



Future flying: Up in the air?

Better connections for good growth:
a case study of policy and practice for Sydney

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PREFACE

Future Flying: Up in the Air.

The central research aim of the Future Flying: Up in the Air research project was to establish how prosperity for the Edinburgh metropolitan area, and Scotland as a whole, might be maintained or enhanced as aviation activity to and from the city confronted the imperative of decarbonising to net zero by mid-century. The main report stresses the urgency of decarbonisation, the complexity of carbon chains in origin to destination movement of people and freight by flight, the range of technological possibilities for flight decarbonisation now emerging as well as more or less supportive on ground transport, land-use, economic development and planning policies and practice.

Whilst metropolitan areas are coming to share the same goal of net zero carbon in aviation varieties in context, differences in preferences

and in policy capabilities may lead to diverse and more or less effective carbon descent trajectories in metropolitan aviation with quite different prosperity-carbon reduction trade-offs. As governments at all scales now face major challenges in understanding climate change and the immense difficulties of constructing transition strategies it was important to get some sense of how Edinburgh was performing relative to other growing cities to review and report on how different cities are currently developing new strategic priorities and approaches, and how effectively they are doing so. Multiple case studies with equal weight were beyond the resource scale of this study and in addition to the core project focus on Edinburgh detailed assessments were made for Sydney and Toronto,

including key actor interviews, with further 'lighter touch' desk based reviews of Adelaide, Halifax, Toronto, and Dublin. References to Sydney and Toronto experiences are made in the Main report.

This paper focusses on the Sydney case study. In what follows, this report will start by presenting the background of the Sydney case study. Policy documents and secondary data are referred to in distilling the political thinking behind the development of major infrastructure and in particular the roles of airport infrastructure. It is followed by the methodology we used to gather first hand data. Section 3 then reports on interview findings. Conclusion will highlight the key lessons learnt and put the Sydney case in light comparison with that of Edinburgh.

The discussion is positioned in the emerging, in flux, and arguably unclear, policy narratives on achieving widening goals of 'green, sustainable, inclusive, and wellbeing economy'. These multiple narratives impose demanding expectations on metropolitan bureaucracies and policy makers to seek new trade-offs between different goals often without any formal decision framework, let alone policy calculus, and sometimes with no clear understanding of the links between different policy levers. The imperative for multiple orders of government to collaborate in governing carbon descent exacerbates these difficulties.

The project was primarily supported by Global Infrastructure Partners, who are the owners of Edinburgh Airport and part-owners of Kingsford-Smith Airport in Sydney.



CHAPTER 1

Better Growth, Stronger Connections: the Sydney Case.

1.1 Sydney context.

Sydney is the capital city of the state of New South Wales, and the most populous city in Australia. Located on Australia's east coast, the metropolis surrounds Port Jackson and extends about 70 km on its periphery towards the Blue Mountains to the west, Hawkesbury to the north, the Royal National Park to the south and Macarthur to the south-west. Sydney is comprised of 658 suburbs, spread across 33 local government areas. As of June 2021, Sydney's estimated metropolitan population was 5,231,147, contributing to around 66% of the state's population. Its gross regional product reached AU\$131.24 billion, accounting for 21% of the State's total (.id 2022). SGS Economics and Planning 2016 data showed that Financial and insurance services was the metropolitan's largest industry, accounting for a 16.2% share of the total income generated, ahead of Professional Services (8.5%), Health care & social assistance (5.7%) and Manufacturing (5.7%). Sydney makes up half of Australia's finance sector. There is a significant concentration of foreign banks and multinational corporations. The city is promoted by consecutive Commonwealth Governments as Australia's financial capital and one of Asia Pacific's leading financial hubs. In the 2017 Global Financial Centres Index, Sydney was ranked as the eighth most competitive financial centre in the world. In addition to Financial Services, the Creative and Technology sectors are focus industries for the City of Sydney and represented 9% and 11% of its economic output in 2012.

Despite being one of the most expensive cities in the world, Sydney frequently ranks in the top ten most liveable cities in the world. It is classified as an Alpha global city by the Globalization and World Cities Research Network, indicating its influence in the region and throughout the world. Sydney has hosted major international events such as the 2000

Summer Olympics. The city is among the top fifteen most-visited cities in the world, with millions of tourists coming each year to see the city's landmarks. Boasting over 1,000,000 ha (2,500,000 acres) of nature reserves and parks, its notable natural features include Sydney Harbour and Royal National Park. Built attractions such as the Sydney Harbour Bridge and the World Heritage-listed Sydney Opera House are also well known to international visitors. Central station is the hub of Sydney's rail network, and the main passenger airport serving the city is Kingsford Smith Airport, one of the world's oldest continually operating airports. However, as part of the metropolitan growth strategy, the State and the Commonwealth Government have used Australia's major City Deal to create Badgerys's Creek Airport as a focus for growing Western Sydney, that will open in 2026.

It is worth pointing out that, Sydney's growing prominence in the global network of cities has been a relatively recent affair, and there are still obstacles that hamper the city's growth ambition. PwC (2021) for example, assessed Sydney's current strengths and weaknesses as a global city. It identified Business prowess, Intellectual Capital, Adequate Infrastructure, and Enviably lifestyle as the specific attributes of a global city, and calculated Sydney's relative ranking from some of the most reputable reports. The relative rankings were then grouped around these four characteristics, with an average taken to produce a score. Consistently high scores (100 as maximal) highlight strengths, while comparably low scores identify areas of potential opportunity to focus upon. As expected, liveability of Sydney was ranked the highest (72.0) and its transport infrastructure was the lowest (39.0). Although its business prowess was ranked relatively high

(62.0), it was noticed that the 'Presence of global firms' (61.7) and 'Accessibility' (59.6) were the weaknesses of this Australia hub.

Specifically, the geographical distance of Australia to other economic centres presents a big challenge for all Australian cities and regions in general, and for Sydney specifically, to attract visitors and businesses. Moreover, when compared to other major international centres, infrastructure, and in particular sustainable transport performance, is

often identified as Sydney's fundamental drawback. Historic underinvestment in public transport infrastructure has led to a spiral of deteriorating commute times and capacity constraints which in turn leads to reliance upon private vehicles and increasing traffic congestion – a contrast to leading European and Asian centres. But there are significant investment happening now to alleviate this situation, which we will turn to later.



1.2 Making an economic case for airport development.

The report of PwC, as well as comments from our interviewees, all highlighted the natural geographical disadvantage of Australia in terms of its location. This underpins the significance of airport and affiliated infrastructures in Australia's development. Sydney is the aviation powerhouse and a gateway to Australia for many international visitors. This section highlights the economic contribution of the Sydney airport, drawing primarily upon the Deloitte (2018) report.

In measuring direct contributions associated with Airport and precinct operations, Deloitte used common financial measures, such as revenue, cost of goods sold, wages and precinct employment to estimate the Airport's contribution to the Australian economy, which is consistent with the framework used by the Australian Bureau of Statistics (See Chapter 3 of the Main Report for wider discussions of such studies and comparable results for Edinburgh). In measuring the derived benefits, i.e., demand for upstream inputs and further interlinkages with other sectors of the economy, the ABS supply-use (or input-output) tables were used to do the modelling. Data for both modelling came from the latest data on aggregate tourism expenditure and export freight value that passed through Sydney Airport, as well as fitted estimations based on a 2014 survey on value added and employment for each type of precinct business.

It was estimated that, the total economic contribution of the Sydney Airport precinct in 2017 were:

- **Direct contribution:** The activities of businesses operating on the Sydney Airport precinct contributed an estimated \$10.7 billion in value added, with associated employment of 57,400 full time equivalent (FTE) jobs; this represents 6.5% and 8.5% growth, respectively, since 2014.
- **Indirect contribution:** The contribution of tourism and freight facilitated by the airport is equivalent to a further \$27.3 billion in value added and generated an estimated 281,200 FTE jobs; this represents 32.5% and 10.8% growth, respectively, since 2014.

This remarkable growth was driven by a range of factors, including:

- A 21% increase in the value of freight exports through Sydney (BITRE 2018), reflecting both the changing profile of export goods to higher value products, and heightened demand due, in large part, to the falling Australian dollar between 2014 and 2017.
- A 21% increase in international passengers (SACL 2018). This comes despite a period of global economic and political uncertainty, and steadily increasing oil prices. Indeed, growth in inbound tourism expenditure over the period was observed to track well above average economic performance.

With a forward-looking modelling, considering factors such as air traffic and passenger volume growth, productivity, and airport development, it was expected that:

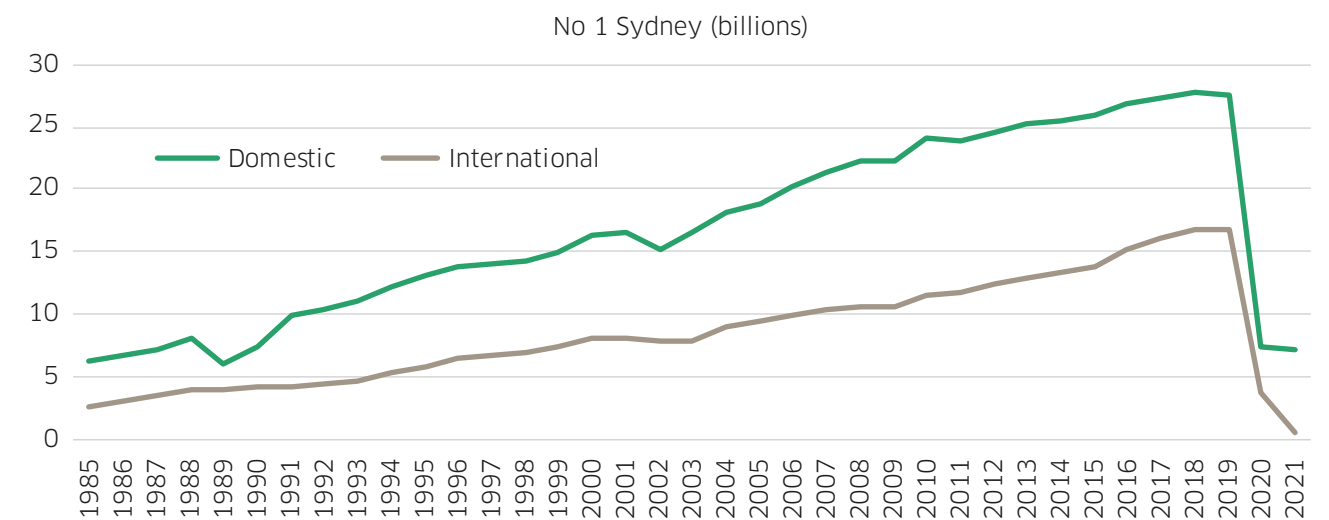
- The airport precinct's direct economic contribution would increase from \$6.2 billion in 2017 to \$7.4 billion by 2024, then to \$9.1 billion by 2039 in real terms (2017 \$).
- When the indirect impacts were taken into account, the total economic contribution of the airport precinct was projected to grow from \$10.7 billion in 2017 to \$12.8 billion by 2024, then to \$15.5 billion by 2039 in real terms.
- In terms of employment, direct FTE jobs would grow from 30,900 in 2017 to 36,200 in 2024, before declining marginally to 35,700 in 2039 (this decline is driven a predicted move to bigger more efficient planes). Total attributable FTE jobs will grow from 57,400 in 2017 to 63,700 in 2024, to 71,000 in 2039.

Both current and expected economic contributions of the Sydney airport had been estimated based on the volume of tourism and freight flows. BITRE aviation statistics showed that Sydney airport has been Australia's largest and busiest port, moving more domestic and international passengers than any other airport in Australia, even during

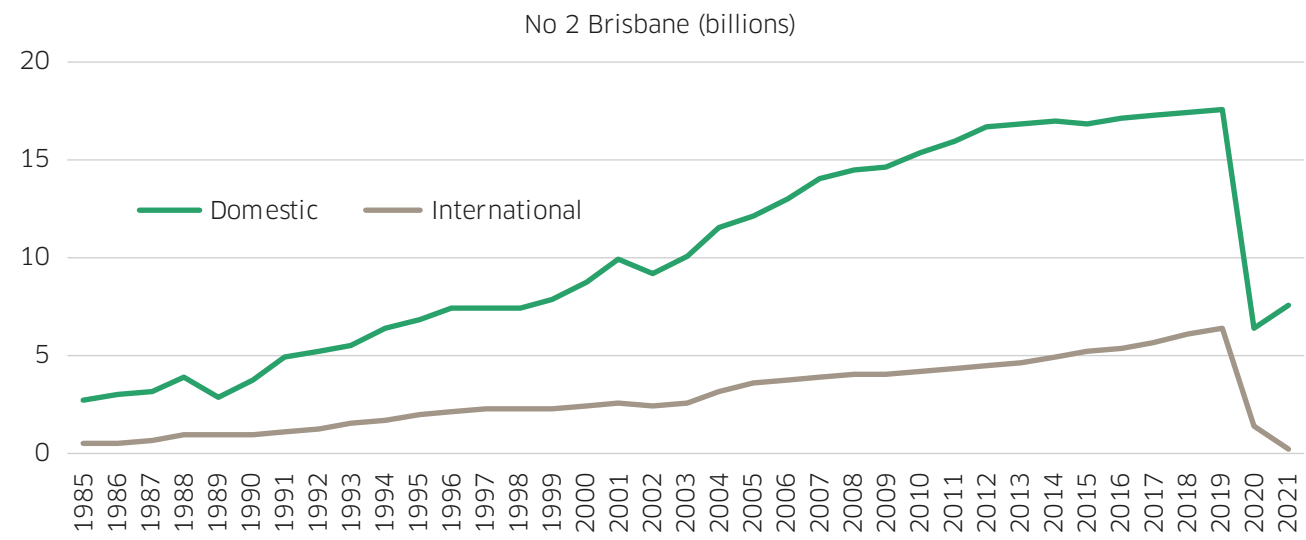
the pandemic (figure 1). At its peak time pre-pandemic (2018) for example, Sydney airport had 44,429,758 of domestic and international passenger movements, a share of 27.3 per cent of the Australia total. Australia border control put in place in April 2020 had dramatic impact on international passenger flows. Sydney airport managed to facilitate over 45 per cent of international passenger movements, followed by Melbourne of 23 per cent. The same dominant position of Sydney airport is recorded with freight

movement as well (figure 2). The total freight movements in Sydney were 568,346 tonnes at the end of 2021, contributing to 60 per cent of that in Australia. Given the importance of adequate infrastructure to service business and social needs in a network of centres that facilitate investment and social development, it is safe to argue that Sydney is the only global city in Australia, and the first point of call for business and tourism in this country (PwC 2021).

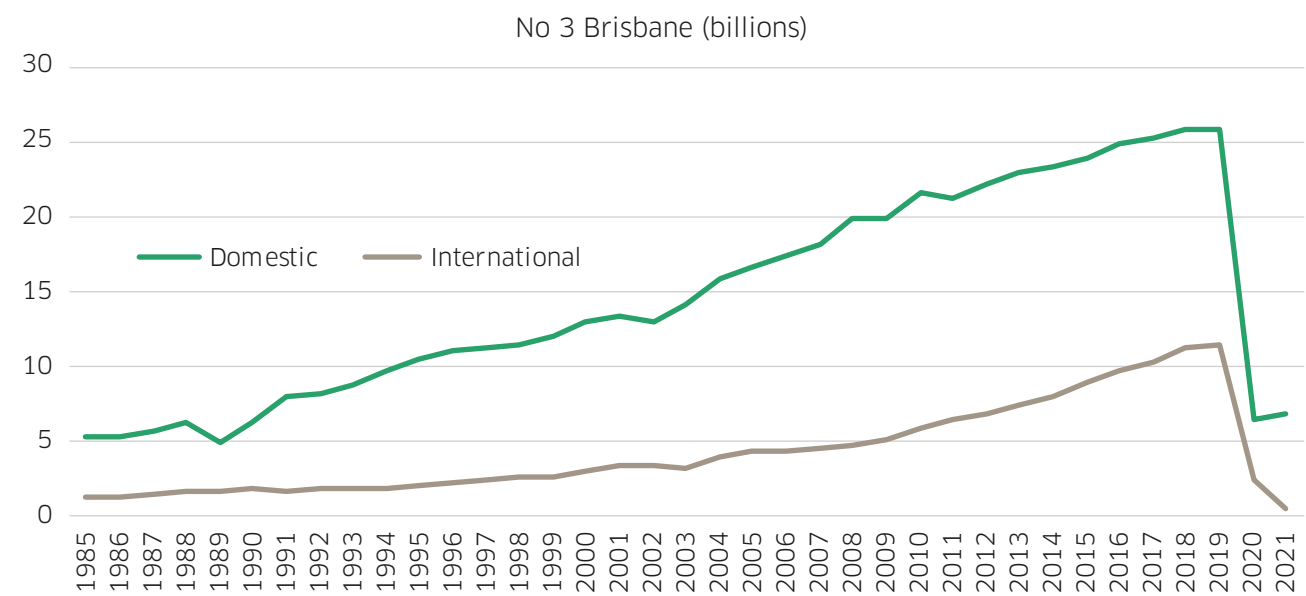
Figure 1 Passenger movements in Australia's top three busiest airports 1985-2021



	Domestic and Regional	International	Total
Passenger Movements in 2021 (millions)	7.163	0.730	7.892
Growth compared to 2020	-3.8%	-80.7%	-29.7%
Share of Total Australia in latest year	15.3%	46.9%	16.4%
Average annual growth:			
5 years 2016 to 2021:	-23.3%	-45.5%	-28.4%
10 years 2011 to 2021:	-11.4%	-24.3%	-14.0%
20 years 2001 to 2021:	-4.1%	-11.4%	-5.6%

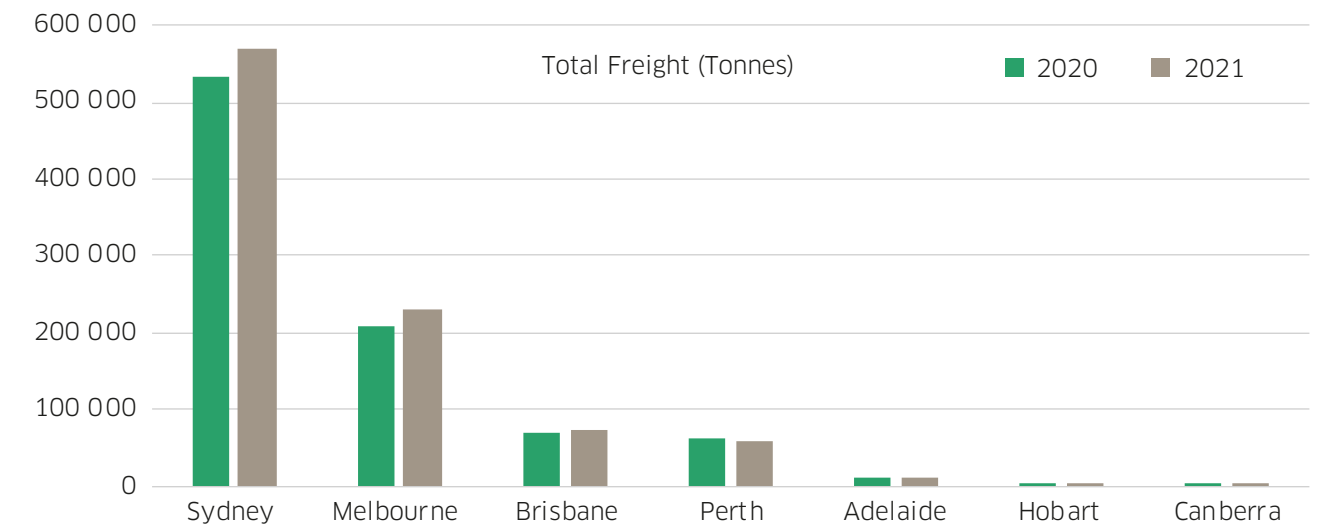


	Domestic and Regional	International	Total
Passenger Movements in 2021 (millions)	7.637	0.248	7.885
Growth compared to 2020	19.6%	-82.1%	1.4%
Share of Total Australia in latest year	16.4%	15.9%	16.3%
Average annual growth:			
5 years 2016 to 2021:	-14.8%	-46.1%	-18.9%
10 years 2011 to 2021:	-7.1%	-25.1%	-9.0%
20 years 2001 to 2021:	-1.3%	-11.0%	-2.3%



	Domestic and Regional	International	Total
Passenger Movements in 2021 (millions)	6.764	0.397	7.160
Growth compared to 2020	4.7%	-83.7%	-19.5%
Share of Total Australia in latest year	14.5%	25.5%	14.8%
Average annual growth:			
5 years 2016 to 2021:	-22.8%	-47.2%	-26.9%
10 years 2011 to 2021:	-10.8%	-24.4%	-12.6%
20 years 2001 to 2021:	-3.3%	-10.1%	-4.1%

Figure 2 Scheduled international freight movements in major Australian airports



CHAPTER 2

Urban development strategy and key infrastructure investment.

As the interview work for the case study was being undertaken the then Government of New South Wales extended its 'arms-length/independent' strategic planning body for the metropolis, the Greater Sydney Commission, to become the Greater Cities Commission with a role to look beyond polycentric, spreading Sydney, and give new integrated focus to the strategic inter-urban links south to Wollongong and north to Newcastle. As the final report was written a new State government, with a very active interest in investment in infrastructure, transport and housing, abolished

the Greater Cities Commission, whilst recognising the quality of their strategic spatial advice and decision taking they have taken the view that the limited powers of a Commission to deliver local change required functions to be reintegrated into a strengthened core government department embracing planning, economic development and infrastructure. Both the strong strategic spatial planning prior to 2024 and the strongly integrated department for future spatial economic change have no Scottish equivalent.



2.1 Strategic Planning

A Metropolis of Three Cities is a comprehensive strategic plan released by the Greater Sydney Commission (2018). It aims to align infrastructure and growth to restructure economic activity and

access across the established Eastern Harbour City, the developing Central River City, and the emerging Western Parkland City (figure 3).

Figure 3 Greater Sydney Region



KEY

- Region Boundary
- District Boundary
- Local Government Area
- Waterways

DISTRICTS

- Conral City Blacktown, Cumberland, Parramatta, The Hills
- Eastern City Strate Bayside, Burnwood, Canada Bay, City of Sydney, Inner West, Randwick, Strathfield, Waverley, Woollahra
- North Hornsby, Hunters Hill, Ku-ring-gal, Lane Cove, Mosman, North Sydney, Northern Beaches, Ryde, Willoughby
- South Canterbury-Bankstown, Georges River, Sutherland
- Western City Blue Mountains, Camden, Campbelltown, Fairfield, Hawkesbury, Liverpool, Penrith, Wollondilly

The vision aims to bring new thinking to land use and transport patterns to boost Greater Sydney's liveability, productivity, and sustainability by spreading the benefits of growth. It is expected that having three cities, each with supporting metropolitan and strategic centres, will put workers closer to knowledge intensive jobs, city-scale infrastructure and services, entertainment, and cultural facilities. It is worth noting here that productivity and sustainability are parallel visions pursued by the Committee. Reading through the strategy, it seems that the key thinking of approaching this triple-objective is to build 30-minute neighbourhoods and employment hubs that can both reduce intraregional commuting and revitalise local economy.

Plausibly, this strategy aims to integrate all the principal spatial structures and government authorities to deliver the vision of the plan and its ten Directions. It was prepared concurrently with

Future Transport 2056 and State Infrastructure Strategy 2018–2038 to align land use, transport, and infrastructure outcomes for Greater Sydney for the first time in a generation. Important planning considerations are:

- The integration of the mass transit network with the economic corridors, centres, transit-oriented development, urban renewal and health and education precincts.
- The connectivity between the rail freight and strategic road networks and the trade gateways and industrial areas.
- The integration of the green grid network with residential neighbourhoods.
- The retention of the integrity of the values of the Metropolitan Rural Area and the Protected Natural Area.

These considerations will help deliver the following visions and directions (table 1):

Table 1 Visions and directions in A Metropolis of Three Cities

Visions	Directions	Potential indicator
infrastructure and collaboration	A city supported by infrastructure	Increased 30-minute access to a metropolitan centre/cluster
	A collaborative city	Increased use of public resources such as open space and community facilities
Liveability	A city for people	Increased walkable access to local centres
	Housing the city	Increased housing completions (by type); Number of councils that implement Affordable Rental Housing Target Schemes
	A city of great places	Increased access to open space
Productivity	A well-connected city	Percentage of dwellings located within 30 minutes by public transport of a metropolitan centre/cluster; Percentage of dwellings located within 30 minutes by public transport of a strategic centre
	Jobs and skills for the city	Increased jobs in metropolitan and strategic centres
Sustainability	A city in its landscape	Increased urban tree canopy; Expanded Greater Sydney Green Grid
	An efficient city	Reduced transport-related greenhouse gas emissions; Reduced energy use per capita
	A resilient city	Number of councils with standardised state-wide natural hazard information

Infrastructure and its role within economic growth and sustainability is a concern of this research as well as the strategic plan. This new strategy emphasises on more interconnections within each city and between the three cities to deliver a 30-minute city; as well as safeguard transport corridors and locations for new centres for future infrastructure investments. A growth infrastructure compact model was developed by the commission, which assessed the nature, level and timing of the infrastructure investment required for an area, by considering its forecast housing and employment growth, and analysing growth scenarios. This helped sequence infrastructure with growth.

All in all, this strategy is forward-looking, comprehensive, and coordinative. It is precisely the kind of spatial thinking and framing for change that

is missing for Edinburgh, indeed Central Scotland as a whole. Being essentially a spatial plan, however, the A Metropolis of Three Cities focuses exclusively on the greater Sydney metropolitan area and intraregional development visions. There is a lack of, or rather implicit, inter-state, cross-state, and international considerations, and aspirations. The existing Sydney airport, for example, is under the pressure of over-capacity, and infrastructure around it has long suffered from congestion, whereas the public transport could be further enhanced. Western Sydney Airport and Badgerys Creek Aerotropolis bear the potential of enhance Sydney's position as the domestic and international hub, but this role was undeveloped in the 2018 Plan, but this has changed markedly since and is discussed below.

2.2 Western Sydney airport and aerotropolis concept.

The development of a second Sydney passenger airport has been a long running issue. Past government policy has alternated between further capacity at Kingsford Smith Airport (KSA), expansion of existing general aviation airports and the development of a greenfield site. Over the past few decades, there have been a number of studies commissioned on future aviation capacity, culminating in the Joint Study on Aviation Capacity in the Sydney Region released in March 2012. The conclusion of the Joint Study was that a second major airport facility was required and that immediate steps should be taken to mitigate the long lead time of such a development. This view is broadly unanimous among the aviation and tourism industries. The Joint Study identified the Badgerys Creek site in Western Sydney as the preferred option for a second Sydney airport, and the Australian Government has committed \$5.3 billion of City Deal funding in the 2017–18 Budget to build the Western Sydney Airport by 2026 (figure 4).

Western Sydney was chosen for multiple reasons (given that the Commonwealth Government had long taken the view that Sydney was to be Australia's main 'gateway' despite the strong claims of Melbourne):

First of all, there is a natural limitation on how far eastern Sydney could expand, even though Australian have an overwhelming preference for coastal living [interview with a planning expert, 13 June 2022].

Second, Western Sydney was where substantial population growth was expected. With a population growth of 12% in the decade to 2011, the region outpaced the rest of Sydney and had twice the growth of the rest of NSW. In 2011, the population of Western Sydney was just over 2 million and by 2036 it is forecast to reach 3 million, according to the NSW Department of Planning and Infrastructure projections. This represents 70% of the population increase across Sydney more broadly, much of which is due to the significant land releases expected for the region.

Thirdly, Western Sydney has a greater proportion of residents born outside Australia than both other parts of Sydney and other parts of NSW. The source of this migration has largely been outh Asia and the Middle East. In contrast, while the rest of Sydney also has a relatively large proportion of people born outside of Australia, these are predominantly from Europe. For both regions, the migrant share of the local population

has grown over the past two census intervals. This bears important implications for the international air travel sector – and hence for the Badgerys Creek airport proposal – as 25% of inbound international passengers to Western Sydney cited visiting friends and relatives as their purpose of visit (figure 5). Moreover, the Indian and Chinese visitors are two key growth markets for international travels. The Indian market now ranks tenth for NSW international arrivals but is sixth in terms of its share of NSW visitor nights. Although still developing off a base of about 70,000 visitor nights per annum, Indian visitors have the longest

average length of stay in NSW (47.8 nights). The Tourism Forecasting Council (TFC) expects inbound tourism to Australia from China to increase at an annual average growth rate of 7.2% over the period to 2020. Indian visitor arrivals are expected to increase at an annual average growth rate of 8.5% - the highest of all inbound markets. Given the large proportion of Western Sydney residents born overseas, and the Western Sydney share of arrivals to visit friends and relatives, the growth in Indian and Chinese visitor arrivals is expected to be reflected in passenger volumes into Western Sydney.

Figure 4 Aerotropolis and regional infrastructure connection



Figure 5 Travellers to/from Western Sydney and Rest of Sydney – by purpose

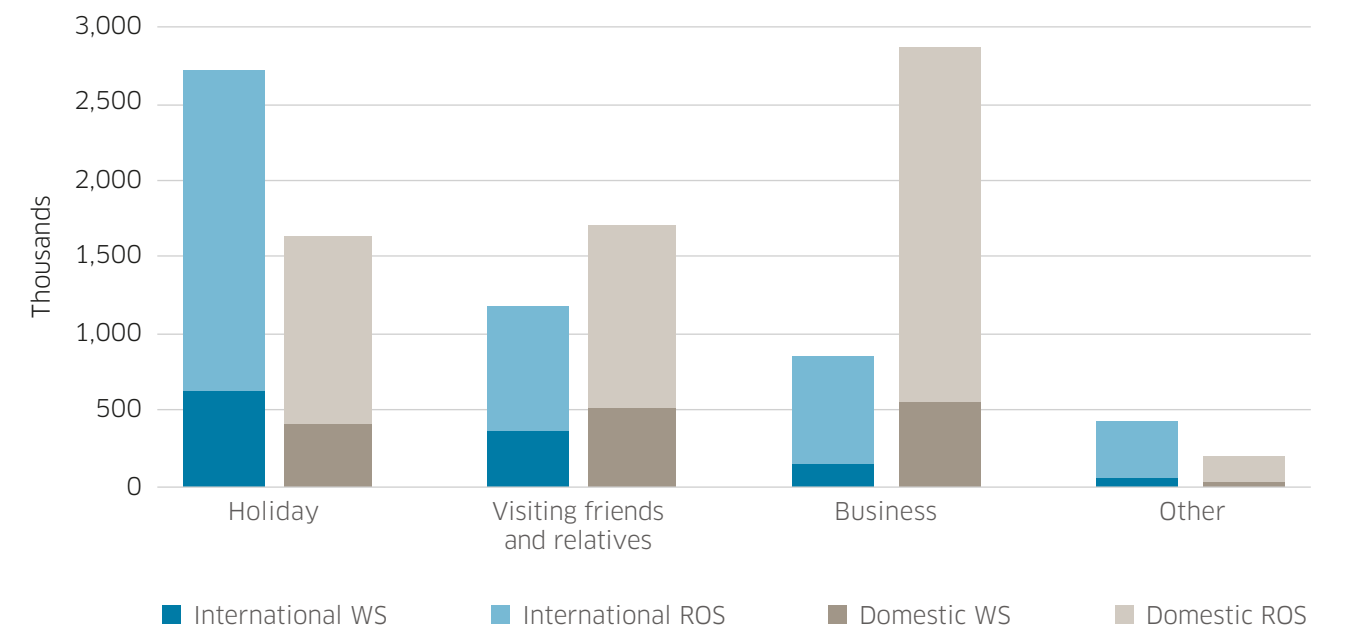


Table 1 Visions and directions in A Metropolis of Three Cities

There was also a wide array of support for turning Western Sydney airport into an aerotropolis. The main report discusses the origins and ideas involved in the aerotropolis concept (Chapter 3). An aerotropolis refers to an orderly airport-centric large-scale metropolitan development. It's exemplified by Dallas Fort Worth, Singapore, and Hong Kong. The core is a bustling airport city at the epicentre of road and rail networks knitting together a bustling job-rich region (Freestone 2017).

This argument is based on the fact that, at the moment, industries that are heavily dependent on air transport are largely underrepresented in the Western Sydney region. However, these industries are present in the rest of Sydney, and draw heavily on workers based in Western Sydney. Hence, a second airport located in Western Sydney would likely attract business to Western Sydney, closer to their labour force and air transport linkages.

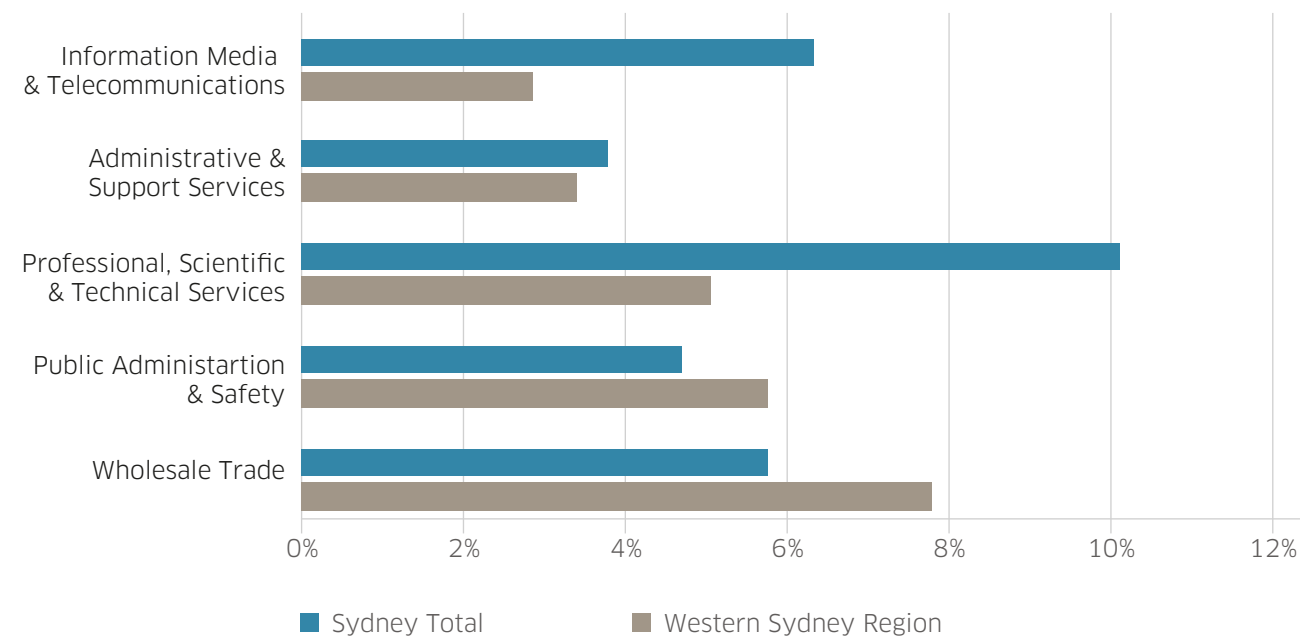
Specifically, air transport use by business, in terms of passengers and freight, is highly concentrated in a small number of industry sectors. The top five sectors make up over 50% of usage of air transport; the top 10 sectors use 67% of air transport; and the top 20 sectors make up nearly 80% of usage.

The top five users of air transport by ABS Input-Output classification are as follows:

1. Professional, Scientific and Technical Services – 21%
2. Wholesale Trade – 10%
3. Building Cleaning, Pest Control, Administrative and Other Support Services – 9%. (This includes travel agency and tour operation services)
4. Public Administration and Regulatory Services – 8%. (This includes foreign government representation)
5. Telecommunication Services – 5%

Figure 6 indicates that overall, these top five air transport dependent industry sectors are underrepresented in the Western Sydney region. Wholesale Trade is an exception – it is overrepresented in Western Sydney, contributing 7.8% of local output, relative to a 4.8% national average, and 5.8% Sydney average. Wholesale traded goods include basic materials, machinery and equipment, motor vehicles and parts, groceries and liquor/tobacco, textiles, and pharmaceuticals (Deloitte 2011).

Figure 6 Gross Regional Product by industry sector



Source: RDA Sydney

While aviation-dependent industry sectors are overall underrepresented in Western Sydney, the region does provide a considerable amount of the labour force for those sectors in the rest of Sydney. For the top five largest air transport users, Western Sydney contributes the following percentages of labour force:

1. Professional, Scientific and Technical Services – 20%
2. Wholesale Trade – 36%
3. Building Cleaning, Pest Control, Administrative and Other Support Services – 36%
4. Public Administration and Regulatory Services – 32%
5. Telecommunication Services – 37%.

These workers would foreseeably be willing to work closer to home, rather than face a lengthy daily commute. Hence prospective businesses looking to take advantage of a new air transport hub at Badgerys Creek should not face labour supply issues. This also applies for existing businesses looking to relocate operations. The creation of an air transport hub at Badgerys Creek would link with other long term surface transport and business precinct projects,

as have been identified in the metropolitan strategy. It is worth highlighting there is no existing analysis of such patterns for Edinburgh and the surrounding metropolitan region not for Central Scotland as a whole.

Based on scenario analysis, Deloitte (2011) expected that, in net present value terms, the impact of Badgerys Creek airport on the Western Sydney economy over the period 2020 to 2050 was estimated at between \$9.2 billion and \$15.6 billion, while the impact on the whole of Sydney economy was estimated at between \$15.7 billion and \$25.6 billion. These impacts were particularly large given that no activity will occur for the next seven years. Average additional employment over the period 2020 to 2050 was estimated at between 12,645 and 19,982 FTE for Western Sydney, and between 20,601 and 31,736 FTE for the Sydney region overall. Most of the additional employment will be generated in the latter part of the modelling period.

A Metropolis of Three Cities lists a dedicated Objective that 'Western Sydney Airport and Badgerys Creek Aerotropolis are economic catalysts for Western Parkland City' and will attract globally significant job types and significantly improve job containment over a 20-40 year period. Sustainability, liveability, and

place making are core considerations in driving productivity and in delivering Greater Sydney's first 21st century city (ibid., p107). Leverage the development of this Aerotropolis, the Greater Sydney Region Plan 2018 identified aerospace and defence (led by the NSW Department of Industry), advanced manufacturing, logistics, trade, and higher education (through a ring of university towns)¹ as key sectors for Western Parkland City, whose growth is expected to be boosted by several transport initiatives that significantly improve the accessibility of the Western City with other parts of Greater Sydney and regional NSW. These initiatives include the Western Sydney Freight Line, the Outer Sydney Orbital, and a potential new intermodal terminal. Sydney Metro has also announced a new Aerotropolis Station as the major transport interchange². Again, we note that this integration of spatial and industrial sector thinking has largely been missing in Scotland in this millenium.

Politically, the Western Sydney City Deal – a partnership of the Australian Government, NSW Government and the local governments of the Blue Mountains, Camden, Campbelltown, Fairfield, Hawkesbury, Liverpool, Penrith and Wollondilly – will be instrumental in delivering on the aspirations of the Western Parkland City. The Deal includes six commitments: connectivity, jobs for the future, skills and education, liveability and environment, planning and housing, and implementation and governance. The key deliverables include realising the 30-minute city by delivering the North South Rail Link, creating 200,000 jobs by supercharging the aerotropolis and agribusiness precinct as catalysts, and skilling residents in the region and initiating an Aerospace Institute (Greater Cities Commission 2018, p108).

What have been discussed above provide a snapshot of the context, initiatives, planning, and assessment behind economic growth and sustainability in general, and the aviation industry in particular. As of late 2023, despite the changes in the strategic planning framework, the major elements of the Badgerys Creek project are on track, the aerotropolis is emerging and the airport will open with an estimated 10m passengers in 2026. The next section summarizes the challenges in balancing growth and zero carbon from stakeholders' perspective.

¹A Metropolis of Three Cities (2018, p109) envisioned the Western Sydney Airport to become the fourth University Town by enabling a university at Badgerys Creek Aerotropolis to be anchored around the development of airport-related industries such as defence and aerospace, avionics, cyber security, food manufacturing and advanced manufacturing.

² <https://www.sydneymetro.info/station/aerotropolis-station>.

Expert views on changes/challenges.

For this case study we conducted twenty interviewees with government officials, committees, business sectors, consultant companies, and leading academics. In 2022, although it is clear that Sydney had a strategic spatial planning conversation and capability unmatched in Scotland, it was also apparent that policy, as opposed to wider, discussion

of reaching net zero by mid-century was much less pronounced and, unlike Scotland, not always at the forefront of discussion. That difference in emphasis has been reduced subsequent to the election of the Albanese government in 2022. Several major observations emerged from this exercise in response to our research purpose.



3.1 There are activities in promoting carbon reduction.

The International Civil Aviation Organization (ICAO) has been actively progressing work with its 191 Member States and the international aviation sector to achieve its global aspirational goal of carbon neutral growth by 2020. Australia published its first Action Plan, Managing the Carbon Footprint of Australian Aviation, in November 2012 in response to the 2010 ICAO Assembly Resolution A37-19. An updated plan was published in 2017 (DIRD 2017), which built on the 2012 plan by outlining Australia's progress in contributing to the ICAO's carbon neutral aspiration. Generally speaking, Australia is taking a 'Direct Action' approach to reducing its greenhouse gas emissions. At the centre of this approach is the Emission Reduction Fund and Safeguard Mechanism. The Australian Government Emissions Reduction Fund creates a positive incentive for Australian businesses to adopt smarter practices to cut the amount of greenhouse gases they create. Under this Fund, airlines can be credited for reducing the emissions intensity of domestic air transport. The Safeguard

Mechanism puts emissions limits on Australia's largest emitters to prevent significant increases above business-as-usual levels. The Safeguard Mechanism applies to the domestic operations of Australia's major airlines. Australia also supported the landmark agreement reached at the 39th ICAO Assembly held in 2016 in Montreal, Canada, to adopt a new global market-based measure scheme in the form of a carbon offsetting scheme to help reduce CO₂ emissions from international aviation. Through the implementation of a range of measures progressively introduced since 2012 to improve the efficiency of Australia's aviation system, including fleet renewal, improved air traffic management and more efficient on-ground operations, Australia is contributing to ICAO's goals of achieving a global fuel efficiency improvement of two per cent year-on-year until 2050 (1.5% between 2012 and 2020), as well as capping the global net CO₂ emissions from international aviation at 2020 levels.

Some of the key measures are summarised in table 2 below.

Table 2 carbon reduction actions taken in Australia.

Measures	Results
1. Australian Airlines	
1.1 Fleet renewal and improvement	Both Qantas and Virgin are investing in renewing their fleet leading to greater fuel efficiency through technological and operational enhancements
1.2 Weight reduction measures	Jet fuel consumption is directly linked to the weight of an aircraft. Airlines are using newer, light aircrafts.
1.3 Fuel optimisation	Fuel represents the largest portion of an airline's cost base and also generates most of the emissions profile. Qantas and Virgin have long-established fuel optimisation programs aimed at achieving the highest possible levels of operational efficiency.
1.4 Carbon Offset Schemes	Qantas and Virgin Australia offer carbon neutral passenger flight services and are certified organisations under the Australia National Carbon Offset Standard (NCOS) Carbon Neutral Program
1.5 Aviation Biofuels	Qantas and Virgin have contributed technically and financially to foster R&D of sustainable alternative aviation fuels including fuels derived from biomass, such as trees, plants, waste and other organic matter

Measures	Results
2. Airservices Australia	
2.1 Optimal Climb and Descent Procedures	Reduce fuel consumption, greenhouse gas emissions and aircraft noise by limiting fuel burn associated with aircraft levelling off or increasing descent rate unnecessarily.
2.2 Airport Capacity Enhancement	Identifies enhancements that can be made utilising existing infrastructure and technologies to increase runway capacity and subsequently generate fuel efficiency improvements.
2.3 Advanced Surface Movement Guidance and Control System	Air traffic surveillance system that allows Airservices to better manage aircraft on the ground.
2.4 Performance Based Navigation	Utilises GPS to enable aircraft to fly with a higher degree of accuracy.
Off Air Route Planning Options	Flexible pre-flight planning options taking advantage of high altitude jetstream winds to improve an aircraft's speed or avoid significant headwinds, reducing fuel consumption on long distance flights.
2.5 Dynamic Airborne Re-Route Procedure	An extension to the pre-flight, planned off airways procedures. This procedure is being trialled with one operator on a low volume city pair.
2.6 MET CDM	A collaborative decision-making process by which Airservices, Australian Bureau of Meteorology, airlines and airports establish and dynamically manage acceptance rates at capacity constrained airports leading to reduced airborne holding. In operation at Brisbane, Melbourne and Perth, and a trial recently completed for Sydney.
2.7 Partnerships	Airservices Australia joined the Asia and South Pacific Initiative to Reduce Emissions (ASPIRE) and The Indian Ocean Strategic Partnership to Reduce Emissions (INSPIRE).
3. Airport Operations	
3.1 Ground Support Equipment	Sydney airport has fixed electrical ground power at new gates to reduce the use of ground support equipment that are harmful to the environment.
3.2 Green buildings	Brisbane Airport was awarded Australia's first Green Star Communities rating in December 2014.
3.3 Solar energy	Brisbane airport's domestic and international terminals are equipped with solar panels
3.4 LED Lighting and Airfield Lighting	Melbourne airport has retrofitted Terminals with energy efficient LED lighting to reduce energy consumption
3.5 Ground Transport Plans	Adelaide and Sydney airport have invested in electric buses and fuel-efficient vehicles

Table 1 Visions and directions in A Metropolis of Three Cities

Table 3 illustrates the rate of change achieved since Australia's first Action Plan in 2012. Fuel use and CO₂ emissions have increased by 16.3 per cent since 2012, at an annual rate of 3.3 per cent. At the same time, total RTK has increased by 7.82 billion or 24.7 per cent since 2012, at an annual rate of 4.9 per cent. This indicates that more passengers and cargo

are being transported than fuel is being used in 2016 compared to 2012. Moreover, fuel consumption rates and emissions intensity has decreased by an annual rate of 1.4 per cent. This improvement partially offsets increasing RTK and demonstrates progress toward meeting ICAO's goal of 2 per cent fuel efficiency improvement per annum.

Table 3 Absolute and Proportional Changes, 2012 to 2016

	Absolute	Proportional	Annual Rate
Fuel Use (Megalitres)	1226	16.3%	3.3%
CO ₂ Emissions (Million tonnes of CO ₂ -e)	3.08	16.3%	3.3%
Traffic (billions)			
Passenger Revenue-Tonne-Kilometres (RTK)	6.46	25.6%	5.1%
Cargo Revenue-Tonne-Kilometres (RTK)	1.36	21.2%	4.2%
Total Revenue-Tonne-Kilometres (RTK)	7.82	24.7%	4.9%
Fuel Consumption Rates			
Litres/Total RTK	-0.0161	-6.8%	-6.8%
-6.8%			
CO ₂ -e/Total RTK	-41	-6.9%	-1.4%

Source: Australian Department of Infrastructure and Regional Development (2017, p9)

Table 4 Annual fuel consumption rate and emission intensity change (%) comparison

Litres/Total RTK	2010	2011	2012	2013	2014	2015	2016
Australia ¹			-35.62	0.34	-2.93	-3.79	-0.49
US ²	-4.9	-1.22	-3.58	-0.29	-0.70	0.13	-1.10
CO ₂ -e/Total RTK	2010	2011	2012	2013	2014	2015	2016
Australia ¹				0.33	-3.0	-3.78	-0.54
Global ³	-6.1	-2.0	-1.9	-1.9	-2.5	-0.9	-1.0

Source: 1. Australian Department of Infrastructure and Regional Development (2017)
2. Cho et al (2019, P128), scheduled service fuel efficiency.
3. European Union Aviation Safety Agency (EASA 2019, p29)

Litres per Revenue Tonne Kilometre is the metric used to assess fuel efficiency advanced by ICAO. Table 4 compares Australia with other member states in terms of its fuel efficiency and improvement. It seems that on average, Australia was meeting the ICAO target, although there was a noticeable lag between the time when Australia started taking serious actions and those of others, especially European countries. Globally, the fuel efficiency of aviation had improved 1.9% per year between 2010 and 2019, after improving by 2.4% annually in the previous decade³. While the more recent rate of improvement surpassed the industry's own target (1.5%), it is just below the aspirational goal of 2% adopted by ICAO. More recent forecast reduced the efficiency improvement even further to 1.0% for 2020 and 1.1% for 2021⁴. The short- and medium-term outlook for fuel efficiency remains somewhat uncertain due to impacts of the Covid-19 crisis. What is certain, however, is that further technical and operational efficiency improvements beyond the ICAO target will be needed to offer any prospect of substituting fossil-based jet kerosene with more sustainable fuels in the long term.

Albeit progress has been made continuously on fuel efficiency and carbon duction, limitations could be noticed in the mitigation methods used in Australia. As can be seen from table 2, at the moment, carbon reduction achievement has largely been made possible through the industry's efforts to enhance aircraft engine technologies, implement operational improvements, reduce airframe weight through the extensive application of composite materials, and use more energy efficiency building design and facilities at the airport. There is however limited consideration of the airports' spatial (ground transport) and economic (spill-over effect) positions within the metropolitan area, and how their connections could be optimized.

As an officer from the Australian Business Council noted:

'Around the airport precinct, there is certainly a lot of discussions around traffic in and out of the airport. Sydney has an airport trainline, but that is shared with suburban route... I suspect the airport itself is also more interested in more public transport solutions as well. It is more of getting to the airport an issue compared to leaving the airport.' [interview: 16 June 2022].

An urban expert interviewed further remarked:

'The ground transport access for both workers and passengers to the airport should have been something that the airport could solve, and it is easier to solve than decarbonising the part in the air... I guess there is quite high share of private vehicles driving to the Sydney airport at the moment. For the Sydney West airport, I assume almost everybody will drive, because it doesn't have good public transport yet. There is a train line to the airport, but it's a much, much slower, longer route, as it gets you to the middle of Sydney, so will take 1.5 hour each way.' [interview: 7 July 2022].

Another officer from the Australia Infrastructure added that:

'We try to make a case that it is time to change the hub-spoke infrastructure model of the airport, to make better integration with on-the-ground transport. We need to think seriously about the 20/30 minutes cities, and the 3-hour city centred on the gateway cities in Australia now.' [interview: 26 June 2022].

Treating airports as an island also plays into the broader thinking on carbon reduction, as our second conclusion noted.

³ <https://www.iea.org/reports/aviation>

⁴ <https://www.iata.org/en/iata-repository/publications/economic-reports/airline-industry-economic-performance-june-2020-report/>

3.2 There is a consensus that zero carbon in particular, and sustainable development in general, is not high on political agenda in Australia.

As noted above, the interviews for this project were undertaken in the early months after the 2022 Commonwealth election. Since then, Commonwealth and State governments have begun to make substantially stronger environmental statements, but lagging the UK in general and Scotland in particular.

Australia, an early contributor on climate change concerns at the OECD before 2000 and with the State Government of Victoria elected and re-elected on a 'Sustainable State Agenda' in the early 200's, has not, in recent decades, been at the forefront of the international push on climate actions. Australia is a late comer in climate actions. The Sustainable Development Report (Renew Economy 2021) for example, scored Australia last out of 193 United Nations member countries for action taken to reduce global greenhouse gas emissions. Its database shows Australia received a score of just 10 out of 100 in an assessment of fossil fuel emissions, emissions associated with imports and exports, and policies for pricing carbon. An interviewed climate expert from the Australia Institute was not surprised by the result, saying that:

'Australia has received similar rankings from other comparable studies, including the Climate Change Performance Index, which ranked Australia second last behind only America last year... The federal government has no climate and energy policy and instead has cherry-picked technologies, many of which support the fossil fuel industry.' [interview: 18 June 2022].

There are multiple reasons underlying such slow/minimal actions.

The first fundamental reason is the economic structure of Australia.

An urban expert explained that *'Australia is barely beginning the renewable generation transition; it hasn't (fully) started on converting vehicle fleets; it is a major exporter of coal, iron ore, and fuel'* [interview: 7 July 2022]. To this a planning practitioner added that:

'In the Australia context, growth has always been immigration driven. We have got big impact during COVID, we don't have that growth, which hit the capital cities the hardest. The economic growth projections rely on that immigration growth to return. I think it is only a small sector of the policy making that is interested in how to get the productivity gains to shift beyond economic growth, looking at hitting broader objective, of which carbon is one of the objectives... there is no alternative. Export from Australia relies on air freight, we cannot really set up trains. We are so far away from everything.' [interview 28 June 2022].

Such growth oriented policymaking mode reflects the dominant business model in Australia as well. As the officer from the Australia Business Council explained:

'I won't say economic competitiveness is becoming a secondary concern (of the private sector). Companies might see it as part of the objectives that are important to deliver. Profitability and serving customers efficiently are still at the top of their minds. But sustainability is coming along to the plate now as part of that mix. Companies will do things more sustainably as it is important for their images. But profitability is definitely the key concern still.' [interview: 16 June 2022].

The second factor highlighted by many interviewees relates to the geography of Australia, and the consequential cultural traits of this country.

Our business council informant for example, remarked that:

'At the higher level, there were desires that new housing is developed around existing infrastructure to make it less car dependent. Yet there are lots of other factors come to play - I don't know whether it is an Australian psychological thing or not - that people still expect to live in double-store, detached houses with big yard, which is not so compatible with transport-oriented development mode. But certainly, for Australia government, TOD is on their mind. Sustainability concern is partly driving that,

and partly is to mitigate congestion and reduce car dependency.' [interview: 16 June 2022].

This preference for larger houses echoes the migration history of Australia, and the fact that 'Australia is so far away from everything else' [interview: planning practitioner, 28 June 2022]. An urban expert we interviewed, who observes the Australian practices as an outsider, further illustrated that:

'Australia has this 'tyranny of distance'... Australians are obsessed with the idea of how far they are from everything. So, there is a culture meaning to aviation to Australians that is beyond the objective of economic impact. In a sense, Australia really got modernized in the 1970s when Gough Whitlam became the prime minister. People say it advanced Australia 100 years in 9 days in terms of the culture, and it is believed that the increased air connection to the rest of the world

really enabled that transformation... for Australians to be less afraid of changes and accelerated that cultural shift. The country had moved from outpost to a modern world because of the improvement of air travel in the 70s.' [interview: 7 July 2022].

Being far away from problems elsewhere in the world and blessed with natural resources also cultivated the 'lucky country mentality, a term Donald Horne (1964) used to lament on the lack of innovation and ambition among the Australian population. This also exemplifies in the environmental field.

'Australia pretty much follows the European lead on vehicle designs and policies. The EU standard is important for Australia. There is a strong commitment to not go alone... and I won't expect Australia to be the first mover' [interview with Australia Infrastructure, 9 June 2022].

Echoing this, an urban expert we interviewed remarked that:

'Australia has been pretty lazy about decarbonising anything... in the context of changing policy narratives internationally, it is pretty close to nothing happening at all in Australia, i.e. there is no discussion on limiting the number of flights or more innovations... I feel the attitude on aviation is that somebody else is going to solve it; somebody like Europe will solve it, and we will just get whatever they came out with'. [interview: 7 July 2022].

The third factor is derived from political struggles and personalities.

Officer from the Australia Business Council summarised this phenomenon as:

'In the past 10 years, it has been the state level that is leading the climate actions. This is because the

previous federal government was initially sceptical, and, even under the first prime minister, was opposed to actions. I suspect later it became more of a political verge issue at the federal level... To be honest, I also think a lot of this is about personality. When you look at the former PMs, Tony Abbott almost didn't believe climate change was happening or it was human induced, then you have Malcolm Turnbull, who was wanting to do things, but was held back by the party; and then Scott Morrison, who was more ambivalent, taking it as a political verge issue. Now the new government is very much committed to actions. But it makes it clear that changes are happening in an economically sustainable way, to make sure that the broader community (especially business community) comes along.' [interview: 16 June 2022].



3.3 Within this broader context, aviation is protected from carbon target in Australia.

All interviewed experts share this view that aviation in Australia is shielded from carbon reduction pressure. Informant from the Australia Business Council, for example, noted that:

'The carbon target is not much a concern for the sector. Neither do I hear the impact on international travel has been articulated. In Australia we have this tyranny of distance... so many people are moving between Melbourne and Sydney even within a day; it is just not possible by other ways expect air travel. There are no alternatives. Driven by economic reason, however, there is a general acknowledgement that the aircrafts are becoming more fuel efficient.' [interview: 16 June 2022].

Similarly, an Urban Expert we interviewed remarked that:

'In Australia you start hearing people talk about green steel, green energy. But I feel the attitude on aviation is that somebody else is going to solve it. Somebody like EU will solve it, and we will just get whatever they come out. They [Australian governments] will never in millions of years reduce the number of flights. Bu they would happily buy electric-powered planes if they could.' [interview: 7 July 2022].

The environmental commissioner from GCC further explained that:

'The greenhouse gas emissions are categorised into three groups or 'Scopes' by the most widely used international accounting tool, the Greenhouse Gas (GHG) Protocol. Scope 1 covers direct emissions from owned or controlled sources. Scope 2 covers indirect emissions from the generation of purchased electricity, steam, heating, and cooling consumed by the reporting company. Scope 3 includes all other indirect emissions that occur in a company's value chain. In Australia, our focus is on scope 1, and scope 2 is being discussed a bit as well. But aviation is classified as scope 3 and is really treated separately... cutting aviation is rather suicidal, it is too hard to tackle.' [interview: 21 July 2022].

Regarding the reasons, interviews quoted above have already touched upon the cultural significance

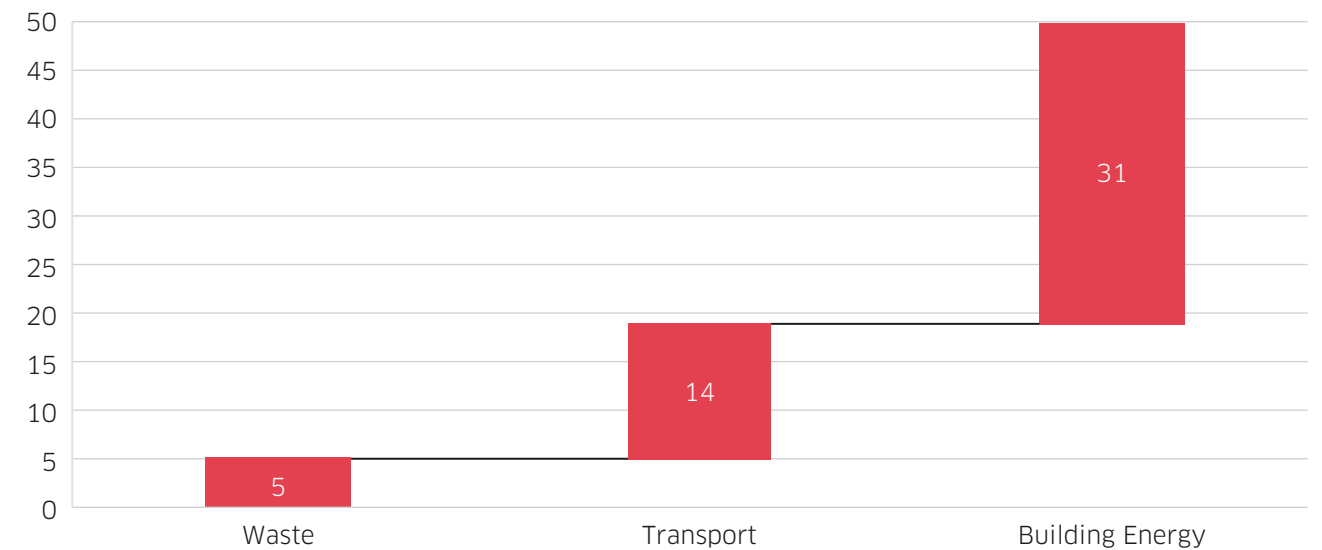
of aviation to Australians. The urban expert further elaborated that:

'Push on carbon reduction for this sector is really minimal... One reason is that, if you look at the wedges, aviation is very small compared to so many other sectors. [So, if you want to see actions, you have to wait till] other sectors have decarbonized and then aviation becomes the biggest one. Australia is barely beginning the renewable generation transition or converting vehicle fleets... but these are the bigger fish to fry. Even the climate activists are not focusing on aviation in Australia... There are just so many big stuffs that have to happen as they are causing bigger percentage of the problem.' [interview: 7 July 2022].

His reflection is supported by evidence. As the Metropolis of Three Cities (Greater Cities Commission 2018, p145) noted, in 2015–16, the combined emissions from electricity and gas used in buildings, transport and waste in Greater Sydney contributed 50 million tonnes of greenhouse gases into the atmosphere, equal to 54 per cent of NSW's emissions from these sources (figure 7). Among this, transport contributed 14 million tonnes, or 28 per cent of the total in comparison to building energy that contributed 62 per cent.

Elaborating on the discussion in the main report (chapter 2), internationally, even pre-COVID, worldwide commercial aviation was computed to be responsible for between 2 and 3% of anthropogenic CO₂ emissions (ATAG, 2018). The most detailed computation states 2.4% (Graver, Zhang et al. 2019), equal to 918 million tonnes in 2019 (Graver, Rutherford et al. 2020). To that figure, passenger travel contributed the most at 85%, with freight carriage (including belly cargo) causing the remaining 15% (Graver, Rutherford et al., 2020). In Europe, departing flights in 2016 were responsible for 171 million tonnes of CO₂ – approximately 20% of global aviation emissions. European commercial aviation emissions have almost doubled between 1990 and 2016, and correspond to 4.3 to 5.6% of total EU CO₂ emissions⁵ and 3.6 to 3.9% of total EU greenhouse gas emissions⁶ in 2016 (Sman, Peerlings et al. 2021). Taking other greenhouse gases and

Figure 7 Greenhouse gas emissions by source (2015–16)



Note: Analysis of emissions does not include emissions from agriculture and land clearing
Source: Greater Sydney Commission, 2017, Exploring Net Zero Emissions for Greater Sydney, report prepared by Kinesis for the Greater Sydney Commission

global warming effects into account, the contribution from global aviation is approximated to be two to three times as large as CO₂ alone (Grewe 2019).

The feature of technology changes and associated infrastructure configuration could exert another layer of complicity. The aviation sector generally takes a long-term perspective on innovation. Aircrafts are designed to have a lifespan of 20 to 30 years. It can take 15 years to develop from concept to production. Programmes normally break even only after ten to twenty years of production, and manufacturers are often said to bet their entire company's worth when committing to a new aircraft. Manufacturers often develop families of aircraft, with each type offering different capacity and range. Similarly, new concepts are regularly based on designs already in production. Due to the complexity of the product, intermediate upgrades are difficult. These characteristics have a clear impact on the capability of the airlines together to take up novel aircrafts in their fleets. Long financial lifetimes make it very costly to replace existing technology frequently and airlines are dependent on what new products are offered in the market. Another difficulty for airlines is that network and fleet planning have a much longer time horizon than the day-to-day operations. Given limited profits, an intense focus on operating costs is unsurprising. Infrastructure planning challenges that airports face see a similarly long-time horizon. Alike as well are the significant investment costs related

to infrastructure, comparable to what is observed in aircraft development. This is true for terminal expansions or changes, but even more so for the addition of runways or new airport development.

Given these systematic planning challenges and limited political intentions of intervene, discussions at the moment are often around those tangible, microlevel questions, as one of the planning practitioners we interviewed reflected:

'Although these are macro questions asked, such as how we are going to build an entirely new city around the western fringes, I don't know how much they are factored in the decision-making process. It probably comes back to the discussion that, we are going to build a new airport for the aviation sector [which is decided without much consideration of its carbon implication], how are we going to build the precincts that are cool and sustainable, and how are we going to make sure the Creek watercourse is repaired... again it goes back to that tangible, landscape level. I don't hear the problematic implications of building a new city around the airport is discussed much.' [interview: 28 June 2022].

⁵ 3,941,273 kilo tonnes without land use, land use change and forestry (LULUCF); 3,185,038 with LULUCF (UNFCCC, n.d.).

⁶ Total EU greenhouse gas emissions in 2016 were 4,441 million tonnes (EEA, 2019), yielding a share of 171 / 4441 = 3.85%. The European Aviation Environmental Report states 3.6% (EEA, EASA & EUROCONTROL, 2019).

3.4 The sectors most closely related to air traffic are tourism, higher education, high-value services etc. These sectors are arguing strongly for international travels to return to normal.

The key sectors connected most strongly with air travel are also the key export sectors of Australia. A Planning practitioner reminded us that:

'There are substantial economic benefits of airports, which in turn are derived from the agricultural sector, high-value goods to Asian market, and the tourist market. We did a study around the Tech sector in east Sydney and found that the ability to get in and out of a place is crucial for visitors. Connectivity is still important.' [interview: 28 June 2022].

There are plenty of reports and studies that acknowledge the economic and social benefits of air transport. Among these, tourism, world trade, and the broad spin-off benefits in serving larger markets, broadening business operations, leveraging investment opportunities, attracting labour market and etc, have been documented (ATAG 2005). In Australia, specifically, its tourism sector contributes \$152 billion to the economy, supports more than 300,000 businesses, and employs more than 660,000 Australians. Yet the travel and tourism sector is one of the most heavily impacted sectors by the COVID-19 pandemic. Therefore, the officer from the Australia Business Council noted that:

'I think the impact of COVID, and the closing of the Australian border is far more impactful than climate change. The voice from industries is that we want to see airport and immigration back-up again pre-COVID. This is really the push we are seeing, as compared to the emission impact.' [interview: 16 June 2022].

Similarly, expert from the Australia Infrastructure remarked that:

'In Australia's big cities, there is a strong view that we need to revitalise tourism, and the night economy in order to support economic activities. So, there is a focus to get tourism going again. For a period of time, there were discussions about making Australia one of those free-to-travel bubbles... reopening the boarder is definitely a political priority.' [interview: 9 June 2022].

As a countermeasure, the Australian Government has committed a more than \$5 billion recovery package to support the aviation sector. The Department of Infrastructure released its Aviation Recovery Framework (2021), which supported operations and jobs through the most severe phases of the crisis and details how the Government will boost recovery, in line with the National Plan to transition Australia's National COVID-19 Response. It also sets out new policies to reposition aviation post COVID-19 to ensure a competitive, safe, and secure aviation sector that meets the needs of Australians now and into the future. Some of the assistances provided to the Aviation Sector are:

- International Airports Security Charges Rebate: The Australian Government has committed \$64 million to the IASCR Program to assist in meeting mandated security obligations.
- International Aviation Support
- Tourism Aviation Network Support: Over 800,000 half-price tickets to the identified regions are being sold under the program.
- Regional Airline Network Support: provides support to airlines to maintain a basic level of connectivity across their network of regional routes during COVID-19.
- Regional Airports Screening Infrastructure

3.5 There is recognition that different places are promoting their own sustainability agendas in very different ways.

Many interviewees believed that the federal government should have played a bigger, leading role in the mission towards carbon reduction, but its actions have been slow or missing until recently. The gap between Scottish and UK governments net zero policy emphases was marginal in comparison with the Commonwealth government and NSW. States and cities and municipalities in Australia, as in other three-order systems and that includes Scotland), have either been more conscious of the consequences of global warming and had more obvious 'green' political constituencies. Therefore, in most instances, it has been the states and municipalities or metropolitan governance entities governments that are driving changes. They have had to do so with limited autonomies other than in relation to infrastructure, planning, and environmental regulations and without major powers or resources to drive change, not least as the last two decades have seen major vertical imbalances in national fiscal leave growth and its emissions originating locally but the associated tax gains accrue centrally. That said, so many of the fiscal, regulatory and expenditure levers to drive transition to zero carbon lie nationally, and indeed overseas, that municipalities may embrace fast net zero goals, but they may never achieve them without higher order support. In Australia, as in Canada, and to a significant extent Scotland, municipalities are mere 'creatures' of states, provinces, and devolved administrations.

An Official from Australia Infrastructure, for example, explained that:

'Who should make decision in carbon reduction? Well, it is complex. Every level of the government can produce their own trajectory and target. Ultimately the responsibility sits within the federal government for maintaining international obligations. However, every state has a target of reaching net carbon by 2050, or even more aggressively for many years. There are even zero carbon target within some councils and other areas. In comparison, the federal government hasn't [got that target], the result of which was a lack of actions and coordination' [interview: 9 June 2022].

This lack of action in Australia has been partially caused by the focus of, and struggles faced by, particular leaders as discussed above, and partially by the power allocations across Australian constitution (and, as highlighted in the main report is mirrored in the UK). As the urban expert remarked that:

'In Australia, cities do not have power, metropolitan areas certainly do not have powers. The power sits at the state level. This is very different from the US, where the power splits across local, state, and federal levels. In Australia, the allocation of power is rather settled. Federal is weaker, and cities are much, much weaker. This is an important context when we discuss who gets the levers.' [interview: 7 July 2022].

Within this governance structure it is widely agreed that the NSW state government is a leader in environmental concerns and has implemented several highly plausible green infrastructure projects and legislations to reduce the state's carbon footprint. Yet at the same time, disparity in implementation was noted on the ground. As the planning practitioner remarked:

'The Greater Cities Commission identified six cities within its metropolitan areas. There are however huge diversities across these cities in terms of how ready they are to transforming their economy into something greener. There are different priorities for cities who boast more skilled sectors verse those who are still service or manufacturing focused.' [interview: 28 June 2022].

Echoing this view, an informant from the Australia Business Council added that,

'Those in the inner-city seats, they are the ones who can afford to worry about environmental issues compared to the other city seats, where people still need to focus on their pocket... There are correlations between neighbourhoods with higher income levels and concerns for climate change, whereas in poorer areas, people are still primarily concerned with everyday life.' [interview: 16 June 2022].

This comment on the connections between income disparity and climate actions is implicitly recognised in GCC's strategic planning for the Sydney metropolitan areas as we will turn to now. We also note that the housing shortages evident in Sydney, Toronto, and Edinburgh in this millennium have driven younger and lower income households away from concentrations of employment to more remote locations and that has not only increased

their reliance on private transport but raised their carbon footprints and travel fuel costs. Gentrified neighbourhoods with access to public transport and within walking distance to job locations have stimulated 'green politics' and '15 minute neighbourhood' movements. Suburban push for change, perhaps just as badly needed, has been less obvious. Edinburgh is obviously different from Sydney and Toronto in these respects.

3.6 Spatial planning of greater Sydney, a strategy too ambitious to fulfil?

As a reflection of our project concern on the growing narrative complexities of policymaking, A Metropolitan of Three Cities listed 10 directions and 38 objectives, covering economic growth, connection, inclusion, equity, sustainability, and resilience. Questions therefore arises as to how much thoughts have been given to their compatibility and deliverability.

One planning expert we interviewed was straightforward here:

'There is a bit of tension [in the strategy]. The overarching desire is to make a greater Sydney region with each of the cities relatively self-contained. There is a big focus on creating and intensifying innovation precincts to agglomerate the knowledge economy, yet there is another residential focus on creating this 30-minute commute circles. I don't think how compatible these objectives have been well thought through. If you are focusing on the knowledge economy, then the jobs are still going to be disproportionately pulled towards the major centers, like the existing CBD and Parramatta. These centers will still need a lot of infrastructure focus to enhance their accessibility. This will go against the starting point of the Greater city strategy, which was driven by the desire of distributing economic opportunities across Sydney.' [interview: 28 June 2022].

Going more specifically to environmental concerns, a planning practitioner summarised that:

'Zero carbon is more of a [microlevel] built-form response rather than a city structure question.

Carbon target is still secondary to other goals such as housing supply and accessibility needs [in this plan]. The structure of Sydney is really confined by its geography. So, the question of climate becomes more of an ad hoc piece because of the flood and sprawls. There has been some discussion of providing more housing in Wollongong because it has better climate. But I don't think it is a big driver.' [interview: 28 June 2022].

Echoing this view yet being more critical, an urban expert we interviewed remarked that the spatial planning of greater Sydney 'did not really push growth to be compatible and walkable, even though I am sure there are words in the plan that says it should be.' [interview: 7 July 2022].

Besides these internal tensions, the deliverability of this strategic planning has also been questioned.

'The Greater Sydney plan emphasises relative specialisations. But it is only now that there is an understanding of relative specialisation among cities, which I would say is still a bit immature... Moreover, The GCC is just one state agency. A lot of the innovations also sit in the health sector, which is still very segmented, and education also has its own remit. So, there is yet to be a fully coordinated economic vision of greater Sydney.' [interview: 28 June 2022].

More critically, the urban expert we interviewed commented that:

'Writing in the plan is one thing, following through is another. GCC is doing spatial planning, but it doesn't mean people will do it on the ground.

There are multi-steps to go before what GCC says could be translated on the ground... the motivation behind the Three city plan is really about social justice, bringing jobs to the west, and the level up agenda. But that has been translated into more justification for greenfield sprawl, isolating people from jobs in the west. Because under the rubber of caring about the west, there has been justification for facilitating investment, letting developers do whatever they want to do.' [interview: 7 July 2022].

Partly responding to the above critics on the slow recognition of relative competitive advantages among cities, as well as the delivery power of the Greater Sydney Commission, the Commission, as noted in the Preface, was renamed as the Greater Cities Commission (GCC) with an expanded remit covering Newcastle, the Central Coast and Wollongong in addition to Greater Sydney at the end of 2021. Interviews with commissioners from GCC remarked on their expanded role from the metropolis of three cities to a city region of six, interconnected, dynamic, and resilient cities, each with their clear and unique identity [21 July 2022]. Initial thoughts of the new Greater Sydney Region Plan are to build two axes:

- The east-west axis of the original metropolis of three cities – the Eastern Harbour City, the Central River City, and the Western Parkland City – will link the two airports and will enable liveable communities where more people work within 30 minutes of where they live.

3.7 The Western Sydney airport is planned as the backbone of an aerotropolis, the foundation of an emerging Western Parkland City concept. But the concept is debated.

There are strong rationales behind a second airport in Sydney. First and foremost, the capacity of the existing Kingsford Smith Airport has been limited for a long time [interview: planning practitioners, 26 June 2022]. Secondly, both the business sector and the federal and state governments view Sydney as the only global city of Australia. 'Our members want to compare Sydney with others, like London, New York, and Paris. That is what Sydney wants to be,

- The north-south axis will connect the seaports of Newcastle and the Illawarra, journeying through the Central Coast and through Parramatta. It too will build important foundations, generating more jobs for citizens in future-facing industries, again close to where people choose to live.

The Chief Commissioner summarised that: the vision of the Sydney city region is to offer more opportunities for individuals, families, and local communities by being able to face the world in a more confident and more competitive ways. 'It is about thinking about the global by acting on the local'. [interview: 21 July 2022].

That vision for the multi-city region appears to have survived the demise of the GCC as have the major strategic insights the GSC then GCC put in place. Sydney stands out in the group of cities that we looked at as having tried to develop a coherent spatial economic strategy at metropolitan scales and been willing to make major spatial choices. Neither Toronto nor Edinburgh, for instance, have managed growth with such clarity at the metropolitan scale. And the thinking of GSC, emphasising its global engagement and competitiveness, still underlines the importance of the western Sydney airport currently being developed. But that thinking goes far beyond a simple airport.

wants to see competing with. That is the thinking behind lots of what Sydney is doing, and it is the driver even at the federal level. Attracting global businesses to Sydney and making it the destination of the region have always been the drivers behind the state government' [interview with Australia Business Council, 16 June 2022]. We note, as an aside, that some experts forecast that Melbourne is forecast to be larger than Sydney by 2050.

Last but not least, the NSW government saw this as a rare opportunity to boost its regional development.

'NSW takes a view that this is not just an airport, but an opportunity that the state government could leverage, an opportunity to build a new city that is not necessarily aviation related, but broader than that... The opportunity the airport presents, apart from offering basic jobs, the federal government is willing to invest a 4 million package on it, 80% of which will be shouldered by the federal, and the rail line is 50-50 split. There are few others with federal funding at this scale. In any other situation, the federal government would be very reluctant, or they just invest a small amount, say 2 billion in another project. This is the opportunity the state government cannot ignore.'

Yes, in part it was a Lucy Turnbull driven politics proposition. I can understand the cynical view here. But having seen it evolve, I don't agree with that view. I think it is pretty much a planning-led initiative. The former Premier Berejiklian went overseas and saw the development around the Incheon Airport. She was convinced that this can work and came back becoming an advocate for it. So yes, there are particular persons driving things, but it was not so much about the politics. Also, we cannot ignore the fact that western Sydney was the last big piece of land that is underdeveloped, so it is logical to make it both more self-contained but also better connected with the rest of Sydney. Otherwise, it feels the city could spawl forever.' [interview: Australia Business Council, 16 June 2022].

Another planning practitioner added that:

'When the concept was conceived, it was really about boosting the export market. But it also attends to the west-east divide, hoping to re-balance it. I think what they have done well, is to identify the areas and industries that logically connect to the airport to build on – so agricultural, aviation, airspace, defence, and advanced manufacturing – and then start to work out the roles of the government to attract the first movers. For better or worse, the government committed to build one of the fast rails across Sydney into the west and encourage research facilities and universities to locate there... The plan is pretty ambitious, I would say it is a 100-year's game. The big challenge is whether the labour market will follow. Perhaps it takes a decade to see labour

moving from the east to the west.' [interview: 28 June 2022].

Contrasting to these more positive views, we also heard concerns raised among experts.

A leading academic in the planning discipline remarked that this aviation-dependent urban form is variously a greenhouse horror story and noise machine. The concentration of critical infrastructure might also create a possible security nightmare. He drew our attention to the fact that there is now a well-organised global anti-aerotropolis network⁷ highlighting the environmental and ecological downsides of aviation mega-projects. Moreover, since the new airport will have to go head-to-head with the established and profitable Kingsford-Smith Airport, question arose as to how vulnerable/sustainable Western Sydney's economic strategy would be based around an airport [interview: 15 July 2022].

Partially echoing this view, a media commentator remarked that,

'There are lots of challenges getting the airport off the ground... The developer lobby group already complains about the excessive developer contributions. Moreover, Greater Sydney has almost 10 million square metres of office space. Of this, nearly 90 per cent is in the eastern city and the rest is in the middle. That leaves the Western Parkland City with nothing much to enter the Aerotropolis to start with. On a more fundamental level, a city built on an airport sounds desperate, especially given that aviation is implicated in both of the two huge crises facing humanity – climate change and pandemic – and has ground to a possible halt, largely for that reason. Therefore, it doesn't feel like a good moment to select "airport" as economic driver for a city of well over 1.5 million inhabitants.'

'It contrasts to what we are expecting from a city too. An airport is noisy, dirty, and dispersed. A city, by contrast, is a centre of delight and desire, of creativity, stimulus as well as economic exchange. A city should be founded in authenticity and enjoyment, not some mad desire for escape. Now in particular [given the environmental concern], we need cities that encourage small, local journeys over big, abstract ones. We need to make localism not just easier, functional, but more delightful and enjoyable. The aerotropolis on the other hand, is built on a transport model of last-century that diminishes

our connection with nature, surrounding it instead with a lot of drive-to, depressing-looking building blocks and industrial parks' [interview: 4 July 2022].

On the ground, challenges were heard in planning and implementing. A Community Commissioner employed for this initiative said that the government needs to improve communication with residents, as there were substantial uncertainty, confusion, and lack of clarity around rezoning. [interview: 15 July 2022]. Adding to this, an officer from Infrastructure Australia remarked that:

'I don't think the western airport has a proven proposition yet. I am also not convinced that Aerotropolis is a thing. It is not an easy story. The concept is very challenging, and the forecast is huge, but I don't see it is happening yet... Australians like to live by the coast. We have a strong history of clinging to the coast for a long time. It has to be underscored by a broad culture shift for that area to grow. That is also complex because of the geopolitical circumstances Australia is facing. Another issue is that the Australian city deals is fundamentally different from the British deals. The latter is about devolution, but the Australian deals are about centralising controls by the federal government. The West Sydney city deal is about enabling infrastructure to support the airport, it is not about city development. This comes back to the visionary piece of the aerotropolis – it is a good vision but might not work.' [interview: 9 June 2022].

⁷<https://antiaero.org/>

Discussions and reflections.

In this section we bring above discussions together to reflect on the key questions we asked at the beginning of this project, that is, how different cities are currently developing new strategic priorities and approaches, and how effectively they are doing so. This report focuses on the case of Sydney in the State of New South Wales, Australia, and contrasts with Edinburgh.

- Unlike the Scottish context, where a pyramid of policy objectives and narratives are brought forefront without considering their internal logics, in Australia, there is an implicit recognition and acknowledge of policy priority – a priority that is still economic competitiveness focused and is still underpinned by air travel. A similar conclusion can be drawn for Toronto, in Canada, but amidst a set of aggressively competitive large US cities.
- In the UK, Australia, and Canada almost all governments recognise the imperative for net zero by 2050 but our case study interviews, and document reviews reveal major uncertainties within politics and bureaucracies about how to understand and govern decarbonisation, for instance many of those with technological solutions are unclear on transition impacts, and spatial thinkers may often be unclear on the real extent of probable technical change. Governments the lack of articulation, or ‘protocol’ in the words of one of our interviewees, of how to change.
- The identification of decarbonisation pathways is inhibited by the structures of government and governance, in particular the power allocation and evolution across different levels of government, has caused major challenges on multiple fronts. First, this misalignment across different levels of government, which leads to confusion in industries, and further leads to wrong pricing of risks and inability to innovate and deliver the outcomes that the government is encouraging them to. Second, the lack of clarity creates conflicting objectives within government,

in a way that agencies making interventions in the same location are pulling against each other. Third, citizens become suspicious of the motives of the government, because of the rather ambiguous and vacillating policy articulations.

- Yet we see in Sydney and Australia a growing policy recognition of the climate impact and pressures for the governments to react. Government may not always be an efficient mechanism of program delivery, but when it comes to setting rules and enforcing standards, they are really the only game in town. Without the rule of law and rigorously enforced air pollution regulation, there seem to be too many incentives for trading off long-term benefits for short-term gains. Innovative policy designs to reduce pollution should always be explored. But there is no substitute for rules that express a nation’s sense of values and for those national values to include preservation of the planet. In many respects, in Sydney as the other case studies, the need for decarbonising aviation and effective regulation was, if anything, more widely recognised by airlines and airports than by those in other sectors and even the general public (and this is reflected in how airports in their own operations have moved faster towards net zero than most sectors). Many policy and planning experts we interviewed in Australia believed that although sustainability is an important issue, it has been always at the back of people’s mind (in contrast to Scotland where governments have placed it firmly in public view for a decade and more). It is only now, in Australia, that this issue has gradually moved to the front of peoples’ mind, partly because they saw the physical manifestations of things such as floods and bushfires. Yet it is important to point out that the Australian government is taking actions on different levels, at different paces, and with different focus. There is a consensus among our interviewees that environmental concerns are played out at the micro, build-form levels (e.g., housing, transport plan, built materials etc.)

and that the aviation sector is, and will for a long time still be, pretty much sheltered from any demand limitations to support climate actions. The Canadian Federal position is, in relation to aviation decarbonisation, similar but reflected in a strong belief in technological change resolving issues, already for smaller planes and shorter flights, and promotion of research and development for change. The concern in Edinburgh was that absence of a coherent long run technological view could lead to demand limitations that foreclose economic growth, and in Sydney there has to be relentless attention to the emerging feasibility of technical progress and what to do if it slows or halts.

- In places where growth, resilience, sustainability, and inclusion have been co-listed as policy targets, there is a lack of understanding on their relations and potential trade-offs and a failure to track change in consistent frameworks of metrics. Policy urgently needs and end to fuzzy narratives and a commitment to delivery metrics. These issues are explored at length in Chapter 2 of the main report. The state of NSW is leading the thinking on protecting environment while boosting its global city position. The state, and especially the Greater Sydney’s strategic planning (previously in the GSC) embody all these aspirational goals, but there is still much conceptual work to be done thinking through how these different objectives might offset or reinforce each other. The same observation applies in Toronto and for Ontario, who start from less spatial clarity in action. In Edinburgh, and Scotland, the near absence of spatial economic thinking in the planning process is reinforced by no clear just transition plan as policy highlights what carbon activities are to cease but has no sectoral or spatial mapping of where and how new jobs and opportunities might, or might not, replace the carbon past.
- A major related weakness of Australian decarbonisation policymaking in general is the lack of sophisticated data analysis, scenario building, and inhouse intelligence to fully comprehend the advice given by external consultants and the assumptions they take. Planning systems in all three countries have been decimated in this Millennium just as governments and localities have embraced

multiple wicked problems that global, local, and inevitable spatial dimensions. Moreover, implementing strategies on the ground might present other challenges such as balancing economic opportunities verse stimulating high-tech growth; agglomerating office spaces verse fostering meaningful clusters; and building communities verse land grasp and capital fix.

- The recognition of airports as key strategic ‘connectivity’ infrastructure with a full and recognised role in infrastructure and spatial planning strategies was, in the case studies, most evident in Sydney and also important in Toronto. They were so regarded because aviation was seen as essential to rising prosperity and efforts were made to understand and enhance the relationships. That emphasis contrasted sharply with Edinburgh and Scotland where governments seemed to underestimate and have a weak empirical understating of Scotland’s remoteness within the UK and Europe and where the airport was not regarded as a major asset within national spatial, nor indeed, economic planning.
- The need to decarbonise aviation will predominantly arise from reductions in in-flight carbon emissions. Just as there is an urgent need rethink the relationships between the aviation industry and spatial planning there is an imperative for a major research technology based strategy for the aviation industry that works collaboratively over multiple sectors and spatial levels. There are multiple ways of reducing the carbon footprint of the aviation industry, including for example, improve fuel efficiency of airplanes and optimising airport design. Major efforts are being made to make such cross-industry connections for technological change by national level governments but there was a lack of evidence that sub-national governments had managed to ground such poles of aviation sector change in their jurisdictions and new green aviation fuel and construction opportunities are being missed.
- The complex polycentric structures of metropolitan growth are better recognised, and generate more significant strategic policy responses, in Sydney than in most world cities. In that pattern of metropolitan growth, that has left behind the old core-suburb understanding of cities the last Millennium, it is a valid question to

ask is, are we building a city around the airport, or building an airport for the city region? The former focuses on planning self-sufficiency (so reduce intraregional travel) whereas the latter emphasises better connection to other parts of the bigger metropolitan area (both the qualitative and pattern of travels will be intensified). GCC's Three Cities and then Six City discussion tried to reconcile this potential tension through, for example, the proposition of building a new aerotropolis around the airport and at the same time improving connections between the airport

and the rest of the city. There are moves to retrofit an aerotropolis around Pearson airport as a new employment growth pole in polycentric suburbia. There are currently no strategic plans to develop an aerotropolis around Edinburgh airport, at arguably Scotland's best connected location, internally and internationally.

Touchdown.

It is clear that there is no best single way to identify and deliver decarbonisation path for metropolitan airports. But it is also clear that governments, increasingly missing carbon reduction targets (as highlighted at COP28), are being tested in their capabilities to govern the complex sectoral, spatial, and temporal relationships involved. And it is also manifestly clear that looking at the

experience of others helps governments make better decisions not because they find 'silver bullets' abroad but because examining the actions of others help understand their own problems and develop their own solutions so that all learn to govern better. Such learning seems to be urgent if net zero aviation is to be about rising prosperity rather negative metropolitan shock.



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