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ISSUE EXPLORATION: URBAN TRANSPORTATION

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EXECUTIVE SUMMARY

With some exceptions, this review focuses on transportation in Canada's 27 largest urban regions and does not provide an international perspective. It may nevertheless be worth noting that Canada—founded in part on a transport concept, a railway from coast to coast—continues to be among the affluent countries that are the most dependent on transportation. Before and after Confederation, Canadians' well-being has been highly dependent upon low-cost, effective movement of people and freight. Canada's communities are widely scattered, and international trade comprises a high and growing share of her economy. Thus, more than in most affluent countries, Canada's governments and agencies have good reason to focus on transportation issues, particularly in urban areas, where most people live, and where most of the movement of people occurs and much of the movement of freight.

The review touches on the economic importance of transportation, but the presentation of bald numbers underestimates its significance. The reality is that life as we know it could not occur without good transportation. Much the same could be said for transportation's social importance, although this is harder to document.

Transportation's benefits are to some degree offset by its costs, not only the financial costs of providing infrastructure, vehicles, and fuel, but also the environmental costs and associated health costs. Transport-related air pollution is the best known of environmental costs and the most important for urban areas, but there are also global effects and effects on water and land.

In general, urban air pollution that could be caused by transportation is lessening, but considerable grounds for concern remain, particularly in urban areas in Eastern Canada. Much of that concern is focussed on the Toronto region, where evidence suggests that thousands of people are hospitalized each year on account of poor air quality and about 1,600 people die prematurely for the same reason.

Another matter for concern could be that road capacity has generally increased in Canada's urban regions while transit capacity has not. However, the only region showing a clear decline in transit capacity is Toronto, where there was an extraordinary reversal in transport spending priorities across the 1990s. The ratio of public investment in roads to public investment in transit was more than six times higher in 2001 than in 1991. The review suggests that this extreme change may well have contributed to the recent large decline in foreign investment in Canada.

Another matter for concern, not confined to the Toronto region, is the growing use of land for urban purposes. Available evidence suggests that the use accelerated dramatically during 1980s and 1990s such that new development at the edge of Canada's urban regions during the 1980s was on average about twice as thinly distributed as development in place in 1981. and the pace of land use was even higher in the 1990s. Often the land taken for extravagant urban development had been used for agricultural or recreational purposes.

Its loss thus resulted in more transport activity for food imports and more travel to find open spaces.

However, the strongest transport-related feature of low-density settlement is the near absence of urban transit—because of the high cost of providing service—and the near-total dependence on automobile travel. Cars make low-density suburbs possible; the suburbs then reinforce car use because distances are large and there are no alternative means of traversing them.

Automobile use increased in urban areas during the 1990s, although only slightly more than the increase in population. Transit use, on the other hand, declined dramatically: trips per capita fell by an average of 28 per cent, notwithstanding the general maintenance of transit capacity other than in the Toronto region. Only in the Montreal region was there an increase in per-capita transit use between 1991 and 2001.

Data on facilities for non-motorized transport are negligible. The few available data suggest an overall pattern similar to that for transit: no decline in capacity but a decline in activity.

Canada-wide data on personal spending on transportation across the 1980s and 1990s reveal a large increase for one purpose: spending on the fixed costs of automobile use, including purchase costs and insurance. This change seems to have had more to do with increases in the power and weight of all available vehicles rather than the shift towards purchase of SUVs and minivans for personal transportation. The extent to which the increase in spending applies to urban regions is not clear, although because about 80 per cent of the population is urbanized, and over 60 per cent lives in the 27 Census Metropolitan Areas, a sharp departure of urban regions in aggregate from a national trend is unlikely.

The above conclusions have mostly been about average trends in urban regions, but the detailed data reveal enormous variability. Residents of Calgary and Thunder Bay own on average 50 per cent more cars than residents of Montreal, Quebec City, and Sherbrooke. Saguenay has more than three times as much road capacity per person as Vancouver. Ottawa has almost five times as much transit capacity as Kitchener-Waterloo.

There is also huge variability *within* urban regions. Residents of central Toronto make only 40 per cent of their trips by car, while residents of Toronto's outer suburbs use cars for 87 per cent of journeys. A slight majority of central Toronto's households do not own a car, whereas 95 per cent of households in the outer suburbs do, mostly more than one car (and per-capita incomes are about the same in both parts of the region).

Almost all of the foregoing concerns the movement of people, for which there is a considerable body of available data, although one that could be greatly improved. By contrast, there are almost no data on freight movement in Canada's urban areas. Canada-wide data

on freight movement generally, mostly derived from sales of diesel fuel, suggest that there was an extraordinary increase in the amount of trucking activity in the 1990s, by more than 50 per cent, in contrast to a slight decline in other freight transport activity and an increase of close to 15 per cent in the amount of movement of people. Whether there was a corresponding increase in trucking within urban areas is not known. There are slight indications that the growth in urban freight activity may have been at a lower rate, but there can be only minimal confidence in this observation.

Urban regions depend on freight transportation to feed and supply their residents, remove products to other destinations, and sustain everyday commerce within the region. Freight transportation ranks among the services essential to the economic and social well-being of a community along with proper provision of water and sewage services and fire protection, and yet we know almost nothing about its functioning in urban areas.

We also know that burning diesel fuel makes a disproportionately large contribution to certain kinds of air pollution; diesel engines result in emission of about eight times as much fine particulate matter as gasoline engines per unit of energy produced, although emission rates of other pollutants are lower.

Diesel engines are more efficient than gasoline engines, thereby contributing to lower fuel use overall and, because fuel use and greenhouse gas emissions are highly correlated, making a reduced contribution to climate change. The high correlation with fuel use means that greenhouse gas emissions from transportation, particularly freight transport, increased substantially during the 1990s, notwithstanding Canada's Kyoto Protocol commitment to reduce these emissions overall.

Based on the foregoing, the review identifies reasonable goals for urban transportation as (i) to achieve improved compatibility with human communities and activities; (ii) to enhance the quality of the physical environment; (iii) to reduce the depletion of key resources; and (iv) to provide capable and cost-efficient movement of people and freight. All these goals are important, but the first may be the most important, not only for the obvious social reasons but also because its attainment can be a stimulus to investment in urban regions.

The review notes 27 types of initiative that can be considered in addressing these challenges and rates each of them according to 14 criteria. The most promising five initiatives are these, in declining order of promise: (i) application of congestion pricing for road use; (ii) attainment of compact mixed land use; (iii) provision of planning and delivery for transportation and land use jointly; (iv) achievement of pedestrian-friendly streets; and (v) use of transit priority facilities (e.g., separate lanes for transit and for high-occupancy vehicles).

Barriers to application of the initiatives are less formally rated and ranked in the review. The five main barriers are identified as: (i) insufficient governmental coordination, fiscal capacity, and will; (ii) concerns of automobile and truck drivers that initiatives will reduce their amenity; (iii) high public costs of some of the initiatives; (iv) concerns of residents and

business operators about loss of amenity; and (v) a more general concern that some initiatives would reduce economic competitiveness.

The above analyses are supplemented by brief accounts of the governance and funding frameworks in place in five of Canada's six largest urban regions. Positive features are identified in the frameworks for four of these regions—Vancouver in particular, and also Edmonton, Calgary, and Montreal—although none is considered entirely adequate. The Toronto region is characterized as a "basket case" in this respect, although there are signs that its predicament may soon be partially remedied.

As background information towards assisting the NRTEE in identifying how it could add value to current consideration of urban transportation, the review notes the major organizations in Canada that provide relevant advice, research, and planning. As well, the review provides snapshots of relevant ongoing and proposed research, mostly in Canada but also elsewhere.

The review concludes with recommendations as to six topic areas that could well be the subject of work by the NRTEE. They are as follows, in no particular order of importance:

Competitiveness. The essential issue, to be addressed in a Canadian context, concerns the trade-offs between mobility and attractive urban places. Both are essential to competitiveness. If people and goods move slowly or unpredictably, business suffers disproportionately (although other aspects of society can suffer too). On the other hand, high levels of mobility are usually incompatible with comfortable urban living, and the loss of attractiveness and liveability can also be a barrier to the inward investment that business may require. NRTEE could address transportation's role in business efficiency and liveability through the prism of competitiveness, the goal being to provide advice as to how to achieve the right balance for Canadian urban regions.

Energy constraints. The review notes the high and growing levels of transport activity in urban areas and the dependence on this activity for a wide range of essential social and economic functions, and also touches on associated energy use. Space precluded consideration in the review of the robustness of supplies of transport fuel to urban areas, but acceptance that we may be leaving the era of cheap oil now seems widespread. Oil provides more than 99 per cent of the transport fuel used in Canada's urban regions. Steep increases in the prices of these fuels could be disruptive, to households and businesses alike. A pertinent question that could be usefully addressed by the NRTEE is what could be done in Canada's urban areas to prepare for high prices of transport fuels? What could be done in advance to reduce their impact on businesses and residents if and when they occur, and what additional actions could be appropriate in a time of fuel-price instigated crisis?

Urban freight movement. The review notes that urban freight movements are essential to the well-being of urban residents and businesses, and yet very little is known about them.

There is a possibility that there have been recent large increases in urban truck traffic. Moreover, trucking activity is associated with disproportionately high levels of some kinds of air pollution. The NRTEE could usefully investigate the state of urban freight transportation in Canada, report on its trends, significance, and impacts, and propose actions as may be appropriate to increase its efficiency while reducing its impacts.

The costs and benefits of better data. A particular theme of parts of the review is the poverty of data on urban transportation in Canada. The largest gaps concern urban freight movements, but, compared with many other countries, much less is known too about the movement of people. A question that could be addressed by the NRTEE is whether economic and environmental benefits could be gained from having better transport data, particularly for urban regions, and what would be costs of providing it? Would the benefits outweigh the costs?

Governance and financing frameworks. There is a wide variety of governance and financing frameworks for transportation and land use in place in Canadian urban regions, ranging from some that are considered by international observers to be positive examples (e.g., Vancouver) to some that are considered as negative examples (e.g., Toronto). What are the features of regional frameworks that seem capable of facilitating attainment of land-use and transportation goals? What are the best funding arrangements? How are the links between transportation planning and land-use planning best made? These are key questions for the future of urban transportation in Canada, and NRTEE could play a useful role by addressing them.

Information. Provision of good information would be an important element of work on any of the above five topics, but it is also an important task in its own right. The general public knows much about the minutiae of particular aspects of our urban transport systems but little about the big picture. It's possible that a better informed public could demand better policy-making about transportation and land use in Canada's urban areas. Better information could be given about the significance of freight movement, the public and private costs of private and public transportation, the features of neighbourhoods that help obviate car ownership, the effects of current transport practices on urban and suburban children and youth, and many other topics. NRTEE could consider development of a primer on urban transportation that would help energize interest and expand knowledge among the public and policy-makers.

1. INTRODUCTION

1.1 PURPOSE OF THIS DOCUMENT

This document is prepared in response to a commission dated July 5, 2004, from the National Round Table on the Environment and the Economy (NRTEE) to "undertake a high-level, strategic, and objective examination of the urban transportation in Canada and to produce an issues exploration paper for the NRTEE plenary meeting in Regina in August 2004". The paper is to broadly achieve the following:

1. Identification of the key current and emerging environmental and economic issues associated with urban transportation/mobility in Canada; consideration of links between transportation and air quality and between air quality and human health; identification of barriers to and opportunities for action around dealing with the challenges, historically and anticipated in the future; a brief description the linkages among the issues
2. Rankings of the issues, perhaps separately for passenger and freight movement, according to actual or potential environmental and economic impacts (with rationale for the rankings)
3. Indication of how the quality of urban transportation may be a factor in private-sector inward investment
4. Provision of examples of the current regulatory and fiscal frameworks governing urban transportation in Canada
5. Overview of relevant work on transportation by Canadian governments, organizations, and individuals, and outside Canada, including academic work such as the proposed Canadian Transport Futures Assessment
6. Listing of the key Canadian stakeholder groups and organizations concerned with urban transportation
7. Presentation of recommendations about specific topics within the general issue area on which NRTEE could add value to the current debate, what that value might be, and how it might be achieved.

The present document is the requested issues exploration paper. Sections 2 and 3 provide background as to the supply and demand for transportation in urban areas. Section 4 overviews some of transportation's impacts. Sections 5-8 provide the meat of what was undertaken in respect of Items 1-6 above. Section 9 corresponds to Item 7 above , presenting five topic areas, based on the foregoing, within which it would be appropriate and useful for NRTEE to make a subsequent contribution.

1.2 SCOPE OF DOCUMENT

The focus here is on the 27 urban regions of Canada defined by Statistics Canada as Census Metropolitan Areas (CMAs).[1] Unless otherwise indicated, data in Sections 1 and 2 are from the Transportation Association of Canada's *Urban Transportation Indicators* conducted for the years 1991, 1996, and 2001.[2] Data for 2001 are often presented in terms of the largest three CMAs (Toronto, Montreal, Vancouver), the next six largest (Ottawa-Gatineau, Calgary, Edmonton, Quebec, Winnipeg, Hamilton), and the remaining 18 (London, Kitchener, Niagara, Halifax, Victoria, Windsor, Oshawa, Saskatoon, Regina, St. John's, Sudbury, Saguenay, Sherbrooke, Abbotsford, Kingston, Trois-Rivières, Saint John, Thunder Bay). 'Largest' always refers to population, not to geographic area. In 2001, the largest CMA was Toronto, population 4,682,897. The smallest was Thunder Bay, population 121,986.

2. TRANSPORT SUPPLY IN URBAN AREAS, INCLUDING TRENDS

This section is concerned with the transport resources available in urban areas, chiefly the number of vehicles, the extent of roads, and the amount of transit service. Also covered are the public and private costs of transport.

2.1 NUMBER OF ROAD VEHICLES AND ROADS

Determining the number of road vehicles and the supply of road space might seem a simple matter, but it is not. Vehicle registration is a provincial responsibility, with differences among provinces and across time in how vehicles are categorized. Moreover, disaggregation to provide registration data for urban regions is often difficult and uncertain. Road inventorying is a local responsibility, with the recording systems of numerous jurisdictions providing even more opportunities for mismatched data as well as several data gaps. Nevertheless, the *Urban Transportation Surveys* compiled data on both variables.

For road vehicle registrations, the range is large. At one extreme among CMAs in 2001 were Calgary and Thunder Bay, with 740 registered vehicles per 1000 residents. At the other extreme were Montreal, Quebec City, and Sherbrooke, all of whom reported below 500 registered vehicles per 1000 residents. On average, the three largest CMAs reported the lowest rates of vehicle registrations, but there was little difference in this respect between the next six largest and the smaller CMAs. Of the registered vehicles in all the CMAs in 2001, 88 per cent were personal vehicles (cars, SUVs, etc.). The remainder were trucks and other vehicles used for commercial purposes (12 per cent), and buses (0.4 per cent).[3]

Across the three UTI surveys, 1991-2001, there is a slight hint of an upwards trend in rate of vehicle registrations all but the three largest urban regions.

Road capacity can be compared across urban areas and different types of road by using the measure lane-kilometres per 1000 residents (lane-km/1000). A two-kilometre length of road with two lanes in each direction provides eight lane-kilometres of road capacity.

The variation in road capacity appears to be even larger than for vehicle fleets. When all roads are considered (local, arterial, expressway) it ranged in 2001 from 18.6 to 5.4 lane-km/1000 (Saguenay and Vancouver). Overall, the larger the CMA the lower the per-capita road capacity. The average for the three largest CMAs was 7.0 lane-km/1000, that for the next six was 12.1 lane-km/1000, and that for the eight of the remaining 18 that had complete data was 15.2 lane-km/1000. Very roughly half the road capacity comprised local roads, but with substantial variation among CMAs and no clear differences in this respect according to regional population.

Data on arterial roads and expressways only are available for 1991 and 1996. They suggest that this type of road capacity remained more or less constant per capita in the three largest CMAs between 1991 and 2001, but increased substantially in the other CMAs.

Thus, the picture concerning the supply of vehicles and roads is one of great variability, especially in road capacity, with the larger CMAs reporting fewer vehicles and less road capacity, and smaller increases between 1991 and 2001, all on a per-capita basis. However, the data for both indicators are questionable, particularly those for road capacity.

2.2 PROVISION OF TRANSIT

A standard measure of supply of transit is the 'seat-kilometre'. Consider a bus route ten kilometres in length on which one bus that could carry 40 people makes eight return trips a day. This route provides 6,400 seat-kilometres of service a day. (The actual number of passengers carried would likely be very much lower.)

As might be expected, supply of transit is even more variable than supply of vehicles and roads. In 2001, it ranged from 8.8 (Ottawa) to 1.8 (Kitchener-Waterloo) seat-km per person per day (seat-km/pp/day). On average, the three largest CMAs had the greatest supply of transit (7.3 seat-km/pp/day). The next six CMAs provided almost as much transit capacity per capita (6.9 seat-km/pp/day), while the smaller CMAs provided much lower amounts, averaging 3.6 seat-km/pp/day

The data across surveys are too few to allow good indications of trends. What seems to have been the case is that between 1991 and 2001 provision of transit per capita declined dramatically in the Toronto CMA, from 12.2 to 7.6 seat-km/pp/day, but remained more or less constant in other CMAs.

Generally speaking, data on transit capacity are as weak as those for road capacity. For example, although the next six largest CMAs (after the three largest) all provided road capacity data for 2001, only four of them provided transit capacity data. One the other hand, eight of the 18 smallest CMAs provided road capacity data and 11 of them provided transit capacity data.

2.3 PUBLIC SPENDING ON TRANSPORT

Public spending on transport in urban areas chiefly comprises expenditures on roads and transit. The amount of public spending largely determines the extent of new and replacement infrastructure and, in the case of transit, the degree to which fare revenue covers the costs of operation.

For expenditures on roads (construction and maintenance), there was considerable variation among reported amounts. In 2001 they ranged from $261 per capita (Ottawa) to $46 per capita (Winnipeg). Overall, there was little systematic variation according to size of CMA. The per-capita averages for the largest three CMAs, the next largest six, and the remaining 18 were $210, $217, and $182, respectively (for reporting CMAs).

Where data on trends in road expenditures are available, they mostly show increases across the years 1991-2001. The largest increase, both absolutely and relatively, was for the Toronto CMA. There, per-capita expenditures on roads increased from $72 in 1991 to $177 in 2001. (All dollar values in this subsection are in 2001$.) The largest reported decline was that for Winnipeg, where per-capita expenditures on roads fell from $172 in 1991 to $46 in 2001.

Per-capita public spending on transit in 2001 (operating and capital, but not including farebox revenue) ranged from $197 (Montreal) to $19 (London) among reporting CMAs. Here there was substantial variation according to CMA size. The per-capita averages for the largest three CMAs, the next largest six, and the remaining 18 were $133, $123, and $48, respectively (for reporting CMAs).

Where data on trends in transit expenditures are available, they mostly show increases. The largest increase, both absolutely and relatively, was for the Calgary CMA. There, per-capita expenditures on transit increased from $91 in 1996 to $187 in 2001. The largest reported decline was that for the Toronto CMA, where per-capita expenditures on transit fell from $176 in 1991 to $69 in 2001.

Of special note is that real per-capita public spending on transport in the Toronto CMA completely reversed in emphasis between 1991 and 2001. In 1991, expenditure on transit was roughly 2.5 times as much as expenditure on roads. In 2001, expenditure on roads was roughly 2.5 times as much as expenditure on transit. No other CMA that provided data saw such a profound change in public policy, as reflected in public spending. The dramatic shift could have been related to province-wide changes in municipal financial arrangements in Ontario across this period. However, the other Ontario CMA for which these data are available, Ottawa-Gatineau, showed only an increase in the road/transit spending ratio, from 1.3 in 1991 to 1.8 in 2001, far short of the greater-than-sixfold change in the Toronto CMA.

As a consequence of diminished support for transit in the Toronto CMA, riders there paid 56 per cent of the cost of transit in 1991 and 80 per cent in 2001. London, Ontario, reported a similar increase, but Ottawa-Gatineau did not. There, the fare-box share increased only from 53 to 57 per cent. In CMAs in other provinces, the fare-box share remained mostly constant across these years, with most values being between 40 and 60 per cent.

2.4 Economic significance of public spending on transport

A recent report by the Conference Board of Canada assessed why Canada's share of foreign direct investment fell from 7.7 of the world total in 1980 to 3.1 per cent in 2002.[4] It noted that increased investment flows to developing countries are not the reason because the United States and the European Union have been able to maintain or increase their shares of global investment. More than 100 executives of internationally active countries were interviewed as to how they view Canada as a place to invest.

The reason for unwillingness to invest given most often—stated by 81 per cent of respondents—was the poor state of Canada's infrastructure in cities, the highways, and border crossings. Other reasons given were poor quality of employees (78 per cent), slow adoption of technology (66 per cent), poor quality of local suppliers (51 per cent), and Canada's tax system and rates (16 per cent).

As noted above, the only significant decline in transport investment in cities in the latter part of this period concerned transit in the Toronto and some other Ontario CMAs. Thus, it may be possible to conclude that this decline contributed to Canada's reduced attractiveness as a place to invest.

A report by the Canadian Urban Transit Association focussed on the economic significance of public spending on transit.[5] It noted among other things that transit investment is many times more effective at creating jobs than expenditure on other modes of transport. Extracts from the summary of the report appear here as Appendix A.

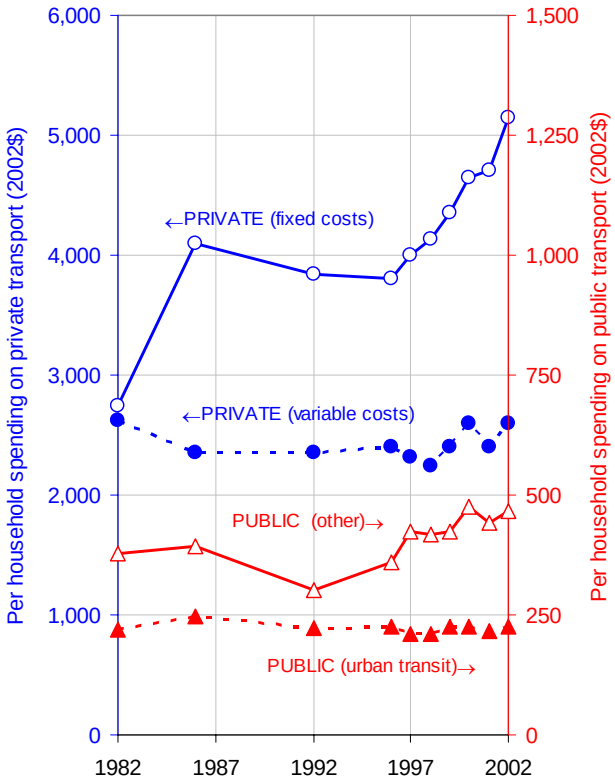
2.5 Private spending on transport

Unlike the supply of road space and, to a lesser extent, supply of transit, the supply of vehicles depends largely on private spending. How private spending on transport has changed since 1982 is illustrated in Figure 1,[6] which represents Canada as a whole rather than urban areas or the CMAs.[7]

What is striking about Figure 1 is the relatively constancy of private spending on transport, with the significant exception of spending on the fixed costs of private transport, which include costs of automobile purchase, insurance, and licensing. This kind of spending increased in real terms by 88 per cent between 1982 and 2002, while spending on the variable costs of private transport (chiefly fuel but also maintenance, repair, and other costs that vary with use) fell by one per cent.

The growth in spending on the fixed costs of private transport can be attributed more to spending per vehicle than to growth in the number of vehicles. This is because between 1982 and 2002 the growth in the number of households seems to have exceeded the growth in the number of vehicles, i.e., there were fewer vehicles per household in 2002 than in 1982.[8] The main factor contributing to the increase in per-vehicle spending were higher purchase and insurance costs.

Figure 1. Household spending on private and public transport, Canada 1982-2002



Higher purchase costs reflected growth in the size and power of personal vehicles, which were substantially heavier and very much more powerful in 2002 than in the early 1980s.[9]

Real spending on public transport other than urban transit also grew, by 23 per cent between 1982 and 2002. This mainly comprised increased spending on air travel.

Spending on urban transit increased by 2.3 per cent. It comprised 3.7 per cent of all private spending on transport in 1982 and 2.7 per cent in 2002. If it is assumed that just about all of this spending occurred in the CMAs, and that other factors are the same, urban transit's share of all transport spending in the CMAs comprised about 4.3 per cent.

Private spending on transport in 2002 averaged about 18 per cent of after-tax income. This share hardly varied among the top four quintiles of household income; the lowest quintile spent an average of 13 per cent of after-tax income.[10]

It follows that a shift of one percentage point of after-tax income towards transit in the CMAs would more than double private spending on transit and, in every CMA, substantially increase investment in transit infrastructure and operations.

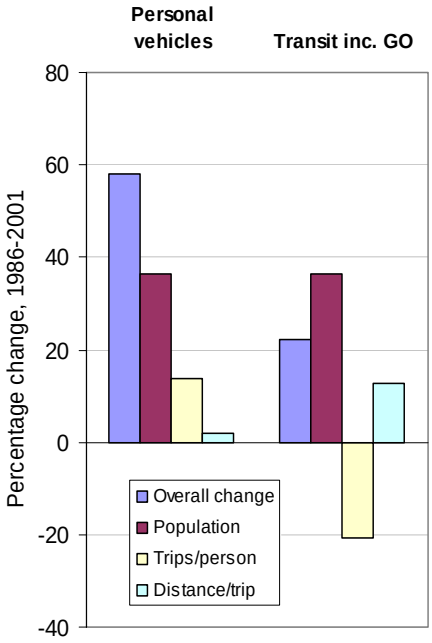
3. TRANSPORT DEMAND IN URBAN AREAS, INCLUDING TRENDS

3.1 PERSONAL VEHICLE ACTIVITY

Both national and local estimates of vehicle movement are based on fuel sales, which have greater reliability and validity for national estimates. Local estimates can be supplemented by data from cordon counts and origin-destination surveys, but not in systematic ways.

The national estimates suggest that annual vehicle-kilometres performed by private motorized vehicles grew by 15.1 per cent between 1990 and 2002.[11] Meanwhile, Canada's population grew by 13.4 per cent. Thus, there was only a small (1.5 per cent) growth in per-capita vehicle use across these 12 years; almost all of the growth in traffic was related to population growth.

Figure 2. Contributions to overall changes in person-kilometres by personal vehicle and transit, GTA, 1986-2001

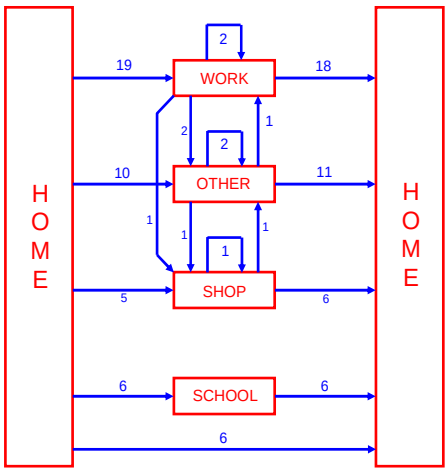


Estimates for CMAs based on fuel sales support the conclusion there has been little per-capita growth in automobile activity. Furthermore, they suggest that overall distances travelled vary little with the size of the CMA, the daily average being about 25 kilometres per person.

Am assessment for the GTA suggests that there the role of population growth may not have been be quite so overwhelming. An example is the left-hand set of bars in Figure 2, where it can be seen that in the Greater Toronto Area (GTA) population growth underlay most of the 58-per-cent increase in weekday transport activity involving personal vehicles between 1986 and 2001. However, growth in travel per person was more significant than the national estimates suggest. It mostly comprised more trip-making rather than longer trip-taking.

The structure of *all* weekday trips in the GTA in 2001 is shown in Figure 3. This should be interpreted as showing that 19 per cent of all trips were from home to work and six per cent of trips were home-bound trips after shopping. It can be seen that 89 per cent of journeys were home-related, 45 were work-related, and 37% were straightforward commuting. When weekends are included, the share of work-related trips falls considerably. U.S. data suggest there may be more travel on Saturdays than on some weekdays, although less on Sundays than on any other day.[12]

Figure 3. Structure of weekday travel in the GTA, 2001



A structure diagram similar to Figure 3 but for transit alone differ only in that shares of trips to and from work and school are higher (27 and 25 per cent to and from work and 10 and 11 per cent to and from school), and shares of all other trips are proportionately lower.

Another variable of interest is occupancy, in that a well occupied car can have less environmental impact per unit of performance (person-kilometre) than a poorly occupied bus. There are national estimates of car occupancy, but no readily available data for individual regions. The national estimates suggest an average occupancy in 2001 of 1.64 persons per vehicle, down from 1.73 in 1990, with most of the decrease occurring after 2000. Other data, including data from the *UTI Surveys*, suggest that these overall averages reflect av-

erage occupancies of near 1.2 for commuting trips and above 2.0 for other trips.

3.2 Transit activity

There are rather better data on transit activity on urban regions than on movement of personal vehicles. For transit, the basic activity datum is the trip from origin to destination, although for comparison with other modes person-kilometres can be appropriate. (Ten person-kilometres is one person moving through ten kilometres or five people moving through two kilometres.)

Across reporting urban regions, the number of transit trips per capita in 2001 averaged 68 in 2001, down from 95 in 1991. The range in 2001 was from 16 (St. Catherines-Niagara) to 131 (Montreal). Transit systems in all CMAs except Montreal reported decreases in *per-capita* ridership between 1991 and 2001. As noted above, in most of these regions—Toronto being the significant exception—per-capita investment in transit did not decline across these years.

Transit performance is often expressed as 'modal split', i.e., the share of all journeys—or all motorized journeys—made by transit. The highest modal splits are reported for rush-period journeys to and from the central business district. For the three largest, the next six, and the remaining CMAs the average such modal splits in 2001 were 53, 27, and 8 per cent respectively (transit's share of all such trips), with the Toronto and Montreal CMAs having the highest shares at 62 and 56 per cent respectively. When the whole urban region is considered, for the whole day, the modal splits are much lower. For example, these shares for the Toronto and Montreal CMAs were both reported as 15 per cent.

The right-hand set of bars in Figure 2 shown shows the contributions to the absolute increase in transit person-kilometres in the GTA between 1986 and 2001. Population growth made the largest contribution, but it was considerably offset by the substantial decline in trips per person. Growth in average transit trip distance also supported the increase in person-kilometres

3.3 Non-motorized transport activity

There is little information available about bicycling and walking in urban areas. Some can be divined from the *UTI Surveys*, but it is not reliable or always comparable. These surveys do provide some information about bicycle infrastructure, indicating a wide range of provision of bicycle lanes among CMAs in 2001, from 13 to 921 lane-metres per 1000 residents (Kingston and Calgary, respectively). Overall, the next six largest CMAs had the largest per-capita provision of bicycle lanes, on average about twice what was provided in the largest three CMAs and the remaining CMAs. The few data from earlier years suggest that there has been an overall increase in the provision of bicycle lanes.

Statistics Canada has sought information about journey-to-work modes during each census, beginning in 1996. Shares of bicycling and walking are surprisingly uniform, clustering around seven per cent of all commuting trips, with the four-per-cent share for Oshawa being unusually low and the 15- and 11-per-cent shares for Victoria and Halifax being unusually high. Reported shares were generally slightly lower in 2001 than in 1996.

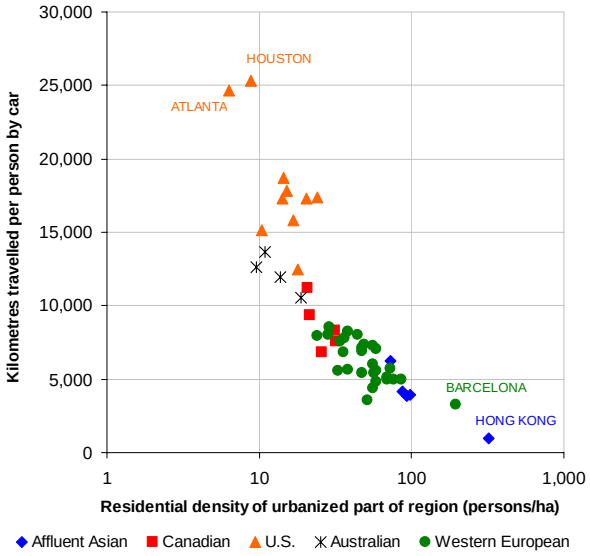
3.4 Variations in transport activity within urban regions

Some of the most profound differences in the patterns of movement of people occur *within* urban regions, especially the larger urban regions. This is illustrated in Figure 5, which disaggregates data for the Greater Toronto Area according to distance from the central business district. The Core is the

extended downtown. The Core Ring is very roughly the former City of Toronto (until 1997). The Inner Suburbs are roughly the remainder of the present City of Toronto (former Metropolitan Toronto). The Outer Suburbs comprise the four regions surrounding the present City of Toronto (Durham, Halton, Peel, and York), where most development occurred after 1970.

The Core is striking because most journeys are not made by car but by transit or by non-motorized modes. Indeed, a slight majority of households in the Core do not own a car. (This is not a matter of income: per-person incomes are roughly uniform throughout the GTA, although per-household incomes increase with distance from the Core because household sizes increase.) The extent of use of non-motorized modes in the Core is especially striking. It is far greater than in the adjacent Core Ring, which is more similar in this respect to the Inner and Outer Suburbs. The Core and the Core Ring are more similar in transit use.

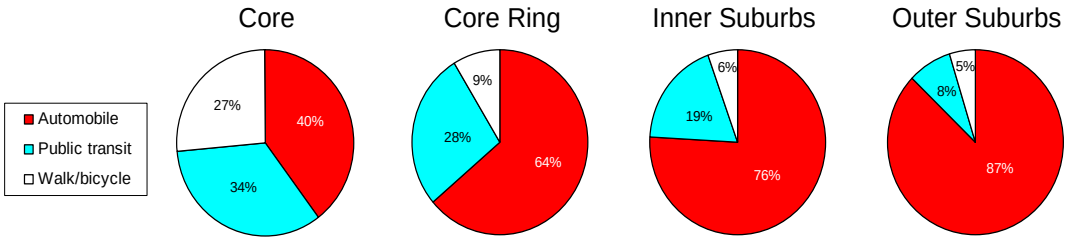
Figure 4. Relationship between urban density and car travel, 52 urban regions, 1995



The critical factor distinguishing the four concentric parts of the GTA may be residential density, shown along the bottom line of Figure 5. Another factor is the greater proximity of business, shopping, and leisure activities in the Core compared with the other parts.

The relationship between residential density and automobile use is evident when urban regions in different parts of the world are compared, as in Figure 4. Of the 52 affluent urban regions represented, five are Canadian (Calgary, Montreal, Ottawa-Gatineau, Toronto, and Vancouver). They have similar densities on a world scale, and similar amounts of car use, clustering between Euro-

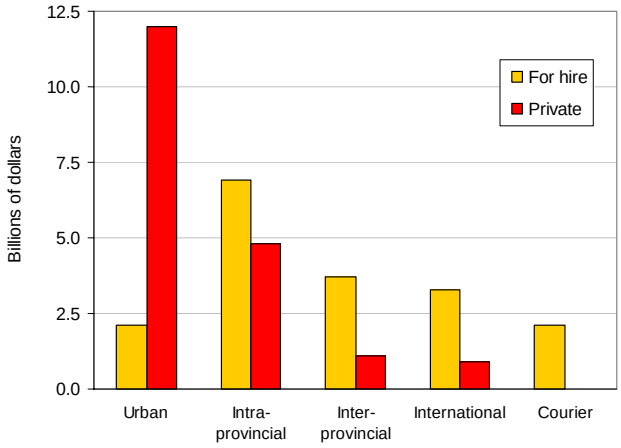
Figure 5. Weekday travel, car ownership, and residential density in different parts of the GTA, 2001



	Core	Core Ring	Inner Suburbs	Outer Suburbs
Number of trips per day per person	2.08	2.31	2.34	2.67
Motorized km. travelled per person	10.5	13.6	16.6	23.7
Households with no car	51%	29%	17%	5%
Residential density (persons per square km. of urbanized area)	9,900	6,100	3,100	2,500

pean and Australian urban regions in both respects.

Figure 6. Value of services provided by for-hire and private trucking by area of operation, Canada, mid-1990s

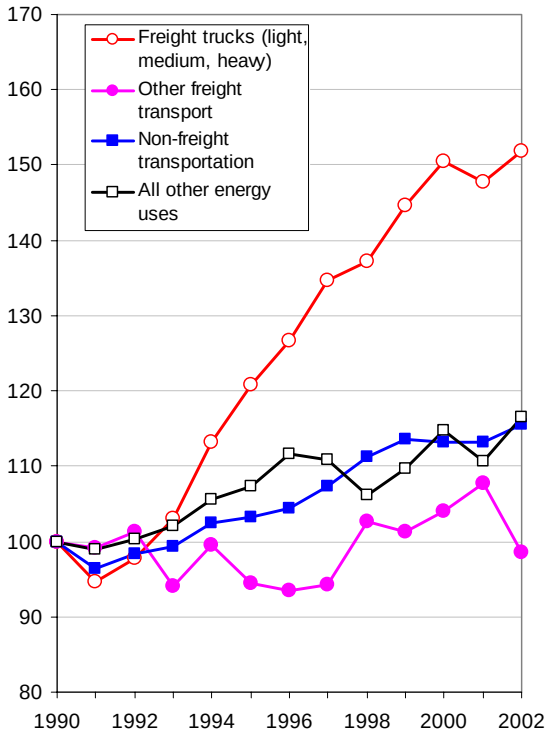


3.5 Freight transport activity

The many data gaps and imperfections concerning the movement of people in urban areas are relatively few when compared with the movement of freight in urban areas, about which almost no data exist. The exceptions are the Vancouver and Edmonton regions, and possibly the Calgary region, all noted below.

The scale of freight movement within urban areas may be indicated by Figure 6, which shows estimates of the annual *value* of freight shipments in the mid-1990s by for-hire and private trucks, according to where the truck movement occurred.[13] The simple conclusion from Figure 6 is that about half of the value of trucking is carried within urban areas, and about half is carried by private trucks (which operate mostly within urban areas).

Figure 7. Changes in energy use for transport modes and other purposes, 1990-2002 (1990 values = 100)



The data in Figure 6 are hardly more than a guess, and in any case say little about the amounts of freight transport activity in urban areas. Commodity flow surveys for Edmonton and Vancouver provide more reliable data.

The Edmonton Region Commodity Flow Survey provided a picture of commercial vehicle operation in the Edmonton CMA in 2000-2001, including regular automobiles used for commercial purposes, chiefly provision of services.[14] The Survey confirmed that the majority of trucks active within the Edmonton CMA may be private trucks—i.e., trucks owned by the freight shippers—although it was a much smaller majority than indicated in Figure 6. (There may not be an inconsistency because Figure 6 represents value of shipments rather than type and extent of truck ownership.)

The Survey also indicated that commercial traffic comprised about 11 per cent of all traffic (i.e., vehicle-kilometres) within the Edmonton region, and that trucks comprised about 40 per cent of commercial traffic, i.e., just over four per cent of all traffic. This may be compared with an estimate

that Canada-wide about 22 per cent of vehicle-kilometres in 2001 were performed by trucks.[15] A possible conclusion from these observations is that much less than half of all truck vehicle-kilometres are performed within urban regions.

Of all commercial movements in the Edmonton Region, just over 93 per cent started and stopped within the region, just under five per cent started *or* stopped within the region (but not both), and the remaining two per cent were passing through the region. It follows that freight movement within the Edmonton region is very much a local matter.

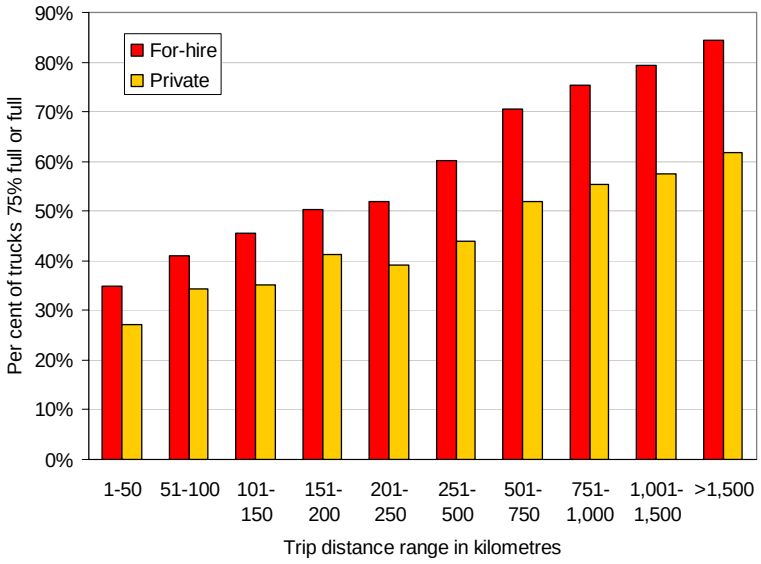
A similar survey may have been carried out in the Calgary region, but little information is available.[16]

A more detailed survey of freight movement has been carried out for the Vancouver region,[17] with the additional advantage that data from several years are available (1985, 1996, and 1999). Two findings stand out. One is that heavy trucks make longer trips than light trucks, even within the urban region (on average, 15.8 vs. 8.5 kilometres in 1999). The other is that the increase in truck traffic within the Vancouver region between 1985 and 1999 seems less than what may have occurred for trucking overall in Canada. The Vancouver increase was 38 per cent over these 13 years. As shown in Figure 7, energy use by trucking—and thus fuel use and distance travelled—increased by 52 per cent over the overlapping 12 years between 1990 and 2002. Thus, unless Vancouver is atypical, this raises the possibility that the growth of trucking within urban areas may have increased recently at a lower rate than trucking between urban areas.

Figure 7 is also of interest because it shows that energy use for trucking—and thus emissions of greenhouse gases and perhaps other emissions—has increased at a much higher rate than energy use for other freight transport, for non-freight transport, and for non-transport sectors. It is possible to conclude from available data that trucking was responsible for 70 per cent of the growth in Canada's oil consumption between 1990 and 2002, even though it accounted for only 34 per cent of total oil consumption in 1990. Similarly, trucking was responsible for 24 per cent of the growth in Canada's greenhouse gas emissions between 1990 and 2002, even though it accounted for only eight per cent of greenhouse gas emissions in 1990.

The Edmonton and Vancouver surveys do not provide information about a matter that may be of critical importance in considering the environment and resource impacts of trucking. It is vehicles' load factors, i.e., the extent to which their carrying capacity is used.

Figure 8. How the load factor of inter-city trucks varied with trip distance, Canada, 1999



A fundamental but not well-understood fact about truck energy use is this: Even when full with a load that weighs more than the truck, most of the fuel is used to move the truck rather than the load. Thus, a one-quarter-full truck uses about 2.5 times as much fuel *per tonne of payload* than a three-quarters-full truck. The fuel penalty for travelling with an empty or even a half-full truck is high.

Figure 8 shows how the loading of *inter-city trucks* varied with distance in 1999. Load factors rose with trips distance, more for for-hire than for private trucks. These data suggest that load factors could be especially low in urban areas, with corresponding high rates of fuel use per payload tonne.

4. TRANSPORT'S IMPACTS

4.1 ENERGY USE AND GLOBALLY ACTING POLLUTANTS

When fossil fuels are burned, he resulting energy (fuel) use and greenhouse gas (GHG) emissions are almost perfectly correlated. Both were touched on in the previous section. There it was noted that energy use and thus GHG emissions from non-freight transport have been increasing at a rate of close to 1.25 per cent per year (Figure 7), similar to the increase for non-transport sectors, both just slightly ahead of the rate of increase in Canada's population growth (1.05 per cent per year). Energy use and GHG emissions from trucking—although not other freight transport—have been increasing at a very much higher rate.[18]

Government policy on GHG emissions and prudence in the light of oil supply prospects both require reductions rather than continuing increases, notwithstanding population growth. Suggestions were made in the last section to the effect that low load factors may be responsible for some of trucking's high energy use and that low load factors may occur more within than between urban regions. Moreover, raising load factors may require little more than better shipping practices.

Other globally acting emissions included radiatively active compounds (chlorofluorocarbons [CFCs] from vehicle air conditioners are the best known) and persistent organic pollutants (POPs) such as dioxins and furans. Road traffic has been found to account for zero to 16 per cent of the production of dioxins.[19]

Compounds such as CFCs thin the stratospheric ozone layer. They have been regulated for some years by international convention, and their use in vehicle systems has been substantially diminished. Such a convention has just been enacted in respect of POPs.[20] The effect on emissions of POPs from transportation is uncertain.

4.2 LOCALLY ACTING POLLUTANTS AND THEIR IMPACTS

Globally acting pollutants, particularly GHGs, have captured the limelight in recent years, but within urban areas the main concern continues to be locally acting pollutants, particularly pollutants in the air such as smog, particulates, and acidifying substances. They remain a major concern of the Government of Canada:

> Air pollution is a serious problem in Canada and the combustion of fuels in vehicles and engines is a major contributor to this problem, particularly in urban areas. Air pollution has major adverse impacts on the environment and the health of Canadians. Health studies indicate that air pollution contributes to numerous adverse health impacts, including premature mortality. While emissions of some pollutants have declined over the past two decades, air pollution continues to be one of Canada's highest environmental priorities and challenges.[21]

Figure 9. Trends in urban air quality, 1980-2000
(see text for explanation of each of the 11 series)

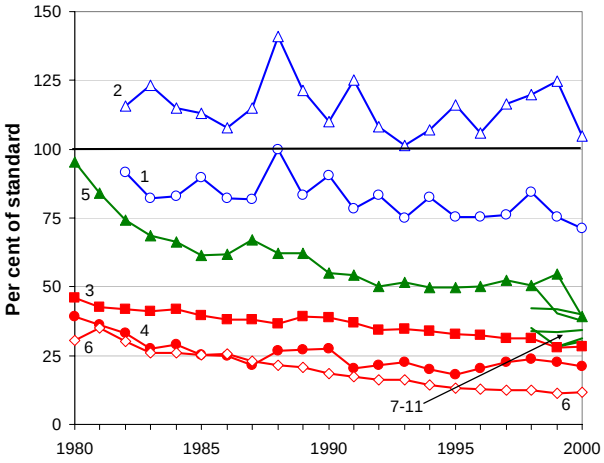


Figure 9 presents eleven series of data points that illustrate recent trends in urban air quality.[22] Each point shows for one year the level of a particular kind of pollutant, indicated below, for a particular urban area or areas, also indicated below, as a percentage of the current or proposed national standard.

Series 1 and 2 show **ground-level ozone** concentrations for urban regions in Western and Eastern Canada for each of the years 1982-2000. Ozone is the principal ingredient of 'smog', and may be harmful at any concentration to all living matter. It is formed by the action of sunlight on vehicle exhaust and other pollutants. The standard, to come into effect in 2010, is 130 micrograms per cubic metre ($\mu g/m^3$) averaged over eight hours. Figure 9 suggests a slight downwards tendency for each series. The series for Eastern Canada may be on a trajectory to reach the proposed standard by 2010.

Series 3 shows levels of nitrogen dioxide (NO_2) in the air for the period 1980-2000 in relation to the current standard of 60 $\mu g/m^3$ averaged over the year. NO_2 is the most prominent of the nitrogen oxides (NO_x) formed during combustion in air, including combustion in vehicle engines. These oxides are a principle ingredient of ozone (see above). They are harmful in their own right. According to Environment Canada, NO_2 "irritates the lungs, and lowers resistance to respiratory infection. In children and adults with respiratory disease, NO_2 can cause symptoms including coughing, wheezing and shortness of breath. Even short-term exposure to NO_2 affects lung function."[23] Figure 9 indicates that NO_2 levels show a clear downward trend. In 1995, transportation contributed 41 per cent of NO_x emissions in Canada, probably a higher share in urban areas.[24]

The other main ingredient in photochemical ozone production is volatile organic compounds (VOCs), not shown in Figure 9. Since 1986, levels of VOCs in the air have remained at close to 28 per cent of the national standard.[25] Several VOCs, notably benzene, are harmful in their own right. In 1995, transportation was responsible for about 19 per cent of national emissions of VOCs, chiefly unburned fuel components and fuel vapours.

Series 4 in Figure 9 shows levels of sulphur dioxide (SO_2) for the period 1980-2002 in relation to the current standard of 30 $\mu g/m^3$ averaged over the year. SO_2 results from combustion of sulphur-containing fuel. A key effect is interference with pollution-control devices, which is why the automotive industry petitions for lower sulphur levels in transport fuels. SO_2 also harms health. According to Environment Canada, it "leads to eye irritation, shortness of breath and impaired lung function. When inhaled SO_2 primarily stays in the nose, mouth and throat but can penetrate more deeply into the lungs during physical activity. When combined with water, SO_2 converts to sulphuric acid, which is highly irritating to the sensitive surface lining the respiratory tract. Prolonged or repeated exposure can cause long-term damage to the lungs." According to Figure 9, SO_2 levels show a slight downward trend. In 1995, transportation contributed 20-60 per cent of SO_2 in the air in urban Canada.

Series 5 in Figure 9 shows levels of total suspended particulate matter for the period 1980-2002 in relation to the current standard of 60 μg/m^3 averaged over the year. Sources of particulates are road dust, brake linings, and fuel combustion, particularly diesel fuel. Particulates of all sizes contribute to smog formation. Fine particulates—discussed below in relation to Series 7-11—may have particularly strong adverse effects on human health.

Series 6 in Figure 9 shows levels of carbon monoxide (CO) for the period 1980-2002 in relation to the current standard of 6 mg/m^3 (eight-hour average). CO results from incomplete combustion of the carbon in fossil fuels, including transport fuels. It interferes with the uptake of oxygen in the blood, and in high concentrations is lethal. According to Figure 9, CO levels show a clear downward trend. In 1995, transportation contributed 38 per cent of national emissions of CO, more in urban areas, mostly from gasoline-fuelled vehicles.

Series 7-11 in Figure 9 show respectively levels of fine particulate matter (diameter less than 2.5 micrometres or microns) for Vancouver, Edmonton, Toronto, Montreal, and Saint John. According to the U.S. Environmental Protection Agency,

> "Health studies have shown a significant association between exposure to fine particles and premature death. Other important effects include aggravation of respiratory and cardiovascular disease (as indicated by increased hospital admissions, emergency room visits, absences from school or work, and restricted activity days), lung disease, decreased lung function, asthma attacks, and certain cardiovascular problems such as heart attacks and irregular heart beat. Individuals particularly sensitive to fine particle exposure include older adults, people with heart and lung disease, and children."[26]

Understanding of the importance of fine particulate matter is relatively recent, as is the technology for ready monitoring of emissions and atmospheric concentrations. Per unit of energy produced, diesel engines result in emission of about eight times as much fine particulate matter as gasoline engines.[27] There are too few data points for Series 7-11 to indicate a trend. However, trends in emission of fine particulate matter can be similar to trends in emission of total suspended particulate matter. Thus, the declining trend in Series 5 in Figure 9 suggests that emission of fine particles may have been declining. In 1995, transportation contributed 25-20 per cent of emissions of fine particulates in urban areas.

4.3 Effects on human and ecosystem health

Human health effects of particular atmospheric pollutants have been noted in the previous subsection. To these may be added effects on other living material, including wild and domesticated animals and agricultural and garden crops.[28]

Several studies have noted a relationship between air pollution and human morbidity and mortality. The most recent of these, conducted for the City of Toronto's public health service, concluded that in that city (population 2.2 million), air pollution contributes annually to about 1,700 premature deaths and about 6,000 hospitalizations.[29] The report notes that transportation is the principal cause of air pollution in Toronto

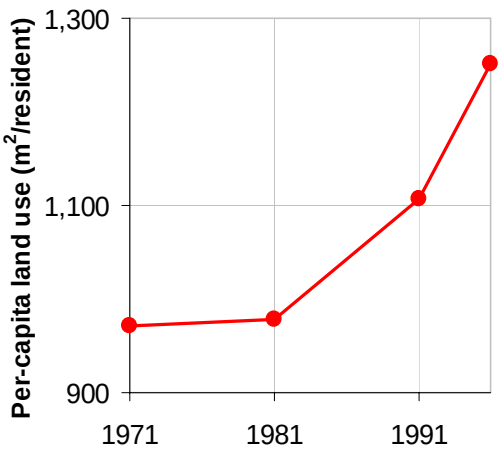
4.4 Land-use impacts

Sketchy data are available as to the trend in land consumption by Canadians for urban purposes. They are presented in Figure 10.[30] After remaining relatively constant in the 1970s, the amount of urban land consumed per person increased by 13 per cent during the 1980s and showed signs of increasing at an even higher rate during the 1990s.

Most of the urban development in place in 1981 was still in place in 1991, probably occupied by just about the same number of people as in 1981. The increase in the amount of land used for urban purposes occurred largely on account of development at the periphery occupied in effect by Canada's growth in population. (In reality, most immigrants went initially to already developed parts of urban regions, replacing residents moving to newly developed parts of the regions.)

From information about population growth, assumptions about where immigrants settle, and the data represented in Figure 10, estimates can be made that the amount of land used for urban purposes across Canada increased by more than a quarter between 1981 and 1991, and that the added land was developed on average at a density only a little more than half the density of existing development.[31]

Figure 10. Trends in the amount of land used for urban purposes, Canada, 1971-1996



This account of lower-density development in the 1980s says nothing about the role of transportation. However, as illustrated in Figure 5, residents of outer suburbs are heavily automobile-dependent. The ready availability of automobiles made the low-density development possible, and their use is sustained by that development's lack of alternative transport modes.

4.5 Economic impacts

Transport Canada's annual report to parliament for 2003 has a useful section entitled "The importance of transportation to the Canadian economy".[32] What follows are highlights from this section:

- Commercial transport services in Canada accounted for $40.1 billion (1997 dollars), or 4.0 per cent of value-added GDP. The highest share of this total was provided by for-hire trucking, in the amount of $12.3 billion. The total does not include the value of private trucking, i.e., trucking services provided by a company to itself, which has been estimated to be similar to the total for for-hire trucking.33 The next highest shares were rail ($5.6 billion), aviation ($3.7 billion), and urban transit ($3.1 billion)
- Expenditures on transportation (transport demand) in 2003 totalled $157.5 billion dollars (2003 dollars) or 13.0 per cent of GDP. The largest share by far was personal expenditure on transportation, which totalled $103.0 billion, of which just under half ($48 billion) went towards new and used transport equipment (chiefly automobiles). The personal expenditure is the aggregate of what is represented in Figure 1.
- Automotive products, chiefly vehicles and parts, comprise a significant part of Canada's trade. These exports were valued at $87.9 billion (2003 dollars); imports were valued at $76.4 billion.
- Governments spent $19.6 billion on transportation in 2002 (2003 dollars), including $6.6 billion on new transport facilities, $8.6 billion on road maintenance, and $2.6 billion on supporting urban transit.

5. CHALLENGES, BARRIERS, AND OPPORTUNITIES

The purpose of this section is to identify key current and emerging environmental and economic issues associated with urban transportation/mobility in Canada, including linkages among the issues such as, for example, those between transportation and human health. This section also identifies some basic goals and objectives related to the key issues, sets out initiatives which could be taken to achieve these, and ranks the initiatives in terms of their potential for contributing to more sustainable urban areas. Finally, the section identifies barriers to achieving the initiatives and suggests actions to address these barriers for six "packages" of initiatives. The material in this section draws on, and updates earlier work by IBI Group in 1995.[34]

5.1 URBAN TRANSPORT ISSUES, GOALS/OBJECTIVES, AND RELEVANCE TO NRTEE MANDATE

Drawing on the discussion in Section 2 and 3 on supply and demand attributes of urban transportation in Canada, and the impacts of urban transport as discussed in Section 4, four key urban transport issues and challenges are identified, as follows:

- achieving improved compatibility with human communities and activities;
- enhancing the quality of the physical environment;
- reducing the depletion of key resources; and
- providing capable and cost-efficient urban transport.

It is evident from the material in Sections 2, 3, and 4 that many of the challenges implicit in these four issues are not being addressed effectively in urban Canada. The issues are listed on the left hand side of Table 1, which also shows in the central column a number of basic goals and objectives associated with each issue. Two goals are listed relative to the compatibility issue: enhanced Quality-of-Life, and Broadened Lifestyle Choices, with associated objectives under each goal. The key goal associated with the second issue is Reduced Emissions while the goal associated with the third issue is Greater Conservation of Resources. Two goals are associated with the fourth issue: Reduced Vehicular Travel Effort, and Improved Economic Efficiency.

Also shown, in the right hand columns of Table 1, are symbols showing with a mid-sized circle objectives relevant to NRTEE's mandate and, with a large circle, those objectives that are very relevant. Considered at this degree of aggregation, it can be seen that most of the objectives are seen to be very relevant in achieving both aspects of NRTEE's mandate, the Environment and the Economy. This suggests that there are strong linkages among the issues, goals and objectives listed in the tabe in terms of their interactions as they pertain to environmental and economic implications.

While all four issues are very relevant to NRTEE's mandate, the first (Compatibility with Human Communities and Activities) is particularly so, not only because of its importance in achieving a positive environment for people and other living beings but also to attract inward investment for growth in economic activities, jobs, income and tax revenues. Capable and Cost-Efficient Urban Transport is also very relevant to economic growth and almost as relevant to environmental quality, based on the ratings in Table 1.

Figure 11 illustrates some key interactions in more detail.[35] It shows how the mindset and behavioural choices of transport system users interact with the land-use patterns and transport supply provided by governments and the private sector to create transportation activity, energy use, emissions, environmental quality and economic performance.

Table 1. Sustainable Urban Transport Issues, Goals/Objectives and Relevance to NRTEE Mandate

ISSUES	GOALS AND OBJECTIVES	RELEVANCE TO NRTEE MANDATE	
		Environment	Economy
1. Compatibility with Human Communities and Activities	Enhanced Quality-of-life		
	• Greater Safety	●	●
	• Attractive People Places	●	●
	Broadened Lifestyle Choices		
	• Housing Types	●	●
	• Travel Modes	●	●
2. Enhanced Physical Environment	Reduced Emissions		
	• Air Emissions	●	○
	• Water Runoff	●	○
3. Reduced Depletion of Resources	Greater Conservation of Resources		
	• Fossil Fuels	○	●
	• Farmland and Green Areas	●	○
4. Capable and Cost-Efficient Urban Transport	Reduced Vehicular Travel Effort		
	• Fewer, Shorter Trips	●	●
	• More Walking, Transit, Cycling	●	●
	Improved Economic Efficiency		
	• Less Congestion	●	●
	• Lower Transport Costs	○	●

Legend: ● = Very relevant

○ = Relevant

Figure 11. Interactions: Transport Behaviour, Energy Use, Emissions and Human Health

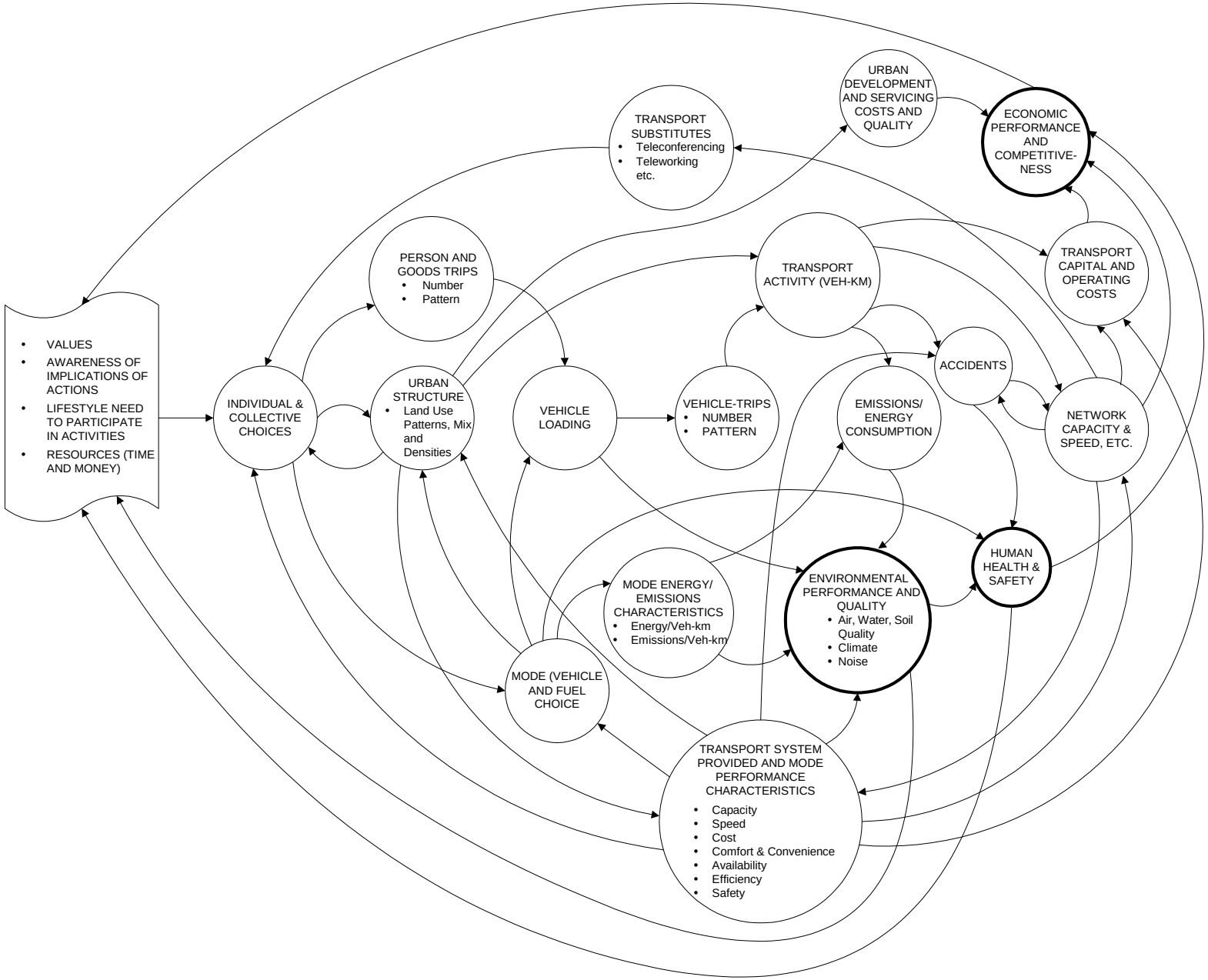


Figure 11 also illustrates a number of key linkages between transport and human health and safety. As shown, transport emissions have an impact on air quality which, in turn, affects human health as documented in a number of reports during the past several years. Transport activity, measured in terms of vehicle-kilometres, and network capacity and speed both have an impact on the number and severity of traffic accidents, and these, as shown, also have an impact on human safety and health. Other key linkages are also shown: land use patterns and mode choice both affect human health by having an impact on the number of walking, transit and cycling trips which, in turn, can contribute to improved health through reduced obesity and increased physical fitness.

Figure 11 also shows in more detail the linkages through which land use patterns in an urban area along with its transport system, its capacity/speed performance, and related costs and benefits have very significant implications for the area's economic performance. If, for example, the modal mix and capacities provided to serve and help shape the land use pattern are such that automobile-dependent urban sprawl and significant and chronic traffic congestion are experienced, the costs of commercial activities, daily commuting and providing essential services will increase and thereby reduce the economic competitiveness of the urban area. Conversely, if, for example, a high quality rapid transit network were provided for a large urban area, thereby helping to achieve a more structured land use pattern, reduced growth in traffic congestion and more efficient person and goods movement, the area's economy would benefit from the increased efficiency and, at the same time, its environment would benefit from reduced vehicular travel effort, energy consumption and emissions.

A possible NRTEE priority initiative to address the implications of more sustainable and efficient urban transport and related urban structure in helping to maintain and improve the competitiveness of Canadian cities is discussed in Section 9.

5.2 Addressing the Challenges: Ranking of Potential Initiatives

Table 2 shows in the left hand column 27 major types of initiative that can be considered in addressing the challenges discussed previously.[36] These are grouped under seven headings:

- Urban Structure/Design Policies
- Transport Infrastructure
- Demand Management Practices
- Transit Management Practices
- Traffic Management Practices
- Cleaner Vehicle Technology Development
- Public Outreach and Awareness Programs.

Historically, each of these types of initiative has been applied in at least one Canadian urban area, although only the largest areas have applied most or all of them and many such applications have to date been incomplete owing to shortages of funds, lack of political will and other barriers. Shown in the column headings of Table 2 are the six goals and associated objectives under each goal which were listed earlier in Table 1. Each of the initiatives is rated in terms of its potential for achieving each of the 14 objectives, with a large circle indicating a large positive impact and smaller circles indicating less significant impacts. It is recognized that these ratings represent the opinions of this report's authors, and a variety of views would undoubtedly be held by various other groups and individuals. Nevertheless it is a starting point for assessing the various initiatives and their potential contribution to improved urban transport in Canada, as a basis for discussion regarding priorities and possible value-added activities by NRTEE.

Table 2. Potential for Improved Sustainability: Rating of Initiatives

ISSUES AND GOALS FOR MORE SUSTAINABLE URBAN TRANSPORT / MAJOR TYPES OF INITIATIVES	ENHANCED QUALITY OF LIFE		BROADENED LIFESTYLE CHOICES		REDUCED EMISSIONS		GREATER CONSERVATION OF RESOURCES		REDUCED VEHICULAR TRAVEL EFFORT				IMPROVED ECONOMIC EFFICIENCY		POTENTIAL FOR CONTRIBUTING TO MORE SUSTAINABLE URBAN AREAS (1)
	Greater Safety	Attractive People Places	Housing Types	Travel Modes	Air Emis-sions	Water Runoff	Fossil Fuels	Farm-land	Fewer/ Shorter Trips	More Walking	More Transit	More Cycling	Less Conges-tion	Lower Transp't Costs	
URBAN STRUCTURE/DESIGN POLICIES															
• Compact Mixed Land Use	L	L	L	L	M	M	M	L	L	L	L	L	S	L	37
• Pedestrian-Friendly Streets	L	L	M	M	L	M	L	M	L	L	L	L	S	S	34
• Joint Transportation/Land Use Planning	M	L	L	L	M	L	M	L	M	L	L	L	M	L	37
• Development Nodes and Intermodal Transfer Nodes	M	L	L	L	M	M	M	M	S	M	L	S	L	L	32
• Parking/Loading Facility Supply Management	S	M		S	M	M	M	M	M	M	L	M	L	M	26
TRANSPORT INFRASTRUCTURE															
• Continuous, Multi-Modal Arterial Roads	S	M		M	M		M		M	M	L	M	L	S	22
• Transit Priority/HOV Facilities	L	L	S	M	L	L	L	M	S	M	L	S	L	L	34
• Rapid Transit and Commuter Rail Networks	L	L	M	L	L	L	L	M	S	M	L		L	M	33
• Local Transit Improvements	S	L	S	L	M	M	M	S		M	L	M	S	S	23
• Cycle and Pedestrian Ways	L	L	S	M	L	M	L	M	L	L	M	L	S	M	33
DEMAND MANAGEMENT PRACTICES															
• Parking Price Management	S	M		S	M	M	M	M	M	M	L	M	L	M	26
• Congestion Pricing for Road Use	L	L	S	L	L	L	L	L	L	M	L	M	L	L	38
• Fuel (Carbon) Tax/Auto Registration Fees	M	M		L	L	S	L	S	S	S	S	S	M	M	23
• Alternative, Work Schedules	S	S		M	M	M	M				M	S	L	M	18
• Ridesharing	M	S		M	M	S	M			M			L	L	16
• Telecommuting	M	M	M	S	L	L	L		L	M	S	M	L	L	30
• Goods Movement Consolidation	M	S			L	S	L	M	L				L	L	21
TRANSIT MANAGEMENT PRACTICES															
• Fare Integration and Schedule Coordination	L	L		L	M	L	M	M		M	L		L	L	28
• Transit Priority and Smart Buses	L	L	S	L	L	L	L	M	S	M	L	S	L	L	34
• Traveller Information/Convenience Improvements	S	M		S	M	S	M	M	S	S	L	S	M	M	21
TRAFFIC MANAGEMENT PRACTICES															
• Advanced Traffic Management Systems	M	S		S	M	M	M		M	S	L		M	M	20
• Driver Information Systems	M				M	S	M		S	S	M	S	M	S	15
• Traffic Calming	L	L			S		S		S	M	L	M			16
CLEANER VEHICLE TECHNOLOGY DEVELOPMENT															
• Low-Emission/Alternative Fuel Vehicles		S		S	L	L	M				M				12
• Energy-Efficient Vehicles				S	L	M	L				M				11
• Emissions Monitoring/Testing Programs	S				L		L								7
PUBLIC OUTREACH AND AWARENESS PROGRAMS	M	M	M	M	M	M	M	M	M	M	M	M	M	M	28

Source: Adapted from IBI Group , March 1995, Exhibit 13

LEGEND: Anticipated Impact of Initiative in Helping to Achieve Sustainable Urban Travel:
L Large Impact M Moderate Impact S Modest Impact Negligible Impact

(1) The sustainability contribution potential is calculated for each initiative by giving it a score of 3 for each Large Impact, 2 for each Moderate Impact, and 1 for each Modest Impact, leading to a maximum possible total score of 42.

Note:
These ratings reflect the views of the authors of this report. Other groups and individuals would no doubt propose different ratings in various cases. The main usefulness of the exercise is to raise awareness of the manner in which different initiatives are likely to affect various measure of sustainability, to help in setting priorities and implementing packages of mutually reinforcing initiatives.

The individual ratings are added together in the right hand column of Table 2 (using a scoring scheme described in the footnote) to produce an overall score for each type of initiative. This, in turn, provides a basis for ranking the initiatives in terms of their potential for contributing to more sustainable urban areas. The most promising initiatives based on these results (with scores greater than 30, in declining order) are:

Congestion Pricing for Road Use
Compact Mixed Land Use
Joint Transportation/Land Use Planning and Delivery
Pedestrian-Friendly Streets
Transit Priority/HOV Facilities
Transit Priority Operations and Smart Buses
Rapid Transit and Commuter Rail Networks
Cycle and Pedestrian Ways
Development Nodes and Intermodal Transfer Nodes.

The ranking of these and other individual initiatives is useful as a basis for grouping the initiatives into possible action packages and ranking the packages, as described below, but first we consider the types of barriers to action which may be experienced.

5.3 Barriers to Action, and Overcoming Them

Based on the authors' transportation planning experience in many urban areas, we have identified nine types of barriers to action which might be anticipated:

- concerns of local residents;
- concerns of local businesses;
- concerns of auto and truck drivers;
- high public costs;
- long lead time;
- loss of economic competitiveness;
- lack of public control;
- safety/security concerns; and
- lack of government coordination, fiscal capacity and will.

Table 3 shows the anticipated extent to which each barrier might impede implementing each of the 27 sustainability initiatives evaluated in Table 2.[37] A large circle on Table 3 indicates a significant anticipated barrier and smaller circles indicate those expected to be of lesser significance.

Stressing again that this is a "first cut" based on the authors' opinions, Table 3 suggests that the most significant barriers to implementing the various sustainability initiatives, in declining order, are as follows:

- lack of government coordination, fiscal capacity and will;
- concerns of auto and truck drivers;

Table 3. Barriers to Implementing Key Sustainability Initiatives

INITIATIVE \ BARRIER	INTEREST GROUP CONCERNS			HIGH PUBLIC COSTS	LONG LEAD TIME	LOSS OF ECONOMIC COMPETITIVE-NESS	LACK OF PUBLIC CONTROL	SAFETY/ SECURITY CONCERNS	LACK OF GOV'T COORD, FISCAL CAP'Y AND WILL
	Local Residents	Local Businesses	Auto and Truck Drivers						
URBAN STRUCTURE/DESIGN POLICIES									
• Compact Mixed Land Use	Large	Medium		Small	Large	Small			Large
• Pedestrian-Friendly Streets			Medium						
• Joint Transportation/Land Use Planning									Large
• Development Nodes and Intermodal Transfer Nodes	Medium				Small				Medium
• Parking/Loading Facility Supply Management		Medium	Large			Medium	Large		Medium
TRANSPORT INFRASTRUCTURE									
• Continuous, multi-modal Arterial Roads	Medium			Small					
• Transit Priority/HOV Facilities	Large	Small	Large	Medium					
• Rapid Transit and Commuter Rail Networks	Medium			Large	Large				Large
• Local Transit Improvements				Medium					Medium
• Cycle and Pedestrian Ways		Small	Medium	Medium					
DEMAND MANAGEMENT PRACTICES									
• Parking Price Management		Medium	Medium			Medium	Large		Medium
• Congestion Pricing for Road Use		Medium	Medium			Large	Large		Large
• Fuel (Carbon) Tax/Auto Registration Fees			Medium			Medium			
• Alternative, Work Schedules									
• Ridesharing							Medium	Medium	
• Telecommuting							Small		
• Goods Movement Consolidation		Small				Small			Medium
TRANSIT MANAGEMENT PRACTICES									
• Fare Integration and Schedule Coordination									Large
• Transit Priority and Smart Buses			Large	Medium					Medium
• Traveller Information/Convenience Improvements				Small					Medium
TRAFFIC MANAGEMENT PRACTICES									
• Advanced Traffic Management Systems				Small					
• Driver Information Systems									
• Traffic Calming			Small						
CLEANER VEHICLE TECHNOLOGY DEVELOPMENT									
• Low-emission/Alternative Fuel Vehicles								Small	
• Energy-Efficient Vehicles									
• Emissions Monitoring/Testing Programs									Medium
PUBLIC OUTREACH AND AWARENESS PROGRAMS									

LEGEND:
Anticipated size of the Barrier: Large Medium Small Negligible

- high public costs;
- concerns of local residents and/or businesses;
- loss of economic competitiveness;
- lack of public control; and
- long lead time.

In general, more widespread coordinated planning and implementation, coupled with vigorous public information programs regarding the benefits of the various initiatives, are seen to hold the promise of addressing many of the barriers if coupled with other, more specific actions.

These are illustrated in Table 4,[38] which groups the initiatives into six packages, based on their ranking in terms of potential contribution to increased sustainability and affinities of the initiatives within each package, lists the major barriers which might be expected in implementing each package, and provides examples of the types of actions suggested to address these barriers. The six packages of initiatives, listed in decreasing priority order, are as follows:

1. **Road Pricing:** widespread **congestion pricing** for use of urban roads;
2. **Urban Land Use and Infrastructure:** joint **urban land use/transportation planning and delivery** leading to compact, mixed use nodes and corridors, transit-supportive land use, pedestrian-friendly streets and improved cycling and pedestrian ways integrated into existing and new communities;
3. **Transit Improvements:** enhanced **urban transit** including priority surface transit on major arteries operating in reserved (HOV) lanes with signal priority, smart buses with electronically timed transfers and smart stops to inform travellers of impending bus arrival times, combined with rapid transit/commuter rail improvements in larger cities, fare integration and schedule coordination, advanced traffic/transit management systems, other local transit improvements, and traveller information systems;
4. **Nodes and Consolidation: development nodes and intermodal transfer nodes** for improved modal integration and to help channel the forces of telecommuting and teleworking into a transit-friendly urban structure rather than urban sprawl, coupled with **goods movement consolidation** for fewer and shorter trips by commercial vehicles;
5. **Supply/Pricing Management and Other User Fees: parking supply and price management** to encourage use of transit, walking and cycling in urban areas; combined with an **increased fuel (carbon) tax** to moderate the growth of auto vehicle-km, and **graduated vehicle registration fees** to favour low emitting and energy-efficient vehicles.
6. **Roads, Traffic Management and Technology: advanced traffic management systems** and **driver information systems** for smoother traffic flow, increased travel time reliability and more efficient use of existing roads, **continuous multi-modal arterial roads**, for more efficient urban transit and goods movement and less circuitous auto movement, and **low-emission, energy-efficient vehicles** plus **vehicle emissions monitoring and testing programs** for reduced emissions/energy use per vehicle..

Table 4. Initiatives, Barriers and Actions

RANK	INITIATIVES IN EACH PACKAGE	MAJOR BARRIERS	ACTIONS
1.	**Road Pricing** – Widespread Congestion Pricing for Use of Urban Roads	– Loss of Economic Competitiveness – Lack of Government Coordination, Fiscal Capacity and Will – Concerns of Auto Drivers and Truckers – Concerns of Local Businesses – Lack of Public Control	– Widespread, Coordinated Implementation – Collective Approach, Common Technology – Public Information Regarding Benefits
2.	**Land Use and Infrastructure** – Compact, Mixed Land Use – Joint Transportation/Land Use Planning and Delivery – Pedestrian-Friendly Streets and Public Places – Cycle and Pedestrian Ways – Traffic Calming	– Concerns of Local Residents – Long Lead Time – Lack of Government Coordination, Fiscal Capacity and Will – Concerns of Auto and Truck Drivers	– Public Information and Coordinated Planning and Delivery Approach – Successes to be Shared with Other Groups – More Coordinated Government Actions – Initiatives to Reduce Government Duplication and Introduce Property Tax Incentives
3.	**Transit Improvements** – Transit Priority/HOV Facilities – Transit-Priority/Operations/Smart Buses – Rapid Transit and Commuter Rail Networks – Fare Integration and Service Coordination – Local Transit Improvements – Traveller Information/Convenience Improvements – Alternative Work Schedules – Ridesharing	– Concerns of Local Residents – Concerns of Auto and Truck Drivers – High Public Costs and Long Lead Time – Lack of Government Coordination, Fiscal Capacity and Will	– A Coordinated Planning/Implementation Approach – Effective Public Information – Set Out Proposals to Address Major Concerns Effectively – Provide ?Semi-Rapid≅ Transit On Arterial Road Networks – Design and Operate Public Facilities to Favour Transit Users – Introduce Road Congestion Pricing At the Same Time As Transit Priority Services

table continues on the next page/

/table continues from the previous page

RANK	INITIATIVES IN EACH PACKAGE	MAJOR BARRIERS	ACTIONS
4.	**Nodes and Consolidation** – Development Nodes and Intermodal Transfer Nodes – Telecommuting – Goods Movement Consolidation	– Concerns of Local Residents – Lack of Government Coordination, Fiscal Capacity and Will – Concerns of Local Businesses	– Favourable Urban Structure/Design Policies – Compact, Mixed Use Centres and Corridors Along Major Arterial Roads and At Transit Stations
5.	**Supply/Pricing Management and Other User Fees** – Parking/Loading Facilities Supply Management – Parking Price Management – Fuel (Carbon) Tax/Auto Registration Fees	– Concerns of Auto/Truck Drivers – Concerns of Local Businesses – Lack of Public Control – Loss of Economic Competitiveness – Lack of Government Coordination, Fiscal Capacity and Will	– Pricing Structure to Favour Short Term Parkers Over Commuters – Maximum As Well As Minimum Parking Supply Standards – ?Level Playing Field≅ Tax Breaks – Legislation for Greater Municipal Control of Supply/Price If Necessary – Coordinated, Widespread Planning and Implementation – Carbon Tax Revenues Dedicated to Transportation Improvements, Operations and Maintenance
6.	**Roads, Traffic Management and Technology** – Advanced Traffic Management Systems – Continuous Multi-Modal Arterial Roads – Driver Information Systems – Low-Emission, Alternative Fuel Vehicle – Energy-Efficient Vehicles – Emissions Monitoring/Testing Programs	– High Public Costs – Concerns by Local Residents – Lack of Government Coordination, Fiscal Capacity and Will	– Cooperative and Coordinated Planning Approach – Provincial and Municipal Governments to Introduce Emissions Monitoring Programs Based On Experience Elsewhere

Reflecting the highly interactive nature of urban transport as illustrated in Figure 11, there are also strong interactions among the six packages of initiatives, anticipated barriers to their implementation, and suggested actions to overcome the barriers. For example, referring to Table 4, the transport pricing, infrastructure, operations and management packages which are ranked as numbers 1, 3, 4, 5 and 6, would all have a major impact on the urban structure and quality of urban spaces package ranked as number 2.

In turn, the patterns, densities and mix of land uses resulting from development decisions, as strongly influenced by transport initiatives, will have a major impact on patterns of transport demand, the efficiency with which the system is used by travellers and commercial users, the resulting capital and operating costs to provide appropriate levels of transport service, and the resulting impacts on the environment, the economy and human health. Transport pricing, facilities/services provided, and real-time information for users are seen as major ways of influencing behaviour as a means of achieving improved system efficiency and effectiveness. One or more of these initiatives are present in each of the six packages, and create linkages among the packages.

There are also linkages among the major barriers which might affect implementing the six packages, in that a relatively small number of the original nine barriers (as shown in Table 3) are identified as major barriers affecting most of the packages. Chief among these are:

- lack of government coordination, fiscal capacity and will;
- concerns by auto and truck drivers;
- concerns by local residents and/or businesses;
- loss of economic competitiveness;
- high public costs and/or long lead time; and
- lack of public control.

The actions suggested to address these major barriers again show considerable similarity regarding the six packages. Chief among these are the following:

- a coordinated planning/implementation approach;
- effective public information;
- drawing on best practices elsewhere and informing the public of major successes elsewhere (e.g., the London, England central area congestion pricing initiative);
- a “customer-oriented” approach aimed at achieving early, significant benefits;
- coordinated implementation of pricing, services and regulatory initiatives.

A fundamentally important example of the latter is the need to introduce significant transit service improvements at the same time as road congestion pricing is introduced, in order to provide a viable alternative for those who are priced off the road. Again, the Central London congestion pricing initiative is a good example of how this was done by introducing substantially increased bus services at the same time as the congestion pricing was implemented. It is for this reason that Lack of Government Coordination, Fiscal Capacity and Will is shown as a major barrier for most of the packages, even for Road Pricing (ranked as the most promising package) and Supply/Pricing Management and Other User Fees (the package ranked fifth); these packages will both require short-term

government investment even though, in the longer run, the user fees can be expected to play a major role in meeting financial requirements.

As noted several times, effective public information/consultation is seen as an important complement to any of the initiatives and actions discussed in this section. An example of the type of information which could be effectively used in such a program is the large disparity between public and private expenditures on urban transport. For example, in the Greater Toronto Area (GTA), annual capital and operating expenditures by the public sector (net of transit fare revenues) are in the order of $2 billion, while private capital and operating costs for automobile use in the GTA are in the order of $25 billion per year, and this number would be substantially bigger if commercial vehicles were also included.

This type of information could affect auto and truck drivers' opinions regarding whether to support or oppose road tolls. It can be argued that, since drivers and commercial operators are spending so much already to own, insure, and operate their vehicles—and since growing congestion is eroding the benefits of their investment—a marginal additional expenditure on road tolls could greatly improve the situation by moderating the growth of auto traffic/congestion and also providing funding for significantly improved transit to make necessary capacity increases. At the same time, significantly improved transit will provide more modal choice for travellers and a more robust urban transport system, better able to maintain service levels in an era of rising prices for fossil fuels.

The findings presented in this and earlier sections suggest a number of possible NRTEE value-added initiatives to address important questions relating to urban transport and mobility, including the following:

- what are the key trade-offs between mobility and attractive urban places, and how can these be used to improve the competitiveness of Canadian cities?
- what can Canadian cities do now in terms of urban transport and related land use initiatives to prepare for future energy supply problems and high prices, and what plans should be considered for further actions if and when a crisis occurs?
- how can the possible rapid growth of urban truck traffic be moderated in order to reduce the resulting growth in emissions and energy consumption from these movements?
- recognizing the paucity of data on urban transport in Canada, particularly for freight traffic, what would be the costs and benefits of various levels of improved data, as a basis for actions to improve the completeness and accuracy of this information?
- what are the features of regional frameworks for governance and financing that seem capable of facilitating attainment of land-use and transportation goals?
- what would be the most cost-effective public information initiatives relating to urban transport and related land use which could be undertaken by NRTEE and other agencies?

These questions and recommendations regarding possible NRTEE action priorities are presented in Section 9 at the end of this report. A further topic is added—concerning regional frameworks for governance and financing—as a result of the overview in Section 6.

6. OVERVIEW OF SELECTED GOVERNANCE AND FUNDING FRAMEWORKS

This section provides a brief summary of the governance and funding approach which has been taken in four sets of urban areas (Greater Vancouver, Greater Montreal, Calgary and Edmonton, Greater Toronto) and current issues/initiatives in these areas.

6.1 GREATER VANCOUVER

Historically, urban transit in much of the Lower Mainland was provided by BC Hydro, reflecting that agency's role in providing electric street railway services before the Second World War. Separate transit agencies provided some suburban service (e.g., in North Vancouver, West Vancouver) and individual municipalities provided roads and traffic engineering services. The Great Vancouver Regional District (GVRD) was established in 1967 to coordinate land use planning at the regional scale and the provision of municipal services including transportation and water/wastewater system. While the region's 21 municipalities are not required to follow the plans and proposals of the GVRD, they have generally found it in their interest to do so, and in 1996 the agency produced a regional development and servicing plan that embodied sustainable development objectives and has provided a basis for coordinated actions.[39] There remained, however, jurisdictional and planning issues between the GVRD and BC Hydro relating to the planning and delivery of transit which required resolution.

Negotiations between the Province of British Columbia and the municipalities represented by the GVRD led to the establishment of a regional transportation authority, TransLink, in 1998. The Province has made unprecedented (in Canada) levels of tax transfers and tax room available to TransLink in order to fund urban transportation. TransLink's current operating funding sources and percentage funding, excluding transit fare box revenues, include residential and non-residential property tax (19%), fuel taxes of 11¢ per litre (37%), a levy on BC Hydro residential accounts (2.7%) and a sales tax on paid parking (1.7%). Under legislation, TransLink is permitted to levy new transportation-related charges, such as an annual registration fee on motor vehicles, parking charges (by area or space), benefitting area charges (for new facilities) and tolls on new facilities (for the purposes of paying for the improvements), etc.

The Province also provides capital grants for major rapid transit projects, covering as much as 100% of project costs. The percentage varies from project to project and is determined through negotiations between the Province and TransLink. Provincial grants do not cover purchases of new vehicles for existing LRT and commuter rail services.

6.2 GREATER MONTREAL

In common with the urban regions of Vancouver and Toronto, Great Montreal has a large number of constituent municipalities, which poses significant challenges in trying to achieve integrated land use and transportation planning and coordinated implementation of urban transport and transit. In order to provide greater coordination in planning and delivering urban services and transportation, the Province of Quebec formed and the Montreal Urban Community Transit Commission (MUCTC) in 1970, which was succeeded by the Societe de Transport de la Communaute Urbaine de Montréal in 1985 and the Société de transport de Montréal in 2001. The Montreal Urban Community was created in 1970.

In order to provide a more effective means of planning, funding and delivering urban transit in Greater Montreal, the Province formed the Agence métropolitaine des transports (AMT). The Prov-

ince dedicates 1.5¢ per litre of the gas tax on fuels sold in Greater Montreal and $30 per vehicle registered provincially. The AMT redistributes this income to provide transit operating funding for the three transit agencies serving Greater Montreal: the Société de transport de Montréal (STM), the Réseau de transport de Longueuil (RTL), and the Société de transport de Laval (STL).

The Province also provides capital funding for up to 100% for transit capital expenditures on approval by the Province alone or in tandem with the AMT. An additional subsidy covers 75% of the transit equipment expenditures, again on approval from the Province alone or in tandem with the AMT, including 50% of eligible costs for purchase and replacement of urban transit buses and modifications to buses and mini buses to facilitate accessibility for disabled travellers. Generally, these project investments and the related planning and implementation activities are coordinated by the AMT; control of the capital funding provides the AMT with the clout necessary to achieve (in most cases) agreement with the individual municipalities on the nature and timing of transit capital projects.

Recently (in March, 2004) the Quebec government was the first province to provide tax benefits to employers and employees for transit commuter benefits. The measure allows an employer who pays the costs of monthly transit passes or who reimburses employees for this cost to deduct this amount from his or her revenue. Employees who receive the benefits will pay no additional tax on the benefits. Workers who purchase their monthly passes themselves and are not reimbursed by their employers, are able to deduct the total cost of the passes from their taxable income as long as they are purchased for travel to work.

6.3 Calgary and Edmonton

Calgary and Edmonton, in common with other major cities in the three Prairie Provinces, have a considerable advantage over Vancouver, Montreal and Toronto in the ability to provide coordinated planning and delivery of urban transport/transit: a single municipality has jurisdiction over most or all of the urban region in each case. This greatly simplifies the governance and delivery of urban transport in comparison with the situation in Canada's three largest urban areas. The internal governance issue of achieving integrated transportation and land use planning and coordinated delivery of road transport and urban transit facilities/services is a continuing challenge for most municipalities, but Calgary and Edmonton appear to compare well in this regard with other major Canadian urban areas.

In common with other Canadian urban areas, however, Calgary and Edmonton have suffered from a chronic lack of sufficient operating and capital funding. To address this problem, the Province established in 1994 the Annual Unconditional Municipal Grant Program which may be used to cover roads and transit operating costs in Calgary and Edmonton. The value of this grant is determined by a per capita rate. The proportion which may be spent on transit operations (as opposed to roads) is determined by the municipality.

To address capital funding, the Province established in 1999 the Annual Transportation Capital Grant which is based each year on the amount of gasoline sold in each city at the rate of 5¢ per litre. When the grant was established, the Province emphasized that it was not a direct transfer of 5¢ per litre from the gas tax, but rather a discretionary annual grant based on 5¢/litre, with the amount subject to change at the discretion of the Province. In fact, in 2001 the Province lowered the capital grant from an amount based on 5¢/litre to one based on 4.25¢/litre for two years. In 2002 the Province announced a much deeper cut to 1.2 ¢/litre, justifying this based on reduced oil and gas reve-

nues to provincial coffers that year; the public outcry was so large, however, that this attempt was aborted, the grant was raised to 5¢/litre as of April 1, 2002, and has consistently been applied at the 5¢/litre rate since then. The grant raises in excess of $85 million for Calgary and $65 million for Edmonton per year, or roughly $100 per capita in each city.

6.4 Greater Toronto

Greater Toronto provides a classic example of triumphs and failures in governance to achieve integrated land use/transport planning and coordinated planning/delivery of roads, transit and related land use. Following formation of Metropolitan Toronto in 1953, the municipal government had control over the major components of urban development: regional land use, water/wastewater systems, and urban transport including roads and transit. The municipality's strong population and economic growth provided the basis for successful debt financing of municipal services, augmented by major provincial funding grants. The result was a "golden age" of coordinated and reasonably sustainable (for the era) urban development and transport for the following 25 years, until Metropolitan Toronto was essentially built-out by the late 1980s. Coordinated urban transit was provided at the same time as new subdivisions were developed and urban arterial roads were widened (from former two-lane country roads), so that residents had the choice of good transit service from the beginning, rather than having to buy a second or third auto and losing the transit habit.

Faced with the coming build-out of Metro Toronto, the Province made the fateful decision in the 1970s to establish four urban regions around Metropolitan Toronto, rather than expanding Metro's jurisdiction for providing regional development planning and urban transport in the rapidly urbanizing surrounding areas. This reintroduced the problem of fragmented governance with a resulting delay in the coordinated improvement of urban transit in the suburban areas and a lack of schedule coordination and fare integration for transit riders crossing regional boundaries. As a consequence, cross-boundary transit ridership on local bus routes and ridership in the suburban areas surrounding Metro have remained significantly lower than ridership levels achieved in Metro itself, with resulting increases in automobile-dependence and related transport costs and impacts in the suburban areas.

These problems were compounded in 1996 when the provincial government of the day completely eliminated transit operating subsidies (which it had previously shared approximately equally with the municipalities) and of capital subsidies (which had previously been about 50% for roads and 75% for transit capital expenditures). The Province stated that additional tax room given to the municipalities would compensate for these reductions, but subsequent experience revealed that the change, while possibly 'revenue-neutral', was inadequate in terms of desirable expenditure levels to move from mere survival to improved services.

The lack of a single agency to plan and deliver urban transport and related land use for the entire urban region also compounded the problem since there was no coordinated approach to developing a plan and setting priorities with the result that municipalities and transit agencies engaged in public disputes regarding sharing of the few ad-hoc transport grants which were received from time to time from the other two orders of government.

In an attempt to address this problem, the provincial government of the day established the Greater Toronto Services Board (GTSB) in 1998 to provide a forum for discussion of regional development and servicing issues which, it was hoped, would lead to agreement on a plan and related priorities. Some progress was made in developing an urban transport plan, but the lack of any arrangements

for provincial funding to the GTSB for plan implementation led to continuing paralysis. In 2001 the Province disbanded the GTSB and replaced it with a number of "Smart Growth Panels" comprised of some municipal politicians and citizens representing various interest groups.

The panel for the Central Zone of Ontario (the "Greater Golden Horseshoe") presented its report in the spring of 2003 with a conceptual plan for urban transport which was not costed and provided a "menu" of possible transport initiatives, rather than an affordable plan. This contributed to increased calls for establishing a "Greater Toronto Transportation Authority" which would have jurisdiction over the planning and delivery of urban transit and possibly urban transport for the Greater Toronto Area (GTA) and possibly for most or all of the Greater Golden Horseshoe.

The new provincial government, elected in November 2003, has stated it is working to define and establish such an agency. In the meantime, it has released in July 2004 a discussion paper that contains more detail than was in the earlier Smart Growth report regarding sub-centres designated for growth and areas where growth would not be encouraged, along with proposed initiatives to provide the necessary incentives and disincentives.[40] The report has been released for public consultation, with the intent of passing legislation and beginning to implement a plan by the end of 2004, an ambitious schedule.

In the meantime, funding for urban transport in the GTA remains largely ad-hoc, with little or no local input/control to establish priorities and allocate funding to specific projects. Incremental funding increases for urban transport are anticipated from announced GST tax relief for municipalities and gradual phasing in of gas tax revenues, but these sources are small relative to the size of the funding shortfall. The provincial and federal governments have announced a $1.5 billion urban transport funding initiative shared equally among the three orders of government, and the Province has given some initial indications of how funding will be allocated among sub-regions and agencies, but the essential problem of coordinated planning and delivery based on adequate and predictable funding levels remains.

6.5 Conclusions

As indicated by the above incomplete summary, we conclude that Greater Vancouver and the Province of British Columbia have made the greatest strides among Canadian urban regions in achieving governance and funding arrangements for coordinated planning and delivery of urban transport and related land use. TransLink has jurisdiction over both roads and urban transit, significant reliable funding for plan implementation, and provincial legislation allowing it to levy new transportation-related charges in the future. Working with the GVRD, it also has significant input regarding related land use. Greater Montreal and the Province of Quebec have also made significant moves in this direction, but with less local control over adequate funding and AMT jurisdiction over urban transit only, not roads.

Greater Toronto remains the 'basket case' among Canada's three largest urban areas, with no single agency in place at the municipal level to provide coordinated planning, funding and delivery of urban transport and related land use for the entire urban region. There are, however, promising indications that this situation may be considerably improved during the coming year. Earlier success by Metropolitan Toronto in planning and delivering balanced urban transport and related land use demonstrates that improvements are possible and provides clues regarding possible improvements in the governance and financing of urban transport. Section 9 presents recommendations regarding possible NRTEE value-added initiatives in this area.

The two largest Prairie cities, Calgary and Edmonton, have appropriate integrated transport/land use planning and delivery powers owing to their unified municipal government structure, and have worked out a reasonable interim funding arrangement with the Province of Alberta.

It is clear, however, that, with the possible exception of Greater Vancouver, none of the urban regions discussed has adequate, reliable funding in place or in prospect to achieve more appropriate service levels and sustainability in their urban transport systems, and Toronto and Montreal continue to suffer from fragmented and uncoordinated governance.

7. KEY TRANSPORT STAKEHOLDERS

This section lists a number of the major organizations which provide advice, research, planning, construction and operations/management of urban transportation in Canada.

7.1 GOVERNMENTS

At the federal government level the department with direct responsibility for transport, including urban transport, is Transport Canada and its research arm in Montreal, the Transportation Development Centre. Other departments with significant involvement in urban transport include Natural Resources Canada (focussing in particular on energy and other resource requirements of transport), Environment Canada (focussing on environmental issues), Health Canada (focussing on health and safety issues), and Industry Canada (focussing on technology and related economic issues). Another relevant federal agency is the Canada Mortgage and Housing Corporation, which conducts research into the interactions between, on the one hand, housing mixes and subdivision designs and, on the other, urban transport requirements and performance, including measures of sustainability. Other relevant federal agencies include the Transportation Safety Board of Canada, Statistics Canada and Infrastructure Canada.

At the provincial and territorial levels the Departments of Transportation and Highways are most directly involved in urban transport. Other relevant departments include Ministries of the Environment, Municipal Affairs (focussing on urban structure and land use issues), Economic Development, Health, Industry and (in the case of Ontario) the newly established Ministry of Public Infrastructure Renewal. The latter is interesting in that it combines urban structure (“Smart Growth”) planning and capital investment in urban transport infrastructure (plus water/wastewater, schools, hospitals and other types of infrastructure) within its mandate and also has the role of coordinating infrastructure and related urban planning aspects of urban transport carried out by other provincial ministries.

At the municipal level, the Transportation Department (or similar departments sometimes labelled as Public Works or Streets and Traffic) and the transit agency (sometimes a municipal department and sometimes a separate commission) have the most direct involvement in urban transport. Other municipal departments, including Planning, Environment, and Economic Development, are also involved in urban transport issues.

7.2 ASSOCIATIONS

These include industry associations such as the Canadian Automobile Association, the Canadian Urban Transit Association, the Canadian Trucking Alliance, the Canadian Vehicle Manufacturers’ Association, the Ontario Municipal Engineers Association (and similar associations in other prov-

inces), the Canadian Association of Petroleum Producers, the Canadian Construction Association and provincial road builders/construction associations.

The Transportation Association of Canada (TAC) is somewhat unique in that it combines membership and involvement from the three orders of government with a wide variety of transportation-related private sector firms and individuals. Transportation Deputy Ministers at the provincial level and an Assistant Deputy Minister from Transport Canada sit on the Association's Board of Directors along with representatives of industry and some municipalities. The Urban Transportation Council of TAC focuses on urban transport within that organization. The Transportation Association of Canada is closely associated with the Canadian Council of Motor Transport Administrators which is made up of the provincial and territorial Ministers of Transportation.

Other associations with involvement in urban transport and/or related activities include the Ontario Community Transportation Association, the Railway Association of Canada (regarding commuter rail services), the Canadian Bus Association, the Canadian Parking Association, the Canadian Transportation Equipment Association, the Electric Vehicle Association of Canada, the Canadian Federation of Municipalities, the Association of Municipalities of Ontario, the Canadian Technical Asphalt Association, and the Canadian Transportation Research Forum.

7.3 Other stakeholder organizations

Academically-oriented organizations involved in urban transport include the Joint Program in Transportation and the Data Management Group at the University of Toronto, the University of Manitoba Transportation Institute, the Canadian Institute of Guided Ground Transport at Queen's University, and other faculties offering transportation courses at the University of British Columbia, the University of Calgary, Carlton University, École Polytechnic de Montréal, Université Laval, McMaster University, Memorial University of Newfoundland, Université de Montréal, University of News Brunswick, Royal Military College, Ryerson University, Université de Sherbrooke, and Waterloo University. The Victoria Transportation Policy Institute provides extensive information on urban transport research on its website. A number of community colleges and technology institutes also provide courses, information and commentary regarding urban transport.

Relevant professional organizations include the Canadian Institute of Transportation Engineers, the Centre for Surface Transportation Technology, the Chartered Institute of Transport, the Canadian Industrial Transportation League, the Canadian Institute of Traffic and Transportation, the Canadian Professional Logistics Institute and Freight Carriers Association of Canada. The latter four organizations, along with the Canadian Trucking Alliance and its provincial counterparts, focus primarily on the goods movement and commercial vehicle aspects of urban transport.

Other stakeholder groups tend to address particular aspects of urban transport or represent citizen groups. These include the Centre for Sustainable Transportation, Intelligent Transportation Systems Society of Canada, Greater Toronto Airports Authority, Ontario Good Roads Association, Canadian Institute of Planners, Canadian Urban Institute, Urban Development Institute, Canadians Responsible for Safe Highways, Transport 2000 Canada, Mobility Plus, Auto Free Ottawa, Moving the Economy, and Environmentalists Plan Transportation, to name a few.

The wide range of subject areas, roles and opinions represented by the above partial list of urban transport stakeholders illustrates the pervasive nature and widespread impacts of urban transport.

8. SNAPSHOTS OF RESEARCH AND RELATED ACTIVITIES

Many of the stakeholder organizations listed in the previous section, for example government departments, academic institutions and various associations and other organizations, carry out research and related activities in connection with urban transport. This section presents a representative but necessarily very incomplete list of current research and related activities regarding urban transport in Canada and abroad.

8.1 FEDERAL GOVERNMENT

For the federal government as a whole, we understand that a committee of deputy ministers and relevant assistant deputy ministers has been established to coordinate transportation activities and research including urban transport. The Cities Secretariat, created shortly after Mr. Martin became Prime Minister will focus on the new deal for cities, including urban transport initiatives and also acts as staff for the External Advisory Committee chaired by Michael Harcourt which will report to the Prime Minister later in 2004 regarding specific initiatives in this area. The Urban Transportation Task Force which reports to the Provincial Council of Ministers responsible for transportation and highway safety and the Policy and Planning Support Committee, is working on an Urban Transportation Strategy for Canada, scheduled for delivery in September 2004. Stemming from Canada's response to the Kyoto Protocol, the Climate Change Plan for Canada (August 2003) is a $161 million program of transport measures which focusses on increased vehicle efficiency, production and use of alternative fuels, freight efficiency, and more sustainable passenger transport in urban areas, aimed at reducing the production of greenhouse gases from transport activities.

Research and related activities within Transport Canada include the Advanced Technology Vehicles Program (conducted jointly with Natural Resources Canada under the Motor Vehicle Fuel Efficiency Initiatives), and the Freight Efficiency and Technology Initiative, also conducted jointly with NRCan; the latter is one of five transportation measures under the Government of Canada Action Plan 2000 on Climate Change, a five year program. Other Transport Canada initiatives include the Urban Transportation Showcase Program, Moving on Sustainable Transportation (MOST), and Active Transportation: SCM Guide for Communities (partnered with Health Canada and Environment Canada). There are also a number of current research and development projects within Transport Canada and its research arm, the Transportation Development Centre, relating particularly to intelligent transportation systems, and bus technology.

Within Natural Resources Canada, in addition to the Motor Vehicle Fuel Efficiency Initiative referred to earlier, other activities include the Outreach Programs (personal and commercial including FleetSmart, Anti-Idling, Be Tire-Smart, One-Tonne Challenge, Energuide; and the Fuel Consumption Guide. Other activities include the Canadian Transportation Fuel Cell Alliance program, Fuel Cell Initiatives including the Sustainable Transportation Development Technology Canada allocation for hydrogen economy-related projects, and the Federal Technology And Innovation Program funding announced in the 2003 budget which focusses on alternative fuels, the hydrogen economy, commercial transportation and freight efficiency, and programs to reduce the cost of natural gas vehicles in urban fleets.

Within Environment Canada, relevant activities include the Sulphur in Diesel Fuel Regulations (2002), Off-Road Small Spark Ignition Engine Emission Regulations (November 2003) and CEPA: On-Road Vehicle and Engine Emission Regulations (effective January 2004).

Health Canada is involved in Active Transportation Awareness Initiatives and is supporting research by other organizations (e.g., the Centre for Sustainable Transportation) on the health and fitness implications of urban transport and neighbourhood design.

The Canadian Fuel Cell Commercialization Roadmap is being prepared by Industry Canada.

8.2 Other Canadian R&D activities

A wide variety of urban transport research and related activities are being carried out across Canada by provincial and municipal government departments, universities, associations and other organizations.

Focussing on academic research, the Joint Program in Transportation at the University of Toronto has an active R&D program involving transportation demand modelling by the Data Management Group, the Integrated Land Use, Transportation, Environment (ILUTE) modelling system being developed with five other universities, Geometrics for Informed Decisions (GEOIDE) and a Major Collaborative Research Initiative (MCRI). The Intelligent Transportation Systems Centre at the University of Toronto uses a world-class ITS technology centre (which was implemented with significant private sector financial support) as the basis for a wide range of ITS research projects relating to traffic measuring, toll collection and driver information system technology, to incident detection and traffic control algorithms, transit priority, safety-conscious route guidance, and micro simulation modelling of traffic flows. Most of the other universities mentioned in the previous section are also carrying out active urban transport research activities, with growing emphasis on urban transport and on cooperative projects by several universities. For example, the Centre for Sustainable Transportation is actively discussing possible affiliation, or joint programs, with one or more of three universities across Canada.

Another important example is the Canadian Transportation Futures Assessment (CTFA), an initiative by the University of Calgary, the Centre for Sustainable Transportation, and over 20 researchers from universities across Canada and the private sector. The CTFA was recently short-listed by the Social Sciences and Humanities Research Council (SSHRC) to be considered for $2.4 million funding of a five year program to develop several scenarios of future urban and inter-urban transport in Canada, conduct demand modelling and other analytical assessments, and draw conclusions regarding preferred scenarios, strategies, and policy implications. The proposal is due in late August, 2004; if successful, the CTFA would commence the five year program in 2005 and there is a strong possibility that other organizations would provide financial resources and become involved on a partnership basis to help meet the objectives of the program. If successful, this program could have a significant impact on urban and inter-urban transport forecasting, backcasting, scenario evaluation, and related planning and policy development in Canada. In addition to developing and applying leading-edge methodologies, an important objective of the CTFA is to include (at a strategic level) the entire surface transport system in Canada. The last time such a comprehensive approach was taken for passenger and freight transport across Canada was in the *National Transportation Policy Review*, which reported to parliament in June, 1975. *Directions: The Final Report of the Royal Commission on National Passenger Transportation* (1992) was more recent but did not address freight.

The Transportation Association of Canada also conducts an active transport research program, including eight projects which started in 2000 or later. One of these is the Urban Transportation Indicators (UTI) survey. This program, sponsored by TAC's Urban Transportation Council, conducted a

comprehensive survey of urban transportation programs, system supply, transport demand and related data: the survey included eight urban areas for the year 1991, 15 urban areas for 1996 conditions, and is currently producing a report for 2001 conditions in all 27 Canadian Census Metropolitan Areas (CMAs). The Urban Transportation Council has also produced several widely distributed briefing documents on urban transport and achieving greater sustainability. The first of these, *A New Vision for Urban Transportation*, was published in 1993 and reprinted in 1998. It sets out 13 decision-making principles for a more desirable future which have been used as guidelines since that time by urban areas across Canada.

8.3 Non-Canadian R&D activities

Extensive research and development programs related to urban transport are carried out in the United States, the European Union and its member states, Japan, Australia and many other countries. As an overview of these activities in the United States, the Transportation Research Board of the National Academies of Science sponsors a wide variety of urban transport research projects itself and maintains a database of Research in Progress describing such activities by other organizations across the country and in some other countries. Their database has some 7,600 entries, of which over 900 relate to current or recently completed transit research projects.

9. RECOMMENDATIONS

Our recommendations, based on the foregoing, concern six topic areas in which work by NRTEE could make a substantial contribution to the improvement of urban transportation in Canada.

9.1 Competitiveness

The essential issue, to be addressed in a Canadian context, concerns the trade-offs between mobility and attractive urban places. Both are essential to competitiveness. If people and goods move slowly or unpredictably, business suffers disproportionately (although other aspects of society can suffer too). On the other hand, high levels of mobility are usually incompatible with comfortable urban living, and the loss of attractiveness and liveability can also be a barrier to the inward investment that business may require. NRTEE could address transportation's role in business efficiency and liveability through the prism of competitiveness, the goal being to provide advice as to how to achieve the right balance for Canadian urban regions.

More specifically, NRTEE could do the following:

1. Review worldwide literature and experience on (a) mobility and competitiveness; (b) liveability and competitiveness; (c) mobility and liveability.
2. With consultation, develop and apply criteria for assessment of Canadian urban regions in respect of the optimal balance of mobility and liveability in relation to competitiveness.
3. With consultation, use the results of the assessment to develop generic strategies for Canadian urban regions to enhance competitiveness through achieving a better balance of mobility and liveability.

9.2 Energy constraints

The review notes the high and growing levels of transport activity in urban areas and the dependence on this activity for a wide range of essential social and economic functions, and also touches on associated energy use. Space precluded consideration in the review of the robustness of supplies

of transport fuel to urban areas, but acceptance that we may be leaving the era of cheap oil now seems widespread. Oil provides more than 99 per cent of the transport fuel used in Canada's urban regions. Steep increases in the prices of these fuels could be disruptive, to households and businesses alike. A pertinent question that could be usefully addressed by the NRTEE is what could be done in Canada's urban areas to prepare for high prices of transport fuels? What could be done in advance to reduce their impact on businesses and residents if and when they occur, and what additional actions could be appropriate in a time of fuel-price instigated crisis?

More specifically, NRTEE could do the following:

1. Review worldwide literature and experience of impacts of increases in transport fuel prices in urban areas
2. Inventory transport energy use in Canada's urban regions, noting purposes of use and sources of supply.
3. Develop one or more plausible scenarios for changes in the price of transport fuels in Canada's urban regions.
4. From the foregoing, estimate the likely adverse effects of likely fuel prices, and devise means of mitigating the effects.
5. Select means of mitigating the effects that could benefit from early action, particularly 'no regrets' action.
6. Produce and share for feedback a draft strategy for anticipating and mitigating the impacts in urban areas of large increases in transport fuel prices together with assessment of the costs and benefits of action and inaction on environment and economy.
7. Finalize and publish the strategy, including the cost-benefit assessment.

9.3 Urban freight movement

The review notes that urban freight movements are essential to the well-being of urban residents and businesses, and yet very little is known about them. There is a possibility that there have been recent large increases in urban truck traffic. Moreover, trucking activity is associated with disproportionately high levels of some kinds of air pollution. The NRTEE could usefully investigate the state of urban freight transportation in Canada, report on its trends, significance, and impacts, and propose actions as may be appropriate to increase its efficiency while reducing its impacts.

More specifically, NRTEE could do the following:

1. Update and supplement the recent OECD report on urban freight transportation.[41]
2. Inventory availability of data on urban freight transportation in Canada, including data on economic and environmental impacts.
3. Assess what is known about urban freight transportation in Canada in light of information and analysis in the updated OECD report.
4. To the extent possible report on trends, significance, and impacts of urban freight transportation in Canada.
5. Identify challenges and opportunities in respect of urban freight transportation and propose initiatives specific to Canadian circumstances.

9.4 The costs and benefits of better data

A particular theme of parts of the review is the poverty of data on urban transportation in Canada. The largest gaps concern urban freight movements, but, compared with many other countries, much less is known too about the movement of people. A question that could be addressed by the NRTEE is whether economic and environmental benefits could be gained from having better transport data, particularly for urban regions, and what would be costs of providing it? Would the benefits outweigh the costs?

More specifically, NRTEE could do the following:

1. Assess the availability of data on the movement of people and freight in urban areas in OECD and other affluent countries.
2. Through interviews and in other ways, assess the costs of collecting the data, the benefits of having the data, the opportunities lost by not having more data, and the extent to which some available data are chronically unused.
3. Based on this information, taking Canadian circumstances into account, develop several scenarios for improved collection and maintenance of data on urban transportation in Canada, estimating the costs and benefits of each scenario.
4. If there are scenarios for which the benefits exceed the costs, select one or more of them for further development, indicating how the costs could be met.

9.5 Governance and financing frameworks

There is a wide variety of governance and financing frameworks for transportation and land use in place in Canadian urban regions, ranging from some that are considered by international observers to be positive examples (e.g., Vancouver) to some that are considered as negative examples (e.g., Toronto). What are the features of regional frameworks that seem capable of facilitating attainment of land-use and transportation goals? What are the best funding arrangements? How are the links between transportation planning and land-use planning best made? These are key questions for the future of urban transportation in Canada, and NRTEE could play a useful role by addressing them.

More specifically, NRTEE could do the following:

1. Review governance and financing frameworks for transportation and land use in OECD and other affluent countries.
2. Assess the frameworks, especially the funding arrangements, in terms of their ability to facilitate attainment of land-use and transportation goals.
3. Identify features of the best and worst government and financing frameworks.
4. Based on the foregoing, develop one or more model regional frameworks appropriate to Canadian circumstances, indicating how they might be implemented and the value of doing so.

9.6 Information

Provision of good information would be an important element of work on any of the above five topics, but it is also an important task in its own right. The general public knows much about the minutiae of particular aspects of our urban transport systems but little about the big picture. It's possible that a better informed public could demand better policy-making about transportation and land use in Canada's urban areas. Better information could be given about the significance of freight move-

ment, the public and private costs of private and public transportation, the features of neighbourhoods that help obviate car ownership, the effects of current transport practices on urban and suburban children and youth, and many other topics. NRTEE could consider development of a primer on urban transportation that would help energize interest and expand knowledge among the public and policy-makers.

More specifically, NRTEE could do the following:

1. Assess the state of public knowledge about urban transportation in Canada, and its relevance to policy-making on this topic.
2. Identify gaps in knowledge, and instances where a better-informed public might have resulted in better policy-making.
3. Prepare, produce, and distribute a primer that would facilitate popular understanding of the economic, social, environmental, and health aspects of urban transportation and provide information as to how to make best use of the material in the primer to achieve better policy-making and better decisions about urban transportation.

APPENDIX A: EXTRACTS FROM 'TRANSIT MEANS BUSINESS'

What follows are extracts from the Executive Summary of the 2003 report by Metropolitan Knowledge International for the Canadian Urban Transit Association entitled *Transit Means Business—The Economic Case for Public Transit in Canada*:[42]

- Public transport is a critical part of the competitiveness of Canada's cities. Through detailed analysis of data from 250 cities around the world, including Montreal, Toronto, Ottawa, Vancouver, and Calgary, an international assessment of transit's return on investment found that, unlike the United States, in Canada public transport in large cities "is always far more efficient than the automobile".
- The average cost of one person-kilometre when travelling by car in Canada is $0.46. For public transit, it is $0.12. This equates to an annual savings to the economy of, for example, $2,495 for every resident of Toronto and $4,278 for every resident in Calgary (based on total kilometres travelled, not adjusted for geographic differences in fuel prices or congestion).
- Cost-benefit analysis work conducted for Transport Canada on three proposed transit projects found a benefit-cost ratio of 1.4, 1.7, and 2.1, with $497.9 million in total economic benefit for an expenditure of $216.8 million
- As one example of transit's impact on a single urban economy, staff at the City of Ottawa found that transit investment resulting in a 10% increase in modal share would return $632,777,128 in economic impact, with the bulk ($408,000,000) resulting from reductions in congestion. Their cost calculation incorporated operator costs, infrastructure costs, time delay factors, environmental, and accident-related costs.
- The British Columbia Treasury board found that transit investment is many times more effective at creating jobs than expenditure on other modes of transport. A $1 million expenditure on public transit in British Columbia creates on average 21.4 new jobs, compared to 7.5 jobs created by expenditures on general automotive expenses and 4.5 jobs through spending in the petroleum industry.
- Time spent travelling on public transit can be productive working time for some individuals. Transport Canada recognizes this fact by assessing a 25% value for time spent on modes of travel that allow individuals to continue to work because they are not operating the vehicle. Looking only at commuter rail and subway riders in Vancouver, Toronto, and Montreal, if 5% of riders are able to work on transit, generates an annual productivity benefit of $33 million.
- Studies of Vancouver, Scarborough, and Calgary have demonstrated property value increases associated with proximity to higher-order transit.
- City of Ottawa staff have calculated the time delay savings of a 10% modal shift to transit at $407 million.
- Congestion in Toronto, Montreal, Ottawa, and Greater Vancouver is estimated to add $300 million to the cost of goods movement every year.
- Business associations in a number of centres have recognized that "Shifting from personal vehicle use to public transit is important to reducing congestion. Strengthening and expanding public transit networks will reduce congestion, ensure a cleaner environment, manage urban growth and provide economic returns." Canadian Chamber of Commerce, Strengthening Canada's Urban Public Transit Systems, 2002.
- The rate of fatal accidents per passenger-kilometre on public transport is approximately one-twentieth that of travel by private automobile.
- The cost of poor air quality in the Province of Ontario is estimated at $600 million annually in health care costs. This is equal to an estimated $1.875 billion in annual health care costs for Canada. [Transportation is the major source of poor air quality.]

END NOTES

[1] Note that Census Metropolitan Areas (CMAs) usually but do not always represent 'true' urban regions. In particular, what is known as the Greater Toronto Area includes both the Toronto and Oshawa CMAs and often includes the Hamilton CMA, without having exactly contiguous boundaries.

[2] The three *Urban Transportation Indicators* surveys were conducted for the Transportation Association of Canada (TAC) by the IBI Group. The report on the first survey presented 1991 data for eight Canadian urban areas. The report on the second survey presented 1996 data for 15 urban areas. The report on the third survey presented 2001 data for all 27 Census Metropolitan Areas (CMAs). The report on the first survey is no longer available. The report on the second survey, which also provides the data from the first survey, is entitled *Urban Transportation Indicators: 1996 Survey 2* and is available for a fee at the URL below. The report on the third survey is scheduled for release during August 2004. It will contain the data from all three surveys.
1. http://www.tac-atc.ca. Accessed July 30, 2004.

[3] The split of light-duty vehicles between private and commercial (91% vs. 9%) was taken from the *End Use Data Handbook*, Natural Resources Canada, June 2004.

[4] *Open for Business? Canada's Foreign Direct Investment Challenge*, Conference Board of Canada, Ottawa, June 2004, available at the URL below.
1. http://www.conferenceboard.ca. Accessed July 23, 2004.

[5] Metropolitan Knowledge International, *Transit Means Business—The Economic Case for Public Transit in Canada*. Canadian Urban Transit Association, Toronto, 2003, available for purchase at the URL below.
1. http://www.cutaactu.ca. Accessed July 30, 2004.

[6] Data for 1982-1996 in Figure 1 are based on files from the *Family Expenditure Survey* kindly provided by Statistics Canada. Data for 1997 and subsequent years are from Statistics Canada's annual *Survey of Household Spending* (CANSIM II Table 2030007).

[7] It should be possible for Statistics Canada to disaggregate household spending data for urban areas, but at considerable cost to the requester.

[8] According to Statistics Canada, the population growth between 1981 and 2001 was close to 25%. Household size fell from 2.9 to 2.6 persons per household (see the first URL below). Thus the number of households grew by more than 35%. Authors' estimates based on Transport Canada's *T-FACTs* and Natural Resource Canada's *Energy Use Data Handbook* suggest that the personal vehicle fleet grew by about 25% over this period.
1. http://www.statcan.ca/Daily/English/021022/d021022a.htm. Accessed July 30, 2004.

[9] According to the U.S. Environmental Protection Agency, between the 1982 and 2004 model years, the curb weight of new light-duty vehicles (automobiles, SUVs, etc.) has increased by 23% and their power has increased by 90 per cent. About 40% of the increase in weight and about 10% of the increase in power can be attributed to the shift towards purchase of SUVs, minivans, etc. rather than regular automobiles, with the former comprising 20% of sales for the 1982 model year and 48% of sales for the 2004 model year. However, about 60% of the weight increase and 90% of the power increase arose through the purchase of more powerful models. These data are based on the report at the URL below. Canadian vehicle sales likely show a similar pattern, although corresponding data are not readily available.
1. http://www.epa.gov/otaq/cert/mpg/fetrends/420r04001.pdf. Accessed July 30, 2004.

[10] Statistics Canada, *The Daily*, December 17, 2003, available at the URL below.
1. http://www.statcan.ca/Daily/English/031217/d031217b.htm. Accessed July 30, 2004.

[11] The national estimates are from the source detailed in Note 3.

[12] See the URL below for weekday and weekend travel in the U.S.
1. http://www.bts.gov/publications/national_household_travel_survey/highlights_of_the_2001_national_household_travel_survey/pdf/entire.pdf. Accessed July 30, 2004.

[13] Figure 6 is based on Exhibit 3.1 of *Profile of Private Trucking in Canada*. Industry Canada, Ottawa, 1998, available at the first URL below. Private trucks are owned by the shippers of the material they carry. For-

hire trucks carry freight for shippers who are not the trucks' owners. Statistics Canada stopped collecting data on private trucking in 1998, so little is known about what likely continues to be both a key aspect of freight transport and an important component of the Canadian economy. A recent report produced by Transport Canada suggests that in 2000 private trucking was still economically more important than for-hire trucking, i.e., $21.8 billion vs. $20.8 billion (Nix F, *Trucking Activity in Canada: A Profile*, Transport Canada, March 2003, available at the URL below) but this estimate seems to have been no more than a scaling up of the mid-1990s values set out in Figure 6.
1. http://strategis.ic.gc.ca/epic/internet/ints-sdc.nsf/vwGeneratedInterE/fd01101e.html. Accessed July 30, 2004.
2. http://www.tc.gc.ca/pol/EN/Report/TruckActivity/Truck%20Activity%20in%20Canada.pdf. Accessed July 30, 2004.

[14] The results of the Edmonton Region Commodity Flow Survey are summarized in Hunt JD, Brownlee AT, Ishani M, *Edmonton Commercial Movements Study*, presented at the 39th Annual Conference of the Canadian Transportation Research Forum, Calgary, May 2004.

[15] The Canada-wide estimate is from the source detailed in Note 3.

[16] There is reference to the 2001 *Calgary Commodity Flow Survey* in the document at the URL below (Hunt JD, et al, *Modelling Retail and Service Delivery Commercial Movement Choice Behaviour in Calgary*, presented at the 10th International Conference on Travel Behaviour Research, Lucerne, 10-15 August 2003).
1. http://www.ivt.baum.ethz.ch/allgemein/pdf/hunt.pdf. Accessed July 30, 2004.

[17] For the 1999 *Lower Mainland Truck Freight Study* contact the Strategic Planning Department of TransLink through the URL below.
1. http://www.translink.bc.ca. Accessed July 30, 2004.

[18] The freight modes vary considerably not only in their trends in overall energy use and GHG emissions (Figure 7), but also in energy use and GHG emissions per tonne-kilometre moved. More specifically, according to the source detailed in Note 3, the various modes had the following rates of GHG emissions (kilograms of carbon dioxide equivalent per 100 tonne-kilometres): light trucks, 73.6; medium trucks, 40.5; heavy trucks, 15.9; air, 43.0; rail, 1.8; marine, 4.1.

[19] For a review of dioxin production from road traffic, see the URLK below.
1. http://www.deh.gov.au/industry/chemicals/dioxins/pubs/report-2.pdf, Accessed July 30, 2004.

[20] The Stockholm Convention on Persistent Organic Pollutants came into effect on May 17, 2004, 90 days after ratification by the fiftieth country. Canada ratified the Convention at the earliest date, in May 2001. For more information, see the URL below.
1. http://www.pops.int, Accessed July 30, 2004.

[21] The quote is the opening paragraph of the 'air quality' section of the part of Environment Canada's Web site concerning transportation and the environment, available at the URL below.
1. http://www.ec.gc.ca/transport/airquality.htm, Accessed July 30, 2004

[22] Figure 9 is based on data compiled by Environment Canada and available at the URL below.
1. http://www.ec.gc.ca/soer-ree/English/Indicator_series/tech_list.cfm, Accessed July 30, 2004.

[23] The quote about the effects of NO_2, the subsequent quote about the effects of SO_2, and is from the part of Environment Canada's Web site concerning the National Indicator Series, available at the URL below.
1. http://www.ec.gc.ca/soer-ree/English/Indicator_series/techs.cfm?tech_id=32&issue_id=8&supp=2#techs, Accessed July 30, 2004.

[24] The information about transport's share of NO_x emissions, and subsequent information about shares of emissions of VOCs, SO_2, CO, and fine particulate matter, are from Environment Canada's Web site, Clean Air section, at the URL below.
1. http://www.ec.gc.ca/air/providing/transportation_e.html. Accessed July 30, 2004.

[25] For levels of VOCs, see the source detailed in Note 22.

[26] The quote is from the Web site of the United Stated Environmental Protection Agency at the URL below.
1. http://www.epa.gov/pmdesignations/faq.htm#0, Accessed July 30, 2004.

[27] More specifically, 2.56 times are much gasoline energy was used for transportation in the U.S. in 2001 as diesel fuel energy, but diesel was responsible for 3.18 times more emissions of fine particulates. Thus, for each energy unit delivered, use of diesel fuel resulted in more than eight times the emissions of gasoline. Data are from Tables 2-6 and 12-12 of Davis SC, Diegel SW, *Transportation Energy Data Book: Edition 23*. Oak Ridge National Laboratory, U.S. Department of Energy, 2003, available at the URL below.
1. http://www-cta.ornl.gov/data/tedb23/Full_Doc_TEDB23.pdf. Accessed July 30, 2004.

[28] For a comprehensive assessment of the damage cause by ground-level ozone to a wide variety of species, see *National ambient air quality objectives for ground-level ozone: Science Assessment Document*. Health Canada, 1999, available at the URL below.
1. http://www.hc-sc.gc.ca/hecs-sesc/air_quality/publications/ground_level_ozone/part1/toc.htm. Accessed July 30, 2004.

[29] The report for Toronto Public Health is Pengelly LD, Sommerfreund J, *Air pollution-related burden of illness in Toronto: 2004 update*, available at the URL below. An earlier report providing estimates for several Canadian cities is Burnett RT, Cakmak S, Brook JR, The effect of the urban ambient air pollution mix on daily mortality rates in 11 Canadian cities. *Canadian Journal of Public Health*, 89, 152–156, 1998.
1. http://www.toronto.ca/health/hphe/pdf/air_and_health_burden_technical.pdf. Accessed July 30, 2004.

[30] Figure 10 is based on data in *Econnections: Linking the Environment and the Economy–Indicators and Detailed Statistics*. Statistics Canada Catalogue No. 16-200-XKE, Ottawa, Ontario, Canada, 2000.

[31] According to the Census of Canada, Canada's population increased by 3.2 million between 1981 and 1991. If it is assumed that just about all of this increase occurred in urban areas, which had about 75% of the total population in 1981, and that the settlement density of existing urban land remained unchanged, estimates can be made that the amount of urban land increased from about 18,000 to 24,000 km^2 and that land use per person in the newly urbanized land was in the order of 1,850 m^2/person. Corresponding densities in are 1,020 persons/km^2 for urban land developed in 1981 and 540 persons/km^2 for urban land developed between 1981 and 1991.

[32] The report to parliament is Transport Canada, *Transportation in Canada 2003*, Ottawa: Ministry of Public Works and Government Services Canada, 2003, is available at the URL below.
1. http://www.tc.gc.ca/pol/en/Report/anre2003/tc2003ae.pdf. Accessed July 30, 2004.

[33] See Figure 6 and the source detailed in Note 13.

[34] IBI Group, *Urban Planning, Public Transit and Related Initiatives for More Sustainable Urban Transportation*, prepared for the Transportation and Climate Change Collaborative (a partnership of the Ontario Round Table on Environment and Economy, and the National Round Table on the Environment and the Economy), March 1995.

[35] Figure 11 is based on Exhibit 1 in the source detailed in Note 34.

[36] Table 2 is based on Exhibit 13 in the source detailed in Note 34.

[37] Table 3 is based on Exhibit 14 in the source detailed in Note 34.

[38] Table 4 is based on Exhibit 15 in the source detailed in Note 34.

[39] The GVRD plan is *Liveable Region Strategic Plan*. Greater Vancouver Regional District, 1996, available at the URL below.
1. http://www.gvrd.bc.ca/growth/lrsp.htm. Accessed July 30, 2004.

[40] The discussion paper is *Places to Grow: Better Choices, Brighter Future*. Ministry of Public Infrastructure Renewal, Ontario, July 2004, available at the URL below.
1. http://www.placestogrow.pir.gov.on.ca/userfiles/HTML/nts_2_20438_1.html. Accessed July 30, 2004.

[41] The 158-page OECD report is *Delivering the goods: 21st century challenges to urban goods transport*. Paris, France: Organization for Economic Cooperation and Development, 2003. It is available for a fee at the URL below.
1. http://www.oecd.org. Accessed July 30, 2004.

[42] This document is detailed in Note 5.