RESEARCH REPORT

Urban Travel and Sustainable Development: The Canadian Experience

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URBAN TRAVEL AND SUSTAINABLE DEVELOPMENT

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THE CANADIAN EXPERIENCE

This report was prepared by IBI Group for
Canada Mortgage and Housing Corporation
February, 1993

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Urban Travel and Sustainable Development: The Canadian Experience

EXECUTIVE SUMMARY

Across Canada, and across the industrialized world there is a growing awareness that our systems for moving people and goods in urban areas are in conflict with the principles of sustainable development The Canadian urban transportation system which with few exceptions is based on the private automobile as the primary means of transport is not considered sustainable for many reasons including its consumption of non renewable energy resources its propensity to encourage a sprawling low intensity and inefficient form of urban development its emission of air and water pollutants its susceptibility to congestion (with attendant increases in emissions and energy consumption inhibition of economic competitiveness and degradation of urban quality of life) and its direct impact on human life and suffering due to accidents

This paper provides an overview of the issues and challenges currently facing Canadian cities as they identify ways of achieving more environmentally sustainable transportation systems and of the initiatives they are taking to improve environmental economic and social attributes of urban travel The paper is part of Canada s contribution to a project on urban travel and sustainable development being undertaken by the Group on Urban Affairs of the Organization for Economic Cooperation and Development

The paper is intended to provide OECD project participants with insight into the major transportation related environmental economic and social problems currently being faced by Canadian cities the social political and economic forces which have shaped Canadian urban transportation during this century and the successes and failures Canadian cities have experienced as they consider and work towards a greener urban transportation system

Following a brief introduction opening chapters discuss the history of urbanization and urban transportation in Canada during this century outlining the social political economic and demographic factors which have shaped them and highlighting the changing role of environmental concerns in urban transportation policies throughout the period They also assess the current situation illustrating the legacy of past transportation decisions and the impact of current demographic and economic trends on the urban environment and describing the need for a fundamental change in current urban transportation policy

Subsequent chapters present a set of 25 initiatives which can be applied to make urban travel more sustainable strategically assess their

potential and review Canadian experience in implementing them The latter is largely drawn from a brief informal survey of Toronto Montreal Vancouver Ottawa Edmonton Calgary Winnipeg and several examples of smaller communities

The concluding chapter briefly summarizes the main challenges faced by Canadian cities in achieving more sustainable urban travel and the main types of initiatives now underway to this end

As is apparent from the paper urban Canada embodies a unique combination of constraints and opportunities as it faces the challenging task of achieving transportation sustainability

In comparison to geographically smaller older more densely populated old world countries Canada s cities are relatively low density and often separated by great distances Thus there is a relatively high level of energy consumption by the transportation sector as a whole and a high level of auto-dependence and auto use within urban areas Culturally Canadians expect a high degree of mobility thinking nothing of travelling long distances for work, recreation shopping and socializing

Within many of Canada s major cities however there are good prospects for improvement In comparison to many new world cities where central areas have been depopulated and original transit systems dismantled core areas of Canadian cities have largely retained their vitality and a full range of functions along with the transit systems that serve them Canadians have also retained traditions of urban living with more affinity for walking bicycling public transit and use of public spaces

Canadian cities therefore are both a promising and logical focus for major initiatives toward sustainable urban transportation Large scale small scale public private and individual initiatives are needed in all areas discussed in the paper with special emphasis on long term change in urban form transportation infrastructure and demand management (particularly road pricing) and more immediate strategies for improved transit facilities and operations traffic management cleaner vehicle technology institutional reform and public education and outreach

It is hoped that the information provided in the paper will be useful to those concerned with these issues in other countries Canadians in turn seek to derive as much benefit as possible from similar information regarding initiatives and accomplishments in other cities around the world

Déplacements Urbains et Développement Durable L'Expérience Canadienne

RÉSUMÉ

Partout au Canada et dans les pays industrialisés on se rend de plus en plus compte que le transport des personnes et des marchandises dans les centres urbains va à l encontre des principes du développement durable Au Canada à quelques exceptions près les transports urbains reposent en grande partie sur l automobile et on considère qu ils ne respectent pas les principes du développement durable et ce pour de nombreuses raisons notamment la consommation de ressources énergétiques non renouvelables, la tendance naturelle à une forme d aménagement favorisant l étalement des banlieues la faible densité d occupation et l'inefficience la pollution de l air et de l eau les risques d embouteillages (ainsi que l augmentation des émissions de polluants et de la consommation énergétique les obstacles à la compétitivité économique et la dégradation de la qualité de la vie urbaine qui en découlent) et, enfin les effets directs sur la vie et sur la souffrance des humains en cas d accident

L étude présente une vue d ensemble des problèmes et des enjeux auxquels sont actuellement confrontées les villes canadiennes qui essaient de rendre leurs réseaux de transport plus respectueux de l environnement ainsi qu un aperçu des mesures qu elles prennent pour améliorer les aspects environnemental économique et social des déplacements urbains L étude s inscrit dans le cadre de la contribution du Canada à un projet sur les déplacements urbains et le développement durable entrepris par le Groupe des affaires urbaines de l Organisation de coopération et de développement économiques (OCDE)

L étude fournira aux participants au projet de l OCDE des données sur les principaux problèmes environnementaux économiques et sociaux auxquels les villes canadiennes sont actuellement confrontées dans le domaine des transports sur les facteurs sociaux politiques et économiques ayant eu une incidence sur les transports urbains au Canada au siècle actuel ainsi que sur les réussites et les échecs des villes canadiennes qui s efforcent de rendre leur réseau de transports urbains plus respectueux de l environnement

Après une brève introduction les premiers chapitres traitent de l histoire de l urbanisation et des transports urbains au Canada au siècle actuel et décrivent les facteurs sociaux politiques économiques et démographiques desquels ceux ci sont tributaires Ils soulignent

l évolution des préoccupations environnementales dans les lignes de conduite en matière de transports tout au long de cette période Ils examinent également la situation actuelle tout en expliquant les conséquences des décisions antérieures en matière de transports les effets des tendances démographiques et économiques actuelles sur le milieu urbain ainsi que la nécessité d apporter des changements fondamentaux à la politique actuelle en matière de transports urbains

Dans les chapitres suivants on présente une série de 25 mesures qui peuvent être prises pour que les déplacements urbains tiennent davantage compte des principes du développement durable on procède à une évaluation stratégique de leur potentiel et on fait un bilan de l expérience canadienne en ce qui a trait à leur mise en oeuvre Ce bilan repose en grande partie sur de courtes enquêtes informelles menées à Toronto Montréal Vancouver Ottawa Edmonton Calgary et Winnipeg ainsi que sur quelques exemples provenant de collectivités plus petites

Le dernier chapitre résume brièvement les principaux défis auxquels sont confrontées les villes canadiennes qui s efforcent de rendre les déplacements urbains plus respectueux des principes du développement durable ainsi que les principaux types de mesures actuellement en vigueur dans ce domaine

Tout au long de l étude il est manifeste que les villes canadiennes doivent trouver un moyen terme entre les contraintes et les objectifs visés pour relever le défi du développement durable dans le domaine des transports

Comparativement aux villes des pays plus petits sur le plan géographique plus vieux plus densément peuplés du «vieux monde» les villes canadiennes se caractérisent par leur faible densité et souvent par les grandes distances qui les séparent les unes des autres Par conséquent le secteur des transports en général consomme relativement beaucoup d énergie et dépend surtout de l automobile même dans les centres urbains En raison de leur culture les Canadiens souhaitent être très mobiles ils trouvent tout naturel de parcourir de longues distances pour aller travailler se divertir magasiner et voir des amis

Toutefois pour un bon nombre de villes canadiennes importantes les perspectives d amélioration sont bonnes Comparativement à de nombreuses villes du «nouveau monde» où les quartiers du centre ville ont été vidés de leurs habitants et où le réseau original de transport en

commun a été détruit les centres villes canadiens ont conservé dans une large mesure leur vitalité et un éventail complet de fonctions ainsi que les réseaux de transport en commun qui les desservent Les Canadiens sont également restés fidèles à leurs habitudes de citadins plus enclins à la marche à la bicyclette ainsi qu à l utilisation des transports en commun et des espaces publics

Les villes canadiennes constituent donc un lieu prometteur et logique pour la mise en oeuvre des principales mesures visant à appliquer les principes du développement durable aux transports urbains Dans tous les secteurs mentionnés dans l étude il faut prendre les mesures nécessaires que ce soit sur une grande ou sur une petite échelle ou qu il s agisse de mesures à caractère public privé ou individuel Il faut mettre l accent sur les changements à long terme en ce qui concerne l aménagement urbain l infrastructure relative aux transports et la gestion de la demande (particulièrement en ce qui a trait à l'établissement du coût des routes) Il faut également élaborer des stratégies plus immédiates relativement à l amélioration des réseaux de transport en commun et de leur fonctionnement à la gestion de la circulation à la conception de véhicules moins polluants à la réforme institutionnelle à l éducation du public et à l action directe

Les auteurs espèrent que les renseignements fournis dans la présente étude seront utiles aux personnes qui s intéressent à ces questions dans d autres pays Les Canadiens pour leur part cherchent à tirer le plus de profit possible d informations comparables sur les initiatives et les réalisations d autres villes étrangères

Urban Travel and Sustainable Development: The Canadian Experience

1 INTRODUCTION

Across Canada and across the industrialized world there is a growing awareness that our systems for moving people and goods in urban areas are in conflict with the principles of sustainable development. The Canadian urban transportation system which with few exceptions is based on the private automobile as the primary means of transport is not sustainable for the following reasons:

- it consumes vast quantities of a non renewable energy resource contributing greatly to Canada s dubious distinction of having the highest per capita energy consumption in the world;

  it makes possible a sprawling low intensity form of urban development which in turn consumes another non renewable resource farmland and natural habitat and which entrenches the dominance of the automobile as other forms of transportation have great difficulty servicing such dispersed development;

  it emits air and water pollutants which degrade the environment on a local regional and global scale;

- it fosters increasing peak period traffic congestion in major urban areas which exacerbates automotive emissions and energy consumption inhibits economic competitiveness and generally degrades the quality of urban life;

- it takes a direct toll in human life and suffering as motor vehicle accidents are responsible for one in three deaths due to accidents

This paper provides an overview of the issues and challenges currently facing Canadian cities as they identify ways of achieving more environmentally sustainable transportation systems and of the initiatives they are taking to improve environmental economic and social attributes of urban travel

The paper is part of Canada s contribution to a project on urban travel and sustainable development being undertaken by the Group on Urban Affairs of the Organization for Economic Cooperation and Development It is a companion piece to the overviews prepared by other OECD member countries as summarized in July 1992 [1]

The paper is intended to provide OECD project participants with insight into the major transportation related environmental economic and social problems currently being faced by Canadian cities the social political and economic forces which have shaped Canadian urban transportation during this century and the successes and failures Canadian cities have experienced as they consider and work towards a greener urban transportation system

Chapter 2 provides a brief review of the history of urbanization and urban transportation in Canada during this century outlining the social political economic and demographic factors which have shaped them and highlighting the changing role of environmental concerns in urban transportation policies throughout the period

Chapter 3 is an assessment of the current situation The legacy of past transportation decisions and the impact of current demographic and economic trends on the urban environment are presented underscoring the need for a fundamental change in current urban transportation policy The obstacles which currently hamper the shift to a more sustainable urban transportation system are also discussed

Chapter 4 sets the context for the remaining chapters by presenting the range of innovations which can be applied to make urban travel more sustainable and strategically assesses their potential

Chapter 5 is a discussion of recent innovative attempts to make urban transportation more harmonious with the concept of sustainable development drawn from a brief informal survey of Toronto Montreal Vancouver, Ottawa Edmonton Calgary Winnipeg and several examples of smaller communities

Chapter 6 presents comments on some of the major Canadian initiatives in the context of the strategic potential of and trade-offs among various initiatives available to achieve more sustainable urban transportation

Finally Chapter 7 concludes the paper by briefly summarizing the main challenges faced by Canadian cities in achieving more sustainable urban travel and the main types of initiatives now underway to this end

2 THE EVOLUTION OF CANADIAN URBAN TRANSPORTATION

This chapter provides an overview of the geographical institutional and historical context for urban transportation in Canada

2 1 AN OVERVIEW OF URBAN CANADA

Present-day Canada presents an interesting study in urbanization since the entire range of human settlement types is represented across the country from temporary hunting and fishing camps to metropolitan areas housing millions of people [2]

Although Canada is correctly perceived as a country of wide open spaces and sparse population in reality most of its population occupies a small fraction of the available land mass; three-quarters of Canada s population lives in urbanized areas and three-quarters of the population lives within a 200 kilometre-wide belt running along the Canada U S border

Canadian cities are situated in two distinct but overlaid bands of settlements The first band stretches from coast to coast along the Canada U S border and consists of cities which are spaced relatively widely apart and function as focal points for semi independent regional economies The second band is a 1 000 kilometre long corridor of intense urban development along the Great Lakes St Lawrence system in Eastern Canada between the cities of Windsor and Quebec City This band which features nine of Canada s 15 largest cities and more than half its population is much more tightly linked and inter dependent both economically and physically; about one third of the belt is characterized by continuous urban development

For reference Exhibit 1 is a listing of Canada s urban areas by population Note that in Exhibit 1 the population figures are quoted for each settlement s Census Metropolitan Area (CMA) a formal statistical aggregation However in the remainder of this paper the term city is used as the generic term referring to a distinct continuous urban area In the case of metropolises this includes the original political unit defined as the city" and the suburbs and other urban areas having a tight link to the central area These extended boundaries present a more accurate picture of the true size of an urban area; they may or may not correspond to each city s currently defined CMA.

Much of this report will focus on the three metropolitan areas of Toronto Montreal and Vancouver and the four major cities of Ottawa Edmonton Calgary and Winnipeg These seven urban areas contain 43% of Canada's total population and it is in these areas that Canada s urban transportation related environmental problems are most evident

and where the bulk of the improvement efforts are underway However Canada s smaller cities are experiencing their share of transportation challenges and implementing innovative responses; where appropriate example problems and solutions from smaller cities are also discussed.

2 2 INSTITUTIONAL SETTING

Canada is a federation of ten provinces each with its own legislative and executive powers and two territories whose legislatures report to the federal government.

The Provinces are constitutionally responsible for internal transportation including urban transportation However all provinces and territories have executed their legislative authority to create local municipal governments and delegated much of the responsibility for urban transportation to local governments

Nevertheless the provincial governments play a large role in urban transportation They are responsible for constructing and maintaining provincial highway systems which although intended primarily for intercity traffic have a profound effect on urban travel and land use patterns In most instances provincial governments subsidize the capital costs of municipal road construction and part of the capital and operating costs of municipal transit systems Most provincial governments sponsor research development and demonstration studies into many transportation issues including the transportation environment issues which are the subject of this paper

Municipal governments have the largest responsibility for urban transportation They plan construct own and maintain most roads and bikeways and own and operate public transit systems (although often through an intermediate agency)

The Federal Government has no direct responsibility in urban transportation matters However it administers many programs policies and research activities which directly or indirectly affect urban transportation such as immigration housing finance interprovincial and international transportation and energy and environmental policies

While the precise division of urban transportation responsibilities varies across Canada in any given City the multiplicity of jurisdictions is complex. This often hampers environmentally motivated transportation innovation as it is difficult for a single agency to take action alone

Exhibit 1

Urban Travel and Sustainable Development
The Canadian Experience
Canadian Cities* by Population - 1990

Census Metropolitan Area	Population (000 s)
Toronto	3 752
Montreal	3 068
Vancouver	1 547
Ottawa-Hull	864
Edmonton	824
Calgary	723
Winnipeg	647
Quebec	622
Hamilton	595
London	368
St Catharines-Niagara Falls	358
Kitchener	346
Halifax-Dartmouth	312
Victoria	279
Windsor	261
Oshawa	245
Saskatoon	205
Regina	191
St John s Nfld	164
Chicoutimi-Jonquiere	158
Sudbury	149
Sherbrooke	134
Trois-Rivieres	132
Saint John NB	124
Thunder Bay	124
CENSUS METROPOLITAN AREAS	16 192
URBAN CANADA	20 350
CANADA	26,600

*Census Metropolitan Areas as defined by Statistics Canada

Source: Statistics Canada

2 3 URBAN TRANSPORTATION HISTORY

A review of developments in Canadian urban transportation over the 20th century reveals four major eras essentially defined by trends in transit ridership Each of these eras is distinct in terms of the dominant mode/technology of urban transportation (and the environmental implications of the dominant mode) and in terms of the role of environmental issues in the transportation decision making process

1900 1946: The Transit Era

In the first decades of the 20th century urban settlement patterns across Canada were characterized by a compact form with densities usually well over 6 000 persons per square kilometre and based upon a fine grained grid street system [3] Buildings were close to and oriented toward the streets which were lined with wide sidewalks The main streets were usually lined with small shops catering to adjacent neighbourhoods with most homes located within easy walking distance of shops and transit lines

Downtowns contained the major institutions and businesses and were the focus for employment Larger cities had subcentres as well Toronto for example is a cluster of urban villages due to the amalgamation of many small municipalities into one

Over the period Canada s urban population grew from 38% of the total population in 1900 to 59% in 1946 This was due to a century long pattern of migration from rural areas to the cities and to the fact that immigrants to Canada tended to locate in the larger cities

Urban transportation of people in all major cities was based upon walking and upon electrically powered transit systems of streetcars trolleys and intraurban rail Diesel and gasoline fuelled buses were also used increasingly in the 1930 s and 1940's

The population was largely transit dependent and ridership was extremely high In Winnipeg for example (which was Canada s third largest city at the time) annual ridership averaged about 500 trips per year per capita Public transit systems were private profit making companies which funded their own capital and operating costs In Halifax and Vancouver transit operations were owned by electric utility companies

Goods movement was largely rail based; factories and distribution centres were located along rail lines and local distribution was by horse drawn vehicles in the earlier years with greater use of trucks as the 1920 s and 1930 s unfolded (limited by gas rationing during World War II) From east coast to west coast the major urban centres were linked

by the national rail systems operated by Canadian National and Canadian Pacific

During this period environmental issues were largely restricted to questions of resource management, and transportation was not generally identified as an environmental issue Nevertheless the pedestrian and public transit-oriented systems of the era were environmentally friendly by today s standards The urban use of land was intensive with a clear distinction between city and countryside and electric rail and trolley operations represented an efficient and relatively clean use of energy

1947 1973: The Automotive City

The end of World War II marked the beginning of a period of economic and population growth in North America which was unprecedented at the time, and may never again be matched Consistent with the continuing urbanization trend the bulk of this growth occurred in urban areas However the urban form which would emerge to accommodate that growth would be radically different than anything seen previously due to the introduction of widespread affordable personal mobility in the form of the automobile and to persistently low energy prices

In the post-war era the technology of transportation shifted dramatically toward the private car and its supporting infrastructure Vehicle ownership increased by 350% from 132 vehicles per 1 000 people in 1947 to 461 vehicles per 1 000 people in 1973 as shown in Exhibit 2

A new form of suburban structure and design emerged based upon the assumption of universal car ownership and characterized by the separation of incompatible activities into large single tract land uses such as residential subdivisions shopping malls office parks and industrial areas

Buildings were increasingly oriented inwards and set back from major arterial roads often separated from the street by large parking lots or backyard fences The street patterns of residential subdivisions provided limited access to the interior by means of winding internal collector roads and cul-de sacs sometimes without sidewalks The wide spacing of through roads suitable for buses plus low development densities and streetscapes designed for vehicles rather than pedestrians reduced both the convenience of transit for users and the efficiency with which it could be provided As service was cut back to save money ridership declined even more creating a downward cycle

Because of the widespread ownership of automobiles development was no longer constrained by the location of rail lines and other forms of public transit and any piece of property might have development potential Thus scattered, low-density leap frogging peripheral development patterns became possible and increasingly difficult for governments to constrain. Average densities in the new suburban areas ranged between 2,000 3,500 persons per square kilometre compared to inner city densities of 4 000 6 000 persons per square kilometre [4]

This development pattern was encouraged by the abundance of relatively cheap land in Canada the price of which did not include all of the long term costs of municipal services nor the environmental costs of automobile pollution and the destruction of farmland and natural areas

In many cities long range transportation master plans were created based almost exclusively on the private automobile featuring construction of urban expressways and auto-oriented arterial roads as keystones of the transportation system. Although some of the planning exercises recognized a few of the environmental and social consequences of urban freeway construction e g neighbourhood disruption such consequences were considered a small price to pay for the mobility and economic benefits of freeways Thus in the largest cities of Toronto and Montreal extensive networks of urban freeways were planned and partially constructed while in virtually all other cities arterial construction was intensified along with the construction of urban freeways in some centres often as connecting links or ring roads to carry both intercity and urban traffic

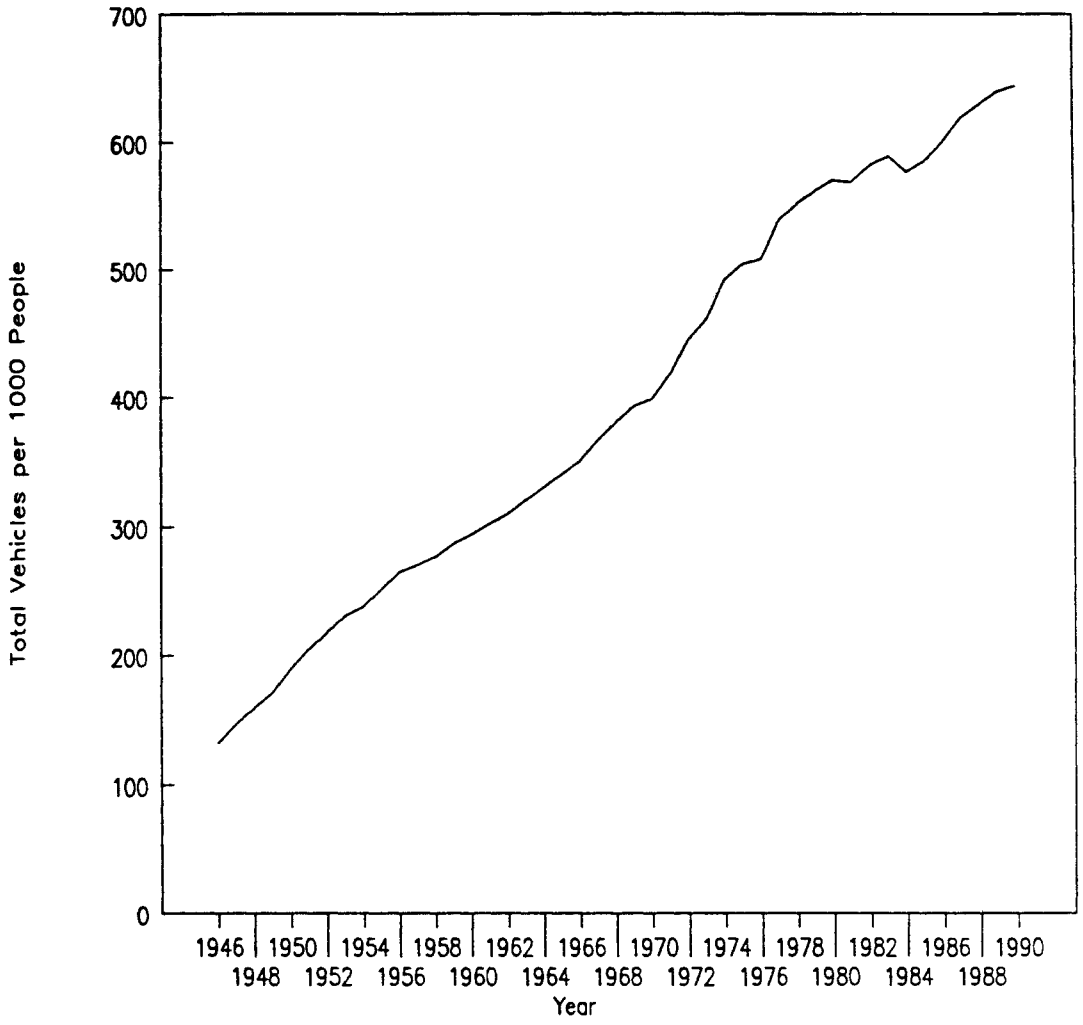
Though much of this activity was led by municipal and provincial governments the federal government also participated by funding and coordinating a cross-country highway and funding construction of a large number of urban road rail grade separations However the role of the Canadian national government in road transportation was limited in comparison with that of the U S federal government (e g the ambitious U S Federal Highway System)

Spurred by economic growth which increased market size the expanding road infrastructure both within and between cities and a relaxation of economic/operational regulations trucking carried a steadily increasing share of the freight market previously dominated by the rail and marine modes

Across all of North America a strong movement emerged to replace electric streetcar and trolley coach systems with diesel buses and debate ensued over the relative merits of the two technologies Proponents of diesel buses claimed they were more flexible interfered

Exhibit 2

Total Vehicle Registration Per Capita in Canada
1946 - 1990



Source: Statistics Canada

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less with automobiles, and were cheaper to purchase and operate. Streetcar and trolley coach proponents argued that streetcars were more attractive to riders, were less polluting and, in the long-run, cheaper because they were more energy-efficient and carried more riders.

The diesel buses generally prevailed and streetcar systems were dismantled in every Canadian city except Toronto. In Montreal, statistics show that by the time the streetcars had been replaced in 1959, the system was using more vehicles to carry fewer passengers. Trolley coach systems were also abandoned (e.g., Winnipeg) or significantly reduced in size.

As the new bus-based transit systems expanded to provide service to the new suburbs, they found that the poor pedestrian environment on and poor pedestrian access to the arterial roads reduced the viability of transit service on the traditional arterial grid network and necessitated the provision of inefficient routes on the internal, looping residential streets instead.

The mutually-reinforcing combination of low-densities, poor pedestrian access and growing car ownership caused a steady decline in transit ridership. By 1962, annual ridership in Winnipeg had declined to 120 trips per capita and by 1972 to 105 trips per capita; similar ridership losses were experienced in most Canadian cities with transit systems. Exhibit 3 summarizes these trends in transit ridership and service levels in Canada's larger and medium sized cities.

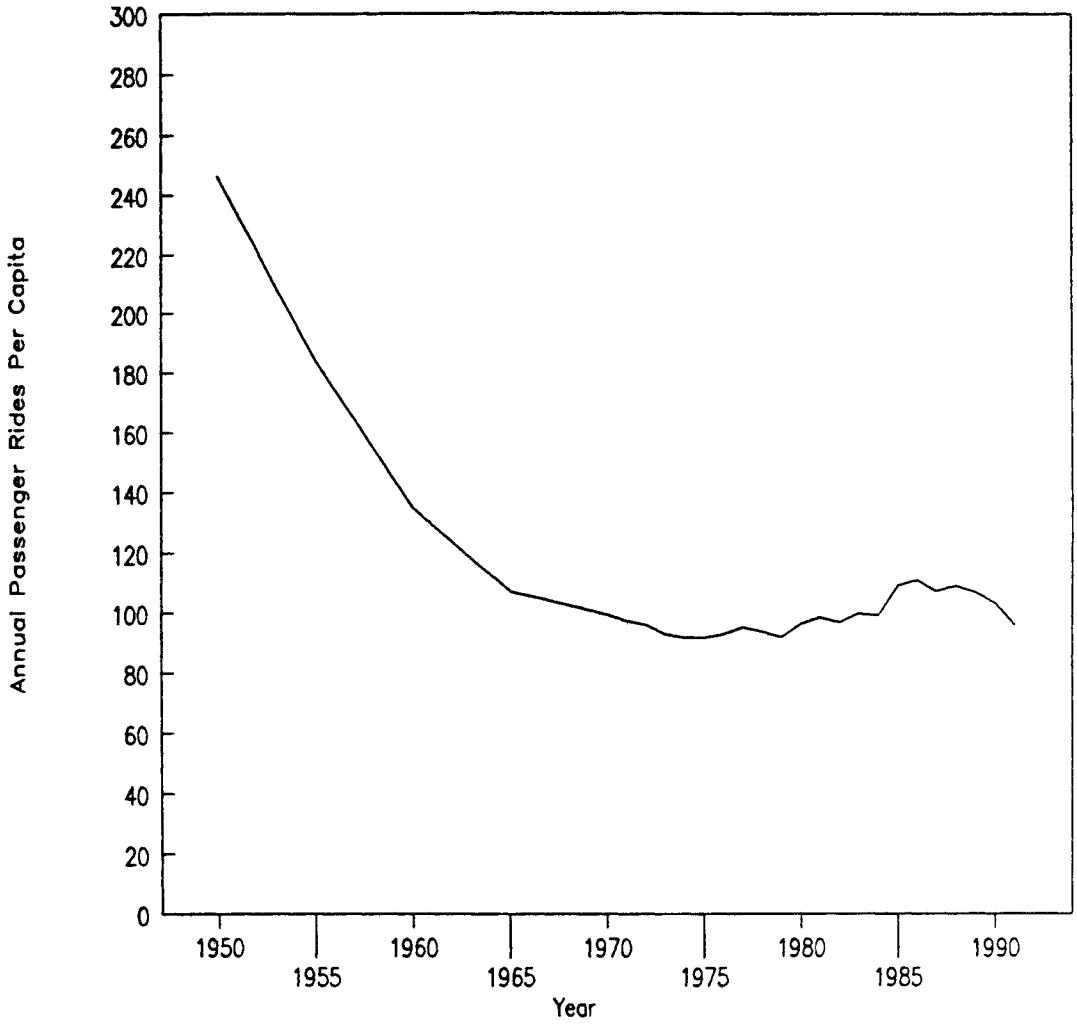
In this situation, transit operations were no longer economically viable without public subsidies. By 1960, most of the private transit companies had been taken over by government and were operated as either municipal departments or transit commissions, with government paying for capital expenses and the mounting operating deficits.

Despite the general decline of transit, there were some notable exceptions. In the largest cities - Toronto and Montreal - surface congestion spurred the construction of subway lines. Montreal built its first subway system with 16 stations on three lines between 1961 and 1966 and Toronto built its first two lines between 1949 and 1974. Both systems were very successful in terms of ridership and operation and are credited with preserving and enhancing the vitality of the downtown areas as well as the urban economy and quality of life in general.

However, as a whole, Canadian cities in the automotive city era were marked by a drastic decline in walking and transit trips and an enormous increase in the number of trips made and distances travelled in private motor vehicles, leading to a significant decline in

Exhibit 3

Annual Transit Passenger Rides Per Capita in Canada 1950 - 1990



Source: Canadian Urban Transit Association

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transportation energy efficiency and corresponding increase in emissions (although to a lesser extent than that experienced in the United States, as Canada's political tradition of comparatively greater government involvement in the land use approvals process was able to somewhat contain urban sprawl).

In large urban areas, the emissions of automobiles and diesel buses degraded air quality and caused concern about the effects of leaded gasoline, among other pollutants. And deaths and injuries due to traffic accidents rose sharply; while death rates did not increase at the same rate as automobile use, there was a dramatic increase in the number of motor vehicle accidents and related non-fatal injuries [5].

1974 - 1985 Freeway Revolt and Transit Revival

Because Canada lagged behind the United States in freeway building, Canadians had the opportunity to observe the environmental and social impact of freeways on the core areas of U.S. cities. Due to citizen opposition, major urban freeway projects in Vancouver, Edmonton, Winnipeg, Toronto and Montreal were cancelled.

The growing citizen dissatisfaction with the lack of concern for environmental and social issues in major transportation projects and other public-sector undertakings led to the establishment of environmental assessment legislation and processes. To varying degrees across the country, transportation plans were required for the first time to consider explicitly environmental and social goals as well as the traditional transportation and cost objectives. On a formal level transportation planning agencies began to incorporate environmental factors into their planning processes.

The unpopularity of freeway projects, the pressure to consider a full range of environmental and social goals in planning transportation systems, and concerns regarding petroleum dependency due to the two petroleum energy "crises" in 1974 and 1979 caused a renewed interest in public transit.

Major transportation planning exercises in Vancouver, Calgary, Edmonton, Winnipeg and Ottawa focussed on alternative ways of providing rapid transit. These included heavy rail, light rail and bus-ways in various combinations with new roads and highways and conventional surface bus routes.

Calgary and Edmonton chose Light Rail, Calgary opening its first line, of an eventual 29 kilometres, in 1981. Edmonton completed 9 kilometres of line in 1978 and 1981. Edmonton incurred substantial costs by building the downtown portion of its line underground, in

contrast to Calgary which created a downtown transit mall on the surface and was able to create a more extensive system with the available capital funds

Ottawa and Winnipeg chose to construct busways instead of Light Rail. Ottawa constructed its planned busway system regionalizing its transit service and providing express service into downtown from the suburbs [6] Winnipeg in contrast never built the planned busway but instead spent money on bridges which provided access to vacant suburban land for further auto-oriented development

In Vancouver the British Columbia Government chose a linear induction motor technology with light-weight computerized cars on elevated guideways inaugurating its Skytrain service in 1986 on a line linking the downtown to the suburban community of New Westminster

Montreal and Toronto engaged in a second phase of rapid transit construction Toronto opened its Spadina line in 1978 and constructed its Scarborough RT as a showcase for the Ontario produced linear induction technology (used in Vancouver s Skytrain) Montreal extended its existing lines and completed a new crosstown line north of the downtown by 1985 In both cities, however the new lines were not as successful as the first lines in terms of ridership and cost effectiveness

In Ontario the provincial government created a commuter rail system for the Greater Toronto area which achieved high ridership levels partly due to its region-oriented enabling legislation which allowed it great flexibility to tailor its services to the emerging market In contrast Quebec did not take over when CN and CP discontinued most of their commuter rail service in the Greater Montreal area; however Montreal s local transit authority (STCUM) began to operate a limited commuter rail service

From its rock bottom low in 1973 transit ridership across the country increased between 1974 and 1985 (see Exhibit 3) In Canada the 1970 s are often referred to as the Golden Age of Transit as most provincial governments provided generous capital and operating funds

However as construction of the new lines was completed many cities found themselves facing a type of planning paralysis at the highest levels Road-oriented infrastructure projects continued to be widely unpopular and some proposed transit projects were also attacked on the grounds that they disrupted local communities Throughout the period transportation budgets steadily decreased in real terms as governments at all levels reoriented their priorities towards social education and health spending These factors led to a virtual freeze on

major capital-intensive network expansion in many cities in the early 1980's, which continues to this day with some exceptions.

As effort focussed away from major transportation infrastructure projects, more attention was paid to alternative methods of reducing congestion and petroleum consumption, and making more efficient use of the existing infrastructure. All levels of government sponsored efforts in the fields of alternative transportation fuels, demand management techniques (e.g. ride-sharing and alternative work hours) and traffic system management techniques such as improved arterial traffic signal control systems and freeway traffic management systems. Since the major driving force behind such efforts was concerns about petroleum dependency, political and general public support for these measures tended to ebb and flow with the energy crises. However, the measures provided enough potential and actual benefits in terms of infrastructure efficiency and reduced congestion and emissions to maintain a steady level of support from all government levels.

Although transit ridership per capita (e.g. market share) was increasing modestly throughout the period (as shown in Exhibit 3), and alternative approaches were providing localized benefits in some areas, the use of the automobile kept pace with such advances. Further, a number of demographic and land use trends, which had started in the post war era, continued to undermine the viability of non-automobile-oriented approaches.

Low-density growth with large single-use areas (e.g., residential, industrial) continued on the urban fringes in a manner that often precluded future provision of efficient transit service. Subdivisions often lacked sidewalks and pedestrian access to arterial roads. Deep set-backs of shopping malls, office buildings and institutions from the street, behind large parking lots, made it difficult to provide transit service from the arterial roads. Often buses were forced to detour onto these sites, creating longer routes and trip times.

The expanding municipal boundaries and decreasing densities meant that transit systems were carrying fewer passengers per revenue kilometre, with increasing emphasis on more long-distance commuter trips from distant suburban and exurban areas to the downtown core. Where businesses migrated to the suburbs they were often located in scattered, segregated, single-use office developments, rather than focussed in compact, mixed use nodes or sub-centres which would favour internal walking trips and could be served efficiently and effectively by transit.

Following in the path of Metropolitan Toronto and Montreal, the transit systems of Vancouver, Ottawa, Halifax and Quebec City became

regionalized, under new regional authorities and/or governments. Regionalization provided for efficient co-ordination and delivery of service, particularly for "trunk" or "backbone" routes, and also made available resources for operating specialized services such as para-transit for persons with disabilities. However, it also tended in some cases to separate the local land-use planning functions from the planning and provision of transit service. With the exception of Saskatchewan, none of the provincial governments currently give transit authorities formal power in the land-development approval process.

Throughout the period, urban population growth continued, and there was a disproportionately higher increase in employment associated with increasing participation of women in the out-of-home work force. These trends, coupled with an aging, generally more affluent population with fewer children and more double income households, led to continued growth in auto-ownership and increased vehicular trip-making, with a decreasing tendency to use transit. The size of the average household decreased over the period, leading to an increase in the number of dwelling units required to house the population. Real estate values in the built-up urban areas continued to grow relative to values in the rural-urban fringe, sustaining the suburbanization trend. The majority of urban growth in the period was accommodated in single-use low-density subdivisions containing detached single-family residences, at the rural-urban fringe. These trends produced an overall decline in the relative role of transit, walking and cycling in the urban transportation system, even as absolute transit ridership levels were in some cases increasing.

With regard to freight and goods distribution, trucks continued to increase their share of the market relative to the rail and water modes. The emergence of courier services and 'just-in-time' factory inventory systems, which rely on frequent and timely shipments, began to place increasing pressure on the urban road networks, exacerbated by periodic increases in the allowable weights and dimensions of trucks which encouraged further modal shifts from rail to truck.

The number of fatalities due to road transportation continued to decline relative to the growth in vehicle use, while traffic accidents and non-fatal injuries also began to decline relative to growth [7].

Urban air quality improved due to major improvements in motor vehicle emissions and energy efficiency, and due to the outward migration of heavy industry. However, toward the end of the period there arose signs that the improvement was slowing, as the gains were beginning to be offset by the increasing number of private motor vehicle trips and declining vehicle occupancy levels.

1986 - present: The Downward Spiral

The period from 1986 to the present can be characterized as the time when the urban transportation trends which tended to decrease the sustainability/livability of urban areas (e.g. sprawl, congestion, increased auto dependency) began in earnest to negate the contributions of positive trends (e.g. increased transit ridership, cleaner automobiles). This is illustrated in Exhibit 4, which summarizes changes in the urban transportation picture between the years 1986 and 1991 in Toronto, one of Canada's most transit-oriented cities.

Rapid transit expansion came to a halt with a virtual freeze on capital intensive work. This was especially problematic in Edmonton, where the LRT system was still too short to function effectively, and in Winnipeg, where the planned busway was never built. In Toronto, suburban congestion grew, while plans for completing a rapid transit grid stayed on the drawing board. Lacking an extensive commuter rail system, Montreal was increasingly affected by traffic from regional commuters.

Growing traffic congestion increasingly conflicted with surface transit operations. Some cities implemented transit priority measures such as reserved lanes and signal light pre-emption. Others gave precedence to cars by making buses pull off the road into 'bus bays' when stopping for passengers.

Almost everywhere, local and regional road expansion projects continued as a solution to congestion. The growth of cheap central area parking was encouraged by some cities, while discouraged by others, such as Toronto and Ottawa [8].

Bicycles became more popular as a means of transportation and some cities hired bicycle planners (e.g. Vancouver, Edmonton, Toronto, Montreal). Comprehensive Bicycle Plans were adopted to provide for development of bike lanes and bike parking facilities.

Since 1986, almost everywhere, transit operating costs increased and revenues declined. In response there were service cuts and fare increases, followed by further declines in ridership. While some transit systems maintained or increased the total number of riders, transit use did not keep pace with population growth, resulting in declining per capita ridership figures.

Thus, in Canada, transit systems began to be caught in a downward spiral of declining revenues and ridership, leading to deterioration of service, an echo of the massive downward spiral experienced following World War II. For example, Edmonton's transit share of daily work

EXHIBIT 4

GREATER TORONTO AREA
SURVEY TRAVEL FACTS

	1986	1991	Percentage Change
Survey Population (Includes Hamilton-Wentworth)	4,063,000	4,730,000	+ 16%
Households	1,466,000	1,716,600	+ 17%
Licensed Drivers	2,522,000	3,020,500	+ 20%
Persons per Household	2.77	2.76	- 0.3%
Drivers per Household	1.72	1.76	+ 2.3%
Vehicles per Household	1.41	1.43	+ 0.7%
No-Vehicle Households	14.8%	14.1%	- 5%
Total Daily Trips by Persons 11 and Older	8,213,000	10,227,000	+ 25%
Trips per Household	5.60	5.96	+ 6.4%
Trips per Person	2.32	2.54	+ 9.5%
Mode Share (%)			
Auto Drivers	60.4	62.7	+ 4%
Auto Passengers	14.7	15.3	+ 4%
Public Transit	16.4	13.5	- 17%
Other (Walk, Bicycle, School Bus)	8.3	8.4	+ 1%
Trips to Work	1,726,000	1,940,000	+ 12%
Trips per Household	1.17	1.13	- 3.4%
Trips per Employed Person	0.77	0.83	+ 8%
Mode Share (%)			
Auto Drivers	63.8	68.4	+ 7%
Auto Passengers	9.3	8.3	- 11%
Public Transit	22.2	18.7	- 16%
Walk, Bicycle	4.5	4.4	- 2.2%

Source: Data Management Group, 1992. "1991 Transportation Tomorrow Survey: Preliminary Comparisons with 1986 (Seminar)"

trips dropped from 24% to 17% between 1981 and 1989, Winnipeg's transit ridership declined by 16% while its operating costs rose by 40% since 1986, and Montreal's transit share dropped from 39% in 1982 to 29% in 1990.

In the context of the severe recession, which began to be felt in 1989 and still grips Canada's economy, provincial governments not only became unwilling to increase operating subsidies but, in the case of Saskatchewan and Quebec, actually withdrew them entirely.

Toronto, Montreal and Vancouver became once again the prime growth centres of Canada, having earlier been supplanted in terms of relative growth rates by smaller cities during the late 1970's. Cheaper land prices at the rural-urban fringe, and some government programs, continued to encourage development of tracts of low density single-family, detached homes in the surrounding regions, leading to increased servicing costs, longer commuter trips to downtown and the massive growth of suburb-to-suburb commuting.

Overall densities continued to decline, with Montreal (for example) losing population to the surrounding regions. The City of Toronto adopted policies to encourage the expansion of housing units downtown aimed at reducing the need for long distance commuting from the suburbs. Metro Toronto developed policies on intensification and reurbanization to make more efficient use of existing urban infrastructure. The Ontario provincial government also began a regional planning exercise for the Greater Toronto Area which has led to widespread agreement that low density, auto-dependent suburban development should give way to a more compact, mixed-use nodal urban structure and significant residential population growth in central areas.

Construction of subway extensions (e.g. the Spadina line) and LRT (e.g. the Spadina LRT) is beginning again in Toronto, and the provincial government recently announced the approval and funding approach for four more subway extensions (portions of cross-town lines on Eglinton Avenue West and on Sheppard Avenue East and further extensions of the Spadina subway and the Scarborough Rapid Transit line) and the first stage of a busway (the Mississauga Transitway) under the Let's Move program.

During the period, Vancouver adopted a policy of reducing the need for travel by "planning for proximity". Calgary, Edmonton and Winnipeg did not develop plans to curtail sprawl, although one new subdivision in Calgary was planned according to the principles of "neo-traditional" neighbourhood design, stressing more compact, mixed-use

development (based on a grid road pattern) which favours walking, cycling and transit rather than building in continuing auto-dependency.

Against this backdrop, a number of events crystallized popular environmental concern. For example, publication of the Brundtland Report popularized the concept of "sustainable development" in all fields of development, including urban transportation, published articles in the scientific and popular literature on acid precipitation and the appearance of an "ozone hole" in the Antarctic brought home the growing impacts of human activities on the environment. The emergence of global warming as an environmental issue refocussed attention on the energy-intensive nature of urban transportation in Canada.

Transportation began to be recognized as an environmental issue in its own right by the major environmental organizations, transit supporters and transit operators. Various publications were produced and programs adopted encouraging a reduction in car use and car dependence. However, unlike the case of the Clean Air Act in the United States, such concerns were not translated into specific reduction targets and schedules enshrined in legislation.

3. 1992: THE CURRENT SITUATION

This section attempts to answer the questions "How sustainable is urban travel in Canadian cities today?" and "How sustainable is it likely to be in the future, if current trends continue?"

Before these questions can be addressed, it is useful to define sustainability as it applies to urban areas in general, and to urban travel in particular.

3.1 THE CONCEPT OF SUSTAINABILITY

The basic concept of sustainability is that each generation of humans passes on to its successor **resources** (e.g. farmland and topsoil, other green spaces, energy sources, undiminished aquifers, lakes and rivers, forests and other vegetation resources, minerals, climate, wildlife species, domesticated animals, other natural amenities, quality of urban landscape, facilities and infrastructure, etc.) and **environmental quality** (e.g. pure water, clean air, uncontaminated wells, acceptable levels of noise and vibration, etc.) which are undiminished and are, if possible, enhanced as they are bequeathed to the next generation.

The concepts of **renewable resources** and **sustainable yield** are closely related to the overall concept of sustainability. Solar power and heating, wind, wave and tidal power, and hydro-electric power are all examples of renewable energy sources in that they are constantly renewed through the effects of solar radiation and in some cases gravity. Conversely, fossil fuels such as coal, oil and natural gas were created by earlier organic growth and geological processes and are considered to be finite in extent, i.e. **non-renewable**. Forest resources are renewable and can be harvested on a sustained yield basis, without loss of the resource, provided that they are replanted and the rate of harvesting does not exceed the rate at which the forest can replenish itself. Similar concepts of sustained yield apply to foodlands, water aquifers used as sources of well water, and lakes and rivers used to generate hydro electricity.

In theory, a fully sustainable society, in the context of resource and energy use, would use only renewable resources and energy sources, at utilization rates equal to or less than achievable sustained yields. Non-renewable resources, (for example various types of metallic minerals) would be fully recycled and reused, such that the available stock would not decline from one generation to the next. Similarly, the quality of the natural environment (e.g. air, water, soil, ultraviolet radiation levels, average temperatures, acidity levels of precipitation, etc.) and of the built environment (e.g. building stock, infrastructure and related equipment, the quality of urban design and streetscape, etc.) would be undiminished from one generation to the next.

From this definition, it follows that a fully sustainable society would

have to regulate its levels of human population and economic activity such that sustainable yields would not be exceeded and non-renewable resources would be fully recycled and reused.

Technology plays an important role in this equation, since technological developments can have a very substantial effect on the efficiency with which resources are used, the extent to which non-renewable resources can be recycled, the level of sustainable yields, and the availability of non-polluting machines and processes.

In the context of the above definition, human societies moved from being fully sustainable to lesser levels of sustainability when they began making stone implements, extracting metals from mineral ores, and burning coal. As long as human populations were relatively small, reserves of non-renewable resources were large in relation to the rate of human consumption, and environmental quality could be maintained by natural processes, sustainability was not a significant issue. It is now, as noted earlier, a very significant issue at existing and projected human population levels and growth rates, per capita resource consumption levels and trends, and degradation of environmental quality and natural amenities.

3.2 HOW CLOSE ARE WE TO SUSTAINABLE URBAN TRAVEL?

Urban travel is, of course, only one element of human society which affects the sustainability of that society. It is an important element, however, since the internal combustion engine powers more than half of the motorized transportation in most urban areas and well over 90% in the cities and towns of most Western countries. This form of propulsion is notorious for its consumption of fossil fuels (primarily petroleum-based) and its production of noxious emissions into the atmosphere and products which contribute to ground water pollution. The automobile has also had an extremely profound impact on the form, density and liveability of urban areas, contributing strongly to low density, spread urban development and continuing consumption of high quality farmland for urban purposes.

Examples of the above dynamics are unfortunately amply represented in Canada's urban areas. Exhibit 5 portrays Canada's seven largest cities in terms of some commonly used indicators of an urban area's sustainability. For context, the exhibit compares the urban form, central area characteristics, transportation system characteristics and environmental performance of the Canadian cities against those of Phoenix, Vienna and Tokyo. As some of the required data was not available within the scope of this study, Exhibit 5 is not complete. However, it presents sufficient information to paint a somewhat disturbing picture.

Exhibit 5

Urban Travel and Sustainable Development: The Canadian Experience

Summary of Major Canadian Cities and Selected International Comparisons - 1991

	Canadian Cities									International Cities*		
	Toronto		Montreal		Vancouver	Calgary	Ottawa	Winnipeg	Edmonton	Phoenix	Vienna	Tokyo
	Metro	GTA	MUC	GMA	GVRD		RMOC					
Population	2,276,000	4,235,530	1,775,871	3,127,242	1,542,744	710,677	678,147	616,790	616,741	1,509,052	1,531,346	11,597,211
Urban Form												
Size of Urbanized Area (km2)	630	1536	496	3509	1200	530	359	459	400			
Residential Density (people/km2)	3613	2758	3580	891	1286	1341	1889	1344	1542	850	7210	10460
Employment Density (jobs/km2)	2305	1571	2286	430		770	1066			400	3840	6630
Proportion of Single-Family Houses in Stock	35	43	12	28	53	57	43	60	58			
Central Area Characteristics												
Parking Availability (spaces/1000 central area jobs	210	210	79	79		620	301			1033	190	66
Proportion of Population (%)	6.7	3.6	2.9	1.7		1.2	0.83			0.5	1.3	1.3
Proportion of Jobs (%)	31	17	30	23		22	22			4	15	27
Transportation System												
Automobile Ownership (vehicles/1000 people)	493	463	369	413	202	669	482	509	622	499	311	156
Road Extent (m/person)	2.6	2.7						4.3		10.4	1.7	1.9
Transit Ridership (annual rides/person)	186	128	225	154	94	68	133	87	69	9	313	472
Transit Service (annual vehicle-km/person)	82	62	75	56	58	50	71	42	52	7	69	94
Environmental Performance												
Gasoline Use (annual MJ/person)	25139	27324	19595	26221						74510	10074	8488
Carbon Dioxide (annual tonnes/person)	1.7	1.9								5.1	0.7	0.6
Ozone (ppb, 1 hour)	100		56		58	55	45	80	60			
Carbon Monoxide (ppm, 8 hour)	3		4		4.8	4	2.5	2	3.6			
Nitrogen Dioxide (ppb, 24 hour)	26		52		25	28	28	17	24			

Source: Statistics Canada and data provided by local planning staff/reports. Blanks indicate that comparable data were not available.

*Note: These are 1980 figures, drawn from Newman and Kenworthy, "Cities and Automobile Dependence, An International Sourcebook"

IBI

It is clear from examining Exhibit 5 that Canada's urban areas today are a long way from providing sustainable urban travel. Fossil fuels are consumed for automobile and truck transportation and also to generate electrical power for subways, trains and elevators. While massive strides have been made during the past two or three decades in reducing automotive emissions and increasing their energy efficiency, the rate of automobile ownership and use is threatening to overwhelm recent gains in these areas, and growing congestion is having an increasingly negative effect on the urban environment.

Although the lack of a sustainable transportation system is common to all Canadian cities, each faces a somewhat different set of issues, problems and opportunities. These are discussed in the following paragraphs, which profile the seven major Canadian cities in terms of the current level of transit service and ridership and the degree of car dependency inherent in the existing urban structure. Described are densities, the existence of centres and subcentres, local and arterial road patterns, the availability of parking, the quality of pedestrian and bicycle facilities, transit infrastructure such as rail rights of way and rolling stock and the current operating system.

Winnipeg

Winnipeg was once the third-largest city in Canada and its streetcar system was one of the most successful in North America. Thus, the older central area is relatively large (about 100 km^2) and transit-oriented in form with the typical urban pattern of the pre-war era. There is a strong downtown, where many major institutions are located. Some of its commercial strength, however, has been eroded by five suburban shopping malls.

The central area and older suburbs are surrounded by a large expanse of scattered, low-density urban sprawl. Since 1967 the population grew by only 21% but the urbanized area of the city doubled, in effect spreading the same population over a much larger area as people left the central area for the suburbs.

Winnipeg is served by an evenly-spaced grid of major arterial roads, many of which lead to downtown. This provides for a largely radial system of bus routes, although there are cross-town routes as well. Travel is constrained by the two rivers around which Winnipeg is built and bridges are often sites for congestion.

Winnipeg has no rapid transit system; instead it offers an all-day express bus service on two of 12 major corridors. Bus priority measures have been implemented on some bridges and intersections. Peak-hour service on main roads averages 5-10 minute frequencies, but off-peak service on feeder routes averages 30-40 minutes and is as low as 30-60 minutes on Sundays.

The Official Plan emphasizes transit service for trips into downtown and auto use for cross town and suburb to suburb trips and this is reflected in actual travel patterns Minimum requirements for downtown parking were reduced in a zoning by law but no maximum requirements were established and developers have built more parking spaces than required.

The pedestrian environment is quite variable According to the standards of Winnipeg Transit every home should be within a 400 meter walking distance of a collector street but developers have not always complied with this As a result it is impractical to provide transit service for portions of some new subdivisions

In the central area many of the arterials function primarily as automobile traffic corridors Crossing areas are far apart wide intersections have continuous right turn lanes and signalling is inconvenient for pedestrians This is partially offset by an extensive system of walkways connecting major developments

Winnipeg is experiencing growing congestion problems in some places such as downtown where there can be 200 buses an hour on a single street, competing with heavy automobile traffic with resulting slower travel speeds and higher operating costs

In summary Winnipeg has a large central area that once supported a high level of transit service and ridership and could potentially do so again For new areas Winnipeg Transit has issued development guidelines that may lead to better pedestrian access and more efficient transit routes However the large scattered suburban areas require a very high level of transit subsidy in order to provide attractive service and the government funds for both operating subsidies and capital projects are in decline

Edmonton

Edmonton is a very low-density suburban city The older core area built on the traditional grid pattern makes up about one third of the land area but the surrounding two thirds follows the suburban style with reversed frontages and winding internal streets

The role of Edmonton s downtown has been eroded by the development of an extremely large suburban shopping and entertainment mall on the west side of the city and by the dispersal of employment growth throughout the urban area The Official Plan does not designate or encourage the growth of subcentres Expansion continues on the periphery in the form of low-density subdivisions although empty land zoned for residential uses exists in the central area

Edmonton s road system is basically a grid interrupted by a wide river valley south of the downtown and other geographical features There is good road access into downtown and a large supply of inexpensive or free parking available

The transit system consists of diesel and trolley buses and 13 kilometres of Light Rail (LRT) Extensive grade separation was undertaken for 40% of the line in the form of a tunnel under the downtown portion and under the University of Alberta and a bridge over the river to the University There are also some downtown busways and signal priority for buses at several locations Except for 5 and 10 minute service at peak periods on main routes service is usually in modules of 15 and 30 minute intervals and sometimes 60 minutes on Sundays

Edmonton has ensured that the distance between collector and/or arterial roads is about 800 meters and the maximum walking distance to transit stops about 400 metres However outside of the core area the arterial roads are intended for traffic only and pedestrian activity is officially discouraged Thus in residential areas buses follow the internal looping collector roads rather than the arterial grid

Edmonton has the potential to reverse recent trends and strive toward sustainability It at one time pioneered in progressive transit policies and operational innovations for suburban transit service and ensured adequate pedestrian access to transit in the design of its subdivisions However, the current level of congestion and noticeable air pollution is not sufficient to spur reductions in automobile use nor do any constraints exist to further low density growth on the periphery Further the high cost of transit in Edmonton due to the extensive grade separation of the LRT and the low densities and long bus routes characteristic of urban sprawl constrain options for service improvements

Regional Municipality of Ottawa Carleton (RMOC)

The Regional Municipality of Ottawa/Carleton (RMOC) includes the City of Ottawa plus 10 municipalities Ottawa the national capital is contiguous with Hull Quebec and closely interrelated in terms of transportation and employment activities The central area has a compact urban form on a rectilinear grid of local streets with densities ranging from 3 000 to 6 000 persons per square kilometre However two rivers and a canal cause a meandering pattern in the major arterial roads Ottawa has an extensive network of off street bike paths

The urban form of the region is broken up by large bands of green space and some development is quite scattered and far flung The newer suburban municipalities are characterized by car-oriented subdivisions and shopping malls with densities sometimes as low as 1 000 persons per square kilometre Local suburban streets often lack

sidewalks although collectors and arterials are required to have them on one side (not all do) Because of regional Official Plan requirements 95% of all homes are within 400 meters of a bus stop

Ottawa s public transportation system is composed of express and local bus service Express bus routes into downtown follow "busways separate from the road network. These were largely constructed on old rail and streetcar right-of-ways and on land reserved by the federal government.

The frequency of service is very high all day on the busways and during rush hour on other express suburban commuter routes Peak period transit ridership into the downtown area is quite high (50%) compared with similar sized North American cities due to the frequent service and policies which have minimized the supply of long term parking in the central area

In the suburbs however where cross town service is infrequent local and suburb to-suburb transit ridership is low The problem is compounded by an often poor pedestrian environment with large parking lots reversed frontages and wide arterials with few crossing points and difficult intersections

Ottawa has a good pattern of downtown transit ridership upon which to build In addition the subject of intensification and infill is being studied by both transportation and land use planning departments and has sparked interest in some area residents However the area s current low densities and scattered development pattern create a high degree of car dependence for off peak and cross town trips

Calgary

Much of Calgary is new its population having doubled between 1961 and 1981 There is a strong downtown core area surrounded by a great expanse of low-density development extending across a flat plain The newer areas follow conventional suburban patterns of large lots wide set backs winding internal roads and separation of uses

Although there is a strong downtown there has not been as much success in creating transit-oriented subcentres as in Winnipeg There is higher-density zoning at LRT stations with bonus provisions for projects that would build direct links to stations but such development has not occurred As noted earlier a new subdivision is being planned according to the principles of neo traditional neighbourhood design But for the most part low-density car-oriented growth continues on the periphery

Calgary possesses an extensive system of wide relatively new roads with major arterials leading from every part of the city into the downtown core in a radial pattern Car ownership is high with almost one car for every person over age 15

The transit system consists of diesel buses and 30 kilometres of Light Rail Transit (LRT) The LRT runs on the surface using a rail right-of way and the medians of wide arterial roads Three lines run from the outer parts of the city into downtown where they share a transit mall which is closed to cars The trains have signal priority at intersections and average 32 km/hour Bus operations are generally feeder routes to the LRT stations and as in other cities the suburban routes use internal subdivision roads On a city wide basis 9% of all trips are made on transit, which carries 41% of peak hour work trips into downtown

By policy Calgary strives to put transit service within 450 meters walking distance of almost all homes within the service area Thus subdivisions are required to meet this standard by providing walkways where needed

Calgary Transit ridership could be further threatened by an excess of cheap parking in the downtown Due to a past agreement with downtown developers the City is obligated to construct a number of parking garages around the city core In the meantime however more private parking lots have been created than were anticipated

In terms of prospects for sustainability Calgary has a strong downtown good rapid transit infrastructure adequate pedestrian access to transit stops and a willingness to try innovative planning However densities are too low to support wide area frequent bus service the pedestrian environment is not always pleasant and there is a lack of mixed use nodes There is little traffic congestion, other than downtown at rush hour to provide a disincentive to auto use Air quality however has become a problem due to the trapping of pollution by temperature inversions and this has provided the basis for programs to reduce automobile pollution

Greater Vancouver Regional District (GVRD)

The GVRD is made up of the City of Vancouver plus 14 municipalities 2 villages and 3 electoral areas The City of Vancouver is largely built on a narrow peninsula bounded by water on three sides Like all older cities it is compact and based on a grid pattern of roads with a density of about 4 000 persons per square kilometre

Because of the rugged terrain to the north and ocean on the west urban growth can only intensify in existing areas or go to the south and to the east along the Fraser Valley Newer development has been

predominantly at low-densities and continues to expand onto valuable farmland, although there are some examples of high-density mixed use downtown redevelopment and also several compact mixed use centres occurring in the growing suburbs

The largest transit district in Canada in terms of land area the GVRD is served by the Vancouver Regional Transit System (VRTS) It is a fully integrated system including local and commuter bus routes the Skytrain rapid transit line and the SeaBus a ferry service linking North Vancouver to the downtown across Burrard Inlet The City of Vancouver has a network of trolley bus lines which is the second largest trolley fleet in North America There is no commuter rail system

Vancouver is one of very few major North American cities without a downtown freeway having rejected plans for a regional freeway network and a third bridge into the city AM peak period travel into downtown Vancouver is 40% by transit Overall about 13% of daily travel is by transit

There is a growing congestion problem in Vancouver especially from suburban commuters As a result some local arterials are being widened or otherwise modified to become high-volume traffic corridors with negative impact on the quality of life in adjacent areas

Traffic in Vancouver is ultimately constrained by the capacity of its bridges and tunnels Congestion and pollution are providing strong incentives for improvements Whether such improvements will be in the form of additional motor vehicle facilities or a significant restructuring of services and behavioural changes remains to be seen

Montreal Urban Community (MUC)

Located largely on an island between two rivers the Montreal Urban Community (MUC) is made up of the City of Montreal plus 28 municipalities The MUC is linked by bridges to the off island communities of Laval (to the north) and the South Shore "The Greater Montreal Area is a general term referring to the Island of Montreal and surrounding regions It can include as little as Laval and the South Shore (about 1 000 km^2) or as much as 10 000 km^2 with 122 municipalities and a population of 3 2 million; the continuous urban area contains slightly more than 3 million people as shown in Exhibits 1 and 5

On the older central part of the Island of Montreal densities range from 5 000 to 8 000 persons per square kilometre and the urban form is densely developed on a fine grid of streets The western part of the island is newer and more suburban with lower densities ranging from 500 to 2 000 persons per square kilometre

On the South Shore the areas closest to Montreal have high urban densities but these get progressively lower as development spreads southward The city of Laval has an average density of 1 300 persons per square kilometre and a largely car-oriented development pattern These low-density bedroom communities are growing with young families while the population of the City of Montreal is gradually declining

Montreal has a large and vital downtown core which is the main employment focus in the Greater Montreal Area Until recently there has not been much emphasis on the development of subcentres but four are beginning to emerge: two on the Island in the east and west and one on each shore

The TransCanada Highway bisects the Island from west to east and is the focus for industrial activities which cluster along the corridor Downtown Montreal to the south is served by several highways

The Island is served by a network of 140 diesel bus lines which are integrated with 65 km of subway along four lines and two commuter rail lines There is an established counterflow reserved bus lane on the eastern part of the Island and four new rush hour reserved lanes being introduced downtown in 1992

The Montreal Urban Community has one of the highest levels of transit service and transit ridership in North America It also has an excellent pedestrian environment and a superb network of bike paths and on street bike lanes However as in other cities the transit system has been beset with increased operating costs and declining ridership

The urban form transit infrastructure and pedestrian/cyclist environment of the MUC are an excellent basis for moving to achieve greater sustainability and can be expected to remain in place over the long term in spite of counter trends However as in other Canadian cities urban sprawl continues in the outlying regions encouraged by government provision of sewer water and road services and by government housing grant programs which indirectly favour low-cost single family homes available only in outlying areas Correspondingly population in the MUC continues to decline

Greater Toronto Area (GTA)

Metropolitan Toronto includes the City of Toronto and five inner suburban municipalities Beyond Metro are four large regional municipalities which along with Metro make up the Greater Toronto Area (GTA)

The City of Toronto located at the heart of Metro and fully built up before 1946 has a compact urban form based upon a rectilinear street

grid. It is well-suited for pedestrians with short blocks buildings facing the street, wide sidewalks and closely spaced crossing areas and transit stops Commercial strips line most arterial roads putting shops and services within walking distance of most homes Thus the city functions as a collection of relatively self-contained urban villages The density averages about 6 500 persons per square kilometre

Densities in the five inner suburbs range from 6 000 persons per square kilometre in the older areas to only 2 500 in the newer areas While the arterial road system continues the grid pattern throughout Metro the residential streets in the suburbs follow the typical subdivision pattern with winding streets cul-de sacs and reversed frontages Land uses are separated into office parks subdivisions and shopping malls although subcentres do exist with buildings typically set back from the street behind large parking lots

In the fast growing regional municipalities outside Metro development is often scattered lacking a coherent urban structure and average densities are generally lower at 1 000 to 2 000 persons per square kilometre

Downtown Toronto is the regional employment centre attracting commuters from all over the GTA. Relatively low land prices in the outlying municipalities however continue to attract new residential development creating a growing regional imbalance between jobs and housing and longer commuting distances

The GTA is bisected from east to west by a sixteen lane freeway which was originally built as a bypass but is now crowded with local as well as long-distance trips Two smaller freeways lead into the downtown core from the east and west

Metropolitan Toronto is served by an integrated transit system of bus trolley coach streetcar and subway routes A grid system of bus routes on all major arteries uses diesel electric trolley and some experimental natural gas vehicles The central area of Toronto is served by a grid of streetcar lines The bus and streetcar routes are fully integrated with one east-west and two north south subway lines There are rush hour reserved bus lanes on some major roads and an extensive network of high occupancy vehicle (HOV) lanes is being implemented In the City of Toronto and other built up areas walking is an important form of transportation and cycling is becoming more popular

The Greater Toronto Area is served by seven provincially operated commuter rail lines which converge on downtown Toronto Fifteen area municipalities outside Metro Toronto operate transit systems there is generally little fare integration and service co-ordination

between the municipal systems although there are ongoing initiatives to improve this and fare integration exists between the commuter rail service and some of the municipal transit systems

Transit service in Metro ranges from headways of a few minutes on subway lines and major arterials to no more than 30 minutes during off peak times on local routes Transit accounts for 61% of work trips to the downtown core and 37% of all work trips in Metro Toronto In the regions outside Metro transit accounts for 22% of work trips coming into Metro but only 6% of all regional work trips

Metro Toronto has one of the highest levels of transit service and transit ridership in North America. However both have been declining since 1990, for reasons discussed in Section 2 and exacerbated by the deep economic recession which has been particularly strongly felt in southern Ontario and Quebec

Metropolitan Toronto already has a transit supportive urban infrastructure with some room for improvement particularly in the inner suburbs and has great potential to become more sustainable However this is not as true of the surrounding regions While both Metro and the Province have advocated an end to urban sprawl and an intensification of existing urban areas these are at present only policies and guidelines which may or may not be implemented

3 3 THE FUTURE

Looking to the future many of the negative trends identified in Section 2 persist in Canada s cities today and show signs of continuing and possibly intensifying over the next decade Past urban development/transportation practices have created urban areas which consist of relatively sustainable cores surrounded by increasingly unsustainable forms of development This is apparent from examining the indicators for Toronto and Montreal in Exhibit 5; virtually all indicators are worse for the greater urban areas (GTA and GMA) which generally developed after the metropolitan areas (Metro and MUC) This is also apparent in Exhibit 6 which compares three communities within the Greater Toronto Area: the City of Toronto a typical post World War II suburb and a typical modern suburb

At the present time within each of Canada s major urban centres there exist three different types of urban form At the heart of each area is the old pre-war city which is pedestrian and transit supportive Surrounding this are the older suburbs which feature lower-densities separation of uses tracts of single family detached homes buildings oriented away from the street often behind large parking lots winding internal roads and cul-de sacs and a poor pedestrian environment On the periphery or in regions beyond are areas of new growth where development is not only auto dependent in style but often widely

Exhibit 6

Urban Travel and Sustainable Development: The Canadian Experience

Generic Urban Form and Transportation Implications

	Central City (City of Toronto)	Post-WWII Suburb (City of North York)	Recent Suburb (Town of Markham)
Population	635,395	562,564	153,811
Urban Form			
Size of Urbanized Area (km2)	97	177	91
Residential Density (people/km2)	6550	3178	1690
Employment Density (jobs/km2)	4323	2292	665
Transportation System			
Automobile Ownership (vehicles/1000 p	388	450	555
Road Extent (m/person)	1.7	3.6	5.5
Transit Ridership (annual rides/person)	199	143	90

Source: Local planning staff/reports.

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scattered and lacking a coherent urban structure There is a predominance of single family detached housing and an imbalance of housing over employment, which fosters commuter travel to the inner suburbs and downtown core

This de-evolutionary" pattern is consistent from city to city with the relative size of each band varying (like the rings of a tree) according to when population growth occurred. Sometimes these variations are all contained within one municipality such as Calgary Edmonton and Winnipeg In other cases they are in different municipal jurisdictions as in the Vancouver Ottawa, Toronto and Montreal regions

What is particularly of concern about the de-evolution of Canadian urban land use practices in terms of sustainability is that most of Canada s future population growth according to current trends is likely to be accommodated in automobile-oriented low-density modern suburbs leading to an increasingly dispersed urban population Further Canada s population will likely continue to concentrate in its three largest cities; currently one third of Canada s population resides in Toronto Montreal and Vancouver with almost half of that in Toronto This combination of concentration at one scale and dispersion at another produces a powerful mix: an urban population which is automobile-dependent due to its low-density single use living areas and which must travel increasing distances to employment

In the absence of fundamental policy changes virtually all growth trends point to a future urban transportation scenario where the private automobile is used more frequently by more people to make longer trips at lower speeds with serious impacts on the economic social and environmental viability of Canadian cities

Further the implementation of any solutions will be hampered by serious lack of funding due to the intense pressure on all government levels to reduce deficits and curb expenditures For example virtually all of the seven cities have plans to expand their transit networks but most of these plans have been delayed scaled down or indefinitely shelved for financial reasons

In assessing the current state of urban transportation in Canada s cities one cannot help but conclude that the prognosis is grim However it is also apparent that the trends of the past 30 years will not continue unabated since in the end these trends are fundamentally unsustainable The only open question is whether Canadian cities will take steps proactively to reverse the trends or allow congestion pollution and resource depletion to do the job

4 ACHIEVING SUSTAINABLE URBAN TRAVEL

It is clear that significant steps must be taken to make urban travel more sustainable This chapter discusses potential initiatives which can be and in some cases are being pursued in Canada

It is apparent that the concept of sustainability embraces many aspects and that any given initiative may not necessarily deal equitably with all aspects of sustainability

For example it is possible to conceive of technological advances in urban transportation which would achieve zero emission of pollutants and would use renewable energy sources One such approach would be to use engines which burn hydrogen since the combustion of hydrogen produces only water vapour If it were possible to create hydrogen (e g from water) using some form of solar energy this would be a fully renewable energy source and also a non polluting one However such a technological advance would only be a partial solution since the types of urban transportation on which our cities rely have a significant impact on the nature of the urban landscape and the extent to which farmland is consumed for urban purposes In other words continuing automobile usage even if the autos were non polluting and used only renewable resources would still tend to separate urban land uses increase average trip lengths use up farmland and degrade the quality of urban neighbourhoods and streetscapes as people places

It is evident then that the level of transportation sustainability is directly related to the level of private automobile use in Canadian cities and any sustainable strategy must involve a reduction in automobile use However in shifting our urban centres to more environmentally friendly transportation patterns the key strategy is not just to reduce car use but to reduce car dependency for many types of trips

If alternatives to the automobile are not readily available and convenient then programs to encourage behavioural change may enjoy only limited or temporary success And the ability to provide good alternatives to the automobile such as frequent reliable and efficient public transportation and safe efficient bicycle and pedestrian ways is dependent upon the existing transport infrastructure and the physical structure of the city in terms of street patterns densities and urban form The ability of the individual to travel without a car is determined by walking distances to transit stops and/or to local shops and services and by the quality of the pedestrian and cycling environment and a successful sustainable strategy must address these issues

As a basis for discussing relevant initiatives in Canadian cities it is useful to consider a number of key categories of initiatives and related

measures of urban travel sustainability, to help understand how various initiatives may affect different aspects of sustainability. These concepts are addressed in the following section.

4.1 POSSIBLE INITIATIVES AND LIKELY IMPACTS ON URBAN TRAVEL SUSTAINABILITY

Exhibit 7 lists (down the left hand column) major types of initiatives which can be taken to improve the sustainability of urban travel by:

- reducing the need for and amount of vehicular travel;
- increasing the use of cleaner modes of travel;
- improving the environmental performance of all modes of travel.

The initiatives are as follows:

- **urban structure and urban design policies**
  - compact, mixed land use
  - pedestrian-friendly streets
  - joint transportation/land use planning
  - development nodes and intermodal transfer nodes
  - parking supply management
- **transportation infrastructure improvements**
  - continuous, multi-modal arterial roads
  - high occupancy vehicle (HOV) facilities
  - rapid transit and commuter rail networks
  - local transit improvements
  - cycle and pedestrian ways
- **demand management practices**
  - parking price management
  - congestion pricing for road use
  - alternative work schedules
  - ridesharing
  - telecommuting
- **transit efficiency practices**
  - fare integration and schedule coordination
  - transit priority
  - traveller information systems
- **traffic management practices**
  - advanced traffic management systems
  - driver information systems
  - traffic calming

EXHIBIT 7

SUSTAINABLE URBAN TRAVEL: INITIATIVES AND INTERACTIONS

Measures of More Sustainable Urban Travel / Major Types of Initiatives	REDUCED VEHICULAR TRAVEL EFFORT				GREATER CONSERVATION OF RESOURCES		IMPROVED ENVIRONMENTAL QUALITY		IMPROVED ECONOMIC EFFICIENCY		ENHANCED QUALITY OF LIFE		BROADENED LIFESTYLE CHOICES	
	Shorter Trips	More Walking	More Transit	More Cycling	Fossil Fuels	Farm-land	Air Emissions	Water Runoff	Less Conges-tion	Lower Transp'n Costs	Greater Safety	People Places	Housing Types	Travel Modes
URBAN STRUCTURE/DESIGN POLICIES														
• Compact Mixed Land Use	●	●	●	●	●	●	●	●	●	●	●	●	●	●
• Pedestrian-Friendly Streets	•	●	●	●	●	●	●	●	•	•	●	●	•	●
• Joint Transportation/Land Use Planning	●	●	●	●	●	●	●	●	●	●	●	●	●	●
• Dev. Nodes and Intermodal Transfer Nodes	•	●	●	•	●	●	●	●	●	●	●	●	●	●
• Parking Supply Management	•	●	●	●	●	●	●	●	●	●	•	●		•
TRANSPORTATION INFRASTRUCTURE														
• Continuous, multi-modal Arterial Roads	●	●	●	●	•		●		●	•	•	●		●
• High Occupancy Vehicle (HOV) Facilities	•	●	●	●	●	●	●	●	●	●	●	●	•	●
• Rapid Transit and Commuter Rail Networks	•	●	●		●	●	●	●	●	●	●	●	●	●
• Local Transit Improvements		●	●	•	●	•	●	●	•	•	•	●	•	●
• Cycle and Pedestrian Ways	●	●	●	●	●	●	●	●	●	●	●	●	•	●
DEMAND MANAGEMENT PRACTICES														
• Parking Price Management	•	●	●	●	●	●	●	●	●	●	•	●		•
• Congestion Pricing for Road Use	●	●	●	●	●	●	●	●	●	●	●	●	•	●
• Alternative Work Schedules			●	•	●		●	●	●	●	•	•		●
• Ridesharing		•			●		●	•	●	●	•	•		●
• Telecommuting	●	●	•	●	●		●	●	●	●	●	●	●	•
TRANSIT MANAGEMENT PRACTICES														
• Fare Integration and Schedule Coordination		•	●		●	●	●	●	●	●	●	●		●
• Transit Priority		•	●		●	●	●	●	●	●	●	●		●
• Traveller Information Systems	•	•	●	•	●	•	●	•	●	●	•	•		•
TRAFFIC MANAGEMENT PRACTICES														
• Advanced Traffic Management Systems	●	•	●		•		●	●	●	●	●	•		•
• Driver Information Systems	•	•	●	•	●		●	•	●	•	●			
• Traffic Calming		•	●	•							●	●		
CLEANER VEHICLE TECHNOLOGY DEVELT														
• Low-emission Vehicles			●		●		●	●				•		•
• Energy-Efficient Vehicles			●		●		●	●						•
• Emissions Monitoring/Testing Programs					●		●				•			
PUBLIC OUTREACH AND AWARENESS PROGRAMS	●	●	●	●	●	●	●	●	●	●	●	●	●	●

LEGEND:

Anticipated Impact of Initiative in Helping to Achieve Sustainable Urban Travel:

- ● Large Impact
- ● Moderate Impact
- • Modest Impact
- Negligible Impact

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cleaner vehicle technology development
low-emission vehicles
energy-efficient vehicles
emissions monitoring/testing programs

- **public outreach and awareness programs**

This is not intended to be a complete list of initiatives which can be taken to achieve more sustainable urban travel but it is representative of the various categories of initiatives with typical examples in each category

Exhibit 7 also summarizes various measures of more sustainable urban travel (in the column headings) as follows:

- **vehicular travel effort**
  shorter trips
  more walking
  more transit
  more cycling

  conservation of resources
  less use of fossil fuels
  less consumption of farmland and open greenspace for urban development

  environmental quality
  reduced air emissions
  reduced contamination of water runoff and improved recharge characteristics

  economic efficiency
  less traffic congestion
  lower per unit transportation costs

  quality of life
  greater safety (both transportation related and on street security)
  more successful people places

  lifestyle choices
  greater choice of housing types
  greater choice of travel modes

While there are undoubtedly other ways of measuring the sustainability of urban travel the above categories capture significant aspects of the concept The addition of economic efficiency quality of life and

lifestyle choices also brings in aspects of sustainability relating to the quality of human habitat and lifestyles available in urban areas as it relates to urban travel

The entries in the various cells of the matrix shown in Exhibit 7 provide an indication of the anticipated impact of each initiative in helping to achieve more sustainable urban travel defined in terms of each of the 14 measures shown in the column headings A large circle indicates that the initiative is expected to have a large impact on that particular measure of sustainability; a medium-sized circle indicates a moderate impact; a small circle indicates a modest impact; and a blank indicates a negligible impact. Once again it should be pointed out that the levels of impact illustrated in this exhibit are based on the judgement and experience of the authors of this report and are meant to be indicative rather than prescriptive at this time They are presented to stimulate thinking and discussion in this area and also to provide a context for the examples of actual Canadian initiatives given in the remainder of this paper

If for the purposes of discussion the sizes of impact shown in Exhibit 6 are accepted as representative of reality a number of initiatives emerge as being particularly potent ways of helping to achieve more sustainable urban travel These would be as follows:

- pricing for road use;

  more compact mixed land use;

  transit priority/HOV lanes;

  rapid transit and commuter rail networks;

  transit fare integration and schedule coordination;

  pedestrian and bicycle ways
- integrated development and intermodal transfer nodes;

  pedestrian friendly streets;

  steps to increase telecommuting

No doubt other students of urban transportation and planning issues would develop different priorities It is hoped however that the ideas presented in Exhibit 7 will stimulate others to develop this typology further and in the meantime will provide a context for discussing initiatives which are actually taking place in Canadian urban centres at this time Examples of these are presented in the next chapter

5 RECENT INITIATIVES IN SUSTAINABLE URBAN TRANSPORTATION

This section provides a brief overview of current efforts to improve the environmental characteristics of urban transportation in Canada Initiatives in each of Canada s seven largest cities are described as are some representative initiatives from smaller cities and related initiatives by senior levels of government and by private sector and citizen organizations

The initiatives are grouped according to the list of possible initiatives in Chapter 4 Also described are recent planning and policy documents which while not representing individual initiatives as such set the context for future action

5 1 PLANNING AND POLICY DOCUMENTS

Some Canadian cities are beginning to embrace the concepts of sustainable development and sustainable development principles are beginning to find their way into high level policy instruments such as Official Plans As well there have been a number of strategic studies in sustainable urban transportation from all levels of government in many areas of the country

The City of Ottawa s new Official Plan has sustainable development as its central theme Work is currently underway to develop an action plan and a set of measurable indicators to track progress in achieving the somewhat general goals of the Official Plan In a similar vein the Regional Municipality of Ottawa Carleton is undertaking a review of its Official Plan from an ecosystem perspective to spot policy areas (e g transportation) which may be inadvertently working against the principles of sustainable development

The Greater Vancouver Regional District has addressed some urban sustainability issues since the 1970 s; its Livable Region program included many land use/transportation policies for improving the Region s economic cultural and environmental viability including an effort to preserve and increase resident population in Vancouver's central area Although that program is generally regarded as having achieved only limited success with many of its benefits being outweighed by the volume of predominantly suburban development which the Region has experienced over the past two decades it did set the foundation for future work

The City of Vancouver has recently adopted a Clouds of Change report which sets out strategies to among other things reduce the need for transportation in the city and region through land use planning The report incorporates the following recommendations of the Federation of Canadian Municipalities:

- Encourage greater density through multiple unit residential developments;
- Integrate work, residence and shopping in mixed use development;
- Encourage residential clustering;
- Zone higher density development along established routes;
- Decentralize commercial and community services to reduce travel distances creating self contained communities with a better balance between employment and population;
- Place controls on outlying shopping centres strip development and urban sprawl;
- Encourage the infilling (development and redevelopment) of existing vacant and under utilized land in built up areas;

  Ensure that major public facilities have provision for walking and bicycling access to transit;

  Encourage the development of high quality walking and bicycling facilities including development of design guidelines and facilities to support transportation alternatives to private automobile use and ways of reducing the need to travel such as provision of on site lunchrooms daycare facilities automated bank teller machines and other facilities

The "Clouds of Change principles have been embodied in Transport 2021 Vancouver s current exercise of developing a Long Range Transportation Plan for the region Early discussion papers include as a central theme the use of three policy levers in addition to the traditional lever of providing transportation infrastructure: increased land use controls using service levels and congestion to affect demand and employing a broad range of demand management techniques telecommuting mandatory employer based trip reductions extensive bus/HOV priority facilities and increased parking and bridge tolls

In the City of Toronto a Technical Working Group on Traffic Calming

and Vehicle Emission Reduction has drafted a strategy to reduce some of the harmful effects of automobile use including some 74 measures aimed at reducing automobile use by 20% by 2005 including aggressive transit vehicle priority measures such as establishing clearways (bus and high occupancy vehicle (HOV) priority lanes) restricting turns and on street parking increasing parking fines promoting bicycle and pedestrian travel by providing more amenities and infrastructure and encouraging senior and adjacent governments to integrate/coordinate transit fares and service

The Montreal City Council has adopted an "Environmental Statement of Principle committing itself to the principles of sustainable development and efforts are being made to better co-ordinate land use and transportation planning

Provincial governments and Provincial Sustainability Round Tables have also produced strategic studies on sustainable urban travel largely focussing on what is required to meet or exceed Canada s commitment to stabilize carbon dioxide emissions at 1990 levels by the year 2000 [9] The Ontario Ministries of Energy Transportation and the Environment have studied the potential of a number of measures to reduce transportation energy usage and are currently working toward a CO_2 reduction strategy A task force on transportation within the Ontario Round Table on Environment and Economy has produced a report calling for a balanced strategy of full-cost pricing regulation market forces education and strategic land/use transportation planning to improve vehicle performance encourage the use of alternative and reformulated fuels reduce waste from the manufacture and use of vehicles provide appropriate information and incentives to consumers manufacturers and regulators and help achieve regional and social equity in the transition to more sustainable urban transportation

5 2 URBAN STRUCTURE AND URBAN DESIGN POLICIES

There has been renewed interest in some Canadian cities in harnessing transportation/land use interactions and the ability of compact mixed land use patterns pedestrian friendly streets integrated transportation/land use planning and controls on parking supply to contribute to an urban area s sustainability

There is general agreement as to what kind of urban form provides the maximum potential for sustainability Pedestrian and transit supportive cities are characterized by:

a compact form with average densities of at least 4 000 persons per square kilometre;

concentration of development in mixed use nodes and corridors (placing shops and services

near all residential areas and creating focal points for public transit routes);

- orientation of buildings close to and facing the street, with parking minimized and/or placed away from the area between the building and the street;

- a road pattern providing 600-800 meter spacing between arterial and/or collector roads and maximum walking distances of about 400 meters from interior sites to main roads;

wide sidewalks and other pedestrian amenities

These principles have been reflected in a number of design documents The Province of Ontario has recently released a document titled "Transit Supportive Land Use Planning Guidelines to help those responsible for urban development make it more transit supportive The Canadian Urban Transit Association the Transportation Association of Canada and individual transit operators (Winnipeg Edmonton Calgary) have also published similar guidelines

Section 3 3 above describes the three distinct urban forms prevalent in Canadian cities In designing policy initiatives to make urban form more pedestrian and transit-oriented these three situations present distinctly different challenges and have prompted a range of initiatives

In older core areas the challenge is to protect the existing character of the urban form retain downtown employment and retain or increase downtown population and enhance the pedestrian environment

Almost all of the major Canadian cities are attempting to do this to some extent The City of Toronto has protected downtown neighbourhoods successfully encouraged development of more housing in the core area carried out urban design projects to beautify the streetscape and has created many pedestrian transit linkages and underground walkways

Montreal has preserved the vitality of its streets and also constructed an extensive network of pleasant underground walkways Ottawa has discouraged downtown commuter parking given priority to transit and undertaken beautification projects

In the older suburbs policies are needed to increase densities create mixed use nodes and corridors and improve pedestrian access and the pedestrian environment

The Metropolitan Toronto official plan has long encouraged the growth of suburban town centres The new Official Plan will set out planning strategies for the reurbanization of Metro Toronto encouraging intensification and the redevelopment of selected arterial roads into main streets It will also foster urban design which maximizes safety accessibility and a liveable pedestrian environment

In peripheral growth areas the priority is to curtail further urban sprawl and create more balanced and diversified communities Restriction is needed on greenfield development and, where that is impossible requirements that new development be planned according to transit supportive principles Growth needs to be re-directed to already urbanized areas in order to improve the urban form and densities in the same manner as in the older suburbs

The Province of Ontario has created the Office of the Greater Toronto Area (OGTA) to address the problems of urban sprawl and encourage coordinated planning and delivery of urban development and infrastructure by the five regional governments A nodal urban structure concept has generally been accepted as the common goal This emphasizes compact mixed use redevelopment/development based on greatly expanded transit services but also allows for additional greenfield development and growth in auto use

The Province of Ontario has also recently issued new "Growth and Settlement Policy Guidelines which say that peripheral development should be restricted until internal sites are fully developed These new Policy Guidelines as well as the "Transit Supportive Land use Planning Guidelines represent excellent policy initiatives

While most high level strategic transportation planning and land use planning studies in Canada recognize the strong interactions between land use/urban design and transportation the mind set in many instances until recently has been to assume a continuation of auto dependent development and infrastructure; the delivery of new suburban subdivisions and the incremental expansion of road infrastructure often includes little or no consideration of transit opportunities and requirements However there are some examples of joint actions in delivering urban development and related transit services in a more integrated manner For example in Edmonton an innovative cost sharing agreement between Edmonton Transit and a major developer resulted in the introduction of transit services to a new subdivision two years in advance of when it would normally have been introduced

In Toronto a major mixed use development proposal adjacent to land which had been set aside for an eventual extension of a rapid transit

line provided an opportunity for integration A working committee consisting of planners the Toronto Transit Commission and the studydevelopers determined an alternative RT alignment within the proposed development, and arrived at an agreement whereby the developer provided significant transit facilities in exchange for part of the previously set aside land, an arrangement of benefit to all stakeholders Also in Toronto a recent study by the Provincial government into the location of new commuter rail stations within the metropolitan area placed as much emphasis on a site s suitability for future mixed use development and potential to serve as a multi modal transfer point as it did on physical, operational and environmental suitability

While many cities do not currently place a cap on proposed parking within a new development, some cities (e g Ottawa Toronto) have realized the detrimental effect of abundant downtown parking on excess automobile use and include maximum as well as minimum parking limits in their development approvals processes The City of Toronto introduced a central area parking and loading policy and related by laws in the 1970 s which established maximum as well as minimum parking standards for various types of buildings and uses defined essential and non-essential auto users in the central area and established pricing structures which favoured short term parking relating to retail and service uses rather than commuters using valuable parking spaces for all-day parking The City of Toronto also requires a developer wishing to build a project requiring more than 75 parking spaces to submit a traffic demand management plan to reduce the expected number of automobile trips generated by the development

5 3 TRANSPORTATION INFRASTRUCTURE MODIFICATIONS

The term transportation infrastructure in this paper refers to the permanent physical facilities required for the movement of people and vehicles Included are streets rights-of way rapid transit lines pedestrian and bicycle ways signal lights and cross-walks parking spaces reserved lanes rail lines power supplies maintenance yards stations and bus shelters Many transportation infrastructure initiatives are currently underway in Canada which reflect the intention to achieve more sustainable urban travel

As discussed in Section 2 other government priorities and fiscal restraint have effectively curtailed the expansion of rapid transit infrastructure in Canadian cities in recent years However virtually all of the seven major cities have stated their intention to expand and/or improve their rapid transit networks In contrast there are relatively few plans to significantly expand the urban freeway network.

The Société de Transport de la Communanté Urbaine de Montréal (STCUM) has no immediate plans to expand its rapid transit service

Instead as part of its "Transit Revival program to reverse the trend in declining ridership it is embarking on an aggressive program of local transit service improvements This includes extending services to industrial areas which previously had little or no service It also includes reorienting local services which were previously focussed on feeding peak hour work trips into the central area onto local activity centres (malls libraries hospitals) for all-day non-work trips (which account for 65% of transit trips in the MUC) Although this is counter to conventional transit planning wisdom initial ridership improvements appear promising (a pilot project reported an initial ridership gain of 22%) The STCUM is also improving its peak hour downtown service using reserved lanes express buses and improved commuter rail

The Let s Move rapid transit expansion program in Toronto recently announced as noted earlier will add about 20 km to the area s rapid transit network at an estimated cost of $2 5 billion over the next ten years

Transit priority/high occupancy vehicle (HOV) facilities are rare in Canada No urban freeway contains them and their presence on urban roads is confined to limited discontinuous locations in a few cities (although dedicated bus lanes are a little more common) However interest in their use is growing A recently completed strategy would see some 600 kilometres of HOV lanes forming a true network within Metropolitan Toronto High-occupancy vehicle lanes are planned as part of the current expansion of the main east west commuter corridor in Vancouver

The Transport 2021 plan of the Greater Vancouver of Regional District while still in its early stages includes consideration of many innovative infrastructure proposals including bicycle routes rapid/local transit and HOV facilities

Walking and bicycling are increasingly being recognized as legitimate and significant modes of urban transportation in Canada Ottawa which is noted for its extensive bicycle path network and relatively high bicycle usage recently established a test program to provide a pool of bicycles for the use of regional government employees An environmental group in Winnipeg established a similar program although it met with some success it was discontinued due to a lack of operating funds to maintain the fleet

In Vancouver $500 000 has been allocated to develop a network of bike routes in the city Toronto is planning to expand its bicycle path network, which is physically separate from the road network and was originally established for recreational purposes in order to align it with the road network and provide routes for commuter cyclists The

Ontario government has adopted a new provincial bicycle policy requiring municipal governments to consider bicycles in their planning process and offering funding for capital projects A number of cities have hired bicycle planners and are developing Comprehensive Bicycle Plans

Edmonton is noted for its downtown Pedway which connects LRT stations with virtually all major buildings in the central area via above street, street level and below street enclosed walkways and benefits from clear standardized signing

In addition to specific infrastructure projects the transportation planning process itself has undergone a transformation in Canada The federal government, and most provinces have enacted Environmental Impact Assessment (EIA) legislation to formally introduce environmental concerns into the planning and design of transportation infrastructure projects While EIA processes vary across the country and application is sometimes inconsistent the best of the Canadian processes are noted for their broad definition of the environment and their consideration of environmental values alongside rather than after traditional project criteria

Ecosystem based planning a logical extension of EIA principles has also been employed recently in urban transportation planning The ecological planning approach articulated by the Royal Commission on the Future of the Toronto Waterfront has aided it in assessing the benefits and costs of replacing part of a major elevated freeway in Toronto s central waterfront area with a combination of urban streets plus greatly improved commuter rail and transit services and related land use/urban design changes including more downtown housing to help moderate the growth in long commuting trips from suburban areas many of which are still by auto

5 4 DEMAND MANAGEMENT PRACTICES

All initiatives in this chapter can impact transportation demand and may all be referred to as demand management practices However in this paper the term is reserved for practices which provide direct incentives to a traveller to travel in off peak times to less congested destinations where possible to use an alternative mode to make shorter trips to combine trip purposes and share vehicle use with others and in general to use existing transportation infrastructure and vehicles more efficiently Demand management practices include parking price management alternative work schedules ride sharing telecommuting and direct congestion pricing for the use of urban roads

Canadian cities have some experience with all of the above methods Although interest in some of these practices waned in the mid 1980 s with the stabilization of oil prices interest has revived in recent years

due to environmental energy financial and related social and economic concerns

Metropolitan Toronto is currently developing a ride sharing strategy to complement the proposed HOV network discussed above A number of major employers in urban areas implemented demand management techniques such as ride-sharing matching services flexible working hours preferred parking for ride-sharing vehicles and subsidized transit passes in the early 1980's and some of these continue to this day In recent years some employers have moved computer related activities formerly often in downtown head office locations to shoulder and suburban locations where congestion levels and land costs are lower and have encouraged employees and contract workers to carry out such functions at home effectively replacing daily commuting trips with telecommuting by means of remote computer/computer linkages and facsimile transmission over telephone lines

Taxation schemes on transportation related items such as parking and vehicles have also been used to some extent Commercial buildings larger than 200 000 ft^2 and non residential parking facilities in areas of concentrated development in and around Toronto are subject to a special provincial tax called the commercial concentration tax. The British Columbia Government is considering implementing a similar tax throughout the Greater Vancouver Regional District primarily to raise operating funds for its transit system but also to curb automobile use and stimulate transit ridership The Ontario Government has implemented an additional sales tax on the purchase of new passenger automobiles ranging from $600 to $3 500 depending on the extent to which a vehicle exceeds a fuel consumption threshold of 9 5 litres per 100 km

Toll roads were once fairly common in Canada particularly in the Provinces of Ontario and Quebec They largely disappeared during the road building period of the 1950 s and 1960 s when transportation infrastructure funding was not a major issue and today toll facilities are confined to some interprovincial and intercity road links and international bridge crossings However recent fiscal pressures have caused governments to examine the issue once again In the Provinces of British Columbia Alberta and Ontario formal road pricing studies are underway Although the primary impetus for these studies is to raise capital funds for infrastructure improvements the potential for using congestion pricing as a demand management tool is also being addressed as is the possibility of doing so with minimum impact on traffic streams by using electronic toll collection

5.5 TRANSIT MANAGEMENT PRACTICES

Many Canadian urban transit operators are looking to improve the efficiency reliability and overall attractiveness of their services in order to stem and possibly reverse the trend toward declining ridership

The Toronto Transit Commission is looking at a number of techniques to improve the on time performance of its surface transit operations particularly its streetcars which are more prone to congestion delays than its more manoeuvrable buses A vehicle actuated signal priority system was successfully field tested, and plans to limit or ban outright the presence of vehicles on critical streetcar route sections have been discussed for some time A limited version of this plan in the form of an urban clearway" consisting of a lane dedicated to transit taxis and bicyclists has been successfully implemented

Across the Greater Toronto Area the limited coordination of individual transit services and the virtual lack of fare integration is a detriment to transit mobility Currently the commuter rail system enjoys a limited form of fare integration with the Metro Toronto transit system and one or two municipal transit systems; studies to integrate the two systems more fully and to coordinate fare and services between the Metropolitan system and local systems are continuing

Another aspect of STCUM s transit revival in Montreal is a significant effort to improve the schedule reliability and punctuality of the system Major investments will also be made to ensure the availability/reliability of transit vehicles

Winnipeg Transit has operated a highly successful computerized telephone transit schedule information system since 1986 which is credited with helping to maintain and encourage transit ridership by providing accurate reliable information Similar systems exist or are being tested in several other municipal systems including Ottawa Toronto and Halifax; in the latter two cities enhanced systems which track the movement of individual vehicles in order to provide patrons with real time schedule information are being implemented

5 6 TRAFFIC MANAGEMENT PRACTICES

A number of Canadian cities have implemented innovative practices designed to make better use of existing roads and to reduce traffic infiltration into residential neighbourhoods

The Greater Toronto Area currently features two freeway traffic management systems operated by the Province with a third municipally-operated system soon to be added The systems consist of traffic sensors and video cameras which feed traffic data to operators and computers in control centres The control centre identifies accidents and related events dispatches response personnel to clear the problem and uses driver information systems such as variable message

signs and media interfaces to alert drivers of problems A similar system operates in a critical tunnel link in Vancouver while Montreal is currently planning such a system for its major urban freeways

As discussed in Section 3 Canada s cities are characterized by compact cores with a disproportionately large number of jobs and a sizeable resident population, surrounded by lower density shells of predominately residential development. This situation often leads to the problem of traffic infiltration as suburban commuters travel through older suburbs and inner-city residential areas in travelling to work by auto creating tension between inner and outer area residents and between inner area residents and transportation engineers Two Canadian cities have implemented innovative arrangements to help resolve such tension The City of Calgary employs a transportation committee formed from citizen groups in each inner and outer area community in a consensus building approach to striking a balance between inner area quality of life and outer area mobility needs The City of Toronto has effectively turned the tables in addressing the problem; they encourage neighbourhood groups to develop their own traffic management studies with the City providing technical expertise to support the resident led studies One result has been a host of traffic calming measures including street narrowing speed bumps stop signs and time-dependent no-entry regulations to protect inner city neighbourhoods from high volumes of through commuter traffic

5 7 CLEANER VEHICLE TECHNOLOGY DEVELOPMENT

Canada is blessed with significant reserves of natural gas and it is not surprising that the use of alternative transportation fuels (ATF's) has been a feature of Canadian transportation As occurred with demand management practices interest and research/development effort in the ATF field waxed and waned with the energy crises of the 1970 s and 1980 s; the early 1980 s saw an aggressive push by provincial and federal governments in the field resulting in record conversions of government utility and commercial fleets to propane and natural gas Since then vehicle attrition and declining conversion rates have reduced the Canadian ATF fleet to the point where ATF's (electric natural gas and propane vehicles) account for less than 3% of the on road transportation fuel consumed in Canada [10]

However there has been a resurgence in ATF interest as a result of potential environmental benefits In the field of urban transportation the City of Toronto is establishing an Alternative Fuel Vehicle Acquisition program to give priority to ATF vehicle purchases and to serve as role model for other fleets in the area There are also a number of field tests underway evaluating the operational feasibility of ATF transit buses including a methanol bus in Windsor and natural gas buses in Hamilton and Toronto and (in the prototype stage) a hydrogen fuel-cell bus in Vancouver The latter project represents the

first such bus in the world, and is the result of a cooperative effort of the Federal Government, the Provincial Government of British Columbia, and a private firm (Ballard Power Systems)

Private-sector associations representing ATF suppliers also have in place marketing and research/development programs aimed at increasing the market share of ATF vehicles largely based on their environmental benefits Private sector research firms partially funded by provincial and federal government grants have developed technological innovations such as the world s first electronic fuel injection system for ATF vehicles and a home refuelling unit for natural gas vehicles and are currently in the process of marketing them

There is also some work underway in improving the environmental performance of conventional petroleum powered vehicles The City of Calgary has instituted Canada's first large scale voluntary emissions testing program for all vehicles while a coalition of authorities in the Vancouver Region has implemented Canada s first and North America s most comprehensive mandatory inspection program And the NOX/VOC Management Plan of the Federal Government includes a number of transportation initiatives such as NOX/VOC motor vehicle emissions standards, improved urban transportation management reduced heavy-duty vehicle speeds in the summer and a proposed national motor vehicle inspection and maintenance program

5 8 PUBLIC OUTREACH AND AWARENESS PROGRAMS

A number of government and non government organizations have recently been undertaking public awareness programs to stress the environmental benefits of non automobile transportation modes The Canadian Urban Transit Association s Modal Shift project includes a substantial outreach program to reverse the trend toward declining transit ridership as does Montreal s transit revival program Winnipeg Transit recently undertook a green bus campaign wherein ten buses were painted green and white as part of a major publicity effort in newspapers transit shelters bus boards and television advertisements stressing the environmental benefits of public transit

The new Driver Education Handbook published by the Ontario Government will include information about the environmental impact of the automobile suggestions for making better use of the automobile and encouragement to use alternative forms of transportation

A number of environmental organizations such as Greenpeace Pollution Probe Friends of the Earth Environmentalists Plan Transportation and the Eco City Society have recognized transportation as a major environmental issue and have issued reports describing the environmental social and economic impacts of the automobile Greenpeace has a national transportation campaign which

supports local initiatives to reduce car dependence and car use They have also produced a bumper sticker listing the contents of auto emissions

A number of cycling and walking groups which previously stressed the recreational and health benefits of these activities now promote them also as important and legitimate modes of transportation In Ottawa, a particularly interesting example is an organization called Ottawalk While it organizes week-end recreational walks in the city it also promotes walking as a part of the daily work trip

6 AN ASSESSMENT OF CANADIAN INITIATIVES

Chapter 4 above presents a strategic assessment of possible initiatives in sustainable urban transportation while Chapter 5 describes current Canadian initiatives This chapter brings the two together commenting on a number of Canadian initiatives in the broader strategic context

6 1 PLANNING AND POLICY DOCUMENTS

The recent Canadian policy initiatives in sustainable urban transportation described in Section 6 1 include a number of sweeping fundamental proposals to reorient our cities away from automobile dependence To date the actions and results from such proposals have been very modest relative to the substantial challenge of achieving sustainable urban travel as defined and discussed in Chapter 3 Nevertheless they represent at least a partial recognition of the problem and set the context for further action

There is one policy level issue which has received relatively little attention Since transportation is such a pervasive factor in Canadian society there are a number of existing policies some within the transportation sphere but many outside it which affect urban transportation sustainability

At the institutional level there is a need for re-examination of policies procedures and regulations in order to remove biases in favour of the automobile and make room for innovation With regard to taxation for example federal law allows companies to provide parking for employees as a tax free benefit Free or subsidized transit passes however are taxable benefits

Transit service standards and funding ratios while providing fair and impartial criteria for all routes and operating agencies can sometimes impede policy and program innovation in special situations When applied to the feasibility of a new route or service such standards are usually predicated on expected ridership levels which in turn are based on past experience An innovative route/service proposal may be underrated in such a framework.

Modern engineering standards for roadways and intersections are designed to ensure the efficiency of traffic flow and provide for the safety of drivers and pedestrians However this is often done at the expense of pedestrian and cyclist needs Under current standards it can be impossible in some areas to build new communities in the traditional pre-war style However awareness of this problem is growing among Canadian urban planners transportation engineers and political leaders The Royal Commission on the Future of the Toronto Waterfront has employed the ecological planning approach to investigate the notions of the social and environmental capacity of

urban streets as well as their capacity to carry vehicular traffic and modified street layouts and standards are being proposed as a result

Similarly traffic signal warrant systems define thresholds for the circumstances under which governments will fund the installation of traffic signals The criteria applied to a given section of road relate to traffic volume and pedestrian crossings over different periods of the day However such counts do not take into consideration that current pedestrian use may under represent the need for and potential use of a protected crossing at that location; because of high traffic volumes in the existing situation pedestrians may be avoiding that site and using less convenient alternatives

As part of a sustainable urban transportation strategy all such policies and standards should be reviewed To a large extent this has not yet occurred in Canada but new "visions of urban transportation and development goals are emerging An important example is the Vision Statement recently issued by the Urban Transportation Council of the Transportation Association of Canada which provides a comprehensive statement of goals in moving toward more sustainable urban transportation in cities across the country

6 2 URBAN STRUCTURE AND URBAN DESIGN POLICIES

Canadian cities have managed to retain their sustainable transit and pedestrian friendly cores and most cities have plans to strengthen them further The quality of life in all the core areas however is under threat from automotive commuter traffic which brings noise pollution congestion and pressures for more parking road widening and traffic facilitation measures Many central areas are still losing population although as noted some have reversed this trend including Toronto and Vancouver

Outside the central areas while guidelines for transit and pedestrian supportive design exist they are generally not enshrined in policy regulation or practice [11] Transit planners and operating agencies lack formal power in the development approval process Since the 1950 s there has generally been poor coordination between land use and transportation planning/delivery at the local level with public transit being provided after the fact and being required to adapt to difficult and inefficient situations

While initiatives have been begun in curtailing sprawl the momentum of piecemeal urban sprawl continues around all major Canadian cities The status-quo is perpetuated by market forces and government policies and programs which directly or indirectly promote development on cheaper land at the rural/urban fringe NIMBY" (Not In My Back Yard) resistance and the general lack of understanding by local politicians civil servants and general public about the need for change

and required actions to achieve it. Given the political will however municipal and provincial governments possess very substantial powers to bring about change through the development planning and approval processes and the funding of infrastructure

6.3 TRANSPORTATION INFRASTRUCTURE MODIFICATIONS

A city's transportation infrastructure is an integral part of its urban form which in turn provides the basis (nodes corridors density orientation of buildings) for the successful functioning of the transportation system A crucial issue for sustainability is whether the automobile is assumed to be the main form of transportation or whether at least equal provision is made for walking bicycling and public transit And, in designing for public transit provision must be made for the evolution and upgrading of the system as population and ridership grow There are three key issues which must be addressed in implementing infrastructure for a sustainable transportation system:

- roadway design;
- road layout;
- transit planning and delivery

Sustainable design practices for each of the above elements are discussed in Appendix A and summarized below

Roadway Design A sustainable road system gives priority to green modes such as walking bicycling and transit and to essential motor vehicle traffic (e g emergency vehicles goods movement) over discretionary automobile traffic

As discussed in Section 2 Canada s era of extensive urban road building is over and few expect a resurgence in urban expressway construction Nevertheless appreciable road system expansion continues today particularly on the fringes of all major cities With very few exceptions the roads being built are almost exclusively automobile oriented In Canada today very little thought is given to constructing multi modal roads or refitting older roads to cater equally to pedestrians cyclists or transit; the latter represents a significant opportunity since most arterial roads outside city centres have generous rights-of way and could be converted relatively easily

Road Layout. Current suburban development throughout Canada uses almost exclusively a hierarchical pattern of arterial collector and local streets Very few new road networks in such areas are based on a rectilinear grid except for major arterial roads which are generally widely spaced (e g 2 km) The absence of a finer grid of continuous collector roads means that only a small proportion of residents are within walking distance of bus services and/or that buses must negotiate lengthy and circuitous routes along collectors to serve their

patrons Also such a pattern tends to cause traffic congestion by concentrating all through traffic onto a relatively small number of arterial roads which in consequence are continually under pressure to be widened and rendered less pedestrian and transit friendly

Transit Planning and Delivery It is highly doubtful that any city can be considered sustainable without an excellent public transit network; a necessary element of any sustainable transportation strategy is the strengthening and improvement of transit infrastructure

By their nature such major transit improvement plans involve significant risk and uncertainty (regarding for example costs and predicted ridership levels) a great deal of financial support and in Canada cooperation among a great number of jurisdictions and public agencies

Given the many forces and uncertainties affecting the decision making process the choice of technologies alignments and implementation strategy becomes critical Moreover with the increasingly tight funding situation there is not the leeway for mistakes that existed several decades earlier and community resources must be used to maximum advantage However potential for significant reduction in the use of private automobiles ultimately depends upon reducing the level of auto dependence inherent in the transportation system; strong transit service is a vital element in such a plan

6 4 DEMAND MANAGEMENT PRACTICES

Canadian cities have enjoyed some success in niche travel market segments with direct demand management practices such as ridesharing alternative work schedules and limited forms of telecommuting Currently these methods are enjoying a resurgence of attention However there are two factors which may limit both the success and potential usefulness of these practices in terms of sustainable urban transportation

First most of these practices involve a trade-off between a loss of convenience and flexibility either in the trip to work or the work day itself and a gain in travel benefits For example ridesharing offers the benefits of reduced transportation costs and potentially travel time at the expense of a drop in trip making flexibility and convenience Given persistently low petroleum prices and the fact that a ridersharing program does not usually reduce the need for personal vehicles for other trips the cost savings are marginal in relation to the loss in convenience And without extensive HOV facilities travel time savings are also marginal Therefore the trade-offs associated with ridesharing are currently not attractive to many people

Alternative work schedules offer the opportunity to save travel time by

using the system during off peak hours at the expense of some scheduling conflicts in the workplace However given that travel time in even the largest Canadian cities is significantly below levels that human beings are willing to tolerate as shown by experience in other industrial nations this trade-off is one that only a small segment of the population is currently willing to make

The same is true for telecommuting In Canadian cities today the benefits of telecommuting in terms of reduced commuting time and cost do not outweigh the disbenefits in terms of reduced ability to interact face to face in a workplace and real or perceived loss of supervisory control by employers

The key flaw in these direct demand management methods is that they require incentive and that incentive is missing in Canadian cities Canadians value the environment their pocket book and their urban amenities but not highly enough to make the benefits of these practices outweigh the disbenefits in terms of less convenience and flexibility longer travel times etc Unless the sensitivity of Canadians to congestion and pollution increases the automobile mode becomes significantly more inconvenient in terms increased costs or congestion or the palatability of alternative practices improves such practices will continue to have only a marginal effect in terms of sustainability

A second and perhaps more fundamental factor limiting the effectiveness of these practices is their highly focussed target markets The methods are largely aimed at peak period work trips an admittedly important component of urban travel but not the only one. While commuting to work is the biggest single reason for urban trip making it typically accounts for approximately 25 35% of trips in the urban area These methods do not address the other 65% to 75% of trips (although the communications technologies involved in telecommuting have great potential to do so) Further the methods are often applicable to only a segment of peak period work trips for example workers with the schedule flexibility which allows alternative work hours or workers with an infrequent need to interface with clients or peers which allows telecommuting

Road Pricing Apart from the direct demand management practices discussed above there is an indirect method: congestion pricing for users of urban roads Some would argue that congestion pricing is an essential feature of any sustainable transportation strategy; an urban area may be designed according to the land use and transportation principles discussed previously so that employment shopping residences and other amenities are located close together and connected by a good transit/pedestrian/cycle network However there is no guarantee that residents will choose to live work socialize and

shop in the same neighbourhood or to use more environmentally friendly modes Financial incentives or disincentives in the form of pricing for road use would help to ensure that such considerations are taken into account more strongly and that the road system is used more efficiently

Others point to the fact that congestion pricing may be the best way to internalize the external hidden or shared-costs of automobile use: e g environmental degradation increased health care costs and resource consumption These items are currently assigned no monetary value and are therefore given less consideration when an individual makes travel choices

Economists argue that congestion pricing harnesses the market mechanism which is the best way yet devised to make the most efficient use of a scarce resource Congestion pricing provides the needed incentive to make other demand management practices (e g ridesharing telecommuting trip pre planning/rationalizing peak spreading) work.

Finally in an era of fiscal restraint congestion pricing can provide a pool of much needed funding for transportation improvements

However opponents of congestion pricing schemes raise a number of philosophical socio-economic feasibility and practicability concerns First there is the concern that road pricing will not reduce congestion pollution and energy use but in fact will do the opposite Rather than reducing automobile usage it will simply displace such usage away from the toll area precipitating further urban sprawl and reducing the economic vitality of existing urban areas

Second since a user s income is not a factor in the toll level road pricing amounts to a regressive form of taxation with inequitable effects on low income groups

Third the fairness of placing an additional tax on transportation when governments already collect more transportation related revenue (e g from gasoline tax, vehicle and driver licences) than they expend on roads is questioned

Fourth there are concerns that the mechanism(s) used to collect the toll will exacerbate congestion and pollution Fifth there are privacy concerns related to the ability of some pricing mechanisms to track the movement of individuals Sixth there are concerns about potential misuse of the collected revenue

Seventh there are concerns about the fairness of charging motor

vehicle users only when other groups (e g pedestrians using sidewalks bicyclists utility companies) also use roads and many non motorists also benefit indirectly from roads (e g from the delivery of goods) Finally questions exist about the hardship placed on tourists and other occasional visitors to toll areas with underlining concerns about economic effects of driving such visitors away

Many of the above concerns reflect an ideological aversion to applying the pricing mechanism to transportation or from a misinterpretation of how such a mechanism would work in reality Others are implementation issues which can be dealt with as a result of the significant advances in Automatic Vehicle Identification/Electronic Toll and Traffic Management technology However all concerns are valid and must be addressed in any proposed congestion pricing strategy

As noted earlier a number of provincial governments in Canada are actively considering road pricing for possible application in and around major urban areas However road pricing is being considered by some primarily as a source of funding to accelerate planned road expansion rather than as a double-edged tool to help achieve sustainable development as well as providing accelerated funding Under the former mind-set road pricing may be a mixed blessing: it may lead to a more efficient use of road infrastructure by harnessing the market mechanism but may also be used only to provide funds for additional roadway capacity which in itself is increasingly viewed as a self defeating mechanism in terms of sustainability If it is introduced sustainability considerations suggest strongly that the funds generated should be used for public transit as well as or perhaps in place of road improvements

Notwithstanding this it may be desirable to introduce road pricing initially to fund road construction; it would acquaint (or in some cases reacquaint) the public with the concept and may receive support from groups who would otherwise be staunchly opposed to road pricing

6 5 TRANSIT MANAGEMENT PRACTICES

The term management in this context refers to planning organizing operating and financing the actual service provided including route patterns frequency of service scheduling transfers fares and funding and efficiency measures such as fare integration service co-ordination transit priority and rider information There are a range of policy issues and options inherent in the management of transit services and specific concerns with regard to sustainable development

The characteristics of transit services of Canadian cities in 1946 provide a useful framework for assessing current initiatives in terms of sustainability The route patterns of the time were comprehensive service frequent fares affordable ridership high and the companies

profit making Further it was possible for the average urban person to live without the use of a car

Today however urban transit operations in Canada are caught in a downward spiral of increasing costs rising fares declining ridership and service cut backs The problems and potential solutions differ in the older and newer areas of the city

In older core areas because most of the original transit supportive infrastructure is still intact in most Canadian cities current levels of service and ridership are still relatively high and there is excellent potential for improvement. The most significant changes since 1946 are declines in population density increases in auto use and traffic congestion and resulting declines in transit ridership service levels and profitability

However at current subsidy and fare levels it is generally still possible to provide frequent multi-directional service during both peak and off peak hours Except for people with special needs or occupations or out-of town destinations there is a low level of car dependence The challenge in the central areas is to reduce traffic congestion improve transit service where appropriate and encourage a modal shift in trips to the Central Area through a variety of measures

In older suburbs because of the low density car-oriented infrastructure of the suburbs service and ridership are lower than in central areas While peak hour service and ridership may be good on main routes to downtown off peak, cross town and suburb to suburb service and ridership are characteristically poor Thus a different strategy will be needed in the suburbs that will set in motion long term changes to the urban structure while in the immediate future making service improvements tailored to the suburban setting

In peripheral and regional growth areas because of the scattered low density car-oriented urban form transit service and ridership are very low If available local transit service tends to be designed to feed commuter rail lines rapid transit or highway express bus service into the central city; internal and suburb to suburb service is generally lacking or available only as paratransit making it extremely difficult or impossible to live without a car As a result it is not uncommon for families to own two or three cars

In Toronto there are plans for expansion of commuter rail service and in Montreal there is a proposal to create additional commuter rail lines In Vancouver the use of mini buses is being considered for low-density and geographically cut off areas

While long term strategies are needed for curbing urban sprawl and creating a more focused urban structure in the meantime it is difficult to improve the general level of transit service in these peripheral communities Some planners have questioned whether significant investment in transit is worthwhile in such areas when the same investment could bring proportionally much better results in other places However the number of auto trips associated with the current level of car dependence is causing increasing congestion on regional highways and inner city roads and perpetuating an expanding cycle of traffic congestion and road construction

Currently there is public pressure on one hand to continue expanding the road system and on the other for more stringent efforts at demand reduction And finally another factor being largely overlooked in the debate is the social impact of the lack of transportation alternatives for people living in these communities

In the context of the current downward spiral of transit service and ridership in Canadian cities there are a number of policy options: do nothing; reduce service/cut funding/raise fares; or increase transit funding to maintain and improve service and/or increase ridership

Doing nothing or reducing the "burden" of public transit on government spending will have a detrimental impact on sustainability A structural long term increase in ridership will come only with the land use changes discussed previously In the short term an increase in operating funds is required To obtain additional funding for transit operations from other than general revenue requires innovations such as a parking tax, a gasoline tax, road pricing or perhaps transferring funds from capital budgets (such as road building projects) to transit operating budgets The social and environmental imperatives for maintaining and improving transit service would seem to provide ample justification for using general revenues as well However these initiatives are generally not being pursued in Canada today and all transit systems face operating budgets which tend to be static or declining

6 6 TRAFFIC MANAGEMENT PRACTICES

In Canada s major cities there is good research and development activity into applying emerging technology to transportation problems in the form of Advanced Traffic Management Systems To the extent that these systems make better use of existing roadway infrastructure they are useful and should be encouraged However it must be recognized that if successful such innovations increase the effective vehicular carrying capacity of a roadway; unless accompanied by the complementary land use/transportation initiatives described above this may simply facilitate greater levels of automobile use

Regarding traffic management practices to reduce traffic infiltration into residential neighbourhoods Canadian cities have developed innovative consensual partnerships to deal with these issues However Canadian practices run far behind the concepts emerging in Europe The Canadian approach is largely a conventional one of traffic control methods such as one-way streets and turn restrictions while the woonerf European techniques have gone beyond this and essentially redefine the pedestrian automobile relationship on residential streets

6 7 CLEANER VEHICLE TECHNOLOGY DEVELOPMENT

Canadians have been in the forefront of alternative fuel innovations and research development and demonstration efforts are continuing However current ATF market penetration is almost negligible [10] As with the demand management practices assessed above the issue is largely one of incentive The cost of petroleum is not significantly higher than that of the alternatives and the environmental benefits of alternative fuels are not yet valued highly enough to prompt a major switch

While ATF vehicles can contribute to sustainability and should be pursued they should not be thought of as a panacea which allow us to retain our auto-dependent lifestyle The so-called clean alternative fuels are in fact only cleaner than conventional petroleum Although definitive on the road long term performance figures have not been collected for any fuels other than petroleum current knowledge suggests that ATF's including electricity only address certain emission problems Carbon monoxide and hydro carbons are usually lower with ATF's but nitrogen-oxides emissions may be the same or even higher The CO_2 performance of most alternative fossil based fuels is relatively comparable to that of petroleum (natural gas is an improvement) and the CO_2 performance of electric vehicles depends on the generation source Finally as pointed out previously even a zero emission vehicle does not address the aspects of sustainability tied to continued use of personal automobiles; e g consumption of farmland economic efficiency in terms of congestion and lower transportation cost and quality of life in terms of safety and people oriented use of urban land

6 8 PUBLIC OUTREACH AND AWARENESS PROGRAMS

The ability to implement demand reduction and traffic management programs as well as effect long term changes in land use and transportation planning practices depends upon public understanding of the need for and support of such measures To date however there has been little in the way of formal government public education programs about transportation Projects such as Environment Canada s Global Action Plan (GAP) and Ottawa s Transportation Environment Action Plan (TEAP) involve interested subgroups but do not necessarily reach the whole population

7 SUMMARY AND CONCLUSIONS

7 1 SYNTHESIS: CURRENT CANADIAN EXPERIENCE

Relative Importance of the Various Initiatives

In attempting to synthesize the Canadian experience and outlook regarding more sustainable urban transportation it is useful to refer back to Exhibit 7 Sustainable Urban Travel: Initiatives and Interactions As discussed in Chapter 4 that exhibit identifies some 25 major types of initiatives (summarized under seven major headings) and shows graphically the anticipated impact of each initiative in helping to achieve sustainable urban travel; the latter is described in terms of some 14 measures summarized under six major headings

Exhibit 8 presents a simplified version of Exhibit 7 For each of the six substantive types of initiatives (not including public outreach/awareness programs) the exhibit shows in symbolic terms the estimated existing and potential importance of that initiative in achieving each of the six sustainability yardsticks The symbolism used is the same as in the earlier exhibit: a large circle indicates that the initiative is anticipated to have a large impact in helping to achieve sustainable urban travel; a medium sized circle indicates a moderate impact; and a small circle indicates a modest impact These ratings reflect in summary form the more detailed ratings shown in Exhibit 7

As was the case for the earlier exhibit the relative important levels shown in Exhibit 8 represent the opinion of the authors of this report and it is recognized that other knowledgeable people might assign different importance levels in a number of instances The purpose of the exhibit is to simulate thought and discussion in this regard and also to provide a convenient summary of major categories of possible initiatives and desired results in moving towards more sustainable urban travel

If one accepts the results presented in Exhibits 7 and 8 as a reasonable premise the major conclusions which emerge may be summarized as follows:

- three of the six types of initiatives stand out as being particularly important because they have a large anticipated impact on at least four of the six sustainability yardsticks These three types of initiatives are:

  1 **Urban Structure/Urban Design Policies**

EXHIBIT 8

INITIATIVES TOWARDS SUSTAINABLE URBAN TRAVEL. SUMMARY OF ANTICIPATED IMPACTS

Major Initiatives \ Sustainability Yardsticks	REDUCED VEHICULAR TRAVEL EFFORT	GREATER CONSERVATION OF RESOURCES	IMPROVED ENVIRONMENTAL QUALITY	INCREASED ECONOMIC EFFICIENCY	ENHANCED QUALITY OF LIFE	BROADENED LIFESTYLE CHOICES
URBAN STRUCTURE/DESIGN POLICIES	●	●	●	●	●	●
TRANSPORTATION INFRASTRUCTURE	●	●	●	●	●	●
DEMAND MANAGEMENT PRACTICES	●	●	●	●	●	●
TRANSIT MANAGEMENT PRACTICES	●	●	●	●	●	●
TRAFFIC MANAGEMENT PRACTICES	●	●	●	●	●	●
CLEANER VEHICLE TECHNOLOGY DEVELT	●	●	●	●	●	●

LEGEND:

Anticipated Impact of Initiative in Helping to Achieve Sustainable Urban Travel:

- ● Large Impact
- ● Moderate Impact
- ● Modest Impact

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2 **Transportation Infrastructure Modifications**; and
3 **Demand Management Practices**

- regarding the other three types of initiatives we conclude the following:

4 **Transit Management Practices** are not rated as having a large impact in achieving any one of the sustainability yardsticks; however this represents an important set of initiatives since it is rated as having a moderate impact in achieving five of the six sustainability yardsticks;

5 **Traffic Management Practices** are seen as somewhat less significant rated as having a modest impact in achieving five of the six sustainability yardsticks; having said this however it is important to recognize that traffic management practices are an essential step in making the most efficient use of existing road infrastructure and the way in which Traffic Management Practices are implemented can have a significant impact on the success and cost-effectiveness of both Demand Management Practices and Transportation Infrastructure Improvements;

6 **Cleaner Vehicle Technology Development** emerges as a more specialized initiative with important impacts in achieving greater conservation of resources and improved environmental quality but with moderate or modest impacts in achieving the other sustainability yardsticks

Again it is recognized that other observers might differ somewhat in relatively importance ratings assigned and it is hoped that the opinions presented here will stimulate discussion and further development of these ideas

Current Status of Canadian Initiatives

In the meantime Exhibits 7 and 8 provide a context for assessing the Canadian experience in moving towards more sustainable urban travel First as noted earlier in the report (Chapters 3 and 4) Canadian cities share with most other cities in the world a heavy reliance on automotive travel modes and non renewable energy sources In that sense and recognizing the continuing trends for rapid increases in car ownership global atmospheric emissions from automobiles growing urban transportation energy consumption and other disruptive effects of urban transportation systems it is clear that Canadian cities are a long way from achieving sustainable urban travel as it is defined in Chapter 3

It is useful however in synthesizing the Canadian experience to

provide a broad summary of the status of current Canadian initiatives towards more sustainable urban travel This summary is presented in Exhibit 9 As broadly summarized in the exhibit the implementation status of the various initiatives is defined in terms of four stages as follows:

1 **talking:** the initiative has been the subject of initial studies and discussions possibly leading to broad policy statements at various government levels;

2. **planning:** specific planning activities are underway as a basis for action;

3 **acting:** physical actions (e g design/construction of infrastructure compact mixed use urban redevelopment pedestrian and transit friendly urban design changes demand management programs etc) are underway; and

4 **accomplishing:** at least some of the initiatives have been implemented and observable results obtained

As shown on the exhibit a solid black bar indicates that a significant proportion (e g three or more) of the seven major Canadian cities have achieved the indicated status while a grey bar indicates that a smaller number (e g one or two) of the major cities have achieved the more advanced implementation stage indicated

This very broad status report indicates that Canadian cities are at various stages in implementing the major types of initiatives towards more sustainable urban travel as follows:

At the Talking Stage

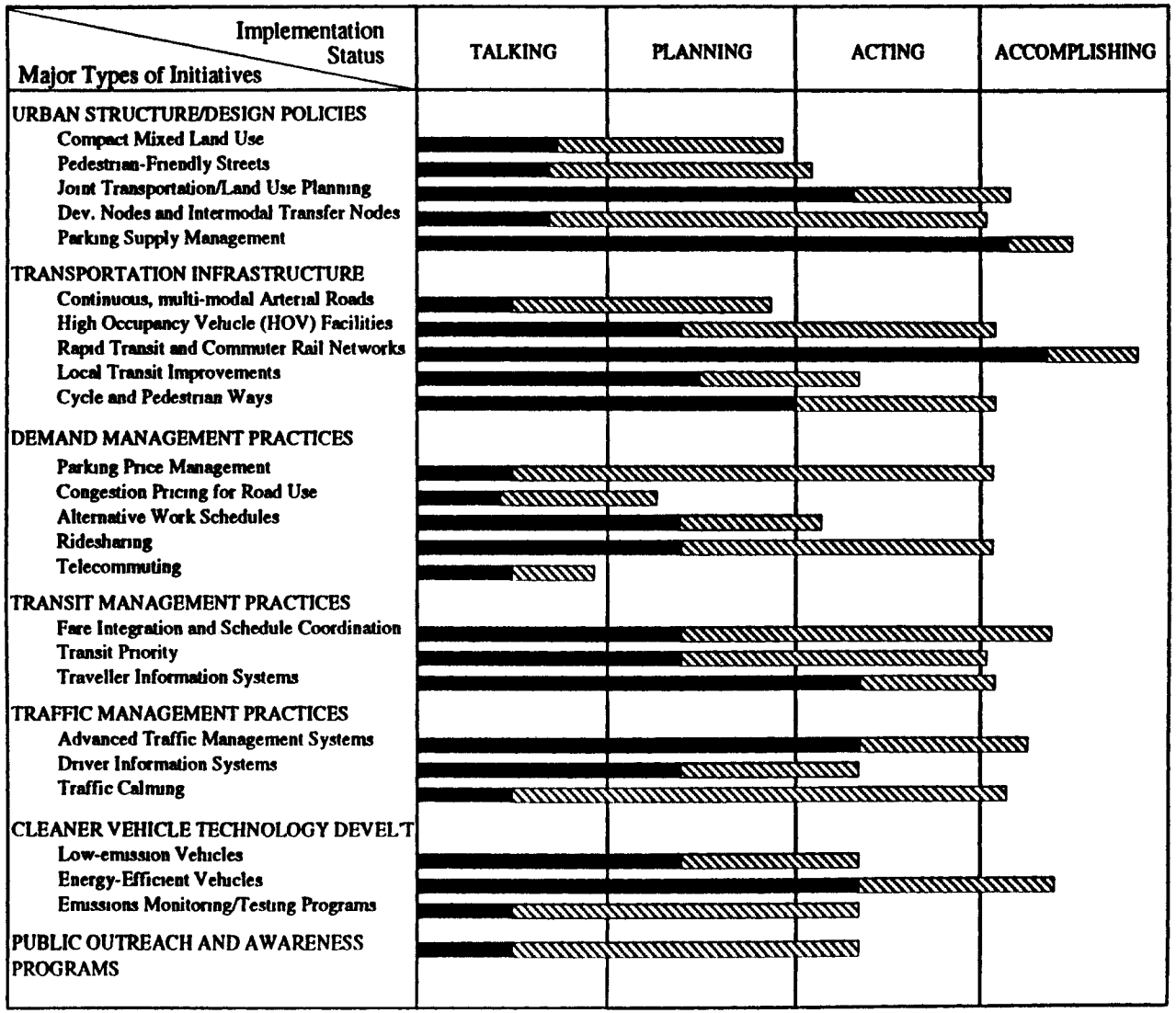
At least one of the seven major Canadian cities has moved beyond the talking stage for all of the 25 initiatives considered with the exception of **Telecommuting**; while there have been initiatives of this type in Canadian cities they have essentially been by the private sector and have not been the result of specific planning and implementation activities by governments

At the Planning Stage

Initiatives that are still in the planning stage include **Compact, Mixed Land Use, Continuous Multi modal Arterial Roads** (designed for bikes and pedestrians as well as transit and autos) and **Congestion Pricing for Road Use** A large number of additional initiatives are still in the planning stage for the majority of major cities in Canada as indicated by the solid black bars in Exhibit 9

EXHIBIT 9

BROAD STATUS OF CURRENT CANADIAN INITIATIVES TOWARD MORE SUSTAINABLE URBAN TRAVEL



LEGEND:

IBI GROUP

Status of Significant Proportion of Major Canadian Cities

Status of One or Two Cities with More Advanced Implementation

T09117/OB/10-20-93

At the Acting Stage

At least one or more of the seven major Canadian cities is/are taking specific actions in the field on quite a large number of the initiatives including the following:

- **Pedestrian friendly Streets;**
- **Joint Transportation/Land Use Planning and Delivery;**
- **Development Nodes and Intermodal Transfer Nodes;**
- **Parking Supply Management;**
- **Transit Priority/HOV Lanes and Facilities;**
- **Rapid Transit and Commuter Rail Networks;**
- **Local Transit Improvements;**
- **Cycle and Pedestrian Ways;**
  Parking Price Management;
  Alternative Work Schedules;
  Ride sharing;
  Fare Integration and Schedule Coordination;
- **Transit Priority;**
  Transit Traveller Information Systems;
  Advanced Traffic Management Systems;
  Driver Information Systems;
  Traffic Calming;
  Low-emission Vehicles;
  Energy-efficient Vehicles;
- **Emissions Monitoring/Testing Programs;**
  Public Outreach and Awareness Programs

Of the 21 initiatives listed above on which action is occurring about five are being acted on by three or more of the seven major cities and the remainder are receiving actions from one or two of the cities

At the Accomplishing Stage

A significantly smaller number of the initiatives have been under way long enough to produce observable results and these apply in all cases to one or two of the major cities Initiatives at this stage of implementation include the following:

- **Joint Transportation/Land Use Planning and Delivery;**
- **Development Nodes and Intermodal Transfer Nodes;**
  Parking Supply Management;
  High Occupancy Vehicle Lanes/Facilities;
  Rapid Transit and Commuter Rail Networks;
  Cycle and Pedestrian Ways;
- **Parking Price Management;**
  Ride sharing;
  Fare Integration and Schedule Coordination;
  Transit Priority;
  Transit Traveller Information Systems;

- **Advanced Traffic Management Systems;**
- **Traffic Calming;**
- **Energy-efficient Vehicles**

The status report summarized in Exhibit 9 does not necessarily represent complete information and is intended to provide a broad indication only of the current situation in Canada. As would be expected Canadian cities are farther ahead in some initiatives than others and it is likely that the accomplishment profile for various European, Asian and American cities would be noticeably different

7 2 CHALLENGES AND OPPORTUNITIES

In comparison to geographically smaller older more densely populated European countries Canada has a particularly challenging task in achieving transportation sustainability A vast country with a small population its cities are relatively low density and often separated by great distances Thus there is a relatively high level of energy consumption by the transportation sector as a whole and a high level of auto-dependence and auto use within urban areas Culturally Canadians expect a high degree of mobility thinking nothing of travelling long distances for work, recreation shopping and socializing

Within many of Canada s major cities however there are good prospects for improvement In comparison to U S cities where central areas have been depopulated and original transit systems dismantled core areas of Canadian cities have largely retained their vitality and a full range of functions along with the transit systems that serve them Canadians have also retained traditions of urban living with more affinity for walking bicycling public transit and use of public spaces

Canadian cities therefore are both a promising and logical focus for major initiatives toward sustainable urban transportation Large scale small scale public private and individual initiatives are needed in all the areas discussed in this paper with special emphasis on long term change in urban form transportation infrastructure and demand management (particularly road pricing) and more immediate strategies for improved transit facilities and operations traffic management cleaner vehicle technology institutional reform and public education and outreach

It is hoped that the information provided in this paper will be useful to those concerned with these issues in other countries Canadians in turn seek to derive as much benefit as possible from similar information regarding initiatives and accomplishments in other cities around the world

REFERENCES AND END NOTES

1 OECD Group on Urban Affairs/ECMT Committee of Deputies July 1992 "Summary of National Overviews Project Group on Urban Travel and Sustainable Development COM/ENV/CEMT (92) 56

2. This discussion is adapted from Nigel Richardson 1990 Urbanization: Building Human Habitats in Government of Canada, 1991 "The State of Canada s Environment

3 For example in 1930 the population density of the City of Toronto was 6 875 people per square kilometre (City of Toronto Archives)

4 For example a common post-war suburban housing form was the single family detached residence on a 60 x 120 foot (18 x 36 m) lot. At an average occupancy of 3 5 people per residence (common in 1950 s urban Canada) and allowing 40% land area for roads schools shopping areas and other community facilities this equates to a density of 3139 people per square kilometre

5 For example while the number of licensed drivers in Ontario grew from 1 144 291 in 1947 to 3 841 628 in 1973 (+236%) traffic accidents grew from 22 293 to 193 021 (+765%) fatalities grew from 734 to 1959 (+167%) and injuries grew from 13 056 to 97 790 (+649%) (Ontario Ministry of Transportation 1990 Ontario Road Safety Annual Report")

6. At present 25 km of the planned busway has been constructed with a further 6 km to be implemented by 1995

7 Between 1973 and 1986 motor vehicle fatality rates across Canada declined from 6 50 fatalities per 10 000 vehicles to 2 51 In Ontario accident rates fell from 502 accidents per 10 000 licensed drivers to 322 and injury rates from 255 injuries per 10 000 drivers to 187 (Transport Canada 1987 Road Accident Statistics in Canada 1986 and Ontario Ministry of Transportation 1990 op cit)

8 For example the City of Ottawa sets no minimum long term parking requirements for new development in the Central Business District; minimum parking requirements are only specified for short term purposes (e g shopping delivery)

9 Government of Canada 1990 Canada s Green Plan Ottawa

10 For example Statistics Canada reports the following energy consumption figures for the on road transportation sector in 1991: natural gas 2715 TJ (0 21 %) propane 28903 TJ (2.22%) electricity 2825 TJ (0 22%) petroleum products (gasoline diesel fuel) 1266849 TJ (97 35%) (Statistics Canada 1991 IV Quarterly Report on Energy Supply Demand in Canada , catalogue 57 003)

11 An exception is Ottawa Carleton where maximum walking distances to transit and sidewalk requirements for arterial and collector roads are enshrined in the Regional Official Plan

APPENDIX A

CONSIDERATIONS FOR SUSTAINABLE TRANSPORTATION INFRASTRUCTURE

Appendix A: Considerations for Sustainable Transportation Infrastructure

A.1 ROADWAY DESIGN

The most basic element of transportation infrastructure is the road system and there are different design features needed to accommodate pedestrians public transit, bicycles and/or cars

Pedestrian friendly roads are not excessively wide and have frequent protected crossing areas and sidewalks Intersections are designed so that cars must stop before turning across pedestrian flows and signals are timed with pedestrians in mind as well as cars Some planners suggest that parallel parking improves the sidewalk environment by creating a shield between pedestrians and fast moving traffic Across Canada almost all of the arterials in the old central city areas were originally designed this way

Transit supportive roads must be pedestrian friendly because transit riders are first and foremost pedestrians If sidewalks access to the road and safe crossing areas are lacking transit use will be discouraged Features which enhance transit efficiency include reserved transit lanes turn lanes signal priority and even as in Calgary gates at intersections to provide transit priority Bus bays on the other hand slow down transit operations by forcing buses to pull off the road to pick up passengers and then wait to re-enter traffic Bus bays are standard features in most suburban areas

Planning for bicycles includes features such as wide curb lanes specially designed storm sewer grates exclusive bike lanes defined by stripes or barriers marked bike routes off street bike paths and bicycle parking areas and facilities

In contrast car-oriented roads designed to move as many vehicles as efficiently as possible are traditionally wide with limited access from side roads long distances between crossing areas and no on street parking Intersections are also wide with free flowing right turn lanes and signal lights timed primarily to facilitate traffic flow There may be an absence of medians and sidewalks especially in cases where pedestrian presence is discouraged Hostility to pedestrians is compounded when buildings are oriented away from the road and replaced by parking lots fences and walls

A.2 ROAD LAYOUT

The pattern of the street system is the skeleton for the urban structure and the basis for the public transit route system In pre war cities the traditional pattern was a fine grained grid or modified grid for both the local and arterial roads In some cases the arterials formed a radial

pattern converging on the city core with cross town links between spokes

The arterial grid and to some extent the radial pattern provides for a comprehensive multi-directional network of transit routes The local grid provides for multi-directional pedestrian access both to local sites and to a variety of transit routes This pattern minimizes the need for transfers and provides a coherent mental map for the pedestrian and transit user

Transit service which coincides with the arterial street system serves numerous points of origin and destination and at the same time encourages a development pattern that is street-oriented and concentrated in nodes and corridors

In contrast the typical suburban street pattern is a hierarchy of major often widely spaced arterial roads interspersed with curvilear often discontinuous collector and local roads Arterial roads serve cross town traffic flow minimizing access from side streets Interior subdivision roads are designed to discourage through traffic by means of a winding internal pattern and restricting entry points from collectors As a result, pedestrian access to the arterial roads is often restricted by the limited entry points and long walking distances and it is difficult for buses to penetrate and serve such subdivisions efficiently or conveniently

Transit service is often provided on internal collector and local roads with routes leading in some cases to transfer centres connecting with downtown and rapid transit service Deep set backs of commercial buildings and institutions behind large parking lots often necessitate diversion of transit vehicles off main routes The internal looping routes and frequent diversions lengthen trip time and make it difficult for riders to plan cross town trips This pattern also creates a dilemma in planning rapid transit routes which should logically follow main arterials and in locating rapid transit stations which should be at main intersections

A.3 TRANSIT PLANNING AND DELIVERY

For larger urban areas the rapid transit system may well be the area s single most important determinant of sustainability Ideally an urban area should have a network of rapid transit lines serving the entire area accessible to everyone by foot or a short bus ride

The body of this paper has discussed the effects of current financial restraint on the ability to improve transit infrastructure A necessary

element of a sustainable transportation strategy must address the transit funding issue

However the availability of funds does not guarantee sustainability Because of the often high capital costs involved and the permanence of the facility great care has to be taken in selecting the appropriate technology and alignment and developing an effective schedule for phasing improvements These attributes greatly affect the relative cost effectiveness of rapid transit and its contribution to sustainable development.

Technology The range of modes or technologies available includes transit priority/HOV lanes (for conventional buses or electric trolleys) busways light rail subway and commuter rail; each has different characteristics in terms of speed coverage carrying capacity accessibility, capital costs and operating costs

Conventional buses on existing streets offer the cheapest initial investment Capital expenses include costs of road and intersection modifications transfer terminals bus shelters and vehicles Operating costs include drivers wages and operative and maintenance costs Where electric trolleys are used overhead wiring and power sources also involving capital and operating/maintenance costs

Busways are separate roads built exclusively for buses The costs may involve not only road construction but also the purchase of rights-of way

Light Rail (LRT) consists of short trains of variable length running on their own right-of way either on street or on a separate corridor and powered by an overhead wire Expenses involve laying the track bed road modifications the power source and purchase of any special corridors Stations can be as cheap as a slab on the ground or more elaborate Grade separation in the form of tunnels or elevation however costs about seven times as much as a surface route

Subway (Heavy Rail) usually requires total grade separation meaning that stations must also be elaborate with escalators station attendants and maintenance workers Vehicles are very expensive However because of the high carrying capacity of trains there are relatively fewer drivers required and capacities are significantly higher

Commuter Rail lines are essentially passenger trains powered by diesel or electric engines and using conventional railway lines Costs involve purchase or rental of the track bed from railway companies rental or

purchase of rolling stock, and construction of stations Operating costs include maintenance and wages of drivers and other staff

The crucial issue is to select the technology that is both appropriate for the setting and most cost-effective in terms of ridership while at the same time providing opportunities for upgrading in the future A technology's cost-effectiveness depends on many situation specific factors other than ridership; definitive generic figures are therefore not available However the maximum practical or design load of a technology can be used as a broad indicator of its cost-effectiveness As demand approaches the design load operating costs tend to rise faster than ridership and the quality of service may begin to suffer due to overcrowding (of passengers on vehicles and/or of transit vehicles on streets) indicating that a higher-capacity technology is warranted The following typical design capacities were derived from the Canadian Transit Handbook (2nd edition 1985) Canadian Urban Transit Association and the Transportation Association of Canada

Transit Technology	**Capacity** (passengers/hour one direction)
Buses or Streetcars Mixed Traffic	7 000 12 000
Buses Exclusive Lanes	10 000 18 000
Streetcars/Short LRT's Exclusive Lanes	12 000 20 000
Busways	20 000 25 000
Long LRT's Grade Separated	25 000 30 000
Subways	40 000

Decision makers then must strike the right balance If they underbuild without leaving opportunities for upgrading the community will not have the full benefits of rapid transit and will suffer from congestion and lack of mobility If they overbuild they will have a revenue shortfall and be saddled with high carrying costs and operating expenses In this case the high capital and operating costs may preclude upgrading of other routes and facilities

A variety of rapid transit approaches have been taken in major Canadian cities including all approaches except busways in Toronto emphasis on subways in Montreal with some commuter rail service and exclusive reliance on the Skytrain in Vancouver LRT in Calgary and Edmonton busways in Ottawa and no rapid transit in Winnipeg

Important decisions regarding system expansion are under consideration in most of these cities and the timing and nature of these and of subsequent actions regarding these and other initiatives will greatly affect the extent to which Canadian cities will achieve more sustainable urban transportation.

Planning the route pattern and choosing specific alignments for a rapid transit system involves balancing a number of policy objectives including the need to:

provide broad coverage of the urban area (comprehensiveness)
serve existing land uses and travel patterns
influence future development and travel patterns

With regard to comprehensiveness there may be a trade-off between the expense of the chosen technology and the number of kilometres of infrastructure provided For example a subway costs seven times as much to build as LRT at grade Thus the same money could buy seven times as much rapid transit line in cases where LRT is appropriate An even greater network coverage could be achieved if transit priority/HOV lanes are used instead of LRT But the three technologies also provide different speeds capacities and stop spacings all of which require careful consideration

Increasingly as early steps in their long range plans Canadian cities are placing initial emphasis on transit priority/HOV lanes and related street design and traffic control steps This is seen as a cost-effective way of achieving several important benefits:

(1) greater people-carrying capacity (as opposed solely to auto carrying capacity) on the roads affected;

(2) higher average transit speeds and more reliable schedule adherence thereby attracting more riders and reducing operating costs;

(3) more cost-effective transit services as a result of increased revenues and reduced costs; and

(4) establishment of increased transit ridership in key travel corridors as a basis for subsequent decisions to upgrade to full rapid transit in some or all of the corridors

An incremental decision making approach appears to be emerging in which an upgraded surface transit network on major arterial roads is

the first step followed or parallelled by selective construction of rapid transit lines in the context of experience gained form the transit priority approach

Role of Commuter Rail. With respect to commuter rail a possible dilemma is the extent to which it may encourage growth of urban sprawl by making long-distance commuting more attractive On the other hand, it reduces the number of cars on the road and therefore potentially reduces the need to build or widen more highways In both the Montreal and Vancouver areas urban sprawl has occurred without the existence of an extensive commuter rail system. In the context of appropriate urban structure land use and urban design policies the consensus among Toronto planners and policy makers is that improved commuter rail services will contribute cost-effectively to more sustainable urban transportation in the Greater Toronto Area

Alignments Another issue is whether alignments should be within the existing street system or in separate off street corridors or a combination of both From a functional point of view it is usually best to follow existing streets locating stations at major intersections activity nodes and transfer centres In this way the system serves existing travel patterns and land use is easily accessible to pedestrians and encourages future street related development. However off street corridors may be attractive because of free or inexpensive land more direct radial routing lower building costs less disruption to roads during construction and no road space taken away from cars The disadvantage of extensive separation however may be that transit is not an integral part of the urban fabric and full ridership potential is not achieved

Timing With regard to influencing growth the classic question is should transit follow development or lead it? If the decision is to select a route that will encourage development of specific areas then there are two alternatives: choose less expensive lower capacity technology appropriate for existing ridership and short term growth incorporating flexibility for upgrading at a later time or choose high capacity technology appropriate for predicted longer range ridership In the latter case front-end costs are higher and there is a risk that growth will not occur as expected On the other hand less disruption is experienced and the early construction of a higher capacity system can be expected to encourage earlier development adjacent to the line and its stations

NOTES