REPORT

CENTRE FOR INTERNATIONAL ECONOMICS

Sydney's transport infrastructure

The real economics

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Summary

AN EFFICIENT AND SUSTAINABLE transport system is critical to Sydney's long term position as the economic epicentre of Australia and the general 'liveability' of the city.

However, there are clear signs that Sydney's transport infrastructure is unable to meet the needs of industry and the travelling public. Under investment in public transport has driven greater reliance on private vehicles to complete the 'transport task'. The pressure on the system will only escalate with Sydney's population expected to increase by an average of almost 42 000 people every year until 2020.

Increasing reliance on road transport looks set to continue as the rail network fails to keep pace with continued housing and employment growth in suburbs away from the rail network. But increasing reliance on road transport brings with it other costs — traffic congestion, accidents, pollution and greater expenditure on roads.

Motorists do not directly incur these 'social' costs, which leads to an inefficient overuse of the road network. Failure to charge motorists for these costs sees the community effectively subsidising private vehicle use when compared to other transport modes, and in doing so, reduces public transport patronage and contributes to further losses on public transport.

Distances travelled in Sydney are expected to increase by 29 per cent between 2005 and 2020, while the social costs arising from road transport are predicted to increase by 32 per cent (see table 1). The increasing social

1 **Increasing costs associated with road transport in Sydney**

Indicator	*2005*	*2020*	*Change*
Vehicle km travelled (million km)	42 428	54 648	12 220 (28.8%)
Social costs of road transport			
Congestion ($ million)	12 072	16 569	4 496 (37.2%)
Accidents ($ million)	3 864	4 977	1 113 (28.8%)
Greenhouse gas emissions ($ million)	145	187	42 (29.1%)
Air pollution ($ million)	1 223	1 228	5 (0.4%)
Subsidisation of the RTA ($ million)	741	946	205 (27.7%)
Total	18 045	23 906	5 861 (32.5%)

Data sources: BTRE 2003 and CIE calculations.

costs of road transport of nearly $5.9 billion is clearly of concern. Of further concern, however, is that the social costs *per vehicle kilometre travelled* are also forecast to rise, indicating that the social cost of forecast road transport patterns is increasing over time. This equates to a further reduction in the amenity of Sydney and a deterioration in economic efficiency and, consequently, activity.

The increasing social costs will impact on the Sydney economy in a variety of ways — loss of productivity in the road transport sector, reduction in labour supply and increased expenditure due to accidents, increased taxation to fund transfers to the RTA, and increased pollution. The TERM general equilibrium model has been used to quantify the economic impacts of the various effects attributable to increasing road transport social costs. A general equilibrium model provides the only framework in which the impacts of rising road transport social costs can be quantified on an economy wide basis.

The results of the economic modelling indicate that the Sydney economy, and the welfare of the community, stands to lose if new approaches to deal with Sydney's transport problems are not adopted. Increasing road transport social costs over the period 2005 to 2020 is estimated to result in:

- real gross regional product (GRP) in Sydney being 0.9 per cent lower;
- real investment inflow being 0.7 per cent lower, with the capital stock being 1 per cent smaller;
- employment being 0.3 per cent lower;
- real wages being 0.5 per cent lower; and
- household welfare being 0.9 per cent lower.

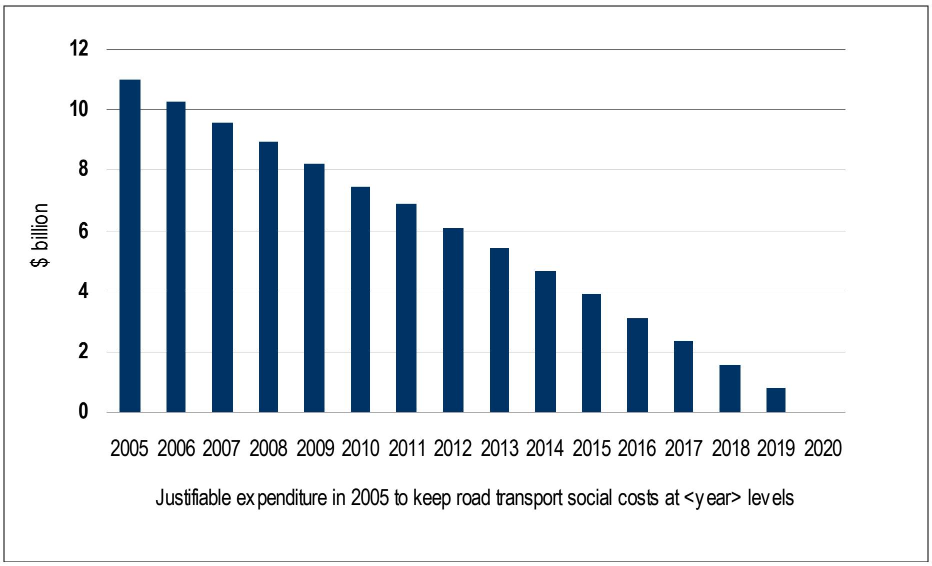
Not only is the Sydney economy adversely affected, but so too are the wider NSW (GRP 0.7 per cent lower) and Australian (GRP 0.1 per cent lower) economies. Some regions, however, are estimated to benefit from Sydney's transport problems. For example, investment and employment relocate from Sydney to Melbourne and Brisbane, with real GRP in those regions being around 0.3 per cent higher.

These results indicate that there is a real and significant cost associated with Sydney's worsening transport situation. Upgrading Sydney's transport infrastructure would likely deliver benefits in the form of avoided GRP etc losses. The question then turns to 'how much should be expended in addressing Sydney's increasing road transport social costs?'

The TERM economic model has been used to answer this question. Under various simplifying assumptions, it has been calculated that the maximum justifiable expenditure in 2005 to address the worsening road transport social costs could lie anywhere between $800 million and $11 billion in present value terms, depending on the social costs to be avoided (see chart 2).

Note that the justifiable expenditure results should be treated with caution as they are premised on simplifying assumptions that may need to be validated and refined. For example, it is assumed that expenditure to address rising road transport social costs occurs in 2005, and that benefits are delivered for only 15 years (until 2020). In practice, however, new transport infrastructure is unlikely to be in place by 2005, and benefits thereof will last longer than 15 years.

2 **Justifiable expenditure on transport infrastructure in Sydney**



Data sources: TERM simulations and CIE calculations.

1 *Background*

MEETING SYDNEY'S TRANSPORT NEEDS in an efficient and sustainable way is critical to Sydney's long term position as an economic epicentre, and has a direct influence on the general 'liveability' of the city. There are already clear signs that Sydney's transport infrastructure, be it roads or public transport, is unable to deliver timely travel solutions that meet the expectations and needs of industry and the travelling public.

Traffic congestion in Sydney is often severe, with delays of around 33 seconds per kilometre not uncommon (Austroads 2005). While 33 seconds per kilometre might not sound like much, over the course of a year a vehicle travelling just 8000 kilometres on arterial roads in Sydney can be expected to be delayed by 264 000 seconds, or over 3 days. With cars accounting for 70 per cent of trips in Sydney and up to 80 per cent in regions outside the city (DIPNR 2004a), the time 'lost' across all of these vehicles will be substantial and represent a waste of resources. The heavy dependence on cars reflects, in part, poor public transport alternatives.

Increasing reliance on road transport looks set to continue as the rail network fails to keep pace with continued housing and employment growth in suburbs away from the rail network. This brings with it other external costs such as congestion, pollution, greenhouse gas emissions, and a rising incidence and cost of road accidents.

Sydney's existing public transport system fails to alleviate road traffic congestion, and carries with it its own limitations to meeting the travel needs of commuters. These pressures will only escalate with Sydney's population expected to increase by an average of almost 42 000 people every year until 2020.

The costs of mobility have a direct impact on the ability of households to earn an income. Businesses using transport to deliver production inputs and move finished goods to consumers are also affected as mobility costs affect productivity and the profitability of doing business in Sydney. The external costs of transport also matter, having a significant influence on economic efficiency and the sustainability of economic growth.

All forms of transport generate social costs, but to varying degrees. The scale and scope of transport externalities are therefore directly influenced by the funding and policy environment for transport infrastructure at the state and federal level, and the way in which different types of travel are encouraged or discouraged in the prevailing policy environment.

Transport infrastructure planning and investment is becoming an increasing priority for the NSW Government, as outlined in the recent Metropolitan Strategy. The current policy and funding platform for Sydney's transport infrastructure as outlined in the Strategy will provide Sydney with what could be called a 'business as usual' infrastructure future.

All indications are that this future will essentially be a continuation of the current policy environment, in which the government, on behalf of the community, trades off between lower investment in order to deliver a budget surplus in exchange for lower quality services that come with lower investment. Quite simply, 'balanced books' are being traded off against worsening transport. And while the NSW Government has recently announced initiatives to augment the transport infrastructure, no analysis has gone into what is the *optimal* level of investment from an economywide perspective. Box 1.1 reports recent government announcements regarding future expenditure on transport infrastructure.

But what does the transport infrastructure future really mean in terms of transport choice, and the reduction in congestion, pollution, emissions and accidents? What does it mean for the utilisation and cost effectiveness of public transport? Will the expected future for transport infrastructure put in place a pricing regime that achieves an efficient use of road infrastructure? Will it reduce the external costs per kilometre travelled, or contribute to its continuing rise?

Perhaps a more fundamental question concerns what resources should be used to address Sydney's transport problems, and then how should those resources be mobilised/funded. The first part of this question, and the focus of this report, requires quantifying what the cost to Sydney will be of doing nothing to address its transport problems — how bad can things get under the 'business as usual' transport infrastructure future?

Ultimately, the true cost of poor infrastructure planning is not having it in place, at the right time, at the right price. Poor infrastructure planning will put at risk the long term comparative and competitive advantage of the Sydney economy and the community's welfare.

1.1 Government commitments to improving transport through infrastructure upgrades

The NSW and Federal Government's have both made recent announcements concerning transport infrastructure upgrades in Sydney and NSW. The NSW Government has committed to several initiatives for meeting the expected future demand for transport in Sydney, these being:

- 3.6 billion investment in the arterial road network, including for the Cross City Tunnel, the Lane Cove Tunnel, the M7 and the Windsor Road upgrade; and
- Public transport network and service improvements including:
  - $1 billion for the Rail Clearways project;
  - $1.5 billion for new trains; and
  - $1 million for the transport interchange at Parramatta (DIPNR 2004a, p. 3).
- The NSW Government's planning initiatives through the Metropolitan Strategy are also designed to better connect housing and employment centres with the transport network.

During 2005-06 the NSW Government has budgeted to spend nearly $2.5 billion on transport infrastructure across wider NSW (NSW Treasury 2005). Transport infrastructure will account for 30 per cent of the Government's total infrastructure expenditure.

In June 2004 the Federal Government released 'AusLink: Building our National Transport Future', which sets out the government's land transport plan. AusLink sets out $12.7 billion in land transport spending over the period 2004-05 to 2008-09. Of this amount, $4.5 billion represents 'new' money ($8.2 billion had already been committed under other programs). In addition to the $12.7 billion, the Australian Rail Track Corporation has committed to investing $872 million on the Hunter Valley and NSW interstate rail networks. Around 28 per cent (or $3.6 billion) of the AusLink expenditure is to occur in NSW, comprising:

- AusLink Investment Programme — $2493.2 million;
- Roads to Recovery — $458.8 million;
- Black Spot Programme — $57.2 million; and
- Untied local road grants — $609.1 million (Hepworth 2005 and DOTARS 2005).

While involving substantial expenditure, the announced transport infrastructure initiatives are likely, at best, to address backlog works and past under investment in transport infrastructure. For example, it has been estimated that the total value of rail and road infrastructure under investment is $18 billion Australia wide. This under investment covers the deficiency in meeting *current demand* only (CEDA 2005, p. 22). Hence the $12.7 billion infrastructure expenditure associated with the AusLink program will not even address current deficiencies, let alone meet future transport needs.

Hence while governments are doing something about the worsening transport situation, the allocated funding does not appear to be sufficient to address years of under investment or to meet future transport needs.

2 Costs of inefficient transport use

ENSURING A SUSTAINABLE TRANSPORT FUTURE for Sydney means investing in transport infrastructure in such a way, under such a policy environment, and at such a scale, that the external costs of transport are minimised and borne by the individuals making the transport choice. This will only occur if transport choices reflect the private and social costs of each journey to the greatest extent practicable, and if policies that affect transport choices create incentives to use transport in an efficient and sustainable way.

Private transport is the dominant transport mode in Sydney, accounting for just over 70 per cent of trips. In contrast, public transport accounts for only 10.3 per cent of commuter trips (DIPNR 2004b, p. 4). There are many factors that contribute to the bias in favour of private road travel — reliability, convenience and timeliness are important attributes to commuters. Cost is also an important factor. The under-recovery of costs on public transport through fare revenue is well known. This should favour public over private transport, however, road use is also underpriced, particularly when its full costs — including congestion, road wear and tear, pollution and accidents — are taken into account.

Every time a motorist uses the road network, they incur some costs, such as the costs of vehicle wear and tear, and general charges like registration and insurance. These are 'private' costs and are paid directly by the motorist. However, driving a vehicle is associated with other 'social' or external costs such as congestion, road wear and tear, pollution and accidents. Motorists typically do not directly bear these costs, and as a result road use is undercharged.

This pricing environment has a direct and significant influence on the composition of travel in Sydney and the dominance of private car travel. With road use receiving heavy subsidies, efforts to boost public transport use by subsidising public transport has been shown to have a negligible effect on mode switching by existing travellers, and therefore on road use.[1]

Striking an efficient and sustainable pattern of transport infrastructure use requires consideration of the social costs of car use. This means charging road users the full marginal social cost arising from their road use, which measures the total cost to society of a road user's journey. Without such an approach, the vicious circle of public-private transport use will continue. The community at large will continue to effectively subsidise private car use compared to other transport modes, and in doing so, reduce public transport patronage and contribute to further losses on public transport.

Social costs associated with transport

The social costs of transport refer to the impact of each journey on congestion, local air pollution, greenhouse gas emissions, and accidents. Where subsidies exist for transport agencies (funding in excess of revenues from travel), there are also additional costs incurred by taxpayers. All these costs are costs that are generated by travel, but not borne in their entirety by the person making the trip. As the person making the trip is not encountering the full cost of that trip, they are faced with the wrong price signals and use the mode beyond what is considered its 'economically efficient' level.

Currently, the charging regime for all modes of transport in Sydney does not reflect the social costs associated with their use. While these costs vary across transport modes, they are considerably higher for road use than rail use. Given existing transport policies and in many instances the lack of viable or sufficiently attractive public transport alternatives, transport modes with the higher social costs are being encouraged. The resulting increase in the social cost of transport equates to a loss of productivity in the transport task, which has wide implications for the economy and welfare of the community.

Quantifying the social cost of transport

For Sydney, the social cost of road transport (or the cost above that which is paid directly by the road users) is substantial, estimated at $18 billion for 2005. By 2020, under current policies and expected infrastructure investments, this cost is forecast to rise to $23.9 billion. The majority of these costs

1 Centre for International Economics, *Subsidies and the social costs and benefits of public transport*, March 2001, pp. 28–42.

relate to the costs of congestion (around 70 per cent), with vehicle accidents comprising around 20 per cent of costs. Of further concern is that the social costs *per vehicle kilometre travelled* are also forecast to rise, indicating that the financial and social cost of forecast road transport patterns is increasing over time. This means a further reduction in the amenity of Sydney, and a deterioration in productivity. The breakdown of these costs is shown in table 2.1 and described further below.

2.1 **The current and projected social cost of road transport in Sydney**

	2005	***2020***
	$ million	$ million
Congestion	12 072	16 569
Motor vehicle accidents	3 864	4 977
Greenhouse gas emissions	145	187
Ambient airborne pollution	1 223	1 228
RTA subsidies	741	946
Total	**18 045**	**23 904**
$/vehicle kilometre travelled	0.425	0.437

Source: CIE.

Congestion costs

Congestion costs refer to marginal external congestion costs, or the cost of time losses experienced by other road users as a result of a motorists' decision to drive. Congestion sees road users themselves incurring higher private costs including increased vehicle operating costs and longer trip times; as well as imposing additional delays and costs on other road users. Congestion costs in Sydney are currently estimated to be higher than in any other Australian city and generate significant economic inefficiencies. They are also certain to escalate with road traffic volumes forecast to increase by 29 per cent in Sydney between 2005 and 2020, driven by a 21 per cent increase in car kilometres travelled, and a 64 per cent increase in distances travelled by light commercial vehicles (table 2.2 and chart 2.3). With these estimates, even if new investments and policies generated a 20 per cent increase in road network capacity, the outlook is still for around a 20 percentage point increase in vehicle volume to capacity ratios in Sydney (Gargett and Gafney 2004, p. 7). Such an increase in traffic volumes will lead to a substantial increase in congestion delays and have major implications for mobility and amenity.

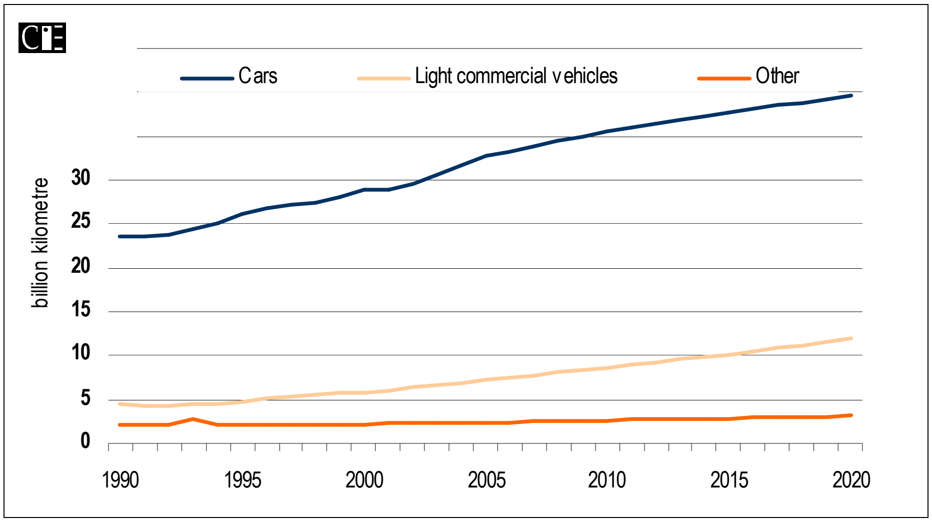
2.2 Forecast increase in road traffic for Sydney

Vehicle type	*Distances travelled*		*Increase in distance*	*Proportion of total distances travelled*	
	2005	2020	2005-20	2005	2020
	billion kilometres	billion kilometres	Per cent	Per cent	Per cent
Cars	32.8	39.59	20.9	77.2	72.4
Light commercial vehicles	7.3	11.95	64.4	17.1	21.9
Other[a]	2.4	3.11	29.1	5.7	5.7
Total	42.4	54.65	28.8	100.0	100.0

[a] Includes articulated trucks, rigid and other trucks, buses and motorcycles.

Source: BTRE (2003, p. 9).

2.3 Historical and forecast vehicle kilometres travelled for Sydney



Data sources: Gargett and Gafney (2004).

In 1999, the Bureau of Transport Economics (BTE) estimated that congestion costs in Sydney will reach around $8.8 billion by 2015 without a fundamental change in household behaviour. This allowed for a 5 per cent growth in network capacity over the period 1995 to 2015 and included the cost of delays, higher fuel consumption, and lower gear driving, but not the costs associated with air quality or greenhouse gas emissions (BTE 1999).

In today's terms these costs are far greater. Our revised estimates for 2005 measure congestion costs in Sydney at $12.1 billion, which are forecast to reach $16.6 billion by 2020. These new estimates allow for revised forecasts for vehicle kilometres travelled (BTRE 2003) and vehicle passenger car equivalent kilometres. It also allows for an increase in the BTE's estimated congestion cost rate in line with inflation since the publication of the 1996 report from which it was sourced (to bring cost estimates into 2005 dollar terms). To accommodate the range of road network enhancing measures announced for Sydney since the BTE's 1999 report, our estimates also allow for an annual increase in network capacity of 1.25 per cent, or 20 per cent over the 2005 to 2020 period, reflecting the business as usual scenario.[2]

Emissions costs

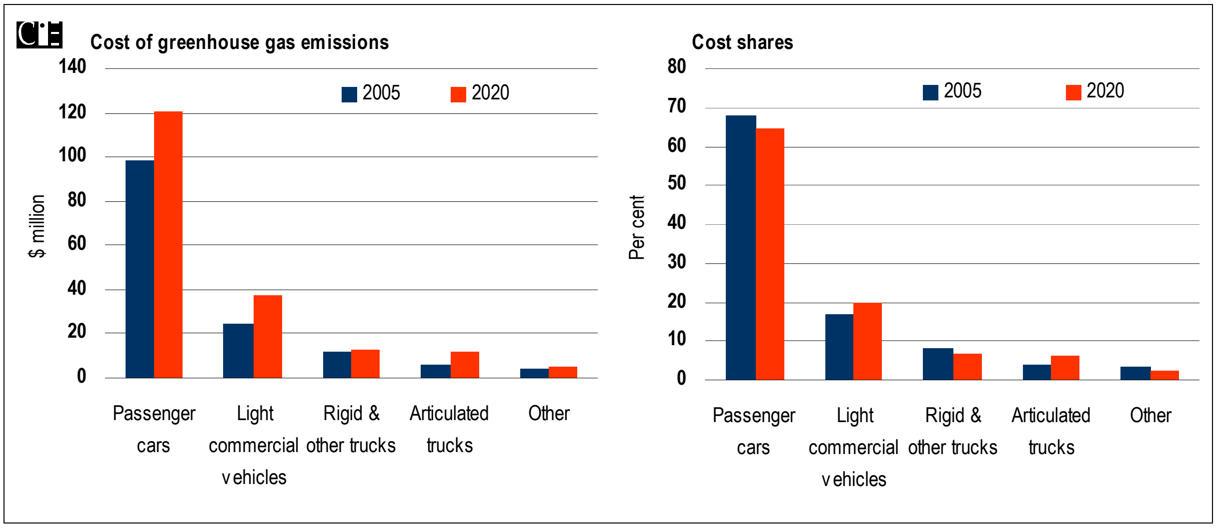
Greenhouse gas emissions resulting from transport use are a significant component of social transport costs. The level of greenhouse gas emissions from the transport sector is influenced by people's travel patterns, transport mode choices, and the general policy environment that influences those decisions. Australia wide, domestic transport accounts for 14.4 per cent of Australia's total greenhouse gas emissions, 88 per cent of which result from road transport compared to 2 per cent for rail transport (BTE 2005, p. 24). Nationwide, greenhouse gas emissions generated by the domestic transport sector total 80 million tonnes (AGO 2005), and are forecast to reach 100.2 million tonnes by 2020 (BTRE 2003b, p. 1). With the city of Sydney predicted to account for 19.5 per cent of the national vehicle kilometres travelled in 2020 (Gargett and Cosgrove 2003), transport patterns and policies affecting Sydney will have a significant impact on national greenhouse gas emissions in the future.

The cost of greenhouse gas emissions from road transport in Sydney is estimated at $144.8 million for 2005, and is forecast to rise to $186.9 million in 2020. These estimates are based on forecast vehicle kilometres travelled for Sydney by vehicle type, CO_2 emissions per kilometre by vehicle type (forecast on the basis of average annual growth from 1987 to 2002), and a modest cost of $10 per tonne of CO_2 emitted. The change in the cost of road transport emissions by vehicle type is illustrated in chart 2.4, which shows the dominance of passenger cars, yet with a rise in costs for light commercial vehicles.

A proportion of these costs can be considered as a direct result of congestion, given that fuel consumption per vehicle under congested conditions is approximately twice that than under free flowing conditions. The BTE has estimated that CO_2 emissions due to congestion account for 17 per cent of total emissions generated by the domestic transport sector. Congestion in Sydney alone was estimated to generate an additional 4 million tonnes of CO_2 emissions every year (BTE 2000a, p. 2). Based on a cost per tonne of CO_2 emitted of $10, this results in annual emissions costs due to Sydney congestion of $40 million.

[2] The 20 per cent increase in network capacity over 2005 to 2020 used here is far greater than that assumed by the BTE (1999). In that study, the BTE assumed network capacity would increase by 5 per cent over the period 1995 to 2015.

2.4 **Cost of greenhouse gas emissions by vehicle type for Sydney**



Data source: CIE calculations.

Accident costs

Personal injury and property damage costs as a result of road vehicle accidents are another component of the external costs of transport. As well as the often substantial personal or human cost, vehicle accidents also result in property damage, and influence the cost of emergency services and infrastructure required to deal with road crashes. The human costs of road accidents identified by the BTE (2000b) include:

- the value of lost labour, where injuries result in an inability to work, or work at the same capacity in the workplace, household, or community;
- any reductions in the quality of life of road accident victims as a result of pain and suffering, and their inability to return to their way of life before the injury;
- medical, ambulance, and rehabilitation costs;
- rehabilitation and long term care costs due to ongoing medical problems;
- coronial costs for fatalities for which the cause is violent, suspicious or unknown;
- premature funeral costs, comprising the difference between costs at the time of death and costs at the end of the actuarially expected lifetime with appropriate discounting;
- legal and correctional service costs for providing services to those who have committed a criminal offence related to a road crash; and

- workplace disruption and staff replacement for recruitment and training.

Vehicle costs include repair costs, towing costs, and time lost due to vehicle unavailability, which could include lost business, employee time wasted, or work delayed or cancelled.

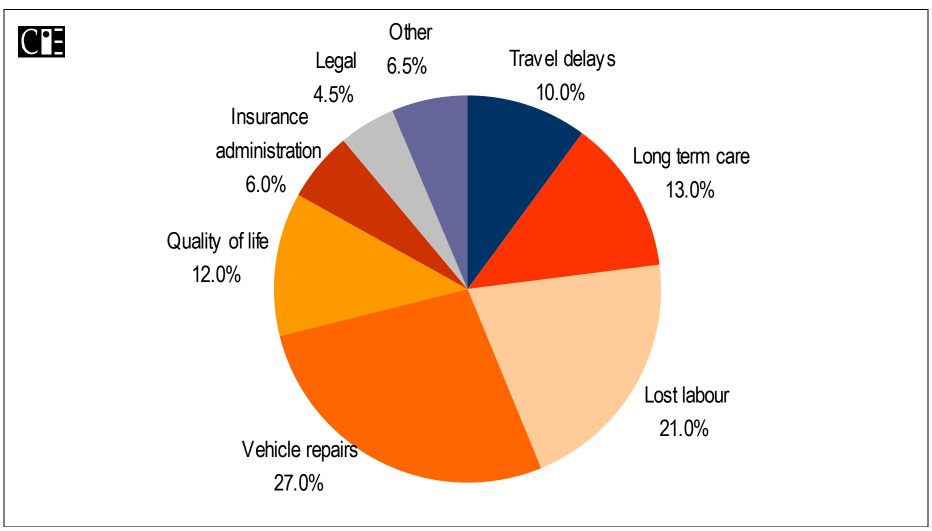
General crash costs include:

- non-vehicle property damage such as to street furniture, fences or housing;
- police costs and the costs of fire and emergency services;
- insurance underwriting costs to administer claims; and
- travel delay costs for other motorists who stop to provide assistance or reduce speed in passing (BTE 2000b).

The majority of accident costs comprise human costs or costs directly relating to the person injured in road accidents (56 per cent). Twenty-seven per cent of costs result from vehicle related costs, and 17 per cent of costs cover 'general' cost items, including insurance underwriting, traffic delays, damage inflicted on property and infrastructure, and police and fire services (chart 2.5).

While there are several estimates of the cost of vehicle accidents, the most comprehensive is that by the BTE in 2000, which estimated national costs of $14.98 billion, which equates to $0.091 per vehicle kilometre travelled. Applying this rate to forecast vehicle kilometres travelled in Sydney yields accident costs for Sydney in 2005 of $3.86 billion. Accident costs for Sydney are expected to reach at least $4.98 billion in 2020, and even more if the

2.5 **Distribution of road crash costs by category**



Data source: BTE 2000b.

forecast increase in congestion increases the propensity for accidents to occur.

Based on the distribution of accident costs found by the BTE (2000b), table 2.6 outlines the level of current and expected accident costs across the human, vehicle, and general cost components. Table 2.6 also highlights the expected incidence of these costs across parts of the community and the economy. For instance, medical costs are primarily borne by Government through its funding of the health system. In total, it is assumed that close to 23 per cent of total accident costs are borne by government requiring additional taxes to fund them, with households wearing the majority of costs (47 per cent), and the remainder borne by industry (30 per cent).

2.6 **Distribution of road accident costs in Sydney**

Costs	***Households***		***Government***		***Industry***		***Total***	
	2005	2020	2005	2020	2005	2020	2005	2020
	$ million	$ million	$ million	$ million	$ million	$ million	$ million	$ million
Human costs								
Medical/ambulance/rehabilitation	0	0	93	120	0	0	93	120
Long-term care	0	0	513	661	0	0	513	661
Labour in the workforce	0	0	0	0	419	540	419	540
Labour in the household/community	385	496	0	0	0	0	385	496
Quality of life	456	588	0	0	0	0	456	588
Legal	138	177	36	46	36	46	210	270
Correctional services	0	0	4	6	0	0	4	6
Workplace disruption	0	0	0	0	81	104	81	104
Funeral	1	1	0	0	0	0	1	1
Coroner	0	0	0	0	0	0	0	0
Sub total	980	1 262	647	833	536	690	2 163	2 786
Vehicle costs								
Repairs	657	846	172	222	172	222	1 002	1 291
Unavailability of vehicles	0	0	0	0	47	61	47	61
Towing	11	14	0	0	0	0	11	14
Sub total	668	861	172	222	219	283	1 060	1 366
General costs								
Travel delays	0	0	0	0	373	480	373	480
Insurance administration	157	202	41	53	41	53	239	308
Police	0	0	19	25	0	0	19	25
Non-vehicle property damage	3	3	3	3	3	3	8	10
Fire	0	0	3	3	0	0	3	3
Sub total	159	205	65	84	416	536	641	826
Total all costs	**1 807**	**2 328**	**885**	**1 140**	**1 172**	**1 509**	**3 864**	**4 977**

Source: CIE.

Air pollution

There is mounting epidemiological evidence that air pollution generated by road traffic has adverse health effects for the community. There are two broad categories of health effects attributable to air pollution, of which vehicular traffic is a major source. These include the following.

- Acute effects, which occur due to short-term variation in pollution exposure and manifest as symptoms and variations in bodily functions, principally respiratory and cardiac functions, and include exacerbations of pre-existing illness. Severe effects may result in either admission to hospital, and in extreme cases, death.
- Longer-term effects, which are cumulative effects of exposure to air pollutants and may result in either the initial manifestations of new illnesses, such as chronic lung disease, or the persistence of pre-existing illnesses. Examples include impaired growth in lung function in children, with lifelong effects on the child's respiratory health, or an accelerated rate of decline in lung function among adults, causing respiratory difficulty in later life.

A recently released BTRE study found that in 2000, vehicle related ambient air pollution accounted for between 368–1756 morbidity cases (cardiovascular and respiratory disease) and between 339–762 early deaths in Sydney (BTRE 2005b, pp. 90–1). Sydney is estimated to account for around 39 per cent of the Australia wide morbidity and mortality cases attributable to motor vehicle related air pollution.

Motor vehicle emissions contain a number of pollutants — lead, nitrogen oxides (NO_x), sulfur oxides (SO_x), carbon monoxide (CO), volatile organic compounds (VOC) and particulate matter (PM). The BTRE have costed the adverse health impacts attributable to emissions of these pollutants from motor vehicles (see BTRE 2005b). Table 2.7 reports the BTRE's findings for select areas.

It is known that almost all pollutants are correlated with other pollutants in their health effects. Such multicollinearity means that the costs associated

2.7 **BTRE estimates of costs attributable to motor vehicle pollutants**

Area	*Mortality*			*Morbidity*			*Total*		
	Lower	*Cental*	*Upper*	*Lower*	*Cental*	*Upper*	*Lower*	*Cental*	*Upper*
	$ million	$ million	$ million	$ million	$ million	$ million	$ million	$ million	$ million
Sydney	441	713	990	173	323	472	613	1 036	1 462
All capital cities	986	1 596	2 214	394	735	1 072	1 380	2 330	3 286
All regional areas	154	250	348	44	82	123	198	332	470
Australia wide	1 140	1 846	2 562	438	817	1 195	1 577	2 663	3 757

Source: BTRE 2005b, pp. 100–1.

from individual pollutants are not easily determined. The BTRE addressed this problem through using particulate matter (of less than 10 microns — PM_{10}) as a surrogate pollutant. Surrogate pollutants capture the combined effects of all other pollutants. That is, mortality and morbidity costs arising from lead, NO_x, SO_x, CO, VOC and PM emissions are all attributed to PM_{10} emissions from motor vehicles.

This approach may see the economic cost estimates of ambient pollution from motor vehicles being conservative, if, as expected, not all pollutants are strongly correlated with PM_{10} (BTRE 2005b, p. xiii).

In 2000, PM_{10} emissions from motor vehicles in Sydney amounted to 4750 tonnes (BTRE 2003, p. 124). These emissions were associated with a total cost of between $613 million and $1.5 billion (the large confidence interval reflects the difficulty in separating motor vehicles emissions from background pollutant levels and epidemiological uncertainties). Working off the central cost estimate, Sydney incurred a cost of $218 105 per tonne of PM_{10} emitted (measured in 2000 dollar terms). In today's dollar terms, that cost is nearly $257 000 per tonne of PM_{10}.

Emissions of PM_{10} from motor vehicles in Sydney are forecast to remain relatively stable over the period to 2020, increasing from 4760 tonnes in 2005 to 4780 tonnes in 2020 (BTRE 2003, p. 124). Using the above calculated cost per tonne of emissions, the economic cost of motor vehicle pollution is estimated to increase from $1223.1 million in 2005 to 1228.2 million in 2020, a net cost increase of $5.1 million.

An area of potential uncertainty regarding this cost estimate concerns whether PM_{10} is a suitable pollution surrogate. Over the period to 2020 vehicle emissions of NO_x, SO_x, CO, and VOC are forecast to fall anywhere between 3.8 per cent (SO_x) and 31.6 per cent (CO) as a result of new vehicle emission and fuel standards, and despite an almost 50 per cent increase in vehicle kilometres travelled.

Hence while PM_{10} emissions (marginally) increase, vehicle emissions of other pollutants are forecast to fall. We therefore have a situation that depending on which pollutant is used as the surrogate, the health costs associated with motor vehicle emissions could either rise or fall over the period to 2020. For example, if CO were used as the surrogate, then health costs associated with motor vehicle emissions would fall by nearly 32 per cent between 2005 and 2020, versus rising by 0.4 per cent when PM_{10} is used as the surrogate.

Particles smaller than 2.5 microns are known to be more highly correlated with cardiopulmonary disease and lung cancer mortality. A high proportion of motor vehicle particle emissions are smaller than one micron (BTRE 2003, p. xii). Given this, it is considered that future motor vehicle emissions of PM_{10} are the appropriate surrogate pollutant on which to estimate the future health costs of vehicle pollution.

Subsidies for road traffic authorities

The NSW Government provides funding for the Roads and Traffic Authority (RTA) out of consolidated revenue, in addition to the RTA's own source revenue. The transfer from consolidated revenue is made so as to overcome a revenue shortfall for the RTA — motorists in NSW meet around 70 per cent of the costs associated with road use/infrastructure (Parry 2003, p. 114). The consolidated revenue payment means that tax-payers are funding motorists' use of the road system above and beyond the direct and targeted charges paid by road users themselves.[3] As a result, taxes are higher and/or funds are transferred from other state government funded activities to supplement the RTA's required budget.

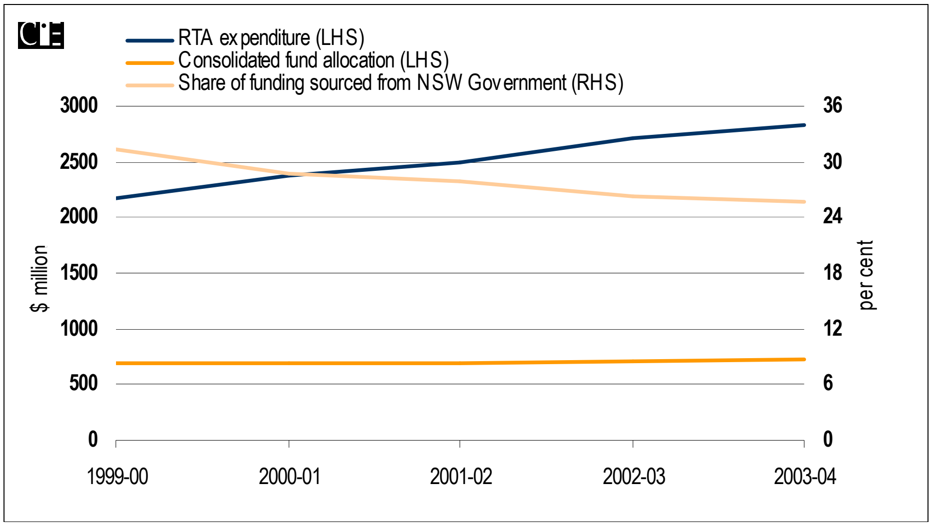
Demand on the road network will increase as road patronage increases. RTA expenditure is therefore also likely to increase, as are the funding requirements. Chart 2.8 shows the RTA's expenditure over the last 5 years. Also shown is the NSW Government's funding of the RTA. As can be seen, funding from NSW taxpayers (via the government) has remained relatively stable, rising from $683 million in 1999-2000 to $729 million in 2003-04. On average, funding from the NSW Government has grown by 1.6 per cent each year. The increasing payments from the NSW Government have not kept pace with growth in the RTA's expenditure, which has averaged 6.8 per cent over the last 5 years. Hence the share of the RTA's funding sourced from the NSW Government has fallen, from 31.4 per cent in 1999-2000 to 25.7 per cent in 2003-04.

Future transfers from the NSW Government to RTA have been estimated through applying the observed trends over the period 1999-2000 to 2003-04 to future years. This sees RTA expenditure rising from $3030 million in 2005 to $8183 million in 2020, while transfers from the NSW Government are estimated to increase by $217 million, from $753 million in 2005 to $946

[3] Note that while Australian motorist are expected to pay over $13.6 billion in fuel excises in 2004-05 (AAA Statistical Database), 99 per cent of this will be paid into (the Federal Government's) consolidated revenue. Hence there is no hypothecation between fuel excises and road funding. Fuel excises simply reflect another 'general' tax, and should not be seen as a tax on motorists to fund road use/infrastructure.

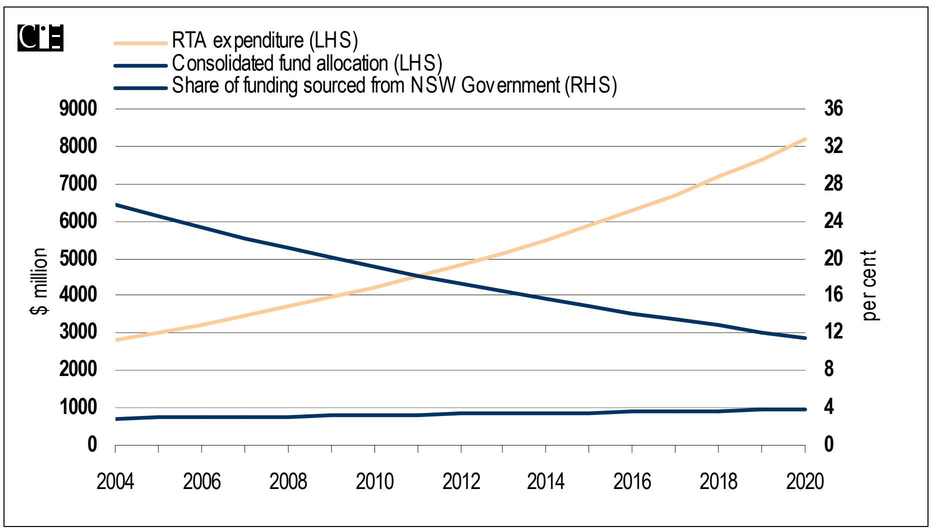
million in 2020 (see chart 2.9). Transfers from consolidated revenue are expected to account for 11.6 per cent of the RTA's funding in 2020.

2.8 **RTA expenditure and NSW Government funding**



Data source: Various RTA Annual Reports.

2.9 **Future government funding of the RTA**



Data source: CIE calculations.

3 Costing the business as usual scenario

INCORPORATING THE SOCIAL COSTS of road transport into transport infrastructure decisions will allow a more comprehensive and rigorous assessment of whether a particular investment is economically justified. The financial cost of investments and necessary policy changes are likely to be significant, but what is the financial cost of not doing so? To answer this question we need to:

- clarify the social costs of transport in accordance with the current policy framework for transport infrastructure (the business as usual approach); and
- quantify the economic costs of the business as usual approach to transport infrastructure in Sydney.

Once the cost of the business as usual approach is know it can be used as an 'upper bound' (or maximum) for the level of funding that could be expended in addressing Sydney's transport problems. That is, so long as the cost associated with keeping Sydney's transport performance *at today's level* is less than the cost associated with the business as usual scenario, then that expenditure would be justified on grounds of economic efficiency.

This chapter discusses the approach taken to quantifying the social costs associated with motor vehicle use in Sydney, with the results presented in chapter 4.

Costing the business as usual scenario

The best framework with which to quantify the economic impacts of escalating road transport social costs is a general equilibrium (GE) model. Increasing costs in the road transport sector will obviously have a direct (and detrimental) effect on road transport. However, other activities that rely on road transport inputs will also face problems — it will cost those activities more to source production inputs and to road freight their products to consumers. A loss of competitiveness in other sectors is the likely result. A GE model provides the only framework in which the impacts of rising road transport social costs can be quantified on an economywide basis.

The GE model used in this study — TERM — is a highly disaggregated model of the Australian economy. TERM identifies 166 sectors of economic activity, and models the Australian economy at the statistical division level. This means TERM covers 57 different regions, including 12 in New South Wales. In order to keep the modelling to a tractable level, the TERM database has been aggregated to 44 sectors of activity and 21 regions (see table 3.1). Further details about TERM can be found at: www.monash.edu.au/policy/term.htm.

3.1 **TERM regions and sectors**

TERM regions		
Sydney, NSW	Central West, NSW	Brisbane, QLD
Hunter, NSW	Southern East, NSW	Other Queensland
Illawarra, NSW	Murrumbidgee, NSW	South Australia
Richmond-Tweed, NSW	Murray, NSW	Western Australia
Mid North Coast, NSW	Far West, NSW	Tasmania
Northern, NSW	Melbourne, VIC	Australian Capital Territory
North West, NSW	Other Victoria	Northern Territory
TERM sectors		
Livestock	Drinks & tobacco	Other manufacturing
Grains	Textiles	Utilities
Vegetables	Clothing	Construction
Other crops	Footwear	Trade
Fruit	Wood products	Repairs
Agriculture services	Paper & printing	Hotels & restaurants
Forestry	Fuel	Road transport
Fishing	Chemicals	Rail transport
Coal, oil & gas	Plastic, rubber & glass	Other transport
Other mining	Metal products	Communication
Meat products	Motor vehicles & parts	Finance
Dairy	Other transport equip	Owner dwellings
Fruit products	Railway equipment	Business services
Vegetable products	Electrical equipment	Gov, education, def & health
Other foods	Machinery	

Source: CIE.

The modelling simulation

In chapter 2 the social costs arising from road transport in Sydney were estimated. Table 3.2 provides a summary of these costs.

For Sydney, the social cost of road transport is substantial, estimated to be $18 billion in 2005. By 2020, and under current approaches and policies to infrastructure development, the social cost is forecast to rise to $23.9 billion, an increase of 32.5 per cent.

Over the same period vehicle kilometres travelled in Sydney are also forecast to increase, from 42.4 billion kilometres to 54.6 billion kilometres, an increase of nearly 29 per cent. Importantly, as costs increase more that kilometres travelled, the social cost per vehicle kilometre travelled (vkt) is also forecast to rise over time. Road transport social costs are estimated to rise from $0.425/vkt to $0.437/vkt, an increase of 2.9 per cent.

Essentially, it will cost more to do the same transport task in the future. This will translate into a further reduction in the amenity of Sydney, and a loss of competitiveness.

3.2 **Current and projected generalised costs for road transport in Sydney**

Cost area	*2005*	*2020*	*Change*
	$ million	$ million	Per cent
Congestion	12 072	16 569	37.2
Motor vehicle accidents	3 864	4 977	28.8
Greenhouse gas emissions	145	187	29.1
Ambient airborne pollution	1 223	1 228	0.4
RTA subsidies	741	946	27.7
Total	**18 045**	**23 904**	**32.5**

Source: See chapter 2 for cost estimation methodology.

Accounting for the increased costs in the economic modelling

While each of the cost areas ultimately increases the total social cost of road transport, in the economic modelling account needs to be taken of the fact that the cost areas will typically impart a different economic incidence and burden. The approach taken to modelling the economic impact of increases in the various cost areas is described below.

Congestion

Congestion costs are forecast to rise from $0.285/vkt in 2005 to $0.303/vkt in 2020, an increase of 6.6 per cent. The congestion cost measures the ‘value of time' lost per vehicle kilometre travelled due to roads being congested. Importantly, the congestion cost is that incurred by other road users as a result of a motorist's decision to drive. The time delay incurred by other motorists is thought to account for around 85 per cent of total (private plus social) congestion costs (BTCE 1996, p. 479).

The forecast increasing congestion costs represent a real resource cost — if the social costs associated with a particular transport task cost $100 in 2005, it will cost $106.6 in 2020 (in 2005 dollar terms). In other words, there is a loss of productivity in the road transport sector. The social costs arising from road congestion have therefore been incorporated into the economic modelling via reducing productivity across all production inputs — labour, capital, fuel, maintenance etc — to Sydney's road transport sector. The productivity loss in the sector is estimated to be 1.7 per cent, given by the 6.6 per cent increase in congestion costs weighted by the share of congestion costs in total road transport costs.

Motor vehicle accidents

The cost of motor vehicle accidents in Sydney is estimated to rise from $3864 million in 2005 to $4977 million in 2020, an increase of $1113 million. These costs will be borne by households, industry and government. Note that not all of the cost areas identified in table 2.6 can be included in the economic modelling. For example, costs associated with (loss of) 'quality of life' do not represent a resource cost, and as such cannot be included in the modelling.

Costs arising from accidents impact in several areas. They either impact on the supply of labour to the workforce, see additional expenditure in areas such as health care, emergency services, motor vehicle repairs, legal services and the like, or see a loss of productivity due to travel delays etc. Costs associated with motor vehicle accidents have been included the economic modelling via:

- impact on Sydney households:
  - $85 million increase in accident administration and legal costs;
  - $189 million increase in insurance costs (as a result of increasing accidents);
- impact on Sydney businesses:
  - $144 million reduction in labour supply/availability and additional costs associated with workplace disruptions;
  - $121 million increase in costs associated with travel delays and non availability of vehicles;

  - $22 million increase in accident administration and legal costs;
  - $50 million increase in insurance costs;
- impact on NSW Government:
  - $182 million increase in cost of health care, ambulance, fire and police services;
  - $22 million increase in accident administration and legal costs; and
  - $50 million increase in costs due to repairing accident damage.

Cost impacts on end consumers — households and government — have been modelled via forcing those end consumers to spend more on various goods/services (see the amounts identified above), but with that additional expenditure not delivering a welfare gain. In other words, the increase in road related accident costs represents additional expenditure that is needed to 'standstill'. This expenditure will translate into a lowering of effective disposable income for households, and a need for the NSW Government to raise more tax revenue from the NSW community. Both of these factors will act to lower household welfare.

Cost impacts on businesses have been apportioned across the various sectors of the Sydney economy according to the most appropriate weight — workforce shares; use of motor vehicles and/or use of road transport.

Greenhouse gas emissions

In table 3.2 it was estimated that the costs associated with greenhouse gas emissions from motor vehicles in Sydney would rise by $42 million. What is not known, however, is on whom, when and where this cost impost will be felt. The costs are unlikely to be felt/incurred in Sydney — emissions from Sydney's motor vehicles will have only a negligible effect on the local and global climates.

Australian Governments have however recognised that something needs to be done about greenhouse gas emissions. Through being a signatory to the Kyoto Protocol, Australia has voluntarily agreed to meet the Protocol's greenhouse gas emission target. By the first commitment period of 2008 to 2012, Australia is to have reduced its greenhouse gas emissions to 108 per cent of 1990 emissions. (Australia's commitment to the target is only voluntary at this stage, as Australia is yet to ratify the Protocol.)

Between 1990 and 2003, greenhouse gas emissions from road transport increased by over 31 per cent. Despite this large increase (and similarly large increases in other sectors), Australia's total greenhouse gas emissions only increased by 1.1 per cent between 1990 and 2003. A dramatic fall —

over 72 per cent — in emissions from land use change and forestry has offset the increase in emissions elsewhere in the economy. If the current emission trends continue, Australia's greenhouse gas emissions will be around 110 per cent of 1990 levels by the target year of 2010.

If Australia is to meet its (voluntary) commitment, then some form of 'cap and trade' system will likely need to be introduced. This system will reflect the fact that Australians are willing to pay something in order to meet the voluntary cap, and in so doing attach a cost to every tonne of emissions, irrespective of where they are generated. The key question for the economic modelling concerns what cost (re tax) needs to be levied on each tonne of CO_2 (equivalent) emissions so as to provide the sufficient incentive for abatement, and in turn meeting the cap.

The available evidence suggests that CO_2 abatement will cost around $10 per tonne (see, for example, Nordhaus and Boyer 2000). The incremental cost associated with increased greenhouse gas emissions arising from Sydney's road transport sector has been included in the economic modelling through applying an ad valorem charge to fuel used by the road transport sector (equivalent to a carbon tax).

The carbon tax required to internalise the social costs associated with increased greenhouse gas emissions from Sydney's road transport sector between 2005 and 2020 is calculated to be 3.4 per cent. (That is, a tax of 3.4 per cent levied on fuel used by households, government and the transport sector would raise $42 million in revenue if fuel consumption remained constant/was not affected by the tax.)

Ambient airborne pollution

In contrast to greenhouse gas emissions from motor vehicles, we know where the impacts of airborne pollution from vehicles are felt — in the Sydney community. It is estimated that the costs associated with mortality and morbidity attributable to ambient airborne pollution from motor vehicles will rise by $5 million between 2005 and 2020. This equates to around 2.3 additional cases of mortality and 4.5 cases of morbidity. Given the size of the Sydney economy, these effects are negligible from an economywide perspective and hence have not been included in the economic modelling.

In purely economic terms, premature death and increased sickness ultimately reduce the supply of labour. If the effects of airborne pollutants were larger, then they could be modelled via reducing the supply of labour in the economy, apportioned across the various sectors of the Sydney economy according to a sector's share of the labour force.

RTA subsidies

It has been estimated that the NSW Government's funding of the RTA will increase by $205 million between 2005 and 2020. As this funding comes from consolidated revenue, the government will either have to generate more taxation revenue or redirect funding from other activities/services to the RTA. For the purpose of this study the former route has been assumed — the NSW Government chooses to raise another $205 million from taxes levied on the NSW tax base.

The need for greater RTA subsidies is incorporated into the economic modelling via increasing the NSW Government's required taxation revenue by $205 million. Note that an increase in tax rate is not always necessary to fund additional revenue requirements. For example, a growing economy (hence larger tax base) will typically be associated with greater taxation revenue even though tax rates have remained constant. Over the period 1995-96 to 2003-04 the NSW economy grew by 3.4 per cent annually in real terms. If this growth rate is maintained until 2019-20, then the $205 million increase in transfers to the RTA will be associated with tax requirements in NSW, measured as a share of gross state product (GSP), being 0.04 per cent higher in 2020 than is the case in 2005. The increase in transfers to the RTA has therefore been modelled via the NSW Government raising additional tax revenue equivalent to 0.04 per cent of GSP in 2020.

A further point to note is that the RTA's activities, and hence expenditure, is spread across all of NSW. If it is assumed that the majority of the taxation revenue raised by the NSW Government is sourced from the Sydney area, then it follows that Sydney will be the source for the majority of the additional $205 million required to be raised from NSW taxpayers. What is not known, however, is what geographical areas are driving the increase in RTA expenditure. If the estimated 29 per cent increase in vkt in Sydney between 2005 and 2020 drives most of the increase in RTA expenditure, and by association the increase in transfers, then it is appropriate that most of the required increase in tax revenue be sourced from Sydney. However, if this is not the case then raising the additional $205 million in revenue from the Sydney tax base could introduce an element of cross subsidisation. The estimated increase in the social costs of road transport in Sydney might therefore include some costs — increased RTA expenditure — attributable to other areas and which are not associated with a real resource cost in Sydney. Given a lack of data, it has not been possible to address this issue.

4 How bad will things get in Sydney?

THE TERM ECONOMIC MODEL has been used to quantify the cost to the Sydney economy of not changing its approach to addressing road transport problems. As is shown below, the costs arising from increasing motor vehicle congestion, accidents and pollution are substantial. Importantly, as the epicentre of economic activity in Australia, the adverse effects of a worsening road transport situation in Sydney radiate throughout the wider NSW and Australian economies.

The economic modelling results provide an important piece of information for the ongoing transport debate — what resources should be devoted to addressing Sydney's transport problems? By undertaking a number of modelling simulations, a matrix is constructed that identifies the justifiable upper bound for expenditure on a particular piece of infrastructure, depending on what road transport social costs are avoided as a result of that infrastructure.

The modelling simulations

As was discussed in chapter 3, increasing social costs associated with road transport are estimated to impact on the economy in a variety of ways — loss of productivity in the road transport sector, reduction in labour supply, increased transfers to the RTA, increased expenditure to rectify damage caused by accidents, and increased pollution.

Given this range of impacts, the economic modelling has been conducted so as to best represent the specific impacts. This has seen the economic impact of increasing social costs attributable to road transport being estimated via 7 'modelling shocks', these being:

- a loss of productivity in the road transport sector reflecting worsening congestion and delays/vehicle unavailability caused by accidents; and
- decreasing the supply of labour to Sydney's workforce;

- increased taxation by the NSW Government so as to fund increased transfers to the RTA;
- an additional tax levied on fuel sales to reflect the cost associated with greenhouse gas emissions; and
- increasing expenditure by households, government and businesses in the Sydney region to address damages/impacts associated with increasing road accidents (3 separate modelling shocks).

The economic modelling has been conducted so that the impact of each of these effects can be identified.

Labour has been assumed to be imperfectly mobile. Faced with lower (higher) wages in a region, labour will be drawn to (move away from) that region. A one per cent decline in the real wage in a region, relative to the national real wage, will see a one per cent decline in that region's labour force. This will be accompanied by an offsetting increase in other regions' labour force so that there is no net change in the national labour force.

Modelling results are presented in 'percentage deviation from baseline' terms. That is, the change in a particular indicator from the value that would have *otherwise been observed*. Hence, for example, a negative value for gross regional product does not mean negative economic growth. Rather, it means that economic growth will be lower than what otherwise would have been the case had road transport social costs not increased.

Also note that the modelling is only used to quantify the economic impacts in terms of productive capacity. While worsening road congestion will likely see people leaving for work earlier/arriving home later, and in so doing erode people's leisure time, no attempt has been made to quantify such costs in the economic modelling. Such costs, can however, be easily approximated outside of the economic model. For example, it is estimated that traffic congestions in Sydney sees motorists being delayed by around 33 seconds per kilometre travelled (Austroads 2005). If the average motorist in Sydney drives 8000 kilometres over a year on congested roads, then that motorist will spend an additional 73 hours 'on the road'. With the average hourly wage in NSW being $25, congestion can be conservatively costed at $1860 per year, per motorist.[4] In addition to this there are also the costs associated with increased fuel consumption etc due to driving at low speeds.

[4] Average weekly adult earnings in NSW in 2004 were $1015.80 (ABS 2005). If we assume a 40 hour working week, the hourly wage is $25.40.

Finally, the economic modelling is independent of what other states do in terms of addressing their transport problems. Depending on what other states do, the economic impacts of increasing road transport social costs in Sydney may be smaller or larger than that reported below. For example, if the transport situation in other states improves relative to the situation in Sydney, then the economic impacts (losses) in Sydney would be larger than that reported. Conversely, if road transport becomes relatively more costly in other states then the economic implications for Sydney of increasing road transport social costs will likely be smaller than that reported in this report.

Impacts on the Sydney economy

Macroeconomic implications

As can be seen in table 4.1, the worsening social costs associated with road transport are estimated to have a dramatic effect on the Sydney economy. In 2020, real gross regional product (GRP) is estimated to be 0.9 per cent lower than otherwise if new approaches to addressing Sydney's worsening transport problems are not adopted.

The large fall in Sydney's GRP primarily reflects, in the first instance, a contraction in investment flows (and hence the capital stock). The productivity loss, decreasing labour supply and increased expenditure by businesses translate into less output/production per unit of input. In other words, it costs more to produce a given quantity of output. The increased government expenditure and RTA transfers, which are funded via increased taxation of private consumption, further contribute to cost increases.

Increasing production costs in Sydney sees either physical capital becoming more costly, or reduced demand for goods and services, and consequently lower demand for capital (and labour) used to produce those products. Either way, this ultimately translates into a lower rate of return to capital. Faced with falling returns, investment flows in Sydney contract by 0.7 per cent, and this is associated with a 1 per cent smaller capital stock by 2020.

The capital flight sees reduced demand for labour. This in turn sees real wages being 0.5 per cent lower than otherwise as the now 'surplus' labour competes for employment. With labour being mobile, there is a reduction in employment of 0.3 per cent as labour leaves Sydney in search of higher wages elsewhere. Note that the imperfectly mobile labour assumption

4.1 Macroeconomic indicators for Sydney 2020

Indicator	*Loss of productivity*	*Decreasing labour supply*	*RTA transfers*	*GHG fuel tax*	*Increased expenditure by*			*Total*
					Households	*Government*	*Business*	
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Real GRP	-0.21	-0.20	-0.08	0.00	0.03	-0.28	-0.13	-0.86
Real investment	-0.15	-0.13	-0.11	0.00	0.02	-0.29	-0.09	-0.74
Capital stock	-0.19	-0.18	-0.14	0.01	0.01	-0.42	-0.10	-1.01
Employment	-0.08	-0.04	-0.06	0.00	0.05	-0.12	-0.05	-0.29
Real wages	-0.11	-0.07	-0.08	0.00	0.05	-0.19	-0.07	-0.47
Household consumption	-0.15	-0.08	-0.11	0.00	0.10	-0.24	-0.09	-0.58
Household welfare	-0.15	-0.08	-0.11	0.00	-0.27	-0.24	-0.09	-0.94
Consumer price index	0.08	0.17	0.04	0.00	0.05	0.38	0.06	0.77

Source: TERM simulation.

means that real wages in Sydney have to fall more so as to eliminate the now surplus labour. For example, if labour was perfectly mobile, then real wages would need to contract by only 0.2 per cent in Sydney in order to restore equilibrium in the labour market.

With lower returns to capital and labour, household consumption contracts and is 0.6 per cent lower than otherwise in 2020. Household welfare, however, is 0.9 per cent lower. Welfare contracts by more than the change in consumption due to some of that consumption being 'forced' — increasing motor vehicle accidents see households spending $274 million more in 2020 on repairs, insurance, legal and accident administration costs etc. This expenditure is required for households to 'stand still' in terms of welfare; and hence is not welfare *improving*. As a result of the increased expenditure household consumption is 0.10 per cent higher in 2020, but as such forced consumption is not welfare improving, this increase in consumption is associated with a reduction in welfare of 0.27 per cent.

The increased government expenditure and RTA transfers are funded via increased taxation of goods and services consumed by households. This, combined with the productivity losses, sees the consumer price index being 0.8 per cent higher than otherwise.

While increased taxation to fund higher government expenditure has a adverse effect on Sydney's economy, increased taxation of fuel has the opposite effect — real GRP is marginally higher (0.002 per cent) when a tax is levied on fuel sales (to internalise the externality associated with greenhouse gas emissions). As demand for fuel is relatively insensitive to price (in the short run at least), a tax on fuel sees the price of fuel increasing, but little drop off in volume consumed. Hence the fuel tax raises noteworthy revenue for the government. In the economic modelling it has assumed that the government functions on a 'revenue neutral' basis. Hence raising revenue via a fuel tax allows more distortionary taxes elsewhere in the economy to be reduced. Replacing distortionary taxes with a less distorting fuel tax improves economic efficiency, and hence leads to a GRP gain. Quite simply, fuel represents the ideal product to levy a tax on.

Sectoral implications

The impacts of increasing social costs of road transport on specific sectors will essentially be determined by a combination of four factors, these being:

- the sector's reliance on road transport to source production inputs and to deliver products to end consumers;
- the importance of labour (as opposed to capital) to a sector's production processes;
- the sector's share of production sold to local households (as opposed to other businesses, government or exported to other regions); and
- the cost impost associated with administration, legal and insurance costs arising from increasing accidents.

The 10 most 'sizeable' sectors (production value greater than $500 million) impacted most adversely by increasing social costs of road transport are reported in table 4.2. Modelling results for all sectors are provided in appendix A.

The Motor vehicles and parts (MVP) sector is estimated to experience the largest fall in output — nearly 5 per cent lower. (It should be noted that this decline is off a relatively low base. The MVP sector accounts for only 0.26 per cent of output in the Sydney economy, hence the economic impact of this decline will be small in an economywide sense.) The decline in output can be attributed to increasing costs associated with vehicle accidents (2.7 per cent), a decline in labour supply (0.6 per cent) and increased govern-

4.2 **Implications for selected sectors in the Sydney economy**

Sector	*Output*	*Employment*	*Investment*	*Price*
	Per cent	Per cent	Per cent	Per cent
Motor vehicles and parts	-4.9	-4.7	-4.8	1.4
Coal, Oil and Gas	-3.4	-3.2	-3.3	0.7
Other transport equipment	-3.4	-3.2	-3.3	1.1
Meat	-3.1	-2.9	-3.0	0.7
Metal products	-2.9	-2.7	-2.7	0.7
Textiles	-2.6	-2.4	-2.4	0.6
Machinery	-2.5	-2.3	-2.4	0.7
Drinks & tobacco	-2.5	-2.3	-2.3	0.8
Other foods	-2.4	-2.2	-2.3	0.7
Dairy	-2.3	-2.2	-2.2	0.7

Source: TERM simulation.

ment expenditure (1.1 per cent) finance by taxation on final consumption, of which motor vehicles represent an important component of. In other words, motor vehicles become more expensive to use and hence demand declines, which sees MVP output being lower.

Broadly speaking, other sectors experience a similar story. There is, however, some variation between the sectors in terms of what is driving the result. For example, consider the Meat sector (abattoirs). Output in this sector is forecast to be 3.1 per cent lower in 2020. The lower output is attributable to productivity losses in the road transport sector (1 per cent), a decline in labour supply (0.5 per cent) and increased government expenditure (1.1 per cent) financed by taxation on final consumption (including meat products). The importance of productivity losses in the road transport sector reflects how 'road transport intensive' the Meat sector is. Road transporting sector output to wholesalers/retailers adds around a 4–5 per cent cost impost. The Meat sector is also a heavy user of road transport to deliver production inputs (principally livestock). Road transport adds around 30 per cent (on average) to the cost of sourcing livestock. Hence anything that acts to increase the cost of road transport will have a noticeable (and adverse) impact on this sector.

Impacts on the wider NSW and Australian economies

Due to its position as the economic centre of NSW, and indeed Australia, an adverse impact on the Sydney economy will be felt elsewhere. As can be seen from table 4.3, worsening road transport in Sydney is estimated to have an adverse impact on other regions of NSW. Impacts will be broadly proportional to other regions' economic ties with Sydney. Results for the Hunter and Illawarra regions of NSW stand out — the decline in GRP in these regions is around 40–50 per cent of the decline in Sydney's GRP.

This result reflects these regions strong economic interdependency with Sydney — Sydney is the largest trading partner of both the Hunter and Illawarra. Sydney is the destination for 18–19 per cent of Hunter and Illawarra production; while being the source of 19–20 per cent of production inputs used in the Hunter and Illawarra. Hence whatever happens to Sydney will be transmitted to the Hunter and Illawarra regions via this strong trading relationship.

Increasing road transport costs are estimated to see prices in Sydney rising by 0.8 per cent. Hence goods produced in Sydney and 'exported' to the Hunter and Illawarra will now be more expensive. Due to Sydney being the origin for such a large share of production inputs, the cost impost on

4.3 **Regional implications of higher cost road transport in Sydney**

Region	*GRP*	*Household welfare*	*Real investment*	*Employment*	*Consumer price index*
	Per cent	Per cent	Per cent	Per cent	Per cent
Sydney, NSW	-0.86	-0.94	-0.74	-0.29	0.77
Hunter, NSW	-0.41	-0.51	-0.48	-0.26	0.32
Illawarra, NSW	-0.36	-0.46	-0.40	-0.23	0.33
Richmond Tweed, NSW	0.05	0.09	0.21	0.05	0.17
Mid North Coast, NSW	-0.13	-0.16	-0.05	-0.08	0.22
Northern, NSW	-0.19	-0.26	-0.17	-0.13	0.22
North West, NSW	-0.23	-0.29	-0.24	-0.14	0.21
Central West, NSW	-0.16	-0.20	-0.14	-0.10	0.24
South East, NSW	-0.13	-0.15	-0.08	-0.07	0.24
Murrumbidgee, NSW	-0.05	-0.06	0.02	-0.03	0.21
Murray, NSW	0.01	0.04	0.11	0.02	0.18
Far West, NSW	-0.24	-0.26	-0.19	-0.13	0.20
ACT	-0.01	0.02	0.11	0.01	0.20
Melbourne, VIC	0.27	0.44	0.49	0.22	0.09
Other, VIC	0.10	0.20	0.23	0.10	0.11
Brisbane, QLD	0.26	0.40	0.49	0.20	0.09
Other, QLD	0.00	0.06	0.11	0.03	0.12
SA	0.16	0.28	0.33	0.14	0.09
NT	-0.07	-0.04	-0.02	-0.02	0.11
WA	0.01	0.10	0.10	0.05	0.07
TAS	0.14	0.23	0.27	0.12	0.12
All NSW	-0.65	-0.73	-0.56	-0.24	0.60
Australia	-0.14	-0.07	0.00	0.00	0.28

Source: TERM simulation.

businesses in the Hunter and Illawarra will be substantial. Furthermore, economic activity in Sydney is estimated to be 0.9 per cent lower by 2020. As Sydney is the destination for 19–20 per cent of Hunter and Illawarra output, a smaller Sydney market will likewise have a substantial impact. Hence if Sydney ‘sneezes’, other regions in NSW will likely catch a ‘cold’.

Finally, not all regions in Australia are adversely impacted on by increasing road transport social costs in Sydney. Most notably, Melbourne and Brisbane are estimated to experience GRP being around 0.3 per cent higher in 2020. This is driven by capital leaving Sydney in search of lower costs/higher returns elsewhere, followed by labour in search of employment and higher wages. Hence increases in the social costs associated with road transport sees economic activity being relocated from Sydney (and NSW) to other states such as Victoria and Queensland.

Justifiable spending on transport infrastructure

The cost (foregone GRP) associated with worsening social costs of road transport in Sydney can be used to identify the maximum justifiable expenditure to address those worsening costs.

The justifiable expenditure has been identified through answering the following question(s). If in year 2020 we want the social costs associated with road transport to be at the level it was in year 2005, or 2006, or 2007…2019, then what is the maximum amount that should be expended in order to keep the social costs at that level?

This question has been answered through using TERM to estimate the foregone GRP through allowing the social costs associated with road transport in Sydney to rise above their 2005 levels. The economic modelling has seen 15 simulations being run. In the first, social costs are allowed to rise from their level in 2005 to the expected levels in 2020. In the second simulation, social costs are increased from 2006 levels to 2020 levels. In the third simulation, social costs are increased from 2007 levels to 2020 levels and so on.

These modelling simulations yield a range of foregone GRP estimates associated with allowing road transport social costs to increase beyond levels experienced in 2005, 2006, 2007…2019. The foregone GRP estimates are then converted into a yearly change, and then into a dollar figure for each year over the period 2005 to 2020 using forecasts of Sydney's GRP in each of those years. As some of these costs will not be incurred until years 2006 to 2020, they are discounted back to present value (year 2005) terms.[5] Summing the present value costs over years 2005 to 2020 allows a dollar figure to be put on allowing the social costs of road transport to worsen.

This dollar figure — the cost of allowing road transport social costs to increase — in turn gives the upper bound for the economically justifiable expenditure used to completely ameliorate those costs. Table 4.4 presents the results of the analysis. The results should be read/interpreted as: if the Sydney community wants road transport social costs in year 2020 to be at the levels they were in <year>, then the maximum economically justifiable expenditure (assumed to take place in year 2005) in achieving that outcome is <result>.

For example, assume in 2020 that the Sydney community wants the social costs of road transport to be at their 2010 levels. Allowing social costs to

[5] Expressing costs in present value terms allows a current value to be placed on costs that may not be experienced until some time in the future.

4.4 Economically justifiable expenditure to address road transport social costs

	If the Sydney community wants road transport social costs in year 2020 to be at <year> levels															
	2005	***2006***	***2007***	***2008***	***2009***	***2010***	***2011***	***2012***	***2013***	***2014***	***2015***	***2016***	***2017***	***2018***	***2019***	***2020***
	$b	$b	$b	$b	$b	$b	$b	$b	$b	$b	$b	$b	$b	$b	$b	$b
Maximum justifiable expenditure	10.98	10.28	9.58	8.93	8.21	7.44	6.88	6.12	5.40	4.68	3.94	3.12	2.36	1.58	0.80	0

Source: TERM simulations and CIE calculations.

rise from their 2010 levels to levels expected in 2020 is estimated to impart a (present value) cost of $7.5 billion on the Sydney economy, hence this is the maximum justifiable expenditure to keep social costs at year 2010 levels. If it cost say $15 billion to keep social costs at year 2010 levels, then this expenditure is not economically justified — the benefit (higher GRP of $7.5 billion) to cost (infrastructure upgrades costing $15 billion) ratio is less than one. If measures to keep social costs at year 2010 levels cost $7.5 billion, then the benefit to cost ratio is one, hence the expenditure is borderline justified. If measures cost $4 billion, then the benefit to cost ratio exceeds one (ratio of 1.86) and the expenditure is justified.

The objective of the government is to minimise the cost of infrastructure upgrades — improved rail and bus services/links, road network capacity, bike paths, light rail etc — used to address road transport problems so as to ensure a benefit to cost ratio of (at least) one is obtained. Secondly, the government should implement infrastructure upgrades according to the benefit to cost ratios — higher ratio projects first.

Note that the results reported in table 4.4 are premised on the assumption that over the long term, labour is imperfectly mobile between regions. If, however, labour proves to be perfectly mobile or not mobile between regions, then the justifiable maximum expenditure will be significantly different from that reported in table 4.4. For example, with perfectly mobile labour, projects up to the value of $25.03 billion can be justified if those projects see the social costs of road transport in 2020 being at 2005 levels. This figure falls to $10.98 billion if labour is imperfectly mobile, and $7.33 billion if labour is not mobile.

The results reported in table 4.4 are also subject to timing considerations. As increasing road transport social costs see GRP being permanently lower than otherwise, considering the costs over a longer period (say 2005 to 2030) would see greater foregone GRP, and hence greater expenditure being justified. Restricting the analysis to years 2005 to 2020 may therefore understate the justifiable expenditure.

When the new infrastructure comes 'on line' also influences the results. The results reported in table 4.4 are based on the simplifying assumption that infrastructure is built and available for use in 2005. That infrastructure then sees the social costs associated with road transport being at some lower level in year 2020. The availability of the new infrastructure in 2005 means that the social costs in years 2006, 2007 and so on are lower than otherwise, as is foregone GRP. Hence the availability of the new infrastructure in 2005 delivers gains in terms of avoided GRP losses in each year post 2005, which in turn increases the maximum justifiable expenditure associated with the infrastructure. If however, the new infrastructure did not come on line until say 2010, then social costs would only be reduced post 2010, with the gains from reduced social costs over the period 2005–10 not being realised, and a lower justifiable expenditure would result.

Finally, the results presented in table 4.4 are derived from the foregone GRP in Sydney only. Strictly speaking, a case could be made for including the impacts (foregone GRP) in other regions of NSW. That is, it may prove to be economically sensible/rational for regions such as the Hunter and Illawarra to contribute to, and in so doing increase, the funding of transport infrastructure upgrades in Sydney so as avoid a contraction in economic activity attributable to worsening road transport in Sydney. Including other regions' foregone GRP in table 4.4 would significantly increase the maximum justifiable expenditure.

Funding arrangements

Given the justifiable expenditure figures above, the question then turns to how should this expenditure be funded? The funding arrangements for transport infrastructure investments of this magnitude add an additional dimension to attempts to curtail social transport costs and improve the efficiency of the transport task. There are several challenges to be confronted in raising the required funds. From an efficiency perspective, the challenge is to fund a larger component of the expenditure from those who benefit from a particular transport investment (whether or not they use the infrastructure directly) without compromising the broader social and environmental responsibilities of government. Hence one option to fund the infrastructure expenditure is to charge beneficiaries (in this sense the expenditure is largely self-financing).

From a pragmatic perspective, it must be recognised that funding options can hinge on what those funds will pay for. For instance, increases in public transport fares to fund public transport investments when the network is operating close to capacity during peak hours, or where quality standards are not being met, can be less viable. Similarly options for private sector investment can depend on the quality of the public transport network or road system that is being upgraded or augmented or other factors likely to affect usage patterns. Hence consideration needs to be given to funding arrangements in the final analysis of meeting Sydney's long term transport needs in a cost effective and sustainable manner.

Appendix

A Detailed sectoral results for Sydney

DETAILED RESULTS for the various economic sectors of the Sydney economy are reported here. Results are reported for:

- sector output — see table A.1;
- sector employment — see table A.2
- sector investment — see table A.3; and
- sector prices — see table A.4.

The impacts of the various effects of increasing road transport social costs — loss of productivity in road transport sector, decrease in supply of labour to the workforce etc — on the reported economic indicators are also identified.

A.1 **Sector output in Sydney** 2020

Indicator	*Loss of productivity*	*Decreasing labour supply*	*RTA transfers*	*GHG fuel tax*	*Increased expenditure by*			*Total*[a]
					Households	*Government*	*Business*	
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Livestock	-0.5	-0.8	-0.1	0.0	-0.4	-1.5	-0.2	-3.4
Grains	-0.8	-0.2	0.0	0.0	-0.1	-0.4	-0.1	-1.6
Vegetables	-0.2	-0.3	0.0	0.0	-0.2	-0.4	-0.1	-1.2
Other crops	-0.2	-0.3	0.0	0.0	-0.2	-0.5	-0.1	-1.3
Fruit	-0.3	-0.3	0.0	0.0	-0.2	-0.3	-0.1	-1.1
Agriculture services	-0.1	-0.2	-0.1	0.0	-0.2	-0.3	-0.1	-0.9
Forestry	-0.7	-0.8	-0.1	0.0	-0.3	-1.3	-0.4	-3.6
Fishing	-0.3	-0.6	-0.1	0.0	-0.3	-1.1	-0.8	-3.2
Coal, oil & gas	-0.5	-0.8	-0.2	0.0	-0.3	-1.4	-0.3	-3.4
Other mining	-3.6	-0.8	-0.2	-0.1	-0.2	-1.6	-0.5	-7.1
Meat products	-1.0	-0.5	-0.1	0.0	-0.3	-1.1	-0.2	-3.1
Dairy	-0.7	-0.3	-0.1	0.0	-0.3	-0.7	-0.1	-2.4
Fruit products	-0.8	-0.3	-0.1	0.0	-0.3	-0.7	-0.1	-2.3
Vegetable products	-0.8	-0.4	-0.1	0.0	-0.3	-0.7	-0.1	-2.4
Other foods	-0.6	-0.4	-0.1	0.0	-0.3	-0.9	-0.2	-2.4
Drinks & tobacco	-0.6	-0.4	-0.1	0.0	-0.3	-0.9	-0.2	-2.5
Textiles	-0.5	-0.6	-0.1	0.0	-0.3	-1.0	-0.2	-2.6
Clothing	-0.2	-0.4	-0.1	0.0	-0.3	-0.6	-0.1	-1.6
Footwear	-0.5	-0.6	-0.1	0.0	-0.3	-1.0	-0.1	-2.6
Wood products	0.0	-0.6	-0.1	0.0	-0.2	-1.0	-0.2	-2.0
Paper & printing	-0.3	-0.4	-0.1	0.0	-0.2	-0.7	-0.1	-1.7
Fuel	-0.3	-0.3	-0.1	0.0	-0.1	-0.6	-0.1	-1.6
Chemicals	-0.3	-0.4	-0.1	0.0	-0.2	-0.7	-0.1	-1.9
Plastic, rubber & glass	-0.5	-0.4	-0.1	0.0	-0.2	-0.8	-0.2	-2.2
Metal products	-0.5	-0.6	-0.1	0.0	-0.2	-1.2	-0.2	-2.9
Motor vehicles & parts	-0.3	-0.6	-0.1	0.0	-0.2	-1.1	-2.7	-4.9
Other transport equip	-0.1	-0.5	-0.1	0.0	-0.2	-0.8	-1.7	-3.4
Railway equipment	-0.2	-0.6	-0.1	0.0	-0.3	-1.0	-0.2	-2.3
Electrical equipment	-0.3	-0.5	-0.1	0.0	-0.2	-0.8	-0.2	-2.1
Machinery	-0.3	-0.6	-0.1	0.0	-0.2	-1.0	-0.4	-2.5
Other manufacturing	-0.4	-0.5	-0.1	0.0	-0.2	-0.8	-0.2	-2.1
Utilities	-0.1	-0.2	-0.1	0.0	-0.1	-0.3	-0.1	-0.9
Construction	-0.1	-0.1	-0.1	0.0	-0.1	-0.2	-0.1	-0.8
Trade	-0.2	-0.2	-0.1	0.0	-0.1	-0.4	-0.1	-1.1
Repairs	0.0	-0.2	-0.1	0.0	-0.1	-0.3	-0.2	-0.9
Hotels & restaurants	-0.1	-0.2	-0.1	0.0	-0.1	-0.3	-0.1	-0.9
Road transport	2.1	-0.2	-0.1	0.0	-0.1	-0.4	-0.1	1.1
Rail transport	-0.1	-0.2	-0.1	0.0	-0.2	-0.3	-0.1	-0.9
Other transport	-0.1	-0.3	-0.1	0.0	-0.1	-0.5	-0.2	-1.2
Communication	-0.1	-0.2	-0.1	0.0	-0.1	-0.3	-0.1	-0.7
Finance	-0.1	-0.1	-0.1	0.0	1.1	-0.2	0.2	0.8
Owner dwellings	-0.2	-0.2	-0.2	0.0	-0.2	-0.5	-0.1	-1.4
Business services	-0.1	-0.2	-0.1	0.0	0.2	-0.2	0.1	-0.2
Gov, edu, def & health	0.0	-0.1	0.0	0.0	-0.1	0.7	0.0	0.5

[a] Results might not add due to rounding.

Source: TERM simulation.

A.2 **Sector employment in Sydney** 2020

Indicator	*Loss of productivity*	*Decreasing labour supply*	*RTA transfers*	*GHG fuel tax*	*Increased expenditure by Households*	*Government*	*Business*	*Total*[a]
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Livestock	-0.5	-0.7	-0.1	0.0	-0.4	-1.5	-0.2	-3.4
Grains	-1.4	-0.3	0.0	0.0	-0.2	-0.6	-0.1	-2.6
Vegetables	-0.3	-0.2	0.0	0.0	-0.3	-0.5	-0.1	-1.5
Other crops	-0.3	-0.3	0.0	0.0	-0.2	-0.7	-0.1	-1.7
Fruit	-0.4	-0.2	0.0	0.0	-0.2	-0.5	-0.1	-1.5
Agriculture services	-0.1	0.0	-0.1	0.0	-0.2	-0.3	-0.1	-0.7
Forestry	-0.7	-0.7	-0.1	0.0	-0.3	-1.3	-0.4	-3.4
Fishing	-0.3	-0.4	-0.1	0.0	-0.3	-1.1	-0.8	-3.0
Coal, oil & gas	-0.5	-0.7	-0.2	0.0	-0.3	-1.4	-0.3	-3.2
Other mining	-3.6	-0.7	-0.2	-0.1	-0.3	-1.6	-0.5	-6.9
Meat products	-1.0	-0.3	-0.1	0.0	-0.3	-1.0	-0.2	-2.9
Dairy	-0.7	-0.2	-0.1	0.0	-0.3	-0.7	-0.1	-2.2
Fruit products	-0.7	-0.2	-0.1	0.0	-0.3	-0.6	-0.1	-2.1
Vegetable products	-0.8	-0.2	-0.1	0.0	-0.3	-0.7	-0.1	-2.2
Other foods	-0.6	-0.3	-0.1	0.0	-0.3	-0.9	-0.1	-2.2
Drinks & tobacco	-0.6	-0.3	-0.1	0.0	-0.3	-0.9	-0.1	-2.3
Textiles	-0.5	-0.4	-0.1	0.0	-0.3	-1.0	-0.1	-2.4
Clothing	-0.2	-0.2	-0.1	0.0	-0.3	-0.6	-0.1	-1.5
Footwear	-0.5	-0.4	-0.1	0.0	-0.3	-1.0	-0.1	-2.4
Wood products	0.0	-0.4	-0.1	0.0	-0.2	-1.0	-0.1	-1.8
Paper & printing	-0.3	-0.3	-0.1	0.0	-0.2	-0.7	-0.1	-1.5
Fuel	-0.3	-0.1	-0.1	0.0	-0.1	-0.6	-0.1	-1.4
Chemicals	-0.3	-0.3	-0.1	0.0	-0.2	-0.7	-0.1	-1.7
Plastic, rubber & glass	-0.5	-0.3	-0.1	0.0	-0.2	-0.8	-0.2	-2.1
Metal products	-0.5	-0.5	-0.1	0.0	-0.2	-1.2	-0.2	-2.7
Motor vehicles & parts	-0.2	-0.4	-0.1	0.0	-0.2	-1.0	-2.7	-4.7
Other transport equip	-0.1	-0.4	-0.1	0.0	-0.2	-0.8	-1.7	-3.2
Railway equipment	-0.2	-0.4	-0.1	0.0	-0.3	-1.0	-0.2	-2.1
Electrical equipment	-0.3	-0.3	-0.1	0.0	-0.2	-0.8	-0.2	-1.9
Machinery	-0.3	-0.4	-0.1	0.0	-0.2	-1.0	-0.4	-2.3
Other manufacturing	-0.4	-0.3	-0.1	0.0	-0.2	-0.8	-0.2	-1.9
Utilities	-0.1	0.0	-0.1	0.0	-0.1	-0.3	0.0	-0.6
Construction	-0.1	0.1	-0.1	0.0	-0.1	-0.2	-0.1	-0.6
Trade	-0.2	-0.1	-0.1	0.0	-0.1	-0.4	-0.1	-0.9
Repairs	0.0	0.0	-0.1	0.0	-0.1	-0.3	-0.2	-0.7
Hotels & restaurants	-0.1	0.0	-0.1	0.0	-0.1	-0.3	-0.1	-0.7
Road transport	2.1	-0.1	-0.1	0.0	-0.1	-0.4	-0.1	1.3
Rail transport	-0.1	0.0	0.0	0.0	-0.2	-0.3	0.0	-0.7
Other transport	-0.1	-0.1	-0.1	0.0	-0.1	-0.4	-0.2	-1.0
Communication	-0.1	0.0	-0.1	0.0	-0.1	-0.2	-0.1	-0.5
Finance	-0.1	0.0	0.0	0.0	1.1	-0.2	0.2	1.0
Owner dwellings	-0.2	-0.1	-0.2	0.0	-0.2	-0.4	-0.1	-1.2
Business services	-0.1	0.0	0.0	0.0	0.2	-0.2	0.1	0.0
Gov, edu, def & health	0.0	0.1	0.0	0.0	-0.1	1.0	0.0	0.9

[a] Results might not add due to rounding.

Source: TERM simulation.

A.3 **Sector investment in Sydney** 2020

Indicator	*Loss of productivity*	*Decreasing labour supply*	*RTA transfers*	*GHG fuel tax*	*Increased expenditure by*			*Total*[a]
					Households	*Government*	*Business*	
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Livestock	-0.5	-0.7	-0.2	0.0	-0.3	-1.5	-0.2	-3.4
Grains	-1.4	-0.3	0.0	0.0	-0.1	-0.6	-0.2	-2.7
Vegetables	-0.4	-0.3	-0.1	0.0	-0.2	-0.5	-0.1	-1.6
Other crops	-0.3	-0.4	-0.1	0.0	-0.2	-0.7	-0.1	-1.8
Fruit	-0.4	-0.3	0.0	0.0	-0.2	-0.5	-0.1	-1.5
Agriculture services	-0.1	-0.1	-0.1	0.0	-0.1	-0.3	-0.1	-0.8
Forestry	-0.8	-0.7	-0.1	0.0	-0.2	-1.3	-0.4	-3.5
Fishing	-0.3	-0.5	-0.1	0.0	-0.3	-1.0	-0.8	-3.0
Coal, oil & gas	-0.5	-0.8	-0.2	0.0	-0.2	-1.4	-0.3	-3.3
Other mining	-3.6	-0.7	-0.2	-0.1	-0.2	-1.6	-0.5	-7.0
Meat products	-1.0	-0.4	-0.1	0.0	-0.2	-1.0	-0.2	-3.0
Dairy	-0.7	-0.3	-0.1	0.0	-0.3	-0.7	-0.1	-2.2
Fruit products	-0.8	-0.2	-0.1	0.0	-0.3	-0.6	-0.1	-2.2
Vegetable products	-0.8	-0.3	-0.1	0.0	-0.3	-0.7	-0.1	-2.3
Other foods	-0.6	-0.3	-0.1	0.0	-0.2	-0.8	-0.2	-2.3
Drinks & tobacco	-0.6	-0.4	-0.1	0.0	-0.2	-0.9	-0.2	-2.3
Textiles	-0.5	-0.5	-0.1	0.0	-0.2	-1.0	-0.2	-2.4
Clothing	-0.2	-0.3	-0.1	0.0	-0.2	-0.6	-0.1	-1.5
Footwear	-0.5	-0.5	-0.1	0.0	-0.2	-1.0	-0.2	-2.4
Wood products	0.0	-0.5	-0.1	0.0	-0.2	-1.0	-0.2	-1.9
Paper & printing	-0.3	-0.3	-0.1	0.0	-0.1	-0.7	-0.1	-1.6
Fuel	-0.3	-0.2	-0.1	0.0	-0.1	-0.5	-0.1	-1.4
Chemicals	-0.3	-0.3	-0.1	0.0	-0.1	-0.7	-0.1	-1.7
Plastic, rubber & glass	-0.5	-0.3	-0.1	0.0	-0.1	-0.8	-0.2	-2.1
Metal products	-0.5	-0.5	-0.1	0.0	-0.2	-1.2	-0.2	-2.7
Motor vehicles & parts	-0.3	-0.5	-0.1	0.0	-0.2	-1.0	-2.7	-4.8
Other transport equip	-0.2	-0.4	-0.1	0.0	-0.1	-0.8	-1.7	-3.3
Railway equipment	-0.2	-0.5	-0.1	0.0	-0.2	-1.0	-0.2	-2.2
Electrical equipment	-0.3	-0.4	-0.1	0.0	-0.1	-0.8	-0.2	-1.9
Machinery	-0.3	-0.5	-0.1	0.0	-0.1	-1.0	-0.4	-2.4
Other manufacturing	-0.4	-0.4	-0.1	0.0	-0.1	-0.8	-0.2	-1.9
Utilities	-0.1	-0.1	-0.1	0.0	-0.1	-0.3	-0.1	-0.7
Construction	-0.2	0.0	-0.1	0.0	0.0	-0.2	-0.1	-0.6
Trade	-0.2	-0.1	-0.1	0.0	-0.1	-0.4	-0.1	-1.0
Repairs	0.0	-0.1	-0.1	0.0	-0.1	-0.3	-0.2	-0.7
Hotels & restaurants	-0.2	-0.1	-0.1	0.0	-0.1	-0.3	-0.1	-0.8
Road transport	2.1	-0.1	-0.1	0.0	-0.1	-0.4	-0.2	1.2
Rail transport	-0.2	-0.1	-0.1	0.0	-0.1	-0.3	-0.1	-0.9
Other transport	-0.1	-0.2	-0.1	0.0	0.0	-0.4	-0.3	-1.1
Communication	-0.1	-0.1	-0.1	0.0	0.0	-0.2	-0.1	-0.6
Finance	-0.1	-0.1	-0.1	0.0	1.1	-0.2	0.2	0.9
Owner dwellings	-0.2	-0.1	-0.2	0.0	-0.2	-0.4	-0.1	-1.3
Business services	-0.1	-0.1	-0.1	0.0	0.3	-0.2	0.1	-0.1
Gov, edu, def & health	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.8

[a] Results might not add due to rounding.

Source: TERM simulation.

A.4 **Sector prices in Sydney** 2020

Indicator	*Loss of productivity*	*Decreasing labour supply*	*RTA transfers*	*GHG fuel tax*	*Increased expenditure by*			*Total*[a]
					Households	*Government*	*Business*	
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Livestock	0.1	0.1	0.0	0.0	0.0	0.2	0.0	0.5
Grains	-0.5	0.0	0.0	0.0	0.0	-0.1	0.0	-0.7
Vegetables	-0.1	0.1	0.0	0.0	0.0	0.1	0.0	0.0
Other crops	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1
Fruit	-0.1	0.1	0.0	0.0	0.0	0.1	0.0	0.0
Agriculture services	0.1	0.2	0.0	0.0	0.1	0.3	0.0	0.6
Forestry	0.1	0.2	0.0	0.0	0.1	0.3	0.1	0.7
Fishing	0.1	0.2	0.0	0.0	0.0	0.3	0.2	0.8
Coal, oil & gas	0.1	0.2	0.0	0.0	0.1	0.3	0.1	0.7
Other mining	0.4	0.2	0.0	0.0	0.0	0.3	0.1	1.0
Meat products	0.3	0.1	0.0	0.0	0.0	0.2	0.0	0.7
Dairy	0.3	0.1	0.0	0.0	0.0	0.2	0.0	0.7
Fruit products	0.3	0.2	0.0	0.0	0.0	0.3	0.1	0.9
Vegetable products	0.3	0.2	0.0	0.0	0.0	0.3	0.1	0.9
Other foods	0.2	0.1	0.0	0.0	0.0	0.3	0.0	0.7
Drinks & tobacco	0.2	0.2	0.0	0.0	0.0	0.3	0.1	0.8
Textiles	0.1	0.2	0.0	0.0	0.0	0.2	0.0	0.6
Clothing	0.1	0.2	0.0	0.0	0.0	0.3	0.0	0.6
Footwear	0.1	0.2	0.0	0.0	0.1	0.3	0.0	0.7
Wood products	0.1	0.2	0.0	0.0	0.1	0.3	0.0	0.7
Paper & printing	0.1	0.2	0.0	0.0	0.1	0.3	0.0	0.7
Fuel	0.1	0.1	0.0	0.0	0.0	0.2	0.0	0.4
Chemicals	0.1	0.2	0.0	0.0	0.0	0.3	0.0	0.7
Plastic, rubber & glass	0.2	0.2	0.0	0.0	0.1	0.3	0.1	0.8
Metal products	0.1	0.2	0.0	0.0	0.0	0.3	0.0	0.7
Motor vehicles & parts	0.1	0.2	0.0	0.0	0.0	0.3	0.9	1.4
Other transport equip	0.0	0.2	0.0	0.0	0.1	0.2	0.5	1.1
Railway equipment	0.0	0.2	0.0	0.0	0.1	0.3	0.0	0.6
Electrical equipment	0.1	0.2	0.0	0.0	0.1	0.3	0.1	0.6
Machinery	0.1	0.2	0.0	0.0	0.1	0.3	0.1	0.7
Other manufacturing	0.1	0.2	0.0	0.0	0.1	0.3	0.1	0.7
Utilities	0.0	0.2	0.0	0.0	0.0	0.3	0.0	0.7
Construction	0.1	0.2	0.0	0.0	0.1	0.3	0.0	0.6
Trade	0.1	0.2	0.0	0.0	0.1	0.3	0.1	0.8
Repairs	0.0	0.2	0.0	0.0	0.1	0.2	0.5	1.0
Hotels & restaurants	0.1	0.2	0.0	0.0	0.1	0.3	0.1	0.7
Road transport	0.0	0.2	0.0	0.2	0.1	0.3	0.3	1.0
Rail transport	0.0	0.2	0.0	0.0	0.1	0.3	0.0	0.6
Other transport	0.1	0.2	0.0	0.0	0.1	0.3	0.3	0.9
Communication	0.1	0.2	0.0	0.0	0.1	0.3	0.1	0.7
Finance	0.0	0.2	0.0	0.0	0.1	0.3	0.0	0.6
Owner dwellings	0.1	0.2	0.0	0.0	0.1	0.4	0.0	0.8
Business services	0.0	0.2	0.0	0.0	0.1	0.3	0.0	0.6
Gov, edu, def & health	0.0	0.2	0.0	0.0	0.1	0.5	0.1	0.9

[a] Results might not add due to rounding.

Source: TERM simulation.

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