

What Could Increased Cycling Contribute to Reducing Australia's Transport Greenhouse Gas Emissions?

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Abstract

Cycling's potential in environmentally sustainable transport receives modest recognition in many state and local government climate change policies and cycling currently performs only a minor transport role. Compared to international locations exhibiting best practices, it has often been regarded that Australian cities cannot aspire to high cycling rates. Contrasting with consistently low cycling rates, selected inner-city capital city locations in Australia have relatively higher cycling rates. Setting public policy to encourage greater Australian cycling rates and emulating the international best practice locations involves formulating public policies to fulfil this objective. This paper examines the question of identifying the potential of cycling in Australian cities to reduce greenhouse gas (GHG) emissions from the transport sector. There are several steps to this analysis, starting with a description of transport sector GHG emissions and current cycling rates. A review of current climate change and cycling policies, federally and by the states and territories, describes the aspirations of current policies. An analysis is made of the potential GHG emissions reduction from cycling. A brief discussion canvasses several key issues and conclusions are drawn that Australian climate change policy makers have neglected the potential GHG savings from investment and policy development in cycling for transport.

1 Introduction

Transport's greenhouse gas (GHG) emissions have proved resistant to the much of the policy directed at their reduction, both in Australia and around the world (e.g., DCCEE, 2011a; ITF, 2009). Active transport – walking and cycling – as the least-polluting modes, can provide for a considerable portion of urban mobility with a negligible carbon footprint. Replacing motorized transport journeys with cycling and walking reduces GHG emissions from the transport sector. But how many motorized trips can be replaced by cycling in a nation where transport is dominated by the private motorcar?

This paper examines the potential of cycling in Australian cities to reduce GHG emissions from the transport sector and the extent of emissions reduction possible. Here the focus is on utilitarian cycling as this journey type can replace a motorized trip; recreational cycling has many virtues, but in principle does not replace a motorized trip and has no impacts on transport GHG emissions.¹

2 Cycling rates

Establishing the level of cycling from current data is challenging. As the *National Cycling Strategy* states with regard to the problems of assessing cycling performance of former strategies due to the 'lack and poor quality of data in this space' (ABC, 2010: 14): 'While the Australian Bureau of Statistics (ABS) does publish some relevant data and a number of states have made efforts to collect useful and relevant data, there is a significant lack of consistent and robust data across the country, an issue that must be addressed.' A report for the NSW

¹ It is acknowledged that greater recreational cycling or participation in mass events can initiate or encourage increased utilitarian cycling.

government, *Cycling in New South Wales* (Lehman, et al, 2008), provides a detailed account of data availability and data needs;² no other state has matched this effort. Accordingly, the following description of cycling rates is based on ABS data.

As a point of interest, there does not seem to have been a study to identify cycling rates across all Australia's towns and cities; most of what is published refers to the capital cities; arguably, we don't definitely know our best practice town or city.

2.1 Journey-to-work in the capital cities: cycling in context

Commuting is of particular interest in transport planning and of relevance to transport GHG emissions; it is typically the longest journey type, contributes most to peak usage of roads, public transport, and active transport infrastructure, and connects households with their typically dominant sources and locations of income. It is unlikely that urban transport can achieve a low rate of GHG emissions if commuting is responsible for high emission levels.

Australian commuters are predominantly car drivers; according to the 2006 census results, the average share for car travel for the Australian capitals was 76 per cent – almost 70 per cent as drivers and another 7 per cent as passengers – of the 4.8 million commuters (Mees et al, 2007). Public transport commuters comprised 15 per cent on average, leaving 1 per cent as cyclists and 4 per cent as walkers (Mees et al, 2007). Historically, this distribution has differed little in recent decades; although in 1981 there were 3.7 million commuters, about 71 per cent were in cars, 21 per cent in public transport, 1 per cent cycled, and 4 per cent walked (Mees et al, 2007). Noteworthy here is that from 1981–2006, total commuters numbers are one-third higher.

Commuting by bicycle is increasing in absolute popularity (see Table 1). For the combined capital cities in 1976, there were 30,259 cycling commuters, the level is stable between the mid-30,000s and low 40,000s over the 1981–2001 period, rising to 55,599 in 2006 (Mees et al, 2007).³ There are important differences between the capital cities (see Table 1). In 2006, over one-half of all cycling commuting occurs in Melbourne and Sydney (29,795 of 55,599 commuters), with Melbourne accounting for one-third of the capital city total. But in terms of relative success, Canberra has by far the highest cycling commuting rates (at 2.5 per cent modal share), followed by Adelaide 1.5 per cent, Melbourne 1.3 per cent, Perth 1.2 per cent, Brisbane 1.1 per cent, Hobart 1.1 per cent, and Sydney 0.7 per cent. Cumulatively, the total distance covered by the nation's commuting cyclists in 2006, based on the census findings, was 189,392,000km (Bauman et al, 2008).

² However, its recommendations for data collection did not explicitly recognize environmental values and the role of cycling in reducing GHG emissions; further, its recognition of data on cycling as transport and its place in the transport system is not strong.

³ Limitations to these data should be noted; cycling is arguably underrepresented. Census surveys undercount overall cycling because it is conducted in June or August; cycling levels are lower in winter (Vicroads, 2004; Rissel and Garrard, 2006). Commuting ignores the role of cycling in other trip categories where it is often more popular. Cycling rates differ greatly in different parts of the cities, with significant differences missed when these are averaged across the whole city.

Table 1 Bicycle commuting in Australian capital cities, 1976–2006

Census Year	Adelaide	Brisbane	Canberra	Hobart	Melbourne	Perth	Sydney	Total
1976	8263	2595	784	196	10,816	2959	4646	30,259
1981	8401	4086	2046	364	13,768	3971	8008	40,644
1986	8061	5063	2272	432	13,062	5066	9262	42,218
1991	7186	6742	2318	385	12,068	6126	8934	43,759
1996	4494	5719	2759	467	10,602	4690	8193	36,924
2001	4572	6788	3112	626	12,837	5580	9223	42,738
2006	6476	7951	3753	834	18,909	6790	10,886	55,599

Source: Abridged from: Mees, P., Sorupia, E. and Stone, J. (2007). *Travel to Work in Australian Capital Cities, 1976--2006: An Analysis of Census Data*. Australasian Centre for the Governance and Management of Urban Transport: Melbourne

In relative terms – at least up to the last census year of 2006 – commuting by cycling has not increased in popularity to any great extent, because, although cycling has increased, so has the national population. By way of simple example, although 2700 more commuters cycled in Sydney between 2000 and 2006, this increase is for a city with a population in excess of four million persons.

A newer ABS survey of travel to work or full-time study in 2009 essentially confirmed the 2006 findings; cycling had a 1.5 per cent mode share nationally (ABS, 2009). Cyclists undertaking this journey tended to be in the 25–34 and 35–44 year old age groups (ABS, 2009), which also agreed with earlier census findings.⁴ These cycling journeys were predominantly less than five kilometres (52 per cent), although 27 per cent were between five and ten kilometres (ABS, 2009).

2.2 *Non-commuting cycle journeys*

Census results of the journey-to-work are the main indicators of cycling, with other irregular, local, route-specific, and time- or event-specific measures and surveys that include the non-commuting trips. Many of these data are derived from travel diary studies that make inter-study comparisons difficult and pose sampling problems for activities with low participation or that tend to be localized. A limitation with many of these studies for this paper is that they don't differentiate between recreational cycling and utilitarian cycling. Using the most recent ABS national data, cycling's mode share for non-commuting journeys is 5.3 per cent in 2009 – interestingly, the non-capital city rate is slightly higher, at 6.6 per cent (ABS, 2009). An example of a more detailed local study comes from Lehman et al (2008) who reported that cycle commuting was only 16 per cent of all cycling trips in the Sydney Household Travel Survey, but this includes social and recreational trips – 25 per cent of weekday and 50 per cent of weekend trips.

2.3 *Intermodal trips*

It is noteworthy that Australian commuting cycling is predominantly directly origin–destination; the level of intermodal trips is low. Journey-to-work data in NSW from the 2006 census, for example, found that of 0.8 per cent journey-to-work trips taken by bicycle (19,274 trips out of 2.4 million), 87 per cent were bicycle-only, 11 per cent were bicycle-plus one mode, and 2 per cent were bicycle-plus two modes (Lehman et al, 2008). Even more telling of the low level of cycling–public transport linkage is that of the 'bicycle-plus one mode group'

⁴ Utilitarian cycling in Australia is narrowly cast: it is concentrated in the inner-city suburbs, male, higher education levels, and of the upper end of the socio-economic spectrum (Bartley Consulting, 2008).

only 34 per cent were ‘bicycle–train’ travellers and 35 per cent were ‘bicycle–car’ travellers – either as car drivers or car passengers (Lehman et al, 2008).

3 Transport sector GHG emissions

3.1 Emissions and trends

Australia’s most recent national GHG emissions inventory provides data for 2009 (DCCEE, 2011a). National emissions were 545.8 MtCO₂-e (excluding land use, land use change, and forestry), of which transport contributed 15.3 per cent (DCCEE, 2011a: 37). Using 1990 as a baseline (the Kyoto Protocol baseline for Australia), transport emissions had risen 34.6 per cent to 2009 (i.e., from 62.1 to 83.6 MtCO₂-e) (DCCEE, 2011a: x). Fuels used for international transport are counted separately from the national totals; if included, these ‘bunker fuels’ add another 12 MtCO₂-e to the national total (DCCEE, 2011a: 37).

Since utilitarian cycling in Australia is primarily personal transport (i.e., its role in commercial or freight tasks is minor), avoided GHG emissions from the private motor vehicle as a result of increased cycling are of particular interest. About 86 per cent of transport emissions arise from road transport (72.2 MtCO₂-e of the 83.6 MtCO₂-e) (DCCEE, 2011a: 37). Most were from passenger cars (41.5 MtCO₂-e) and trucks and buses (30.5 MtCO₂-e) (DCCEE, 2011a: 37). Passenger vehicle emissions increased almost 18 per cent from 1990–2009 (DCCEE, 2011a: 37). Forecasts by the federal government in *Australia’s Emissions Projections* are for the transport sector emissions to increase 29 per cent above the year 2000 levels by 2020 under a BAU scenario (DCCEE, 2011b).

3.2 Motorcars and emissions

Australia has a high level of motor vehicle ownership and use and relatively poor GHG emissions efficiency from its vehicle fleet, factors that contribute to the transport sector’s GHG emission levels. In 2010, there were 16.1 million registered vehicles (ABS, 2010) in a population of 22.3 million people; in 2009, 92 per cent of households had one or more registered motor vehicles (ABS, 2009). This fleet comprised 12.2 million passenger vehicles, 2.5 million light commercial vehicles, 430,000 rigid trucks, 82,000 articulated trucks, 86,000 buses, and 660,000 motorcycles (ABS, 2010). For the most recent national data available, for 2006–2007, the average Australia motor vehicle covered 14,600km per annum – ranging across the states/ territories from 12,400 to 15,200km (ABS, 2008). Average fuel consumption for all Australian motor vehicles in 2007 was 14 l/100km (ABS, 2008), which is comparatively poor within the OECD⁵. By way of scaling, the average Australian passenger car with its (petrol) fuel efficiency of 11.1 l/100 km (ABS, 2008), covering 14,600 km per annum, and with a litre of petroleum producing 2.3 kg of CO₂, the car will produce slightly over three tonnes of CO₂ emissions for the year.

3.3 Mode-switching and GHG emissions

Of the many ways to cut GHG emissions from transport, switching from high-carbon modes to low-carbon modes remains a central and indispensable strategy. There are many different estimates of the emissions from each mode in different locations and also due to differences in calculation method, assumptions made, and data used. Below, findings of the Victorian government’s Commissioner for Sustainability (CES, 2008) are shown in Table 2, using a full fuel-cycle analysis – not life-cycle analysis. In some ways these results may be surprising, but it should be remembered that the trains and trams in Melbourne use electricity generated substantially from brown coal and that the off-peak loads in public transport are often low. These data show average emissions intensity, but it is incremental emissions intensity that is probably more important, i.e., the additional emissions for each additional kilometre travelled in patronage; for public transport modes, each kilometre adds another 50 or so grams of CO₂-

⁵ See, e.g., www.aij.com.au.

e emissions, but for motor cars at average occupancy, that extra kilometre adds almost 320 grams (COE, 2008).

Table 2 Greenhouse Gas emissions intensity for different transport modes: Melbourne (grams CO₂-e per passenger kilometre travelled).

	Average	Peak	Off-Peak
Train	145	96	198
Tram	158	122	178
Bus	159	101	194
Car: Driver only	302	313	297
Car: Average occupancy	213	250	189
Motorbike	112	-	-

Source: Commissioner for Environmental Sustainability (2008). *Public Transport's Role in Reducing Greenhouse Emissions*. Melbourne: Commissioner for Environmental Sustainability: Page 17.

4.0 Climate change policies: federal and state/territorial

Our interest in climate change policies at these broad scales is the extent to which they recognize the role of active transport as a means to reduce transport GHG emissions. Local government may be the most important sphere of government for active transport initiatives; however, there is no current national review available and it is beyond the scope of this paper to review all 560~ local government administrations. 'Policy', of course, refers to more than formal documents and there may be relevant activity under way not recorded in these documents, but our interest in these formal statements is their expression of formal government intention.

4.1 National

Neither the last (Rudd), nor the current (Gillard), federal governments have had a formal climate change strategy document; the most recent of these was produced late in the final term of the Howard government (Australia, 2007). In place of formal policy documents have been a number of specific policy announcements. These include the Rudd government's decision to ratify the Kyoto Protocol and proposed Carbon Pollution Reduction Scheme legislation and the Gillard government's proposals for a carbon tax and carbon emission trading.

There have been a number of federal agency policies and initiatives directed at reducing transport GHG emissions and a number of general propositions to increase the level of cycling and walking as a means to this end. None carry the weight of being enacted in legislative form or have the specificity of being numerical targets against known baselines. What we do have is the national GHG emissions reduction target.

Australia has a number of national GHG emission reduction targets, but none are applied to specific sectors, such as transport. Under the Copenhagen Accord, Australia has committed to both unconditional and conditional emission reduction targets. Australia's unconditional target is a long-term emissions reduction of 60 per cent below the baseline year (i.e., the year 2000) levels by 2050 and a near-term target of 5 per cent below the baseline year levels by 2020. If other nations agree to certain commitments, Australia will increase its emission targets for 2020 to either 15 per cent or 25 per cent below those of the baseline year (i.e., 2000) levels.

Some consider these targets inadequate to address climate change – or to satisfy the goals of the Copenhagen Accord. Professor Ross Garnaut of the Garnaut Climate Change Review

called for a target of 80 per cent reduction to stabilized atmospheric concentrations of CO₂ of 550 ppm and 90 per cent cut to achieve a concentration of 450 ppm, against the baseline year (GCCR, 2008). US climate scientist James Hansen (2009) argues for stabilization at the current levels at around 350 ppm, which would necessitate a very low level of GHG emissions in the relatively short term, implying even greater short-term emission cuts.

4.2 States and territories

Each state and territory has a climate change policy; at least one (Victoria) may have been unofficially removed. These policies may express a linkage to the national climate change policy, but the states and territories can set such policies independently from the federal policy.

Weathering the Change: The ACT Climate Change Strategy 2007–2025 (ACT, 2007a: 20–2) states that the ACT will reduce its GHG emissions of 2000 by 60 per cent by 2050 and set an interim target of stabilizing the emissions of 2000 by 2025. *Action Plan I 2007–2011* (ACT, 2007b) includes Action 14: Bicycle riders who use the on-bus bike racks provided by ACTION will travel on that bus at no cost.’

New South Wales’s *NSW Greenhouse Plan* (NSWGO, 2005: 2) had as its long-term goal a 60 per cent cut of 2000 GHG emissions by 2050 and reducing emissions by 2025 to those of 2000. A new climate change action plan is being prepared to replace the 2005 plan. Now possibly redundant under the new state government, the *State Plan 2010* contains the goal (NSW, 2010a: 11): ‘Increase the mode share of bicycle trips made in the Greater Sydney region, at a local district level, to 5 per cent by 2016.’ NSW’s earlier *NSW Greenhouse Plan* of 2005 identified active transport as a means to lower GHG emissions (NSWGO, 2005).

Although the Northern Territory adopts a long-term GHG reduction target (60 per cent of 2007 emissions by 2050) the current *Northern Territory Climate Change Strategy 2009* (NT, 2009) describes this as an ‘aspirational goal’. How an ‘aspirational goal’ differs from a ‘goal’ is not explained. Target 23 of the strategy is: ‘Plan and implement an integrated public transport system that sees a 20 per cent increase in the use of cycling, walking and public transport across the Territory by 2020.’ Under the actions to be taken for this target are listed: 23.4 ‘Actively promote the use of alternative transport, including cycling and walking, through: the installation of bike storage facilities at high demand public bus interchanges; provision of an extensive cycle path network; provision of facilities such as showers, secure bike storage and lockers in government owned and leased buildings; and a trial of bike racks on buses in the Darwin region.’ No estimates of potential GHG emissions savings are given.

Queensland’s *ClimateQ: Toward a Greener Queensland* (Queensland, 2009: 169) lists several active transport initiatives including 88 approved new projects to expand the southeast cycle network by an additional 90km (costing \$18 million), a dedicated pedestrian and cycling project for the Gateway Upgrade, bicycle end-of-trip facility at King George Station in Brisbane’s CBD, and a cycle centre at the Royal Brisbane Women’s Hospital. No mention is made of potential emissions savings from these initiatives. There does not seem to be an explicit GHG target in any of this document, other than a pledge to contribute to the nation’s long-term target.

South Australia’s *Tackling Climate Change: South Australia’s Greenhouse Strategy 2007–2020* expresses its target as (SA, 2007: 6): ‘... reducing emissions by 60 per cent (to 40 per cent of 1990 levels) by 2050.’ Objective 6.2 to achieve more sustainable behaviour includes actions to expand the TravelSmart programme which includes promoting greater use of cycling. Objective 6.4 is to encourage mode shifting and describes the role for infrastructure in encouraging walking and cycling; specifically the strategy supports implementation of the state’s cycling strategy (*Safety in Numbers: A Cycling Strategy for SA 2006–2010*) and states

that the government will develop a walking strategy (p. 39). There are no estimates for the emissions reductions expected from these policies.

Tasmania's 2008 *Tasmanian Framework for Action on Climate Change* states as the first of its objectives: '1. Reducing our greenhouse gas emissions to at least 60 per cent below 1990 levels by 2050' (Tasmania, 2008: 4). In its section on transport actions, the strategy states that the government would spend \$4 million over three years to develop a network of community trails for 'recreational and transport opportunities'.

Following the election of the coalition government in Victoria in late 2010 the status of climate change policy is not clear; the former *Victorian Greenhouse Strategy* (Victoria, 2002) – and the 2005 updated Action Plan – have been withdrawn from the Office of Climate Change website. Premier Baillieu described the state's former government's GHG emissions reduction target of 20 per cent below 2000 levels by 2020 as 'aspirational' (Rood and Morton, 2011).

Western Australia's *Western Australian Greenhouse Strategy* (WA, 2004) commits to support national efforts to reduce GHG emissions, but contains no reduction targets for the state. Cycling is identified as an action under the travel demand programme strategic direction, namely: 2.4.2 'Promote focused programs for cycling and walking and link these to the Premier's Physical task Force'. Under the transport infrastructure investment actions there is strong support for cycling and walking: 2.4.9 'Review and upgrade the Bike Ahead Strategy and Perth Bicycle Network Plan that aims to improve services and infrastructure for cycling and cyclists'; 2.4.10 'Support local governments to prepare local integrated transport plans that prioritise improvements to public transport, cycling and walking facilities'; and 2.4.11 'Construct principal shared paths, particularly along new rail lines and freeways, along with other road routes and paths for cyclists that enable access to stations and accessibility and connectivity to local communities.' No quantification of possible emission reductions is given.

5 Cycling policies: national and state/ territorial

International and national experience has shown that public policy is critical in promoting increased cycling (e.g., Dekoster and Schollaert, 1999; Pucher, 1988; Pucher et al, 2011; Pucher and Buehler, 2007). The potential role of active transport in reducing transport GHG emissions is acknowledged both in some of the climate change policies described above and in the scholarly literature on sustainable transport; here we examine the extent to which this acknowledgement is reciprocated in the cycling policies and strategies.

5.1 National

National policy is expressed in the Australian Bicycling Council's (ABC) *National Cycling Strategy 2011–2016* (ABC, 2010) – the third of these strategies; the ABC represents federal, state, and local government agencies, the bicycle industry, and cyclist user groups. Its goals include increasing cycling participation, infrastructure and facilities, and integrated planning, improving cycling safety, monitoring and evaluation, and providing guidance and identifying best practices (ABC, 2010). Cycling's role in reducing GHG emissions is recognized (ABC, 2010: 9): 'As a zero emission mode of transport, cycling should be a key component of any future emissions reduction strategy.' Its goal is to double the number of cyclists by 2016, although it's not clear what is being used as the baseline, and this goal may include recreational cycling.

5.2 States and territories

Although this account describes the existing bicycle strategies for the states and territories, it is important to note that this does not imply anything about the actual level of cycling or about cycling infrastructure and facilities. For example, there is no cycling strategy for the

Northern Territory, but Darwin has a network of cycle paths. Perth has developed the Perth Bicycle Network, one the nation's best in recent years, but this has, in some respects, outstripped the currency of the public cycling strategy.

Canberra's *Canberra Bicycle 2000 Strategy* was developed in 2000 and a new strategy is in preparation; the current strategy contains in its 'Vision' section the following (ACT, n.d.): 'To increase the proportion of commuter trips by cycling from 3 per cent in 1997 to 6 per cent by 2007'. In the section 'Objectives', the following is added to the above target: '... and increase the participation rate for all types of trips.' This strategy has no formal monitoring or performance assessment provisions.

New South Wales's *NSW Bike Plan* contains two specific goals (NSW, 2010b: 3): to 'increase the share of short trips by bike in Greater Sydney for all travel purposes to five per cent by 2016 and double the use of cycling to get to work, across all of NSW, between 2006 and 2016.' Presumably the baseline for the Greater Sydney goal is 2010, the year of publication, but this is not stated. There is no formal monitoring or reporting process described in the plan.

South Australia's *Safety in Numbers: A Cycling Strategy for South Australia 2006–2010* states its goal as (SA, n.d.: 2): 'More people cycling safely more often in South Australia, with an aim to double cycling trips by 2015'. No explanation is offered as to what this means, no assessment or monitoring is included in the strategy.

Queensland has adopted the approach of having the *Queensland Cycle Strategy* (QT, 2003) and releasing reports on the implementation progress (available for the years 2003–5, 2005–6, 2007–8, and 2008–9). *Queensland Cycle Strategy* (QT, 2003) set the target for Queensland to increase the proportion of 'all person trips' from 3 per cent to 6 per cent by 2021; for South East Queensland the target is 5 per cent for all trips by 2007 and 8 per cent by 2011. A linked, major initiative is the *South-East Queensland Principal Cycle Network Plan* (QT, 2007) which contains a breakdown of current cycling activity and details plans for cycling infrastructure development. In the most recent implementation report for 2008–9, it states (QT, 2010: n.p.): '*Queensland Cycle Strategy* implementation outcomes throughout the 2008 to 2009 period continue to deliver on the vision of "more cycling" for Queensland.' This implies that the numerical target has been met, but does not explicitly confirm this.⁶ It does not state whether the strategy target had been achieved for Queensland or South East Queensland.

Tasmania's *Tasmanian Walking and Cycling for Active Transport Strategy* (Tasmania, 2010) states that it shares the (previous) national strategy (i.e., of 2005–2010) goal of increasing cycling. This earlier national strategy did not have a numerical target; clearly, the state's strategy does not have any means to assess its performance.

Victoria's 2009 *Victorian Cycling Strategy* (Victoria, 2009: 5) states: 'The aim is to increase the number of cycling and walking trips in inner Melbourne by 15,000 and grow cycling in the rest of the State by 2020.' Although specific, combining walking and cycling into a single metric makes this of no value for assessing cycling performance; further, it presumably includes both utilitarian and recreational cycling; 'inner Melbourne' is imprecise and undefined in the strategy. There are no monitoring aspects to the strategy.

Western Australia's *Bike Ahead* strategy (WA, 1996) dates back to 1996; it contains mode share target for cycling derived from a Perth transport plan of the same era. This set a mode share for cycling for personal journeys at 11.5 per cent for 2029; the currency of this goal is

⁶ Commuting rates in Brisbane from the 2006 census do not indicate a doubling since 2001, see Table 1 above.

unknown. There are no monitoring, performance assessment, or similar components mentioned in the strategy.

5.3 States and territories overview

A summary of current state and territory cycling policies is shown at Table 3. Each is reviewed to determine whether or not there is a specific target for future cycling rates. South Australia's target is deemed too vague to constitute a specific target. Each strategy/plan is assessed as to whether there is a stated baseline from which the target is set; Victoria and Western Australia do not state what the baseline for their targets are. Whether each strategy/plan is still current is assessed by whether the period it addresses is still current; where it is not, it means that the last strategy/plan is presumed to have expired.

Table 3 State and territory cycling strategies/plans

State/Territory	Specific targets for cycling levels?	Is there an explicit baseline?	Is the policy still current?
Australian Capital Territory	Yes	Yes	No (to 2007)
New South Wales	Yes	No	Yes (to 2016)
Queensland	Yes	Yes	Yes (to 2020)
SE Queensland	Yes	Yes	Yes (to 2011)
South Australia	No	–	–
Tasmania	No	–	–
Victoria	Yes	No	Yes (to 2020)
Western Australia	Yes	No	Yes (to 2029)

5.4 Capital city strategies and plans

Brief attention is given to the cycling plans of the capital cities because the CBDs are a focus of cycling activity and plans for these areas can have wider implications. These activities are, for the most part, concerned with the planning and development of infrastructure programmes; all of the capital cities have cycle path systems of various types. Currently, the City of Perth is in the process of developing its *City of Perth Cycling Plan* and the City of Darwin does not seem to have a formal cycling strategy.

Broadly, here are CBD-only bicycle strategies and plans and there are city-wide approaches. Brisbane is governed by a single local government, so the activities of the Brisbane City Council are of particular significance. Brisbane City Council's *Transport Plan for Brisbane 2008–2026* (BCC, 2008: 10) states that for 24-hour average weekday mode share: 'By 2026, the *Transport Plan for Brisbane 2008–2026* aims to achieve a 5 per cent share of trips by bicycle and 12 per cent by walking.'

Hobart City Council has a *Bike Plan* from 1996; it states (HCC, 1996): 'A target for the number of trips by bicycle in future is 5 per cent by the year 2002 and 10 per cent by the year 2012. These are ambitious targets considering that the current level of usage is approximately 0.6 per cent of all urban journeys.' A reference for this baseline is not given; there does not appear to have been subsequent reporting on these goals.

Adelaide City Council's (ACC, n.d.) *Bicycle Action Plan 2008–2011* does not contain any targets for mode share or GHG emission reductions from transport through increased cycling, although it does expect the strategy to contribute to this overall goal of lowering emissions.

Sydney City Council's *Cycle Strategy and Action Plan: 2007–2017* has the following targets (SCC, 2007: 11):

- Increase the number of bicycle trips made in the City of Sydney, as a percentage of total trips, from less than 2 per cent in 2006 to 5 per cent by 2011, and to 10 per cent by 2016
- Increase the number of bicycle trips between 2 and 20 km made in the City of Sydney, as a percentage of total trips to 20 per cent by 2016.

The City of Melbourne *Bicycle Plan 2007–2011* (CoM, 2007: 6): ‘By 2011, 10 per cent of on-road vehicle movements to or through the CBD in the morning peak will be undertaken by bicycles [2006 figure 3.9 per cent].’

6 International best practice in cycling

Best practice cycling national levels are far higher than Australia and no Australian city can match the best-practice cities. For example, as the Australian national cycling strategy notes, in 2001, Denmark had almost one-fifth of its commuting by bicycle (ABC, 2010), giving an indication of what a nation with a similar level of overall economic development status as Australia can achieve. In contrasting cycling rates in Denmark, Germany and the Netherlands against the major English-speaking nations, Pucher and Buehler concluded (2008: 497):

With only a few exceptions, however, even the most bike-oriented cities in the UK, Australia, Canada and the USA generally have bike shares of travel that are lower than the least bike-oriented cities in the Netherlands, Denmark and Germany. No British, Canadian, Australian or American city even approaches the bike share of trips in most Dutch and Danish cities.

An overview of the Dutch experience gives an indication of the parameters of cycling in a leading national exemplar. One-third (34 per cent) of all journeys under 7.5km were by bicycle in 2007; impressively, 15 per cent of the 7.5–15km journeys were also cycled; overall, 26 per cent of all journeys were cycled (see Table 4). As *Cycling in the Netherlands* (MTPW&WM, 2009) notes, 70 per cent of all journeys are 7.5 km or less. Cycling rates vary by journey type, for example, the highest rates are for education (50 per cent), social-recreational (31 per cent), shopping (28 per cent), commuting (25 per cent), visiting (21 per cent), with lower rates for services and personal care (18 per cent), touring and hiking (16 per cent) and business trips (11 per cent) (MTPW&WM, 2009). Also in *Cycling in the Netherlands* has a list of the best five and worst five cycling cities in 2003 (with populations over 50,000): all the best have above a 30 per cent mode share for cycling and the worst range from 10 to 19 per cent (MTPW&WM, 2009). Groningen (38 per cent) and Zwolle (37 per cent) top the list, with Rotterdam (16 per cent) and Heerlen (10 per cent) at the bottom (MTPW&WM, 2009).

Table 4 Holland: all journeys by main mode and distance, 2007 (as percentages of mode share)

	Up to 7.5km	7.5–15 km	15km or more	Total
Car driver or Passenger	36	76	81	48
Train	–	–	11	2
Bus/Tram/Metro	2	6	4	3
Walking	27	15	2	19
Bicycle	34	–	–	26

Source: Ministry of Transport, Public Works, and Water Management (MTPW&WM) (2009). *Cycling in the Netherlands*, The Hague: Figure 1.

A good many Australian cycling policies examining best practices draw on summaries or reviews, such as *Cycling Infrastructure for Australian Cities* (Infrastructure Australia, 2009).

7 Cycling's potential contribution to reducing transport GHG emissions

7.1 Background

There are a number of methods in use to calculate the GHG emissions savings from increased cycling – and walking. Essentially, the calculation involves converting those motor vehicle trips avoided by cycling into a measure of avoided GHG emissions, which can be expressed in various ways, such as total avoided emissions per unit of distance, avoided per capita emissions, and so on.

Most studies examine the actual or potential mode switch from private motorcars to cycling – and often to walking, as well. A mode switch from a motorized journey to a bicycle journey is more likely to occur for shorter trips, so the associated GHG emissions reduction by avoided driving is likely to be relatively small on this basis. Some studies have considered the wider aspects of emissions savings from increased cycling – and walking – such as the emission reduction benefits of reducing traffic congestion on roads.

Greater avoided emissions resulting from increased cycling arise when it is linked with public transport. These combined journeys can be of greater length and cycling can increase the catchment area of public transport collection points. Such combined journeys can replace a greater number of motorcar journeys than cycling-only journeys.

Cities with high cycling rates have lower transport GHG emissions than comparable cities with low rates of active transport and high rates of motorcar use, as occurs across Australia. For example, Buehler and Pucher (2011) found that within the OECD those nations with higher proportion of travel using public transport and active transport have lower GHG levels than those with lower levels, and this is reflected in lower overall per capita GHG levels.

7.2 Examples of avoided emission estimates

A study for Bicycle Victoria of the GHG emissions savings from the 2007 National Ride-to-Work day counted registrant's responses that on the event day that they cycled rather than travelled by motorcar that they would have otherwise done (Sassafras Solutions, 2007). It calculated that there had been 298,991 avoided vehicle kilometres travelled and 89 tonnes of GHG avoided (Sassafras Solutions, 2007).

An example of study that projects potential emissions savings is that by a US NGO, the Rails-to-Trails Conservancy, which made the case for increased US government support of cycling (Gotchi and Mills, 2008). It used three scenarios – business as usual (BAU), modest change, and substantial change – and estimated the GHG emissions savings from reduced US petroleum consumption. Three broad strategies were employed: 1) more walking and cycling by replacing short car trips with active transport; 2) using more public transport; and 3) shortening trips through mixed-use land use development to produce road congestion relief (see Table 5).

Of interest here is that there are two different journey lengths for replacement by cycling, the very short (1 mile) and the short (1–3 miles), with corresponding rates of change for each. A second strategy entails the role of walking and cycling in increasing the use of public transport and the third involves land planning to reduce trip lengths.

Table 5 Scenarios for reducing transport emissions using active transport: a study by Gotchi and Mills (2008)

Strategy	Measure	Scenarios (billion tons CO ₂)		
		Status quo	Modest change (%)	Substantial change (%)
Bicycling and walking mode share	Trips 1 mile or less: walking & cycling mode share	31	40	70
	Trips 1–3 miles: walking & cycling mode share	4	10	25
Public transportation mode share	Trips 1–15 miles	2	5	15
	Increase due to walking & cycling	Unknown	10	30
Trip length reduction through induced mixed use (1–15 miles)		Unknown	1	3

Source: After: Gotchi, T. and Mills, K. (2008). *Active Transportation for America: The Case for Increased Federal Investment in Bicycling and Walking*. Washington, DC: Rails-to-Trails Conservancy.

Based on a number of assumptions, such as fuel economy car and public transport, the authors calculate that all the measures in the modest scenario would reduce US CO₂ emissions by 33 million tons and by 91 million tons under the substantial scenario (Table 6).

Table 6 Avoided driven miles using active transport scenarios: a study by Gotchi and Mills (2008)

	Status quo (billion miles)	Modest change (billion miles)	Substantial change (billion miles)
Trips <1 mile	15	28	49
Trips 1–3 miles	8	21	52
Increase of public transport ridership because of cycling & walking	Unknown	7	66
Trip length reduction through induced mixed use (1–5 miles)	Unknown	13	32
Totals	23	69	199

Source: After: Gotchi, T. and Mills, K. (2008). *Active Transportation for America: The Case for Increased Federal Investment in Bicycling and Walking*. Washington, DC: Rails-to-Trails Conservancy.

A study by the Los Angeles County Metropolitan Transportation Authority exemplifies another aspect of these studies as it sought to assess the GHG savings from bicycle–rail journeys (LAMTA, 2011).

7.3 How increased cycling could reduce GHG emissions

Efforts to estimate the potential GHG emissions reduction through increased cycling in Australia are constrained by the lack of availability of data on cycling. By making a number of broad assumptions and using available basic transport data it is possible to estimate the avoided GHG emissions through increased cycling. Using the journey to work or study, two contrasting cycling strategies are examined for their potential contribution to reducing GHG emissions. Data from the ABS on national transport in 2009 are used for this purpose (see Table 7).

Table 7 Journey to work or to full-time study, 2009, mode share (no. and proportion)

	No. x 1000	<5 km	5–10 km	10–20 km	20–30 km	>30 km	Total
Distance: Capital cities	%	15.9	19.7	27.6	15.7	15.2	–
	No.	1091	1351	1889	1077	1041	6853
Distance: Balance of population	%	25.5	17.7	17.7	8.6	23	–
	No.	954	662	662	320	861	3740
Distance by mode: Car	%	17.6	20.6	26.4	14.1	19.7	–
	No.	1410	1654	2116	1129	1583	8023
Distance by mode: Public transport	%	10	21	29	19	19	–
	No.	145	297	408	264	275	4112
Distance by mode: Bicycle	%	51.8	27.1	15.3	–	–	–
	No.	78	41	23	–	–	151

Source: After: Australian Bureau of Statistics (ABS) (2009). *Environmental Issues: Waste, Waste Management and Transport Use*, Cat. No. 4602.0.55.002.

Strategy 1: Cycling as a direct substitution for short car journeys to work/education. This strategy is directed at the short car journey, which is most amenable to being replaced by cycling. Assuming that the short journeys – i.e., those up to 5km – cover the entire distance and that each journey to work/education is matched by a return journey, gives 10km/day for each of the 229 working days a year. With average Australian motorcar fuel efficiency of 11 l/100 km, some 251.9 litres are consumed annually for each of these return journeys. If each litre of petroleum produces 2.3kg of CO₂, over a year avoided car journeys saves 252 litres of fuel and 579kgs CO₂. Australia's short-journey car-commuting population of 1,409,700 produces 816,216 tonnes CO₂.

Because of the large quantity of short distance car commuting and small quantity of bicycle commuting, only a small proportion of mode switching would increase national cycling numbers considerably. A 10 per cent mode switch from cars to bicycles would mean an increase of 141,000 cycle commuters and an emissions saving of almost 82,000 tonnes of CO₂.

Strategy 2: Cycling–public transport journeys as a direct substitution for all car journeys to work/education. This strategy examines the potential to replace commuting to work or travel

to school over all distances by trips that involve cycling to public transport stops and stations and using public transport to complete the journey. Public transport commuting is reasonably evenly spread across the distance categories, with the greatest concentration in 10–20km (some 29 per cent) and is least used for the shortest distance category of less than 5km (at 10 per cent) (ABS, 2009). Assuming again a 10 per cent mode switch from car commuting to bicycle–public transport commuting would yield GHG savings, for although public transport produces GHG emissions, public transport services compete across the same journey distance as car commuters. If we assume the nominal values of 150g/p/km CO₂ emissions for public transport and 300g/p/km for driver-only cars, then mode switching to public transport avoids 50 per cent of the car emissions (see Table 2 above). Further, we assume a car median commuting distance of 15km and a round trip of 30km. Each commuter then covers 6870km annually for the 229 working days and consumes some 756 litres (at 11 l/100km) which produces 1739kg CO₂. Switching to public transport reduces this by one-half, so that the equivalent commuting of 6870km produces 870 tonnes CO₂. A 10 per cent mode switch from cars to bicycles–public transport trips, on these assumptions, would mean an increase of 141,000 cycle–public transport commuters and an emissions saving of almost 1,226,000 tonnes of CO₂.

From this simplified example, a couple of lessons can be drawn. An additional 141,000 cyclists would almost double the cycle commuting population from the 2009 total of 151,000 (ABS, 2009). Despite the magnitude of this gain, it would only lift the mode share of cycling from 1.5 per cent to 3 per cent, which compares poorly with the aforementioned best-practice cities and nations. Short-distance car commuting journeys, although numerous (at 1.41 million persons), constitute only 18 per cent of all commuting by car (ABS, 2009). Public transport commuting is of the same scale as short-distance car commuting and accounts for 1.412 million persons across Australia (ABS, 2009). Adding 141,000 additional mode-switching commuters to public transport brings this up to 1.553 million commuters. Of interest is that, across Australia, the increase between 2006/07–07/08 in rail passengers – measured as billions of passenger kilometres – was around 7 per cent (BITRE, 2009). However, the current level of bicycle–public transport commuting is very low.

In comparing these two strategies, there are two-thirds greater potential GHG emissions savings to be made from attracting all car commuters to cycling–public transport than from attracting the same number of short-journey car commuters to cycling. Comparing the extent of the changes involved, attracting mode switching from cars for short distance commuting, while seeming more immediately feasible, must be drawn from 18 per cent of all car commuters, whereas the cycling–public transport mode switch is drawn from all eight million car commuters. Contrasting against such prospects is that bicycle commuting is well established in the inner capital cities, whereas bicycle–public transport commuting could not be said to be well established anywhere.

8 Discussion and conclusions

Australia's GHG transport emissions are high and growing. There are many contributing factors, but one stands out – the majority of the population relying on private motorcars, using fossil fuels at low efficiencies, for most journeys. Low-carbon mobility requires greater use of public transport, active transport, and demand management in towns and cities where such choices don't compromise mobility. Greater utilitarian cycling can contribute to lowering GHG emissions; cities with high cycling rates have lower per capita transport GHG emissions than those with high rates of motorcar use.

Australia's overall cycling levels are low and well below those of comparable best-practice nations and our capital cities' cycling levels are well below comparable best-practice cities. Commuting by cycling in Australia has less than a 2 per cent mode share. Utilitarian cycling in Australia is narrowly cast and dominated by being concentrated in the inner-city suburbs,

male, higher education levels, and of the upper end of the socio-economic spectrum. High cycling participation rates will necessitate wider social representation as occurs in best-practice locations.

Our understanding of cycling in Australia, notably at the broader scales, is generally based on rather limited data sets. This limits our understanding of cycling as transport and inhibits the formulation of public policy to use increased cycling to reduce GHG emissions.

Cycling advocacy in recent years has tended to build its case on the associated health benefits and has become a part of the national debate on obesity, for instance. Environmental benefits of cycling seem to have become a lesser component on these efforts. A case can be made that this advocacy should seek to re-engage with the potential contributions of cycling to the nation's response to climate change.

Federal, state, and territory climate change policies have not generally considered cycling as having much, or any, potential to reduce transport GHG emissions. Cycling policies at these scales usually recognize the GHG-abatement benefits of increased cycling but are not concerned with seeking large-scale GHG emissions reductions nor have targets to this effect. Cycling strategies appear sporadically, rarely contain or aspire to performance monitoring or performance assessment; usually there is insufficient monitoring to assess policy performance. Targets are, for most part, window-dressing. Linkages between cycling and climate change policies are not universal among these policies in the national and state/territorial spheres. Where cycling targets have been set, they tend to be modest and are modestly supported with funding or, if they are more ambitious, there tends to be insufficient funding for their realization.

Two contrasting strategies for increasing cycling to reduce GHG emissions from journey to work and study were examined. Although based on many broad assumptions, it appears that GHG emissions reduction through cycling are only modest for substantial increases in cycling using more cycling for short commutes and for bicycle–public transport trips for all distances. Each avoided car journey can bring down individual transport emissions, but the extent of car use in Australia is such that only a substantial increase in cycling using both strategies for can make a substantial difference in total transport emissions. Australia has experienced relatively high population growth in recent decades and this growth has been accompanied by continued increases in private motorcar use; to date, the overall increases in cycling have not sufficiently exceeded the increases in motoring to have been able to make a meaningful impact on the task of emissions reduction.

To achieve effective GHG reductions through increased cycling using public policy in Australia a broader depiction of the role of cycling in this task is required. We have been narrowly looking at cycling trips replacing short driving trips that yield important, but modest GHG reductions. Realizing the potential of cycling to reduce emissions requires a more comprehensive view of its role, particularly in cycling–public transport trips, in enabling cycling in all parts of our cities, the emissions savings from motorcars through congestion relief, and cycling's role in urban design and urban planning as a means to facilitate low-carbon transport. Believing that cycling cannot make significant contributions to GHG emissions-reduction is a self-fulfilling prophesy: significant GHG emissions savings are possible in Australia using transport strategies with high cycling levels with appropriate resource allocations. Both climate change policy and cycling policy at the national and state/territorial levels have failed to pursue increased cycling as a means to reduced GHG emissions.

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