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Contents

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- 2 Abstracts & keywords
- 3 Editorial
- 4 Mortality reductions as a result of changing to alternative powered vehicles in Tel-Aviv-Jafo
Gary Ginsberg, Aharon Serri, Elaine Fletcher, Tene Moshe, Eric Karsenty & Joshua Shemer
- 10 Exploding myths about the cost of car transport
Alan James
- 16 Sustainable Transport: Edinburgh's Approach
George Hazel
- 24 The North American growth fixation & the inner city: Roads of excess
Christopher Leo
- 30 Area-Wide Traffic Management: An Innovative Strategy for Urban Centres
Gavin Davidson, Mark Roseland & Don Alexander
- 38 A Tea for the 21st Century: Sustainable Transportation in the USA
Norbert Goriben
- 46 Author and Title Index to Volume 4

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Abstracts and keywords

Mortality reductions as a result of changing to alternative powered vehicles in Tel-Aviv-Jafo

Gary Ginsberg, Aharon Serri, Elaine Fletcher, Tene Moshe, Eric Karsenty & Joshua Shemer

Keywords: Air pollution, buses, cars, fuel, health, mortality, particulates, Tel-Aviv-Jafo.

Mortality from tailpipe vehicular emissions alone in Tel-Aviv-Jafo is around ten times that from motor vehicle accidents. Alternative methods to reduce the annual 293 deaths from tailpipe emissions and 10 deaths from refinery or power station emissions are explored.

Exploding myths about the cost of car transport

Alan James

Keywords: Cars, equitability, perceptions, public transport, taxation, travel costs.

In Britain it is widely believed that the cost of travelling by car is relatively cheap once the fixed costs of owning a car have been paid, but this is not the case when all mileage-related costs are properly assessed. This false perception distorts the comparison between the cost of travel by car and by public transport. An awareness campaign on this issue, coupled with a taxation shift from car ownership to use, would be an effective and immediately available policy tool to help reduce levels of car use and encourage use of other transport modes, in line with the objectives of the 1998 Transport White Paper.

Sustainable Transport: Edinburgh's Approach

George Hazel

Keywords: Car-free residences, economic development, Edinburgh, land use planning, sustainability, transport.

Edinburgh is pursuing an innovative approach to land use planning and associated transport matters. This mixed-bag approach is at the forefront in the UK and includes car-free residential developments, car sharing schemes, public transport corridors and resident-only parking strategies.

The North American growth fixation & the inner city: Roads of excess

Christopher Leo

Keywords: Anytown, doughnut city, economic growth, road construction, sustainability, Winnipeg.

"It's the economy, stupid." Economic growth is the yardstick by which so many governments believe they will be judged, and moderate growth is often considered insufficient. As a result, many slowly-growing cities unthinkingly extend their infrastructure on the assumption of rapid growth that does not materialise. Winnipeg has followed such policies, and the results illustrate their weaknesses. The suburbs sprawl while the inner city decays, and its infrastructure deteriorates. Plans for a rapid transit line that could both relieve congestion and promote more compact development are postponed year after year while new roads and bridges are extended into sparsely-populated fringe areas.

Area-Wide Traffic Management: An Innovative Strategy for Urban Centres

Gavin Davidson, Mark Roseland & Don Alexander

Keywords: Efficiency, equity, innovative solutions, traffic management, sustainability, Vancouver.

This study compares and contrasts a traditional view of traffic management with an emerging, broad interpretation that supports sustainable development. We then summarise recent research we undertook to examine the feasibility of applying sustainable transportation principles within Vancouver's downtown in a comprehensive programme called area-wide traffic management (AWTM). AWTM attempts to improve transportation efficiency by reducing over-reliance upon motorised vehicles within urban centres.

A Tea for the 21st Century: Sustainable Transportation in the USA

Norbert Gorißen

Keywords: California, Chicago, ISTEA, New York, Portland, public policy, sustainability, transport, USA.

This paper assesses the Intermodal Surface Transportation Efficiency Act, and its benefits, implementation and effects. ISTEA has tremendous potential to lead change towards sustainable transportation. It encourages dialogue between NGOs and administrations, and a holistic approach to transportation planning.

Editorial

A visit to Brussels is a vivid reminder, if one were needed, of the seriousness of the transport problem and the enormous amount of progress that still has to be made to transform our cities into the joyful and nurturing places that they can so easily become. The importance of Brussels in conveying this message is considerably heightened by the close juxtaposition of European-level administrative offices charged with improving environmental quality and transport problems and an appalling urban environment. A walk along Rue de la Loi and Rue Belliard or Boulevard du Triomphe and Avenue de Beaulieu is a walk into the very opposite of what anyone would want from their streets and public space. Rue de la Loi and Rue Belliard present the pedestrian with a terrifying 4 or 5 lanes of one-way traffic through a canyon street of faceless high security office blocks. This is the beating heart of the European Union's fast growing body politic and it is on the verge of collapse.

Pedestrians in Brussels have no rights and no future. The main roads are impossible to cross unless the person on foot has plenty of time to spare to wait for the unfriendly pedestrian phase on the traffic signals or a liking for the sterile world of underground tunnels. At major intersections traffic continues to turn into the path of crossing pedestrians even when they have the 'green light'. It is difficult to find a pedestrian crossing that is not blocked by a parked car and always there is the shrieking noise and stink of the car rushing along the very wide boulevards, careering into tunnels, emerging from tunnels and weaving a wall of noise, smell and unpleasantness around the green spaces that do survive, e.g. the Botanical Gardens alongside the aptly named 'Boulevard du Jardin Botanique'. Even when the cars are silent they manage to pollute some of the finest

public spaces in the world. The area around the Palais de Justice is one huge car park (plus yet another tunnel entrance) and anyone with a passing interest in Europe's architectural and historical heritage must interpret everything through a wasteland of cars (as in the case of the Place Royale). The police do nothing to control the excesses of the drivers, the traffic engineers do everything to encourage the drivers to come into the centre of Brussels and the busy, dedicated administrators of our brave new Europe hide behind their triple glazing in their fine buildings equipped with generous amounts of basement car parking.

Every problem has a solution and this problem is no exception. The solution to the despoilation and destruction of a fine European city is to control and then eradicate the car. Nothing less will do. Brussels illustrates the extent to which a Darwinian struggle for supremacy has run its course. Brussels is as car-centred and attractive as Detroit or a Los Angeles freeway but with the added ingredient of lots of people and several thousand fine buildings and spaces left over from the public art and public space excesses of the last 300 years. If ever there was an argument for a surge of well funded emergency action bigger than a NASA project or Marshall Aid plan then it is Brussels (and by extension Paris, London, Madrid, Rome and Athens). The case for urban civilisation does not need to be made anew. The case for doing something about it does need to be made. The car as we know it must go. Just as our civic minded 19th century urban managers got their act together and supplied cities with clean drinking water and sewage-free streets so we must get our act together and provide 21st century cities with clean air and rid them of the mobile sewage that has reduced urban life to a misery.

John Whitelegg, Editor

Mortality reductions as a result of changing to alternative powered vehicles in Tel-Aviv-Jafo

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We wish to acknowledge the assistance of Dr. Leonid Tartakovski (Technion University, Haifa) and Mr Joe Basis (Tel Aviv Municipality) regarding Israeli vehicular emission factors.

The currency used is the US\$.

Ginsberg *et al.* Mortality reductions as a result of changing to alternative powered vehicles in Tel-Aviv-Jafo

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Abstract

Mortality from tailpipe vehicular emissions alone in Tel-Aviv-Jafo is around ten times that from motor vehicle accidents. Alternative methods to reduce the annual 293 deaths from tailpipe emissions and 10 deaths from refinery or power station emissions are explored.

Keywords

Air pollution, buses, cars, fuel, health, mortality, particulates, Tel-Aviv-Jafo

Introduction

In contrast to the huge attention concentrated on reducing the 550 annual road fatalities in Israel (Central Bureau of Statistics, 1996), little or no attention has been given to fatalities caused in a more indirect manner as a result of emissions from motor vehicles. A companion paper (Ginsberg *et al.*, 1998) estimated the present level of mortality caused by motor vehicle emissions in Israel's second largest city (Tel-Aviv-Jafo: population 353,100) to be around 293 deaths annually from tailpipe emissions with 10 more fatalities from refinery emissions. The annual toll of 293 deaths from tailpipe emissions was found to exceed the combined total of deaths whose primary underlying causes were falls, homicides, infectious diseases, suicides, traffic and non-traffic accidents.

There has been an increasing trend towards the use of electrical vehicles in Western Europe and Liquefied Petroleum Gas-powered (LPG) vehicles worldwide. In response to this, an inter-ministerial committee under the auspices of the Ministry of National Infrastructures was set up in Israel in 1997 with a mandate to study the implications of a shift to electric and LPG vehicles. A sub-committee was set up to look into the health implications of a shift from petrol/diesel to electric and LPG propulsion.

This paper has the specific goal of estimating the impact of the use of electric and LPG vehicles on total vehicle emissions and hence on mortality and morbidity in Tel-Aviv-Jafo. The effect of the addition of oxidising catalysts to reduce emissions from existing diesel vehicles is also considered.

Methods

Data as to the number of vehicles by type (car, taxis, buses, trucks, etc.) and actual or potential alternative fuel used (petrol, diesel, LPG, electric) were collected for various scenarios for the city of Tel-Aviv-Jafo. Data on the annual average number of kilometres by vehicle type, travelled within the city was also obtained (Central Bureau of Statistics, 1996), enabling total vehicle kilometres by vehicle type and fuel used to be calculated.

Table 1 summarises the suspended particulate matter (SPM) tailpipe and refinery emissions per kilometre travelled by the various modes that we used in our model. For the majority of present fuel modalities, tailpipe SPM emissions were obtained from fleet-weighted data from Holland (Ministry of Housing, 1997) adjusted to Israeli urban-cycle fuel consumption, and emissions data obtained from trials in conjunction with the Technion - Israel Institute of Technology, Haifa. UK fleet data was used for petrol taxi and motorcycle emissions (UK Emission Factors Internet Database). Data on total annual kilometrage by vehicle type was multiplied by the emission factor co-efficients in order to arrive at the total annual tailpipe emissions by type of vehicle. Data on SPM was converted to PM₁₀ (particulate matter < 10 µm) under the assumption that PM₁₀s constitute approximately 99.4% and 96% of SPM from petrol and diesel motor vehicle emissions respectively (Small and Kazimi, 1995). Electric vehicle tailpipe emissions are zero.

Refinery SPM emissions for petrol and

electric vehicles were mainly based on Israeli data (*pers comm* A. Kotler, Israel Electric Corporation) adjusted for differentials in fuel consumption. Diesel refinery emissions were assumed to be similar to petrol refinery emissions and LPG refinery emissions were based on UK data (Lewis and Gover, 1995) adjusted to Israeli refinery and fuel consumption conditions.

Since the refineries are based near coastal ports, we assumed that only 50% of their emissions would actually fall on Israel, the

remainder falling into the Mediterranean sea. Based on nationwide data from the USA, we assumed that 50.95% of SPM emitted from the fuel refineries were PM_{10s} (US-EPA, 1995).

Data from the Environment Ministry's newly established air monitoring stations found the average ambient air level of PM_{10s} from three monitoring stations in Tel-Aviv-Jafo to be 56.8 µg/m³ in 1996 (*pers comm* Aaron Serry, Department of Environment). The largest single source of these PM_{10s} (48.4%) is emissions from the Reading electric power generating station situated on the north-west sea front of the municipality, based on the assumption that 40% of the 1377 annual tonnes of PM_{10s} emitted actually fall within the municipal boundaries (*pers comm* Dr Ilan Setter, National Meteorological Center, Beit Dagan). Around 36.1% of these PM_{10s} (i.e. 20.51 µg/m³) are generated by motor vehicles, 14.4% coming from natural sources such as sand (*pers comm* Tel-Aviv-Jafo Environment Monitoring Unit) and 1.3% from industry and home heating. For each tonne of PM_{10s} emitted from vehicles, ambient PM₁₀ air levels will rise by 0.0499 µg/m³ (20.51/412.7 total tonnes of PM_{10s} emitted from motor vehicles).

Table 1: Annual tailpipe and refinery SPM emissions (g/km) by mode and fuel type in Tel-Aviv-Jafo.

	<i>Tailpipe</i>	<i>Data source</i>	<i>Refinery</i>	<i>Data source</i>
CARS				
<i>Diesel</i>	0.27	Adjusted Dutch car data ¹	0.012	Similar to petrol ²
<i>Petrol</i>	0.026	Adjusted Dutch fleet average ¹	0.012	IEC-Urban Cycle
<i>LPG</i>	0.009	Dutch ¹ and British ² adjusted	0.009	British ²
<i>Electric-coal</i>	0		0.052	IEC-Urban Cycle
<i>Electric-gas</i>	0		0.007	IEC-Urban Cycle
BUSES				
<i>Diesel</i>	1.87	Adjusted Dutch fleet average ¹	0.292	Adjusted French ⁴ & USA ⁵
<i>LPG</i>	0.022	Dutch ³ and World LPG associations ⁴	0.038	energy consumption relative to car on urban cycle ²
<i>Electric-coal</i>	0		0.217	energy consumption relative to cars ²
<i>Electric-gas</i>	0		0.029	energy consumption relative to cars ²
VAN: (<4tonnes)				
<i>Diesel</i>	0.30	Adjusted Dutch fleet average ¹	0.007	British Urban car ² adjusted by consumption
<i>LPG</i>	0.015	Dutch fleet averages ¹	0.005	British Urban car ² adjusted by consumption
<i>Electric-coal</i>	0		0.029	energy consumption relative to cars ²
<i>Electric-gas</i>	0		0.004	energy consumption relative to cars ²
TRUCKS				
<i>Diesel</i>	1.18	Adjusted Dutch fleet average ¹	0.29	USA ⁵
<i>LPG</i>	0.022	As for buses	0.038	as for buses
TAXIS				
<i>Petrol</i>	0.020	Cars with catalytic converters-UK fleet ⁶	0.012	IEC
<i>Diesel</i>	0.27	Adjusted Dutch car data ¹	0.012	Similar to petrol ²
<i>LPG</i>	0.009	Dutch ¹ and British ² adjusted	0.009	British ²
<i>Electric-coal</i>	0		0.052	IEC
<i>Electric-gas</i>	0		0.007	IEC
MOTORCYCLES				
<i>Motorcycles</i>	0.09	UK ⁶ by engine size & stroke parity ⁷	0.009	Relative fuel consumption of cars

Notes:

1. Ministry of Housing, 1997; 2. Lewis and Gover, 1995. IEC = *pers comm* A. Kotler, Department of Environmental Quality, Israel Electric Corporation; 3. NOVEM, 1997; 4. Hollemans Bas, 1995; 5. Kitchen and Damico, 1992; 6. UK emission factors Internet database; 7. Central Bureau of Statistics, 1997

Health Effects of Emissions

A 1.0 µg/m³ increase in ambient air levels of PM_{10s} will increase all cause non-accidental mortality in persons aged over 30 by around 0.381% (Pope *et al.*, 1995). There are 4048 non-accidental deaths annually in Tel-Aviv-Jafo in the over 30 population in 1997 (Center for Economic and Social Research, 1996). If there were no vehicular emissions, ambient air levels of PM_{10s} would be 20.51 µg/m³ lower and the number of deaths would be only 3755 (i.e. 4048/(1+20.51*0.381%). Therefore each tonne of PM₁₀ emitted from vehicles contributes 0.711 deaths (i.e. (4048-3755)/412.7 tonnes). By multiplying this co-efficient of 0.711 deaths/tonne by the number of tonnes emitted by type of vehicle we arrive at the number of excess deaths attributable to PM_{10s} by type of vehicle.

Health effects of PM_{10s} emitted from refineries were similarly calculated based on an estimated (population weighted) national ambient PM₁₀ level of 38.3 µg/m³, produced by 37,923 tonnes of PM_{10s}. Based on 32,720 non-accidental deaths annually in the over 30 population (Central Bureau of Statistics, 1998), it is estimated that 1 tonne of PM₁₀ emitted from refineries causes 0.126 deaths nationwide.

This paper will estimate the changes in mortality as a result of the following fuel substitutions:-

- i) Diesel, LPG and electric cars for petrol cars.
- ii) Substituting LPG or Electric buses for the 1100 diesel buses run by the Dan Bus company that operate exclusively within Tel-Aviv-Jafo and account for 78% of the total bus kilometrage in the municipality.
- iii) LPG or electric buses for all diesel buses.
- iv) LPG trucks for diesel trucks.
- v) LPG or electric taxis for all taxis, 95.3% are diesel and the remainder petrol fuelled.

Finally the effects of reducing the emissions of diesel vehicles by around 25% by means of adding oxidising catalysts at a cost of \$2500 for buses and trucks and \$750 for taxis were examined. It was assumed that the fitting of an oxidising catalyst would increase fuel consumption by 5% (Faiz *et al.*, 1996).

Life expectancy at the average age of a tailpipe death of 72.8 years old (Pope *et al.*, 1995) is around 84.9 years (Central Bureau of Statistics, 1996) meaning that there were on

average 12.1 potential years of life lost for each tailpipe death. Costs per life year saved were calculated as follows:-

$$\frac{\text{costs of alternative technology (eg. oxidising catalyst)}}{\text{lives saved annually}} \div \left[\frac{\text{length of life of technology}}{\text{of technology}} * 12.1 \right]$$

Results

Private motor cars constitute the majority of Carbon monoxide (CO) emissions, while diesel bus tailpipe emissions account for the majority of Nitrogen Oxides (NOX) and SPM emissions (Table 2). Except for petrol fuelled cars and the zero tailpipe emission electrically powered vehicles, SPM refinery emissions (that actually fall on land) are lower than tailpipe emissions.

The estimated effects of the use of alternative fuels on tailpipe and refinery mortality are shown in Table 3. The results clearly show that the increase of 430 lives lost annually as a result of moving over to diesel cars by far outweigh the small gain of seven lives as a result

Table 2: Annual emissions from vehicular travel (tonnes) in Tel-Aviv-Jafo:

	NOx	Tailpipe			Refinery falling on land (a)		
		CO	SPM	NOx	CO	SPM	
CARS:							
Diesel	1868	2310	701	397	48	15.6	
Petrol*	1583	93629	67	519	78	129.8	
LPG	426	1868	23	397	78	11.7	
Electric-coal	0	0	0	753	415	67.5	
Electric-gas	0	0	0	662	208	9.1	
BUSES:							
Diesel*	2199	687	206	85	11	16.0	
LPG (Dan buses only)	517	211	47	57	24	5.1	
LPG (All buses)	44	77	2	48	27	2.1	
Electric-coal	0	0	0	46	73	6.0	
Electric-gas	0	0	0	40	36	36.5	
TRUCKS:							
Diesel*	288	225	76	50	7	9.4	
LPG	67	52	6	28	16	1.2	
TAXIS:							
Petrol & Diesel*	117	280	42	25	3	1.3	
LPG	27	118	1	1	0	0.0	
Electric-coal	0	0	0	48	26	4.3	
Electric-gas	0	0	0	42	13	0.6	
VANS (< 4 tonnes):							
Diesel*	147	120	31	31	3	0.7	
LPG	247	319	2	31	4	0.5	
Electric-coal	0	0	0	59	22	3.0	
Electric-gas	0	0	0	52	11	0.4	
MOTORCYCLES*							
	11	894	5	1	0	0.3	

Note:

(a) assuming that only 50% of actual refinery emissions fall on land in Israel.

* denotes current main fuel modality.

Table 3: Annual tailpipe and refinery emission mortality by mode and fuel type in Tel-Aviv-Jafo.

	Tailpipe	Refinery	Total
CARS			
Diesel	478	1.0	479
Petrol*	48	8.3	56
LPG	17	3.7	20
Electric-coal	0	8.2	8
Electric-gas	0	1.1	1
BUSES			
Diesel*	140	1.0	141
LPG (Dan buses only)	33	0.3	33
LPG (All buses)	2	0.1	2
Electric-coal for Dan only	31	0.8	32
Electric-coal for all	0	0.7	1
Electric-gas for Dan only	31	0.3	31
Electric-gas for all	0	0	0
TRUCKS			
Diesel*	52	1	52
LPG	1	0	1
TAXIS			
Petrol & Diesel*	29	0.08	29
LPG	1	0.00	1
Electric-coal	0	0.27	0
Electric-gas	0	0.04	0
VANS < 4 tonnes			
Diesel*	21	0.04	21
LPG	1	0.03	1
Electric-coal	0	0.19	0
Electric-gas	0	0.03	0
Motorcycles*			
	4	0.09	4

* denotes current main fuel modality.

outweigh the small gain of seven lives as a result of the decrease in refinery SPM emissions.

The substitution of LPG and electric cars from coal- and gas-produced electricity will save 31, 48 and 48 lives respectively annually by reducing tailpipe emissions. A further 4.6, 0.1 and 7.2 lives respectively will be saved annually from reduced refinery emissions.

Even larger annual savings in lives of around 138 and 140 persons can be realised by the substitution of LPG and electric buses for diesel buses.

A further 51 lives annually can be saved by transferring the 6000 trucks operating in the municipality over to LPG from diesel. An additional 28 or 29 lives annually could be saved eventually after the gradual transfer of taxis over to using LPG or electricity. Transferring diesel vans over to LPG or electricity will annually save a further 20 or 21 lives respectively.

The fitting of oxidising catalysts would reduce the number of tailpipe fatalities from diesel buses, trucks and taxis by 25% from 221 to 166 annually (Table 4).

Discussion

Considerable savings in lives can be realised by transferring vehicles over to alternative fuels. Moving all vehicles (except motorcycles) over to LPG will reduce tailpipe mortality in Tel-Aviv-Jafo from 293 to 25 or 56 lives a year, depending on whether all 8083 buses or just the 1100 buses of the Dan co-operative that operate exclusively on routes within the municipality change to LPG. In addition, mortality from refinery emissions will be reduced from 10.2 to 4.0 or 4.2 persons annually.

Transferring all vehicles to run on electricity (with LPG for trucks) will reduce tailpipe mortality to just five cases annually. Refinery mortality will fall from 10.2 to 9.5 or 1.4 persons annually for coal- and gas-produced

electricity respectively.

Calculations of cost per life saved (with the exception of Dan buses) were unable to be made since data was not available on ambient PM₁₀ air levels, proportion of particulates from motor vehicle sources and annual kilometrage travelled outside the municipality by type of district (suburban, rural, etc.).

Because of the relatively higher purchase price of electric cars or taxis (around \$50,000 versus \$20,000 in Israel) and the relatively low annual emissions, capital costs per life year saved are expected to be very high. While saving fewer lives overall, LPG cars or taxis appear to be a more cost-effective option than electric cars since capital costs are only around 16.7% higher (NOVEM, 1997) than petrol cars. For both electricity and LPG, the lower overall running costs are likely to defray the larger initial capital costs meaning that the true long-run cost per life year saved are likely to be zero or even negative.

While Carbon monoxide emissions will be reduced by a move to diesel, the huge increase in SPM tailpipe (as opposed to refinery) emissions necessitate that steps should be taken to stem the current increasing trend to purchase diesel cars. Such steps could include an upward adjustment in the price of diesel fuel relative to other fuels and a still further increase in the road fund licence for diesel cars.

Such financial incentives via fuel pricing and even via subsidies could be given to encourage the private motorist to move over to LPG or electric cars. France currently subsidises the purchase price of electric cars in order to encourage the use of this perceived 'greener' mode of travel (Faiz *et al.*, 1996). However, approximately 70% of French electricity consumption is provided by nuclear sources. In Israel (partly for security reasons) no electricity is generated from nuclear sources, while around 17% is generated by hydroelectric and solar means. Future plans for generating electricity are to substitute coal with natural gas.

Despite the 5% lower overall life-cycle (running and capital) costs of LPG buses (NOVEM, 1997), the fact that initial capital costs of LPG buses are about 20% higher than the diesel bus costs of around \$215,000 (Chander *et al.*, 1996) is likely to deter bus companies from moving over to LPG buses. The option of moving all 8083 buses, which operate all or partly within the municipality, over to LPG would save around 138 lives annually within the municipality (plus a further life from reduction in refinery mortality), however the total additional capital cost will be around \$328 million.

A more feasible and cost-effective option,

Table 4: Effect of Oxidising Catalysts on annual Tailpipe Mortality.

	Without Catalyst	With Catalyst	With Catalyst	With Catalyst
Diesel Buses (DAN internal)	1100	109.5	82.1	27.4
Diesel Trucks	6000	51.6	38.7	12.9
Diesel Buses (excluding DAN)	6983	30.8	23.1	7.7
Diesel Taxis	1740	28.8	21.6	7.2
Total	15823	220.7	178.5	55.2

would be to pass legislation that buses which operate exclusively (or mainly) on urban routes should move gradually (say over a five year period) to LPG or electricity. Just by substituting LPG buses for the 1100 diesel buses run by the Dan bus company travelling 78,000 kilometres a year exclusively within Tel-Aviv-Jafo would reduce additional capital costs to just \$44 million and save 108 lives annually at a cost of \$49,671 per life saved or only \$4,108 per life year saved. Because of the aforementioned 5% drop in overall lifetime costs, a transfer to LPG buses would not only actually save lives but also possibly reduce the long-term costs of the bus companies.

Electric buses initial capital costs are around 33% higher than diesel buses (Lavie, 1996), meaning that an additional capital cost of around \$58.5 million would be needed to purchase 1100 electric buses. This would save around 107 lives annually at a cost of \$65,041 per life saved or only \$5,380 per life year saved. Overall lifetime running costs (i.e. including capital costs but excluding salary of driver) are expected to be around 8% lower than for diesel buses (Lavie, 1996). Hence lives can be saved at no additional long term costs by transferring over to electric buses.

A further 51 lives annually can be saved by transferring the 6000 diesel trucks operating in the municipality to LPG, at an additional annual capital cost of \$240 million. Again overall long-run costs are likely to actually decrease.

In all scenarios, NO_x, CO and SPM emissions from gas-fired power stations are far lower than coal-powered generating stations. A gradual shift towards gas-fired plants is recommended from both an environmental and a health viewpoint.

The use of zero tailpipe emission electrically-powered vehicles effectively eliminates tailpipe mortality from PM₁₀ or any other emissions. While our model based its health effects only on the amount of PM₁₀ (partly to avoid double counting), it should not be forgotten that other gases, particularly CO (Morris *et al.*, 1995; Allred *et al.*, 1989; Allred *et al.*, 1991) and NO_x (Hasselblad *et al.*, 1992) have been shown to be related to morbidity. However, while refinery emissions from the use of electric cars for CO and NO_x are higher than refinery emissions for petrol cars, the overall total CO and NO_x emissions for electric cars (and LPG) is lower than for petrol driven cars.

As an interim measure, the option of legislating for the fitting of oxidising catalysts on all diesel vehicles should be considered in the light of the favourable cost-effectiveness ratios ranging from as low as only \$2,996 in

costs per life year for fitting to the 1100 Dan buses. Estimates of \$12,078 and \$39,029 per life year saved alone for taxis and trucks, overestimate the cost per life years saved due to the difficulty in estimating and hence exclusion of lives saved from tailpipe emissions outside the municipality. Despite a 5% rise in refinery mortality as a result of the 5% increase in fuel consumption (Lavie, 1996), the fitting of oxidising catalysts to buses, trucks and taxis will likely save between 47 and 55 lives annually depending on whether all buses or just the 1100 Dan buses change to the alternative fuel.

It should be emphasised that the cost-effective estimates or emission reduction measures presented are biased downwards since they do not contain provision for the reduced morbidity costs resulting from decreases in the incidence of chronic bronchitis (Abbey *et al.*, 1993; US-EPA, 1997), respiratory admissions (Wordley *et al.*, 1997; Thurston *et al.*, 1994), cerebrovascular admissions in persons over 65 (Wordley *et al.*, 1997; Schwartz and Morris, 1995), and Congestive Heart Failure and Ischaemic Heart Disease admissions (Schwartz and Morris, 1995). Furthermore, positive impacts on improved quality of life; such as unblemished sunsets, more pleasant surroundings, cleaner air, increased opportunity for informal interpersonal and communal interaction; have not been quantified.

An alternative way of reducing vehicle emissions is to economise on the very need to travel and to shift to public transport modes. Over-dependence on car oriented modes of travel is fostered largely by patterns of urban development which emphasise roads and suburban sprawl on the periphery, which in turn spur increased vehicle travel distances via bus, truck and car modes (Fletcher, 1998). In contrast, urban agglomerations in which public transport modes, pedestrians and cycling, are emphasised develop differently. Shopping, homes and businesses tend to be more clustered around urban or suburban nodes in the public transport and pedestrian networks, sprawl is reduced, and travel distances are minimised.

Future development of bus lanes, train and light-rail modes of travel could reduce dependence on private car travel and hence emissions. Such a scenario for the national metropolitan Tel-Aviv-Jafo area where 22% of all passenger kilometres could be made by bus and a further 11% by train or light rail, would enable a decrease of 28% in private car travel to be achieved (*pers comm* P. Vovya, Transport Consultant, Tel-Aviv-Jafo). However, this will result in an overall reduction in PM₁₀ emissions and hence tailpipe mortality of only around

15%. Such a scenario if implemented without changes to alternative fuels would only reduce tailpipe mortality from 293 to 249 persons, though there would be benefits in reduction of travel times and possible reductions in traffic fatalities. A strategy of both transferring to alternative fuels and adopting approaches which increase bus and rail travel together could reduce annual tailpipe mortality from 293 to just four persons. In summary, since shifting to more 'public transport' modes will only have

a marginal effect on tailpipe mortality, priority should be given to firstly gradually changing over the 1100 buses of the Dan bus company to LPG or electricity, followed by conversion of trucks and private cars to alternative fuel modalities.

Changing buses, trucks, taxis and cars to alternative modes is not only justifiable on health grounds but also on long-term economic grounds.

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Exploding myths about the cost of car transport

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Abstract

In Britain it is widely believed that the cost of travelling by car is relatively cheap once the fixed costs of owning a car have been paid, but this is not the case when all mileage-related costs are properly assessed. This false perception distorts the comparison between the cost of travel by car and by public transport. An awareness campaign on this issue, coupled with a taxation shift from car ownership to use, would be an effective and immediately available policy tool to help reduce levels of car use and encourage use of other transport modes, in line with the objectives of the 1998 Transport White Paper.

Keywords

Cars, equitability, perceptions, public transport, taxation, travel costs.

Introduction

The UK Government's Transport White Paper *A New Deal for Transport: Better for Everyone* (July 1998) signalled a marked shift in direction of transport policy, towards restraint of private vehicle use and promotion of other forms of transport, along with land use and transport policies aimed at reducing the need to travel. There is however a widespread view - amounting to a rear guard action on the part of pro-motoring organisations - that little can be done to bring about reductions in car use without very high levels of investment and subsidy in public transport, to make it a realistic alternative to the car in terms of convenience, speed, and above all cost.

It is frequently asserted that public transport cannot be cost-effective for car owners compared with using their cars, because once the fixed costs of ownership have been paid the actual cost of making a journey by car is cheap - little more than the cost of the petrol - so car owners will continue to use cars in preference to public transport. Such drawbacks are often acknowledged by transport consultants, even those actively involved in encouraging modal

shifts in travel behaviour and themselves coming up with innovative solutions; for example:-

'once the high ownership costs (of cars) are paid, the marginal cost of travelling is very low' (MTRU, 1998)

'Once one has a car, it is difficult to find situations, on a cost basis, where someone would favour using public transport. Petrol for cars is cheap when related to the benefits it is perceived to bring ... Public transport fares, even when they are low, can generally not compete with these rates ... When all motoring costs are added up the cost is higher (but) the fixed costs of motoring are such a proportion of that cost that only 25% of motoring costs are for petrol' (Stokes, 1998).

The relative costs could be made more equal by massive increases in fuel costs through taxation, but this would be socially and politically unacceptable to large sectors of the population, especially in rural areas, who are dependent on cars and have no real alternative.

The above lines of argument appear persuasive, but are in fact highly debatable. Whilst there is a popular perception that it makes little sense to spend say £ 3 per day on a car in tax, insurance, and depreciation, only to leave it at home and travel by bus, this is not the same as saying that the actual cost of travelling by car is cheaper than by train or bus. And whilst car dependence amongst low income groups without alternative means of transport is a very real issue, it is important not to confuse levels of car dependency with levels of car use; many car dependent people have relatively low annual mileages (and many other people will have relatively low proportions of car-dependent use), and it is fairly straightforward to devise a taxation system which targets high use and high fuel consumption and actually benefits car-dependent but low mileage users.

This paper elaborates these two themes, and argues that much can and should be done by the British government, in the short term and

without massive capital expenditure, to correct false perceptions of the real cost of travel by car and to address the present anomalies in taxation.

The Real Costs of Car Travel

At the present time, the average marginal cost of travel by car is at least 18 pence per mile, and a round figure of 20p per mile would be a reasonable estimate for many car users. The most commonly used rail fare generally costs in the range 9 - 13 pence per mile. The unit cost of travel by bus varies greatly; it can be very high for short journeys within urban areas but fairly low for urban trips over about three miles, and is generally cheaper than rail for long-distance travel.

For many journeys, then, it is already cheaper in actual journey costs - and potentially half the price or less - for a single car-owning person to travel by train than by car, contrary to the popular belief that trains are horrendously expensive compared with cars. It can even be as cheap for two adults to travel by public transport as by car, and only when cars have three or four people aboard - at which point they are in any case becoming a more efficient mode of transport - do the costs per head drop significantly below those of public transport.

In the above comparison, the marginal cost of car travel excludes the fixed costs of ownership - road tax, insurance, MOT, rescue service subscriptions, and age-related depreciation - which occur irrespective of the number of miles a car does. It includes only those costs which are incurred for each mile travelled; costs which are not incurred unless and until a car journey takes place. The constituents of these marginal costs are expanded below. The average rail travel cost is based on the 'Supersaver' standard fare, a return ticket not requiring advance booking or specified travel times and largely unrestricted in use (the main exceptions being travel on Fridays which can be about 25% more expensive, and travel on early morning trains on some routes).

A figure of 20 pence per mile for marginal car transport costs comes as a surprise to many people, but is supported by the Inland Revenue, an organisation not noted for its generosity in assessing business costs, in a method of estimating costs of car use by self-employed people using personal cars partly for business purposes. Its leaflet 'IR 125' gives a formula for allowable expense rates for business mileage, in which the first 4,000 miles are at a higher rate to include for fixed costs, but above 4,000 miles a lower rate kicks in. The rates for 1996/97 for

average sized cars are shown in Table 1.

Table 1: Tax-free rates per mile for business use of private cars (Source: Inland Revenue leaflet 'IR 125')

<i>Enginesize</i>	<i>First 4,000 miles pa</i>	<i>Each mile over 4,000 pa</i>
1,001 - 1,500 cc	34p	19p
1,501 - 2,000 cc	43p	23p

The extra 15 or 20p per mile for the 'all-in' rate amounts to £ 600 or £ 800 over 4,000 miles pa, which is a substantial proportion of total fixed costs. Bearing in mind that in this formula some fixed costs are expected to be defrayed by non-business use of the vehicle, it is reasonable to conclude that the Inland Revenue 'above 4,000 miles' rate is close to the actual marginal cost per mile of travel by car. An average figure in the range 18-20p per mile also tallies with data from the Central Statistical Office (Root *et al.*, 1996).

The components of marginal costs are:-

- petrol and oil;
- replacement of items that wear out through use;
- service costs;
- repair costs;
- mileage-related depreciation.

Of these, all but the last would generally be recognised as marginal costs, although the actual costs would probably be hotly disputed, since few areas of human endeavour are more prone to optimism than a car owner's assessment of car fuel consumption and running costs!

Mileage-related depreciation is perhaps less familiar as a marginal cost. Depreciation is usually regarded entirely as a fixed cost, but this is only true of the age-related element: mileage affects depreciation rates significantly, and must logically be treated as a marginal cost. Parker's Car Price Guide contains a matrix giving the amounts by which guide prices should be adjusted for different sizes and ages of car, per 1,000 miles above or below an average 10,000 miles per annum. The adjustment ranges from £ 8 - £ 152/ 1,000 miles, with a median value of about £ 35/ 1,000 miles. This is the value for a car of medium size and age, so may be used for an average marginal cost of mileage-related depreciation, which is thus 3.5p per mile. It should be borne in mind however that for newer or larger cars this cost element rises very rapidly (for example, to 7.2p per mile for a one year old medium size car).

In broad terms the breakdown of average marginal costs is:-

- petrol and oil: 9.0p per mile
- running costs: 5.5p per mile
- mileage-related depreciation: 3.5p per mile

The breakdown may vary with the age of the car; for example, newer cars may have better fuel economy and lower running costs, but have higher mileage-related depreciation costs. In either case, a marginal cost figure of 18-20p per mile withstands scrutiny, and again tallies with figures derived from Central Statistical Office data.

The above outline of the elements of marginal costs of car travel has two particular consequences of note:-

1. The general perception of marginal costs as 'petrol plus a bit for wear and tear' - say about 12p per mile - is a considerable under-estimate of the purely mileage-related costs of car use. The reason for this is almost certainly that only fuel costs are incurred at the time of use, and other costs will if anything be treated as an overall cost of car ownership; mileage-related depreciation is probably not often even recognised as a cost, being incurred only in the resale value of the car.
2. Recognising mileage-related depreciation as a marginal cost not only contributes substantially to marginal costs, but also reduces the level of fixed costs as generally perceived. Parker's Car Price Guide indicates that about 40% of annual depreciation rates are mile-

age-related; the average size three year old car doing 10,000 miles pa depreciates by £ 850, of which £ 350 is mileage related (£ 35/ 1,000 miles), so the fixed cost element is only £ 500.

These two factors alter significantly the common only perceived balance between fixed and marginal costs, as illustrated in Table 2.

All but one of the assumptions in Table 2 are verified by data from elsewhere. The exception is annual average mileage; other studies (Root *et al.*, 1996; Stokes, n.d.) indicate a figure of 8,000 miles pa, which reduces all annual costs somewhat but marginal costs to a greater extent, resulting in increases in the proportion of fixed to total costs to 55% and 38%. It seems improbable that car price guides would be based on anything other than actual average mileages, since the guide prices would become progressively more inaccurate with increasing age, so use of the 10,000 miles pa figure is defensible.

Whichever figure is used, the central message remains the same. This table exposes the myth of fixed costs being the lion's share of total motoring costs, which is at the heart of the perception of car travel being cheap once the fixed costs have been paid. Even with costs as generally perceived, fixed costs are only just half of total costs, and a more realistic assessment puts fixed costs at or near one-third of total costs.

A comparison of real marginal costs of car travel against the equivalent costs of travel by public transport is even more revelatory. Table 3 gives a few personal examples.

For individuals travelling alone, the competitive edge of public transport over private cars in travel costs is clearly demonstrated by this table, without even including the fixed costs of car ownership in the equation. Often the cost advantage of public transport is so great that even two adults would travel more cheaply or at comparable cost by public transport.

Table 3 also points to the flaw in the logic of using a car as much as possible to justify or defray the fixed costs of ownership. If fixed costs are £ 3/ day, and on a given day the car is used for example for the trip to Lancaster as shown in the table, total transport costs for the day are £ 41.00 (£ 3 fixed + £ 38 marginal costs) and the car's existence justified; if the car stays at home and £ 3 of fixed cost is wasted, total transport costs for the day are £ 25.75 (£ 3 fixed car cost + £ 2.25 bus fare + £ 20.50 train fare) and over £ 15 has been saved! Viewed in this light, the cost rationale of car use changes, from always using the car to justify its costly

Table 2: Fixed and Marginal Costs of Car transport

	<i>Fixed costs</i>	<i>Marginal costs</i>	<i>Total costs</i>	<i>Proportion of to total costs</i>
<i>Common perception</i>	£1,250.00	£1,200.00	£2,450.00	51%
<i>Revised perception</i>	£900.00	£1,800.00	£2,700.00	33%

Notes:

Figures are for average medium size car (e.g. Ford Escort 1.4 litre engine, 3 years old).
 Average 10,000 miles pa (figure used in Parker's Car Price Guide, September 1998).
 Depreciation: £ 850 over 12 months; mileage adjustment £ 35/ 1,000 miles (Source: Parker's Car Price Guide, September 1998).
 Fixed costs £ 400 tax/ insurance etc., plus depreciation (see below).
 'Common Perception': All depreciation treated as fixed cost; marginal cost 12p per mile.
 'Revised Perception': Age-related depreciation treated as fixed cost (£ 500); marginal cost 18p per mile including mileage-related depreciation (£ 350 over 10,000 miles = 3.5p per mile).

Table 3: Comparative costs of travel by car and public transport

<i>Journey Approx return distance (miles)</i>	<i>Return journey by car @ 19p per mile¹</i>	<i>Return fare by specified public transport</i>	<i>Cost per mile by public transport</i>
<i>Home-Dumfries (26)</i>	£4.94	Bus: £2.25	8.6p
<i>Home-Edinburgh² (140)</i>	£26.60	Car/Bus: £14.96	10.7p
<i>Dumfries-Lancaster (200)</i>	£38.00	Train: £20.50	10.3p
<i>Dumfries-London (670)</i>	£127.30	Train: £58.50	8.7p
<i>Bristol-Truro (490)</i>	£93.10	Train: £41.00	8.3p
<i>London-Ramsgate (160)</i>	£30.40	Train: £20.50	12.8p

Notes

1. 19p per mile marginal costs based on Inland Revenue marginal rate for class of car.
 2. Home - Edinburgh: Car/ bus - car 2 return journeys @ 19p per mile to nearest stopping point for express bus, express bus £ 8.50 return (6.9p per mile).
 Source: journeys by public transport May - October 1998

existence, to ensuring that car use is confined to occasions when alternatives are impractical. The judgment of 'practicability' will vary from person to person and from place to place, but if the principle were more widely understood it would undoubtedly be more widely adopted, and could bring about potentially significant reductions in levels of car use.

The above cost arguments have been used in two commuter management projects, in focus group discussions covering 5 - 10% of the workforce in each location. The figures, once explained, were widely accepted, and formed the basis for interesting and important comparisons of journey to work costs by different modes. These discussions highlighted not only that car users generally underestimate travel costs by car, but also that they consistently over-estimate the real costs of journeys to work by public transport, usually by looking at standard fares for one-off journeys rather than at fares available for regular journeys along the same route. An example from the Derriford Hospital transport project is given in Table 4, for a three mile journey along heavily congested urban roads, for which the bus was shunned by considerable numbers of staff mostly because of the exorbitant 90p single fare.

Table 4: Derriford Hospital, Plymouth: comparative costs for 3 mile journey to work 1996

	<i>Cost per single journey by bus</i>	<i>Cost per single journey by car</i>
Common perception	90p	36p
Revised perception	60p	60p
Additional incentives	45p	60p

Notes:

'Common perception' car travel cost 12p per mile.

'Revised perception' 20p per mile.

The common perception of focus group members was that the bus cost around three times as much as the car, comparing a single journey bus fare with the cost of 'petrol plus a bit' for cars. However, a season ticket was already available giving a one-third discount on bus fares, and with the real marginal cost for cars at the 20p per mile figure (reflecting higher fuel consumption for short car journeys with cold engine running and congested urban conditions), the costs are dramatically equalised in the 'revised perception'. An additional financial incentive to bus use was proposed and adopted in the creation of the 'Derriford Travelpass', for which the bus companies upped their discount and the Hospital Trust added further discounts to staff, resulting in bus fares at 40 - 50% of single journey fares, and thus significantly cheaper than the cost of single-occupancy car travel. The initiative is reported

to have increased bus use by 25% and 42% (figures for two bus operating companies) in the first year of implementation, along with a marked increase in car sharing.

Taxation Myths

Concern is frequently voiced - not least by promoting factions - at the possibility of the Government using increasing fuel taxation as a strategic tool for driving down levels of vehicle use. This is regarded as particularly inequitable for:-

- low income car-owning households, most of whom have cars out of necessity and already spend a high proportion of their disposable income keeping a car on the road;
- rural dwellers without adequate alternatives to car transport; and
- people in remote, sparsely populated regions who have to travel disproportionately long distances.

Rather less concern seems to be voiced at the inequity of the present taxation system for many people in these groups. A low income rural dweller in the Scottish Highlands doing say 3,000 miles a year of essential and car-dependent travel pays exactly the same road tax (£ 150 a year) as an affluent urban dweller travelling 23,000 miles a year to a second home every weekend. The example is extreme, but highlights the crucial distinctions between car dependency and levels of car use, and between taxation of ownership and taxation of use. These distinctions enable taxation to be re-directed at high mileage and high fuel consumption, which are the real targets of traffic reduction strategies, and at the same time improve equity for disadvantaged user groups.

Recent research studies (Root *et al.*, 1996; Stokes n.d.) have shown that a high proportion of total vehicle mileage is done by a small percentage of users. Both studies find a ratio in which about 60% of mileage is done by the top 24% of car users, while conversely the bottom 50% of car users account for only 16% of total mileage. Taking an average annual mileage of 10,000 miles per car, this means that out of 100 people travelling 1,000,000 miles pa, on average:-

- 24 persons account for 600,000 miles at an average of 25,000 miles pa each;
 - 50 persons account for 160,000 miles at an average of 3,200 miles pa each; and
 - 26 persons account for 240,000 miles at an average of just under 9,250 miles pa each.
- Further data (Stokes, n.d.) show that low

income groups have generally low annual mileage, and vice-versa. Households in the lowest income quartile account for only 7% of total annual mileage in Britain; the equivalent figure for the highest quartile is over 47%. In simple terms this means that most low income car users will be in the lowest mileage group, and few if any will be in the highest group, a fact confirmed by Root (1998) who found that in the lowest income quintile:-

- 70% of car users travel less than 5,000 miles pa;
- only 10% of car users travel more than 10,000 miles pa;
- the number travelling more than 15,000 miles pa did not register statistically; and
- in rural areas the percentages of car users in different mileage classes were not greatly different from the above, but significantly more people in the income group - 35% compared with 20% of the total population - own and use cars.

Mileage increases with increasing affluence (one of the strongest correlations of all), but even in the second lowest quintile 64% of car users travel less than 5,000 miles a year, while in the third (middle) quintile the figure is still 57%.

These findings confirm that low income car users are largely in low mileage groups purely on grounds of affordability, but the fact that they take on disproportionately high motoring costs in relation to disposable income suggests that most are probably heavily dependent on the car to travel those few miles. They are therefore disadvantaged by taxation on car ownership as at present, since they are unable to avoid owning a car and must pay a set amount for relatively few miles.

A simple way to redress this taxation anomaly is to transfer the burden of car taxation from ownership to use, scrapping the road fund licence and increasing the tax on fuel accordingly. There is nothing new in this idea, but it is rarely expounded to demonstrate its true potential. Above all, the meaning of 'accordingly' has not been fully explored.

It is suggested that the road fund licence could be abolished, and an increased fuel tax

set at a level which is financially neutral at average annual mileage and average fuel consumption. In other words, for a person doing about 10,000 miles per annum at about 35 mpg the cost of car taxation would be the same after the taxation transfer as before. Higher mileage and higher fuel consumption would incur increased levels of taxation, but car users at below average mileage levels would experience lower car taxation overall. This produces a more equitable tax regime for motoring, since:-

- it relates taxation more directly to consumption, and is therefore fairer to low mileage users of any income group; and
- it is likely to lower the burden of taxation on most low-income car users

Because of the skewed distribution of average mileage (i.e. the average is nearer the bottom end of the range) and the nature of car use as discussed above, a tax transfer which is financially neutral at the average point will benefit many more people than it adversely affects. For every person doing 30,000 miles pa there have to be four people doing 5,000 miles pa, or ten people doing 8,000 miles pa, to maintain an average of 10,000 miles pa: with the average set at 8,000 miles pa as discussed earlier, this effect is still more marked. Whilst the primary purpose is to improve the equitability and targeting of taxation rather than count winners and losers, this factor would undoubtedly assist the political acceptability of the proposal.

The Two Together

The main aim of a cost strategy for traffic reduction is to improve the performance of alternative transport modes relative to the cost of car transport, and to dispel the myth that most of the costs of car transport are incurred in the fixed costs of ownership. As discussed above, it is already the case that the marginal cost of car travel is considerably higher than is generally perceived, and fixed costs proportionately lower. The changes to taxation proposed above propel the balance further still in the required direction.

It is calculated that the transfer of road fund licence proposed above would add about 11.5p per litre to fuel prices to achieve a financially neutral effect at 10,000 miles pa @ 35 mpg. This adds about 1.5p per mile to the average marginal cost of car travel, a 7.5% increase: it would arguably have a still greater psychological effect as an 18% increase in fuel costs affecting the most visible area of marginal travel costs.

The effect on the changing balance between

Table 5: Fixed and Marginal Costs of Car transport, with Taxation Shift

	<i>Fixed costs</i>	<i>Marginal costs</i>	<i>Total costs</i>	<i>Proportion of fixed to total costs</i>
<i>Common perception</i>	£1,250.00	£1,200.00	£2,450.00	51%
<i>Revised perception</i>	£900.00	£1,800.00	£2,700.00	33%
<i>Taxation effect</i>	£750.00	£1,950.00	£2,700.00	28%

Notes

'Common perception' and 'Revised perception' as for Table 2

'Taxation effect' - transfer of £ 150 from fixed (car tax) to marginal (fuel tax) costs

fixed and marginal costs can be seen by revisiting Table 2, as in Table 5.

Conclusion

The notions of marginal car travel costing more than twice the bare petrol price, and of fixed costs being barely one-quarter of total motoring costs, are a far cry from the standpoint of the quotations in the Introduction, but are attainable given a single taxation shift towards a more equitable system, coupled with an awareness campaign to help people to price journeys more realistically. Both are within the scope of government action in the short term at relatively low cost, an equally far cry from the calls for massive long-term investment as a prerequisite of any action to implement the strategic objectives of the Transport White Paper.

A more pertinent prerequisite for the White Paper is to ensure that transport costs are being properly assessed, and that the car is on a 'level playing field' in cost comparisons with other transport modes. This is clearly not the case at present, and is in urgent need of redress: but more than this, setting the story straight on car travel costs acts as a positive policy tool towards the strategic end of reducing levels of car use. If people were aware now of the real costs of car travel they would be taking a hard look at the implications for their travel behaviour patterns.

Cost alone will not achieve everything. Even if the costs of travel by car are properly understood as being much higher than those of alternative modes, especially for single occupancy vehicle use, there will still be people for whom the cost of travel by car is seen as a price worth paying, either habitually or in certain circumstances, for the convenience or speed of travel. The longer-term objectives of the White Paper also require improvements in alternative transport modes; the more attractive they are to use, the more likely people are to use them. This said, cost is a central factor in

the equation of travel behaviour, and it is one on which early action is readily available.

This latter point is in itself important. At the moment there seems to be a real danger that the good intentions of the White Paper may be dissipated by inactivity, instead of being followed up by immediate action to set the winds of change in motion. The British Government appears to be unwilling to give priority to legislation on transport, and reluctant or unable to commit public funds to public transport. Some (though not all) local planning policy is lagging behind strategic aspirations, with development control decisions and even the framework of Local Plans frequently stuck in a 1980s time warp. A recent glaring example is the Preston Local Plan Inquiry Inspector's endorsement of major greenfield housing developments and new roads to unlock the chosen sites, overturning the preferred policy of the Local Authority which is manifestly more in line with strategic Government policy on housing and transport.

In the meantime, for car users it is largely 'business as usual' except where congestion exerts a throttling hold, or in the still too few cases where demand management strategies to reduce car use are actively being adopted, almost invariably with successful results.

Although a cost awareness campaign coupled with a simple taxation shift is only one start in one policy area, it is a readily available initiative with the potential for dramatic results. It is important to recognise that motorists are not a monolithic group conforming to car-junkie stereotypes. Significant numbers are actively interested in changing their travel behaviour at least some of the time: commuter management studies such as at Derriford Hospital indicate that about 20% of people positively want to reduce car use, and a further 60% are open to switching travel modes if the benefits are clear. In many cases it needs only the smallest of stimuli to encourage change, and exploding the myths of car travel costs is a far from small step in the right direction.

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Sustainable Transport: Edinburgh's Approach

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We wish to thank Hackland + Dore Architects, Edinburgh, for the diagram of the Gorgie Goods Yard development

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Abstract

Edinburgh is pursuing an innovative approach to land use planning and associated transport matters. This mixed-bag approach is at the forefront in the UK and includes car-free residential developments, car sharing schemes, public transport corridors and resident-only parking strategies.

Keywords

Car-free residences, economic development, Edinburgh, land use planning, sustainability, transport

Introduction

Two key aims expressed by the new City of Edinburgh Council when it came into existence in April 1996 were 'to promote a healthy and sustainable environment' and 'to develop the local economy'. Cities exist in order to promote the interchange of goods, labour, ideas and culture through a vast range of activities, both formal and informal. A sustainable, prosperous city will be one that facilitates this interchange by making it easy for people to meet, by design and by chance. The informal, chance element of city life is often forgotten - yet this is probably the key to a city's success, creating the quality of life that attracts people to the city. Street cafés and benches in public squares symbolise that lifestyle.

To enable this requires careful use of city space: there is a delicate balance between space for activities - including public space for the informal aspects - and space needed to provide accessibility to those activities. Where the balance is wrong, the city's economy and environment will be damaged. Over the last forty years or so, more and more city space has been used inefficiently to try and cope with growing car use. Buildings, pedestrian and other public spaces have been replaced by car space, and low density, car based suburbs, business and retail 'parks', have taken over former countryside.

These trends have occurred in Edinburgh as elsewhere, and in 1995 the Council embarked on a radical approach to escape from the vicious circle of increasing dependence on the car and the growing imbalance in the use of space. The aim is to restore the role of the city as a place where people come first. Failing to do this will put at risk the functioning of the city, and therefore its very existence as an effective economic unit.

Transport trends

There has been very rapid growth in car ownership in Edinburgh. Between 1981 and 1991, the number of cars per 1000 people grew by 47%, compared to a UK average of 29% - albeit from a lower base. Around 600 buses and 18,000 cars each bring about the same number of people (20,000) to work in the city centre each morning. But the number of bus journeys made citywide has declined from 177 million in 1980 to 135 million in 1992, a reduction of almost 25%.

Commuting from outside the city boundary has more than doubled over the last 20 years, as the city has increasingly dominated the regional jobs market. In 1993, there were 250,000 jobs based in the city. By 2005, 300,000 jobs are forecast, with only a small population increase from 450,000 to 457,000.

As in many cities, the trend towards out-of-town or edge-of-town business and retail development, and low density housing has been very pronounced over the last 10 to 15 years. There are continuing pressures for new development, and there is concern that the fragmentation of the local authority structure will result in a more favourable attitude by authorities outside the city to development designed to attract Edinburgh's residents. By its nature, such development is primarily car-based.

Consequences of recent trends

Conventional wisdom is that the growth of traffic is an inevitable sign of economic growth - that the two are inextricably linked. Yet only a

small proportion of traffic is essential to the functioning of the economy. The major impacts of congestion, environmental pollution and road accidents are well known, but it can help to provide local examples to illustrate the point.

For example, a study of a new shopping centre on the western edge of Edinburgh showed that it had generated up to an additional 200,000 car-kilometres every day. This added approximately 30 tons per day to local CO₂ emissions - 5% of daily CO₂ emissions by all traffic in Edinburgh. The same study showed that the city centre lost 4.4% of its comparison shopping market share. Perhaps even more importantly, a nearby neighbourhood shopping centre lost 80% of its convenience turnover, causing considerable difficulties for local residents.

In addition to these measurable impacts, there are more subtle, social effects that must be taken into account in developing transport policies. Transport affects social exclusion: car dependency reduces the opportunities for anyone without access to a car to gain access to jobs, education, services and leisure facilities. It also effectively reduces the labour pool and skill levels available to employers. Excessive traffic can cause a breakdown of neighbourhood communities, as people retreat away from the perceived danger of the street into their own homes. It can result in increasing polarisation in society between people with access to a car, and those without.

Edinburgh as a 'sustainable city'

The underlying principle of the Council's approach for dealing with these problems is to recognise that for Edinburgh, a first class economy and a first class environment must go hand in hand. The key is to provide a better environment, and better accessibility for all residents, businesses and visitors to the activities they want or need to undertake - neither of these can be achieved by a laissez-faire attitude to car traffic. The balance in the way city space is used must be restored.

Reducing vehicular traffic reduces the problem at source, but does not treat the symptoms. It has been considered unrealistic in the past - the growth in car use was seen as inexorable. But perhaps this approach is now becoming more acceptable. A recent survey in Edinburgh found that 82% of residents felt that 'the increase in car use is a serious problem in Edinburgh'. Only 14% agreed that 'capacity for cars on the roads should be increased', while 73% *disagreed* with the statement 'there is no real alternative to the car for transport'. 60%

agreed that 'more money should be spent on improving public transport, even if it means slightly higher local taxes'.

The Council is taking a holistic view of land use, transport, the environment and the local economy. Edinburgh was one of the first local authorities to set clear targets for stabilising and reducing car use (see Table 1), aimed at ensuring that all policies were working towards clearly defined objectives for maximising accessibility rather than movement *per se*.

Table 1: Edinburgh's modal share targets (city residents)

	1991	2000	2010
Car	48%	46%	34%
Public transport	34%	34%	39%
Cycle	2%	4%	10%
Walk	16%	16%	17%

To achieve these objectives, the Council is pursuing a wide range of different types of action:

- Locational policies for new development at both the strategic and the detailed, local level to minimise travel demand, implemented through the planning process;
- Re-allocation of road space from cars to efficient and environmentally-friendly modes of transport - buses, cyclists, pedestrians; and to non-transport uses that enhance the environment and the activities carried on in the city;
- Investment in better public transport infrastructure, and in new approaches to transport to bridge the gap between car and conventional public transport;
- 'Demand management' measures - carrots and sticks to reduce car travel at source, particularly at the workplace;
- Encouragement of lifestyle and technological alternatives to car travel such as teleworking and teleshopping, delivery services, and importantly the enhancement of local centres as the focus of communities; and
- Increasing public awareness of transport issues - decisions on whether or not to use a car are in the end made by individuals, not the local authority.

It is not possible in this brief paper to describe all the measures that are being taken under these headings. However, a number of more innovative proposals aimed at creating a vibrant city that is less dependent on car ownership are worth identifying.

City Car Club

The concept
 A City Car Club is a form of shared car

ownership providing access to a car where this is needed without the need for ownership. City Car Clubs have significant potential for reducing both parking pressure and car use.

City Car Club (pay as you drive car sharing) is a relatively new concept which has developed furthest in Germany. Members of car sharing clubs can book use of a car 24 hours a day at short notice, and the cars are located at reserved parking within local neighbourhoods. Costs are very attractive especially for low mileage car users (see Table 2). City Car Clubs - which go under various names in Europe - are now operating in more than 300 European towns and cities. Membership is typically growing very fast (e.g. average yearly growth rate in Berlin 1991 to 1995 was 76% with 3000 members in 1995). In Switzerland the clubs are diversifying into the shared ownership of sailing boats, specialised cycles and video cameras, and charging structures are increasingly integrated with public transport. The clubs are linked in a Federation, enabling members of any club to book the vehicles of other clubs. This enables, for example, the 'trunk haul' of a holiday trip to be completed by rail with a City Car Club vehicle at the destination town being used during the vacation.

From the transport policy viewpoint, there are two main advantages of car sharing clubs:

- The ratio of households to cars in car sharing clubs is about 12 to 1. This has the potential to greatly reduce residential parking pressure in inner urban areas. Up to 8 cars owned privately can be replaced by each car in a sharing club; and
- Because users pay as they drive, the relative costs of using alternative means of transport reflect their real costs much more closely. This considerably increases the attractiveness of public transport, walking and cycling. As a result, the mileage travelled by car by former car owners who sell their car to join clubs typically reduces by nearly 50%.

Benefits for the member of the car sharing club include:

- Cost savings for car mileages of less than around 6000 per year;
- Convenience (Insurance, maintenance, etc. dealt with by club);

- Access to a range of vehicles from town cars to vans and minibuses;
- Access to clubs all over Europe when away from home on holiday or business; and
- Release of the financial capital which would otherwise be tied up in a car.

The Edinburgh scheme

In 1996, the Council commissioned local market research on the potential for car sharing clubs in Edinburgh. This research focused on target groups seen as especially likely to consider and/or benefit from car sharing, including people who find themselves forced to buy a car to get to work, people working for large employers including central and local government and people who want to help the environment but need the use of a car on occasion. This research concluded that there was potential for a scheme to succeed in Edinburgh, and an area of the city was identified as suitable for a pilot scheme.

The area chosen (Marchmont) is a high density, turn of the century, tenemental area about 1.5 km from the city centre with a mixed population ranging from professional people to students. Parking in the area is becoming an increasing problem as car ownership grows, in spite of reasonable access to public transport, and the city's major employment areas in and around the city centre being within easy walking distance.

Substantial funding was secured from central government to assist the project: £150,000 from the then Department of Transport and £30,000 from the Scottish Office, with £48,000 contributed by the Council. This funding supported the development of a business plan, and the transfer of booking and vehicle management technology.

A strategic decision had to be made at an early stage on the nature of the technology to be adopted. For a City Car Club scheme to function effectively, there needs to be an effective booking service, with 24 hour cover, users have to be able to access the cars, and there has to be a record of distance and time for each user. Many of the German schemes relied on a low-tech approach. The booking service was often provided through a local taxi firm, with specialised booking and scheduling software. Access to the vehicles was through a key held by all members that provided access to a safe provided at the parking location, within which were the car keys, and also possibly accessories such as a child's seat for the car. Time and distance were logged by hand on forms, by the user, who returned a copy to the central office.

It was felt that in the UK environment, such an approach would deter users, and that there

Table 2: City Car Club Illustrative Costs (Medium Sized Car)

Subscription	Rental	Mileage charge
£120 per year	£2.50 per hour / £30 per day / £200 per week	32p per mile

Based on these costs and an annual mileage of 5600 (split over two weeks, 13 weekends and 240 hours) a City Car Club vehicle would cost £3700, compared with £5500 for an equivalent privately-owned vehicle doing the same mileage. It should be emphasised that typical City Car Club members reduce their car mileage by 50%. As the marginal costs of alternative forms of transport are lower, real savings would typically be greater than those outlined here. [Costs based on typical German scheme. Source: Car Free Cities Network, Boulevard de Waterloo 27, B-1000, Bruxelles]

could be a problem of vandalism or misuse of the safes, and theft of the vehicles. An alternative high-tech approach has been adopted, providing each user with a smartcard to activate the vehicle and record usage, and each vehicle with a direct link to the central control point that can activate/deactivate an immobiliser and detect the vehicle's location at any time. The development of this telematics-based hire management system has been an important element in the development cost.

From the customer end, publicity in the pilot area has led to the setting up of a local user group that has been involved in the development of the project. It is anticipated that such user groups will ensure a clear customer focus in the operation of the scheme.

It became clear from the business plan that a significant financial commitment would be required to underwrite the enterprise, with a likelihood of significant losses during the first two to three years. This was indeed the experience of the equivalent German organisations, where these costs were met by local authorities. However, in the current budget climate, the City of Edinburgh Council could not provide this financial support, and the decision was taken to seek assistance from the private sector to secure the existence of the Club.

This has taken a considerable amount of time and effort and the Council has now reached a decision on a preferred operator for the Club. The selection process involved inviting several private operators to submit proposals based on a detailed prospectus outlining the principal requirements for the operation of the club. The user group was invited to comment on the prospectus and representatives of the user group were present at a presentation to the potential operators.

Following this process Budget Car & Van Rental was selected as the preferred operator for the Edinburgh City Car Club. The approval is subject to the completion of a formal agreement between the Council and Budget, and this is currently being negotiated.

It is clear from the discussions to date that the scheme has an operator who has the resources, expertise and infrastructure to provide an efficient and reliable service. Budget has made a positive long term commitment to the scheme and has indicated that it wishes to develop the scheme on a citywide basis very quickly. It has proposed a flexible and competitive hire tariff structure and will be offering members useful discounts for daily and weekly hired vehicles locally, across Scotland and the rest of the UK. The Club will be promoted and offered to both private and

business users in Edinburgh. Budget also proposes to develop strategic partnerships with other transport providers that will enable members to choose the most appropriate means of transport for any given journey from a range of options available to them through the Club.

One of the unique features of the Edinburgh scheme in comparison to those on the continent, is to use on-street parking space for the vehicle stations. In the pilot area of Marchmont/Sciennes, there are no possible off-street locations. The statutory procedure for the first on-street parking stations in this area is already underway. Provision for a number of on-street parking stations in other parts of the city will be started in the near future. The potential for off-street stations (which do not require a traffic regulation order) in other areas will also be explored and Budget has indicated that it will find ways to deliver the service in advance of parking stations being set up in areas where there is a viable level of demand for the scheme.

The startup date for the Club has yet to be finalised but it is expected that this will be early in 1999. However, this date is dependent upon the final stages of development of the computer and telematics-based hire management system. Both the Council and Budget are agreed that startup will only take place once the system has been fully tested and proven as we know that quality and reliability of the service are crucial to the success of the Club.

Car-free residential areas

At present virtually all new urban housing is dominated by the need to provide parking and access for vehicles; such buildings generally sit in a sea of tarmac covered in cars. Developers see this type of development as meeting customer requirements and cannot envision a market for an alternative. The aim of this Council in promoting car-free housing developments is to provide some good examples to demonstrate that there is a market for an alternative approach; an approach which uses the space normally consumed by parked vehicles to improve the inhabitants' immediate environment, and enhance their quality of life.

Car-Free Residential Areas (CFRAs) are based on the principle that in return for the improvements in their quality of life, each resident of the estate would agree not to own a car. Residents living in a car-free environment would gain the following benefits:

- Land normally required for wide roads and car parking would be available for additional

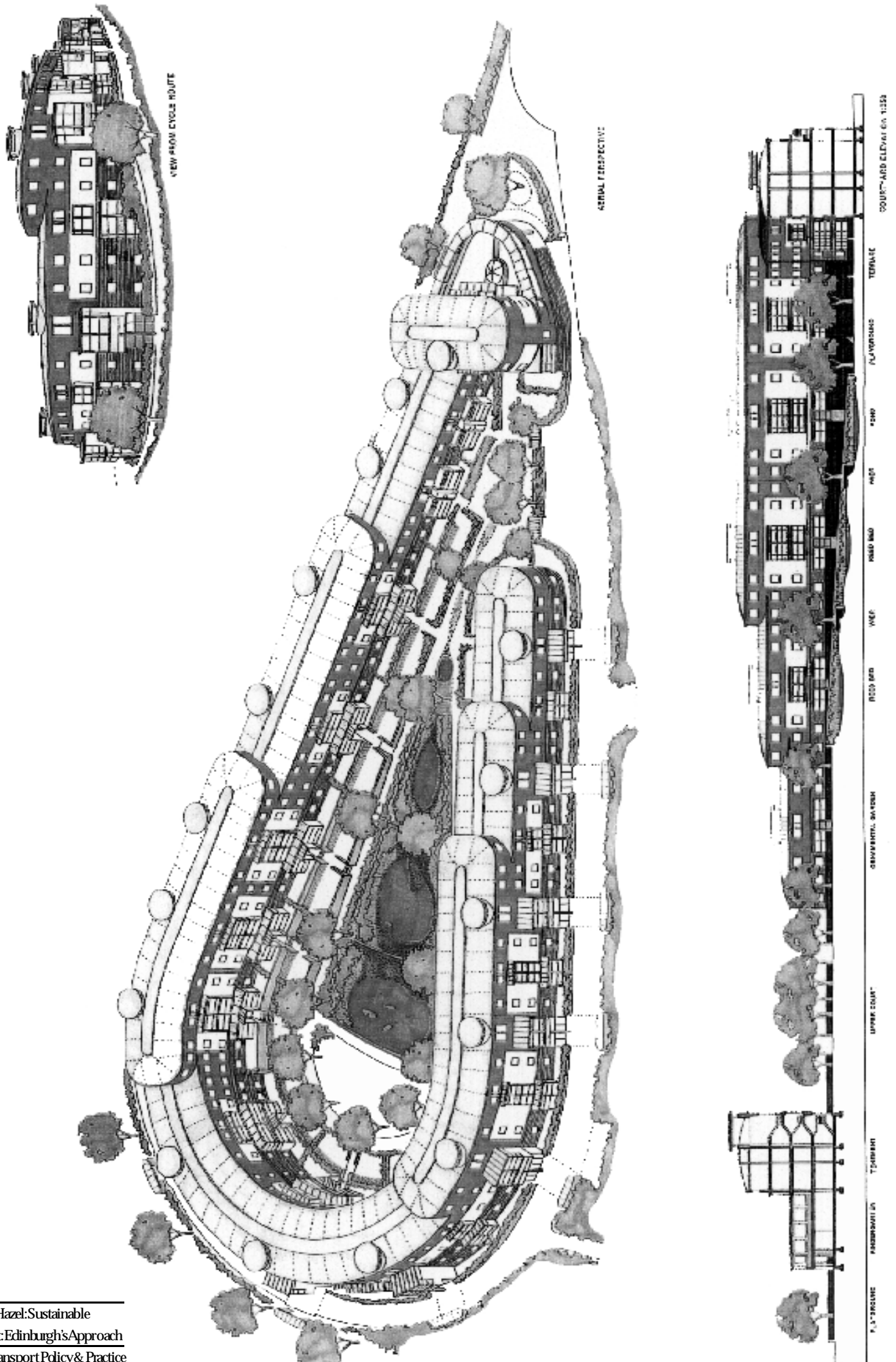


Diagram 1: The Gorgie Goods Yard Development. Source: Hackland + Dore Architects, Edinburgh

open space, landscaping, play areas or other community facilities. In other words, more space to live in and more pleasant surroundings with no traffic congestion;

- A safer environment to raise children as a result of minimal traffic and easily supervised open space;
- Reduced air pollution and noise pollution; and
- Financial savings to households as a result of not running a car.

A Car-Free Residential Area must have excellent public transport links and nearby shopping facilities and schools. High quality, safe, pedestrian and cycle routes should link the CFRA with these facilities. In order to have access to a car for journeys where there is no realistic alternative, residents could form a car ownership co-operative (City Car Club) or negotiate preferential rates with local car hire companies. The concept should not be seen by developers as an opportunity to reduce the level of car parking provision and thereby increase the number of housing units within a site. Any land resulting from a reduction in parking provision should be used for open space, landscaping, play areas or other benefits to the residents.

A car-free housing therefore provides an alternative housing market choice not currently available, in which residents undertake not to own cars. Car non-ownership is rewarded by higher environmental quality, lower costs of housing (because of less need for road and parking space) and the elimination of traffic danger. Cars could be available in a City Car Club for use by residents when required.

The need for clear criteria in identifying locations was considered fundamental to the success of such a development. It is important that lessons learned in Europe are applied effectively to development sites in Edinburgh. The following criteria used to assess sites in Edinburgh are therefore derived from similar principles:

- Service density - proximity and access to a wide range of local facilities such as schools, shops, health services and recreation centres;
- Car ownership levels - areas with low levels of car ownership are often serviced by higher levels of transport and local shopping;
- Tenure - areas with a good mix of housing tenure are likely to provide the best opportunities for CFRA's;
- Access to a transportation network - proximity to good public transport links, in particular well connected with the city centre;
- Position in relation to Controlled Parking Zones - areas within the city centre

controlled parking zone are most appropriate as residents would be unable to own a car and park on surrounding streets; and

- Population Density - areas of higher population tend to have a better concentration of local services and a good socioeconomic mix of residents.

It was considered that the inner areas of the City were more likely to meet these criteria. Five inner city wards were assessed in relation to each of the above criteria and given a suitability score ranging from Very High to Very Low.

The benefits of CFRA's are obviously attractive, although there remain some areas of concern:

- Will sites, even in the centre of Edinburgh, be perceived as having access to adequate levels of transportation and basic services? Does the concept of car-free living require enforcement, or will it be self-enforcing? Is safety and quality in design affordable?
- Is there strong enough consensus of opinion institutionally and with the public to allow the concept to have adequate support or marketability?
- Are there sufficient numbers from every income group willing to give up ownership of cars and will a developer be able to undertake development without subsidy?

The limited evidence available, especially from Europe, suggests that in spite of these concerns, the development of some pilot or demonstration car-free housing areas is justifiable. Using the criteria referred to earlier a number of sites have therefore been identified as having potential as CFRA's and two schemes are live: Lauriston Place and Gorgie Goods Yard.

Lauriston Place, Tollcross

The site lies within a relatively densely populated area with a good mix of private rented and owner occupied housing. It is well served in terms of local services, is located close to the city centre and has excellent access to the public transport network. Parking controls operate in the immediate vicinity. As a result the redevelopment of this site provided the opportunity for the introduction of a car-free housing scheme.

On 27 November 1996 planning permission was granted for the development of 65 flats with a ground floor café and office space at 128-150 Lauriston Place, subject to a Section 75 agreement. [These are voluntary agreements, made under Section 75 of the Town and Country Planning (Scotland) Act 1997 between Planning Authorities and other parties with an interest in land in their area, to restrict or regulate its use. Usually linked to planning

permissions, and tied to the title deeds thereafter, they can allow aspects to be controlled which might not be appropriate as normal conditions of consent.] The applicant was Miller Partnerships. The 65 flats are accommodated in 3 individual buildings each 5 storeys in height. In normal circumstances the applicant would be required to provide one car parking space per dwelling. In this instance only 5 places are proposed. Two generous areas of open space are incorporated within the scheme.

The principle behind car-free housing is that any land that would normally be required for car parking and access roads should be utilised for open space or other community purpose. In this instance the Council recognised that in quantitative terms the proposed open space did not equate to 65 parking spaces. However this concern has been overcome by the quality of the anticipated development in urban design terms and the intention to meet the open space objective within the wider Tollcross site.

In order to ensure that the site is developed and operates as a car-free housing area, a number of conditions are attached to the planning consent. These include the provision of cycle racks and bus stop and shelter facilities and a requirement for a Section 75 agreement to ensure that the car parking spaces provided are restricted to the needs of essential users. Furthermore, the developer will be required to oblige each owner or tenant to undertake never to park, or cause or permit the parking of a vehicle within the development. The Council does not intend to issue Residents Parking Permits to occupiers of the development.

Gorgie Goods Yard

This site covers 1.4 hectares, is situated on Slateford Road on the west side of Edinburgh about 3 km from Princes Street, and was formerly a railway goods yard. It is identified in the Local Plan for industrial use, but in recent years has been the subject of interest from housing developers. It is located in a mixed use area with easy access to a main bus route into the city centre which by the end of 1998 will form one of the city's 'Greenways' bus priority routes. The site meets many of the parameters for a successful car-free housing development. However it is not within the controlled parking zone.

On 13th December 1995 the Council agreed to grant outline planning permission for the erection of 120 flats based on the principles of 'car-free development', subject to a Section 75 agreement. The developer, Canmore Housing Association, has extended the 'car-free' concept to a much wider definition of 'sustainable

housing', including low energy, recycling, low maintenance characteristics and an 'ecological' approach to the open space. The housing is seen by Canmore and Scottish Homes, the national housing agency, as a model for housing for the new millennium. Canmore, together with the Royal Incorporation of Architects in Scotland, have held a design competition for the development. The first stage of this competition attracted over 40 submissions from the UK and the Netherlands. Six designs were short listed. The second stage to select a winning entry was completed in April 1997, and the winning design is the basis for the detailed planning application. The design is for 2 to 4 storey buildings reflecting the traditional tenement style of building that is characteristic of Edinburgh's inner suburbs. Funding has been agreed by Scottish Homes, with an approximate cost of £ 8.5m. Construction was started this year and the development should be occupied in summer 2000.

The proposal seeks to meet the needs of disabled residents and will include 4 ground floor flats with parking spaces specifically for wheelchair users. The development will only include a further 8 parking spaces to be used by essential visitors and a possible car ownership co-operative. Secure cycle parking will be provided, and the main common area will contain information on public transport and cycle access routes. One of the problems to be overcome with regard to this car-free scheme relates to the site's location well outwith the controlled parking zone. At present, unrestricted parking is available in nearby streets. Parking controls would have to be introduced to avoid displacement parking by residents of this development.

However the Council have sought to address this issue and other requirements of car-free housing through the drafting of a detailed Section 75 agreement. The Heads of Agreement include:-

- access to the site beyond a parking and turning area to be restricted to emergency and service vehicles; and
- the developer to impose obligations on future owners and tenants by which they will undertake not to park, or cause or permit the parking of, any vehicle within the development.

In addition, the developer has undertaken to require tenants to agree to management rules voluntarily in addition to the tenancy agreement. The management rules as presented by the Housing Association state that residents should not park any vehicle on nearby streets, and should discourage visitors from doing likewise. However these rules do not form part

of any legally binding agreement. A residents' association will be encouraged in the development to further reinforce the 'car-free' ethos through peer group pressure. Finally, the Housing Association will give priority to people requesting transfer to 'conventional' housing because their circumstances have changed so that they require to use a car.

A sustainable suburb

The 'South-East Wedge' is a significant expansion of the City to meet future housing and business location needs. The Lothian Structure Plan identified a need for new land for 19,000 houses up to 2005, and this area can accommodate about 5,000 of this total. The location is however controversial, as it is largely within the City's Green Belt. It is however located within the urban envelope, and for this reason was perceived to be more attractive from a sustainable development point of view than the main alternative locations which were linked with settlements outside the Green Belt and at a greater distance from the main employment locations which are in and around the city itself.

Three key development objectives for this area were established from the outset as follows:

- to maximise integration between new development and existing urban areas and deliver significant economic and social benefits to the adjacent communities (which currently have above average levels of unemployment and deprivation);
- to plan the new urban areas in a responsible, sustainable way, encouraging the use of public transport and reducing the use of private cars for non-essential trips; and
- to provide an appropriate setting for development within a strong landscape framework which respects the context of the area, protects important views and provides public access to green space.

Proposals for the area include:

- Up to 5000 new homes,
- The new Edinburgh Royal Infirmary,
- Up to 30 hectares of business land, including a medical business park,
- Craigmillar Castle Country Park,
- Concentration of Edinburgh University's medical and veterinary facilities,
- Community and local retail facilities.

In transport terms, the development will focus on an effective public transport network linking the district to the existing built-up area and the city centre, with higher than normal development densities along the corridor. Several park-and-ride and rail station sites have been identified. A comprehensive cycle network will also serve the area. It is intended that new development should have a strong urban shape and scale, presenting a strong townscape image which is a pleasure to walk through.

The development will take place around neighbourhood centres, and a new town centre for the area will provide retail and employment opportunities. A mixed use approach to development is being encouraged.

The mechanism that is being adopted to put this in place is through the development of a master plan, agreed between the two local authorities involved, the City of Edinburgh Council and Midlothian Council, which these authorities will then incorporate into their Local Plans. This will be supplemented by detailed codes for landscape, civic design including density and permeability issues, and environmental and sustainability principles to guide developers and assess projects.

Developers will be expected to submit proposals with a civic design analysis demonstrating an understanding of townscape groupings, building form, skylines, access and mobility issues, and the design of the public realm.

Conclusion

This paper has highlighted some of the measures being undertaken by the the City of Edinburgh Council to try to match economic performance and environmental quality and thereby to ensure the continuing central role of the city. Two elements are crucial:

- the de-linking of economic growth and traffic growth by concentrating on accessibility to activities rather than movement of vehicles;
- the re-allocation of space from inefficient transport modes to efficient and environmentally friendly transport, but also to non-transport uses.

Edinburgh consistently appears high on the lists of 'desirable places to live' prepared by academics and businesses. We believe that the approach to its future development outlined in this paper will keep it in that position.

The North American growth fixation & the inner city: Roads of excess

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'The road of excess leads to the palace of wisdom' William Blake, The marriage of heaven and hell.

*The currency used is the Canadian dollar.
Can\$ 1 ≈ £ 0.40 ≈
US\$ 0.65*

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Abstract

"It's the economy, stupid." Economic growth is the yardstick by which so many governments believe they will be judged, and moderate growth is often considered insufficient. As a result, many slowly-growing cities unthinkingly extend their infrastructure on the assumption of rapid growth that does not materialise. Winnipeg has followed such policies, and the results illustrate their weaknesses. The suburbs sprawl while the inner city decays, and its infrastructure deteriorates. Plans for a rapid transit line that could both relieve congestion and promote more compact development are postponed year after year while new roads and bridges are extended into sparsely-populated fringe areas.

Keywords

Anytown, doughnut city, economic growth, road construction, sustainability, Winnipeg

Growth Fixation

In North America, growth has long been the Holy Grail of city politics, for reasons that are not entirely frivolous. Since it is of the essence of city life, even more than of life generally, that change is constant, some growth is necessary to avoid decline. As some people or activities vacate a city, or part of a city, either something else must take their place, or decay sets in. A certain amount of growth, therefore, is essential to a city's well-being.

But, carried to excess, the desire to promote growth can be damaging and it is my argument that in many North American cities, it is leading us astray. Deference to the god of rapid growth has become a virtual given in North American society, a fixation. Virtually everyone is in some way caught up in the belief that the big apple – New York, Toronto, Los Angeles, or the nearest metropolitan centre, wherever one happens to be – is deserving of obsessive attention.

The attention is not all favourable. Those

who make their lives outside the realm of such metropolises often feel resentful of it, decrying it as a breeder of crime and false values, or maintaining that its administration and its residents are the favourites of the national or regional government, while perhaps simultaneously nurturing a sense of inferiority. But whether the attention is favourable or unfavourable, it bespeaks an obsession with growth, a sense that it represents power, importance, legitimacy.

This obsession has many consequences (Leo and Brown with Dick, 1998), but in this article I focus on the way our growth fixation influences our decisions on the development and maintenance of city streets. My argument is that our common obsession with rapid growth leads us to over-build roads in anticipation of future growth that may or may not materialise. Such policies are followed indiscriminately in both rapidly-growing and slowly-growing cities, but are especially damaging to the health of the latter, where the future growth needed to justify current expenditures virtually never materialises. Unlike Blake's road of excess, these roads are not leading us to the palace of wisdom.

In making my case for this contention, I draw extensively on the example of Winnipeg, a city that takes in most of a metropolitan area with a population of about 700,000. Many other examples would have done as well, and the data would have produced similar conclusions, because Winnipeg is a typical example of a slowly-growing North American city whose growth, I contend, has been flagrantly mismanaged thanks to the unthinking pursuit of fast-growth policies.

It has become a local cliché that Winnipeg is a city in decline. In this respect as well, Winnipeg's situation is probably more nearly the rule than the exception in North America. Edmonton is sometimes sarcastically referred to as 'Deadmonton'. The inner city of Hamilton, Ontario, is decaying, and the city is widely considered to be in decline, and St John, New Brunswick, has been struggling with decline for decades, indeed, for more than a century. More examples could easily be cited. In the United States, examples are even easier to find: Detroit,

Duluth, Omaha, Des Moines, Camden – the list goes on.

Without trying to generalise about all these examples – and referring now to Winnipeg – it is my contention that the decline, which is real enough, has nothing to do with any failure of needed growth. It is true that Winnipeg is becoming a less important centre in Canada because a number of other cities are growing faster, but to say that adds up to decline is to be hooked on growth. Metropolitan Winnipeg's population, for a long time, has been growing at about one per cent per year. For example, from 1986 to 1991, the population of the Winnipeg census metropolitan area (CMA) grew from 625,304 to 652,354, a percentage change of 4.3 per cent, less than 1% per year (Statistics Canada 1986, 1991) while the economy has been growing at a rate of perhaps two or three per cent. For those who are not hooked on growth, that is not decline: it is a description of a metropolitan area that is steadily becoming wealthier, in the aggregate.

In what sense then is the decline real? It is the city of Winnipeg, and especially Winnipeg's inner city that is in decline, not the CMA. Population growth within the city limits crawls along at less than one per cent a year, while municipalities bordering the city are growing at rates in excess of 10%, and in some instances more than 20%. Until recently new housing starts within the city were about half of those in the CMA, despite the fact that much new municipal infrastructure remains underutilised, and older infrastructure is deteriorating at an frightening rate. Some of the most alarming deterioration becomes visible only when an automobile or truck plunges through a hole that suddenly opens up in the street. This has occurred several times in recent years, thanks to deteriorating sewer lines.

The visible inner city is deteriorating less spectacularly, but possibly even faster. Despite heroic efforts on the part of all three levels of government and the local business community, once-bustling inner city streets are becoming ominously quiet, while unoccupied retail premises and boarded-up residences are becoming a common sight. Much of the inner city has been red-lined by insurance companies, with the result that home-owners applying for insurance may be refused, or may be required to pay more than the standard premium. All of these changes are typical features of slowly-growing cities across North America. Indeed, Winnipeg is far from the worst case.

It is my argument that the glaring disparity between the health of the metropolitan area as a whole and that of the inner city is a result of a set of growth policies based inappropriately on

the premise of rapid growth – a result of the fact that our growth fixation makes it difficult to think about city development in any other terms. My prescription is to accept slow growth as a reality and re-think our policies accordingly. In this article, I look at how this argument applies to the extension of the road system.

Civil engineering norms and development conventions

The ideas about road systems that are being applied in Canadian cities, whether rapidly- or slowly-growing, have two sources that are important for our purposes: developer proposals and the traditional norms and conventions of civil engineering. The contribution of developers is that they decide on the parcels of land that they think will be suitable for profitable development and present development proposals to the city. In Winnipeg and many other cities they have good reason to expect a sympathetic hearing from local government and, as part of the cost of development, they accept the obligation of building, or paying for, the necessary road connections.

It then becomes the obligation of the city to work out the development of the rest of the city's transportation system to accommodate recent and expected future development. For example, a burgeoning of new subdivisions at Winnipeg's southern edge in South St Vital and South St Boniface contributed to a city decision to build an expressway serving that part of the city – Bishop Grandin Boulevard – and occasioned the opening-up of an under-used and heavily subsidised bus line into Island Lakes, one of the new subdivisions. It also eventually stimulated the replacement of the Norwood and Main Street bridges with a massive new eight-lane structure. These bridges, located downtown, are part of the road system leading to the newer southern subdivisions.

While money was readily available for these extensions of the transportation infrastructure, as well as a long list of other, similar extensions in all directions from the centre of the city, funds for the maintenance of existing infrastructure dwindled. A meticulous 1998 survey of the state of Winnipeg's infrastructure found a massive disparity between the amount needed to maintain existing infrastructure and the amount actually being spent. Regional streets, for example were found to be \$10.2 m per year short of the required amount. Even more drastic was the situation of residential streets, which were found to have benefited

from an average annual budgeted expenditure of \$2.5 m, compared with a requirement of \$30 m, a disparity of \$27.5 m. (City of Winnipeg, 1998, ch. 3).

In all of these respects, Winnipeg was following the conventions of modern North American city building: developers decide where they want to locate new development and pay for some of the services immediately required by the new subdivisions. The city ensures that they become connected into the city-wide service network, and that the city-wide network is expanded as necessary to accommodate them. It is in deciding on the character of this expansion that long-established norms of the engineering profession take over.

Most engineering designers and managers now at the peak of the profession were educated in engineering faculties where the dominant tendency was to think of road-building as a technical matter, in which road design involved the projection of traffic demands and the efficient accommodation of that traffic at a manageable cost. In that climate of thought, the suggestion that there is a social and an environmental dimension to road-building was not taken seriously and, when such suggestions came from politicians or members of the public, they were resented as political interference and as an assault on engineers' professional integrity. This belief-system is still very much in evidence, especially among the decision-makers in municipal public works departments.

It is important to emphasise that I am pointing to a belief-system, not some special penchant for the pursuit of narrow self-interest. Indeed, engineers are probably less vulnerable to the charge of feathering their own nests at public expense than many other professionals. The Association of Professional Engineers of Manitoba, a typical case, are self-consciously protective of the public interest and show no reluctance to let colleagues whose professional standards are found wanting feel the full weight of the Association's censure. The problem is not self-aggrandisement, but a predisposition to assume and promote rapid growth, to favour roads over alternative forms of transportation, and sometimes to go to questionable lengths in promoting them.

Easy decisions

Many examples could be found (Leo, 1977), but a recent case in point was that of the Norwood Bridge, the inner city-suburban link already referred to. When the plans for the Norwood Bridge reconstruction were being mooted, city

officials presented four alternatives, including the following two: It would cost \$78 m for a six-lane, divided bridge that was pictured as providing a fair level of safety, and poor traffic capacity, accommodation for transit and accommodation of traffic during construction. By contrast, an eight-lane, divided bridge that was rated good in all four categories would cost only \$80 m. (City of Winnipeg 1992) That was an easy decision: only \$2 m extra for a vastly superior bridge. Such easy decisions are standard items in the arsenal of public servants who have made up their minds about which course they wish their political masters and the public to pursue.

Council chose an eight-lane bridge, and it soon became obvious – as it often does in such cases – that the easy choice was not so easy after all. By 1998, the cost of the new bridge had escalated to \$102 m (City of Winnipeg, 1998, 31). And with only one of the two spans built – still less than the six-lane alternative that was portrayed as inadequate – traffic line-ups at rush hour had greatly eased. Given the bias, or lack of reliability, that is apparent from this course of events, it might well be asked whether the officials' advice is deserving of any trust at all. Was a new bridge necessary in the first place? On the face of it, it is not obvious why Canadian bridges are routinely declared to have outlived their usefulness in decades, while European bridges are functional for centuries.

Over-building of bridges and roads exacerbates the difficulties Winnipeg will face in future. Increased road and bridge capacity has two consequences: First, an improved route draws traffic as it becomes the route of choice for drivers who previously favoured other routes. Sooner or later, this increases pressure on City Council for further road works. For example, traffic line-ups at a bridge entrance may be replaced by line-ups of vehicles on the bridge waiting to exit onto a narrower road. Such consequences are not unanticipated by engineering staff, and resulting public demands for widening of the road leading away from the bridge may be seen by them as long-overdue recognition of necessities they understood to begin with.

A second consequence of increased bridge and road capacity is reduced travel time to the urban fringe, which leads to an increase in the economic viability of sprawl and leap-frog development. The upshot is intensified political pressure from developers for the approval of subdivisions that will be costly to serve – pressure the councils of slowly-growing cities have frequently shown themselves unable to resist, precisely because they are predisposed to see rapid growth as a self-evident virtue. And

once the new, typically low-density, auto-dependent subdivisions are built, they provide a fresh supply of citizens who have no convenient means of getting around other than the private automobile. It is a vicious cycle, in which each new attempt to solve the problem of allegedly inadequate road capacity has the ultimate effect of exacerbating it. (Downs, 1992, 27-33).

The high priority accorded to road projects tends to crowd out alternatives. In Winnipeg, City Council has readily agreed to one road project after another, heedless of the fact that each one exacerbates the sprawl dilemma. Meanwhile, transit facilities that could contribute to the amelioration of sprawl are postponed indefinitely. Since the mid-1970s, plans have been underway for the construction of the Southwest Transit Corridor, a rapid transit line consisting of cost-effective diesel buses running on a concrete strip dedicated exclusively to transit.

The Southwest Transit Corridor is considered viable because it connects two population concentrations – downtown and the University of Manitoba – along the relatively heavily-populated Pembina Highway corridor. It would ameliorate traffic congestion along Pembina Highway – the artery connecting the University of Manitoba with the inner city – and encourage cost-effective, compact development along the route, in contrast to road and bridge projects' encouragement of sprawl. Estimated total cost for the entire facility would be \$70 million (City of Winnipeg 1997) – less than the lower-cost alternative for the Norwood Bridge, which was deemed inadequate. However, the estimated cost is a moot point, because postponement of the project has been a routine feature of City Council's annual budget deliberations for at least two decades.

Alternatives

Councils need to reconsider their indiscriminate compliance with road proposals, to the neglect of alternatives. Politicians need not accept the norms of traditionally-minded engineering designers and managers as the major determinant for the extension of transportation infrastructure. As well, instead of (in effect) delegating to developers the right to decide where the city will expand, cities could exercise their authority to determine the location, development mix, and densities of new subdivisions.

In theory, that power is being exercised now by city councils through their planning departments, but in practice the main influence

over those decisions rests with developers. Alternative models are available, both for the planning of roads and transit, and for more compact forms of development. Ironically, they are beginning to be applied in rapidly-growing cities, (City of Calgary, n.d.; Oregon Department of Transportation, 1995; 1000 Friends of Oregon, 1997) while many slow-growth centres such as Winnipeg continue to ape what they imagine to be the winning ways of rapid growth.

To stick with the main example, Winnipeg could have developed very differently. It seems very likely that the Norwood Bridge project could reasonably have been much more modest than it was, if it was necessary at all. With a less auto-dependent, more compact form of development, the suburban road system – of which Bishop Grandin is only one example – could have been less extensive, and the transit system less of a drain on the treasury. In their development of roads, as well as the full range of other municipal services, governments are allowing their cities to expand rapidly, at ever lower densities, primarily in response to developers' calculations about where the profit picture looks favourable for them, without serious consideration of how all of these developments will be tied together with infrastructure and services.

When a proposal for a new subdivision is brought to Winnipeg city planners, three cost factors are taken into consideration: roads, underground municipal services (sewer and water service) and parks. If the subdivision proposal incurs extra costs in any of these areas, the developer is responsible. When negotiations are complete, and the subdivision proposal comes before City Council, the typical reaction is delight over the fact that a sizable chunk of new tax assessment will be added to the city's coffers with the developer covering all the costs.

Forgotten is the fact that the transportation pattern has a large influence on the full range of municipal services. Once the new, allegedly no-cost, subdivision is in place, the new residents rightly argue that, as residents and taxpayers of Winnipeg, they deserve services comparable to those that other residents enjoy. City politicians have no valid answer when they ask: Why is there no conveniently-located library branch and community centre? Why are police and fire response times here slower than in other subdivisions? Why do we not have a neighbourhood school? City council and school boards have no politically realistic alternative but to spend money to meet the demands.

It is easy to see, therefore, why – with Winnipeg expanding at ever lower densities –

residential property taxes have reached tax-revolt levels, while downtown infrastructure deteriorates. Indeed, the problem is now largely out of the hands of City Council. For some time, residents of the metropolitan area have been voting with their feet, and accepting the property tax reductions they can achieve by moving beyond the boundaries of the city. Businesses are beginning to follow. With ex-urban migration underway, City Council has lost much of the control it once might have exercised over new development. Developers now have alternatives: if the city is not sufficiently generous in dealing with residential subdivision proposals or commercial developments, it is becoming increasingly easy for them to find a parcel of land for a similar development in an adjacent municipality.

Unsustainable development

Recent studies suggest that these patterns of development are, in the long run, unsustainable or at least dangerously cost-ineffective in any urban area (Blais, 1995; CUPR, 1996; Greater Toronto Area Task Force, 1996). Even the wealthiest and fastest-growing metropolitan areas have experienced inner city deterioration in the face of uncontrolled suburban and ex-urban development. The South Bronx turned, first into a jungle and then into something resembling a post-war saturation bombing victim, as Queens and Long Island expanded. Most of downtown Detroit became an unoccupied wasteland ringed by older neighbourhoods and prosperous suburbs.

Such decay is a complex phenomenon, and some of its causes can be sought in such disparate phenomena as family breakdown, crime, welfare dependency, inadequate education and de-industrialisation. However, there is no doubt that untrammelled suburban expansion, and the flight of the middle class from the inner city, is a major cause. In the long run, therefore, the typical North American metropolitan development pattern seems likely to be sustainable only at the expense of inner city deterioration, usually followed by deterioration of the first ring of suburbs.

That is bad enough, but the problem is even more acute for slowly-growing cities. A rapidly-growing city can mask the costliness of sprawl development, at least for awhile: a leap-frog subdivision approval may not incur an immediate financial penalty if growth potential is strong enough to assure, within the foreseeable future, that infill development will help to pay for the needed infrastructure. Downtown decay may not occasion immediate alarm when

there are proposals for commercial developments to replace decaying downtown residential districts, though it is unlikely that, in the longer run, simply filling empty spaces with office towers will suffice as a strategy for the prevention of decay.

Whatever the situation in a fast-growing centre, the piper demands immediate payment when the city council of a slowly-growing city calls the low-density tune. Here there are no heavy pressures for new development, and assurances of growing tax revenues, to cover up mistakes. Politicians in cities like Winnipeg, and provinces like Manitoba – in cities like Des Moines and Omaha and states like Iowa and Nebraska – need to understand that their mistakes will catch up with them, possibly within their current term of office.

For them, it is important, not only as a substantive matter, but also from the viewpoint of realpolitik, to be conservative in their approvals of subdivisions and new roads, to support infill development and more compact forms of development, to seek out viable alternatives to private automobile trips, and to instruct their officials accordingly. In not doing so, many slow-growth cities have passed up their chance to remain viable and attractive places to live.

Conclusion

It is possible, however, to end this bleak discussion on a positive note. There are signs (see Leo with Beavis, Carver and Turner, 1998) that local authorities are moving beyond the narrow, new-roads-to-new-subdivisions approach to urban expansion and taking instead a regional approach that considers the implications of development decisions for the inner city, for the environment and for the region as a whole.

There is also a different wind blowing in the engineering profession. Many younger engineers are sensitive to the environmental and social dimensions of transportation design and are more oriented to collaborative decision-making processes than the traditional-minded members of the profession. In future, these younger engineering designers and managers are likely available in growing numbers to offer constructive technical advice to politicians and citizens interested in promoting an approach to urban growth that takes the well-being of the entire urban region into consideration.

Regionally-focussed approaches to urban development, known by various names, including Regional Growth Management and Smart Growth, are already fairly well-

established in a number of jurisdictions, including Oregon, Florida, New Jersey and Washington state, and are drawing influential support in many jurisdictions throughout North America (Leo with Beavis *et al.*, 1998). Much of

this remains little more than ambitious talk, but if, in the end, it produces action in a significant number of jurisdictions, our roads of excess may yet lead to the palace of wisdom.

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Area-Wide Traffic Management: An Innovative Strategy for Urban Centres

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Abstract

This study compares and contrasts a traditional view of traffic management with an emerging, broad interpretation that supports sustainable development. We then summarise recent research we undertook to examine the feasibility of applying sustainable transportation principles within Vancouver's downtown in a comprehensive programme called area-wide traffic management (AWTM). AWTM attempts to improve transportation efficiency by reducing over-reliance upon motorised vehicles within urban centres.

Keywords

Efficiency, equity, innovative solutions, traffic management, sustainability, Vancouver

Introduction

A recent *State of the Environment Report* defined sustainability in urban settlements as reducing the resource inputs to a city (land, water, energy and materials) and waste outputs from the city (solid, liquid and gaseous) while simultaneously improving human livability (income, employment, housing, accessibility, community and health) (Australian Commonwealth Government, 1996). Transportation has a significant impact on all of the parameters listed (Bank of America *et al.*, 1995; Ewing, 1995; Litman, 1995, 1996; Newman, 1996; Newman and Kenworthy, 1988; Roseland, 1996b, 1997, 1998; Whitelegg, 1996). Transportation planning and traffic management initiatives are therefore central to sustainable urban development.

This paper compares and contrasts a traditional view of traffic management with an emerging, broad interpretation that supports sustainable development. We then summarise recent research we undertook to examine the feasibility of applying sustainable transportation principles within Vancouver's downtown in a comprehensive programme called area-wide traffic management (AWTM). AWTM attempts to improve transportation

efficiency by reducing over-reliance upon motorised vehicles within urban centres.

The research identified 36 traffic management measures that were potentially applicable within the study area. A multiple accounts evaluation involving social, economic and environmental criteria (see Box 1) as well as a cost effectiveness analysis helped to reduce the total number of measures under consideration to 30. The cost effectiveness analysis examined the relative cost to government, individuals and private firms of alternative methods for reducing overall vehicle kilometres travelled (see Davidson, 1997). Finally key stakeholders were questioned in order to assess the feasibility and acceptability of the remaining measures.

Box 1: Assessment Criteria

<i>Mobility and Access:</i>	Congestion Reduction, Access
<i>Environmental:</i>	Local Air Pollution Emissions, Livability
<i>Travel Impacts:</i>	Reduction in Vehicle Kilometres Travelled, Reduced Trips
<i>Socioeconomic Impacts:</i>	Capital Costs, Operating Costs, Economic Equity
<i>Acceptability and Feasibility:</i>	Legislation Required, Degree of Co-ordination Needed, Political Support

The findings suggest that AWTM is an innovative planning strategy that is applicable within North American urban centres and which has exciting implications for North American city centres struggling to balance social, economic and environmental imperatives.

Traffic Management Narrowly Defined
Although traffic management is practised in towns and cities throughout North America, the term remains a multi-faceted notion that may be variously interpreted. On the one hand, there is a narrow interpretation of traffic management. In this case, the sole objective of traffic engineers has been to move vehicles in and around communities as rapidly and efficiently

as possible (Sale, 1980). Management strategies associated with this interpretation include, for example, designation of one way streets, synchronisation of traffic signals, road widening and construction of left hand turn bays.

and by reducing many privileges and road space which in recent years have been given uniquely to the car" (Monheim, 1986, p74). It focuses on the whole road network, the public transport system, land use and all different transport modes. AWTM takes this broad interpretation and applies it to a specific geographic region.

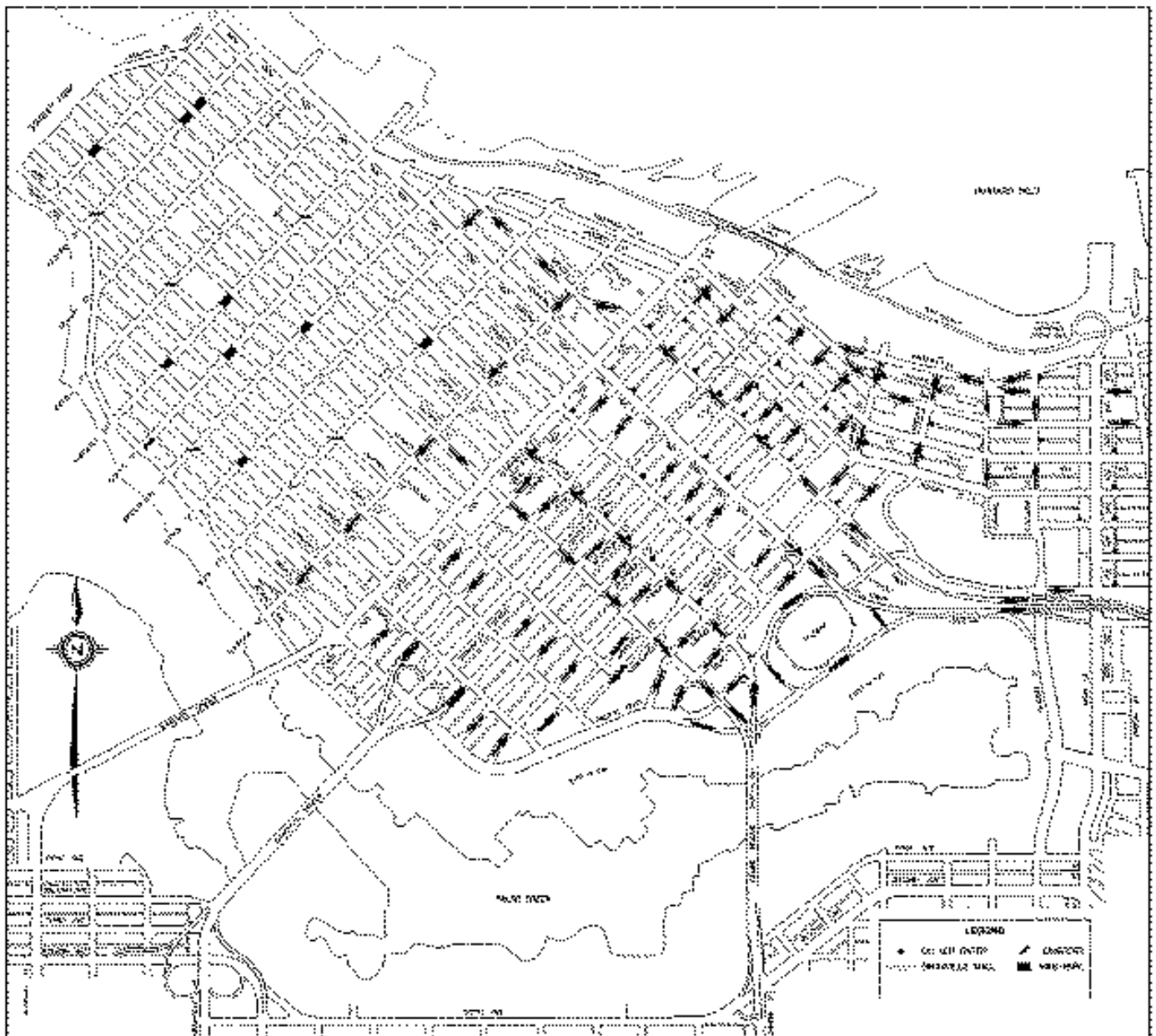
Traffic Management: A Broad Interpretation

A broad interpretation of traffic management focuses on improving the efficiency of the transportation system by influencing when people travel, how they travel and how far they need to go to reach major destination points. It "tries to reduce car traffic in general by changes to other transport modes, i.e. change from car use to walking, bicycle and public transport,

Area-Wide Traffic Management

Although AWTM is practised in Scandinavia, the Netherlands, Italy, Switzerland, Japan and Germany (Monheim, 1986), it has not been attempted in any North American cities. We therefore decided to investigate the feasibility of implementing an AWTM programme within downtown Vancouver (see Map 1).

Map 1: Downtown Vancouver



The Study Area
Downtown Vancouver is bounded by Burrard Inlet to the north, False Creek to the south, Stanley Park to the west and Main Street to the east. The area houses over 120,000 workers and

Box2: Area Wide Traffic Management Measures

A Enabling Programmes

1. Development of a co-ordinating body to oversee implementation and monitoring
2. Least cost planning and funding
3. Public education, communication and encouragement
4. Co-operation between local government, community and non-profit sectors as an inexpensive means to deliver AWTM measures
5. Co-ordination within and between businesses to help deliver trip reduction programmes more efficiently
6. Management and regulation of special transport classes and activities (freight, special events, etc.)
7. AWTM programme monitoring and adjustment

B Land Use

1. Jobs and housing balance

C Transportation System Management

1. HOV lanes and preferential treatment
2. Allowing strategic congestion

D Transportation Demand Management (TDM)

D1 TDM incentive programmes

1. Increased fuel tax
2. Road pricing
3. Prorating of insurance, licensing and registration by mileage
4. Increased and marginalised parking prices

D2 Voluntary measures that encourage alternative modes and reduce automobile ownership

1. Development of car co-operatives and encouragement of car rentals
2. Telecommuting
3. Guaranteed ride home programme
4. Voluntary commuter trip reduction programmes
5. Alternative work hours
6. Transportation allowance

D3 TDM regulatory measures

1. Cashing out paid parking
2. Trip reduction by laws (TRBs)
3. Vehicle restrictions
4. Parking supply restrictions and relaxed requirements
5. Preferential parking for rideshare vehicles

E Traffic Calming

F Improving Other Modes

Pedestrian

1. Addressing security concerns
2. Pedestrian environment and facility improvement

Cycling

1. Bicycle and transit intermodal treatment
2. Bicycle network improvements
3. End of trip facility improvement

Transit

1. Service innovations
2. Payment innovations
3. Rail system development
4. Integration of taxis and shared services into transport system

Adapted from: Litman, 1995

has a resident population of over 50,000. Although Vancouver does not come close to achieving a housing to jobs balance, it has, nevertheless, the highest downtown housing density of any city in North America and offers a mix of shops, services, and recreational destinations within walking distance.

The road system includes a series of one way streets, shown on Map 1. Most major roads leaving and entering the core have synchronised traffic signals to allow general traffic to move efficiently. There are about 0.353 off-street parking spaces per employee in the downtown central business district. This ratio is relatively high in comparison with other major cities in Canada. Toronto, for example, has 0.122 while Ottawa and Montreal have 0.278 and 0.264 respectively. Because there is ample parking, the majority of workers enter the core by car. During the morning peak 55% of people enter the downtown by car, 46% as drivers and 9% as passengers. This occurs despite a commitment made by Vancouver City Council in 1974 to limit parking to serve only one quarter of all downtown workers.

Vancouver has a policy of giving priority to pedestrians over other vehicular traffic. Yet, the transportation system within the downtown is not designed to prioritise the needs of pedestrians over other modes. For example, traffic signals often give priority to turning vehicles, there is often little buffer between pedestrians and curb lane traffic and signalisation is timed based on the flow of vehicular traffic. Vancouver has also continued to develop shopping facilities in segregated malls, despite evidence that such facilities draw traffic away from the street level, leaving such areas barren and uninviting (Robertson, 1993; Wascoe, 1984).

Facilities for cyclists are slowly improving. There are bike racks throughout the core and there is a bylaw in place that requires new developments to provide secure parking, shower and change room facilities. On the other hand, none of the streets provide bike lanes. Bike racks are available on several inter-urban buses, but there are no plans to expand the service.

Downtown Vancouver is served by inter-urban and local buses, a sea bus from North Vancouver, the SkyTrain elevated light rapid transit line that originates in Surrey, an eastern suburb and the West Coast Express commuter rail service serving the suburbs to the north-east. In order to maintain auto trips to the core at a manageable number, the regional government has projected that the number of daily transit trips to the downtown must increase by over 37% between 1991 and 2006.

Regional services have improved somewhat in recent years with the purchase of additional SkyTrain cars and with the introduction of the West Coast Express. Yet service on the majority of local bus routes serving the downtown has actually deteriorated over the last 5 years (Judd, 1996). Overall it is unlikely that transit will be able to achieve the projected increase, given that BC Transit plans to reduce, not increase, service over the next five years.

Elements of Area-Wide Traffic Management
Since the 1980s there has been an enormous growth in the number and range of traffic management measures. An initial literature review identified 36 separate measures that seemed as though they might be applicable within downtown Vancouver. Although there is no accepted list of taxonomies into which different measures fall, this study grouped measures into six separate categories for ease of comparison and organisation. Box 2 lists some of the categories and measures.

Examining The Feasibility of Area-Wide Traffic Management in Downtown Vancouver

The Research Programme

Each of the measures were reviewed using a multiple accounts evaluation involving social, economic and environmental criteria and a cost effectiveness analysis. These assessments helped to divide measures into high and low priorities. Low priority measures were eliminated from the final assessment that examined the acceptability and feasibility of the recommended measures from the perspective of key stakeholder groups.

High priority measures were those that would be suitable for immediate implementation. Generally, these measures enjoyed strong or fairly strong political support and had the potential to reduce vehicle travel to, from and within the downtown. Low priority measures were those which did not have strong political support or whose overall benefits were uncertain or suspect. These programmes may be justified in the future if the city does not manage to achieve transportation reduction targets using high priority measures, or once additional research has proven that they would be worthwhile.

Six measures were considered low priority and were eliminated from further consideration. They included an increased fuel tax, telecommuting promotion, vehicle restrictions, high occupancy vehicle lanes, a local road pricing strategy and a trip reduction bylaw.

The increased fuel tax would have increased the real price of gas by 50% and was given a low priority due to strong political opposition. Telecommuting promotion was considered ill advised unless matched with strong policies to reduce regional sprawl. Vehicle restrictions would ban non-resident traffic in downtown residential neighbourhoods during certain periods. They were given a low priority since implementation is difficult, while political opposition and operating costs are potentially high. High occupancy vehicle lanes were given a low priority since they have a tendency to draw users from transit, thereby reducing the long-term capacity and effectiveness of the facility. Instead, transit only lanes are a preferred option within high density nodes.

The local road pricing strategy would require auto drivers who visit the downtown frequently to display a valid transit pass on their windshield. This tactic could encourage increased transit usage, however it would be difficult to enforce and might make suburban destinations more attractive, thereby reducing equity and effectiveness. The proposed trip reduction bylaw would have required each business to implement various trip reduction measures with different levels of participation based on the size of the business and its access to transit. This measure was given a low priority due to strong political opposition as well as the possibility that administrative costs might be high for government and businesses.

The Questionnaire

In order to test the feasibility and acceptability of the recommended measures we then administered a questionnaire to 15 key stakeholders. Respondents included:

- two members of the development industry;
- civic staff from five different departments, including Central Area Planning, Planning, Transportation Engineering, and a temporary group of staff called the Transportation Planning Team;
- two civic politicians;
- two representatives affiliated with different residents' associations;
- a BC Transit representative;
- two members of business associations; and
- one representative from the parking industry.

Individual respondents were required to demonstrate that they were familiar with the views of a particular constituency as well as a wide range of different transportation and land use related issues. Thirteen people responded to the questionnaire. The politicians were

unable to respond, they said, due to time constraints.

A measure was considered acceptable if respondents felt that it would be supported by members of their stakeholder group. A measure was considered feasible if it was something that respondents felt could be achieved, taking into account current social, political, and economic conditions. In assessing measures respondents were asked to rank them in the following manner: strongly agree, agree, unsure, disagree, strongly disagree, and no opinion. While respondents were asked to take the concerns and needs of their interest groups into consideration, responses were made personally and did not necessarily reflect the positions of such groups.

Findings

Respondents showed a high level of interest and awareness of the issues surrounding traffic management and took, on average, two hours to complete the survey. They felt that the majority of traffic management measures were acceptable. Twenty-three of 30 (75%) recommended measures were considered acceptable by the majority of respondents.

Feasibility, on the other hand, seemed to be a bigger concern. Sixteen of 30 (53%) recommended measures were deemed feasible by the majority of respondents.

However, in instances where respondents had doubts about the acceptability or feasibility of a measure they were often able to suggest viable alternatives. For example, 54% of respondents felt that it would be acceptable for the province to levy a region wide charge of \$1.50 per day on all vehicles used for the purposes of work and commuting. Yet only 30% felt that a commuter levy would be feasible to implement. In order to increase feasibility of this measure several respondents suggested directing the funds (over \$193 million per year) toward improved transit service. One respondent also recommended that those required to pay such a fee be given a transit pass as an incentive to avoid incremental trips by car. Such steps would likely enhance feasibility and acceptability of such a measure. Box 3 shows a list of measure that respondents found to be acceptable and feasible.

Several of the measures were considered feasible by the majority and were acceptable to 100% of the respondents. For instance, 100% felt that it would be acceptable for BC Transit to attempt to increase the number of prepaid riders from 52% to 70% for routes travelling to, from, and within Vancouver's downtown. 100% also felt that it would be acceptable to place bike racks on all inter-municipal buses thereby increasing the mobility of cyclists.

Comparing the views of different stakeholders Because the sample size was small, it is difficult to generalise about the views of various stakeholders. On the other hand it is important to compare differences so that those involved in future discussions are aware of any potential conflicts.

Differences of opinion occur not only between various stakeholder groups but also between members within each group. The views of City staff members for instance vary greatly. Responses by staff in the Planning Department and within the Draft Transportation Planning Team were similar in over 70% of the time. Views of the Transportation Engineering Staff agreed with other departments less than 45% of the time. It is perhaps because of such differences that planning staff recommended 'decision processes that cut across traditional functional boundaries'.

Predictably, interest groups were upset by measures which affected them directly. Developers, for instance, were upset by a suggestion that the City limit the number of parking spaces on lots awaiting development.

Box 3: Acceptable and feasible measures

Transit Initiatives

- Building bus bulges in the downtown to improve the speed and flow of transit vehicles (The opposite of a bus lay-by, a bus bulge is a curb extended to meet the buses so they do not have to pull in and out to wait for traffic. Bus bulges are a good way to speed up buses and improve the sidewalk environment.)
- Providing bus activated lights on busy streets so that buses can continue through lights if behind schedule.
- Ensuring that all transit stops in the core are well lit and comfortable.
- Constructing electronic bus schedule information boards at major transit stops indicating bus arrival times.
- Implementing a free downtown transit route that circulates through the downtown.

Land Use

- Continuing to change zoning within the downtown core to achieve a better balance between jobs and housing

Transportation Demand Management

- Promoting cashing out of paid parking amongst companies which lease car parking
- Relaxing workplace parking requirements by 10-25% in return for establishment and promotion of an employee trip reduction programme
- Establishing an aggressive voluntary trip reduction programme directed at employers, unions, schools, and neighbourhoods
- Supporting the establishment and growth of car co-operatives and local car rental agencies in order to reduce ownership of private vehicles

Traffic Calming

- Implementing traffic calming on some main streets within the downtown peninsula

Bicycle Initiatives

- Creating bike lanes within the downtown core
- Providing incentives toward development of bike storage and shower facilities within existing downtown offices
- Establishing enclosed bike storage at all Sky/Train stations

Developers often place pay parking on land awaiting development and use the proceeds from parking revenues to defray carrying costs.

Since TDM measures were first proposed governing bodies have felt, and continue to feel, strong opposition from particular interest groups faced with the burden of implementing specific measures. The Californian Regulation XV, for example, required employers with over 50 employees to significantly reduce the number of employees travelling to a particular destination. It has experienced strong opposition from affected businesses. As a result of this pressure government has been forced to implement changes that allow employers other alternatives for achieving targets such as green fleet procurement and even by paying a fee in lieu of compliance.

This research highlights a number of means of responding to resistance from particular interest groups. First it is important to allow flexibility where possible, as regulators in California were forced to do. Also regulatory agencies can propose measures that offset the impacts of other measures. In the case of developers, for instance, a limit on the number of parking spaces permitted on lots awaiting development is balanced with a measure that would reduce parking requirements at residential and commercial developments, thereby reducing development costs. In general a variety of complementary measures should be proposed as a package. This strategy ensures, as much as possible that stakeholders share both costs and benefits and provides incentives such as improved transit or financial gain thus making it easier for travellers to rationalise a change in travel habits.

Throughout the survey many respondents made comments regarding increased costs for car drivers. Some respondents were concerned that increasing the cost of driving to the core would discourage auto drivers from visiting the downtown and would eventually lead businesses to leave the downtown in favour of suburban locations. One respondent from the business community stated that, 'residential property taxes would have to be increased to offset declining commercial taxes due to the out-migration of business'.

Other respondents suggested that increased costs might increase activity within the downtown. A city planner suggested that one might expect to see a 'gradual change in live/work decisions to favour shorter trips' [and that, one could expect] 'improved long term viability as livability will attract business and workers'. Overall it appears that respondents do not object to increasing the costs of driving as long as it is on a region-wide basis and does not

disadvantage the downtown by increasing costs there disproportionately. This claim is supported by the fact that it was Vancouver's Downtown Business Association who first recommended a charge on all vehicles used for commuting and work related purposes as an alternative to a regional toll system.

The responses also suggested that there is growing tension between downtown residents and commercial interests. Residents strongly supported traffic calming on main roads while commercial interests feared that such changes would limit access to cars and delivery vehicles. There are however numerous examples from Europe that suggest that efforts to reduce the intrusion of vehicles into a downtown centre can improve livability and turnover simultaneously (Hass-Klau, 1993).

Significance of Findings

British Columbia has pioneered efforts in shared decision making in order to resolve disputes over natural resources and land use issues within remote areas of the province (Roseland 1994, 1996a). The Commission on Resources and the Environment (CORE) process, for instance, has brought together different stakeholder groups to collectively resolve land use designations on provincial crown lands.

By contrast, Vancouver's means for establishing transportation related policy is ineffective. Normally, political leaders establish transportation related policy after having heard the reports of planning staff as well as arguments from various stakeholders. This is ineffective because although it can involve debate, it does not leave room for the joint construction of innovative solutions (Guba, 1981; Campbell, 1996). The findings of the questionnaire suggest that a process involving negotiation between a variety of different stakeholder groups working toward a common resolution could be an appropriate means of developing a traffic management plan for downtown Vancouver.

A joint construction of solutions works best when all interested parties agree to participate, each party feels on equal ground, and there are a variety of potential compromises and innovative solutions (Crowfoot and Wondolleck, 1990). In responding to this survey, respondents have indicated a willingness to become involved in discussions regarding transportation and land use issues in downtown Vancouver. Since responsibility for transportation and land use is shared by a number of different groups, including private interests and various levels of government, it seems that the second criteria is also met, at

least to some degree. And considering the range of comments, it seems that there are a number of different solutions that might be feasible. Moreover, responses indicate that there is greater consensus regarding solutions than decision makers might realise. Consequently a process involving negotiation between a variety of different stakeholder groups working toward a joint construction of a transportation and land use strategy for the downtown seems feasible and desirable.

Conclusion

The results of this study suggest that Area-Wide

Traffic Management is a powerful tool that is applicable to the North American context.

This study, however, only marks a beginning. The transportation management measures that were given a high priority and which were considered acceptable and feasible could likely be implemented with little discussion. Other measures, such as the commuter levy, limiting excess long-term surface stalls on lots awaiting development, and insurance prorated by mileage, require further discussion. If planners and government representatives turn to stakeholder groups and empower them to jointly construct AWTM plans, they may find that such groups are able to come up with innovative and workable solutions.

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A Tea for the 21st Century: Sustainable Transportation in the USA

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Abstract

This paper assesses the Intermodal Surface Transportation Efficiency Act, and its benefits, implementation and effects. ISTEA has tremendous potential to lead change towards sustainable transportation. It encourages dialogue between NGOs and administrations, and a holistic approach to transportation planning.

Keywords

California, Chicago, ISTEA, New York, Portland, public policy, sustainability, transport, USA.

Introduction

This article was written following a four week study trip through the United States of America in April 1997. The purpose of the trip was to discuss the idea and application of the principles of sustainability to transport, as defined and adopted at the 1992 Rio Conference. The basic assumption of this report and the underlying study trip is the belief of the author, that the transport sector must adopt, and adapt to, the concept of sustainability, even though Agenda 21 does not deal specifically with transportation. This in general is felt to be a leftover, since the transport sector on the one hand is one of the major burdens on the environment (because of its steady growth rates, in particular greenhouse gas emissions) and on the other hand is vital for social and economic well-being. Therefore, little consensus exists in industrialised countries about what sustainable transportation means and to what extent transportation has to develop sustainably.

Applying sustainability criteria to the transport sector in the USA is not as well developed as it is in some European countries. The discussion about the environmental burden caused by transport mainly focuses on the standard air pollutants (CO, HC, NOx, Particulates). These pollutants are already covered by the Clean Air Act and the Clean Air Act Amendments, and thus the actual

discussion seems to focus around complying with legislation. Only little concern is given to noise, greenhouse gas emissions, ground and water pollution, and habitat destruction. Furthermore, passenger car traffic, and to some extent, heavy duty vehicle traffic are the focal point of measures. Other transportation modes, particularly rail traffic and aviation are not discussed to the same extent. The Intermodal Surface Transportation Efficiency Act (ISTEA, pronounced 'ice-tea') has changed that to some degree, since it has mandated the United States Department of Transportation to create the Bureau of Transportation Statistics. Each year the Bureau reports a comprehensive statistical assessment of the nation's transportation system to the office of the President. The 1996 report focuses on 'transportation and the environment'. This report covers in its 110 theme sections all major aspects of transportation and the environment including noise, habitat destruction, urban sprawl, greenhouse gas emissions and externalities. To that end, this report may be crucial in intensifying the debate about the effect of transportation on the environment. See Box 1 for some basic facts about transport in the USA

Discussion about sustainable development has started in the USA. Up to now the main

Box 1: Basic facts about transport in the USA

During the last 25 years, vehicle-miles travelled (VMT) has grown faster than both population and gross domestic product.

Particulate pollution may contribute to the death of 60,000 people each year in the USA.

Transportation is responsible for 30% of the CO₂ emissions (second biggest sector after power plants). Transportation's share of pollutant emissions lies at nearly 80% for CO and nearly 50% for NO_x and VOCs. As much as one-half of urban and suburban areas are paved for roads and parking.

On an international basis the USA has the most extensive road system (rank 1 in total road miles, VMT and VMT per person).

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focus and consensus has been reducing greenhouse gas emissions to a 'sustainable' level, while other air pollutants have been considered of less importance - except among transport and the environment advocates. Of greater concern has been reversing urban sprawl because it 'doughnuts' livability in city centres. Equity aspects in providing access for all (in particular for black and poor communities) and giving alternatives to the single occupancy vehicle (SOV) are of further importance. In a nutshell, there are two views to be considered: one group believes in technological fixes to reduce greenhouse gas emissions, and the other group sees the need for VMT reductions and changes in land use patterns. There was some consensus that financial measures, both carrots and sticks, need to be implemented, although it is recognised that public acceptance will prove difficult. A critical point for most stakeholders is the question to what extent intelligent transportation systems can be helpful.

Nobody discusses sustainable transportation for all modes. While passenger car traffic in the USA is subdivided between SOV and high occupancy vehicles (HOV) - (two or more passengers), freight transportation plays a subordinate role, and aviation is not considered by most.

The Intermodal Surface Transportation Efficiency Act

In the US roughly 20% of the cost of road infrastructure is financed by federal revenue, 40% with state capital and 40% by local government and/or private bodies. In 1990, the 44,000 miles of Interstate Highway System, which was initiated in the 1940s and financed by the Highway Trust Fund with dedicated federal fuel tax, was almost completed. However, problems such as air quality, congestion, inadequate maintenance of roads and bridges, poor alternatives to the car and urban sprawl continued. This was the situation when the new federal transportation funding law, the Intermodal Surface Transportation Efficiency Act, was enacted. For the first time, a more comprehensive look at transportation has been part of federal infrastructure financing. ISTEA has replaced and combined different funding programs for transportation systems (in particular the long standing highway program of US Code, Title 23 and the Urban Mass Transportation Act of 1964). The new funding has generally been more flexible, has strengthened local planning authorities and public participation, has encouraged better use and maintenance of the existing system rather

than enlarging it, has put environmental considerations into the planning process and has created a new 160,000 miles National Highway System of existing roads. The principal annual funding categories of ISTEA and their budget shares are shown in Table 1.

Table 1: ISTEA funding categories and budget allocations

Interstate Maintenance Program	14%
Bridge Replacement & Rehabilitation Program	13%
National Highway System ¹	17%
Congestion Mitigation and Air Quality Improvement Program	5%
Surface Transportation Program ²	20%
Miscellaneous small program and dedicated single projects	31%
Notes	
1 flexible to some extent for new transit projects along corridors	
2 includes Transportation Enhancement Program	

A crucial change in the policy has been the flexibility of some programs which allowed funding to be used not only for highway expansion and maintenance but also for transit projects and non-motorised traffic. Furthermore, ISTEA has defined a new role for local and regional planning authorities. The decision making power has been shifted away from federal and state departments of transportation (DoTs) to Metropolitan Planning Organizations newly established in urban areas with more than 50,000 inhabitants. These organizations are responsible for developing Long Range Plans with a twenty year horizon and three year Transportation Improvement Programs. These Long Range Plans and Transportation Improvement Programs have to conform to the Clean Air Act Amendments, in particular achieving the National Ambient Air Quality Standards. Long Range Plans and Transportation Improvement Programs are an integral part of State Implementation Plans which are mandatory in non-attainment areas (too high air pollution) as defined by the Clean Air Act Amendments. To that extent ISTEA forms the basis for a legal binding between transportation and environmental considerations². Furthermore, ISTEA and the Clean Air Act Amendments have given new impetus to transport demand management (TDM), although implementation thus far has failed to reduce congestion and emissions³.

Sustainable Elements of ISTEA

Special consideration needs to be given to new elements of ISTEA which were established to meet particular environmental needs. The

Congestion Mitigation and Air Quality Improvement Program is a new ISTEA funding category. The CMAQ Program has been designed to help states to attain, and remain at, the National Ambient Air Quality Standards. Programs had to show a potential to reduce transport emissions before being financed. CMAQ programs have included transit improvements (no operational costs), traffic measures, rideshare and TDM initiatives, enhanced Inspection and Maintenance programs, and some bike and pedestrian projects. In this context it should be clear that congestion mitigation is believed to reduce emissions as well, although there are some doubts: NOx emissions may rise with higher speeds than with stop-go conditions and traffic induction may occur as people become aware that a former bottleneck is less congested. The federal Environmental Protection Agency (US-EPA) has done some investigations on the emission reduction potential of Congestion Mitigation and Air Quality Improvement Programs and has concluded that it has been quite successful in reducing CO, VOCs and NOx⁴. The study has estimated emission reductions of up to 16% of total on-road VOCs emissions and up to 23% of NOx and 10% of CO emissions. Some opposition has been stated against these calculations, since the analytical tools to evaluate measures such as TDM are very uncertain⁵.

The Transportation Enhancement Program, funded by 10% of the Surface Transportation Program, has allowed the use of federal dollars for non-motorised transport in the USA for the first time. This fund – although small in comparison to the total ISTEA funding – has been very successful in improving provision for cycling. California and New York, in particular have benefited greatly from this expenditure⁶.

Examples of the ISTEA decision making process

Much has changed in transport decision making since the implementation of ISTEA. In particular, the participation and involvement of NGOs and citizen groups in the process has changed the 'closed-shop planning mentality' of the pre-ISTEA era. Some examples may help:

The Tri-State Transportation Campaign
In New York the Tri-State Transportation Campaign, comprising 13 consumer and environmental NGOs, is calling for a more environmentally friendly, safer and socially-equitable transportation system for the city region which encompasses the three states of

New York, New Jersey, and Connecticut⁷. In particular, this campaign is encouraging the proper application of ISTEA by these states and the Metropolitan Planning Organizations. In addition, it is lobbying for the spending of money on transit, cycling and pedestrian facilities and on maintenance of existing infrastructure; contesting any highway expansion proposals; recommending congestion solutions such as congestion pricing; and pressing for reauthorisation of ISTEA. At the same time, the Campaign regards ISTEA as a somewhat schizophrenic act since it authorises a list of 16 specific highway projects (decided upon in the National Transportation System, 1995) as well⁸.

ISTEA progress so far can be described as follows: For state DoTs it is no longer possible to close the doors on environmental groups. Joint projects by different NGOs in society (business, citizen and environmental groups, etc.) can be considered and to some extent public participation in decision making is acquired.

There are increasing doubts that the states do not know what proper use of ISTEA money means⁹. The most important part of ISTEA, the administrations to decide upon the actual needs of the region and allocate Surface Transportation Program money subsequently, was not fulfilled in NY. New York has not used the new flexibility of this Program, but instead pursued a policy of 'business-as-usual' – it has spent money on maintaining bridges and extending highways, while no additional money was used for new transit capacity. The intended strengthening of planning procedures of the Metropolitan Planning Organization was not fulfilled in NY, since MPO employees historically were dependent on the state DoT. Although a Long Range Plan was drafted in NY, this plan is neutered by current policy decisions.

ISTEA was not effective in influencing state, MPO and city policy on transportation; but it was not expected that the existing culture of transportation thinking could be changed within 5 years. Given that ISTEA mandated a stronger public participation, some progress in the NY region has been made. In particular the Enhancement Program and the Congestion Mitigation Air Quality Program can be described as successful for non-motorised transport and transit in NY, lead by the pressure of NGOs like Transportation Alternatives.

Complaints were expressed about the poor role US-EPA played in the eyes of NGOs. US-EPA has tended to focus too much on stationary sources of pollution, allowed too many exemptions to the mandated Inspection and

Maintenance programs in non-attainment areas, and relaxed the conformity requirement of ISTEA and the Clean Air Act Amendments. A key issue is the debate about the Tappan Zee Bridge (crossing Hudson river between NJ and NY), run by the NY Thruway Authority. On this bridge user tolls are already collected and a congestion depending toll system may be introduced, which gives rebate for multi-users. Citizens and environmental groups are demanding more environmentally-sound changes to these suggestions¹⁰.

The Center for Neighborhood Technology In Chicago, the Transit Authority wanted to close the old Green Line (elevated/subway trains) in 1993. This was due to its poor economic efficiency, its need to be modernised and its decreasing ridership. Although these plans caused community outrage, the mayor chose to back a trolley project for the downtown area to link major tourist attractions, in particular the newly renovated Navy Pier and the expanded convention centre instead of supporting funding to save the Green Line. It was proposed that this trolley project be financed from the 'New Starts' program of the discretionary fund in the Mass Transit Account (of which 58% comes from the Highway Trust Fund).

The Center for Neighborhood Technology provided citizens groups with basic information and supporting their participation in public community planning processes, supported a campaign against this proposal¹¹. The Center argued that the Chicago region is a non-attainment region and helped citizens become more aware and articulate of their basic transportation needs – which were better met by the existing Green Line. Since ISTEA strongly mandates reinvestment rather than new investment, the decision could be revised. Accordingly, the Green Line has been reconstructed (\$300 million ISTEA money was used), redevelopment has been started and promoted in the vicinity of the transit stations and Congestion Mitigation and Air Quality Improvement Program funding has been used to construct 'super stations'. Now the Green Line provides citizens with basic needs (local authorities, social services, shops, etc.) and gives improved transit access at the same time. This success helped Chicago citizens better to understand what ISTEA means. A coalition of 128 citizens group joined together to work on an alternative Long Range Plan, since the originally draft plan, the Chicago Area Transportation Study, was not well balanced.

The Center for Neighborhood Technology supports the national lobbying work of the

Surface Transportation Policy Project for a strongly reauthorised ISTEA. In particular the Center supports proposals to improve social issues in ISTEA by establishing a \$100 million 'welfare to work' program. The Center wants Amtrak to be included in ISTEA funding and that the money of the highway safety programs can be used as well for pedestrians safety.

Portland Metro

Portland Metro in Oregon is an independently elected regional government responsible for transportation, land use planning, waste management, parks, cemeteries and the zoo. In the framework of ISTEA Portland Metro has the function of a metropolitan planning organization. It is ruled by an elected council and its executive officer is directly elected; additionally a committee (representatives of the counties, agencies, state) makes recommendations. Portland Metro is totally independent from the state DoT. Since Oregon has a tradition of public participation (elections and referenda have had participation rates of up to 60%) and regional governments, the new requirement of ISTEA were easily to fulfil.

Portland is an exceptional region in the US in terms of land use, transportation planning and public participation. Urban growth boundaries limit developments to the already built-up areas. The downtown area was redeveloped, some streets closed to vehicles except transit and non-motorised traffic, former parking sites and a riverside highway were redeveloped (new buildings, public space, parks). A recently planned freeway was stopped by a referendum and a new light rail project was realised instead. This line is being extended at present, and a new line is being planned. The light rail projects are funded 75% to 80% with federal money. As the constitution of Oregon does not allow state gasoline tax revenues to be used for anything other than highways, Oregon therefore uses the flexibility of ISTEA money to fund over-proportionally transit projects.

California Air Resources Board

ISTEA has been a very important tool in California in nudging transportation in a more sustainable direction. ISTEA funding is the biggest piece of all public spending for local authorities today. The federal ISTEA money is about 17% of all public spending for transportation in California¹². Decisions how to spend the money in California are undertaken quite independently by the metropolitan planning organizations and not by the California DoT (Caltrans).

The Congestion Mitigation and Air Quality

Improvement Program has not been successful in reducing emissions, but it has led the transportation system a little bit in the right direction and has been very good for introducing experiments such as congestion pricing. 50% of the money has gone in transit programs, but the need to improve services and renovate buses was neglected. Therefore the Transportation Strategies Group of the California Air Resources Board has put its emphasis on cost-effectiveness of the ISTEAs programs. The Air Resources Board has developed a cost-effectiveness toolkit to compare different modal projects. The TDM programs of the South Coast Basin are considered to be quite successful. While vehicle occupancy has gone down everywhere in the state, it has been stabilised in Los Angeles due to the introduction of HOV-lanes and rideshare rules. By law any Californian employer in a non-attainment area with more than 200 employees has to develop a plan which demonstrates how the average vehicle occupancy can be improved every year. The Air Resources Boards of the districts check these plans. Many employers dislike these programs and therefore the expected reductions have not been achieved¹³.

Southern California Association of Governments
The Southern California Association of Governments – the metropolitan planning organization of the Los Angeles region - expects a population growth of 44% within the next 20 years (85% of this growth from births). It is anticipated that this growth will be accompanied by a dramatic increase in vehicle traffic. Although California has the tightest emission standards for new vehicles attaining air quality standards is a big challenge. However a new urbanism movement is developing in the LA region, with support from former Governor Jerry Brown, the Local Government Commission and the Livable Community Initiative. Those groups, including the Surface Transportation Policy Project¹⁴, are recommending that monies be invested once again in cities, rather than in major highway infrastructure, thus fulfilling the principal idea of ISTEAs.

The Southern California Association of Governments is being encouraged to focus on the livability of communities. These developments maintain a tense contradiction to the foreground reality of the LA region. However, neighbourhood groups are fighting for traffic calming, for improved pedestrian space in city centres, for transportation alternatives (metro and better bus services), etc. Therefore,

many communities and urban situations, each with a very different quality of life, exist in the LA region.

The implementation of ISTEAs in this region could be improved. The Southern California Association of Governments has very limited power, compared to Caltrans. The Metropolitan Transportation Agency is responsible for highway planning, construction, and maintenance and for operating the transit system. To that end the Agency has problems balancing its spending for roads and transit, being influenced by the highway lobby and Caltrans. Some counties and cities in the region are planning to leave the MTA (e.g. Orange County), while some cities are already running their own transit company (e.g. Santa Monica).

Conformity with Clean Air Requirements

A very critical issue of ISTEAs is the conformity requirement both in implementation and in political discussion about the law. The Clean Air Act Amendments of 1990 requires all states to draft a State Implementation Plan for their non-attainment areas. These State Implementation Plans have to show that all transportation actions are aimed at achieving the National Ambient Air Quality Standards within a certain time frame.

Transportation activities shall not cause new violations of standards; shall not increase existing violations; and shall not delay attainment of the standards.

Since ISTEAs's overall goal has been to focus the transportation sector's actions on attaining the air quality standards, it became clear that Transportation Improvement Programs and Long Range Plans have a crucial part to play in achieving this objective. This condition projects the regional air quality impacts of an area's proposed transportation system using a stepwise consultation process; first at state level, where the state EPA, in consultation with the various agencies, considers whether the Transportation Improvement Programs and Long Range Plan as drafted by a metropolitan planning organization complies with ISTEAs. Then the federal EPA, combined with an intense consultation process, contemplates it again. Should it fail, the US-EPA is mandated to implement a penalty – the withdraw of federal ISTEAs money. To date, this penalty has not been applied, since its implementation involves the political process.

The sense that there were tough hurdles was very clear and this had a bearing on changing state and metropolitan transport and air quality strategies¹⁵. However, US-EPA for the first time in November 1993 tried to implement a penalty¹⁶. Hearings at Congress in Washington forced US-EPA to reduce the proposed fine. Be that as it may, some experiences with the process were made: at first intensive talks between the related agencies took place (environmental, transportation and metropolitan planning organizations). In every case there was a public meeting before approving transportation implementation plans. In none of the cases were projects or funding withdrawn (mainly for political reasons) but projects were adapted more in line with environmental needs. The Kennedy School (Harvard University) is currently undertaking an evaluation study. At the same time the Department of Energy is developing a new procedural model and analytical tools¹⁷.

Reactions and experiences have been very different in each state. A recent study of the National Governors' Association has explored the experiences of 14 states¹⁸. While a majority of the states in general had no problems, and welcomed the need to link air quality and transportation, some states found it bureaucratic and less effective. Anyway, the process was found to be too complex and was not served by precise analytical tools. Regarding the development of the analytical tools the problems are: on the one hand the emission factors don't allow a detailed analysis of the driving behaviour changes and on the other hand the effects on traffic – on VMT as well as on driving behaviour – themselves are very uncertain. In particular transport control measures, following the National Governors' Association study, were not found to be effective in reducing emissions. Transport control measures are aimed at decreasing the SOV mileage, by the introduction of HOV lanes and promoting rideshare programs. Originally the Clean Air Act Amendments requires areas with the worst air quality to implement employee commute option programs, which mandates large employers to reduce the number of SOV to work. This very strict measure was watered down to a voluntary program in 1996. Compliance was only enforced in an interim process in pilot projects before US-EPA laid out its final rules. The transportation models used by metropolitan planning organizations were those provided by US-DoT, some states have or develop their own models. How to handle induced traffic caused by new infrastructure and to what extent it exists is still being discussed.

Reauthorisation of ISTEA

After intense debate an ISTEA reauthorisation bill, the Building Efficiency through Surface Transportation and Equity Act (BESTEA) has been passed by the House of Representatives (HR 2400). Other bills were brought into the ISTEA reauthorisation debate¹⁹. Most elements of ISTEA WORKS have been incorporated into the BESTEA bill. STEP 21 has been the most serious threat to ISTEA where the Congestion Mitigation and Air Quality Improvement Program and interstate maintenance and bridge repair processes have been made eligible but not required. This bill was supported by the so called 'donor states' (states where more federal gas taxes are collected than spent by the ISTEA programs) claiming to get more money under their control. The STEP 21 coalition was later split by the introduction of the 'Rural States Highway Preservation Act' which provides western and mountain states with more money while keeping the existing ISTEA more or less unchanged.

Reauthorisation negotiations to replace ISTEA after its expiration took much longer than expected. President Clinton called transportation the biggest environmental problem when he was introducing the administration's proposal for NEXTEA, National Economic Crossroads Transportation Efficiency Act on March 12, 1997. 32 of 100 Senators supported NEXTEA, while 20 supported the devolution proposed in the Transportation Empowerment Act (more or less elimination of the whole program and cut of all but 2 cents of the current 18.3 cents per gallon federal gasoline tax). In the Senate, the Committee on Environmental and Public Works (jurisdiction on highways) and the Committee on Banking, Housing, and Urban Affairs (jurisdiction on transit) elaborated an ISTEA II bill, maintaining the general structure of the old ISTEA, which later passed the Senate (S. 1178).

On June 9, 1998 President Clinton signed a compromise bill of the two proposals, the 'Transportation Equity Act for the 21st Century' (TEA-21). This new law maintains the principal changes in transportation funding which started with ISTEA. In particular the strong role of local governments and the public, the sensible planning, the flexibility of funds (to be used for highways, transit or other things), the dedicated funding of alternatives to roads, and the dedicated funding of system preservation. In a first analysis Surface Transportation Policy Project sees TEA-21 as a major victory for the transportation reform movement. Although many details have to be decided on in Congress it is expected that absolutely (up to 50% greater)

and relatively more money is spent for air quality programs, transportation enhancements and road maintenance while spending for new highway capacity will decrease²⁰.

Conclusions

It was a surprising experience to find a lot of different approaches, thoughts and concepts for sustainable transportation in the United States of America. A comprehensive idea about sustainable transportation does not exist, as is not really found in Europe. Does sustainability only relate to long-term environmental threats which may cause intergenerational problems or is that concept also relevant for today's environmental burdens and equity problems of a car-dominant society? Does sustainability consist of a 'right' balance of ecological, economic, and social issues? Is there a possibility to define sector-related targets and objectives or can sustainability only be discussed in a broader more non-specific framework? It depends very much on the interests of individuals, and which standpoint they support. On the one hand the belief is that technology can solve the problem, when the main problems are seen as air pollution and greenhouse gas emissions. On the other hand, historic preservation, threats to biodiversity, urban sprawl, costs of a car dependent society, and equity problems need to be addressed. This group supports firstly reducing VMT (in particular SOVs), providing alternatives to the car (transit, bikes; and pedestrians), and changing land use policies. But the right path towards sustainable transportation only can be a balance of both strategies: using technology as far as feasible and economically efficient on the one hand; and changing transportation patterns in a way less dependent on the car, improving livability of communities and starting new approaches to land use on the other. ISTEA has been a very important piece of legislation which has encouraged a change in thinking, deciding, and developing future sustainable transportation systems. ISTEA can be seen as the first major success of the anti-highway-campaigns since the 1960s. Furthermore the new successor TEA-21 (signed into law by the

President on June 9, 1998 - ed.) heightens that spirit.

It is local NGOs and citizens groups under the umbrella of the Surface Transportation Policy Project who pushed for a proper implementation of ISTEA and involved a broader public and fought for a reauthorisation of ISTEA. The new TEA-21 is also a success for their powerful lobbying work for another transportation policy in the US.

All the discussion in the US momentarily is focused on road transport (in particular passenger car traffic); environmental problems of other modes are less discussed. The modal split in the freight market seems to be more sustainable compared to the European situation due to the efficiency of American railway companies since privatisation. But the increasing transport distances caused by further centralisation of production patterns and globalisation - as in the rest of the world - result in absolute rising truck VMT and deserve deeper consideration. Although the USA is responsible for approximately 40% of the passenger aviation miles, little attention is given to the environmental problems of air pollutant emissions from aeroplanes.

To that end the situation between Germany and the USA seems comparable. Looking more in detail, it can be concluded that the awareness of the problems seems to be rising in the US, while deteriorating in Germany. Since most German planners think on the safe side (dense urban towns), in the US land use problems and their linkage to emissions are increasingly better understood. Furthermore, public involvement in general is deeper in the US and NGOs are working more pragmatically, professionally and with a better access to the administration.

Although generally one can say that the US transportation system is far from being sustainable, there are hints that this situation may change and ISTEA has supported these developments. There is a big need to share opinions and experience and to co-operate more deeply across the Atlantic. This in particular is evident for the long-lasting environmental problems such as climate change and threats to biodiversity for which the transport sector is increasingly to blame.

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Author & Title Index to Volume 4, 1998

-
- A**
ALEXANDER, D., see DAVIDSON, G.
- Are automobiles really benign members of the modern family? SANDQVIST, K. (3) 4
- Area-Wide Traffic Management: An Innovative Strategy for Urban Centres, DAVIDSON, G., ROSELAND, M. & ALEXANDER, D. (4) 30
- A Tea for the 21st Century: Sustainable Transportation in the USA, GORIBEN, N. (4) 38
-
- B**
BOLHUIS, M., see HAQ, G.
- BROWNING, R., HELOU, M. & LAROCQUE, P.
The Impact of Transportation on Household Energy Consumption (1) 36
- BUCHAN, K., From Consistency To Chaos (3) 35
- Can Demand Management Tame the Automobile in a Metropolitan Region?
HAVLICK, S. & NEWMAN, P. (1) 30
-
- C**
Car-Free Housing in Europe: A New Approach to Sustainable Residential Development,
SCHEURER, J. (3) 16
- Car Sharing and Mobility Management: Facing new challenges with technology and innovative business planning, WAGNER, C. & SHAHEEN, S. (2) 39
- Children's Perceptions of Transport Modes: car culture in the classroom? MEATON, J. & KINGHAM, S. (2) 12
- (The) Comparative Pollution Exposure of Road Users - A Summary, TAYLOR, D. & FERGUSSON, M.(2) 22
- CROSSET, J. Road Project Evaluation Techniques in the United States of America: A Case Study of the Boston Central Artery/Tunnel (3) 30
-
- D**
DAVIDSON, G.,ROSELAND, M. & ALEXANDER, D.,
Area-Wide Traffic Management: An Innovative Strategy for Urban Centres (4) 30
- Dutch Transport Policy: From Rhetoric to Reality,
HAQ, G. & BOLHUIS, M. (1) 4
-
- E**
Exploding myths about the cost of car transport,
JAMES, A. (4) 10
-
- F**
FERGUSSON, M., see TAYLOR, D.
- FLETCHER, E., see GINSBERG, G.
- (The) Free Lunch Public Transport Centre: A New Zealand case study on how to acquire 2,900 car parking spaces and \$0.4 billion in public debt, GUNDER, M. (3) 8
- From Consistency To Chaos, BUCHAN, K. (3) 35
- From Curitiba to Quito: reserved traffic lanes for public transport as an ecological, an economic and a social policy for cities, LAMBERT, B. (1) 40
-
- G**
GARB, Y., Sustainable Transport: – Some Challenges for Israel and Palestine (1) 21
- GILBERT, R., Reduced car ownership as a route to clean transport (3) 21
- GINSBERG, G., SERRI, A., FLETCHER, E., KOUTIK, D., KARSENTY, E. & SHEMER, J., Mortality from vehicular particulate emissions in Tel-Aviv-Jafo (2) 27
- GINSBERG, G., SERRI, A., FLETCHER, E., MOSHE, T., KARSENTY, E. & SHEMER, J., Mortality reductions as a result of changing to alternative powered vehicles in Tel-Aviv-Jafo (4) 4
- GORIBEN, N., A Tea for the 21st Century: Sustainable Transportation in the USA (4) 38
- GUNDER, M., (The) Free Lunch Public Transport Centre: A New Zealand case study on how to acquire 2,900 car parking spaces and \$0.4 billion in public debt (3) 4
-
- H**
HAQ, G. & BOLHUIS, M.,
Dutch Transport Policy: From Rhetoric to Reality (1) 4
- HAVLICK, S. & NEWMAN, P., Can Demand Management Tame the Automobile in a Metropolitan Region? (1) 30
- HAZEL, G.,
Sustainable Transport: Edinburgh's Approach (4) 16
- HELOU, M., see BROWNING, R.
- High Occupancy Vehicle (HOV) Lanes: Highway Expansions in Search of Meaning, SCHILLER, P.L. (2) 32
- HOOK, W., Hungary's M3 Highway: Multilateral Development Banks undercutting each other's objectives (3) 27
- Hungary's M3 Highway: Multilateral Development Banks undercutting each other's objectives, HOOK, W. (3) 27

<hr/>			
I	America: A Case Study of the Boston Central Artery/ Tunnel, CROSSET, J. (3) 30		
(The) Impact of Transportation on Household Energy Consumption, BROWNING, R., HELOU, M. & LAROCQUE, P. (1) 36	ROSELAND, M., see DAVIDSON, G.		
<hr/>			
J	S		
JAMES, A., Exploding myths about the cost of car transport (4) 10	SANDQVIST, K., Are automobiles really benign members of the modern family? (3) 4		
<hr/>			
K	SERRI, A., see GINSBERG, G.		
KARSENTY, E., see GINSBERG, G.	SCHEURER, J., Car-Free Housing in Europe A New Approach to Sustainable Residential Development (3) 16		
KINGHAM, S., see MEATON, J.	SCHILLER, P.L., High Occupancy Vehicle (HOV) Lanes: Highway Expansions in Search of Meaning (2) 32		
KOUTIK, D., see GINSBERG, G.	SHAHEEN, S., see WAGNER, C.		
<hr/>			
L	SHEATE, W.R., see SWIDERSKA, C.		
LAKE, S., see WIXEY, S.	SHEMER, J., see GINSBERG, G.		
LAMBERT, B., From Curitiba to Quito: reserved traffic lanes for public transport as an ecological, an economic and a social policy for cities (1) 40	Solving the rural transport dilemma: a case study of North Devon, SWIDERSKA, C. & SHEATE, W.R. (2) 4		
LAROCQUE, P. see BROWNING, R.	Sustainable Transport: Edinburgh's Approach, HAZEL, G. (4) 16		
LEO, C. (The) North American growth fixation & the inner city: Roads of excess (4) 24	Sustainable Transport: – Some Challenges for Israel and Palestine, GARB, Y. (1) 21		
<hr/>			
M	SWIDERSKA, C. & SHEATE, W.R., Solving the rural transport dilemma: a case study of North Devon (2) 4		
MEATON, J. & KINGHAM, S., Children's Perceptions of Transport Modes: car culture in the classroom? (2) 12	<hr/>		
Mortality from vehicular particulate emissions in Tel-Aviv-Jafo, GINSBERG, G., SERRI, A., FLETCHER, E., KOUTIK, D., KARSENTY, E. & SHEMER, J. (2) 27	T	TAYLOR, D. & FERGUSON, M., The Comparative Pollution Exposure of Road Users - A Summary (2) 22	
Mortality reductions as a result of changing to alternative powered vehicles in Tel-Aviv-Jafo, GINSBERG, G., SERRI, A., FLETCHER, E., MOSHE, T., KARSENTY, E. & SHEMER, J. (4) 4	Transport Policy in the EU: A Strategy for Sustainable Development? WIXEY, S. & LAKE, S. (2) 17	<hr/>	
MOSHE, T., see GINSBERG, G.	U	Urban Transport and Equity: the case of São Paulo, VASCONCELLOS, E. (1) 9	
<hr/>		<hr/>	
N	V	VASCONCELLOS, E. Urban Transport and Equity: the case of São Paulo (1) 9	
NEWMAN, P., see HAVLICK, S.	<hr/>		
(The) North American growth fixation & the inner city: Roads of excess, LEO, C. (4) 24	W	WAGNER, C. & SHAHEEN, S., Car Sharing and Mobility Management: Facing new challenges with technology and innovative business planning (2) 39	
<hr/>		WIXEY, S. & LAKE, S., Transport Policy in the EU : A Strategy for Sustainable Development? (2) 4	
R	<hr/>		
Reduced car ownership as a route to clean transport, GILBERT, R. (3) 21	Road Project Evaluation Techniques in the United States of		