HOW A TRANSPORT FUTURES ASSESSMENT COULD FACILITATE CANADA'S NEXT TRANSPORTATION REVOLUTION

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The Canadian Transport Futures Assessment outlined below, shortened here to 'Transport Futures', seeks to provide a new analytical approach that can contribute to improving future private and public sector decision-making about mobility options in Canada. By developing analytical methods and perspectives that can better accommodate the effect of economic, political, and technical discontinuities that are emerging to influence 21st century transport systems, Transport Futures will offer decision-makers the ability to make better informed choices than could otherwise arise from extrapolation of past trends and the extension of prior relationships among economic, demographic and other factors commonly considered in transportation planning.

Such new analytical perspectives can help reduce the likelihood that unanticipated events will leave transport providers and government

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agencies caught unprepared by sudden shifts in demand and changing expectations, as occurred following the terrorist attacks of September 11, 2001, and the SARS outbreak of 2003. Better understanding the dynamics of change in an uncertain future can pay dividends by improving the transport industry's overall capacity to adapt quickly.

A changed balance of opportunity and risk

The new analytical approaches will need to accommodate higher levels of uncertainty about the nature and implications of future threats to Canadian society, and to the transport sector that serves it, than those to which we have been accustomed. At the close of the 20th century, the range of risks facing Canada appeared relatively clear and manageable through an established set of strategies that relied upon known techniques. Just a few years later, not only has uncertainty about the extent of such risks expanded dramatically, but our collective understanding of how to best manage previously unknown risks and respond to sudden new threats is also in a state of flux.

In particular, the longstanding relationship between risk and opportunity that is found within the strategic paradigm of government and industry appears open to change. Past understandings of how to make effective decisions about transport options assumed an inverse relationship between risk and opportunity. Precautions and mitigation measures to deal with risk could be pursued against a known (or knowable) cost, so that clear trade-offs between the benefits and costs of risk management options could be formulated. Today, a new dynamic can be identified in which uncertainty about the level of risk and the opportunity for gains both appear to be rising (though not necessarily in parallel) particularly in the transport sector.

The elevated level of uncertainty, and its influence on the relationship between risk and opportunity warrant greater levels of vigilance and innovation than have been customary in past considerations of Canada's transport options. Transport Futures, as outlined below, could improve the capacity for strategically managing the relationship between opportunities and risks produced by transport activity over the coming decades.

New opportunities presenting a different calculus for transport planning efforts can be expected to arise from at least three dynamics, all increasingly apparent. First, the widespread adoption of intelligent transport systems offers considerable potential to improve productivity and enhance the safety and security of people and goods in motion. Second, new kinds of organization are emerging to provide mobility in innovative ways and with lower costs than previously considered possible. They range from new low-cost air carriers to third-party logistics providers and to local car-sharing cooperatives. What these diverse organizations have in common—and what separates them from traditional entities that have provided much of Canada's 20th century mobility—is their ability to catalyze new configurations of transport inputs, notably labour, technology, and energy, and translate them into high-value mobility outputs. Third, consumer preferences for more flexible, healthy, and active lifestyles—reflective of Canada's more diverse and worldly population—could create new niches in the marketplace for transport innovations.

Previously deferred problems

As new opportunities emerge, challenges from the unsustainability of established transport trends create pressure to deal with previously deferred problems. One problem is that transport's energy demands could outstrip the supply of low or moderately priced hydrocarbon fuels before substitute fuels are readily available.[1] Another arises from the ways in which transport development has influenced spatial configuration, enabling 'sprawl' to become a prominent feature of the North American built environment.[2] Many costs of such low-density development have been deferred. Dealing with them will necessitate new regulations on, and/or ways of charging for, urban transport. The spatial challenges include the fiscal costs of renewing extensive infrastructure and the health and social costs arising from 'auto-dependent' lifestyles. A third challenge arises from Canadian transport's production of environmental pollution that exceeds the absorptive capacities of local and global ecosystems, harming much life.[3] Children, the elderly, those living near well-used transport routes and

terminals, and others bear a disproportionate burden of adverse health and social effects.[4]

Integrating insights through four stages of analysis

Dealing with such an array of opportunities and challenges calls for incorporating a broader accumulation of knowledge into analytical efforts than has often been the case in transport analysis. The conceptual core best suited to creating both intellectual integration and analytical innovation is grounded in the social sciences, whose disciplines will provide an intellectual foundation for Transport Futures. Such an approach does not seek to bring much that is 'new' to considering transport issues and options, but it does seek to forge new connections among numerous perspectives that have often been pursued in isolation from one another, and thereby draw new insights,

Most studies of transport and its impacts make use of a subset of social science tools and techniques. Engineers use the economic technique of benefit-cost analysis to evaluate design options for new transport infrastructure and to assess the prospects of new technology.[5] Health researchers use geographic information systems in modelling the effects of aviation and road traffic on morbidity and mortality.[6] The relationships between transport research and social science analysis are bi-directional, bringing economists, geographers, political scientists, psychologists, and others who study transport into contact with particular aspects of engineering, scientific, and health-related research. Much of this useful combination of disciplinary perspectives and methods is unstructured. It thus yields only a partial approximation of the synergy that could emerge from integrating economic, geographic, historical, political, and sociological techniques for understanding transport activity and its impacts. Transport Futures will pursue just such an integration through a truly collaborative framework that will inform four stages of analysis.

Stage 1: Identifying the factors and forces with potential to reshape Canada's transport future

Making the most of future opportunities and effectively managing future risks demands a good understanding of how key 'drivers' of change can be expected to influence Canada's transport sector, and society as a whole. Transport Futures will begin by identifying and carefully assessing such drivers. They include energy availability, the deployment of new technology, urbanization and demographic factors, and the impacts of environmental pollution on global climate and local public health, among others. Future rates of urbanization and macroeconomic growth will also be considered. These drivers will be used to construct plausible, but intentionally different, scenarios for Canada's transport future, focussing on the period 2010-2030. The resulting scenarios are not intended to yield direct insights into future transport outcomes. Rather, they will provide a base from which to identify the likely opportunities and risks that could emerge in the event that particular change drivers do come to exert a major influence on the transport sector. The scenarios will generate their greatest value by enabling the estimation of alternative outcomes and impacts in subsequent stages of this assessment.

Stage 2: Estimating transport activity and resulting impacts

Economic, social, and behavioural research methods will be used to estimate transport activity levels (movement of both goods and people) for each scenario produced during Stage 1, chiefly through the application of models that forecast travel behaviour, time use, market development, material consumption, and the dynamics of supply-chain management. The activity estimates for each scenario will be used to quantify the resulting impacts of transport in several ways. For example, ecosystem integrity impacts will be developed through estimating the greenhouse gas emissions generated by transport activity. Human health impacts will be highlighted through projections of local and regional air and water pollution by substances known to affect mortality and morbidity. Impacts that pose unusual risks to children and other vulnerable groups will receive special attention.

Stage 3: Understanding the economic, social, and spatial outcomes

This phase of analysis will form the heart of a successful Transport Futures investigation. It aims to generate an integrated view of the outcomes produced by transport activity levels associated with each different scenario. These outcomes would be presented in terms of economic prospects, social cohesion, and ecological integrity. Economic considerations will include assessment of the implications of the chosen transport futures for the economic well being of Canadians. Socio-behavioural considerations will include the interactions of transport development and land-use arrangements, and the implications of different futures for social structure and equity. Ecosystem integrity will be measured by using cumulative environmental impact assessment techniques. The economic and social outcomes will be integrated with measures of ecological integrity and human health impacts to provide an overall indication of the sustainability associated with each scenario, and provide a basis for initial identification of associated opportunities and risks.

Stage 4: Identifying policy options that can best enable opportunities and mitigate risks in tomorrow's transport options

Here, the resource, technological, and other driving forces that were first identified in Stage 1 will be shown to exert considerable influence over the direction of Canada's transport future, by creating distinctive sets of opportunities and risks that form boundaries for possible outcomes. Economic and political choices made within these boundaries can enable both the successful pursuit of future opportunities and the effective management of future risks, just as they can frustrate success in such efforts. To facilitate future decision-making by government and industry, this phase of Transport Futures will elaborate the governance structures and economic instruments, such as pricing and fiscal policies, that can facilitate the attainment of desired outcomes and the avoidance of unpalatable risks. The nature of governing arrangements needed to realize opportunities and minimize risks will be explored for each scenario. These will include matters of regulation and deregulation, institutional arrangements, and the rela-

tionships between governments and markets in influencing transport activity.

Implementing the Transport Futures project

The disciplinary scope and analytical ambition of Transport Futures makes this project a good candidate for the "Major Collaborative Research Initiatives" (MCRI) program of the Social Sciences and Humanities Research Council of Canada (SSHRC), The MCRI provides up to $2.5 million over five years to support innovative interdisciplinary analysis based in the Social Sciences. To date, close to 40 researchers at 14 Canadian universities have been joined colleagues in Australia, Britain, the Netherlands, and the United States to participate in developing this research program. Further development work will continue through the summer of 2004, with the prospect of research starting in 2005 and continuing through 2009. The project will disseminate findings in the form of working papers, research reports, and policy briefings that will benefit from the feedback of an advisory committee, which will include government, industry, and labour representatives.

Transport Futures presents a training opportunity

A research effort that seeks to advance Canada's future transport opportunities should give priority to developing the skills needed to turn desired transport options into reality. Canada's post-secondary educational institutions lack the capacity for training a sufficient number of professionals needed to plan, develop, and manage our future transport needs.[7] Aside from a very few universities that graduate a handful of transport professionals each year, Canada's post-secondary institutions lack the critical mass of faculty to offer a comprehensive academic program in transport.

Transport Futures will build capacity in transport education by supporting students in several ways. First, all participating researchers will be expected to include graduate, and, where appropriate, undergraduate assistants in their research teams. The resulting flow of funds to students would significantly expand the very limited aca-

demic support that is currently targeted toward transport education at Canadian universities. Such funding opportunities are a necessary component in attracting students into transport studies. Second, by participating in research that yields insight into Canada's future transport options, students will be exposed to innovative analytical techniques and gain problem-solving skills well beyond what they could acquire from courses otherwise available to them.

Third, Transport Futures will offer students the opportunity to learn from faculty at universities across the network by supporting student exchanges among participating institutions, enabling students to acquire knowledge that would not be accessible at their home institution. Such exchanges could lead to common course offerings in which students at universities across Canada could enrol in transport courses offered by faculty at another institution and participate by videoconference and other distance-learning methods. Fourth, one or more participating researchers will coordinate internship placements with industry and government agencies in Canada's transport sector for students who have participated in this assessment.

The analytical strategy behind transport futures

There are basically three ways to approach the future. One is to do little in the way of serious strategic assessment, and then muddle along, exploiting opportunities and putting out fires as they occur. Another is to define a clear set of goals and work out the best or several ways of reaching the goals. The third is to identify several ways in which changes *could* unfold, select the most attractive of these, and figure out how to increase the likelihood of desired changes or decrease the possibility of undesired changes, or both. Each approach has merit, but the third approach, involving development of several *scenarios* of the future, may have the strongest analytical power. This is because it acknowledges a range of possible outcomes, and explicitly considers the set of *plausible* circumstances that could give rise to such outcomes. Through carefully analyzing the interplay among 'drivers' of change and the key choices available to decision-makers in industry and government, understanding is gained of how a trans-

port system, could be guided towards one, rather than another, of the futures.

Transport Futures is a scenario study. Scenario-based assessments have been used by governments and businesses when seeking to build their understanding of, and readiness to deal with, uncertain futures. Royal Dutch Shell pioneered "scenario planning" techniques in the late 1960s and used them to attain superior performance following the 1973 oil shock.[8] National governments—e.g., Norway and Singapore—have relied upon scenario-based assessments to inform their industrial and natural resource development strategies.[9]. In Canada, scenario-based assessment techniques have been used to create economic development strategies for Ontario's financial and information technology sectors.[10]

As noted above, several scenarios will be identified in Stage 1 and analysed carefully in Stage 2. The scenarios will be heuristic devices. There will be no commitment to them except as tools to understand how transport systems in Canada might unfold and how transport trajectories can be influenced by strategic choices that may be available to industry and government.

The next transport revolution

How do the participants in Transport Futures see Canada's next transport revolution? The honest answer is, we don't know yet. That is why we want to undertake Transport Futures. Moreover, agreement among Transport Futures' participants now or at the end of the process may well be unlikely, except for agreement as to the value of the process in identifying opportunities and risks and how they might be addressed.

The present authors, instigators of Transport Futures, agree with the premise behind this year's CTRF annual conference, that a third revolution in transport may be needed. We agree too that information technologies will likely be a strong element in shaping what emerges from the revolution. However, we do not believe that IT is, in itself,

the factor that will drive change. As noted above, we would give as much or more prominence to at least three other factors:

- Transport's energy demands, which could outstrip the supply of low or moderately priced hydrocarbon fuels before substitute fuels are readily available.
- Canadian transport's production of environmental pollution that exceeds the absorptive capacities of local and global ecosystems, harming much life.
- The dysfunctional impacts of transport on urban form, and the need to cover resulting deferred infrastructure and other significant costs.

Accordingly, we believe that the third transport revolution will generate transport systems that are more energy efficient, land conserving, and environmentally benign than present systems. Information technology will likely facilitate each of these advances. For example, IT can facilitate dramatic increases in the efficiency with which vehicles are used, by matching rides and by matching loads. They will reduce the number of vehicles on the road, thus lessening overall energy use and environmental impacts. IT can help curb sprawl by providing better information about development options and their transport implications.

Thus, we share the conference organizers' view that the third transport revolution could be more about the way in which new information—rather than new motive power—propels the planning and practice of how goods and people will move around Canada in the years to come.

End Notes

[1] There are various estimates of when worldwide production liquid hydrocarbons suitable for conversion into transport fuels will reach a peak. The authors consider the work of the Uppsala Hydrocarbon Depletion Group to be the most authoritative. It suggests that production will peak in about 2012. It is available at the first URL below. Some estimates point to earlier peaks, e.g., in 2005, as projected in Deffeyes KS, *Hubbert's Peak: The Impending World Oil Shortage.* Princeton University Press, 2001. Others point to later peaks, e.g., in 2018-2023, as projected in White N, Thompson M, Barwise T, Understanding the thermal evolution of deep-water continental margins, *Nature*, 426:6964, 324-333, 2003. Extreme among the projections of later production peaks are those of the U.S. Energy Information Administration (EIA), which suggests production will continue rising beyond 2025 (EIA, *International Energy Outlook 2003*, available at the second URL below) and those of the International Energy Agency (IEA), which suggests oil production will continue rising until 2030 (IEA, *Energy to 2050: Scenarios for a Sustainable Future*. IEA, Paris, France, 2003). Energy constraints will arise from potential demand running ahead of actual production of liquid hydrocarbons resulting in high prices, *not* from depletion of all available oil. Put another way: "The world is not about to run out of hydrocarbons, and perhaps it is not going to run out of oil from unconventional sources any time soon. What will be difficult to obtain is cheap petroleum, because what is left is an enormous amount of low-grade hydrocarbons, which are likely to be much more expensive financially, energetically, politically and especially environmentally." (Hall C and four others, Hydrocarbons and the evolution of human culture. *Nature*, 426:6964, 318-322, 2003). The most-discussed substitute for hydrocarbon transport fuels is hydrogen, for use in fuel cells. A recent authoritative report suggests that little can be expected from this option before 2029. See *The Hydrogen Economy: Opportunities, Costs, Barriers, and R&D Needs*. (Washington DC, National Academies Press, 2004), available at the third URL below.

1. http://www.isv.uu.se/uhdsg/. Accessed Feb. 8, 2004.
2. ftp://ftp.eia.doe.gov/pub/pdf/international/0484(2003).pdf. Accessed

Feb. 8, 2004.
3. http://books.nap.edu/books/0309091632/html/index.html. Accessed Feb. 8, 2004.

[2] For documentation on the challenges posed by sprawl and the contribution of transport, see the 'sprawl' section of the Web site of the *Planning Commissioners Journal* at the first URL below. For relevant data on Canada's five largest urban regions in relation to 47 other affluent urban regions, see Issue No. 7 of the *Sustainable Transportation Monitor* (Toronto, Centre for Sustainable Transportation, October 2002), available at the second URL below.
1. http://www.plannersweb.com/articles/sprawl-articles.html, Accessed Feb. 8, 2004.
2. http://www.cstctd.org/CSTadobefiles/STM7%20English.pdf. Accessed Feb. 8, 2004.

[3] For a brief account of the scope of impacts of transport on the environment and thus potentially on human and ecosystem health, see Section 4.8.2 of *Human Activity and the Environment 2000* (Ottawa: Statistics Canada, Catalogue No. 11-509-XPE, June 2000).

[4] For an account of the vulnerability of children to transport's impacts see Issue No. 9 of the *Sustainable Transportation Monitor* (Toronto, Centre for Sustainable Transportation, December 2003), available at the first URL below. Also see material prepared in connection with the workshop 'Sprawl: The Impact on Vulnerable Populations' held by the Department of Environmental Health of the University of Cincinnati, available at the second URL below.
1. http://www.cstctd.org/CSTadobefiles/STM9English.pdf. Accessed Feb. 8, 2004.
2. http://www.eh.uc.edu/epc/EPC%20accomplishments.asp, Accessed Feb. 8, 2004.

[5] See, for example, the following well-used text-book: Sullivan WG, Wicks EM, Bontadelli JA, *Engineering Economy*. (New York: Prentice Hall, 1999).

[6] See, for example, the following paper: Priemer DA, Diamond ML, Application of the Multimedia Urban Model to compare the fate of

SOCs in an urban and forested watershed. *Environ. Sci. Technol.* 36, 1004-1013, 2002.

[7] Lake R, Schwier C, Tardif L-P, Hackston D, *Inventory of Professional Training in Transport*. Ottawa: Research and Traffic Group for Transport Canada, 2000. Perl A, Bates M. *Enabling Tomorrow's Transport Professionals to Address Climate Change: Curriculum Research Findings*, Toronto: Centre for Sustainable Transportation, 2001. Available at the URL below.
1. http://www.cstctd.org. Accessed Feb. 8, 2004.

[8] Wack P, Scenarios: Uncharted Waters Ahead, *Harvard Business Review*, 63(5), 73–89. 1985.

[9] Burt G, van der Heidjen K, First Steps: towards purposeful activities in scenario thinking and future studies, *Futures*, 35, 1011–1026, 2003.

[10] Gertler M, Wolfe DA, Local social knowledge management: Community actors, institutions, and multilevel governance in regional foresight exercises, *Futures*, 36, 45–65, 2004.