The Centre for Sustainable Transportation

Le Centre pour un transport durable

Sustainable Transportation Monitor

No. 1, March 1998

In this issue:

Centre for Sustainable Transportation
15 Borden Street
Toronto, Ontario
Canada M5S 2M8

Phone (416) 923-9970
Fax (416) 923-6531
E-mail cstctd@web.net

ISSN 1480-4840

Le *Bulletin du transport durable* est disponible en français

WHY A SUSTAINABLE TRANSPORTATION MONITOR?

Sustainability means using resources and managing emissions and other wastes in ways that will allow future generations to meet their needs.

We're becoming more sustainable in many of the things we do. Buildings are using less energy, electric power is generated more efficiently, cars emit less pollution and waste per kilometre travelled.

But the improvements are mostly modest. Moreover, they are often offset by growth in population and in the activities that use resources and cause pollution.

Energy use is the prime concern. Nearly all the energy used in Canada comes from burning fossil fuels: coal, oil, and natural gas. These resources are not renewable. Use of them results in waste beyond what can be absorbed by natural processes. This waste accumulates in the ground, the water, and particularly in the atmosphere.

A near-consensus of experts—the United Nations Intergovernmental Panel on Climate Change (IPCC)—has indicated that **achieving sustainability will require reductions in fossil fuel use by at least 50 per cent**.

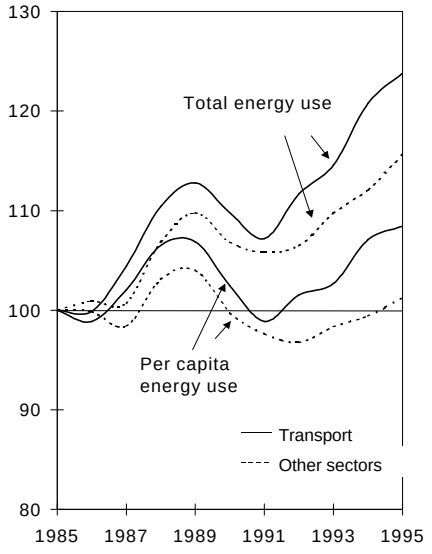
Above all, sustainability is threatened by our transport practices. Most journeys and freight movements are motorized, and almost all motor-vehicle fuel is non-renewable oil. As Box 1 shows, **energy use for transport has been growing at a higher rate than energy use for all other purposes**. (Transport uses are responsible for close to 30 per cent of energy consumption in Canada.)

Excellent, low-cost, available transportation is a central feature of how Canadians live. It is hard to imagine how the comfort, convenience, and efficiency of Canadian lifestyles could be maintained with, for example, 50-per-cent less motorized movement of people and goods than we have today.

The first step towards making this kind of fundamental change is developing awareness of the need for change. The *Sustainable Transportation Monitor* will contribute to this awareness by providing an annual assessment of Canada's transportation systems according to how much they are moving towards or away from sustainability.

Box 1 CST

Secondary energy use* by Canadians (1985=100)



Source: Transport Canada, T-FACTS.

* See the background document noted below for elaboration of the distinction between primary and secondary energy.

The *Sustainable Transportation Monitor* is the collective expression of the Board of Directors of the Centre for Sustainable Transportation. The views and analysis presented here are not necessarily those of the organizations with which members of the Board are affiliated. A background document is available from the Centre that provides details of the sources used in the preparation of this issue of the *Monitor* together with other information and analysis.

Box 2 CST

Sustainable Transportation: Definition and Vision

A sustainable transportation system, says the Centre for Sustainable Transportation, is one that:

- allows the basic access needs of individuals and societies to be met safely and in a manner consistent with human and ecosystem health, and with equity within and between generations.
- is affordable, operates efficiently, offers choice of transport mode, and supports a vibrant economy.
- limits emissions and waste within the planet's ability to absorb them, minimizes consumption of non-renewable resources, reuses and recycles its components, and minimizes the use of land and the production of noise.

The Centre has a vision of what sustainable transportation will be like, looking at the year 2030. Here are some of its elements:

- There is a focus on *access* rather than mobility, i.e., on the ends of transportation rather than on transportation itself.
- There is much more walking, bicycling, and other non-motorized transportation.
- Some motorized transportation is by unfamiliar means, including maglev trains and airships.
- Much more transportation than now is collective rather than individual.
- The result is transportation that has little or no impact on the environment and on human health.
- This sustainable transportation is maintained by full-cost pricing and tight environmental standards.

The transport sector deserves special attention because of all sectors it has the most rapid growth in energy use and is thus farthest from the *declines* in energy use required for sustainability. The close correlation between energy use and pollution provides another reason for a focus on transport.

But perhaps **the most important reason for beginning publication of the *Sustainable Transportation Monitor* is the growing awareness of the huge challenges posed by the need to change the ways we move ourselves and our freight, and the urgency of addressing these challenges**.

The need for change has been made more urgent by Canada's recent signing of the Kyoto Protocol, discussed here on Pages 10-14.

DEFINING AND ENVISIONING SUSTAINABLE TRANSPORT

The first publication of the Centre, dated September 1997, was entitled *Definition and Vision of Sustainable Transportation*. The Centre's definition is set out in Box 2 together with elements of the vision.

Other organizations are also attempting to put some flesh on what sustainable transportation might mean from environmental and other perspectives. The **National Round Table on the Environment and the Economy** has established a Task Force on Sustainable Transportation. In November 1997 it produced a 50-page overview report entitled *State of the Debate on the Environment and the Economy: The Road to Sustainable Transportation in Canada.*

Also of significance is **Transport Canada**'s *Sustainable Development Strategy*, released in December 1997 and described by the Transport Minister as "the first step in a process to work towards sustainability in the transport sector."

Another notable document is *A New Vision for Urban Transportation* produced by the **Transportation Association of Canada** in 1993. It proposed a 30-year generic vision for Canadian urban areas that can be fitted to local conditions.

The efforts are certainly not confined to Canada. An example involving eight countries, including Canada, is the work of the Paris-based **Organization for Economic Cooperation and Development** (OECD) on sustainable transportation. Several scenarios for 2030 are being explored in which total emissions of major pollutants from transportation are 80 per cent or more below 1990 levels.

SOCIAL AND ECONOMIC SUSTAINABILITY OF TRANSPORT

The Centre's definition of sustainable transportation and its vision have three components: environmental, social, and economic. Environmental considerations set the limits within which transportation must function if it is to be sustainable. To the extent possible, **the environmental limits are to be met in ways that enhance social and economic welfare**.

The present issue of the *Sustainable Transportation Monitor* pays more attention to the environmental component of sustainability. Social and economic components deserve at least as much attention; they will be addressed in future issues of the *Monitor*. Some preliminary comments follow.

The sustainability of societies is a necessary precondition for meeting human needs, and for providing a beneficial legacy for future generations. If transportation enhances education, health care, and productive human relationships, it might well be considered to be becoming more socially sustainable. If transportation increasingly contributes to social polarization, criminal activity, and emotional disorder, it might well be considered to be becoming less socially sustainable.

Determining whether transportation in Canada is becoming more or less socially sustainable presents numerous challenges. Indices of social sustainability—and even the concepts of social sustainability—are not well developed. Linking such indices to transport activity is presently beyond the resources of the Centre. Work of this kind is under way at the OECD.

Economic considerations are often seen as a barrier to the attainment of sustainable transportation. This is in part because economic activity is believed to be dependent on transport activity to the extent that reducing transport activity would be economically harmful. Another consideration is the financial cost of the technological changes that might needed to achieve sustainable transportation.

Two things might be said in this respect. One is that it may be possible to achieve sustainable transportation in ways that contribute to economic activity or at least have a minimal negative impact, so that the economy can grow without growth in transport activity. How economic growth has become decoupled or unlinked from materials use serves as an example of what might be possible. Until the 1970s, economic growth was tied closely to the amount of materials used in manufacturing. Since the 1970s, the economy has grown but the overall amount of materials used each year has remained about the same. An element of this change has been the substantial reduction in the weight of materials used for packaging, which fell by more than 50 per cent between 1988 and 1996.

The other thing that might be said is that economists themselves increasingly support the need for action to prevent climate change, a central issue in the attainment of sustainability.

During 1997, more than 2,500 U.S. economists, including eight Nobel laureates, issued a brief, influential *Statement on Climate Change*. It noted that "sound economic analysis shows there are policy options that would slow climate change without harming American living standards, and these measures may in fact improve U.S. productivity in the longer run." An associated document includes the text in Box 3.

TRENDS IN THE MOVEMENT OF PEOPLE IN CANADA

During the last 40 years there have been some remarkable trends in the movement of people in Canada. Some of them are illustrated in Boxes 4, 5, and 6.

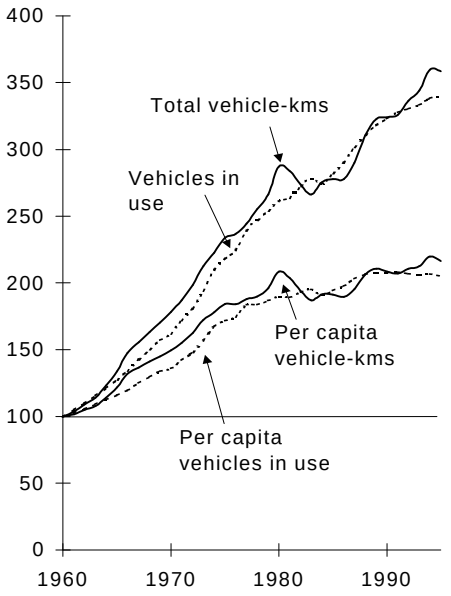
Box 4 shows how ownership and use of personal vehicles has grown since 1960. The lower pair of lines shows **that ownership per person is now about twice what it was in 1960, as is the amount of driving per person**, although the rates of increase of both are now less than in the 1960s and early 1970s.

Population increases mean there are now more than three times as many cars and more than three times as much travel by car as in 1960, shown by the upper pair of lines in Box 4.

The data in Box 4 include both regular automobiles and other four-wheeled vehicles used for personal transportation. **Light trucks, passenger vans, and sports-utility vehicles now account for close to half of all sales of private automobiles in Canada.** On average they are heavier and have

Box 4 CST

Personal vehicles in use in Canada and the distances they travel (1960=100)



Source: Transport Canada, Annual Report, 1996.

Box 3 CST

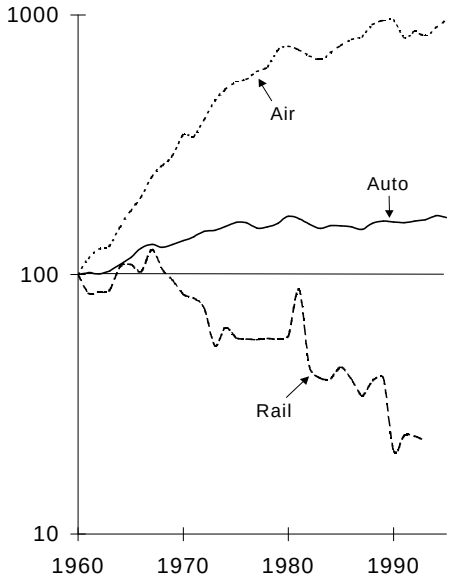
Playing Russian Roulette with One's Children and Grandchildren

"Even if the direction of climate change's impact on specific economic activities is unknown, it is prudent to act to avert the change. Uncertainty itself is undesirable. If there were a compulsory lottery that involved the equally probable outcomes of winning a large sum of money or suffering a large loss, most people would be willing to pay something to avoid being forced to participate. Similarly, it is reasonable to be willing to pay a modest price to avert climate change, in order to reduce the risk that an uncertain outcome will turn out badly. In fact, the climate situation is even worse than the lottery example; most of the likely impacts of climate change are negative, and some of them are potentially catastrophic. Instead of a big gain/big loss lottery, climate change is more like a game of Russian roulette, with negligible short-run benefits (of unconstrained fossil fuel consumption) weighed against the chance of huge losses (from climate-related disasters). Most people would not agree to play a game of Russian roulette for *any* sum of money. In a way, risking climate change is even more frightening than playing Russian roulette, because the risks and "benefits" are borne by different generations. The image of a game of Russian roulette being played for some trivial payoff but with the pistol pointed at the head of one's *child* is almost too gruesome to contemplate. Yet modifying the global climate without knowing the ultimate consequences is akin to just this sort of imposition of dire risk on future generations for our own transitory or illusory advantage."

Source: Stephan DeCanio, *The Economics of Climate Change*. Redefining Progress, San Francisco, 1997.

Box 5 CST

Passenger-kilometres travelled by Canadians by air, automobile, and inter-city rail (per capita, 1960=100, log scale)



Sources: Air: Transport Canada, Annual Report, 1996; Auto: Transport Canada, T-FACTS; Rail: Statistics Canada.

larger engines and thus use more fuel and pollute more than regular cars.

Box 5 shows that **the growth in automobile use has been small compared with the growth in air travel**, which typically pollutes more and uses more energy per passenger-kilometre. Rail travel, the most environmentally sound mode (if the trains are well occupied and especially so if they are fuelled from renewable sources), has experienced a sharp decline in per-capita ridership, as Box 5 shows, and even in actual ridership.

Another sharp decline—in inter-city bus passengers—is shown in Box 6. Urban transit, which mostly involves bus travel, has not fared so badly since 1960. Box 6 suggests a sharp declining trend in use of transit during the last few years. However, a survey of 67 transit systems conducted by the Canadian Urban Transit Association suggests ridership was slightly higher in the first six months of 1997 than in the same months in 1996.

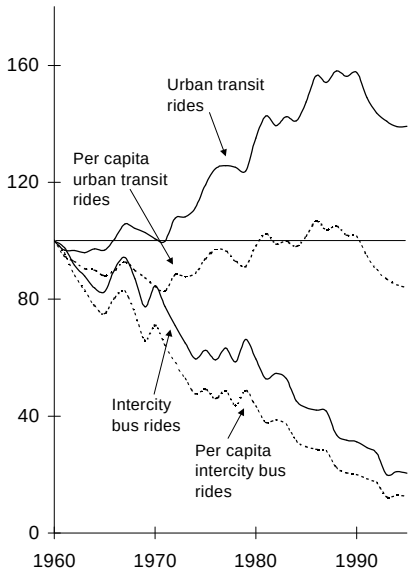
The pie chart in the centre of Box 7 provides an estimate of how motorized travel within Canada is shared among the different modes. It shows the extent to which travel by automobile is dominant, and how little travel overall is done by urban transit.

Box 7 also shows comparable data for the U.S. and Germany. **The car is dominant in every country**. Urban transit is suprisingly insignificant, even in Germany. There is much more inter-city travel by air in the U.S. and by bus or train in Germany.

Perhaps the most important differences among the three countries from the perspective of attaining sustainability lie in the *total* amounts of travel per person. In the U.S. there is 50 per cent more travel than in Canada and 115 per cent more than in Germany. Another likely significant difference, not evident in Box 7, is that much more walking and bicycling is done in Germany than in Canada or the U.S.

Box 6 CST

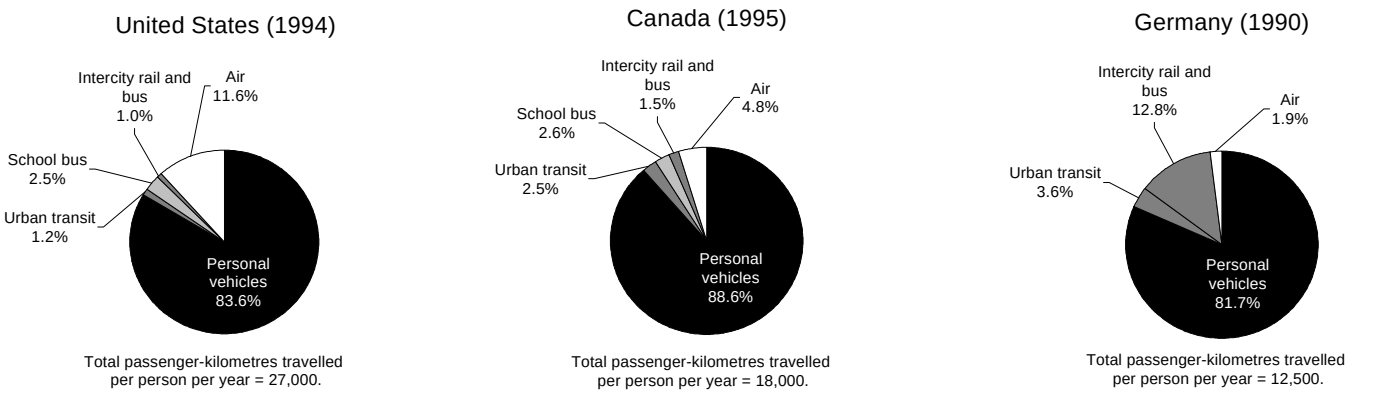
Urban Transit and Intercity Bus Passengers (1960=100)



Sources: Canadian Urban Transit Association and Transport Canada, T-FACTS.

Box 7 CST

Total person-kilometres* travelled annually by motorized modes in the U.S., Canada, and Germany, and how this travel is shared among the different modes

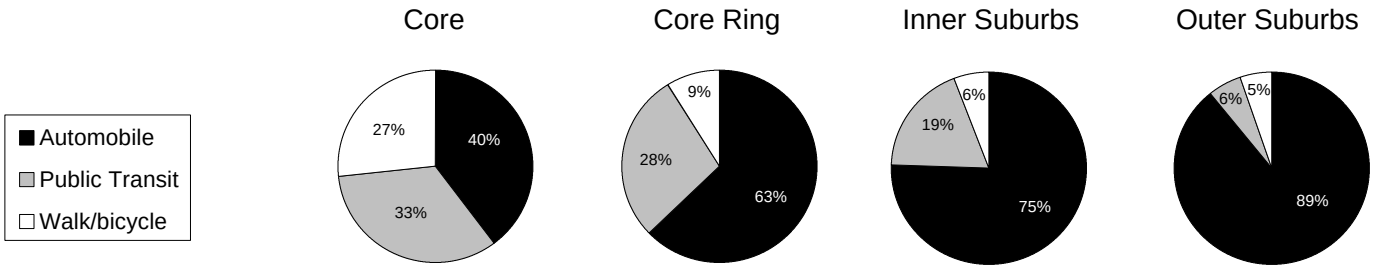


Sources: U.S.: Bureau of Transportation Statistics; Canada: Transport Canada; Germany: Wuppertal Institute.

*Note: Two people in a car travelling for 50 kilometres or 10 people in a bus travelling for 10 kilometres both result in travel of 100 person-kilometres.

Box 8 CST

Distribution of trips (pie charts), numbers of trips made, motorized distances travelled, and car ownership in the Greater Toronto Area in 1996 according to place of residence, and also residential densities (see the text for descriptions of Core, Core Ring, etc.)



	Core	Core Ring	Inner Suburbs	Outer Suburbs
Number of trips per day per person	2.06	2.23	2.26	2.51
Motorized distance travelled (km)	12.5	15.0	17.3	25.7
Households with no car	52%	31%	17%	6%
Residential density (persons per square kilometre of urbanized area)	8,500	5,900	2,900	2,000

Source: Transportation Tomorrow Survey, 1996.

URBAN AND SUBURBAN TRAVEL

In some parts of large urban areas, urban transit is far from insignificant, as Box 8 shows. (The data represented in Box 8 are for the Toronto region, for which the results of a major travel survey were reported in 1997. Other urban areas will be covered in subsequent issues of the *Monitor* as new data become available.)

Box 8 shows how persons living in the Greater Toronto Area (GTA) travel within the GTA. The four pie charts and associated numbers represent data about people living in different parts of the GTA.

The **Core** is downtown Toronto and the adjacent area, a total of some 18 square kilometres. The **Core Ring** is a band roughly 8 km wide around the Core. The **Inner Suburbs** are a band some 12 km wide around the Core Ring, mostly the former Cities of Etobicoke, North York, and Scarborough. The **Outer Suburbs** are the remainder of the GTA; they include the cities of Brampton, Markham, Mississauga, Newmarket, Oshawa, Vaughan, and many other communities.

The Core, Core Ring, and Inner Suburbs, on the one hand, and the Outer Suburbs, on the other hand, each have about half of the GTA's population of 4.6 million. The population of the Outer Suburbs grows rapidly; that of the remainder grows hardly at all. Indeed the Outer Suburbs of the GTA (together with the corresponding areas of Calgary, Edmonton, Montreal, Ottawa, Vancouver, and Winnipeg) are some of the fastest growing areas in Canada. As a result, **the travel patterns of the Outer Suburbs are more and more the future of travel in Canada.**

Box 8 shows that the farther a person lives from downtown Toronto, the more he or she travels by car and the less by transit or by walking or bicycle. Indeed, **people in the Outer Suburbs, even though they are in what is classified as an urban area, may do more of their travelling by car than the national average**. The daily distance travelled by motorized means is much greater, and consequently the environmental impact is much greater.

The data in Box 8 support the often-expressed view that automobile use is inversely related to residential density.

Box 8 shows too that most households living in and near downtown Toronto do not own a car, but that in the GTA's Outer Suburbs almost every household has at least one car. (Most have two or more.) It's not obviously a matter of income. Per capita income is highest in the Core, although income per household is lower there than in the other parts of the GTA. This is because households in the Core are smaller and have fewer earners on average.

The decline in the share of all motorized trips taken by public transit in the GTA seems to be levelling off. Earlier surveys showed it was 16.9 per cent in 1986 and 13.9 per cent in 1991. In 1996 it was 13.3 per cent. Each survey showed that walking and bicycling accounted for roughly eight per cent of all trips in the GTA.

ENERGY EFFICIENCY OF DIFFERENT PASSENGER MODES

Data allowing comparisons of the energy efficiencies of the different motorized means of moving people in Canada are hard to come by, and for a clue as to what is happening it may be necessary to turn to the not-too-dissimilar circumstances of the United States. Data on the different modes in the U.S. are shown in Box 9 on the next page. There has

been a marked deterioration in the performance of urban transit, and a marked improvement in the performance of personal automobiles. (This category has shown improvement even though it includes a growing proportion of vans, light trucks, and sport-utility vehicles.)

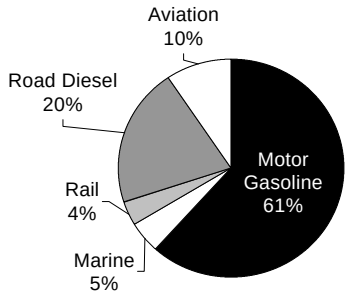
In the U.S., a car now uses less energy on average to take a person over a given distance than a bus. This has happened because cars have become more efficient per vehicle-km, while buses have become less efficient. More important, the average occupancy of buses has fallen more steeply than the average occupancy of cars. A bus in the U.S. uses more than six times as much fuel as a car, on average, but now carries less than six times the number of passengers.

Box 9 shows that other kinds of urban transit in the U.S. on average perform no better than buses in terms of energy use per passenger-km. Again, occupancy is likely the most important factor. School buses, intercity buses, and intercity rail perform much better than automobiles and urban transit.

The few available data suggest that buses in Canada may still be more energy efficient than cars per person-km, although the present trend may be towards what prevails in the U.S. The significance of the possible poor performance of Canadian urban transit is discussed below on Page 14.

Box 10 CST

Shares of sales of petroleum products for transport purposes in 1996



Total sales in 1996 = 55.1 billion litres.

Source: Transport Canada, T-FACTS.

TRENDS IN THE MOVEMENT OF FREIGHT

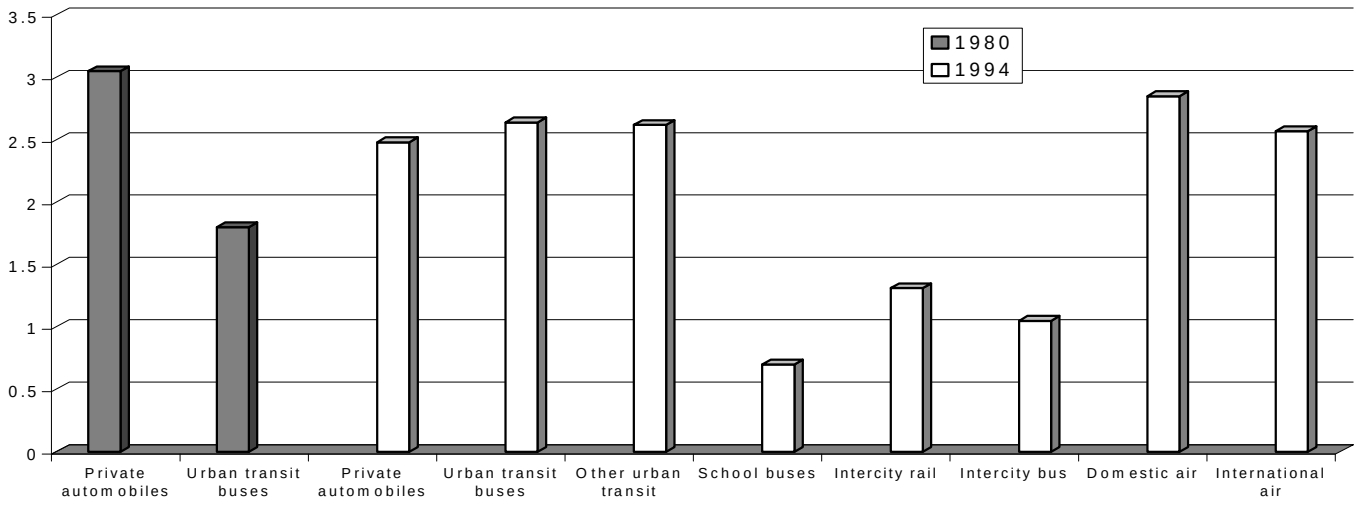
The initial focus here on the movement of people is justified because about 70 per cent of the energy used for transport in Canada is for the movement of people and about 30 per cent is for the movement of freight**.** This can be derived from Box 10, which shows a breakdown of the 1996 sales of the petroleum products that provide more than 99 per cent of transport energy. Motor gasoline and aviation fuel, both used mostly for the movement of people, comprised over 70 per cent of transport fuel. Road diesel fuel, and fuel for marine and rail, all used mostly for carrying freight, comprised the balance.

Because environmental impact is closely related to energy use, it follows that **overall the movement of people is responsible for roughly 70 per cent of transport's environmental impact. The movement of freight is responsible for almost all of the remainder**.

Energy use for the movement of freight is of particular concern because it has been increasing while energy use for the movement of people has remained relatively constant. This is shown in Box 11, where it can be seen that sales of road diesel fuel, used mostly for medium and heavy-duty trucks, have more than doubled since 1979 while sales of other transport fuels have remained relatively constant. The rela-

Box 9 CST

Actual energy intensities of passenger travel in the United States, megajoules per passenger-kilometre, 1980 and 1994

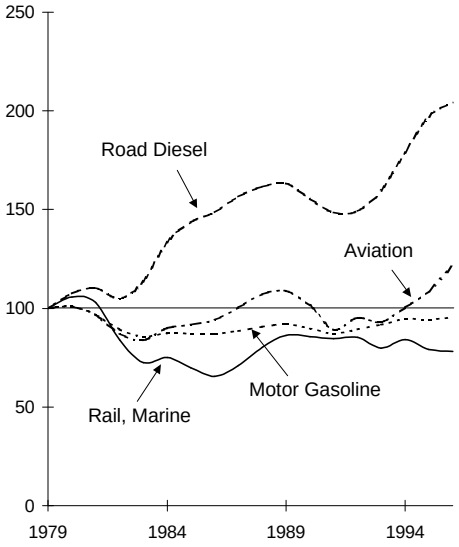


Source: U.S. Bureau of Transportation Statistics, *National Transportation Statistics*, 1997.

Note: One megajoule is equivalent to 948 BTU.

Box 11 CST

Sales of petroleum products for transport purposes (1979=100)



Source: Transport Canada, T-FACTS.

tive constancy of the sales of the other fuels is especially remarkable in view of the population increase of more than 20 per cent since 1979 and the increases in car use and air travel noted here in Boxes 4 and 5.

Indeed, **the increase in fuel used for the transport of freight by road is almost entirely responsible for the increase in transport energy use** that was illustrated in Box 1.

Each mode has natural advantages for carrying different types of goods, and the modes also vary in terms of energy use. Opportunities for major modal shifts are often limited, but the following modal energy-use comparisons are nevertheless relevant in a discussion of sustainable freight transportation.

Road freight uses about four times as much fuel overall as rail freight, but rail freight is responsible for more tonne-km of freight activity. This can be seen in Box 12, which shows that truck activity has been increasing, marine activity has been declining, and rail activity is about where it was in the early 1980s. The energy data in Boxes 10 and 11 and the tonne-km data in Box 12 together suggest that moving an item by truck over a given distance typically requires five to six times more energy than moving it by rail. Transport by water appears to require less energy than trucking per tonne-km, but more than rail.

Although Box 11 shows that overall the sale of aviation fuel is about where it was in 1979, it also shows a very recent increase in sales of aviation fuel that could be a cause for special concern. The increase has occurred notwithstanding what appears to be a levelling off in air travel (see Box 5), which may possibly mean that the long-term trend of improvements in the efficiency of air travel is at an end. It could also mean that there has been a spurt in the movement of freight by air. Data that would allow firm conclusions to be drawn are not available.

A NOTE ABOUT TRANSPORTATION DATA

Canadians depend more on travel and the movement of goods than the people of almost every other country, but the quality of the data collection about Canadian transportation has not been commensurate with this high level of dependence. Indeed, among the rich countries of the world, Canada has some of the least complete information about the movement of people and goods. The decentralization of responsibilities in Canada and the highly porous border with the United States make for special challenges in the collection and organization of transport data, but the challenges are no greater than are faced by several countries in Europe that have much better information.

A further challenge for Canada is that the U.S. produces among the best transportation data in the world, creating temptations to engage in what may be inappropriate extrapolation.

The recent requirement that Transport Canada submit an annual report to Parliament on Canadian transport activity holds out the promise of great improvement in the quality of Canadian transport data. The first report was submitted in late 1997 (entitled *Transportation in Canada, 1996*) and there is already evident progress in how data are organized, presented, and made available.

Data on the environmental impacts of transportation are even less complete than the data on transport activity.

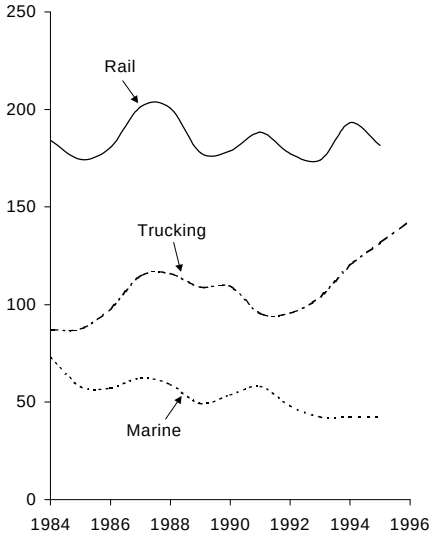
All this is by way of qualification with respect to the quality of the information presented here. There are evident imperfections, imbalances, and omissions. Every attempt will be made to achieve improvement in later issues of the *Monitor*.

GLOBAL ENVIRONMENTAL IMPACTS OF TRANSPORTATION

From an environmental perspective, sustainability is more about global than about local or regional impacts. The human and other species can survive local or regional distress, in that life can continue elsewhere, but global distress could mean the end of life, at least life as we know it. There are many effects

Box 12 CST

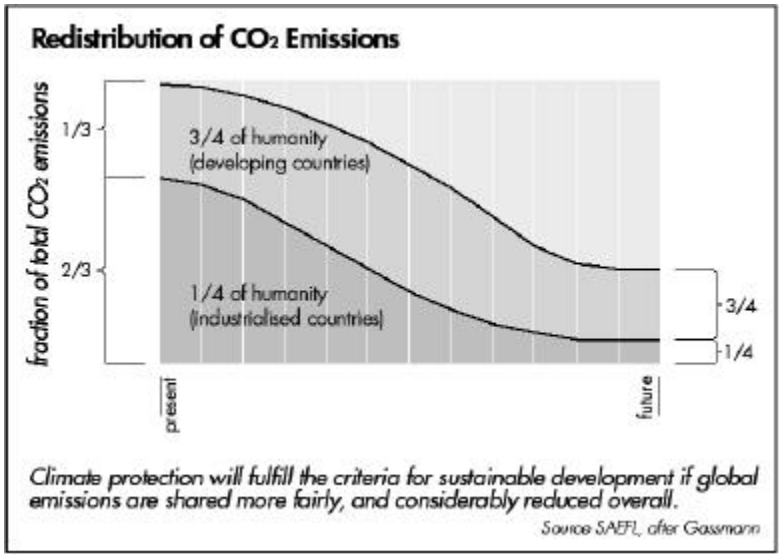
Annual freight movement in Canada by mode, 1984-1995, in billions of tonne-kilometres



Source: Transport Canada, T-FACTS.

Box 13 CST

View of a Swiss government agency as to how CO_2 emissions should be reduced



Adapted from *Climate in Danger: Facts and Implications of the Greenhouse Effect*, produced in 1997 by the Swiss Agency for the Environment, Forests, and Landscape.

of transportation that could have global impacts—often indirect, as air travel facilitates the spread of disease—but there is one global impact that probably outweighs in importance all of the others. It is the emission of carbon dioxide (CO_2) into the atmosphere from the burning of fossil fuel, including the fossil fuel that provides the energy for nearly all motorized transportation in Canada.

The IPCC's atmospheric scientists and other experts (see Page 1) for the most part believe that human activity, including motorized transportation, is resulting in accumulations in the atmosphere of CO_2 and other so-called greenhouse gases (GHGs) at a rate that if continued will produce catastrophe, perhaps during the 21st century. Overall, rates of emissions of greenhouse gases will have to be reduced by at least 50 per cent to avoid catastrophe. According to a Swiss government agency and others, this may mean reductions by as much as 80 per cent in the rich countries of the world so as to allow poor countries some room for development (see Box 13).

CO_2 is the most important GHG, accounting for 60-65 per cent of the human contribution to potential global warming, followed by methane (CH_4, 20 per cent), nitrous oxide (N_2O, 6 per cent), various halocarbons (CFCs, HCFCs, and HFCs, 6 per cent), and nitrogen dioxide (NO_2, unknown portion). Transport activity contributes to the emission of all these GHGs.

Transportation is *directly* responsible for about 21 per cent of GHG emissions worldwide, and about 27 per cent of the Canadian contribution. Because as much as 40 per cent of transport's total contribution is *indirect*—through vehicle manufacture, fuel production, etc.—**the actual contribution of transportation may be near 40 per cent of the total Canadian contribution to potential climate change**.

Direct CO_2 emissions from transportation are almost precisely related to vehicle energy use. Use of a megajoule of energy from diesel fuel or gasoline results in the emission of about 68 grams of CO_2. (Diesel-fuelled vehicles can produce lower CO_2 emissions per kilometre, even though they are often heavier, because the diesel engines usually use energy more efficiently. Natural-gas-fuelled engines are better still because less CO_2 is emitted per unit of energy used.)

Because of the relationship between energy use and CO_2 emissions, the data presented above on energy use (Boxes 1, 9, 10, and 11) can serve as indications of CO_2 emissions and their trends.

The data suggest that emissions of CO_2 from transportation have been increasing, but that this increase can be almost entirely attributable to growth in truck traffic. Very recently, some of the growth in CO_2 emissions can also be attributed to growth in aviation.

Methane (CH_4) is the main constituent of natural gas. Methane emissions are a by-product of the production of all fossil fuels. Methane leaks also occur during the transmission of natural gas used for vehicle fuel and during the refuelling process. Directly and indirectly, **transportation may be responsible overall for about 5 per cent of methane emissions in Canada**.

Nitrous oxide (N_2O)—not to be confused with nitrogen dioxide (NO_2), discussed below—is created during the operation of three-way catalytic converters. These are the devices used with great effect to reduce emissions of local pollutants during operation of gasoline-fueled engines. **Vehicle emissions comprise a substantial but unknown portion of N_2O emissions from human activity.**

The situation regarding CFCs, HCFCs, and HFCs, used in vehicle air conditioners, is uncertain in three respects. The first is that they make both positive and negative contributions to potential global warming, with the former probably but not certainly being stronger. The second is that CFCs are no longer produced and HCFCs are being phased out, although large quantities of both are still in use, as well as growing amounts of HFCs, the coolant

with the highest global warming potential. The third is related to the second: practices concerning the escape of these coolants into the atmosphere have changed dramatically during the last decade, with unknown impact. Available data do not allow an estimate of transport's contribution, except to suggest that it is not yet negligible.

The situation regarding nitrogen dioxide (NO_2) is especially interesting. It is an inevitable product of high-temperature combustion in air and is a significant contributor to local and regional pollution. Its action as a greenhouse gas appears low when released at ground level but may be as much as equal to the contribution of CO_2 at the altitude of the tropopause, where jet aircraft mostly fly. Thus although the global warming impact can be derived from energy use in the case of other transport modes, such derivation may seriously underestimate the contribution of aviation, which may be as much as twice what would be expected from the amount of fossil fuel used.

The contribution to potential climate change is the overwhelming concern of a global nature respecting transportation, but there are other global concerns that should be noted. Stratospheric ozone depletion is still an issue, and transportation makes a contribution from vehicle air conditioning and some production techniques. Transport's contamination of land and particularly water may result in irreversible effects on a global scale. Some local and regional pollutants also have a more global impact: ground-level ozone produced in South East Asia has been shown to drift across the Pacific.

LOCAL AND REGIONAL ENVIRONMENTAL IMPACTS OF TRANSPORTATION

There are at least two ways in which local and regional impacts bear on the environmental sustainability of transportation. The first is that the overall effect of widespread local impacts can be global. To give a hypothetical example: a global impact would occur if every human exposed to vehicle pollution were to be less fertile as a result. The second is that local and regional impacts are usually felt more strongly than global impacts. Their identification is thus more likely to produce mitigating action—action that may as a by-product reduce global impacts of transportation.

The principal emissions from transportation that result in local and regional pollution are listed in Box 14 together with the estimated contribution transportation made in 1994 to the total emissions of each pollutant and trends in these emissions from transport and other sources.

Box 15, on the next page, shows the trends in atmospheric pollution as measured at (mostly urban) monitoring sites in Canada. The table in Box 15 needs some explanation, both in itself and in relation to the table in Box 14.

Regarding Box 15, the last two columns show the average annual level of each pollutant in 1990 in relation to the desirable annual average; the concentrations are expressed in micrograms per cubic metre ($\mu g/m^{-3}$). 'Desirable levels' represent long-term goals set out in Canada's National Ambient Air Quality Objectives. No desirable level is set for ozone, and so the *acceptable level* is shown—defined as the level that provides adequate protection against adverse effects on humans, animals, vegetation, soil, water, materials, and visibility. Desirable levels are generally 33-50 per cent below acceptable levels. There is no objective of any kind for carbon monoxide based on annual averaging periods; eight hours is the longest period.

Regarding the relation between Boxes 14 and 15, the main thing to note is that Box 14 concerns *emissions* and Box 15 concerns *atmospheric concentrations*. The two tables differ in the pollutants covered because of measuring practices and because ground-level ozone is not emitted from vehicle exhausts (and other sources) but is the product of the action of sunlight on emissions, chiefly nitrogen oxides and volatile organic compounds.

Box 15 indicates that overall the amounts of transport-caused pollution in the air have been falling. Between them the tables in Boxes 14 and 15 highlight two pollutants to be of concern: **particulates because transport's contribution is rising, and ground-level ozone because its atmospheric concentrations remain on average above an acceptable level**.

Recent evidence suggest that there should be a revision in the way particulates are measured, and that the proposed revision could well result in increased concern about emissions of particulates from transport activity.

Box 14 CST

Trends in the contribution of transportation and other sources to local and regional air pollution in Canada

Pollutant	Contribution of transport to total emissions in 1994	Change in total emissions, 1980 to 1994	
		From transport	From other sources
Sulphur oxides	5.1%	0.0%	-42.5%
Nitrogen oxides	58.6%	-9.9%	+1.8%
Particulates	8.6%	+44.9%	-13.5%
Carbon monoxide	64.4%	-16.4%	-1.9%
Volatile organic compounds	24.7%	-35.1%	+28.7%

Source: OECD Environmental Data, 1997.

Box 15 CST

Trends in the atmospheric concentration of indicated pollutants at monitoring sites in Canada

Pollutant (No. of sites in 1990)	Change in concentration (period)	Average level	Desirable level
Sulphur dioxide (59)	-61% (1974-1992)	16	30
Nitrogen dioxide (42)	-41% (1977-1992)	39	60
Particulates (73)	-55% (1974-1992)	39	60
Carbon monoxide (46)	-68% (1974-1992)	n.a.	n.a.
Ground-level ozone (44)	-33% (1979-1992)	36	*30*

Source: OECD Environmental Data, 1997; Environment Canada.

The concern is specifically about the levels in the air of the smallest particulates—i.e., less than 2.5 microns—which are especially harmful to health and especially likely to be a component of diesel exhaust. Breathing such fine particles is associated with numerous adverse conditions of the respiratory tract, including asthma and lung cancer. In Canada, diesel engines are found mostly in medium- and heavy-duty trucks and in buses.

Diesel engines are also involved in the production of nitrogen oxides (NO_x). NO_x are an element in the production of ground-level ozone, whose atmospheric levels remain unacceptable (see Box 15). **A heavy truck or bus that just meets early 1990s emissions standards typically produces two to three times as much NO_x per unit of energy consumed as a private automobile that just meets its comparable standards.**

Formation of ground-level ozone—also known as *summer smog*—requires three constituents: NO_x, volatile organic compounds (VOCs), and sunlight. Box 14 indicates that emissions of VOCs from non-transport sources have been increasing. This could lead to the suggestion that non-transport sources are more responsible for the increase in ground-level ozone levels. However, levels of NO_x are usually the limiting factor in ozone formation (given sufficient sunlight); in this respect, Box 14 suggests that transport and non-transport sources of NO_x may be similarly implicated. **Perhaps as much as 60 per cent of NO_x emissions from transport come from diesel engines.**

When reviewing the atmospheric impacts of transportation, **consideration should be given to the quality of the air *inside* motor vehicles, which can be much worse than the surrounding air.** One expert wrote, "Drivers and passengers in cars may inhale up to 18 times as much pollution as people outside their vehicles, the worst occurring in congested slow-moving conditions in urban areas." Of special concern are in-vehicle accumulations of carbon monoxide, benzene, and NO_2.

There are numerous other local and regional impacts of transportation, notably noise, contamination of land and water, and disruption of species migration by land transport routes. There are few data on these impacts.

IS TRANSPORTATION IN CANADA BECOMING MORE OR LESS SUSTAINABLE?

From an environmental perspective, ***transportation in Canada is becoming less sustainable*.** Energy use by the transport sector is increasing at a higher rate than energy use by other sectors. Some local and regional pollutants associated with transport activity are at unacceptable levels.

Closer analysis has shown that almost the entire growth in energy use is due to growth in truck traffic. The growth in aviation activity is also of concern. Other types of traffic have not grown or, in the conspicuous case of private automobiles, have experienced improvements in environmental performance that have offset the growth in activity.

The trends for non-truck traffic are less dramatic than for truck traffic, but they are not moving in the direction of sustainability. This is shown most clearly in Box 11, where it can be seen that energy use for transportation shows no sign of declining at all—not by the amounts considered by the Centre for Sustainable Transportation to be necessary for sustainability nor even by the much more modest reductions that may be required by the recently signed Kyoto Protocol on Climate Change.

THE KYOTO PROTOCOL AS A STEPPING STONE TOWARDS SUSTAINABILITY

The Kyoto Protocol, adopted on December 10, 1997, binds Canada—subject to ratification by March 1999—to reducing its total emissions of six greenhouse gases by six per cent below 1990 levels by a date between 2008 and 2012. The six gases are carbon dioxide, methane, nitrous oxide, and hydrofluorocarbons—all noted above as emissions related to motorized transport—as well as perfluorocarbons, produced during the production of aluminum, and sulphur hexafluoride, used as an insulator in power grids. (The base year for the last three gases can be as late as 1995.) Of the six, by far the most significant is carbon dioxide, human-caused emissions of which arise almost entirely from the burning of fossil fuels.

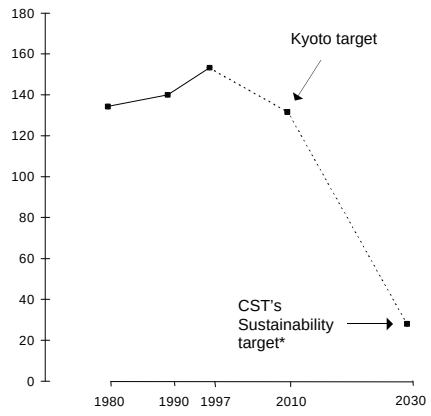
The Kyoto Protocol allows credit for increases in CO_2 sinks such as forests to offset CO_2 emissions. It also allows purchases and other transfers of credits among countries. What the Protocol essentially means, however, is that by

about 2010 use of fossil fuels in Canada must be about six per cent below 1990 levels. **The working assumption here—likely to be controversial—is that the transport sector will be required to contribute its proportionate share, i.e., it will have to demonstrate a six-per-cent reduction in fossil fuel use from 1990 levels.**

Box 16 illustrates what the Kyoto target would mean for CO_2 emissions from transport in the light of the recent performance of this sector. It also shows what further reduction will be required by 2030 to realize the Centre's vision of sustainable transportation. The change in trend required by the Kyoto Protocol is from an annual 1.3 per cent *increase* between 1990 and 1997 to an annual 1.2 per cent *decrease* between 1997 and 2010. The rate of reduction in emissions required after 2010 will have to be a much larger 7.4 per cent annually if sustainability is to be achieved by 2030.

Box 16 CST

Actual, estimated, and targetted total emissions of CO_2 from transportation in Canada in selected years (megatonnes)

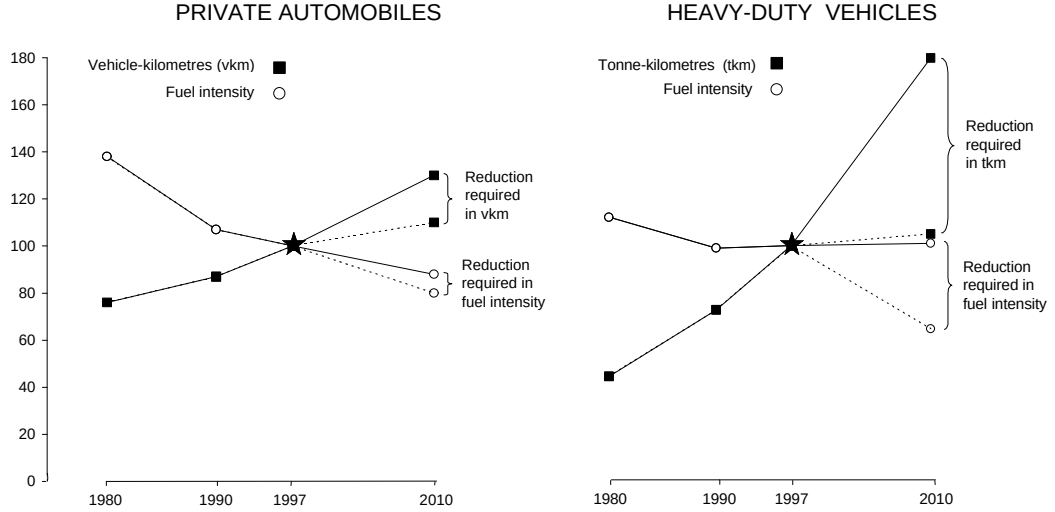


Source for 1980-1997 values: *OECD Environmental Data, 1997*.

*See the CST's *Definition and Vision* statement

Box 17 CST

Actual and estimated transport activity and fuel intensity, 1980-1997, and the changes required if the Kyoto target is to be met in the manner of Option 1 described in the text (1997=100)



Source for 1980-1997 values: Transport Canada, T-FACTS.

Moving to an annual 7.4-per-cent decrease in CO_2 emissions to attain sustainable transportation in 2030 will be difficult, but it may not be much more challenging than the move from a 1.3 per cent annual increase to a 1.2 per cent annual decrease that must occur very soon if the Kyoto commitment is to be met. Indeed, once CO_2 emissions are well and truly declining, it may be easy to increase the rate of decline. **By setting clear targets and requiring change in the direction of trends in CO_2 emissions, the Kyoto Protocol can be seen as a beneficial stepping stone towards sustainable transportation.**

HOW CANADA'S KYOTO TARGET COULD BE MET

This section aims to provoke discussion and action as to what must be done to meet the Kyoto target as a stepping-stone to the longer-term goal of securing sustainable transportation. It sets out possible options for action to illustrate some of the issues and indicate the kinds of action that will be required. **The options set out here should not be regarded as specific proposals; they require more analysis and much more discussion.** Supporting calculations, information, and analysis can be found in the background document.

There are basically two ways to reduce vehicle emissions. One is to improve transport technology (vehicles, fuels or infrastructure). The other is to reduce or change transport activity. Preliminary work at the OECD suggests that attaining sustainable transportation through improving transport technology alone would be extremely costly. Transportation would be consuming an unrealistically high proportion of the Gross Domestic Product. Doing it all through reducing or changing transport activity would be extremely socially disruptive. A mix of the two is needed.

What seems to be emerging from the OECD work is that **the most feasible mix may well be about one third technology improvement and about two thirds activity reduction or change.** For the moment, this seems a good guideline to work with.

Another guideline could be that measures should be implemented during the Kyoto commitment period (1997-2010) with the more challenging sub-

Box 18 CST

Measures that could be used to reduce emissions of greenhouse gases

- Raise fuel taxes
- Impose strict fuel efficiency standards
- Improve public transit
- Conduct educational campaigns
- Implement on-road inspection programs
- Intensify land use
- Reduce material consumption
- Impose taxes/restrictions on ownership
- Provide incentives for the use of efficient vehicles
- Introduce system-wide road pricing

sequent two decades in mind, i.e., the period leading up to 2030, which is the Centre's preliminary target date for the attainment of sustainable transportation. It may be possible to meet the Kyoto target for a particular transport mode by technological means alone. However, because fundamental changes in transport activity will certainly be required during subsequent decades it could be helpful to prepare for the later period by using measures designed to secure such changes during the Kyoto period.

Box 17 sets out the scales of the changes required for private automobiles and for medium- and heavy-duty trucks if the above guidelines are followed. (Technological improvement is represented here as reductions in fuel intensity, i.e., fuel use per unit of transport activity.) The solid lines in Box 17 show what has been happening recently and what can be expected in 2010 if no special measures are taken to meet the Kyoto target. The dotted lines show what has to be achieved if the Kyoto target is to be met in a manner consistent with the above two guidelines.

IMPLICATIONS FOR CARS. The target for cars (including sport-utility vehicles etc.) could be relatively easily achieved, because the current trends are relatively favourable. Although private automobile vehicle-kilometres in 2010 are expected to be 30 per cent above 1997 levels if no special measures are taken, the fuel intensity of the fleet is set to improve by 12 per cent.

To meet the guideline that two thirds of the required reduction in CO_2 emissions is to be achieved through activity changes and one third through technological improvement, total vehicle-kilometres in 2010 would have to be reduced by 15 per cent from what they otherwise would have been, and fuel intensity would have to decline by an additional 8 per cent.

Many methods exist for governments to bring about reductions in transport activity and improvements in transport technology. Box 18 lists some of the measures that have been frequently proposed—and in some cases used.

Evidence on the effectiveness of measures suggests that the most productive strategies for changing transport activity are likely to involve several if not all of the measures listed in Box 18. The importance of coordinated implementation of a wide range of measures is understood, but the analysis that follows is nevertheless limited to the first two measures. This is done to illustrate the issues with some clarity and demonstrate the type of work that must be done before deciding upon a course of action to reduce GHG emissions.

These measures—raising fuel prices and tightening fuel efficiency standards—are two of the most frequently discussed measures. There is a considerable body of evidence, often inconclusive, as to their effectiveness. Much of it has been taken into account in the present elaboration of options.

How much would fuel taxes have to be raised to secure the required 15-percent reduction in automobile use? Deciding this depends on knowing the price elasticity of travel demand, i.e., the percentage reduction in vehicle-kilometres that results from a given increase in price. The best estimates of elasticity with respect to motor vehicle fuel are that the short-term elasticity (i.e., within five years) is in the order of 0.3 and the medium-term elasticity (5-15 years) is about 0.7. Thus the average elasticity for the Kyoto commitment period may be about 0.5. This means that a fuel price increase of 30 per cent would be required to achieve a travel reduction of 15 per cent. **The Canadian average 1997 gasoline price of close to 60¢/litre (before GST) would have to be increased to about 78¢ (in 1997 dollars).** This increase could be achieved by raising the current federal gasoline tax of 10¢/litre to 28¢, or by raising the federal and provincial taxes, now totalling an average of about 27¢/litre, to 45¢.

Stimulating sufficient technological improvement to meet the balance of the Kyoto commitment would be a comparatively simple matter. The mandated Corporate Average Fuel Efficiency (CAFE) standards in the United States and the corresponding voluntary Corporate Average Fuel Consumption (CAFC) standards in Canada were effective in reducing the energy consumption of North American automobiles in the 1970s and 1980s. They could be used to achieve the further reduction in fuel intensity required to meet the Kyoto commitments. **The tax increases alone, working through the market, could stimulate a sufficient measure of improvement in fuel efficiency, but the application of appropriate standards would ensure that it happens.**

In any year, new cars represent roughly one fifteenth of the total automobile fleet, which suggests that many vehicles in use today could still be in use in 2010. Accordingly, the extra reduction required in the average fuel intensity of *new* vehicles may have to be greater than the 8 per cent estimated above, say 10 per cent.

Standards such as CAFE work only for new vehicles. Inspection and maintenance programs, such as exist in British Columbia and are planned for Ontario, can serve to ensure good performance as a vehicle ages.

IMPLICATIONS FOR TRUCKS. The trends for trucks are not as favourable. Box 17 suggests that the number of tonne-kilometres is expected to increase by 80 per cent between 1997 and 2010, based on present trends. Fuel intensity is expected to be unchanged. Applying the above guidelines would mean a cut of more than 40 per cent in truck activity, and a reduction of more than 35 per cent in fuel intensity. Assuming similar relationships between price and transport activity, **the price of diesel fuel would have to rise from about 50¢/litre to about 90¢/litre**, through commensurate increases in taxes.

The required reduction in the fuel intensity could occur at least in part as a result of the fuel price increases. Stricter fuel efficiency standards, similar to CAFE/CAFC and supported by inspection and maintenance programs, would ensure that the necessary improvements occurred. As for cars, the increase in *new-vehicle* performance required to reduce the average fuel intensity of the truck fleet by 35 per cent would likely have to be higher, perhaps in the order of 40 per cent.

The guidelines used above may be the most appropriate for the long term, but their application to achieve the Kyoto target could result in what may be uncomfortably large and even impracticable increases in the price of diesel fuel. This could be supported on the grounds that diesel engines are the prime source of breathable particulates. They also produce a disproportionate amount of nitrogen oxides, implicated in smog formation and acid rain.

However, the adverse economic impacts of such increases could outweigh the environmental and economic benefits, especially if corresponding price increases are not implemented in the U.S.. Moreover, private automobiles are responsible for emission of more than twice as much CO_2 as trucks. Thus it may be useful to consider other options for reaching a Kyoto target for the transport sector, options that put more emphasis on technological change and put more of the burden of attainment on private automobiles.

TWO OTHER OPTIONS are summarized as Options 2 and 3 in Box 19. **Option 1** is set out above. **Option 2** reverses the emerging OECD guideline concerning the balance between the contributions of technology and activity reduction or change: for the Kyoto period, one third of the contribution would come from activity reduction or change and two thirds from improvements in technology.

Option 3 builds on Option 2 by further adjusting the contributions of activity change so that the required percentage price increases are the same for cars and trucks, and then adjusting the contributions of technology so that each transport mode makes the same overall contribution to meeting the Kyoto target as for Option 2. Box 19 shows the increases in prices and reductions in fuel intensity required by Options 2 and 3.

Thus in meeting the assumed Kyoto target for transportation various trade-offs may be possible between activity change and technological improvement and between the movement of people and the movement of freight. **The options presented here would all require both real increases in fuel prices and substantial improvements in technology, particularly for trucks. Other options are possible for meeting the Kyoto target.** They should be defined and discussed.

What should also be discussed is the extent to which attainment of a Kyoto target might rely on raising fuel prices and tightening fuel-efficiency standards alone, or might better involve use of other measures listed in Box 18. As noted earlier, measures can be mutually reinforcing. For example, applying at the same time both increased prices for automobile use and improved public transit would likely be more effective—and more equitable—than applying either measure alone.

FURTHER COMMENTS ON FREIGHT TRANSPORT. The previous analysis suggests that attainment of even the Kyoto target may be difficult for the road freight industry. Some mitigating factors should be noted.

One is that the projections for freight traffic are in tonne-km, because data are normally available only in this form (or as tonnes of freight moved, without reference to distance). The indicator of real concern, however, is vehicle-km, because CO_2 emissions are determined more by the distances travelled by vehicles than by what is carried. The impact of truck traffic could be much reduced by improving the loading of vehicles, i.e., by carrying

Box 19 CST

Summary of some options for meeting the Kyoto target as they apply to cars and trucks

Options defined in text	Changes in new-vehicle fuel intensity (%)		Changes in transport activity (%)		Required fuel prices (in 1997¢/litre)	
	Cars	Trucks	Cars	Trucks	Gas	Diesel
Option 1	-10	-40	-15	-40	78	90
Option 2	-17	-55	-8	-20	70	70
Option 3	-17	-70	-8	-8	70	58

Notes: Changes in fuel intensity and activity are from levels in 2010 estimated from recent trends. Required fuel prices are based on current average pump prices of 60¢ for gasoline and 50¢ for diesel fuel (both before GST).

the same total amount of freight in fewer vehicles, preferably by improving their load factors rather than by increasing vehicle size. This would require more attention to the specifics of freight logistics, which may be more likely to happen if fuel prices rise.

A large part of the cause of the rise in truck traffic appears to be the adoption of 'just-in-time' (JIT) logistics, which substitutes numerous deliveries to a production plant for conventional warehousing. A U.K. Royal Commission found that JIT typically involves use of more than twice as much transport energy as conventional warehousing. What may be required is a system that allows the production efficiencies of JIT but with much reduced transport impacts. This could involve more local sourcing of parts, even to the extent of housing suppliers under the same roof as the assembly operation.

A higher price of gasoline is likely to reduce travel. A higher price of diesel fuel could mean that much freight would be moved by rail rather than road, with a resulting increase in CO_2 emissions from rail operations. The increase would be relatively small. As noted above, in moving a given amount of freight rail typically uses less than one fifth of the energy used by trucks.

IMPLICATIONS FOR OTHER MODES. Similar tax increases and requirements for technological improvement could well be required of other modes. Aviation presents a special challenge both because it may be set for large increases in traffic and because international agreements limit the application of fuel taxes. The government of the Netherlands is rallying support for agreements that would allow aviation fuels to be taxed in the way that other fuels are taxed.

WHAT TO DO WITH THE INCREASE IN REVENUES. The increase in annual tax revenue from the implementation of Option 1 could be close to $12 billion. This is a little more than the total of current federal and provincial revenues from taxes on fuels, including the GST, and a little less than the total of all revenues from the GST. The increase in revenue from each of Options 2 and 3 would be about half of the revenue from Option 1. The new revenue could be used to reduce the GST or to reduce income taxes. Some of it could be used to provide short-term compensation to businesses and governments for loss of revenue due to the proposed changes. Some of it could be used to stimulate more sustainable modes including walking and bicycling, rail freight, and well-occupied, fuel-efficient public transit.

Even at 78¢ and 90¢/litre both gasoline and diesel fuel would still cost less than in any country in Europe, where prices in excess of C$1.50/litre are not unusual. However, the critical comparison is with the U.S.. Canadian prices would be far above U.S. prices, unless U.S. prices were also to rise. (The U.S. pump price of gasoline now averages about C$0.45/litre.) They may well have to be raised to ensure that the more challenging, seven-per-cent Kyoto commitment undertaken by the U.S. administration will be met, even though opposition to fuel price increases may be even stronger in the U.S. than in Canada.

BEYOND KYOTO

Fuel tax increases and incremental technological improvements will likely not be sufficient to achieve the kinds of reductions in CO_2 emissions required for attainment of sustainable transportation.

Truly difficult things will have to be done, such as curbing sprawl and deterring car ownership. Above all achieving sustainability will require a change in societal attitudes. Burning fossil fuel in public may become as socially unacceptable as burning tobacco. Eschewing motorized transportation may become chic, and using local products may become stylish. (The Swiss government has already begun to discuss the rationing of foreign travel—in the document from which the diagram in Box 13 was reproduced.)

Public transit poses a dilemma for sustainable transportation. In theory it should be more environmentally sound than automobile use. As Box 9 shows, this may not be the case in current practice. Expansion of public transit systems could be counterproductive if the main result were to be more fuel use. The transit industry has reason to be profoundly concerned by this possibility. It may want to act to ensure that it is part of the sustainability solution and not part of the sustainability problem.

The most important feature of public transit may not be its reputed and possibly spurious energy efficiency but rather the way in which it obviates automobile ownership. Buying a car is the biggest stimulus to car use. If available public transit helps avoid the purchase then there is likely a large gain in progress towards sustainability. However, the undoubted efficiencies to be achieved with well-occupied transit should not be overlooked, nor should the opportunities presented by rail-based systems for the use of renewable sources of energy.

PROMISING SIGNS

Canada's transportation systems are far from being sustainable, and in some respects are becoming more unsustainable. Attainment of even the Kyoto target will be challenging for many sectors of society. These challenges will be made easier if many promising signs of beneficial change become realized into widespread practice. Some of them are noted below. To the extent that they flourish they could reduce, even if slightly, the need for the strong actions discussed above.

CAR SHARING. Canada is one of the many countries in which a new approach to car ownership is emerging, one that offers many of the advantages of ownership (and

some additional advantages) **while reducing the motorized travel of participants by an average of close to 50 per cent**. It is known as car sharing. The system exists in more than 100 cities in Europe, in some U.S. cities, and also in Montreal, Quebec City, Toronto, Vancouver, and Victoria. It can be managed commercially, as in Montreal, or cooperatively, as in most cities where there is a car sharing system.

Here is a description of car sharing taken from the Web page of CarSharing Portland:

"Car sharing is joint access to a fleet of vehicles, located throughout neighborhoods, close to your home or work. When you want to use a car, you simply make a phone call to reserve a car for future use or find out if one is available for the length of time you need it. ... To use the car, simply walk or bike to the location, typically 3 to 5 blocks away, use your access key and drive away. At the end of your trip, return the car, lock it up and you're done. You pay only for what you use. Members have access to any vehicle in the fleet."

The advantages over regular car rental are the location of the car sharing sites within residential neighbourhoods and numerous features geared towards substituting for car ownership rather than meeting the special demands of business users.

For some people car sharing is a low-cost way of having ready access to an automobile, and thus the availability of car sharing can increase their use of motorized transport. Indeed, car sharing is being promoted in Singapore, one of the most costly places in the world to own a car, as a means of allowing more people to drive. However, the general finding noted above stands: the motorized travel of a person or household joining a car sharing system typically falls by close to 50 per cent.

Good sources of information about car sharing in Canada are Benoît Robert of Auto-Com (Quebec City, 418 523-1788) and Tracey Axelsson of the Co-operative Auto Network (Vancouver, 604 685-1393)

RIMOUSKI'S TAXIBUSES. This small city in eastern Quebec provides a model as to how to provide effective public transit in areas (such as most of urban Canada) where ridership is not high enough to justify provision of comprehensive public transit by means of regular fixed-route, fixed-schedule services. Rimouski is a spread-out city and it was found particularly expensive to run even the bare minimum of hourly bus service on four routes from 7 a.m. to 6 p.m. Since late 1993, public transit has been provided entirely by the city's taxicab companies. Instead of a few dozen bus stops there are 253 designated pick-up and set-down points throughout the city. Most people live within a few minutes walk of one.

If you call Taxibus Rimouski, giving at least an hour's notice, a cab will be at the pick-up point of your choice at the indicated time to take you to any set-down point in the city for a flat fare, currently $2.30; a monthly pass allows unlimited trips for $67.75. You may be sharing your taxibus with other riders and thus may not go directly to your destination; but you'll be there much sooner than would have been the case by regular bus and almost as soon as if you had driven yourself. You will have a warm vehicle on a cold day, no driveway to clear, and you get to meet some of your neighbours. If you want door-to-door service in an unshared cab you can call one the cab companies directly for regular taxi service.

Taxibus Rimouski is a municipal service, ultimately managed by the City but operated by the private sector. The subsidy is less than the City would have spent on the minimal bus service indicated earlier. This kind of on-demand transit service may well be the wave of the future for the low-density parts of large urban regions and for smaller cities that find it difficult to justify a regular service.

Is taking Taxibus Rimouski more environmentally sound than driving a car? Perhaps not directly, but there is another important factor to consider. Acquiring a first, second or even third car almost always means a big boost in the number of motorized trips made by a household. **The availability of a public transit system, whether it provides fixed-route, fixed-schedule service or on-demand service, helps a household avoid car purchase.**

For more information call Louis-Marie Beaulieu of the City of Rimouski at 418 723-5555.

THE WALKING SCHOOL BUS. Increasingly children are being driven to school, even though they live only a walk from school, because of parental fears about road safety and about other kinds of harm. The extra driving increases the risk to kids who continue to walk and increases neighbourhood pollution, particularly in the vicinity of the school. Also, children receive added exposure to the high pollution levels found *within* automobiles.

The Walking School Bus—an example is shown below—resolves many of these problems. Interested parents, usually of 6- to 9-year-olds, mark their home on a map

of the school's catchment area. Natural 'bus routes' are identified. Parents on a route decide how they want to operate their 'bus' and establish 'driver schedules'. A participating parent might have a regular 'driving' duty once each week.

In many communities in Canada the Walking School Bus means that children get exercise and fresher air, get to know their neighbourhood better, learn about streets and traffic, and enjoy participating in cooperative activity. **It also means there is less motorized transportation.**

For more information call Jackie Kennedy at 416 488-7263 or visit the Active and Safe Routes to School Web site at www.activeliving.ca/activeliving/go4green.

THE CENTRE FOR SUSTAINABLE TRANSPORTATION

The Centre was formed to help overcome the barriers to the attainment of sustainable transportation, in Canada and elsewhere, through the provision of well reasoned and balanced information and analysis. It began work in 1996 with start-up funds from two departments of the Government of Canada, Environment Canada and Transport Canada.

The Centre's mission is to provide leadership in achieving sustainable transportation in Canada by facilitating cooperative actions, and thus contributing to Canadian and global sustainability. To achieve this, the Centre will:

- focus attention on national, regional and local sustainable transportation issues and opportunities;
- generate impartial, factual information on these subjects; and
- provide a neutral forum within which all active parties can work together to achieve sustainable transportation goals.

The Centre's first publication was its *Definition and Vision of Sustainable Transportation*, published in mid 1997. The present document, the *Sustainable Transportation Monitor*, is the first of a series to be published annually or more frequently. It will provide continuing evaluation and discussion of progress with respect to sustainable transportation and related matters.

Comments on this first issue of the *Monitor* and proposals as to what should be covered in subsequent issues will be very much appreciated. E-mail is the preferred mode of communication but input by any mode will be welcome. Please see the front page for our e-mail address, fax and phone number, and mailing address. You may want to make use of the response form inserted into this issue.

The Centre has several ongoing and planned projects concerning sustainable transportation. One aims to introduce more content about sustainable transportation into the training of transportation professionals. Another concerns teaching pre-adolescent children about sustainable transportation.

Le *Bulletin du transport durable* est disponible en français