

Development of Sustainable Transportation in Toronto

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Abstract

The Canadian government has been concerned about a wide variety of issues during the past few decades. Among them are principal economic factors and competitiveness, the changing structure of the population itself, both in terms of its age profile and new forms of family structure. In addition, there is the fact that the current generation is the first to have had almost unlimited access to the car and the opportunity for high levels of mobility. The second great social issue is the concern over transportation accessibility. It should be noted that not all society has equal access to transport and the growth arguments have to be balanced against the distribution of the benefits. This paper addresses the factors of changing structure of the population in Toronto, access to public transport, and the need for sustainable development of the modern transportation system in this Canadian city. Also, policies relating to public transportation, infrastructure, land use, and cost of travel in Toronto are analyzed in the paper.

Section 1: Introduction

Canadian government has made a firm commitment to stabilize levels of CO₂ emissions at their 1990 levels in the year 2000 (AAA). In the transport sector, the level of CO₂ emissions is directly related to the amount of fossil fuels used. Stabilizing emissions requires a combination of more efficient use of fuel and less travel, but the trends in most countries are in the opposite direction (QTD). Additional investments by Toronto Transport Commission (TTC) into transport may help achieve more fuel efficiency, at least in the short term, as relief of congestion allows the transport system to operate more efficiently. Yet, in the longer term those benefits may be offset by the growth in traffic. In addition to the CO₂ stabilization targets there are many other environmental costs associated with transport.

The objectives of transport investment in Toronto must be to identify situations where the economic, equity and environmental factors all point in the same direction. It is not a simple trade-off between these factors, but a clear policy challenge. People want investment in opportunities that lead to economic development, with a more equitable distribution and environmental benefits.

Historically, traffic congestion, air pollution, and other side-effects of auto motoring in Toronto have been tackled through initiatives that work on either the demand side or the supply side of the problem. Demand-side measures seek either to reduce traffic volumes or to shift them over time, land-use management, or mode. In contrast, supply-side initiatives intend to offer conveniences and services that adequately adapt to peoples' wishes to travel (Cervero 1998). New roads, systems enhancements, and transit investments are the standard supply-side responses to traffic

congestion. However, as other considerations, such as air quality, weigh into decisions about how scarce resources are allocated, road expansion is no longer a preferred choice in many instances. Fiscal constraints and community concerns of urban highways have moderated new road construction in Toronto. Transit improvements are just one of many potential supply-side alternatives to highway expansion. This paper concentrates on outlining and analyzing the current transportation policy development in Toronto and provides recommendations of the sustainable transportation development in Toronto.

Section 2: Changing and Challenges

2.1 Demographic changes

The patterns of mobility are similar in America and Canada. The levels of mobility are somewhat lower than those in the USA, but higher than in Japan (Cervero 1998). In all cities in Canada, including Toronto, there is an overriding dependence on the car for travel. The growth in population is slow. The current low levels of fertility will be maintained, at least into the 21st century (Derkson 2002).

2.2 Ageing and changing family structures

However, within this relatively stable population, two major changes can be detected in Toronto. The most significant growth in population will take place in the elderly and non-working population as a joint effect of the increases in life expectancy and the tendency to retire earlier. The proportion of elderly people in Toronto will raise from 13 per cent (1985) to 20 per cent (2020) (Cervero 1998). The population of most advanced economies is becoming greyer. In addition to the ageing of the population, there are other important changes taking place in demographic terms in Toronto:

Average household size is expected to continue to fall from current levels of 2.7 persons per household to 2.4 persons per household (2010) (Derksen 2002). Household size reflects the lower fertility rates and births outside marriage. The concept of a traditional household with two adults (married) with children is no longer valid. Indeed. The structure of households is no longer based on the family unit as there are now so many variants.

Perhaps, at the micro level, this means that analysis should be based on the individual rather than the household as a unit in Toronto. Similarly, much of trip generation is based on the assumption that certain activities relate to household size. There are common activities in which all households have to participate in Toronto. The following factors are important to consider while analyzing the impact demographic conditions have on Toronto's transportation:

The increased participation of women in the labor force in Toronto is also apparent throughout Canada, particularly the growth in part-time working.

The implications for work-related travel in Toronto are likely to be substantial as many households have two wage earners, so the location decision may not be optimal for even one of the workers. It has been argued that households now establish a residential base and career needs are met by (long-distance) commuting (Banister and Bayliss 1992).

The second major change has been the effect automobiles have on city dwellers. The current groups of elderly people in Toronto are the first to have experienced the use of the car all their lives and they will not want to give it up. To expect that today's elderly population will adopt the travel patterns of the elderly of yesterday is unrealistic. The implication of this argument is that dynamic approaches must be developed to

account for the desire of individuals to maintain the ability to drive as long as possible. A demographic analysis of car ownership and use patterns takes as its starting point the growth in license ownership and car ownership for different age groups of men and women (Banister 1994). For instance, in the USA nearly 90 per cent of the adult population has driving licenses and there are, on average, nearly two vehicles per household. The distances traveled by residents averages at over 29,000 km per household. These levels are about one-third higher than those in Toronto (Frisken 2007).

The recent evidence from the national travel surveys demonstrates the increasing dependence on the car over the last twenty years and the gradual growth in mobility in Toronto (Derkson 2002). Over that period total travel per person has increased by 37 per cent with the car's share also increasing from 68 per cent to 78 per cent. The proportion of travel by all other modes has declined (except van/truck) both in absolute terms and as a proportion of the total travel. The growth in travel is explained in equal parts by the increase in trips made and the increase in the average journey length in Toronto (Frisken 2007).

The picture presented here is of substantial further increases in travel over the next fifteen years, resulting from demographic changes. The demand for travel will continue to increase in Toronto, but the nature of that demand may change as a result of demographic factors. Although the changes in population structure are important, other changes (such as the industrial structure, technological innovation, levels of richness and leisure time) will also influence demand.

2.3 Accessibility to Transport in Toronto

These general changes brought about by the aging and motorization effects hide other fundamental changes within the population in Toronto. Transport as with other commodities will never be available to all people equally, nor will it be distributed equally over space (Lee and Perl 2003). There are many constraints that mean that not all people will have equal access to facilities and services. Even if it were available to all equally in Toronto, it would not be ideal as different people (and businesses) have different requirements. Many of these requirements have already been mentioned in the changing patterns of work and leisure, the changes in family structure and the changes in business organization. In addition to the changes in patterns of demand, there have been significant changes in the distribution of services and facilities in Toronto (Lee and Perl 2003). The basic issue here is that of accessibility to facilities, both at the aggregate level and for particular groups of people. Accessibility relates both to the physical distribution of land uses within the urban areas and the availability of transport and to the needs of the people to use the services provided. Access is a function of both travel times and the number and quality of nearby destinations and the value different people place on access to different destinations also varies.

2.4 Environmental and Sustainability Effects

In 1996 the transport sector was responsible for over 25 per cent of world primary energy use and 23 per cent of CO₂ emissions from fossil fuel use (Derkson 2002). It forms the most rapidly growing sector with energy use in 1996 at about 70 EJ. Without action, this figure will double to 140 EJ in 2025 (Derkson 2002). Industrialized countries will contribute the majority of this figure until 2025. After that date, the

majority of transport related emissions would come from those countries that are currently developing rapidly or have economies in transition. Transport activity increases with rising economic activity, disposable income, access to motorized transport and falling real vehicle and fuel costs.

Projections of transport greenhouse gas emissions follow the historic trends as CO₂ emissions are directly related to energy use in the transport sector. The assumptions made are that the relationships between transport fuel consumption and variables such as gross domestic product (GDP), fuel prices and vehicle energy efficiency will remain stable, at least until 2025 (Derksen 2002). In addition, technological innovation may result in greater levels of mobility being achieved with lower levels of energy input. There are also strong political and economic arguments for breaking the historic links between transport demand, energy use and economic factors as has happened in the energy sector (Banister 1996).

Despite the many advantages brought about by the car and other transport, there are also serious negative consequences for society as a whole in Toronto.

The environmental costs of transport in Toronto have been grouped under four main headings—pollution, resources, environment and development. Decisions taken to improve benefits along one dimension may be likely to increase costs along another dimension or in another sector. The complexity of decision making in environmental policy cannot be underestimated, but all governments must now face difficult choices.

Many of the environmental costs of transport are non-linear in their effects (e.g. health effects and congestion). The crucial issue becomes not how to measure, but how to avoid reaching critical levels where the environmental costs become too high (e.g.

lethal doses of pollution). Still, the measurement difficulties are substantial and placing values (or money costs) on environmental factors tends to be subjective (Button 1994).

The challenge for environmental policy in transport is to improve as many elements of this complex interrelated list of environmental costs as possible without increasing those elsewhere, or at least being aware of them and making an informed choice. It should also be remembered that transport is only one part of the economy and so the environmental choices in the transport sector need to be balanced against other priorities. It is argued that transport infrastructure investment has social benefits (e.g. bypasses of congested town centers) but that it destroys the environment in Toronto (e.g. through the generation of more car travel).

More recently, the environmental arguments have been linked to those of sustainability development in Canada generally and in Toronto specifically (McCalla, Slack, and Comtois 2001). This more sophisticated view links environmental concerns with those of economic development and equity. To achieve an objective of sustainable development needs to maintain competitiveness through economic growth and development objectives. Where possible, the environmental and development objectives should be working in the same direction, and many transport investment decisions have tried to achieve these benefits. For example, bypass schemes have been justified both by the economic benefits from reduced travel times and by opening up new areas for development in Toronto. Yet they have also brought environmental benefits to Toronto city centers. In addition to achieve the objectives stated for sustainable development, citizens have to carry out their daily activities in different ways, using resources more efficiently. Similarly, industry and the new post-industrial economy need to be more sustainable in their operations and organization. This requires clear policy directions

through pricing, regulation and control, but the scale of change necessary to achieve sustainability objectives also requires political support from all affected parties.

Underlying much of the debate over the environment and sustainability in Toronto is the crucial link between the environment and competitiveness. Much of the literature discusses the balance between these two dimensions. One would argue that the most productive way to actually achieve sustainability objectives is through these two dimensions operating in the same direction—the ‘win-win’ situation. Porter and Van der Linde (1995, p. 97) have argued that the “struggle between ecology and the economy grows out of a static view of environmental regulation, in which technology, products, processes and customer needs are all fixed”.

In the real world, firms have made cost-minimizing choices. Environmental regulation raises costs and reduces market share of domestic companies on global markets. They go on to develop a dynamic paradigm, based on innovation and the capacity to improve competitiveness through shifting the constraints. Properly designed environmental standards can trigger innovation, which may more than offset the costs of compliance. We would go further and suggest that environmental incentives should be used to promote greater efficiency and innovation. A positive promotion of environmental incentives is one way to achieve sustainability objectives and gain public support through the demonstration effects of policy actions.

McCalla, Slack, and Comtois (2001) make reference to earlier researchers who state that there is much more transport today than there has been in the past and that trend is likely to increase in Toronto and Canada. In the longer term the greatest growth is likely to be in China and India. In addition, the continuous growth in air transport has added a further new element of travel. Yet it is the rapid growth in car ownership and

use that forms the most important factor in assessing the environmental costs of transport. It is clear that the simple growth in transport poses environmental degradation, but there are also real qualitative factors (Table 1).

Table 1: The environmental costs of transport

<i>POLLUTANTS</i>	<i>Transport's share</i>	<i>Impact</i>
Carbon dioxide	23%	Global warming
Nitrogen oxides	60%	Acid rain
Sulphur dioxide	4%	Acid rain, bronchitis
Carbon monoxide	80-90%	Morbidity, fertility
Benzene	80%	Carcinogenic
Lead	50%	Mental development
Hydrocarbons	50%	Toxic trace substances
Particulates	27%	Inflammation, cardiovascular diseases
<i>2 RESOURCES</i>	<i>Consumption</i>	
Oil Land take	54%	Depletion of natural resources 4.2 ha of land per km of three lane motorway
Ecology Ecosystems		Landscape and destroyed water quality, flood hazards river systems modified
<i>3 ENVIRONMENT</i>		
Noise		Stress, concentration, and health
Vibration		Historic buildings
Community severance		Dividing communities
Visual impact and aesthetics		Changes in physical appearance

<i>POLLUTANTS</i>	<i>Transport's share</i>	<i>Impact</i>
Conservation and townscape		Preservation
<i>4 DEVELOPMENT</i>		
Regional development		Location of Industry
Local economic impacts		Income levels, employment, social impact
Congestion		Delay, use of resources
Urban sprawl		Traffic generation, induced development
Construction effects		Blight, property prices, compensation
Source: Frisken Frances, (2007), The public metropolis, Ontario: Canadian Scholars' Press.		

For many years transport policy has been primarily concerned with the local problems of transport, principally congestion, accidents and noise. The debate in the last twenty years has become more sophisticated and complex as the broader impacts of transport have embraced both global and international effects, as can be seen from the following example (McCalla, Slack, and Comtois 2001).

Concern over the damaging effects of 'acid rain' on forests and water life grew in the 1970s and 1980s. The importance of NOX and other gaseous emissions from cars were recognized as major contributing factors. Concern also emerged in the 1980s over high-level ozone depletion and its impact on the long-term incidence of skin cancer. Transport's role was relatively small, as it was confined to CFCs in air-conditioning units. In the 1990s global warming has become the key issue with its impact on raising

average temperatures and the consequences for climate change and sea level rises. The new agenda requires the collective action of national governments and international agencies in limiting the growth of CO₂ emissions (McCalla, Slack, and Comtois 2001).

To continue, there is a growing concern over the long-term future of the planet and a commitment to sustainability. Transport has become a key element in that debate and one that is beginning to attract a disproportionate amount of attention. Transport contributes at all levels to environmental degradation. It has a high profile, it is perceived as being a major intruder and it also interacts with other activities which can be seen as being environmentally harmful (McCalla, Slack, and Comtois 2001).

Transport is also seen as an area where Canadian government can and have intervened through fiscal measures, regulation and the planning system. Many of the environmental costs imposed by transport are the consequences of policy decisions made for other reasons (Pigott 2001).

People know that there are high environmental costs associated with public transportation. Sometimes citizens are supportive of actions by governments to improve environmental quality. At other times, they do not support the governmental actions if they result in change to their lifestyles and they can no longer continue their use of the car, and if their costs rise (Pill 1979). This is a problem with no solution. It accounts for the general resistance against higher prices in transport so that some of the environmental externalities can be internalized. It accounts for the belief that technological solutions will solve the problem through more efficient engines, alternative fuels and modern technologies. Researchers argue that the solution to the problem lies in proper city planning, which is to create higher population densities in the city centers or develop larger suburbs, provided the roads and public transportation

withstands the high number of travelers daily (Qtd in Pigott 2001). In Toronto, it accounts for the use of public awareness campaigns and raising the social consciousness to gain public support for actions that are often politically unpopular. In short, even if one could establish clear links between health quality and amount of motorized travel in Toronto, this might not be a necessary condition to radically change policy direction. There will always be strong reasons to continue to keep the external costs of transport as externalities and to resist the strong environmental case for internalizing them (Pigott 2001).

Section 3: Current Transportation Policy

In Toronto, a number of transportation policies exist, which govern the transportation growth and urban infrastructure development. This section discusses public transportation, land use, infrastructure, and metro transportation policies in Toronto.

3.1 Public transportation policy

In the past, Toronto was often praised as the best North American example of the inner-city rail's abilities and benefits it could bring to the city dwellers. Even though much has changed since the time Toronto first introduced its extended public transportation system, it is still regarded as one of the best in Canada and the United States. The results of the initial 24.3-kilometer subway system, opened between 1954 and 1966, were striking. Statistics reveal that during the subway's first ten years of operations, about 50 percent of trendy apartments and 90 percent of office construction in the city of Toronto took place in the station's neighborhood (Heenan 1986). The

subway not only had a major positive impact on the development of areas that were formerly uninhabited or underused, but it also gave new life to the down-town commercial buildings and shopping areas. One study claimed that the subway brought about a US\$12 billion appreciation in citywide land values during its first decade of service (Cervero 1998).

For example, when Toronto's Yonge Street subway line began its operations in 1954, going from the heart of downtown to a traditional commercial center, it replaced an old streetcar line that was in bus shape and needed renovation. The system, which has been operated by the Toronto Transit Commission (TTC), grew in stages to the east and west of downtown over the 1954 to 1966 period (Cervero 1998). Only a few extensions have since been added. One was the opening of a fully automated advanced light rail transit (ALRT) line, called Sky Train, eastward to the regional town center, Scarborough.

Nowadays, the TTC system stretches some 57 kilometers in length, served by sixty stations (McCalla 2004). Feeding into mainline rail stations are among the richest mixes of surface transit connections found anywhere, comprising trolley buses, diesel buses, historic trams, and modern mixed-traffic light rail vehicles. Key to service integration has been the close coordination of schedules across modes and a free transfer policy. At some stations, trams and trolley buses penetrate directly into enclosed areas, enabling transferring patrons to step directly onto subway concourses without passing through turnstiles, what locals call free body transfers.

One of the greatest accomplishments of the TTC system has been in strengthening the central business district (CBD)—partly a consequence of the radially oriented subway system, but mainly a result of strategic regional land-use planning

(McCalla 2004). A strong CBD has in turn spawned high ridership levels—about 65 percent of all trips entering the CBD and historically well over 200 transit trips per capita per year, higher than in any U.S. metropolitan area, including greater New York. Indeed, radial rail connections and CBD dominance have been co-dependent. Today, an estimated 45 percent of regional office employment is downtown (officially called the Central Area), the largest share in North America (Cervero, 1998).

As everywhere else, however, this share has been steadily eroding. Toronto's decades-old subway system has been unable to stem the tide of job decentralization. Continuing expansion of the provincially operated regional commuter rail system, GO Transit, has helped spur growth beyond the traditional metropolitan boundaries.

While many jobs exiting the CBD have ended up in auto-oriented, suburban offices, a considerable share—much larger than found in U.S. rail cities—have ended up in rail-served sub-centers. This is largely a product of metropolitan Toronto's strong tradition of regional governance. Up until 1998, the Metropolitan Corporation, or Metro for short, was responsible for coordinating the planning and the delivery of government services across the six municipalities (Solomon 2007).

3.2 Metro transportation

Formed in 1953 just before the opening of the Youge Street subway, Metro's key responsibility was to coordinate regional growth, specifically the co-development of TTC services and land deployment. This role now belongs to the planning office of the newly expanded city of Toronto. In 1980, Metro's plan endorsed a hierarchical pattern of regional sub-centering. Downtown Toronto was to be supplemented by two transit-served regional sub-centers (Scarborough and North York), and four local centers. With

financial help from the Ontario government, Scarborough was to serve as the regions demonstration of modern design related to urban form (Cervero 1986). A mix of office, retail, institutional, and residential activities have concentrated around the Scarborough Town Centre and the Sky Train station since 1980. Over time, however, local planners seem resigned to the fact that the presence of a mega-shopping mall enveloped by a sea of asphalt parking, just north of the rail station, pre-established Scarborough's character as a largely auto-oriented place. Rail transit and pro-active planning have proven incapable of undoing this (Cervero 1986).

More successful has been the regions other sub-center. North York, which today features a more human-scale, less auto-oriented shopping center integrated into the subway station and an impressive array of surrounding high-rise offices and apartment towers, all flanking a central open civic space. As reported by Cervero (1986, pp. 88), some “35 percent of workers heading to central North York and 22 percent of those going to the Scarborough Town Centre take transit, respectable shares by any standard”.

3.3 Land use and infrastructure policies

One the one hand, there is a debate over whether road infrastructure in Toronto reduces congestion and vehicle emissions or leads to a more dispersed and inefficient pattern of land development. On the other hand, there is also uncertainty over the most efficient urban form in this city (Ross and Stanbury 2001). Urban form covers fixed elements within a metropolitan area, including the pattern of land use and density and the supporting transport and communications infrastructure. There is some agreement over the different urban form types in Toronto:

Urban infill. Here the aim is to make maximum use of urban sites to accommodate development.

Urban extensions. This is the suburbanization solution that has been popular, but rarely questioned.

Multiple village extensions. This has resulted from practical approaches to planning rather than a selected solution. It is often unpopular, particularly with residents in the villages.

Key villages. This concept was popular, but has not been used recently. It was argued that key villages would help maintain rural services and public transport.

New settlements. In the 1980s there were many schemes for privately promoted new settlements, but few have actually been started. There is now a renewed interest in the concept as the housing market is stronger than in the last ten years (Ross and Stanbury 2001).

In addition to Toronto's urban form types, settlements need to be considered in relation to one another, not only in isolation. The compact city results from higher population sizes and densities in the city, with high quality accessible public transport. The edge city encourages development at selected external points together with increased investment in orbital roads to link the edge cities (Newton 1997). The corridor city focuses growth along linear corridors where high quality public transport is available, while the fringe city encourages general suburban development along the road network. implications for transit? All these possibilities apply to individual cities and also to city regions (Banister 1996).

Toronto urban area does not conform to any one type as patterns of development are continually changing in this city. Overall, it is clear that there has been a flattening

out of density measures, but there is still no agreement over what is the most desirable urban form in terms of energy efficiency and environmental quality. Even if there was some agreement it may not be possible to achieve that pattern of development.

Gordon and Richardson concluded that urban sprawl is a transportation solution, not a problem. The argument was that there is a dynamic process which is continuously at work. As urban sprawl takes place, jobs follow people so that the journey to work length remains relatively constant over time. But the journey to work is becoming less important. Households often have more than one worker and the growth in travel is taking place for other trip purposes (Ewing 1997). Most commentators do not take these extreme positions, but are content to focus on the intermediate issues of reducing trip lengths, encouraging moderate concentration, specialization and mixed use (Banister 1997).

Section 4: Thinking and Conclusion

Perhaps there is a greater potential in other activities in Toronto as firms downsize, leaving traditional city locations and have a scattered workforce distributed in locations (even homes) where the labor and overhead costs are much lower (Cervero 1998). Similarly, telephone banking, catalogue marketing and other services may offer a greater travel reduction potential.

The links between land use, urban form, sustainability and transport are complex, and the role that infrastructure investment can have in this process is unclear. Some would argue for a balance between jobs and housing to minimize trip lengths (Cervero 1989). Others urge neo-traditional neighborhood design to bring the small scale back to cities (Calthorpe 1993). Others look towards transit-oriented development

to influence mode choice (Cervero 1994). In particular, it seems that it is difficult to get the car user to leave the vehicle at home and use other forms of transport in Toronto. Similarly, the complexity of the labor market and the distribution of facilities means that journey lengths have also become longer (Boarnet and Sarmiento 1996). New investment in transport infrastructure will always facilitate more travel, particularly by car. Similarly, the new opportunities provided by technology make it easier to carry out work, shopping and business-related activities from home or a local television center.

The social and environmental effects and infrastructure investment has been outlined in this paper. The relationships between investment and economic development do not hold and may never have been appropriate. For example, the construction or expansion of the existing infrastructure may affect the emissions levels both directly and indirectly in Toronto. By reducing levels of congestion (at least in the short term), new roads would allow traffic to flow more smoothly at a faster speed in this city. The indirect effects reflect growing car dependence, longer journeys and changes in land use, all resulting from additional road capacity in Toronto. The net result is that total travel increases, with additional fuel being used and higher pollution levels. In Toronto, these effects are likely to be even more stated to provide that congestion is reduced. In addition, many journeys across Toronto are short and vehicles operating under cold start conditions also use more fuel and create more emissions. Catalytic converters are ineffective when cold. It is here that most VOCs, CO₂ and NO_X emissions are made (Gratwick 2001).

So it is hard to determine whether a new highway has a positive or negative effect on emissions (Ross and Stanbury 2001). Once a road has been built, the negative

environmental effects in terms of emissions, land take, noise, intrusion and accidents (Table 1) are likely to be felt for many years. It is both difficult to establish sound methodologies for the measurement and assessment of the environmental effects. The environmental and sustainability issues have also resulted in a similar questioning of traditional concepts of physical accessibility in Toronto. But new technology and lifestyles have made it possible to create much greater flexibility in travel behavior and in the location of industrial, commercial and residential activities. One popular element of the debate is the role that telecommuting and other forms of technological substitution might have on travel (Mokhtarian 1996).

It is important to further the sustainable transportation in Toronto, the crucial path of sustainable transportation development is to reduce congestion in GTA area and enhance the region's public transit systems, also influence more people to use them (Frisken 2007).

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