

Choosing Our Future
Foundation Paper Series

MOBILITY & TRANSPORTATION SYSTEMS

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Foundation Paper Series

This Foundation Paper is one of 11 that have been developed for “Choosing Our Future”, which is an innovative joint planning initiative of the City of Ottawa, the City of Gatineau, and the National Capital Commission. The goal of this multi-year project is to help Canada’s Capital Region face the challenges of the 21st century, and integrate concepts of sustainability and resiliency into all facets of regional planning and design.

The Foundation Papers are intended to stimulate discussion on key topics to be addressed in the development of three plans: a Sustainability Plan; a Community Energy Plan; and a Risk & Mitigation Plan. The Foundation Papers will be made available during the public Choosing Our Future Forum on September 26th, 2009, when the topics and contents of these papers will be discussed in greater detail. These papers will also be made available for the duration of the project, as they provide a snap-shot of the sustainability issues addressed as part of “Choosing Our Future”; however it should be noted that a more in-depth analysis will follow and will form part of another series of strategic papers to be developed in Spring 2010.

Introduction

This topic embraces movement of people and freight within, to and from the National Capital Region (NCR). Intercity and intercontinental movement are not usually local responsibilities but how they unfold could have profound influence on land use within the NCR and on other matters of local interest. Also, local considerations can have a bearing on how movement to and from distant places is accomplished. How movement occurs within the NCR is very much the result of two kinds of local decision-making. One concerns transportation facilities and infrastructure: for example, whether there is convenient transit, agreeable biking routes or an emphasis on the requirement for automobile travel.

The other kind of local decision-making concerns how land is used. Land use is a key matter for transportation because it can determine how close people are to where they want to be, and thus the amount of travelling required and often the mode that is used. (If people live a walking distance from workplaces or stores they are more likely to walk.)

This Paper takes the longer view and is infused with the perspective that transport revolutions can be expected during the next few decades. In transport and related matters, 2031 is likely to be much more different from 2005 than 2005 was from 1979, chiefly but not only because of what is happening to the availability and price of petroleum oil.

Major Issues & Trends and Their Potential Impact on the National Capital Region

OIL FUTURES

The mobility and transportation systems of the National Capital Region (NCR) are overwhelmingly dependent on petroleum oil. Indeed, all movement to and from the NCR, including all freight movement within and surrounding the NCR, depend on internal

Just about 100 per cent of motorized transportation in the NCR depends on oil.

I believe strongly we have to get off oil. The electrification of the automobile is inevitable.

Bob Lutz, General Motors Vice-President, quoted in Newsweek, December 31, 2007.

combustion engines fuelled by gasoline, diesel fuel or jet kerosene.¹ In considering the medium- and long-term future of the NCR's mobility and transportation systems, two primary considerations are the related matters of the availability and price of oil.

There is substantial debate on the matter, but the most plausible perspective could be that world oil production has peaked or is just about to peak, for geological or economic reasons, or both.² The events of 2008 were instructive:

- Surging demand, much of it from China, pushed prices to record levels. Supply did not expand to accommodate demand, in spite of high prices, suggesting limits were being reached.
- The recession followed shortly after the oil price spike, which had strongly affected automotive and other transport industries. (North American auto sales fell 40 per cent in 2008.) Oil prices collapsed with the recession but soon resumed their upward trajectory. In August 2009, they are about where they were in mid 2007.

The prospect now may be that of a repeating vicious cycle circumscribed by ever-tightening oil supplies (Figure 1). Rising oil prices cause economic recession, which lowers prices allowing recovery, during which oil prices rise again, eventually causing further recession, and so on. Relying on recessions to moderate oil prices is a harmful and potentially disastrous strategy (or lack of strategy). A better way is to reduce dependence on oil, particularly for transportation, which consumes more than 60 per cent of the oil used in Canada.³

Finally, Canada's oil bounty does not protect the NCR. Almost all Western Canada's oil is used there or exported to the United States. Most of Eastern Canada's oil is imported from elsewhere, including from some politically unstable places. (See Figure 2.)

Please refer to the Energy Foundation Paper for additional discussion on transportation and energy.

CLIMATE CHANGE

In addition to energy security issues, greenhouse gas emissions resulting from road transportation – which represents approximately 30% of all energy consumed in Canada – make mobility and transport systems a major climate change issue. From 1990 to 2006, greenhouse gas emissions from transportation, driven primarily by energy used for personal vehicles, rose 32% in Canada. Overall, transportation was the second largest emission-producing category in 2006 accounting for 36% of Canada's emission growth from 1990 to 2006 (Environment Canada, 2008). In the National Capital Region, trip volume across the Ottawa River, for example, increased over 20% in 10 years, and the trip volume between urban and rural areas increased 90% in the same time⁴.

¹The summary report on the fall 2005 origin-destination survey for the NCR (www.O-DSurvey.ca) suggests that walking and cycling comprised 12 per cent of weekday trips by NCR residents. The share of the total amount of such travel was likely much less because motorized trips are usually much longer than non-motorized trips and because movement of people for business purposes other than commuting was not included.

²For a balanced discussion, see Fisher B, Review and Analysis of the Peak Oil Debate, Institute for Defense Analyses, Washington DC, August 2008 (www.dtic.mil). In August 2009, the OECD's chief economist, Dr. Fatih Birol, warned of the "real risk of a crunch in the oil supply after next year" (www.independent.co.uk/news/science/warning-oil-supplies-are-running-out-fast-1766585.html).

³The data in this paragraph and Figure 2 are from the National Energy Board (www.neb-one.gc.ca).

⁴NCR 2005 Study: <http://www.ncr-trans-rcn.ca/uploadedFiles/O-DSurvey/KeyFindingsEN.pdf>

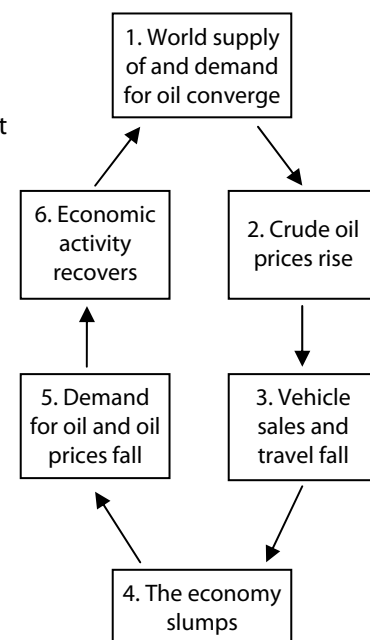


Figure 1: Vicious cycle of high oil prices and recession

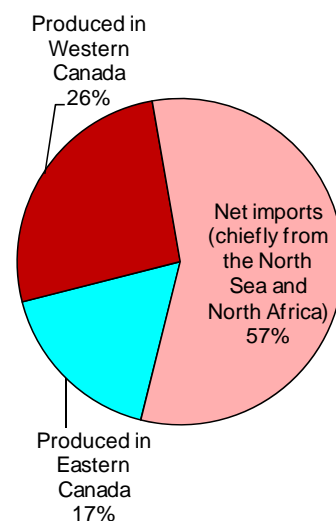


Figure 2: Sources of Eastern Canada's oil in 2007 (National Energy Board, footnote No. 3)

Increasingly, governments are focusing climate change policies, programs, and corporate initiatives on the transportation sector, and this trend applies in the National Capital Region (please refer to next section). Climate change and transportation issues are discussed further in the Climate Change Foundation Paper.

LAND USE AND DEMOGRAPHICS

There is a strong relationship between transportation and land use planning, with Smart Growth development reducing the amount people drive by 20-40% compared to conventional, low-density single-use development. This translates into 18-36% reductions in greenhouse gas emissions compared to business-as-usual scenarios⁵.

Smart Growth development includes the following characteristics⁶:

- Compact – Low-density development is auto-dependent; transit service requires that medium to high densities, especially along transit corridors.
- Centred – Concentrated activities and destinations (e.g. places of employment, shops, etc) make active transportation (e.g. cycling, walking, etc) more viable.
- Complete – A mix of land uses – including residential, commercial, institutional and light industrial – provides for a self-contained neighbourhood and allows residents to meet their needs on foot.
- Connected – A fine-grained, grid (or similar) street network is important to ensure efficient, intuitive routes for walkers, cyclists, and transit users.

A large rise in the number of elderly residents, many of whom might choose not to drive for safety or other reasons⁷, represents a growing need for such neighbourhoods in order to ensure transit options and availability of services and amenities within walking distance of homes, allowing seniors to “age in place”. Similarly, empty nesters and young singles are choosing multi-family housing over single-family housing⁸, and empty nesters are a rapidly growing segment of the population in the region.

HEALTH

Health is an important consideration for land use and transportation planning as auto-dependent development increases the amount of time people spend in vehicles, resulting in higher rates of obesity. Conversely, living in higher-density, mixed-used neighbourhoods encourages active transportation and reduces the probabilities of obesity by approximately 30 percent⁹. Further, air pollution – caused in part by traffic – costs Ontario citizens more than \$1 billion per year in hospital admissions, emergency room visits, and absenteeism. Qualitative costs include reduction in quality of life, such as breathing difficulties and IQ point losses in children¹⁰.

Impacts and opportunities for municipalities in the National Capital Region are significant as land use and design of the public realm are important community elements over which they have jurisdiction; growing demand for Smart Growth communities suggests

5 Government of BC Climate Change Action Toolkit: <http://www.toolkit.bc.ca/solution/land-use-solutions>

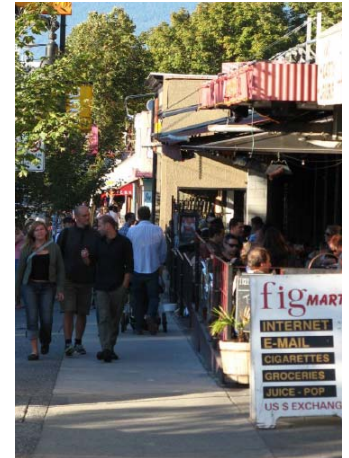
6 Adapted from Provincial Government’s BC Climate Action Toolkit (HB Lanarc)

7 A good entry point from a Canadian perspective into the extensive literature on this topic is Scott DM, Newbold KB, Spinney JEL, Mercado R, Páez A, Kanaroglou PS (2009) New Insights into Senior Travel Behavior: The Canadian Experience, *Growth and Change*, 40(1), 140-168.

8 Campoli and MacLean, 2007, *Visualizing Density*, Lincoln Institute of Land Policy, <http://www.lincolnst.edu>

9 Frank, L. et al. 2004. “Obesity Relationships with Community Design, Physical Activity, and Time Spent in Cars”. *American Journal of Preventative Medicine*. 27:2.

10 Ontario Medical Association. 2000. “The Illness Costs of Air Pollution in Ontario”.



Land use is a critical determinant of sustainable transportation systems. Compact, centred, complete and connected neighbourhoods are prerequisites to most sustainable transportation systems, and make for more attractive, vibrant communities.



Walkable communities allow people to “age in place”, giving seniors independence and allowing them to remain in their neighbourhoods.



Walkable communities encourage active transportation and healthier citizens.

expanding opportunities for active transportation and healthier citizens, and local governments will have a critical and immediate role to play in building on progressive land use policy and zoning regulations.

GOODS MOVEMENT AND AIR TRAVEL TO AND FROM THE NCR

Other changes associated with different oil futures could concern intercity and intercontinental movement of people and freight. Aviation has been a major casualty of both the high oil prices of 2008 and the subsequent recession.¹¹ Aviation is the transport mode most dependent on oil. Unless an alternative to jet kerosene (or aviation gasoline) becomes available – which at present seems unlikely – aviation could undergo major retraction particularly in providing services to destinations less than 1,000 kilometres distant. These could be mostly replaced by rail-based for movement of both people and freight, mostly electrically powered. Fewer commercial airports could be needed; the NCR might be served by Montreal’s Trudeau Airport or even Toronto’s Pearson Airport, accessible in each case by high-speed rail service.

Such prospects beg questions concerning the disposition of the Macdonald-Cartier Airport lands and the adequacy of Ottawa’s rail station. Re-establishment of the main passenger station in downtown Ottawa could be an option. These matters require detailed investigation, ideally soon so that land use and development decisions made today will not limit potential for the longer-term rail system development.

Most freight movement to and from the NCR is by truck. Trucking has also been severely affected by high oil prices and the recession.¹² In a regime of high fuel prices, some freight movement could shift to rail. Much freight could continue to be moved by road but in trucks that could be rather different from what we are used to. They are likely to be much larger, to reduce fuel costs. These trucks could be powered by electricity (perhaps only while on main highways, i.e., they would be trolley trucks that can operate on diesel engines.)

Very large trucks might not be welcome in the NCR, which points to the establishment of distribution centres where freight is offloaded to smaller vehicles for local delivery – much as freight can be offloaded from a train for local delivery – and to where smaller vehicles bring outgoing freight. Distribution centres are of value for other reasons. Among the best known is the Retail Consolidation Centre at Heathrow Airport (London, UK), which receives and distributes all items for the stores in the five Heathrow terminals. Establishment of the Centre has reduced related traffic within the airport by 70 per cent, with corresponding reductions in fuel use and emissions, improvement in security and in the punctuality of deliveries, and reductions in overall costs.¹³



France’s Train à Grande Vitesse (high-speed train) travelling at a record-breaking 575 km/h. At regular cruising speeds of 250-375 km/h, these trains provide efficient, low-impact inter-city travel.

(Photo: iainhall.wordpress.com)

11 For perspectives on the fate of the aviation industry, see the July 30, 2009, press release ‘Weak Demand, Falling load factors’ by the International Air Transport Association (www.iata.org) and the August 16, 2009, presentation ‘Industry Review and Outlook’ by the Air Transport Association of America (www.airlines.org). Also see, Kuhlman A (2006) Peak oil – and the collapse of commercial aviation? *Airways*, 13(5), 12-19, July.

12 See, for example, Dan Goodwill’s blog on freight transportation in Canada (blogdg.ctl.ca)

13 For information about Heathrow’s and other consolidation centres, see Brown M, Sweet M, Woodburn A, Allen J (2005) *Urban Consolidation Centres*, University of Westminster, London, UK (www.freightbestpractice.org.uk) For a Canadian perspective, see Crainic TG, Ricciardi N, Storchi G (2007) *Models for Evaluating and Planning City Logistics Transportation Systems*, Université de Montréal (www.cirrelet.ca).

Current Responses in the National Capital Region

Many aspects of the National Capital Region's transportation system, particularly its transit infrastructure and services, are considered successful. For example, in 2008, 82% of transit users rated transit service in Ottawa to be good or very good, which reflects a 12% increase from the year before.¹⁴

As transportation systems continue to create and be faced with new challenges, it is critical that transportation planning anticipate the transport revolutions that may be ahead. This requires some changes to existing approaches. For example, *Ottawa's Transportation Master Plan*, approved in November 2008 assumes that 2031 will be much like 2005 with automobiles still accounting for most rush hours trips¹⁵. It therefore focuses on encouraging greater demand for transit and cycling, which are indeed important strategies towards a more sustainable system of mobility.¹⁶ The City of Gatineau's November 2008 *Action Plan for Implementing Environmental Policy*¹⁷ likewise does not address the possibility of forthcoming transport revolutions. The sidebar on the right provides a quotation from the National Capital Commission's June 2005 document *A Strategic Transportation Initiative for Canada's Capital Region*,¹⁸ which speaks more to business as usual than to revolutionary change, although the need for some changes in direction is clearly indicated.

On the other hand, innovative planning efforts are in place that are moving the region in the right direction. Examples include:

- The City of Ottawa's *Transportation Plan* includes a first increment of investment in transit of \$1.7 billion for a tunnel through downtown, and several kilometres of infrastructure for its two rapid transit and supplementary transit systems. Other examples include their anti-idling bylaw and Ottawa 20/20's direction to reduce energy consumption through transportation.
- The City of Gatineau's *Action Plan for Environmental Policy Implementation* includes commitments to reduce automobile traffic, improve public transit, and encourage active transportation modes. The City has also recently undertaken a Rapibus study to determine how to best enhance the reliability and efficiency of their bus system, with higher levels of government pledging \$195 million to the project.
- The National Capital Region's *Strategic Transportation Initiative (2007)*, which supports provincial and municipal goals for smart growth and integrated transportation planning for movement of people and goods.

¹⁴ 2008 Transit Services Annual Performance Report, City of Ottawa.

¹⁵ Similarly, the Official Plan for the City of Ottawa has a clear planning horizon of 2031; if there were a reasonable chance that 2031 will be as similar to 2005 as 2005 was to 26 years earlier in 1979, the planning directions could be considered a satisfactory indication of how the NCR might best proceed in its transportation investments and commitments. However, the turbulence of our times and the coming revolutions due to declining oil availability may well reduce their utility.

¹⁶ Figure 2.13 of the Plan suggests that modes shares for walking, cycling, transit, and automobile use in 2005 were 9, 2, 21, and 68 per cent, and that in 2031 they will be 9, 3, 26, and 62 per cent. There is no evident discussion of availability of fuel for automobile use, or for transit, which appears to be set to remain mostly diesel fuelled.

¹⁷ The documents *Politique environnementale de la Ville de Gatineau* and *Plan d'action pour la mise en œuvre de la politique environnementale* are both available at the Web site of the City of Gatineau (www.gatineau.ca).

¹⁸ The document is available at the National Capital Commission's Web site at www.canadascapital.gc.ca.

Residents, businesses and visitors in Canada's Capital Region presently enjoy excellent transportation. The future prosperity and quality of life of the Capital region will largely depend on the extent to which the present high level of access and mobility can be maintained in the face of current transportation trends and projected significant growth. Transportation in the Capital region is predominantly based on the automobile, small vans and trucks. This approach will likely continue to meet transportation needs for many years. However, it is already evident that simply continuing and expanding the transportation infrastructure will not meet long-term requirements.

A Strategic Transportation Initiative for Canada's Capital Region (NCC, 2005).

Best Practices and Other Possible Responses in the National Capital Region

A number of approaches, including both incentives (i.e. carrots) and disincentives (i.e. sticks) are required. Some best practices are already in place, including some of the following:

Land Use and Built Form

- Integrate land use and transportation planning;
- Promote nodal development (e.g. clusters of businesses and amenities) in centres and along corridors to support transit; and
- Improve the public realm to encourage walking.

Active Mode Infrastructure

- Provide “end of trip” facilities for cyclists, including showers, change rooms and personal storage in commercial and institutional buildings;
- Elevate the safety and status of cyclists by providing separate lanes, and secure and weather-protected bicycle storage facilities; and
- Increase pedestrian access to and through parks and other public spaces that do not already include sidewalk infrastructure, and ensure it meets accessibility (e.g. wheelchair) requirements.

Transportation Demand Management

- Reduce parking requirements and parking availability to make personal vehicular use less attractive;
- Reduce road widths by adding additional space for bicycle and/or transit (e.g. new / separate lanes);
- Support car-shares and car co-operatives to reduce overall demand; and
- Invest in transit service to increase its frequency, reliability, and network coverage.

Strong leadership and changing mindsets are important to implementing and enhancing best practices in the NCR.

CASE STUDY: OIL FUTURES AND THE ELECTRIFICATION OF LAND TRANSPORT

What is to replace oil for transportation? Many proposals would allow continued use of familiar internal combustion engines with replacements including natural gas and biofuels. The current favourite option, however, is electricity, which powers a quite different kind of traction system: the electric motor. There are basically three ways of getting electricity to electric traction motors:

The most efficient way is to deliver electricity while the vehicle is in motion. Calgary’s light rail system is powered entirely by wind turbines in the Rockies, justifying its ‘Ride the Wind’ slogan. The energy loss from turbine to electric motor is about 10 per cent (through conversion and distribution). The major disadvantage of such grid-connected systems is



Bicycle infrastructure increases safety and ridership levels



Electric bus, Vancouver (Photo: trans-vancouver.fotopic.net)

their inflexibility. A trolley bus can go only where there are overhead wires; a diesel bus can use almost any road.¹⁹

The least efficient way can be to generate the electricity on board the vehicle. If Calgary's trains were powered by on-board fuel cells rather than from an overhead wire, for example, the energy loss could be about 75 per cent (through using electricity to make hydrogen, then using the hydrogen to make electricity – and through storing and distributing the hydrogen).

In between the above two means, with about a 40-per-cent energy loss, are systems relying on stored electricity. The vehicle is connected to the grid while stationary but is then as free to move as an internal combustion engine-powered vehicle. The disadvantages of battery-electric vehicles are the high cost of batteries and their low capacity, which translates into short ranges.

There can be combinations of these three means, as in hybrid ICE-electric automobiles and trolley buses with battery assist. (Vancouver's trolley buses can travel 700 metres on their batteries. Those in Rome, Italy, can travel 10 kilometres.) Efficient electricity use could offset disadvantages of particular means to the extent renewably produced electricity is scarce and expensive.

Electric vehicles provide numerous advantages beyond use of a potentially renewable, alternative fuel to oil. The advantages include high energy efficiency; remarkable stop-start performance, and absence of locally or globally acting emissions at the vehicle. There can be pollution at the generating station, according to the fuel used. However, pollution from stationary sources is more manageable and usually less harmful to humans than pollution from traffic because of its distance from them.

Although the burden of electric traction on electricity supply can be surprisingly small,²⁰ a growing preference for scarce renewable supply could impel use of the most efficient modes.

From the standpoint of 2009, a transition from internal combustion engines to electrically-powered transportation seems inevitable, although its rapidity and precise nature are uncertain. Within the NCR there can be one or more of four attitudes to the transition, explicitly or by omission:

1. Lead the flow. Become an innovator in electric traction through, for example, deployment of prototype systems for grid-connected, automated, individualized travel.²¹
2. Embrace the flow. Be just ahead of the average urban region through early investments in, for example, trolley buses, light rail, and public charging stations for light-duty vehicles.
3. Go with the flow. Prepare for the shift to electric traction, but take major steps only when strongly compelled by high oil prices or other pressures for change.
4. Resist the flow. Assume internal combustion engines fuelled by oil products (or other fuels) will prevail throughout the planning period.

¹⁹ Efficiency estimates in these bullet points are from Gilbert R, Perl A, Transport Revolutions, Earthscan, London, 2008.

²⁰ Gilbert and Perl (2008)

²¹ For more on what is known as personal rapid transit, see Bulls K (2009) Personal Rapid Transit Startup: Small, automatic electric vehicles will be demonstrated in two new projects, Technology Review, February 9, (www.technologyreview.com/energy/22083/).



Light-rail train in Calgary (Photo: Prof. Judith Patterson, Concordia University)



Public charging station in Berlin (Photo: www.daimler.com)



Artist's impression of personal rapid transit (Photo: www.acprt.org)

The greatest risks could lie with the first and last attitudes (and the last may best characterize where the NCR is now). The first attitude could bring the greatest rewards in terms of both transport improvement and economic development. Economic benefit could come not only from availability of a means of efficient and convenient personal travel in an era in which automobiles are increasingly costly to own and operate, but also from the establishment of related industries based on an NCR prototype system. But there are always risks in being an innovator or leader.

The first attitude – and to some extent the second – could involve numerous other measures consistent with a transition to electric traction. They could include:

- Conversion of the NCR's bus and rail systems to fuelling by electricity, notably Ottawa's Transitway buses.
- Establishment of charging stations for battery-electric and plug-in hybrid vehicles throughout the NCR .
- Requirements that all new buildings in the NCR at least rough in provision for charging facilities for electric vehicles,

"Prediction is very hard, especially about the future," said both Neils Bohr, Danish atomic physicist, and Yogi Berra, US baseball player, perhaps independently. What is anticipated here may well be wrong, including the suggestion that oil products will become scarce and expensive. However, the sense that we may be in for a period of change has not been stronger for several decades. Planning for the medium term (for example, 2031) and the longer term (perhaps the rest of the 21st century) should at least take into account the possibility that what will be available to fuel transport may be quite different from what is available now.