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Australian Transport and Greenhouse Gas Reduction Targets

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Abstract

Transport greenhouse gas emissions have increased by about 24 per cent since 1990-91 making transport the fastest growing contributor of all sources of greenhouse gas emissions in Australia. This paper compares the energy efficiency of different modes of transport for freight and passenger tasks. If demand for road vehicle travel was managed and growth in passenger and freight tasks was picked up by the more energy efficient public transport and rail, Australia would begin to reduce its greenhouse gas emissions and move closer to achieving its greenhouse gas target.

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Australian Transport and Greenhouse Gas Reduction Targets

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1. INTRODUCTION

Transport greenhouse gas emissions have increased by about 24 per cent since 1990-91 making transport the fastest growing contributor of all sources of greenhouse gas emissions in Australia. Australia's emission reduction target under the Kyoto Protocol is an increase of emissions of no more than an 8 per cent on 1990 levels. This paper compares the energy efficiency of different modes of transport for freight and passenger tasks. If demand for road vehicle travel was managed and growth in passenger and freight tasks was picked up by the more energy efficient public transport and rail, Australia would begin to reduce its greenhouse gas emissions and move closer to achieving its greenhouse gas target.

To the twelve months ended 31 October 2001, Australia's 12.4 million road vehicles travelled about 190 billion kilometres (from Australian Bureau of Statistics (ABS, 2003) estimates). This required the consumption of some 16.5 billion litres of petrol, 6.7 billion litres of diesel and 2.7 billion litres of LPG etc (ABS, 2003) with outputs including the movement of people plus 1482 million tonnes of freight. Rail, during 2000-01 used 533 million litres of diesel (Australian Tax Office, 2002) and approximately 1800 gigaWatt hours of electric power (Rail CRC, 2003) to move approximately 535 million tonnes of freight and over 600 million passengers including urban light rail (Australasian Railway Association, 2002). During 1997-98, domestic shipping used 439 million litres of fuel oil and diesel and domestic airlines used 2152 million litres of aviation turbine fuel (Apelbaum Consulting Group - ACG, 2001)..

The Australian Greenhouse Office (AGO - www.greenhouse.gov.au) advises that in 2000, Australia's movements of people and goods resulted in the release of 76 million tonnes of greenhouse gas emissions in carbon dioxide equivalents (about 4 tonnes per capita). The AGO further advises that Australia's transport greenhouse gas emissions for 2008-12 are expected to rise to some 91 million tonnes per annum, and thus transport emissions will have increased by 48 per cent from 1990 levels of 61 million tonnes.

Road transport was responsible for 88 per cent of all domestic transport greenhouse gas emissions in 2000. Despite having a similar freight task to that of road plus a modest passenger task, rail was responsible for only 2 per cent of transport GHG emissions. Domestic sea had 3 per cent whilst domestic air had 7 per

cent. Some 57 per cent of all transport greenhouse gas emissions is due to passenger vehicle movements.

2. AUSTRALIA'S TRANSPORT TASKS

Passenger transport tasks are measured in passenger kilometres (pax km) where one pax km results when one person moves one km. From Table 1, we see that road pax kms are projected to increase some 38 per cent from 1990 to 2010.

Freight transport tasks are measured in net tonne kilometres (tkm) where one tkm results if one tonne of freight moves one km. From Table 2, we see that the total road freight task is projected to more than double between 1990 and 2010.

Australia's inter-capital city non-bulk land freight task was estimated by the BTRE (1999) at about 40.6 billion tonne kilometres (btkm) in 1994-95. Of this, 26.0 btkm were held by road and 14.6 btkm by rail. This report also notes that in 1979-80 road and rail had about equal modal shares (at approximately 11 btkm each); and that, based on recent trends, the road share will continue to grow faster than rail, and by 2019-20, that road will have grown to 90 btkm and rail will have grown to 26 btkm.

As noted by Treasury Secretary, Dr Ken Henry (2002), even with significant increases in the sizes and loads carried by trucks, BTRE projections would seem to imply interstate truck kilometres travelled could grow by something like 75 per cent over a 15 year period; also *"Urban car traffic is likely to grow at a much slower rate by about 20 per cent over 15 years, or 1.2 per cent a year. Including urban commercial traffic, the figure is likely to be more like 23 per cent. Even those …*

TABLE 1 AUSTRALIAN LAND PASSENGER TASKS
Billion passenger kilometres

	1981-82	1990-91	2000-01	2010-11	2019-20
Urban Road	99	139	167	197	214
Total Road	**157**	**216**	**256**	**298**	**320**
Urban Rail	6.4	7.5	8.2	9.9	11.6
Total Rail	**9.4**	**9.9**	**10.2**	**12.0**	**13.8**

TABLE 2 AUSTRALIAN LAND FREIGHT TASKS
Billion tonne kilometres

	1981-82	1990-91	2000-01	2010-11	2019-20
Urban Road	18	29	44	59	74

Total Road	**53**	**87**	**143**	**215**	**296**
Total Rail	**68**	**91**	**134**	**176**	**225**

Reference Bureau of Transport and Regional Economics (BTRE - 2002a) for road and BTRE (2003, Tables IV.6 and IV7)) for rail, where urban rail includes light rail. Note data has been rounded, and that road passenger kilometres include car and bus.

apparently relatively modest rates of growth in urban traffic raise important issues, especially of urban congestion and, of course, urban air quality. And truck traffic projections raise questions about the capacity and quality of maintenance of our highways. ***Not dealing with these issues now amounts to passing a very challenging set of problems to future generations."***(emphasis added)

3. ENERGY EFFICIENCY

For moving people in major cities, based on 1997-98 estimates, urban rail had an average energy efficiency of 0.68 passenger (pax) km per Megajoule (MJ) as compared with 0.35 pax km per MJ for urban passenger road vehicles, and 0.63 passenger km per MJ for urban buses (ACG, 2001). Note one litre of petrol on a "full fuel cycle basis" is equivalent to 34.2 MJ of energy.

The energy efficiencies are different for non-urban transport, which showed the least energy efficient mode in 1997-98 was 0.34 pax km per MJ for domestic airlines (ACG, 2001). This is followed by 0.45 pax km per MJ for non-urban passenger vehicles, then 0.86 pax km per MJ for non-urban rail and 1.06 pax km per MJ for non-urban buses. However, Australian non-urban trains in 2000-01 had an aggregate energy efficiency of about 1.06 pax km per MJ (Rail CRC, 2003) and trains with good load factors would have a higher energy efficiency than buses. The Tokaido Shinkansen operated by JR Central had an energy efficiency of about 2 pax km per MJ in 2002.

For moving urban passengers, energy efficiency varies as to loading factors. However, whereas a car is more energy efficient than a train with a few people in it, a fully laden train is five times more energy efficient than a car with one person in it. There are many reasons for this, including rail having ‘economy of size’ with larger payloads than road, a better payload to tare ratio and a steel wheel on a steel rail having much less friction than a rubber tyre on asphalt.

In addition, rail has the option of electric traction. In this case, energy efficiency can be enhanced by the use of regenerative braking.

Land freight energy efficiency is best measured in net tonne kilometres per MJ. For end use energy, one litre of diesel releases 38.6 MJ and 1 kilowatt hour (kWh) of electricity releases 3.6 MJ of energy. For full fuel cycle (FFC or primary) energy, one litre of diesel is taken as 41.77 MJ and 1 kWh varies as to power station efficiency with 1 kWh = 12 MJ in Qld. Both road and rail freight improved their FFC energy efficiency by about 20 per cent during the 1990s.

Some recent examples of average FFC energy efficiencies, in net tonne km per Megajoule (tkm/MJ), for various road and rail freight tasks include:

0.36 for rigid trucks (smaller trucks used in urban goods movement)

0.93 Articulated trucks – mostly six axle but also B-Doubles and road trains

3 ± Line haul interstate rail freight

5+ Central Queensland coal trains

12 + Pilbara (WA) iron ore trains

These iron ore trains are the most efficient trains in the world. Their superior energy efficiency and low operating costs are due to factors including improved wheel-rail interaction and longer trains. In fact, fuel use per tonne for BHP Iron Ore operations has decreased by 43 per cent between 1980 and 2000 (Darby, 2001). This was assisted by heavier axle loads using well built and maintained track with heavy rails, top class maintenance of locos and wagons, and increasing use of aerodynamically designed wagons and new generation locomotives with AC traction motors. The train consists include 4 locos and 224 wagons with 2 locos in the middle.

For road, B-Doubles and road trains, running over good quality sealed roads outside urban areas can give impressive fuel efficiencies. With B-Doubles and six axle articulated trucks operating on a much improved Hume Highway (over 80 per cent reconstructed since 1974) Melbourne - Sydney inter city road freight operations could average 1.15 net tkm per MJ.

4. SOCIAL AND POLITICAL FACTORS

There are many factors affecting the fuel efficiency of moving people. Although more fuel-efficient cars are increasingly available, people often choose to purchase either larger cars or four wheel drives. As shown by Mees (2000) the fuel consumption rate of the Australian car fleet has seen little overall improvement since the 1960s - in 1993 and in 1995, it was about 11.4 litres per 100 km. ABS (2003) notes that for the 12 months ended 31 Oct 2001, 16.4 billion litres of fuel (mostly petrol) was used to move passenger vehicles an estimated 144 billion kilometres, an average of 11.4

litres per 100 km (although it is possibly less, as the ABS estimates of vehicle kilometres are considered by some as too low).

Fuel efficiency is just one of many factors in modal choice and formulating transport policy. In response to the second oil crisis during the late 1970s, the Fraser Government moved Australia to world parity oil pricing, with a Prime Minister's statement and an Australian Transport Advisory Council (1979, pp. 85-86) report. Its findings are still relevant. *"The present modal split in transport is determined by numerous factors, including government regulation and pricing policies. As far as possible pricing and cost recovery policies should be consistent across the modes so as to encourage use of modes appropriate to particular tasks. Appropriateness may be defined broadly as minimising the total social cost of transport services, including externalities.*

"As far as possible, externalities such as airport noise, urban congestion, highway law enforcement, accident prevention and air pollution should be internalised to the transport users… This is in fact synonymous with an objective of achieving maximum economic efficiency."

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For most of the 1980s and 1990s, Governments in Australia were not too concerned about energy efficiency (or indeed economic efficiency) in transport. Indeed, State Governments were more likely to be concerned about air pollution in their State capital cities, which is now mostly due to vehicle emissions.

A further dimension to transport policy is safety. The BTRE (1995) noted that in 1993, the total cost of transport accidents was about $5.5 billion, with about 93 per cent due to road transport and the remaining 7 per cent for sea, aviation and rail. The high percentage for road is a reminder that road transport is responsible for 88 per cent of Australian domestic transport greenhouse gas emissions.

With so much at stake, one could be excused for thinking that Governments would be moved to action. Along with efforts to try to reduce road crashes - the cost of which is now (BTRE, 2000) at over $15 billion per year - there have been recent limited measures to conserve fuel such as energy labelling of cars as recommended by the BTRE (1996), and (mainly for safety reasons) 50 km/h urban speed limits.

The BTRE (1996) reviewed no fewer than 16 measures (including five 'no regrets' measures) to reduce greenhouse gas emissions in transport. The BTRE (2002b) revisited the issue, with some 11 groups of measures to reduce vehicle kilometres travelled (VKT), 9 measures to reduce emissions per VKT, 4 road pricing measures (mass-distance charges for heavy trucks, tolls, internalising transport externalities and emission charging), carbon taxes and tradable permits. Of the

policies examined, optimal road pricing was judged "…to offer the largest potential for reducing greenhouse gas emissions from transport by 2010".

5. MORE ON RAIL

In regards to intercity land freight, four federal inquiries (House of Reps 1998, 2001, PM's Rail Projects Task Force 1999 and Productivity Commission 1999) found that there is a demonstrated need to upgrade "substandard" mainline track between Melbourne, Sydney and Brisbane for Fast Freight Trains. The Federal Government's Australian Rail Track Corporation (2001) National Track Audit recommended an optimal investment package for interstate rail freight at a cost of $507 million. In July 2002, the Federal Government had committed some $110 million towards a larger $870 million package, with a view to reducing Sydney - Melbourne freight train transit times from 13.5 hours to 10.5 hours. This reduction in transit time was found by the ARTC (2001) as necessary to make rail competitive on this corridor; however such a reduction could well require a major rail deviation such as new track from Bowning to near Cootamundra at additional cost (Laird et al, 2002). A case has also been made by the Railway Technical Society of Australasia (2003) for improved passenger trains along the Sydney - Melbourne corridor and to Canberra.

With various assumptions including rail gaining a 50 per cent modal share of intercity freight, Melbourne - Sydney track upgrading with mass distance charges were found to give diesel savings of about 28 million litres per year (some 75,000 tonnes of CO2) by 2020 (Laird et al, 2002). With full track upgrading between Melbourne, Sydney and Brisbane along with the application of New Zealand level mass - distance charges for heavy trucks, the diesel savings would exceed 115 million litres per annum (over 300,000 tonnes of CO2) by 2010. On the other hand, the BTRE (2003, p53) in report no 107 with its 'business as usual' projections considered (despite completion of the Alice Springs to Darwin railway under way) *'Allowing for the possible provision of major new infrastructure during the projection period was considered by the BTRE as* ***overly speculative*** *[emphasis added] and has not been included in the analysis.'*

The NSW Government's 1998 Action for Transport 2010 statement gave an outline of major rail projects needed within the Sydney Greater Metropolitan Region to keep pace with a growing population. Due to many factors, including a lack of funding, it is now apparent that many of these projects will not be delivered on time.

Despite the problems of underinvestment in rail infrastructure, it is important to note that Australia does well with some aspects of energy efficient rail and public transport. Some examples follow.

1. Perth rescued and revitalised its urban rail system in the early 1990s, with a three fold increase in patronage over the last decade. This system is now being extended.
2. Melbourne is getting new trams and trains, plus 29 new high speed intercity train sets that are due to start in 2004 (Regional Fast Rail).
3. Queensland's Main Line Upgrade with over 120 km of new track has allowed for faster and heavier freight trains. The Queensland tilt train introduced in November 1998 between Brisbane and Rockhampton at speeds of up to 170 km per hour has been an outstanding success. The service was extended to Cairns in June 2003.
4. Sustained investment over four decades in Melbourne - Adelaide - Perth rail track has allowed rail freight companies to compete giving better service at lower prices. Rail's modal share of interstate land freight in and out of Perth is now about 80 per cent.

6. SUBSIDIES TO ROAD VEHICLE USE

In addition to large allocations to roads from the three levels of Government that now exceed $7 billion per year, there are other subsidies to road vehicle use. Estimates of these costs, per year for recent years (Laird, Newman et al 2001), as updated to include a greenhouse gas emission cost, automobile industry assistance (Productivity Commission, 2002), and a higher estimate of environmental costs (Bus Industry Confederation, 2001), follow:

- at least $12 b in road congestion costs
- at least a $7 b 'gap' in road crash costs
- a $3 b tax refund (to cover over $12 b of motor vehicle expense)
- a $5 b environmental cost (air pollution and noise)
- a $1.7 b greenhouse gas cost (at $25 per tonne cf $NZ 30 per tonne)
- a $0.7 b non-tariff automobile industry assistance
- a $0.5 b Queensland fuel subsidy

In addition, there is an estimated increased health cost of lack of physical activity due to excessive car use of about $0.8 b per annum in Australia (Mason,2003).

Road vehicle specific revenues to Government in 1997-98 were about $12 billion. Hence, excluding congestion costs, a case can be made that there is a 'road deficit' that now exceeds $12 billion per year.

In the 25 years from 1974 to 1999, the Federal Government allocated $18 billion to the National Highway System, and $25 billion on other roads (a total of $43 billion) in 1999 terms (Laird, Newman et al 2001). Less than $2 billion was allocated to rail capital works, and about $1.5 billion to urban public transport.

Moreover, in eight Howard-Costello budgets, over $10 billion has been allocated to roads, with the amount actually invested in rail capital works over this time equal to about 1 per cent of the road funding, with very little to public transport.

This is in contrast to Federal support by the Whitlam, Fraser, Hawke and Keating Governments for public transport, and funding of mass transit in the United States. Under the 1998 US Transportation Equity Act, about 20 per cent of United States land transport funds are allocated to mass transit or urban public transport. This pattern was set by the US 1991 *Intermodal Surface Transportation Efficiency Act 1991* whose objectives included to *"...reduce energy consumption and air pollution while promoting economic development."*

Whilst one would have expected most Federal land transport funding in Australia to go to roads, a more balanced approach is warranted.

7. EXPRESSIONS OF CONCERN

Various Non-Governmental Organisations in Australia have expressed some concern about transport policy. The Chartered Institute of Transport in Australia is a conservative body that found it necessary to issue a sternly worded statement at their 1998 National Symposium. This was about the oil situation and in order to warn the government, industry and the general public:*"Our greatest ever source of cheap energy may soon contract and the 'Petroleum Age' in which we live now can be seen to be approaching an eventual end.*

The Symposium heard that a clear consensus is emerging that cheap oil production outside the Middle East will begin permanent decline around the year 2000, to be followed by permanent world decline within 15 years.

We have reached a crucial stage in the development of our local, national and international transport services. Our present path is leading us into potentially serious economic, social and environmental problems. New directions are needed for our future transport fuels and vehicles.

'More of the same' in our current transport plans and ways of thinking is no longer tenable. ..."

The Institution of Engineers, Australia (1999) is another conservative group. It found that we have major problems in major cities, and that there is a clear need to respond to the challenges. These include a change in taxation and fiscal policy instruments so as to encourage sustainable transport. At present, these measures encourage car and truck use.

There is also a strong case for increased investment in transport infrastructure that is more sustainable and less greenhouse gas intensive. Where market forces fail, government should intervene.

Most State Governments have introduced some initiatives to try to reduce automotive dependence. Along with supporting public transport, recent initiatives include parking levies in Sydney and Perth with some proceeds to improve public transport, Travel Smart and Travel Blending programmes in SA and WA, and in 2003, the WA Government introduced a Sustainable Transport Energy Programme (STEP).

Greenhouse and Transport was carefully addressed by a Senate Committee chaired by Senator Lyn Allison. The Committee's 2000 report "The Heat is On" had 105 recommendations. Of these, no fewer than 21 addressed transport. However, only four of these 21 transport recommendations received the full support of the Federal Government (AGO website, 2001), with a further 11 recommendations being considered as already supported, or addressed, through existing measures.

Even the Federal Government has recognised a need for change in its new integrated transport policy called 'Aus Link'. ***"We cannot go on this way. We have to make changes now."*** So said Acting Prime Minister Anderson on 21 May 2002 when announcing the new 'AusLink' plan. Here, Mr Anderson was finally echoing a central finding of the National Transport Planning Task Force (1994) some eight years ago ***'Perpetuation of existing arrangements will condemn the nation to ineffective results'***

In November 2002, the Federal Government issued a Green Paper on AusLink. In response, over 550 submissions were received. A common concern with State and Local Government was the potential reduction in road funds for both the National Highway System and local roads. There was widespread support for an improved interstate rail system, and some support for both road congestion pricing and for the Commonwealth to take more interest in urban public transport. A White Paper is now due by the end of 2003. With suitable modification of the present plan, it could be a much needed new approach.

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A Ten Point Plan (Laird, Newman et al, 2001) proposed, in summary:

1. Stronger road safety measures including shifting some freight to rail.
2. Cleaner urban environment and reductions of transport greenhouse gas emissions
3. All government 'road funds' to be replaced by 'transport funds'.
4. All cities need CBD parking levies with proceeds used to improve public transport.
5. All States need to ensure that their capital cities use congestion tolling.
6. Increase the aggregate level of road cost recovery from heavy vehicles.
7. Improve the level of public debate on transport issues.
8. World best practice urban public transport in major urban areas.
9. Reduce federal taxation benefits for cars and allow urban public transport tax benefits.
10. Establish a National Bureau of Transportation Statistics to provide better transport data.

If one considers that ten points are too many, the European Community 2001 White Paper on Transport has about 60 points. Their transport use is much more sustainable than Australia's.

In addition, Switzerland is even further advanced, and has a 30 billion Swiss Franc Rail development fund to upgrade existing lines as well as build two very long rail tunnels to improve international freight flows. The Swiss Fund, which resulted from a citizens-initiated referendum, has four revenue streams. The largest, at 45 per cent, is a kilometre tax on all heavy trucks. The other sources of revenue are increased fuel excise and GST, plus loans.

New Zealand has also moved to more sustainable transport options, with 2002 initiatives including increasing petrol excise by some 4.7 cents per litre (as opposed to cuts in fuel excise in Australia in 2001), with proceeds going to public transport and rail as well as roads. Further initiatives were replacing road funds by transport funds. As seen by Transport Minister Paul Swain (media release 3/12/02) the New Zealand Transport Strategy " … aims to ensure that transport can contribute to the government's objective to return New Zealand's per capita income to the top half of the OECD, while also improving our communities and environment."

8. CONCLUSION - REDUCING TRANSPORT EMISSIONS

Given that transport GHG emissions increased by 24 per cent between 1990 and 2000, is it possible to secure a reduction of transport greenhouse emissions in Australia ?

Business as Usual - There is no doubt that another decade with "Business As Usual" or BAU will see transport GHG's increase. This increase will occur even with an ongoing improvement in the energy efficiency of passenger and freight transport tasks. However, in line with the Treasury analysis (Henry, 2002) the increase between 1990 and 2008-12 may not quite be 48 per cent.

Target - We have noted that in 2000, transport greenhouse gas emissions were about 4 tonnes per capita. Of this, 3.6 tonnes were for land transport and 0.4 tonnes were for air and sea. This compares with an average of 1.9 tonnes per capita in Europe in 1997 for land transport (International Energy Agency (2000, p104) noting 373 million people's land transport resulting in 723.7 million tonnes CO2). If, by 2010, Australia was able to move half way between recent EC levels and Australian levels of land transport greenhouse emissions to some of about 2.75 tonnes per capita by 2010 for land transport and kept air and sea emissions at current levels, and allowed for a population of 21 million by 2010, total transport emissions would be about 66 million tonnes. This would mean near achievement of a goal of no more than an 8 per cent increase on 1990 levels (of 61 million tonnes).

How do we do it - This reduction in average per capita greenhouse gas emissions could be achieved if there is road vehicle demand management with improved road pricing and if growth in passenger and freight tasks is picked up by more energy efficient modes. The energy efficiency figures cited above show that bus and rail were more energy efficient than cars and planes for passenger movements, and that rail is more energy efficient for bulk and/ or longer distance freight movements.

Given that transport GHG emissions increased by 24 per cent between 1990 and 2000, is it possible to secure a reduction of transport greenhouse emissions in Australia ?

A more realistic scenario would be to have road vehicle demand management and where growth in passenger and freight tasks occur, assume that it is picked up by the more energy efficient urban public transport and rail. We have already noted that the BTRE (1996, 2002b) have proposed many measures to reduce transport greenhouse gas emissions.

Further support is given in a National Strategy for Lowering Emissions from Urban Traffic and a National Action Plan, as approved by the Australian Transport Council in August 2002. To quote from the communique for this meeting: *The Strategy and Action Plan developed by the National Transport Secretariat in collaboration with all states, territories and the Commonwealth government provides a groundbreaking national approach to reducing greenhouse emissions from the*

transport sector. This includes, within the next 5-10 year 'programs that encourage people to take fewer trips by car' and transport 'from predominantly fixed to predominantly variable costs' to '… ensure that transport users experience more of the true cost of their travel choices.'

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