Harmonising Transport Policy to Pursue Economic, Environmental and Social Objectives.

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Abstract:

It has long been recognised that motorists do not directly pay for the full environmental and social costs of their travel. To date, however, Australian research into the scale of these costs has been somewhat limited. Moreover, the work that has been undertaken has tended to rely on overseas, rather than local data. Work undertaken as part of the Victorian Transport Externalities Study (VTES), and upon which this paper is based, seeks to redress this shortcoming.

This paper presents estimates, in monetary terms, of the costs of transport noise, the impacts on human health of motor vehicle emissions, and the costs of traffic congestion and accidents. Whilst it is acknowledged that a high degree of uncertainty is involved in making these estimates, the results indicate that, despite the uncertainty, the costs are substantial exceeding $6 billion per year in Victoria.

The paper also provides an assessment of the contribution of land-based transport in Victoria to emissions of carbon dioxide - the major transport greenhouse gas, and presents an evaluation of strategies for reducing these emissions. Importantly, it is found that, to a significant extent, the implementation of these strategies will not involve a trade-off with the economic well-being of the community. It is shown that carbon dioxide emissions can be reduced by around 16% (compared with projected levels in the year 2005), at no financial cost. It is only reductions beyond this level which impose a cost on the community.

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1. INTRODUCTION

The final report of the Ecologically Sustainable Development Transport Working Group (1991) noted that the major impediment inhibiting a move towards more ecologically sustainable transport, is the fact that transport users do not pay the full costs resulting from their use of transport services. The report concluded that the adjustment of transport prices in all modes towards levels that account for *full economic, social and environmental costs*, is likely to be an important component of a strategy to ensure that transport is provided in a way consistent with the principles of ecologically sustainable development.

Somewhat earlier, in its inquiry into road user charges and vehicle registration, the Inter-State Commission (1990) attempted to estimate the monetary value of a range of the social and environmental costs of transport. It concluded that taking these costs into account might increase road transport costs by between 12 and 100 per cent

It was against this background that the Environment Protection Authority (EPA) and the Bureau of Transport and Communications Economics (BTCE) sought to investigate the "hidden" social and environmental costs of transport in Victoria. It is the findings of this investigation, as reported in the Victorian Transport Externalities Study (EPA, 1994), which provide the basis for this paper.

Results from the Victorian Transport Externalities Study confirm that the "hidden" costs of transport are substantial. Importantly, the Study also concludes that attempts to address these costs need not always result in a trade-off with the economic well-being of the community. The view that such trade-offs are inevitable, fails to account for opportunities to implement policies which address the environmental and social impacts of transport, while simultaneously generating a *financial return* to the community.

As with any area of public policy, transport policy-makers must strive to achieve a balance between competing objectives. This paper shows that striking a balance is made easier by the fact that, to a significant extent, environmental and social objectives can be pursued in a manner which complements, rather than conflicts with, the economic goals of society

Structure of the paper

This paper is structured as follows

Section 2 outlines the concept of transport externalities and presents estimates, for Victoria, of the monetary value of the impacts of road traffic noise, road accidents, traffic congestion, and the health effects of motor vehicle-sourced ozone (photochemical smog) and toxic emissions

Section 3 discusses transport emissions of the greenhouse gas - carbon dioxide (CO_2). It is the build-up of greenhouse gases in the atmosphere that is expected to lead to a significant warming of the earth's climate. The discussion indicates that, because of

uncertainty regarding both the nature and scale of the impacts of global warming, it is impossible to estimate the monetary value of the external costs associated with CO_2 emissions

Section 4 uses the example of measures to reduce greenhouse gas emissions to support the proposition that it is possible to redress the environmental and social impacts of transport, whilst simultaneously promoting economic objectives.

2. TRANSPORT EXTERNALITIES IN VICTORIA

The concept of externalities

The law of supply and demand is central to the study of economics. A basic tenet of this law is that demand for a product is a function of its price - the higher the price, the lower the demand. A corollary of this is that if a product is *underpriced*, demand for that product will be greater than would be the case if it were priced 'correctly'.

A major cause of underpricing is the existence of external costs (or *externalities*). An external cost is a cost which is paid for, not by the people who cause it, but by others who have nothing to do with causing it. Because they are 'paid for by others', external costs effectively are *hidden costs*, and because they are hidden, they are often simply ignored

Transport externalities - a cause for concern?

It is difficult to think of any area of economic activity which does not give rise to external costs. The question which naturally arises, therefore, is whether transport externalities should be regarded as a cause for concern. The answer is an unequivocal *yes*

As outlined above, the failure of prices to reflect external costs results in the underpricing and overconsumption of transport services. This in turn leads to more resources being used in providing these services, and to higher levels of environmental and social impacts, than would occur case if transport users were required to pay full costs.

Furthermore, if, as is likely to be the case, the level of external costs varies between modes (eg the external costs of road transport may be higher than for rail transport), competition between modes will be distorted. A mode with high external costs will receive an unfair advantage over modes with lower external costs, due to the fact that relative price levels do not reflect this cost differential.

Estimates of the external costs of transport in Victoria

The Environment Protection Authority recently published the Victorian Transport Externalities Study (EPA, 1994). The study provides estimates of the monetary value of selected environmental and social impacts of transport - a summary of these estimates is presented in Table 1. A few precautionary comments should be noted

First, because of the uncertainties involved, the estimates in Table 1 are best regarded as indicative, rather than definitive The problem posed by uncertainty in making estimates of the monetary value of external costs is well exemplified by Figure 1, which outlines the steps involved in estimating the monetary value of the health impacts of motor vehicle emissions. It can clearly be seen that uncertainty is a difficulty encountered at each stage of the estimation process.

Second, while estimates of the costs of road traffic noise, and the human health effects of motor vehicle-sourced ozone and air toxics, are *external* costs, the estimates relating to accidents and congestion represent *total* costs A proportion of the costs of accidents and congestion are borne by those who cause them - that proportion is therefore regarded as being an *internal*, as opposed to an external, cost Due to limitations in respect of data and study budget, the Victorian Transport Externalities Study was unable to assess the proportion of the total costs of accidents and congestion that are external.

Third, a different geographic focus is considered for the different impacts. While the cost of accidents is estimated for the whole of Victoria, the estimated costs of congestion, and the health impacts of ozone (photochemical smog) and air toxic emissions from motor vehicles, are for the Melbourne metropolitan area only. In the case of road traffic noise, cost estimates relate to only the arterial road network in Melbourne

Despite these limitations, the results presented in Table 1 represent an important advance in the assessment of transport externalities in Australia In particular, the Victorian Transport Externalities Study provides the first systematic attempt to estimate the cost of transport externalities using *local data*.

Table 1 Estimated monetary value of selected environmental and social impacts of transport in Victoria ($1992)

Selected Impact		Estimated Annual Cost ($ million)		Comment
Road Traffic Noise in Melbourne		43 to 86		Estimate is based on 1988 traffic volumes. The estimate relates to the cost of noise levels in excess of 63 dB(A) on arterial roads in Melbourne.
Effects on human health of motor vehicle-sourced ozone (photochemical smog) in Melbourne	1988/89	*"low"*	0.8	The Victorian Transport Externalities Study presents "low", "central" and "high" estimates for each year from 1986/87 to 1992/93. This range (i.e. "low" to "high") reflects the uncertainties involved in estimating the health effects associated with air pollution. There is significant variation between years as a consequence of meteorological variability. The estimates for 1988/89 and 1991/92, the "worst" and "best" years over the study period, are presented here to highlight this variability.
		"central"	5.7	
		"high"	10.9	
	1991/92	*"low"*	0.01	
		"central"	0.08	
		"high"	0.1	
"Excess" cancers due to toxic emissions from vehicles in Melbourne		26 to 45		Estimate relates to 1990 emissions levels.
Road accidents in Victoria		4,000		Estimate based on 1988 accident statistics. The estimate of $4,000 million represents the *total* cost of accidents. The Victorian Transport Externalities Study does not isolate that component of the total cost of accidents which is *external*.
Traffic congestion in Melbourne		2,000		Estimate based on 1991 traffic volumes. The estimate of $2,000 million represents the *total* cost of congestion. The Victorian Transport Externalities Study does not isolate that component of the total cost of congestion which is *external*.

Source: EPA (1994)

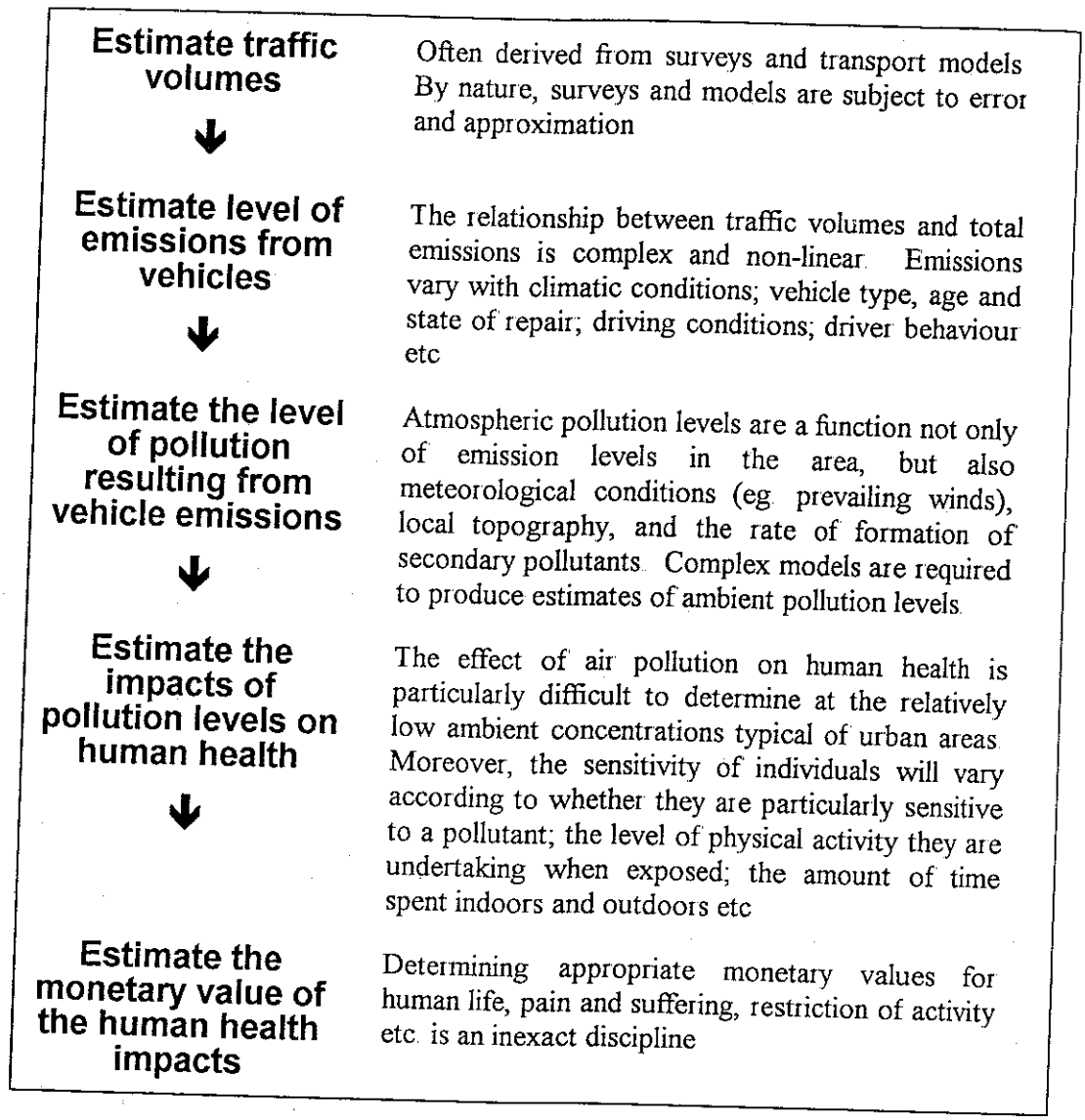


Figure 1 Process for estimating a monetary value for the health impacts of motor vehicle emissions

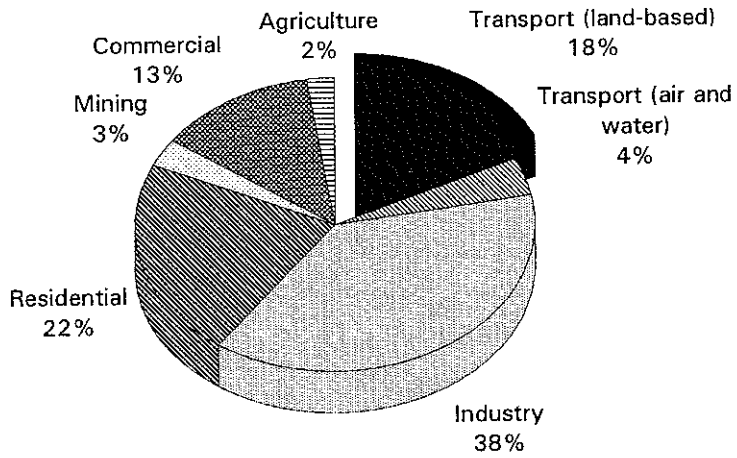
3. TRANSPORT AND GREENHOUSE GAS EMISSIONS

In recent decades, accumulating evidence has indicated that human activity has markedly raised the concentration of greenhouse gases in the atmosphere Transport, through its consumption of fossil fuels, is a major contributor to the build-up of these gases The increased concentration of greenhouse gases will *enhance* the natural greenhouse effect and is expected to lead to a warming of the earth's climate

Estimating the cost of the impacts associated with the enhanced greenhouse effect is highly problematic While there is general agreement as to the existence of this effect,

there is considerable scientific uncertainty regarding both the scale of global warming and the regional impacts it is likely to bring about Therefore, no attempt was made as part of the Victorian Transport Externalities Study to estimate the external cost of global warming resulting from greenhouse gas emissions from transport Rather, effort was directed to estimating the (physical) contribution of land-based transport in Victoria to the emission of carbon dioxide (CO_2) - the major greenhouse gas - and to analysing the cost-effectiveness of a range of strategies for reducing transport CO_2 emissions (see Section 4)

Figure 2 shows that land-based transport is responsible for nearly 20% of total CO_2 emissions in Victoria

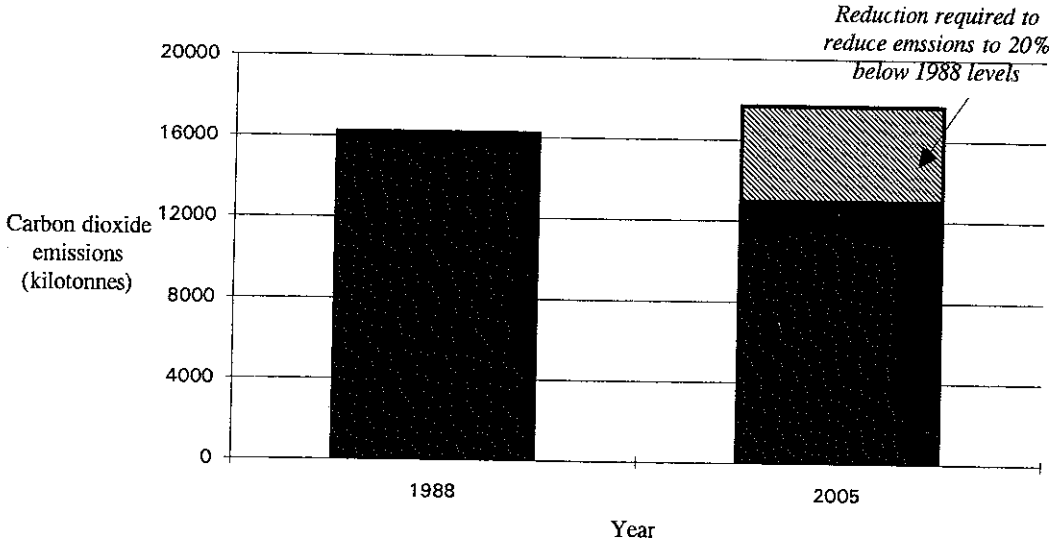


Source: EPA (1994)

Figure 2 Victorian CO_2 emissions by sector - 1988

In line with international efforts to reduce greenhouse gas emissions and mitigate the effects of global warming, the Australian government has adopted, as an interim planning target, an objective to reduce greenhouse gas emissions to *20% below 1988 levels by the year 2005* While this objective applies to aggregate emissions from all sectors of the Australian economy, its pro-rata application to land-based transport in Victoria would necessitate a reduction in CO_2 emissions of *27% compared with projected emission levels in 2005*

The level of CO_2 emissions in 1988 and their projected level in 2005, along with the reduction in emissions required to achieve the pro-rated interim planning target, are depicted in Figure 3



Source: EPA (1994)

Figure 3 Projected CO_2 emissions from land-based transport and reductions required to achieve a pro-rata share of Australia's interim planning target

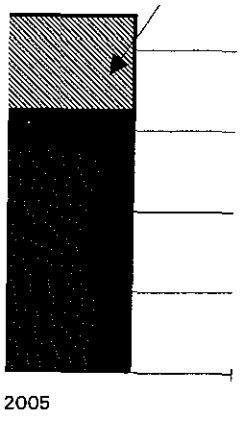
4. HARMONISING TRANSPORT POLICY - THE CASE OF GREENHOUSE GAS EMISSION REDUCTIONS

The objective of policy

According to economic theory, the objective of policy is to implement control measures so as to reduce externalities to the *optimal* economic level The optimal level of control occurs where the marginal (or incremental) benefits equal the marginal costs of control This concept is explained in Appendix 1.

Determining the optimal level of control in practice, however, is more difficult than theory might suggest As discussed above, an important cause of this difficulty is the uncertainty involved in estimating the costs and benefits of measures to control externalities.

In the absence of a precise knowledge of marginal costs and benefits, it is not possible to determine the optimal level of control Consequently, policy-makers must make a decision as to what constitutes an *appropriate* level of control, by reference to a range of information This may include scientific assessment of the levels of environmental impact that are ecologically sustainable; public opinion as to what levels of environmental and social impact are acceptable; and the costs involved in bringing about different levels of control over an externality As it will not always be possible to achieve a consensus of opinion, policy-makers often will be required to make decisions which strike a balance between different views, and between different objectives.



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The key issue, of course, is the extent to which different objectives are in competition. The following discussion of measures to control greenhouse gas emissions from transport suggests that it is simplistic to presume that conflict between economic, social and environmental objectives is inevitable.

Conflicts and complementarities in the pursuit of economic, environmental and social objectives - reducing emissions of greenhouse gases from transport

It is often contended that there is an inherent conflict between economic, environmental and social objectives. This view, however, fails to account for opportunities to implement measures which address the environmental and social impacts of transport, at the same time as providing a *financial return* to the community. The reduction of greenhouse gas emissions from transport exemplifies the fact that the pursuit of environmental and economic objectives can be complementary, rather than conflicting.

The Victorian Transport Externalities Study provides an assessment of measures that could be implemented to reduce transport emissions of the greenhouse gas, CO_2. A significant finding of this assessment is that CO_2 emissions can be reduced by around 10% from their projected level in 2005, by measures which yield a *net financial benefit* to the community estimated at $958 million. A description of these measures is presented in Table 2, along with estimates of their effectiveness and net financial benefits (shown in the table as a *negative net cost*).

The following points regarding the information in Table 2 should be noted:

- the CO_2 reductions presented in Table 2 have been calculated to establish the impact of each measure on *aggregate Victorian land-based transport emissions of* CO_2. They should not be interpreted as showing the reduction in CO_2 emissions for the transport segment affected by the measure. For example, the first measure presented in Table 2 - "reduce passenger vehicle travel in Melbourne by increasing travel costs by 10%" - is estimated to reduce Victorian land-based transport emissions by 1.4% in 2005. The measure, however, would reduce CO_2 emissions from passenger vehicles operating in Melbourne by 4% (EPA, 1994). Because passenger vehicle travel in Melbourne is a sub-set of total land-based transport in Victoria, the emissions reduction for passenger vehicles is adjusted accordingly to reflect the impact on total transport emissions.

- the 10% reduction in CO_2 emissions is more than one-third of the reduction required if a pro-rata share of the Australian government's interim planning target for greenhouse gas emissions was applied to land-based transport (see Figure 3).

- savings in fuel consumption are the only benefit considered in the calculation of net benefit. For the reasons discussed above, it is not feasible to estimate a monetary value for the effects of global warming. The net benefit, therefore, excludes the benefits resulting from a reduction in global warming due to lower emissions of CO_2.

Table 2 Measures which reduce CO_2 emissions from land-based transport in Victoria *and* provide a net financial benefit to the community

Measure[1]	Reduction[2] in CO_2 emissions compared with projected levels in 2005 (%)	Net Cost[3] of Measure ($m)
Reduce passenger vehicle[4] travel in Melbourne by increasing travel costs by 10%	1 4	- 233
Reduce travel speeds throughout Victoria by increased education and enforcement	0 8	- 117
Reduce Melbourne public transport fares by 10% to encourage a modal shift toward public transport	0 3	- 43
Accelerate the introduction to Victoria of improvements to passenger vehicle[4] technology (eg lighter materials and improvements in aerodynamics, engine and transmission design and tyres)	5 6	- 460
Encourage telecommuting as a substitute for physical travel to work	1 0	- 75
Reduce travel times on Melbourne public transport to encourage a modal shift toward public transport	0 5	- 30
Change urban form so that Melbourne's future development promotes a second major activity focus in the south-east of the Metropolitan area (eg Dandenong), and develop transport infrastructure to complement this change	0 3	- 15
Total	*9 9*	*- 958*

Source: EPA (1994)

Notes
1 Measures are listed in order of *cost-effectiveness*.
2 If measures are introduced concurrently, their effectiveness often will be less than if they were introduced in isolation. These "interaction effects" between measures have been accounted for in the figures presented in this table
3 Net costs are for the period 1995 to 2005, expressed in $1992. A 5% discount rate was used in their calculation. A negative net cost represents a net *benefit*.
4 Passenger vehicles include cars, station wagons and (passenger) 4 wheel drives

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O_2 l with 2005	Net Cost[3] of Measure ($m)
	- 233
	- 117
	- 43
	- 460
	- 75
	- 30
	- 15
	- 958

- a number of the measures presented in Table 2 also provide a range of other environmental and social benefits Depending on the measure, these additional benefits may include a reduction in emissions which adversely affect local air quality and, therefore, human health; a reduction of traffic congestion; and fewer accidents These benefits are also excluded from the estimates of net benefit Were a monetary value for these benefits to be included, the net benefit of each measure would be higher than is indicated in Table 2

- while each of the measures in Table 2 provide a net financial benefit in addition to a reduction in CO_2 emissions, the distribution of the costs and benefits which make up the net result are not presented As the financial benefits of each strategy result from fuel cost savings, motorists will be the beneficiaries Costs, however, are borne to a varying degree (depending on the measure) by motorists and the wider community - the latter in providing funds for education programs, infrastructure improvements etc (EPA, 1994)

A number of other measures to reduce CO_2 emissions from land-based were also considered in the Victorian Transport Externalities Study However, each of these measures were found to impose a *net cost* on the community An overview is presented in Table 3

Figure 4 combines the information in Tables 2 and 3 to show the *cumulative* reduction in emissions and the *cumulative* net cost of measures to reduce CO_2 emissions The measures listed in Table 2 are those to the left of the turning point in the graph - the successive introduction of each of these measures provides an accumulating net financial benefit to society The measures listed in Table 3, because their implementation involves a net cost, appear to the right of the turning point

It is important to note that the net benefit of $958 million generated by the measures listed in Table 2, provides a *credit* which "pays for" a further reduction in CO_2 emissions of around 6% Figure 4 shows that a reduction in emissions of around 16% can be achieved at *zero cumulative net cost* (i e where the graph cuts the x-axis) Because of the "credit" provided by the measures in Table 2, it is only the pursuit of CO_2 reductions in excess of 16% that will impose a net financial burden on the community (i e a *cumulative* net cost > zero)

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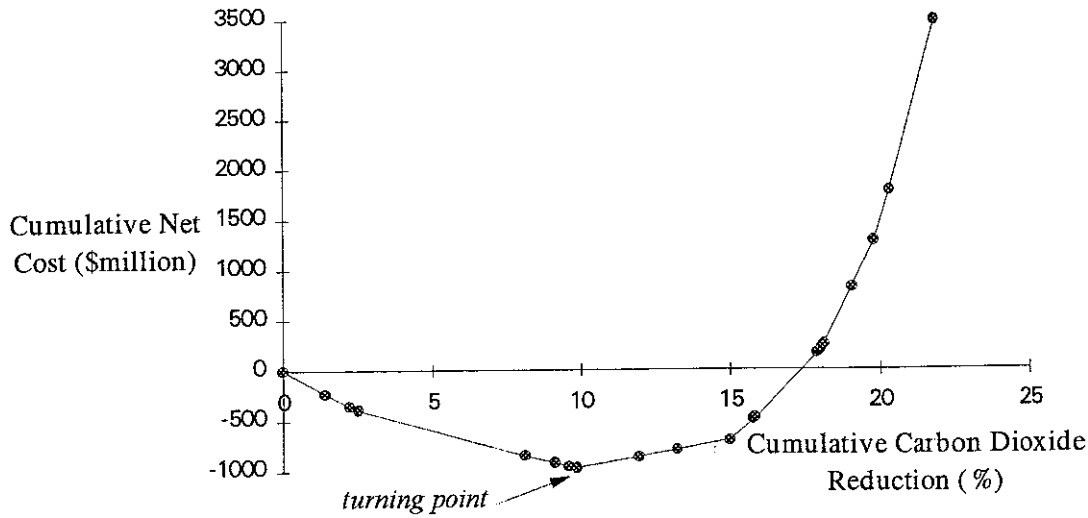
Table 3 Measures which reduce CO_2 emissions from land-based transport in Victoria at a net financial cost to the community[1]

Measure	Reduction in CO_2 emissions compared with projected levels in 2005 (%)	Net Cost of Measure ($m)
Promote smoother driving in the metropolitan area by providing advice to drivers on optimal travel speed on a given section of road	2.0	105
Improve the technical specification of trucks	1.3	69
Develop new sub-divisions in Melbourne at a higher density with mixed land-use opportunities and complementary transport infrastructure	1.8	99
Reduce total travel by road freight vehicles by inducing modal shift and improving manufacturing, warehousing and distribution systems	0.8	203
Introduce petrol-ethanol blends to capture a 12.5% share of the passenger vehicle fuel market	0.2	50
Reduce speed limits and encourage adherence to these new limits through education and enforcement	2.1	650
Encourage car pooling for peak period travel in Melbourne	0.1	52
Increase the compressed natural gas (CNG) share of the passenger vehicle fuel market from 1% to 11%	1.0	555
Increase LPG's share of the passenger vehicle fuel market from 3% to 13%	0.7	467
Regulate to require all passenger vehicles registered in Melbourne to be subject to annual inspection and maintenance	0.5	493
Increase the market share of smaller passenger vehicles	1.6	1703

Source: EPA (1994)

1. See notes to Table 2



Source: EPA (1994)

Figure 4 Cumulative CO_2 reductions and cumulative net cost of emissions reduction measures

5. CONCLUSION

Does the pursuit of environmental and social objectives involve a trade-off with economic objectives? From the discussion in this paper, it is clear that the answer to this question is likely to be determined by the scale of the environmental and social improvements that are being sought

As exemplified by the assessment of measures to reduce emissions of CO_2 from land-based transport, it *is* possible to tackle transport's environmental and social impacts at the same time as providing a net financial benefit to the community. It was found that a reduction in CO_2 emissions of around 10% from projected levels in 2005 could be achieved by introducing measures which also yield a net financial benefit of $958 million. Furthermore, because of the "credit" provided by these measures, a reduction in CO_2 emissions of some 16% could be achieved at zero net cost to the community. It is only if a reduction in emissions of greater than 16% is sought, that a net financial burden is incurred

Significantly, these net cost calculations exclude the monetary value of the environmental and social benefits associated with each of the measures. As part of this paper, we have seen that, despite the uncertainty involved in their estimation, the monetary value of these benefits is significant. Were a monetary value for social and environmental benefits to be included in the net cost estimates, an even more favourable result would be achieved

The distribution of the financial costs and benefits associated with measures introduced to achieve environmental and social objectives remains an issue. The financial beneficiaries of measures to reduce transport CO_2 emissions are motorists, while the costs of these measures often fall on the broader community or taxpayer. While distributional issues must be considered in the development of policy, they should not be permitted to draw attention from the fact that, to a significant degree, it is possible to develop policies which achieve not only a reduction in the environmental and social impacts of transport, but also an improvement in the net financial position of the community as a whole.

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Appendix 1 Achieving the Right Balance in Theory - The "Optimal Level of Control"

In the hypothetical illustration presented in Table I, 5 levels of control over an externality are possible. The lowest level of control is represented by level 1, increasing to the highest level of control - level 5. The marginal costs and benefits associated with each level of control show the incremental (or additional) costs and benefits that result from successively higher levels of control. Thus, if the level of control was to increase from level 3 to level 4, *additional* costs of $500, and additional benefits of $100, would be generated.

The change in net benefit (i.e. marginal benefit - marginal cost) reflects the net impact of implementing successively higher levels of control. Again using the example of moving from level 3 to level 4, a net benefit of -$400 or, in other words, a net *cost* of $400 would be incurred.

The optimal level is level 3. Up to this level, successively higher levels of control result in a net benefit to society. Beyond level 3, successive levels of control add more to costs than they do to benefits - that is, they can only be achieved at a net *cost*.

Table I Illustration of the concept of the optimal level of externality control

Level of Control	Marginal Benefit ($)	Marginal Cost ($)	Change in Net Benefit ($)
1	500	200	+300
2	400	250	+150
3	300	300	0
4	100	500	-400
5	50	550	-500

This information is reproduced graphically in Figure I. The optimal level of control occurs where marginal cost equals marginal benefit - that is, at the point of intersection between the marginal cost and benefit curves.

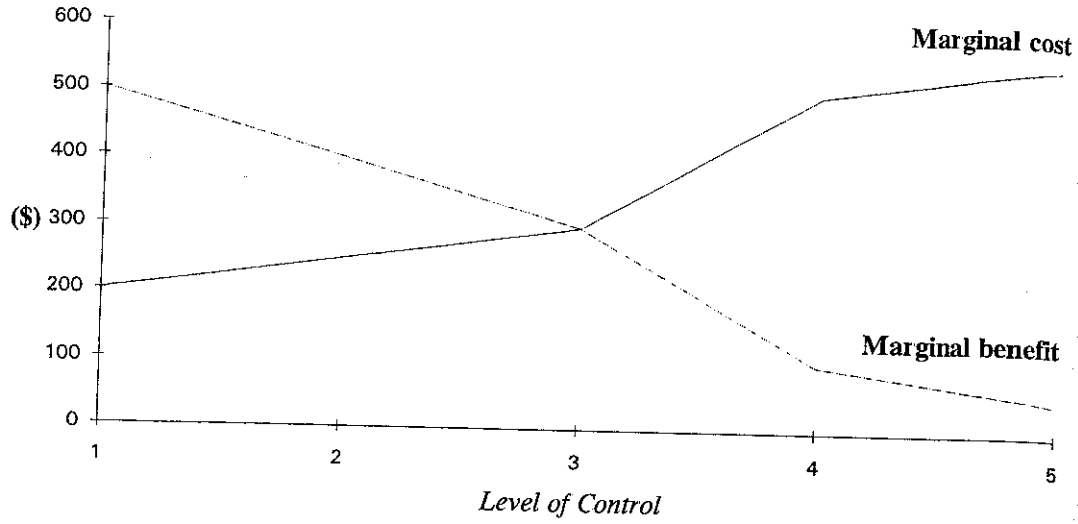

Figure I **Graphical illustration of the optimal control of externalities**