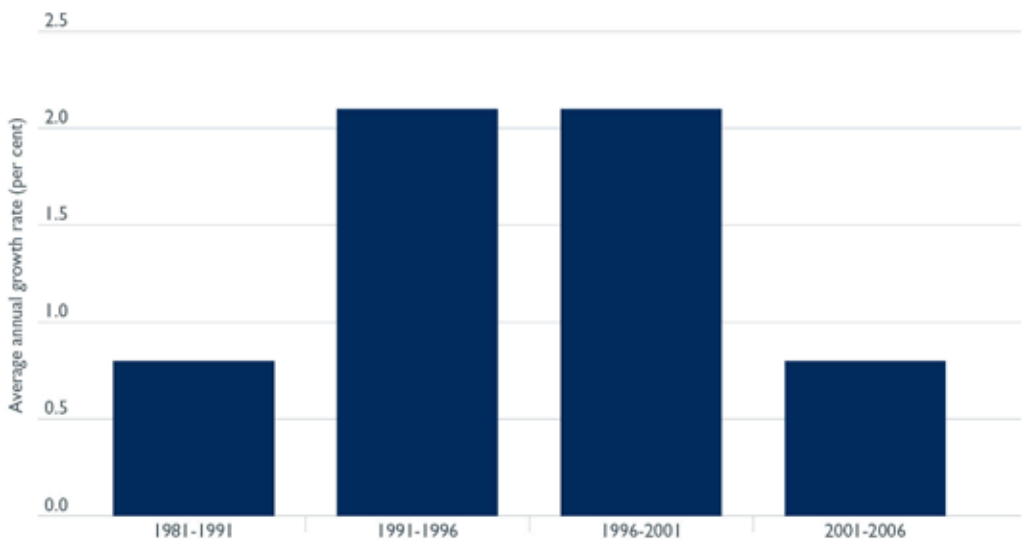
Long term trends in place of work

This section provides a summary of historical changes in the spatial distribution of employment within Sydney. While the discussion focuses on the post-1981 period, it is worth noting some of the key trends evident in earlier decades, as outlined in Pfister et al. (2000):

- Up until the 1950s, Sydney had a 'startling level of centralisation, particularly for industrial jobs' (ibid., p.431), with jobs heavily concentrated in the CBD and inner suburbs
- There was considerable suburbanisation of jobs in industries such as manufacturing and retailing during the 1950s and 1960s, although office jobs remained highly centralised
- The suburbanisation of office employment accelerated in the 1970s.

The number of jobs in Sydney grew from 1.39 million in 1981 (TDC 1998) to reach 1.92 million in 2006 (TDC 2008b). This represents average annual growth of 1.3 per cent per annum over the 25 year period. Figure 4.3 reveals that job growth was most rapid between 1991 and 2001.

Figure 4.3 Growth in the number of persons who work in Sydney, 1981 to 2006



Note: Based on census place of work data.

Sources: 1981 and 1991 data from TDC (1998), 1996, 2001 and 2006 data from TDC (2008b).

While the CBD has traditionally dominated Sydney's employment, jobs dispersed to suburban locations in the 1970s and 1980s and CBD employment declined (NSW Government 2005). In 1981, jobs in the Sydney CBD accounted for 15.0 per cent of Sydney employment, but this decreased to 11.6 per cent in 1991²⁶ before rising slightly to 12.1 per cent in 1996 (TDC 1998). Between 1996 and 2006, employment in the CBD rose as a proportion of total Sydney employment by about one percentage point (TDC 2008b). The 1980s decline in the relative importance of Sydney City (defined as the former Sydney and South Sydney LGAs) was more modest, due to job growth on the fringe of the CBD. The proportion of jobs located in Sydney

²⁶ Results presented in this section for 1991 will be influenced by the effect of the early 1990s recession on employment.

City fell from 22 per cent in 1981 to 20 per cent in 1991 (Pfister et al. 2000), and remained at 20 per cent in 2001 and 2006. The proportion of Sydney's employment located within 10 kilometres of the CBD also fell from 71 per cent in 1981 to 62 per cent in 2001 (Parolin 2005).

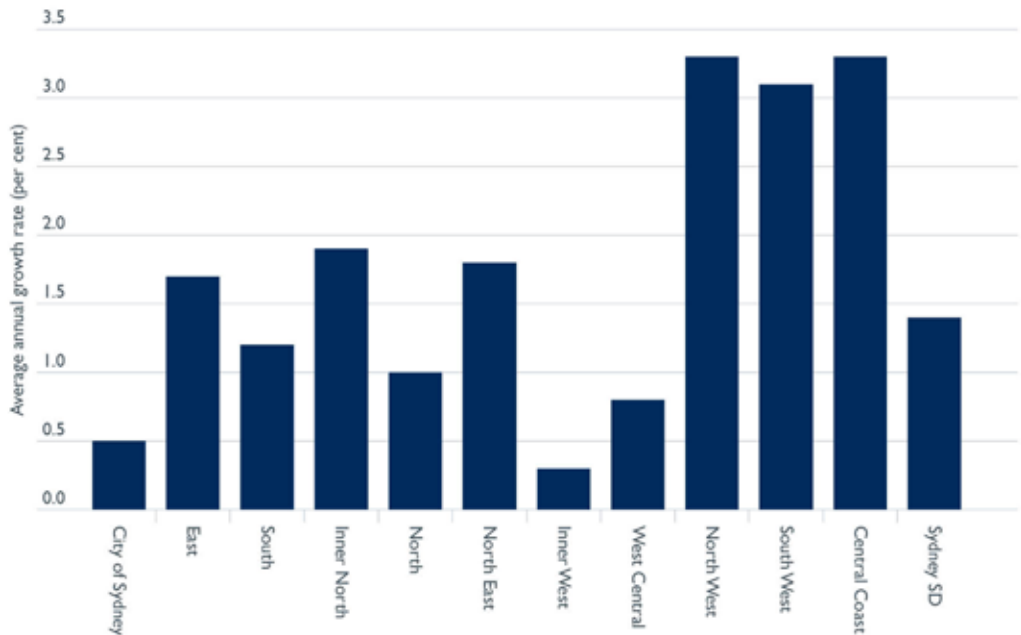
The trend towards suburbanisation of manufacturing and service sector jobs has moderated (Urban Research Centre 2008). In 1971, there were 67 jobs in Western Sydney for every 100 resident workers, a figure which rose to 73 in 1981, 78 in 1991 and 80 in 2001 (ibid., Fagan and Dowling 2005).

Figure 4.4 illustrates employment growth by planning subregion between 1981 and 2004. Sydney City's employment growth was slow, at only 0.5 per cent per annum, while the Inner West averaged growth of just 0.3 per cent per annum. In the North West, South West and Central Coast planning subregions, jobs grew by more than 3 per cent annually. Relative to the other subregions, North West grew by the largest absolute amount, representing almost 23 per cent of job growth over the period. *City of Cities* attributes the strong job growth in Western Sydney to two key drivers:

- the consumption demands of the growing population
- the decentralisation of manufacturing, transport and distribution jobs (NSW Government 2005).

TDC (1998) examined employment in Sydney's designated centres between 1981 and 1996, finding the employment share declined from 31.3 per cent in 1981 to 29.0 per cent in 1991, before rising slightly to 29.7 per cent in 1996. The follow up study (TDC 2008b) used an expanded set of centres which was only loosely linked to the *City of Cities* designated centres. It found that the centred employment share increased from 36.3 per cent in 1996 to 37.2 per cent in 2001.

Pfister et al. (2000) also analysed changes in the employment share of centres in the GMA between 1981 and 1996, while Parolin (2005) undertook a similar analysis for Sydney for the 1981 to 2001 period. Rather than using the state government's designated centres, both studies defined centres based on total employment and an employment density threshold. According to Pfister et al. (2000), the employment share of centres fell from 39.3 per cent in 1981 to 35.5 per cent of GMA employment in 1991, before rising to 36.4 per cent in 1996. The number of people employed in centres declined from 597 000 to 580 000 between 1981 and 1991, before rising to 661 000 in 1996 (ibid.). In contrast, Parolin (2005) estimates that the employment share of centres increased from 48 per cent in 1981 to 51 per cent in 2001 for Sydney. Taken together with the TDC studies, the evidence suggests the proportion of jobs located in centres declined during the 1980s, but rose between 1991 and 2001.

Figure 4.4 Long term employment growth by planning subregion, Sydney, 1981 to 2004

Source: BITRE analysis of data from NSW Government 2005 table A1.

These studies also provide some insight about the spatial locations of job growth in Sydney over the last few decades. Between 1981 and 1991, the CBD lost 27 000 jobs, but more than 4 000 jobs were added in each of Parramatta, Chatswood, North Ryde, Wetherill Park, Liverpool and Darlinghurst (Pfister et al. 2000). In the 1990s, job growth accelerated in the CBD, at Sydney Airport and in specialised institutional nodes such as the Randwick education and health precinct (ibid.). Parolin (2005) highlights the emergence of new employment centres in the outer suburbs, such as Mt Druitt, Castle Hill, Minto, Ingleburn and Norwest.

Between 1996 and 2006, the Sydney CBD added 42 500 jobs, Macquarie Park added 11 600 jobs and Norwest Business Park added 9 800 jobs (TDC 2008b). Norwest, Rhodes Corporate Park, Castle Hill, Huntingwood-Arndell Park and the Western Sydney Employment Hub all experienced very rapid job growth off a low base. The regional/retail centres with the largest increase in employment were Campbelltown and Parramatta. The South Sydney industrial centre, Surry Hills/Kings Cross, Bankstown and Hurstville recorded a net job loss between 1996 and 2006 (ibid.).

An important emerging trend in Sydney over the last two decades is the increasing prominence of office, technology and business parks. According to SGS (2004), the number of jobs in Sydney's major business parks grew at an average annual rate of more than 6 per cent between 1991 and 2001. Other key trends in the spatial distribution of employment include:

- The concentration of jobs in and around Sydney Airport and Port Botany
- Conversion of employment lands to residential uses in established areas

- Residential growth has outpaced job growth in some strategic centres (e.g. Liverpool, Bankstown, Campbelltown, Blacktown, Gosford, Wyong)
- Freight generating industries are looking to locate near the Orbital Motorway Network (NSW Government 2005).

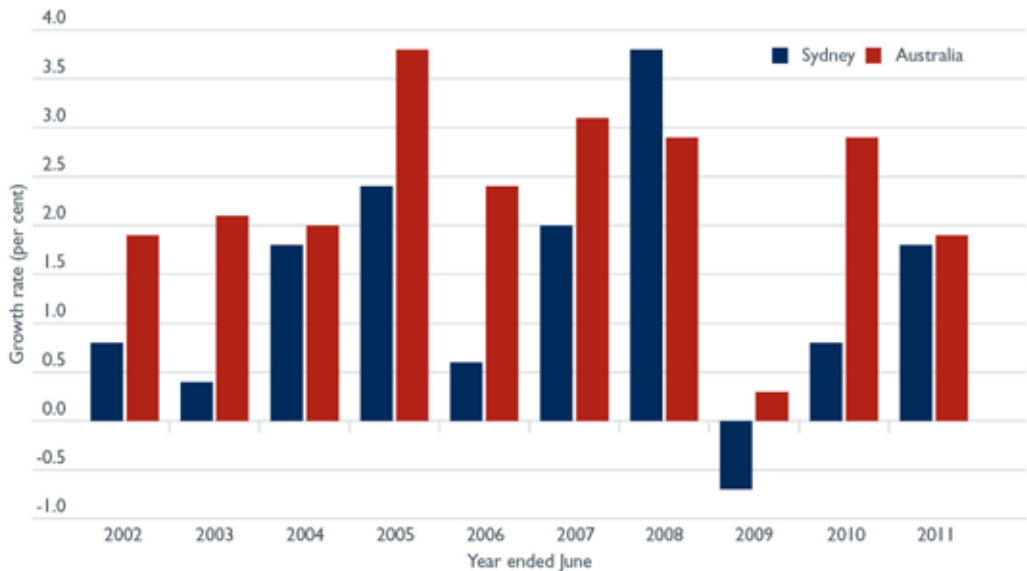
Changes in place of work since 2001

Changes 2001 to 2011

The ABS *Labour Force Survey* (LFS) provides up-to-date information on the number of employed residents in Sydney, but does not provide information on where those jobs are located. The LFS data is used here to provide a broad overview of employment change for Sydney as a whole since 2001. Census data is then used to identify the main locations of job growth and decline in Sydney between 2001 and 2006. The LFS and Census figures for the 2001 to 2006 period do not align very closely, due to the different methodologies and due to issues of census undercount and non-response.

Figure 4.5 plots annual growth in employed residents for Sydney since 2001. The average annual growth rate between 2001 and 2011 was 1.4 per cent for Sydney compared to 2.3 per cent for Australia as a whole. The rate of growth has fluctuated a bit over the decade examined. Sydney's rate of growth of employed residents was strongest in the year ended 2008, but that was the only year it outperformed the national growth rate. Nationally, employment grew most strongly in the year ended June 2005, which was the second most rapid growth year for Sydney.

The employment effect of the global financial crisis is evident in both the Sydney and Australian data for the year ended June 2009, but the effect is more pronounced for Sydney, resulting in a net loss of employment, rather than the slight growth in employment that occurred at a national scale. The number of employed residents of Sydney fell by 15 000 persons from June 2008 to June 2009.

Figure 4.5 Growth in employed residents of Sydney and Australia, 2001 to 2011

Source: BITRE analysis of ABS Labour Force Survey Cat. 6291.0.55.001 (July 2011 issue).

The LFS reports that the number of employed residents of Sydney grew by 1.2 per cent per annum between 2001 and 2006, while the average annual growth rate from June 2006 to June 2011 was 1.5 per cent. Thus, while there has been considerable year to year volatility in job growth in Sydney, since 2006 employment has grown at a slightly stronger average pace than it did during the 2001 to 2006 period.

Census estimates show a lower growth rate than the LFS for the 2001 to 2006 period. Census data shows that the number of employed residents of Sydney grew at an average annual rate of 0.8 per cent between 2001 and 2006, while the number of jobs with a known fixed work address averaged 0.6 per cent annual growth. This is a much lower average annual rate of job growth than experienced by Perth (2.3 per cent) or Melbourne (1.5 per cent) between 2001 and 2006 (BITRE 2010, BITRE 2011).

Changes 2001 to 2006

The following analysis of changes in Sydney's spatial distribution of employment relies on data from the 2001 and 2006 ABS Censuses of Population and Housing.²⁷ Specifically, the change analysis is based on BTS journey to work tables, rather than the ABS working population profile data which was the basis of the 2006 snapshot analysis presented earlier in the chapter.²⁸

The spatial analysis is based on 2006 Australian Standard Geographical Classification (ASGC) boundaries. Between 2001 and 2006, the most notable boundary change was the City of Sydney's expansion to include the former South Sydney LGA and part of the Leichhardt LGA. The 2001 place of work data for SLAs has been concorded to reflect the 2006 boundaries, using BTS employment-weighted concordances.

Sectoral and subregional overview

From 2001 to 2006, the number of employed residents within the GMA grew by 1.0 per cent per annum, from 2.16 million to 2.27 million. The number of people who reported a fixed place of work within the GMA grew by 0.7 per cent per annum, from 1.97 million in 2001 to 2.05 million in 2006. The difference in the two growth rates is partly attributable to strong growth in 'not stated' place of work and strong growth in the number of GMA residents who commute to a place of work outside the GMA.

A key point, that was also evident for Melbourne and Perth, is that employed residents grew faster between 2001 and 2006 than population. In Sydney, about 44 per cent of residents were employed on either a full-time or part-time basis in 2006.

Figure 4.6 summarises the distribution of employment between 2001 and 2006 for sectors of the GMA. There is relative stability across the regions, but an observable shift in employment from the Inner sector to the Outer sector and the Lower Hunter. The largest change over the period was the decrease in Inner sector employment from 30.7 per cent to 29.4 per cent of the GMA total. The Outer sector and Lower Hunter both increased over the period by 0.6 of a percentage point. The Middle sector fell 0.2 of a percentage point, and Illawarra rose by the same magnitude.

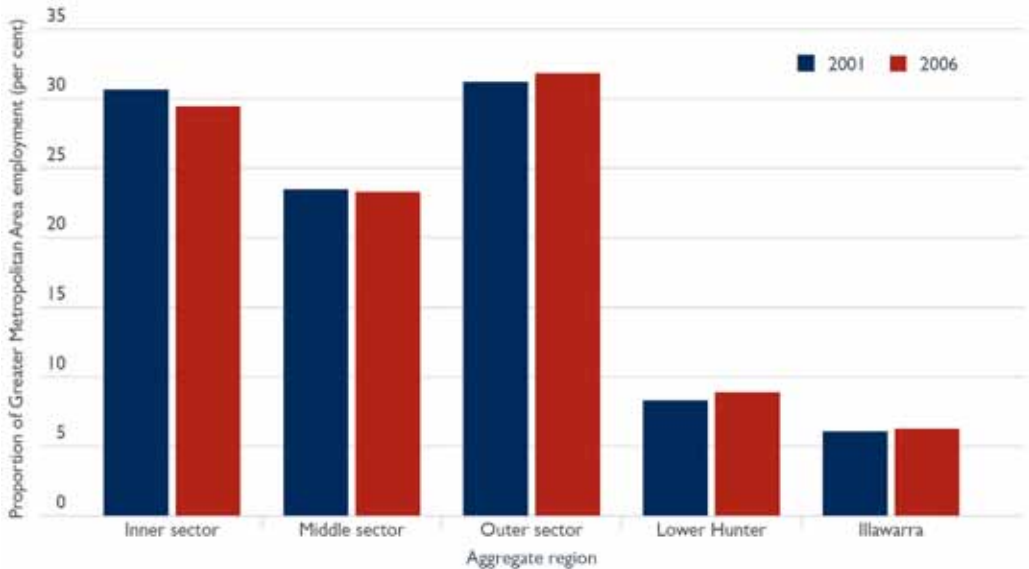
Figure 4.7 summarises the employment change over the period for Sydney's planning subregions. This reveals the same sort of stability as observed for the sectors. The biggest change was for North West, which increased its employment share by 0.6 percentage points. The rest of the planning subregions rose and fell by less than 0.4 percentage points.

²⁷ Results of Census 2011 were not available at the time this report was written.

²⁸ The 2001 and 2006 change analysis is based on persons who reported a fixed place of work within the GMA. The total GMA figure includes 'Sydney Undefined', and excludes the categories of 'no fixed address', 'NSW Undefined', and 'Not stated'. Due to issues of non-response, undercount and inadequately described place of work, the actual number of people employed within the GMA is likely to be considerably higher than the figure reported here.

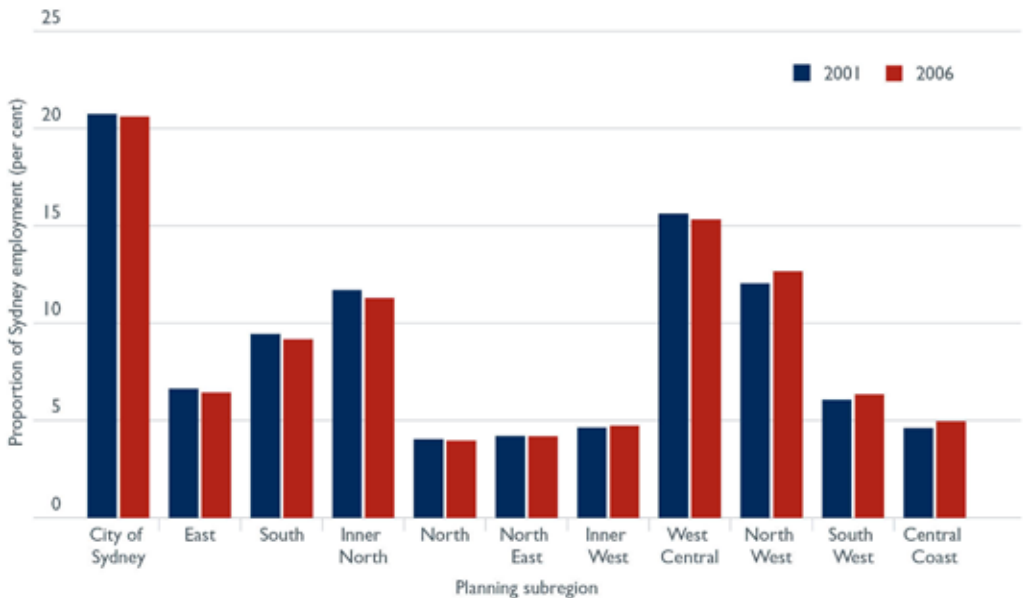
The aggregate region totals compiled from 2006 BTS data for this analysis differ from those compiled from ABS working population profile data used in the 2006 snapshot above (e.g. Table 4.1). The Inner sector of Sydney has about 1800 more workers in the aggregated BTS data, about 1500 of which have shifted from the Middle sector and about 300 from the Outer sector (accounting for only 0.3 per cent or less of workers for each affected region). This affects the planning subregions in the same way, where the South sector has lost 1800 workers, largely to the East sector. Proportionately, the East sector is most affected, being 1.5 per cent smaller than the ABS estimate. The issue does not affect the total employment figure.

Figure 4.6 Contribution of sectors to Sydney Greater Metropolitan Area employment, 2001 and 2006



Source: BITRE analysis of BTS JTW tables 2001 (table 19) and 2006 (table 1).

Figure 4.7 Contributions of planning subregions to total employment, Sydney, 2001 and 2006



Note: Data for the City of Sydney relates to the 2006 boundaries of this LGA/planning subregion.

Source: BITRE analysis of BTS JTW tables 2001 (table 19) and 2006 (table 1).

Table 4.4 summarises changes in place of work by planning subregion and sector between 2001 and 2006. About 47 000 additional people were employed in Sydney in 2006, and about 74 000 additional people were employed in the GMA. The increase of 47 300 persons for the Sydney working zone was well below the increases for Perth (69 300) and Melbourne (111 200).

Table 4.4 Changes in place of work data by planning subregion and sector, Sydney Greater Metropolitan Area, 2001 to 2006

	Change in employment	Average annual employment growth (per cent)	Share of total employment growth (per cent)	Average annual population growth (per cent)
Planning subregions				
City of Sydney ^	7 400	0.4	16	5.0
East	– 200	0.0	0	0.2
Inner North	–1 800	–0.2	–4	0.7
Inner West ^	4 000	1.0	8	1.3
South	– 300	0.0	–1	0.1
North	900	0.3	2	0.1
North East	1 800	0.5	4	0.3
West Central	2 200	0.2	5	0.7
North West	16 300	1.6	34	0.9
South West	7 700	1.5	16	0.9
Central Coast	8 400	2.1	18	0.6
Unknown address	800	2.9	1	na
Total Sydney	47 300	0.6	100	0.7
Sectors				
Inner Sydney	–2 300	–0.1	–3	1.2
Middle Sydney	13 300	0.6	18	0.7
Outer Sydney	35 500	1.1	48	0.6
Rest of GMA				
Lower Hunter	18 100	2.1	24	1.0
Illawarra	8 900	1.4	12	0.7
Greater Metropolitan Area*	74 300	0.7	100	0.8

Notes: ^ All data relates to 2006 subregion boundaries. Data for the City of Sydney relates to the 2006 boundaries of this LGA, which gained the former South Sydney LGA and part of the Leichhardt LGA from the Inner West subregion between 2001 and 2006. Na is not applicable.

Employment data has been rounded to the nearest hundred persons, as confidentialisation and concordance processes have introduced a degree of approximation to the estimates.

*Includes unknown address in Sydney, excludes residents with no fixed address or employment address not stated.

Source: BITRE analysis of BTS JTW tables 2001 (table 19) and 2006 (table 1), ABS Cat. 3218.0 Regional Population Growth, 2007–08.

Almost half (48 per cent) of the job growth in the GMA was in Outer Sydney, which added around 35 500 jobs. Inner Sydney experienced a decline of about 2300 employed people, which is in contrast to its relatively strong population growth over the same period. Middle Sydney, the Illawarra and Lower Hunter each added between 8000 and 19 000 jobs. The Lower

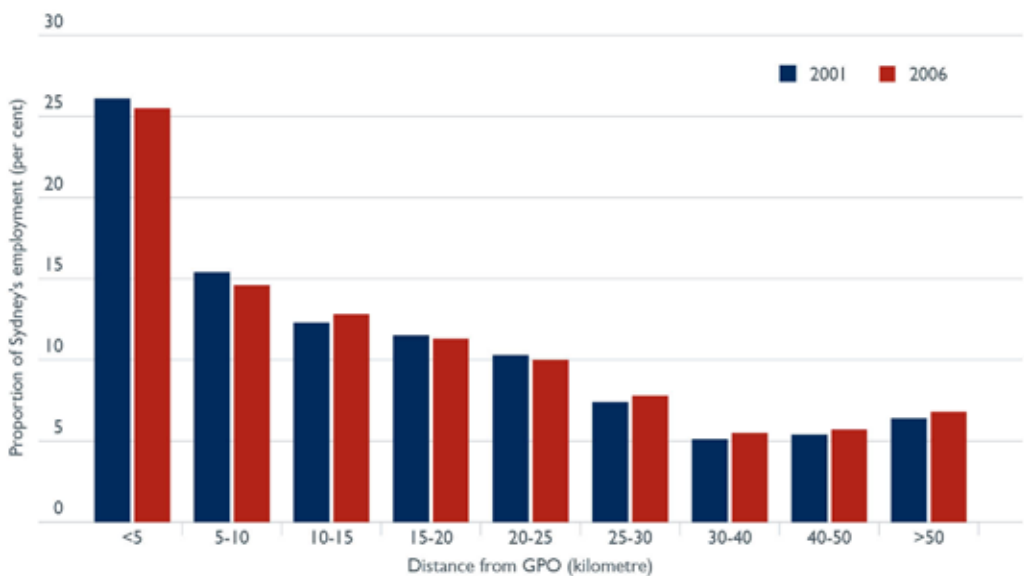
Hunter and Illawarra experienced relatively strong employment growth in percentage terms, with annual average growth rates of 2.1 per cent and 1.4 per cent respectively, compared with Sydney's growth rate of 0.6 per cent per annum.

Among the planning subregions, Central Coast, North West and South West all experienced relatively rapid employment growth of 1.5 per cent or more, with the rest of the subregions experiencing more moderate growth (or decline) of between -0.2 per cent and 1.0 per cent per annum.

The North West planning subregion alone accounted for more than one third of Sydney's job growth, and the South West and the Central Coast contributed a further 16 and 18 per cent, respectively. Employment in the City of Sydney increased by 7400 jobs, representing 16 per cent of Sydney's job growth, but the 0.4 per cent growth rate was less than the Sydney-wide average (0.6 per cent).

Figure 4.8 shows how the distribution of employment has changed according to distance from the CBD. While the distribution of employment was quite stable between 2001 and 2006, there is an apparent shift towards more employment being located further away from the CBD. The proportion of employment located within 10 kilometres of the CBD has declined from 41.5 per cent in 2001 to 40.1 per cent in 2006. The proportion of employment located more than 25 kilometres from the CBD increased from 24.4 to 25.8 per cent. Strong outer suburban job growth in the 2001 to 2006 period has resulted in a more decentralised employment distribution within Sydney.

Figure 4.8 Proportion of employment located at various distances from the Central Business District, Sydney, 2001 and 2006



Note: The General Post Office was used as the central point of the CBD. Calculation based on straight line distance from each TZ centroid to GPO.

Source: BITRE analysis of BTS 2006 and 2001 JTW data for TZs.

Statistical Local Areas

Between 2001 and 2006, the spatial concentration of employment at the SLA scale was quite stable. The top five employing SLAs accounted for 23 per cent of employment in the GMA in both 2001 and 2006, while the employment share of the top ten SLAs decreased slightly from 34.0 per cent in 2001 to 33.4 per cent in 2006.

At the SLA scale, 2001 employment was highest for Sydney Inner (221 400), followed by Parramatta Inner (64 400), North Sydney (62 300), Willoughby (52 300) and Ryde (52 200). In 2006, this ranking remained steady except that Ryde (58 300) had surpassed Willoughby (51 500).

Table 4.5 lists the SLAs that experienced an absolute increase in the place of work data involving more than 4000 employed persons between 2001 and 2006. Strong job growth occurred in a mix of Inner, Middle and Outer sector SLAs. Sydney Inner alone accounted for 12 per cent of GMA growth, and 18 per cent of Sydney's growth. However, the rate of growth was considerably less than the other high growth SLAs.

Sydney Inner, Ryde, Sydney West and Baulkham Hills Central all experienced an increase in employment of more than 5000 people. While Sydney Inner and Sydney West's population growth outstripped their employment growth in percentage terms, Ryde and Baulkham Hills Central had considerably higher employment growth than population growth. Newcastle–Throsby and Maitland in the Lower Hunter also experienced high growth in employment, with increases of about 4900 and 4600 jobs respectively.

Table 4.5 Increases in place of work data by Statistical Local Area, Sydney Greater Metropolitan Area, 2001 to 2006

SLA	Aggregate region	Change in employment, 2001 to 2006	Average annual employment growth (per cent)	Share of GMA employment growth (per cent)	Share of Sydney employment growth (per cent)	Average annual population growth (per cent)
Sydney Inner	Inner	8 600	0.8	12	18	9.2
Ryde	Middle	6 100	2.2	8	13	0.4
Sydney West	Inner	5 100	2.6	7	11	5.8
Baulkham Hills Central	Outer	5 100	3.4	7	11	1.6
Newcastle–Throsby	Lower Hunter	4 900	4.0	7	na	0.5
Maitland	Lower Hunter	4 600	5.4	6	na	2.7
Blacktown South East	Outer	4 500	2.2	6	10	0.0
Canada Bay –Concord	Middle	4 100	6.3	6	9	3.3
Auburn	Middle	4 000	2.1	5	9	3.1

Note: All data relates to 2006 SLA boundaries. Na is not applicable.

Source: BITRE analysis of BTS JTW tables 2001 (table 19) and 2006 (table 1), ABS Cat 3218.0 Regional Population Growth, 2007-08.

Table 4.6 lists the SLAs that experienced an absolute decrease in the place of work data involving more than 2000 employed persons between 2001 and 2006. With the exception of Fairfield East, all of these areas are in the Inner sector of Sydney. Except for Lane Cove, all of them experienced an increase in population accompanying the decrease in jobs. This is particularly notable in Sydney South, which had population growth of 5.3 per cent per annum while its employment fell 1.4 per cent each year over the same period. This may reflect conversion of land from employment to residential purposes, particularly around the Green Square redevelopment.

Table 4.6 Decreases in place of work data by Statistical Local Area, Sydney Greater Metropolitan Area, 2001 to 2006

SLA	Aggregate region	Change in employment, 2001 to 2006	Average annual employment growth (per cent)	Share of GMA employment growth (per cent)	Share of Sydney employment growth (per cent)	Average annual population growth (per cent)
Lane Cove*	Inner	-4 200	-4.8	-6	-9	-0.2
Fairfield East	Outer	-3 300	-3.0	-4	-7	0.1
Sydney East	Inner	-3 300	-1.5	-4	-7	2.5
Sydney South	Inner	-3 100	-1.4	-4	-6	5.3
North Sydney	Inner	-2 300	-0.7	-3	-5	1.1

Note: All data relates to 2006 SLA boundaries.

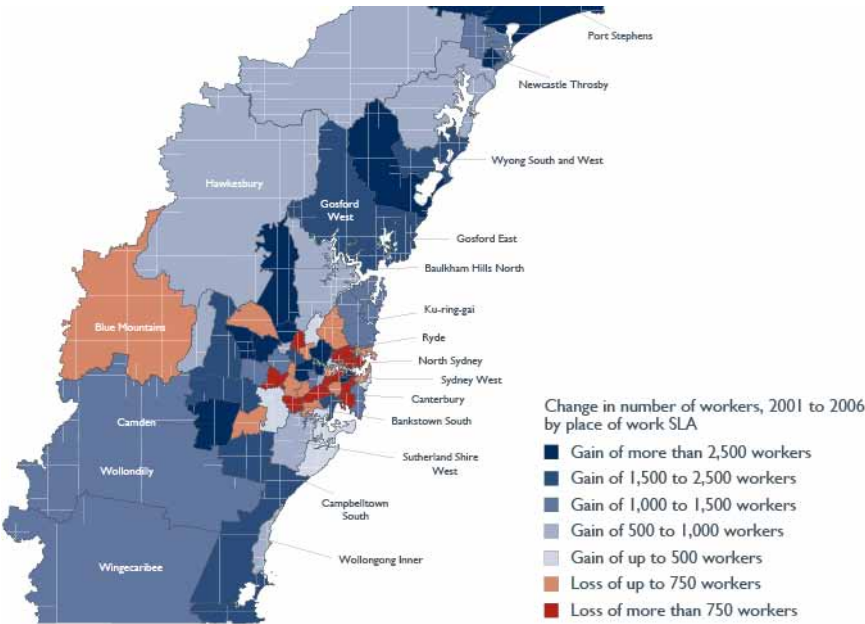
* A large decline in jobs in Lane Cove is apparent in the statistics. However this appears to be an anomaly: the Royal North Shore Hospital is on the border of Lane Cove and Willoughby, and a large number of 'Health and community services' jobs appears to have moved from Lane Cove to Willoughby between 2001 and 2006 which might be a result of miscoding.

Source: BITRE analysis of New South Wales BTS JTW tables 2001 (table 19) and 2006 (table 1), ABS Cat 3218.0 Regional Population Growth, 2007-08.

Maps 4.6 and 4.7 show the change in the place of work data between 2001 and 2006 for SLAs and the changes in the number of employed residents in each SLA over the same period.

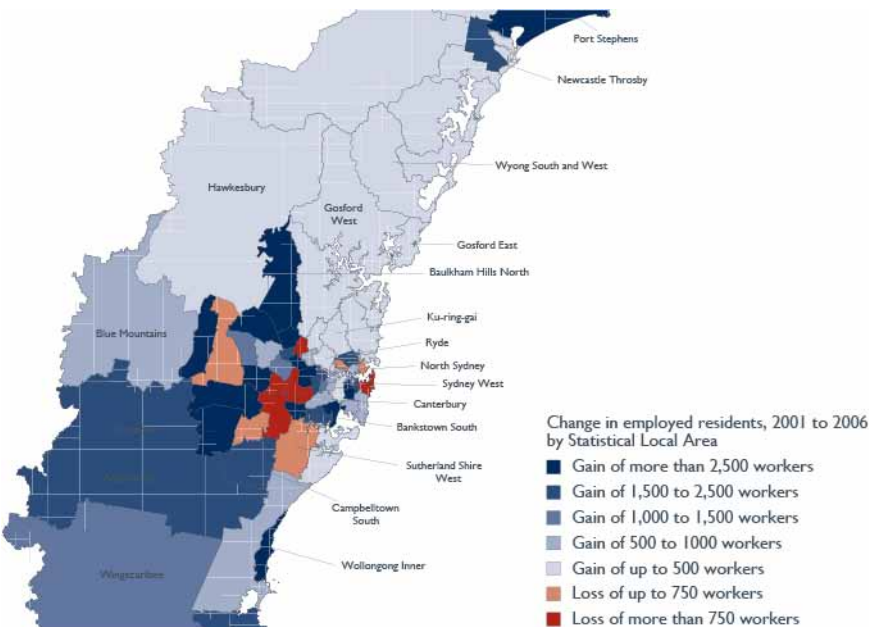
What is striking in comparing the two maps is how many SLAs in the north of the GMA, from Ryde up to just short of Newcastle, have grown by less than 500 employed residents, while these same SLAs have experienced considerably stronger job growth. At the same time, SLAs such as Bankstown South and Hurstville have experienced a strong decrease in jobs and a strong increase in employed residents.

Map 4.6 Changes in number of employed people working in Statistical Local Area, Sydney Greater Metropolitan Area, 2001 to 2006



Source: BITRE analysis of BTS JTW 2001 (table 19) and 2006 (table 1).

Map 4.7 Changes in number of employed residents living in Statistical Local Area, Sydney Greater Metropolitan Area, 2001 to 2006



Source: BITRE analysis of ABS *Census of Population and Housing* place of usual residence data, 2001, 2006.

Maps 4.8 and 4.9 illustrate the average annual rate of change for jobs and employed residents from 2001 to 2006 by SLA. Between 2001 and 2006, the rate of employment growth was greatest for:

- Baulkham Hills North (average annual employment growth of 7 per cent)
- Canada Bay–Concord (6 per cent)
- Maitland (5 per cent)
- Shoalhaven Part B (5 per cent)
- Camden (4 per cent)
- Newcastle–Throsby (4 per cent).

The highest rates of job growth were concentrated in the outer areas of the city. Of the 16 Sydney SLAs whose employment grew more than 2 per cent per annum, 11 were in the Outer sector. Only one Inner sector SLA (Sydney West at 2.6 per cent) grew by more than one per cent per annum.

The SLAs experiencing employment declines of more than 2 per cent were:

- Lane Cove²⁹ (annual average change of –5 per cent)
- Fairfield East (–3 per cent)
- Baulkham Hills South (–2 per cent)
- Mosman (–2 per cent).

Of the 14 Inner sector SLAs, 10 experienced declines in employment. Only one of the SLAs in the Rest of the GMA, namely Shoalhaven Part A, experienced a net loss of jobs (–0.4 per cent per annum).

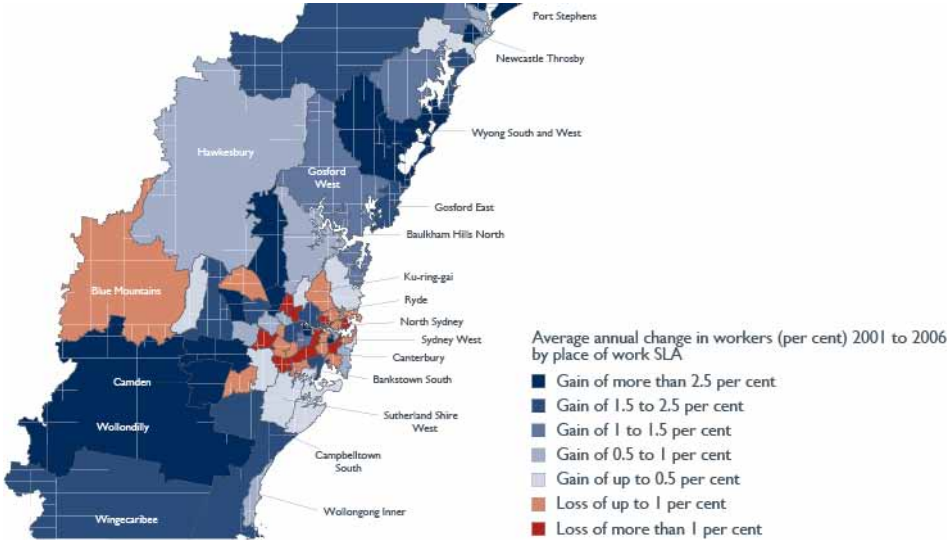
In most Outer sector and Illawarra SLAs, the rate of job growth outstripped the growth of employed residents. In the Inner sector, the opposite was true, with the rate of growth for employed residents exceeding job growth in the majority of SLAs. SLAs in the Middle sector and the Lower Hunter were mixed in this regard.

The average annual growth in employed residents for Sydney South, Bankstown South and Blacktown North SLAs exceeded the employment growth rate by more than 4 percentage points. These SLAs became significantly more residentially-oriented between 2001 and 2006.

The rate of employment growth exceeded the rate of growth in employed residents by more than 2.5 percentage points in Parramatta South, Canada Bay–Concord and Shoalhaven Part B, resulting in an increase in the employment self-sufficiency ratio.

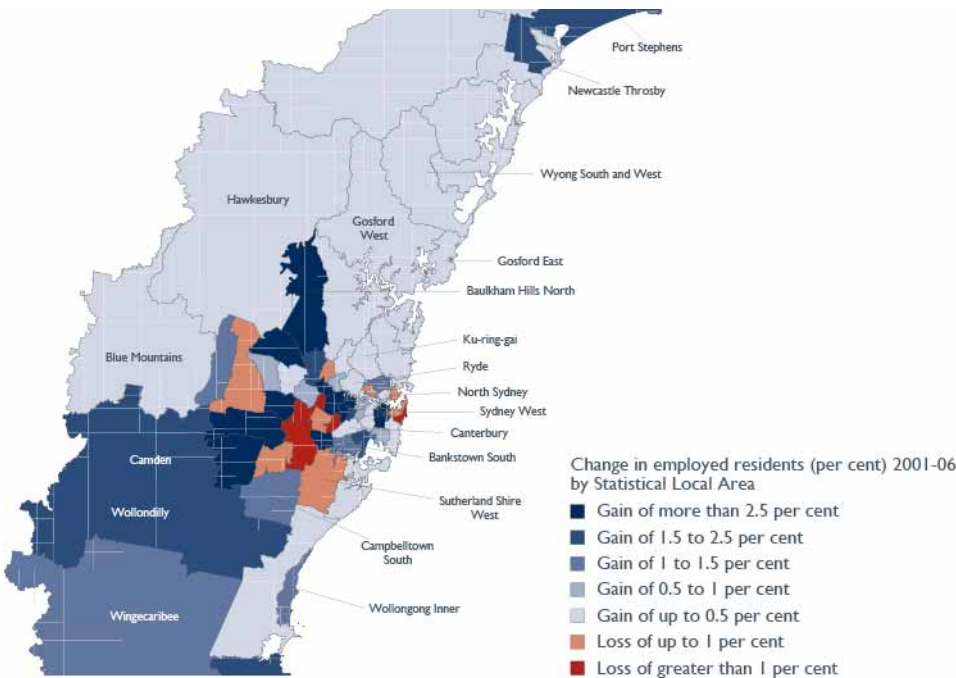
²⁹ As noted previously a large decline in jobs in Lane Cove is apparent in the statistics. However this appears to be an anomaly: the Royal North Shore Hospital is on the border of Lane Cove and Willoughby, and a large number of 'Health and community services' jobs appear to have moved from Lane Cove to Willoughby between 2001 and 2006 which might be a result of miscoding.

Map 4.8 Average annual percentage changes in workers in Statistical Local Area, Sydney Greater Metropolitan Area, 2001 to 2006



Source: BITRE analysis of BTS JTW 2001 (table 19) and 2006 (table 1).

Map 4.9 Average annual percentage changes in employed residents in Statistical Local Area, Sydney Greater Metropolitan Area, 2001 to 2006



Source: BITRE analysis of ABS *Census of Population and Housing* place of usual residence, 2001 and 2006.

At the SLA scale, there is a positive correlation between the growth rates for employment and employed residents of 0.52. This correlation indicates that the greater the residential growth rate for an area, the greater the likely rate of job growth in that area.

Destination zones/travel zones

Some further insights into the location of employment growth can be gained from analysing data for destination zones. BTS destination zone data for 2001 was transformed to 2006 boundaries using an employment-based concordance. This analysis is therefore based on the 2006 destination zone boundaries. At this detailed spatial scale, estimates of employment change are subject to numerous sources of error. Rather than relying on the measure of change for any single DZ, it is more useful to look for clusters of DZs experiencing a similar pattern of change.

Map 4.10 uses the destination zone data to show how employment change was distributed throughout Sydney. Areas of job loss and job growth are intermixed throughout the middle and outer suburbs. Consistent with the SLA data presented in Table 4.6, job loss appears to be particularly concentrated in Inner Sydney, with many DZs in the North Sydney and City of Sydney LGAs experiencing substantial job loss. This is very different to what we saw for population (see Map 3.8 in Chapter 3), where these same locations were home to substantial population increases.

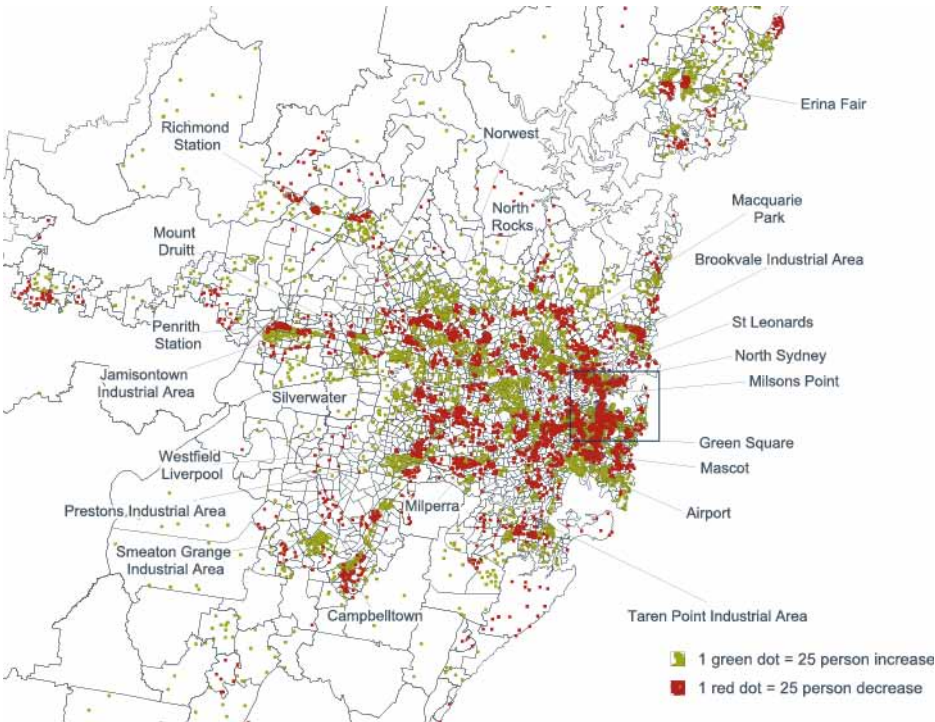
Map 4.11 provides a more detailed picture of the pattern of change in inner Sydney. Within the City of Sydney, there are several clusters of DZs experiencing strong job growth, including clusters of DZs:³⁰

- to the west of Wynyard station
- around Martin Place and Parliament House
- the area bordered by George St, Bathurst St, Elizabeth St and Goulburn St (including World Square)
- Pyrmont and Ultimo
- University of Sydney and Royal Prince Alfred Hospital.

Within the City of Sydney, the Sydney Inner and Sydney West SLAs experienced a substantial increase in jobs—this is reflected in the above list which primarily consists of DZs from these two SLAs. In contrast, the Sydney East and Sydney South SLAs experienced substantial employment losses between 2001 and 2006.

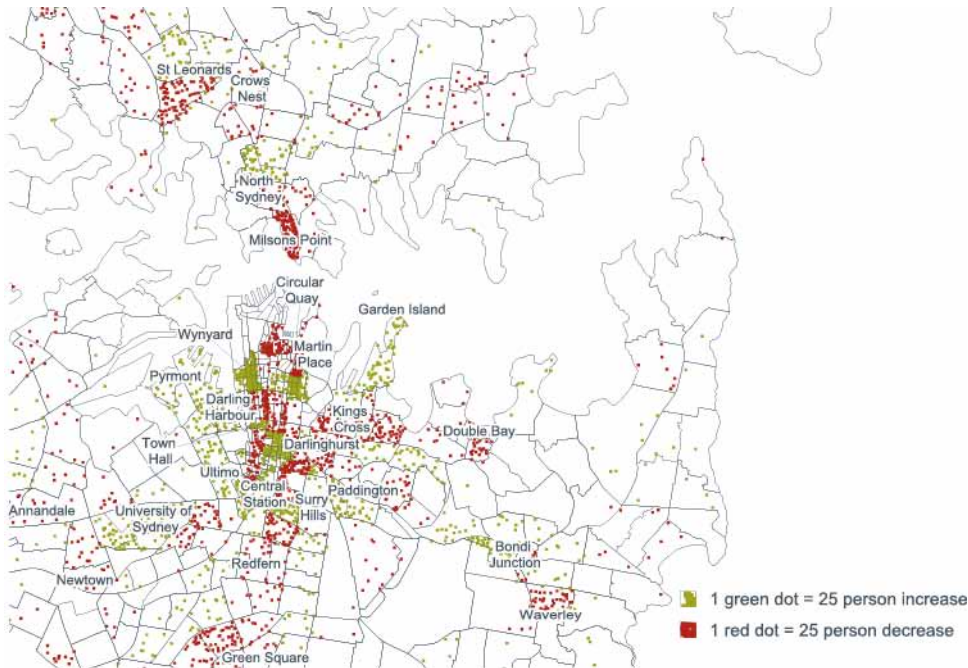
³⁰ Note that the extent of clustering is, to some extent, an artefact of the application of concordances and the change in DZ boundaries between 2001 and 2006, with the 2006 DZs being more disaggregated. However, we can be confident that, in aggregate, each of these clusters of DZs experienced significant job growth.

Map 4.10 Dot density map of employment change, Sydney, 2001 to 2006



Source: BITRE analysis of BTS JTW tables 2001 (table 19) and 2006 (table 1).

Map 4.11 Dot density map of employment change, Inner Sydney, 2001 to 2006



Source: BITRE analysis of BTS JTW tables 2001 (table 19) and 2006 (table 1).

Map 4.11 reveals the following clusters of DZs experiencing job loss in the City of Sydney:

- around Circular Quay
- the shopping district around the Queen Victoria Building
- Haymarket, including Chinatown
- Kings Cross
- East Sydney
- parts of Surry Hills
- around Green Square (including parts of Alexandria, Beaconsfield, Waterloo and Zetland).

The North Sydney LGA had 2300 fewer jobs in 2006, compared to 2001. Map 4.11 reveals that job loss was concentrated in Milsons Point, the southern end of the North Sydney CBD and in parts of the St Leonards-Crows Nest specialised centre. However, there were also some clusters of DZs experiencing job growth, including the northern end of the North Sydney CBD and parts of St Leonards. In discussing North Sydney, the relevant subregional plan points out that 'new office construction in Sydney CBD, such as Barangaroo (East Darling Harbour) and increasing competition of lower cost, large scale office development at Macquarie Park, has impacted in recent years on the uptake of the centre's office market' (Department of Planning 2007b, p.42).

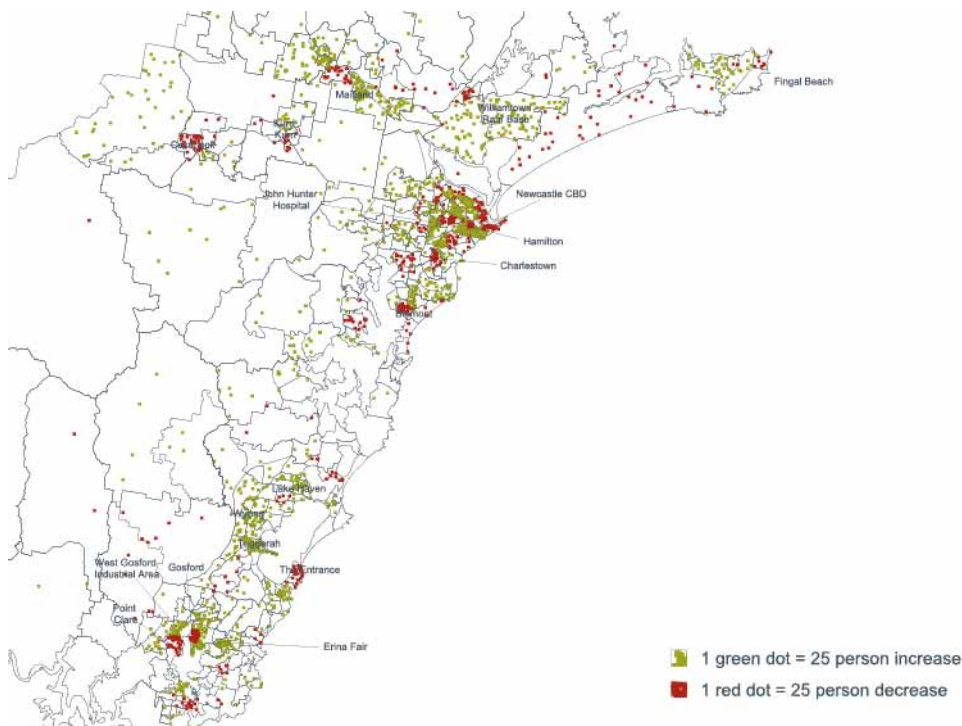
In places such as Milsons Point and Green Square, the substantial job losses were associated with a significant increase in population, as former employment locations were converted to residential purposes.

Returning to Map 4.10 for all of Sydney, substantial job losses also occurred in Mascot (despite strong job growth at the nearby airport); Brookvale Industrial Area; the Liverpool, Penrith and Gosford town centres; Milperra; North Rocks; Fairfield; a corridor starting at the city-end of Parramatta Road and extending on to Liverpool Road and Canterbury Road through the inner west; and the suburbs to the south of the Campbelltown-Macarthur strategic centre (e.g. Ambarvale, Rosemeadow). Clusters of substantial job growth were also prominent, including:

- Sydney Airport
- Macquarie Business Park and surrounds
- Norwest Business Park
- Campbelltown-Macarthur strategic centre
- around Olympic Park, Rhodes Corporate Park, Homebush and Silverwater
- in and around the outer suburban industrial areas of Smeaton Grange, Prestons and Jamisontown.

Map 4.12 presents employment change information for Central Coast and the Lower Hunter. The Newcastle CBD and the Gosford town centre both experienced job loss between 2001 and 2006, as did The Entrance, Cessnock and Point Clare. The map also shows widespread areas of job growth, including the Williamstown RAAF base, John Hunter Hospital, East Maitland, Wyong, Tuggerah and the West Gosford Industrial Area.

Map 4.12 Dot density map of employment change, Central Coast and Lower Hunter, 2001 to 2006



Source: BITRE analysis of BTS JTW tables 2001 (table 19) and 2006 (table 1).

This section has examined the spatial distribution of employment change since 2001 for Sydney SD and the GMA at a range of different scales. The following section includes analysis of how employment change is distributed across strategic centres, employment lands, and other locations.

Employment and the Metropolitan Strategy

Jobs and economic competitiveness are a primary focus of the Metropolitan Strategy. According to Bunker (2007, p.10), *City of Cities* acts 'as a default program of economic development for Sydney' and is designed to achieve a 'restructuring of Sydney to facilitate economic development and provide certainty for developers, investors and businesses' (ibid., p.14).

Historically, 'there has been very limited intervention by the NSW state government in the spatial distribution of employment within the metropolis' (Fagan and Dowling 2005, p.72). Consequently, market forces have largely shaped the spatial distribution of jobs within Sydney. For example, major new developments, such as the Norwest Business Park, have been allowed to locate outside the nominated strategic centres in areas with poor public transport access (ibid., p.77).

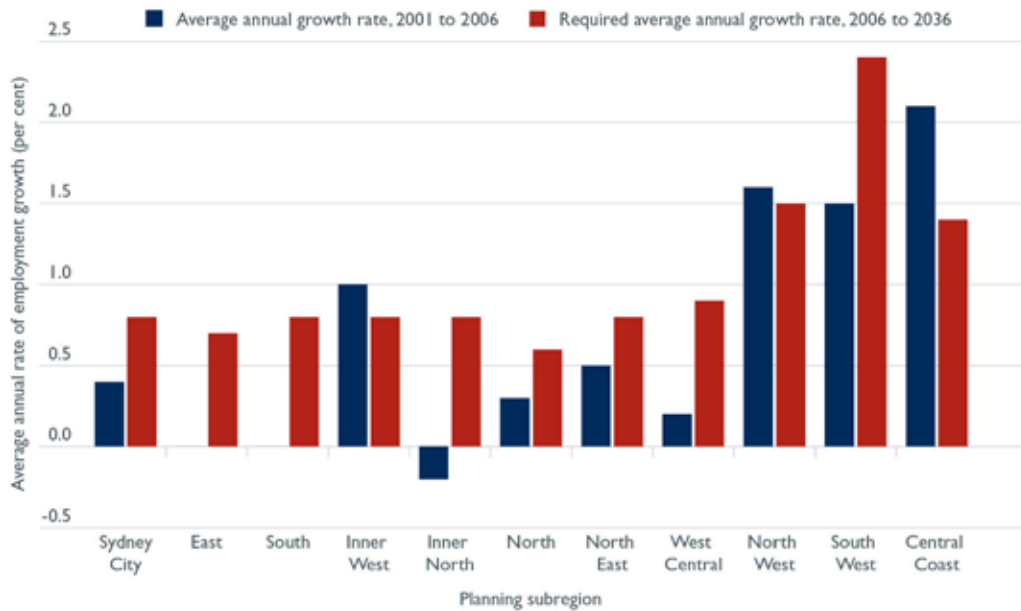
City of Cities anticipates there will be 500 000 additional jobs in Sydney by 2031, giving a total of 2.5 million employed persons (NSW Government 2005, p.39). *Sydney 2036* anticipates there will be 760 000 additional jobs created between 2006 and 2036, giving a total of 2.85 million employed persons (NSW Government 2010a, p.133). Achievement of the *Sydney 2036* employment target requires average annual employment growth of 1.2 per cent per annum between 2006 and 2036. This is comparable to Sydney's long term employment growth rate between 1981 and 2006 of 1.3 per cent (TDC 1998, 2008b).

Figure 4.9 compares the subregional average annual growth rate of employment for the 2001 to 2006 period to the required future average annual growth rate if the 2036 target is to be achieved. A turnaround from the recent employment declines is required for the East, South and Inner North subregions in order to meet the 2036 employment targets. The West Central and South West planning subregions also need a much higher rate of employment growth than that experienced between 2001 and 2006 to achieve the targets. In contrast, employment growth in the Central Coast subregion between 2001 and 2006 was much higher than the average annual growth required to achieve the *Sydney 2036* target. For the North West subregion, the targeted rate of future jobs is similar to the recent rate of job growth in this subregion. A more detailed discussion of employment forecasts for Sydney is contained in Chapter 9.

The recent metropolitan strategies contain a number of objectives relating to the spatial distribution of employment within Sydney (see Table 2.4). The remainder of this chapter uses the available place of work data to assess the extent to which there has been change since 2001 with respect to:

- concentrating job growth in strategic centres
- accommodating about 20 per cent of jobs in employment lands
- locating more jobs in Western Sydney
- focusing job growth in corridors
- better aligning jobs with where people live.

Figure 4.9 Employment growth by planning subregion for Sydney, 2001 to 2006 and 2006 to 2036 target



Note: The 2001 to 2006 growth rate is based on census place of work data for 2001 and 2006, while the required growth rate is based on 2006 and 2036 TDC small area employment forecasts (which are benchmarked to ABS Labour Force Survey totals).

Source: BITRE analysis of BTS JTJW tables 2001 (table 19) and 2006 (table 1) and required 2006 to 2036 employment growth rates sourced from NSW Government 2010a table EI.

Concentrate job growth in centres

All of Sydney's employment is considered to be located in one of the following three types of areas:

- Strategic centres: includes Global Sydney, Regional Cities, Major Centres and Specialised Centres
- Employment lands: Includes industrial areas and technology and business parks (excluding specialised centres)
- Other locations: includes town centres and villages, neighbourhood centres, enterprise corridors, dispersed and home based employment (NSW Government 2005).

Map 4.13 shows the strategic centres³¹ and employment lands located within Sydney (excluding the Central Coast). Twenty nine existing strategic centres are identified for Sydney, along with ten planned or potential strategic centres. The Central Coast contains two strategic centres—Gosford and Tuggerah-Wyong.

³¹ Further information on the strategic centres is provided in Table 2.3.

Map 4.13 Strategic centres and employment lands, Sydney



Note: The map does not display strategic centres and employment lands located in the Central Coast subregion of Sydney.

Source: NSW Department of Planning (2007a, p.4).

'Over the past 50 years, metropolitan strategies for Sydney have contained centres policies that have identified major centres, supported nominated centres and restricted and regulated office based and retail activities outside of centres' (NSW Government 2005, p.84). Concentrating activities in centres is seen to have a range of benefits, including reducing travel times and car dependence and making better use of existing public transport infrastructure and government services. For example, in 2001, 39 per cent of commutes to a place of work in a strategic centre were by public transport, compared to 7 per cent for other places (ibid.).

City of Cities seeks to concentrate employment in centres, as a 'dispersed city with low concentrations of jobs would have high economic, social and environmental costs' (NSW Government 2005, p.39). The main goal is to significantly increase the share of jobs in strategic centres from 40 per cent in 2001 to 45 per cent by 2031 (ibid., p.82). More specific aims include:

- Achievement of the specified employment targets for strategic centres
- Growing employment in the regional cities of Parramatta, Liverpool and Penrith
- Increasing the share of jobs going to centres in the rapidly growing areas of Western Sydney and the Central Coast (ibid.).

Sydney 2036 retained this aim of concentrating employment in strategic centres, although the target is now less ambitious, aiming to increase the share of jobs in strategic centres from 39 per cent in 2006 to 42 per cent by 2036 (NSW Government 2010a, p.135). The new strategy places a stronger emphasis on the economic role of the regional cities—particularly Parramatta.

The recent strategies aim to build on the success of past centres policies, which have 'reduced pressure on central Sydney, created a second CBD at Parramatta, upgraded the public transport network serving those centres and concentrated major retail developments at subregional centres' (NSW Government 2005, p.84). Meyer (2005) regards the establishment of regional shopping centres in the designated activity centres, rather than the standalone malls common in other Australian cities, as a notable success of early centres policy, while the lack of attention given to improving public transport links between the suburbs and the strategic centres is seen as a key shortfall. More generally, a deficit of infrastructure—transport, communications, cultural and recreational—is perceived to be constraining Sydney's outer suburban strategic centres (Fagan and Dowling 2005, SGS 2004, O'Neill 2010). Liverpool, Campbelltown, Blacktown, Gosford and Wyong have been identified as outer suburban centres that have underperformed in terms of job growth (NSW Government 2005).

A particular challenge for centres policy has been achieving a good balance between working and living in centres:

'For some years, the rate of return for developers of medium to high density residential development in centres has been greater than the rates of return from commercial development. It is important that strategic centres offer sufficient sites for employment as well as residential development.' (NSW Government 2005, p.87)

The centres hierarchy has evolved over time, and the number of nominated centres has increased with each successive plan. The following analysis adopts the centres hierarchy outlined in the 2005 Metropolitan Strategy.³²

Measurement of the extent to which employment is concentrated in strategic centres requires centre boundaries to be defined. As a starting point, BITRE has adopted the centre boundaries which form the basis of TDC (2008b) and in which each centre is defined as an aggregate of 2006 destination zones. However, not all of the strategic centres (and planned/potential major centres) identified in *City of Cities* are covered by TDC (2008b). For the planned and potential major centres and the existing centres of Gosford, Sydney Airport, Bankstown, Kogarah, Brookvale-Dee Why and Tuggerah-Wyong, BITRE has estimated 2006 employment by aligning destination zone boundaries with the information provided on what is included in each centre from the relevant draft subregional plan.³³

³² There have been several changes to the centres hierarchy since 2005. Cabramatta is no longer considered a potential major centre. Olympic Park and Rhodes are now identified as two distinct specialised centres, rather than a single specialised centre. Frenchs Forest and the Penrith Education and Health Precinct are two newly identified potential specialised centres (NSW Government 2010a p.66–67).

³³ BITRE's employment estimates for centres may differ from other estimates due to differences in centre boundaries. BITRE's employment estimates are derived from census place of work data, while employment figures presented for strategic centres in the NSW Government's recent metropolitan strategies are modelled estimates that adjust the census place of work data upwards to compensate for census undercount and for census responses which cannot be assigned to a specific travel zone.

2006 snapshot

Table 4.7 summarises 2006 employment information for the strategic centres identified in *City of Cities*. In 2006, almost 40 per cent of Sydney's employment was concentrated in existing strategic centres, while a further 1.3 per cent of employment was in planned and potential strategic centres. The remaining 59 per cent includes jobs located in employment lands (discussed later in this chapter), jobs in smaller centres (town centres, standalone shopping centres, villages, neighbourhood centres) and jobs in dispersed suburban locations (e.g. schools, home-based employment).

Global Sydney—which comprises the CBD, City East, Pyrmont-Ultimo, Redfern Centre and Sydney Education and Health precincts together with North Sydney—contributes 335 800 jobs or roughly half of centred employment.

Outside of Global Sydney, the major employing centres are:

- The specialised centre of St Leonards-Crows Nest in the Inner North subregion which contains considerable commercial office space, Royal North Shore Hospital and the Northern Sydney TAFE Institute (34 400 jobs)
- The regional city of Parramatta in the West Central subregion (34 200 jobs)
- The specialised centre of Macquarie Park in the Inner North, which includes Macquarie University and Riverside Corporate Park and has a research and technology focus (32 000 jobs)
- The specialised centre of Sydney Airport and environs, which includes the domestic and international terminals as well as the adjoining suburb of Mascot, and cuts across the South and East subregions (28 200 jobs).

The remaining regional cities of Liverpool, Penrith and Gosford contain relatively few jobs in comparison to Parramatta. In fact, their combined total employment approximates that of Parramatta. Regional cities are intended to provide the 'full range of business, government, retail, cultural, entertainment and recreational activities' (NSW Government 2005, p.92) and serve as a major employment focal point, while major centres offer a more limited range of retail and business activities to the surrounding district and contain a minimum of 8000 jobs. Table 4.7 suggests that Liverpool, Penrith and Gosford contain a concentration of jobs that is similar to many of the Major Centres. Chatswood and Campbelltown-Macarthur are much more substantial employment hubs than the remaining Major Centres.

Sydney's specialised centres contribute close to 10 per cent of the city's employment. This is a diverse group of centres, with some focused around transport facilities, some around business parks, and others based around health or education facilities.

Table 4.7 Employment in strategic centres, Sydney, 2006

Centre type ¹	Centre	Employed persons 2006	Proportion of employment (per cent)
Global Sydney	Central Sydney ²	300 067	17.3
	North Sydney	35 761	2.1
	Global Sydney total	335 828	19.3
Regional Cities	Parramatta	34 234	2.0
	Liverpool	13 597	0.8
	Penrith	11 704	0.6
	Gosford ³	9 734	0.6
	Regional cities total	69 269	4.0
Specialised centres	Macquarie Park	31 982	1.8
	St Leonards (includes Crows Nest)	34 447	2.0
	Olympic Park-Rhodes	11 696	0.7
	Port Botany and environs	12 907	0.7
	Sydney Airport and environs (includes Mascot) ³	28 199	1.6
	Randwick education and health	13 216	0.8
	Westmead	13 008	0.7
	Bankstown Airport-Milperra ³	9 382	0.5
	Norwest	10 305	0.6
	Specialised centres total	165 142	9.5
Major centres	Bankstown ³	7 625	0.4
	Blacktown	9 513	0.5
	Bondi Junction	8 796	0.5
	Brookvale-Dee Why ³	9 366	0.5
	Burwood	7 660	0.4
	Campbelltown-Macarthur	13 270	0.8
	Castle Hill	5 644	0.3
	Chatswood	17 901	1.0
	Hornsby	8 112	0.5
	Hurstville	7 880	0.5
	Kogarah ³	8 239	0.5
	Tuggerah-Wyong ³	9 416	0.5
	Major centres total	113 422	6.5
Planned major centres ³	Rouse Hill	653	0.0
	Green Square	7 740	0.4
	Leppington	121	0.0
	Planned major centres total	8 514	0.5
Potential major centres ³	Fairfield	3 491	0.2
	Mt Druitt	3 402	0.2
	Prairiewood	1 689	0.1
	Cabramatta	1 796	0.1
	Sutherland	4 113	0.2
	Potential major centres total	14 491	0.8
Existing centres total		683 661	39.4
Planned and potential major centres total		23 005	1.3
All centres total		706 666	40.7
Non-centred total		1 030 141	59.3
Total Sydney ⁴		1 736 807	100.0

Notes: Employment data sourced from TDC (2008b) except where otherwise noted.

1 See Table 2.3 for further information about each centre type.

2 Comprises the Sydney CBD, City East, Pyrmont-Ultimo, Redfern Centre and Sydney Education and Health precincts. Some parts of the City of Sydney LGA are excluded (e.g. Glebe, Elizabeth Bay, Green Square).

3 Defined by BITRE using 2006 destination zone boundaries and, where available, relevant information contained in the subregional plan.

4 Excludes those with no fixed place of work or unknown place of work.

Sources: TDC (2008b) and BITRE analysis of 2005 Metropolitan Strategy subregional plans, ABS 2006 *Census of Population and Housing* and 2006 destination zone boundaries.

Turning to the planned and potential major centres, all but Green Square (an urban renewal area a few kilometres to the south of the CBD) contained less than 5000 jobs in 2006. Rouse Hill and Leppington contained few jobs in 2006, but over time are expected to develop as the main retail and service hubs of the North West and South West Growth Centres, respectively. The potential major centres are established town centres in Sydney's Outer sector identified by *City of Cities* as having the potential to transform into a major centre by 2031.

Change, 2001 to 2006

Table 4.8 summarises BITRE's estimates of the change in employment for each of these strategic centres between 2001 and 2006. There was a 31 500 person increase in employment in centres between 2001 and 2006, representing 67 per cent of Sydney's job growth. Growth in centred employment (0.9 per cent per annum) outpaced growth in non-centred employment (0.3 per cent). While the existing centres recorded solid job growth, the planned strategic centres experienced an overall decline in employment.

Between 2001 and 2006, the centred employment share rose from 40.0 to 40.7 per cent. This recent trend is consistent with the targets from *City of Cities* and *Sydney 2036*, which aim for a modest increase in the proportion of employment in centres between 2006 and 2031/2036.

Specialised centres were a major source of job growth in Sydney between 2001 and 2006, accounting for 35 per cent of job growth and over half of job growth in centres. More than 16 000 jobs were added in Sydney's specialised centres, with the main contributors being Norwest (+6300 jobs), Macquarie Park (+5300) and Olympic Park-Rhodes (+5000). The expansion of suburban business parks has impacted office markets in other centres, which have struggled to compete with the larger sites and parking availability (Department of Planning 2005b). Several established commercial centres recorded significant job losses between 2001 and 2006, including North Sydney (–2000), St Leonards (–1700) and Chatswood (–1000). Thus, one of the major patterns to emerge over this period was a shift of office-based employment away from the long established inner north commercial centres, towards the more recently established business parks. The implications of this shift for car dependency and public transport use are discussed in Chapter 6.

Despite North Sydney's decline, Global Sydney nevertheless accounted for 18 per cent of Sydney's job growth between 2001 and 2006. The rate of job growth in Global Sydney (0.5 per cent per annum) was slightly below the Sydney-wide average of 0.6 per cent.

Table 4.8 Employment change in strategic centres, Sydney, 2001 to 2006

Centre type ¹	Centre	Change in employed persons	Proportion of Sydney employment		Average annual growth 2001–06 (per cent)	Share of employment growth
			2001	2006		
Global Sydney	Central Sydney ²	10 600	17.1	17.3	0.7	22
	North Sydney	–2 000	2.2	2.1	–1.1	–4
	Global Sydney total	8 600	19.4	19.3	0.5	18
Regional Cities	Parramatta	1 300	1.9	2.0	0.8	3
	Liverpool	0	0.8	0.8	0.0	0
	Penrith	–700	0.7	0.7	–1.2	–1
	Gosford ³	–900	0.6	0.6	–1.7	–2
	Regional cities total	–300	4.1	4.0	–0.1	–1
Specialised centres	Macquarie Park	5 300	1.6	1.8	3.7	11
	St Leonards (includes Crows Nest)	–1 700	2.1	2.0	–1.0	–4
	Olympic Park-Rhodes	5 000	0.4	0.7	11.9	11
	Port Botany & environs	1 000	0.7	0.7	1.7	2
	Sydney Airport and environs ³ (includes Mascot)	500	1.6	1.6	0.4	1
	Randwick education and health	1 000	0.7	0.8	1.6	2
	Westmead	–200	0.8	0.7	–0.3	0
	Bankstown Airport-Milperra ³	–900	0.6	0.5	–1.7	–2
	Norwest	6 300	0.2	0.6	21.1	13
	Specialised centres total	16 400	8.8	9.5	2.1	35
Major centres	Bankstown ³	–600	0.5	0.4	–1.6	–1
	Blacktown	1 200	0.5	0.5	2.7	3
	Bondi Junction ⁴	800	0.5	0.5	1.9	2
	Brookvale-Dee Why ³	1 200	0.5	0.5	2.8	3
	Burwood	–500	0.5	0.4	–1.2	–1
	Campbelltown-Macarthur	2 700	0.6	0.8	4.6	6
	Castle Hill	100	0.3	0.3	0.2	0
	Chatswood	–1 000	1.1	1.0	–1.0	–2
	Hornsby	700	0.4	0.5	2.0	2
	Hurstville	–700	0.5	0.5	–1.8	–2
	Kogarah ³	–100	0.5	0.5	–0.1	0
	Tuggerah-Wyong ³	2 500	0.4	0.5	6.4	5
	Major centres total	6 300	6.3	6.5	1.1	13
Planned major centres ³	Rouse Hill	200	0.0	0.0	7.5	0
	Green Square	–1 200	0.5	0.4	–2.8	–2
	Leppington	0	0.0	0.0	–0.9	0
	Planned major centres total	–1 000	0.6	0.5	–2.1	–2
Potential major centres ³	Fairfield	–500	0.2	0.2	–2.8	–1
	Mt Druitt	1 000	0.1	0.2	6.9	2
	Prairiewood	400	0.1	0.1	5.5	1
	Cabramatta	–100	0.1	0.1	–1.2	0
	Sutherland	700	0.2	0.2	3.9	2
	Potential major centres total	1 400	0.8	0.8	2.1	3
Existing centres total		31 000	38.6	39.4	0.9	66
Planned and potential major centres total		500	1.3	1.3	0.4	1
All centres total		31 500	40.0	40.7	0.9	67
Non-centred		15 800	60.0	59.3	0.3	33
Total Sydney ⁵		47 300	100.0	100.0	0.6	100

Notes: 1 See Table 2.3 for further information about each centre type.

2 Comprises the Sydney CBD, City East, Pyrmont-Ultimo, Redfern Centre and Sydney Education and Health precincts. Some parts of the City of Sydney LGA are excluded (e.g. Glebe, Elizabeth Bay, Green Square).

3 Defined by BITRE using 2006 destination zone boundaries and, where available, relevant information contained in the subregional plan. All other centre definitions based on TDC (2008b).

4 The 2001 destination zones are large relative to this centre's boundaries, meaning that destination zone data is unlikely to provide an accurate estimate of jobs in this centre in 2001.

5 Excludes those with no fixed place of work or unknown place of work.

Sources: Employment data sourced from NSW BTS online census tabulations for 2001 (table 19) and 2006 (table 1). Centre boundaries based on TDC (2008b), BITRE analysis of Metropolitan Strategy subregional plans and 2006 destination zone boundaries.

Regional cities are intended to be 'a focal point for transport and jobs' (NSW Government 2005, p.92). *City of Cities* targeted a 55 per cent increase in jobs in these regional cities between 2001 and 2031 (ibid., p.95), while *Sydney 2036* targets a gain of 58 000 jobs, representing a 63 per cent increase (NSW Government 2010a, p.135).

According to BITRE's estimates in Table 4.8, the regional cities experienced an overall decline in employment between 2001 and 2006. Although Parramatta recorded solid job growth, Liverpool recorded no change in employment and Penrith and Gosford experienced a decline in employment.

In the context of Western Sydney, O'Neill (2010, p.1) highlights some of the issues constraining job growth in the regional cities:

'there is scant investment in our regional cities and sub-regional centres. Our regional cities—Parramatta, Penrith and Liverpool—are under-equipped with decent transport and communications infrastructure. Their links to surrounding suburbs are stifled by choked and inaccessible motorways. Their public spaces and amenities need urgent upgrade. Their sites for premium office investments need urgent planning and nurturing.'

More generally, the Property Council of Australia (2002, p.45) points out that many of Sydney's centres present poorly and 'if the government really wants to encourage growth in centres... then it has to help make these centres more attractive places to be'. SGS (2004, p.11) also emphasises the importance of suburban infrastructure, pointing out that 'suburban centres can only remain competitive if investment in recreational, cultural, physical and environmental infrastructure is provided'.

The existing major centres did show solid growth overall, averaging 1.1 per cent growth per annum. Job growth was particularly strong in Campbelltown-Macarthur (+2700) and Tuggerah-Wyong (+2500), while Blacktown (+1200) and Brookvale-Dee Why (+1200) also experienced substantial growth.

As a group, the planned major centres experienced job losses between 2001 and 2006. This result was largely driven by job losses in the Green Square Urban Renewal Area, as former employment sites were redeveloped for residential purposes. The potential major centres experienced above-average growth in employment, with Mt Druitt adding around 1000 jobs.

Table 4.9 presents the *Sydney 2036* targets for centres. For these targets to be met, particularly strong job growth will need to be achieved in the three planned major centres. Above-average rates of job growth will also need to be achieved in the regional cities and specialised centres. The job growth target for Global Sydney is comparatively modest.

Table 4.9 **Comparison of actual and targeted employment in centres, Sydney**

Centre type	Targeted proportion of Sydney employment in 2036 (per cent)	Required average annual employment growth rate, 2006 to 2036 (per cent)
Global Sydney	18.1	0.8
Regional cities	5.3	1.6
Specialised centres	10.3	1.5
Existing major centres	7.0	1.2
Planned major centres	1.4	10.6
All centres*	42.0	1.3
Sydney total	100.0	1.0

Note: * Relates to existing and planned centres only. Excludes potential centres.

Sources: BITRE analysis of NSW Government 2010a, p.135.

Between 2001 and 2006, good progress was made against the objective of increasingly concentrating employment within Sydney’s centres. This progress can be attributed to the very strong job growth in business parks.³⁴ O’Neill (2010) points out that Norwest and Olympic Park are almost full, and while the Barangaroo office development in the Sydney CBD is underway, no new big business park developments have been identified for Western Sydney. As the existing business parks approach capacity, their future contributions to job growth will be much more modest. If Sydney is to continue to make progress against the objective of increasingly concentrating employment within centres, the job growth will need to come from elsewhere—whether from new business parks, other types of specialised centres, Global Sydney or the remaining strategic centres.

³⁴ Together, Macquarie Park, Olympic Park-Rhodes and Norwest increased their employment share by 0.9 percentage points from 2.2 per cent in 2001 to 3.1 per cent in 2006. Centred employment rose by 0.7 percentage points between 2001 and 2006.

Accommodate jobs in employment lands

Employment lands comprise industrial areas and technology and business parks, except those which belong to one of the strategic centres identified in Table 4.7.

In the inner and middle suburbs of Sydney, the last twenty years have seen substantial rezoning of employment land for residential or mixed use development, driven by urban consolidation and industrial restructuring, but with 'the absence of a strategic context' (NSW Government 2005, p.62). The Property Council of Australia (2004, p.11) has previously advised that 'Sydney has a systemic problem in the planning for and delivery of Industrial land' which 'is severely undermining the Government's employment objectives'. *City of Cities* aimed to respond to these concerns by:

- protecting employment lands around Sydney Airport and Port Botany and on the M5 and M7 motorway corridors from rezoning
- encouraging redevelopment of underutilised industrial areas
- developing greenfield employment lands to meet demand in new growth areas (ibid.).

More recently, the Employment Lands for Sydney Action Plan (Department of Planning 2007a) details the initiatives the NSW government is pursuing with respect to employment lands. The emphasis on greenfield land release and regeneration of brownfield sites remains, while the action plan also focuses on improved monitoring and coordination and streamlined zoning and development processes (ibid.).

While *City of Cities* aimed to locate over 100 000 new jobs, and 23 per cent of all employment in 2031, in employment lands (NSW Government 2005, pp.60–61), the targeted job share of employment lands was lowered in the *Metropolitan Plan for Sydney 2036*. The current target is that the 'share of jobs in employment lands will be maintained at about 20 per cent' through to 2036 (NSW Government 2010a, p.140).

The draft subregional plans identify the strategic employment land precincts within Sydney (NSW Government 2005, p.61). BITRE has defined all employment land precincts of more than five hectares³⁵ by aggregating 2006 destination zones, using information provided in the subregional plans. A fairly encompassing approach has been adopted, in that sometimes the selected destination zones include not just the employment land, but also neighbouring residential areas, retail areas and services.³⁶

2006 snapshot

Table 4.10 summarises BITRE's 2006 employment estimates for these employment land precincts by planning subregion. For 2006, it is estimated that 342 400 people were employed in Sydney's employment land precincts, representing about 20 per cent of Sydney's employment. Just over half were employed in just two adjoining subregions—West Central and the North West.

³⁵ Employment land precincts of less than five hectares typically formed only a small part of a destination zone. Employment land precincts of this size would typically employ only one or two hundred people, based on the average employment density of employment land precincts of 30 persons per hectare (NSW Government 2005).

³⁶ BITRE's employment land and strategic centre classifications are both based on 2006 destination zone boundaries. The classifications are mutually exclusive but not mutually exhaustive (i.e. many of Sydney's destination zones belong to neither an employment land precinct nor a strategic centre).

The West Central planning subregion not only has the largest number of jobs in employment land precincts, it also has the highest proportion of its jobs located in these precincts. Employment in the West Central subregion is oriented towards manufacturing, wholesale and transport industries that prefer to locate in industrial areas (see Chapter 5). In contrast, the high proportion of North East subregion employment located in employment lands reflects the prominence of business parks in this subregion, particularly in the Frenchs Forest, Austlink and Warriewood Valley precincts.

At the opposite end of the spectrum, only a very small fraction of jobs in the City of Sydney, East, Inner North and North subregions are located in employment land precincts.

Table 4.10 Employment in employment land precincts, Sydney, 2006

Planning subregion	Employment in employment lands precincts	Percent of Sydney total for employment land precincts	Total employment	Percent of subregion jobs on employment land
City of Sydney	16 164	5	357 772	5
East	5 317	2	110 197	5
Inner North	10 647	3	195 847	5
Inner West	15 328	4	82 062	19
South	40 101	12	161 088	25
North	3 925	1	68 808	6
North East	24 917	7	72 802	34
West Central	105 839	31	266 218	40
North West	68 951	20	219 643	31
South West	32 072	9	110 236	29
Central Coast	19 140	6	86 038	22
Total Sydney	342 401	100	1 736 807	20

Notes: Excludes employment land precincts of less than five hectares. Excludes employment land precincts which have been defined as part of one of the strategic centres listed in Table 4.7. This has a major impact on the East subregion, as nearly all employment land in this subregion has been classified to either the Airport and environs or Port Botany and environs specialised centres. It also has an important impact on the Inner North subregion estimates due to the exclusion of Macquarie Park and Artarmon (part of St Leonards strategic centre). The Central West and North West subregions are affected to a lesser extent.

Sources: BITRE estimates based on analysis of Metropolitan Strategy subregional plans, NSW BTS online census tabulations for 2006 (table 1) and 2006 destination zone boundaries.

Table 4.11 lists the top ten employment land precincts for 2006. All but one are located in Western Sydney and many form part of a larger cluster of employment land precincts. Several of these clusters of employment land are located close to Sydney's orbital motorway network.

Table 4.11 Employment land precincts ranked by employment, Sydney, 2006

Employment land precinct	Planning subregion	Employment	Description
Wetherill Park ¹	West Central	16 226	Located in Fairfield LGA, this 600 hectare precinct contains urban services, manufacturing, transport and logistics. Companies include Onesteel, CSR Gyprock, Visypak, Canon, Du Pont and Whirlpool.
Silverwater ²	West Central	12 200	This 150 hectare precinct in the Auburn LGA contains a mix of urban services, light manufacturing and warehousing. It also contains the Mulawa and Silverwater prisons.
Smithfield ¹	West Central	11 022	Located in Holroyd LGA and adjoined to the south by the smaller Smithfield 2 precinct, this 270 hectare site contains a mix of urban services, manufacturing, transport and logistics. Companies include Castrol, AMCOR Packaging, Berri and Uncle Tobys.
Blacktown North	North West	8 687	This 110 hectare area to the north of the Blacktown strategic centre includes business such as the Blacktown Distribution Centre and Coca Cola Amatil.
Seven Hills	North West	8 684	Also in the Blacktown LGA, this 225 hectare site has a mix of uses including manufacturing, business parks, a recycling centre, the Australia Post Parcel Centre and a Bunnings Warehouse.
Caringbah-Miranda and Taren Pt	South	8 093	This 120 hectare precinct in the Sutherland LGA contains utilities, urban services, bulky goods retailing and manufacturing.
Moorebank ³	South West	7 198	Located to the east of Liverpool regional city, this precinct covers about 200 hectares. It contains urban services, warehousing, manufacturing and retail.
Castle Hill	North West	6 925	Located in the Baulkham Hills LGA, this 135 hectare precinct mainly provides services for the surrounding area, with little manufacturing. It includes two homemaker centres and the council offices.
Ingleburn	South West	6 785	This 320 hectare precinct is located along the M5 in the Campbelltown LGA. It contains freight and logistics, urban support and manufacturing.
Rydalmere ²	West Central	6 436	In the Parramatta LGA, this 110 hectare precinct contains a mix of light manufacturing and urban services. It includes the Quantum Corporate Park.

Notes:

1. Forms part of a broader employment lands belt consisting of Pemulwuy, Wetherill Park, Smithfield, Smithfield 2, Yennora and Fairfield East.
2. Forms part of a broader cluster of employment lands that includes Rydalmere, Camelia/Rosehill, Silverwater and Clyde.
3. Forms part of a broader cluster of employment lands that includes the Chipping Norton, Sappho Rd, Priddle/Scrivener St and Shepherd St precincts.

Sources: BITRE analysis of Metropolitan Strategy subregional plans, NSW BTS online census tabulations for 2006 (table 1) and 2006 destination zone boundaries.

Change since 2001

Between 2001 and 2006, BITRE estimates that the number of jobs in employment land precincts rose by 13 900, representing almost 30 per cent of Sydney's employment growth. Thus, employment land precincts and strategic centres both had more rapid job growth (0.8 and 0.9 per cent per annum, respectively) than Sydney as a whole (0.6 per cent)

Table 4.12 summarises job growth and decline in employment land precincts by planning subregion. The great majority of the job growth occurred in the outer suburbs, particularly in the North West (+5100), South West (+5100) and Central Coast (+3200) subregions. Employment land precincts in the Inner North and the City of Sydney experienced significant job loss, probably reflecting the ongoing conversion of employment land to residential purposes in the inner suburbs.

Table 4.12 Change in employment in employment land precincts by planning subregion, Sydney, 2001 to 2006

Planning subregion	Change in number of jobs in employment land precincts	Proportion of Sydney's employment growth (per cent)	Average annual growth (per cent)
City of Sydney	-1 700	-3.7	-2.0
East	500	1.1	2.2
Inner North	-1 700	-3.5	-2.9
Inner West	1 000	2.1	1.4
South	100	0.2	0.0
North	200	0.4	0.9
North East	1 400	3.0	1.2
West Central	800	1.8	0.2
North West	5 100	10.7	1.5
South West	5 100	10.7	3.5
Central Coast	3 200	6.8	3.7
Total Sydney	13 900	29.5	0.8

Notes: Excludes employment land precincts of less than five hectares. Excludes employment land precincts which have been defined as part of one of the strategic centres listed in Table 4.7.

Sources: BITRE estimates based on analysis of Metropolitan Strategy subregional plans, 2006 destination zone boundaries and NSW BTS online census tabulations for 2001 (table 19) and 2006 (table 1).

Several employment land precincts experienced a job increase of more than 1 000 persons, namely:

- Prestons (+2100) and Smeatons Grange (+2000) in the South West
- Huntingwood (+1400) and Jamisontown (+1000) in the North West
- Silverwater (+1300) in West Central
- Flemington (+1200) in the Inner West
- Caringbah, Miranda, Taren Pt (+1100) in the South
- Frenchs Forest (+1100) in the North East
- Erina Industrial Estate (+1000) on the Central Coast.

The most substantial job losses were experienced by the employment land precincts of Alexandria-Rosebery (–1700) in the City of Sydney, Brookvale (–1000) in the North East and Winston Hills (–900) in the North West.

Between 2001 and 2006, the job share of employment land precincts rose from 19.4 to 19.7 per cent. The recent experience is therefore consistent with the *Sydney 2036* target that about 20 per cent of Sydney's jobs be located in employment land precincts in 2036.

More recent data shows that industrial land sales were most prevalent in Wetherill Park, St Mary's and Ingleburn during the 2005–06 to 2009–10 period (Productivity Commission 2011), all of which are located in Western Sydney.

Locate more jobs in Western Sydney

City of Cities and *Sydney 2036* both anticipate that close to half of the additional jobs created in Sydney to 2031 (2036) will be located in Western Sydney (NSW Government 2005, 2010a). More specifically, *Sydney 2036* targets an employment increase of 384 000 jobs, representing a rise in Western Sydney's employment share from 34 per cent in 2006 to 39 per cent in 2036 (NSW Government 2010a, p.133). Western Sydney comprises three planning subregions—West Central, North West and South West—which are often also referred as Greater Western Sydney.

The regional cities and specialised centres of Western Sydney are expected to accommodate a substantial proportion of the anticipated job growth. The strategies also place an emphasis on diversifying the job base by increasing the number of skilled jobs—changes in the diversity of the jobs base in Western Sydney between 2001 and 2006 will be examined in Chapter 5 on industry.

An initiative to achieve job growth is the Western Sydney Employment Hub (WSEH), a 2450 hectare area that spans four LGAs and is situated at the intersection of the M4 and M7 motorways. BITRE estimates that employment in the WSEH was about 10 000 in 2006³⁷, with businesses such as the Coles Myer and Coca Cola distribution centres having opened since then. Up to 36 000 jobs are being targeted for the WSEH by 2031 (Department of Planning 2005b).

Table 4.13 compares 2006 employment in Western Sydney to the 2036 projections from the 2010 Metropolitan Strategy. Job growth in Western Sydney is expected to slightly outpace job growth for Sydney as a whole, with the region's employment share rising from 34.5 to 38.7 per cent. The fastest rate of job growth rate is anticipated for the South West subregion, although the North West is expected to add slightly more jobs than the South West (145 000 and 141 000, respectively).

Between 2001 and 2006, Western Sydney added 26 200 jobs, which amounts to 56 per cent of Sydney's total job growth over the period—this compares favourably to the targeted 50 per cent share of new jobs from 2006 to 2036. Western Sydney experienced a higher employment growth rate than Sydney as a whole, resulting in a 0.6 percentage point rise in Western Sydney's share of Sydney's total employment. However, the rates of job growth in Sydney and Western Sydney both fell well short of the longer term growth targets. A substantial upturn in job growth will be required in the West Central and South West subregions to achieve these targets.

³⁷ Including Huntingwood, but excluding the adjoining Arndell Park, Wetherill Park and Minchinbury employment land precincts.

A study by the University of Western Sydney (Urban Research Centre 2008) argues that the (less ambitious) *City of Cities* employment targets for Western Sydney will be difficult to achieve, if economic conditions from 1983 to 2001 are a reasonable guide for the 2006 to 2031 period. Furthermore, job growth is likely to be largely part-time in nature (ibid., p.43). In particular, the *City of Cities* target to locate 99 000 additional jobs in the North West subregion between 2004 and 2031 is considered ambitious because 'no outlying subregion in the metropolitan area has experienced employment increases in the past as significant as forecast for the North West subregion to 2031' (ibid., p.118).

Table 4.13 Employment in Western Sydney, 2001 to 2036

Planning subregion	Average annual growth rate, 2001 to 2006 (per cent)	2006 employment ('000)	2036 targeted employment ('000)	Targeted average annual growth rate, 2006 to 2036 (per cent)
West Central	0.2	322	420	0.9
North West	1.6	266	411	1.5
South West	1.5	133	274	2.4
Western Sydney	0.9	721	1105	1.4
Total Sydney	0.6	2092	2852	1.0
Western Sydney as a per cent of Sydney total	na	34.5	38.7	na

Note: The employment figures provided for 2006 in the 2010 Metropolitan Strategy are considerably higher than employment estimates derived from the 2006 census. Na is not applicable.

Source: Average annual growth rate between 2001 and 2006 derived by BITRE from BTS online census tabulations for 2001 (table 19) and 2006 (table 1). 2006 and 2036 employment data are sourced from NSW Government 2010a, and used to derive targeted growth rate for 2006 to 2036.

City of Cities proposes locating the majority of the new Western Sydney jobs 'in strategic centres or employment lands, [which] will provide the basis for more sustainable, and targeted, infrastructure and transport planning' (NSW Government 2005, p.39). Between 2001 and 2006, Western Sydney's jobs did indeed become more centres based, with the centred employment share rising from 22 to 25 per cent. This rise was mainly due to the very strong job growth in Norwest and Olympic Park, as well as strong job growth in Campbelltown-Macarthur. The proportion of Western Sydney's jobs located in employment land precincts also increased strongly, rising from 31 per cent in 2001 to 35 per cent in 2006, while the proportion of jobs located in other locations fell.

Enable jobs growth in corridors

The concept of corridors refers to the areas along transport routes that have high concentrations of activity and link Sydney's centres. Of particular relevance to employment are the five nominated economic corridors—Airport to City, North Sydney to Macquarie Park, M5, Parramatta Road and the M7. Together the Airport to City and North Sydney to Macquarie Park corridors form the Global Economic Corridor, which contains about 32 per cent of Sydney's jobs (NSW Government 2005). The economic corridors are illustrated in Map 2.1.

A high-level objective of *City of Cities* was to 'protect and strengthen the primary role of economic corridors' (objective B5, *ibid.*, p.107). In particular, it targeted 150 000 new jobs, representing thirty per cent of all new jobs in Sydney, in the Global Economic Corridor (*ibid.*, p.46). The list of 'strategic directions, objectives and actions' for *Sydney 2036* does not specifically refer to economic corridors, nor does it contain any objectives that relate to locating employment or economic activity in corridors. However, the detail of *Sydney 2036* makes it clear there is an ongoing aim to protect prime commercial precincts in the Global Economic Corridor so there is capacity to attract global businesses and meet employment targets (NSW Government 2010a, p.45). In *Sydney 2036* the focus has shifted to centres within these economic corridors, rather than the corridor as a whole (*ibid.*, p.61).

Table 4.14 details BITRE's estimates of employment in Sydney's economic corridors. The five economic corridors accounted for 45 per cent of Sydney's employment in 2006, with most of that attributable to the Global Economic Corridor. Note that strategic centres, employment lands and other locations can all form part of a corridor. The employment share of the economic corridors declined from 45.4 per cent in 2001 to 45.0 per cent in 2006, due to slow job growth in the Global Economic Corridor (0.2 per cent per annum).

While *City of Cities* aimed to create 150 000 new jobs in the Global Economic Corridor by 2031 (NSW Government 2005, p.58), only 6 700 jobs were added between 2001 and 2006, with the northern part of the corridor experiencing a net job loss (–1 600). The M7 experienced more rapid job growth (2.4 per cent per annum) than the other corridors. The Parramatta to City corridor experienced job growth of 0.9 per cent per annum and added 6300 additional jobs.

Table 4.14 Employment in economic corridors, Sydney, 2001 and 2006

Economic corridor	Proportion of Sydney employment (per cent)	
	2001	2006
Global Economic Corridor: Airport to City ¹	25.1	24.9
Global Economic Corridor: North Sydney to Macquarie Park	8.6	8.3
Global Economic Corridor: Total	33.6	33.1
Parramatta to City ²	7.8	8.0
M5 (including Milperra and Moorebank employment lands)	2.7	2.6
M7 (including Western Sydney Employment Hub and Wetherill Park)	2.1	2.4
All economic corridors ³	45.4	45.0

Notes:

1 Includes Port Botany and environs strategic centre

2 Excludes Parramatta regional city and the Sydney CBD

3 Destination zones that belong to more than one corridor are counted only once.

Source: BITRE analysis of NSW Department of Planning 2005a (particularly Figure B8), Metropolitan Strategy subregional plans, destination zone boundaries and BTS online census tabulations for 2001 (table 19) and 2006 (table 1),

Better align jobs with where people live³⁸

City of Cities 'seeks to more closely integrate employment and population growth in subregions, particularly to ensure that job growth matches population growth in rapidly growing subregions' (NSW Government 2005, p.59). The principle of better aligning jobs with where people live is also an important feature of *Sydney 2036*, which aims 'to provide jobs closer to home by setting new employment capacity targets for each subregion' (NSW Government 2010a, p.132). In particular, *Sydney 2036* aspires to achieve substantial job growth and improved employment self-sufficiency in the South West subregion (ibid.).

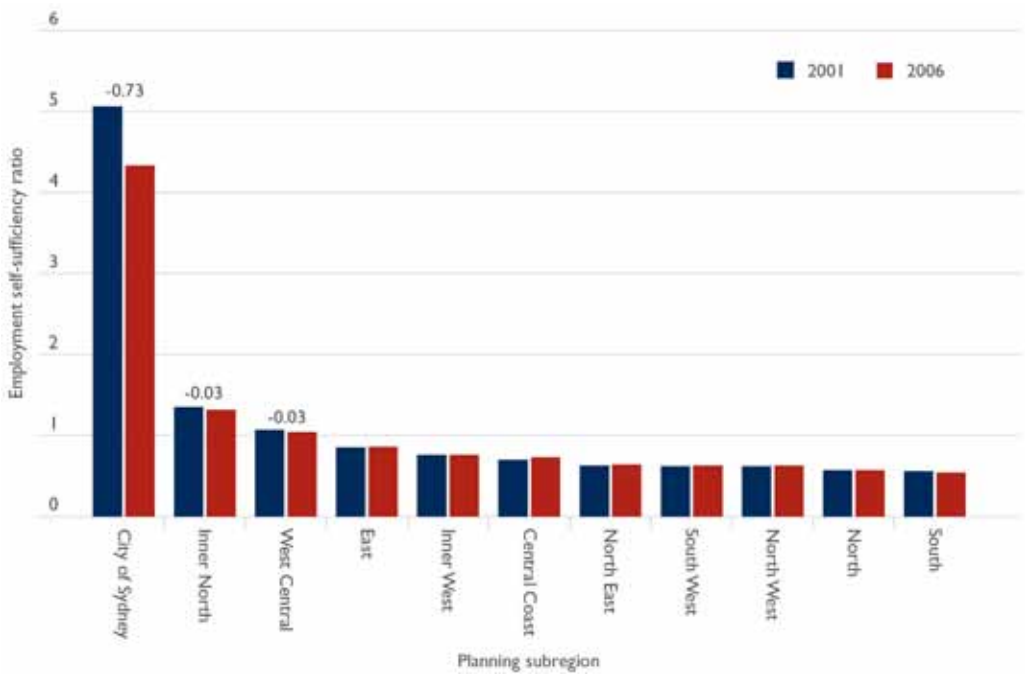
Table 4.1 revealed that some of Sydney's planning subregions contain relatively few jobs compared to the number of employed residents who live in the area (i.e. the self-sufficiency ratio is well below one). A better alignment of jobs with where people live should result in subregional self-sufficiency ratios that are closer to unity.

Figure 4.10 presents the employment self-sufficiency ratios for each of the subregions in 2001 and 2006. While rapid residential growth has resulted in the City of Sydney subregion having a much lower self-sufficiency ratio in 2006 than 2001, it continues to have over four times as many jobs as employed residents. The Inner North and West Central subregions contain more jobs than employed residents, but the self-sufficiency ratio declined by 3 jobs per 100 employed residents in both subregions between 2001 and 2006. Thus, there was a consistent pattern of decline in self-sufficiency amongst those subregions which contain more jobs than employed residents.

The Central Coast experienced an increase of 2 jobs per 100 employed residents from 2001 to 2006. All of the remaining subregions recorded a change of less than 2 jobs per 100 employed residents in the self-sufficiency ratio between 2001 and 2006. The North and South subregions are the two least self-sufficient subregions, and the self-sufficiency ratio declined marginally (i.e. by less than 0.02) for these two subregions between 2001 and 2006. However, in the subregions that contain most of Sydney's greenfield residential development—North West and South West—there was enough job growth to marginally boost the self-sufficiency ratio (by about one extra job per 100 employed residents).

³⁸ Note that the related planning objective from Table 2.4 that *people work closer to home* is assessed separately in Chapter 7 (commuting flows), as it requires consideration of the journeys that individuals take between their place of residence and place of work. This section instead considers the alignment between aggregate levels of employment and population in different parts of Sydney.

Figure 4.10 Employment self-sufficiency ratios for Sydney's planning subregions, 2001 and 2006



Note: The self-sufficiency ratio is the ratio of people who work in the region to the number of employed people who live in the region. The ratio for Sydney SD is less than one due to non-response and no fixed place of work responses. Using 2001 and 2006 employed residents data from the ABS Time Series Profile ensured 2001 data was on 2006 boundaries, which was necessary for assessing change. However, the place of enumeration basis of the Time Series Profile tends to understate the self-sufficiency of the City of Sydney (compared to place of usual residence based self-sufficiency estimates for 2006 in Table 4.1).

Source: BITRE analysis of BTS JTW tables 2001 (table 19) and 2006 (table 1) and ABS Census of Population and Housing 2006 Time Series Profile for employed residents data.

Between 2001 and 2006 there was relatively weak alignment between the average annual rates of job growth and population growth for subregions—the correlation coefficient was statistically insignificant at 0.03. However, the subregions that experienced the largest increase in the number of residents (City of Sydney and North West) also experienced some of the most substantial increases in the number of employed persons. While over one-third of Sydney's job growth from 2001 to 2006 was concentrated in the North West subregion, which is the principal subregion for greenfield residential development, this job growth only resulted in a very modest boost to its self-sufficiency ratio.

Overall, from 2001 to 2006, there was limited change in the degree to which jobs are aligned with where people live across Sydney's subregions. The exception was the City of Sydney subregion, where strong residential growth reduced the excess of available jobs over employed residents.

In summary

This chapter has provided a detailed description of the spatial distribution of employment throughout Sydney and changes in that distribution between 2001 and 2006. Between 2001 and 2006, the Inner sector experienced a net loss of jobs, and three quarters of Sydney's job growth occurred in the outer suburbs. The principal locations of job growth were the CBD, Ryde (home to Macquarie Park specialised centre), Sydney West and Baulkham Hills Central (home to the Norwest specialised centre).

Average annual job growth in Sydney has been well below the national rate of job growth over the last decade. The modest recent pace of change is reflected in the overall stability of the spatial structure of employment within Sydney. The key exceptions were the rapid job growth in specialised centres (particularly business parks) and outer suburban industrial areas—these two categories were also the standout job growth locations in the more rapidly growing cities of Perth (BITRE 2010) and Melbourne (BITRE 2011).

This chapter considered the strategies in place for managing spatial aspects of employment growth in Sydney and examined recent changes related to these strategic planning objectives. The available data suggests that, between 2001 and 2006, employment became increasingly concentrated in Sydney's strategic centres, in its employment land precincts, and in Western Sydney.

CHAPTER 5

Industry

Key points

- Sydney's major employing industries in 2006 were Property and business services (14 per cent), Retail trade (14 per cent), Manufacturing (11 per cent) and Health and community services (11 per cent).
- The Property and business services industry is the major employer in the Inner sector, while Retail is the major employer in the Middle and Outer sectors.
- Employment in Retail trade, Education, and Personal and other services, is well dispersed across SLAs and aligned to the population distribution.
- Sydney's Statistical Local Areas (SLAs) each have their own distinctive mix of industries. Retail was the largest employing industry in 27 of the 64 SLAs (e.g. Baulkham Hills Central, Hawkesbury), compared to 14 SLAs for Manufacturing (e.g. Holroyd, Fairfield West), 10 SLAs for Health and community services (e.g. Randwick, Gosford West) and 9 SLAs for Property and business services (e.g. Ryde, Woollahra).
- Between 2001 and 2011 (using the ANZSIC 2006 classification), the Health care and social assistance industry contributed 26 per cent of new jobs and the Professional, scientific and technical services industry contributed 22 per cent.
- From 2001 to 2006, the main contributors to Sydney's job growth were Health and community services (gain of 27 200), Government administration and defence (17 100) and Education (15 900). Significant job losses were evident for Manufacturing (–19 700 jobs).
- The industry drivers of job growth vary across Sydney. Government administration and defence was the main contributor to job growth in the Inner sector from 2001 to 2006, while Health and community services was the main contributor for the Middle and Outer sectors. The four top job growth SLAs had different industry drivers—for Sydney Inner the Finance and insurance industry was the main contributor to job growth, for Ryde it was the Wholesale trade, for Sydney West it was Education, and for Baulkham Hills Central the Retail trade industry made the largest contribution.
- The main industry contributors to employment growth in strategic centres were the Health and community services and Government administration and defence industries. Retail and commercial jobs were increasingly being located in strategic centres, rather than in out-of-centre locations.

- There was a significant increase in the skills base of Western Sydney, with Managerial and professional occupations accounting for 25 per cent of jobs in 2001 and 31 per cent in 2006. The industry mix of Western Sydney jobs became slightly more diversified over this period.

Background

This chapter considers the location of different industries within Sydney and how that has changed since 2001. The spatial analysis is based on employment data for different industries from the ABS *Census of Population and Housing* for 2001 and 2006. Two versions of census data are used—ABS working population profile is used to profile industry structure in 2006, while BTS journey to work tables are used to assess industry change from 2001 to 2006. The ABS Labour Force Survey is also an important source, providing aggregate information on the changes that have occurred in industry employment in the Sydney Statistical Division (SD) between 2001 and 2011.

Chapter 4 identified the principal locations of job growth in Sydney including the CBD, Sydney West, Ryde and Baulkham Hills Central (the latter two of which include the Macquarie Park and Norwest specialised centres, respectively). The main role of Chapter 5 is to build a more complete picture of the spatial distribution of employment and employment change, by examining the location of different industries within Sydney, and identifying the main industries which have been driving job growth in different locations.

The industry structure of city or a region has a close relationship with its economic performance. Regions which specialise in industries for which demand is growing nationally or internationally can be expected to do better than the ones which specialise in industries where demand is stable or declining (Stilwell 1992).

By the early 1980s federal and state governments recognised that restructuring of the economy was necessary to regain competitiveness and to become more productive (Roberts and Enright 2004). A number of initiatives were taken during the late 1980s and early 1990s to reform the economy and encourage greater innovation. This resulted in changes to the spatial distribution of industry and the geography of employment, which included restructuring of the manufacturing sector and increasing the development of business services, especially financial services (O'Neill and McGuirk 2002). By the mid 1990s, most of the old industry structure had been replaced by more globally integrated business networks, with many operated by multinational corporations (Roberts and Enright 2004).

Distinctive patterns of industries are present in the Greater Metropolitan Area of Sydney. Sydney is the nation's leading centre in finance, information technology, biotechnology, and producer service industries (Roberts and Enright 2004). The information services and technology industries have been concentrated in the CBD and the northern suburbs/Ryde corridor; transportation and logistics in the Sydney airport corridor; and biomedical in the mid-west (ibid.). Research to map the metropolitan region's industry clusters shows the west and South West developing as a significant technology based cluster for component manufacturing (Roberts and Murray 2002).

Employment by industry: 2006 snapshot

This section investigates the spatial distribution of industries within the Sydney SD in 2006 using census data on employment by industry. The data is analysed using the ANZSIC 1993 classification at the one digit level, which involves 17 different industries.³⁹ The analysis is undertaken on a place of work basis.

For Sydney, the largest employing industries were Property and business services (14.2 per cent), Retail trade (13.9 per cent), Manufacturing (11.2 per cent), and Health and community services (10.7 per cent). Fagan and Dowling (2005) argue that the global city narrative of *City of Cities* underplays the importance of manufacturing and local services (including health, retailing and education) as generators of employment.

Sectors and planning subregions

Table 5.1 shows the major employing industry for each planning subregion, as well as its main industry of specialisation. Property and business services is the major employing industry in the City of Sydney and Inner North. Retail trade is the major employing industry for the South, North, North East, Inner West, North West, South West and Central Coast subregions. The West Central subregion is the only subregion which has Manufacturing as its main employing industry, while the East subregion was the only subregion in which Transport and storage was the top employing industry.

The major employing industry in the Inner sector was Property and business services, while in both the Middle and the Outer sectors it was Retail trade. In the rest of the Greater Metropolitan Area—Illawarra and Lower Hunter—the major employing industry was also Retail trade, which was consistent with the Retail industry as the largest employing industry in the Australian economy. Retail has a workforce which is skewed towards younger workers, with 57 per cent of the workforce aged less than 35 years in recent years (Department of Education 2008). The flexible working hours and lower skills requirement enable younger workers to work part-time whilst pursuing other interests such as studying (ibid.).

The top specialisation for each planning subregion was identified using location quotients⁴⁰. The City of Sydney was most specialised in Finance and insurance, which was also the second largest employing industry in the subregion (see Table 5.1).

³⁹ The analysis of 2001 to 2011 change presented later in the chapter using *Labour Force Survey* data is based on the 2006 ANZSIC industry classification, as is the material from TDC (2008b) on the industry mix of strategic centres in 2006. Throughout this chapter, the official ANZSIC industry names are denoted using an initial capital (e.g. Property and business services or Accommodation, cafes and restaurants).

⁴⁰ The Location Quotient is a measure of the concentration of industry in a region compared to the national average.

Table 5.1 Main employing industries and specialisations by planning subregion, Sydney, 2006

	Main employing industry	Employment share (per cent)	Main specialisation
Planning subregion			
City of Sydney	Property and business services	22.8	Finance and insurance
East	Transport and storage	19.4	Transport and storage
Inner North	Property and business services	23.7	Communication services
Inner West	Retail trade	16.2	Communication services
South	Retail trade	18.3	Wholesale trade
North	Retail trade	16.8	Education
North East	Retail trade	18.3	Wholesale trade
West Central	Manufacturing	21.4	Wholesale trade
North West	Retail trade	18.9	Wholesale trade
South West	Retail trade	17.7	Manufacturing
Central Coast	Retail trade	21.0	Retail trade
Sector			
Inner sector	Property and business services	21.0	Finance and insurance
Middle sector	Retail trade	13.6	Communication services
Outer sector	Retail trade	18.8	Wholesale trade

Note: The main specialisation is the industry with the highest location quotient (which measures the concentration of industry in a region compared to the national average). The top specialisation industry may employ relatively few people in the subregion.

Source: BITRE analysis of ABS *Census of Population and Housing* 2006.

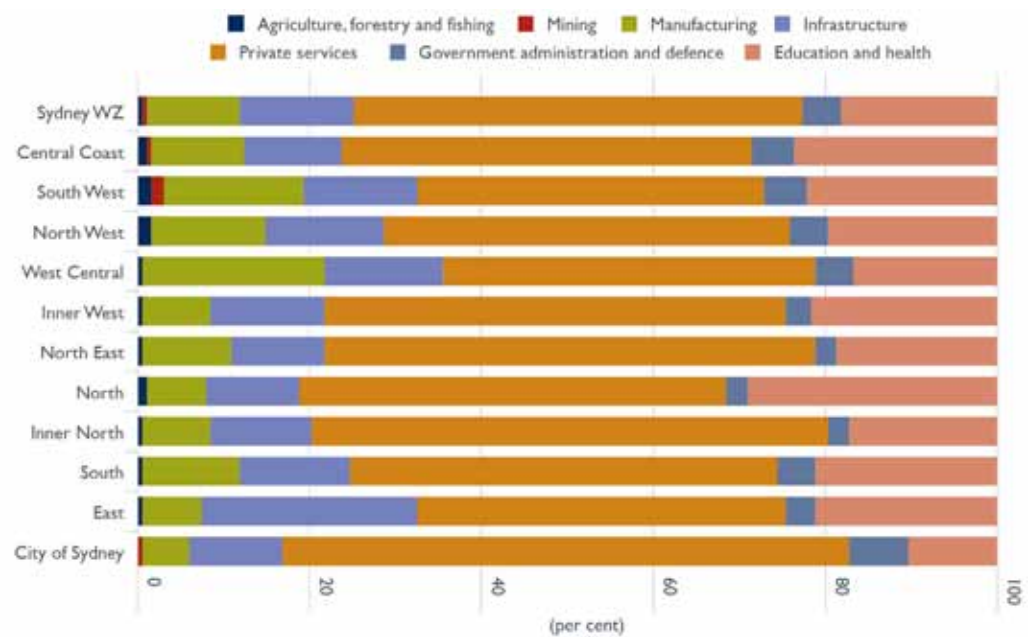
Four planning subregions—South, North East, West Central and North West—had Wholesale trade as the top specialisation. Wholesale trade was also the main specialisation for the Outer sector.

The Middle sector's main specialisation was Communication services with four SLAs—Burwood, Strathfield, Parramatta South and Willoughby—driving the result. The Inner sector's top specialisation was Finance and insurance, and the Sydney Inner SLA was the main location for this industry.

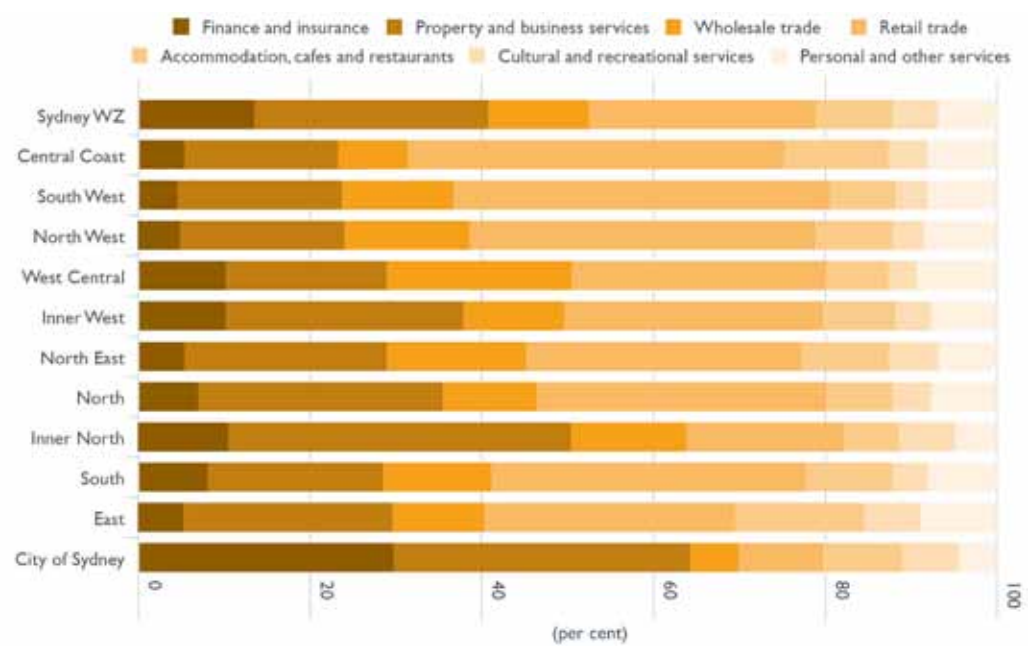
Figure 5.1 (a) and (b) compare the industry mix of employment across the different subregions. For presentation purposes, the 17 industries have been summarised into 7 aggregate industries. Private services is defined as consisting of Property and business services; Finance and insurance; Wholesale trade; Retail trade; Accommodation, cafes and restaurants; Cultural and recreational services; and Personal and other services. The Infrastructure sector consists of Construction; Communication services; Transport and storage; and Electricity, gas and water (BITRE 2009a). A key feature of an advanced or developed economy is a high share of the workforce employed in the production and delivery of services. In 2006, Property and business services and Finance and insurance together contributed 21 per cent of Sydney's employment. Other private services were also significant employing industries, accounting for 31 per cent of total employment, so that more than half (52 per cent) of Sydney's employment was in the Private services sector.

Figure 5.1 Employment by industry for planning subregions of Sydney, 2006

a) All employment



b) Private services employment



Note: Private services is defined as consisting of Property and business services, Finance and insurance, Wholesale trade, Retail trade, Accommodation, cafes and restaurants, Cultural and recreational services, and Personal and other services. The Infrastructure sector is defined as consisting of Construction, Communication services, Transport and storage, Electricity, gas and water.

Source: BITRE analysis of ABS Census of Population and Housing 2006.

Figures 5.1 (a) and (b) show that:

- Private services account for the largest share of employment in all subregions, ranging from 40 per cent in the South West to 66 per cent in the City of Sydney. Within Private services, Retail trade is relatively important in most subregions. However, for the City of Sydney and Inner North subregions, Property and business services had a greater employment share than the Retail trade.
- Manufacturing accounts for a significant proportion of employment in West Central and South West, but is relatively unimportant to the inner city.
- Infrastructure accounts for 10 to 14 per cent of employment for each planning subregion, except for the East subregion where 25 per cent of employment is in Infrastructure industries, due to the airport and port facilities being located in this subregion.
- Government administration and defence employment is relatively high in the City of Sydney (7 per cent) compared to the other subregions.
- Education and health contributes just 10 per cent of employment in the City of Sydney, compared to 29 per cent in the North. In the remaining subregions, it is an important contributor, accounting for between 17 and 24 per cent of employment.

Within the Sydney SD, the industries which were most centralised in the Inner sector were Finance and insurance (67 per cent), Property and business services (51 per cent) and Cultural and recreational services (50 per cent). The City of Sydney subregion accounted for 58 per cent of all of Sydney's Finance and insurance employment, and one-third of Sydney's employment in the Property and business services and Government administration and defence industries.

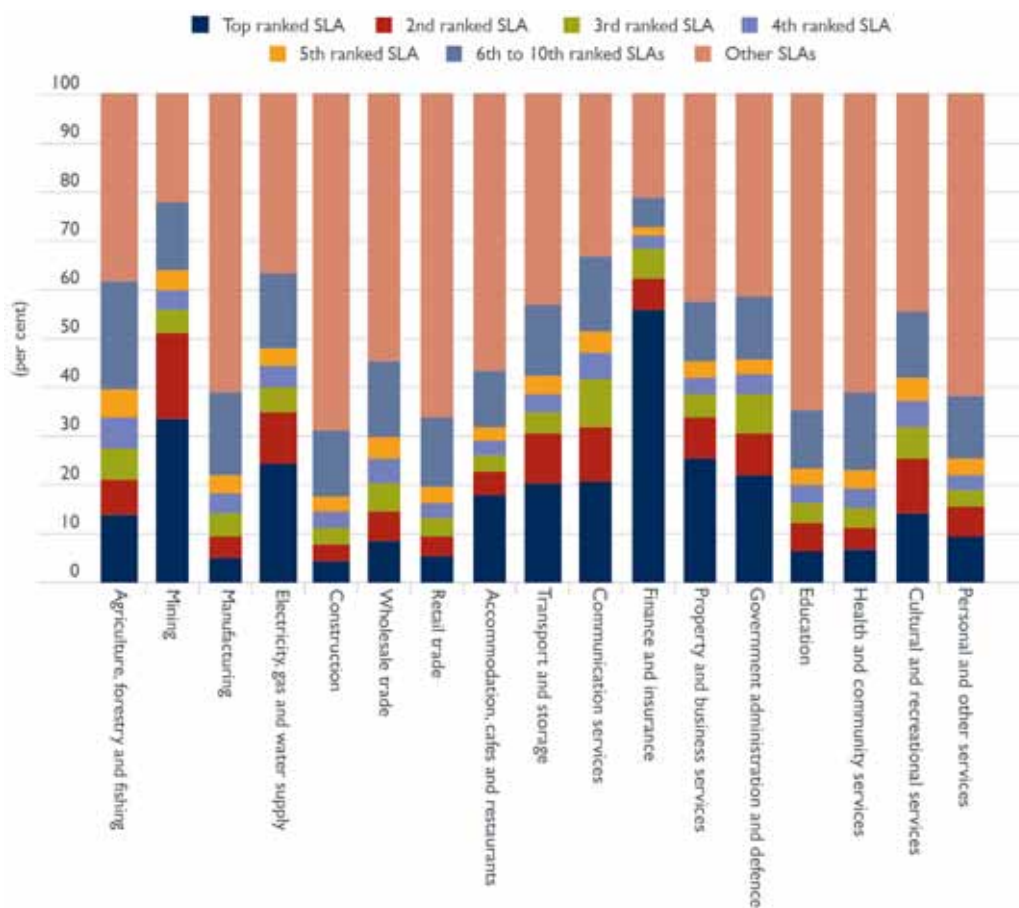
The industries which were most decentralised in that they had the highest proportion of employment in the Outer sector were Agriculture, forestry and fishing (83 per cent), Mining (67 per cent) and Retail trade (51 per cent).

Statistical local areas

While some industries are widely dispersed across the whole city, for other industries employment is more spatially concentrated. In terms of location preferences there are three different types of industries:

- High order services (e.g. Finance, Government, Business services) favour central locations.
- Other services (e.g. Retail, Education, Personal services) are more dispersed and tend to follow the distribution of the population.
- Some industries (e.g. Manufacturing, Transport, Wholesale trade) locate in places that meet their specific infrastructure and land use requirements (Western Australian Planning Commission 2003).

Figure 5.2 illustrates the extent to which employment in each industry is concentrated in a relatively small number of SLAs. Finance and insurance was the most heavily concentrated industry with over half of the industry's total employment located in the Sydney Inner SLA. Other spatially concentrated industries, with more than 63 per cent of employment in the top ten SLAs include Electricity, gas and water; Communication services and Mining. Industries in which employment was much more evenly distributed across SLAs include Education, Construction, Retail trade and Personal and other services.

Figure 5.2 Spatial concentration of each industry's employment within Sydney, 2006

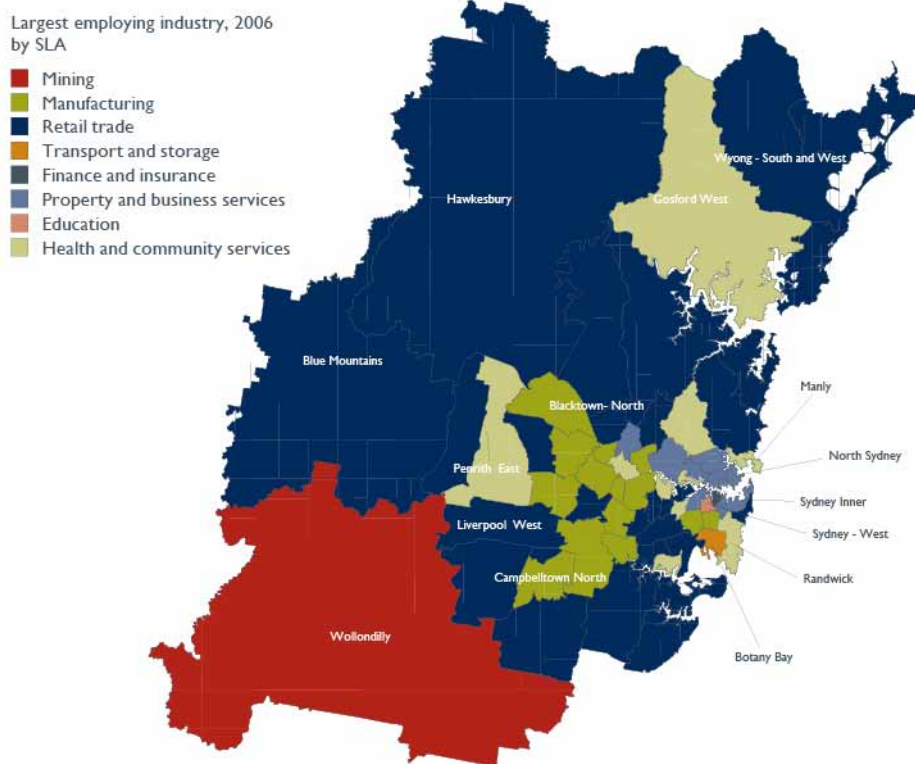
Source: BITRE analysis of ABS *Census of Population and Housing 2006*.

There is considerable variation in the major employing industries at the SLA scale. Map 5.1 shows the largest employing industry for each SLA in 2006. Eight industries feature as the largest employer in at least one SLA:

- The Retail trade industry was most dominant being the largest employer in 27 of the 64 SLAs.
- Finance and insurance was the largest employing industry in Sydney Inner.
- Manufacturing was the largest industry in 14 SLAs. Many of the SLAs in which Manufacturing is the largest employer are clustered together in Western Sydney, including Bankstown North West and South; Parramatta North East, North West and South; Fairfield West; Liverpool East; Campbelltown North; Holroyd; Auburn; and Blacktown North and South East. In the inner city, Manufacturing is the dominant employer in the Marrickville and Sydney South SLAs.
- Health and community services was the largest industry in ten SLAs, which were distributed across the Inner sector (e.g. Randwick, Ashfield), Middle sector (e.g. Concord, Parramatta Inner, Manly) and Outer sector (e.g. Penrith East, Gosford West).

- Property and business services was the main employer in nine SLAs, six in the Inner sector (Sydney East, Woollahra, Lane Cove, Mosman, North Sydney, Leichhardt), two in the Middle sector (Ryde and Willoughby), and one in the Outer sector (Baulkham Hills South).
- Education was the major source of employment in the Sydney West SLA, home of The University of Sydney and the University of Technology, Sydney.
- The Botany Bay SLA contains the port and airport facilities, with employment concentrated in the Transport and storage industry.
- The Outer sector SLA of Wollondilly was the only place where the Mining industry was the major employer.

Map 5.1 Largest employing industry in each Statistical Local Area, Sydney, 2006



Source: BITRE analysis of ABS *Census of Population and Housing* 2006.

Table 5.2 lists the main employing industry and the top industry specialisation for the Sydney SLAs which contain the largest number of workers. There were a number of SLAs where the top industry specialisation was also the largest source of employment. Transport and storage was both the main employing and the top specialisation industry in Botany Bay (46 per cent of employment). Botany Bay was extremely specialised and had the lowest industry diversity index of all Sydney SLAs. The Health and community services industry was both the main employing and top specialisation industry for Ashfield (19 per cent of employment). Finance and insurance was both the main employing and top specialisation industry for Sydney Inner (29 per cent of employment). The Finance and insurance industry was also the top specialisation for Parramatta Inner.

Table 5.2 Main employing industries and specialisations by place of work, selected Statistical Local Areas, Sydney, 2006

Place of work SLA	People working in SLA	Main employing industry	Main industry's employment share (per cent)	Top specialisation
Sydney Inner	231 562	Finance and insurance	29	Finance and insurance
Parramatta Inner	65 901	Health and community services	19	Finance and insurance
North Sydney	60 047	Property and business services	36	Communication services
Ryde	58 314	Property and business services	19	Wholesale trade
Willoughby	51 426	Property and business services	17	Communication services
Warringah	45 545	Retail trade	20	Wholesale trade
Blacktown South East	43 435	Manufacturing	20	Electricity, gas and water supply
Sydney East	43 099	Property and business services	18	Cultural and recreational services
Sydney West	41 614	Education	20	Cultural and recreational services
Sydney South	41 497	Manufacturing	18	Wholesale trade
Auburn	41 031	Manufacturing	21	Wholesale trade
Botany Bay	39 796	Transport and storage	46	Transport and storage
Liverpool East	38 432	Manufacturing	18	Manufacturing
Randwick	35 643	Health and community services	23	Education
Gosford West	34 171	Health and community services	21	Health and community services
Baulkham Hills Central	33 192	Retail trade	28	Wholesale trade
Sutherland Shire East	32 684	Retail trade	25	Retail trade
Holroyd	31 585	Manufacturing	31	Manufacturing

Note: The main specialisation is the industry with the highest location quotient (which measures the concentration of industry in a region compared to the national average). The top specialisation industry may employ relatively few people in the SLA.

Source: BITRE analysis of ABS *Census of Population and Housing* 2006.

There were several industries that did not feature as the top employing industry for any SLA, but nevertheless featured as the top industry specialisation for several SLAs:

- Cultural and recreational services (e.g. Sydney East, Sydney West).
- Communication services (e.g. North Sydney, Willoughby)
- Wholesale trade (e.g. Auburn, Baulkham Hill Central, Ryde)
- Electricity, gas and water supply (e.g. Blacktown South East).

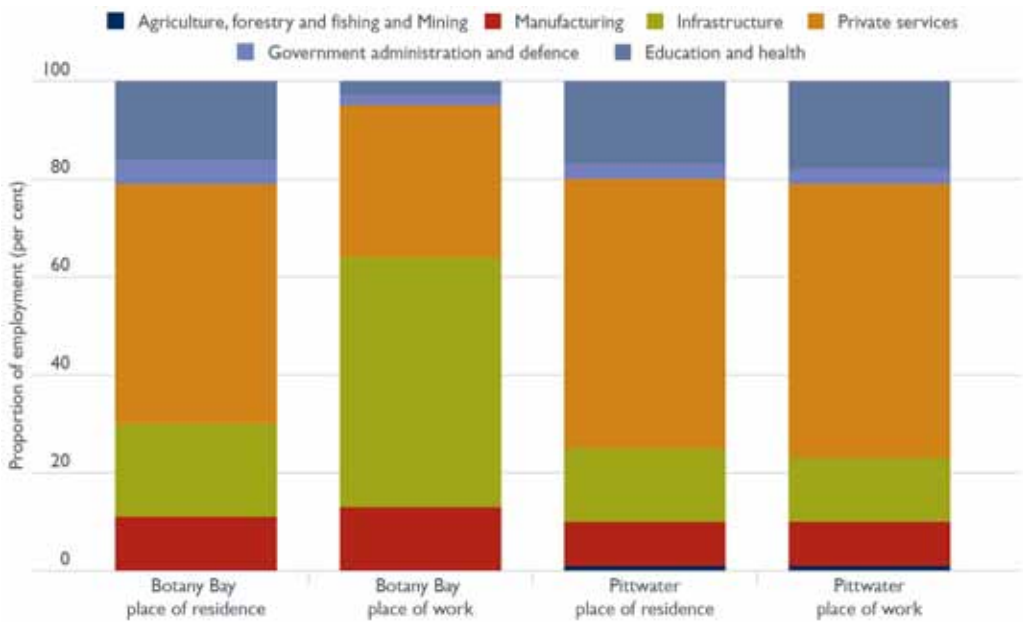
A message emerging from Table 5.2 is that the industry base of Sydney's employment hubs is rather variable. Sydney's suburban SLAs tend to have their own distinctive mix of industries. Even though there is considerable diversity in the industry mix of jobs available in different parts of the city, the Retail trade industry plays an important role as an employer in the great majority of SLAs—it was the most significant employing industry in 42 per cent of SLAs and one of the three top employing industries in 80 per cent of SLAs.

In some parts of Sydney, there is a mismatch between the local jobs available and the industries in which local residents are employed. For the purpose of examining a mismatch, another

employment dataset by place of usual residence was used. By contrasting the place of work data and place of usual residence data, we can infer the mismatch of local employment in various industries. The SLAs of Botany Bay, Kogarah and Sydney South have the most pronounced difference between the industries in which jobs are available within the SLA and the industries in which employed residents choose to work. Other SLAs in the Sydney SD—such as Pittwater, Hurstville and Wyong South West—have a much closer alignment.

Figure 5.3 illustrates the different degrees of mismatch in the Botany Bay and Pittwater SLAs. The figure compares the shares of employment in various industries between employed persons who reside in the SLA and the jobs available locally. The figure shows a high degree of industry alignment between the jobs available in the Pittwater SLA and the industries in which the local residents are employed. Botany Bay has considerable industry mismatch, with around half of all local jobs being in the Infrastructure sector (particularly in transport), while less than 20 per cent of employed people who reside in the SLA are employed in the Infrastructure sector. The employed residents of Botany Bay are more likely to work in the Private services sector than in the Infrastructure sector.

Figure 5.3 Industry mismatch in Pittwater and Botany Bay Statistical Local Areas, 2006



Note: Private services is defined as consisting of Property and business services, Finance and insurance, Wholesale trade, Retail trade, Accommodation, cafes and restaurants, Cultural and recreational services, and Personal and other services. The Infrastructure sector is defined as consisting of Construction, Communication services, Transport and storage, Electricity, gas and water.

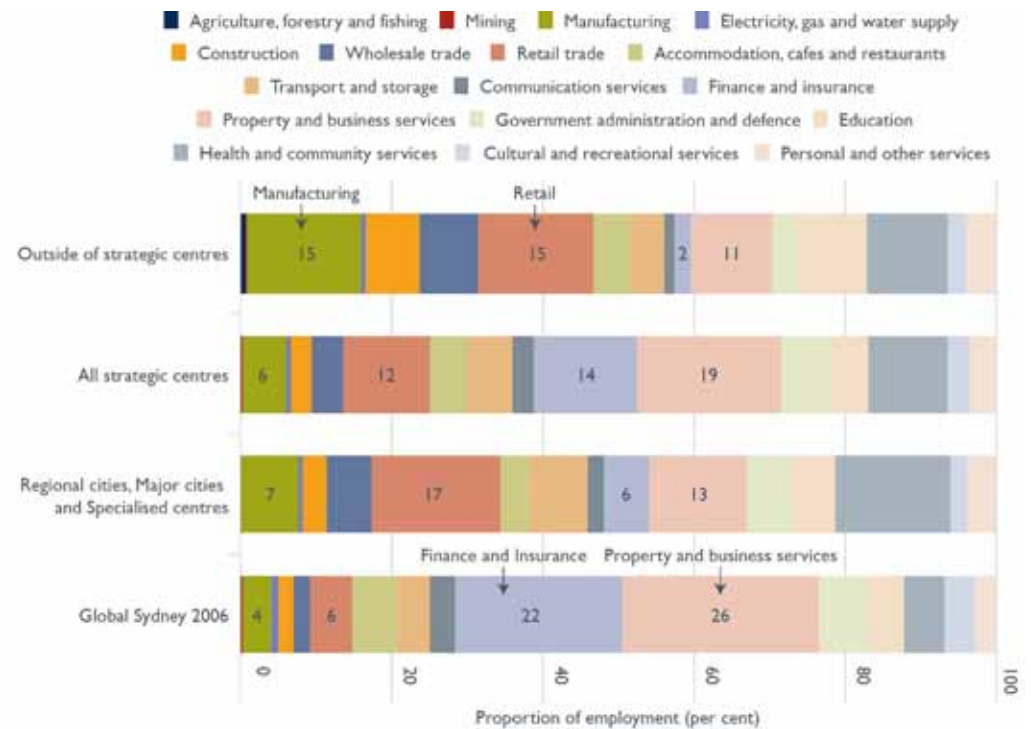
Source: BITRE analysis of ABS *Census of Population and Housing* 2006.

The spatial concentration of the different industries has implications for commuting, particularly where workers have specialised skills which closely tie them to specific industries. Employees of the Finance and insurance industry have a very high probability of commuting to Sydney Inner for work. In contrast, jobs for teachers and construction workers are widely distributed throughout the city, so we would expect such workers to be more likely to have a place of work relatively close to their place of residence.

Strategic centres

Figure 5.4 summarises how the industry structure of employment differs between strategic centres and other parts of Sydney as of 2006. A key difference is that the Property and business services and Finance and insurance industries account for 33 per cent of employment in strategic centres compared to just 13 per cent of employment in other parts of Sydney. Much of this difference is attributable to Global Sydney, rather than the smaller strategic centres.

Figure 5.4 Employment by industry in Sydney’s strategic centres, 2006



Notes: The data in this chart have been concorded by BITRE to the 1993 ANZSIC industry classification from the original 2006 ANZSIC classification, for which data was available at the 4 digit scale.

Global Sydney consists of Central Sydney and North Sydney. Further details of centres classification available from Tables 2.3 and 4.7.

Source: BITRE analysis of BTS JTW table 5, 2006.

In contrast, the Manufacturing industry is underrepresented in strategic centres where it accounts for just 6 per cent of employment, compared to its 15 per cent share of non-centred

employment. The Construction, Wholesale trade and Education industries are also somewhat underrepresented in strategic centres.

The Retail trade industry accounts for a relatively small share of employment in Global Sydney (6 per cent). The remaining strategic centres and the non-centred locations have much larger proportions of Retail employment (17 and 15 per cent, respectively).

Transport Data Centre (2008b) also analyses the industry structure of employment in many of Sydney's strategic centres as of 2006. The study categorises strategic centres into six groups based on industry mix, as follows:⁴¹

- *Central Sydney* is the largest employment agglomeration within Sydney SD, and the CBD accounts for over three-quarters of Central Sydney employment. In 2006, half of the employed persons in the CBD worked in Finance and insurance or Professional, scientific and technical services.
- *Commercial centres* covers the established high density commercial centres on rail lines north of the CBD and the recently developed business parks combining commercial and industrial functions. In 2006, North Sydney employed 35 761 persons, mostly in the Professional, scientific and technical services, Finance and insurance, and Information, media and telecommunications industries. The main industries in St Leonards/Crows Nest were Professional, scientific and technical services and Health care and social assistance. For Chatswood and Norwest, the largest employing industry was the Retail trade, for Macquarie Park and Olympic Park it was the Wholesale trade and for Rhodes it was Manufacturing.
- *Regional centres* consist of Parramatta, Liverpool, Penrith and Campbelltown. Retail trade was the dominant employing industry in Penrith and Campbelltown in 2006, Health care and social assistance was the largest industry in Liverpool, while the Public administration and safety industry employed more people than any other industry in Parramatta.
- *Retail centres* are spread across the city, including Blacktown, Bondi Junction, Hornsby, Hurstville, Burwood, Bankstown and Castle Hill. Retail was the top employing industry in each of these centres.
- *Industrial centres* include South Sydney industrial area, Sydney Airport, Port Botany, Eastern Creek, Wetherill Park and Huntingwood/Arndell Park. These centres had a large share of employment in the Manufacturing, Wholesale trade, and Transport, postal and warehousing industries.
- *The health and education centres* include the City health and education precinct, Randwick health and education precinct, Westmead, Gosford and Kogarah. Health care and social assistance was the dominant employer in the latter three centres, while the City and Randwick health and education precincts had substantial employment in both the Education and training and Health care and social assistance industries (TDC 2008b, pp. 3–6).

⁴¹ TDC uses ANZSIC 2006 industry classification whilst BITRE's analysis of industry in this study is primarily based on the ANZSIC 1993 industry classification, so some industry names are different.

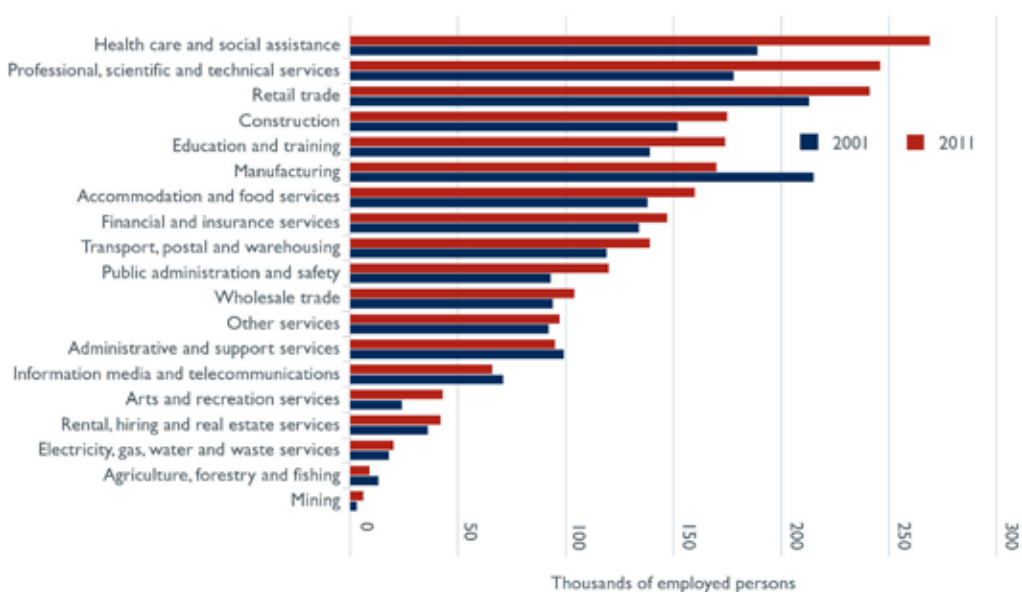
Industry changes

Aggregate change from 2001 to 2011

The ABS' *Labour Force Survey* provides some insight into the industry drivers of employment change in Sydney in the past decade. Note that the data relates to employed residents of the Sydney Statistical Division (SD), which does not correspond to jobs located in the Sydney SD. However, as discussed in Chapter 4, the great majority of employed Sydney residents work at a location within the Sydney SD.

Figure 5.5 shows that in 2011 Health care and social assistance is the largest industry, employing over 269 000 residents of the Sydney SD, followed by Professional, scientific and technical services (246 000 persons) and Retail trade (241 000 persons). In 2001, Manufacturing and Retail trade were the two largest employing industries. However, Manufacturing has suffered a loss of employment in the past decade and Retail trade employment has grown at a slower pace than other industries.

Figure 5.5 Employed persons by industry, Sydney, 2001 and 2011



Note: Based on employed residents of Sydney Statistical Division (i.e. does not correspond to jobs located in the Sydney Statistical Division). Based on ANZSIC 2006 industry classification.

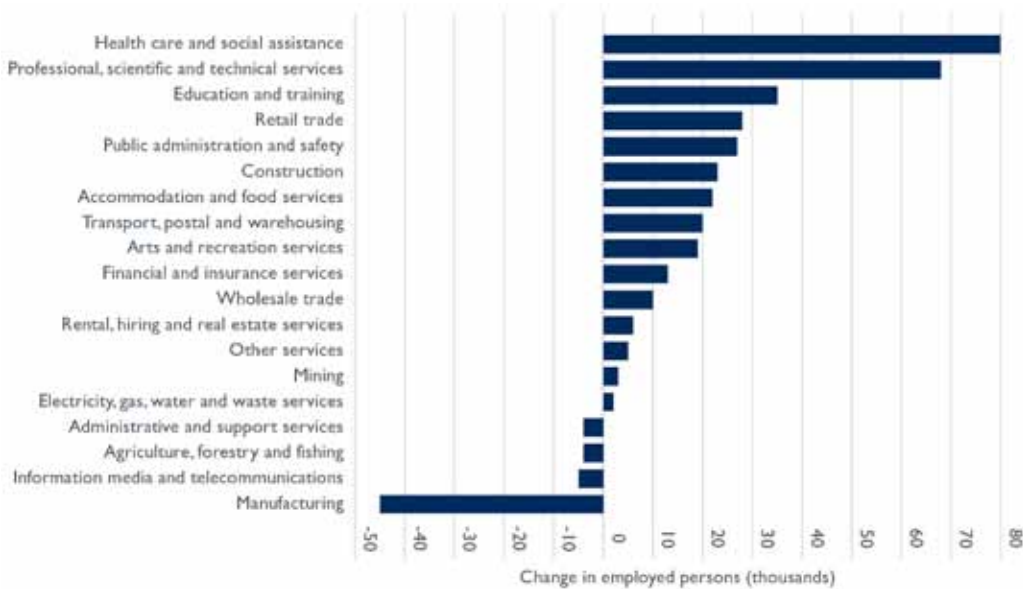
Source: ABS Cat. 6291.0.55.003 (August 2011 issue), based on August quarter of 2001 and 2011 data.

Out of the 303 000 jobs added between 2001 and 2011, the Health care and social assistance industry contributed the largest share of new jobs at 26 per cent (ABS 2011e). As shown in Figure 5.6 the following industries recorded the most substantial change in the number of employed residents for Sydney SD between the August quarter of 2001 and the August quarter of 2011:

- Health care and social assistance (80 000)
- Professional, scientific and technical services (68 000)
- Education and training (35 000)
- Manufacturing (–45 000).

Between 2001 and 2011, employment in the Agriculture, forestry and fishing and Manufacturing industries declined on average by –3.6 per cent and –2.3 per cent per annum, respectively. The most rapidly growing industries in percentage terms were the Mining industry (7.2 per cent per annum), Arts and recreation services (6.0 per cent) and Health care and social assistance (3.6 per cent).

Figure 5.6 Change in employed persons by industry, Sydney, 2001 to 2011



Note: Based on employed residents of Sydney Statistical Division (i.e. does not correspond to jobs located in the Sydney Statistical Division). Based on ANZSIC 2006 industry classification.

Source: ABS Cat. 6291.0.55.003 (August 2011 issue), based on August quarter of 2001 and 2011 data.

Some differences emerge if the 2001 to 2006 and 2006 to 2011 periods are analysed separately. Between 2001 and 2006, the main industry contributor to employment growth in Sydney was Public administration and safety (24 per cent of growth), followed by the Wholesale trade (23 per cent) and Professional, scientific and technical services industries (21 per cent), with the Health care and social assistance industry accounting for just 10 per cent of growth (ABS 2011e). Between 2006 and 2011, the Health care and social assistance industry was responsible for 40 per cent of employment growth in Sydney, with the Professional, scientific and technical services industry contributing a further 23 per cent. The performance of the

Manufacturing industry was consistent, losing just over 20 000 employed persons in both subperiods. While Wholesale trade gained substantial employment between 2001 and 2006, it suffered an employment loss of 22 000 persons between 2006 and 2011, resulting in only a small net gain over the 2001 to 2011 period as a whole. Following strong employment gains from 2001 to 2006, the Public administration and safety industry also recorded a minor loss of employed persons between 2006 and 2011 (*ibid.*).

From 2006 to 2011, the *Labour Force Survey* shows that the two most rapidly growing industries in Sydney were Arts and recreation services (6.8 per cent per annum) and Health care and social assistance (5.8 per cent). In contrast, the Information, media and telecommunications industry had the largest average annual decline (–4.5 per cent) (ABS 2011e).

Change from 2001 to 2006

The remainder of this chapter relies on ABS *Census of Population and Housing* data for 2001 to 2006, to provide information on the industry drivers of job growth in different parts of Sydney. In contrast to the *Labour Force Survey*, the census data is available on a place of work basis, and can be spatially disaggregated to a relatively fine scale (i.e. destination zones).

As was discussed in Chapter 4, aggregate estimates of Sydney's employment growth for the 2001 to 2006 period differ between the *Census of Population and Housing* and the *Labour Force Survey*. For similar reasons, the two data sources provide somewhat different pictures of industry change in Sydney from 2001 to 2006. Another source of difference is that the following census-based analysis adopts the ANZSIC 1993 industry classification, while the *Labour Force Survey* analysis presented in the previous section used the ANZSIC 2006 industry classification.

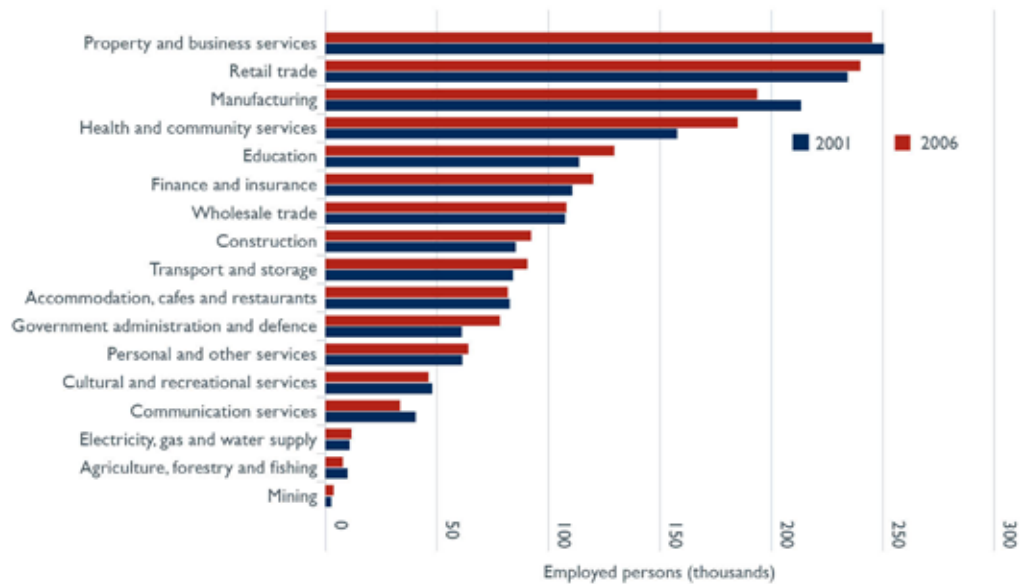
Sydney Statistical Division

Structural change indexes—as defined in Productivity Commission (1998)—show limited structural change for Sydney between 2001 and 2006 (BITRE 2009a). The index value of 4.0 for Sydney implies that only 4 per cent of workers in 2006 would need to change industries to replicate the industry structure that existed in 2001 (*ibid.*).

Nevertheless there were some notable changes in the industry composition of Sydney's employment between 2001 and 2006. Figure 5.7 shows employment by industry for residents of Sydney in the two periods. Property and business services was the major employing industry in both periods, followed by Retail trade and Manufacturing. The Retail industry experienced average annual growth of just 0.5 per cent, while Property and business services and Manufacturing both suffered a decline in employed persons.

Health and community services was the major source of job growth, adding over 27 000 jobs between 2001 and 2006, growing at about 3.2 per cent per annum. Government administration and defence and Education added 17 100 and 15 900 jobs respectively, while an additional 9300 Sydney residents were employed in the Finance and insurance industry. Significant job losses were evident in Manufacturing (–19 700 jobs), Communication services (–7000), and to a lesser extent in Property and business services (–5300) and Agriculture, forestry and fishing (–2000). Manufacturing employment in Sydney declined faster than the national Manufacturing contraction between 2001 and 2006 (BITRE 2009a).

Figure 5.7 Employment by industry for residents of Sydney, 2001 and 2006

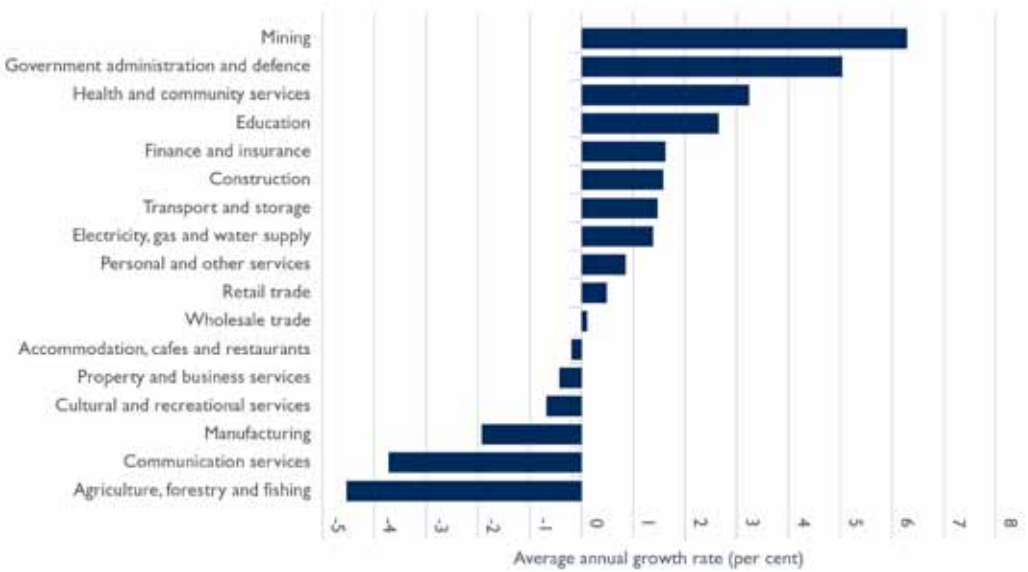


Note: Based on employed residents of Sydney Statistical Division (i.e. does not correspond to jobs located in the Sydney Statistical Division). Based on ANZSIC 1993 industry classification.

Source: BITRE analysis of ABS *Census of Population and Housing* 2006 and 2001.

As shown in Figure 5.8, between 2001 and 2006 the most rapidly growing industries of employment were Government administration and defence (5 per cent annual growth) and Mining (6.3 per cent). The Mining industry has only a small employment base in Sydney, and added 960 employed persons over the five years. The Health and community services and Education industries also experienced strong employment growth of 3.2 per cent and 2.7 per cent per annum, respectively.

Figure 5.8 Employment growth rate by industry, Sydney residents, 2001 to 2006



Note: Based on employed residents of Sydney Statistical Division (i.e. does not correspond to jobs located in the Sydney Statistical Division). Based on ANZSIC 1993 industry classification.

Source: BITRE analysis of ABS *Census of Population and Housing 2006* and 2001.

Planning subregions and sectors

The following analysis of industry change represents a decomposition of Chapter Four’s employment change results, and is based on the same Bureau of Transport Statistics (BTS) journey to work tabulations of census data.

As previously noted, from 2001 to 2006 the main industry contributors to job growth in the Sydney SD were Health and community services, Government administration and defence and Education, while the Manufacturing industry had the largest employment decline. The previous chapter highlighted the strong job growth in the outer areas of Sydney—Table 5.3 reveals that the main industry contributor to job growth in the Outer sector was Health and community services, followed by Education and Retail trade. Health and community services was also the main contributor to job growth in the Middle sector; but Government administration and defence was the main contributor in the Inner sector. Education was amongst the top three contributors for all three sectors and Manufacturing was the principal job loss industry in all three sectors.

Table 5.3 Main industry contributors to employment growth and decline between 2001 and 2006 by planning subregion and sector, Sydney

	Largest source of growth	2nd largest source of growth	3rd largest source of growth	Largest source of job decline
Planning subregion				
City of Sydney	Finance and insurance	Government administration and defence	Health and community services	Manufacturing
East	Education	Health and community services	Government administration and defence	Manufacturing
Inner North	Health and community services	Construction	Education	Property and business services
Inner West	Health and community services	Education	Government administration and defence	Manufacturing
South	Government administration and defence	Health and community services	Education	Manufacturing
North	Health and community services	Education	Government administration and defence	Property and business services
North East	Health and community services	Education	Government administration and defence	Manufacturing
West Central	Health and community services	Government administration and defence	Transport and storage	Manufacturing
North West	Health and community services	Retail trade	Transport and storage	Manufacturing
South West	Health and community services	Transport and storage	Retail trade	Manufacturing
Central Coast	Health and community services	Retail trade	Government administration and defence	Mining
<i>Sydney SD</i>	Health and community services	Government administration and defence	Education	Manufacturing
Sector				
Inner	Government administration and defence	Finance and insurance	Education	Manufacturing
Middle	Health and community services	Government administration and defence	Education	Manufacturing
Outer	Health and community services	Education	Retail trade	Manufacturing

Note: Results relate to 2006 subregion boundaries. City of Sydney results relate to 2006 LGA boundary.

Source: BITRE analysis of NSW BTS online census tabulations for 2001 (table 19) and 2006 (table 8), with 2006 data concorded to 1993 ANZSIC boundaries.

Table 5.3 also shows Health and community services featuring as the main industry contributor to employment growth in eight of the eleven planning subregions, and as one of the top three contributors in the remaining three subregions. The Health and community services industry grew particularly strongly in the North West subregion, where it added 4000 jobs between 2001 and 2006.

In the City of Sydney, Finance and insurance was the largest source of growth (adding 5200 jobs). The Government administration and defence industry was one of the top three contributors to job growth in many of the subregions, and grew particularly strongly in the City of Sydney (where it added 4700 jobs) and in the West Central subregion (2900). Education was also one of the top three industry contributors for many subregions, and grew particularly strongly in the City of Sydney (where it added 2700 jobs) and the North West subregion (2500).

Retail trade was amongst the top three industry contributors to growth for the three outermost subregions—North West, South West and Central Coast—and added 3100 jobs in the North West subregion from 2001 to 2006. Transport and storage was amongst the top three industry contributors to growth for the three subregions which together form Western Sydney (i.e. West Central, North West, South West), adding 2500 jobs in the North West and 2300 jobs in West Central. The Inner North was the only subregion for which Construction was amongst the top industry contributors to job growth, with 2000 Construction jobs being added in this subregion between 2001 and 2006.

The Manufacturing industry experienced the largest job loss in eight of the subregions, with the most pronounced job losses occurring in the West Central and South subregions (which both lost 5200 Manufacturing jobs). The other important driver of decline was the Property and business services industry, which had 5400 fewer jobs in the Inner North subregion in 2006, compared to 2001.

Statistical local areas

Table 5.4 summarises the main industry drivers of job growth for the eight SLAs that added more than 3000 jobs and the principal industry drivers of decline for the four SLAs which lost more than 2500 jobs between 2001 and 2006. The main industry drivers of job growth vary considerably by place. In the CBD (Sydney Inner) and Concord, job growth is coming particularly from the Finance and insurance industry. The Transport and storage industry is the main contributor to job growth in Auburn and Blacktown South East, while Retail trade is the main contributor in Baulkham Hills Central and Wyong South and West. In Sydney West, the job growth was primarily occurring in the Education industry, while in Ryde the job growth was primarily occurring in the Wholesale trade industry. The Health and community services industry was one of the top three contributors to growth in seven of the eight listed employment growth SLAs.

Although the number of jobs in Sydney in the Manufacturing and Property and business services industries declined between 2001 and 2006 (see Figure 5.8), these industries did make a positive contribution to job growth in some SLAs. For example, Property and business services added 1500 jobs in Ryde and 1200 jobs in Sydney West, while Manufacturing added around 600 jobs in Wyong South and West.

Table 5.4 Main industry contributors to employment growth/loss for selected Statistical Local Areas, Sydney, 2001 to 2006

SLA	Largest source of growth/loss	2nd largest source of growth/loss	3rd largest source of growth/loss
Source of job growth			
Sydney Inner	Finance and insurance	Government administration and defence	Health and community services
Ryde	Wholesale trade	Property and business services	Health and community services
Sydney West	Education	Property and business services	Health and community services
Baulkham Hills Central	Retail trade	Health and community services	Finance and insurance
Blacktown South East	Transport and storage	Health and community services	Finance and insurance
Auburn	Transport and storage	Property and business services	Retail trade
Canada Bay–Concord	Finance and insurance	Retail trade	Personal and other services
Wyong–South and West	Retail trade	Manufacturing	Health and community services
Source of job loss			
Lane Cove*	Health and community services	Property and business services	Communication services
Sydney East	Property and business services	Accommodation, cafes and restaurants	Finance and insurance
Fairfield East	Manufacturing	Retail trade	Wholesale trade
Sydney South	Manufacturing	Communication services	Wholesale trade

Note: Statistical Local Areas that added more than 3000 jobs or lost more than 2500 jobs. Results relate to 2006 SLA boundaries. The BTS 2001 travel zone data was concorded to 2006 travel zone boundaries by BITRE using a BTS employment-weighted concordance, and then aggregated to the SLA scale. For SLAs with significant boundary changes between 2001 and 2006 the results should be considered approximate.

*Result for loss of employment in Health and community services in Lane Cove between 2001 and 2006 was accompanied by a similar scale increase in employment in the adjacent SLA. This result is likely due to the coding issues, rather than real growth/loss of employment.

Source: BITRE analysis of NSW BTS online census tabulations for 2001 (table 19) and 2006 (table 8), with 2006 data concorded to 1993 ANZSIC boundaries.

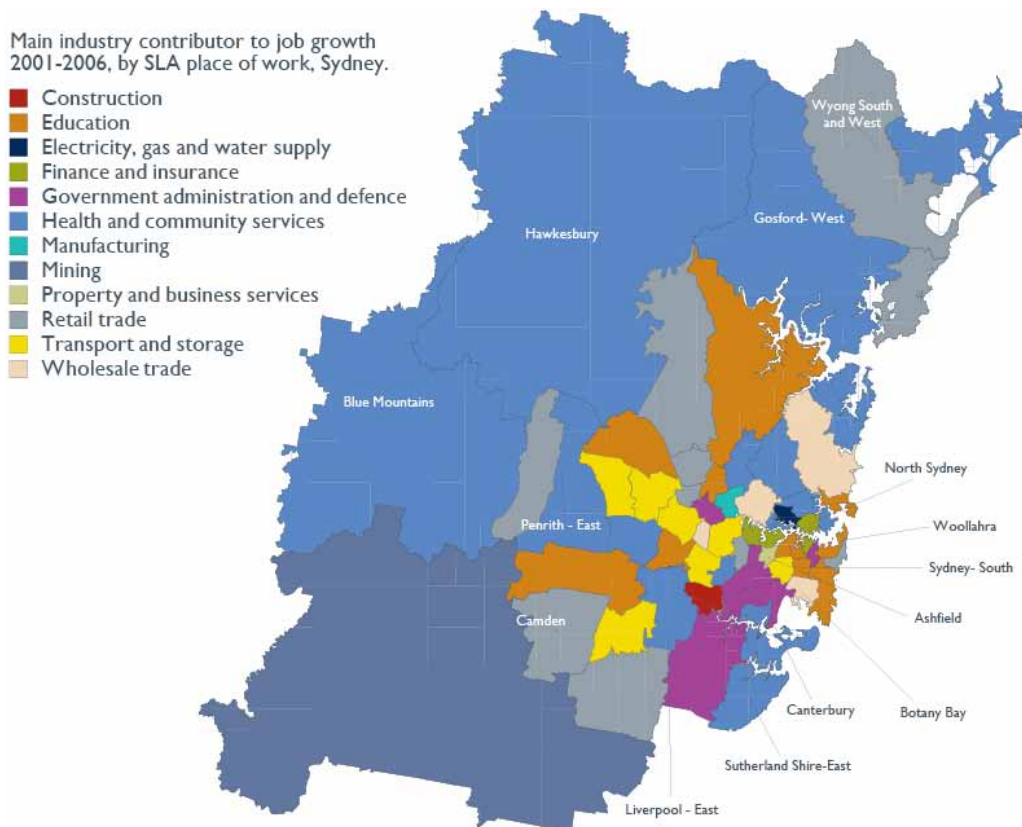
Lane Cove, Sydney East, Fairfield East and Sydney South lost over 2500 jobs between 2001 and 2006. In Lane Cove the loss of jobs in Health and community services was accompanied by an increase of jobs in the bordering SLA, indicating a likely coding issue and hence this result should be treated with caution. Manufacturing was the major contributor to job losses in Fairfield East and Sydney South. Property and business services was the major source of job loss in Sydney East.

Map 5.2 shows the largest industry contributor to employment growth for each SLA between 2001 and 2006. Health and community services, Government administration and defence and Education were the three industries with the largest net employment growth in Sydney. There were 16 SLAs—including Blue Mountains, Hawkesbury, Fairfield West and Mosman—in which Health and community services was the top contributor to net job growth. Government administration and defence was the largest contributor in 7 SLAs, including Parramatta Inner, Canterbury and Burwood. Woollahra, Manly, Liverpool West and Blacktown North were among the 11 SLAs with Education as the most significant contributor to job growth.

Retail trade was the most important contributor for 10 SLAs in Sydney, even though only a modest 3400 total net jobs were added throughout Sydney between 2001 and 2006.

An interesting feature of Map 5.2 is the cluster of SLAs in Western Sydney for which Transport and storage was the main industry contributor to job growth (e.g. Auburn, Blacktown South East, Holroyd).

Map 5.2 Main industry contributors to employment growth Statistical Local Areas, Sydney, 2001 to 2006,



Source: BITRE analysis of NSW BTS online census tabulations for 2001 (table 19) and 2006 (table 8), with 2006 data conformed to 1993 ANZSIC boundaries.

Job growth within Sydney is arising from a diverse range of industries and the remainder of this section focuses on the industries which have experienced the largest growth in employment between 2001 and 2006, as well as the Manufacturing industry which experienced the largest decline in employment. To set the context, Table 5.5 identifies the primary location of job growth within Sydney for each industry. Ryde was the top contributor to net job growth in three industries—Construction, Wholesale trade and Property and business services. Sydney Inner was also the largest contributor for three industries—Finance and insurance, Government administration and defence, and Cultural and recreation services. Sydney West—which includes The University of Sydney and the University of Technology, Sydney—was the location which had the most substantial growth in Education employment.

Table 5.5 Statistical Local Areas which had largest increase in employed persons for each industry, Sydney, 2001 to 2006

Industry	SLA which had largest job growth for industry	Planning subregion
Agriculture, forestry and fishing	Blacktown South West*	North West
Mining	Wollondilly	South West
Manufacturing	Wyong South and West	Central Coast
Electricity, gas and water supply	Lane Cove	Inner North
Construction	Ryde	Inner North
Wholesale trade	Ryde	Inner North
Retail trade	Baulkham Hills Central	North West
Accommodation, cafes and restaurants	Auburn	West Central
Transport and storage	Blacktown South East	North West
Communication services	Penrith West	North West
Finance and insurance	Sydney Inner	City of Sydney
Property and business services	Ryde	Inner North
Government administration and defence	Sydney Inner	City of Sydney
Education	SydneyWest	City of Sydney
Health and community services	Willoughby^	Inner North
Cultural and recreational services	Sydney Inner	City of Sydney
Personal and other services	Parramatta Inner	West Central

Notes:

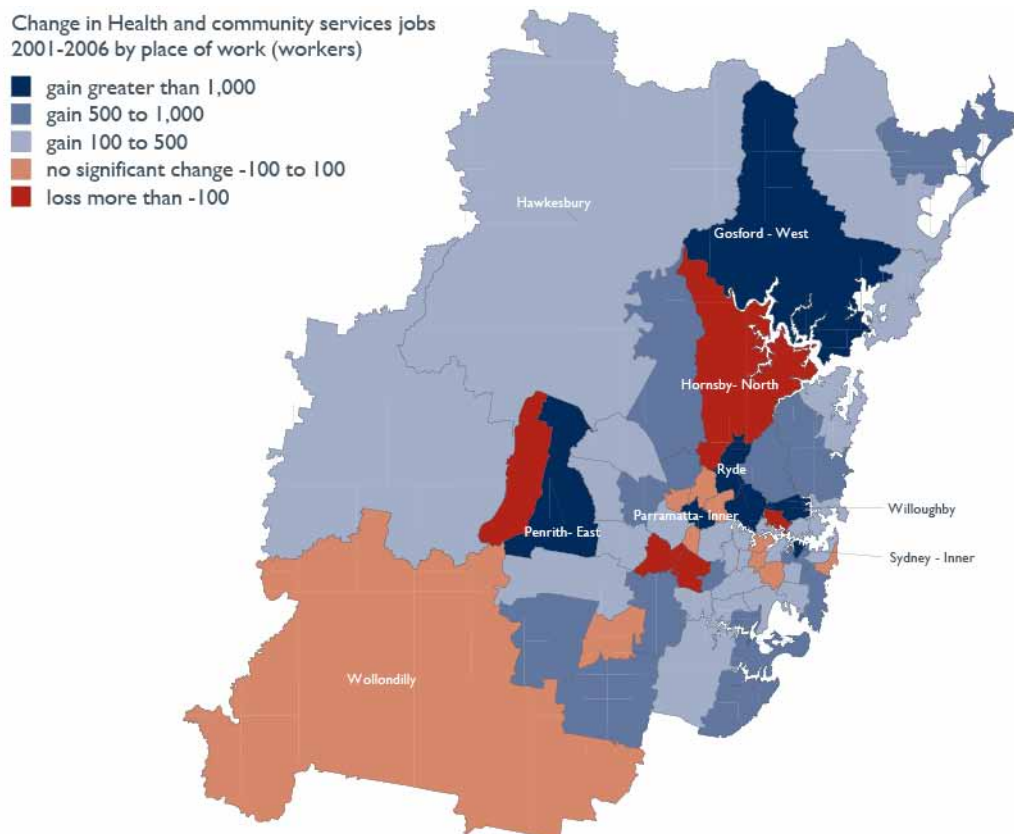
*There were fewer than 100 Agriculture, forestry and fishing jobs in Blacktown South West in both 2001 and 2006.

^ Result for gain in employment in Health and community services in Willoughby between 2001 and 2006 was accompanied by a similar scale loss of employment in the adjacent Lane Cove SLA. At least part of the job growth in Willoughby is likely to reflect coding issues, rather than real growth/loss of employment.

Source: BITRE analysis of NSW BTS online census tabulations for 2001 (table 19) and 2006 (table 8), with 2006 data conformed to 1993 ANZSIC boundaries.

Map 5.3 presents the spatial distribution of the 2001 to 2006 change in the number of persons employed in the Health and community services industry—the most significant industry source of employment growth for Sydney as a whole. Penrith East, Parramatta Inner, Sydney Inner, Ryde and Gosford West were among the SLAs where the Health and community services industry added more than 1000 jobs from 2001 to 2006.

Map 5.3 Change in the number of employed persons in Health and community services by Statistical Local Area, Sydney, 2001 to 2006

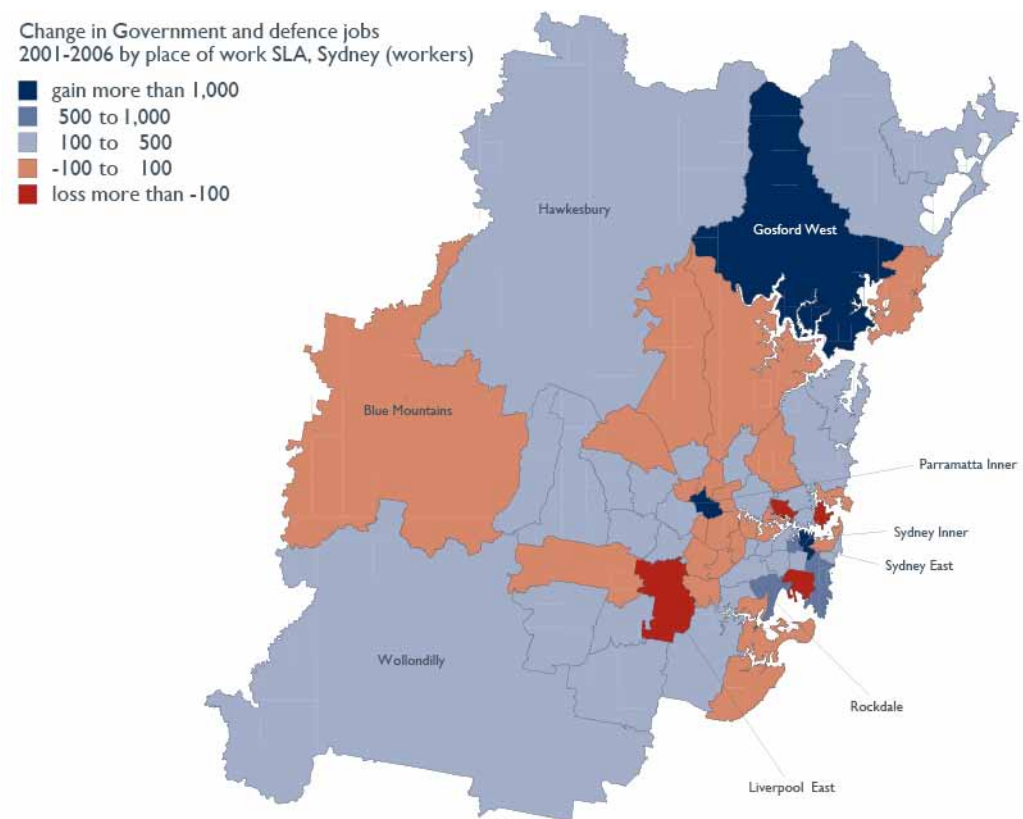


Note: Result for Willoughby and Lane Cove SLAs is likely to reflect coding issues, rather than real growth/loss of employment.

Source: BITRE analysis of NSW BTS online census tabulations for 2001 (table 19) and 2006 (table 8), with 2006 data concurred to 1993 ANZSIC boundaries.

The second largest industry source of employment increase was the Government administration and defence industry. Map 5.4 shows the main areas of Government administration and defence job growth and also loss. There were significant job gains in Sydney Inner (2900), Parramatta Inner (2200) and Gosford West, Rockdale and Sydney East (1000 jobs each). NSW government agencies were relocated to locations such as Parramatta and Rockdale between 2001 and 2006 as part of the government's decentralisation program (Ward 2007). The largest Government administration and defence employment loss was in the Liverpool East SLA (around 250 jobs).

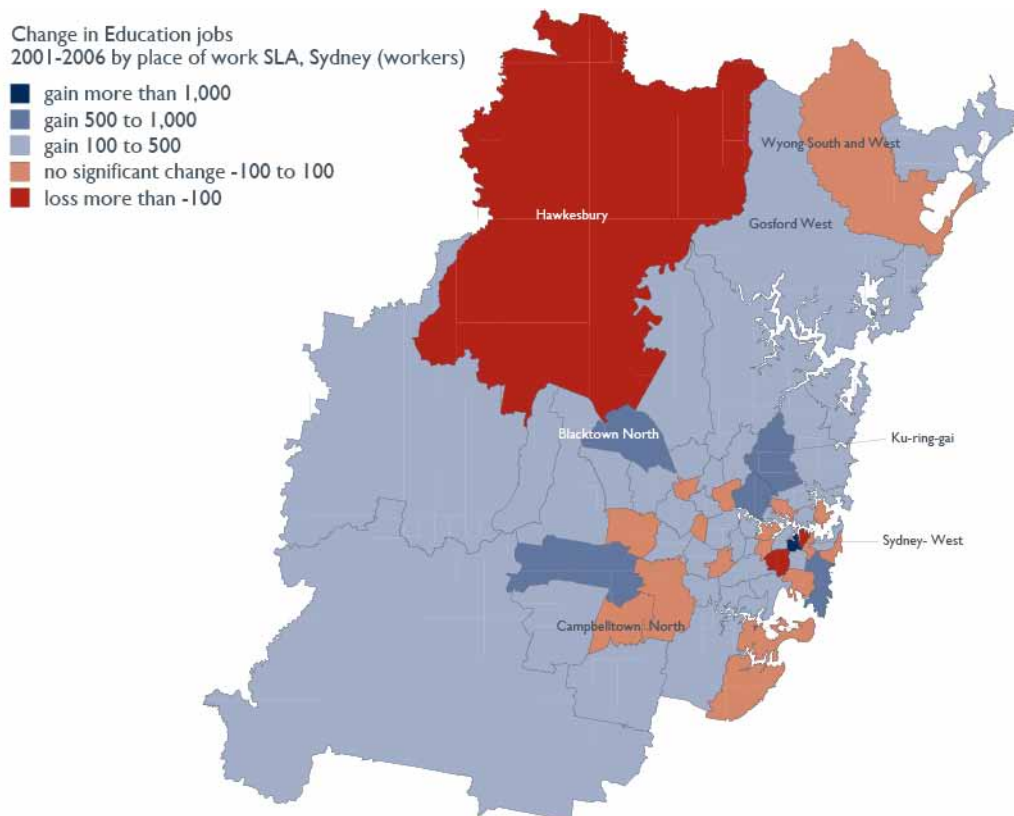
Map 5.4 Change in the number of employed persons in Government administration and defence by Statistical Local Area, Sydney, 2001 to 2006



Source: BITRE analysis of NSW BTS online census tabulations for 2001 (table 19) and 2006 (table 8), with 2006 data concorded to 1993 ANZSIC boundaries.

The final job growth industry to be examined is Education, which contributed net job growth of 15 900 persons between 2001 and 2006. Map 5.5 shows the main areas of Education job growth and decline within Sydney. The only SLA with a gain of over 1000 jobs was Sydney West (2600 jobs), although many other SLAs experienced smaller gains of between 100 and 1000 jobs. Several SLAs experienced a loss of over 100 Education jobs (i.e. Marrickville, Sydney Inner and Hawkesbury).

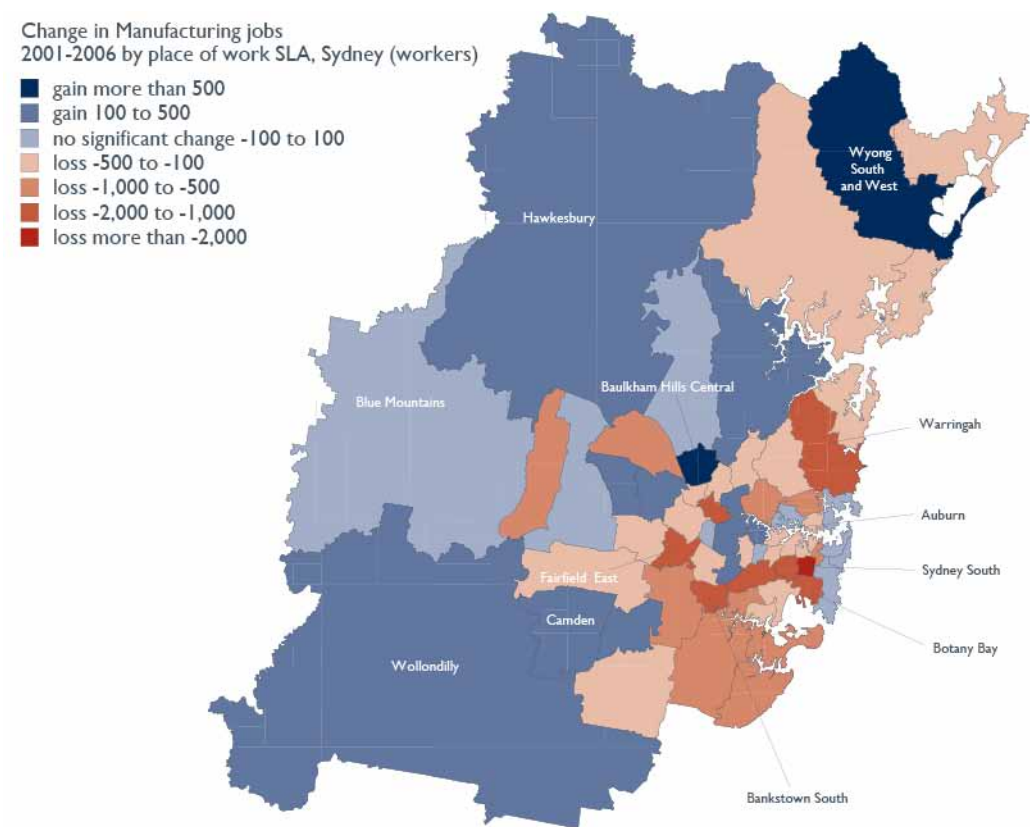
Map 5.5 Change in the number of employed persons in Education industry by Statistical Local Area, Sydney, 2001 to 2006



Source: BITRE analysis of NSW BTS online census tabulations for 2001 (table 19) and 2006 (table 8), with 2006 data conformed to 1993 ANZSIC boundaries.

The Manufacturing industry lost around 20 000 jobs in Sydney between 2001 and 2006. Map 5.6 shows the main areas of Manufacturing job loss within the Sydney working zone. Numerous SLAs lost more than 1 000 Manufacturing jobs between 2001 and 2006, including Sydney South (2800 fewer jobs), Fairfield East (1900), Bankstown South (1800), Botany Bay (1600) and Warringah (1500). Most SLAs experienced smaller losses of under 1 000 Manufacturing jobs. There were, however, several outer suburban SLAs which experienced substantial growth, with Baulkham Hills Central and Wyong South and West both adding more than 500 Manufacturing jobs between 2001 and 2006.

Map 5.6 Change in the number of employed persons in Manufacturing industry by Statistical Local Area, Sydney, 2001 to 2006



Source: BITRE analysis of NSW BTS online census tabulations for 2001 (table 19) and 2006 (table 8), with 2006 data conformed to 1993 ANZSIC boundaries.

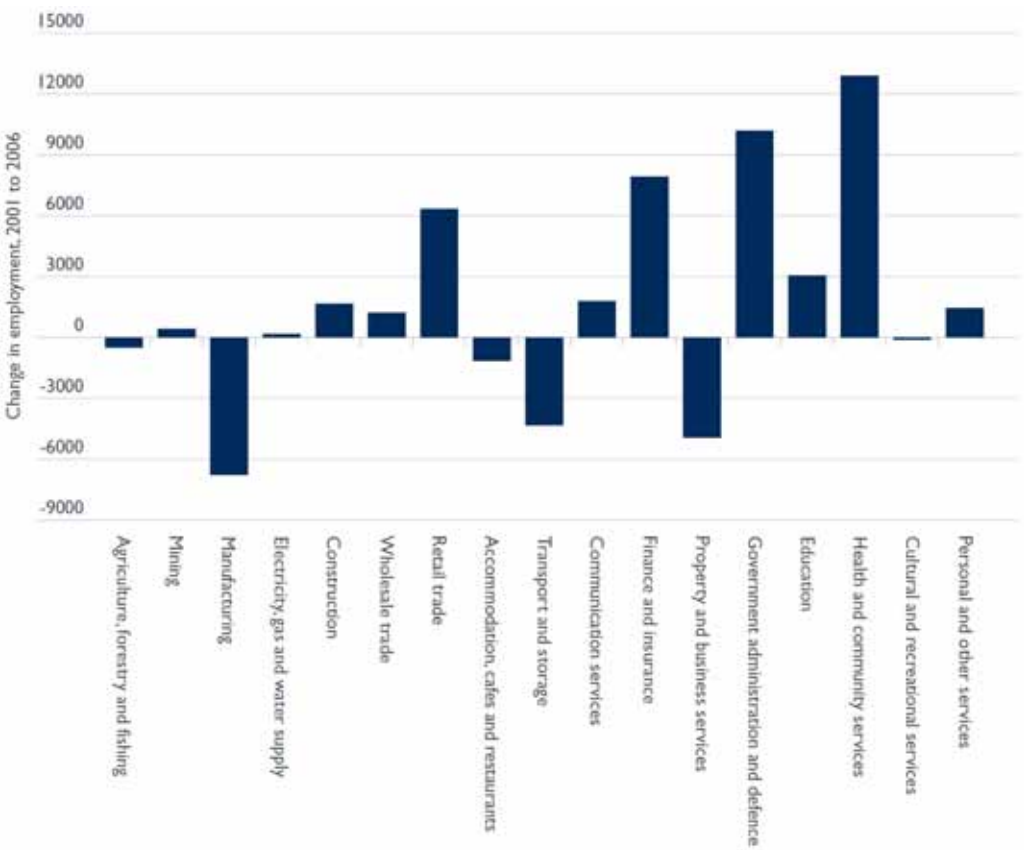
Strategic centres

Chapter Four revealed that of the 47 300 jobs added in Sydney between 2001 and 2006, two-thirds were added in Sydney's strategic centres (see Table 4.8). This section investigates which industries made the largest contribution to this job growth in strategic centres.

Figure 5.9 displays employment growth in Sydney's strategic centres by industry. As was the case for Sydney as a whole, the Health and community services and Government administration and defence industries made the largest contribution to employment growth in strategic centres. Other important contributors to job growth in centres were the Finance and insurance and Retail trade industries. While Education was the third top contributor to job growth in the Sydney SD, the Education industry made a relatively modest contribution to job growth in strategic centres.

Manufacturing was the major industry source of employment decline in Sydney from 2001 to 2006, and it was also the main declining industry within strategic centres. The Transport and storage and Property and business services industry also had fewer jobs in strategic centres in 2006 than in 2001.

Figure 5.9 Employment growth in strategic centres, Sydney, 2001 to 2006



Note: Includes all existing, planned and potential strategic centres. Centres defined as described in notes to Table 4.7.
Source: BITRE analysis of TDC (2008b), Metropolitan Strategy subregional plans, 2006 destination zone boundaries, NSW BTS online census tabulations for 2001 (table 19) and 2006 (table 8), with 2006 data concorded to 1993 ANZSIC boundaries.

The contribution of the different industries differs by centre type. For example, Finance and insurance was the main industry contributor to job growth in Global Sydney, whereas Health and community services was the main contributor for the specialised centres. Of particular interest are the Regional cities of Parramatta, Liverpool, Penrith and Gosford, which together experienced a net loss of 300 jobs between 2001 and 2006 (see Table 4.8). The main industry contributors to job loss in Regional cities were Manufacturing and Retail trade, which both lost around 1200 jobs, while Property and business services had around 1000 fewer jobs in 2006 than 2001. The main contributor to job growth in Regional cities was Government administration and defence, which added 3300 jobs between 2001 and 2006. Thus, the creation or relocation of a substantial number of public sector jobs in the Regional cities largely offset the job losses occurring in many of the private sector industries. O'Neill (2010) argues that the Regional cities are under-equipped with infrastructure, with public spaces and office sites in urgent need of upgrade. The recent employment declines in Retail and Property and business services may well be a reaction to these issues, and present a significant challenge to the policy goal of concentrating employment growth in the Regional cities.

Metropolitan strategy objectives

At the heart of the Metropolitan Strategy's objective of growing Sydney's economy is the aim to concentrate growth of key industries in strategic centres. When a cluster of firms locate in a centre which has a high density of economic activities, they are expected to benefit from agglomeration. Agglomeration in centres also provides an opportunity to access a pool of labour living nearby (Rawnsley and Szafraneic 2007). The metropolitan plan promotes concentration of commercial activities in centres to maximise these advantages (NSW Government 2010a, p.60).

Of the metropolitan planning objectives listed in Table 2.4, two of the broad employment-related objectives relate to the industry mix of employment:

- Strengthen core functions of centres and corridors—this encompasses a range of quite detailed goals which aim to locate certain industries in specific locations (e.g. focus commercial and retail jobs in strategic centres)
- More jobs in Western Sydney—specifically the goal of increasing the diversity of jobs in Western Sydney.

The remainder of this chapter uses census data to investigate the changes that occurred between 2001 and 2006 in relation to these objectives.

Focus commercial and retail jobs in centres

The broad objective of strengthening core functions of centres and corridors encompasses a range of much more specific industry-related goals, and these detailed goals differ considerably between *City of Cities* and *Sydney 2036* (see Table 2.4). Here we have chosen to focus on an objective which is common to both of the recent strategies—the desire to concentrate commercial and retail development in centres. *City of Cities* aimed to 'concentrate retail activity in centres' and 'cluster business and knowledge-based activities in strategic centres' (NSW Government 2005, pp. 97, 104), while *Sydney 2036* aims to locate 'more commercial and retail jobs in highly accessible Strategic Centres' (NSW Government 2010a, p.134).

Between 2001 and 2006, the number of jobs in strategic centres rose for Retail trade (by 6600) and for other commercial activities (3600). Commercial jobs are defined here as jobs in the Property and business services and Finance and insurance industries.

In 2001, 32 per cent of Retail trade jobs in Sydney were located in the strategic centres, and this increased to 34 per cent in 2006. The proportion of commercial employment in Sydney's strategic centres rose slightly from 63 to 64 per cent between 2001 and 2006. While 55 per cent of Property and business services jobs were in strategic centres in 2006, the industry suffered a loss of jobs in centres and across Sydney as a whole between 2001 and 2006. However, Finance and insurance had a strong presence in the centres (81 per cent in 2006) and added 8300 jobs between 2001 and 2006, leading to a net increase in commercial employment in Sydney's strategic centres.

Thus, the census data provides evidence that retail and commercial jobs were increasingly being located in strategic centres between 2001 and 2006, rather than in out-of-centre locations.

Increase the diversity of jobs in Western Sydney

The broad objective of locating 'more jobs in Western Sydney' was assessed in Chapter 4—56 per cent of Sydney's total job growth from 2001 to 2006 was in Western Sydney, which added 26 200 jobs. It is not just the volume of employment growth that is of interest, but also the quality of those jobs, with *Sydney 2036* aiming to 'increase and diversify the jobs and skills base of Western Sydney' to 'address inequities in job distribution and accessibility, particularly higher income jobs' (NSW Government 2010a, p.148). Similarly, *City of Cities* identified 'a need to increase the number of full-time and highly skilled jobs' in Western Sydney (NSW Government 2005, p.57). This section analyses changes in the diversity of the jobs base in Western Sydney between 2001 and 2006, using census data on industry and skills mix.

Industry

The main industry of employment in Western Sydney remains Manufacturing, which accounted for 19.4 per cent of employment in 2001 and 17.5 per cent in 2006 (compared to 10.4 per cent for the Sydney SD). The Finance and insurance and Property and business services industries are substantially underrepresented in Western Sydney, where they together contribute 11.5 per cent of jobs as of 2006, compared to 18.2 per cent for the Sydney SD. These two industries have particularly high income potential, but their contribution to Western Sydney employment declined between 2001 and 2006 (from 11.8 to 11.5 per cent), as it did for Sydney as a whole.

Of the 26 200 jobs added in Western Sydney between 2001 and 2006, the main industry changes were:

- Health and community services added 9400 jobs
- Transport and storage added 6500 jobs
- Education added 5000 jobs
- Government administration and defence added 4800 jobs
- Retail trade added 3700 jobs
- Manufacturing lost 6500 jobs.

Health and community services, Education and Government administration and defence were also important contributors to employment growth for the Sydney SD as a whole. Transport and storage and Retail trade were much more important contributors for Western Sydney than for the rest of Sydney.

An industry diversity index provides a summary measure of the diversity of a region's employment base (BTRE 2003). An index value of zero indicates all employment is in a single industry while an index value approaching 100 per cent indicates that employment is relatively evenly spread across all industries. BTRE (2003) shows that regions with a highly diverse industry structure tend to experienced more stable economic performance over time.

The industry diversity index was calculated at the one digit industry scale for Western Sydney, and shows a small increase from 89.5 per cent in 2001 to 89.9 per cent in 2006, indicating that the industry mix of jobs in Western Sydney became slightly more diversified over the period. The more diverse industry mix of jobs in Western Sydney reflects a substantial decline in the principal local industry—Manufacturing—coupled with strong growth in Health and community services, Transport and storage, and Education jobs.

The increase in the industrial diversity index was most pronounced for the West Central subregion, although the North West and South West subregions also had a slight increase in the index value. The West Central subregion recorded the lowest diversity index value of the subregions in both 2001 and 2006, reflecting the substantial (albeit declining) concentration of Manufacturing employment in the subregion.

Skills

Given the importance of human capital in terms of generating ideas to improve processes or produce new products, the innovative capability of many firms rests on their skills base (NSW Government 2010a). However, it is important to recognise that not all jobs can be highly skilled, and the less skilled occupations are essential to the functioning and servicing of the city (NSW Government 2005).

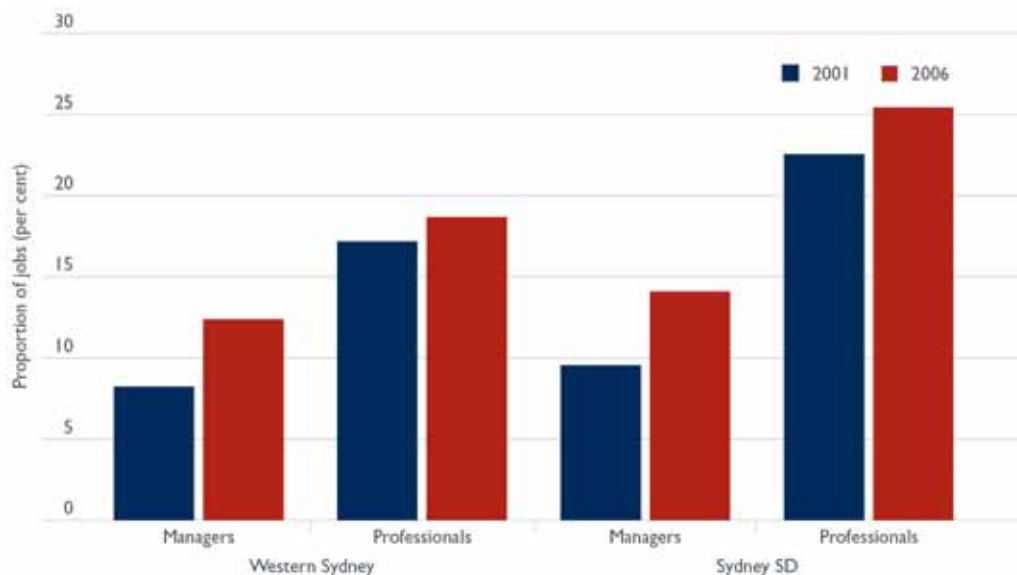
This section examines changes in educational attainment and occupational mix between 2001 and 2006 to see if there is evidence of an increase in Western Sydney's skill base. Analysis of both occupation and educational qualifications is relevant to this objective, as there is no necessary correlation between the two, since highly educated people may be employed in a low skill job (or vice versa). The occupational data enables us to focus on the skills of people who have a job located in the region, while the educational data relates to employed people who reside in the region.

As is illustrated by Figure 5.10, the proportion of jobs located in Western Sydney that were skilled professional jobs rose from 17 per cent in 2001 to 19 per cent in 2006. It rose from 23 to 25 per cent for the Sydney SD. Almost 14 000 new professional jobs were created in Western Sydney between 2001 and 2006 across a range of industries (e.g. Education, Health, Finance and insurance, Government administration).

The proportion of Managers amongst jobs located in Western Sydney rose substantially from 8 per cent in 2001 to 12 per cent in 2006, with the Sydney SD experiencing a similar rise from 10 to 14 per cent. Around 27 000 new Manager jobs were created in Western Sydney over the period, mainly in the retail and government sectors.

The proportion of Western Sydney employment in the two most highly skilled occupational categories—Managers and Professionals—increased considerably from 25 per cent in 2001 to 31 per cent in 2006. However, it remained well below the skilled labour proportion for Sydney as a whole, which was 40 per cent in 2006. In 2001, 26.7 per cent of all Manager and Professional jobs in the Sydney SD were located in Western Sydney, and this rose only slightly to 27.0 per cent in 2006. This suggests that while the skill base is increasing in Western Sydney, this upgrade of skills is occurring at a similar pace to the rest of Sydney.

Figure 5.10 Managerial and professional employment in Western Sydney and Sydney, 2001 and 2006



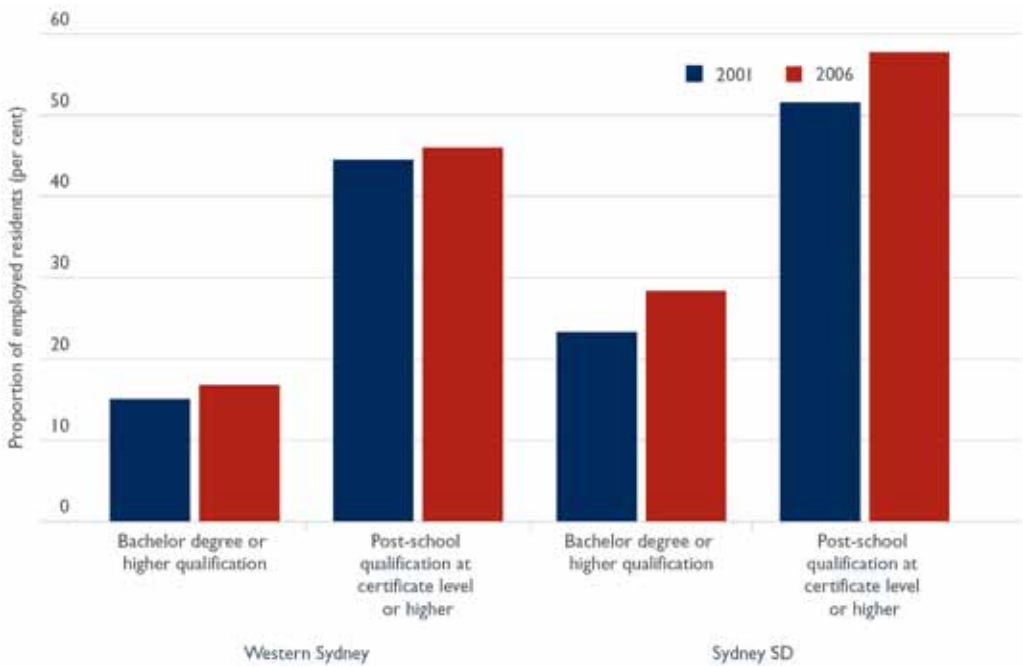
Notes: There was a change in the underlying occupational classification between the 2001 and 2006 census, but the impact was relatively minor for these two high level occupational categories.

Source: BITRE analysis of *Census of Population and Housing 2006* and 2001 Working Population Profile data on employed persons by Industry by occupation.

The proportion of employed residents of Western Sydney with post-school educational qualifications increased from 44.5 to 46.0 per cent between 2001 and 2006 (see Figure 5.11). This primarily reflected an increase in the proportion with a bachelor degree or higher qualification, which rose from 15.1 to 16.8 per cent. There were an extra 19 500 employed residents of Western Sydney with bachelor degree or higher qualifications in 2006, compared to 2001.

Employed residents of Western Sydney are not as highly educated as employed residents of the rest of Sydney. The proportion of employed Sydney residents with a post-school educational qualification rose from 51.6 to 57.8 per cent, while the proportion with a bachelor degree or higher qualification rose from 23.3 to 28.4 per cent. Although employed residents of Western Sydney increased their educational attainment between 2001 and 2006, the gap in educational attainment between residents of Western Sydney and the Sydney SD actually widened over the period. In terms of bachelor degree or higher qualifications, the gap was 8.2 percentage points in 2001 and rose to 11.6 percentage points in 2006.

Figure 5.11 Proportion of employed residents of Western Sydney and Sydney with post school educational qualifications, 2001 and 2006



Source: BITRE analysis of *Census of Population and Housing 2006* and 2001 Expanded Community Profile data on employed persons by Industry by educational qualification.

Overall assessment

The 2005 and 2010 metropolitan strategies aimed to achieve a greater diversity of jobs in Western Sydney and to increase the number of highly skilled jobs. While changes in industry structure have been gradual in Western Sydney (and in Sydney and Australia—see BITRE 2009a), the declining concentration of Manufacturing employment led to the industry mix of jobs in Western Sydney becoming slightly more diversified between 2001 and 2006. The skill base of the jobs available in Western Sydney increased considerably between 2001 and 2006. However, because this upgrade of skills is occurring at a similar pace in Western Sydney as in the rest of Sydney, substantial spatial inequities remain.

In summary

This chapter has helped place the employment information presented in Chapter 4 in context, by examining how the industry mix of employment varies across Sydney, and by identifying the principal industry drivers of recent job growth and decline in different parts of Sydney. While Health and community services was the largest contributor to job growth in the Middle and Outer sectors of Sydney, Government administration and defence was the major contributor to job growth in Inner Sydney. The Manufacturing industry was the main job loss industry in all three sectors.

CHAPTER 6

Transport mode

Key points

- Private vehicle was the dominant mode of travel to work in Sydney's outer suburbs on 2006 census day, with 77 per cent of Outer sector residents and 84 per cent of Outer sector employees travelling to work by private vehicle.
- Less than half of Inner sector residents commute by car, while more Inner sector employees use public transport than private vehicle to get to work.
- Use of public transport for the journey to work in Sydney is concentrated around the heavy rail lines, and more than half of all commutes by public transport are to destinations in the City of Sydney subregion.
- Walking is a common mode of travel to work for inner city residents, but less than 5 per cent of total journeys to work by Greater Metropolitan Area (GMA) residents were by walking. Cycling represents less than one per cent of journeys to work, with a higher proportion of inner suburban residents cycling to work. Walking and cycling both increased their mode shares from 2001 to 2006, and these increases were concentrated in the Inner sector.
- Between 2001 and 2006, the proportion of GMA residents commuting by car rose by 1.6 percentage points, although it fell for Inner sector residents. In the same period, public transport use declined by 1.2 percentage points.
- The overall increase in private vehicle use between 2001 and 2006 was predominantly due to growth in employment in areas with high rates of private vehicle use, as well as a shift towards private vehicle use to access jobs in employment lands. The biggest influence on the fall in public transport use was a shift in behaviour by employees in dispersed locations within the Sydney SD.
- Access to a frequent public transport service is close to universal in the Inner sector, but the North, North West, South West and Central Coast subregions have much lower levels of access as do the Illawarra and Lower Hunter. About 73 per cent of employed residents and 82 per cent of jobs in the GMA were located within 1 km of a frequent public transport service in 2006.
- Between 2001 and 2010 the active transport mode share of commuter travel increased in Sydney. There was also a net increase in the public transport mode share for commuters, with the decline in the first part of the decade being more than offset by recent growth.

- The proportion of commuters travelling to and from strategic centres by public transport declined from 2001 to 2006, although there was a notable increase for the regional city of Parramatta.
- Around 40 per cent of Sydney's recent residential development has been concentrated near public transport nodes, but only 5 per cent of employment growth was concentrated around rail nodes.

Background

This chapter considers the use of different modes of travel within the Sydney Greater Metropolitan Area (GMA), concentrating on the journey to work data collected by the ABS in the *Census of Population and Housing*. Journeys to work as recorded in the 2006 census are examined both by place of residence and place of work. These are compared against the results of the 2001 census to provide an indication of the changes which occurred during that 5-year period. More recent evidence relating to the period since the 2006 census is also considered.

Transport in recent metropolitan strategies

The 1998 NSW Government planning document *Shaping our Cities* set out a number of objectives for travel within the Sydney GMA, including encouraging walking and cycling and discouraging unnecessary car use by integrating transport and land use planning (Department of Urban Affairs and Planning 1998). The need to ensure new housing has sufficient access to public transport was highlighted, and the integration of housing, employment and services in order to reduce demand for travel was a stated objective of the strategy.

In late 2005 the NSW Government released *City of Cities: A plan for Sydney's future* (NSW Government 2005). This was much more detailed than *Shaping our Cities* while also adopting a broader view of Sydney's future transport needs. A much greater emphasis was placed on integration between transport, housing, and job creation strategies. In this context a number of long-term objectives were identified. These included improving transport links between centres and from centres to suburbs, improving existing transport systems by increasing capacity and service integration, encouraging more sustainable travel choices, concentrating development in areas near the public transport network, and managing overall demand for travel.

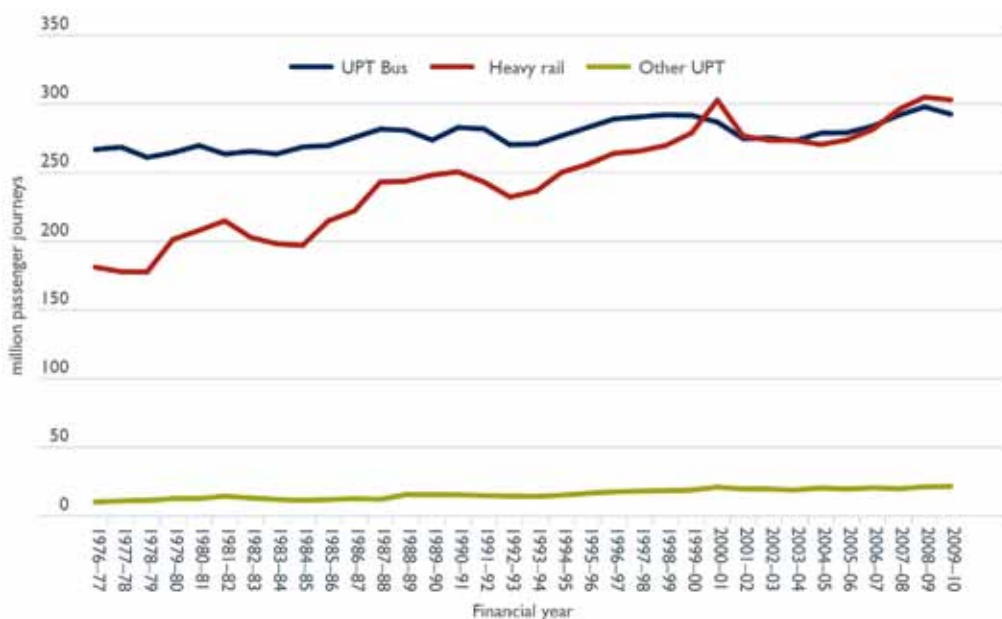
The 2010 plan *Metropolitan Plan for Sydney 2036*, along with the *Metropolitan Transport Plan: Connecting the City of Cities* released earlier in 2010, continued to emphasise the importance of co-ordination between land use and transport planning with the specific aim of increasing the public transport mode share (NSW Government 2010a). The goals of improving accessibility to and between centres and encouraging active travel also retained their prominence from *City of Cities*.

Historical trends

Since 1945, Sydney's population has grown from 1.46 million (ABS 2006c) to 4.58 million in 2010 (ABS 2011a). Despite this, the number of Urban Public Transport (UPT) trips taken in Sydney in 2009–10 remains well below estimates for 1945 (BITRE 2012a). The decades following the end of World War II saw a dramatic fall in UPT trips on a per-capita basis from 450 trips per person per year in 1945 to less than 100 by the 1990s (*ibid.*). This coincided with the period of most rapid growth in per-capita motor vehicle ownership (BTCE 1996). The rate of growth in vehicle ownership has slowed since the mid-1980s while population growth has continued, resulting in increased UPT patronage in absolute terms in Sydney, Melbourne, Brisbane and Perth. However, it is only since 2004–05 that any improvement in per-capita UPT patronage has been evident in any of the state capitals (BITRE 2012a).

Figure 6.1 shows UPT patronage estimates for the Sydney Statistical Division for the period 1976–77 to 2009–10. Heavy rail patronage increased markedly during the period, from 181.1 million trips in 1976–77 to 302.9 million trips in 2009–10. UPT bus patronage has been more stable over the period, increasing from 266.7 million trips in 1976–77 to 292.5 million in 2009–10. Other UPT (comprising light rail and ferry) doubled its patronage from 10.4 million to 21.7 million trips per annum due to a combination of moderate increases in ferry patronage, the recommencement of light rail services in 1988 with the completion of the Metro Monorail, and the completion of the Metro Light Rail in 1997 and its subsequent extension in 2000.

Figure 6.1 Historical trends in public transport patronage, Sydney, 1976–77 to 2009–10



Notes: Other UPT comprises light rail and ferry.

Source: BITRE (2012a).

Despite the increases in patronage numbers shown in Figure 6.1, population growth has resulted in per-capita UPT trips in Sydney remaining relatively stable. From the mid-1990s to 2000–01 Sydneysiders consistently took around 144 UPT trips per person per annum. This fell noticeably in 2001–02 and has remained between 133 and 139 trips per person per annum until 2009–10. In contrast, since 2001–02 per capita UPT patronage has increased markedly in the other mainland state capitals. During this period an average annual increase of one per cent was recorded in Adelaide, 2.5 per cent in Melbourne, and more than 3 per cent in both Brisbane and Perth. However, despite the lack of recent progress Sydney’s per capita UPT patronage remains somewhat higher than Melbourne’s (at 122 trips per person per annum in 2009–10), and substantially higher than any other Australian capital.

Infrastructure

One set of factors that may have influenced the changes in mode choice by Sydney residents during the period is the completion of major transport infrastructure projects. As shown in Table 6.1, a number of major improvements have been made to Sydney’s motorway network since the mid-1990s culminating in the completion of the orbital network with the opening of the Lane Cove Tunnel in 2007.

Table 6.1 Recently completed transport infrastructure projects, Sydney, 1997 to 2010

Project	Type	Date of completion
M2 Hills Motorway	Road	May 1997
Metro Light Rail	Light Rail	May 1997 (Central to Wentworth Park) August 2000 (Wentworth Park to Lilyfield)
Olympic Park branch	Heavy Rail	March 1998
Eastern Distributor	Road	December 1999
Airport line	Heavy Rail	May 2000
M5 East	Road	December 2001
Liverpool—Parramatta T-way	Busway	February 2003
Cross-City Tunnel	Road	August 2005
Westlink M7	Road	December 2005
Lane Cove Tunnel	Road	June 2007
North West T-way	Busway	March 2006 (Parramatta—Rouse Hill) November 2007 (Blacktown—Parklea)
Epping—Chatswood Rail Line	Heavy Rail	June 2008

Notes: Includes selected infrastructure projects only. Date of opening used when no date of completion is available. Date of completion and date of opening differ for Lane Cove Tunnel and Epping—Chatswood Rail Line.

Source: Roads and Traffic Authority 2011, Audit Office of New South Wales 2005, Leighton 2011, railway-technology.com 2011.

It has been argued that the heavy rail network in Sydney has not kept pace with urban development. Norley (2010) suggests that the development of transit infrastructure has become disconnected from the patterns of metropolitan growth. Brooker (2010) states that current rail infrastructure in and around the Sydney CBD is close to capacity during the morning peak resulting in crowding. Residential growth thus contributes in two different ways to higher private vehicle mode share: directly, due to the lack of choice afforded new residents in areas poorly serviced by public transport, and indirectly due to increased crowding resulting in services which are less attractive to commuters.

Notes on census journey to work data

Many commuters use more than one mode of transport to get to work, and up to three modes can be recorded in the census data. In the figures presented in this chapter, data which represent multiple modes of travel are assigned to a single mode in the following order of priority (TDC 2008c):

- Train
- Bus
- Ferry
- Tram/light rail
- Taxi
- Car as driver
- Car as passenger
- Truck
- Motorbike
- Bicycle
- Other mode
- Walk only.

For example, if a person's journey to work involved a car, a bus, and walking their journey would be classified as a "bus" journey, because bus is the highest of those modes in the hierarchy. It is worth noting that the hierarchy gives priority to public transport over private vehicles, and to motorised transport over non-motorised. This has implications for the interpretation of the statistics presented in this chapter, particularly when considering common activities involving multiple modes such as park-and-ride. For example, while single mode commuting by public transport increased by 6.7 per cent, commuting by public transport (including multiple mode journeys to work) declined by 1.3 per cent (TDC 2008c).

Analysis by place of residence

Place of residence is an important factor in determining mode choice for journeys to work. This section examines and compares journey to work data collected in the 2001 and 2006 *Census of Population and Housing* by the Australian Bureau of Statistics based on place of residence using various levels of spatial aggregation from broad sectors down to the Census Collection Districts (CCDs) shown in Map 6.1. The results of the 2006 census are presented first. Then, by comparing with 2001 census data, some conclusions are drawn regarding how transport use changed during this period.

2006 snapshot

Approximately 10 per cent of the 2.3 million employed usual residents of the Sydney Greater Metropolitan Area (GMA) did not attend work on 2006 census day, while for a further 2 per cent no information on their mode of travel is available in the census. The analyses in this section and elsewhere in this chapter focus on those who attended work and provided information on their mode of travel. The mode share calculation differs from the usual method in that those who worked at home were retained in the analysis.

Table 6.2 summarises journeys to work by mode in 2006 for employed usual residents of the Sydney GMA. As shown, car is the most popular method of travel to work, representing over two thirds of all recorded journeys. Public transport accounts for approximately 18 per cent of journeys to work in the Sydney GMA. Train and bus are the most commonly used modes of public transport. Taxi and ferry are the other major contributors to public transport use, each representing approximately one third of one per cent of total journeys to work, while light rail's mode share is negligible. Relatively few commuters chose to cycle to work (less than one per cent), while nearly 5 per cent of journeys to work across the GMA were made by walking.

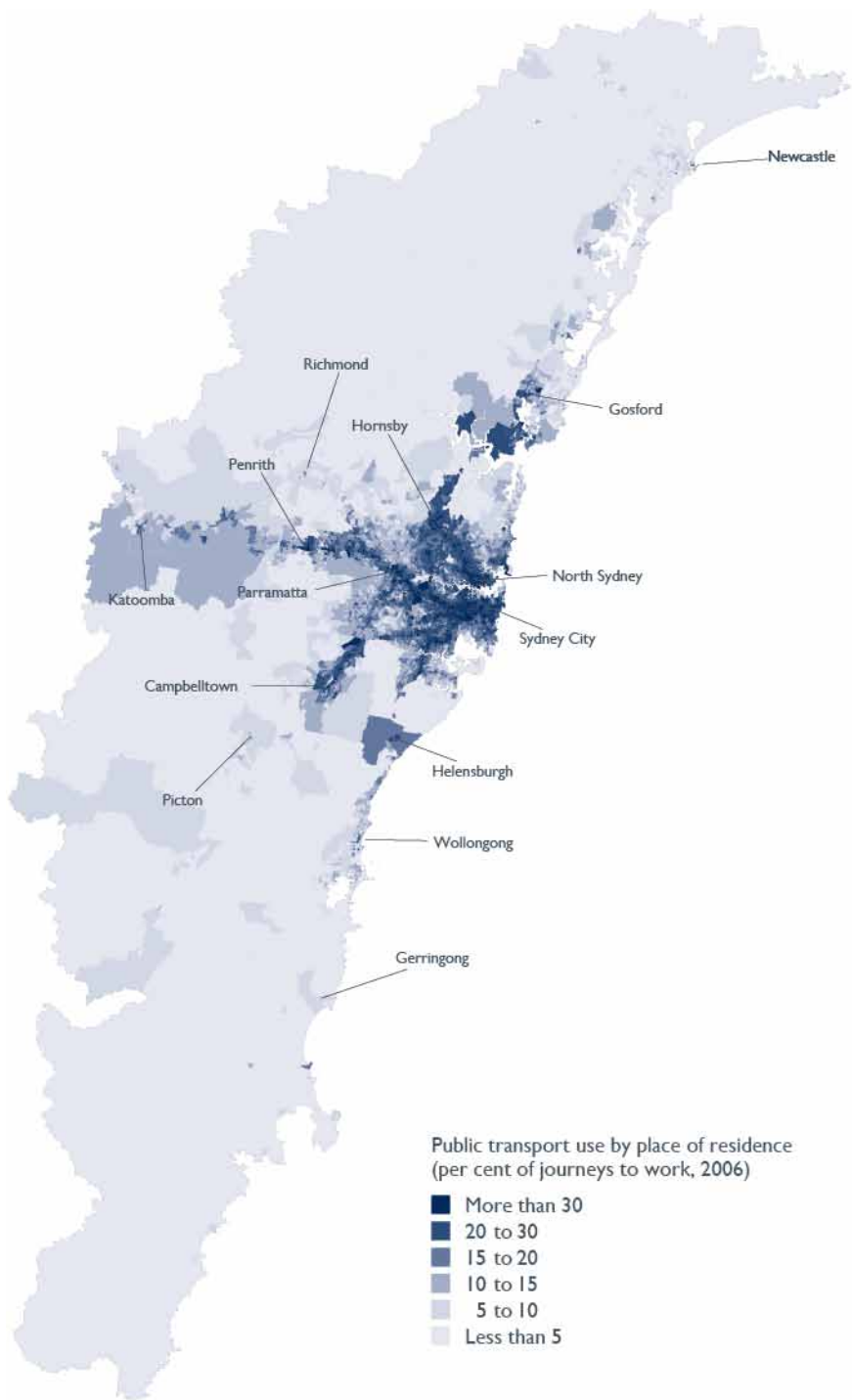
Table 6.2 Journey to work by transport mode for employed usual residents of the Sydney Greater Metropolitan Area, 2006

Mode of transport	Employed usual residents (number)	Employed usual residents (per cent of subtotal)
Car (as driver)	1 256 301	62.9
Car (as passenger)	123 388	6.2
Other private vehicle	43 026	2.2
Train	239 512	12.0
Bus	106 424	5.2
Other public transport	13 956	0.7
Cycling	13 787	0.7
Walking	90 925	4.6
Other modes	20 072	1.0
Worked at home	88 418	4.4
Subtotal	1 996 149	100.0
Did not go to work	233 802	—
Method of travel not stated	42 206	—
Total employed residents	2 272 157	—

Notes: Percentages are of total employed persons who attended work on census day and who stated their method of travel. Individual figures may not sum to totals due to rounding and confidentialisation.

Source: BITRE analysis using ABS 2007a Census Basic Community Profile.

Map 6.1 Public transport mode share for journeys to work by Census Collection District of residence, Sydney Greater Metropolitan Area, 2006



Source: BITRE analysis of ABS 2007a Census Basic Community Profile.

Sectors and planning subregions

Looking first at the highest level geographies, some broad patterns are evident. As shown in Tables 6.3 and 6.4, in general public transport use decreases with distance from the CBD while car use increases. The less accessible and frequent public transport services in the outer suburbs cause more commuters to travel by car, and the comparatively lower employment densities in these areas mean more residents need to travel long distances to their place of employment, preventing the use of non-motorised travel (walking or cycling). Residents of the Illawarra and Lower Hunter have particularly low rates of public transport use and high rates of private vehicle use compared to the Sydney Statistical Division (SD).

Table 6.3 Transport mode share for journey to work by sector of residence, Sydney Greater Metropolitan Area, 2006

Sector	Car	Other private vehicle	Public transport	Cycling	Walking	Other modes	Worked at home
(per cent)							
Sydney GMA	69.1	2.2	18.0	0.7	4.6	1.0	4.4
Sydney SD	66.5	2.1	20.7	0.6	4.7	1.0	4.4
Inner	46.7	1.3	32.4	1.5	11.8	1.3	5.1
Middle	63.9	1.7	25.0	0.5	4.1	0.9	4.0
Outer	74.9	2.5	14.3	0.4	2.6	0.9	4.4
Illawarra	81.6	2.7	4.9	0.8	3.8	1.1	5.0
Lower Hunter	84.4	2.6	3.3	1.0	3.5	1.1	4.1

Notes: Percentages are of total employed persons who attended work on census day. Individual figures may not sum to totals due to rounding and confidentialisation.
Source: BITRE analysis using ABS 2007a Census Basic Community Profile.

Variations in mode share for walking and cycling show a slightly different picture. Both initially decrease with distance from the CBD, but are higher for the Illawarra and Lower Hunter sectors than for the Outer sector. As these modes are most viable for short-distance travel this suggests that there may be relatively more short-distance commuters in the Illawarra/Lower Hunter sectors than in the Outer sector. Commuting patterns are examined further in Chapter 7.

Table 6.4 shows mode shares for the planning subregions within the Sydney SD. The same general pattern of private vehicle use increasing with distance from the CBD is evident here. This also suggests that the residents of the City of Sydney planning subregion are the primary influence on the higher walking mode share for the Inner sector shown above.

Table 6.4 Transport mode share for journey to work by planning subregion of residence, Sydney, 2006

Planning subregion	Car	Other private vehicle	Public transport	Cycling	Walking	Other modes	Worked at home
(per cent)							
Sydney SD	66.5	2.1	20.7	0.6	4.7	1.0	4.4
City of Sydney	31.6	1.1	32.4	1.9	26.9	1.7	4.4
East	54.4	1.5	29.1	1.3	7.3	1.3	5.2
Inner North	54.0	1.2	29.7	0.7	7.6	1.1	5.8
Inner West	56.5	1.5	30.9	1.0	4.7	1.0	4.5
South	65.4	1.8	24.2	0.7	3.7	0.8	3.5
North	63.9	1.2	23.2	0.3	3.2	0.9	7.3
North East	68.1	2.2	16.6	0.8	4.1	1.4	6.9
West Central	71.5	2.3	19.3	0.4	3.2	0.8	2.5
North West	76.5	2.7	13.1	0.4	2.2	0.9	4.2
South West	76.5	3.1	13.6	0.3	2.3	0.9	3.4
Central Coast	77.7	2.6	10.4	0.5	2.5	1.1	5.3

Notes: Percentages are of total employed persons who attended work on census day. Individual figures may not sum to totals due to rounding and confidentialisation.

Source: BITRE analysis using ABS 2007a Census Basic Community Profile.

Table 6.5 shows how public transport use is split between the different modes of public transport for each sector. As shown, train is by far the most utilised public transport mode overall, but bus use is higher than train for Inner sector residents and for residents of the Lower Hunter.

Table 6.5 Detailed public transport mode share for journey to work by sector of residence, Sydney Greater Metropolitan Area, 2006

Sector	Train	Bus	Ferry	Light rail	Taxi	Total public transport
(per cent)						
Sydney GMA	12.0	5.3	0.3	0.0	0.4	18.0
Sydney SD	13.8	6.1	0.3	0.1	0.4	20.7
Inner	13.7	16.5	0.9	0.2	1.0	32.4
Middle	18.9	5.2	0.5	0.0	0.4	25.0
Outer	11.3	2.8	0.0	0.0	0.2	14.3
Illawarra	3.7	1.1	0.0	0.0	0.2	4.9
Lower Hunter	1.3	1.8	0.0	0.0	0.2	3.3

Notes: Percentages are of total employed persons who attended work on census day. Individual figures may not sum to totals due to rounding and confidentialisation.

Source: BITRE analysis using ABS 2007a Census Basic Community Profile.

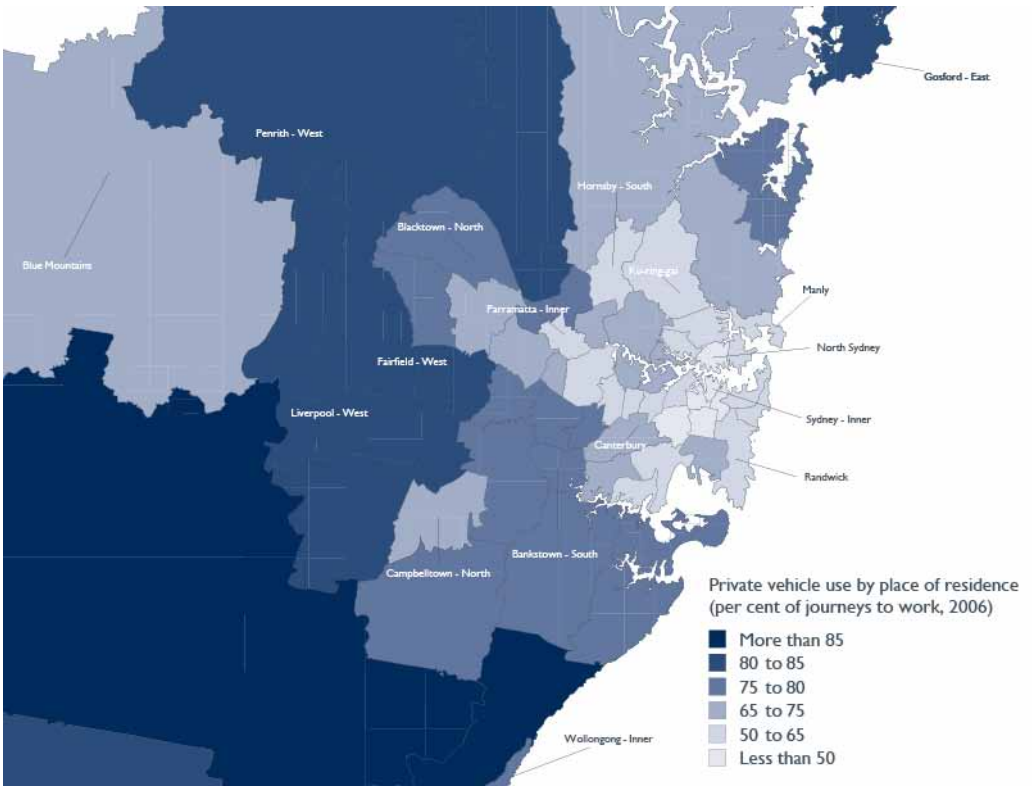
Statistical Local Areas

Map 6.2 illustrates how the private vehicle mode share differs across Sydney's Statistical Local Areas (SLAs) of residence, while Map 6.3 illustrates differences across SLAs in the public transport mode share.

Car use is lowest amongst residents of the inner city SLAs of Sydney Inner; Sydney East and Sydney West with less than one third of residents of each of these SLAs travelling to work by private vehicle. In Sydney South, North Sydney and Marrickville this figure was above one third but below 50 per cent. The residents of the Leichhardt, Ashfield and Burwood SLAs in the Inner West; Randwick, Waverley and Woollahra in the eastern suburbs; the northern suburb SLAs of Manly, Mosman, Willoughby and Lane Cove; and the Parramatta Inner SLA also had relatively low rates of private vehicle use (between 50 and 60 per cent of journeys to work).

The SLAs with the highest levels of private vehicle use were the Shellharbour SLA in the Illawarra and Lake Macquarie North in the Lower Hunter, both with over 90 per cent of residents making the journey to work by private vehicle. Of the 12 SLAs with private vehicle use above 85 per cent, 7 are in the Lower Hunter and 3 are in the Illawarra, with the final two being Wyong North East in the Central Coast and Wollondilly in the South West. Of all the Illawarra and Lower Hunter SLAs, only Wollongong Inner and Newcastle Inner City recorded private vehicle use below 80 per cent (they were 79.2 per cent and 78.7 per cent, respectively).

Map 6.2 Private vehicle mode share for journey to work by Statistical Local Area of residence, Sydney, 2006

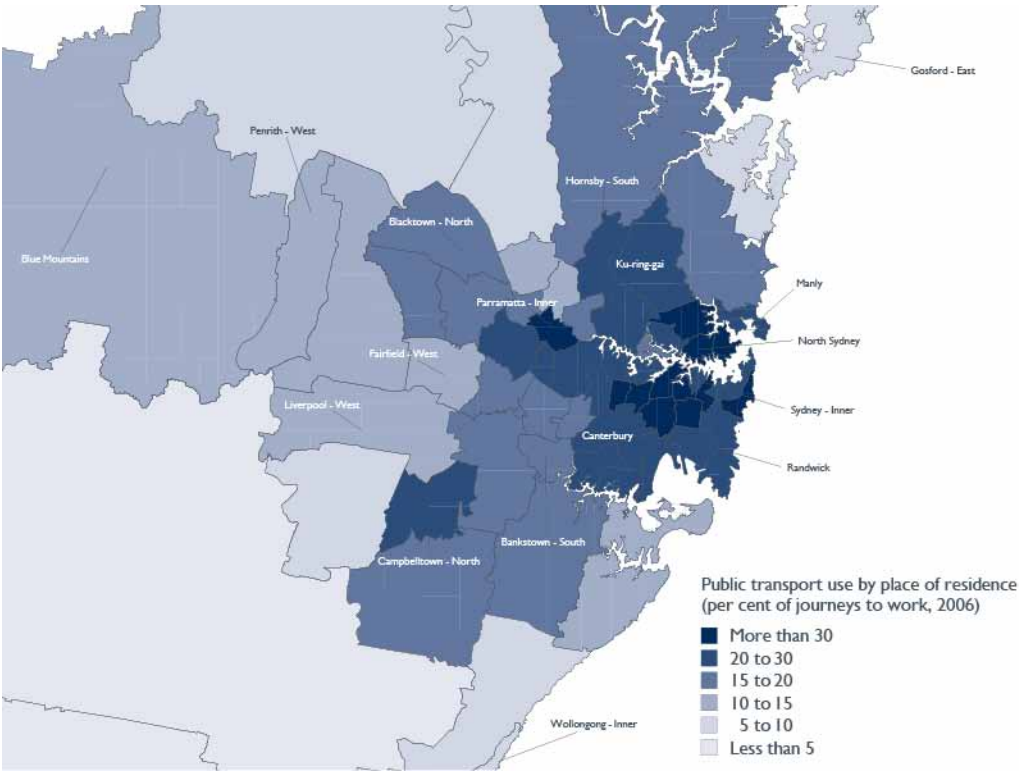


Source: BITRE analysis using ABS 2007a Census Basic Community Profile.

As expected, a very similar set of SLAs to those with the highest private vehicle use represent those with the lowest use of public transport for journeys to work. There are 14 SLAs in the GMA which recorded less than 5 per cent of journeys to work by public transport in the 2006 census, and 11 of them were those identified above as having private vehicle use over 85 per cent (Wyang North East, the twelfth, recorded 5.3 per cent public transport use).

In contrast, the correspondence between SLAs with the highest public transport use and those with the lowest private vehicle use is not as close, although the majority of SLAs in both groups are close to the CBD. This is because the lowest rates of car use coincide with substantial mode shares for active modes (walking and cycling), leading to comparatively low public transport use. For residents of the SLAs of Sydney Inner, Sydney East and Sydney West active modes represent over 25 per cent of journeys to work, while the average across the GMA is 4.6 per cent.

Map 6.3 Public transport mode share for journey to work by Statistical Local Area of residence, Sydney, 2006



Source: BITRE analysis using ABS 2007a Census Basic Community Profile.

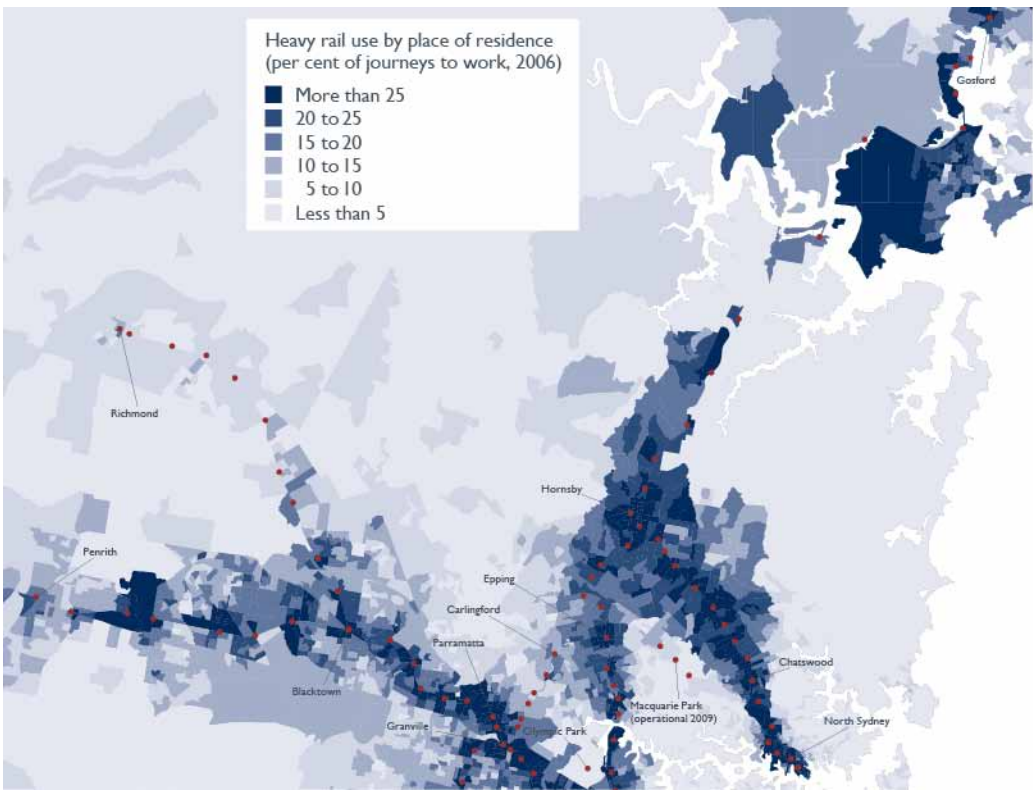
The majority of the active travel by inner city residents is walking, although many of these SLAs also have above-average rates of cycling. The highest rates of cycling are achieved by residents of Sydney South and Marrickville in the Inner sector, and Newcastle Inner City and Newcastle–Throsby. These were the only SLAs for which more than 2 per cent of residents cycled to work.

The SLAs with the highest public transport use are all within a short distance of the CBD along the major rail lines. The top four are Ashfield, North Sydney, Marrickville and Burwood, which all (in addition to Sydney South) recorded rates of public transport use of 35 per cent or greater.

Census Collection Districts

Examining public transport use by Census Collection District (CCD) reveals that the highest levels of rail use are clustered around the heavy rail lines. Rail mode share drops off rapidly as distance from stations increases. As a result there are very low rates of train use in large areas of the outer suburbs which lie between rail lines. Maps 6.4 and 6.5 illustrate this.

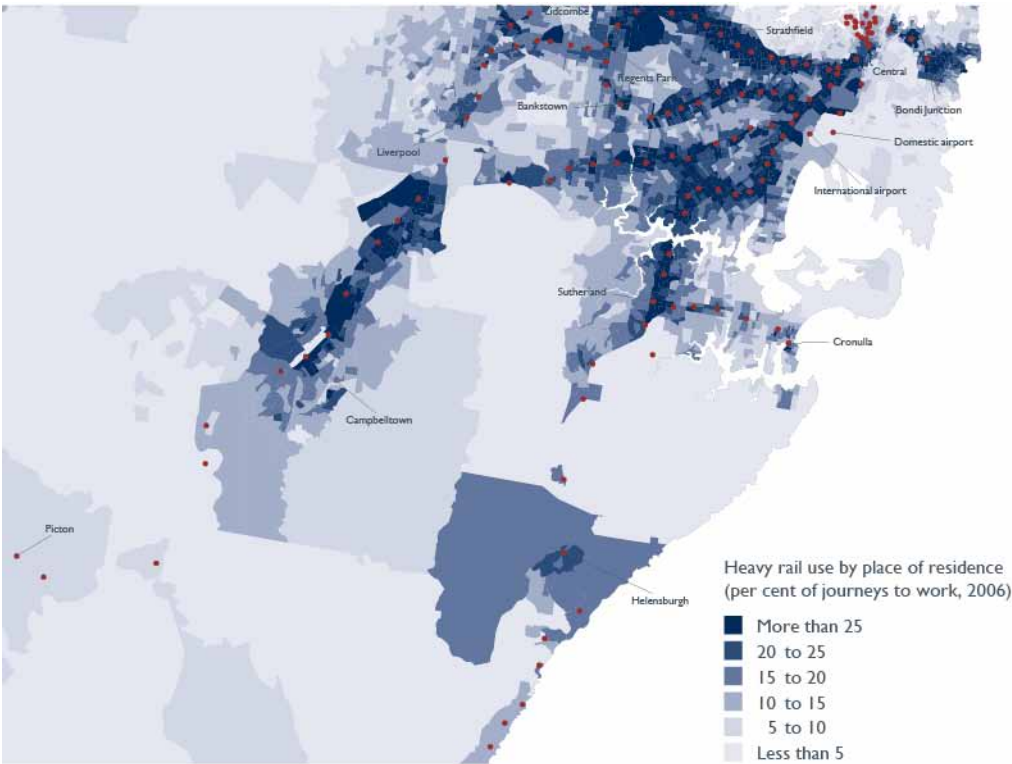
Map 6.4 Heavy rail mode share for journey to work by Census Collection District of residence, Sydney northern rail lines, 2006



Notes: Some rail stations shown were not operational in 2006. Includes light rail and monorail stations.

Source: BITRE analysis using ABS 2007a Census Basic Community Profile.

Map 6.5 Heavy rail mode share for journey to work by Census Collection District of residence, Sydney southern rail lines, 2006

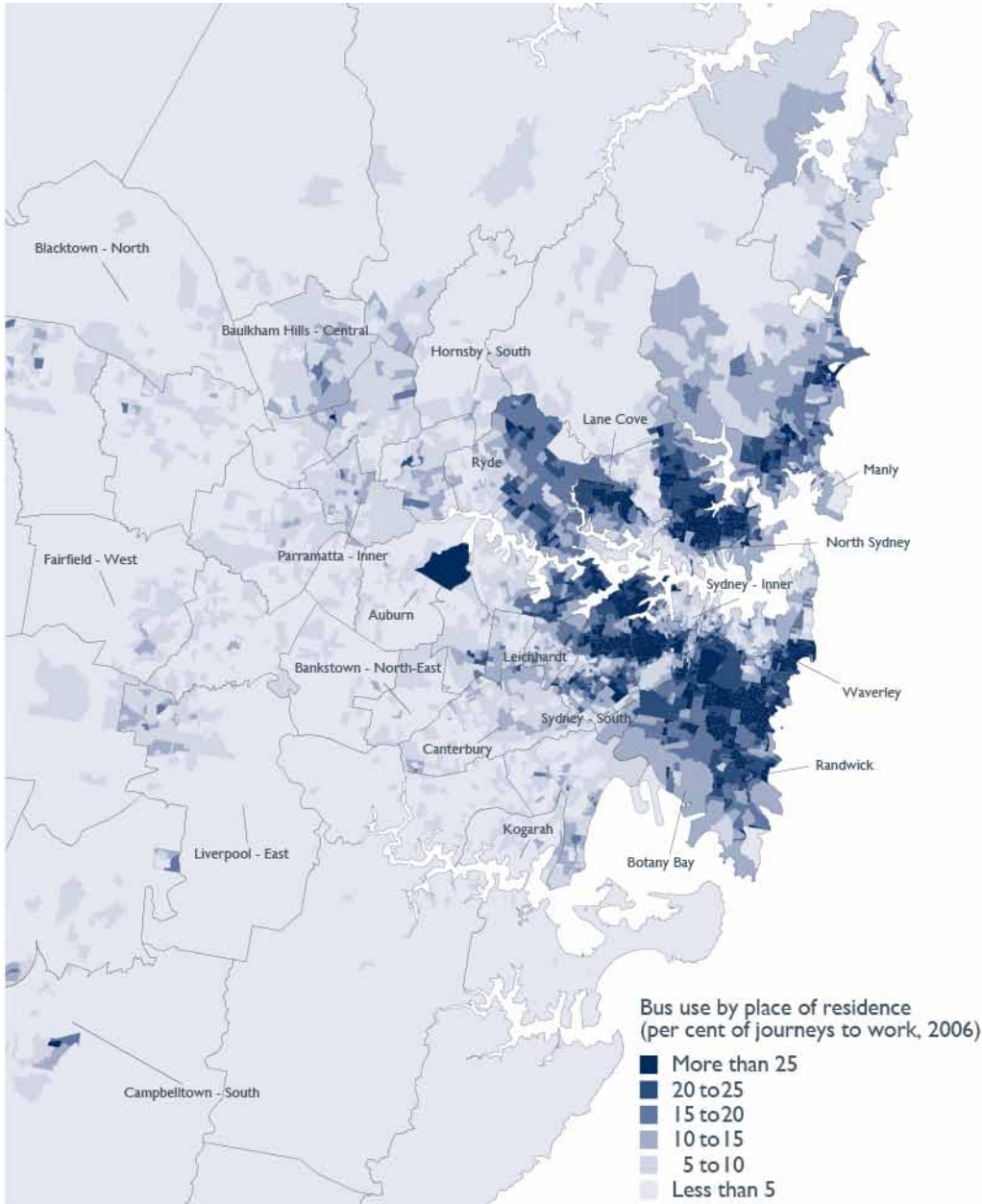


Notes: Some rail stations shown were not operational in 2006. Includes light rail and monorail stations.
Source: BITRE analysis using ABS 2007a Census Basic Community Profile.

Map 6.6 shows bus mode share for Sydney, and includes “bus and train” trips which elsewhere are reported as train journeys. In contrast to Maps 6.4 and 6.5, the highest rates of bus use exist in the suburbs surrounding the CBD rather than along corridors. Areas with substantial bus use also exist around Parramatta, Blacktown, Liverpool and Pittwater as well as some areas of the Central Coast and Illawarra (not shown). The area of high bus use in the Auburn SLA comprises a single CCD covering part of the Olympic Park complex. As the employed resident population of this CCD is very small, this result can be considered an anomaly.

There are also areas of high bus use to the east of the city. Some of this is the result of commuters using buses to access the rail network. This is evidenced by the high levels of train use visible in Map 6.5 to the east of Bondi Junction station in the Waverley SLA. While this could theoretically be due to high rates of park-and-ride, an examination of the raw census data shows that these CCDs have some of the highest rates of “train and bus” responses in the GMA. However, the bus use visible in Map 6.6 in the nearby Randwick SLA does not appear to be feeding into the rail network in the same way.

Map 6.6 Bus mode share for journey to work by Census Collection District of residence, Sydney, 2006



Notes: Includes journeys involving both bus and train, which are classified as train journeys elsewhere.

Source: BITRE analysis using ABS 2007a Census Basic Community Profile.

Changes from 2001 to 2006

As 2001 census data for place of usual residence was not available, place of enumeration data for both 2001 and 2006 has been used to compare census results. Although this is slightly different data to that used above, it allows a like-for-like comparison to be performed while not substantially affecting the interpretation of the results.

Sectors and planning subregions

Examining the changes by sector shows two major differences between 2001 and 2006 journeys to work. Firstly, public transport use has declined in all sectors during this period (by between 0.32 and 1.36 percentage points), while private vehicle use has increased in all sectors except the Inner sector. Secondly, the mode shares for both cycling and walking have remained relatively steady in all except the Inner sector, where there has been a modest increase in cycling and a significant increase in walking. Table 6.6 shows the percentage point change in mode share for each sector.

Table 6.6 Change in mode share for journeys to work by sector of residence, Sydney Greater Metropolitan Area, 2001 to 2006

Sector	Car	Other private vehicle	Public transport	Cycling	Walking	Worked at home
(percentage point change)						
Sydney GMA	1.61	-0.28	-1.17	0.05	0.36	-0.24
Sydney SD	1.36	-0.24	-1.09	0.07	0.43	-0.23
Inner	-0.77	0.11	-1.33	0.26	1.75	-0.09
Middle	0.78	-0.24	-0.32	0.07	0.29	-0.21
Outer	2.35	-0.37	-1.36	0.01	0.04	-0.29
Illawarra	2.71	-0.60	-1.30	-0.08	-0.08	-0.12
Lower Hunter	1.91	-0.50	-0.48	-0.11	0.13	-0.44

Notes: Percentages are of total employed persons who attended work on census day. Individual figures may not sum to totals due to rounding and confidentialisation. Change in mode share for "other modes" not shown.

Source: BITRE analysis of ABS 2001 and 2006 *Census of Population and Housing* data (using ABS 2007b, ABS 2003).

Although the mode share for both cycling and walking increased only slightly for the GMA, this represents a noticeable change in the absolute number of journeys using these modes. In 2006 there were 8.1 per cent more journeys to work by cycling and 9.1 per cent more by walking than there were in 2001, while the number of employed people enumerated in the Sydney GMA in the 2006 census was only 5.3 per cent higher than in 2001.

Examining the same data for public transport use it is evident that despite the substantial drop in mode share, the absolute number of trips to work by public transport has remained relatively constant during the period, even though there was growth in population.

Table 6.7 shows that the planning subregions which experienced the largest increases in car use were the Central Coast, South West and North West. Each of these has had population growth concentrated in areas where public transport infrastructure is not yet well established. It can also be seen that the increase in walking is confined primarily to the City of Sydney subregion.

Table 6.7 Change in mode share for journeys to work by planning subregion of residence, Sydney Greater Metropolitan Area, 2001 to 2006

Planning subregion	Car	Other private vehicle	Public transport	Cycling	Walking	Worked at home
(per cent)						
Sydney SD	1.36	-0.24	-1.09	0.07	0.43	-0.23
City of Sydney	-2.02	0.19	-2.87	0.19	4.18	-0.53
East	0.29	0.07	-1.22	0.21	0.72	0.10
Inner North	-0.66	-0.02	0.38	0.13	0.53	-0.02
Inner West	0.88	-0.09	-0.50	0.16	-0.03	-0.12
South	1.55	-0.26	-1.18	0.11	0.27	-0.14
North	0.82	-0.15	-0.51	0.04	0.29	-0.23
North East	0.47	-0.24	-0.51	0.09	0.43	0.20
West Central	1.65	-0.29	-0.89	0.05	0.18	-0.34
North West	2.29	-0.45	-1.01	0.01	-0.08	-0.38
South West	2.79	-0.34	-1.58	-0.05	-0.08	-0.34
Central Coast	4.38	-0.59	-2.64	-0.03	-0.24	-0.44

Notes: Percentages are of total employed persons who attended work on census day. Individual figures may not sum to totals due to rounding and confidentialisation.

Source: BITRE analysis of ABS 2001 and 2006 *Census of Population and Housing* data (using ABS 2007b, ABS 2003).

Statistical Local Areas

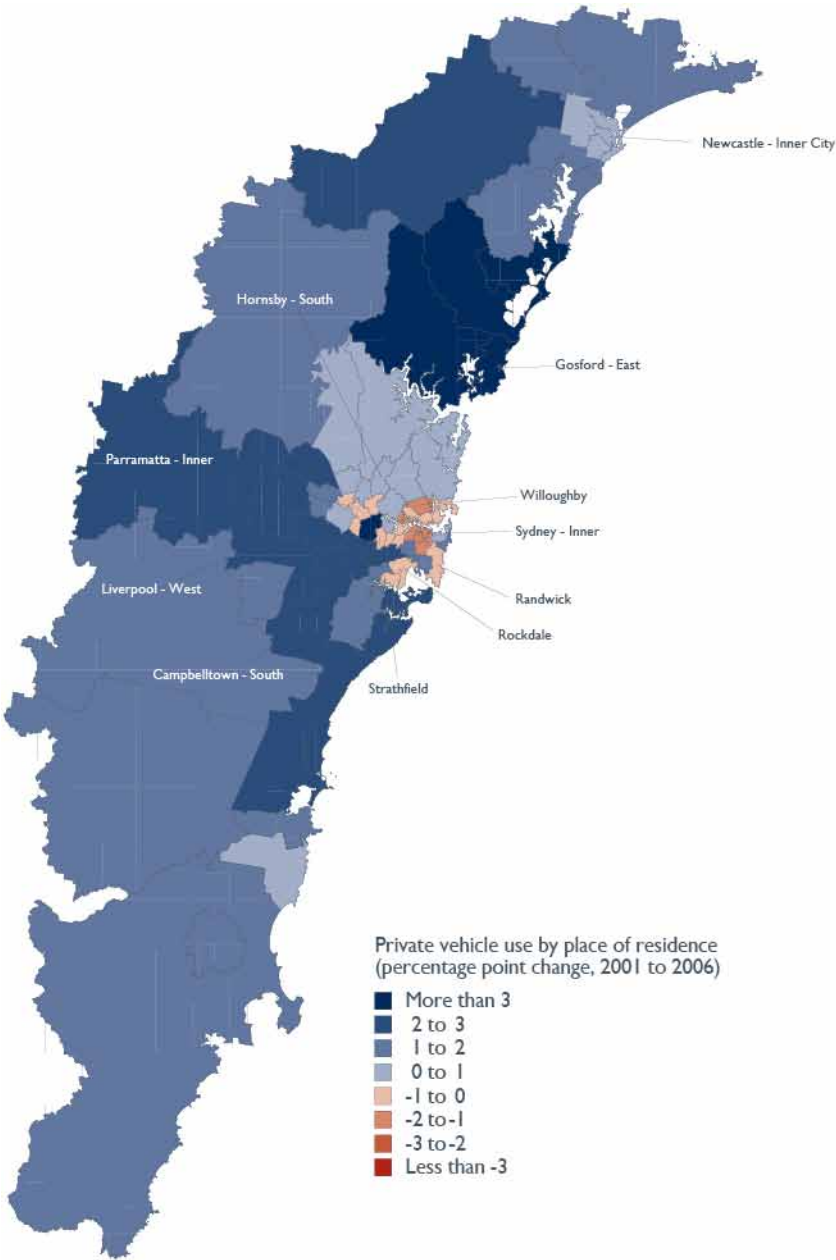
The comparison between 2001 and 2006 census results at the SLA level is complicated by the fact that the definitions of some SLAs changed during this period. In particular, some 2001 SLAs have been split into two or more SLAs in the 2006 definitions. To avoid reporting changes caused by SLA redefinitions, some SLAs have been grouped together prior to calculating the change in mode share⁴².

As shown in Maps 6.7 and 6.8, for residents of most SLAs in the Sydney GMA private vehicle mode share for journey to work has increased between 2001 and 2006, while public transport mode share has decreased. The areas where public transport mode share has increased are the Parramatta LGA (i.e. the aggregate of the four Parramatta SLAs); the SLAs of Strathfield and Burwood in the Inner West; Rockdale and Kogarah to the south of the city; and the SLAs surrounding North Sydney. The other main exceptions to the prevailing trend are a handful of

⁴² These are:
 Leichhardt, Sydney East, Sydney Inner, Sydney South, and Sydney West;
 Bankstown North East, Bankstown North West, and Bankstown South;
 Baulkham Hills Central, Baulkham Hills North, and Baulkham Hills South;
 Campbelltown North and Campbelltown South;
 Fairfield East and Fairfield West;
 Gosford East and Gosford West;
 Hornsby North and Hornsby South;
 Lake Macquarie East, Lake Macquarie North, and Lake Macquarie South;
 Liverpool East and Liverpool West;
 Newcastle Inner City, Newcastle Outer West, and Newcastle-Throsby;
 Parramatta Inner, Parramatta North East, Parramatta North West, and Parramatta South;
 Penrith East and Penrith West;
 Wollongong Inner and Wollongong Balance; and
 Wyong North East and Wyong South and West.

SLAs in and around the CBD, where increases in the use of active modes (primarily walking) have resulted in a drop in the mode shares of both private vehicles and public transport. However, in the majority of SLAs there has been little change in the use of either cycling or walking.

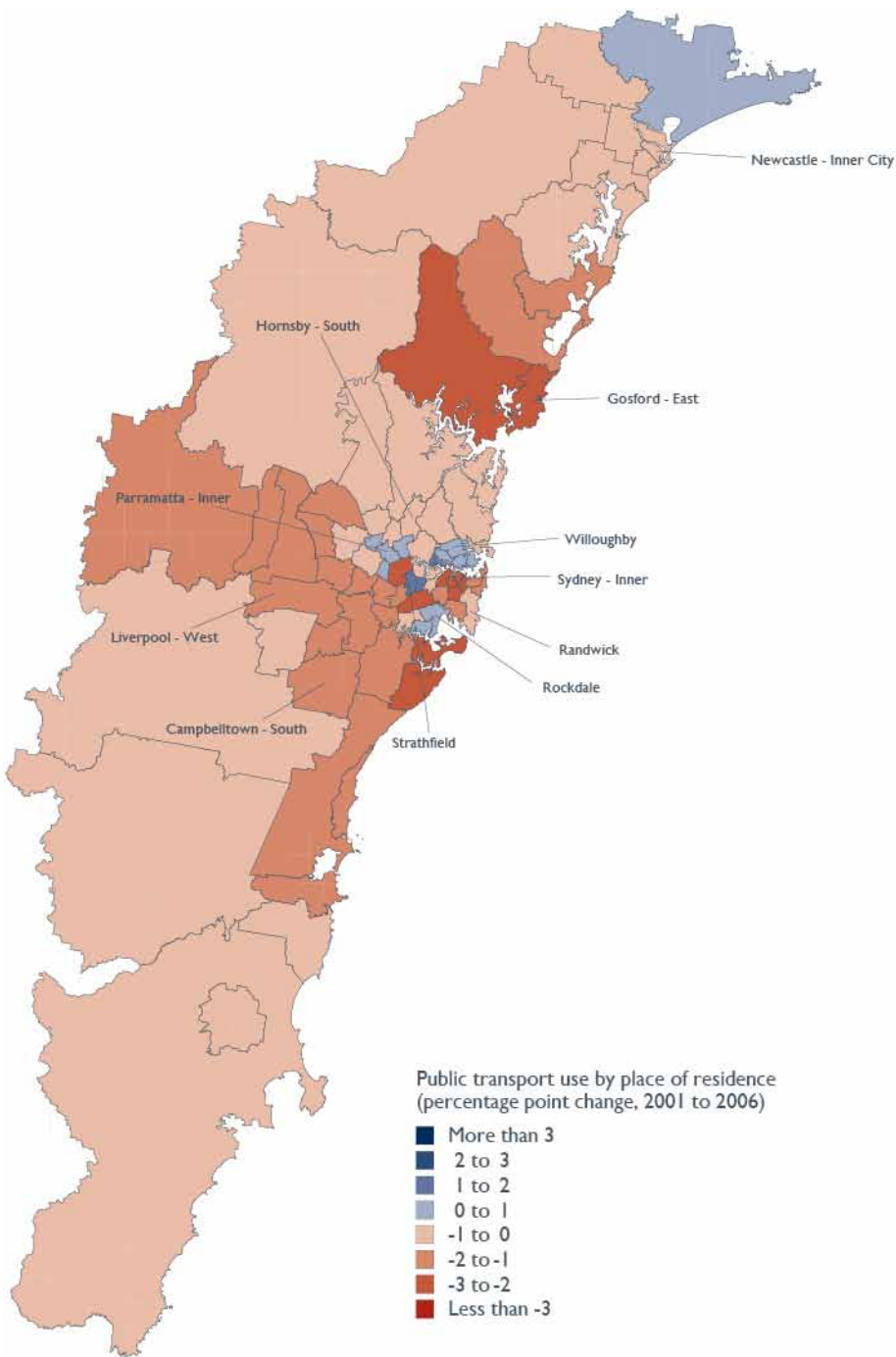
Map 6.7 Change in private vehicle mode share for journey to work by SLA of residence, Sydney Greater Metropolitan Area, 2001 to 2006



Note: To avoid reporting changes caused by SLA redefinitions between 2001 and 2006, some SLAs have been grouped together prior to calculating the change in mode share.

Source: BITRE analysis of ABS 2001 and 2006 *Census of Population and Housing* data (using ABS 2007b, ABS 2003).

Map 6.8 Change in public transport mode share for journey to work by SLA of residence, Sydney Greater Metropolitan Area, 2001 to 2006



Note: To avoid reporting changes caused by SLA redefinitions between 2001 and 2006, some SLAs have been grouped together prior to calculating the change in mode share.

Source: BITRE analysis of ABS 2001 and 2006 *Census of Population and Housing* data (using ABS 2007b, ABS 2003).

Analysis by place of work

Examining the use of different transport modes by place of work provides a different picture to analysis by place of residence. Although there is some difference between total employed residents and total employees for the GMA, the mode shares by place of work at the GMA level are very similar to those by place of residence. This is because the majority of GMA residents are employed within the GMA, and *vice versa*. However, even at the relatively broad scale of sectors, substantial differences are apparent. This is due to the difference in the spatial distributions of the employed resident population and the jobs in which they are employed.

2006 snapshot

This section examines the modes of transport used by employed persons on journeys to work in 2006 based on their place of work. This uses data from the NSW Bureau of Transport Statistics which is derived from the 2006 ABS *Census of Population and Housing*. This data is examined at similar levels of spatial aggregation as were used in the place of residence analysis.

Approximately 10 per cent of the 2 million employees of the Sydney GMA did not attend work on 2006 census day, while a further one per cent did not provide information on their mode of travel. As for place of residence, the focus of the analysis in this section is on the remaining employees who attended work and provided details of their mode of travel.

Table 6.8 summarises journeys to work by mode in 2006 for employees of the Sydney GMA. As for the place of residence data, car is the most popular method of travel to work, representing nearly 70 per cent of all recorded journeys. Public transport accounts for approximately 18 per cent of journeys to work in the Sydney GMA. Train and bus are the most commonly used modes of public transport. Relatively few commuters chose to cycle to work (less than one per cent), while nearly 5 per cent of journeys to work across the GMA were made by walking.

Table 6.8 Journey to work by transport mode for persons employed in the Sydney Greater Metropolitan Area, 2006

Mode of transport	Employees (number)	Employees (per cent of subtotal)
Car (as driver)	1 133 836	62.7
Car (as passenger)	108 302	6.0
Other private vehicle	31 229	1.7
Train	222 043	12.3
Bus	99 753	5.5
Other public transport	12 587	0.7
Cycling	12 858	0.7
Walking	85 072	4.7
Other modes	16 162	0.9
Worked at home	85 109	4.7
Subtotal	1 806 951	100.0
Did not go to work	211 498	—
Method of travel not stated	22 565	—
Total employees	2 041 014	—

Notes: Percentages are of total employed persons who attended work on census day and who stated their method of travel. Individual figures may not sum to totals due to rounding and confidentialisation.

Source: BITRE analysis of BTS JTW table 12 for 2006.

Sectors and planning subregions

The broad patterns in travel to work by place of work are similar to those by place of residence, although there are some important differences. The public transport mode share is higher for Inner sector employees than for Inner sector residents (as shown in Table 6.9), and lower for Middle and Outer sector employees than residents. This is not surprising given the different distribution of population and employment discussed in previous chapters, and that the public transport system (particularly the rail system) is designed primarily to facilitate radial journeys. Table 6.9 shows that while the use of public transport by place of residence decreases gradually with distance from the city, by place of work public transport usage drops off much faster.

The public transport system in Sydney, as in most cities, has historically been designed to facilitate travel to and from the city centre. This provides residents from across the city with access to jobs in and around the city centre, but does not necessarily provide easy access to jobs in other areas. This is reflected in the low rates of public transport use and high rates of car use for the South West, North West and Central Coast subregions, as shown in Table 6.10.

The use of active modes is much more evenly distributed by place of employment than by place of residence, although the general pattern is similar with the highest rates in the City of Sydney and East subregions. The West Central, South West, North West and Central Coast subregions have the lowest rates of walking, while the North subregion has the lowest rate of cycling.

Table 6.9 Transport mode share for journey to work by sector of employment, Sydney Greater Metropolitan Area, 2006

Sector	Car	Other private vehicle	Public transport	Cycling	Walking	Other modes	Worked at home
(per cent)							
Sydney GMA	68.7	1.7	18.5	0.7	4.7	0.9	4.7
Sydney SD	66.1	1.6	21.2	0.7	4.9	0.9	4.7
Inner	42.4	1.0	44.4	0.9	6.9	1.0	3.2
Middle	75.9	1.5	13.1	0.5	4.1	0.7	4.2
Outer	81.4	2.3	5.1	0.6	3.5	0.9	6.3
Illawarra	83.2	2.3	2.5	1.0	4.3	0.9	5.8
Lower Hunter	84.7	2.3	3.1	1.0	3.6	0.9	4.5

Notes: Percentages are of total employed persons who attended work on census day. Individual figures may not sum to totals due to rounding and confidentialisation.

Source: BITRE analysis of BTS JTW table 12 for 2006.

Table 6.10 Transport mode share for journey to work by planning subregion of employment, Sydney, 2006

Planning subregion	Car	Other private vehicle	Public transport	Cycling	Walking	Other modes	Worked at home
(per cent)							
Sydney SD	66.1	1.6	21.2	0.7	4.9	0.9	4.7
City of Sydney	30.0	0.8	58.9	1.0	6.7	1.1	1.5
East	66.9	1.4	16.7	0.9	7.3	1.0	5.8
Inner North	62.9	1.1	24.7	0.5	5.5	0.8	4.6
Inner West	72.0	1.6	14.1	0.6	5.5	0.7	5.6
South	75.4	1.8	10.1	0.6	5.5	0.7	5.8
North	71.7	1.2	9.4	0.3	4.7	1.0	11.8
North East	73.0	1.9	7.5	1.0	5.8	1.0	9.9
West Central	81.6	2.1	9.9	0.4	2.8	0.7	2.3
North West	82.4	2.3	4.5	0.6	3.0	0.9	6.3
South West	82.8	2.6	5.1	0.5	3.2	0.8	5.0
Central Coast	83.1	2.2	3.5	0.6	3.0	0.9	6.7

Notes: Percentages are of total employed persons who attended work on census day. Individual figures may not sum to totals due to rounding and confidentialisation.

Source: BITRE analysis of BTS JTW table 12 for 2006.

Examining the breakdown of public transport modes in Table 6.11 provides further insight into these differences. By place of residence, train use in the Inner sector is lower than the Middle sector; but by place of work it is much higher. This is due to the number of commuters who use the rail system to access jobs in the Inner sector; but who live in the Middle or Outer sectors. Commuting flows are examined in more detail in Chapter 7.

Table 6.11 Detailed public transport mode share for journey to work by sector of employment, Sydney Greater Metropolitan Area, 2006

Sector	Train	Bus	Ferry	Light rail	Taxi	Total public transport
(per cent)						
Sydney GMA	12.3	5.5	0.3	0.0	0.3	18.5
Sydney SD	14.2	6.2	0.4	0.1	0.4	21.2
Inner	29.3	13.3	1.0	0.1	0.7	44.4
Middle	9.8	3.0	0.0	0.0	0.2	13.1
Outer	3.1	1.8	0.0	0.0	0.2	5.1
Illawarra	1.2	1.1	0.0	0.0	0.2	2.5
Lower Hunter	1.1	1.8	0.0	0.0	0.2	3.1

Notes: Percentages are of total employed persons who attended work on census day. Individual figures may not sum to totals due to rounding and confidentialisation.

Source: BITRE analysis of BTS JTW table 12 for 2006.

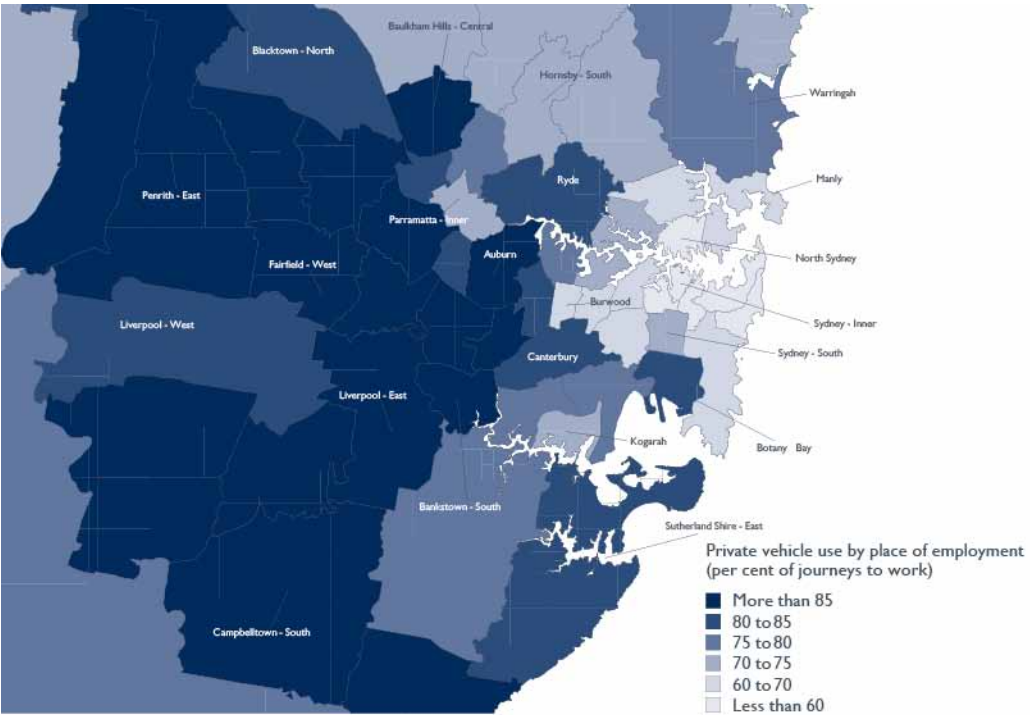
Statistical Local Areas

Map 6.9 illustrates how the private vehicle mode share differs across Sydney's SLAs of work, while Map 6.10 illustrates differences across SLAs in the public transport mode share. As shown in Map 6.10, high rates of public transport use are restricted to the CBD and North Sydney, a corridor stretching from the CBD to Burwood, and the Parramatta Inner SLA. Private vehicle mode share by place of employment is highest amongst SLAs in the Outer sector, as it is by place of residence. However, unlike the results by place of residence, many SLAs in the Middle sector also have high rates of private vehicle use.

The Sydney Inner SLA recorded both the highest rate of public transport use and the lowest rate of private vehicle use of any SLA. Only 19 per cent of employees used a private vehicle to travel to work, while 73 per cent used public transport. By comparison, the next lowest private vehicle mode share was over 40 per cent recorded in Sydney East, and the next highest public transport figure was for North Sydney where 42 per cent of employees used it to get to work. These three SLAs (Sydney Inner, Sydney East and North Sydney) along with Sydney West were the only to record public transport mode shares above 40 per cent, and were also the only SLAs to record private vehicle mode shares under 50 per cent. The SLAs of Waverley, Willoughby, Burwood, Parramatta Inner and Sydney South all had public transport mode shares above 20 per cent, while Waverley and Woollahra were the only other SLAs with private vehicle use by employees of under 60 per cent.

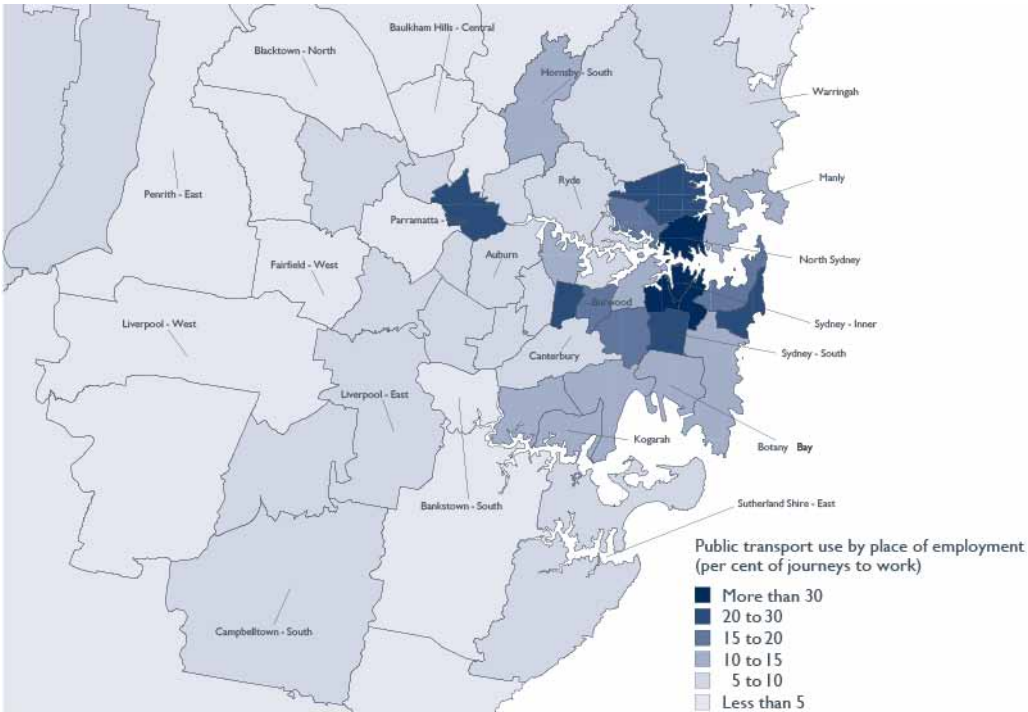
By place of employment, the SLAs with the highest proportion of journeys using active modes are somewhat different to those by place of residence. The distribution of active modes is also much flatter by place of work, with no SLA recording more than 13 per cent active modes. There are six SLAs for which active modes represented over 10 per cent of journeys to work—Sydney East, Manly, Randwick, Sydney West, Waverley and Woollahra. All of these except Manly are in the City of Sydney or East planning subregions.

Map 6.9 Private vehicle mode share for journey to work by Statistical Local Area of employment, Sydney, 2006



Source: BITRE analysis of BTS JTW table 12 for 2006.

Map 6.10 Public transport mode share for journey to work by Statistical Local Area of employment, Sydney, 2006



Source: BITRE analysis of BTS JTJW table 12 for 2006.

Strategic centres and employment lands

Centres act as focal points for employment and services, and feature prominently in recent Sydney metropolitan strategies. Providing good public transport services and infrastructure that encourages sustainable transport to these areas can potentially provide a large number of employees with a viable alternative to the car.

Table 6.12 shows mode shares for each type of centre as well as employment lands, dispersed employment within the Sydney SD, and employment in the Illawarra SD and Lower Hunter SSD. Some centres recorded substantial levels of public transport use amongst employees in 2006, while in others employees relied heavily on private vehicles to get to work. The definitions used for each centre are based on the definitions provided in TDC (2008b), modified by BITRE in some instances to reflect information provided in the relevant subregional plan (see Table 4.7 for more detail). BITRE defined employment land precincts of more than five hectares by aggregating 2006 destination zones, using information provided in the subregional plans.

As shown, there are significant differences between the various types of centre in the mode shares for both public transport and private vehicles. These reflect differences in the overall levels of accessibility by public transport for each type of centre. Public transport mode share is lower for employment lands and for dispersed employment in the Sydney SD than for any of the types of strategic centres, and lower still for the Illawarra and Lower Hunter.

Table 6.12 Transport mode share for journey to work by place of employment, Sydney Greater Metropolitan Area, 2006

Place of employment	Car	Other private vehicle	Public transport	Cycling	Walking	Other modes	Worked at home
(per cent)							
Strategic centres total	50.7	0.8	40.3	0.7	5.5	0.8	1.2
Global Sydney	25.0	0.7	64.6	0.9	6.6	0.9	1.3
Regional cities	72.4	0.8	21.5	0.4	3.9	0.5	0.6
Major centres	71.9	0.8	19.6	0.5	5.6	0.6	1.1
Specialised centres	77.5	1.1	15.0	0.6	3.9	0.7	1.2
Planned major centres	73.1	1.9	17.2	1.1	3.6	0.7	2.3
Potential major centres	83.2	0.8	9.3	0.3	4.9	0.4	1.0
Employment lands	86.4	2.5	6.7	0.6	1.9	0.7	1.1
Dispersed employment (Sydney SD)	71.7	2.0	8.6	0.6	5.7	1.1	10.3
Illawarra/Lower Hunter	84.1	2.3	2.8	1.0	3.9	0.9	5.0

Notes: Percentages are of total employed persons who attended work on census day. Individual figures may not sum to totals due to rounding and confidentialisation. Data for strategic centres, employment lands and dispersed locations relate solely to the Sydney SD. Table 2.3 provides information on each centre type, while Table 4.7 provides information on centre definitions.

Source: BITRE analysis of BTS JTW table 11 for 2006. Centre boundaries based on TDC (2008b), BITRE analysis of Metropolitan Strategy subregional plans and 2006 destination zone boundaries.

The proportion of commutes by walking also shows some variation between the different types of centre, but is much lower for employment lands. Dispersed employment in the Sydney SD is more commonly accessed by walking than employment in any of the centre types except Global Sydney. For the whole GMA the average proportion of commutes by bicycle is relatively small at 0.7 per cent. Global Sydney, planned major centres (principally Green Square), and the Illawarra/Lower Hunter exceed this figure, each with around one per cent of commuters cycling to work in these locations.

Dispersed employment in the Sydney SD and employment located in the Illawarra and Lower Hunter have much higher rates of working at home than employment in strategic centres or employment lands.

There is also considerable variation between individual centres, as detailed in Table 6.13. Predictably, the centres with the highest public transport mode shares are Central Sydney and North Sydney (comprising Global Sydney). Over half of commuters to North Sydney travelled by public transport, along with nearly two thirds of commuters to Central Sydney.

Table 6.13 Transport mode share for journey to work by strategic centre of employment, Sydney, 2006

Centre	Car	Other private vehicle	Public transport	Cycling	Walking	Other modes	Worked at home
(per cent)							
Global Sydney							
Central Sydney	23.6	0.7	66.0	1.0	6.7	0.9	1.2
North Sydney	36.1	0.8	53.5	0.6	6.4	0.8	1.8
Regional cities							
Liverpool	81.8	0.5	13.1	0.2	3.5	0.5	0.5
Parramatta	61.1	0.7	32.0	0.4	4.7	0.6	0.5
Penrith	84.2	0.7	10.4	0.4	3.2	0.4	0.7
Gosford	86.7	1.8	7.4	0.6	2.3	0.6	0.7
Major centres							
Bankstown	82.6	0.7	11.2	0.2	3.8	0.5	1.0
Blacktown	80.9	0.3	14.2	0.4	3.1	0.5	0.5
Bondi Junction	43.5	0.8	44.3	0.7	9.4	0.4	0.9
Brookvale–Dee Why	75.4	1.2	14.3	1.1	6.4	0.8	0.9
Burwood	65.1	0.6	26.6	0.4	5.6	0.4	1.4
Campbelltown–Macarthur	87.9	0.9	7.3	0.5	2.1	0.8	0.4
Castle Hill	86.8	0.5	7.1	0.1	3.7	0.5	1.4
Chatswood	53.5	0.6	36.1	0.4	7.4	0.6	1.4
Hornsby	69.6	0.9	17.9	0.3	8.9	0.7	1.7
Hurstville	71.4	0.3	18.3	0.4	7.8	0.4	1.5
Kogarah	74.0	0.4	16.5	0.4	7.2	0.5	0.9
Tuggerah–Wyong	88.8	2.5	4.5	0.6	1.3	0.7	1.6
Specialised centres							
Bankstown Airport–Milperra	91.6	1.9	4.1	0.5	0.8	0.5	0.6
Macquarie Park	84.9	0.8	9.9	0.5	2.0	0.7	1.2
Norwest Business Park	94.2	0.4	3.2	0.1	0.8	0.6	0.6
Olympic Park–Rhodes	80.3	1.2	15.0	0.3	1.4	0.7	1.0
Port Botany and environs	84.5	2.4	8.7	0.9	2.0	0.5	0.9
Randwick education and health	60.5	0.7	20.2	1.4	14.7	0.7	1.8
St Leonards–Crows Nest	61.1	1.0	28.2	0.5	6.4	0.6	2.1
Sydney Airport and environs	80.2	1.3	14.6	0.8	1.3	1.4	0.4
Westmead	80.2	0.4	12.3	0.5	5.4	0.5	0.6

Notes: Percentages are of total employed persons who attended work on census day. Individual figures may not sum to totals due to rounding and confidentialisation. Excludes planned and potential major centres. Table 2.3 provides information on each centre type, while Table 4.7 provides information on centre definitions.

Source: BITRE analysis of BTS JTW table 11 for 2006. Centre boundaries based on TDC (2008b), BITRE analysis of Metropolitan Strategy subregional plans and 2006 destination zone boundaries.

The regional city of Parramatta and the major centres of Bondi Junction and Chatswood also recorded public transport mode shares above 30 per cent. Only a handful of the other strategic centres recorded public transport mode shares above 18.5 per cent (the average for the Sydney GMA). These were Burwood, St Leonards–Crows Nest and Randwick education and health. Of the four Regional cities, only Parramatta had an above-average public transport mode share, with a relatively small proportion of workers in Liverpool (13 per cent), Penrith (10 per cent) and Gosford (7 per cent) travelling to work by public transport.

The strategic centres that were most reliant on private vehicles as the mode of travel to work were the Norwest Business Park (95 per cent), Bankstown Airport–Milperra (94 per cent), Tuggerah–Wyong (91 per cent), Campbelltown–Macarthur (89 per cent) and Gosford (89 per cent). All but Bankstown Airport–Milperra are located in the Outer sector of Sydney. Chapter Four showed that Norwest was one of the main focal points for job growth in Sydney between 2001 and 2006 adding 6300 jobs, while Campbelltown–Macarthur and Tuggerah–Wyong also experienced substantial job growth (adding 2700 and 2500 jobs, respectively).

The cycling mode share is relatively high for those who work in Brookvale–Dee Why, Randwick education and health, and Central Sydney. Walking to work is relatively common amongst those who are employed at the Bondi Junction, Hornsby and Randwick education and health strategic centres.

Changes from 2001 to 2006

The data used for place of work analysis for 2001 does not separately identify “not stated” responses. As such, in this section “not stated” is included with “other modes” for both 2001 and 2006. Although this is a slightly different treatment to the 2006 figures presented above, it allows a like-for-like comparison to be performed while not substantially affecting the interpretation of the results.

Sectors and planning subregions

By place of work, between 2001 and 2006 private vehicle use increased in all sectors except the Inner sector, while public transport use fell in all sectors. The biggest increase in private vehicle use occurred in the Outer sector which recorded a 0.8 percentage point increase in mode share, while increases in the Middle sector, Illawarra and Lower Hunter were relatively small. Private vehicle use in the Inner sector fell 1.4 percentage points.

Public transport use experienced falls of between 0.4 and 1.1 percentage points in all sectors, while the public transport mode share for the GMA as a whole fell by 1.3 percentage points. This slightly unintuitive result is due to a substantial increase in the number of jobs in the Outer sector, where the public transport mode share is low (5.1 per cent in 2006). There were an additional 35 500 journeys to work in this sector in 2006 compared to 2001, representing nearly half the total increase in journeys to work for the whole GMA. This raised the relative contribution of the Outer sector figures to the GMA average, causing the larger fall in overall public transport mode share shown.

Table 6.14 Change in mode share for journey to work by sector of employment, Sydney Greater Metropolitan Area, 2001 to 2006

Sector	Car	Other private vehicle	Public transport	Cycling	Walking	Worked at home
(percentage point change)						
Sydney GMA	0.59	-0.19	-1.33	0.05	0.36	-0.23
Sydney SD	0.41	-0.15	-1.29	0.07	0.42	-0.21
Inner	-1.48	0.07	-0.82	0.22	1.06	0.11
Middle	0.31	-0.21	-1.02	0.03	0.34	-0.13
Outer	1.18	-0.38	-0.75	-0.03	-0.05	-0.69
Illawarra	0.95	-0.55	-0.64	-0.07	-0.16	-0.24
Lower Hunter	0.50	-0.39	-0.47	-0.12	0.12	-0.48

Notes: Change in mode share for "other modes" not shown.

Source: BITRE analysis of BTS JTW table 12 for 2006 and table 6 for 2001.

Planning subregions tell a similar story to sectors, as shown in Table 6.15. All subregions experienced a decrease in public transport use between 2001 and 2006, and the majority also saw an increase in private vehicle use. Those for which private vehicle use decreased were the City of Sydney, East, West Central, and North East.

Table 6.15 Change in mode share for journey to work by planning subregion of employment, Sydney Greater Metropolitan Area, 2001 to 2006

Planning subregion	Car	Other private vehicle	Public transport	Cycling	Walking	Worked at home
(percentage point change)						
Sydney SD	0.41	-0.15	-1.29	0.07	0.42	-0.21
City of Sydney	-1.53	0.13	-1.51	0.32	1.48	0.14
East	-0.62	-0.11	-0.55	0.07	0.52	-0.04
Inner North	0.25	0.04	-1.53	0.01	0.40	0.16
Inner West	1.09	-0.27	-1.82	0.03	0.38	0.02
South	0.96	-0.17	-1.57	0.00	0.40	-0.25
North	1.11	-0.35	-1.43	-0.01	0.46	-0.56
North East	-0.05	-0.26	-0.65	-0.03	0.38	-0.08
West Central	0.05	-0.30	-0.49	0.06	0.20	-0.23
North West	1.64	-0.45	-0.78	0.00	-0.24	-0.90
South West	1.26	-0.22	-0.49	-0.08	-0.30	-0.73
Central Coast	1.54	-0.55	-0.41	-0.09	-0.39	-0.97

Notes: Percentages are of total employed persons who attended work on census day. Individual figures may not sum to totals due to rounding and confidentialisation.

Source: BITRE analysis of BTS JTW table 12 for 2006 and table 6 for 2001.

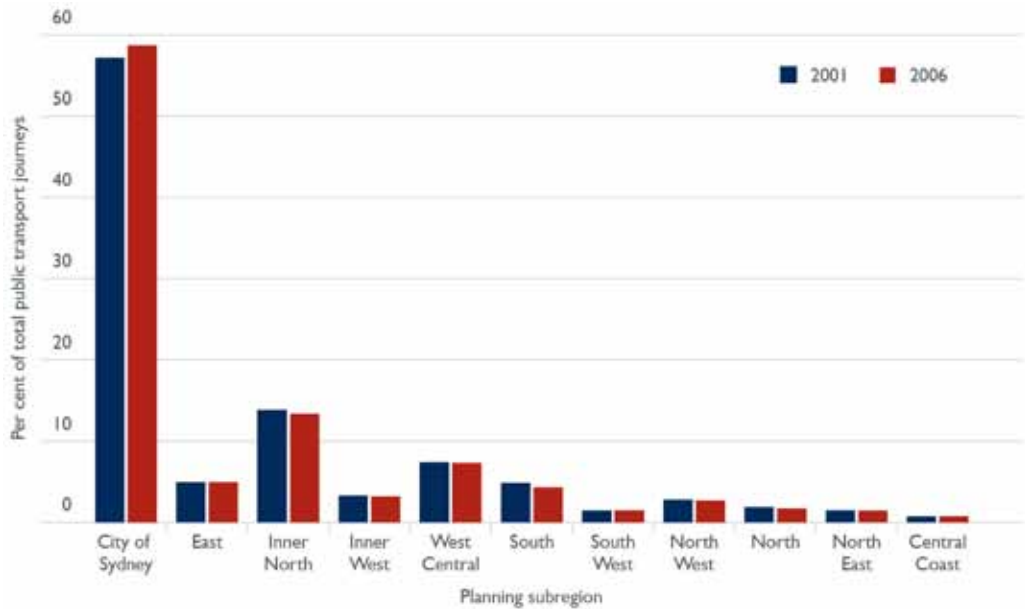
The City of Sydney was the only planning subregion to see a substantial change in the cycling mode share—an increase of 0.3 percentage points. City of Sydney also experienced by far the largest increase in walking, while moderate changes (both positive and negative) occurred for other planning subregions. Generally, there was a tendency for the walking mode share to decline for jobs located in the outer suburbs (i.e. North West, South West and Central Coast subregions), and rise in the inner and middle suburbs. The largest declines in the proportion working from home occurred in the three outermost subregions—North West, South West and Central Coast.

Figure 6.2 provides a different perspective on public transport use in the Sydney SD. This shows what proportion of total commutes by public transport is to jobs in each planning subregion in both 2001 and 2006. The majority of commutes by public transport are to jobs in the City of Sydney, and this proportion increased slightly from 57.2 to 58.7 per cent between 2001 and 2006. Around 13.3 per cent of total public transport commutes in 2006 were to destinations in the Inner North subregion (down 0.5 percentage points from 2001), while West Central represents the destination of a further 7.3 per cent (which remained relatively steady throughout the period). The East and South subregions were each the destination of just under 5 per cent of public transport commutes in 2001, with the East region retaining its share in 2006 and South declining slightly.

The Inner sector as a whole was the destination of 73.3 per cent of all public transport trips to work. This is a slightly lower proportion than the Inner sector in Melbourne represents of the Melbourne total, which in turn is slightly lower than the equivalent figure for Perth (BITRE 2011, BITRE 2010). The same pattern also exists when comparing the City of Sydney LGA with the equivalent areas of Melbourne and Perth. This suggests that commuting by public transport in Sydney is somewhat less focussed on the CBD and surrounding areas than in these other cities, perhaps because Melbourne and Perth do not contain rail accessible secondary employment centres of the same scale as Parramatta and North Sydney.

Unlike Melbourne (but like Perth), in the Sydney SD the pattern of destinations is similar for bus and train journeys separately as it is for overall public transport use. The City of Sydney was the destination for 57.8 per cent of total commutes by train and 59.5 per cent of commutes by bus, whereas the City of Melbourne is the destination for less than 30 per cent of total commutes by bus in the Melbourne Working Zone (BITRE 2011). Some differences do exist in Sydney though—the East and North East subregions account for noticeably higher proportions of total bus commutes than total train commutes, while the opposite is true of the Inner North and West Central subregions.

Figure 6.2 Proportion of total public transport trips by place of work subregion, Sydney, 2001 and 2006



Source: BITRE analysis of BTS JTJW table 12 for 2006 and table 6 for 2001.

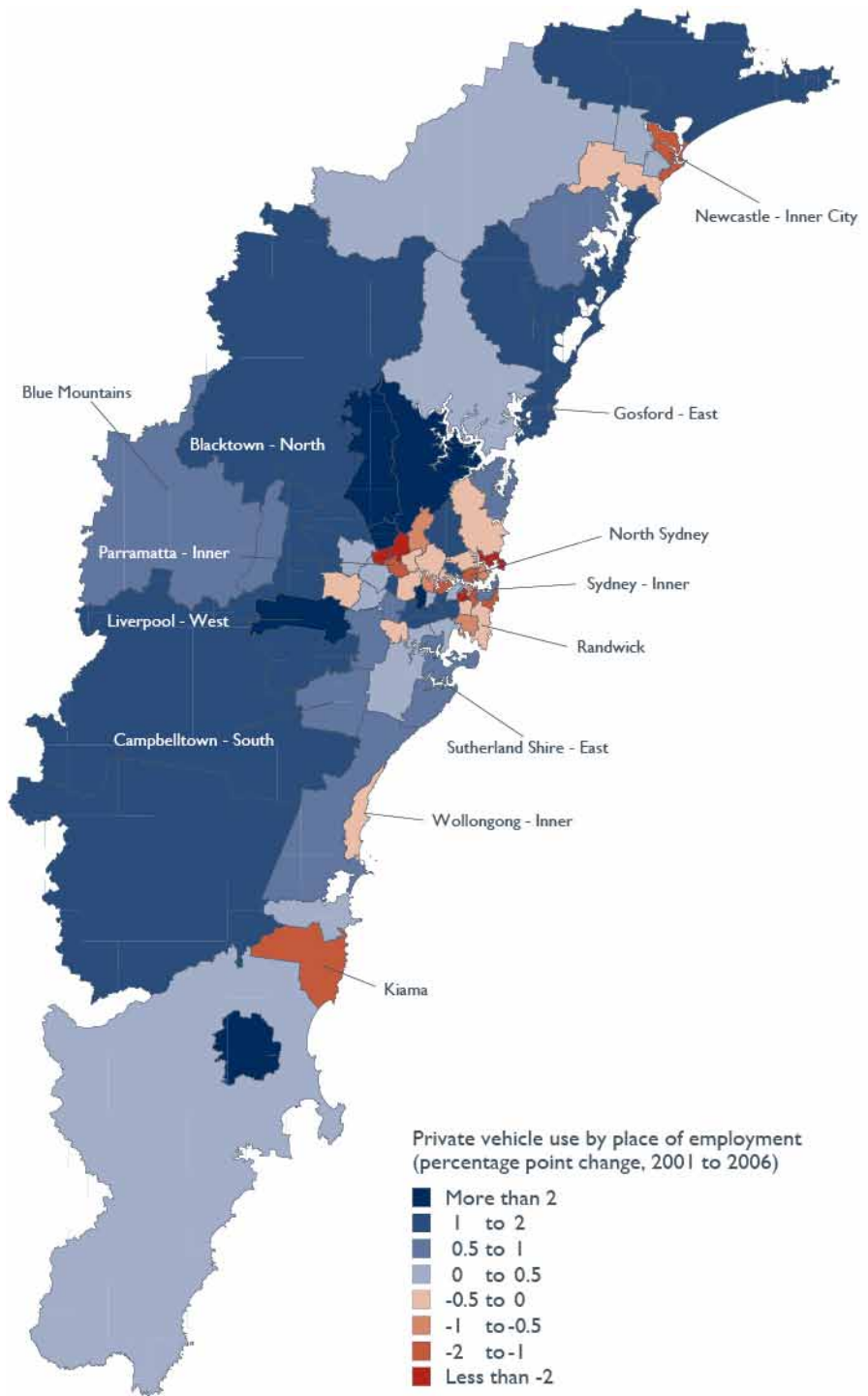
Statistical Local Areas

Map 6.11 shows changes in private vehicle use between 2001 and 2006 for journeys to work by place of employment. In 52 of the 80 SLAs in the Sydney GMA, the private vehicle mode share increased between 2001 and 2006. Of these, 38 experienced an increase of more than 0.5 percentage points. Those that increased more than 2 percentage points were Baulkham Hills Central, Baulkham Hills North, Hornsby North, Liverpool West, Shoalhaven Part A and Strathfield.

A total of 16 SLAs experienced a drop of more than 0.5 percentage points in the private vehicle mode share. Those for which the private vehicle mode share fell by more than 2 percentage points were Baulkham Hills South, Manly, Parramatta North West and Sydney West.

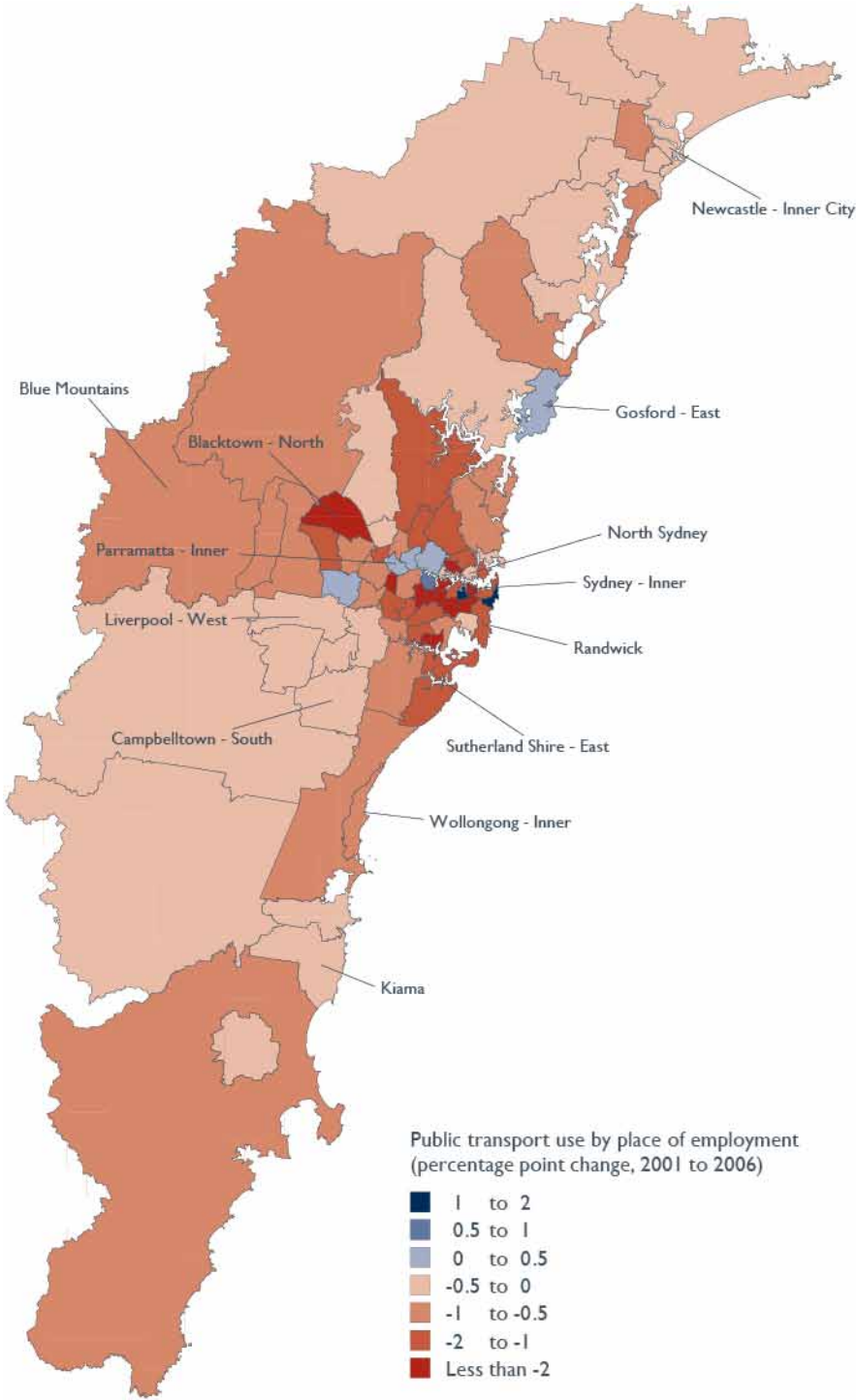
As shown in Map 6.12, 72 of the 80 SLAs in the Sydney GMA experienced some decline in public transport mode share between 2001 and 2006, and for 48 of those this was at least 0.5 percentage points. In 12 SLAs the mode share dropped by 2 percentage points or more. These were Ashfield, Blacktown North, Burwood, Drummoyne, Kogarah, Lane Cove, Marrickville, Parramatta South, Strathfield, Sydney East, Sydney Inner and Sydney South.

Map 6.11 Change in private vehicle mode share for journey to work by SLA of employment, Sydney Greater Metropolitan Area, 2001 to 2006



Source: BITRE analysis of BTS JTWW table 12 for 2006 and table 6 for 2001.

Map 6.12 Change in public transport mode share for journey to work by SLA of employment, Sydney Greater Metropolitan Area, 2001 to 2006



Source: BITRE analysis of BTS JTWW table 12 for 2006 and table 6 for 2001.

Of the 8 SLAs in which the public transport mode share increased between 2001 and 2006, only three saw increases of half a percentage point or more. These were Concord, Sydney West and Waverley, which experienced increases of 0.5, 1.5 and 1.9 percentage points respectively.

There was a strong shift from private vehicle to public transport for accessing jobs in Sydney West and Waverley. Those SLAs where a similar shift occurred in the opposite direction are far more numerous. However, not all reductions in public transport mode share were due to direct shifts towards private vehicle use. In some of the SLAs in which public transport mode share declined by more than 0.5 percentage points, private vehicle mode share similarly declined. In many other SLAs private vehicle mode share was relatively unchanged by the drop in public transport use. This was due to increases in active modes and, in some cases, higher rates of working at home.

There were 13 SLAs in the Sydney GMA which increased their walking mode share by more than one percentage point between 2001 and 2006. The majority of these are in the Inner sector, but they also include Burwood, Drummoyne, Kogarah and Willoughby in the Middle sector; Hornsby South in the Outer sector; and Newcastle Inner City in the Lower Hunter. The SLAs experiencing more than a 0.5 percentage point decline in walking were Blue Mountains, Camden, Hornsby North, Maitland, Shoalhaven Part A, Wingecarribee, Wyong North East, and Wyong South and West. All of these are in the Outer sector; Illawarra or Lower Hunter.

By place of employment, only two SLAs experienced a change of more than half a percentage point in the cycling mode share between 2001 and 2006. These were Sydney East, which increased its mode share by 0.53 percentage points, and Hunter's Hill in which cycling decreased by 0.65 percentage points.

Strategic centres and employment lands

While most individual centres are too small to allow reliable estimates of changes between 2001 and 2006, examining combined data for the different types of centres produces some useful results. Table 6.16 shows the percentage point changes in modes for accessing jobs in each of the types of centres, in employment lands, in dispersed locations in the Sydney SD, and in the remainder of the GMA.

Of the different centre types, only the Regional cities (Liverpool, Parramatta, Penrith and Gosford) experienced an increase in public transport mode share between 2001 and 2006. Employment in Regional cities declined slightly during this period.

Global Sydney (comprising Central Sydney and North Sydney) and the planned major centres (Green Square, Leppington and Rouse Hill) were the other types of centre to see a drop in private vehicle mode share, and while public transport use also fell, there were substantial increases in walking and (to a lesser extent) cycling. The changes in planned major centres primarily reflect changes in commuting patterns to Green Square. The result for Global Sydney is more interesting. The total number of journeys to work by car is almost unchanged for Central Sydney, while the number of walking and cycling trips increased by 5 600. This represents a 37 per cent increase in the number of trips using active modes. The same shift from motorised to non-motorised transport, and in particular the shift away from private vehicle use, occurred in North Sydney.

Table 6.16 Change in mode share for journey to work by place of employment, Sydney Greater Metropolitan Area, 2001 to 2006

Place of employment	Car	Other private vehicle	Public transport	Cycling	Walking	Worked at home
(percentage point change)						
Strategic centres total	0.04	0.00	-1.65	0.17	0.92	-0.19
Global Sydney	-1.15	0.19	-1.53	0.33	1.29	0.13
Regional cities	-1.89	-0.10	0.89	0.07	0.55	-0.21
Major centres	0.79	-0.18	-1.36	0.01	0.74	-0.92
Specialised centres	0.49	-0.26	-0.91	-0.02	0.39	-0.33
Planned major centres	-0.98	0.19	-2.07	0.20	1.27	0.61
Potential major centres	1.46	-0.43	-0.67	-0.10	0.88	-1.62
Employment lands	1.11	0.05	0.79	-0.05	-0.65	-1.70
Dispersed employment (Sydney SD)	2.69	-0.32	-1.95	0.05	0.86	1.49
Illawarra/Lower Hunter	0.71	-0.46	-0.54	-0.10	0.00	-0.39

Notes: Change in mode share for "other modes" not shown. Data for strategic centres, employment lands and dispersed locations relate solely to the Sydney SD. Table 2.3 provides information on each centre type, while Table 4.7 provides information on centre definitions.

Source: BITRE analysis of BTS JTW table 11 for 2006 and table 3 for 2001. Centre boundaries based on TDC (2008b), BITRE analysis of Metropolitan Strategy subregional plans and 2006 destination zone boundaries.

Increases in rates of walking can be seen for all types of strategic centre and for dispersed employment in the Sydney SD, but there has been a reduction in walking to access employment lands from 2.4 per cent in 2001 to 1.9 per cent in 2006. Employment lands experienced a large increase in private vehicle use, while the public transport mode share also increased noticeably. The causes are hard to identify, as employment lands are relatively heterogeneous and geographically dispersed. However, these changes are important—in 2006 employment lands accounted for slightly more jobs than Global Sydney, and substantially more than any other type of centre. The effect of the changes in employment lands on the overall increase in private vehicle use across the GMA is greater than any of the centre types. Table 6.17 summarises this.

Table 6.17 shows there are three places of employment where changes in mode share have had a significant effect on the overall mode share for the GMA. These are Global Sydney, the employment lands, and dispersed employment within the Sydney SD. Employment lands had a larger effect on the private vehicle mode share for the GMA than any other place of employment. However the biggest contributor to the change in private vehicle mode share is the residual change, which is explained in more detail below.

Table 6.17 Influence of change in mode share by place of employment, Sydney Greater Metropolitan Area, 2001 to 2006

Place of employment	2006 commuters	Change in private vehicle mode share	Contribution to GMA change	Change in public transport mode share	Contribution to GMA change
	(persons)	(percentage points)			
Sydney GMA	1 829 516	0.40	0.40	-1.33	-1.33
Strategic centres total	638 365	0.03	-0.17	-1.65	-0.39
Global Sydney	309 373	-0.97	-0.16	-1.53	-0.26
Regional cities	61 038	-1.98	-0.07	0.89	0.03
Major centres	98 197	0.61	0.03	-1.36	-0.07
Specialised centres	149 166	0.23	0.02	-0.91	-0.07
Planned major centres	8 008	-0.79	0.00	-2.07	-0.01
Potential major centres	12 583	1.02	0.01	-0.67	0.00
Employment lands	320 129	1.16	0.20	0.79	0.14
Dispersed employment (Sydney SD)	601 993	-0.46	-0.15	-2.28	-0.75
Illawarra/Lower Hunter	269 029	0.25	0.04	-0.54	-0.08
Residual change			0.49		-0.26

Notes: Commuter figures exclude employees who did not attend work on census day, but include those who did not state their method of travel to work. Residual change is the change that would have occurred due to increases in the number of commuters if mode shares had remained constant for each place of employment.

Source: BITRE analysis of BTS journey to work table 11 for 2006 and table 3 for 2001. Centre boundaries based on TDC (2008b), BITRE analysis of Metropolitan Strategy subregional plans and 2006 destination zone boundaries.

Changes in mode choice by employees in dispersed locations account for the majority of the overall fall in public transport mode share, with Global Sydney also contributing. Changes in mode share occurring in centres other than Global Sydney had only minor effects on the overall result for the GMA.

The contributions to total change are calculated by comparing the actual change in mode share for the GMA with that which would have occurred if the mode share for a particular place of employment had remained constant during the period. For instance, if the private vehicle modes share of Global Sydney had remained constant instead of falling 0.97 percentage points this would have resulted in an additional 0.16 percentage point increase in the private vehicle mode share for the GMA. This calculation does not assume that the number of commuters remains the same, only that the mode shares are constant.

The residual change arises from changes in the number of commuters to each place of employment. This has an effect on mode share because the actual increases that occurred in the period were not distributed proportionally among the different places of employment. As Table 6.17 shows, the net effect of the residual change was to increase private vehicle mode share and decrease public transport mode share. This is because more of the growth in numbers of commuters occurred in areas which had high private vehicle and low public transport mode share relative to the GMA average. In the case of private vehicles this effect accounts for more than the net change in mode share for the GMA, although it is moderated somewhat by decreases in private vehicle mode share in Global Sydney and dispersed

employment locations. The residual change also had some effect on the public transport mode share for the GMA, but was not the primary driver of change.

The size and direction of the residual change is due to significant employment growth in areas which have higher private vehicle use and lower public transport use than the GMA average. There was above-average growth in the number of commutes to employment lands between 2001 and 2006 which have higher private vehicle mode share than any other place of employment (see Table 6.12). There was also rapid growth in the number of commutes to specialised centres, with the majority of this growth occurring in Norwest Business Park and Macquarie Park. Neither of these centres could be accessed by rail in 2006, although this has subsequently changed for Macquarie Park with the opening of the Epping—Chatswood Rail Line in early 2009.

Public transport access

This section provides some information on how transport access varies geographically across the Sydney GMA, both in terms of place of residence and place of work. The information presented is based on 2006 census population and the public transport network as it existed in 2007.

In order to assess access in a simple and consistent manner, benchmarks for the frequency and proximity of services are used. For the purpose of this section, a frequent public transport service is defined to be one which departs at least eight times during the morning peak (7am to 9am). An employed resident is considered to have access to a service if they live within either 500m or 1000m of a departure point (bus stop or rail station). These distance benchmarks are also used for determining access by place of employment.

As Table 6.18 shows, across the GMA 52.6 per cent of employed residents live within 500m of a frequent public transport service, and 72.6 per cent live within 1000m. These figures are higher if only the Sydney SD is considered (59.5 per cent and 80.0 per cent respectively). Levels of access are lowest in the Illawarra and the Lower Hunter, and get progressively higher for areas closer to the CBD.

Table 6.18 Employed residents' access to public transport by sector of residence, Sydney Greater Metropolitan Area, 2006

Sector	Access to frequent public transport service		Public transport share of journeys to work
	Within 500m	Within 1000m	
	(per cent)		
Sydney GMA	52.6	72.6	18.0
Sydney SD	59.5	80.0	20.7
Inner	93.9	99.8	32.4
Middle	68.7	91.8	25.0
Outer	42.9	67.1	14.3
Illawarra	13.1	27.7	4.9
Lower Hunter	20.1	39.3	3.3

Note: Based on public transport services which depart at least eight times during the morning peak.

Source: BTS 2011 data on request.

Table 6.19 shows that this pattern is repeated when examining the planning subregions. In general, higher proportions of residents have access to frequent public transport services in regions closer to the CBD. However, it highlights that public transport access for residents of the Central Coast is comparable with the Lower Hunter, and much lower than other areas within the Sydney SD.

Table 6.19 Employed residents' access to public transport by region of residence, Sydney, 2006

Planning subregion	Access to frequent public transport service		Public transport share of journeys to work
	Within 500m	Within 1000m	
	(per cent)		
Sydney SD	59.5	80.0	20.7
City of Sydney	98.5	100.0	32.4
East	94.5	99.7	29.1
Inner North	82.4	98.8	29.7
Inner West	90.0	97.7	30.9
South	61.8	88.3	24.2
North	36.3	68.5	23.2
North East	68.4	86.1	16.6
West Central	64.3	91.5	19.3
North West	41.1	63.0	13.1
South West	41.4	64.2	13.6
Central Coast	19.8	39.7	10.4

Note: Based on public transport services which depart at least eight times during the morning peak.

Source: BTS 2011 data on request.

Public transport mode share for journeys to work follows the same pattern as public transport access figures. In general, regions with higher levels of access recorded greater public transport mode shares. However, the North subregion has substantially lower levels of access than the average for the Sydney SD, while the public transport mode share for journeys to work by residents is higher than the SD average. Conversely, the West Central subregion has noticeably higher levels of access than the SD average, but lower public transport mode share.

The proportion of jobs in Sydney which are located within 500m or 1000m of a frequent public transport service is higher than the proportion of residents. This reflects the differences in spatial distributions of residents and jobs—residents are distributed more evenly than jobs, and the largest concentrations of jobs typically exist in locations which have relatively good public transport services (although this is not universally true). Tables 6.20 and 6.21 present the equivalent public transport access figures to those above, by place of employment rather than place of residence.

Table 6.20 Access to public transport by sector of employment, Sydney Greater Metropolitan Area, 2006

Sector	Access to frequent public transport service		Public transport share of journeys to work
	Within 500m	Within 1000m	
	(per cent)		
Sydney GMA	65.3	81.6	18.5
Sydney SD	71.3	87.3	21.2
Inner	96.5	99.8	44.4
Middle	73.8	94.2	13.1
Outer	46.3	70.7	5.1
Illawarra	26.2	43.1	2.5
Lower Hunter	35.3	54.9	3.1

Note: Based on public transport services which depart at least eight times during the morning peak.

Source: BTS 2011 data on request.

As shown, in each sector the proportion of jobs within 500m or 1000m of a frequent public transport service is equal to or higher than the proportion of residents. However, in some planning subregions (particularly those in inner suburban areas) this is reversed. For example, 90.0 per cent of residents of the Inner West subregion are within 500m of a frequent public transport service, while this is true of only 80.7 per cent of jobs in the subregion.

Furthermore, while public transport services in the majority of planning subregions offer better access to the jobs than to the residents' home addresses, only the City of Sydney planning subregion has a higher public transport mode share by place of work than it does by place of residence. So while many residents of outer suburbs are using public transport, this is typically to get to jobs located in the CBD. Relatively few of the jobs located in outer areas are being accessed by public transport. This demonstrates a limitation of this type of analysis: a resident may live in a location which is near a frequent public transport service, and their job may be similarly located, but there may be no convenient service between the two locations. In this case that resident is unlikely to choose public transport.

Table 6.21 Access to public transport by region of employment, Sydney, 2006

Planning subregion	Access to frequent public transport service		Public transport share of journeys to work
	Within 500m	Within 1000m	
	(per cent)		
Sydney SD	71.3	87.3	21.2
City of Sydney	99.1	100.0	58.9
East	90.1	99.0	16.7
Inner North	92.3	99.6	24.7
Inner West	80.7	92.3	14.1
South	64.7	86.9	10.1
North	44.3	70.6	9.4
North East	74.1	89.2	7.5
West Central	63.9	92.1	9.9
North West	43.4	68.3	4.5
South West	46.8	71.0	5.1
Central Coast	32.0	53.0	3.5

Note: Based on public transport services which depart at least eight times during the morning peak.

Source: BTS 2011 data on request.

There is some variation between the levels of access for individual SLAs within the larger regions detailed above. Public transport access for SLAs in the Illawarra and Lower Hunter is particularly diverse. The SLAs in Newcastle and Wollongong are comparable to outer suburban Sydney, while other areas have very low levels of access. Levels of access in the North West and South West subregions are similarly diverse, with the SLAs of Blue Mountains, Camden, Hawkesbury, Wollondilly and several Central Coast SLAs particularly poor in comparison to other Outer sector SLAs. Outer SLAs with comparatively good access include Baulkham Hills Central and South, Campbelltown South, Fairfield East and Warringah.

The Middle and Inner sectors are more homogeneous. Strathfield is the only SLA which stands out, having much lower levels of access than surrounding SLAs for both residents and jobs.

BITRE (2010) includes a similar analysis of access for Perth in 2006.⁴³ The Perth SD has a higher proportion of employed residents living within one kilometre of a frequent public transport service (89 per cent, compared to 80 per cent for the Sydney SD). However, the two cities have a similar proportion of jobs being within one kilometre of a frequent public transport service (88 per cent for Perth and 87 per cent for Sydney).

⁴³ The Perth stops and services dataset treats each platform at a rail station as a separate stop, while the Sydney dataset treats each rail station as a single stop, so the minimum frequency standard of 8 is more lenient for Sydney.

Metropolitan Strategy objectives

The broad planning objectives assessed here are those related to mode of transport for commuting trips. These objectives are:

- Greater use of public transport
- Greater use of active transport
- Better connect people to centres
- Concentrate development near public transport.

Progress since 2001 against each of these objectives is assessed below.

Greater use of public transport

A clear objective of recent Metropolitan Strategies has been to increase the use of public transport. In *City of Cities* this objective is expressed as part of a broader move towards encouraging more sustainable travel while *Sydney 2036* is more explicit, framing it in terms of increasing the public transport mode share.

Specific targets for the public transport mode share were set out in the 2006, 2010 and 2011 state plans and referred to in both the *Metropolitan Transport Plan* and *Sydney 2036*. The 2006 *State Plan* target was to increase the public transport mode share for journeys to work to 25 per cent by 2016 (NSW Government 2006). The 2010 *State Plan* increased this target to 28 per cent (NSW Government 2010c), and this target was retained in *NSW 2021* (NSW Government 2011c).

Public transport use for journeys to work declined in Sydney in the years following the 2001 census, and in 2006 the overall public transport mode share in the Sydney SD was 20.7 per cent by place of enumeration—1.1 percentage points lower than in 2001 (ABS 2003, ABS 2007b). This represents a decline in public transport use in absolute terms—on census day in 2006 there were approximately 3000 fewer people using public transport to get to work, despite a substantial population increase occurring over the five-year period.

Declines in the public transport mode share occurred in nearly all subregions (of work and residence) between 2001 and 2006. Outer suburban residents experienced a shift away from public transport use towards private vehicle use. However, Inner sector residents shifted away from both public transport and private vehicle use, towards active travel modes. On a place of work basis, the most pronounced decline in the public transport mode share occurred for dispersed locations (i.e. those locations which are neither strategic centres nor employment lands).

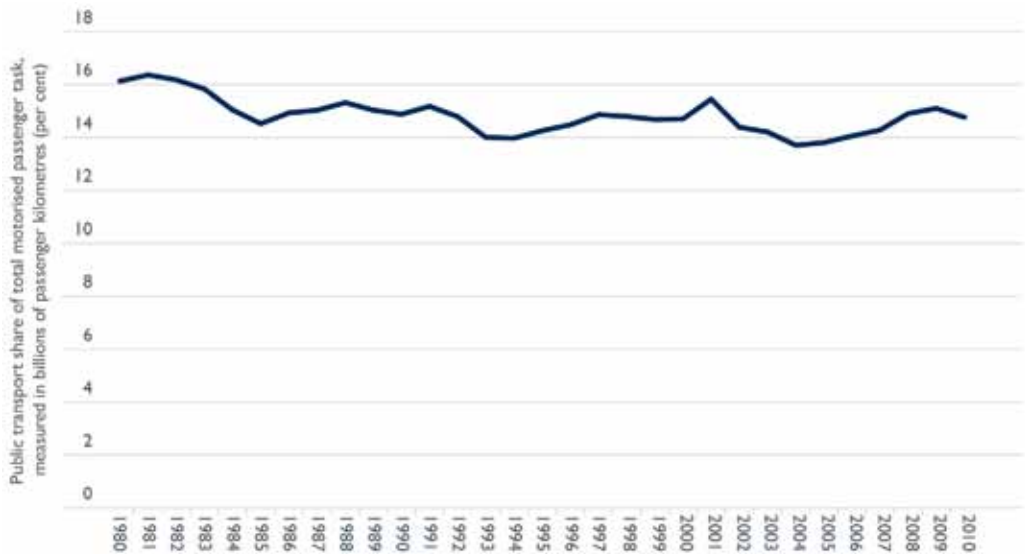
More recent data from the *Sydney Household Travel Survey* (HTS) suggests that this trend may have reversed since the 2006 census (BTS 2011). Although not directly comparable with census figures, the HTS reports that public transport experienced a 2 percentage point increase in mode share for the purpose of commuting between 2005–06 and 2007–08, with the mode share then remaining stable through to 2009–10 (ibid.).⁴⁴ Between 2000–01 and

⁴⁴ Based on reported mode shares for train and bus only (Table 4.3.3 of BTS 2011). NSW Government (2011d) covers all public transport modes (giving a mode share that is 0.6 percentage points higher than the train and bus mode share as of 2009–10), but displays the same pattern of growth.

2009–10 the public transport mode share recorded a net increase of around 3 percentage points for commuters (ibid.). Being a sample survey, there is some uncertainty associated with HTS results. However, this suggests that the public transport mode share has increased well beyond 2001 levels in the period since the 2006 census was taken.

Figure 6.3 displays BITRE's estimates of the overall public transport mode share which relate to passenger travel for all purposes, not just commuter travel. It reveals that the proportion of motorised passenger kilometres travelled on public transport in Sydney has oscillated around the 15 per cent mark for several decades, and stood at 14.8 per cent in 2009–10. Figure 6.3 shows that after the atypical rise in public transport use associated with the Sydney Olympics, the public transport mode share declined in the early 2000s, but this was followed by a substantial rise between 2003–04 and 2008–09.⁴⁵

Figure 6.3 Public transport share of total motorised passenger transport task, Sydney, 1980 to 2010



Note: Data relate to financial years. The spike in 2000–01 reflects the Sydney Olympics.

Source: BITRE 2012a.

One possibility is that changes in the cost of fuel have been affecting recent commuter behaviour, with relatively low fuel prices throughout the period from 2001 to late 2005 (Australian Automobile Association 2011) encouraging shifts to private vehicle use and subsequent price increases from 2006 to late 2008 pushing commuters back to public transport. This is unlikely to be the whole story for Sydney though. Substantial growth in both population and employment in Outer areas between 2001 and 2006 is also likely to have contributed to the observed change (see Chapters 4 and 5). Other factors that may also have had an effect include changes to public transport services, changes in household income, and public education or advertising campaigns.

⁴⁵ BITRE's estimates show that the public transport mode share ended the decade at a similar level to where it started (i.e. 14.7 per cent in 1999–2000 and 14.8 per cent in 2009–10). This differs from the net increase in the HTS results, probably due to differences in the underlying sources of information, scope and methodologies. More detailed and consistent data for assessing recent progress on this objective will be available after the relevant 2011 census results are released.

According to census data, in 2006 the public transport mode share for journeys to work stood at 20.7 per cent for the Sydney SD on a place of residence basis and 21.2 per cent on a place of work basis. Therefore, achieving the target of 28 per cent would require an increase in public transport mode share of approximately 0.7 percentage points per year between 2006 and 2016. Between the 2001 and 2006 censuses there was a 1.1 percentage point decrease in the public transport mode share in the Sydney SD by place of enumeration, or a 1.3 percentage point decrease by place of employment. On the surface this may seem to suggest that the target will be difficult to meet. However, the HTS estimates that the public transport mode share recorded a net increase of around 3 percentage points from 2000–01 to stand at 23.9 per cent in 2009–10 (NSW Government 2011d, BTS 2011). This suggests some progress has been made towards the target of 28 per cent by 2016, although an upturn in growth is required in the coming years for the target to be met.

Overall, there appears to have been some progress against this objective since 2001—the available evidence points to a significant decline in the public transport mode share for commuter travel following the Sydney Olympics in the early 2000s, followed by a significant increase from around 2004, with the result being that the mode share of commuter travel has been above 2001 levels since 2007–08.

When the focus is shifted beyond commuter travel, to all purposes of travel, there was little net change in Sydney's public transport mode share over the last decade. During this period Sydney (and Adelaide) recorded relatively modest growth in public transport patronage compared to other Australian cities, but Sydney continues to have a higher public transport mode share than the other cities (BITRE 2012a, 2012b).

Greater use of active transport

Increasing the use of active transport has been a goal of successive plans. In *City of Cities* it forms part of the broader objective of encouraging more sustainable travel while *Sydney 2036* articulates a specific goal of promoting active transport opportunities. *NSW 2021* aims to more than double the mode share of bicycle trips in the GMA and increase the walking mode share to at least 25 per cent by 2016 (NSW Government 2011c). These active transport goals relate to all types of trips, rather than specifically to travel for commuting purposes.

According to census journey to work data, the active transport mode share for the journey to work stood at 5.4 per cent for Sydney SD residents and 5.2 per cent for GMA residents in 2006. Around 85 per cent of active transport use was due to walking, rather than cycling. Between 2001 and 2006, the active transport mode share increased by 0.5 percentage points for the Sydney SD (and 0.4 percentage points for the GMA). While both walking and cycling increased, walking accounted for the majority of the increased mode share.

The increases in cycling were concentrated in the Inner sector, while a notable increase in walking to work was evident in both the Inner and Middle sectors of Sydney. The most pronounced change occurred amongst City of Sydney residents—the proportion walking to work rose from 23 per cent in 2001 to 27 per cent in 2006. In contrast, the outermost subregions of Sydney (i.e. Central Coast, North West and South West) experienced small declines in the active transport mode share between 2001 and 2006, as did the Illawarra.

HTS results suggest that the walking mode share of commuting trips in Sydney has increased slightly since the 2006 census, standing at 6.4 per cent in 2005–06 and 6.7 per cent in 2009–10 (BTS 2011). Across all travel purposes, the active transport mode share has risen gradually over the decade from 17.8 per cent in 2001–02 to 18.7 per cent in 2006 and 19.1 per cent in 2009–10 (*ibid.*).

Thus, there has been some progress against this objective, with multiple data sources identifying a gradual increase in the active transport mode share in Sydney since 2001—both for commuter travel, and for travel more generally.

Better connect people to centres

This objective relates to providing better transport access to centres for all, as these are not only important as locations for employment⁴⁶, but also as locations for many of the services that Sydney residents need such as shopping and recreation. *City of Cities* aims to 'connect people to centres by focusing on public transport links to serve existing and new centres in Sydney' (NSW Government 2005, p.165). *Sydney 2036* aims 'to ensure that our key centres are accessible and connected', with a particular focus on the CBD and the Regional cities of Parramatta, Liverpool and Penrith (NSW Government 2010a, p.96). *Sydney 2036* identifies the following performance targets relevant to connecting people to centres (NSW Government 2010a, p.248):

'Increase the percentage of the population living within 30 minutes by public transport of a city or major centre in Metropolitan Sydney'

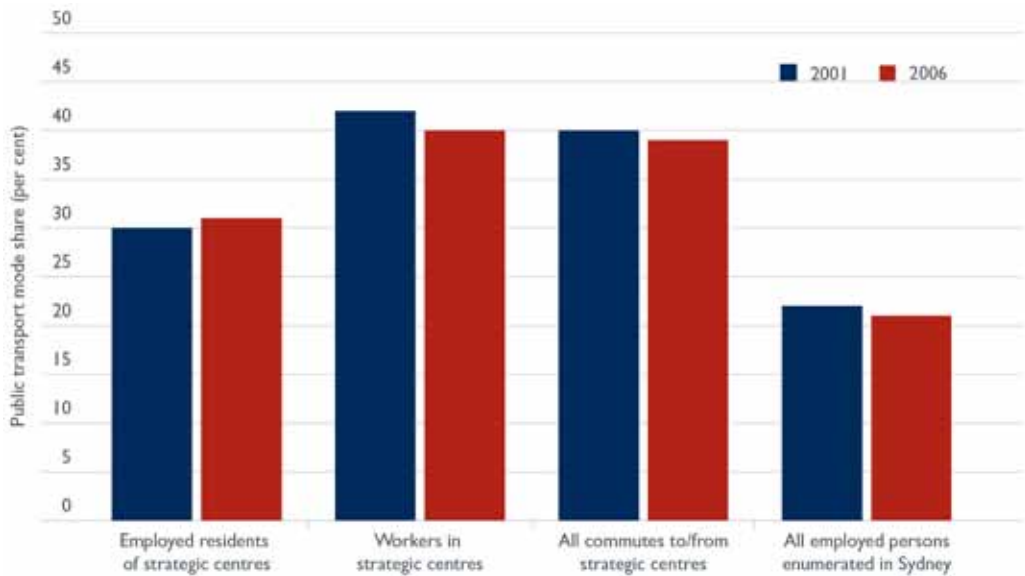
'Increase the share of commute trips made by public transport during peak hour to and from: Sydney CBD, Parramatta CBD, Liverpool CBD, Penrith CBD'.

These correspond to the *NSW State Plan* targets, except that the 2010 *State Plan* quantified the public transport mode shares to be achieved by 2016 for the CBD and Regional cities (NSW Government 2010c). The current *State Plan—NSW 2021*—further specifies targets for the Newcastle and Wollongong CBDs (NSW Government 2011c).

Figure 6.4 presents the 2001 to 2006 change in the census journey to work public transport mode share data for those who live in strategic centres and for those who work in strategic centres. Employed residents and workers at strategic centres both have relatively high use of public transport for the journey to work. As previously identified in Table 6.16, there was a 1.6 percentage point reduction in the public transport mode share for journeys to work in strategic centres between 2001 and 2006. The public transport mode share also declined substantially for the Sydney SD as a whole (see Table 6.7).

⁴⁶ As noted in Chapter 4 of this report, about 40 per cent of all jobs in the Sydney GMA are located in strategic centres.

Figure 6.4 Public transport mode share for employed residents and workers in strategic centres, Sydney, 2001 and 2006



Notes: Centre boundaries based on TDC (2008b), BITRE analysis of Metropolitan Strategy subregional plans and 2006 destination zone boundaries. Table 4.7 provides information on centre definitions.

Source: BITRE analysis of BTS JTW tables 11 and 13 for 2006 and tables 3 and 9 for 2001.

However, Figure 6.4 reveals that despite this overall decline in Sydney's public transport mode share, there was a 1.1 percentage point increase from 2001 to 2006 in the proportion of employed residents of strategic centres who used public transport to get to work.⁴⁷ Because the number of people who work in strategic centres is several times greater than the number who live in strategic centres (see Tables 3.16 and 4.7), this translates into an overall 1.4 percentage point decline in the public transport mode share for commutes to and from strategic centres.

Table 6.22 lists the *NSW 2021* targets along with the 2001 and 2006 public transport mode shares for employed people who live or work in the corresponding centre. Central Sydney experienced a substantial decline in the public transport mode share. This decline for Central Sydney reflected a shift to active travel modes rather than to private vehicle use. The Regional city of Liverpool also experienced a substantial decline in its public transport mode share between 2001 and 2006, while there was limited change over the period for the Regional city of Penrith. In contrast to the other results, the Regional city of Parramatta experienced significant growth in its public transport mode share. Employed residents of Parramatta were much more likely to journey to work by public transport in 2006 (42 per cent) than they were in 2001 (34 per cent), while there was also an increase in the proportion of workers accessing jobs in this centre by public transport.

⁴⁷ The increase in the public transport mode share for employed residents of strategic centres is coming from a range of centres, including Parramatta, Green Square, St Leonards-Crows Nest, Hurstville and Kogarah. The public transport mode share declined by 2 percentage points for employed residents of Central Sydney.

The census data includes all journeys to work, not just peak hour commutes. Thus, while the census information presented in Table 6.22 is certainly relevant to understanding recent trends against this objective, it differs from the NSW Government's chosen performance indicators.

Table 6.22 Public transport use targets for peak hour commuting to and from selected centres

Location	2001 public transport mode share for commuters	2006 public transport mode share for commuters	2016 public transport use target for peak hour commutes
(per cent)			
Sydney CBD	67	65	80
Parramatta CBD	32	34	50
Liverpool CBD	17	15	20
Penrith CBD	12	12	25
Newcastle CBD	na	na	20
Wollongong CBD	na	na	15

Notes: 2001 and 2006 public transport mode shares represent an average across those who either live or work in the relevant centre. An adjustment was made to ensure those who live and work within the same centre were not double counted. The definitions used for census-based mode shares are the centre definitions for Central Sydney and the three Regional cities as used in Table 4.7. Central Sydney comprises the Sydney CBD, City East, Pyrmont-Ultimo, Redfern Centre and Sydney Education and Health precincts. Some parts of the City of Sydney LGA are excluded (e.g. Glebe, Elizabeth Bay, Green Square). Definitions for the three Regional cities are from TDC (2008b). No centres which approximate the Newcastle or Wollongong CBDs are defined. Na is not applicable.

Source: NSW Government 2011c and BITRE analysis of BTS JTW tables 11 and 13 for 2006 and tables 3 and 9 for 2001.

Using HTS data, NSW Government (2011d) presents benchmark data for the Government's selected performance indicators. The HTS trends between 2001–02 and 2005–06 are largely in line with the census-based trends in Table 6.22, in that the HTS shows a large increase in the public transport mode share of peak hour commutes to and from the Parramatta CBD, and declines for the Sydney and Liverpool CBDs. However, the HTS identifies a substantial rise in the public transport mode share for Penrith, which was not evident in the census data. Being a sample survey, there is some uncertainty associated with HTS estimates, particularly estimates for the smaller centres which would be based on relatively small samples.

As of 2009–10, the HTS public transport mode share remained well below the 2016 target for all six centres (NSW Government 2011d). Four of the listed centres did experience a significant boost to their peak hour public transport mode share between 2001–02 and 2009–10 (i.e. Sydney, Parramatta, Penrith and Newcastle). Since 2005–06, the public transport mode share has been trending upwards in only three of the centres (i.e. Sydney, Liverpool and Newcastle).

The other performance indicator relevant to this objective captures the percentage of the population living within 30 minutes by public transport of a city or major centre in Metropolitan Sydney.⁴⁸ This is a measure of potential access to the services and employment opportunities available in these centres, rather than a measure based on actual travel behaviour. An increase in this indicator could result from improved public transport connections to and from centres, or from greater concentration of residential development around centres.

⁴⁸ The definition of Metropolitan Sydney corresponds to the Sydney SD minus the Central Coast planning subregion.

Measurement of performance against this indicator is based on the Sydney Strategic Travel Model and is sensitive to the underlying assumptions and definitions, which have evolved over time. The BTS provided BITRE with a comparable measurement of this indicator for 2001 and 2006,⁴⁹ identifying a marginal decline between 2001 and 2006 (from 70 per cent to 69 per cent living within 30 minutes of a city or major centre). The main contributor to this result was a decline in the proportion of residents of the South West planning subregion who lived within 30 minutes of a city or major centre. The South West subregion contains the Regional city of Liverpool and the Major centre of Campbelltown, but the main residential growth suburbs (e.g. Prestons, West Hoxton, Harrington Park) are located some distance from these strategic centres, and only 41 per cent of South West residents live within 500 metres of a frequent public transport service (see Table 6.19). In reporting against this performance indicator, NSW Government (2010a, p.247) identified a rise in this indicator from 75 per cent in 2005 to 77 per cent in 2010. As this set of measurements appears to be incompatible with the earlier set of measurements for 2001 and 2006, it is difficult to draw any inferences about the overall direction of movement since 2001.

With regard to the objective of better connecting people to centres, while there are positive signs in some locations such as Parramatta, several of the indicators were not heading in the desired direction. From 2001 to 2006, there was a substantial decline in the proportion of commuter trips to and from strategic centres which used public transport. Of the four Sydney SD centres targeted by *City of Cities*, only Parramatta recorded a significant boost in the public transport mode share of commuter travel between the 2001 and 2006 censuses. Over the longer 2001 to 2010 period, the HTS and census data together suggest that the public transport mode share of commuters increased for the Sydney and Parramatta CBDs and decreased for the Liverpool CBD, while the direction of change is unclear for the Penrith CBD.⁵⁰ As of 2009–10, each of these public transport mode shares remained below the 2016 target. It is difficult to draw overall conclusions about progress against this objective since 2001 due to the conflicting messages from the various indicators, changes to the underlying methodologies over time, and concerns about the robustness of some estimates.

Concentrate development near public transport

In comparison to other Australian cities, Sydney has a far greater proportion of its residents living in densities regarded as necessary to support a quality mass transit system, with over 500 000 people living in areas with at least 70 persons per hectare (NSW Government 2010a). *City of Cities* aimed to further concentrate population, employment and retail activities near public transport (NSW Government 2005, pp. 104–6). *Sydney 2036* aims to integrate transport and land use planning to support an increased public transport mode share, and accommodate urban renewal in locations where there is existing transport capacity such as Green Square, Parramatta, Liverpool and Penrith (NSW Government 2010a, p.91).

Table 6.23 shows the proportion of Sydney's population and employment located in railway station catchments, based on 500 and 1 000 metre radius catchments. As of 2006, about 30 per

⁴⁹ Based on travel time to travel zone centroid, including wait time. 'City or major centre' incorporates Global Sydney, Parramatta, Liverpool, Penrith, and the 11 major centres in the Sydney SD. 2001 estimates reflect 2001 public transport network and 2001 census data. 2006 estimates reflect 2006 public transport network and projections of population and employment for 2006 (made in 2004).

⁵⁰ The HTS and census data are difficult to reconcile for the Penrith CBD—it is not clear whether the public transport mode share for Penrith was stable or experienced a net increase between 2001 and 2010.

cent of Sydney's population lived within one kilometre of a railway station, but half of all jobs were located within one kilometre of a railway station. The proportion of Sydney's population living in railway station catchments increased by 0.6–0.7 percentage points between 2001 and 2006. The proportion of employment located in railway station catchments declined between 2001 and 2006. This reflects the strong job growth occurring in outer suburban industrial areas and non-rail connected specialised centres such as Norwest (see Chapter 4), and also the substantial job losses around Inner North rail stations. Forty four per cent of Sydney's 2001 to 2006 population growth occurred within one kilometre of a railway station, compared to just 5 per cent of employment growth.

The NSW Government's Metropolitan Development Program (MDP) monitors the extent to which residential development is occurring around transit nodes. Areas within 800 metres of a railway station or 400 metres of a major bus node or light rail station are regarded as transit nodes (Department of Planning 2010a).

Table 6.24 summarises the proportion of Sydney's dwelling production occurring in transit nodes for various periods. Since 2001, about 42 per cent of Sydney's total dwelling production occurred in transit nodes. The proportion of residential development occurring in transit nodes rose over the course of the decade. Note that the volume of dwelling production in transit nodes was actually much lower in the more recent five yearly periods—the increase in the transit node proportion reflects the much lower greenfield and total dwelling production in recent years (see Figure 3.11).

Table 6.23 Changes in population and employment around railway stations in Sydney, 2001 to 2006

Area around rail stations	Population 2001	Population 2006	Change in population 2001–2006 (per cent)	Employment 2001	Employment 2006	Change in employment 2001–2006 (per cent)
Within 500 metres	412 135	457 549	11.2	512 062	514 280	0.4
Outside 500 metres	3 530 824	3 661 477	3.7	1 172 183	1 216 438	3.6
Percentage within 500 metres	10.5	11.1	0.7	30.4	29.7	–0.7
Within 1000 metres	1 154 723	1 232 233	6.7	877 031	879 463	0.3
Outside 1000 metres	2 788 236	2 886 793	3.5	807 214	851 255	5.2
Percentage within 1000 metres	29.3	29.9	0.6	52.1	50.8	–1.3

Source: BITRE analysis using 2006 railway station locations, ABS 2001 and 2006 *Census of Population and Housing* place of usual residence data at CCD scale, and BTS JTW table 19 for 2001 (concorded to 2006 destination zone boundaries) and table 1 for 2006.

Table 6.24 Dwelling production in transit nodes, Sydney, 1998 to 2010

Time period	Proportion of dwelling production in transit nodes (per cent)
1998–99 to 2002–03	37
2000–01 to 2004–05	39
2003–04 to 2007–08	47
2005–06 to 2009–10	44
2000–01 to 2009–10	42

Source: NSW Department of Planning (2010a) and Department of Planning and Infrastructure (2001h).

Key locations for transit node development include the City of Sydney, which added almost 11 000 dwellings in transit nodes between 2003–04 and 2007–08, and the Rhodes, Parramatta and Waitara transit nodes, which added over 1000 dwellings each (Department of Planning 2010a).

Thus, the MDP provides evidence that a large and rising proportion of residential development in Sydney over the past decade has been concentrated near public transport nodes, with a declining proportion being located in greenfield sites. Census data provides supporting evidence of residential development being concentrated near railway stations from 2001 to 2006. However, only a very small fraction (5 per cent) of Sydney's net employment growth occurred near railway stations during this period.

In summary

This chapter has summarised spatial variation in the use of different transport modes, and recent shifts in transport mode shares, within Sydney. This analysis provides context for the population and employment information presented in Chapters 3 and 4, by helping to draw out the links between the spatial distribution of population and jobs and the use of different transport modes.

The chapter has also explored progress against several transport-related planning objectives. Since 2001 the active transport share of commuter travel has risen. There was also an increase in the public transport mode share of Sydney's commuters, with the decline in the first part of the decade being more than offset by recent growth. There was limited progress in better connecting people to centres, with a decline in the proportion of commuters travelling to and from strategic centres by public transport between 2001 and 2006. Just under half of Sydney's recent residential development has been concentrated near public transport nodes, but only 5 per cent of employment growth was concentrated around rail nodes.

CHAPTER 7

Commuting flows

Key points

- In 2006, 2.3 per cent of Sydney's workforce lived outside the Sydney Statistical Division (SD), mainly in the rest of the Greater Metropolitan Area (GMA). About 1.1 per cent of Sydney's employed residents worked outside the SD.
- The principal types of commuter flow within Sydney are inward flows (38 per cent), commutes within the home Statistical Local Area (SLA) (27 per cent) and commutes to a different SLA in the home subregion and ring (16 per cent).
- About 44 per cent of employed Sydney residents worked in their home subregion. Self-containment was highest for the Central Coast and very low for the Inner West and North subregions. The Central Coast increased its self-containment rate by 2.6 percentage points between 2001 and 2006, but there was minimal change in Sydney's overall level of self-containment.
- The largest volume commuting flows were within the home subregion, such as the 171 700 North West residents who commuted to a place of work in the North West. The most common cross-subregion flow was the 66 000 residents of the South subregion who commuted to a place of work in the City of Sydney.
- While 30 to 40 per cent of employed residents of the East and Inner West subregions commuted to a City of Sydney workplace, just 5 to 8 per cent of employed residents of the North West, South West and Central Coast subregions commuted to the City of Sydney.
- Average commuting distances are low for Inner sector residents (7.5km), higher for Middle sector residents (11.5km) and highest for Outer sector residents (18.8km). Average work trip durations rise more gradually across the sectors of residence, standing at 30 minutes for the Inner sector, 32 minutes for the Middle sector and 35 minutes for the Outer sector.
- Changes in commuting patterns from 2001 to 2006 were relatively subtle, and Sydney's overall commuting structure remained very stable. Outward flows had the most rapid growth (1.6 per cent per annum), increasing from 7.5 to 7.8 per cent of all flows. Inward commutes recorded subdued growth (0.3 per cent), declining from 38.6 to 37.7 per cent of all commuting flows.
- There were large increases in the number of people commuting within the North West (12 654), Central Coast (8 230) and City of Sydney (7 051), as well as from the Inner West to the City of Sydney (2 840). The number of Outer sector residents commuting to a place of work in the Inner sector declined by 4 234 persons between 2001 and 2006.

- The likelihood of commuting to the City of Sydney increased for East, Inner North and Inner West residents, but it declined for West Central, South West and Central Coast residents. The likelihood of commuting to an Inner North workplace declined for a range of different subregions.
- Between 2001 and 2010 there was very little change in average commuting distance (+0.3km) and a modest rise in average commuting trip duration (1.6 minutes). These shifts were not in line with the recent strategic plans that aim to achieve a shift to people working closer to home.

Background

This chapter connects the residential location analysis of Chapter 3 with the job location analysis of Chapter 4. The term 'commuting flow' is used to refer to the number of people who travel from a particular place of residence to a particular place of work. This chapter identifies the main commuting flows within Sydney and the commuting connections to neighbouring regions, as well as spatial differences in the average distance and time involved in travelling to work. It also highlights the main changes that occurred between 2001 and 2006.

BITRE's analysis of commuting flows is based on the 2001 and 2006 ABS *Census of Population and Housing*, and specifically on the NSW Bureau of Transport Statistics (BTS) version of the journey to work (JTW) matrix from the 2001 and 2006 censuses.^{51,52} A range of additional data sources are used to shed light on commuting distances, commuting times and travel speeds (e.g. BTS' Household Travel Survey, Productivity Commission 2011). The majority of BITRE's analysis is presented at the sector, subregion and statistical local area (SLA) scales, but more disaggregated destination zone data⁵³ was used for the distance calculations and for analysing commuting flows to centres.

2006 snapshot

Long distance commutes

The 2006 census shows 2.05 million people working in the Sydney Greater Metropolitan Area (GMA) and 1.74 million working in the Sydney Statistical Division (SD). There were approximately 41 000 people employed in the Sydney SD who lived outside of the SD, representing 2.3 per cent of Sydney's workforce. Almost 70 per cent of this group lived elsewhere in the GMA, while 18 per cent lived interstate.

Table 7.1 summarises the main regions of residence for these long distance commuters to Sydney. Nearly 98 per cent of those who work in Sydney live in Sydney. The main place of origin outside of Sydney itself is Wollongong, which generated almost 16 000 commuters to Sydney on census day. Newcastle generated a further 8400 commuters to Sydney. Also

⁵¹ The BTS (formerly known as the Transport Data Centre or TDC) undertook enhancements of ABS JTW data to improve the quality of the data; hence the BTS and ABS datasets may provide slightly different counts (TDC 2008a).

⁵² BITRE's analysis of long distance commutes in 2006 is instead based on the original ABS JTW matrix, which contains more detailed information on interstate commutes than the BTS online data.

⁵³ Destination zones or travel zones (TZ) are generally larger than Census Collection Districts (CDs), but smaller than SLAs. They are the most detailed scale at which employment data is available. TZs amalgamate to form SLAs.

within the GMA, Wingecarribee (i.e. the Southern Highlands) and Shoalhaven each generated more than 1000 commuters to Sydney. Outside the GMA, the main sources of commuters to Sydney are the four closest metropolitan areas—Melbourne, Brisbane, Gold Coast and Canberra—and the regional city of Lithgow, located near the western border of the GMA. The residents of the more distant places listed in the table (e.g. Melbourne, Brisbane, Gold Coast) are not likely to be commuting to Sydney on a daily basis, but rather on a less frequent basis, such as weekly. Alternatively, they may have been temporarily living and working in Sydney at the time of the census, while retaining a usual place of residence in another city.

From Table 7.1 it is also evident that (ignoring Sydney), employed residents of Wollongong and Wingecarribee have the highest propensity to commute to a place of work in Sydney, at 15 and 17 per cent respectively. Lithgow residents also have a relatively high propensity to commute to work in Sydney (10 per cent). While Newcastle generates a large volume of commuters to Sydney, this represents a smaller proportion of its employed residents (4 per cent). Employed residents of Melbourne, Brisbane, Gold Coast and Canberra have very low propensities to work in Sydney, but feature in the table due to the large size of their labour force.

Table 7.1 Main regions of residence for people employed in Sydney, 2006

Working zone of residence	Number of residents employed at fixed work address in Sydney working zone	Proportion of Sydney working zone employment (per cent)	Proportion of employed residents of origin working zone (per cent)
Sydney & surrounds	1 694 670	97.57	93.9*
Wollongong & surrounds	15 753	0.91	14.9
Newcastle & surrounds	8 395	0.48	4.2
Wingecarribee	2 900	0.17	16.6
Melbourne & surrounds	2 188	0.13	0.1
Brisbane & surrounds	1 369	0.08	0.2
Shoalhaven & surrounds	1 023	0.06	3.4
Canberra & surrounds	943	0.05	0.5
Gold Coast-Tweed	748	0.04	0.3
Lithgow	722	0.04	9.7

Note: * More than 4 per cent of Sydney employed residents reported no fixed work addresses. The Sydney and surrounds working zone corresponds to the Sydney SD. For other working zone definitions see BITRE Industry Structure Database 2009 at <www.bitre.gov.au/databases/regional.aspx>

Source: BITRE analysis of ABS *Census of Population and Housing* 2006 unpublished data.

Those who commute from Wollongong to Sydney are most likely to be commuting to a place of work located in Sydney Inner, Sutherland Shire or Wollondilly, and the latter two SLAs directly border the Wollongong and surrounds working zone. Those who commute from Newcastle to Sydney are most likely to be commuting to a place of work located on the Central Coast, particularly the Wyong Local Government Area (LGA) which directly borders the Newcastle and surrounds working zone. Similarly, for Wingecarribee residents, Wollondilly and Campbelltown are the most prominent places of work, while for Lithgow residents, the Blue Mountains is the dominant place of work in Sydney.

The picture is quite different for the more distant places of origin, such as Melbourne, Brisbane and Gold Coast—the residents of these cities are most likely to work in either the Botany Bay or Sydney Inner SLAs. These two SLAs are highly accessible by air transport.

About 1.1 per cent of Sydney's employed residents reported a place of work located outside the SD in 2006. This amounts to 20 370 employed persons, of which 44 per cent had a workplace elsewhere in the GMA, 14 per cent had a workplace elsewhere in NSW, and 43 per cent worked interstate.

Table 7.2 summarises the main places of work for these long distance commuters. Newcastle and Wollongong were the most common places of work outside the Sydney working zone for Sydney residents. However, there was also significant commuting by Sydney residents to locations much further afield such as Melbourne, Brisbane, Perth, Snowy River and Gold Coast. The presence of Snowy River in the table reflects the timing of the census in the middle of the ski season. In addition to daily commuters and those who commute to a non-Sydney place of work on a less frequent basis (e.g. weekly or around shifts), the data in Table 7.2 may capture usual residents of Sydney who are living and working in another part of Australia for some of the year.

Table 7.2 Main non-Sydney places of work for employed residents of Sydney, 2006

Working zone	Number of Sydney residents employed in working zone
Newcastle & surrounds	4855
Wollongong & surrounds	2698
Melbourne & surrounds	1762
Wingecarribee	1082
Canberra & surrounds	1034
Brisbane & surrounds	773
Lithgow	561
Snowy River	340
Perth & surrounds	332
Gold Coast-Tweed	298

Note: The Sydney and surrounds working zone corresponds to the Sydney SD. For other working zone definitions see BITRE Industry Structure Database 2009 at <www.bitre.gov.au/databases/regional.aspx>

Source: BITRE analysis of ABS *Census of Population and Housing* 2006 unpublished data.

The Sydney SLAs that generate the most commuters to places of work located outside the Sydney working zone are the peripheral SLAs. Most notably, 10 per cent of Wyong North East employed residents commute to a place of work outside the Sydney working zone, typically in the Newcastle working zone. A significant proportion of Wollondilly employed residents (6 per cent) also commute to a place of work located outside the Sydney working zone, typically to either the Wingecarribee or Wollongong working zones.

The equivalent table in the Perth study (BITRE 2010) was dominated by mining regions. The fact that mining regions do not appear amongst the more prominent places of work for Sydney residents is a clear point of difference between the two cities. A further point of difference is that commuter flows in an inward direction to Sydney dominate commuter outflows from Sydney (this is also the case for Melbourne—see BITRE 2011), while the opposite pattern was evident for Perth (see BITRE 2010).

Overview—sectors and planning subregions

The remainder of the analysis of commuting flows for 2006 focuses on the flows that occur *within* the Sydney SD, and to a lesser extent on flows within the Sydney GMA.

In pursuing the goal of sustainability, raising the employment self-containment rate is often viewed as an important strategy with potential benefits in terms of reduced commuting distances and reduced emissions. The self-containment rate measures the proportion of employed residents who work in the home area (e.g. the home Statistical Local Area or planning subregion). There is no *ideal target* for self-containment for particular spatial units—high self-containment is not desirable if it reflects poor access to jobs located outside of the area. Paradoxically, while high self-containment involves relatively short distance commuting, it may potentially be inconsistent with sustainability objectives for reducing car use or increasing use of sustainable modes. Short commuting trips within low population density outer suburbs often involve car use due to convenience and the availability of free parking (Daniels 2007). Rail is used more for longer trips, particularly for commuting to the CBD⁵⁴ (Battellino and Stone 2004; Daniels 2007).

The larger the spatial unit in population and area, the higher the likely self-containment indicator (Daniels 2007). Table 7.3 summarises each planning subregion's degree of employment self-containment, as well as the extent to which each sector is able to attract workers who reside outside the subregion. For Sydney as a whole, 44 per cent of employed residents had a place of work in their home subregion.

Self-containment is highest for the Central Coast planning subregion, with 65 per cent of employed residents having a place of work in the Central Coast. The City of Sydney also has a relatively high self-containment rate (60 per cent). This is a very similar pattern to Perth, where the two highest self-containment rates were for the Inner (65 per cent) and Peel (63 per cent) sectors. Like Peel in Western Australia, the Central Coast is a coastal region with a historically separate identity, but it is now seen as part of the metropolitan area.

In Sydney, the lowest self-containment rates occur in the Inner West (25 per cent) and North (32 per cent). The low self-containment in the North subregion relates to the limited availability of jobs in the area (see the employment self-sufficiency ratios presented in Table 4.1). The low self-containment rate in the Inner West reflects not just limited availability of jobs in the Inner West subregion, but also the proximity and accessibility of the City of Sydney, which attracts many commuters from the Inner West.

The three outermost subregions—North West, South West and Central Coast—have self-containment rates which are similar to or higher than the SD average. For example, about half of North West employed residents also work in the North West. This differs from the situation in Perth, where the outer suburban sectors had the lowest self-containment rates (BITRE 2010).

⁵⁴ For example the average rail commute trip is 23 kilometres for the Sydney SD and 31 kilometres in Greater Western Sydney, whilst the average car commute trip is 18 kilometres (Battellino and Stone 2004).

Table 7.3 Self-containment and proportion who commute from outside by planning subregion, Sydney, 2006

Planning subregion	Workers	Employed residents	Work in home sector	Self-containment rate	Proportion of commuters from outside subregion
(per cent)					
City of Sydney	357 853	77 460	46 128	60	87
East	111 989	131 048	49 521	38	56
Inner North	195 857	148 796	64 111	43	67
Inner West	82 067	109 152	27 051	25	67
South	159 233	295 527	110 756	37	30
North	68 813	123 115	39 298	32	43
North East	72 805	115 364	57 610	50	21
West Central	266 231	256 661	108 897	42	59
North West	219 651	350 547	171 718	49	22
South West	110 235	175 136	77 625	44	30
Central Coast	86 051	120 713	78 910	65	8
Sydney SD	1 736 807	1 903 519	831 625	44	52

Note: The SD workers total includes those with an unknown address within Sydney. The place of work figure is less than employed persons, due to non-response and no fixed work address. The counts of workers include those who live outside Sydney, while the counts of employed residents include those who work outside Sydney. The number of employed residents is sourced directly from the ABS 2006 Basic Community Profile.

Source: BITRE analysis of BTS JTW 2006 data (table 7) sourced from the ABS *Census of Population and Housing* 2006 unpublished data and ABS 2006 Basic Community Profile.

Despite the City of Sydney's high degree of self-containment, 87 per cent of its workers are sourced from other subregions. About two-thirds of the workforce of the Inner West and Inner North subregions resides outside the subregion of work. At the opposite extreme lies the Central Coast, where only 8 per cent of workers are sourced from further afield, primarily from the Lower Hunter rather than the rest of Sydney. The North East and North West subregions also attract a relatively small proportion of workers from further afield.

While the Central Coast attracts few workers from elsewhere, it is able to retain a high proportion of its employed residents. These results reveal a significant degree of separation between the Central Coast labour market and the rest of the Sydney SD. This reflects a range of factors, including the significant commuting distances involved and limited access to frequent public transport services amongst Central Coast residents (see Table 6.19).

Table 7.4 summarises commuting flows within the GMA for 2006. The single most important category is commuter flows within Sydney's Outer sector, which accounted for 28 per cent of all commuters. Commutes within the Rest of the GMA (i.e. within the Lower Hunter and Illawarra) account for 15 per cent of flows. Commutes within Sydney's Middle sector contributed 11 per cent of total flows.

Commuting flows within each of these broadly defined sectors dominate Table 7.4, accounting for 63 per cent of the flows. Commuting in an inward direction is also significant, with inward commuting to the CBD accounting for 11 per cent of all GMA commutes, inward commuting to the rest of the Inner sector accounting for 9 per cent of commutes, and inward commutes to the Middle sector (largely from the Outer sector) for 10 per cent of commutes. Commuting in an outward direction is less important, amounting to just 6 per cent of the flows.

Table 7.4 Summary of commuter flows in the Sydney Greater Metropolitan Area by sector, 2006

Place of residence	Place of work					Total GMA
	CBD/ Sydney Inner	Inner sector (excluding CBD)	Middle sector	Outer sector	Rest of GMA	
	Proportion of all commuter flows within GMA (per cent)					
CBD/Sydney Inner	0.2	0.1	0.0	0.0	0.0	0.3
Inner sector (excluding CBD)	4.2	8.7	2.3	0.7	0.0	15.9
Middle sector	3.5	5.0	11.3	2.8	0.0	22.6
Outer sector	3.3	4.2	9.5	27.8	0.4	45.1
Rest of GMA	0.2	0.3	0.3	0.7	14.6	16.0
Total GMA	11.3	18.2	23.4	32.0	15.1	100.0

Note: This is based on the 2.02 million workers who had a known SLA of residence within the GMA and a known SLA of work within the GMA in 2006.

Source: BITRE analysis of BTS JTW 2006 data (table 7) sourced from the ABS *Census of Population and Housing 2006* unpublished data.

Table 7.5 takes a more disaggregated perspective, summarising commuting flows for the planning subregions for 2006. Table 7.6 presents the same information in percentage format, which can be interpreted as the probability that an employed resident of one subregion will work in another subregion.

As expected, the main source of workers in most subregions is those residing within the home subregion. The highest shares of commuting within the home subregion are in the Lower Hunter, Illawarra and Central Coast (83, 76 and 65 per cent respectively). In the Sydney SD, the largest numbers of employed residents live in the North West (351 000), South (296 000) and West Central subregions (257 000). Reflecting their large residential base, each of these subregions recorded over 100 000 commutes within the home subregion on census day. Close to 172 000 commuters travelled from a place of residence in the North West subregion to a place of work in the North West subregion.

Table 7.5 Planning subregion commuting flows in the Sydney Greater Metropolitan Area, 2006

Residence	City of Sydney	Place of work											
		East	Inner North	Inner West	South	North	North East	West Central	North West	South West	Central Coast	Illawarra	Lower Hunter
City of Sydney	46 128	7 446	7 661	2 326	2 659	553	641	2 332	646	494	85	127	84
East	46 933	49 521	8 636	2 385	5 138	523	603	3 027	832	783	54	166	57
Inner North	40 687	4 253	64 111	5 455	2 399	4 420	3 785	8 316	3 034	557	204	118	102
Inner West	33 517	4 503	11 691	27 051	6 292	1 306	802	10 177	2 406	1 208	92	119	52
South	66 019	24 586	14 278	12 544	110 756	1 158	1 050	22 090	2 854	5 587	140	1 128	130
North	21 999	2 096	24 726	2 950	1 178	39 298	3 384	8 352	7 534	506	716	64	119
North East	17 678	2 254	17 114	1 348	878	2 803	57 610	2 207	1 053	186	143	44	79
West Central	30 503	5 696	16 756	12 994	12 995	3 320	1 218	108 897	17 525	11 947	159	308	133
North West	27 283	3 415	18 710	8 783	3 486	8 532	1 459	61 960	171 718	5 721	325	214	225
South West	14 505	3 806	3 829	3 982	6 979	569	280	31 931	7 460	77 625	64	1 787	85
Central Coast	5 488	850	4 961	986	490	5 230	1 067	2 602	1 368	178	78 910	87	3 769
Illawarra	4 305	1 603	910	611	4 966	84	89	2 216	640	4 430	22	122 421	88
Lower Hunter	985	272	783	172	177	413	105	653	394	77	4 492	70	172 825

Note: This is based on the 2.02 million workers who had a known SLA of residence within the GMA and a known SLA of work within the GMA in 2006.
Source: BITRE analysis of BTS JTW 2006 data (table 7) sourced from the ABS *Census of Population and Housing* 2006 unpublished data.

Table 7.6 Probability of employed residents commuting to a subregion of work, Sydney Greater Metropolitan Area, 2006

Residence	City of Sydney	Place of work (per cent)												Total	
		East	Inner North	Inner West	South	North	North East	West Central	North West	South West	Central Coast	Illawarra	Lower Hunter		Other/ Unknown*
City of Sydney	60	10	10	3	3	1	1	3	1	1	0	0	0	8	100
East	36	38	7	2	4	0	0	2	1	1	0	0	0	9	100
Inner North	27	3	43	4	2	3	3	6	2	0	0	0	0	8	100
Inner West	31	4	11	25	6	1	1	9	2	1	0	0	0	9	100
South	22	8	5	4	37	0	0	7	1	2	0	0	0	11	100
North	18	2	20	2	1	32	3	7	6	0	1	0	0	8	100
North East	15	2	15	1	1	2	50	2	1	0	0	0	0	10	100
West Central	12	2	7	5	5	1	0	42	7	5	0	0	0	13	100
North West	8	1	5	3	1	2	0	18	49	2	0	0	0	11	100
South West	8	2	2	2	4	0	0	18	4	44	0	1	0	13	100
Central Coast	5	1	4	1	0	4	1	2	1	0	65	0	3	12	100
Illawarra	3	1	1	0	3	0	0	1	0	3	0	76	0	11	100
Lower Hunter	0	0	0	0	0	0	0	0	0	0	2	0	83	13	100

Note: *This total includes people who worked outside the GMA and those who did not respond, have an undefined place of work or no fixed work address.

The number of employed residents (i.e. the denominator) is sourced directly from the ABS 2006 Basic Community Profile.

Source: BITRE analysis of BTS JTW 2006 data (table 7) sourced from the ABS *Census of Population and Housing 2006* unpublished data and ABS 2006 Basic Community Profile.

The most common across region flow was the 66 019 residents of the South subregion who commuted to a place of work in the City of Sydney. Excluding commuter flows within the home subregion, the commuter flows which exceeded 20 000 persons were:

- to a place of work in the City of Sydney from East, South, Inner West, Inner North, North, West Central and North West
- to East from South
- to Inner North from North
- to a West Central place of work from South, North West or South West.

The probability that employed residents of a subregion would commute to a place of work outside the home subregion was 10 per cent or more for the following origin-destination pairs:

- to a place of work in the City of Sydney from East, South, Inner West, Inner North, North, North East and West Central
- to East from City of Sydney
- to Inner North from City of Sydney, Inner West, North and North East
- to West Central from North West and South West.

City of Sydney is the subregion with the largest number of jobs (357 800), followed by West Central (266 200), North West (219 600) and Inner North (195 800). Of the close to 900 000 GMA residents who commuted to a workplace located outside their home subregion, a high proportion of those commuter flows involved a workplace in the City of Sydney (35 per cent), West Central (17 per cent) or Inner North (15 per cent). Although the North West subregion contains more jobs than the Inner North, the Inner North attracts a much higher proportion of its workforce from other subregions (67 per cent, compared to 21 per cent for the North West).

Table 7.7 reveals the three top Statistical Local Areas (SLAs) of work for residents of each of the subregions. Typically the Sydney Inner SLA features prominently as a workplace, and at least two of the three main SLAs of work are located within the relevant subregion. However, for residents of the outer suburban North West, South West and Central Coast subregions, Sydney Inner does not feature amongst the three main SLAs of work, since it was the workplace of just 3 to 6 per cent of employed residents of each of these subregions. Apart from Sydney Inner, the only other SLAs to make multiple appearances in Table 7.7 are Sydney West and Parramatta Inner, which feature as a main place of work for residents of the home subregion and for residents of a neighbouring subregion.

For residents of the South West and Central Coast subregions, all three of the main SLAs of work are located within the subregion. For residents of the Inner West subregion, only one of the top three SLAs of work is located within the subregion, reflecting the low self-containment rate.

Table 7.7 Main Statistical Local Areas of work for residents of each subregion, Sydney, 2006

Subregion of residence	Main SLA of work	2 nd main SLA of work	3 rd main SLA of work
City of Sydney	Sydney Inner	Sydney East	Sydney West
East	Sydney Inner	Randwick	Waverley
Inner North	Sydney Inner	North Sydney	Ryde
Inner West	Sydney Inner	Leichhardt	Sydney West
South	Sydney Inner	Sutherland Shire East	Sutherland Shire West
North	Sydney Inner	Ku-ring-gai	Hornsby South
North East	Warringah	Pittwater	Sydney Inner
West Central	Parramatta Inner	Sydney Inner	Auburn
North West	Blacktown South-East	Penrith West	Parramatta Inner
South West	Liverpool East	Campbelltown South	Campbelltown North
Central Coast	Gosford West	Wyong South and West	Gosford East

Source: BITRE analysis of BTS JTW 2006 data (table 7) sourced from the ABS *Census of Population and Housing* 2006 unpublished data.

Table 7.8 shows the public transport mode share by place of residence and work combination for the Sydney SD in 2006. The public transport mode share was generally high for commutes to a place of work in the City of Sydney—particularly for those travelling from the Central Coast, South West, West Central and North West subregions, where close to two-thirds of all commuters used public transport. Public transport mode shares were also well above average for City of Sydney residents commuting to a place of work in the Inner North, Inner West, North, West Central and Central Coast subregions, and for residents of the South, South West and Central Coast commuting to a place of work in the Inner North subregion. In contrast, commuters to the North West subregion very rarely rely on public transport (unless they are residents of the City of Sydney). These results reflect the radial nature of the rail network, which mainly caters to journeys to or from the central nodes (i.e. the City of Sydney and Inner North subregions).

About 5 per cent of journeys to work in 2006 in Sydney involved either cycling or walking. Table 7.9 reveals that travel to work by active transport (i.e. cycling or walking) is highest for relatively short distance commutes within the home subregion—and is particularly high for commutes within the more densely populated inner subregions such as the City of Sydney, East, Inner North and Inner West. City of Sydney residents commuting to a place of work in the East, South or Inner West subregions also had an above-average active travel mode share. Employed residents of the outer suburban North West, South West and Central Coast subregions who work in their home subregion had an active travel mode share slightly below the city-wide average.

Table 7.8 Public transport mode share by subregions of residence and work, Sydney, 2006

Residence	Place of work (per cent)										
	City of Sydney	East	Inner North	Inner West	South	North	North East	West Central	North West	South West	Sydney SD
City of Sydney	27	26	43	30	22	30	22	30	19	18	33
East	45	11	29	17	11	22	15	13	8	4	17
Inner North	60	16	14	13	13	13	11	10	3	9	19
Inner West	56	20	27	8	12	19	11	13	6	15	26
South	55	13	38	12	7	21	13	9	7	4	19
North	62	22	23	17	14	5	4	6	3	6	17
North East	53	7	15	5	9	2	6	5	2	0	4
West Central	66	23	26	14	12	12	9	7	7	8	13
North West	65	23	19	15	14	4	6	11	3	4	6
South West	66	14	36	15	11	17	15	8	3	4	9
Central Coast	64	22	38	28	20	23	9	12	4	10	3
Sydney SD	53	14	22	12	9	8	6	9	4	4	3

Note: The data in this table differs slightly from the data presented in Chapter 6, as it reflects the BTS 9 mode classification, rather than the 14 mode classification. One effect of this is that taxi users are excluded from the public transport mode share.

Source: BITRE analysis of BTS 2006 JTW data (table 7) sourced from the ABS *Census of Population and Housing 2006* unpublished data.

Table 7.9 Active transport (cycling and walking) mode share by subregions of residence and work, Sydney, 2006

Residence	Place of work (per cent)										
	City of Sydney	East	Inner North	Inner West	South	North	North East	West Central	North West	South West	Sydney SD
City of Sydney	39	7	3	6	7	2	3	1	2	1	9
East	5	14	1	1	1	0	2	0	2	1	6
Inner North	2	1	14	1	1	1	1	1	0	2	8
Inner West	3	1	1	14	2	1	1	1	0	1	7
South	2	1	1	3	7	0	0	1	1	1	0
North	1	1	1	0	1	7	1	1	1	1	0
North East	1	0	1	0	0	1	7	1	0	2	3
West Central	1	0	1	1	1	2	0	6	1	1	2
North West	1	1	0	1	1	1	0	0	4	1	0
South West	0	0	1	0	0	1	0	0	0	4	0
Central Coast	2	0	1	1	2	0	1	0	1	4	3
Sydney SD	7	7	5	5	6	4	6	3	3	3	5

Note: * The number of observations is very small for commuters to a place of work in the Central Coast from City of Sydney, East and Inner West, and the active travel mode shares should not be relied upon for these origin-destination pairs.

Source: BITRE analysis of BTS 2006 JTW data (table 7 and table 15) sourced from the ABS *Census of Population and Housing 2006* unpublished data.

Commuting flows between Statistical Local Areas

Summary of different types of flows

In 2006, 1.69 million commuting flows occurred solely within the Sydney SD from a known place of residence to a known place of work.

The flows between SLAs have been identified as occurring either within a 'ring' or across rings, and if the flows involve travel across rings they have been classified as occurring in either an inward direction (e.g. Outer to Middle, Middle to City of Sydney) or outward direction (e.g. Middle to Outer). The geographic entities referred to as rings are the same as the sectors, except that the Inner sector has been split into two rings—the City of Sydney LGA and the Rest of the Inner sector. The City of Sydney LGA is the central point of reference for the direction of flow.

Commuting flows that take place within the boundaries of one of the rings—irrespective of whether the direction is oriented towards the inner or outer edge of the ring or is circumferential—are treated as ambiguous in direction and allocated to one of the following categories of commuter flow:

- within the home SLA
- to a different SLA within the home subregion and ring
- to a different subregion within the home ring
 - for those who live in the Outer ring
 - for those who live in the Middle or 'Rest of Inner' rings.

Table 7.10 shows that the majority of Sydney's commuter flows are ambiguous in direction (i.e. the majority of flows occur within a ring). Of these, 448 677 commutes—representing 27 per cent of all commutes in the SD—occurred within the home SLA. Commutes from one SLA to a different SLA within the same subregion were also relatively important, contributing 16 per cent of all commutes. The largest volume flows of this type were commutes from Sutherland Shire West to Sutherland Shire East, and from Gosford East to Gosford West. Together these two categories of relatively short distance commutes account for 43 per cent of all commutes within Sydney.

In Table 7.10, 38 per cent of commuting flows have been identified as occurring in an inward direction. Of particular importance were the inward flows to a place of work in the City of Sydney LGA, which represented about half of all inward commuter flows (see Tables 7.5 and 7.6 and Map 7.4 for further information). Inward commuter flows from the Outer sector to the Middle sector were also significant (11 per cent), such as:

- Holroyd, Blacktown North and Blacktown South East to a place of work in Parramatta Inner
- Warringah to Willoughby and Manly
- Hornsby South to Ryde.

Only 8 per cent of commuting flows were classified as occurring in an outward direction. Some of the most important examples were:

- North Sydney and Lane Cove to a place of work in Willoughby
- Manly to Warringah
- Ku-ring-gai to Hornsby South.

Table 7.10 Total commuting flows within Sydney Statistical Division by type, 2006

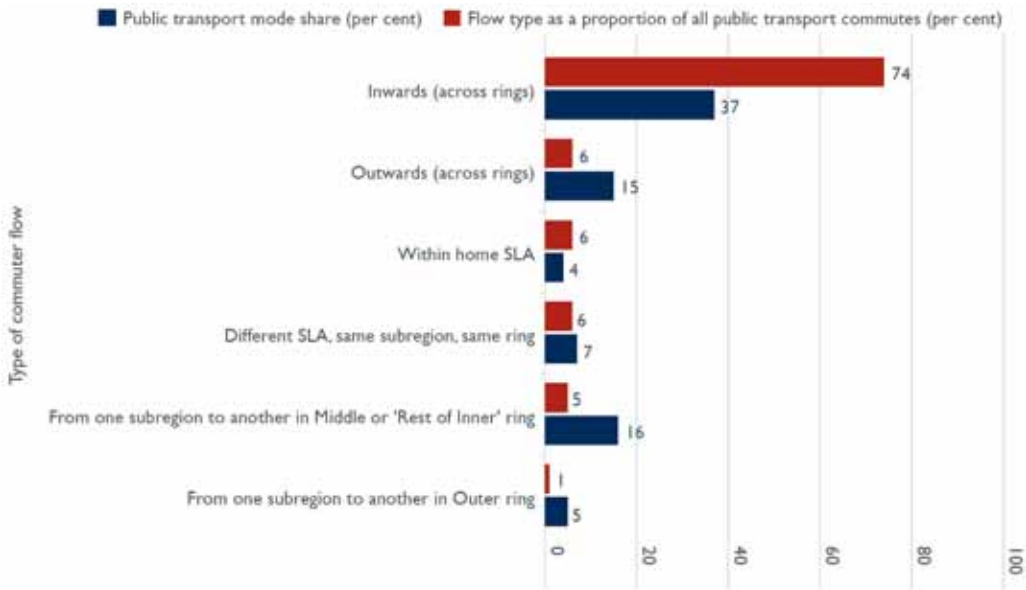
Type of commuting flow	Number of commuters	Proportion (per cent)
Inwards (across rings)	637 339	37.7
Outwards (across rings)	132 141	7.8
Ambiguous in direction (within a ring)	919 829	54.5
Within home SLA	448 677	26.6
Different SLA, same subregion, same ring	273 641	16.2
From one subregion to another in Outer ring	95 968	5.7
From one subregion to another in Middle or 'Rest of Inner' rings	101 543	6.0
Sydney SD	1 689 309	100.0

Note: Based on commutes that have an origin and destination within SD. Inward commutes include commutes to workplaces in the central LGA from elsewhere in SD, from outer suburban residences to middle or inner workplaces and from middle suburban residences to inner workplaces. The opposing flows are categorised as outward commutes (e.g. from Middle to Outer).

Source: BITRE analysis of BTS 2006 JTW data (table 7) sourced from the ABS *Census of Population and Housing 2006* unpublished data.

Figure 7.1 shows how commuter use of public transport is heavily oriented towards inward commutes in Sydney. While 38 per cent of commutes were in an inward direction, almost three-quarters of commuter use of public transport was due to inward commuting. About 37 per cent of all inward commutes in Sydney made use of public transport, but all other flow type categories had below-average public transport mode shares. The public transport mode share was very low for commutes within the home SLA (4 per cent) and for cross-suburban commutes in the Outer sector (5 per cent).

Figure 7.1 Public transport uses by type of commuting flow, Sydney, 2006



Note: Based on commutes that have an origin and destination within SD. Inward commutes include commutes to workplaces in the central LGA from elsewhere in SD, from outer suburban residences to middle or inner workplaces and from middle suburban residences to inner workplaces. The opposing flows are categorised as outward commutes (e.g. from Middle to Outer).

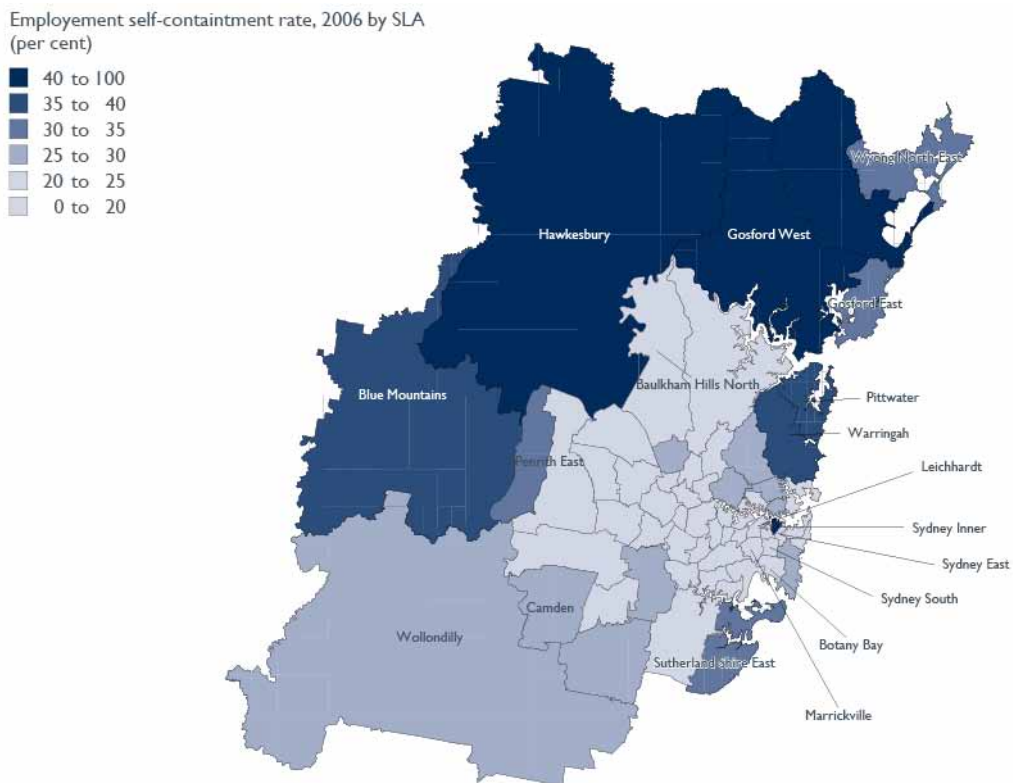
Source: BITRE analysis of BTS 2006 JTW data (table 7) sourced from the ABS *Census of Population and Housing* 2006 unpublished data.

Flows within and between Statistical Local Areas

In 2006 about 27 per cent of all employed Sydney SD residents worked in the same SLA in which they lived. Map 7.1 shows the self-containment rate for all Sydney SLAs. The highest rate of self-containment is for the Sydney Inner SLA (49 per cent), reflecting the number and variety of jobs available in that SLA. However, self-containment rates are typically relatively low in the Inner sector. The Inner sector SLAs of Botany Bay, Randwick and North Sydney have self-containment rates similar to the city wide average (24–27 per cent). Ashfield has the lowest self-containment rate in the Inner sector, with only 12 per cent of employed residents working in their home SLA.

Self-containment rates are at their lowest for the Middle sector SLAs of Parramatta North West (9 per cent), Parramatta South (10 per cent) and Parramatta North East (11 per cent). Most Middle sector SLAs have relatively low self-containment rates, although the self-containment rates for Ryde and Willoughby are close to the city-wide average.

Outer sector SLAs are typically more self-contained, with over 35 per cent of employed residents working in the home SLA in Hawkesbury, Gosford West, Wyong South and West, Warringah, Blue Mountains and Pittwater. However, self-containment rates are relatively low in Blacktown North (13 per cent), Baulkham Hills South (14 per cent) and Liverpool West (14 per cent).

Map 7.1 Self-containment rates in each Statistical Local Area in Sydney, 2006

Note: The number of employed residents (i.e. the denominator) is sourced directly from the ABS 2006 Basic Community Profile.

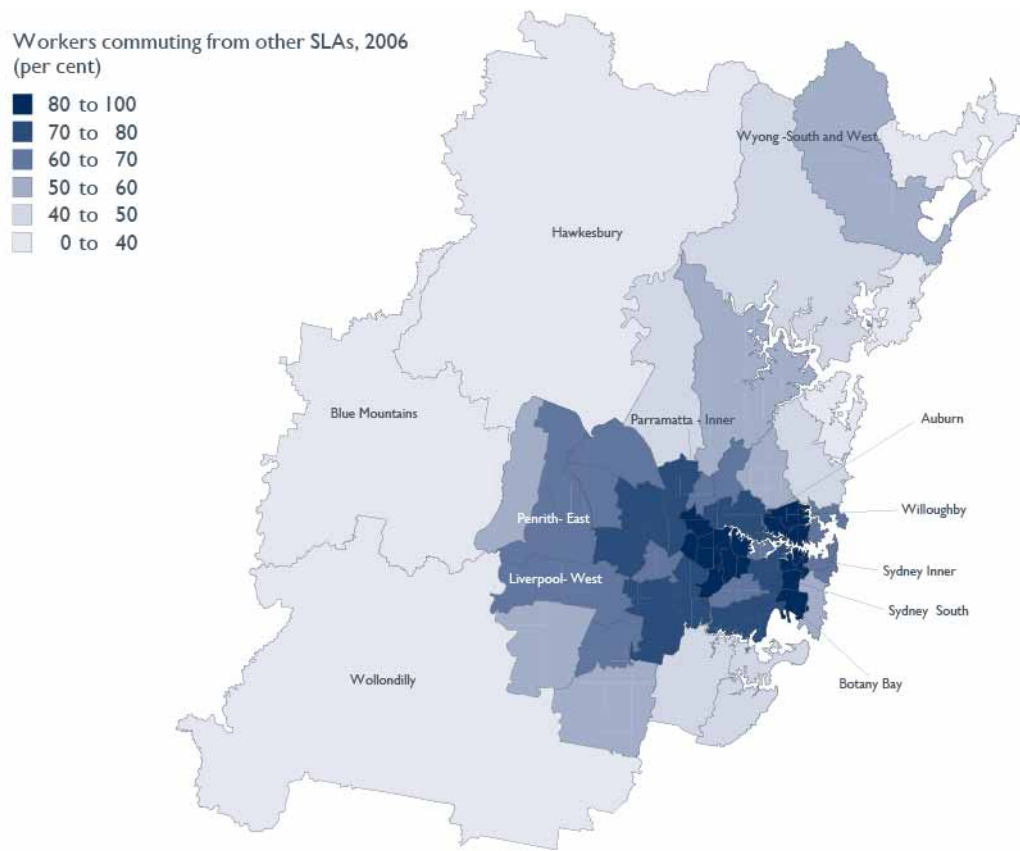
Source: BITRE analysis of BTS JTW 2006 data (table 7) sourced from the ABS *Census of Population and Housing* 2006 unpublished data and ABS 2006 Basic Community Profile.

The proportion of an SLA's workers who commute from a residence located outside the SLA provides a different perspective (see Map 7.2). Over 90 per cent of those who work in Sydney Inner, Sydney South and Sydney West commute from outside the SLA. The Parramatta Inner and Botany Bay SLAs also attract more than 90 per cent of their workers from outside the SLA. The SLAs which attract a high proportion of workers from further afield form two clusters in Map 7.2:

- A cluster stretching from Botany Bay through the CBD and North Sydney to Willoughby (roughly corresponding to the Global Economic Corridor)
- An inner and middle west cluster which includes Parramatta Inner, Parramatta South, Auburn, Strathfield, Burwood and Concord.

The Hawkesbury, Blue Mountains, Wyong North East, and Wollondilly SLAs are much more reliant on the local population to provide their workforce. For example, only 15 per cent of those who work in the Blue Mountains commuted from a different SLA of residence.

Map 7.2 Proportion of workers who commute from outside the Statistical Local Area of residence, Sydney, 2006



Source: BITRE analysis of BTS JTW 2006 data (table 7) sourced from the ABS *Census of Population and Housing* 2006 unpublished data.

While many of the Outer sector SLAs are able to provide jobs for a relatively high proportion of their employed residents, they typically have a limited ability to attract workers from further afield. There are some exceptions such as Wyong South and West which has 42 per cent employment self-containment and is able to attract around half of its workers from other SLAs.

Table 7.11 lists the major commuting flows within Sydney. The single largest commuting flow of 27 314 occurred within the SLA of Willoughby. All the top ten flows were commutes within the home SLA.

The second part of the table lists the twenty largest volume commuting flows which involved an SLA of work different to the SLA of residence. The highest flow is the 10 959 Randwick residents who have a place of work within the Sydney Inner SLA. Nearly all of the listed origin-destination pairs involve the Sydney Inner SLA as the place of work. However, there is also a high volume of commuters travelling from Sutherland Shire West to Sutherland Shire East, from Gosford East to Gosford West, and from Holroyd to Parramatta Inner.

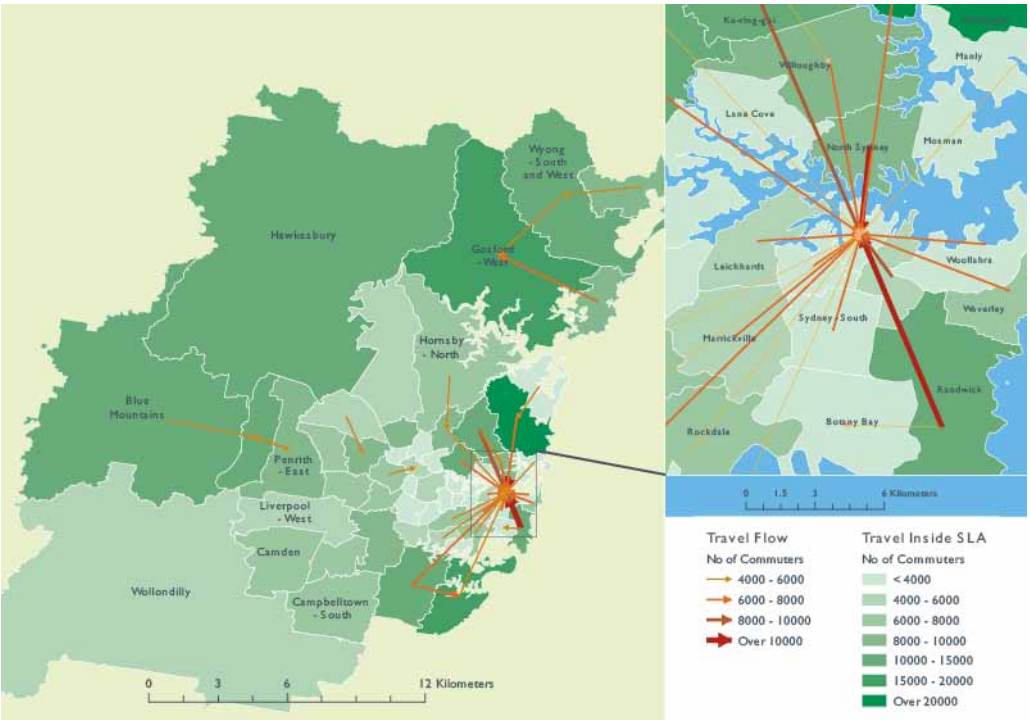
Table 7.11 Major commuting flows between Statistical Local Areas in Sydney, 2006

SLA of residence	Subregion of residence	SLA of work	Subregion of work	Number of people
Top commuting flows				
Warringah	North East	Warringah	North East	27 314
Gosford West	Central Coast	Gosford West	Central Coast	17 459
Sutherland Shire East	South	Sutherland Shire East	South	16 482
Randwick	East	Randwick	East	14 884
Blue Mountains	North West	Blue Mountains	North West	13 837
Hawkesbury	North West	Hawkesbury	North West	13 639
Ryde	Inner North	Ryde	Inner North	13 123
Sutherland Shire West	South	Sutherland Shire West	South	13 035
Penrith West	North West	Penrith West	North West	12 588
Ku-ring-gai	North	Ku-ring-gai	North	12 023
Wyong South and West	Central Coast	Wyong South and West	Central Coast	11 553
Randwick	East	Sydney Inner	City of Sydney	10 959
Pittwater	North East	Pittwater	North East	10 552
North Sydney	Inner North	Sydney Inner	City of Sydney	10 355
Liverpool East	South West	Liverpool East	South West	9 774
Gosford East	Central Coast	Gosford East	Central Coast	9 519
North Sydney	Inner North	North Sydney	Inner North	9 268
Baulkham Hills Central	North West	Baulkham Hills Central	North West	9 250
Blacktown South-East	North West	Blacktown South-East	North West	9 202
Hornsby South	North	Hornsby South	North	9 142
Top commuting flows between different SLAs				
Randwick	East	Sydney Inner	City of Sydney	10 959
North Sydney	Inner North	Sydney Inner	City of Sydney	10 355
Ku-ring-gai	North	Sydney Inner	City of Sydney	8 331
Sydney East	City of Sydney	Sydney Inner	City of Sydney	8 287
Sutherland Shire West	South	Sutherland Shire East	South	7 784
Leichhardt	Inner West	Sydney Inner	City of Sydney	7 523
Warringah	North East	Sydney Inner	City of Sydney	7 479
Marrickville	South	Sydney Inner	City of Sydney	7 463
Woollahra	East	Sydney Inner	City of Sydney	7 375
Gosford East	Central Coast	Gosford West	Central Coast	7 189
Waverley	East	Sydney Inner	City of Sydney	7 136
Willoughby	Inner North	Sydney Inner	City of Sydney	6 967
Sydney South	City of Sydney	Sydney Inner	City of Sydney	6 481
Ryde	Inner North	Sydney Inner	City of Sydney	6 199
Sydney West	City of Sydney	Sydney Inner	City of Sydney	6 152
Sutherland Shire West	South	Sydney Inner	City of Sydney	6 017
Canterbury	South	Sydney Inner	City of Sydney	5 987
Rockdale	South	Sydney Inner	City of Sydney	5 849
Holroyd	West Central	Parramatta Inner	West Central	5 373
Hornsby South	North	Sydney Inner	City of Sydney	5 227

Source: BITRE analysis of BTS JTW 2006 data (table 7) sourced from the ABS *Census of Population and Housing 2006* unpublished data.

Map 7.3 illustrates the main commuting flows between SLAs in the Sydney SD. Almost all of the flows between different SLAs that involved over 4000 commuters were in an inward direction, typically to a place of work in the CBD. The map also reveals substantial commuting flows between neighbouring SLAs in several outer suburban areas—including the Central Coast, Penrith–Blue Mountains, and Sutherland Shire.

Map 7.3 **Commuting flows between Statistical Local Areas of residence and work, Sydney, 2006**



Source: BITRE analysis of BTS JTW 2006 data (table 7) sourced from the ABS *Census of Population and Housing* 2006 unpublished data.

Map 7.3 (and the bottom half of Table 7.11) is dominated by commutes to a place of work in the CBD. Chapter Four identified a range of other important employment locations within the Sydney SD, and Table 7.12 lists the main SLAs from which those employment hubs draw their workforce. For most of these top employing SLAs, a substantial proportion of workers are drawn from within the SLA's boundaries. This is particularly pronounced for Warringah, where 61 per cent of workers live in Warringah. Some of the other top employing SLAs draw their workers from a considerably wider range of locations. For example, Parramatta Inner draws over 2500 workers from a relatively large range of SLAs, mainly in the Outer sector. Blacktown South East mainly draws its workers from a set of neighbouring outer suburban SLAs. North Sydney and Willoughby draw their workforce from a largely common set of SLAs in the northern suburbs.

Table 7.12 Main Statistical Local Areas of residence for top employment locations in Sydney, 2006

SLA of work	People who work in area	SLAs from which it attracts more than 2500 workers
Sydney Inner	231 562	Randwick, North Sydney, Ku-ring-gai, Sydney East, Leichhardt, Warringah, Marrickville, Woollahra, Waverley, Willoughby, Ryde, Sydney West, Sutherland Shire West, Canterbury, Rockdale, Hornsby South, Hurstville, Sutherland Shire East, Manly, Ashfield, Drummoyne, Mosman, Sydney Inner, Kogarah, Hornsby North, Lane Cove, Holroyd, Baulkham Hills Central, Blacktown North, Blacktown South East
Parramatta Inner	65 901	Holroyd, Parramatta Inner, Blacktown North, Blacktown South East, Baulkham Hills Central, Penrith East, Blacktown South West, Parramatta North West
North Sydney	60 047	North Sydney, Willoughby, Warringah, Ku-ring-gai
Ryde	58 314	Ryde, Hornsby
Willoughby	51 426	Willoughby, Ku-ring-gai, Warringah, North Sydney, Ryde
Warringah	45 545	Warringah, Pittwater, Manly
Blacktown South East	43 435	Blacktown South East, Blacktown North, Blacktown South West, Penrith East
Sydney East	43 099	Sydney East, Randwick
Sydney West	41 614	Sydney South, Randwick
Sydney South	41 497	Sydney West, Marrickville

Note: Statistical Local Areas are listed in declining order—the first listed SLA provides the most workers to the relevant SLA of work.

Source: BITRE analysis of BTS JTW 2006 data (table 7) sourced from the ABS *Census of Population and Housing 2006* unpublished data.

Table 7.13 lists the origin-destination pairs with the highest probabilities—these probabilities are measured simply by taking the number commuting to a given destination as a proportion of the number of employed residents in the origin SLA.

Around 21 per cent of total commuting flows within the Sydney SD involved commuting to a place of work in the City of Sydney subregion and 13 per cent involved commuting to a place of work in the Sydney Inner SLA (i.e. the CBD). Table 7.13 shows that the probability of commuting to the CBD exceeds 20 per cent for a range of Inner and Middle sector SLAs. Employed residents of the Sydney East and Sydney West SLAs are particularly likely to have a place of work in Sydney Inner.

The probability of commuting to work in the broader City of Sydney subregion is relatively high for Inner sector residents (41 per cent) and Middle sector residents (21 per cent), but this type of commute is much less common for outer suburban residents (only 9 per cent commute to a place of work in the City of Sydney).

Table 7.13 Highest probabilities of commuting between different Statistical Local Areas, Sydney, 2006

Origin SLA	Destination SLA	Number of persons	Probability an employed resident of origin SLA will work in destination SLA (per cent)
Top ten probabilities of commuting to work in CBD			
Sydney East	Sydney Inner	8 287	34
Sydney West	Sydney Inner	6 152	33
North Sydney	Sydney Inner	10 355	29
Woollahra	Sydney Inner	7 375	29
Mosman	Sydney Inner	3 850	29
Leichhardt	Sydney Inner	7 523	26
Sydney South	Sydney Inner	6 481	25
Waverley	Sydney Inner	7 136	24
Willoughby	Sydney Inner	6 967	22
Manly	Sydney Inner	4 029	21
Top ten probabilities of commuting to work outside CBD			
Gosford East	Gosford West	7 189	25
Wyong North East	Wyong South and West	4 925	19
Pittwater	Warringah	4 644	17
Wyong South and West	Gosford West	4 387	16
Parramatta North West	Parramatta Inner	2 514	16
Botany Bay	Randwick	2 366	14
Holroyd	Parramatta Inner	5 373	14
Manly	Warringah	2 594	14
Sutherland Shire West	Sutherland Shire East	7 784	13
Baulkham Hills North	Baulkham Hills Central	3 519	13

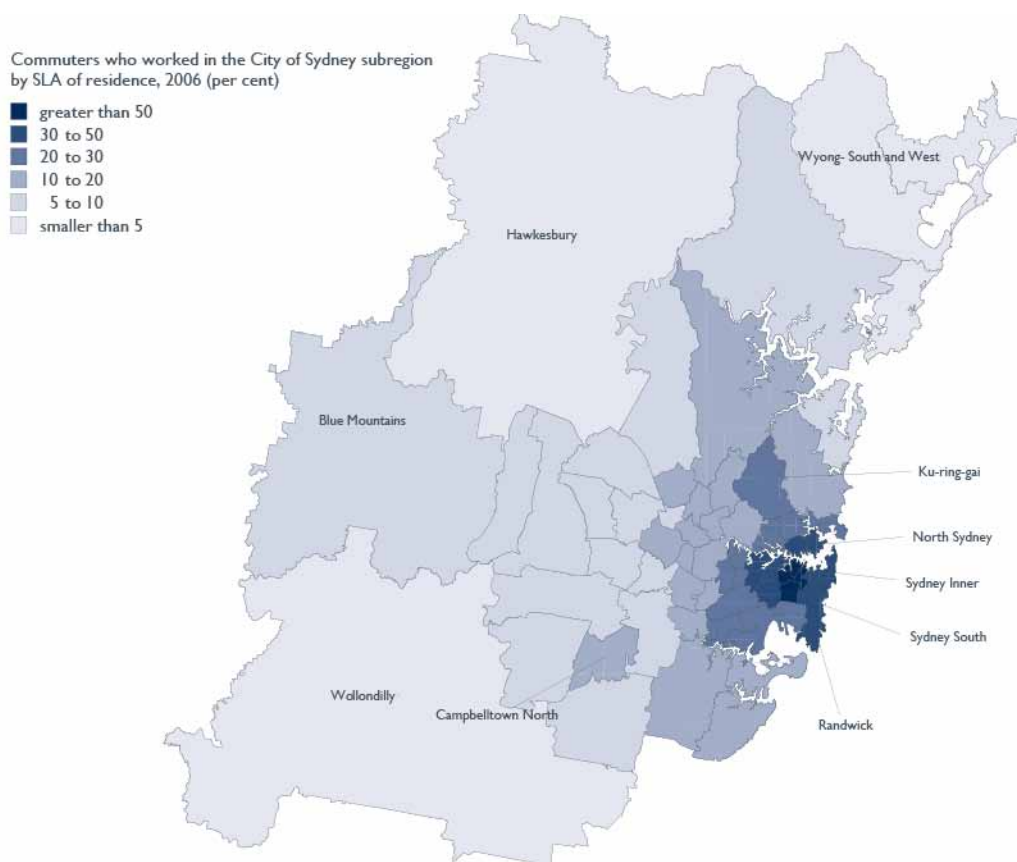
Note: Excludes commutes within the SLA of residence. The number of employed residents (i.e. the denominator) is sourced directly from the ABS 2006 Basic Community Profile.

Source: BITRE analysis of BTS JTW 2006 data (table 7 and table 11) sourced from the ABS *Census of Population and Housing* 2006 unpublished data and ABS 2006 Basic Community Profile.

Map 7.4 shows that the probability of commuting to a place of work in the City of Sydney is highest in the inner city and declines relatively rapidly with distance from the city centre. The probability of commuting to a place of work in the City of Sydney was highest for the Sydney East SLA (64 per cent), while Drummoyne has the highest probability amongst Middle sector SLAs (32 per cent) and Hornsby South has the highest probability amongst Outer sector SLAs (17 per cent). Campbelltown North residents have a somewhat higher probability of commuting to the City of Sydney (12 per cent) than do residents of surrounding SLAs.

In the Outer sector, Wollondilly, Hawkesbury, Gosford East and both Wyong SLAs each have less than 5 per cent of employed residents commuting to a place of work in the City of Sydney subregion. Compared to other Middle sector SLAs, Parramatta North West residents have a relatively low probability of commuting to a place of work in the City of Sydney (10 per cent).

Map 7.4 Proportion of employed residents of each Statistical Local Area who commute to a place of work in the City of Sydney planning subregion, Sydney, 2006



Note: The number of employed residents (i.e. the denominator) is sourced directly from the ABS 2006 Basic Community Profile.

Source: BITRE analysis of BTS JTW 2006 data (table 7) sourced from the ABS *Census of Population and Housing* 2006 unpublished data and ABS 2006 Basic Community Profile.

The bottom half of Table 7.13 reveals the highest probabilities of commuting to locations outside of the CBD. The origin-destination pairs with the highest probabilities all involve neighbouring SLAs. For example, employed residents of Gosford East have a relatively high probability of commuting to Gosford West (25 per cent). Many of these origin-destination pairs involve commutes from a relatively residentially-oriented location to a more employment-oriented location (e.g. Holroyd to Parramatta Inner; Sutherland Shire West to Sutherland Shire East). However, employed residents of the very employment-oriented Botany Bay SLA had a high probability of commuting to the neighbouring Randwick SLA.

Commuting patterns depend on the proximity of employment and the availability of transport to access jobs. The metropolitan strategies plan to locate up to 30 per cent of new homes on the urban fringe, largely in the North West and South West growth centres (NSW Government 2010a). Table 7.14 shows the existing journey to work patterns in the urban fringe growth SLAs.

Typically around 30 per cent of employed residents work in the home LGA. The neighbouring LGAs are also important destinations—for example, Blacktown North residents commute to Baulkham Hills and Parramatta, while Camden residents commute to Campbelltown and Liverpool. For each of these growth SLAs, less than 10 per cent of employed residents are commuting to a place of work in the City of Sydney. A detailed profile of commuting patterns in Western Sydney in 2006 is available from Beard (2011).

Table 7.14 Journey to work destinations for employed residents of four selected urban fringe growth areas, Sydney, 2006

SLA of residence	Number of employed residents	Per cent of employed residents in each place of work				
		Own SLA	Rest of own LGA	Sydney LGA	Parramatta LGA	Other LGAs which attract more than 5 per cent of employed residents
Baulkham Hills North	26 439	19	15	7	8	Blacktown (10), Hornsby (6)
Blacktown North	43 530	13	15	9	11	Baulkham Hills (10)
Camden	24 753	28	Na	6	2	Campbelltown (17), Liverpool (10)
Liverpool West	29 890	14	13	7	4	Fairfield (11), Bankstown (6)

Note: The number of employed residents (i.e. the denominator) is sourced directly from the ABS 2006 Basic Community Profile. Na is not available

Source: BITRE analysis of BTS JTW 2006 data (table 7) sourced from the ABS 2006 *Census of Population and Housing* unpublished data and ABS 2006 Basic Community Profile.

Commuting flows to strategic centres

Table 7.15 focuses on the existing strategic centres that accounted for 39 per cent of Sydney's employment in 2006, presenting information on the subregions from which those workers are drawn.

Over 17 per cent of Sydney's employment was in Central Sydney. The workers in Central Sydney came from the full range of planning subregions, but particularly from the South (17 per cent), Inner North (13 per cent), East (12 per cent) and City of Sydney (12 per cent). North Sydney is the other centre within Global Sydney and it drew its workers mainly from within the home subregion of Inner North (24 per cent), but also from the North (12 per cent) and the South (11 per cent). St Leonards-Crows Nest, Chatswood and Macquarie Park similarly drew a high proportion of their workers from the Inner North and North, although Macquarie Park also attracted many workers from the North West subregion.

The remaining centres typically had one or two subregions providing the majority of the workforce. The workers at Parramatta, Westmead and Olympic Park-Rhodes were primarily drawn from the West Central and North West subregions, while Liverpool's workers were mainly drawn from the West Central and South West subregions. The East subregion has four main centres—Sydney Airport, Port Botany, Bondi Junction and Randwick education and health—and while Airport and Port Botany workers largely resided in the neighbouring South subregion, Bondi Junction and Randwick workers largely resided in the East subregion.

Table 7.15 Proportion of workers in existing strategic centres of work by subregion of residence, Sydney, 2006

Centre of work	Proportion of workers from each place of residence (per cent)											
	City of Sydney	East	Inner North	Inner West	South	North	North East	West Central	North West	South West	Central Coast	Sydney SD
Global Sydney												
Central Sydney	12	12	13	9	17	7	5	9	8	4	2	98
North Sydney	6	7	24	7	11	12	9	8	8	3	2	98
Regional cities												
Parramatta	1	1	4	4	6	4	1	32	36	8	1	99
Liverpool	1	1	1	3	7	1	0	22	7	54	0	98
Penrith	0	0	1	1	1	1	0	4	89	4	0	99
Gosford	0	0	0	0	0	2	0	0	1	0	91	95
Specialised centres												
Macquarie Park	3	3	23	7	7	16	6	12	17	2	2	98
St Leonards-Crows Nest	5	5	31	6	8	13	11	7	8	2	3	98
Olympic Park-Rhodes	2	3	9	12	12	7	3	22	19	7	2	98
Port Botany & environs	4	29	3	3	35	1	2	8	4	6	1	97
Sydney Airport & environs	5	14	5	5	38	2	3	8	5	7	1	93
Randwick education and health	8	53	5	5	17	3	2	3	2	2	0	98
Westmead	1	1	5	4	4	6	1	31	42	4	1	99
Bankstown Airport-Milperra	1	2	1	3	20	1	1	34	7	26	1	97
Norwest Business Park	1	1	5	3	3	8	2	14	55	4	2	98
Major centres												
Bankstown	1	1	1	5	21	1	0	48	5	13	0	98
Blacktown	0	0	1	2	2	2	0	11	76	3	0	99
Bondi Junction	10	49	4	5	16	2	2	5	3	2	0	98
Brookvale-Dee Why	1	1	6	1	1	4	80	2	2	0	1	99
Burwood	2	3	5	29	17	4	1	19	12	5	1	98
Campbelltown-Macarthur	0	1	0	1	3	0	0	4	2	83	0	95
Castle Hill	0	0	2	1	1	15	0	8	72	1	0	100
Chatswood	4	4	29	5	7	20	10	7	7	1	4	99
Hornsby	1	1	5	1	1	59	3	4	9	0	15	98
Hurstville	1	3	1	3	73	1	0	9	2	4	0	96
Kogarah	2	5	2	3	70	1	0	6	2	4	0	96
Tuggerah-Wyong	0	0	0	0	0	1	0	0	0	0	88	89

Note: See Table 4.7 for information on centre classification. Rows do not sum to 100 per cent, as some centre workers reside in the rest of the GMA or outside the GMA.

Source: BITRE analysis of BTS JTW 2006 data (table 11) sourced from the ABS *Census of Population and Housing 2006* and strategic centre employment estimates from Table 4.7 of this report.

Many of the strategic centres listed in Table 7.15—particularly the major centres—have a limited catchment, drawing the great majority of the workforce from within the home subregion. Examples include Penrith (which drew 89 per cent of workers from within the subregion), Gosford (91 per cent), Tuggerah-Wyong (88 per cent), Campbelltown-Macarthur (83 per cent) and Brookvale-Dee Why (80 per cent). Despite this general pattern, there were some major centres that drew a significant proportion of their workforce from beyond the home subregion, including Burwood, Chatswood, Bondi Junction and Bankstown.

None of the specialised centres were as heavily reliant on the home subregion to provide their workforce. Norwest was the specialised centre that was most reliant, with 55 per cent of workers living in the North West subregion.

Commuting distance, speed and time

A key component of this section is the analysis of spatial variation in the average distance travelled to work within Sydney. The analysis is based on Sydney residents who work within the Sydney SD (i.e. it excludes commuting to/from the rest of the GMA or other more distant locations). The average distance estimates presented in this chapter represent road network distances, which were derived by BITRE based on detailed BTS Strategic Travel Model outputs of the road network distance between each travel zone pair. These distance estimates were then weighted according to census counts of total commuters, and aggregated to the SLA scale. BITRE's estimates assume that the road network distance between each origin-destination pair is representative of the distance travelled by all commuters between the origin-destination pair (even though some commuters use rail, cycle or footpath networks). This approach results in an estimated average distance of 14.6 kilometres (km) for commutes within the Sydney SD.⁵⁵

The BITRE estimates of average commuting distance align with estimates from the *Household Travel Survey* (HTS), which show that the average commuting distance in Sydney stood at 14.6km in 2005–06 (BTS 2011). The two sets of estimates also align very closely at the subregion scale, with a correlation coefficient of over 99 per cent and a maximum variation of 6 per cent.

Straight line distance estimates were also calculated by BITRE for Sydney, to enable cross-city comparison of regression results—see Tables 8.9 and 8.12. However, the current chapter focuses on the road network distance figures, which are systematically higher than the straight line distance estimates.

In addition to analysing spatial variation in commuting distances, this section pulls together information from several sources that reveal patterns of spatial variation in travel time and speeds within Sydney.

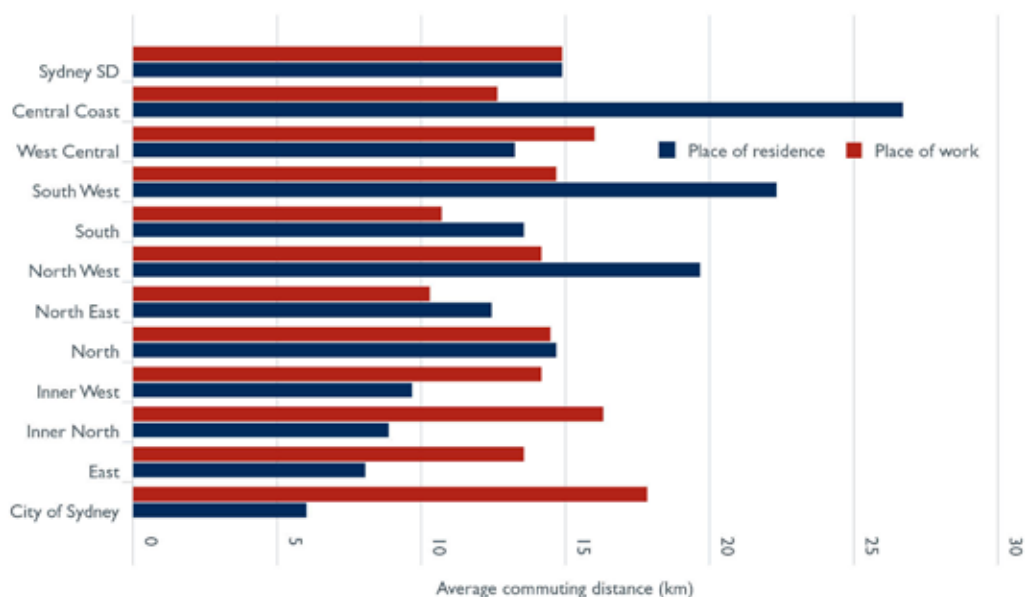
Overview—sectors and subregions

Figure 7.2 shows the average distance of commuter travel within the Sydney SD based on the subregion of residence and subregion of work. Table 7.16 presents the same information, alongside averages for the Inner, Middle and Outer sectors of Sydney.

⁵⁵ Including all commutes within the GMA raises the average commuting distance for Sydney SD residents from 14.6km to 15.5km, but has little impact on the relativities across the different subregions.

The City of Sydney had the lowest average commuting distance by place of residence and yet the highest average commuting distance by place of work. Central Coast residents had a higher average commuting distance than residents of other subregions. The HTS produces a similar ordering, with commuting distances lowest for residents of the City of Sydney (6km) and highest for residents of the Central Coast subregion (25km) (TDC 2009c).

Figure 7.2 Average commuting distance by subregion, Sydney, 2006



Note: Distance calculation based on the road network distance between travel zone pairs, sourced from BTS Strategic Travel Model. Based on commutes within Sydney SD only.

Source: BITRE analysis of BTS Strategic Travel Model distance outputs and BTS 2006 origin-destination matrix at travel zone scale (table 7), sourced from the ABS *Census of Population and Housing 2006*.

The average commuting distances were low for Inner sector residents (7.5 kilometres), somewhat higher for Middle sector residents (11.5 kilometres) and higher again for Outer sector residents (18.8 kilometres). On average, residents of the Outer sector travelled well over double the distance that Inner sector residents travelled to get to work. The further away the subregions were from the CBD, the longer the average commuting distances.

On a place of work basis, Inner sector workers had the longest average commuting distance, followed by Middle sector workers and Outer sector workers. The shorter distance commutes to jobs in the Outer sector reflects the fact that a high proportion of Outer sector jobs are filled by residents of nearby outer suburban locations. Those who worked in the City of Sydney had the highest average commuting distance because the greater quantity and range of jobs attracted workers from more distant areas. A similar effect also underpins the relatively high distances commuted to access jobs in the Inner North (which includes the key employment centres of North Sydney and St Leonards) and West Central (which includes the regional city of Parramatta). On a place of work basis, the North East subregion had the lowest average commuting distance.

Table 7.16 Average commuting distance by subregion and sector, Sydney, 2006

	Average distance by place of residence (km)	Average distance by place of work (km)
Planning subregion		
City of Sydney	5.9	17.5
East	7.9	13.3
Inner North	8.7	16.0
Inner West	9.5	13.9
South	13.3	10.5
North	14.4	14.2
North East	12.2	10.1
West Central	13.0	15.7
North West	19.3	13.9
South West	21.9	14.4
Central Coast	26.2	12.4
Sydney SD	14.6	14.6
Sector		
Inner	7.5	16.1
Middle	11.5	14.7
Outer	18.8	13.2

Note: Distance calculation based on the road network distance between travel zone pairs, sourced from BTS Strategic Travel Model. Based on commutes within Sydney SD only.

Source: BITRE analysis of BTS Strategic Travel Model distance outputs and BTS 2006 origin-destination matrix at travel zone scale (table 7) sourced from the ABS *Census of Population and Housing 2006*.

Average commuting distances differ by mode of travel. *Household Travel Survey* data for 2009–10 reveal that commuting by train involves relatively long distances (19 kilometres, on average), particularly compared to commuting by bus (8 kilometres) or on foot (1 kilometre) (BTS 2011). Similarly, average trip durations are highest for train commutes, and lowest for walking commutes (ibid.).

There are a range of data sources which provide estimates of average commuting times for Sydney as a whole:

- The *Household Travel Survey* estimate of the average duration of a commuting trip is 33 minutes per trip for 2005–06 (BTS 2011). This commuting duration is based on the door-to-door journey time of linked trips, which may include walking as part of the trip to work.⁵⁶
- According to the HILDA survey, Sydney residents who were employed full-time spent about 5.8 hours commuting to work each week in 2006, which is 35 minutes per one-way commute (Melbourne Institute 2009). This is the highest of the average commuting times for the major capital cities (ibid.).
- Productivity Commission (2011) reports a median peak commuting time for the Sydney SD of 35 minutes for 2010, which is again higher than the other capital cities.

⁵⁶ HTS estimates of the average duration of tours that involve commuting from home to work are considerably higher (i.e. around 43 minutes for the Sydney SD). This is because the concept of a tour (as opposed to a linked trip) incorporates stops made along the way, such as dropping the children off at school, going to the gym, or running errands.

Household Travel Survey information is available on the average duration of work trips at the subregion scale. Work trips include commutes and other work-related business trips (TDC 2009c). Figure 7.3 displays the average work trip duration for residents of each subregion, based on pooled HTS estimates for the five years to 2007–08.⁵⁷ The durations are based on the door-to-door journey time of linked trips.

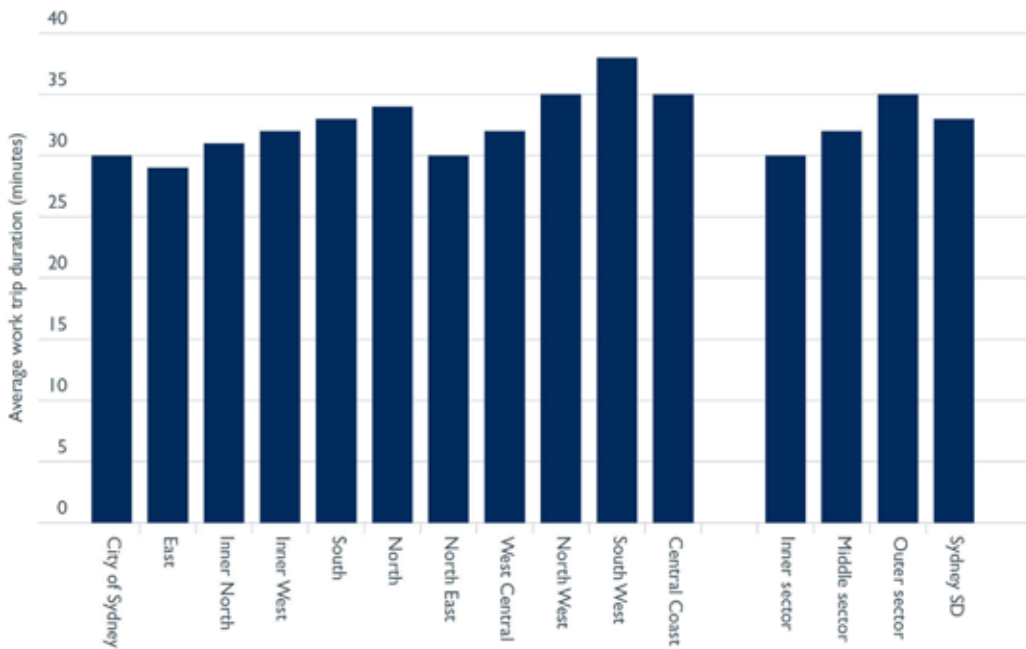
The average work trip duration was 33 minutes across the Sydney SD. Figure 7.3 shows there was limited variation in average work trip duration at the sectoral scale, with Outer sector residents having an average duration which was just four minutes (or 14 per cent) higher than that of Inner sector residents. The average work trip distance travelled by Outer sector residents was more than double that of Inner sector residents. The longer trip distances do not translate into longer trip durations for Outer sector residents, due to the greater speed of travel.

Average work trip durations ranged between 29 and 38 minutes at the subregion scale (TDC 2009c). Residents of the South West had the highest average duration (38 minutes), followed by North West and Central Coast residents (35 minutes each). Residents of the East subregion had the lowest average work trip duration (29 minutes). While City of Sydney residents travelled less than half the average distance to work of Sydney SD residents, their average duration was only slightly less than the other subregions, reflecting low travel speeds in and around the CBD, which in turn reflects use of active travel modes and congestion.

Combining the average commuting distance and time figures for Sydney SD residents in 2005–06 from BTS (2011) gives an average door-to-door speed of roughly 26 kilometres per hour (km/hour) while commuting to work. The speed of commuting depends on the time of travel. For many people, commuting to work involves non-discretionary peak hour travel, which comprises around 60 per cent of AM peak travel in Sydney (Corpuz 2006). The NSW Government conducts routine travel speed surveys in Sydney twice yearly on the busiest routes (Roads and Maritime Services 2011). The average speed in the AM peak on the seven major road routes was 32 kilometres per hour (km/hour) in 2005–06. For the AM peak the speed ranged from 44 km/hour in the M5 corridor to 23 km/hour on Victoria Road (ibid.).

⁵⁷ Average commuting trip duration estimates are available for subregions for the five years ending 2004–05 from Transport and Population Data Centre (2006a). Comparison of the commuting trip and work trip duration estimates for subregions shows a good spatial correlation (0.79) between the two sets of estimates, despite the differences in scope and timing. The work trip duration estimates are presented here because they are less dated and better match the 2006 focus of the analysis.

Figure 7.3 Average work trip duration by subregion and sector of residence, Sydney, 2007



Note: Work trip includes commutes and other work-related business trips. Sector estimates derived by BITRE from HTS data for LGAs.

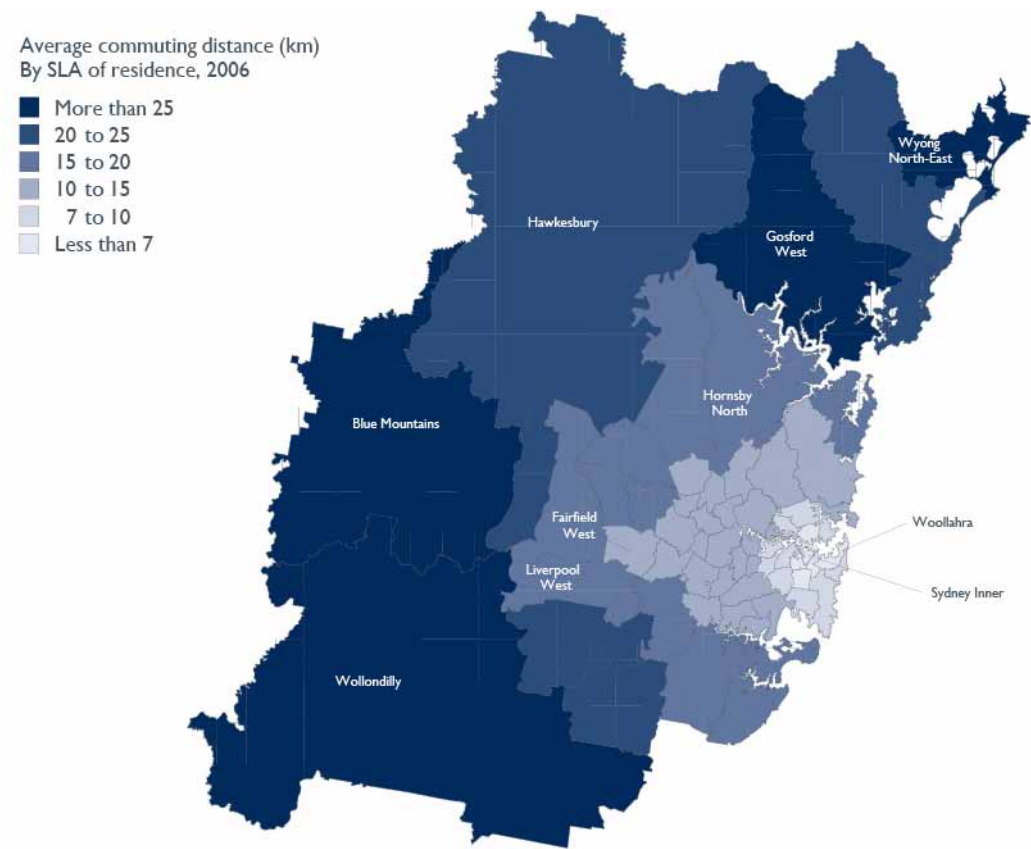
Source: BITRE analysis of TDC (2009c, 2009d), which is based on the *Household Travel Survey* 2007 five year pooled datasets.

Small area differences

Map 7.5 shows how average commuting distance varies by SLA of residence. The map shows a pattern of layered rings—residents of the City of Sydney commute the least average distance to work, followed by residents of other Inner sector SLAs, then the Middle sector SLAs, with residents of the Outer sector SLAs tending to have the highest commuting distances.

Table 7.17 lists the SLAs of residence which have the highest and lowest average commuting distances. Outer sector SLAs such as Blue Mountains and Wollondilly have the longest average commuting distances, while residents of SLAs adjacent to the CBD tend to have a shorter average distance to work.

Map 7.5 Average commuting distance by Statistical Local Area of residence, Sydney, 2006



Note: Distance calculation based on the road network distance between travel zone pairs, sourced from BTS Strategic Travel Model. Based on commutes within Sydney SD only.

Source: BITRE analysis of BTS Strategic Travel Model distance outputs and BTS 2006 origin-destination matrix at travel zone scale (Table 7) sourced from the ABS *Census of Population and Housing* 2006.

Table 7.17 Five longest and shortest average commuting distances by Statistical Local Area of residence, Sydney, 2006

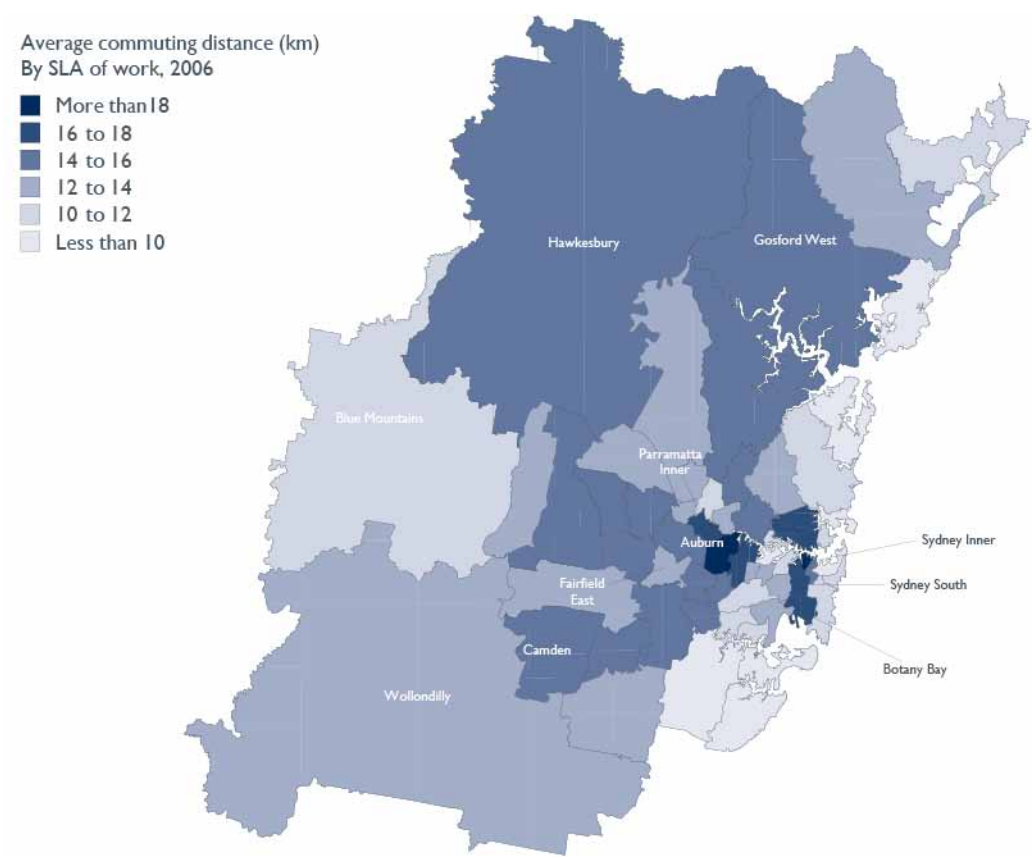
SLA of residence	Longest average commuting distance (km)	SLA of residence	Shortest average commuting distance (km)
Wollondilly	31.7	Sydney Inner	4.8
Wyong North-East	29.1	Sydney East	5.2
Blue Mountains	28.9	Sydney West	5.9
Gosford West	28.1	Woollahra	6.6
Gosford East	24.5	Sydney South	6.8

Note: Distance calculation based on the road network distance between travel zone pairs, sourced from BTS Strategic Travel Model. Based on commutes within Sydney SD only.

Source: BITRE analysis of BTS Strategic Travel Model distance outputs and BTS 2006 origin-destination matrix at travel zone scale (table 7) sourced from the ABS *Census of Population and Housing* 2006.

Map 7.6 shows the average commuting distance to each SLA of work. The spatial pattern is much less obvious than that of the previous map. The Global Economic Corridor stands out from the surrounding SLAs as having relatively high commuting distances, as do the Auburn, Strathfield and Parramatta Inner SLAs in Sydney's west. A similar set of SLAs stood out in Map 7.2 as attracting a relatively high proportion of their workforce from other SLAs.

Map 7.6 **Average commuting distance by Statistical Local Area of work, Sydney, 2006**



Note: Distance calculation based on the road network distance between travel zone pairs, sourced from BTS Strategic Travel Model. Based on commutes within Sydney SD only.

Source: BITRE analysis of BTS Strategic Travel Model distance outputs and BTS 2006 origin-destination matrix at travel zone scale (table 7) sourced from the ABS *Census of Population and Housing 2006*.

An area's ability to attract workers from further afield is related to its industry specialisations and the size of the employment agglomeration. Table 7.18 lists the employment self-sufficiency ratio and main industries of the SLAs with the longest average commuting distance on a place of work basis. All of these SLAs are self-sufficient in employment, whereas the SLAs with the shortest average commuting distances (see Table 7.19) all have self-sufficiency ratios of much less than one.

The Sydney Inner SLA is the centre of Sydney's major employment agglomeration, offering a range of highly skilled and well-renumerated employment opportunities, particularly in the

Finance and insurance industry, and attracts commuters from throughout the metropolitan area. Parramatta Inner is the second top employing SLA, containing the regional city of Parramatta and the specialised centre of Westmead, which attract commuters from much of Western Sydney. The Auburn and Botany Bay SLAs are smaller employment hubs which offer specialised employment opportunities in Manufacturing and Transport respectively, and are able to draw workers from a considerable distance away.

The SLAs in Table 7.19 with the shortest commuting distances were residentially oriented SLAs, in which most of the jobs were focused on serving the local population. In Manly, Gosford, Sutherland Shire and Drummoyne, the average commuter travelled less than 10 kilometres to get to work.

Table 7.18 Five longest average commuting distances by Statistical Local Area of work, Sydney, 2006

SLA of work	Largest employing industry	Employment self-sufficiency ratio	Average commuting distance (km)
Sydney Inner	Finance and insurance	29.88	18.4
Auburn	Manufacturing	1.77	18.3
Botany Bay	Transport and storage	2.42	17.7
Strathfield	Retail trade	1.25	17.5
Parramatta Inner	Health and community services	3.48	17.4

Note: Distance calculation based on the road network distance between travel zone pairs, sourced from BTS Strategic Travel Model. Based on commutes within Sydney SD only.

Source: BITRE analysis of BTS Strategic Travel Model distance outputs and BTS 2006 origin-destination matrix at travel zone scale (table 7) sourced from the ABS *Census of Population and Housing* 2006.

Table 7.19 Five shortest average commuting distances by Statistical Local Area of work, Sydney, 2006

SLA of residence	Largest employing industry	Employment self-sufficiency ratio	Average commuting distance (km)
Manly	Health and community services	0.57	8.7
Sutherland Shire West	Retail trade	0.38	8.8
Gosford East	Retail trade	0.55	9.2
Drummoyne	Retail trade	0.39	9.3
Sutherland Shire East	Retail trade	0.66	9.4

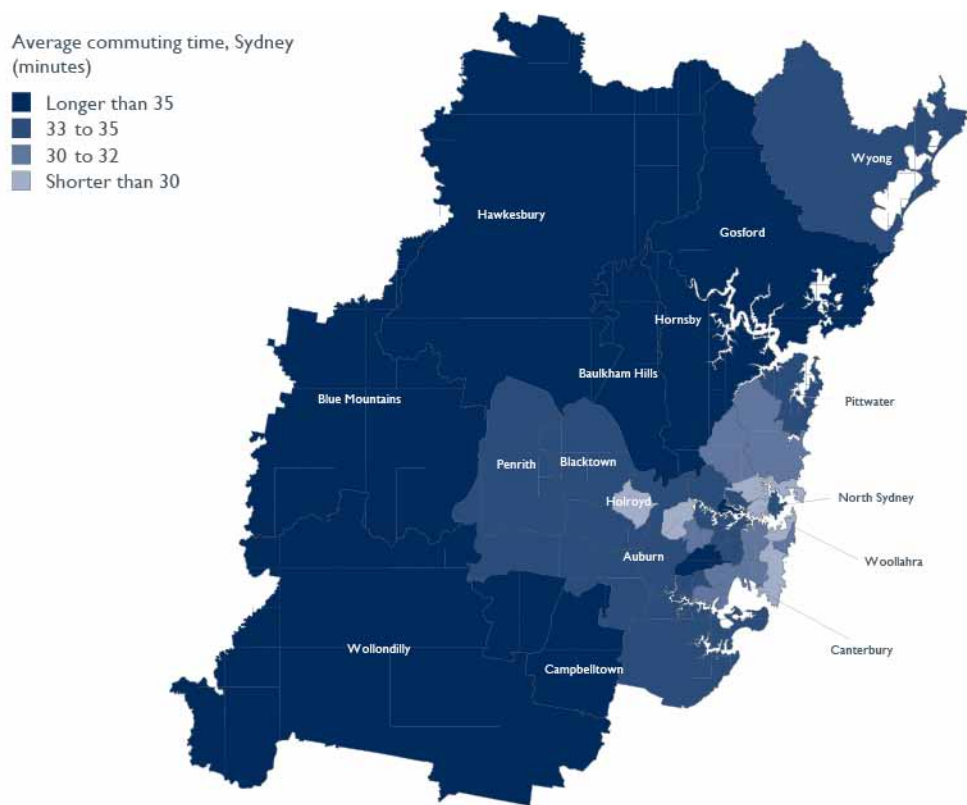
Note: Distance calculation based on the road network distance between travel zone pairs, sourced from BTS Strategic Travel Model. Based on commutes within Sydney SD only.

Source: BITRE analysis of BTS Strategic Travel Model distance outputs and BTS 2006 origin-destination matrix at travel zone scale (table 7) sourced from the ABS *Census of Population and Housing* 2006.

Map 7.7 illustrates how the average duration of work trips varies across Sydney's LGAs based on TDC (2009d). For Sydney as a whole the average work trip duration was 33 minutes. At the LGA scale, 33 of the 47 LGAs had an average work trip duration of between 30 and 36 minutes.

There is a tendency for the outermost LGAs to have the longest trip durations, with Wollondilly, Campbelltown, Camden, Blue Mountains, Hawkesbury and Gosford residents all having durations of 36 minutes or more. However, the spatial pattern for trip duration is much less pronounced than the very systematic pattern shown in Map 7.5 of increasing commuting trip distances as one moves further from the CBD. The LGAs with average work trip durations of under 30 minutes were more centrally located, and included Manly, North Sydney, Willoughby, Woollahra, Randwick and Holroyd. While residents of the City of Sydney LGA had the shortest average work trip distance of 7 kilometres, their average work trip duration of 30 minutes was only slightly below the city-wide average, due to the slow door-to-door travel speeds (about 14 kilometres per hour, on average).

Map 7.7 **Average work trip duration by Local Government Area of residence, Sydney, 2007**



Note: Work trips includes commutes and other work-related business trips.

Source: BITRE analysis of TDC (2009d), which is based on the *Household Travel Survey 2007* five year pooled dataset.

Congestion levels in different parts of the city can explain some of these spatial differences in travel times. Table 7.20 shows Centre for International Economics (2010) estimates of average congestion delays for road use by LGA of residence. The average daily road use delay across the city is 8 minutes per person. The table indicates that congestion costs fall mainly on residents of outer areas of Sydney. All of the LGAs with high average delays are in the Outer sector; whilst the low delay LGAs are in the Inner sector. These results reflect behavioural adjustments by inner city residents to avoid road congestion by walking or catching the train (ibid.).

Table 7.20 Average delays for road use by Local Government Area of residence, Sydney

High delay LGAs	Minutes per person per day	Low delay LGAs	Minutes per person per day
Sutherland	13.9	Sydney	3.2
Camden	12.4	Marrickville	3.8
Baulkham Hills	11.8	Randwick	3.8
Hornsby	11.0	Woollahra	3.8
Campbelltown	10.6	Waverley	4.0

Note: Estimates relate to the entire population, which includes people who undertake no travel. Delays relate to road use, whether as a car driver, car passengers or bus users.

Source: Centre for International Economics (2010) estimates based on figures from Transport Data Centre.

Transport Population and Data Centre (2006b) presents some information relevant to understanding how travel times differ across key *places of work*—specifically the Sydney CBD, North Sydney and the regional cities of Parramatta, Penrith and Liverpool. The focus is on motorised travel into each centre on an average weekday in 2003, for any purpose. The average travel time per motorised trip was particularly high for trips to the Sydney CBD (48 minutes), reflecting the long trip distances involved (see Table 7.18 and TPDC 2006b). The average travel time was lower for North Sydney (34 minutes), Parramatta (33 minutes), Liverpool (29 minutes) and particularly Penrith (24 minutes). The average speed of travel to work in Penrith was considerably faster than for the other centres (*ibid.*).

Travel costs

This section discusses the generalised cost of daily travel for an individual or a household. Ideally, a comprehensive estimate of travel costs should include not only the time and financial costs to an individual, but also a range of indirect costs, such as external costs of congestion, pollution, crashes, etc. (Litman and Doherty 2009; BITRE 2011). Resource and data constraints often mean that the indirect costs are excluded in calculating travel costs.

This section draws heavily on the Hensher and Chen (2010) study of the generalised cost of travel in Sydney subregions. Generalised costs refer to the total financial cost associated with movement between specific geographic locations within Sydney, plus the travel times converted to a dollar basis using a behavioural value of travel time saving as shown in Table 7.21 (*ibid.*).

Table 7.21 Value of opportunity cost of travel time, Sydney Greater Metropolitan Area

Mode	Value (\$ per hour)
Car commuting	16
Public transport	9
Walking, cycling etc	9

Source: Hensher and Chen (2010)

The Hensher and Chen (2010) estimates were based on the Sydney HTS, covering an 11 year period (1997–2008). The data provides daily travel times and money costs outlaid by individuals and households and we reproduce the results here at the subregional scale. Additional data was sourced from the NRMA on the costs of car ownership by class of vehicle.

The generalised cost presented here covers all purposes of travel in Sydney, even though our concern in particular is for commuting. Commuting trips comprise around 16 per cent of all travel and 27 per cent of the distance travelled (BTS 2011).

When including the time and financial costs in the estimates, the generalised cost of daily travel by public transport ranges from \$27.55 per user per day for residents of the North East subregion to \$11.94 for Lower Hunter residents (see Table 7.22). The generalised cost of travel by private vehicle ranges from \$37.96 for the South West subregion to \$26.26 for the City of Sydney, with the majority of subregions having daily car costs between \$30 and \$35. If only the marginal cost of cars is used, the generalised costs of public transport and car use on average are very similar (Hensher and Chen 2010).

Table 7.22 Generalised travel cost by mode and subregion of residence, Sydney Greater Metropolitan Area

Planning subregion of residence	Generalised cost, \$ per person per day			Public transport mode share, 2006 (per cent)	Proportion living within 1km of frequent public transport service, 2006 (per cent)
	Public transport	Private vehicle			
		(marginal costs)	All generalised costs		
City of Sydney	18.00	18.23	26.26	32.4	100.0
East	23.15	17.32	30.21	29.1	99.7
Inner North	22.07	18.30	31.64	29.7	98.8
Inner West	19.68	17.64	30.05	30.9	97.7
South	17.57	18.75	32.65	24.2	88.3
North	16.98	19.04	34.55	23.2	68.5
North East	27.55	18.79	32.99	16.6	86.1
West Central	16.73	18.05	32.18	19.3	91.5
North West	17.39	21.85	37.63	13.1	63.0
South West	17.40	22.35	37.96	13.6	64.2
Central Coast	23.10	20.37	36.07	10.4	39.7
Lower Hunter	11.94	18.63	34.54	3.3	39.3
Illawarra	15.33	18.90	34.95	4.9	27.7

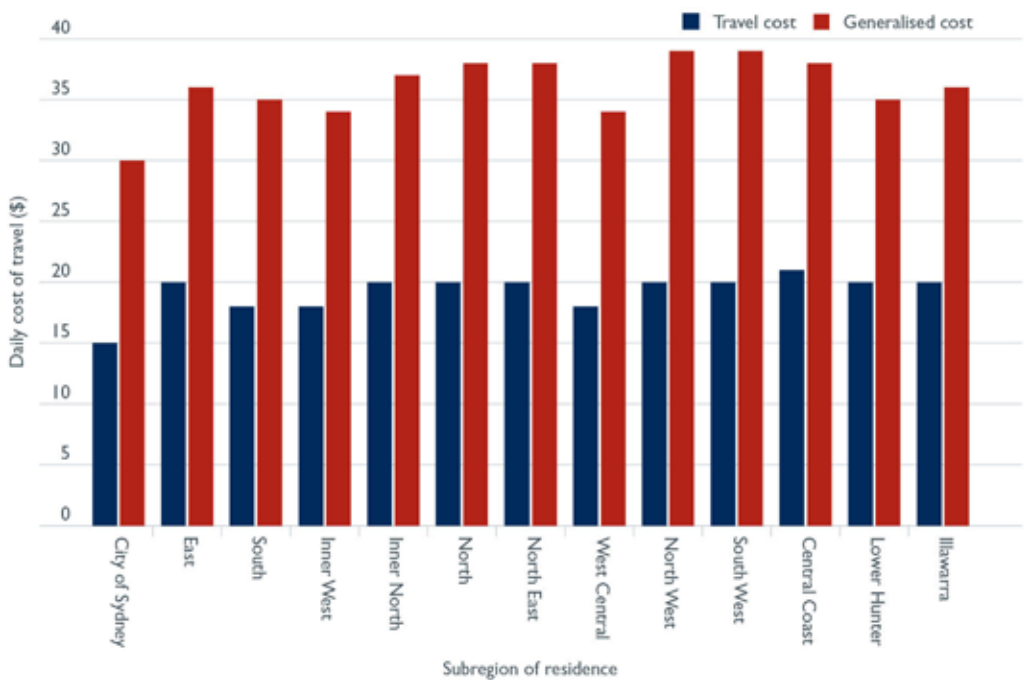
Note: Data relates to all travel purposes, not just commuter travel.

Source: Hensher and Chen (2010), table 4 (pooled data from BTS/TDC Household Travel Survey 1997–2008). Public transport mode share and access data are from Tables 6.3, 6.4, 6.18 and 6.19 of this report.

The public transport mode share has also been included in Table 7.22. Because of the range of other factors that influence public transport use, a lower relative cost of public transport does not directly translate into a higher public transport mode share. The coverage of the public transport network is a particularly important influence on mode shares. The daily generalised cost of using public transport is less than 80 per cent of the cost of using a private vehicle for residents of the Lower Hunter, South West and North West, but these areas all have below-average access to public transport services and below-average public transport mode shares.

As shown in Figure 7.4, when all modes were considered, the average daily generalised costs ranged from \$30.10 (City of Sydney) to \$39.42 (South West). The North West, South West and Central Coast are the three most expensive subregions in terms of average daily travel outlays and generalised travel costs (Hensher and Chen 2010). As discussed in the previous section, these three subregions also had the lengthiest average commuting times.

Figure 7.4 Generalised travel cost by subregion of residence, Sydney Greater Metropolitan Area



Note: Data relates to all travel purposes, not just commuter travel. Travel cost refers to money outlays only. Generalised cost includes travel cost and monetised travel time.

Source: Hensher and Chen (2010), daily cost of travel, all modes (pooled data from BTS/TDC Household Travel Survey 1997–2008).

Infrastructure Partnerships Australia (2012) compared generalised travel cost estimates across modes for the Penrith to Sydney CBD corridor. For trips of less than 21 kilometres, cycling emerges as the most cost effective mode for users, although the disutility associated with the discomfort of cycling over longer distances was not captured. Walking was found to be a relatively cost effective mode for trips of less than 10 kilometres. For trips of more than 21 kilometres, heavy rail was the most cost effective mode, because of relatively frequent services, speed and lower monetary cost. Heavy rail was more cost effective than bus for trips of over 3 kilometres due to higher speeds. Private cars also performed better than buses for long distance travel, 'meaning that in areas with no heavy rail link, it is more cost-effective for users to drive than catch a bus' (ibid, p.60).

Changes since 2001

Based on the BTS *Household Travel Survey* 2009–10, the share of commuting in total trips by purpose⁵⁸ in the Sydney SD on an average weekday had increased from 14.9 to 15.9 per cent between 2001 and 2010. Commuting trips had an average annual growth of 1.6 per cent during the period (BTS 2011). The share of the total distance travelled that was due to commuting trips increased from 25.5 to 28.4 per cent between 2001 and 2010, representing average annual growth of 1.9 per cent. The growth in the relative importance of commuter travel in Sydney mainly occurred after 2006 (ibid.).

Change in long distance commutes

Due to the coding issues with the 2001 ABS commuting matrix, BITRE sourced 2001 and 2006 data from the BTS JTW data. This limits analysis of changes in commuting flows to the Greater Metropolitan Area. The BTS JTW data suggests that between 2001 and 2006:

- There was a modest absolute increase in the number of people who were employed in the Sydney SD but lived in the Illawarra (365 persons) and Lower Hunter (540 persons). This reflected increases in commuter flows from Lower Hunter to the Central Coast and from the Illawarra to the South West subregion of Sydney.
- The proportion of employed Lower Hunter residents who worked in the Sydney SD increased marginally from 4.1 to 4.3 per cent, while the proportion of employed Illawarra residents working in Sydney rose from 12.4 to 13.0 per cent.
- There was an increase of 856 Sydney residents commuting to a workplace in Lower Hunter. This was driven by Central Coast residents increasingly commuting to a place of work in the Lower Hunter, with the probability increasing from 2.3 to 3.1 per cent over the period.
- There were also 585 extra Sydney residents who commuted to a workplace in the Illawarra between 2001 and 2006. This increased commuting was by residents of the South West and South subregions of Sydney.
- Illawarra and the Lower Hunter both provide many more commuters to the Sydney SD than they receive in return. The net outflow was about 15 700 for the Illawarra and 3 700 for the Lower Hunter in 2006. However, between 2001 and 2006, the net outflow of commuters declined by several hundred persons for both the Illawarra and the Lower Hunter.

⁵⁸ Linked trips are used for trips by purpose. Trips to 'return home' are allocated to the 'priority purpose hierarchy'. For further details see BTS (2011). The period refers to the years ended 30 June 2001 and 2010.

Overview of change—sectors and planning subregions

The following analysis of changes in commuting flows between 2001 and 2006 focuses primarily on flows within the Sydney SD. However, Table 7.23 below provides a broad overview of changes in commuting flows at the sectoral scale (i.e. Inner, Middle, Outer and Rest of GMA).

Between 2001 and 2006, the commuting flows within the GMA grew by 0.9 per cent per annum, while commuting flows within the Sydney SD grew by 0.7 per cent per annum. There was an increase of 91 948 commuters with a known SLA of work and residence within the GMA. Much of the increase was due to commutes within the Outer sector (33 681), commutes within the Rest of the GMA (27 822) and commutes within the Middle sector (10 287). The number of commutes occurring within the Rest of the Inner sector (i.e. excluding the CBD) declined between 2001 and 2006. In terms of cross-sector flows, the main growth related to commuting from the Rest of the Inner sector and the Middle sector to a place of work in the CBD. There was a substantial decline in the number of people travelling from the Outer sector to a place of work in the Rest of the Inner sector (–4271 persons). There was a similar decline in the number of Outer sector residents working in the Inner sector as a whole (i.e. including the CBD).

Table 7.23 Change in number of people commuting between sectors, Sydney Greater Metropolitan Area, 2001 to 2006

Sector of residence	Sector of work					
	CBD	Rest of Inner	Middle	Outer	Rest of GMA	GMA
CBD	675	326	237	43	–85	1 197
Rest of Inner	6 271	–1 876	3 433	1 531	–15	9 344
Middle	4 526	–408	10 287	3 755	–69	18 091
Outer	37	–4 271	3 532	33 681	1 610	34 590
Rest of GMA	–158	–37	–141	1 240	27 822	28 726
GMA	11 352	–6 265	17 348	40 250	29 263	91 948

Note: This is based on workers who had a known SLA of residence within the GMA and a known SLA of work within the GMA. CBD refers to the Sydney Inner SLA.

Source: BITRE analysis of BTS JTW 2001 (table 2) and 2006 (table 7) data sourced from the ABS 2001 and 2006 *Census of Population and Housing*.

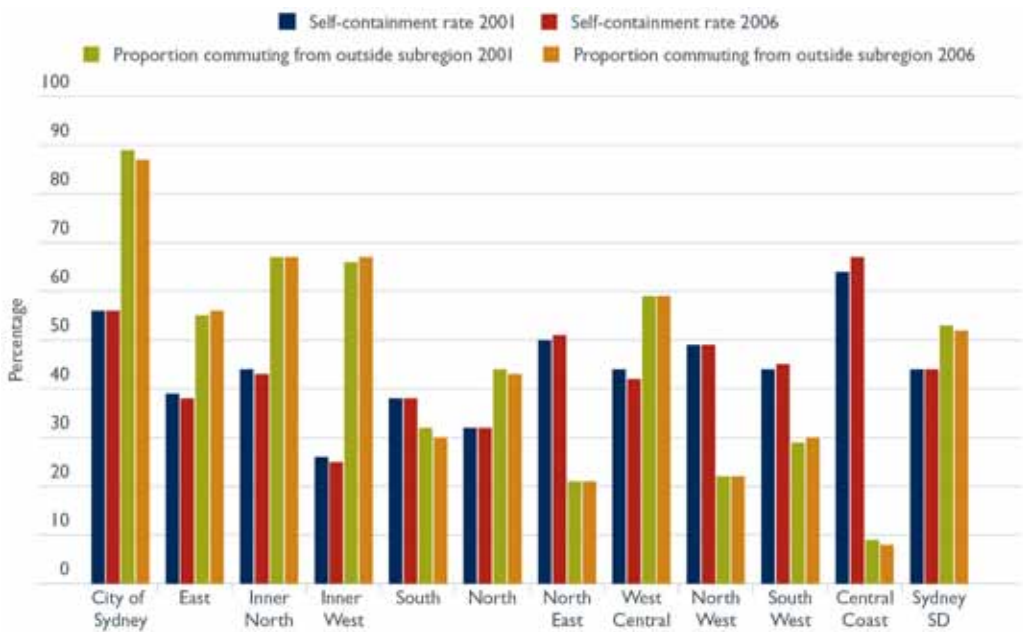
Figure 7.7 summarises the change in each subregion's degree of employment self-containment (i.e. the proportion of employed residents who work in their home subregion) and the change in the extent to which each subregion is able to attract commuters from outside its own boundaries. Neither measure has changed substantially for Sydney between 2001 and 2006. Small changes have occurred in a number of the subregions:

- The Central Coast increased its self-containment rate by 2.6 percentage points and the North East subregion by 1.0 percentage points.
- The Inner North and West Central subregions experienced a decline of just over 1.0 percentage point in their self-containment rate between 2001 and 2006.
- The City of Sydney attracted a smaller proportion of its workers from outside the subregion in 2006, compared to 2001, reflecting the strong residential growth in the subregion. The South and North subregions also attracted a smaller proportion of their workers from outside the home subregion.

- The East subregion attracted a higher proportion of its workforce from outside the subregion in 2006, reflecting a decline in the number of employed residents of this subregion.

Figure 7.5 shows that there has been little progress improving employment self-containment in Sydney between 2001 and 2006. Other cities with plans to promote self-containment 'have rarely fulfilled their planner's ambitions' (Yigitcanlar, Dodson et al. 2007, p.131).

Figure 7.5 Self-containment and proportion of commuters from outside by subregion, Sydney, 2001 and 2006



Note: Self-containment rate expressed as a proportion of all employed residents. Using 2001 and 2006 employed residents estimates from the ABS Time Series Profile ensured 2001 data was on 2006 boundaries which was necessary for assessing spatial change. However, the place of enumeration basis of the Time Series Profile tends to understate self-containment in the City of Sydney (compared to place of usual residence estimates for 2006 in Table 7.3).

Source: BITRE analysis of BTS JTW 2001 (table 2) and 2006 (table 7) data sourced from the ABS 2001 and 2006 *Census of Population and Housing* and ABS 2006 Time Series Profile for employed residents data.

Table 7.24 summarises the changes in commuter flows at the subregion scale. The largest absolute increases between 2001 and 2006 occurred for the flows *within* the home subregion. Commuting flows within the North West increased by 12 654 persons, while there was also substantial growth in flows within the Central Coast (8230), City of Sydney (7051) and South West (5290) subregions. The number of people commuting within the East subregion declined substantially from 2001 to 2006, as did the number of people commuting within the Inner North.

The largest changes in flows between different subregions were:

- An extra 2840 persons commuting from the Inner West to the City of Sydney
- An extra 1308 persons commuting from the South West to the North West
- An extra 1300 persons commuting from the Inner North to the City of Sydney

- An extra 1 256 persons commuting from West Central to the North West
- A decline of 1 254 persons commuting from the North East to the Inner North
- An extra 1 192 persons commuting from the North West to West Central
- An extra 1 167 persons commuting from the City of Sydney to the East subregion
- An extra 1 081 persons commuting from West Central to the Inner North
- An extra 1 051 persons commuting from West Central to the Inner West.

Table 7.24 Change in commuting flow by subregion of origin and destination, Sydney, 2001 to 2006

Place of residence	Place of work											
	City of Sydney	East	Inner North	Inner West	South	North	North East	West Central	North West	South West	Central Coast	Sydney SD
City of Sydney	7 051	1 167	722	216	183	26	139	386	141	213	- 27	10 218
East	413	-1 328	- 341	- 165	327	- 151	- 73	140	176	374	- 24	- 652
Inner North	1 300	- 86	- 853	745	51	- 89	211	522	350	- 8	69	2 212
Inner West	2 840	271	796	832	396	180	143	341	386	- 24	17	6 177
South	905	- 15	548	753	1 648	- 35	42	652	472	945	23	5 938
North	78	- 14	- 265	378	- 16	1 220	360	129	711	42	84	2 707
North East	794	8	- 1 254	76	- 5	- 21	1 509	- 126	125	23	53	1 182
West Central	- 233	353	1 081	1 051	- 303	65	207	930	1 256	479	- 46	4 840
North West	397	270	912	629	- 133	690	93	1 192	12 654	230	6	16 940
South West	- 727	286	226	59	- 436	98	- 7	- 200	1 308	5 290	- 16	5 880
Central Coast	- 310	95	- 981	- 150	- 17	- 585	53	- 73	59	17	8 230	6 338
Sydney SD	12 508	1 007	591	4 424	1 695	1 398	2 677	3 893	17 638	7 581	8 369	61 780

Note: This is based on workers who had a known SLA of residence within the SD and a known SLA of work within the SD. The change in the number of commuters within the Sydney SD from 2001 to 2006 is considerably higher than the Table 4.4 change in the number of persons with a fixed place of work in the Sydney SD, because in 2001 there were around 17 000 persons with a known SLA of work in Sydney but an unknown SLA of residence, which have to be omitted in calculating the change in commuting for origin-destination pairs. Consequently, the estimated change in total commuter volumes in the SD from 2001 to 2006 is an overestimate. If the 2001 non-respondents had residential addresses which were well dispersed across subregions, this issue should not significantly distort the spatial breakdown of the change in commuter flows.

Source: BITRE analysis of BTS JTW 2001 (table 2) and 2006 (table 7) data sourced from the ABS 2001 and 2006 *Census of Population and Housing*.

Table 7.25 presents the percentage point change between 2001 and 2006 in the likelihood of employed residents of the origin subregion commuting to a place of work in the destination subregion. It shows only very minor changes occurred in these probabilities over the five year period, pointing to a high degree of stability in commuter behaviour. Central Coast residents had an increased likelihood of commuting to a place of work in the home subregion, as did

North West, South West and North East residents. Residents of West Central, East, Inner North, Inner West and the City of Sydney had a reduced likelihood of commuting to a place of work in the home subregion. City of Sydney, West Central and South West residents had an increased likelihood of having no fixed work address or working outside the GMA.

An interesting feature of Table 7.25 is that five different subregions have experienced reductions in the likelihood that employed residents would commute to a place of work in the Inner North, while no subregions experienced a notable increase in the likelihood of commuting to the Inner North.

Commuting to the City of Sydney for work became more common for employed residents of the adjacent East, Inner North and Inner West subregions from 2001 to 2006. However, West Central, South West and Central Coast residents all reduced their probability of commuting to the City of Sydney between 2001 and 2006. For North West and South West residents, there was a reduction in the probability of commuting to West Central and an increase in the probability of commuting to a workplace in the North West subregion.

Table 7.25 Change in probability of employed residents of origin subregion commuting to destination subregion, Sydney, 2001 to 2006

Place of residence	Place of work									
	City of Sydney	East	Inner North	Inner West	South	North	North East	West Central	South West	Total
percentage point change from 2001 to 2006										
City of Sydney	-1	0	-1	0	0	0	0	0	0	0
East		-1	0	0	0	0	0	0	0	0
Inner North			-1	0	0	0	0	0	0	0
Inner West				-1	0	0	0	0	0	-1
South					0	0	0	0	0	0
North						0	0	0	0	0
North East							1	0	0	0
West Central								-1	0	0
North West									1	0
South West										1
Central Coast										3
Sydney SD										0

Note: Table 7.6 presents the probabilities for each subregion pair in 2006.

*This includes people who worked outside the GMA and those who did not respond, have an undefined place of work or no fixed work address.

Source: BITRE analysis of BTS JTW 2001 (table 2) and 2006 (table 7) data sourced from the ABS 2001 and 2006 *Census of Population and Housing*, and ABS 2006 Time Series Profile data on employed residents.

Change in commuting flows between Statistical Local Areas

Table 7.26 provides an overview of the main types of commuting flows observed within the Sydney SD in 2001 and 2006. There have been small shifts in the relative prominence of different types of flows between 2001 and 2006:

- Commuting flows operating in an inward direction have declined from 38.6 to 37.7 per cent of all commuting flows within the Sydney SD. Inward flows grew at an average annual rate of just 0.3 per cent from 2001 to 2006, which was lower growth than any of the other flow type categories. A similar decline in the relative importance of inward flows was experienced in Perth and Melbourne (BITRE 2010, 2011).
- Commuting flows operating in an outward direction have marginally increased their share of total flows (from 7.5 to 7.8 per cent). Outward flows grew by 1.6 per cent per annum from 2001 to 2006, which was the most rapid growth of the different types of commuter flow shown in Table 7.26.
- The proportion of commutes within the home SLA has increased marginally, as has the proportion of commutes to a different SLA within the home subregion and ring.
- 'Cross-suburban commutes' refers to the final two flow type categories in Table 7.26, which involve commuting from one subregion to another, while remaining in the same ring. Both types of cross-suburban commutes experienced a marginal increase in their share of total commutes from 2001 to 2006.

Table 7.26 Proportion of total commuting flows within Sydney Statistical Division by type, 2001 and 2006

Type of commuter flow	Proportion of total commutes, 2001 (per cent)	Proportion of total commutes, 2006 (per cent)	Change in number of commuters, 2001 to 2006	Average annual growth rate (per cent)
Inwards (across rings)	38.6	37.7	9 463	0.3
Outwards (across rings)	7.5	7.8	10 300	1.6
Ambiguous in direction (within a ring)	53.9	54.5	42 017	0.9
Within home SLA	26.4	26.6	19 754	0.9
Different SLA, same subregion, same ring	16.0	16.2	13 380	1.0
From one subregion to another in Outer ring	5.6	5.7	4 354	0.9
From one subregion to another in Middle or 'Rest of Inner' rings	5.9	6.0	4 710	1.0
Sydney SD	100.0	100.0	61 780	0.7

Note: Based on commutes that have an origin and destination within SD. Inward commutes include commutes to workplaces in the central LGA from elsewhere in SD, from outer suburban residences to middle or inner workplaces and from middle suburban residences to inner workplaces. The opposing flows are categorised as outward commutes (e.g. from Inner to Middle).

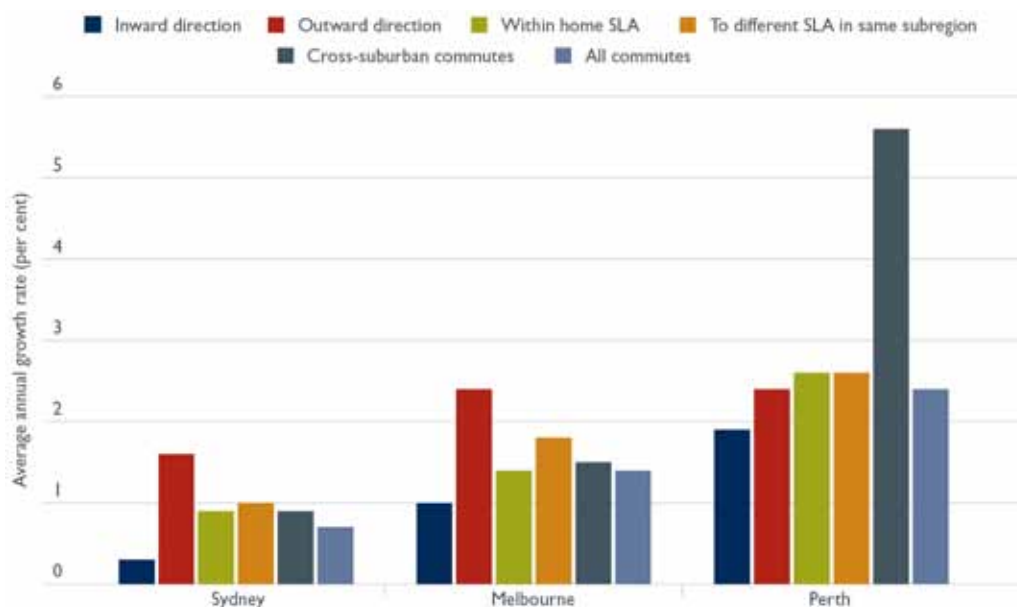
Source: BITRE analysis of BTS JTW 2001 (table 2) and 2006 (table 7) data sourced from the ABS 2001 and 2006 *Census of Population and Housing*.

Overall, the mix of commuter flows has changed to having a somewhat lower proportion of inward flows and a greater proportion of outward flows and flows that are ambiguous in direction (e.g. same SLA flows). In terms of the absolute number of commuters, the largest changes in Sydney between 2001 and 2006 occurred for commutes within the home SLA, followed by commutes to a different SLA within the same subregion and ring.

As shown in Figure 7.6, the Sydney results have much in common with the results for Perth and Melbourne. While growth rates were considerably lower in Sydney than the other two cities, in all three cities inward commutes recorded the slowest rate of growth, and there was above-average growth in cross-suburban commutes. Melbourne and Sydney both recorded relatively rapid growth in outward commuting.

While the focus here is on change, it is important to recognise that the Sydney changes are relatively subtle, and the two most important types of flow—inwards flows and same SLA flows—continue to dominate.

Figure 7.6 Growth by type of commuter flow for Sydney, Melbourne and Perth Statistical Divisions, 2001 to 2006



Notes: Based on commutes that have an origin and destination within SD. Inward commutes include commutes to workplaces in the central LGA from elsewhere in SD, from outer suburban residences to middle or inner workplaces and from middle suburban residences to inner workplaces. The opposing flows are categorised as outward commutes (e.g. from Inner to Middle). The term 'cross suburban commutes' for Sydney refers to the final two flow type categories in Table 7.26. Further information on flow type definitions for Perth and Melbourne provided in BITRE (2010, 2011).

Source: BITRE analysis of BTS JTW 2001 (table 2) and 2006 (table 7) data sourced from the ABS 2001 and 2006 *Census of Population and Housing*, BITRE (2010) and BITRE (2011).

Table 7.27 presents the origin-destination pairs which experienced the greatest change in the number of commuters between 2001 and 2006. The single largest increase related to the extra 1807 commuters who travelled from Sydney South to Sydney Inner. A large proportion of the origin-destination pairs with a substantial increase in flows are commutes within the home SLA, with strong growth experienced in commutes within Baulkham Hills North, Wyong South and West, Wyong North East and Camden. Most of the remaining origin-destination pairs are commutes to a neighbouring SLA in the same subregion and sector (e.g. from Sydney West to Sydney Inner; from Blacktown North to Baulkham Hills Central). Of the growth pairs listed in Table 7.27, only one involves travel to a different sector—that is, inward commuting by residents of the Middle sector SLA of Rockdale to the CBD.

The single largest decrease from 2001 to 2006 was the 802 fewer commuters travelling from Fairfield West to Fairfield East. A range of different types of commuter flow are listed as experiencing substantial decline in Table 7.27, including same SLA flows (i.e. within Liverpool East), flows to a different SLA in the same subregion and sector (i.e. from Blacktown South East to Blacktown North) and inward flows (i.e. from Sutherland Shire West to Botany Bay).

Table 7.27 Statistical Local Area origin-destination pairs with greatest change in number of commuters, Sydney, 2001 to 2006

SLA of residence	SLA of work	Average annual growth (per cent)	Change (persons)
Greatest increase			
Sydney South	Sydney Inner	6.8	1807
Baulkham Hills North	Baulkham Hills North	8.8	1705
Wyong South and West	Wyong South and West	3.0	1603
Wyong North-East	Wyong North-East	4.0	1563
Camden	Camden	4.0	1237
Sydney West	Sydney Inner	4.4	1202
Baulkham Hills Central	Baulkham Hills Central	2.5	1088
Gosford West	Gosford West	1.2	988
Sydney East	Sydney Inner	2.4	941
Blacktown North	Baulkham Hills Central	6.9	931
Warringah	Warringah	0.7	922
Fairfield West	Fairfield West	3.0	879
Liverpool West	Liverpool West	4.4	816
Auburn	Auburn	3.9	806
Gosford East	Gosford East	1.8	803
Hornsby South	Hornsby South	1.8	779
Rockdale	Sydney Inner	2.8	765
Sydney South	Sydney South	4.3	740
Blacktown North	Blacktown South-East	3.1	728
Greatest decrease			
Fairfield West	Fairfield East	-5.4	-802
Liverpool East	Liverpool East	-1.2	-615
Fairfield East	Fairfield East	-1.6	-522
Parramatta North-West	Baulkham Hills Central	-8.3	-504
Blacktown South-East	Blacktown North	-6.3	-491
Sutherland Shire West	Botany Bay	-3.2	-471

Note: The 2001 flow data was converted to 2006 boundaries through a concordance process applied at the travel zone scale—consequently change estimates for SLAs that experienced significant boundary change between 2001 and 2006 (e.g. the Sydney, Parramatta, Bankstown and Baulkham Hills LGAS) are subject to error introduced through the assumptions implicit in the concordance process.

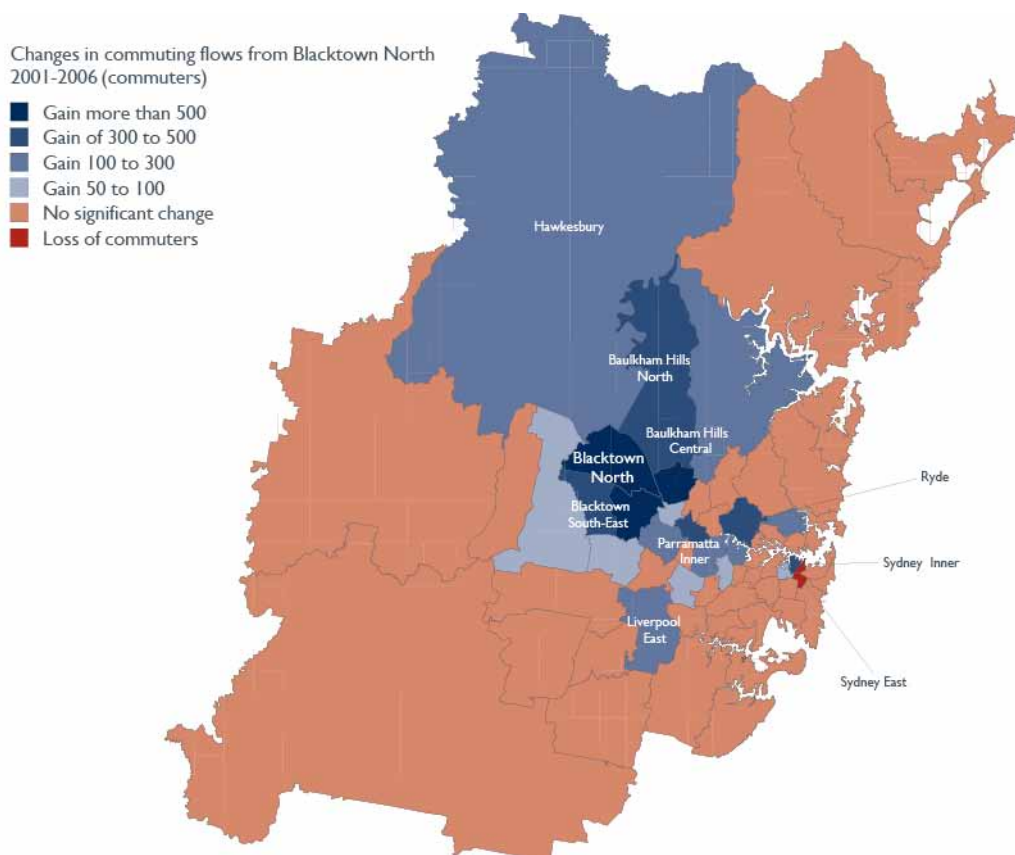
Source: BITRE analysis of BTS JTW 2001 (table 2) and 2006 (table 7) data sourced from the ABS 2001 and 2006 *Census of Population and Housing*.

The remainder of this section focuses on changes in commuting patterns for two key growth locations in Sydney:

- The Blacktown North SLA which was the main residential growth area between 2001 and 2006
- The Ryde SLA which added more jobs than any other suburban SLA from 2001 to 2006, mainly at the Macquarie Park specialised centre.

From 2001 to 2006, Blacktown North gained almost 6600 employed residents, which was more than any other SLA in Sydney. Map 7.8 presents the change in the number of employed residents commuting from Blacktown North to other SLAs in the Sydney SD. There were substantial increases in the number of people commuting from Blacktown North to the neighbouring SLAs of Baulkham Hills Central and Blacktown South East, as well as in the number of people commuting to a place of work within the Blacktown North SLA. There were also large increases in commuter flows to the more distant Parramatta Inner, Ryde and Sydney Inner SLAs.

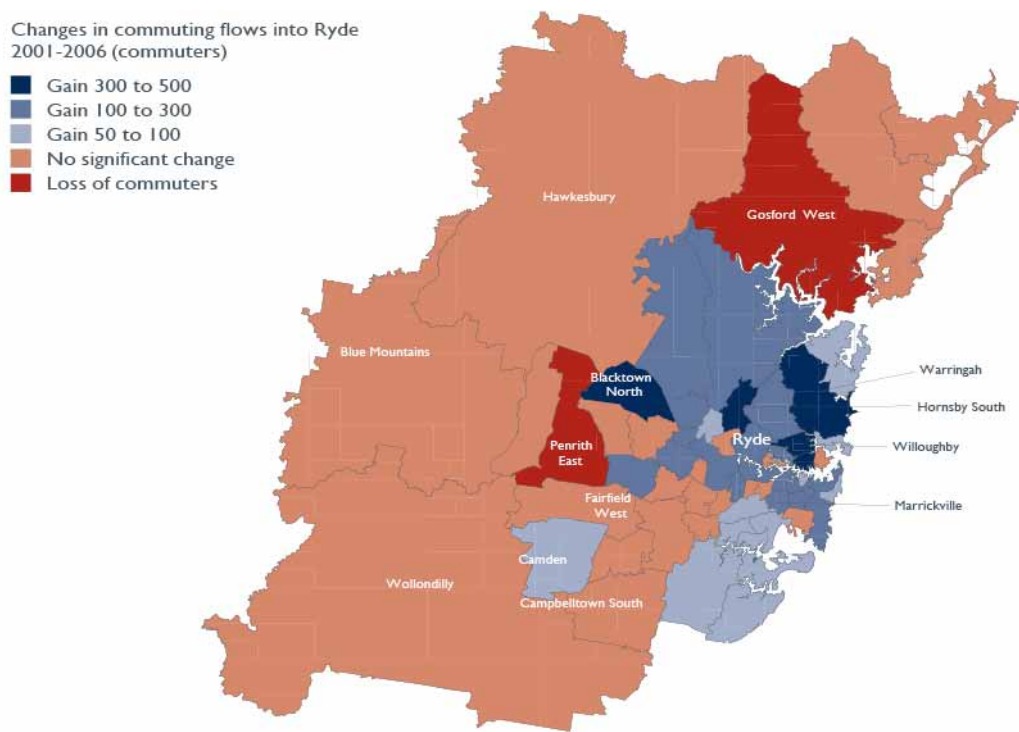
Map 7.8 Change in number of persons commuting from Blacktown North to other Statistical Local Areas in Sydney, 2001 to 2006



Source: BITRE analysis of BTS JTW 2001 (table 2) and 2006 (table 7) data sourced from the ABS 2001 and 2006 *Census of Population and Housing*.

From 2001 to 2006, the Ryde SLA added 6100 jobs, making it the second main job growth SLA after Sydney Inner. The Ryde SLA contains the specialised centre of Macquarie Park, which added 5300 jobs from 2001 to 2006. Map 7.9 presents the change in the number of workers that are commuting to a place of work in Ryde. The increase in workers was not heavily concentrated within Ryde and its immediately adjacent SLAs, and was instead fairly widely dispersed across a range of SLAs, some a considerable distance away from Ryde. The Blacktown North, Willoughby, Warringah and Hornsby South SLAs were most prominent, each contributing between 4 and 8 per cent of the additional workers.

Map 7.9 Change in number of persons commuting from Sydney Statistical Local Areas to Ryde, 2001 to 2006



Source: BITRE analysis of BTS JTW 2001 (table 2) and 2006 (table 7) data sourced from the ABS 2001 and 2006 *Census of Population and Housing*.

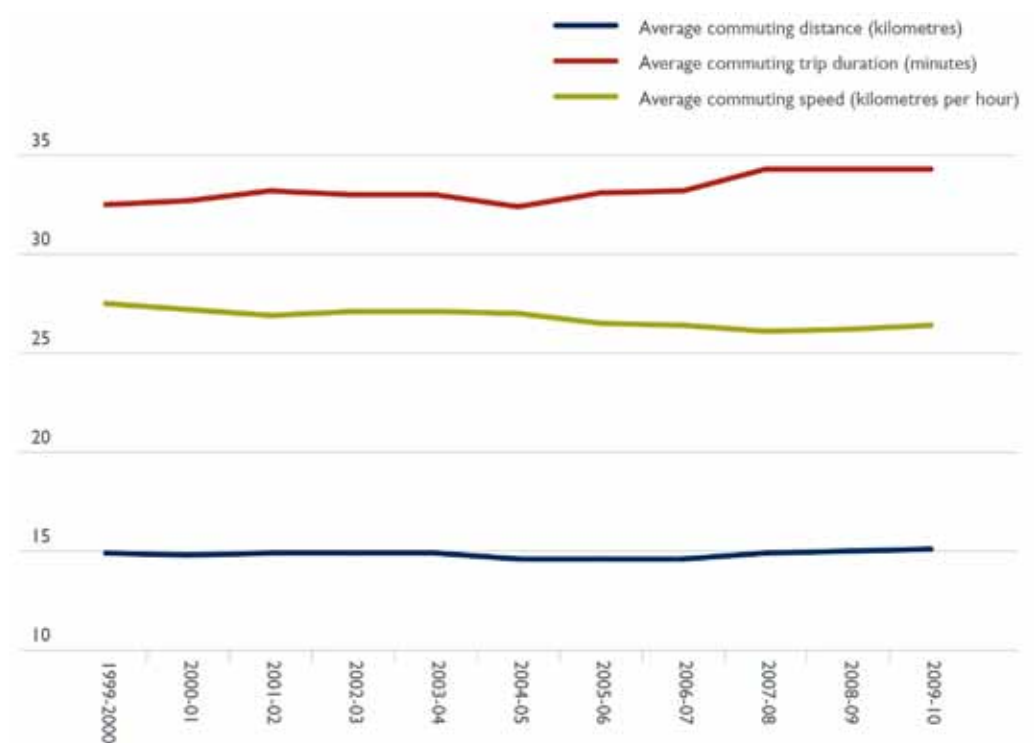
Change in distance travelled, speed and time

Sydney trends

Figure 7.7 summarises changes in average commuting distances, times and speeds for Sydney between 1999–2000 and 2009–10, based on the Household Travel Survey (HTS). From 1999–2000 to 2009–10, average commuting distances grew by just 0.1 per cent per annum, average commuting speeds declined by 0.4 per cent per annum, and average commuting trip durations rose by 0.5 per cent per annum. The average duration of a commuting trip fluctuated around 33 minutes from 1999–2000 through to 2004–05, before rising to reach 34.3 minutes in 2007–08, which was then maintained through to 2009–10. Over the 1999–2000 to 2009–10

period, average commuting distances remained virtually stable (with a net increase of just 200 metres) and there was a modest 1.8 minute increase in the duration of the average commuting trip.

Figure 7.7 Average commuting trip distance, duration and speed, Sydney, 1999–2000 to 2009–10



Note: Average commuting trip durations and speeds are on a door-to-door basis.

Source: BITRE analysis of BTS (2011) graphs and tables supplement, based on Household Travel Survey.

BTS (2011) reveals that the average commuting distances and times remained relatively stable for the different modes between 2001–02 and 2009–10, apart from a change in commuter use of buses, which involved significantly greater distances and travel time in 2009–10 than in 2001–02.

Another relevant source of information on commuting times is the HILDA survey. According to the HILDA survey, average commuting times for full-time Sydney workers were 5.4 hours per week in 2002 and 5.8 hours in 2006 (Melbourne Institute 2009). This equates to 34.8 minutes per one-way commute in 2006, up 2.4 minutes from 2002. This is an increase of similar magnitude to the average for the five largest capital cities, although Brisbane experienced a considerably larger increase in commuting times than Sydney, Melbourne, Perth and Adelaide (*ibid.*).

BITRE has produced its own estimates of average commuting distances for 2001 and 2006, based on road network distances derived from the Sydney Strategic Travel Model and BTS

JTW data for 2001 and 2006 (as outlined earlier in this chapter). Using this approach, BITRE has estimated the average commuting distance for trips within the Sydney SD at 14.8km in 2001 and 14.6km in 2006. This matches the estimated HTS change in average commuting distance from 14.8km in 2000–01 to 14.6km in 2005–06 (BTS 2011). From 2001 to 2006, the distribution of BITRE's commuting distance estimates was essentially stable, although there was a slight decline in the relative importance of trips of more than 30km.

Table 7.28 presents the results of an ABS survey of the distance travelled to the usual place of work or study in 2006 and 2009 (ABS 2006d, 2009a), which indicates that the proportion who travelled 30km or more increased from 17 per cent in 2006 to 19 per cent in 2009 for the Sydney SD. The ABS surveys also reveal a slight decline in the relative importance of short distance commutes (of less than 5km) and so are suggestive of an increase in average commuting distances in Sydney since 2006. This is consistent with the HTS data, which had average commuting distances rising slightly from 14.6km in 2005–06 to 15.1km in 2009–10 (BTS 2011).

Table 7.28 **Distribution of workers by distance of journey to work or study, Sydney, 2006 and 2009**

Distance range	Proportion of trips 2006	Proportion of trips 2009
	(per cent)	
Less than 5 km	16.9	15.5
5 km to less than 10 km	17.5	17.4
10 km to less than 20 km	24.5	27.6
20 km to less than 30 km	18.2	14.6
30 km or more	17.0	19.4
Other (does not travel, unstated)	5.8	5.5
All trips	100.0	100

Source: BITRE analysis of ABS 2006d and ABS 2009a.

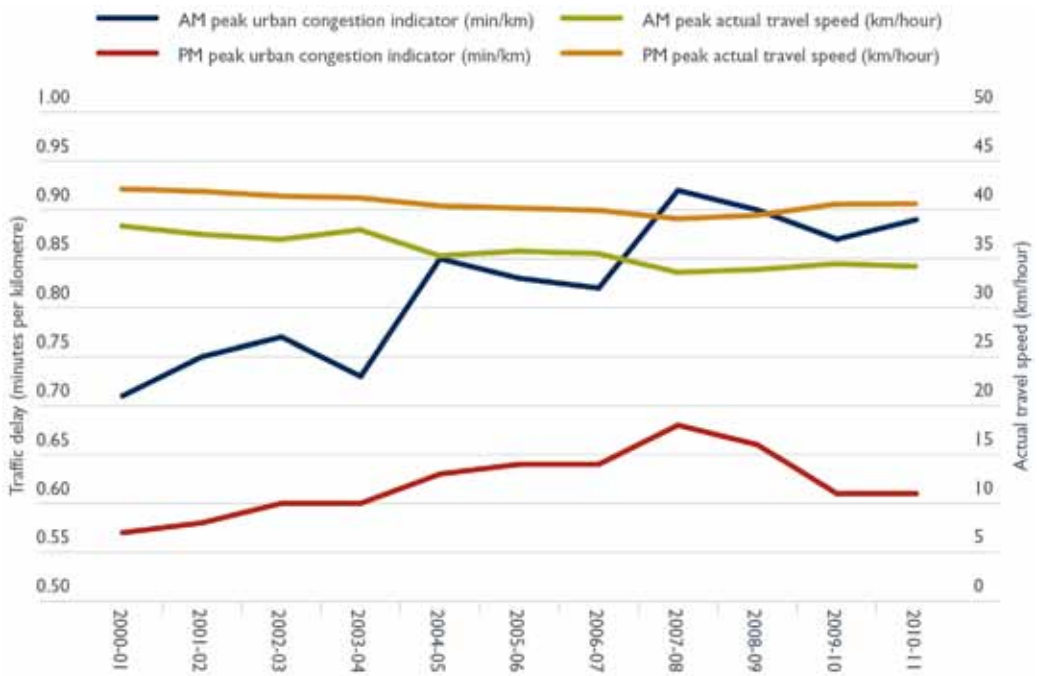
Figure 7.8 shows that peak period road travel speeds declined in Sydney between 2000–01 and 2007–08, with a slight improvement in travel speeds occurring after 2007–08. Peak period traffic delays increased between 2000–01 and 2007–08, but have since declined. The morning peak travel speed declined from 38 km/hour in 2000–01 to 34 km/hour in 2010–11. However, the decline in travel speeds and the increase in the urban congestion indicator were much less pronounced in the afternoon peak. While the data relates only to road travel, it is consistent with the observed upward movement in average commuting times.

For Sydney as a whole, bringing the different data sources together identifies the following recent trends:

- There was a very small net rise in average commuting distances between 1999–2000 and 2009–10, reflecting a small decline between 2001 and 2006, followed by a slightly larger increase after 2006.

- There was a modest rise⁵⁹ in average commuting trip duration between 1999–2000 and 2009–10, and the increase occurred after 2004–05.
- There was a modest decline in average commuting speeds over the decade.

Figure 7.8 Morning and afternoon peak period road travel speed and congestion indicators, Sydney, 2000–01 to 2010–11



Note: This is a weighted speed across a sample of freeways and major arterial roads in Sydney.

Source: AustRoads National Performance Indicators.

Small area changes

Using the approach outlined earlier in this chapter, BITRE estimated the average distance of commutes within the Sydney SD at 14.8km in 2001 and 14.6km in 2006.

On a place of residence basis, the main change was that Central Coast residents experienced a 2.0km decline in their average commuting distance from 2001 to 2006. This reflects the higher self-containment rate for the Central Coast subregion (see Figure 7.5), as well as a lower probability of commuting to the City of Sydney, Inner North and North subregions (Table 7.25). All four SLAs within the Central Coast reduced their average commuting distance by more than one kilometre from 2001 to 2006. For all of the remaining subregions, the change in commuting distance was less than 0.5 kilometres.

⁵⁹ Note that the HTS and HILDA differ with regard to the magnitude and timing of this increase. The HTS identifies a 1.8 minute rise between 1999–2000 and 2009–10, but no net change from 2001–02 to 2005–06. HILDA identified a 2.4 minute rise from 2001–02 to 2005–06.

On a place of work basis, the largest changes were the reductions in the average commuting distance to a place of work in the City of Sydney (−0.6km) and the North subregion (−0.7km). These reductions reflect reduced commuting from more distant locations, including reduced commuting from the Central Coast to both subregions and from the South West to the City of Sydney. The Hunters Hill SLA was the only place of work SLA to increase commuting distance by more than one kilometre, while several SLAs experienced a decline of more than one kilometre (e.g. Hornsby South, Parramatta North West, Drummoyne).

Small area information on changes in travel times is limited. Transport and Population Data Centre (2003) provides HTS-based estimates of the average duration of a work trip on an average weekday in 2001 for residents of eight different regions within Sydney. BITRE has derived average work trip duration estimates for an average weekday in 2007 for these eight regions using the HTS data for LGAs in TDC (2009d). Comparison of these two sets of estimates reveals that the main change in average work trip duration between 2001 and 2007 related to residents of 'Inner/East Sydney', which comprises the Sydney, Leichhardt, Marrickville, Botany Bay, Randwick, Waverley and Woollahra LGAs. Residents of 'Inner/East Sydney' had an average work trip duration of 30 minutes in 2007, compared to 28 minutes in 2001.⁶⁰ The average distances commuted by residents of the City of Sydney and East subregions showed minimal change from 2001 to 2006, so this increase in trip duration most probably reflects a reduction in average travel speeds. Chapter 6 revealed a significant shift towards active travel modes by residents of the City of Sydney and East subregions from 2001 to 2006, and this is likely to be an important contributor to the observed 2 minute increase in average work trip duration.

Roads and Maritime Services (2011) presents estimates of the average speed of commuting during peak periods for seven major road routes to the CBD. Between 2006 and 2010, reductions in speed are evident for the M4/Parramatta Road/Westlink during both the morning and afternoon peak, for the M5/Eastern distributor and F3/Pacific Highway/F1 during the morning peak, and for Pittwater Road/Military Road/F1 during the afternoon peak. However, the M2/Lane Cove tunnel/Gore Hill Freeway experienced a significant increase in speed, particularly during the afternoon peak.

Metropolitan plan objective—people work closer to home

Sydney 2036 aims to ensure 'more jobs are located closer to home' (NSW Government 2010a, p.6). The objective of locating jobs closer to home can be interpreted in two rather different ways, namely as:

- a) increasing the number of jobs that exist in residentially oriented parts of the city
- b) ensuring the jobs people actually work in are increasingly located close to their place of residence.

⁶⁰ The significant reduction in commuting distances for Central Coast residents between 2001 and 2006 did not translate into a significant reduction in average work trip durations.

Both interpretations are evident in *Sydney 2036*, but the first interpretation—which relates to the alignment between aggregate levels of employment and population in Sydney—is more prominent. Chapter Four includes an assessment of recent changes in the alignment between population and jobs in Sydney.

This section focuses on the second interpretation—that people actually work closer to home—which requires consideration of the commuting journeys that individuals take between their place of residence and place of work.

Recent metropolitan strategies include some references to changing the type of commutes that people take. For example, *Sydney 2036* notes that '[i]ncreasing "employment self-containment"—people living and working in the same region—remains an important objective' (NSW Government 2010a, p.148). More fundamentally, reducing journey to work travel times is an underpinning aim of the urban containment, transport and centres policies in the recent metropolitan strategies. For example, *City of Cities* identifies the need to '[r]educe average journey to work travel times from Western Sydney and the Central Coast through transforming Sydney into a multi-centred city' (NSW Government 2005, p.58). The Ministerial foreword to *Sydney 2036* argues that '[b]uilding most of Sydney's new homes in existing centres means fewer homes will be needed on Sydney's fringes ... It will also cut travel times and costs' (NSW Government 2010a, p.2). Several of *Sydney 2036*'s proposed transport infrastructure upgrades or expansions were also justified on the basis of travel time savings. More recently, a new state plan goal to 'reduce travel times' was introduced in *NSW 2021* (NSW Government 2011c, p.18).

Changes in the self-containment rate provide one way of assessing whether people are increasingly working closer to home. Sydney's overall degree of self-containment showed minimal change between 2001 and 2006, although the change that occurred was in the desired direction. The proportion of Sydney SD commutes that were within the SLA of residence increased from 26.4 per cent in 2001 to 26.6 per cent in 2006. The proportion of employed residents working in their home subregion also increased by 0.2 percentage points from 2001 to 2006. There were some significant changes in self-containment for particular locations. The Central Coast subregion increased its self-containment rate by 2.6 percentage points, while the North East experienced a 1.0 percentage point rise. The Inner North and West Central subregions experienced a decline of just over 1 percentage point in their self-containment rate between 2001 and 2006.

ABS surveys identify a 1.4 percentage point decline in the proportion of Sydney residents travelling less than 5 kilometres to their place of work or study between 2006 and 2009 (ABS 2006d, 2009a), which suggests a less favourable trend in self-containment since 2006.

The average commuting distance and time data are also relevant to assessing whether, since 2001, Sydney residents have been increasingly working closer to home. The *Household Travel Survey* identifies the following trends:

- There was a very small net rise in average commuting distances from 14.8 kilometres in 2000–01 to 15.1 kilometres in 2009–10, reflecting a small decline between 2001 and 2006, followed by a larger increase after 2006.
- There was a modest rise in the average duration of a commuting trip from 32.7 minutes in 2000–01 to 34.3 minutes in 2009–10, and the increase was concentrated between 2004–05 and 2007–08.

This general stability in commuting distance was also evident at a small area scale. The principal exception was a 2km decline in the average commuting distance of Central Coast residents between 2001 and 2006, reflecting higher self-containment. The travel time increase was most pronounced for residents of 'Inner/East Sydney', where the average duration of a work trip rose from 28 minutes in 2001 to 30 minutes in 2007.

Overall, the evidence suggests that since 2001 there has been a shift to Sydney residents working *a little* further away from home (on both a distance and time basis). The magnitude of this shift is very modest, particularly for distance. While the Sydney-wide shift has not been in the desired direction, people who live on the Central Coast do appear to be increasingly working closer to home.

In summary

This chapter has provided a detailed picture of spatial commuting flows in Sydney in 2006, and has explored how average commuting distances and times vary across different parts of the city. While the overall structure of commuting flows remained relatively stable in Sydney between 2001 and 2006, a number of changes were identified, such as:

- rapid growth in outward commuting flows
- increased self-containment of the Central Coast subregion
- substantial increases in the number of people commuting within the North West, Central Coast and City of Sydney subregions
- a reduced likelihood of commuting to a place of work in the Inner North from several different subregions
- a substantial decline in the number of Outer sector residents travelling to a place of work in the Inner sector.

Over the last decade, there has also been a shift to Sydney residents working slightly further away from home. While average commuting distances rose by just 0.3 kilometres between 2000–01 and 2009–10, there was a 1.6 minute increase in the average duration of a commuting trip within Sydney.

CHAPTER 8

Drivers of change in commuting patterns

Key points

- The areas experiencing rapid residential growth tend to generate increased commuting flows to destinations within the home Statistical Local Area (SLA) and neighbouring SLAs. Inner and Middle sector growth SLAs also generate increased commuting flows to the Central Business District (CBD).
- Areas experiencing rapid jobs growth are predominantly drawing their additional workers from the home SLA and other nearby areas.
- Job access is one of several key factors—alongside proximity to family and friends, lifestyle and housing cost—that underpin people's choices as to where to live. The distance from home to work is a particularly important factor behind the moving decisions of employed people who walk/cycle to work or move to a residence located within five kilometres of where they work.
- Commuting patterns are largely explained by population and employment patterns, with commuting flows more likely to occur between nearby SLAs. A simple gravity model accounting for these factors explains 75 per cent of variation in origin-destination commuter flows between SLAs in Sydney.
- The 'distance penalty' for commuting from one SLA to another is lower where there is a direct rail connection or freeway connection between the SLAs.
- Distance was more of an impediment to travel in Sydney and Melbourne than in Perth, reflecting the greater density and congestion of the two larger cities.
- The greater the alignment between the skills available in the origin SLA and the skills demanded in the destination SLA, the greater the predicted commuting flows between the two locations.
- The fundamental drivers of commuter flows remained very stable for Sydney between 2001 and 2006.
- Growth in employed residents and jobs played an important role in explaining *changes* in commuting flows from one SLA to another between 2001 and 2006.
- Expansion of Sydney's motorway network between 2001 and 2006 also explains some *changes* in commuting patterns. Commuting flows between areas connected by the new motorways increased more than otherwise would have been expected given residential and job growth in those areas.
- More distant origin-destination pairs tended to experience lower *growth* in commuting flows between 2001 and 2006.

Introduction

This chapter explores how changes in commuting flows relate to patterns of residential and job growth, and explores other potential drivers such as travel costs, transport infrastructure, industry structure and skills. This chapter also presents gravity model results for Sydney.

Overall patterns of residential and job growth are shaped by planning policy. Within this context, commuting patterns are determined by individual's choices about where to live and work. Distance between home and work is one of many considerations taken into account when these decisions are made (ABS 2009b). The role that distance plays in influencing commuting decisions varies between individuals and between industries, and will also be influenced by the quality of transport infrastructure. The complexity and variety of individual decisions is reflected in the complex relationship between overall residential and job patterns and commuting patterns.

The first part of this chapter investigates the influence that residential and job growth have had on commuting patterns in Sydney. This is followed by a discussion of the role of other potential drivers of changes in commuting patterns, such as travel costs, transport infrastructure, and the spatial distribution of skills and industries. The final section presents the results of an empirical investigation (using a gravity model specification) of the role that these factors play in explaining origin-destination commuting flows within Sydney, and in explaining recent changes in those commuting flows.

Residential and job growth

Changes in commuting flows in Sydney relate to patterns of growth in both employed residents and jobs. Correlation analysis across the 4096 origin-destination SLA pairs (i.e. 64 X 64) in the Sydney Statistical Division (SD) shows that the change from 2001 to 2006 in the number of persons commuting between any two SLAs was:

- significantly positively associated with the change in the number of employed residents of the origin SLA (correlation=0.20)
- significantly positively associated with the change in the number of jobs in the destination SLA (correlation=0.33).

In this section, areas of strong residential and job growth, and corresponding changes in commuting flows, will be discussed.

Changes in commuting from areas of high residential growth

Table 8.1 shows areas with particularly strong growth in employed residents, and lists the main areas to which additional commuting flows from these SLAs are occurring. The residential growth areas tend to generate increased commuting flows to destinations within the home SLA and neighbouring SLAs, and in many instances to the Central Business District (CBD). However, the nature of additional commuter flows from areas experiencing rapid growth in employed residents differs between the Inner, Middle and Outer sectors.

For the Inner SLAs experiencing strong growth in employed residents (Sydney South, Sydney Inner and Sydney West), residents are predominantly finding work in Sydney Inner and adjacent

SLAs. As discussed in Chapter 6, these are areas where a relatively large, and increasing, proportion of people commute by walking or bus. There was particularly strong growth in the share of residents using non-motorised transport in this sector. The fastest growing areas in each of these SLAs had bus as the predominant mode of commuting (for example, Waterloo in Sydney South and Forest Lodge in Sydney West).

Table 8.1 Areas in which residents of rapid residential growth Statistical Local Areas are increasingly finding work, Sydney, 2001 to 2006

2006 SLA of residence	Ring	Average annual growth rate – employed residents (per cent)	Increase in employed residents	SLAs providing more than 300 additional jobs for residents of SLA between 2001 and 2006 (in descending order of importance)	Change in average commuting distance, 2001 to 2006 (km)
Sydney Inner	Inner	6.3	2935	Sydney Inner	0.5
Baulkham Hills North	Outer	5.5	6145	Baulkham Hills North, Baulkham Hills Central, Blacktown South-East, Sydney Inner, Parramatta Inner	–0.4
Sydney South	Inner	5.2	5803	Sydney Inner; Sydney South, Sydney West, Randwick, Sydney East, Botany Bay	0.2
Auburn	Middle	3.8	3924	Auburn, Sydney Inner	0.1
Parramatta Inner	Middle	3.6	3243	Parramatta Inner; Sydney Inner	0.3
Sydney West	Inner	3.5	3115	Sydney Inner; Sydney West	0.1
Canada Bay–Concord	Middle	3.5	2451	Canada Bay–Concord	0.6
Wyong North–East	Outer	3.4	4045	Wyong North-East, Wyong South and West	–1.5
Strathfield	Middle	3.3	2132	Sydney Inner	0.3
Blacktown North	Outer	3.3	6551	Baulkham Hills Central, Blacktown South-East, Blacktown North, Sydney Inner, Blacktown South-West, Baulkham Hills North	–0.2

Note: For the Sydney SD as a whole, the average rate of growth in employed residents was 0.8 per cent per annum.

Using 2001 and 2006 employed residents estimates from the ABS Time Series Profile ensures 2001 data is on 2006 boundaries which is necessary for assessing spatial change. However, the place of enumeration basis of the Time Series Profile is not a good approximation to usual residents for the CBD.

Source: BITRE analysis of BTS JTW 2001 (table 11) and 2006 (table 10) data sourced from the ABS 2001 and 2006 *Census of Population and Housing* and ABS 2006 Time Series Profile for employed residents data.

For the Middle sector SLAs experiencing strong growth in employed residents (Concord, Auburn, Strathfield and Parramatta Inner), the additional commuter flows are predominantly to the CBD and within the origin SLA itself. These SLAs are close together geographically, but fall into two categories.

In Strathfield and Parramatta Inner, the fastest growing areas are adjacent to Homebush West and Westmead stations respectively, with 35 per cent of employed residents commuting by public transport (almost all by train, and primarily to Sydney Inner). In both cases this is higher than the public transport mode share for the SLA as a whole. In the latter travel zone, around 20 per cent of employed residents used non-motorised transport, primarily to the adjacent Westmead Hospital. Overall, the residential development in these SLAs appears to be

consistent with the planning aim of encouraging residential growth in areas with good public transport access to jobs. As discussed in Chapter 6, the overall share of residents of these SLAs commuting by private vehicle fell between 2001 and 2006.

In Concord and Auburn, the fastest growing travel zones are in areas recently converted from industrial to residential use, in both cases some distance from railway stations (although the former is close to a well used ferry service to the city). In these fast-growing travel zones, the public transport share is around 15 per cent in both cases, which is around 10 percentage points lower than the public transport mode share for the SLA as a whole, and slightly lower than the average across the entire Sydney metropolitan area.

For the two Outer SLAs in the list that contain parts of the 'north west growth centre' (Baulkham Hills North and Blacktown North), the additional commuter flows are spread across a range of north-west suburban destinations. As discussed in Chapter 6, these are areas in which a large and growing share of workers commute by road. In both these SLAs, the fastest growing areas were areas with low public transport use, not close to railway stations, where commuters predominantly commuted to nearby SLAs (for example Beaumont Hills in Baulkham Hills North and Kellyville Ridge in Blacktown North). For the other Outer sector SLA of Wyong North East, the additional commuter flows were predominantly to workplaces within Wyong North East itself. An interesting characteristic of the three Outer sector growth SLAs is that they all experienced a decline in the average commuting distance between 2001 and 2006, reflecting strong job growth and improved self-containment in the Central Coast and North West subregions.

Changes in commuting to areas of high job growth

Turning attention to place of work, Table 8.2 shows where areas of fast job growth sourced their additional workers from. For areas of rapid job growth, additional workers were predominantly drawn from within the same SLA, and the other SLAs providing significant additional flows of commuters were adjacent SLAs.

In most of these SLAs, the predominant growth industries were Retail trade and/or Health and community services. The exceptions were Concord (where Finance and insurance was predominant), Rockdale (where Government administration and defence was predominant) and Blacktown South West, where Transport and storage was predominant.

Table 8.2 Areas which rapid jobs growth Statistical Local Areas are drawing their additional workers from, Sydney, 2001 to 2006

2001 SLA of work	Average annual growth rate of jobs (per cent)	Increase in jobs	SLAs providing more than 300 additional workers to SLA (in descending order of importance)	Industries with more than 300 additional jobs in SLA (in descending order of importance)	Change in average commuting distance, 2001 to 2006 (km)
Baulkham Hills North	7.7	3018	Baulkham Hills North, Blacktown North	Retail trade, Health and community services, Education, Construction	0.3
Canada Bay—Concord	6.2	4060	Canada Bay—Concord	Finance and insurance, Retail trade, Manufacturing, Personal and other services, Construction, Health and community services	−0.4
Camden	4.8	2956	Camden, Campbelltown South, Wollondilly	Retail trade, Health and community services, Manufacturing, Education	0.7
Liverpool West	4.1	1912	Liverpool West	Health and community services, Retail trade	0.7
Baulkham Hills Central	3.5	5228	Baulkham Hills Central, Blacktown North, Baulkham Hills North	Retail trade, Health and community services, Manufacturing, Wholesale trade	0.9
Rockdale	3.4	3676	Rockdale	Government administration and defence, Retail trade, Property and business services	0.5
Wyong South and West	3.2	3414	Wyong South and West, Gosford West, Wyong North-East	Retail trade, Manufacturing, Health and community services, Construction	0.2
Blacktown South-West	3.1	2743	Penrith East, Blacktown North, Penrith West	Transport and storage, Wholesale trade, Education, Retail trade	0.7
Parramatta North-West	3.0	774	Parramatta North West	Retail trade	−1.6

Note: For the Sydney SD as a whole, the average annual growth rate in jobs was 0.9 per cent.

Source: BITRE analysis of BTS JTW 2001 (table 11) and 2006 (table 10) data sourced from the ABS 2001 and 2006 *Census of Population and Housing*.

For all of the Outer sector job growth SLAs, the average distance commuted to a place of work in that SLA increased between 2001 and 2006, indicating that the strong job growth was increasingly drawing workers from further afield. This runs counter to the trend for Sydney as a whole, where the average commuting distance declined marginally from 14.8km in 2001 to 14.6km in 2006.

Commuting and the decision to move residence or place of work

Spatial patterns of population and job growth in Sydney result from the choices made by individuals and families about whether to move residence, change jobs or stay put. Based on the data in ABS (2009b), Hay (2009) reports that 35 per cent of Sydney employed residents with a fixed place of work moved house in the three years to October 2008, while 29 per cent moved their job location, and 15 per cent moved both house and job location.

According to ABS (2009b), the most commonly cited reason for Sydney residents who moved suburb of residence between 2005 and 2008 was 'to live nearby family/friends' (21 per cent), followed by 'lifestyle' (19 per cent), 'work—better access or prospects' (18 per cent) and housing cost (18 per cent). Access to public transport was cited by only 8 per cent of movers. Hay (2009) finds that the desire to move to a better house or a better location is the most important factor in the decision to move and the choice of location.

While proximity to work does not generally rank as highly as other factors in the choice of where to live, ABS (2009b) identifies it as the most commonly cited consideration for certain demographic groups in Sydney, such as couple only households and renters. When the focus is restricted just to employed people, better work access and prospects was the equal most important consideration (at 21 per cent), alongside lifestyle factors (Hay 2009). For employed movers who lived within five kilometres of work after their move, better work access or prospects was the dominant consideration (40 per cent cited this as a reason). However, housing cost was the key consideration for movers commuting more than ten kilometres to work, suggesting that different groups make the trade-off between affordability and commuting time in different ways (*ibid.*). Better work access or prospects was also the dominant consideration for those who travelled to work by bicycle or on foot (47 per cent). Not surprisingly, access to public transport was a relatively important factor for those movers who subsequently commuted to work by train or bus.

For those moving suburb of employment between 2005 and 2008, Hay (2009) reports that 'job related reasons' were cited as a reason by 86 per cent, while 14 per cent identified that the job was 'close to home' and only one per cent nominated 'close to public transport'. The latter two travel related reasons were considerably more important for those movers who subsequently cycled or walked to work (cited by 35 per cent) and for those who subsequently commuted less than five kilometres to work (33 per cent).

Thus, job access is one of several key factors—alongside proximity to family and friends, lifestyle and housing cost—that underpin people's choices as to where to live and the distance they commute to work. The decision to change job location largely depends on the attributes of the job, although proximity of the job to home is a secondary consideration. The distance from home to work is a particularly important factor behind the home and job moves of employed people who walk/cycle to work or live within five kilometres of where they work.

Travel cost

The cost of travel is an important driver of commuting flows. The cost of travel between two areas depends on the opportunity cost of the time spent undertaking the journey, as well as direct costs such as petrol, tolls, public transport fares and parking fees. The journey time depends on the distance between the two areas and the average speed, which in turn depends on transport infrastructure and the level of congestion.

In this chapter, BITRE uses estimates of the road network distance between any origin-destination pair (derived from BTS Strategic Travel Model outputs) as a proxy for travel costs. Note that the cross-city comparison of regression results later in this chapter makes use of straight line distance estimates (see Tables 8.9 and 8.12). Estimates of the average travel time between each origin-destination pair were also derived from BTS Strategic Travel Model outputs of car travel times and public transport travel times (including wait time, in-vehicle time and access/egress time). The travel time estimates proved less robust than the distance estimates, and had lower explanatory power in the gravity models, so this chapter focuses primarily on the road network distance measure—which is consistent with the approach adopted for Melbourne in BITRE (2011).

BITRE's road network distance estimates were very highly correlated with the straight line distance estimates (correlation=0.95) and less well correlated with the travel time estimates (0.82). Regression results for Sydney using the travel time data are presented in Appendix B.

Table 8.3 presents the results of a simple correlation analysis across all of the origin-destination pairs within the Sydney SD at the SLA scale. The expected relationship is that a greater distance or travel time between any origin-destination pair will generally be associated with a greater travel cost and a greater impediment to travel between those two regions. The table shows that the distance (and time) between an origin-destination pair is significantly negatively correlated with the number of people commuting between those SLAs and with the change in commuter flows between those SLAs.

Table 8.3 Correlation analysis of relationships between commuting flows and distance or time, Sydney, 2001 and 2006

Commuting flow variable	Correlation with road network distance	Correlation with travel time
Number of persons commuting between origin-destination pair in 2006	-0.24	-0.25
Number of persons commuting between origin-destination pair in 2001	-0.24	-0.25
Change in number of persons commuting between origin-destination pair, 2001 to 2006	-0.11	-0.13

Note: Correlation calculated across all SLA pairs within Sydney SD. Travel time measure is an average of morning and afternoon peak period travel times, and an average across all modes of transport.

Source: BITRE analysis of BTS Strategic Travel Model distance and time outputs and BTS JTW 2001 (table 11) and 2006 (table 10) origin-destination matrices at travel zone scale, sourced from the ABS *Census of Population and Housing* 2001 and 2006.

Transport infrastructure

The extent to which distance acts as an impediment to travel is likely to depend on the choice of transport mode and the capacity of the transport network. For example, in peak period, commuting times by rail can be substantially quicker than commuting between the same origin-destination pair by car (Haynes 2012, Western Australian Planning Commission 2009). Where this is the case, the impact of distance may be less pronounced for origin-destination pairs that have a direct rail connection than for those that are reliant on the road network. Peak period travel speeds can also be quicker on freeways than on arterial roads (VicRoads 2010). Consequently the impact of road distance may be less pronounced for origin-destination pairs that are connected by Sydney's freeway network, than by those that are not. These relationships will be explored through the gravity model, with results presented later in the chapter.

Changes in commuting patterns will also be shaped, to some extent, by development of new transport infrastructure, which changes the relative costs of commuting to different areas. The most significant expansions of Sydney's transport infrastructure between 2001 and 2006 were those to the motorway network:

- the M5 East motorway between Beverly Hills and Sydney Airport, opened in December 2001
- the Cross-city tunnel, which connects the Inner West with the Eastern Distributor, opened in August 2005
- Westlink M7, a 40 kilometre motorway between Liverpool and Baulkham Hills, opened in December 2005.

It is likely that openings of other major parts of this motorway network in the years leading up to 2001, and anticipated openings of sections in 2007, also influenced changes in commuting patterns during the period.

While new motorway infrastructure appears to have been a strong determinant of employment growth patterns, particularly in the wholesale trade and logistics industries, any additional effect that the expansion of the freeway network may have had on commuting patterns is difficult to discern from casual observation of the data. The results of the gravity model estimation in the next section suggest that commuting flows between areas newly connected by freeways increased more than otherwise would have been expected given residential and job growth in those areas.

There were no expansions to Sydney's metropolitan rail system between 2001 and 2006. However, the railway between Sydney Airport and the CBD opened in 2000, and it is possible that commuting patterns were still responding after August 2001. The most significant expansion of public transport infrastructure during the period was the Liverpool-Parramatta T-way, completed in 2003. However, there is evidence that significant changes in bus services resulting from the T-way did not occur until after 2006 (Baker 2006).

Industry and skills

As discussed in chapter 5, some significant industry-specific employment changes occurred between 2001 and 2006. Changes in industry structure are likely to impact changes in commuting flows beyond their impact on where jobs are located. As suggested by the gravity model results presented later in the chapter, the role distance plays in determining commuting flows differs between industries. Distance appears to be less important a factor at explaining commuting flows for industries where jobs are more concentrated relative to the overall population.

Table 8.4 shows the average distance that people commute in each industry, along with a measure of the geographical spread of each industry relative to the population—the proportion of jobs in the industry that would have to move SLAs in order for jobs in the industry to have the same spatial spread as overall employed residents. This is related to the concentration of industries discussed in Chapter 5, in which it was highlighted that financial services jobs are relatively concentrated, while education, retail and construction jobs are relatively spread out.

The correlation of commuting distance with the spatial concentration of an industry's jobs relative to population (53 per cent) and with spatial concentration relative to an industry's own workforce (65 per cent) is suggestive of a relationship between spatial concentration of industries and the drivers of commuting flows. This is confirmed by the analysis in the next section (see Table 8.10), which finds that the 'distance penalty' parameter in industry-specific gravity models is even more correlated with spatial concentration than distance itself.

Table 8.4 Average commuting distances, relative concentrations, and growth of industries in Sydney, 2001 to 2006

Industry	Average straight line commuting distance, 2006 (km)	Industry jobs concentration relative to population	Industry jobs concentration relative to workers in industry	Change in jobs between 2001 and 2006	Proportion of workers working in home SLA (per cent)
Agriculture, forestry and fishing	8.5	0.52	0.14	-1 758	61
Mining	17.5	0.62	0.39	-3 721	28
Manufacturing	13.3	0.31	0.29	-25 526	21
Electricity, gas, water and waste services	16.4	0.43	0.41	-16 964	16
Construction	12.6	0.16	0.19	21 451	36
Wholesale trade	12.9	0.35	0.32	-12 361	21
Retail trade	9.3	0.19	0.19	34 807	35
Accommodation and food services	8.1	0.23	0.19	5 461	38
Transport, postal and warehousing	14.9	0.42	0.40	-7 896	20
Information media and telecommunications	13.3	0.59	0.51	-46 255	16
Financial and insurance services	13.6	0.64	0.61	12 654	13
Rental, hiring and real estate services	10.0	0.25	0.25	5 719	33
Professional, scientific and technical services	11.1	0.47	0.39	19 592	26
Administrative and support services	11.4	0.35	0.33	13 737	27
Public administration and safety	15.3	0.39	0.35	26 182	18
Education and training	10.7	0.18	0.21	15 980	29
Health care and social assistance	10.4	0.26	0.25	50 719	29
Arts and recreation services	10.5	0.32	0.28	6 144	34
Other services	10.5	0.18	0.20	16 895	33

Note: Based on ANZSIC 2006 Classification.

Source: BITRE analysis of BTS JTW online census tabulations for 2001 (table 11, table 19) and 2006 (table 8, table 10) data sourced from the ABS 2001 and 2006 *Census of Population and Housing*.

Skills related factors also play an important role in shaping commuter flows between different parts of the city and how they change over time. For example, Trendle and Siu (2005) show that distance has less of a deterrent effect in the commuting decision for more educated workers.

Other things equal, commuting flows are likely to be greater for origin-destination pairs which have good alignment between the skills (or industry) mix of employed residents in the origin SLA and the skills (or industry) mix of jobs in the destination SLA. To investigate the influence of skills and industry on commuting flows, BITRE has developed measures of industry mismatch and skills mismatch.⁶¹ These measures identify the proportion of employed residents of the origin SLA who would need to change industries (skill categories) to match the industry (skill) mix of the destination SLA.

- The **industry mismatch index** was calculated based on the single digit ANZSIC 1993 industry classification. While the industry mismatch index can theoretically take values between 0 and 1, in practice no origin-destination pair in the Sydney SD has an industry mismatch index over 0.56 in 2006. Industry mismatch was highest for the SLA pair of Wollondilly and Sydney Inner, and lowest for the pair of Parramatta North East and Hurstville.
- The **skills mismatch index** was calculated for 2006 in a parallel manner to the industry mismatch index. It was based on three qualifications categories: no post-school qualifications, certificate level qualification and higher qualification. While the skill mismatch index can theoretically take values between 0 and 1, in practice no origin-destination pair in the Sydney SD had a skill mismatch index over 0.47. Skills mismatch was highest for the SLA pair of Wyong North East and Sydney Inner and lowest for the SLA pair of Sydney East and Sydney Inner.

Table 8.5 presents the results of correlation analysis. As expected, the greater the extent of the industry or skills mismatch, the lower the observed commuting flow. The results also suggest that a high degree of skills mismatch may negatively effect the change in commuting flows. As was the case for Melbourne and Perth (see BITRE 2011, 2010), the skills mismatch index is more closely matched to commuting patterns than the industry mismatch variable.

Table 8.5 Correlation analysis of relationships between commuting flows and industry and skills mismatch, Sydney, 2001 and 2006

Commuting flow variable	Correlation with industry mismatch index	Correlation with skills mismatch index
Number of persons commuting between origin-destination pair in 2006	-0.08	-0.18
Number of persons commuting between origin-destination pair in 2001	-0.08	-0.18
Change in number of persons commuting between origin-destination pair, 2001 to 2006	-0.05	-0.11

Note: Correlation calculated across all SLA pairs within Sydney SD.

Source: BITRE analysis of BTS JTW 2001 (table 11) and 2006 (table 10) origin-destination matrices at travel zone scale, and ABS 2001 and 2006 *Census of Population and Housing* industry and educational qualifications data.

⁶¹ An alternate method for investigating the influence of skills and industry is to estimate gravity models of commuting flows which are disaggregated by skills (as per Trendle and Siu 2005) or industry (see Table 8.10).

A gravity model of commuting

The previous discussion has identified a number of factors which are likely to be important drivers of spatial commuting flows in Sydney. There are many other factors that are also likely to have an influence, such as age, home ownership, occupation, income and gender (Trendle and Siu 2005).

This section presents estimates of a gravity model for origin-destination commuting flows in Sydney. The model is not intended to be comprehensive. Note that the state transport departments have typically developed rather more sophisticated models of spatial commuting flows (e.g. the NSW Government's Strategic Travel Model), which reflect more detailed information on transport infrastructure, mode usage and relative prices. Such models have been progressively improved over many years and have the capability of addressing a broader set of questions. The relatively simple gravity model presented in this report nevertheless provides a useful introduction to some of the principal drivers of spatial commuting patterns within Sydney. Its role is primarily to investigate the impact of population and job growth, distance, skills, and transport infrastructure on spatial patterns of commuting in Sydney. The base model is the same as that used in BITRE's studies of other capital cities, allowing comparisons across Australia's largest cities.

The gravity model results have also been used to undertake some scenario modelling in Chapter 9, based on the available spatial projections of population and job growth in Sydney.

Explaining origin-destination commuting flows

Gravity models, commonly used to explain spatial variation in commuter flows, relate passenger flows between origin and destination regions to the relevant population total in the origin and destination regions and to distance. The basic structure of a gravity model of commuting is as follows:

$$C_{ij} = \alpha^l R_i^\beta W_j^\gamma / (T_{ij}^\delta)$$

where:

C_{ij} = commuting flow from region i to region j

R_i = the number of employed residents of region i

W_j = the number of jobs in region j

T_{ij} = the generalised cost of travel between regions i and j

α^l , β , γ and δ are the model parameters to be estimated.

The generalised cost of travel between two regions includes the cost of the time lost to travel, as well as direct expenses such as vehicle operating costs, parking fees or public transport fares. As accurate data on these costs is rarely available, distance or time are often used as proxies for this variable.

According to Trendle and Siu (2005) 'the underlying assumption to this model is that every worker is equally attracted to any type of job and they also have the equal amount of chance to obtain any job'. In practice, employees are not homogeneous—they have different skills

and educational attainment and vary in their suitability for employment in different industries. Some authors have addressed this issue by estimating separate gravity models for different skill categories (Harsman and Quigley 1998, Trendle and Siu 2005). BITRE has attempted to capture this heterogeneity through inclusion of a skill mismatch variable in the regression analysis, and has also estimated separate gravity models for different industries.

Base model for Sydney, 2001 and 2006

The results presented in this section use the same methodology as was used in BITRE's analyses of commuting flows in Perth (BITRE 2010) and Melbourne (BITRE 2011). The logarithmic form of the model was estimated for each time period, t :

$$\ln C_{ij} = \alpha + \beta \ln R_i + \gamma \ln W_j - \delta \ln T_{ij} \quad (\text{where } \alpha = \ln \alpha')$$

For the main results presented here, the variable T_{ij} is represented by the estimated road network distance between SLAs, which was considered the most reliable measure of generalised travel costs available. The road network distance estimates are derived from BTS Strategic Travel Model distance outputs for travel zone pairs and, when aggregated, are well correlated with findings from the NSW *Household Travel Survey*. A more detailed description of the underlying methodology is provided in Chapter 7. The results of exploring alternative proxies of generalised travel costs are described in Appendix B.

For the base model, the analysis is based on the 64 SLAs in the Sydney SD, so there is a potential sample of 4096 origin-destination pairs. Pairs with three or less commuting flows were removed⁶², resulting in 3788 origin-destination pairs in the sample. Ordinary least squares regression was used to estimate parameters for the base model.

Table 8.6 summarises the base gravity model results for 2001 and 2006. It is evident that:

- The gravity model has high explanatory power, with the three independent variables explaining about 75 per cent of all variation in origin-destination commuter flows in both years. Other studies have found similarly high explanatory power of gravity models for other locations (eg Trendle and Siu 2005, Harsman and Quigley 1998, BITRE 2010).
- For both years, all three explanatory variables are highly significant and have the expected signs: commuting between an origin-destination pair tends to increase with the number of employed residents at the origin and the number of jobs at the destination, and decrease with the distance between the origin and destination.
- The estimated parameters for employed residents in the origin SLA and jobs in the destination SLA are both close to one.
- The parameter estimates do not change much between 2001 and 2006.

⁶² Values of three and zero are generated by randomisation techniques applied by ABS to protect confidentiality and should not be relied upon. Values of zero create estimation problems when using a logarithmic formulation. Using a Poisson model allows the retention of observations with a zero value, and results for Sydney using a Poisson specification are presented in Appendix B.

Table 8.6 Estimation of base gravity model of origin-destination commuter flows, Sydney, 2001 and 2006

	2001	2006
Sample	3828	3788
Adjusted R-squared	74.33	75.34
Parameter estimates		
Constant	-14.24	-14.53
Employed residents in origin SLA	1.21	1.23
Jobs in destination SLA	1.13	1.14
Road network distance between origin and destination SLA	-1.43	-1.44
Robust t-values		
Constant	-45.37	-46.78
Employed residents in origin SLA	47.85	48.73
Jobs in destination SLA	62.20	65.88
Road network distance between origin and destination SLA	-80.76	-83.01

Note: The dependent variable is the log of the number of persons commuting from the origin SLA to the destination SLA in the given year.

Source: Estimated by BITRE using OLS estimation and robust standard errors, based on ABS 2001 and 2006 *Census of Population and Housing* commuting, jobs and employed residents data and BTS' Sydney Strategic Travel Model distance outputs.

Appendix B presents results from BITRE's investigation of the sensitivity of the gravity model regression to various changes in model specification, including changes in geographic scope, methods of representing travel costs, and form of regression. Amongst other results, it was found that the parameter estimates did not differ significantly when the Greater Metropolitan Area was considered rather than the Sydney Statistical Division, and that road network distance was found to be the most appropriate representation of generalised travel cost amongst the available alternatives. Overall, while there are some differences in the results between specifications, the conclusions drawn from the base model proved robust across specifications, and the potential gains from using different specifications were not considered worthwhile compared to the benefit of having uniform models across the capital cities.

Extended model for Sydney, 2001 and 2006

Table 8.7 presents an extended gravity model of commuting flows, which allows for:

- Heterogeneity of workers, captured through a 'skills mismatch' variable: the proportion of employed residents of the origin SLA who would need to change skill levels to match the skill mix of jobs in the destination SLA. An industry mismatch variable was also trialled, but it was omitted as it was sufficiently closely correlated with the skill mismatch variable (correlation=0.60 in 2006) to pose multicollinearity risks, but had lower explanatory power.
- An additional 'rail connection' variable, to identify whether the distance penalty is reduced for origin-destination pairs between which there is a direct rail service. Only stations on the same train line are considered to have a direct rail connection. The variable takes a value of zero if the origin-destination pair does not have a direct rail connection, and is set equal to the log of the distance between the origin-destination pair if there is a direct rail connection.
- An additional 'freeway connection' variable, to identify whether the distance penalty is reduced for origin-destination pairs which have a direct freeway connection. This variable is set equal to the log of the distance between the origin-destination pair if the two SLAs would be travelled between without leaving Sydney's freeway network, and to zero in all other instances. Changes to the freeway network between 2001 and 2006 (such as the M7 and M5 East) cause the freeway connection variable to differ considerably across the two periods.

There is a modest increase in explanatory power with the inclusion of these variables, and the parameter estimates for the retained variables undergo little change.

The results of the regression show that a direct rail or freeway connection between an origin-destination pair is associated with higher commuter flows. For example, consider an origin-destination pair located five kilometres apart which each have 20 000 employed residents and jobs and for which there is no skills mismatch or direct freeway connection. The 2006 model predicts that if they have no direct rail connection then 744 commuters will flow from one to the other, while if there is a direct rail connection there will be 889 commuters. The impact of the freeway connection variable is somewhat larger.

The skills mismatch variable is a highly significant addition to the gravity model of commuter flows. When an origin-destination pair has a large degree of skills mismatch, commuter flows are predicted to be significantly lower than if the supply and demand for skills is well aligned between the two SLAs.

The freeway and rail parameters were stable between 2001 and 2006, and while the skills mismatch parameter declined, the change was not statistically significant.

Table 8.7 Estimation of extended gravity model of origin-destination commuter flows, Sydney, 2001 and 2006

	Sydney SD, 2001	Sydney SD, 2006
Sample	3828	3788
Adjusted R-squared	76.89	78.06
Parameter estimates		
Constant	−13.50	−13.58
Employed residents in origin SLA	1.15	1.15
Jobs in destination SLA	1.10	1.11
Road distance between origin and destination SLA	−1.34	−1.36
Direct rail connection * log of distance	0.11	0.11
Freeway connection * log of distance	0.17	0.17
Skills mismatch index for origin-destination pair	−1.97	−1.85
Robust t-values		
Constant	−42.8	−43.6
Employed residents in origin SLA	46.0	46.2
Jobs in destination SLA	59.6	62.0
Road distance between origin and destination SLA	−74.5	−76.7
Direct rail connection * log of distance	11.3	12.1
Freeway connection * log of distance	6.0	9.3
Skills mismatch index for origin-destination pair	−13.8	−13.5

Note: The dependent variable is the log of the number of persons commuting from the origin SLA to the destination SLA in the given year.

Source: Estimated by BITRE using OLS estimation and robust standard errors, based on ABS 2001 and 2006 *Census of Population and Housing* commuting, jobs, employed residents and qualifications data and BTS' Sydney Strategic Travel Model distance outputs.

In summary, the regression results for the base and extended gravity models show that a very high proportion of spatial variation in Sydney commuting flows can be explained by:

- the distributions of employed residents and jobs
- the distance between SLA pairs
- the location of transport infrastructure
- the degree of alignment between the skills held by residents of origin SLAs and the skills required for jobs in the destination SLAs.

Comparison to results for Melbourne and Perth

The regression analysis has been designed to eventually enable comparisons across Australia's largest capital cities through adoption of a common model specification across the cities. At this stage, results are available for three cities—Sydney, Melbourne and Perth.

Table 8.8 presents comparative results of regressions for Sydney and Melbourne for 2006, using the extended gravity model described above. Table 8.9 presents comparative results of regressions for Sydney, Melbourne and Perth for 2006, using a common specification. To enable comparability with Perth, a straight line measure of distance is used for all three cities, and the direct freeway variable is not included.

The explanatory variables are highly significant and have the expected signs in all three city regressions. The Perth model had a higher explanatory power (82 per cent) than the Sydney and Melbourne models (both 77 per cent). The parameter estimate for Sydney's straight line distance variable is of a larger magnitude than that obtained for Perth, but is broadly similar to that obtained for Melbourne. This implies that distance is a lesser impediment to commuter travel in Perth than it is in the two larger cities, a result which is consistent with the greater density and congestion of Sydney and Melbourne.

Table 8.8 shows that rail connections and freeway connections both have a significant positive effect on commuting flows in Sydney and Melbourne, but while the effect of freeway connections is of larger magnitude than that of rail connections in Sydney, rail connections had more of an effect than freeway connections in Melbourne.

Table 8.8 Comparison of gravity model of origin-destination flows between Sydney and Melbourne, 2006

	Sydney Statistical Division	Melbourne Statistical Division
Sample	3788	5152
Adjusted R-squared	78.1	77.4
Parameter estimates		
Constant	-13.58	-4.59
Employed residents in origin SLA	1.15	0.53
Jobs in destination SLA	1.11	0.93
Road distance between origin and destination SLA	-1.36	-1.58
Direct rail connection * log of distance	0.11	0.13
Freeway connection * log of distance	0.17	0.05
Skills mismatch index for origin-destination pair	-1.85	-2.08
Robust t-values		
Constant	-43.6	-11.4
Employed residents in origin SLA	46.2	17.0
Jobs in destination SLA	62.0	59.2
Road distance between origin and destination SLA	-76.7	-76.7
Direct rail connection * log of distance	12.1	11.4
Freeway connection * log of distance	9.3	6.4
Skills mismatch index for origin-destination pair	-13.5	-20.9

Note: The dependent variable is the log of the number of persons commuting from the origin SLA to the destination SLA in the given year.

Source: Table 8.7 of this report and table 8.7 of BITRE (2011).

Table 8.9 Comparison of gravity model of origin-destination flows between Sydney, Melbourne and Perth, 2006

	Sydney Statistical Division/ working zone	Melbourne Statistical Division	Perth working zone
Sample	3788	5152	1359
Adjusted R-squared	76.8	76.5	82.4
Parameter estimates			
Constant	-13.90	-6.64	-11.17
Employed residents in origin SLA	1.13	0.59	1.02
Jobs in destination SLA	1.11	0.96	0.99
Straight line distance between origin and destination SLA	-1.30	-1.33	-1.07
Direct rail connection * log of straight line distance	0.15	0.21	0.11
Skills mismatch index for origin-destination pair	-1.94	-2.00	-1.26
Robust t-values			
Constant	-44.4	-17.6	-37.5
Employed residents in origin SLA	43.7	19.5	45.4
Jobs in destination SLA	62.4	60.0	49.6
Straight line distance between origin and destination SLA	-63.2	-58.5	-31.9
Direct rail connection * log of straight line distance	14.7	16.2	5.2
Skills mismatch index for origin-destination pair	-13.8	-19.8	-6.8

Note: The dependent variable is the log of the number of persons commuting from the origin SLA to the destination SLA in the given year.

Source: Sydney results derived by BITRE using OLS estimation and robust standard errors, based on ABS 2001 and 2006 *Census of Population and Housing* commuting, jobs, employed residents and qualifications data, Melbourne results from table 8.9 of BITRE (2011) and Perth results from table 8.6 of BITRE (2010).

Industry specific gravity models

Different industries have different geographic concentrations of jobs and different average commuting distances. This suggests that the determinants of commuting patterns may be qualitatively different in different industries. For example, it might be expected that the more closely aligned the distribution of an industry's jobs are with employed residents, the higher the distance penalty is likely to be for commuters in that industry.

To analyse the differences in commuting patterns between industries, separate gravity models have been estimated for each industry, using the 21 industries in the 2006 ANZSIC 1-digit classification of industries. In each gravity model, the explanatory variables for each SLA pair are the number of residents of the origin SLA employed in that industry, the number of jobs of that industry in the destination SLA, and the straight line distance between the two SLAs.

Table 8.10 shows the estimated distance parameters for industry-specific gravity models for the GMA, using a straight-line distance measure, along with the proportion of the variation in commuting flows explained by the gravity model, and the measure of spatial concentration defined for each industry as in Table 8.4.

The industries with the highest estimated distance penalty parameter were Retail trade, Health care and social assistance, Accommodation and food services, and Manufacturing. The industries with the lowest distance penalty were Information media and telecommunications, Electricity, gas, water and waste services, and Financial and insurance services. People employed in this latter set of industries are less deterred by the prospect of a lengthy commute to their place of work.

The relative spatial concentration index is highly negatively correlated with the strength of the distance penalty parameter and the explanatory power of the model (correlations of -0.67 and -0.79 respectively). It is less strongly correlated with the average commuting distance in each industry.

Table 8.10 Industry-specific gravity model results and other industry characteristics, Sydney Greater Metropolitan Area, 2006

	R-squared (per cent)	Distance parameter (and standard error)	Relative spatial concentration index for industry	Average commuting distance
Agriculture, forestry and fishing	51.4	-0.91 (0.03)	0.52	8.5
Mining	43.7	-0.80 (0.04)	0.62	17.5
Manufacturing	63.6	-1.11 (0.01)	0.31	13.3
Electricity, gas, water and waste services	40.0	-0.65 (0.02)	0.43	16.4
Construction	63.3	-0.94 (0.01)	0.16	12.6
Wholesale trade	44.5	-0.83 (0.02)	0.35	12.9
Retail trade	64.1	-1.19 (0.02)	0.19	9.3
Accommodation and food services	60.7	-1.11 (0.02)	0.23	8.1
Transport, postal and warehousing	46.4	-0.83 (0.02)	0.42	14.9
Information media and telecommunications	24.8	-0.62 (0.02)	0.59	13.3
Financial and insurance services	27.9	-0.71 (0.02)	0.64	13.6
Rental, hiring and real estate services	44.4	-0.78 (0.02)	0.25	10.0
Professional, scientific and technical services	36.0	-0.80 (0.02)	0.47	11.1
Administrative and support services	43.3	-0.77 (0.02)	0.35	11.4
Public administration and safety	48.1	-0.85 (0.02)	0.39	15.3
Education and training	59.8	-1.10 (0.02)	0.18	10.7
Health care and social assistance	60.3	-1.13 (0.02)	0.26	10.4
Arts and recreation services	40.6	-0.71 (0.02)	0.32	10.5
Other services	55.9	-0.94 (0.02)	0.18	10.5

Note: The dependent variable is the log of the number of persons commuting from the origin SLA to a job in the destination SLA in the given industry.

Source: Estimated by BITRE using OLS estimation and robust standard errors, based on ABS 2001 and 2006 *Census of Population and Housing* commuting, jobs and employed residents data.

Explaining changes in commuter flows

The main drivers of change in commuter flows can be explored further by transforming the gravity model into log difference form:

$$\begin{aligned} [\ln C_{ij2006} - \ln C_{ij2001}] &= \theta + \mu [\ln R_{i2006} - \ln R_{i2001}] + \rho [\ln W_{j2006} - \ln W_{j2001}] \\ &\quad - \lambda [\ln T_{ij2006} - \ln T_{ij2001}] \\ &\approx \theta + \mu [\ln R_{i2006} - \ln R_{i2001}] + \rho [\ln W_{j2006} - \ln W_{j2001}] \end{aligned}$$

where θ , μ and ρ are the model parameters to be estimated. For this study, the second expression is used since no reliable measure of changes in generalised travel costs between SLA pairs is available. The dependent variable in this specification approximates the percentage change in commuter flows between 2001 and 2006. This specification resembles that used by BITRE (2009) to project growth in intercity travel.

A practical issue with this specification is that the dependent variable tends to take very extreme values for origin-destination pairs which have low commuter flows in one of the two periods. BITRE has dealt with this issue by excluding origin-destination pairs with less than 100 commuters in either period from the analysis.

Table 8.11 summarises the regression results for the changes in commuting flows between 2001 and 2006. Four different models have been estimated:

- (a) the baseline model which includes just the employed residents and job growth variables
- (b) adds in the skills mismatch variable to test for whether origin-destination pairs with a high degree of skills mismatch tend to experience lesser growth in commuting flows
- (c) adds in an 'infrastructure investment' variable to capture some of the impact major transport infrastructure investments may have had on commuter flows—the variable is set equal to one for origin-destination pairs directly impacted by motorway construction between 2001 and 2006 and zero for other pairs.
- (d) adds in the log of distance between the two SLAs to test for whether more distant origin-destination pairs experienced lesser growth in commuting flows.

Model (a) explains only 39.8 per cent of the variation in the dependent variable. This is much lower explanatory power than for the snapshot models for 2001 and 2006—change in commuting patterns is often found to be harder to explain than commuting patterns at a point in time. The parameters on the change in employed residents and change in jobs variables are highly statistically significant. These parameter estimates are also very robust across the alternate model specifications (b) to (d).

For model (b), the exponent on the skills mismatch variable was found to be statistically significant and negative, as expected, and the overall explanatory power was slightly higher than that of the base model. Holding other factors constant, origin-destination pairs where the skills available in the origin region were very well aligned with the skills required in the destination region tended to experience more rapid growth in commuting flows than pairs which had poor skills alignment (i.e. substantial mismatch).

For model (c), the exponent on transport infrastructure investment is statistically significant at the 5 per cent probability level (but not at the one per cent level) and positively signed, and again the overall explanatory power is higher than that of the base model. The transport infrastructure investment variable attempts to capture the impact of the construction of the Westlink M7 and M5 East motorways and the Cross-city Tunnel on commuting flows in Sydney between 2001 and 2006. The results suggest that commuting flows between areas connected by these motorways increased more than would otherwise have been expected given residential and job growth in those areas.

The significance of the rail and freeway connection variables in the 2001 and 2006 snapshot regressions shows that the current rail and freeway network, built over many decades, plays an important role in shaping current commuting flows. The significance of the transport infrastructure investment variable in the change regression analysis further suggests that the expansions to the motorway network between 2001 and 2006 significantly altered the spatial pattern of commuting in Sydney during the period.

For model (d), the exponent on the road network distance between the origin and destination SLAs is found to be significant, implying that closer SLA pairs tended to experience stronger growth in commuter flows between 2001 and 2006. However, for this model the skills mismatch variable is not found to be significant. This suggests the index of skills mismatch between SLA pairs is correlated with the distance between SLA pairs.

Table 8.11 Estimation of extended gravity model of changes in origin–destination commuter flows, Sydney, from 2001 to 2006

	Base model (a)	Model (b)	Model (c)	Model (d)
Sample	1734	1734	1734	1734
Adjusted R-squared (per cent)	39.8	40.1	40.2	40.5
Parameter estimates				
Constant	−0.03	−0.02	−0.02	0.05
Growth rate of employed residents in SLA	0.82	0.81	0.81	0.81
Growth rate of jobs in destination SLA	1.03	1.03	1.02	1.02
Skills mismatch index for origin–destination pair, 2006	-	−0.11	−0.11	−0.06
Transport infrastructure investment	-	-	0.04	0.04
Log of road distance between origin and destination in 2006	-	-	-	−0.02
Robust t-value				
Constant	−7.63	−2.78	−3.04	2.00
Growth rate of employed residents in SLA	15.90	15.56	15.47	15.51
Growth rate of jobs in destination SLA	25.18	25.16	24.65	24.64
Skills mismatch index for origin–destination pair, 2006	-	−3.10	−2.95	−1.52
Transport infrastructure investment	-	-	2.16	2.28
Log of road distance between origin and destination in 2006	-	-	-	−2.83

Note: The dependent variable is essentially the percentage change in the number of persons commuting from the origin SLA to the destination SLA between 2001 and 2006. Based on origin–destination pairs that have at least 100 commuters in both 2001 and 2006.

Source: Estimated by BITRE using OLS estimation and robust standard errors, based on ABS 2001 and 2006 *Census of Population and Housing* commuting, jobs, employed residents and qualifications data and BTS' Sydney Strategic Travel Model distance outputs.

Table 8.12 presents comparative results of regressions of the change in commuting flows between 2001 and 2006 for Sydney, Melbourne, and Perth, using a common model. The model for Sydney is found to explain less of the variation in changes in commuter flows than the models for Melbourne and Perth.

Table 8.12 Comparison of base regression model of growth in origin-destination commuter flows, Sydney, Melbourne and Perth, from 2001 to 2006

	Sydney Statistical Division/ working zone	Melbourne Statistical Division	Perth working zone
Sample	1734	1790	621
Adjusted R-squared (per cent)	39.8	68.7	51.8
Parameter estimates			
Constant	−0.03	−0.06	−0.06
Growth rate of employed residents in SLA	0.82	0.88	0.55
Growth rate of jobs in destination SLA	1.03	0.90	1.04
Robust t-value			
Constant	−7.6	−11.9	−6.3
Growth rate of employed residents in SLA	15.9	19.7	7.9
Growth rate of jobs in destination SLA	25.2	21.5	23.0

Note: The dependent variable is essentially the percentage change in the number of persons commuting from the origin SLA to the destination SLA between 2001 and 2006. Based on origin-destination pairs that have at least 100 commuters in both 2001 and 2006.

Source: Estimated by BITRE for Sydney using OLS estimation and robust standard errors, based on ABS 2001 and 2006 *Census of Population and Housing* commuting, jobs and employed residents data, Melbourne results from BITRE (2011) and Perth results from BITRE (2010).

While not shown in the above table, the skills mismatch parameter was negatively signed for all three cities (see Table 8.11, BITRE 2011, 2010). While it was statistically significant for Melbourne, and in some of the Sydney model specifications, it was not significant for Perth.

A variable capturing major transport infrastructure investments between 2001 and 2006 was included in the change regression for all three cities. The variable proved insignificant in the Perth and Melbourne regressions (see BITRE 2010, 2011), but was statistically significant and positively signed in the Sydney change regression (see Table 8.11). The transport infrastructure projects considered for Sydney were much larger in scale (costing around \$3 billion altogether) than the projects that were completed in Perth⁶³ and Melbourne⁶⁴ during the period, and thus are rather more likely to be associated with significant change in the spatial patterns of commuting within the city. The Sydney regression results indicate that very large scale transport infrastructure investments—such as the series of motorway expansions that occurred in Sydney between 2001 and 2006—can significantly alter commuting flows within a city.

⁶³ The specific transport infrastructure investments reflected in the 2001 to 2006 change regression for Perth were the opening of the Thornlie spur line, the extension of the northern rail line to Clarkson, and the extensions of the Roe, Tonkin and Kwinana freeways. The Mandurah rail line was opened in December 2007 (BITRE 2010).

⁶⁴ The most substantial project completed in Melbourne between 2001 and 2006 was the Craigieburn bypass. CityLink and the Western Ring Road were larger scale projects that were completed prior to 2001, while Eastlink was completed in 2008 (BITRE 2011).

In summary

This chapter uses gravity models to explain variation in origin-destination commuter flows within Sydney and to identify some of the key drivers of recent change in these commuter flows.

About three-quarters of spatial variation in Sydney's commuting flows can be explained by reference to just a few key factors, namely:

- the number of employed residents in the origin SLA
- the number of jobs in the destination SLA
- the distance between the two SLAs
- whether there is a direct rail or freeway connection between the SLAs
- the degree of alignment between the skills available in the origin SLA and the skills demanded in the destination SLA.

Growth in employed residents and jobs also play an important role in explaining changes in commuting flows in Sydney between 2001 and 2006. These two factors alone explain around 40 per cent of the variation in commuting growth rates for origin-destination pairs. Factors such as the distance between origin-destination pairs and new transport infrastructure investments also helped to explain variation in the growth of commuting flows between different parts of Sydney.

CHAPTER 9

Outlook

Key points

- The NSW Government projects Sydney will grow by 1.1 per cent annually between 2006 and 2036, adding 1.7 million people to reach a population of 6.0 million in 2036. The Greater Metropolitan Area is projected to have a population of 7.2 million at that time.
- Two-thirds of Sydney's population growth from 2006 to 2036 is projected to occur in the Outer sector, with 21 per cent in the Middle sector and 12 per cent in the Inner sector. The largest increases are projected for the SLAs of Camden (198 900), Blacktown North (158 500), Liverpool West (125 300), Wyong North East (63 500) and Baulkham Hills North (62 700).
- This population growth will generate demand for around 770 000 new homes in Sydney, mainly in the North West and South West subregions (22 and 20 per cent, respectively).
- Sydney's employment is forecast to increase by 761 000 workers from 2006 to 2036. The additional jobs are expected to be concentrated in the North West (21 per cent), City of Sydney (19 per cent), South West (14 per cent) and West Central (13 per cent) subregions. The most rapid job growth is forecast for the Outer sector, averaging 1.4 per cent growth per annum.
- Should these spatial projections of population and employment growth be realised, a large proportion of the increase in commuting in Sydney between 2006 and 2036 will likely be increased commutes within the North West and South West subregions (17 and 16 per cent, respectively). This increase in the relative importance of same-subregion flows, together with the modelled reduction in the relative importance of inward commutes, will pose a challenge to growing the public transport mode share. The projected pattern of growth is also expected to involve a small rise in average commuting distances. Scenario modelling suggests the magnitude of these changes will be greater if a larger proportion of residential and job growth occurs on the urban fringe.
- Average morning peak road speeds are projected to decline between 2006 and 2031, particularly in the South West.

Context

This chapter considers the future population, employment and commuting patterns of Sydney. The chapter begins with an analysis of population projections from both the Commonwealth and State governments. It then proceeds to investigate the spatial dwellings forecasts for the city. Information is also presented about forecast employment growth in Sydney, and the industries which are expected to experience the most job growth. The implications of this projected population and employment growth for future spatial patterns of commuting within Sydney are considered next. The chapter concludes with a summary of results from other studies which have considered the future outlook for public transport, congestion and travel times within the Sydney Greater Metropolitan Area (GMA).

Projected population growth

Using results of ABS *Projection Series B*⁶⁵ (ABS 2008), Table 9.1 compares the expected average annual growth in population for the five most populous capitals in Australia. According to these projections, the population of Sydney will grow by an average 1.0 per cent per annum between 2006 and 2036—although this is a lower growth rate than that projected for Perth, Brisbane and Melbourne. In absolute terms this is a gross increase of about 2.5 million persons from 2010. As shown in Table 9.1, these projections also indicate that by 2056, the five capital cities will continue to retain their current population rankings. However, under the ABS' Series A projections, the assumed higher levels of net overseas migration and fertility result in Melbourne being projected to surpass Sydney as Australia's largest city in 2039 (ibid.).

Table 9.1 Population projections for Australia's largest capital cities, 2006 to 2056

	Population ('000)					
	Sydney	Melbourne	Brisbane	Perth	Adelaide	All capital cities
2006	4282	3743	1820	1519	1146	13 163
2010	4497	3998	1981	1662	1194	14 023
2026	5426	5038	2681	2268	1385	17 625
2056	6977	6789	3979	3358	1652	23 788
Average annual growth rate (per cent), 2006 to 2056	1.0	1.2	1.6	1.6	0.7	1.2

Note: Projections relate to capital city statistical divisions. Figures in the last column are the totals for the 8 capital cities, including Hobart, Canberra and Darwin.

Source: ABS Cat. 3222.0 Population Projections Australia, 2006 to 2101 (Series B projections).

Table 9.2 shows the Australian Government projections for five future years from the base year of 2007 and the expected average annual population growth between 2007 and 2027 for each of the 11 planning subregions, based on Department of Health and Ageing (2009). It also shows population projections and the long term growth rates for the five aggregate regions that collectively form the Greater Metropolitan Area (GMA) of Sydney.

⁶⁵ Projection Series B 'largely reflects current trends in fertility, life expectancy at birth, net overseas migration and net interstate migration' (ABS 2008, p.3).

These spatial projections of population are consistent with the aggregate capital city projections displayed in Table 9.1 from ABS (2008). Compared to its 2007 population of 4.3 million, the Sydney Statistical Division is expected to grow to a population of 5.5 million by 2027, while the population of the Sydney GMA is expected to grow by an estimated 1.3 million people to bring it up to 6.6 million by 2027. This is an overall growth of 66 500 persons per year.

Table 9.2 Federal Government population projections by sector and subregion, Sydney Greater Metropolitan Area, 2007 to 2027

Sector or subregion	Population 2007	Population projection ('000)					Projected increase in population, 2007 to 2027	Average annual growth 2007 to 2027 (per cent)
		2011	2016	2021	2026	2027		
Planning subregion								
City of Sydney	170	186	207	228	250	254	84	2.04
East	285	294	305	316	327	329	44	0.72
Inner North	306	318	331	345	359	362	56	0.84
Inner West	232	247	263	280	296	300	68	1.29
South	658	679	703	727	750	755	97	0.69
North	264	269	273	278	282	282	19	0.34
North East	237	246	256	266	276	278	40	0.79
West Central	692	735	784	836	888	898	206	1.31
North West	769	813	875	940	1 004	1 017	248	1.41
South West	415	448	501	556	612	623	208	2.05
Central Coast	306	319	340	362	383	387	81	1.17
<i>Sydney SD</i>	4 334	4 553	4 840	5 133	5 426	5 484	1 150	1.18
Aggregate region								
Inner	747	783	826	869	913	922	175	1.06
Middle	1 244	1 313	1 392	1 474	1 557	1 574	330	1.18
Outer	2 343	2 457	2 622	2 790	2 956	2 989	646	1.22
Illawarra	418	433	450	466	480	483	64	0.72
Lower Hunter	524	548	578	607	635	640	116	1.01
<i>Total GMA</i>	5 276	5 534	5 868	6 206	6 541	6 607	1 331	1.13

Source: Department of Health and Ageing (2009).

About 85 per cent of GMA population growth is expected to occur within the Sydney Statistical Division, largely in the Outer sector (49 per cent) and the Middle sector (25 per cent). Much of this growth is projected to occur in the North West, South West and West Central planning subregions, which are each expected to accommodate over 200 000 additional people.

The projected long term average annual growth rate for the whole of the GMA is 1.1 per cent. The Inner, Middle and Outer rings are all projected to grow at a similar rate, but modest growth is projected for the Illawarra. The North subregion is expected to grow at the slowest pace (0.34 per cent), while the City of Sydney and the South West subregions are expected to show the fastest growth, with an average annual growth rate of over 2 per cent.

According to the NSW Department of Planning (2008), three-fifths of the projected population growth in NSW to 2036 will be driven by natural increase (net increase of births over deaths) and two fifths by net migration. The department also notes that 'faster projected population growth in the rest of Australia will reduce NSW share of the national population from 32.9 per cent in 2006 to 30.3 per cent in 2036' (ibid., p.3). The differences between the ABS' national population growth projections and the Department of Planning projections are summarised below.

- In the Department of Planning projections for NSW, the total fertility rate (TFR) was held constant at 1.85 from 2007–08 onwards. In the national projections by ABS (2008), TFR was assumed to fall gradually to 1.73 by 2020–21 and was held constant at that level thereafter.
- In the NSW Government projections, life expectancy was expected to increase to 85.6 for males and to 89.1 for females by 2035–36. ABS assumed a lower life expectancy of 83.5 years for males and 87.2 for females by 2035–36.
- In the NSW Government projections, net overseas migration was assumed to be 50 000 per year from 2011–12 onwards. The corresponding ABS assumption was 56 700 per year from 2010–11 onwards. The Department of Planning and the ABS both assumed that the net interstate migration would be –20 000 per year from 2009–10 onwards.
- The assumptions made by the Department of Planning and the ABS also differed marginally for Sydney. The former assumed a total net migration of 17 500 per year from 2011–12 onwards—but according to the latter, Sydney's total net migration would be higher at 20 383 from 2010–11 onwards.

Population projections are long-term averages based on key predictors of population such as fertility, mortality and migration. Therefore the population projections do not necessarily reflect policy positions and 'may well differ from policy targets expressed in the Department's Sydney Metropolitan Strategy and Regional Strategies' (Department of Planning 2010b, p.xiii).

Table 9.3 shows the most recent NSW Government population growth projections from Department of Planning (2010b). They match the population forecasts released by the NSW Transport Data Centre in October 2009 for Statistical Local Areas (SLAs), planning subregions and sectors. As is evident from this and the preceding table, both spheres of government project that the population of the GMA will grow at an average annual rate of just over one per cent to reach a population of 6.5 million by 2026.

The NSW Government projections in Table 9.3 have Sydney's population growing faster than expected in their previous projections. Accordingly, the GMA's population will begin to exceed 6 million by 2021. Australian Government projections also show the GMA's population reaching the 6 million mark by 2021 (DHA 2009). According to Department of Planning (2010b), Sydney is projected to add an extra 1.7 million to its population in the 30 year period between 2006 and 2036 or grow at an average annual rate of 56 650 persons, while the GMA is projected to gain an extra 2.0 million people.

Table 9.3 State Government population projections by sector and subregion, Sydney Greater Metropolitan Area, 2006 to 2036

Sector or subregion	Population projections ('000)							Projected increase in population, 2006 to 2036	Average annual growth rate, 2006 to 2036 (per cent)
	2006	2011	2016	2021	2026	2031	2036		
Planning subregion									
City of Sydney	166	193	205	220	234	249	265	99	1.58
East	282	296	305	313	318	326	334	52	0.57
Inner North	303	319	330	343	354	366	379	76	0.75
Inner West	227	246	262	274	284	295	307	80	1.00
South	651	677	696	709	720	733	748	96	0.46
North	262	273	285	294	302	311	321	59	0.68
North East	235	245	250	258	263	270	277	42	0.55
West Central	680	730	773	802	827	861	897	217	0.93
North West	761	801	871	946	1 026	1 095	1 156	395	1.40
South West	411	453	514	593	691	785	875	464	2.55
Central Coast	305	317	330	352	375	399	425	120	1.11
Sydney SD	4 282	4 550	4 822	5 104	5 395	5 689	5 982	1 700	1.12
Sector									
Inner	737	790	821	852	877	907	939	202	0.81
Middle	1 223	1 308	1 379	1 430	1 473	1 523	1 577	355	0.85
Outer	2 322	2 453	2 622	2 823	3 044	3 259	3 466	1 144	1.34
Illawarra	415	435	455	475	494	513	529	114	0.82
Lower Hunter	518	546	573	601	627	653	676	158	0.89
Total GMA	5 214	5 531	5 850	6 180	6 516	6 854	7 187	1 973	1.08

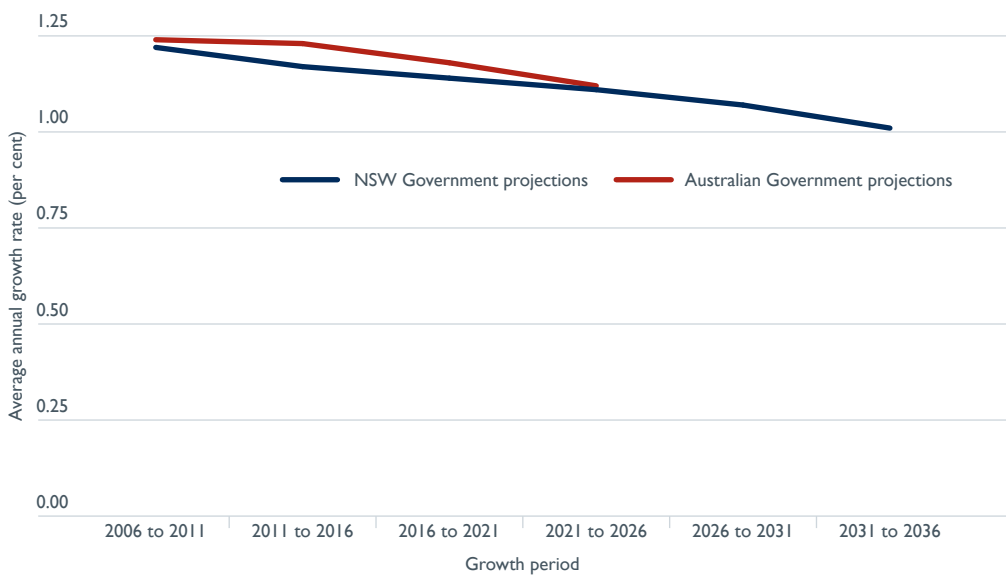
Source: BITRE analysis of NSW Department of Planning (2010b).

Similar to the Australian Government projections, the NSW Government's projections of the average annual growth rate for the GMA are about 1.1 per cent. The two sets of projections in Table 9.2 and Table 9.3 bear some further similarities:

- Both sets of projections expect an above average growth rate for the City of Sydney, South West, North West and Central Coast subregions. The common planning subregions that are expected to have a below average population growth rate are North, East, South, Inner North and the North East.
- The Federal Government (DHA 2009) and the NSW Government both expect that a majority (49 per cent and 58 per cent respectively) of the population increase will occur in the Outer sector, particularly in the SLAs of Blacktown North and Camden. However, while Table 9.2 predicts that the North West will accommodate more population growth than the South West to 2026, in the State Government projections displayed in Table 9.3, the South West subregion emerges as the principal location for growth.

- Both sets of projections show relatively strong growth in the Outer sector (average annual growth of 1.22 per cent and 1.34 per cent respectively in Tables 9.2 and 9.3). However, the Federal Government’s projected growth for the Middle sector to 2026 is about 313 000 new residents—a supposition not shared by the State Government which predicts only an additional 250 000 new residents to 2026.
- Figure 9.1 shows progressive decline in the five-yearly changes in rates of average annual growth for the Sydney SD by both the Australian Government and the NSW Government.

Figure 9.1 Trends in population growth projections by the NSW and Australian Governments for the Sydney Greater Metropolitan Area, 2006 to 2036



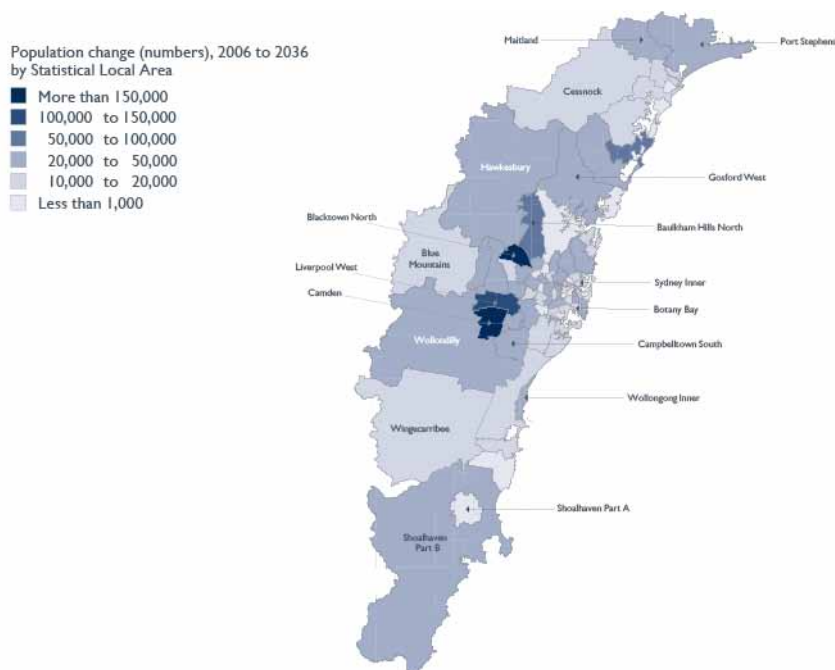
Note: DHA (2009) projections are to 2027 only.

Source: BITRE analysis of Department of Planning (2010b) and DHA (2009) population projections.

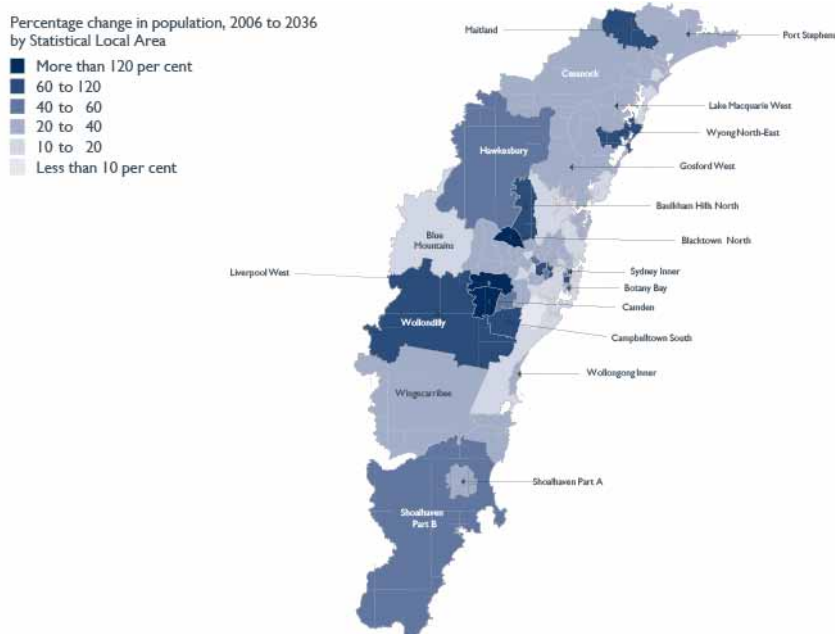
Panels ‘a’ and ‘b’ of Map 9.1 present the absolute and percentage changes in the population by SLA, from 2006 to 2036, based on the NSW Government’s population projections. The largest increases are projected for the SLAs of Camden (198 900), Blacktown North (158 500), Liverpool West (125 300), Wyong North East (63 500) and Baulkham Hills North (62 700). Camden, Blacktown North, Liverpool West and Baulkham Hills North are expected to show population increases of over 100 per cent.

Map 9.1 Projected change in population by Statistical Local Area, Sydney Greater Metropolitan Area, 2006 to 2031

(a) Change in number of persons



(b) Percentage change in population



Source: Department of Planning (2010b).

Targeted growth in dwellings

The population projections outlined in the preceding section are expected to generate demand for 770 000 more homes in 2036, compared to 2006 (NSW Government 2010a). The *Metropolitan Plan for Sydney 2036* presented housing targets for Sydney's planning subregions, informed by 'household and dwelling projections, demographic and economic trends, land capacity, infrastructure and feasibility. A key guiding factor for distributing new housing targets is the subregional jobs to population ratio' (NSW Government 2010a, p.115). According to the plan, this 'broadly indicates a city's efficiency in terms of work travel distances and local employment opportunities' (ibid., p.115). It used this ratio to guide land use and link decisions about housing to one of the plan's key aims—namely 'more jobs closer to home'.

Table 9.4 shows the 2031 and 2036 dwelling supply targets for Sydney. Dwelling needs in 2031 were forecast based on the population in 2004 (5.4 million), population projections available at that time, and forecast trends in living arrangements. Figures for 2036 are revised targets which reflect the expected population growth from 2006 onwards.

Table 9.4 Projected dwelling requirements in Sydney, by planning subregion, for the period ended 2031 and 2036

Planning subregion	Local Government Area	New homes target and distribution for 2004 to 2031		New homes target and distribution for 2006 to 2036	
		Target	Percentage distribution	Target	Percentage distribution
Sydney City	Sydney City	55 000	8.4	61 000	7.9
East	Botany Bay, Randwick, Waverley, Woollahra	20 000	3.1	23 000	3.0
Inner North	Lane Cove, North Sydney, Ryde, Willoughby, Hunters Hill, Mosman	30 000	4.6	44 000	5.7
Inner West	Ashfield, Burwood, Canada Bay, Leichhardt, Strathfield	30 000	4.6	35 000	4.6
South	Kogarah, Hurstville, Canterbury, Rockdale, Sutherland, Marrickville	35 000	5.3	58 000	7.5
North	Hornsby, Ku-ring-gai	21 000	3.2	29 000	3.8
North East	Pittwater, Warringah, Manly	17 300	2.6	29 000	3.8
West Central	Auburn, Bankstown, Fairfield, Holroyd, Parramatta	95 500	14.6	96 000	12.5
North West	Baulkham Hills, Blacktown, Blue Mountains, Hawkesbury, Penrith	140 000	21.4	169 000	22.0
South West	Wollondilly, Camden, Campbelltown, Liverpool	155 000	23.7	155 000	20.2
Central Coast	Gosford, Wyong	56 000	8.6	70 000	9.1
Sydney Total		654 800	100.0	769 000	100.0

Notes: For the 2031 target, new homes were compared to a 2004 base, while for the updated 2036 target, new homes were compared to a 2006 base.

Source: Adapted from NSW Government (2005), *City of Cities* and NSW Government (2010a), *Sydney 2036*.

Of the targeted total of 769 000 new dwellings between 2006 and 2036, it is envisaged that the North West, South West and Central Coast subregions would together require about 394 000 or 51 per cent of the total projected supply. These three planning subregions, along with West Central, were also expected to have the largest increase in dwelling numbers as per the 2031 targets.

The 2036 targets for North West, South West and the Central Coast include the expected development of 199 000 dwellings in new release areas. The North West targets include 87 000 dwellings in new release areas, South West includes 83 000, and Central Coast includes 29 000. A small amount of greenfield development is also expected in the North East subregion.

The *Sydney 2036* targets have not yet been translated to the LGA scale. However, the previous *City of Cities* dwelling targets were translated to the LGA scale through the subregional planning process (see Department of Planning 2009). The process concluded that dwelling requirements to 2031 were expected to be greatest in the:

- South West Growth Centre, which falls predominantly within the Liverpool and Camden LGAs, and is expected to add 100 000 new dwellings
- North West Growth Centre, which falls predominantly within the Blacktown and Baulkham Hills LGAs, and is expected to add 60 000 dwellings
- City of Sydney, which is expected to add 55 000 dwellings.

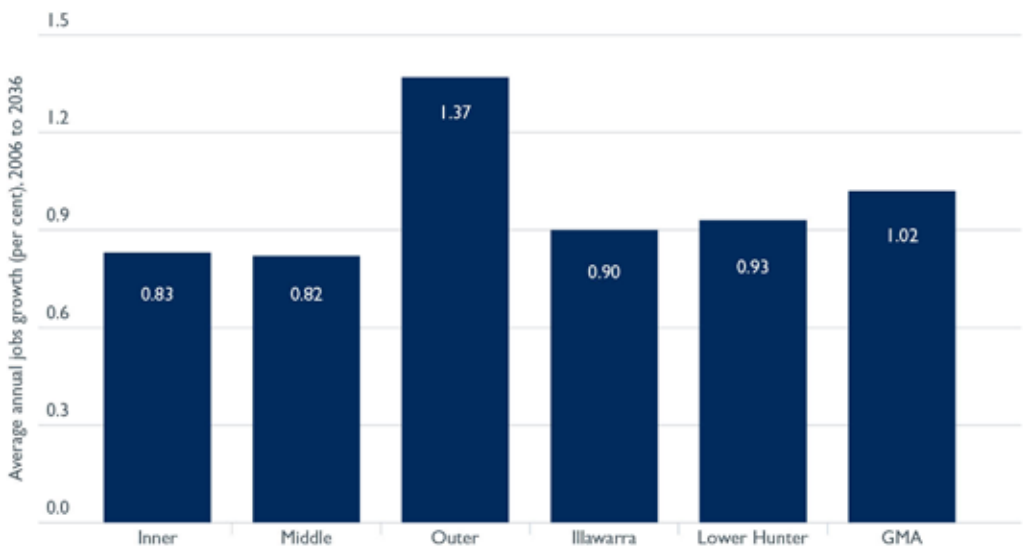
The spatial distribution of new dwellings is fundamentally very similar for the two forecast years (see Table 9.4), with the new dwelling targets typically being revised upwards between the 2005 and 2010 strategic plans. Exceptions to this general trend are the West Central and South West planning subregions—where the average annual dwelling requirements have remained unchanged. The targets for the South and North West subregions have both been raised upwards by more than 20 000 dwellings.

Forecast growth in employment

Small area employment forecasts are published by the Transport Data Centre (TDC). As noted by TDC (2009a), this data represents the estimated number employed at the place of work. These employment estimates are often 'different from Journey to Work (JTW) employment counts for the equivalent Census year. The Census undercounts the population (and therefore workers) and gives less accurate counts of labour force participation than the official estimates derived from the ABS Labour Force Survey' (TDC 2009a, p.1). In its modelling, the TDC uses 'JTW employment distribution at the TZ level, but total employment is factored up to match total Labour Force' (ibid., p.1).

Figure 9.2 presents the employment forecasts for the GMA of Sydney from 2006 to 2036. These forecasts anticipate that the Outer sector will grow substantially faster than the other sectors, at an average growth rate of 1.4 per cent per annum. The slowest growth has been predicted to occur in the Middle sector, which is 0.6 percentage points below the expected growth rate for the Outer sector. About fifty per cent of the Sydney Statistical Division's job growth is expected to occur in the Outer sector. The above-average rate of job growth forecast for the Outer sector (1.37 per cent)—which amounts to 397 400 new jobs—is marginally above the forecast population growth (which is 1.34 per cent) in that sector (see Table 9.3).

Figure 9.2 Employment forecasts for the Sydney Greater Metropolitan Area, 2006 to 2036



Source: BITRE analysis of TDC (2009b) data.

The overall forecasts of employment growth for the Sydney SD and the Sydney GMA are virtually the same (1.04 per cent and 1.02 per cent respectively).

Table 9.5 provides the forecast employment change and average annual growth rates for the planning subregions within Sydney. According to these forecasts, Sydney would have an extra 761 000 new jobs in 2036 with a relatively high proportion expected to be in the City of Sydney (19 per cent) and the North West (21 per cent).

The forecasts imply that 48 per cent of the additional jobs will be in Western Sydney (i.e. in the West Central, North West and South West subregions)—this aligns with the stated aim of *City of Cities* and *Sydney 2036* to accommodate half of all new jobs in Western Sydney (NSW Government 2010a, 2005).

Table 9.5 Employment forecasts for Sydney, 2006 to 2036

Planning subregions	Forecast employment, 2036 ('000)	Forecast change in employment, 2006 to 2036 ('000)	Share of growth (per cent)	Forecast percentage change in employment, 2006 to 2036	Forecast average annual growth in employment (per cent)	Forecast distribution of employment in 2036 (per cent)
City of Sydney	570	141	18.5	32.8	0.9	20.0
Inner North	289	51	6.7	21.6	0.7	10.1
Inner West	125	26	3.4	26.3	0.8	4.4
South	245	53	6.9	27.2	0.8	8.6
East	171	36	4.7	26.5	0.8	6.0
North East	112	23	3.1	26.5	0.8	3.9
North	103	20	2.6	23.5	0.7	3.6
North West	426	160	21.0	60.2	1.6	14.9
West Central	421	99	13.0	30.8	0.9	14.8
South West	238	105	13.8	78.9	2.0	8.4
Central Coast	151	47	6.2	45.7	1.3	5.3
<i>Sydney Total</i>	2 854	761	100.0	36.0	1.0	100.0

Note: Based on jobs with a fixed location.

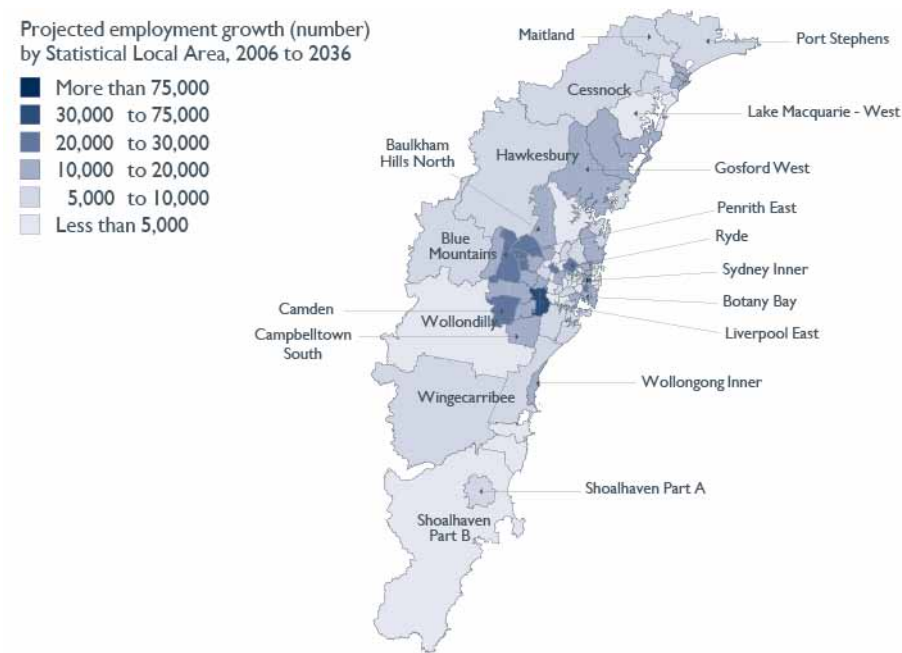
Source: BITRE analysis of TDC (2009b) data.

Maps 9.2a and b present the forecast employment growth by Statistical Local Area in terms of both the number of employees and percentage change, from 2006 to 2036. The maps illustrate the spatial contrast in the forecast employment growth. For example, at the SLA scale, relatively rapid job growth is forecast for a set of Outer SLAs extending from Baulkham Hills North through to Campbelltown South. In those SLAs, employment is expected to increase between 90 and 160 per cent from 2006 employment levels. In terms of the absolute numbers of jobs added, Sydney Inner ranks as the SLA adding the most jobs to the employee base, with an extra 83 000 jobs in 2036. Of the SLAs in the Outer sector, the SLA of Liverpool East ranks most highly, with 30 500 additional jobs predicted. Several SLAs are forecast to add between 20 000 and 30 000 jobs from 2006 to 2036, namely Blacktown South West, Blacktown North, Camden, Penrith East, Parramatta-Inner, Ryde and Sydney South.

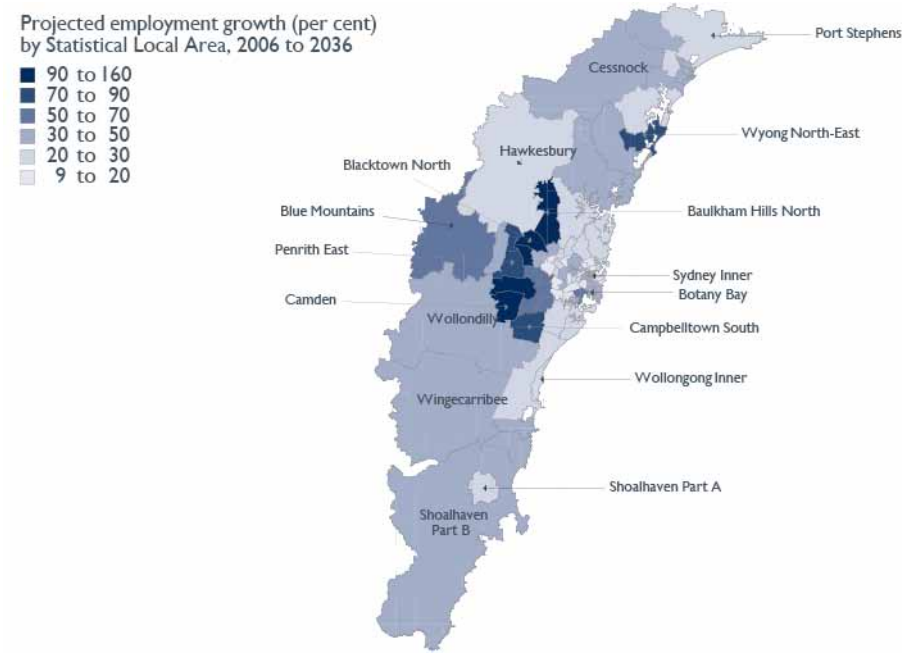
Table 9.6 shows employment forecasts for 2036 and the corresponding average annual growth rates for Global Sydney, the regional cities, specialised centres and major centres, based on TDC (2009b). The proportion of Sydney's employment located in strategic centres is expected to increase marginally from 39.8 per cent in 2006 to 40.2 per cent in 2036, because the average annual rate of job growth in centres (1.1 per cent) is expected to be slightly higher than job growth for Sydney as a whole (1.0 per cent). Thus, the extent to which employment is concentrated in Sydney's strategic centres is forecast to remain relatively unchanged through to 2036.

Map 9.2 Change in forecast employment by Statistical Local Area, Greater Metropolitan Area, 2006 to 2036

(a) Change in number of employed persons



(b) Percentage change



Source: BITRE analysis of TDC employment forecasts (TDC 2009b)

Table 9.6 Forecasts of employment for strategic centres in Sydney in 2036

Category	Centre	Forecast employment, 2036 ('000)	Forecast change in employment, 2006 to 2036 ('000)	Forecast average annual growth rate, 2006 to 2036 (per cent)
Global Sydney	Central Sydney ¹	483	124	1.0
	North Sydney	47	3	0.2
	Global Sydney total	530	127	0.9
Regional cities	Parramatta	52	11	0.8
	Liverpool	32	16	2.3
	Penrith	21	7	1.4
	Gosford ²	16	4	1.0
	Regional cities total	121	38	1.3
Specialised centres	Macquarie Park	58	19	1.3
	St Leonards (includes Crows Nest)	53	11	0.8
	Olympic Park	19	13	3.6
	Rhodes	10	3	1.1
	Port Botany & environs	22	7	1.2
	Sydney Airport and environs (includes Mascot) ²	47	12	1.0
	Randwick education and health	23	8	1.3
	Westmead	24	9	1.5
	Bankstown Airport-Milperra ²	13	1	0.3
	Norwest	19	6	1.4
	Specialised centres total	289	89	1.2
Major centres	Bankstown ²	12	3	1.0
	Blacktown	17	5	1.3
	Bondi Junction	12	2	0.5
	Brookvale-Dee Why ²	15	4	1.0
	Burwood	12	3	0.9
	Campbelltown-Macarthur	29	13	2.0
	Castle Hill	11	4	1.6
	Chatswood	25	3	0.5
	Hornsby	12	2	0.6
	Hurstville	12	3	0.9
	Kogarah ²	14	4	1.3
	Tuggerah-Wyong ²	18	6	1.5
	Major centres total	189	53	1.1
Existing strategic centres total		1 129	307	1.1
Planned major centres total (i.e. Green Square, Leppington and Rouse Hill) ²		19	8	2.0
Existing and planned strategic centres total		1 148	315	1.1
Employment lands		534	116	0.8
Other locations³		1 117	330	1.1
Sydney SD		2 854	761	1.0

Note: Based on jobs with a fixed location. See Table 2.1 for further information about each centre type. The *Metropolitan Plan for Sydney 2036* employment estimates for centres in 2006 are based on a somewhat different classification of travel zones to centres.

¹ Comprises the Sydney CBD, City East, Pyrmont-Ultimo, Redfern Centre and Sydney Education and Health precincts. Some parts of the City of Sydney LGA are excluded (e.g. Glebe, Elizabeth Bay, Green Square).

² Defined by BITRE using 2006 destination zone boundaries and, where available, relevant information contained in the subregional plan.

³ Includes town centres, villages, neighbourhood centres, potential strategic centres, and dispersed locations.

Source: BITRE analysis of TDC (2009b) using activity centre classification from TDC (2008b), except where otherwise noted.

Amongst the different categories of strategic centres, Global Sydney is expected to grow relatively slowly at 0.9 per cent per annum, while the planned major centres are forecast to experience much more rapid job growth (averaging 2.0 per cent per annum). Global Sydney is nevertheless forecast to add 127 000 jobs between 2006 and 2036, with 124 000 of those in Central Sydney. Other centres forecast to add many new jobs include Macquarie Park, Liverpool, Campbelltown-Macarthur, Olympic Park and Sydney Airport and environs—each is forecast to add between 12 000 and 20 000 new jobs by 2036.

Jobs in employment lands are forecast to grow more slowly than for the rest of Sydney at 0.8 per cent per annum, with a total of 115 900 jobs added to Sydney's employment lands. Most notably, the Eastern Creek employment land in Sydney's North West subregion is forecast to add 17 000 jobs to 2036. Around 330 000 jobs are forecast to be added in 'other locations' (i.e. outside of strategic centres and employment lands), mainly in the North West (29 per cent) and South West (19 per cent) planning subregions.

Note that the *Sydney 2036* metropolitan strategy's employment targets are informed by these TDC small area employment forecasts, but depart from them in order to give effect to policy objectives such as 'jobs closer to home'. For example, *Sydney 2036* targets higher employment in Parramatta in 2036 (70 000 jobs) than the TDC forecasts (52 000 jobs).

Industry employment

This section outlines the main industries that are expected to contribute to this future employment growth. The analysis is based on TDC (2009b) forecasts of future employment by industry for the GMA.

The method used to generate the employment forecasts in Table 9.7 is outlined in TDC (2009a). The forecasts in the table anticipate that Retail trade will be responsible for much of the employment growth (19 per cent) in the GMA. Health care and social assistance (18 per cent) is the second main supplier of forecast new jobs for the GMA. The Accommodation and food services industry has the highest forecast rate of employment growth. The Information and telecommunications and Electricity, gas, water and waste services industries are projected to decline.

An interesting feature of the TDC (2009b) forecasts is that they predict that the Accommodation and food services, Retail trade and Health care and social assistance industries will experience the most rapid rates of job growth through to 2036, and will each add over 100 000 new employees. Industry employment forecasts by Access Economics (2009) for Australia and SGS (2008) for Melbourne also anticipate that jobs in Health will grow relatively rapidly in coming years, reflecting the increased demand for health care associated with the ageing of our population. However, Access Economics (2009) and SGS (2008) predict that the future rate of job growth of the Retail trade and Accommodation and food services industries will be similar to the industry-wide average, rather than well above it. Sydney's recent pattern of job growth in these two industries is one of limited growth, with Retail trade employment averaging 0.1 per cent growth per annum between 2001 and 2010 and Accommodation and food services averaging 0.6 per cent growth, compared to 1.4 per cent growth for Sydney's total employment (ABS 2011c). Between 2001 and 2010, the Professional, scientific and technical services and Health care and social assistance industries were the major industry contributors to job growth in Sydney (ibid.).

Table 9.7 Employment forecasts for Sydney Greater Metropolitan Area by industry type, 2006 to 2036

Industry	Forecast number of jobs in 2036 ('000)	Forecast change in employment, 2006 to 2036 ('000)	Forecast average annual growth rate, 2006 to 2036 (per cent)	Proportion of total job growth, 2006 to 2036 (per cent)
Retail trade	425	150	1.5	18.8
Health care and social assistance	404	144	1.5	18.0
Accommodation and food services	261	102	1.7	12.8
Education and training	279	92	1.3	11.5
Professional, scientific and technical services	292	83	1.1	10.4
Public administration and safety	203	58	1.1	7.3
Transport, postal and warehousing	172	44	1.0	5.5
Finance and insurance services	183	32	0.7	4.1
Manufacturing	281	29	0.4	3.6
Rental hiring and real estate services	74	27	1.6	3.4
Construction	166	23	0.5	2.9
Arts and recreation services	44	9	0.8	1.2
Agriculture, forestry and fishing	17	4	0.9	0.5
Mining	11	2	0.8	0.3
Administrative and support services	77	1	0.1	0.2
Wholesale trade	132	1	0.0	0.1
Electricity, gas, water and waste services	22	0	-0.1	0.0
Information media and telecommunications	63	-4	-0.2	-0.5
Total GMA	3 105	799	1.0	100.0

Source: BITRE analysis of TDC (2009b) employment forecasts, October 2009 release.

Commuting implications of population and employment growth patterns— a scenario analysis

The spatial projections of population and employment growth discussed in this chapter have implications for spatial patterns of commuting within Sydney through to 2036. The aim of this section is to explore these implications for future commuting flows, using the change model for the Sydney SD (see Table 8.12) as a device for translating the available population and employment projections into the potential impacts on commuter flows. This exercise is undertaken for exploratory purposes only, and is not intended to be predictive.

Methodology

The available projections of residential and job growth are inputted into the change in commuting flow model for Sydney to elicit likely outcomes in spatial commuter flows *if the population and job growth projections are realised*. BITRE's change model and the population and employment projections are all available at the SLA scale. While the explanatory power of the model is not as high as the corresponding values for Melbourne and Perth (see Table 8.12), owing to the very high statistical significance of the explanatory variables and the correct signs of variable coefficients, it has been used here to investigate future patterns of commuting in Sydney. The approach involves several assumptions:

- The change model for the 2001 to 2006 period explains about two-fifths of the observed variation in the growth of commuting flows by reference to just two factors—growth in employed residents in the origin SLA and growth in jobs in the destination SLA. All other variables that may influence origin-destination commuter flows—apart from residential and job growth—are assumed constant.
- The future growth rate of employed residents for each SLA is assumed to equal the future growth rate of the working age population (15 to 64 year olds) for the SLA.
- The parameters in the change model are assumed to remain stable over time. The model was estimated for a short term time horizon (i.e. 2001 to 2006), but is being applied to a much longer time period (i.e. 2006 to 2036), over which fundamental changes in the nature of the relationship are likely.
- In calculating average commuting distance, the road network distance between each origin-destination pair is assumed to remain unchanged between 2006 and 2036.

Three different scenarios are analysed and compared to the 2006 baseline. Each of the scenarios involves a different spatial allocation of population and/or jobs in 2036:

- **“NSW Government projections scenario”** reflects the NSW Government's population projections (Department of Planning 2010b) and employment forecasts (TDC 2009b), which both relate to the 2006 to 2036 period. As previously noted, the *Sydney 2036* targets for employment are informed by the TDC forecasts, but depart from them to give effect to policy objectives, such as 'jobs closer to home'.
- **“Australian Government population projections scenario”** reflects the alternate set of population projections produced by the Australian Government Department of Health and Ageing (2009), while retaining the TDC (2009b) employment forecasts. As the DHA (2009) data spans the period from 2007 to 2027, the average annual growth factor for the 20 year period ending 2027 has been used to backcast 2007 to 2006 and to forecast from 2027 to 2036.
- **“Fringe focused growth scenario”** assumes that Sydney's urban fringe has 20 per cent more capacity to accommodate the increases in population than targeted in the 2005 Metropolitan Strategy (which aimed for 30 per cent of new dwellings to be accommodated in greenfield developments). This scenario draws on CIE (2010), which in turn reflects BTS modelling that assumed a 'substantial shift in employment towards the West Central, North West and South West' (CIE 2010, p.176). The projected growth rates for planning subregions under this scenario, as given in CIE (2010) Table 3.3 scenario two and Table C.1 BTS modelling (fringe focused),—are assumed to hold for all SLAs within the subregion.

Due to benchmarking, in all three scenarios the aggregate population of the Sydney Statistical Division is set to reach 5.982 million in 2036, with 2.854 million people employed—this is consistent with Department of Planning (2010b) and TDC (2009b). Thus, while the scenario analysis explores the commuting impacts of different spatial allocations of population and jobs, it does not explore the impacts of different *aggregate rates of growth*.

Relative to the “NSW government projections scenario”, the spatial projections underlying the “fringe focused growth scenario” involve a greater concentration of growth on Sydney’s urban fringe. The “Australian Government population projections scenario” reflects a greater degree of urban consolidation than embodied in the other two scenarios.

The scenario modelling only investigates the influence of spatial projections of population and job growth on commuting patterns—the potential impacts of changes to the transport network are not explored.

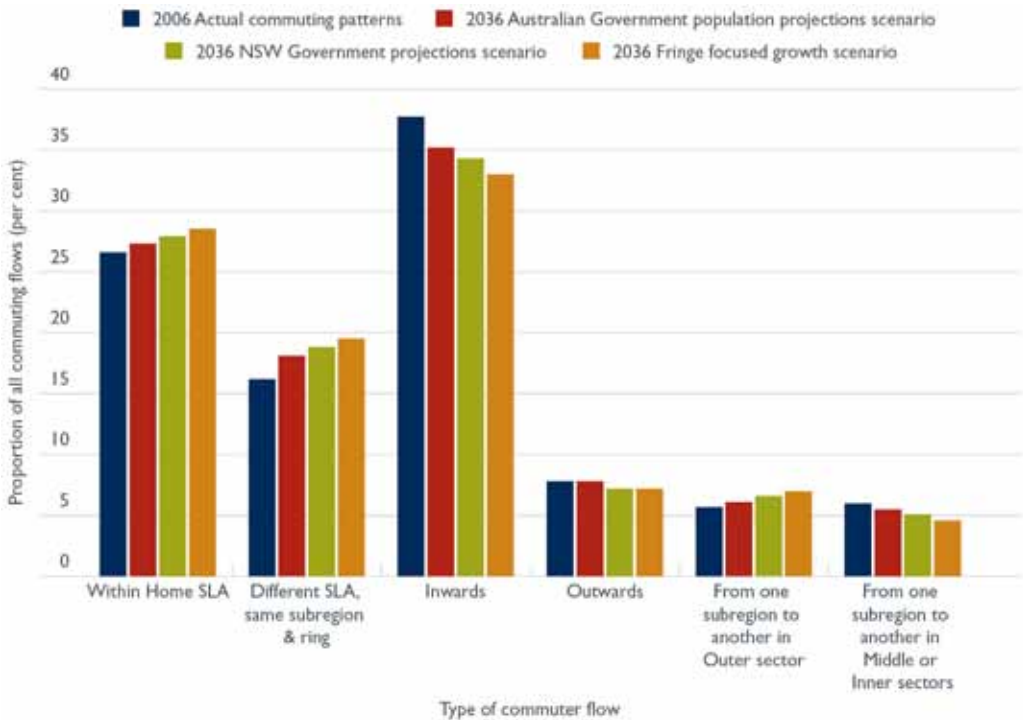
Scenario modelling results

Figure 9.3 shows the spatial patterns of commuting flows in 2036 under the three different scenarios and compares them with the actual pattern of commuting flows in 2006. For each type of commuter flow, all three scenarios involve the same direction of change to 2036.⁶⁶ The magnitude of change is consistently smallest under the “Australian Government population projections scenario” (which involves urban consolidation) and largest under the “fringe focused growth scenario”.

The scenario modelling suggests that the mix of different types of commuter flows is likely to undergo a modest degree of change over the 30 year timeframe. All three scenarios involve a reduction in inward commuting from 38 per cent of Sydney’s commuter flows in 2006 to 33–35 per cent in 2036. All three scenarios also involve growth in relatively short distance commuting within the home SLA or to a different SLA within the home subregion. Commuting to a different SLA within the home subregion and ring accounted for 16 per cent of flows in 2006 and the scenario modelling has this rising to 18–20 per cent of all commuter flows by 2036. Commuting from one Outer subregion to another also rises in importance between 2006 and 2036, under all three scenarios, but particularly when growth is focused on the urban fringe.

⁶⁶ Although for outwards commuting, the “Australian Government population projections scenario” displays no change from the 2006 figure, while the other two scenarios show a decline in the importance of outwards commuting.

Figure 9.3 A comparison of the spatial patterns of commuting in 2006 and 2036 under different scenarios, Sydney



Note: Relates to commutes within the Sydney SD. The spatial distribution of commuting flows in 2036 assumes that population and employment projections to 2036 are realised. Inward commutes include commutes to workplaces in the central LGA from elsewhere in SD, from outer suburban residences to middle or inner workplaces and from middle suburban residences to inner workplaces. The opposing flows are categorised as outward commutes (e.g. from Inner to Middle). Further details of the different types of commuter flow are provided in Chapter 7. Details of scenarios are provided earlier in this section.

Source: BITRE analysis of TDC (2009b), Department of Planning (2010b), DHA (2009) and Tables 3.3 and C.1 of CIE (2010) using Sydney regression results in Table 8.12.

Scenario modelling for Perth produced very similar results, with all four scenarios pointing to a decline in inward flows and growth in same subregion flows to 2031 (BITRE 2010), with the changes similar in magnitude to those shown for Sydney in Figure 9.3. However, modelling of the Victorian Government’s spatial projections of population and job growth involved minimal change in the mix of commuting flows for Melbourne to 2026 (BITRE 2011).

Results of the scenario modelling indicate that commuter flows within Sydney’s Outer sector account for 45–55 per cent of the expected increase in commuter flows to 2036. The “fringe focused growth scenario” is associated with the largest expected increase in the volume of commuter flows in the Outer suburbs, reflecting the large projected increases in the number of residents and jobs in the Outer sector under that scenario.

Table 9.8 highlights the origin-destination combinations that are expected to account for a large share of growth in commuting flows between 2006 and 2036, should the NSW Government’s spatial population and employment projections be realised. The top eight origin-destination pairs in the table together account for 57 per cent of the increase in commuter flows between 2006 and 2036.

The growth in commuter flows in Sydney is expected to be dominated by flows within the North West and South West subregions, which together account for one-third of the expected increase to 2036. This reflects the expected concentration of Sydney's future residential and job growth in these two subregions. The other two scenarios also identify these two origin-destination pairs as the most dominant sources of commuting growth in Sydney. However, the dominance is less pronounced under the "Australian Government population projections scenario" where these two pairs contribute 29 per cent of growth, compared to the 35 per cent share under the "fringe focused growth scenario".

Table 9.8 Principal expected contributors to growth in commuting flows in Sydney if NSW Government projections are realised, 2006 to 2036

Subregion of residence	Subregion of work	Actual proportion of commuting flows, 2006 (per cent)	The proportion of commuting flows in 2036 if the expected population and employment levels are realised (per cent)	Estimated share of total change in number of commuters, 2006 to 2036 (per cent)
North West	North West	10	13	17
South West	South West	5	9	16
Central Coast	Central Coast	5	5	5
West Central	West Central	6	6	5
North West	West Central	4	4	4
South West	West Central	2	3	4
South	South	7	5	3
City of Sydney	City of Sydney	3	3	3

Note: Results based on "NSW Government projections scenario", as described earlier in section.

Source: BITRE analysis of TDC (2009b) and Department of Planning (2010b) using Sydney regression results in Table 8.12.

A feature of the "Australian Government population projections scenario", with its more consolidated pattern of development, is that commuter flows within the West Central and City of Sydney planning subregions are expected to make a more pronounced contribution to growth (compared to the results of the "NSW Government projections scenario" shown in Table 9.8).

At the more detailed SLA scale, the implications of the NSW Government's spatial projections of population and employment are for growth in commuter flows in the 30 years to 2036 to be concentrated:

- within the Camden, Liverpool West and Campbelltown South SLAs in the South West planning subregion
- from Camden to Campbelltown South
- within the North West subregion's Blacktown North and Baulkham Hills North SLAs
- within the Central Coast SLA of Wyong North East.

The spatial projections of population and employment therefore imply substantial growth in commuter travel for this set of origin-destination pairs, which will involve increased demand for public transport and road infrastructure that facilitates these local area commutes. For example, the greatly expanded volume of commuting within the Camden SLA will require investment in road infrastructure and expanded bus services.

The scenario modelling also points to the need to cater for increased commuter flows from the North West and South West residential growth areas to the major employment precincts in the West Central subregion (e.g. Parramatta–Westmead, Olympic Park, Wetherill Park). Some of the implications of this growth have been recognised in infrastructure planning. For example, construction is currently underway on the South West Rail Link, and one of its key aims is to provide improved access for residents of the South West Growth Centre to the employment centre of Parramatta (Transport Infrastructure Development Corporation 2010).

The spatial projections of population and employment have implications for use of different transport modes. When the modelled shifts in commuting patterns are applied to the existing public transport mode shares for each subregion pair, the result is a reduction in Sydney's public transport mode share under all three scenarios. The impact on the public transport mode share is again largest under the "fringe focused growth scenario" (a 2.3 percentage point reduction). The changes in commuting patterns that flow from the available spatial projections of population and job growth to 2036 (i.e. the reduction in the relative importance of inward commutes and the increase in same subregion flows) therefore pose challenges for maintaining or growing the public transport mode share. In particular, the anticipated concentration of future growth in commuting flows within the North West and South West subregions represents a challenge, because only 3 per cent of commutes within these subregions were undertaken using public transport in 2006. A reorientation of the public transport system, to better service those making shorter-distance commutes within the North West and South West subregions, and those accessing outer suburban workplaces, may be needed to encourage a significant shift towards public transport.

The spatial projections also have implications for commuting distances. Table 9.9 presents estimates of the average commuting distance in 2036 under the three scenarios. The "Australian Government population projections scenario" involves a minimal increase in the average commuting distance, while the "Fringe focused growth scenario" involves a larger (but still modest) increase.

Table 9.9 A comparison of the average commuting distance under different scenarios, Sydney, 2006 and 2036

Scenario	Average road commuting distance (km)	Percentage of commuters travelling less than 5 km	Percentage of commuters travelling more than 30 km
2006 Actual commuting patterns	14.6	27	12
2036 Australian Government population projections scenario	14.7	28	12
2036 NSW Government projections scenario	14.9	28	13
2036 Fringe focused growth scenario	15.1	27	13

Note: The estimated increases to 2036 are conservative as we have not factored in the effect that expanding urban sprawl could have on increasing the average road distance involved in travelling from a specific outer suburban SLA to an inner or middle SLA over this period of time. Instead, in calculating average commuting distance, the road distance between each origin-destination pair is assumed to remain unchanged from 2006 to 2036.

Source: BITRE analysis of TDC (2009b), Department of Planning (2010b), DHA (2009) and Tables 3.3 and C.1 of CIE (2010) using Sydney regression results in Table 8.12.

The spatial distribution of population and jobs within Sydney may evolve in a variety of different ways between now and 2036—three possible scenarios, and their implications for commuting patterns, have been considered in this section. The direction of change from 2006 to 2036 is robust across the scenarios, involving:

- A reduction in the relative importance of inward commutes.
- An increase in the relative importance of commutes within the home subregion (including the home SLA)
- An increase in the relative importance of commutes from one Outer subregion to another.
- A substantial increase in commuter flows within the South West and North West subregions, which together are expected to account for about one-third of all growth in commuting flows in Sydney.
- Shifts in commuting patterns that are unfavourable to the public transport mode share, given the existing public transport network structure.
- A slight increase in the average commuting distance.

The scenario modelling suggests that the magnitude of this change will tend to be greater if a larger proportion of Sydney's residential and jobs development is concentrated on the urban fringe.

Some broader implications of population and employment growth patterns

Transport use and congestion

Commuter travel is just one component of urban passenger transport demand, representing 16 per cent of trips, 28 per cent of distance travelled and 25 per cent of time spent travelling on the average weekday in Sydney in 2008–09 (TDC 2010). Commuter travel is a particularly important component of transport demand during the morning and afternoon peak periods.

The Bureau of Transport Statistics has produced trip forecasts to 2020 by transport mode for the Greater Metropolitan Area, which cover all trip purposes and reflect anticipated population and employment growth. The forecast is for a 22 per cent increase in rail trips on the average weekday from 2010 to 2020, compared to 11 per cent growth in total trips and bus trips, 13 per cent growth in vehicle driver trips, 8 per cent growth in vehicle passenger trips and 7 per cent growth in cycling and walking trips (NSW Government 2010b).

BITRE has compiled projections of total urban traffic for Sydney and the other capital cities between 2006 and 2031 (BITRE forthcoming). The Sydney projections were prepared by BTS using the Sydney Strategic Travel Model. The projections are for total AM peak vehicle kilometres travelled in the Sydney Statistical Division to grow by 27 per cent between 2006 and 2031, with car kilometres growing by 24 per cent and commercial vehicle kilometres by 47 per cent (ibid.).

The projections of car kilometres travelled during the morning peak period are relevant in the context of the present study of commuting behaviour. Growth in kilometres travelled by car in the morning peak is projected to be concentrated in the following Statistical Subdivisions (SSDs):

- Outer South Western Sydney (17 per cent of growth in kilometres travelled by car in morning peak in Sydney SD)
- Fairfield-Liverpool (12 per cent)
- Gosford-Wyong (11 per cent)
- Blacktown (10 per cent)
- Central Northern Sydney (9 per cent)
- Outer Western Sydney (9 per cent) (BITRE forthcoming).

The pattern of strong traffic growth in the outer south western and north western suburbs, and on the Central Coast, is in line with the scenario modelling results presented in Table 9.8.

The morning peak average road speed is projected to decline in most parts of Sydney between 2006 and 2031. Some of the more pronounced declines are for a 7 km/hour reduction in speed in the Outer South Western SSD and a 4 km/hour reduction in Fairfield-Liverpool and Blacktown (BITRE forthcoming). This is in line with the earlier scenario modelling results which have future commuting growth concentrated within the South West and North West subregions.

Congestion costs in Sydney have been projected to more than double between 2005 and 2020 to reach \$7.8 billion (BTRE 2007). Modelling by CIE (2010) for the 2011 to 2036 period finds that congestion delays are expected to be greater under a fringe focused growth scenario than under a scenario based on City of Cities (which targets 60 to 70 per cent of new dwellings being located within the existing urban area). However, the difference between the two scenarios is small, and under both scenarios the increase in congestion far exceeds the expected population increase for the period (i.e. 31 per cent increase in population compared to a 57–59 per cent increase in congestion delays).

Another scenario modelling exercise for Sydney was undertaken by Kilsby and Millthorpe (2002). The study found that, compared to the business as usual scenario, concentrating employment in centres was associated with an increased public transport mode share for commuters, but also resulted in increased traffic congestion around centres and slightly longer distance car trips. The authors identified the need for appropriate parking controls and improved local bus services if this option was to be pursued (*ibid.*).

Infrastructure requirements

Kilsby and Millthorpe (2002) undertook scenario modelling focused on the morning peak period which assumed that a range of major transport infrastructure enhancements would be implemented by 2021 (e.g. M5 East, Western Sydney Orbital, Lane Cove tunnel, Cross City tunnel, M2 to F3 link, F6 Tempe to Loftus, North West Rail Link, Parramatta to Chatswood rail link, South West Rail Link (Glenfield to Bringelly), Liverpool Y-link, Bondi turn-back). The study concluded that even with completion of all of these projects, '[t]ransport infrastructure in North West Sydney, South West Sydney and the Central Coast is inadequate for the population growth envisaged' (*ibid.*, p.9). Based on the modelling, the authors identified a need to expand road networks in the outer suburban growth areas, and also pointed out that 'the rail system could not accommodate the additional patronage growth and network expansions as modelled in these scenarios without additional capacity to move trains through the CBD' (*ibid.*, p.9). Consistent with this earlier modelling, Transport for NSW (2011) identifies the main requirements for long term development of Sydney's rail network as:

- developing new connections to residential growth areas
- improving the efficiency of the existing network
- expanding network capacity by building a CBD extension line and expanding cross-harbour capacity.

The Steering Committee for the Joint Study of aviation capacity in the Sydney region (2012, p.13) identified some further capacity constraints:

'Current roads and intersections at the entrance to the airport Domestic Terminal precinct are expected to reach a critical point as early as 2015. Unless substantial investment is made in upgrading the ground transport network, by 2023 road traffic to and from the airport will experience substantial delays and a near constant traffic jam on key roads around the airport, the links to the CBD and the M5 Motorway.

At the current level of operations, train services to the city travelling via the airport will reach capacity by 2013 in the morning peak period. Even with the increase to 12 trains per hour proposed, the morning peak period will be at capacity by 2018 for CBD-bound trains.'

A report prepared by the Centre for International Economics (CIE) for the NSW Government examined the benefits and costs of alternative growth paths for Sydney. CIE (2010) explores three alternative options for accommodating population growth within Sydney. Table 9.10 compares the relative merits of the three scenarios.

Table 9.10 Costs and benefits of alternative growth scenarios for Sydney Greater Metropolitan Area

Costs and benefits of the scenarios	2005 Metropolitan Strategy (base scenario)	Fringe focused growth	Urban renewal
Ratio of infill to greenfield development	70/30	50/50	90/10
	\$ million	\$ million	\$ million
Transformational benefits (relative to base scenario)	0	-1 716	-1 351
Transport costs	13 503	15 834	12 168
Physical infrastructure costs	7 815	8 539	7 102
Social infrastructure costs	18 594	18 536	18 656
Environmental costs	1 203	1 482	1 043
Total costs	41 115	44 391	38 969
Costs (relative to base scenario costs)	0	3 276	-2 146
Net benefits relative to base scenario	0	-4 992	795

Note: The benefits and costs are evaluated for the period from 2011 to 2036 at a real discount rate of 7 per cent.
Source: Based on Table 8 in CIE (2010).

CIE (2010) reports that transport costs rise with the share of development occurring in greenfield areas. This reflects the costs of connecting newly developed areas into Sydney's transport systems through new roads, rail and bus services, as well as higher congestion costs (or major infrastructure costs to mitigate congestion) for people who live on Sydney's fringe. Water and wastewater infrastructure costs also increase with the share of development occurring in greenfield areas, but electricity infrastructure costs and social infrastructure costs are relatively stable across the three growth scenarios. The measurable environmental costs were greatest for the fringe focused growth scenario (ibid.).

The estimates of benefits in Table 9.10 relate to the value people place on living in different areas above and beyond the cost of providing dwellings in those areas. According to the CIE modelling, these 'transformational benefits' are maximised under the 2005 Metropolitan Strategy scenario.

The overall message from Table 9.10 is that the most beneficial growth scenario—with the minimum net costs—is the one focused on urban renewal.

In summary

This chapter summarises the outlook for Sydney in terms of spatial projections of population, dwellings, employment, industry and commuting patterns over the next 25 years.

The NSW Government projects that Sydney will grow by 1.1 per cent annually to reach 6.0 million people by 2036. The Outer sector is expected to accommodate 67 per cent of Sydney's projected 1.7 million population increase. Accommodating this growth will require around 770 000 new homes to be built in Sydney, mainly in the North West and South West subregions. Sydney's employment is forecast to increase by 761 000 workers from 2006 to 2036. The additional jobs are predicted to be concentrated in the North West (21 per cent) and City of Sydney (19 per cent) subregions.

Should these population and employment projections be realised, commuter flows within the Outer sector will potentially account for around half of the additional commuter flows between 2006 and 2036. Scenario modelling results indicate that commutes within the North West and South West subregions will each contribute about one-sixth of Sydney's growth in commuting flows to 2036. The modelled shift towards same-subregion flows and the reduced importance of inward commutes pose a challenge for growing Sydney's public transport mode share. A further implication of the expected population and job growth is that average morning peak road speeds are projected to decline between 2006 and 2031, particularly in the South West and North West.

CHAPTER 10

Reviewing the evidence

The aim of this report is to provide key stakeholders with evidence on the spatial nature of changes in population, jobs and commuting flows in Sydney in the 2001 to 2010 period. This chapter presents an overview of the main findings of the analysis, which focuses mainly on the Sydney Statistical Division (SD), however in parts also considers the Lower Hunter and Illawarra, which together make up the Greater Metropolitan Area (GMA). The analysis covers a range of geographic scales including the GMA and SD, sectors (Inner, Middle and Outer), planning subregions, Statistical Local Areas (SLAs), suburbs, and travel zones.

This chapter begins with a summary of shifts in the spatial distribution of population and employment as well as a description of commuter use of different transport modes in Sydney. This is followed by analysis of the spatial patterns of commuting in Sydney and a discussion of how commuting behaviour has responded to the observed changes in employment and population.⁶⁷ Finally, some observations are made about the extent to which there has been progress against key urban policy goals that relate to shaping the spatial distribution of population, employment and commuting in Sydney.

Residential and jobs growth

Historical overview of residential and jobs growth

The population of the Sydney SD grew from almost 0.5 million in 1901 to 3.2 million in 1981, and by 2010 it had reached 4.6 million. The average annual rate of population growth was 2.3 per cent from 1961 to 1971, but has averaged around one per cent in each subsequent decade.

The Outer sector gained 1.7 million residents between 1961 and 2010, compared to 371 000 for the Middle sector and 95 000 for the Inner sector. The Inner sector experienced population decline in the 1970s, but has been growing solidly since 1991 due to inner city redevelopment.

Up until the 1950s, Sydney's employment was heavily centralised in the Central Business District (CBD) and inner suburbs (Pfister et al. 2000). From the 1950s through to the 1970s there was a strong trend towards suburbanisation of manufacturing and service sector jobs, which has since moderated (ibid., Urban Research Centre 2008).

⁶⁷ The evidence presented about spatial changes in population, employment, transport and commuting is based on BITRE's analysis of the ABS Census of Population and Housing, Estimated resident population data and TDC/BTS datasets (including Journey to Work), as presented in the body of this report, unless another source is specified.

The number of jobs in Sydney grew from 1.39 million in 1981 (TDC 1998) to reach 1.92 million in 2006 (TDC 2008b). This represents average annual growth of 1.3 per cent per annum over the 25 year period. Between 1981 and 2004, job growth was relatively modest in the City of Sydney (0.5 per cent per annum) and Inner West (0.3 per cent), whereas the North West, South West and Central Coast subregions all had employment growth of over 3 per cent per annum (NSW Government 2005). Despite the NSW government's longstanding attempts to encourage centre based employment concentrations outside the urban core, the trend in Sydney through the 1980s and early 1990s was towards greater dispersion of employment, not towards a polycentric structure (Pfister et al. 2000). An important trend over the last two decades is the increasing prominence of office, technology and business parks (SGS 2004).

Residential growth, 2001 to 2010

As of 2010, 54 per cent of the population of the Sydney SD live in the Outer sector, 29 per cent in the Middle sector and 17 per cent in Inner sector. Western Sydney (the West Central, North West and South West planning subregions) accommodated 43 per cent of the population. The Sydney SD accounts for 82 per cent of the population of the GMA, which also includes Lower Hunter and the Illawarra.

Sydney's population increased by 447 000 persons from 2001 to 2010 to reach 4.6 million. Eighty per cent of this population growth was due to natural increase and 20 per cent to net migration. The net gains from overseas migration outweighed the migration losses to the rest of Australia. Sydney had an average annual growth rate of 1.1 per cent from 2001 to 2010, which lagged behind the national rate of 1.6 per cent. However, Sydney's growth rate did increase from 0.7 per cent in the pre-2006 period to 1.7 per cent in the post-2006 period.

Between 2001 and 2010, the annual rate of population growth was greatest for the Inner sector (1.4 per cent), followed by the Middle sector (1.3 per cent) and the Outer sector (1.0 per cent). The City of Sydney subregion experienced the most rapid population growth, averaging 3.9 per cent growth per annum, followed by the Inner West (1.7 per cent). The average annual rate of population growth was lowest in the South (0.7 per cent) and North (0.7 per cent) subregions.

Sydney's increased population was accommodated largely within established suburbs, with 81 per cent of new housing development between 2001 and 2010 occurring within the existing urban area (Department of Planning and Infrastructure 2011h). Almost twenty per cent of the city's population growth between 2001 and 2010 occurred in the North West subregion, 18 per cent in West Central, 12 per cent in the City of Sydney and 10 per cent in the South West subregion. At the SLA scale, Blacktown North added the most population (27 600), followed by Auburn (19 900), Baulkham Hills North (19 000) and Sydney South (18 500). Campbelltown North experienced the largest loss of population from 2001 to 2010 (–377 persons).

Sydney is Australia's most densely populated city—its established inner and middle suburbs averaged 3244 persons per square kilometre in 2010, up 13 per cent from 2001. This reflects a shift towards higher density forms of housing, particularly in strategic centres. The largest gains in population density occurred in the City of Sydney subregion (particularly Central Sydney and Green Square) and in the Concord SLA.

In terms of housing development, there were 203 000 dwelling approvals between 2001 and 2010 (ABS 2011d). More than 70 per cent of these dwelling approvals related to multi-unit dwellings, pointing to the important role of infill development in accommodating Sydney's population growth. The level of dwelling completions in Sydney more than halved from 30 545 in 2000–01 to 13 908 in 2009–10 (Department of Planning and Infrastructure 2011h), which reflected declines in both greenfields and infill dwelling production.

*Employment growth, 2001 to 2011*⁶⁸

An important aspect of recent metropolitan strategies is the aim to achieve better integration between the jobs available in an area and the skills of the local workforce (NSW Government 2005, p.76). Sydney's employment is currently concentrated in the inner suburbs, while population is concentrated in the outer suburbs. In 2006, the Inner sector contained 35 per cent of the Sydney SD's jobs, but only 17 per cent of its population, while the Outer sector contained 38 per cent of jobs and 54 per cent of population.

In 2006, the top employing subregion was the City of Sydney with 357 800 jobs (21 per cent of SD employment), followed by West Central (15 per cent), which includes Parramatta. At the SLA scale, Sydney Inner (i.e. the CBD) was the top employing SLA, with 231 600 jobs and 13 per cent of employment. Parramatta Inner, which is promoted as the second CBD, contained 65 900 jobs and just under 4 per cent of employment. Other SLAs with more than 40 000 jobs include North Sydney, Sydney East, Sydney West and Sydney South (in the Inner sector); Ryde and Willoughby (in the Middle sector); and Warringah and Blacktown South East (in the Outer sector).

The major employing industries in Sydney in 2006 were Property and business services (14 per cent of employment), Retail trade (14 per cent), Manufacturing and Health and community services (11 per cent each). Property and business services was the major employing industry for the Inner sector; Retail trade was the major employer for the Middle and Outer sectors, while Manufacturing was the major employer in Western Sydney.

Sydney had relatively modest job growth of 1.4 per cent per annum between 2001 and 2011, which was well below the national rate of job growth (2.3 per cent). Between 2001 and 2011, the Health care and social assistance industry contributed 26 per cent of new jobs and the Professional, scientific and technical services industry contributed 22 per cent. The Manufacturing industry suffered a substantial job loss.⁶⁹

Between 2001 and 2006, there was an increase of 47 300 jobs with a fixed place of work in Sydney, 18 100 in the Lower Hunter and 8900 in the Illawarra. Job growth was greatest for Health and community services (which added 27 200 jobs), Government administration and defence (17 100) and Education (15 900), while the Manufacturing industry lost 19 700 jobs.

⁶⁸ BITRE's employment analysis is based on census place of work data—estimates differ from employment figures in the NSW Government's recent metropolitan strategies, which are modelled estimates that adjust the census data upwards to match ABS *Labour Force Survey* totals.

⁶⁹ This uses the ANZSIC 2006 industry classification, whereas the remaining industry analysis—which focuses on the 2001 to 2006 period—is based on the ANZSIC 1993 classification.

The Inner sector experienced a 2300 person decline in employment, as the job gains in the CBD and Sydney West were offset by job losses in most of the remaining inner suburban SLAs. The Outer sector added 35 500 jobs, which represented three-quarters of Sydney's job growth, and Western Sydney added 26 200 jobs. The North West subregion alone accounted for 34 per cent of Sydney's job growth between 2001 and 2006, while the Central Coast also made a substantial contribution (18 per cent). The most rapid job growth occurred in the Central Coast (2.1 per cent), North West (1.6 per cent) and South West (1.5 per cent), while the Inner North recorded a net loss of 1800 jobs (–0.2 per cent).

Important locations for job growth between 2001 and 2006 included the CBD (8600 jobs added), Ryde (6100), Sydney West (5100) and Baulkham Hills Central (5100). Around two-thirds of employment growth occurred in strategic centres, with particularly substantial gains in Central Sydney (10 600), Norwest (6300), Macquarie Park (5300) and Olympic Park-Rhodes (5000), although significant job losses were experienced at North Sydney (–2000) and St Leonards (–1700). Around 30 per cent of job growth occurred in employment land precincts, which reflected strong job growth in several outer suburban industrial areas (e.g. Prestons, Smeatons Grange).

The industry drivers of job growth varied across Sydney. Government administration and defence was the principal contributor to job growth in the Inner sector from 2001 to 2006, while Health and community services was the main contributor for the Middle and Outer sectors and for Western Sydney. The four top job growth SLAs had different industry drivers—for Sydney Inner the Finance and insurance industry was the main contributor; for Ryde it was the Wholesale trade, for Sydney West it was Education, and for Baulkham Hills Central the Retail trade industry made the largest contribution. The strong employment growth in strategic centres from 2001 to 2006 was primarily in the Health and community services, Government administration and defence, and Finance and insurance industries.

Future growth projections

NSW Department of Planning (2010b) population projections estimate that Sydney will grow by 1.1 per cent annually between 2006 and 2036. By 2036, Sydney is projected to reach 6.0 million population and the GMA is projected to have a population of 7.2 million. Around two-thirds of the additional 1.7 million residents of Sydney are expected to live in the Outer sector, with 21 per cent in the Middle sector and 12 per cent in the Inner sector. The largest increases are projected for the SLAs of Camden (198 900), Blacktown North (158 500), Liverpool West (125 300), Wyong North East (63 500) and Baulkham Hills North (62 700) (*ibid.*). The population growth will generate demand for around 770 000 new dwellings, mainly in the North West and South West subregions (NSW Government 2010a).

Sydney's employment is forecast to increase by 761 000 jobs from 2006 to 2036 (TDC 2009b). The Retail trade and Health care and social assistance industries are forecast to add the most jobs to 2036 (150 000 and 144 000 jobs respectively). Close to half of the additional jobs are expected to be located in Western Sydney, comprising the North West (21 per cent), South West (14 per cent) and West Central (13 per cent) subregions (TDC 2009b). The City of Sydney is forecast to accommodate 19 per cent of the additional employment. Specific job growth locations include the CBD (which is forecast to add 83 000 jobs) and Liverpool East (30 500). The most rapid job growth is forecast for the South West (2.0 per cent per annum) and the North West (1.6 per cent), compared to the Sydney-wide average of 1.0 per cent (*ibid.*).

Transport usage

Private vehicle was the dominant mode of travel to work on census day 2006, with 69 per cent of Sydney SD residents using a private vehicle to commute, compared to the 21 per cent who used public transport, the 5 per cent who used active travel modes (cycling or walking) and the 4 per cent who worked at home. The Outer sector was most car dependent, with 77 per cent of Outer sector residents and 84 per cent of Outer sector employees commuting by private vehicle.

Sydney has a higher public transport mode share than any other Australian city. Inner sector workers are slightly more likely to use public transport (44 per cent) than private vehicle (43 per cent) to get to work. City of Sydney workers are particularly likely to use public transport for the journey to work (59 per cent), while only 5 per cent of Outer sector jobs are accessed by public transport. The majority (73 per cent) of Sydney's commutes by public transport are to a place of work in the Inner sector.

While walking accounted for less than 5 per cent of total Sydney commutes, walking is a common commuting mode for inner city residents, particularly for those who live in the City of Sydney (27 per cent), Inner North (8 per cent) and East subregions (7 per cent). Cycling represents less than one per cent of journeys to work, with a higher proportion of inner suburban residents cycling to work. Walking and cycling both increased their mode shares from 2001 to 2006, and these increases were concentrated in the Inner sector.

Between 2001 and 2006, the proportion of Sydney residents commuting by private vehicle rose by 1.1 percentage points, although it fell for Inner sector residents. This increase in private vehicle use was predominantly due to job growth occurring in areas with high rates of private vehicle use, as well as a shift towards private vehicle use to access jobs in employment lands.

Over the last decade, Sydney recorded relatively modest growth in public transport patronage compared to other Australian cities (BITRE 2012a, 2012b). While there was a significant decline in the public transport mode share of commuter travel in the early 2000s, the mode share has been above 2001 levels since 2007–08 (NSW Government 2011d, BTS 2011).

Commuting flows

Overview of Sydney commuting flows in 2006

In 2006, Sydney attracted around 2.3 per cent of its workforce from outside the SD, mainly from Wollongong and (to a lesser extent) Newcastle. About 1.1 per cent of Sydney's employed residents worked outside the SD, primarily in Newcastle. The Illawarra and Lower Hunter both provide many more commuters to the Sydney SD than they receive in return.

Focusing on commuting flows within the Sydney SD in 2006, trips to work in an inward direction (38 per cent) dominated those in an outward direction (8 per cent). Of particular importance were the inward flows to a place of work in the City of Sydney subregion (19 per cent). Inward commutes from the Outer sector to Middle sector workplaces were also significant (11 per cent).

The largest volume flows between different subregions are the 66 000 residents of the South subregion who commute to a City of Sydney workplace and the 62 000 North West residents who commute to a West Central workplace. In 2006, 30–40 per cent of employed residents of the East and Inner West subregions commuted to a City of Sydney workplace. Only 5–8 per cent of employed residents of the North West, South West and Central Coast subregions commuted to the City of Sydney.

About 27 per cent of all commutes within Sydney occur within the home SLA and a further 16 per cent are to a different SLA in the home subregion and ring. Since about 44 per cent of employed residents work in their home subregion, the largest volume commuting flows are those within the home subregion, such as the 171 700 North West residents who commute to a place of work in the North West. Self-containment is highest for the Central Coast subregion (65 per cent) followed by the City of Sydney (60 per cent), and is very low for the Inner West (25 per cent) and North (32 per cent) subregions.

At the SLA scale, the ten most common commuter journeys were all trips within the home SLA (e.g. 27 314 Warringah residents travelled to a workplace in Warringah). The most common inter-SLA flows were typically journeys to work in the CBD from inner and middle suburban SLAs such as Randwick, North Sydney and Ku-ring-gai. Other substantial flows, with between 5000 and 8000 daily commuters each, were Sutherland Shire West to Sutherland Shire East, Gosford East to Gosford West, and Holroyd to Parramatta Inner.

The average commuting distance within the Sydney SD in 2006 was 14.6km. Average commuting distances are low for Inner sector residents (7.5km), higher for Middle sector residents (11.5km) and highest for Outer sector residents (18.8km). Commuting distances were particularly high for residents of the Central Coast (26.2km) and South West (21.9km). While City of Sydney residents had the lowest average commuting distance (5.9km), those who worked in the City of Sydney travelled an average of 17.5km to work.

Average work trip durations rise more gradually across the sectors of residence, standing at 30 minutes for the Inner sector, 32 minutes for the Middle sector and 35 minutes for the Outer sector in 2007 (TDC 2009d). Residents of the South West subregion had the lengthiest average work trip duration of 38 minutes (TDC 2009c).

Changes since 2001

Changes in commuting patterns from 2001 to 2006 were relatively subtle, and Sydney's overall commuting structure remained very stable.

The number of Sydney residents commuting to a place of work in the Lower Hunter increased more than commutes in the opposite direction, as did commutes from Sydney to the Illawarra.

Focusing on commuting flows *within* the Sydney SD, the most rapid growth related to outward flows (1.6 per cent per annum), which increased from 7.5 to 7.8 per cent of all flows. Inward commutes recorded subdued growth (0.3 per cent per annum), declining from 38.6 to 37.7 per cent of all commuting flows.

At the subregional scale, the largest increases between 2001 and 2006 related to commuting flows within the home subregion. The flows within the North West increased by 12 700 persons, and substantial growth also occurred in the Central Coast (+8200) and City of

Sydney (+7100). In contrast, the number of people commuting within the East subregion declined (−1300). There was little change in Sydney's overall level of self-containment between 2001 and 2006, except for in the Central Coast subregion which increased its self-containment rate by 2.6 percentage points.

The largest changes in flows between different subregions related to commutes from the Inner West to the City of Sydney (+2800), from the South West to the North West (+1300), and from the Inner North to the City of Sydney (+1300). The number of Outer sector residents commuting to a place of work in the Inner sector declined by 4200 persons between 2001 and 2006.

The likelihood of commuting to a City of Sydney workplace increased for East, Inner North and Inner West residents, but it declined for West Central, South West and Central Coast residents between 2001 and 2006. The likelihood of commuting to an Inner North workplace declined for a range of subregions of residence between 2001 and 2006.

Between 2001 and 2010 there was very little change in average commuting distance (+0.3km) and a modest rise in average commuting trip duration (1.6 minutes) (BTS 2011). There was also a 4 km/hour decline in morning peak road travel speeds in Sydney between 2001 and 2010, but the decline in afternoon peak speeds was much less pronounced (Austroads 2011).

There were some larger changes in specific locations—the average commuting distance of Central Coast residents declined by 2.0km from 2001 to 2006, while the average trip work duration of residents of 'Inner/East Sydney' rose by 2 minutes between 2001 and 2007.

Some drivers of commuting flows

In addition to describing spatial patterns and trends in commuting, this project set out to explore how commuting behaviour has responded to recent spatial changes in population and employment. Regression analysis was used to investigate this issue.

Commuting patterns are largely explained by the distribution of population and employment, with commuting flows more likely to occur between nearby SLAs. A simple gravity model explains about three-quarters of the variation in commuter flows between SLAs in Sydney. The fundamental drivers of commuting flows remained very stable between 2001 and 2006:

- The number of people commuting between an origin–destination pair tends to increase with the number of employed residents of the origin SLA and the number of jobs in the destination SLA. For example, rapid population growth in places such as Sydney South and Blacktown North has generated increased commuter flows within the home SLA and to a range of nearby areas.
- The number of people commuting between an origin-destination pair tends to decline as the road network distance between the two SLAs widens. Distance is less of an impediment to travel for SLA pairs that have a direct rail connection and for SLA pairs that would be travelled between without leaving Sydney's freeway network. Distance tends to impede commuter travel more in Sydney and Melbourne, than in Perth, reflecting the greater density and congestion in the two larger cities.

- The spatial concentration of industries also has implications for commuting, particularly where workers have specialised skills that tie them closely to specific industries. The greater the alignment between the skills available in the origin SLA and the skills demanded in the destination SLA, the greater the predicted commuting flows between those two places. The analysis further suggests that the role distance plays in determining commuting flows differs between industries, with people employed in Retail and Health being greatly deterred by distance, whereas people employed in Finance and Information media and telecommunications are less deterred by the prospect of a lengthy commute to their place of work.

Spatial patterns of growth in employed residents and jobs play an important role in explaining *changes* in commuting flows. These two factors alone explain around 40 per cent of the variation in commuting growth rates for origin-destination pairs with non-trivial commuter flows. Spatial patterns of residential and job growth reflect the accumulated effect of numerous business and household decisions about location. Job access is one of several key factors—alongside proximity to family and friends, lifestyle and housing cost—that underpin people's choice of where to live. In Sydney, 21 per cent of decisions to move house by employed people were specifically undertaken with the aim of improving work access or prospects (Hay 2009). The distance from home to work is a particularly important factor behind the moving decisions of employed people who walk/cycle to work or move to a residence located within five kilometres of where they work.

Between 2001 and 2006, more distant origin-destination pairs within Sydney tended to experience lower *growth* in commuting flows. The significant expansion of Sydney's motorway network between 2001 and 2006 (i.e. the M7, M5 East and Cross-city tunnel) also explains some of the changes that occurred in commuting patterns. Commuting flows between areas connected by the new motorways increased more than otherwise would have been expected given residential and job growth in those areas.

Outlook

Sydney's future spatial distribution of population and employment will shape future spatial patterns of commuting in the city, which will in turn have ramifications for future congestion and infrastructure investment. The NSW Department of Planning (2010b) projects that Sydney will add 1.7 million people and 761 000 jobs between 2006 and 2036. If the NSW Government's spatial projections of population and employment are realised, the likely commuting implications include:

- A large proportion of the increase in commuting in Sydney between 2006 and 2036 will likely be due to increased commutes within the North West and South West subregions. This will involve increased demand for public transport and road infrastructure that facilitates these local area commutes. In addition, a trend of increasing commuter flows from the North West and South West to the major employment precincts in the West Central subregion demands infrastructure planning and provision. Construction is currently underway on the South West Rail Link to improve access for residents of the South West Growth Centre to the employment centre of Parramatta (Transport Infrastructure Development Corporation 2010).

- An increase in the relative importance of same-subregion flows, which together with the modelled reduction in the relative importance of inward flows, will pose a challenge to growing the public transport mode share.
- The projected pattern of growth is expected to involve a small rise in average commuting distances.

Scenario modelling suggests that the magnitude of each of the above-mentioned changes will be greater if a larger proportion of residential and job growth occurs on the urban fringe.

A further implication of the NSW Government's spatial projections of population and employment growth is that average morning peak road speeds in Sydney are projected to decline between 2006 and 2031, with a particularly pronounced decline forecast for the South West (BITRE forthcoming).

Shaping the spatial distribution of population, employment and commuting in Sydney

Commuting flows within Sydney are driven by the spatial distribution of the residential population and jobs throughout the city. The current spatial distribution of population and jobs reflects the accumulated pattern of development over many decades, but continues to be shaped and influenced by demographic trends, cultural preferences, economic forces and government interventions.

There are a range of mechanisms through which governments attempt to directly influence the spatial allocation of population, jobs and commuting within our cities, including through the development of strategic metropolitan plans, provision of urban infrastructure, management of land release and zoning of land use. Many other social, economic and environmental policy domains also play an important role in shaping our cities, even where that is not the primary aim.

The primary focus of this study has been identifying spatial changes in population, employment and commuting, with a view to providing a solid evidence base about the trends that have been shaping Sydney in recent years. A secondary focus has been to provide some contextual information about urban policy directions for Sydney and to investigate the extent to which recent spatial changes have been in line with the stated policy goals.

The *Metropolitan Plan for Sydney 2036* was released in 2010 and sets out the overall strategic direction for the growth and development of the metropolitan area over a 25 year timeframe (NSW Government 2010a). *Sydney 2036* is an extension and update of the 2005 metropolitan strategy—*City of Cities* (NSW Government 2005). Following the change of government in NSW in March 2011, a comprehensive 18 month review of the NSW planning system was announced, which will include the creation of new planning legislation (Hazzard 2011).

Both *Sydney 2036* and *City of Cities* promote similar principles—liveability, economic competitiveness, fairness, protection of the environment and improved governance—and primarily represent a program of long term economic development to maintain global competitiveness. The plans structure Sydney as a system of regional cities and major centres which are connected by the rail network, bus corridors and the orbital motorway network. *Sydney 2036* and *City of Cities* have a number of common goals that relate to the spatial

distribution of population and employment, or to commuting patterns. These include limiting urban sprawl, concentrating development around centres, growing jobs in Western Sydney, better connecting people to centres, achieving greater use of sustainable transport modes, and ensuring people work closer to home.

BITRE has analysed the extent to which progress has been achieved since 2001 against those metropolitan strategy goals that relate to the spatial distribution of population and employment or to commuting patterns—the remainder of this chapter summarises the results. Outcome measures on their own do not provide a reliable indication of how effectively government planning systems are working, due to the many other influences that can impact on outcomes (Productivity Commission 2011). The purpose of this exercise is not to evaluate the success of the strategic planning system or any specific planning document, but rather to provide evidence about the actual ‘on-the-ground’ changes that have been occurring with respect to these strategic planning goals, whether such developments are in the desired direction and whether they are progressing at the intended pace of change. This evidence about the reality of the trends that have been shaping Sydney’s population, employment and commuting flows can then be used to inform future planning initiatives.

Limiting urban sprawl⁷⁰

The intent of Sydney’s recent metropolitan strategies is that the existing urban area will accommodate the majority of the growth in population and dwellings over the next 25 years. *City of Cities* aims to contain Sydney’s urban footprint by ensuring that new land release areas provide for 30–40 per cent of housing development, while ‘[t]he remaining 60–70 per cent of housing development will occur within the existing urban area’ (NSW Government 2005, p.217). The urban consolidation target was raised slightly in *Sydney 2036* to ‘[l]ocate at least 70% of new homes in existing suburbs and up to 30% in greenfield areas’ (NSW Government 2010a, p.6).

Sydney 2036 argues that limiting the city’s urban footprint will provide benefits including smaller overall net cost relative to the alternative growth path, reduced congestion and travel times, and protection of agricultural land and biodiversity. However, excessive urban consolidation is also likely to impose costs by putting pressure on existing suburbs and reducing housing affordability (NSW Government 2005, p.133).

The *Sydney 2036* target for at least 70 per cent of new homes to be located in existing suburbs was met and exceeded between 2001–02 and 2009–10 when 81 per cent of new housing development occurred within the existing urban area. About 33 000 dwellings were added in greenfield areas over this period, representing 19 per cent of new housing development. *City of Cities* had previously envisaged a greater role for greenfield sites (i.e. 30–40 per cent).

BITRE estimates that just 29 per cent of Sydney’s population growth between 2001 and 2006 occurred within newly developing outer suburbs, compared to 50 per cent for Melbourne and 61 per cent for Perth. Urban infill development therefore played a much more dominant role in accommodating Sydney’s population growth than it did in either Melbourne or Perth.

⁷⁰ The dwelling completions data referred to in this section is NSW Department of Planning official data based on Sydney Water and Central Coast councils (provided in 2011), updated to reflect latest information from Department of Planning and Infrastructure (2011h).

The *Sydney 2036* urban infill percentage target has consistently been met and exceeded since 2001, but this reflects a very low level of greenfield dwelling production, averaging just 2400 dwellings per year since 2004–05, compared to the average of 8300 dwellings per year from 1999–2000 to 2001–02. There was also a decline from 2003–04 in new dwelling production within the existing urban area. Thus, while the extent of Sydney's urban sprawl has been contained since 2001, the level of new dwelling production has declined considerably, with implications for housing affordability and for Sydney's growth.

Focusing residential development around centres

City of Cities and *Sydney 2036* both aim to concentrate residential development around activity centres to achieve a compact city and enhance liveability. *Sydney 2036* specifically 'aims to accommodate 80 per cent of Sydney's new housing within the walking catchments of existing and planned centres' (NSW Government 2010a, p.63).

Between 2001 and 2006, the population living in strategic centres⁷¹ increased at a much faster rate than the rest of the city (4.0 and 0.5 per cent per annum, respectively). While only 5 per cent of Sydney's population lives in the existing strategic centres, they accounted for 27 per cent of population growth between 2001 and 2006. The strategic centres contributed 23 per cent of dwelling completions between 2003–04 and 2007–08 (Department of Planning 2010a), which is in line with the 21 per cent share envisaged by *City of Cities*. However, the smaller local centres accommodated much less than the 36 per cent share of residential development envisaged by *City of Cities*.

At the same time, a relatively high rate of out-of-centre residential development is occurring in Sydney's established suburbs, which is not in line with the stated policy aim of focusing residential development around centres. Around 61 per cent of the new dwellings built within the existing urban area between 2003–04 and 2007–08 were built within the walking catchment of centres (Department of Planning 2010a), which is well below the target from *Sydney 2036*.

Increasing residential densities in centres

City of Cities aimed to 'encourage greater housing density in centres' (NSW Government 2005, p.96). Between 2001 and 2006, there was a shift towards higher density forms of housing being built in Sydney, the majority of which was built in strategic centres. Of the 20 900 new dwellings added to strategic centres, 17 200 were flats, units or apartments in blocks of four or more storeys. The stock of high rise flats, units and apartments in strategic centres expanded by over 50 per cent in just five years. As a result, the average population density of strategic centres (excluding the specialised centres) rose by 26 per cent to reach 2545 persons per square kilometre in 2006. This was much higher than the 4 per cent increase in density for the city as whole and the 5 per cent increase for Sydney's established inner and middle suburbs. The density gains were concentrated in a few centres located within 10km of the CBD (e.g. Central Sydney, Green Square, Chatswood), but all of the different types of strategic centre recorded density gains. Thus, there was good progress in increasing residential densities in Sydney's strategic centres from 2001 to 2006. There has been a further shift towards higher density

⁷¹ BITRE has defined strategic centre boundaries based on TDC (2008b), subregional plans and 2006 travel zone boundaries. The same boundaries are applied to both population and employment.

forms of housing in Sydney since 2006, with multi-unit dwellings accounting for 75 per cent of all dwelling completions from 2006 to 2010 (Department of Planning and Infrastructure 2011h).

The density objective of *Sydney 2036* has a narrower focus than that of *City of Cities*, aiming for 'more low rise medium density housing in and around local centres' (NSW Government 2010a, p.117). Due to lack of data, no analysis was undertaken of changes in density for the smaller local centres.

Focusing job growth in strategic centres

Activity centres are the core element of the strategy to support employment growth and a more efficient utilisation of infrastructure and services. *City of Cities* aimed to significantly increase the share of jobs in strategic centres from 40 per cent in 2001 to 45 per cent by 2031 (NSW Government 2005, p.82). *Sydney 2036* retained the aim of concentrating employment in strategic centres, but the target was less ambitious, aiming to increase the share of jobs in strategic centres from 39 per cent in 2006 to 42 per cent by 2036 (NSW Government 2010a, p.135).

From 2001 to 2006 there was an increase of 31 500 jobs in strategic centres, representing 67 per cent of Sydney's jobs growth. Specialised centres—such as Norwest, Macquarie Park and Olympic Park-Rhodes—were responsible for over half of this growth. The centred employment share rose from 40.0 to 40.7 per cent, which is in line with the *Sydney 2036* target to grow the centred employment share by 3 percentage points to 2036. Thus, between 2001 and 2006, good progress was made against the goal of focusing job growth in strategic centres.

Enable job growth in corridors

City of Cities aimed to protect and strengthen the primary role of economic corridors, and specified a target of 150 000 new jobs in the Global Economic Corridor by 2031 (NSW Government 2005, p.46). *Sydney 2036* aims to protect prime commercial precincts in the Global Economic Corridor to attract global businesses and meet employment targets (NSW Government 2010a, p.45). However, focusing job growth in the remaining economic corridors—M5, M7 and Parramatta Road—is not identified as an objective in *Sydney 2036*.

Between 2001 and 2006 the Global Economic Corridor added only 6700 jobs, with the northern part of the corridor experiencing a net job loss (–1600). Its employment share declined from 33.6 per cent to 33.1 per cent. Recent job growth is well below that envisaged by *City of Cities* which targeted 150 000 new jobs between 2006 and 2031. While *Sydney 2036* did not specify employment targets for the Global Economic Corridor, the job figures indicate there was little progress in attracting employment to this corridor between 2001 and 2006.

Accommodating jobs in employment lands

City of Cities aimed to locate over 100 000 new jobs, and 23 per cent of all employment in 2031, in employment lands (NSW Government 2005, p.60–61). *Sydney 2036* introduced a lower target that the ‘share of jobs in employment lands will be maintained at about 20 per cent’ through to 2036 (NSW Government 2010a, p.140).

About 30 per cent of Sydney’s job growth from 2001 to 2006 occurred in employment land precincts, amounting to 13 900 additional jobs. The increase in jobs in employment land precincts is due to strong growth in several outer suburban industrial areas (e.g. Prestons, Smeatons Grange, Huntingwood, Silverwater). Employment land precincts had slightly more rapid job growth than Sydney as a whole (0.8 and 0.6 per cent per annum, respectively). The job share of employment land precincts rose from 19.4 per cent in 2001 to 19.7 per cent in 2006, which is broadly consistent with the 20 per cent target from *Sydney 2036*.

Locating more jobs in Western Sydney

The recent metropolitan strategies seek to locate more jobs in Western Sydney, particularly in its regional cities and specialised centres, and also place an emphasis on diversifying the job base by increasing the number of skilled jobs in the region. *City of Cities* and *Sydney 2036* both anticipate that close to half of the additional jobs created in Sydney to 2031 (2036) will be located in Western Sydney. More specifically, *Sydney 2036* targets an employment increase of 384 000 jobs, representing a rise in Western Sydney’s employment share from 34 per cent in 2006 to 39 per cent in 2036 (NSW Government 2010a, p.133).

Western Sydney added 26 200 jobs from 2001 to 2006, mainly in the Health and community services (9400 jobs) and Transport and storage (6500) industries. This job growth resulted in a slightly more diversified industry structure. It also involved an upgraded skills base, with the proportion of Western Sydney employment in the two most highly skilled occupational categories (Managers and Professionals) increasing from 25 to 31 per cent, but remaining well below the Sydney-wide figure of 40 per cent in 2006.

The proportion of Sydney’s employment located in Western Sydney rose by 0.6 percentage points to reach 34.5 per cent in 2006, which represents some progress in the desired direction. However, the recent creation of 26 200 jobs in Western Sydney is modest compared to the long term growth target to create 384 000 new jobs in Western Sydney from 2006 to 2036.

Better align jobs with where people live

City of Cities ‘seeks to more closely integrate employment and population growth in subregions, particularly to ensure that job growth matches population growth in rapidly growing subregions’ (NSW Government 2005, p.59). This principle of better aligning jobs with where people live was retained in *Sydney 2036* which aimed ‘to provide jobs closer to home by setting new employment capacity targets for each subregion’ (NSW Government 2010a, p.132).

Between 2001 and 2006 there was relatively weak alignment between the average annual rates of job growth and population growth for subregions. However, the subregions that experienced the largest increase in the number of residents (City of Sydney and North West) also experienced some of the most substantial increases in the number of employed persons.

Employment self-sufficiency ratios reveal little change from 2001 to 2006 in the degree to which jobs are aligned with where people live across Sydney's subregions. The exception was the City of Sydney subregion, where strong population growth reduced the excess of available jobs over employed residents.

Strengthen core functions of centres and corridors—focus commercial and retail jobs in centres

Recent metropolitan strategies contain a range of quite detailed goals which aim to strengthen the core functions of centres and corridors by concentrating certain industries in these locations. While the set of goals differs considerably between *City of Cities* and *Sydney 2036*, a goal common to both of these strategies is the desire to concentrate retail and commercial development in centres. *City of Cities* aimed to 'concentrate retail activity in centres' and 'cluster business and knowledge-based activities in strategic centres' (NSW Government 2005, p.97, 104), while *Sydney 2036* aims to locate 'more commercial and retail jobs in highly accessible Strategic Centres' (NSW Government 2010a, p.134).

Between 2001 and 2006, the number of jobs in strategic centres rose for Retail trade (by 6600) and for other commercial activities (3600), defined here as jobs in the Property and business services and Finance and insurance industries. The proportion of Retail jobs located in Sydney's strategic centres rose from 32 to 34 per cent, while the proportion of commercial employment in strategic centres also rose slightly from 63 to 64 per cent. Both retail and commercial jobs were increasingly being located in strategic centres between 2001 and 2006, rather than in out-of-centre locations, which is consistent with the strategic planning goals.

Greater use of public transport

City of Cities and *Sydney 2036* both aim to achieve greater use of public transport. In *City of Cities* this was expressed as part of a broader shift towards encouraging more sustainable travel, while *Sydney 2036* specifically aimed to increase the public transport mode share (NSW Government 2005, 2010a). The State Plans identify mode share targets, which are referred to in *Sydney 2036*. The 2006 *State Plan* target was to increase the public transport mode share for journeys to work to 25 per cent by 2016 (NSW Government 2006). The 2010 *State Plan* increased this target to 28 per cent by 2016 (NSW Government 2010c), and this target was retained in *NSW 2021* (NSW Government 2011c).

Sydney has the highest public transport mode share of Australia's cities, with 21 per cent of journeys to work undertaken by public transport in 2006. The public transport mode share of commuter travel declined significantly in Sydney in the early 2000s, but recovered strongly between 2004 and 2008, before stabilising (NSW Government 2011d, BTS 2011). It stood at 23.9 per cent in 2009–10, which is about 3 percentage points higher than in 2000–01 (*ibid.*), and suggests some progress has been made towards the target of 28 per cent by 2016.

When the focus is shifted beyond commuter travel, to all purposes of travel, there was little net change in Sydney's public transport mode share over the last decade—during this period Sydney (and Adelaide) recorded relatively modest growth in public transport patronage compared to other Australian cities (BITRE 2012a, 2012b).

Greater use of active transport

Increasing use of active transport has been a goal of successive plans. In *City of Cities* it formed part of the broader goal of encouraging more sustainable travel, while *Sydney 2036* articulates a specific goal of promoting active transport opportunities (NSW Government 2005, 2010a). These active transport goals relate to all types of trips, rather than specifically to commuter travel.

In Sydney the active transport mode share increased by 0.5 percentage points between 2001 and 2006 to reach 5.4 per cent of all commutes. Walking and cycling mode shares both increased. These shifts were largely confined to the inner and middle suburbs, with the outermost subregions (i.e. North West, South West, Central Coast) experiencing small declines in the proportion of residents walking to work. More recent data suggest the active transport mode share of commuter travel in Sydney continued to rise gradually from 2006 through to 2010 (BTS 2011). Across all travel purposes, the active transport mode share has risen gradually over the decade from 17.8 per cent in 2001–02 to 19.1 per cent in 2009–10 (*ibid.*).

Better connect people to centres

The metropolitan strategies promote centres as focal points of jobs, services and transport networks. *City of Cities* aims to 'connect people to centres by focusing on public transport links to serve existing and new centres in Sydney' (NSW Government 2005, p.165). *Sydney 2036* aims 'to ensure that that our key centres are accessible and connected' (NSW Government 2010a, p.96).

The extent to which people are connected to centres by public transport can be analysed based on the mode shares of travel to and from centres. Between 2001 and 2006, there was a substantial 1.4 percentage point decline in public transport's share of commuter travel to and from strategic centres. An exception was the Parramatta CBD which increased its public transport mode share. *Sydney 2036* proposes using the peak hour public transport mode share of commuting trips for the Sydney, Parramatta, Penrith and Liverpool CBDs as a relevant performance indicator (NSW Government 2010a, p.248) and *NSW 2021* sets out quantitative targets for these centres in 2016 (NSW Government 2011c). Over the 2001–02 to 2009–10 period, the peak hour public transport mode share declined for Liverpool, and while it rose for the Sydney and Parramatta CBDs (NSW Government 2011d), the public transport mode shares remained below the 2016 target for all four of the targeted centres. Thus, with regard to the goal of better connecting people to centres, there are positive signs in some locations such as Parramatta, but several of the indicators have not been heading in the desired direction.

Sydney 2036 also proposes 'an increase in the percentage of the population living within 30 minutes by public transport of a city or major centre' as a relevant performance indicator (NSW Government 2010a, p.248), but inconsistent measurement makes it difficult to assess the direction of change in this indicator since 2001.

Concentrate development near public transport

City of Cities aimed to 'concentrate activities near public transport', including both population and jobs (NSW Government 2005, p.104). *Sydney 2036* aims to integrate transport and land use planning to support an increased public transport mode share, and accommodate urban renewal in locations where there is existing transport capacity (NSW Government 2010a, p.91).

About 42 per cent of Sydney's residential development since 2000–01 has been concentrated near public transit nodes, and there was a net rise in this proportion over the course of the decade (Department of Planning and Infrastructure 2011h, Department of Planning 2010a). Census data provides supporting evidence of residential development being concentrated near rail stations, with 44 per cent of population growth from 2001 to 2006 occurring within 1km of a rail station and a 0.6 percentage point increase in the proportion of Sydney's population who live within 1km of a rail station. In contrast, only a very small fraction (5 per cent) of Sydney's employment growth occurred near rail stations during this period. Thus, while recent residential development has been concentrated near Sydney's rail network, economic development (as measured by job growth) has not.

People work close to home

Reducing commuter travel times is an underlying aim of the urban containment, transport and centres policies in the recent metropolitan strategies. *City of Cities* identified the need to '[r]educ[e] average journey to work travel times from Western Sydney and the Central Coast through transforming Sydney into a multi-centred city' (NSW Government 2005, p.58). *Sydney 2036* aims to ensure 'more jobs are located closer to home' (NSW Government 2010a, p.6), and identifies increased employment self-containment as an important objective (ibid., p.148). The latest State Plan, *NSW 2021*, also aims to 'reduce travel times' (NSW Government 2011c).

Sydney's level of self-containment remained stable over the period, with 44 per cent of employed residents working in the home subregion in both 2001 and 2006. Between 2000–01 and 2009–10, there was a very small 0.3km rise in the average commuting distance within Sydney to reach 15.1km in 2009–10 and a modest 1.6 minute rise in the average duration of a commuting trip, which reached 34.3 minutes in 2009–10 (BTS 2011). Since 2001 there has been a shift to Sydney residents working a little further away from home, on both a distance and time basis. While the Sydney-wide shift has not been in the desired direction, there was a shift towards working closer to home for Central Coast residents between 2001 and 2006 (i.e. improved self-containment and reduced commuting distances).

Overall assessment

A feature of the preceding assessment is the shifting nature of the NSW Government's metropolitan planning goals and targets over the period. For example, there were significant shifts in how the residential density and urban containment goals were framed between *City of Cities* and *Sydney 2036*, while *City of Cities* placed a greater emphasis on corridors than did its successor.

The available evidence suggests that there has been some movement in the desired direction for most of these strategic planning goals since 2001, with the principal exception being that Sydney's average commuting time has not been heading in the desired direction. Good progress was achieved against several of these objectives, such as increasing the residential density of centres and focusing job growth in strategic centres. More often, evidence is mixed. For example, Western Sydney increased its share of Sydney's employment between 2001 and 2006, but an upturn in job growth will be required to meet the longer term targets. While some progress has been made against most of these planning goals, it has been incremental in nature as the accumulated effects of decades of residential and industry development do not reverse in just five to ten years.

The various objectives are highly inter-related and progress against one objective may aid or hinder progress in other areas. For example, the increase in use of active transport modes by inner city residents from 2001 to 2006 arose largely through their reduced public transport use. Progress against strategic planning goals can also have implications for broader economic, social or environmental policy goals which need to be taken into account. For example, while recent progress in 'limiting urban sprawl' has exceeded expectations, the COAG Reform Council (2012, p.98) notes that the 'goal of a more compact city is a delicate balancing act. Infill development will help Sydney meet sustainability and economic competitiveness goals but may have negative effects on affordability and growth'.

The recent spatial changes in population, jobs and commuting flows in Sydney largely reflect market forces, demography and people's preferences as to where they live, work and do business. Government planning policies and infrastructure provision also play a role, but tend not to be the dominant influence. For example, the substantial recent job growth in Western Sydney reflects a combination of population-led growth in demand for consumer services (particularly health and education) and the development of transport and distribution nodes in the outer suburbs. While the regional cities of Parramatta, Penrith and Liverpool are the government's priority locations for job growth in Western Sydney, recent growth has instead been concentrated in the specialised centres of Norwest and Olympic Park, the major centre of Campbelltown-Macarthur, and a range of outer suburban industrial areas. State and territory governments are of the view that the issues most able to be influenced by planning systems are the management of greenfield development, accommodation of population growth, and the transition to higher densities (Productivity Commission 2011).

Future directions

This study represents the third of four case studies in a broader research project which aims to identify recent spatial changes in employment and residential patterns in Australia's largest cities, and investigate how commuting behaviour has responded to those changes. The Perth and Melbourne reports have already been released (BITRE 2010, 2011) and a South East Queensland report is being prepared. A comparative report will also be produced, which provides an overview of relevant statistics for the major capital cities, extracts some common themes and differences, and discusses the implications for infrastructure and urban development.

APPENDIX A

Geographical classification

Table A.1 Classification of Statistical Local Areas in Sydney Greater Metropolitan Area to sectors and planning subregions

SLA reference in Map A.1	SLA code	SLA name	Sector	Planning subregion
1	I05051100	Botany Bay	Inner	East
2	I05054800	Leichhardt	Inner	Inner West
3	I05055200	Marrickville	Inner	South
4	I05057201	Sydney–Inner	Inner	City of Sydney
5	I05057204	Sydney–East	Inner	City of Sydney
6	I05057205	Sydney–South	Inner	City of Sydney
7	I05057206	Sydney–West	Inner	City of Sydney
8	I05106550	Randwick	Inner	East
9	I05108050	Waverley	Inner	East
10	I05108500	Woollahra	Inner	East
11	I05154150	Hurstville	Middle	South
12	I05154450	Kogarah	Middle	South
13	I05156650	Rockdale	Middle	South
14	I05157151	Sutherland Shire–East	Outer	South
15	I05157152	Sutherland Shire–West	Outer	South
16	I05200351	Bankstown–North-East	Middle	West Central
17	I05200353	Bankstown–North-West	Middle	West Central
18	I05200355	Bankstown–South	Middle	West Central
19	I05201550	Canterbury	Middle	South
20	I05252851	Fairfield–East	Outer	West Central
21	I05252854	Fairfield–West	Outer	West Central
22	I05254901	Liverpool–East	Outer	South West
23	I05254904	Liverpool–West	Outer	South West
24	I05301450	Camden	Outer	South West
25	I05301501	Campbelltown–North	Outer	South West
26	I05301504	Campbelltown–South	Outer	South West
27	I05308400	Wollondilly	Outer	South West
28	I05350150	Ashfield	Inner	Inner West
29	I05351300	Burwood	Middle	Inner West
30	I05351521	Canada Bay–Concord	Middle	Inner West

(continued)

Table A.1 Classification of Statistical Local Areas in Sydney Greater Metropolitan Area to sectors and planning subregions (continued)

SLA reference in Map A.1	SLA code	SLA name	Sector	Planning subregion
31	I05351524	Canada Bay–Drummoyne	Middle	Inner West
32	I05357100	Strathfield	Middle	Inner West
33	I05400200	Auburn	Middle	West Central
34	I05403950	Holroyd	Outer	West Central
35	I05406251	Parramatta–Inner	Middle	West Central
36	I05406252	Parramatta–North-East	Middle	West Central
37	I05406253	Parramatta–North-West	Middle	West Central
38	I05406254	Parramatta–South	Middle	West Central
39	I05450900	Blue Mountains	Outer	North West
40	I05453800	Hawkesbury	Outer	North West
41	I05456351	Penrith–East	Outer	North West
42	I05456354	Penrith–West	Outer	North West
43	I05530751	Blacktown–North	Outer	North West
44	I05530752	Blacktown–South-East	Outer	North West
45	I05530753	Blacktown–South-West	Outer	North West
46	I05554100	Hunter's Hill	Middle	Inner North
47	I05554700	Lane Cove	Inner	Inner North
48	I05555350	Mosman	Inner	Inner North
49	I05555950	North Sydney	Inner	Inner North
50	I05556700	Ryde	Middle	Inner North
51	I05558250	Willoughby	Middle	Inner North
52	I05600501	Baulkham Hills–Central	Outer	North West
53	I05600503	Baulkham Hills–North	Outer	North West
54	I05600505	Baulkham Hills–South	Outer	North West
55	I05604001	Hornsby–North	Outer	North
56	I05604004	Hornsby–South	Outer	North
57	I05604500	Ku-ring-gai	Middle	North
58	I05655150	Manly	Middle	North East
59	I05656370	Pittwater	Outer	North East
60	I05658000	Warringah	Outer	North East
61	I05703101	Gosford–East	Outer	Central Coast
62	I05703104	Gosford–West	Outer	Central Coast
63	I05708551	Wyong–North-East	Outer	Central Coast
64	I05708554	Wyong–South and West	Outer	Central Coast
65	I10051720	Cessnock	Rest of GMA	Lower Hunter
66	I10054651	Lake Macquarie–East	Rest of GMA	Lower Hunter
67	I10054653	Lake Macquarie–North	Rest of GMA	Lower Hunter
68	I10054655	Lake Macquarie–West	Rest of GMA	Lower Hunter
69	I10055050	Maitland	Rest of GMA	Lower Hunter
70	I10055903	Newcastle–Inner City	Rest of GMA	Lower Hunter

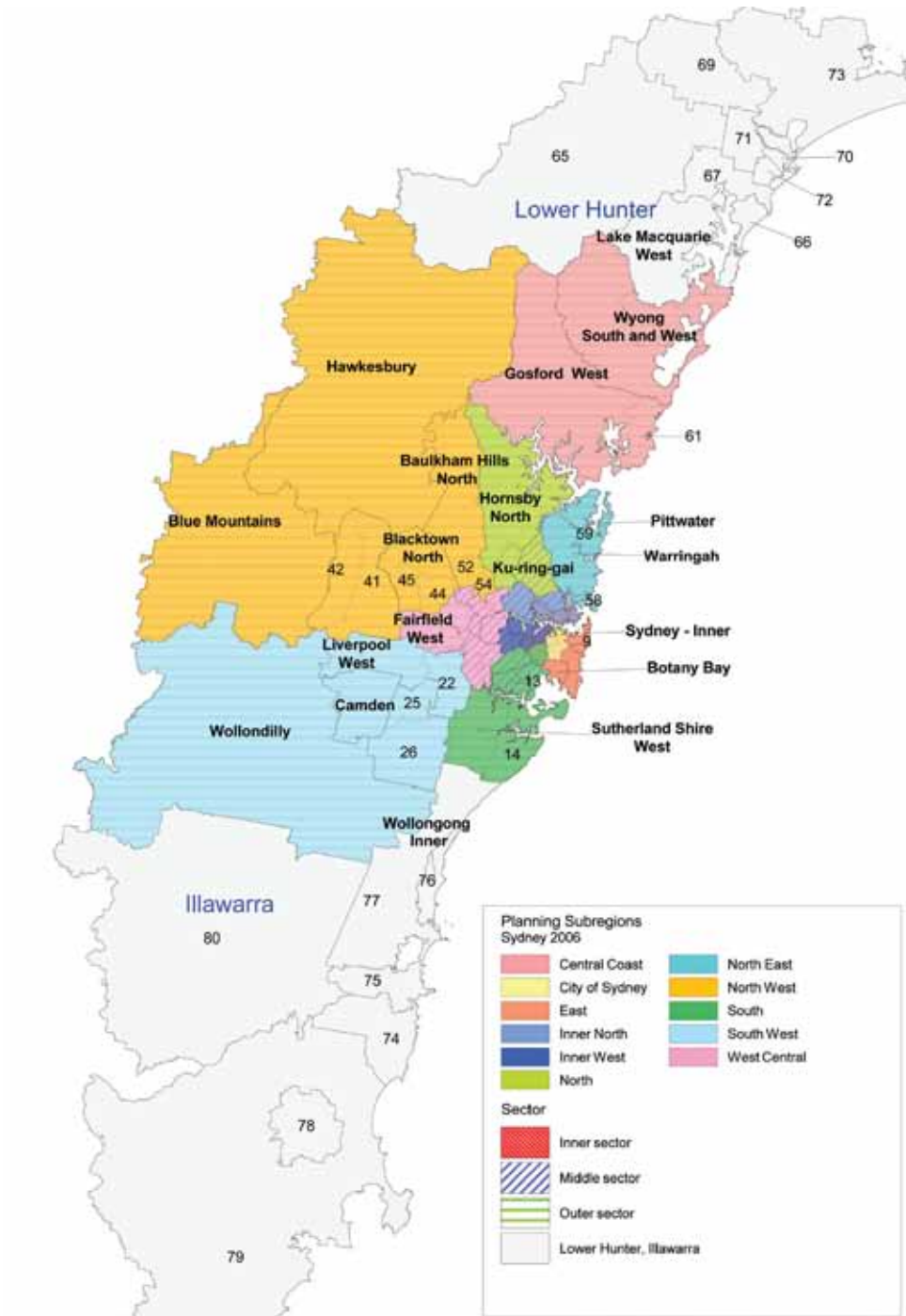
(continued)

Table A.1 Classification of Statistical Local Areas in Sydney Greater Metropolitan Area to sectors and planning subregions (continued)

SLA reference in Map A.1	SLA code	SLA name	Sector	Planning subregion
71	I10055904	Newcastle–Outer West	Rest of GMA	Lower Hunter
72	I10055905	Newcastle–Throsby	Rest of GMA	Lower Hunter
73	I10056400	Port Stephens	Rest of GMA	Lower Hunter
74	I15054400	Kiama	Rest of GMA	Illawarra
75	I15056900	Shellharbour	Rest of GMA	Illawarra
76	I15058451	Wollongong–Inner	Rest of GMA	Illawarra
77	I15058454	Wollongong–Bal	Rest of GMA	Illawarra
78	I15076951	Shoalhaven–Pt A	Rest of GMA	Illawarra
79	I15106952	Shoalhaven–Pt B	Rest of GMA	Illawarra
80	I15108350	Wingecaribee	Rest of GMA	Illawarra

Source: BITRE analysis based on BTS 2006 sector geography, NSW Government planning subregion geography, and ABS 2006 Australian Standard Geographical Classification.

Map A.1 Statistical Local Area, sector and planning subregion boundaries, Sydney Greater Metropolitan Area, 2006



Note: Details of the numbers can be found in Table A.1.

Source: BITRE analysis based on BTS 2006 sector geography, NSW Government planning subregion geography, and ABS 2006 Australian Standard Geographical Classification.

Map A.2 Statistical Local Area and planning subregion boundaries, Sydney Statistical Division, 2006



Note: Details of the numbers can be found in Table A.1.

Source: BITRE analysis based on NSW Government planning subregion geography, and ABS 2006 Australian Standard Geographical Classification.

APPENDIX B

Gravity model sensitivity analysis

There are a number of possible specifications for gravity models of commuting flows, and those presented in Chapter 8 were chosen in part to allow consistency between the models estimated for each capital city. In this section, the results of a number of alternative specifications for gravity models are presented. This allows a greater understanding of the extent to which the model parameters, and hence the scenario modelling, are sensitive to model specification.

In particular, this appendix describes the following alternative gravity model specifications:

- A model fitted to data for a wider geographical scope: the Sydney Greater Metropolitan Area rather than the Sydney Statistical Division (SD)
- Models using alternative measures representing travel costs between Statistical Local Areas (SLAs)
- A model with the population parameters fixed
- A model estimated using a weighted-least-squares regression, in case low-population SLAs are having a disproportionate effect on the regression results
- A model estimated using a Poisson, rather than an ordinary least squares, regression (which allows inclusion of SLA pairs with no flow between them in the data set)
- A gravity model fitted to travel zone level origin-destination data, allowing an order-of-magnitude larger sample.

Overall, the gravity model results appear to be robust to model specification, geographic scope, and methods of representing travel costs. While there are some differences in the parameter estimates between specifications, the conclusions drawn from the base model proved robust across specifications, and the potential gains from using different specifications were not considered worthwhile compared to the benefit of having uniform models across the capital cities.

Given the similarities between Australian capital cities, the apparent robustness of the gravity model results for Sydney also increases confidence in the models used for the other capital cities.

Gravity model for the Sydney Greater Metropolitan Area

The first alternative model presented is effectively the base model, but fitted for the whole Sydney Greater Metropolitan Area rather than the Sydney SD. This involves an additional 2304 SLA pairs, so potentially will provide more accurate parameter estimates as the number of sample points is higher. However it is also possible that the nature of commuting flows are different outside Sydney, so that the model may be less useful for predicting flows in the Sydney SD than the base model. For this reason, it would not be concerning if the parameter estimates are somewhat different to those in the base model. However, if they were very different it would suggest that the model is not robust to differences in geographical scope.

Table B.1 shows the results for the gravity model for the entire Sydney Greater Metropolitan Area compared with those for the base model discussed in Chapter 8. It can be seen that none of the parameter estimates are significantly different to those estimated for the smaller Sydney SD. The proportion of variation in commuting explained by the simple gravity model is slightly higher for the Sydney SD than it is for the Greater Metropolitan Area. This might reflect greater heterogeneity of regions within the Greater Metropolitan Area.

Table B.1 Estimation of base gravity model of origin-destination commuter flows, Sydney Greater Metropolitan Area and Sydney Statistical Division, 2001 and 2006

	Sydney Greater Metropolitan Area		Sydney Statistical Division	
	2001	2006	2001	2006
Sample	4950	4950	3828	3788
Adjusted R-squared	71.3	73.1	73.1	74.3
Parameter estimates (standard error)				
Constant	-11.46	-12.09	-14.50	-14.75
Employed residents in origin SLA	1.00	0.99	1.17	1.19
Jobs in destination SLA	1.03	1.09	1.13	1.14
Distance between origin and destination SLA	-1.39	-1.39	-1.34	-1.35
Standard errors				
Constant	-33.67	-35.20	-45.13	-46.45
Employed residents in origin SLA	36.70	35.52	44.28	45.00
Jobs in destination SLA	52.86	56.76	60.98	64.35
Distance between origin and destination SLA	-104.98	-108.99	-63.15	-63.95

Note: Distance measure is straight line distance between SLA employment and population weighted centroids, derived by BITRE.

Source: Estimated by BITRE using OLS estimation and robust standard errors, based on ABS 2001 and 2006 *Census of Population and Housing* commuting, jobs and employed residents data.

Gravity models using alternative measures of impedance

In reality, commuting decisions will be made in relation to generalised travel cost, rather than on distance or time alone. However, accurate estimates of generalised travel cost between SLA pairs are generally unavailable, meaning that estimates of distances or travel times must be used as proxies. In the gravity model literature, the measure of generalised travel costs is often referred to as a measure of 'impedance'.

In the main gravity models presented in Chapter 8, road network distances were used as the measure of travel costs between SLAs. Here a number of alternatives are investigated. Table B.2 presents the results of gravity models using a time measurement and two versions of straight line distance measurement, compared with the base model presented in Chapter 8 (Table 8.6). Both the explanatory power of the model, and the estimated impedance parameter, are found to vary with the measure of impedance. As the estimated impedance parameter varies, the distribution of trips implied by the gravity model for a given distribution of workers and jobs would also vary.

The 'weighted time' measure is derived from travel zone pair level commuting times, modelled using the Sydney Strategic Travel Model. For each SLA pair, the 'weighted time' is a weighted average of modelled times for car, public transport, walking and cycling commuters, depending on the mode shares between the two SLAs. In theory, an accurate measure of travel time would better represent generalised travel costs than road network distance, and a gravity model using travel time would be expected to have higher explanatory power. However, in this case, the gravity model regression using estimates of travel time has an adjusted R-squared of 67 per cent, compared with 75 per cent for the base model using road network distance. One possible explanation for this is that these estimates of travel time do not reflect actual travel time as well as the estimates of road network distance reflect actual distance. This explanation is given extra credence by the finding that these modelled estimates of travel time are less consistent with the results of the NSW Household Travel Survey than the modelled estimates of road network distance.

The first estimate of straight line distance is the distance between the population-weighted-centroid of the origin SLA and the jobs-weighted-centroid of the destination SLA. As this is expected to be a poorer proxy for generalised travel cost than the road network distance, we would expect the gravity model regression using straight line distance to have lower explanatory power than that using network distance. This is reflected in the results for both 2001 and 2006. The parameter for straight line distance is also found to be lower, and less significant, than that for road network distance.

The second estimate of straight line distance is weighted using actual commuting flows, at the TZ level, between the origin and destination SLAs, rather than using overall distributions of residents and jobs in origin and destination SLAs. This measure of distance will better represent actual distances travelled by commuters between SLAs, and takes account of the tendency for people to be more likely to commute to neighbouring SLAs that they live relatively close to. Because of this tendency, distances weighted by actual commutes tend to be smaller than those between SLA centroids. However, because for a gravity model regression we are interested in how actual commutes depend on the overall distribution of workers and jobs, it is not clear that it is desirable to use a variable that itself depends on actual commutes as a predictor in a gravity model regression.

Table B.2 Comparison of base gravity model of origin-destination commuter flows to models using alternative measures of impedance, Sydney, 2006

	Using road network distance	Using weighted time	Using straight line distance (centroid-centroid method)	Straight line distance (TZ-TZ weighted)
Sample	3788	3788	3788	3788
Adjusted R-squared	75.3	67.1	74.3	75.9
Parameter estimates (and standard error)				
Constant	-14.53	-12.21	-14.75	-13.90
Employed residents in origin SLA	1.23	1.21	1.19	1.14
Jobs in destination SLA	1.14	1.25	1.14	1.14
Distance or time between origin and destination SLA	-1.44	-1.91	-1.35	-1.48
Robust t-values				
Constant	-46.78	-29.79	-46.45	-40.04
Employed residents in origin SLA	48.73	35.85	45.00	39.83
Jobs in destination SLA	65.88	54.40	64.35	58.76
Distance or time between origin and destination SLA	-83.01	-69.46	-63.95	-101.87

Note: Straight line distance estimates derived by BITRE. Where there are no commuters flow between two SLAs, TZ-TZ based distance cannot be calculated, so SLA-centroid based distance has been used instead.

Source: Estimated by BITRE using OLS estimation and robust standard errors, based on ABS 2006 *Census of Population and Housing* commuting, jobs and employed residents data and BTS' Sydney Strategic Travel Model road network distance and time outputs.

Table B.3 presents a comparison of the results of the 'extended model' from Chapter 8 with equivalent models using estimates of weighted travel time and straight line distance.

As with the comparisons for alternative distance measures in the 'base' regression, the explanatory power of the extended model using straight line distance is slightly lower, and that of the extended model using modelled commuting time is much lower, than that of the extended model using modelled road network distances. As in the previous table, the distance parameter estimates are of smaller magnitude than the time parameter estimate.

The estimates of the skills mismatch parameter are similar for both regressions which use distance measures, and slightly higher for the regression using a time measure. The results for the direct rail connection are similar for all three regressions. The estimated effect of a direct freeway connection is much weaker, and less significant, when time is used as a measure of impedance rather than distance. This is as would be expected, as most of the benefits of a direct freeway connection are related to higher travel speeds, which will already be taken account of in the measure of time. The remaining effect could relate to higher reliability or less stressful driving conditions.

Table B.3 Comparison of extended gravity model of origin-destination commuter flows to similar models using weighted travel times and straight line distance measure, Sydney, 2006

	Using road distance	Using weighted travel time	Using straight line distance (TZ-TZ weighted)
Sample	3788	3788	3788
Adjusted R-squared	78.06	73.08	77.61
Parameter estimates (standard error)			
Constant	-13.58	-12.02	-13.76
Employed residents in origin SLA	1.15	1.12	1.12
Jobs in destination SLA	1.11	1.21	1.10
Distance or time between origin and destination SLA	-1.36	-1.62	-1.30
Direct rail connection * log of distance/time	0.11	0.09	0.14
Freeway connection * log of distance/time	0.17	0.06	0.21
Skills mismatch index for origin-destination pair	-1.85	-2.25	-1.81
Robust t-values			
Constant	-43.6	-34.2	-44.0
Employed residents in origin SLA	46.2	39.4	43.8
Jobs in destination SLA	62.0	62.3	61.2
Distance or time between origin and destination SLA	-76.7	-67.8	-66.2
Direct rail connection * log of distance	12.1	11.8	14.0
Freeway connection * log of distance	9.3	4.5	10.7
Skills mismatch index for origin-destination pair	-13.5	-14.7	-13.1

Note: Straight line distance estimates derived by BITRE. Where there are no commuters flow between two SLAs, TZ-TZ based distance cannot be calculated, so SLA-centroid based distance has been used instead.

Source: Estimated by BITRE using OLS estimation and robust standard errors, based on ABS 2006 *Census of Population and Housing* commuting, jobs and employed residents data and BTS' Sydney Strategic Travel Model road network distance and time outputs.

Fixing parameters on employed residents in origin SLA and jobs in destination SLA to one

Gravity models are frequently used to model trade flows between countries, or flows of long-distance travellers between cities. In both these cases, there is no a priori relationship between the mass variables and the explanatory variable: in the case of trade for example, the overall amount of trade, as well as the distribution of that trade, is one of the things the model is aiming to explain. In this case, the parameters on the 'mass' variables can be interpreted as 'propensities' to trade or travel respectively. The propensities could be significantly different from one: if the population of two regions doubles, it is plausible that the overall level of trade more than doubles, or that the number of travellers between the two regions more than doubles.

However, in our modelling of commuter flows, the overall number of commuters is not indeterminate in the same way, but is fixed by the overall number of jobs. With this specification, the ‘propensity’ for a marginal additional worker or job to induce an additional commute must be close to one, and when these parameters are significantly different from one, the model can cease to be useful for predictive purposes.⁷²

However, there is also an aggregation problem when the parameters are fixed at one: with this specification, an equi-proportional increase in workers and jobs in all SLAs would be predicted to result in a greater increase in the number of commutes. For the gravity model to make sense in this aggregate predictive sense, we need the parameters to sum to one.

Table B.4 shows the results of regressions in which the employed resident and job parameters are fixed at one and one half. In both cases, altering the population parameters does not have a significant effect on the distance parameter.

If, when the model is used for predictions, a balancing parameter is used to constrain total commutes to total jobs, as long as the values of these parameters are not significantly different to each other, their value does not have a significant effect on the predictions of commuting patterns.

Table B.4 Comparison of base gravity model to models with fixed parameters on number of employed residents and jobs, Sydney, 2006

	With unfixed parameters	With mass parameters fixed at one	With mass parameters fixed at one half
R-squared	74.3	71.4	56.8
Constant	-14.75	n/a	n/a
Employed residents in origin	1.19	n/a	n/a
Jobs in destination	1.14	n/a	n/a
Straight line distance parameter	-1.35	-1.36	-1.37

Source: Estimated by BITRE based on ABS 2006 *Census of Population and Housing* commuting, jobs and employed residents data.

Weighted least squares regression

Observations of commuting flows from low-population SLAs may have greater variance than those of larger areas (due to the lower ‘sample’). This can result in ordinary least squares not leading to ‘best linear unbiased estimates’. In a sense, low-population SLA pairs may be over-represented when fitting the model. A possible treatment is to weight the observations by the reciprocals of the variance. As the variance itself is likely to be inversely related to the number of resident workers in the origin SLA, this has been chosen as a weighting.

Table B.5 shows the results of this regression compared to that for the base model. The explanatory power of this model is slightly higher than for the OLS regression used for the base model. The most important difference is that the estimated distance parameter is significantly lower when weighted least squares is used.

⁷² Note that the number of workers will be slightly different from 1, as there is some commuting across the border of the region modelled. Nevertheless, the system is qualitatively different to that of trade or long-distance travel, and the propensity is effectively constrained to be close to one.

Table B.5 Comparison of base gravity model to model using weighted least squares estimation, Sydney, 2006

	Base model regression (ordinary least squares)	With weighted least squares regression
R-squared	74.3	81.1
Constant	-14.75	-16.73
Employed residents in origin	1.19	1.22 (0.01)
Jobs in destination	1.14	1.25 (0.01)
Straight line distance parameter	-1.35	-1.21 (0.02)

Note: Numbers in brackets represent standard errors.

Source: Estimated by BITRE based on ABS 2006 *Census of Population and Housing* commuting, jobs and employed residents data.

Use of a Poisson model

In the base model described in chapter eight, all SLA pairs with reported commuting flows of three or less were omitted from the data for the regression. This was done partly because of unreliability of numbers three or less in the data, due to the ABS randomising to protect privacy. However it was also convenient because zero flows cannot be incorporated into the basic model due to the impossibility of dividing by zero. In general, the appropriateness of including zeros depends on the nature of the transport activity being modelled. For pairs where it is believed that flows are impossible for some reason (such as trade flows between certain countries), it is appropriate to exclude such pairs from the model, while pairs where flows are possible but are zero should be included. We can think of all pairs where flows are possible as having a positive expected flow, but with a high probability of being zero. For these pairs the fact that flows are so low—possibly due to large distances or low populations—is part of the phenomena the gravity model is intended to explain, and excluding such pairs may represent a loss of important information, and has been shown to lead to bias. A Poisson model may also be a closer approximation to the multinomial nature of the system.

Table B.6 shows the results for a Poisson regression compared with the base model regression. While the parameters on number of employed residents and number of jobs are still close to one, the parameter on distance is significantly lower than in the base model. That is, with this specification, distance appears to play less of a role in explaining commuter flows.

Table B.6 Comparison of base gravity model to Poisson regression results, Sydney, 2006

	Base model	Poisson model
Sample	3788	4096
Adjusted R-squared	74.3	n/a
Parameter estimates (standard error)		
Constant	-14.75	-13.02 (0.02)
Employed residents in origin SLA	1.19	1.16 (0.00)
Jobs in destination SLA	1.14	0.92 (0.00)
Distance between origin and destination SLA	-1.35	-0.89 (0.00)

Source: Estimated by BITRE based on ABS 2006 *Census of Population and Housing* commuting, jobs and employed residents data.

Gravity model using travel zone pairs

The existence of travel zone level commuting data allows estimation of a gravity model using this much larger data set. In the Sydney Greater Metropolitan Area, there are 7 236 100 travel zone pairs. Because 95 per cent of these pairs have no commuting flow between them, it is not feasible to exclude zero-flow pairs as was done in the base model. For the reasons described above, a Poisson distribution has been assumed instead.

Table B.7 shows the results for the gravity model using travel zone pairs compared with the model using SLA pairs, for the Greater Metropolitan area, and using a Poisson regression. The distance parameter estimated using travel zone pairs is not significantly different to that using SLA pairs, so would not appear to lead to significantly different conclusions. This may reflect that, even using SLA level data, the number of sample points is already high enough for all parameter estimates to be highly significant.

Table B.7 Comparison of gravity model of origin-destination travel zone commuter flows and model of origin-destination Statistical Local Area flows, Sydney Greater Metropolitan Area, 2006

	SLA-SLA regression, using Poisson regression	TZ-TZ regression, using Poisson regression
Sample	6 400	7 236 100
Parameter estimates (standard error)		
Constant	-11.58 (0.02)	-12.00 (0.01)
Employed residents in origin travel zone	1.21 (0.00)	1.18 (0.00)
Jobs in destination travel zone	0.81 (0.00)	0.94 (0.00)
Distance between origin and destination travel zones	-1.21 (0.00)	-1.21 (0.00)

Source: Estimated by BITRE based on ABS 2006 *Census of Population and Housing* commuting, jobs and employed residents data.

Abbreviations and acronyms

ABS	Australian Bureau of Statistics
AHURI	Australian Housing and Urban Research Institute
ANZSIC	Australian and New Zealand Standard Industry Classification
ASBEC	Australian Sustainable Built Environment Council
ASGC	Australian Standard Geographical Classification
Bal	Balance
BITRE	Bureau of Infrastructure, Transport and Regional Economics
BTCE	Bureau of Transport and Communication Economics
BTS	Bureau of Transport Statistics (previously known as TDC)
Cat.	Catalogue
CBD	Central Business District
CCD or CD	Census Collection District
CIE	Centre for International Economics
COAG	Council of Australian Governments
DEEWR	Department of Education, Employment and Workplace Relations
DHA	Department of Health and Ageing
DIAC	Department of Immigration and Citizenship
DIPNR	Department of Infrastructure, Planning and Natural Resources
DIT	Department of Infrastructure and Transport
DZ	Destination Zone
e.g.	Latin, short for <i>exempli gratia</i> , meaning for example
EDO	Environmental Defender's Office
EPIs	Environmental Planning Instruments
ERP	Estimated Resident Population
et al.	Latin, short for <i>et alia</i> , meaning and others
GMA	Greater Metropolitan Area
GPO	General Post Office
HILDA	Household Income and Labour Dynamics in Australia
HTS	Household Travel Survey
i.e.	Latin, short for <i>id est</i> , meaning that is
ibid.	Latin, short for <i>ibidem</i> , meaning in the same place
JTW	Journey to Work

LEP	Local Environmental Plan
LGA	Local Government Area
MDP	Metropolitan Development Plan
No.	Number
NSW	New South Wales
OLS	Ordinary Least Squares
PAC	Planning Assessment Commission
PC	Productivity Commission
PIA	Planning Institute of Australia
Pt	Part
SD	Statistical Division
SEPP	State Environmental Planning Policy
SLA	Statistical Local Area
SPA	State Planning Authority
SSD	Statistical Subdivision
STM	Strategic Travel Model
TDC	Transport Data Centre
TPDC	Transport and Population Data Centre
TZ	Travel Zone
WZ	Working Zone

References

Abelson, P 2010, *Residential building activity in Sydney: an overview and seven case studies*, Paper prepared for NSW Treasury, accessed 19 December 2011 from www.treasury.nsw.gov.au/___data/assets/pdf_file/0004/18562/GIPA_11_21_Report_Building_Activity_Peter_Abelson_Sept_2010_dnd.pdf

ABS, see Australian Bureau of Statistics.

Australian Bureau of Statistics 2003, 2001 *Census of Population and Housing: Census Basics* (re-issued December 2003), Cat. 2045.0.30.001, Australian Bureau of Statistics, Canberra.

-- 2006a, *Statistical geography volume 1: Australian Standard Geographic Classification (ASGC)* July 2006, Cat. 1216.0, Australian Bureau of Statistics, Canberra.

-- 2006b, *Labour force status, Census dictionary 2006*, Cat. 2901.0, Australian Bureau of Statistics, Canberra.

-- 2006c, *Australian Historical Population Statistics, 2006*, Cat. 3105.0.65.001, Australian Bureau of Statistics, Canberra.

-- 2006d, *Environmental issues: people's views and practices*, Cat. 4130.0.55.001, Australian Bureau of Statistics, Canberra.

-- 2007a, *2006 Census of Population and Housing: Basic Community Profile Data pack second release*, Cat. 2069.0.30.001, Australian Bureau of Statistics, Canberra.

-- 2007b, *2006 Census of Population and Housing: Place of Enumeration Profile Data pack second release*, Cat. 2069.0.30.004, Australian Bureau of Statistics, Canberra.

-- 2008, *Population projections, Australia, 2006 to 2101*, Cat. 3222.0, Australian Bureau of Statistics, Canberra.

-- 2009a, *Environmental issues: waste management and transport use*, March 2009. Cat. 4602.0.55.002, Australian Bureau of Statistics, Canberra.

-- 2009b, *Residential and workplace mobility, and implications for travel: NSW and Vic*, October 2008, Cat. 3240.0, Australian Bureau of Statistics, Canberra

-- 2009c, *Consumer price index, Australia, Jun 2009*, Cat. 6401.0, Australian Bureau of Statistics, Canberra.

-- 2011a, *Regional population growth, Australia, 2009–10*, Cat. 3218.0, Australian Bureau of Statistics, Canberra.

-- 2011b, *Australian demographic statistics, Mar 2011*, Cat. 3101.0, Australian Bureau of Statistics, Canberra

-- 2011c, *Labour force, Australia, detailed—electronic delivery*, Cat. 6291.0.55.001, Australian Bureau of Statistics, Canberra.

--2011d, *Building approvals, Australia, September 2011*, Cat. 8731.0, Australian Bureau of Statistics, Canberra.

-- 2011e, *Labour force, Australia, detailed, quarterly, Aug 2011*, Cat. 6291.0.55.003, Australian Bureau of Statistics, Canberra.

Access Economics 2009, *Economic modelling of skills demand*, Report by Access Economics Pty Limited for Skills Australia, Access Economics, Canberra.

Audit Office of New South Wales 2005, *Liverpool to Parramatta Bus Transitways Performance Audit*, NSW Government, Sydney.

Australian Automobile Association 2011, *Petrol Prices*, Australian Automobile Association, Canberra, accessed May 2011 from www.aaa.asn.au/issues/petrol.htm

Austrroads 2011, *Austrroads National Performance Indicators*, Australian and New Zealand road system and road authorities, accessed 7 March 2012 from www.algin.net/austrroads/site/index.asp

Baker, J 2006, 'Transport's vision splendid running at only half capacity', *Sydney Morning Herald*, August 25 2006, accessed from www.smh.com.au/news/national/transport-s-vision-splendid-running-at-only-half-capacity/2006/08/24/1156012675629.html

Battellino, H and C Stone 2004, *Greater Western Sydney regional transportation study: forecasting travel demand*, Paper presented to The 27th Australasian Transport Research Forum, 29 September–1 October, Adelaide.

Beard, B 2011, *Who works where and how do they get there*, WESTIR Occasional Paper No. 6, WESTIR Ltd, Parramatta, Sydney.

BITRE, see Bureau of Infrastructure, Transport and Regional Economics

Brooker, T 2010, *Peak hour passenger train crowding levels in Sydney and their implications for urban consolidation*, proceedings of the 33rd Australasian Transport Research Forum, Canberra

BTCE, see Bureau of Transport and Communications Economics

BTS, see Bureau of Transport Statistics, formerly known as Transport Data Centre (TDC).

Bunker, R and D Holloway 2006, *How much of 'City of Cities, A plan for Sydney's future' is likely to happen?*, City Futures Research Centre, Issues Paper No. 2, The University of New South Wales, Sydney.

Bunker, R, D Holloway and B Randolph 2005, 'The expansion of urban consolidation in Sydney: social impacts and implications', *Australian Planner*, Vol. 42, no. 3, pp. 16–25.

Bunker, R 2007, *Progress and prospect with 'City of Cities: a plan for Sydney's future*, City Futures, Sydney, City Future Research Centre, The University of New South Wales, Sydney.

-- 2008, *Metropolitan strategies in Australia*, Research paper No.9, City Futures Research Centre, pp.1-83, The University of New South Wales, Sydney.

- Bunker, R and G Searle 2007, 'Seeking certainty: recent planning for Sydney and Melbourne', *Town Planning Review*, Vol.78, no.5, pp.619-642.
- Bunker, R, A Tice, et al. 2009, *Travel characteristics and access to jobs by higher density residents in Sydney and Melbourne*. Sydney, City Futures Research Centre, The University of New South Wales, Sydney.
- Bureau of Transport and Communications Economics 1996, *Costs of reducing greenhouse gas emissions from Australian cars: An application of the BTCE CARMOD model*, BTCE, Canberra
- Bureau of Transport and Regional Economics 2003, *Focus on Regions Number 1: Industry structure*, Information Paper Number 49, BTRE, Canberra.
- 2007, *Estimating urban traffic and congestion cost trends for Australian cities*, Working Paper 71, BTRE, Canberra.
- Bureau of Infrastructure, Transport and Regional Economics 2009a, *Changes in Australia's industry structure: main cities 2001-06*, Information Sheet 32, BITRE, Canberra.
- 2009b, *National road network intercity traffic projections to 2030*, Working Paper 75, BITRE, Canberra.
- 2010, *Population growth, job growth and commuting flows in Perth*, Report 119, BITRE, Canberra.
- 2011, *Population growth, job growth and commuting flows in Melbourne*, Report 125, BITRE, Canberra.
- 2012a, *Public transport use in Australia's capital cities: Modelling and Forecasting*, Report 129, BITRE, Canberra.
- 2012b, *Understanding Australia's urban railways*, Report 131, BITRE, Canberra.
- (forthcoming), *Australian capital city traffic projections 2006–2031*, BITRE, Canberra.
- Bureau of Transport Statistics 2011, *2009–10 Household Travel Survey summary report (2011 release)*, NSW Bureau of Transport Statistics, Sydney.
- Centre for International Economics 2010, *The benefits and costs of alternative growth paths for Sydney—economic, social and environmental impacts*, Centre for International Economics, Sydney, www.metroplansydney.nsw.gov.au/Portals/0/pdf/AlternativeGrowthPaths.pdf
- Chancellor, J 2011, 'Urban density joins the political debate', *Sydney Morning Herald*, February 28, 2011.
- Christie, R 2010, *Long-Term Public Transport Plan for Sydney*, Final report, Office of the Independent Public Inquiry, Sydney, www.transportpublicinquiry.com.au/pdf/F2_Public_Transport_Inquiry_Final_Report_26May2010_full_report.pdf
- COAG Reform Council 2012, *Review of capital city strategic planning systems*, COAG Reform Council, Sydney.
- Corpuz, G 2006, *Analysis of peak hour travel using Sydney Household Travel Survey data*, Paper presented to the 29th Australasian Transport Research Forum, 27–29 September, Gold Coast.
- Daniels, R 2007, *Jobs closer to home: what does it mean and how to achieve it*, Paper presented to The 30th Australasian Transport Research Forum, 25–27 September, Melbourne.

Department of Health and Ageing 2009, *Statistical local area population projections, 2007 to 2027, revised*, Department of Health and Ageing, Canberra, Retrieved 15 August 2011 from www.health.gov.au/internet/main/publishing.nsf/Content/ageing-stats-lapp.htm

Department of Infrastructure and Transport 2011, *Our cities, our future: a National Urban Policy*, Department of Infrastructure and Transport, Canberra.

Department of Planning 2005a, *MDP 2005 Metropolitan Development Program—Summary, Databook, Atlas* (CD), NSW Department of Planning, Sydney.

-- 2005b, *NSW Government's plan for the Western Sydney Employment Hub*, NSW Department of Planning, Sydney.

-- 2007a, *Employment lands for Sydney Action Plan*, NSW Department of Planning, Sydney.

-- 2007b, *Inner North subregion: Draft subregional strategy*, NSW Department of Planning, Sydney.

-- 2008, *New South Wales State and Regional Population Projections, 2006–2036: 2008 Release*, Department of Planning, Sydney.

-- 2009, *MDP 2006 Metropolitan Development Program—Summary, Databook, Atlas* (CD), Department of Planning, Sydney.

-- 2010a, *MDP 2008 Metropolitan Development Program—Summary, Databook, Atlas* (CD), Department of Planning, Sydney.

-- 2010b, *New South Wales Statistical Local Area Population Projections, 2006–2036*, April 2010, Department of Planning, Sydney.

Department of Planning and Infrastructure 2011a, *Standard instrument*, accessed 15 June 2011 from www.planning.nsw.gov.au/LocalEnvironmentalPlans/StandardInstrument/tabid/247/language/en-US/Default.aspx

-- 2011b, *The major projects assessment system*, accessed 5 August 2011 from www.planning.nsw.gov.au/DevelopmentAssessments/Majorprojectassessments/tabid/203/language/en-US/Default.aspx

-- 2011c, *Home page*, accessed 15 June 2011 from www.planning.nsw.gov.au/Home/tabid/471/language/en-US/Default.aspx

-- 2011d, *Environmental Planning and Assessment Amendment (Part 3A Repeal) Bill 2011: an overview*, Fact Sheet, accessed 5 August 2011 from www.planning.nsw.gov.au/DevelopmentAssessments/Majorprojectassessments/tabid/203/language/en-US/Default.aspx

-- 2011e, *Land supply and management*, accessed 17 June 2011 from www.planning.nsw.gov.au/Programsservices/LandSupplyandManagement/Metropolitandevlopmentprogram/tabid/126/language/en-AU/Default.aspx

-- 2011f, *North West Growth Centre*, accessed 19 December 2011 from www.gcc.nsw.gov.au/north+west-21.html

-- 2011g, *South West Growth Centre*, accessed 19 December 2011 from www.gcc.nsw.gov.au/south+west-22.html

-- 2011h, *2010–11 Metropolitan Development Program Report*, Department of Planning and Infrastructure, Sydney.

Department of Transport 2011, *North West Rail Link Community Newsletter*, NSW Government, June 2011, accessed 17 October 2011 from northwestrail.com.au/document/show/7

Department of Urban Affairs and Planning 1998, *Shaping our Cities*, NSW Government, Sydney.

DHA, see Department of Health and Ageing

Department of Infrastructure Planning and Natural Resources 2003, *Long-term strategic plan for rail* — Cabinet in confidence, Department of Infrastructure, Planning and natural resources, Sydney, www.railcorp.info/___data/assets/pdf_file/0003/6834/2003_Long-Term_Strategic_Plan_For_Rail.pdf

-- 2004, *'Sydney's Economic Geography: Trends and Drivers'*, SGS Economics and Planning, Sydney, NSW Department of Infrastructure Planning and Natural Resources.

DIPNR, see Department Infrastructure, Planning, and Natural Resources.

Dodson, J 2009, *The infrastructure Turn in Australian metropolitan spatial planning*, Urban Research Program, Research Paper, Urban Research Program, Griffith University, Brisbane.

Easthope, H and B Randolph 2008, *Governing the compact city: The challenges of apartment living in Sydney*, Sydney, City Futures Research Centre, The University of New South Wales, Sydney.

Environmental Defender's Office (EDO) 2009, *Planning in NSW: Reconnecting the community with the planning system*, Discussion Paper, accessed 14 June 2011 from www.edo.org.au/edonsw/site/pdf/pubs/091112planning_discussion_paper.pdf

Ergas, H 2012, 'Urban infrastructure and land use', Paper presented to the *Infrastructure Economics and Policy Workshop: new tools for new problems*, 24 February 2012, SMART Infrastructure Facility, University of Wollongong.

Fagan, B and R Dowling 2005, 'Neoliberalism and suburban employment: Western Sydney in the 1990s', *Geographical Research*, Vol. 43, no. 1, pp. 71–81.

Glazebrook, G 2009, 'Designing a thirty year public transport plan for Sydney', University of Technology, Sydney, from <http://www.dab.uts.edu.au/research/outcomes/garry-glazebrook-main.pdf>

Gleeson, B, T Darbas and S Lawson 2004, 'Governance, sustainability and recent Australian metropolitan strategies: a socio-theoretic analysis', *Urban policy and research*, Vol. 22, no. 4, pp. 345–366.

Harsman, B and J Quigley 1998, 'Education, job requirements and commuting: an analysis of network flows' in Beckman (ed), *Knowledge and networks in a dynamic economy*, pp. 261–72, Springer, New York.

Hay, A 2009, 'Household and workplace mobility: implications for travel', Paper presented to the 32nd Australasian Transport Research Forum, 29 September–1 October, Auckland.

Haynes, R 2012, 'Two wheels beats four in race to Parramatta', *The Telegraph*, 16 March.

Hazzard, B 2011, 'Overhaul of the planning system heralds a new era in NSW', Media Release, July 12 2011, accessed 5 August 2011, www.nsw.liberal.org.au/news/planning/overhaul-of-the-planning-system-heralds-a-new-era-in-nsw

-- 2012, 'Planning for Sydney's big challenges', Media Release, May 3 2012, accessed 4 May 2012, www.planning.nsw.gov.au/AboutUs/Contactus/MediaCentre/tabid/381/language/en-US/Default.aspx

Hensher, D and X Chen, 2010, 'What does it cost to travel in Sydney? Spatial and equity contrasts across the metropolitan region', Working paper, Institute of Transport and Logistics Studies, Sydney.

Hutchings, A and S Hammets 2006, *Metropolitan planning, state of South Australia: trends and issues* 2006 update, Adelaide, Australian Institute for Social Research, Don Dunstan Foundation.

Iemma, M 2006, Premier's economic and financial statement, February 26, accessed 10 August 2011, www.hawkerbritton.com/hawker-britton-media/public-affairs/morris-iemma-premiers-statement.htm

Infrastructure Partnerships Australia 2012, *Integrating Australia's transport systems: A strategy for an energy efficient future*, accessed 19 July 2012, www.infrastructure.org.au/Content/Integratingtransportsystems.aspx

Kelly, T 2010, *Sydney Metropolitan Development Authority*, Media Release, 23 September 2010, accessed 14 June 2011 from www.smda.nsw.gov.au/downloads/press_release.pdf

Keneally, K (NSW Government Planning Minister) 2009, *New funding for joint regional planning panels*, media release, 3 June 2009, Sydney.

Kilsby, D and F Milthorpe 2002, *Scenario modelling for Sydney*, Paper presented at the 25th Australasian Transport Research Forum, Canberra, 3 October.

Kipfer, S and R Keil 2002, 'Toronto Inc? Planning the competitive city in the new Toronto,' *Antipode* Vol.34, no.2, pp.227–264.

KPMG 2010, *Spotlight on Australia's Capital Cities: An independent assessment of city planning systems*, Built Environment Meets Parliament.

Kubler, D 2005, 'Problems and prospects of metropolitan governance in Sydney: Towards 'old' or 'new' regionalism?' Research Paper. Sydney City Futures Research Centre, University of New South Wales.

Leighton 2011, *Completed projects*, Leighton Holdings Limited, St Leonards, Sydney, accessed May 2011 from http://www.leighton.com.au/shareholder_centre/projects/projects_archive_by_group_company.html

Major Cities Unit 2011, *State of Australian Cities 2011*, Department of Infrastructure and Transport, Canberra.

Melbourne Institute 2009, 'Time spent travelling to and from work', in *Families, income and jobs, volume 4: A statistical report on waves 1 to 6 of the HILDA survey*, pp. 202–204, Melbourne Institute, Melbourne.

- Meyer B 2005, 'Future Sydney—a city of cities', Paper presented to Post suburban Sydney Conference: After Sprawl, November 22–23, Parramatta.
- Milthorpe, F 2009, 'Consistency in Daily Travel Time – An Empirical Assessment from Sydney Travel Surveys', proceedings of the 32nd Australasian Transport Research Forum, Auckland.
- Moore, M 2012, 'Rezoning blitz in push for housing', *Sydney Morning Herald*, January 30 2012.
- Nicholls, S 2011, 'Libs' 'urban sprawl' criticised', *Sydney Morning Herald*, 15 February 2011.
- Norley, K 2010, 'The role of the rail system in the Sydney journey to work – a geospatial analysis', Proceedings of the 33rd Australasian Transport Research Forum, Canberra.
- NSW Government 1999, *Shaping our Cities*, NSW Government, Sydney.
- 2005, *City of Cities: a plan for Sydney's future*, NSW Government, Sydney.
- 2006, *NSW State Plan 2006: A new direction for NSW*, NSW Government, Sydney.
- 2010a, *Metropolitan Plan for Sydney 2036*, NSW Government, Sydney
- 2010b, *Metropolitan Transport Plan—Connecting the City of Cities*, NSW Government, Sydney
- 2010c, *NSW State Plan 2010: Investing in a better future*, NSW Government, Sydney
- 2011a, 100 day action plan, accessed 29 June 2011 from www.nsw.liberal.org.au/download/100-day-plan.html
- 2011b, Budget Paper No. 4: Infrastructure Statement 2011–12, NSW Government, accessed 30 September 2011 from www.budget.nsw.gov.au/budget_papers_2011-12/bp4/2011-12_budget_paper_4
- 2011c, NSW 2021: A plan to make NSW number one, NSW Government, accessed 30 September 2011 from www.2021.nsw.gov.au/
- 2011d, NSW 2021 *baseline report* (December 2011), NSW Government, accessed 13 February 2012 from www.2021.nsw.gov.au/reports
- 2012, *Sydney over the next 20 years—A discussion paper* (May 2012), NSW Government, accessed 4 May 2012 from www.planning.nsw.gov.au/StrategicPlanning/MetropolitanPlanningforSydney/tabid/487/language/en-US/Default.aspx
- O'Farrell, B 2011, Accelerated land release to make Sydney housing more affordable, Media Release, 12 July 2011, accessed August 5 2011, www.gcc.nsw.gov.au/what%27s+new-10.html
- O'Neill, P 2010, 'Time to ban Western Sydney's blue singlet image and inject some vital capital into 'business parks'', *Macarthur Advertiser*, 7 January, viewed 28 January 2010 from www.macarthuradvertiser.com.au/
- O'Neill, P and P McGuirk 2002, 'Prosperity along Australia's Eastern Seaboard: Sydney and the geopolitics of urban and economic change.' *Australian Geographer* Vol.33, no.3, pp.241--261.
- Parolin, B 2005, 'Employment centres and the journey to work in Sydney', Paper presented to the State of Australian Cities, 2nd National Conference, Brisbane, 30 November to 2nd December.
- PC, see Productivity Commission

Pfister, N, R Freestone and P Murphy 2000, 'Polycentricity or dispersion? Changes in center employment in metropolitan Sydney, 1981 to 1996', *Urban geography*, Vol. 21, no. 5, pp. 428–42.

Planning Assessment Commission 2010, Annual Report 2009–10, accessed 14 June 2011 from www.pac.nsw.gov.au/LinkClick.aspx?fileticket=PYmcPy4luh0%3d&tabid=38>

Productivity Commission 1998, *Aspects of structural change in Australia*, Research Report, AusInfo, Canberra.

-- 2011, Performance benchmarking of Australian business regulation: Planning, zoning and development assessments, Productivity Commission Research Report, April.

-- 2004, 'Metro strategy: A property industry perspective', accessed 3 February 2010 from www.propertyoz.com.au/library/

Randolph, B and R Freestone 2008, *Problems and prospects for Suburban Renewal: An Australian Perspective*, Sydney, City Future Research Centre.

Randolph, B, S Pinnegar, H Easthope and A Tice 2010, *Metropolitan Strategy Review: Sydney Towards 2036*, Submission from City Futures Research Centre, UNSW.

Roads and Maritime Services 2011, accessed 2 March 2012 from [www.rta.nsw.gov.au/ .../annual_speed_and_traffic_volume_data_2009-2010.pdf](http://www.rta.nsw.gov.au/.../annual_speed_and_traffic_volume_data_2009-2010.pdf)

Roads and Traffic Authority 2011, *About Sydney motorways*, NSW Government, Sydney, accessed May 2011 from <http://sydneymotorways.com/about.html>

Roberts, BH and A Murray 2002, 'National and Regional Corporate Spatial Structure.' *The Annals of Regional Science* Vol.36, no.3, pp.347–368.

Roberts, BH and MJ Enright 2004, 'Industry clusters in Australia: recent trends and prospects.' *European Planning Studies* Vol.12, no.1, pp. 99–121.

Salusinszky, I 2011, NSW planning minister's powers curbed, *The Australian*, 5 April 2011.

Searle, G 2002, 'The demise of place equity in Sydney's economic development planning.' *Australian Geographer*, Vol.33, no.3, pp. 317–36

-- 2004, 'Sydney's Recent Metropolitan Strategies.' *Urban Policy and Research* Vol.22, no.4, pp. 367–391.

SGS 2004, *Sydney's economic geography: trends and drivers*, Report prepared on behalf of Department of Infrastructure, Planning and Natural Resources, June.

-- 2008, *Melbourne employment projections—Final report*, Report prepared for the Victorian Department of Transport, SGS Economics and Planning, Melbourne.

SkillsInfo 2010, *New Jobs 2010*, Department of Education, Employment and Workplace relations (DEEWR), Canberra.

Spearritt, P 2000, *Sydney's Century a History*. Sydney, University of New South Wales Press Ltd.

Steering Committee of Joint Study of aviation capacity in the Sydney region 2012, *Joint study of aviation capacity in the Sydney region*, Australian Government and NSW Government, accessed 23 March 2012 from www.infrastructure.gov.au/aviation/sydney_av_cap/index.aspx

- Stilwell, F 1992, *Understanding Cities and Regions: Spatial Political Economy*. Sydney, Pluto Press.
- Sydney Metro 2008, Sydney's Metro Network – Priorities for Shaping Sydney's Grow, Sydney Metro, Government of NSW, Sydney [http://www.transport.nsw.gov.au/sites/default/file/metrodocs/Metro%20Network%20Development/05-Priorities%20Shaping%20Sydney's%20Future%20Dec%202009%20\(A70433\).pdf](http://www.transport.nsw.gov.au/sites/default/file/metrodocs/Metro%20Network%20Development/05-Priorities%20Shaping%20Sydney's%20Future%20Dec%202009%20(A70433).pdf)
- TDC, see Transport Data Centre
- Thornley, 1999, Urban Planning and competitive advantage: London, Sydney and Singapore. London, London School of Economic and Political Science. Discussion Paper 19.
- Transport and Population Data Centre 2003, *Regional transport indicators for Sydney*, Transport and Population Data Centre, Sydney
- 2006a, Statistics for the Subregional Planning Process, *TransFigures*, Transport and Population Data Centre, Sydney.
- 2006b, Trip flows into Sydney and other regional cities, *TransFigures*, Transport and Population Data Centre, Sydney.
- Transport Data Centre 1998, *Journey to work travel patterns in Sydney 1981–1996*, Report number 99/3, Transport Data Centre, Sydney.
- 2008a, *2006 Journey to work user guide (version 3.0)*, Transport Data Centre, Sydney
- 2008b, 'Employment and commuting in Sydney's centres, 1996 to 2006', *Transfigures*, December 2008, Transport Data Centre, Sydney.
- 2008c, '2006 employment and commuting', *Transfigures*, April 2008, Transport Data Centre, Sydney.
- 2009a, *Travel zone employment forecasts, October 2009 data release*, Technical documentation, Transport Data Centre, Sydney.
- 2009b, *TDC employment forecasts*, TDC online data access system, Transport Data Centre, Sydney.
- 2009c, *2007–08 Household Travel Survey—summary transport statistics by subregion*, Electronic publication number S2009/02, Transport Data Centre, Sydney.
- 2009d, *2007–08 Household Travel Survey—summary transport statistics by local government area*, Electronic publication number S2009/03, Transport Data Centre, Sydney.
- 2010, *2008/09 Household Travel Survey Summary Report 2010 Release*, Transport Data Centre, Sydney.
- Transport for NSW 2011, *Rail options for the Sydney Greater Metropolitan Area—Draft options paper*, Sydney, NSW Government, November.
- Transport Infrastructure Development Corporation 2010, *South West Rail Link—Overview*, NSW Government, accessed 17 October 2011 from www.tca.nsw.gov.au/ArticleDocuments/130/SWRL%20EA%20Summary%20Booklet-LR.pdf.aspx

Trendle, B and J Siu 2005, *Commuting patterns of Sunshine Coast residents and the impact of education*, Working paper number 37, Labour market research unit, Department of Education and Training, Queensland Government.

Trubka, R, P Newman and D Bilsborough (2009) Assessing the costs of alternative development paths in Australian cities, Curtin University Sustainability Policy Institute, Fremantle, http://sustainability.curtin.edu.au/local/docs/Curtin_Sustainability_Paper_0209.pdf

Urban Research Centre 2008, *North West and West Central Sydney employment strategies*, Urban Research Centre, University of Western Sydney, Sydney.

Urban Taskforce Australia 2010, *Getting Sydney back on track—how to re-boot the Sydney Metropolitan Strategy*, A submission to the NSW Department of Planning's Metropolitan Strategy Review, accessed 11 August 2011 from www.urbantaskforce.com.au/attachment.php?id=3425

VicRoads 2008, *Journey to work 1996–2006: census statistics for origin/destination of journeys to work, method of travel and mode share for Victorian geographies*, VicRoads, Melbourne

-- 2010, *Traffic monitor 2008–09*, VicRoads, Melbourne.

Ward, S 2007, *The decentralisation of key government services*, The Urban Development Research Institute.

Weber, AF 1967, *The growth of cities in the nineteenth century: a study in statistics*, Ithaca, Cornell University Press.

West A 2011, 'Boulevard of dreams comes with a hidden cost', *Sydney Morning Herald*, 15 February.

Western Australian Planning Commission 2003, *Greater Perth economy and employment*, Discussion Paper No. 3, WAPC, August.

Western Australian Planning Commission 2009, *Directions 2031: Draft spatial framework for Perth and Peel*, WAPC, June.

Williams, P 2007, 'Government, People and Politics' in Thompson, S. (ed), *Planning Australia: an Overview of Urban and Regional Planning*, Melbourne, Cambridge University Press, pp.29–48.

Yigitcanlar, T, J Dodson, B Gleeson, J Sipe and G Neil 2007, 'Travel self-containment in master planned estates: analysis of recent Australian trends', *Urban Policy and Research*, Vol.25, no.1, pp. 129–149.



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