
Economics drove our first sustainable urban transport system and the unsustainable one that followed

Vince Dravitzki and Tiffany Lester
Opus International Consultants, Central Laboratories
PO Box 30-845, Lower Hutt
Email: vince.dravitzki@opus.co.nz

1 Introduction

Typically New Zealanders look to learn from experience in other countries but then need to assess whether those situations are applicable to New Zealand. In this paper we look instead to New Zealand's past for understandings as to circumstances in which either public transport or private transport was successful (sustainable). While the Paper draws on historical data the Paper is not intended as a comprehensive history of transport in New Zealand. Rather we review the eras in which different forms of transport were dominant, highlight a number of the economic issues, illustrate that people's behaviour is economic rather than emotive, and conclude that if we want behaviours in transport that are sustainable then we need the economic settings to direct this type of behaviour.

In this Paper we have divided the period 1900-2005 into four key phases of urban transport in New Zealand cities, showing the key role of economics in first supporting sustainable urban transport, then driving and reinforcing the shift to unsustainable forms.

2 Sustainable transport

There are numerous depictions of sustainability. These representations seek to link a number of the parameters of sustainability such as the environment, society, economics, and sometimes justice and governance. The depictions use a variety of geometric shapes such as pyramids with the factors in the corners, concentric rings, overlapping rings, and the like; but whatever their style the common thread of these depictions is that sustainability is located in the region of overlap of these separate factors, that sustainability is the optimum mix of a number of desirable outcomes.

Sustainability has predominantly been defined verbally, not mathematically, and hence it has not been quantified. People describe situations as either "more sustainable", or "less sustainable" but there is an inherent assumption that "more" or "less" can be quantified when sustainability itself has not been.

Economics is usually one of the factors contained within the sustainability depictions. Most people tend to see this as a constraint to be applied to activities of business rather than to their own individual or household-level activities. However outside of subsistence living, economic interaction is fundamental to our lives and a sustainable urban system and a sustainable transport system must connect us to these economic activities and the economic activities to each other. This highlights the limitations of the walking and cycling forms of transport commonly described as "sustainable", and implies that if we accept that large cities could be sustainable, then there is the need for "quick" transport to facilitate economic and social interactions. This is supported by data from a 1960 study in Christchurch. Being flat and essentially circular, all

modes are equally possible but as Figure 1 shows, as distance increases walking and cycling give way to the faster buses.

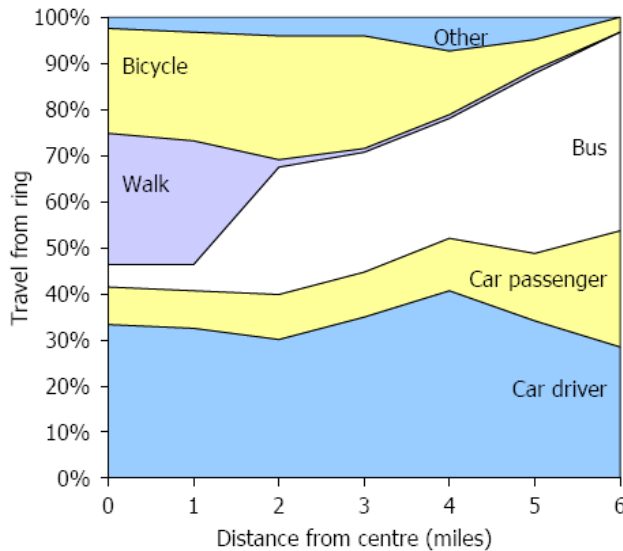


Figure 1 Mode of transport used versus distance from centre of Christchurch Central Business District, 1959

There can be an inherent assumption that public transport is a more sustainable transport form and private cars are a less sustainable form. This need not necessarily be true as the form of public travel may be of low sustainability. For example, a poorly patronised public transport bus will be less sustainable than a high-occupancy car. Context is also important. In a rural setting car travel is probably the most sustainable option.

The *New Zealand Transport Strategy* demonstrates a wider perspective than just environmental sustainability and gives emphasis to economic and social objectives also. A set of sustainability criteria for individual or household travel could be:

1. Facilitate our economic interactions
2. Facilitate our social interactions
3. Promote the health and safety of individuals
4. Make efficient and wise use of energy, including selection of energy resource, and investment
5. Complement the urban form and its liveability
6. Impact only minimally on the natural, local and global, environment

Comparing public transport systems, such as trams, buses, and trains, with private car travel against the above list of criteria, the high mobility given by car travel ensures a wide accessibility and means that car travel will score highly for the first two objectives against our current limited and fairly slow public transport system. But public transport, so long as it is reasonably patronised, will score more highly on the last three objectives. The balance as to which system, private-car or public, is most sustainable is dependent on the weighting given to each criterion. At present climate change and peak oil issues make the last three "environmental" criteria critical, while experience is showing that once car use reaches a high level, congestion can cause mobility to decline rapidly, and car travel becomes increasingly ineffective at delivering those outcomes that arise from its speed of journey.

3 Growth of the first sustainable urban transport system

The period 1899 to 1916 was the start of a new era in New Zealand transport with twelve Local Authorities investing in publicly owned electric tram systems. This was the first time electricity was used as a significant source of transport energy. These trams replaced the privately owned, horse- or steam-powered systems.

The populations to support these tram networks were not large. The four main cities (Auckland, Wellington, Christchurch, and Dunedin) had populations ranging from 50,000 to 180,000, while the smaller towns had small populations of only 6,000 to 20,000. Three of these tram systems were short-lived, but the remainder continued until the 1950s and dominated urban passenger travel until their replacement by motor-buses or by trolley-buses.

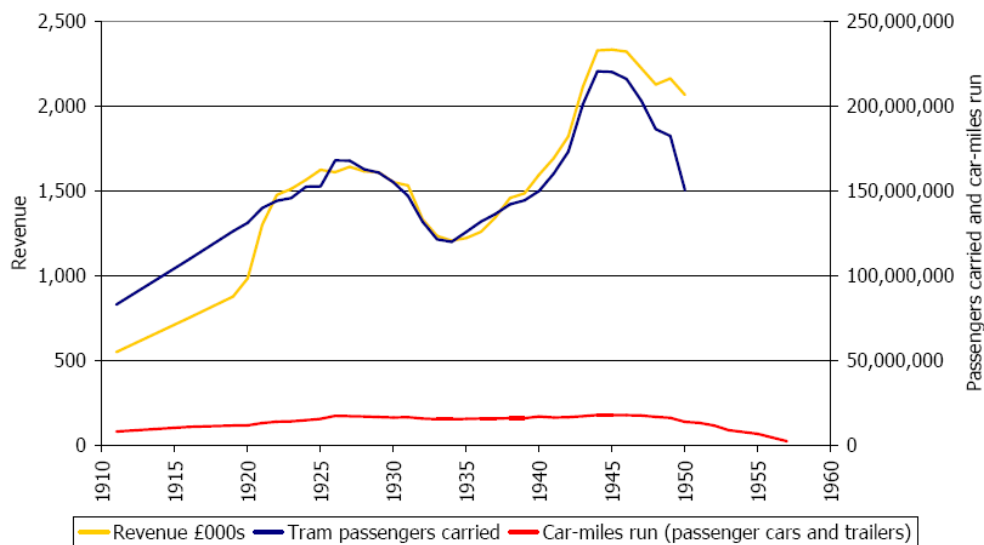


Figure 2 Growth of urban public transport systems

These tram systems were essentially run on a user-pays basis with the intention not to make a profit but to operate so as to produce the barest possible surplus, usually no more than 2 to 5 percent. Where a system went slightly into arrears the difference was made up from general rates. The systems were however very affordable. Then (1920) 38 percent of household expenditure was spent on food and 2 percent was needed for transport fares. (This compares to 9 percent on transport in 1950 and then in the car-age at the end of the century 20 percent of expenditure on food and 15 percent on transport.)

These tram systems had a huge impact on the growth of the cities where they operated. Development expanded around the public transport routes, and small adjacent settlements became amalgamated into the wider city area. The Central Business Districts (CBDs) also grew. Comparing historic photographs of the CBDs from 1910 to 1920 with comparable scenes twenty years later show a much larger scale of buildings of a more opulent style and greatly increased numbers of pedestrians.

The tram systems were also operated successfully with the residential density of that time, that is, detached housing on 300 to 1000 square metre lots. This challenges the current “new urbanism” philosophy that we need to densify our residential living to make public transport more viable. Public transport systems of this period enjoyed a patronage about 300 percent greater than current levels. The *New Zealand Railway and Tramway Atlas* shows that these

networks had reaches of about 12 km and extended close to the limits of the settlement at the time.

It appears that from the 1920s trams experienced strong competition from cycling, private cars (120,000 in New Zealand in 1928) but most especially from privately owned motor buses. Buchanan (*Traffic in Towns*) identified that the First World War exposed many soldiers to the uses of trucks, and that post-war many soldiers set up small bus companies and trucking firms or motor repair services. A similar trend appears to have happened in New Zealand and both countries passed legislation (1926 and 1928) to protect tram systems from the competition of buses, which would have otherwise undermined the tram network by taking passengers off the most profitable routes.

4 1950s to 1970s: The mixed system

Up until the 1950s public transport was the dominant form of urban transport but the next period brought a marked change on a number of fronts. Urban transport moved towards a mixed system of public transport, mainly by buses, sharing the road space with a growing number of private cars. Motorways were planned as a major form of transport to link the sub-cities of the metropolitan areas. Public transport and private cars would exist side by side.

Car usage and uptake increased markedly after 1945 and on through the 1950s, with matching falls in public transport usage. Firstly most of the restrictions of the 1930s Depression and the Second World War, that may have constrained private car uptake and use in the previous two decades, had disappeared. Therefore the initial decline in passenger transport use immediately post-World War Two is principally attributed to a greater use of *existing* private cars once fuel and tyre restrictions were eased while few additional cars entered the fleet. Then the 1950s was a period of great wealth in New Zealand, and private car ownership and use increased rapidly so that by the early 1960s, on average, there was one car per household. Figure 3 shows the trend of private car uptake and usage (represented by fuel used) over this period. A related study indicates that social recreational travel was a significant factor in this vehicle uptake.

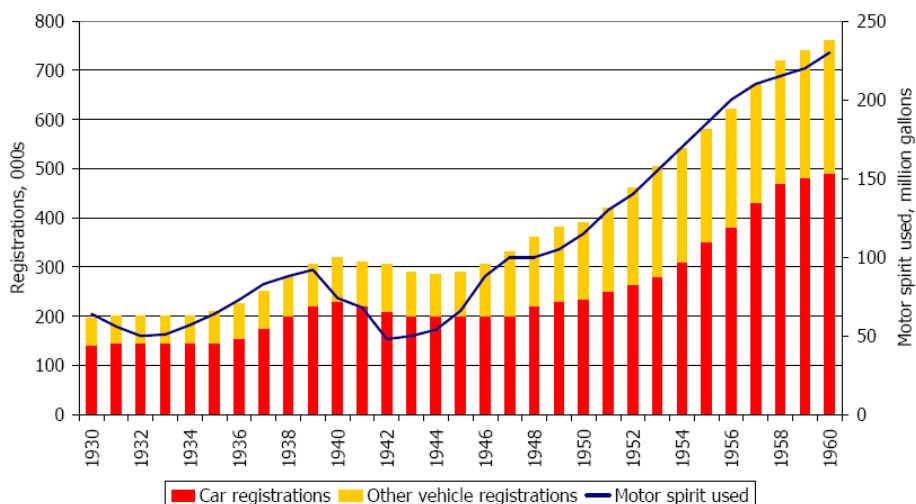


Figure 3 Annual vehicle registrations and motor spirit usage

As New Zealand's population grew, cities began to expand but this time in a form governed by the private car, taking a form in which it was increasing difficult for public transport to operate.

The CBD was the common and increasingly congested destination of both the private car and the bus. While tram systems operated in dedicated space, the bus-based systems, which replaced the trams in the 1950s (Wellington 1963), generally operated in the same space as private cars and were subjected to the same congestion as private cars. Thus some of the priority and advantage that was held previously by public transport was eroded, furthering the loss of public transport's appeal.

The 1950s were also the time when Auckland and Wellington expanded into larger metropolitan centres. Motorways were chosen as the dominant form of travel between the cities of these regions. The transport studies of the 1960s sought better ways to tie these systems into the CBDs so as to free the congestion around the CBDs. Recent work around Spaghetti Junction in Auckland and the Wellington Inner City Bypass are essentially completing these old plans.

The 1960s transport studies recommended upgrade of the public transport systems in both Auckland and Wellington but only the Wellington public transport system was upgraded to a metropolitan scale, through electrification and double-tracking of the rail and integrating it to link with the various bus systems. Despite the transport studies recommendations, in both Auckland and Wellington rail remained poorly linked to their CBDs, thereby further reducing the appeal of rail relative to car use. Although the same 1960s transport studies also advocated stronger public transport connections into the CBDs, only the motorway component of the CBD connections was proceeded with, the governance sector being hesitant to spend heavily on public transport given the ongoing falls in patronage of the period.

Figure 4 shows the history of urban public transport patronage for buses and trams combined, in New Zealand's four "metropolitans": Auckland, Wellington, Christchurch, and Dunedin. The figure shows the total public transport patronages peaking around the early 1950s and the generally continuous decline of patronages since then. The trends of "revenue per passenger" are also shown on Figure 4 and are similar for each metropolitan public passenger system. The "revenue per passenger" is seen to increase more steeply than New Zealand's Consumer Price Index (shown as the black dotted line on Figure 4) around the 1950s in particular, then again in the 1970s. Both occasions coincided with falls in patronage. The declines in patronages of the 1970s are discussed further in the next section.

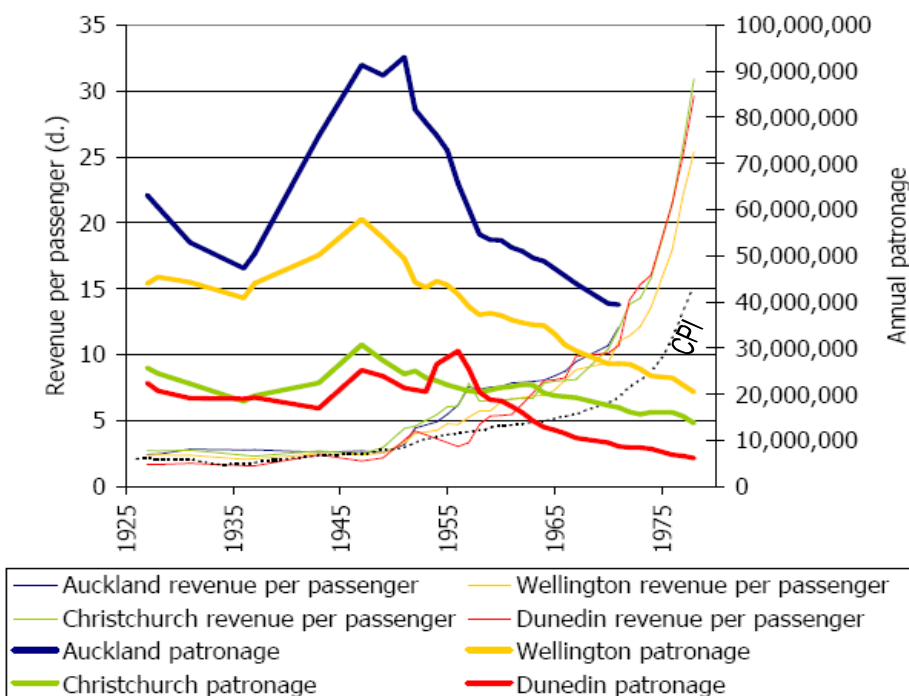


Figure 4 Public transport operations in main urban areas

5 The 1970s

The 1970s was a difficult decade for New Zealand as the economy had to adjust to restricted access to its main export market for farm products following the United Kingdom's entry into the European Economic Community. This setback was compounded by the steep rise in international oil prices following the oil export embargo/price rises by OPEC of 1973 to 1975 and then further price rises at the end of the decade surrounding the Iranian Revolution. These resulted in first a threefold increase in fuel prices followed then by a further doubling of prices. The Government introduced a number of fuel restriction measures, mainly focused around the "oil shock" events (but some imposed for longer periods) including:

- Reduction of open road speed limit from 90 or 100 km/h to 80 km/h;
- Additional vehicle sales taxes and increased vehicle licensing costs that favoured smaller engine sizes;
- Banning of petrol sales on the weekend;
- Carless days, where for each household vehicle one day per week was nominated when that vehicle would not be used (imposed from July 1979 to May 1980);
- Rules on the hire purchase arrangements for new car purchase.
- Allowing Government workers flexible start times so as to spread congestion (late 1970s); and
- Established agencies to identify alternate energy sources, including as CNG, LPG, and biofuels.

Most of these measures were focused on restraint of fuel use by discouraging travel but several measures sought to alter vehicle-purchasing behaviour. Although vehicle numbers continued to rise over the decade, and travel restriction measures were resented and often circumvented, those measures targeting purchasing behaviour were more successful. Figure 5 shows vehicle-

purchasing patterns of new vehicles over the 1970s decade. The combination of increased petrol prices, the fuel-efficiencies offered by smaller-engines, and weighting of vehicle-taxation rates and vehicle registration against engine-size are attributed as key factors in the dramatic changes.

The Government measures were notable for there being almost no encouragement to shift to public transport. Even without this encouragement, given that petroleum fuels rose steadily in price (600 %) over the period 1973 to 1979, and there were also restrictions on its use, an increase in public transport use would have been expected. However, concurrently bus fares rose steeply, and this may have greater weight in explaining the decline in patronage.

The Urban Public Passenger Transport Council noted in its reports of the period that the rapidly rising operating costs were worsened by the age of their bus fleet. For the Local Authorities, of the fleet of about 1,200 buses, 50 percent were over 15 years old and 30 percent more than 20 years old. In short, the buses that were bought in the 1950s to replace the trams and expand the service in that period, needed in the 1970s to be replaced but the justification and finance to do so were becoming increasingly difficult. Faced with ongoing budget deficits and sliding currency devaluations the Government first had little money for, and second even less commitment for public transport expenditure. Government focus was on liquid fuel self-sufficiency to insulate New Zealand against overseas trends, and the “Think Big” expenditure that followed in the early 1980’s was to further this goal.

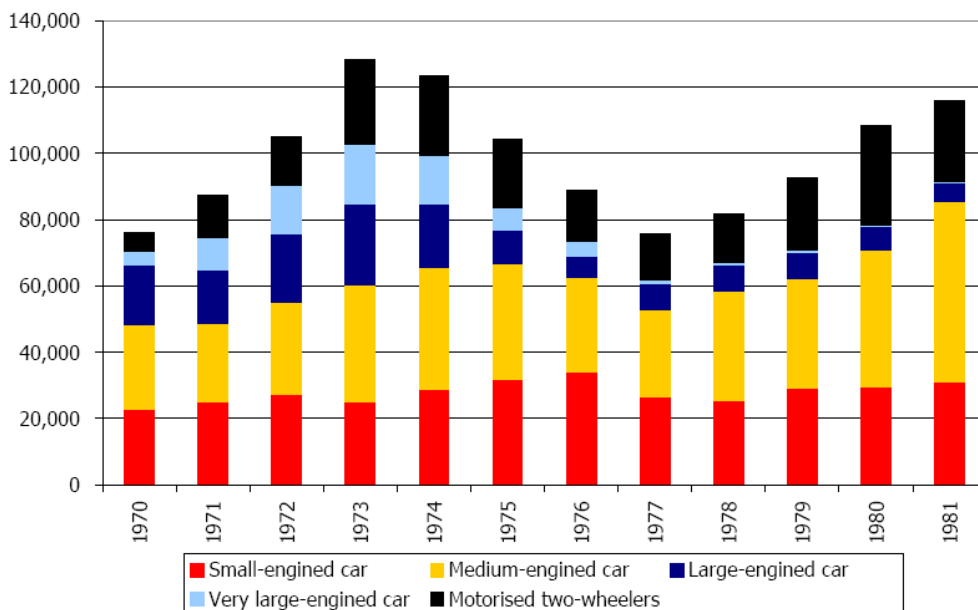


Figure 5 Annual vehicle registrations, representing vehicle-purchasing patterns, during the 1970s

6 Energy and resilience

New Zealand has had two major periods of fuel restriction: the Second World War when petrol for cars was rationed, and in the 1970s when the price first tripled then doubled again and there were intermittent periods of restrictions when fuel could not be bought or cars used. The effects of these two periods on public transport were markedly different.

In the Second World War the tram system was operated by local hydro-electric power (so its energy supply was unaffected by the wartime restrictions), services were expanded, and it proved to be a resilient system throughout the period, helping to cushion the impact of fuel shortages. Average fares remained constant throughout the period. Public transport patronage increased markedly, by about 25 percent.

The 1970s were a stark contrast. The public transport system had been converted over to be a largely diesel-based system in the 1950s. Fuel costs rose steeply in the 1970s period and these costs were translated to the public transport system as rising operating costs. The fuel price rise also triggered wage and price inflation also compounding the rise in public transport operating costs. The Urban Passenger Transport Council reports service impacts from an ageing fleet. Fares rose steeply to attempt to cover these rapidly rising expenditures. Though public transport patronage was already falling prior to the oil shocks, patronage started falling at an even greater rate. The result was patronage declined by more than 25 percent over the period

7 The economic Reforms of the 1980s and 1990s

The New Zealand economy up until the early 1970s was highly regulated. Slow Reforms had occurred between 1970 and 1984 but in 1984 and the years following, the economy was greatly liberalised. However with respect to transport and cars the main effects occurred in the early 1990s with the removal of tariffs on imports, the closure of all local vehicle assembly, and the effective privatisation of public transport. The result is that since 1995 new car prices have decreased by over 30 percent. Simultaneously second-hand cars began to be imported into New Zealand with a dramatic impact on used car prices so that over the same ten-year period used vehicles have decreased in price by about 50 percent.

The effects of these lower prices show in several ways. As Table 1 shows, cars increased by 550,000 vehicles in the period 1996 to 2005, essentially double the rate of the previous thirty years. Figure 6 also shows the number of cars per household has increased so that 50 percent of the households have two or more vehicles and only 8 percent have no vehicles. This has occurred even though 60 percent of households have only one or two occupants

Table 1 Trends of population and vehicle numbers

Year	Population ('000)		Total number of licensed cars ^{1*} ('000)	Cars/Person		Cars/Household
	Total	20+ years		Total	20+ years	
1961	2,450	1,450	541	0.221	0.373	
1966	2,700	1,550	766	0.312	0.434	1.07
1971	2,850	1,700	933	0.327	0.549	1.16
1976	3,150	1,900	1,172	0.372	0.616	1.25
1981	3,200	2,000	1,333	0.416	0.666	1.33
1986	3,300	2,200	1,480	0.448	0.672	1.36
1991	3,400	2,300	1,700	0.500	0.739	1.44
1996	3,650	2,510	1,800	0.490	0.717	1.41
2001	3,750	2,600	2,100	0.560	0.808	1.56
2005	4,110	2,921	2,350	0.573	0.804	

^{1*} Data to 1976: Statistics New Zealand; Data from 1976: Ministry of Transport - Vehicle Fleet Model

The *Household Expenditure Survey* shows the amount spent by households on a range of items, including transportation. Table 2 shows the household expenditure for transportation over a

thirty-year period, subdivided between high and low income groups. The downward trend over time is evident. It is also evident that increased wealth is directly associated with increased transport. While there is some fluctuation across all survey periods it appears that pre-1984, 14.7 to 16.3 percent was spent on private transport and post-1984, 11.5 to 13.4 percent was spent. Pre-1984, 1.0 to 1.2 percent was spent on public transport and post-1984, 1.0 to 0.8 percent was spent. Therefore even though households, on average, have more cars than before and have increased their usage and vehicles are much larger, still transportation costs have fallen by 3 percent of total household expenditure or 18 percent of transportation expenditure.

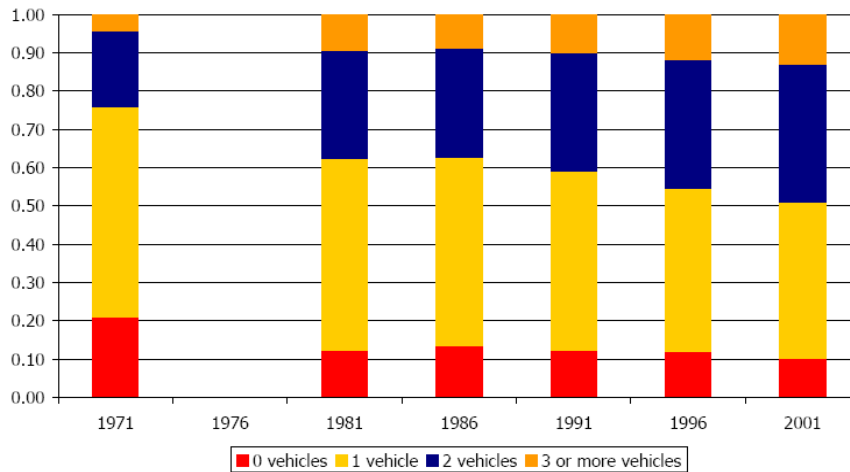


Figure 6 Cars per household

Table 2 Percentage of household expenditure for transportation

Percentage of household expenditure for transportation		1973-1974	1975-1976	1979-1980	1981-1982	1983-1984	1987-1988	1989-1990	1991-1992	1993-1994	1995-1996	2000-2001	2003-2004
High income	Public	1.0	1.2	1.0	0.9	1.0	1.0	0.9	0.8	0.7	1.3	0.8	1.0
	Private	14.5	16.8	15.4	14.1	15.6	12.6	13.1	12.7	10.8	14.1	11.8	13.3
Low income	Public	1.9	1.3	1.6	1.4	1.1	1.6	0.8	1.3	0.8	1.0	0.9	0.9
	Private	7.8	14.8	8.3	10.7	12.6	12.2	10.9	12.7	10.1	10.0	8.8	11.2

8 Discussion

These four phases show that with respect to transport, people's behaviour has been largely economic rather than emotive. The period of public transport's success was when it was by far the best option for travel. The trams were established as city-wide networks and provided much faster transport than was possible earlier by walking, bicycling, or horse-drawn vehicles. Fares were set low. It appears that money spent on fares comprised about 2 percent of the total household budget (1909 and 1920).

The success of trams is readily explicable in terms of the space-time prisms used mainly to explain accessibility. These prisms are anchored by key fixed activities located in space. Other activities can be included if the travel to and from this activity *and* the activity can be completed in the unused time. By greatly shortening travel times, trams increased the range of activities

available. They also had a beneficial effect on the CBDs by increasing concentrations of customers and workers and the CBDs grew significantly in scale.

Cars were reasonably available in the early 1900s but the uptake was slow because of their cost. Local assembly started in 1926 and reduced selling prices by 50 percent but spare parts were expensive, limiting uptake. The Depression and Second World War restrictions also suppressed demand. The rapid uptake of cars, through 1950 to 1965, owed much to the high prosperity of the time but indications are that a major motivator for the purchase was for social recreational travel and then the vehicle, once purchased, was used also for the work trip and other trips. Being able to get out of town, weekend trip-making, and travel for visiting friends were highly-valued. In large metropolitan centres this travel was either not feasible by public transport because of the locations of origins and destinations and/or timing and duration of travel.

The 1970s economic behaviour was clear cut. With car operational costs and ownership costs being skewed towards smaller vehicles, purchasing behaviour followed. Both smaller cars and two-wheelers increased significantly in sales. The public transport services were already poorly patronised but fare increases decreased patronage further. In Wellington seven successive fare rises coincided with seven successive declines in patronage. Transport operators noted that their passengers were increasingly concession tickets of the elderly or school-children. Although fares were subsidised from rates, given the make up of passengers, this was done with overtones of welfarism. The wider benefits of public transport were articulated by White in the 1972 *New Zealand Transport Policy Study* that the main beneficiaries of transport are the businesses, employers, or property owners of the CBD and industrial areas as it delivers them a workforce and customer base. This view was not specifically enacted other than by the coincidence in Wellington that businesses paid 60 percent of the rates.

The market deregulation since then removed differential charges for large vehicles and the size make-up of the New Zealand fleet now matches that of the 1960s with a high proportion of large cars. Car costs have fallen to such an extent that the increased use has not offset the fall and an approximate 20 percent decrease in the cost of travel has occurred. The result has been significant decreases in walking, cycling, and public transport usage, although recent efforts to reverse these trends are showing some effect but from a very low base.

9 Conclusions

1. Sustainable transport has a wider framework than just environmental sustainability. Facilitating our economic and social connections is a crucial role of transport, and whether public transport or the private-car is more sustainable also depends on context. Overall, an urban transport system underpinned by a quality public transport service would be the more sustainable.
2. All indications from New Zealand's past are that economics is the major factor behind users' choice of travel mode and vehicle-purchase decisions.
3. Economic deregulation has greatly reduced vehicle costs promoting non-sustainable behaviours such as high-vehicle ownership, use of high fuel-consumption-vehicles and consequent poor use of public transport. Returning to more sustainable transport is unlikely until the economic framework within which people live drives them in this direction.

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