GREEN ECONOMICS

How much society saves by substituting bicycle trips for short car trips

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Urban passenger transport is very expensive and generates large hidden costs through accidents, pollution, noise, congestion and greenhouse gas emissions. In this article, ALAN PARKER quantifies the potential social cost savings from increased bicycle use.

IN AUSTRALIA, funding to build new bicycle infrastructure is inadequate and always will be unless the costs are known and the economic benefits proven to politicians. In the past, the benefits of cycling could not be established because the social costs of urban car use were not reliably quantified. A welcome new development is that the health costs of air pollution, costs of time lost through road congestion, the costs of noise effects and even some provisional costs for greenhouse gas emissions have been quantified in reputable studies. Furthermore, the prestigious British Medical Association has established that the health benefits of cycling are greater than the accident costs.

The hidden (or external) costs of driving in Sydney, Melbourne, Brisbane, Adelaide and Perth are around $4,000 per year, so the cost savings to society of substituting bicycle trips for short car trips are high (59c/km.) The net benefit of substituting one billion single-occupant car-km with one billion bicycle-km is around $600 million a year. So there is an economic case for the Federal government investing a billion dollars on bicycle infrastructure over ten years.

World best practice: The Dutch model

In the Netherlands, which has a similar urban population to Australia, the national government's $1.5 billion investment in bicycle infrastructure has been very profitable, reducing transport costs and social costs. The Dutch have reduced car travel but, more importantly, they have lowered the proportion of extremely polluting, fuel wasting, short car trips with cold engines.

Millions of Dutch householders use bicycles to avoid the purchase of second or third cars and, if carless, are better able to get by. Indeed, by integrating the bicycle into the transport system and substituting bike trips for many short single-occupant car trips, they are making better and cleaner use of their car fleet.

The Dutch did this by building close-knit urban bikeway networks of finer mesh than the arterial road network, providing safer main-road cycle crossings, providing secure bicycle storage and not discriminating against bicycle users in transport planning as has happened in most Australian states until very recently. A comparison of the existing and planned percentage bicycle trips, made in the Netherlands and Australia is shown on figure 1.

One of the most interesting studies of both the hidden (external) cost of motoring and the hidden benefits of bicycling was an evaluation in 1988 of urban policies practised in the Dutch city of Groningen. (Krommendijk 1988). Groningen has 240,000 inhabitants and, for 20 years, has

FIGURE 1: How trips are made in the Netherlands and Australia

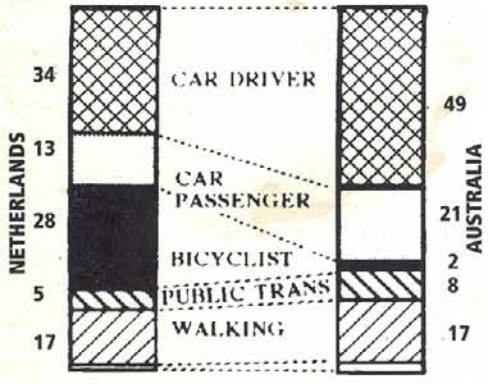
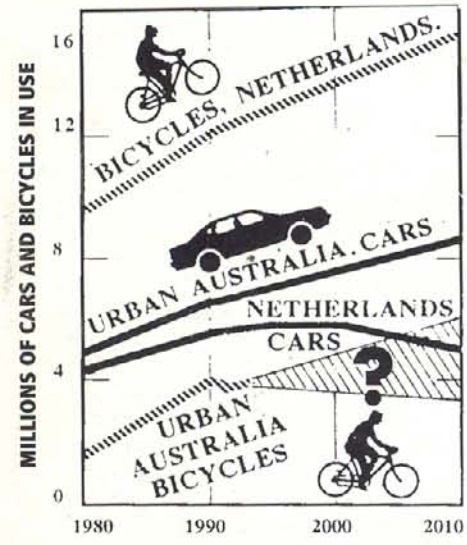


FIGURE 2: Vehicle fleets



given priority to public transport and bicycling, more recently banning cars in its central area. Furthermore, it restricts long-term car parking and suburbanisation while concentrating employment around or near public transport interchanges.

Per capita greenhouse gas emissions from transport are only a third of those in Australian capital cities. The 1988 study estimated that people who used a bicycle to replace short car trips saved the city $405 each per year in hidden (external) costs.

Today 50% of Groningen commuters cycle to work. People not only enjoy cycling but understand that it adds to the quality of urban life (Johan 1993). For example, bicycle use enabled a giant car parking lot to become a town square. A traffic jammed street was turned into a popular open air marketplace. High quality apartments in traffic-free precincts have been built on former highways. Cities all over the Netherlands are successfully following the Groningen example, and so should Australia.

Back in the 1970s, the Netherlands began enhancing its bicycle infrastructure, spending up to 10% of the road budget on bicycle facilities (**Cyclist** October—November). Today, with petrol at $1.45/l, car users pay more towards motoring's hidden costs.

The need to make better use of the urban car fleet

Per capita, Australia's urban car fleet uses nearly twice the resources, creating twice the pollution and greenhouse gases as the Netherlands' fleet. In Australia, while most new small cars are fuel efficient and less polluting than ever, we choose bigger, older, dirty cars and use them too much in the wrong places at the wrong time.

Trends indicate that, by the year 2005, around 30% of all car trips will be less than 5 minutes' duration. These are the most inefficient trips, so the volume and toxicity of emissions will increase. The average Aussie urban motorist produces 4.9 tonnes of carbon dioxide a year, one of the highest per capita emission rates in the world.

Yesterday's health problem was airborne lead; tomorrow's problem will be microscopically small airborne particles from three sources — exhaust pipe, tyre wear and brake wear. These particles will carry hydrocarbons, carcinogenic chemicals and asbestos deep into people's lungs (Bown 1994). By 2005 the volume of these small particles will greatly increase.

The most recent estimates made in the US by the EPA (Bown 1994) show that 60,000 people die prematurely each year in USA as a result of small airborne particles. That equates to around 4,000 premature deaths each year in Australia.

The weight of the combustion excreta from the average car over the 12 years of its life is shown on figure 3.

Sydney is the worst environmentally affected city in Australia. Sydney when viewed from Manly on many days is shrouded in a brown cloud of car exhaust. Air pollution in Sydney's western and southwestern suburbs regularly exceeds World Health Organisation danger levels and photo-chemical smog is likely to exceed Los Angeles' levels within 10 years. Other Australian cities are spending billions on traffic-generating road works to catch up with Sydney.

Calculating social costs of urban driving

Adding the external costs to personal costs of driving gives total social cost of driving. Motorists in rural areas are not creating as much congestion or noise nuisance and exhaust pollutants are dispersed, so more of the external costs they incur are covered by charges and taxes. The external costs of urban driving are very high and increasing. Overseas studies of external costs of urban driving in USA and Europe using different estimation methods for costs of pollution, accidents, noise, congestion, indirect subsidies of parking and roads, show car owners being encouraged to overuse their cars by a subsidy of about $5,000 each per year.

The Victorian (VTES 1994) and Western Australian (Laube and Lynch 1994) transport externalities studies show that the external costs are around $4,000 car per year

FIGURE 3
The average car exhaust excreta (12 years)

Carbon dioxide. (GHG)	53.3 tonnes
Carbon monoxide	3.3 tonnes
Hydrocarbons	450 kg
Nitrogen oxides	351 kg
Methane (GHG)	47 kg
Particulates	26 kg
Lead	17 kg
Sulphur dioxide	11 kg
Nitrous oxide (GHG)	7 kg

Note: GHG = greenhouse gas.

FIGURE 4
Social costs of the average urban car (cents/km)
Hidden + Running = Social

Casualty accidents	6.2
Property accidents	7.8
Arterial road noise	0.3
Pollution. Cancer/Health effects	0.5
Time lost due to congestion	10.0
Carbon dioxide emissions	1.1
Total hidden (external) cost	**25.9**
Depreciation, Interest, Insurance and Licence	34.28
Operational; Tyres, Repairs, etc	6.02
Petrol & Oil	7.20
Total running costs	**47.5**
TOTAL SOCIAL COST OF DRIVING	**73.4**

Sources: Hidden costs from VTE Study, Volume 4.
CO_2 at $30 per tonne which is on the low side of a range of estimates, (Pearce 1990).
RACV estimates of a Toyota Camry 2.0 litre automatic that travels 15,000 km per year for the first five years of its life. This car is near to the theoretical fleet average for Melbourne.

in major Australian cities. However, what all these studies have in common is that the external costs over the 12-year life of the average car exceed its initial purchase price. The Australian urban car fleet of 6.9 million vehicles is subsidised by between $17 and $25 billion. An economic consequence is the premature draining of offshore oil reserves which may soon cost Australia dearly as oil reserves run out.

The Victorian Study contains data that can be used to calculate hidden costs of the statistically average Melbourne car in cents per km in 1994. The social costs of urban driving are summarised on figure 4.

Figure 4 specifically applies to car use in Melbourne but similar costs will apply for Sydney, Brisbane, Adelaide and Perth where travel distances are longer and the external costs are higher per car than in provincial cities. For provincial cities of less than 400,000 population, assume that the total external costs are only around 10c/km.

The largest external cost on figure 4 is the 10c/km for congestion which is predicted to increase exponentially because of the self-defeating cycle of building new urban freeways and road tunnels, which will predictably generate more and more demand for road space. What actually happens is that after a few years the roads fill up with cars and become just as congested as they were (Laube and Lynch 1994.) The collective share of the transport task filled by public transport, walking and bicycling will continue to decline.

Other unaccounted hidden costs of cars

In addition to the combustion excreta (Figure 3) and the external costs of motoring (Figure 4), there are other unaccounted costs associated with the complete life-cycle of the car from its manufacture to its final disposal.

The average car produces 70.1 tonnes of carbon dioxide over its life, 16.8 tonnes more than comes out of the exhaust pipe. Before a car is used, 10.8 tonnes of carbon dioxide and 1.5 tonnes of factory waste is produced from car manufacture and the processing of over a tonne of metal, plastic and glass in each car. Another 6 tonnes of carbon dioxide is produced by servicing the average car, repairing it and disposing of it. This is such a large amount because 35% of cars are damaged in road accidents during their life. Indeed, in Victoria one in every 267 cars kills a human being, one in every 60 permanently handicaps a person and one in every 7.3 causes personal injury. No estimates exist for greenhouse gas and pollutant emissions from road building and maintenance but they must be considerable.

Oil drilling and extraction, refining and distribution of the petrol produce oil and gas leakage, evaporation and energy use at every stage from sinking an oil well right through to spillage at the petrol pump that are responsible for at least 3 million tonnes of carbon dioxide emissions in Australia. There are also methane and benzene emissions which add to urban air pollution. During its brief life the car will produce hundreds of litres of waste oil and brake fluids and great volumes of contaminated water from car washes. Forty percent of the car fleet has air conditioners, most of which leak ozone-depleting CFCs.

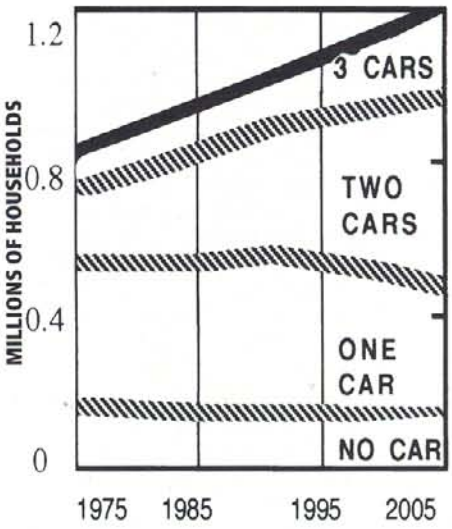
Motor vehicle related services provided for out of general taxation include traffic policing, emergency services, and street lighting. The costly armed forces exist largely to protect Australian oil resources and easily destroyed targets such as oil refineries. The average urban car is responsible for around 800 square metres of land under tarmac or concrete for roads and parking, four times more than in Europe. Around 13% of Australia's best agricultural land lies beneath roads. Clearly the estimate of the bicycle's cost saving on chart 3 is a very conservative estimate.

FIGURE 5.
SOCIAL COST SAVINGS OF BIKE TRIPS REPLACING DRIVER-ONLY CAR TRIPS
COSTS, 1994 YEAR, IN CENTS/KM

Car external costs	25.9
Car running costs	47.5
TOTAL SOCIAL COST	**73.4**
Bicycle depreciation	5.2
Bicycle repairs, etc	8.6
Health benefits less costs	0.0
BIKE TOTAL COST	**13.8**
SOCIAL COST SAVINGS	**59.6**

Note: Assumes 1,500 bicycle km per year, & that the use of the bicycle enables a car to be dispensed with in a multi-car household

FIGURE 6: MELBOURNE HOUSEHOLDS & CAR OWNERSHIP, 1975 TO 2005



The hidden social and health benefits of cycling

In 1992 the personal health costs of a motorised and sedentary lifestyle were analysed and health benefits of regular cycling were reliably estimated by the British Medical Association. Regular bicycling, even at low to moderate levels, can reduce the risk of coronary heart disease, stroke and other chronic diseases. The BMA found that the life years gained from the health effects of bicycle exercise were greater than the life years lost due to road accident injuries or fatalities (BMA 1992, CTC 1993). The cyclist death rate per 100,000 km in the UK was 3.7 in 1992 and 1.8 in Australia in 1993, so, whatever the health benefits in the UK, it could be argued that there will be twice the health benefits in Australia. However, I have conservatively costed the health benefits as merely cancelling out the accident costs.

There are other external health benefits due to reduced health care costs and a contribution towards greater functional independence in later life. Replacing short, polluting car trips saves more than the 0.5 cents/km health costs shown on Figure 6. The real cost is probably about 2c/km for short trips on a cold engine, which shows the total cost saving to be very conservative.

Bicycle economics is about the health benefits for cyclists and the social benefits of using bicycles to make better use of the car fleet and reducing fleet size. The sizes of urban bicycle and car fleets shown on Figure 2 suggest that, if we assume that a bicycle has half the life of a car, the size of the bicycle fleet is at least two thirds that of the car fleet so the opportunity is there for many people to choose to ride a bicycle if they wish.

Figure 6 shows the number of Melbourne households and the growing proportion with two or three cars. This trend continues despite the reduction in average household size from 3.47 persons in 1966 to 2.81 persons in 1991. Similar trends can be seen in other cities. Nearly half of all households consist of only one or two people.

The proportion of households without a car will increase due to the increasing age of the Australian population — those who cease to drive due to health or road safety regulations will need alternative means of transport. Current trends will greatly restrict old people's mobility and access to basic services. In the Netherlands the elderly have the option of riding a bicycle in comparative safety — an important consideration since by 2030 there will be 5 million Australians over 65 years of age compared to 2 million today.

Figure 5 shows that when bicycle trips substitute for car trips it saves society 59.5 c/km. The assumption is that nearly all the cost savings comes from car-owning households. For example, in Melbourne, 11% of households have three or more cars, 35% of households have two cars and 38% have one car and only 13% of households have no car. The current trends for multiple car ownership are shown on figure 8.

The social cost savings will mostly result from 84% of the car owning households using bicycles to stretch the usefulness of the motor vehicles they own to avoid the purchase of another car.

Only a small proportion of the cost saving will come from the 13% of households without a car who use bikes by choice or out of necessity. If one person in a household cycles, it is often enough avoid the purchase of another car, especially if it is a commuter trip direct to work or to access the rail network. If children cycle to school and to most of the other places they want to go, a chauffeur vehicle is not needed by the parents. There will also be cost saving due to the adoption of a more bicycle-oriented lifestyle where people choose to do more things within bicycle range because they like cycling.

The 59.5c/km cost savings can be best realised by learning from the Netherlands where in-depth behavioural studies of motorists have found that 41% of under-10-minute car trips are replaceable by bicycle and they intend to greatly increase the substitution of car trips by bicycle trips (Louisse 1992). Figure 7 shows my estimate of the potential for substituting car trips of different durations in Melbourne which will be similar for other Australian cities.

The major Australian cities are changing to become multi-centred metropolises with multi-directional transport flows. These trends are likely to increase the dominance of the car to move people. In the Netherlands the problem of decentralisation is partly overcome by recognising that the bicycle can improve access to fixed track vehicles (**Cyclist** October—November 1993) and is a competitor with the car for short trips.

The polluter must pay

The level of bicycle facility funding and federal government provision for cycling is a pathetic joke. It is symptomatic of a sick fuel pricing and transport planning system which greatly encourages inefficient behaviour by able-bodied motorists while discouraging cycling. Traffic conditions grow more stressful for cyclists in the bigger cities and where bicycle-safe main roads are few and far between.

The benefits of building up bicycle infrastructure so that by the year 2010 there would be several billion more bicycle kilometres ridden each per year would be in the order of $600 million per billion bicycle km. The potential cost saving runs into $billions. Clearly allocating the equivalent of 10% of the urban roads budget to building up a dense and continuous network of bikeways as was done in the Netherlands would be a very profitable investment.

Unfortunately the government is doing the very opposite, clearly giving motorists the wrong price signals which encourage people to consume more car kilometres, buy bigger cars and to develop our cities in a space and energy greedy way. A basic principle in environmental economics is that the polluter should pay for both the costs of pollution and the means of preventing future pollution. To apply this principle the federal government should put a levy of two cents on every litre of petrol, with the specific purpose of encouraging bicycles to be used instead of cars for short trips. This levy would raise $205 million a year for urban bicycle facilities and programs. The Federal Government should also establish a national bicycle planning group to ensure that the states spend the funds available.

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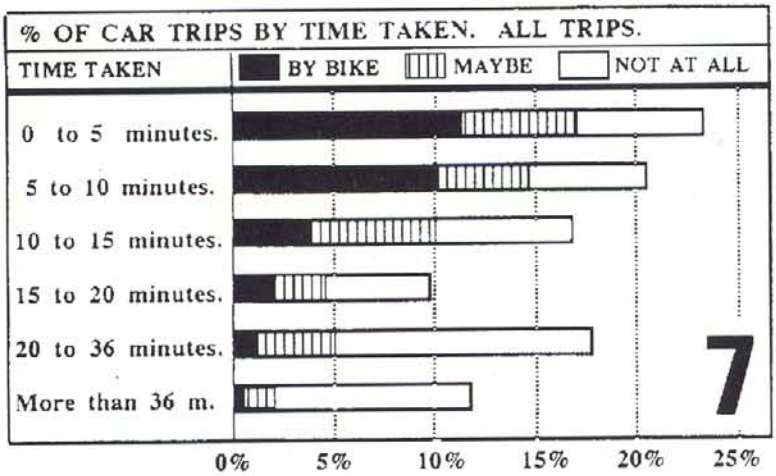
FIGURE 7: THE POTENTIAL TO USE BICYCLES INSTEAD OF CARS IN MELBOURNE



PERCENTAGE OF CAR TRIPS IN MELBOURNE METRO AREA