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TABLE RONDE NATIONALE SUR L'ENVIRONNEMENT ET L'ÉCONOMIE

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PROGRAM FOR SUSTAINABLE TRANSPORTATION
SYNTHESIS OF DOCUMENTATION

Prepared for:
National Round Table on the Environment and the Economy
Task Force on Sustainable Development
Transportation

Phase 1, Step 1 - Draft Report
September 6, 1996

Prepared by:
APOGEE RESEARCH

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1. INTRODUCTION

1.1 The Unsustainability of Transportation in Canada

Despite decades of highway construction and investments in public transit in major urban regions, we are still faced with increasing congestion, serious health impacts from deteriorating air quality, and increasing social isolation for the roughly one third of our citizens who are unlikely to ever drive a car. Population growth, low density urban settlement patterns, the explosion of global communications and steadily increasing use of high energy intensive modes of transport including cars, trucks and aircraft, have combined to make transportation unsustainable.

John Whitelegg suggests there is a "boomerang" effect in building transportation systems. "If we build a freeway system or an extended airport system to meet some prediction of future demand, then we should not be surprised to discover that these investments hasten our progress in that direction. Our plans and analyses boomerang so that our efforts are rewarded by the return of the problem, usually with some force and destructive impact".[1]

To this list, we must now add the continuing growth in emissions of greenhouse gases from the transport sector and the contribution of those emissions to global climate change. Transportation is responsible for about 22% of global greenhouse gas emissions and is the fastest growing source world-wide. Per capita emissions of greenhouse gases from transportation in Canada and the U.S. are approximately three times greater than the average in other OECD countries.

Governments face declining financial resources with which to meet demands for maintaining and expanding transportation infrastructure. There have been continuous calls for increased transit spending in Canada over many years but transit ridership continues to fall. Toll roads are being built in Ontario and Nova Scotia to pay for new highways. From airports to highways to marine ports, governments are divesting themselves of responsibility for funding massive additions to infrastructure which will be necessary if current demand trends continue.

The relative decline and rationalization of rail systems for moving goods in Canada continues in the face of competition from trucking. This is occurring despite the fact that energy use and associated environmental impacts of trucking are several times greater per tonne kilometre than those of rail.

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[1] *The Information Society and Sustainable Development,* Journal of World Transport Policy & Practice, Vol.2, 1996, page 4

Air transport continues to be the fastest growing source of air pollution from transportation and a major challenge for both the public and private sectors in terms of financing the infrastructure needed to meet relentless increases in demand. All indicators point to continuing growth in air transport in the decades ahead, at rates that will overwhelm any projected advances in aviation fuel efficiency.

It is important to understand the deep roots such trends have in our economic, political and social systems. They are integral to Canadians' lifestyles, have been evolving over many decades, and will not change easily. For example:

- Canadian consumers demand and get strawberries flown from Chile, tangerines from Morocco, and tomatoes trucked from Mexico. International trade in food products is only one of many examples of the market's ability to satisfy the desires of consumers with a growing capacity and willingness to pay, despite the environmental, social and economic consequences. Liberalisation of trade is increasing the international flow of goods. Growing percentages of this international freight is moving by high energy intensive modes, including trucks and aircraft.

- Children who in previous decades would have ridden their bicycles to school, the hockey rink or the ballet class, must now be driven because of fear for their safety, or just the physical separation among home, school and recreation facilities.

- Elderly people, who are no longer able to drive and do not have direct access to good public transportation, are isolated and dependent on others for access to any needs outside of their homes.

- Masses of people now take annual vacations using air transport to get to international destinations. A family of four which chooses to fly to Disney World uses over twelve times more fuel than they would have consumed by making the same trip by car. A passenger flying from Toronto to Paris will be responsible for consumption of enough fuel to drive an automobile for about 35,000 kilometres in Canada.

There is a growing consensus that changes must occur. Indeed, driven by increasing air pollution, increased congestion and government fiscal constraints, some changes *are* occurring. But the pace is slow and the measures taken to date are unlikely to move us very far towards a transportation system that is sustainable in the long run.

1.2 NRTEE's Program for Sustainable Transportation

In light of these unsustainable trends in Canada's transportation system, the National Round Table on the Environment and the Economy established a Task Force on Sustainable

Transportation. The Task Force has developed a program to assist the Government to prepare a reference framework for the development and implementation of a sustainable transportation strategy in Canada.[2]

Specifically, NRTEE's Program for Sustainable Transportation has four objectives and five phases, as described in Exhibit 1.1.

Exhibit 1.1
NRTEE's Program for Sustainable Transportation

OBJECTIVES

1. Establish the Elements of a Strategy for Sustainable Development (existing situation)
2. Determine What the Requirements and Restrictions are for Implementing It (existing situation)
3. Provide Solutions (state of the debate)
4. Suggest a Reference Framework for Sustainable Transportation (position of NRTEE)

PROGRAM PHASES

1. Report on the State of the Art with an Issues Paper
2. Forum on Sustainable Transportation
3. Drafting of a State of the Debate and a Position of the NRTEE on Sustainable Transportation
4. Public Consultation on the Elements of a Strategy for Sustainable Transportation
5. NRTEE Report on Sustainable Transportation

[2] Task Force on Sustainable Transportation (1996) *Program for Sustainable Transportation.* Ottawa: National Round Table on the Environment and the Economy.

1.3 Phase 1 - State of the Art and Issues Paper

NRTEE has retained Apogee Research to conduct Phase 1 under the direction of its Task Force on Sustainable Transportation. Phase 1 is being conducted in three steps:

- Step 1 - Synthesize documentation in the field of sustainable transportation;
- Step 2 - Meet with key organizations to refine the understanding of the current situation;
- Step 3 - Produce a final report on the state of the art.

1.4 Report Objectives

The ultimate product of Phase I of the Program on Sustainable Transportation will be an issues paper describing the state of the art in sustainable transportation. This first report is the result of Step 1.

The objective of this report is to provide a review of the literature on sustainable transportation to stimulate thought and discussion among Canadian stakeholders. After distribution of this document, we will be interviewing a number of organizations and individuals for their input on the contents of the final issues paper.

In this paper, we do *not* provide recommendations on goals, strategies and actions, but try to present an unbiased survey of the range of opinions in the literature.

The scope of the literature review undertaken for this report covered over 100 studies, books and papers. The review focused on Canadian sources, as well as selected sources from other countries and multi-lateral organizations such as the Organisation for Economic Co-operation and Development. Appendix A lists the material reviewed.

Specifically, the report summarizes the literature on:

- visions of sustainable transportation;
- definitions of sustainable transportation;
- decision-making principles for sustainable transportation;
- quantifiable performance measures of transportation sustainability;
- existing strategies and their objectives;
- jurisdictional roles and activities in Canada;

- policy instruments and associated jurisdictional and timing issues;
- reasons for failure of sustainable development strategies; and

2. ANALYSIS AND POLICY/PROGRAM DEVELOPMENT

2.1 Visions of Sustainable Transportation

Vision statements present desired futures in lieu of the outcomes expected from current trends or the status quo. Therefore, a vision typically talks about the future, but contains underlying assumptions about where we will be if no actions are taken.

There are many visions *related to* sustainable transportation recorded in the literature. However, few address the full range of environmental, social and financial issues involved in sustainable transportation. Instead, most visions focus on:

- a specific mode (particularly road);
- a specific region (particularly urban travel); or
- a specific set of air emissions (particularly smog and greenhouse gas emissions).

This is not necessarily a significant constraint since, frequently, addressing one aspect of sustainability will have spin-off benefits on other aspects.

A sampling of Canadian sources of vision statements reviewed, included those of the Transportation Association of Canada; the Ontario Transportation and Climate Change Collaborative; the International Institute for Sustainable Development; The Canadian Urban Institute; as well as several individuals.

The visions for sustainable transportation are based on the consensus which is developing around the world, and in Canada, that:

- transportation has become environmentally, socially and economically unsustainable;
- deterioration in the quality of life including negative health effects, increased social isolation, psychological stress, increased energy costs, and reduced economic efficiency will continue under current trends;
- the most serious impediments to sustainable transportation are continued growth in urban automobile use, intercity truck transport of goods, and air transportation;

- the growth in automobile use is highly correlated to historical patterns of low density, single use development in major urban areas, increasing disposable income of consumers, and advances in vehicle technologies;

- urban form and transportation systems have evolved under policies which have failed to require market players, including consumers, to pay for the full environmental, social and health and safety and economic costs of their transportation or land use decisions;

- change will be required over a time horizon of 25 years or more to reflect the massive changes in behaviour, technology and built infrastructure required for truly sustainable transportation;

- there is uncertainty about whether or not there is any set of policies that could gain political acceptance at this time and that would result in truly sustainable transportation.

The desired future envisioned in the statements typically includes the following componenets.

Exhibit 2.1
Typical Components of Sustainable Transportation Vision Statements

- Changed public values based on understanding of the urgency of the threat of inaction and the benefits of sustainable development and transportation practices;
- Increased commitment of citizens as well as governments to achievement of sustainable transportation;
- Transition from dispersed, single use urban, suburban and rural development to more compact, mixed use and liveable neighbourhoods which reduce the requirement for automobile use and movement of goods and which at the same time solve multiple social, environmental and economic problems;
- Emphasis on accessibility rather than mobility;
- Increased availability of more sustainable alternatives for access to activities , including walking and cycling, public transit and use of information technologies to reduce the need for movement of people;
- Increased use of more sustainable alternatives for the movement of goods within urban areas, regionally and globally, as well as reductions in the need for goods movement over any distance;
- Viable urban and intercity rail systems;
- Transportation and other urban infrastructure which is cost effective and affordable;
- Elimination of hidden subsidies;
- Integrated transportation and land use decision making;
- Development and use of appropriate technology which "serves to increase access to basic needs without the use of the automobile" or other high energy intensive motorised transport;

Two vision statements illustrate the range of possible transportation system outcomes in Canada.

Perhaps the most influential vision statement currently in Canada is *A New Vision for Urban Transportation in Canada* published in 1993 by the Urban Transportation Council of the Transportation Association of Canada (TAC). TAC acknowledges that although "...this is not a truly sustainable transportation vision in that it still depends on the internal combustion engine powered by fossil fuels, it moves us a long way towards sustainability. Many consider this the best vision available in Canada."

It has been widely endorsed by organizations such as the Federation of Canadian Municipalities, the Canadian Urban Transit Association and the Ontario Transportation and Climate Change Collaborative, as well as some of Canada's largest municipalities. It has influenced recent planning studies in Winnipeg, London, Montreal and elsewhere.

Exhibit 2.2 presents the vision statement. One noteworthy element is the time frame in which TAC suggests the vision could be realized.

Exhibit 2.2
A Generic Vision for Urban Transportation in 2003 from the Transportation Association of Canada

- A long term urban development plan has been approved. It emphasized multi use town centres and high density, mixed use along connecting corridors. Transit has funding and operating priority in those corridors.
- Short-medium term community/ neighbourhood plans have been approved. They emphasize compact, mixed use communities based on pedestrian, cycling and transit friendly design.
- Transit, highways, arterials, parking and truck routes are planned and co-ordinated across the urban area.
- The percentages of trips made by walking, cycling, transit and high occupancy automobiles are all increasing; the percentage of trips made by single occupant automobiles is decreasing.
- The average distance and time for peak hour commuter travel is decreasing.
- An area wide parking strategy is in place and enforced.
- There are very few places which still require on-street goods transfer.
- The physically challenged enjoy universal access to public transport facility and services.
- Roads and bridges are in a good state of repair.
- Air pollution from motor vehicle sources is declining.
- Urban transportation infrastructure and services are adequately funded from stable and sustainable revenue sources.
- Political leaders have the support of a well informed public when making decisions on urban development and transportation systems to serve the area.

Source: "Transportation Association of Canada Briefing: Urban Vision Sampler", Transportation Association of Canada, February 1996.

The Canadian Urban Institute, in its 1994 study *Cities Without Cars*, presented a substantially different approach to sustainable transportation visions. *Cities Without Cars* postulates a more extreme outcome in the future, in which massive reductions in road transport and other high energy intensive modes such as aviation will be required if sustainability is to be achieved.

Starting from the assumption that sustainable transportation requires cities without cars, two teams of land use and transportation planners from Toronto and Vancouver envisioned what their regions would be like if use of personal automobiles was gradually phased out by 2032 and 2021 respectively.

The visions are not easily summarized and interested readers are directed to the study for further information.

Initially, the *Cities Without Cars* was a visioning exercise "in which one of several possible futures [was] assumed for the purpose of securing fresh perspectives on the present." After initial scepticism, the teams concluded that the cities without cars scenario is "desirable, feasible and even necessary."

This is a valuable insight for the NRTEE and others working towards sustainable transportation. Visioning is a powerful tool to "break out of existing moulds and methods to permit the development of new paradigms."[3] Given how deeply ingrained current transportation patterns are in our lifestyles and institutions, new ways of thinking are essential to create a sustainable transportation system.

2.2 Definitions of Sustainable Transportation

Despite the voluminous literature on different facets of "sustainable transportation," there are surprisingly few formal definitions of the term.

[3] Greater Vancouver Regional District and Canadian Urban Institute (1994) "Cities Without Cars: A Visioning Process to Reduce Auto Dependency" in Canadian Urban Institute (1994) *Cities Without Cars*. Toronto: Canadian Urban Institute, page 3.

Nonetheless, it is clear that definitions of "sustainable transportation" derive from the definition of sustainable development. As conceived by the Bruntland Commission in 1983, sustainable development is "development which meets the needs of the present without compromising the ability of future generations to meet their own needs." Subsequent elaborations have refined and expanded this definition to encompass a range of environmental, social and economic issues. For example, the authors of the "First Annual Report of the EU Expert Group on Sustainable Cities" suggests that:

> *Sustainable development is a much broader concept than environmental protection. It implies a concern for future generations and for long term health and integrity of the environment. It embraces concern for quality of life (not just income growth), for intergenerational equity (people in the future deserve and environment at least as good as the one we currently enjoy, if not better) and for the social and ethical dimensions of human welfare. It also implies that further development should only take place as long as it is within the carrying capacity of natural systems. Clearly, addressing the sustainable development agenda provides new challenges for policy makers and citizens.*[4]

Analogous ideas are found in definitions of sustainable transportation. For example, an OECD task group's definition of "environmentally sustainable transport" focuses on the Brundtland Commission's concept of not compromising the ability of future generations to meet their needs by ensuring resource stocks are not depleted.

"Environmentally sustainable transport" is "transportation that does not endanger public health or ecosystems and meets mobility needs consistent with:

- use of renewable resources at below their rates of regeneration; and
- the use of non-renewable resources at below the rates of development of renewable substitutes."

Source: OECD Pollution Prevention and Control Task Group on Transport, *Environmental Criteria for Sustainable Transportation,* Paris 1996

Going beyond environmental sustainability, Neil Irwin of the IBI Group suggests a broader definition of sustainable transportation.

[4] Ibid, page 7.

Sustainable transportation is a transportation system that is:

- **capable** of delivering required capacity and performance;
- **renewable**, which ultimately means using solar energy, or failing this a relatively inexhaustible energy source such as nuclear fusion;
- **compatible** with the kinds of places we want to live in;
- **clean**, so that environmental quality is maintained or enhanced; and
- **affordable** in terms of capital and operating/maintenance costs.

Source: IBI Group (1995) *Full Cost Transportation Study.* Toronto: Ontario Round Table on Environment and Economy.

Deborah Gordon takes an even broader approach, incorporating the types of changes needed to realize a sustainable transportation system.

"Sustainable transportation entails elements of several visions. These visions include changing people and the way they live, changing prices and changing technology"

"Changing people and how they live" means reducing the need for transportation, premised on the belief that automobile vehicle miles travelled are a destructive ecological force.

"Changing prices" means modifying transportation demand through the use of market forces to enhance system wide transportation efficiency. The role of public policy, in this vision, is to send the right signals to the economy to make the marketplace work for instead of against sustainable development. and ecological integrity.

"Changing technology" means employing appropriate technologies to reduce the impact of transportation on society.

Source: Deborah Gordon, *Transportation and Energy, Sustainable Transportation and How We Get There,* ACEEE, 1995

Comparing any of these definitions to the trends in Canada described at the beginning of this report makes one thing clear: Canada's current transportation system is not sustainable.

2.3 Decision Making Principles for Sustainable Transportation

One of the basic barriers hindering progress towards sustainable transportation is the decision making principles currently in place. Two important points to note are that:

- there is no central oversight to ensure that, together, the decisions create the transportation system we want (whatever that may look like);
- some of the key decision making principles in use now, work against sustainability.

If sustainable transportation is to be achieved, there must be changes in the way transportation decisions are made by individuals and governments. Within the literature there are calls for changes to:

- provide for public education to ensure awareness of the risks from inaction and the opportunities for multiple benefits from shifts to sustainable development and sustainable transportation approaches;
- integrate environmental objectives fully into transportation policies;
- integrate land use and transportation policies. Make transportation respond to desired land use and urban form;
- shift the emphasis in transportation systems from mobility to accessibility, to minimize the need for motorised transport;
- ensure that transportation decisions of individuals, commerce and governments take full account of the external costs of such decisions;
- use economic instruments to achieve specific environmental, economic and social targets when fuller cost pricing which "internalizes" external costs is inadequate to achieve sustainability;
- think creatively about our vision of the future, without being constrained by current transportation or urban settlement practices;
- provide of accessibility/ mobility alternatives in parallel with measures to reduce availability of high external cost transportation infrastructure and services such as road or air transport;

- look for the environmental, social and economic benefits to society and to individuals from transportation practices, which meet the test of sustainability; and

- ensure flexibility in policy development and implementation by adopting integrated packages of policy measures to achieve sustainable transportation which can be altered to reflect experience gained from new approaches.

Suggestions for new decision making principles have emerged from many sources, including the Transportation Association of Canada, the *Cities Without Cars* study and the International Council for Local Environmental Initiatives.

The Transportation Association of Canada's articulated 13 decision making principles in support of *A New Vision of Urban Transportation.*

Exhibit 2.3
Decision Making Principles from *A New Vision of Urban Transportation*

- Plan for increased densities and more mixed land use
- Promote walking as the preferred mode of person trips
- Increase opportunities for cycling as an optional mode of travel
- Provide higher quality transit service to increase its attractiveness relative to the private automobile
- Create an environment in which automobiles can play a more balanced role
- Plan parking supply and price to be in balance with walking, cycling and transit priorities
- Improve the efficiency of the urban goods distribution systems
- Promote inter-modal and interline connections
- Promote new technologies that improve urban mobility and help protect the environment
- Optimize the use of existing transportation systems to move people and goods
- Design and operate transportation systems that can be used by the physically challenged
- Ensure that urban transportation decisions protect and enhance the environment
- Create better ways to pay for future transportation systems

Canada was one of the signatory nations to the Habitat II Agenda which was adopted as an outcome of the U.N. Conference on Sustainable Human Settlement in Istanbul in June 1996.

The commitments and the specific principles and actions of Habitat II, as they relate to transportation incorporate virtually all of the above principles. Extracts from the advance, unedited Habitat II Agenda which have implications for transportation are summarized in Appendix B.

The essential elements of the U.N. Framework Convention on Climate Change are included in Exhibit 2.4.

Exhibit 2.4
Elements of the Framework Convention on Climate Change

The Climate Convention contains the following essential agreements:

- The goal of the parties is to stabilize the concentration of greenhouse gases at a level that would prevent dangerous anthropogenic interference with the climate system.
- The parties agree that this level must be reached in sufficient time to allow
  - the ecosystems to adapt to climate changes,
  - the threat to food production to be eliminated
  - economic development to continue in a sustainable way.
- The parties (only developed countries and some other countries) commit themselves to take measures to limit anthropogenic emissions of greenhouse gases and to protect and enhance greenhouse gas sinks and reservoirs (for example, forests). They further commit themselves to communicate national reports on these policies and measures with the aim of returning individually or jointly to 1990 levels of these anthropogenic emissions of carbon dioxide and other greenhouse gases not controlled by the Montreal Protocol.

Source: "Saving the Climate - Saving the Cities", U.S. Environmental Protection Agency and the International Council for Local Environmental Initiatives, 1996.

Canada's National Climate Change Action Program, 1995 sets out principles to be used by the Canadian government in meeting its commitments under the U.N. Framework Convention on Climate Change, summarized as follows:

Precautionary principle - lack of scientific certainty should not be used as a reason to postpone mitigative actions which are cost effective or justified for other reasons;

- Shared responsibility - with all sectors of society;
- Effectiveness - measures that clearly reduce greenhouse gas emissions;
- Competitiveness - measures which do not compromise Canada's international competitiveness;
- Transparency and Accountability - establish who is to be accountable;
- Flexibility - to change with experience and technology;
- International co-operation - as part of a global effort;
- Strategic directions - working to reduce Canada's net greenhouse gas emissions for 2000 and beyond.

The International Council for Local Environmental Initiatives, in its guide to municipalities entitled *Saving the Climate - Saving the Cities* suggests six principles should guide local authorities towards sustainability. These same principles, with modification could be adapted by any level of government in the development of sustainable transportation policies within its jurisdiction.

Exhibit 2.5
ICLEI's Decision Making Principles for Local Authorities

- *Ecological integrity* - Sustainable (transportation) requires that economic activity be environmentally sustainable. The current dependency on cars, intercity goods movement by truck and the growing impacts of aviation are environmentally unsustainable. This has, of course, profound implications for the long term structure of key sectors of Canadian and global, industry;

- *Emphasis on prevention* - The principle "anticipate and prevent" needs to replace "react and cure" in guiding government authorities to better manage urban growth, (transportation), energy systems and waste;

- *Reduction of poverty* - Sustainable transportation requires that all people's needs be met. Wealth that governments at any level help to create, that is not distributed to meet these needs means that the development is fundamentally flawed;

- *Equity among generations and social groups* - People's needs should be met in a manner that does not diminish the ability of future generations to meet their needs. Authorities can implement this principle by managing economic growth in a way that minimizes, on a per capita basis, the life cycle energy that citizens consume for transportation.

- *Precautionary approach* - Lack of scientific certainty should not be a reason for delaying an action to prevent social, environmental and economic damage. Given the great risks involved, enough consensus exists today on the serious negative social, health, climate change and economic impacts of current trends in transportation to compel action from governments at all levels.

- *Polluters should pay* - Those who pollute and degrade the environment through their transportation decisions should bear the full social and environmental cost of their pollution. Authorities can turn to economic measures, such as taxes and fees, to implement this principle.

It is noted that the Canadian government's list of principles includes only one in common with ICLEI - the precautionary principle. In addition, there is no mention of modifying behaviours in Canada's principles.

The Canadian Urban Institute's *Cities Without Cars* study produced a set of decision making principles by its two study teams (Toronto and Vancouver).

There is significant overlap between the principles proposed by the two teams, as well as interesting differences. For example, the first three principles for Toronto -- comfort, convenience and efficiency of travel -- correspond to Vancouver's principles #3 and #11. However, the Toronto principles have a stronger focus on travel characteristics and the Vancouver principles have a stronger focus on equity and fairness.

Exhibit 2.6
Principles Proposed by the *Cities Without Cars* Teams

Toronto Principles	Vancouver Principles
1. Travel in the GTA without cars should be at least as *comfortable* as travel in the GTA today	***Lifestyle Principles***
2. Travel in the GTA without cars should be at least as *convenient* as travel in the GTA today	1. Minimize impacts upon auto users and auto dependent services when changing from auto dependency to and auto-free lifestyle 2. Promote understanding and knowledge of the benefits of an auto-free city to ensure that any perceived or real changes to lifestyles are supported by those affected 3. Ensure that comfort, convenience, and efficiency of travel is similar, to or exceeds, existing levels of user experience
3. The GTA without cars should [be] at least as *efficient* as the GTA today	***Economic Principles*** 4. Fully account the true costs of auto use against the costs associated with building an auto-free city 5. Ensure that the full costs for building/operating an auto-free city are substantially less than the costs of an auto city
4. Travel in the GTA without cars should have *less impact on the environment* than travel with cars	***Environmental Principles*** 6. Re-orient auto dependent resource industries in an orderly and equitable fashion 7. Minimize detrimental impact upon auto-dependent activities 8. Ensure that the auto-free city displays improved air quality and other environmental benefits 9. Ensure that any development associated with an auto-free option must be environmentally sustainable
5. Travel in the GTA without cars should be at least as *safe and secure* as travel in the region today	
6. The process of reconfiguring the GTA must be gradual and fair and be such as to *enhance the social fabric* of the GTA rather than diminish it	***Social Principles*** 10. Promote and equitable system of moving goods and people in the auto-free city 11. Ensure that comfort, convenience, and efficiency are similar to, or exceed existing levels of user experience 12. Recognize increased personal and public safety as a major real and perceived benefit of an auto-free city
7. Residents of the GTA without cars will have at least as much *access to green space* within the region and outside, as residents of the region today	***Political Principles*** 13. Need for political will and massive public support to move to an auto-free city 14. Need to address all of the issues relating to converting to a city without cars at a regional level 15. Need structural changes and associated municipal changes to respond to all requirements

Source: Canadian Urban Institute (1994) *Cities Without Cars*. Toronto: Canadian Urban Institute.

2.4 Quantifiable Performance Measures

Quantifiable performance measures are essential to provide a baseline of where we are at now, track the sustainability of the transportation as it evolves, and measure the contribution of policy instruments to achieving goals and targets.

We found no source of performance measures that covered the full spectrum of issues in sustainable transportation. Two sources provided measures of the environmental impacts of the transportation sector.

First, the OECD Pollution Prevention and Control Task Group on Transport has proposed six quantitative criteria for "environmentally sustainable transport," namely:

- emissions of NO_x;
- emissions of VOCs;
- emissions of particulates;
- emissions of greenhouse gases;
- land in use for motorised transport; and
- noise levels.

The list clearly does not cover the full set of environmental impacts from transportation activities. For example, the environmental impacts of infrastructure are not included, except in the land use criteria. Nonetheless, the list does indicate the priority placed by the OECD on air quality impacts, with three of the six criteria concerning themselves with this aspect of sustainability.

A recent study by Apogee Research for the U.S. Environmental Protection Agency, is more comprehensive. It covers the environmental effects of road, air, marine and rail transportation.[5] For each mode, quantifiable measures are provided for environmental effects relating to:

- infrastructure construction and maintenance;
- vehicle and parts manufacture;
- vehicle travel;

[5] *Indicators of the Environmental Impacts of Transportation,* Apogee Research for U.S. EPA, June 1996

- vehicle maintenance and support; and
- vehicle and parts disposal.

The measures recommended by this study are too numerous for summary here. However, Appendix C provides summary tables from the original study.

We draw several observations from our search for performance indicators.

First, sustainable transportation has many facets, each of which could be measured using a variety of indicators. Prioritization may be necessary to avoid unwieldy data collection and manipulation. For example, for NRTEE's purposes, tracking accessibility or safety performance may be less important that environmental performance.

Second, transportation has numerous environmental effects, not all of which are equal in importance. Prioritization will likely be necessary here. For example, tracking highway runoff may be less important than tracking air quality measures.

Third, it may be possible to use "reference indicators" that represent a group of effects. For example, emissions of a pollutant that are strongly correlated with emissions of other pollutants may be a suitable reference indicator for that entire group of pollutants.

2.5 Objectives and Strategies

Addressing what it would take for transportation to be environmentally sustainable in 2030, the OECD suggests that for major air pollutants, the following emission reduction levels would need to be achieved[6]:

- transport-related NO_x emissions are to be reduced so that objectives for ambient NO_2 and for ozone levels as well as for nitrogen deposition are achieved;
- emissions of VOC's have been reduced to the extent that excessive ozone levels are avoided;
- emissions of particulates are reduced to the extent that harmful ambient air levels are avoided;

[6] *Environmental Criteria for Sustainable Transport,* OECD, Paris, 1996, page 62

- climate change is being prevented by achieving per capita carbon dioxide emissions from fossil fuel use which are consistent with the global protection goals for the atmosphere;

- land surface in urban areas is used for the movement, maintenance, and storage of motorised vehicles, including transport vehicles such that the objectives for ecosystem protection are met, and a high degree of mixed urban structure is maintained.

- noise caused by transportation should not result in excessive outdoor noise levels that present a health concern or serious nuisance.

The OECD argues that from the perspective of the 1990's, these criteria seem to be the most comprehensive and relevant. However, they should be reviewed frequently and adjusted accordingly.

The Second Assessment Report of the Intergovernmental Panel on Climate Change says that for atmospheric CO_2 concentrations to be stabilised at near current levels, world-wide CO_2 emissions would need to be reduced immediately by 50 - 70 percent, with further reductions thereafter. Other authors have argued that reductions of 80 percent or more per capita should be achieved in industrialised countries to allow for increases in emissions in countries that are presently responsible for very low levels of emissions.[7]

In contrast to such challenging targets, which have profound implications for transportation systems, particularly in North America, national governments have committed themselves to much more modest goals. Some of these targets are shown in Exhibit 2.7.

[7] Ibid., page 59

Exhibit 2.7
Reduction Targets for Carbon Dioxide Emissions from Transportation - OECD Countries

OECD Member	Carbon Dioxide Reduction		
	Base Year	Target Year	Reduction Goal - %
Austria	1988	2005	20
Canada	1990	2000	0
Denmark	1988	2030	25
Finland	1990	2000	0
Germany	1990	2005	25*
Japan	1990	2000	0
Netherlands	1986	2010	10
Norway	1989	2000	0
Sweden	1990	2000	0
Switzerland	1990	2000	0
UK	1990	2000	0
EU	1990	2000	0

* The targets for Germany are understood to include the former East Germany, where substantial investment in upgrading of automotive technology, with expected environmental improvement, is occurring.

In reporting their plans to the OECD, many countries report difficulty meeting even these modest targets.

Policy development in the sustainable transportation field in Canada is not at present being carried out in an atmosphere of crisis. For example, Canada has committed itself only to meet the target of stabilizing emissions of greenhouse gases at 1990 levels by the year 2000, and is, in any event, unlikely to meet that modest target. The Province of Ontario has not yet decided whether to proceed with a mandatory Inspection and Maintenance program for either light or heavy duty road vehicles, despite strong evidence of the potential effectiveness of such a measure to reduce overall emissions of air pollutants, and public opinion polls which indicate support for such a move. And the Province of Ontario has decided not to proceed with implementation of amendments to the province's planning legislation which were designed to promote the kinds of sustainable urban form called for by experts world-wide.

Canada's Climate Change Action Program, 1995, does not set out specific objectives for reduction of greenhouse gas emissions from the transportation sector. The report does summarize a range of activities of various government departments which are expected to have a positive effect in this respect. No indication is given in the report, however, on the quantitative gains expected from these program activities.

Reductions of carbon dioxide emissions from transportation in Canada, to be consistent with the reductions necessary in the view of the IPCC, would require far more aggressive policy measures and changes in societal behaviour than any so far in place or under serious consideration by governments in Canada.

B.C. has adopted three complementary policy approaches in its clean air strategy:

- reducing the need for transportation through such actions as land-use planning and telecommuting;
- encouraging alternatives to the automobile such as public transit, carpooling and cycling; and
- reducing emissions per vehicle kilometre through use of cleaner vehicles and fuels.

B.C. has not published estimates of the impact these measures and has not set itself specific targets for reduction of carbon dioxide emissions. It has however, expressed its intent to support Canada's commitment to reduce greenhouse gas emissions to 1990 levels by the year 2000, and to examine sustainable approaches to further reductions.[8]

The Ontario Transportation and Climate Change Collaborative, which was jointly sponsored by NRTEE and the Ontario Round Table on the Environment and Economy, proposed the following strategy for Sustainable Transportation in its Report *A Strategy for Sustainable Transportation in Ontario,* submitted to the Government of Ontario, in November 1995.

[8] Ibid., page 14.

Exhibit 2.8
A Recommended Strategy for Sustainable Transportation

Design and implement a broad range of programs to ensure that the public understands the risks of climate change and the need to economize on the use of fossil fuels;

Implement policies that will bring about more compact, mixed use development in urban areas to shorten travel distances and reduce vehicular travel demand;

Establish decision-making bodies in large urban areas to evaluate, plan and deliver integrated transportation and urban development, as well as integration of transit systems and services;

Implement transit priority measures to make transit time competitive with automobile travel;

Maintain sufficient funding to ensure adequate transit funding capacity; increase the acceptability of using funds from user pay sources to improve public transit and enhance transit service in areas with sufficient population density;

Implement pricing and supply policies to control parking and encourage transfer to transit

Implement fuller cost pricing for transportation modes to discourage overuse of single occupancy vehicles and encourage the use of more fuel efficient technologies and transportation modes;

Develop a Memorandum of Understanding with automotive manufacturers to increase the availability of fuel efficient models, recognizing the linkage between gasoline prices and consumer demand for more fuel-efficient vehicles;

Implement mandatory vehicle inspection and maintenance programs in large urban areas to ensure the proper operation of emission control equipment;

Maintain incentives for the use of cleaner alternative fuels and explore ways to promote further the development and use of alternative fuelled vehicles.

Develop an Ontario capability to participate in the U.S. Government's and the Big Three auto manufacturers' Partnership for a New Generation of Vehicles (PNGV). The PNGV is working to develop vehicles that will achieve a threefold increase in fuel efficiency over today's vehicles, while maintaining size, performance utility and safety.

This strategy has not been formally endorsed by the governments of Ontario.

2.6 Jurisdictional Roles and Activities

Every level of government has a number of important roles to play if sustainable transportation is to be achieved. It would not be possible in this document to list and comment on all of these roles. We will, instead, attempt to summarize some of the key responsibilities and initiatives in different jurisdictions and identify some of the more important interjurisdictional issues which have been raised in the literature. We expect that this section will undergo substantial revision as we conduct interviews with stakeholder organizations in Step 2 of this study.

International Bodies

At the international level, bodies such as the U.N. set international goals for sustainability including broadly defined sustainable human settlements and global environmental sustainability. The most important of these related to transportation are the 1988 Montreal Protocol on stratospheric ozone depleting substances, the 1992 Framework Convention on Climate Change, and the June 1996, Istanbul Declaration on Sustainable Human Settlement. The latter was the outcome of Habitat II, the U.N. Conference on Sustainable Human Settlement.

The OECD has been a very strong player in the research, education and awareness, and policy development aspects of sustainable transportation. It has published the results of many of its studies and disseminated the experience of many countries in the field. It has also influenced transport policymaking, particularly in the EC.

Government of Canada

The key areas of responsibility of the Canadian government in the achievement of sustainable transportation, include:

- Canada's contribution to the development, negotiation of and commitment to international protocols related to sustainable development and sustainable transportation;
- programs of public education and awareness;
- monitoring and evaluation of performance against national air quality standards, including health effects and impacts on ecosystems;

- national energy policy including measures to encourage use of lower carbon content fuels than gasoline and diesel, and standards for cleaner fuels;
- development of technologies which contribute to reduced fuel use, and reduced need for transportation;
- regulating vehicle emissions standards, with particular attention to harmonization with the U.S. and dealing with transboundary air and water pollution;
- regulating vehicle safety standards;
- regulating vehicle fuel efficiency standards, including harmonization with U.S. standards;
- harmonization of sustainable transportation strategies and actions with other governments, particularly the U.S., to ensure that Canada remains economically competitive with other jurisdictions;
- using its taxation powers to apply economic instruments in ways which help to internalise "external" costs of transportation or to meet specific environmental, economic and social objectives, by changing consumer and business behaviours. In particular, the federal government has fuel tax and income tax levers which could be adapted to meet sustainability objectives; and
- policies which provide for improving the energy efficiency and environmental performance of its own transportation fleets.

Key initiatives at the federal level include the NOx/ VOC Management Plan, the National Action Plan on Climate Change, the newly established Commissioner for the Environment and Development, the Ozone Depleting Substances Plan as well as the federal Green Fleets program. The NOx / VOC Management Plan has been developed jointly with the provinces through the CCME and is well along in implementation. In general, it is meeting its targets, and as noted above, progress has been made in urban air quality, with the noted exceptions.

Given the health concerns, it is clear however that we are far from acceptable levels of certain air pollutants, and that there is much more yet to do. Further, it is apparent that science has much more to tell us in future about the health effects of a broader range of pollutants

The National Action Program on Climate Change does not yet contain specific targets for the transportation sector. There is no indication that the impact of the transportation measures identified in the plan will enable Canada to meet its current commitment to stabilise carbon dioxide emissions at 1990 levels by the year 2000. In particular, the Voluntary Challenge and

Registry, which is currently the principle initiative of the federal government in its Climate Change Action plan will have negligible impact on transportation since the VCR does not involve significant numbers of transportation users.

The National Action Plan on Climate Change is silent on the need for integrated packages of policies for achieving sustainable transportation, despite the extensive international attention being paid to this approach. The program is silent on the use by the federal and provincial governments of economic instruments including fuel taxes, to promote long term changes in market behaviour which could help in achieving sustainable transportation. In its present form, the transportation section of the National Action Program, is not a strategy with an expected outcome. It is a list of some initiatives in Canada which may have an unspecified impact on sustainability.

Provincial Governments

Provincial governments have a very large role in transportation decision making, in particular related to capital and maintenance costs of road infrastructure and public transit, the registration and licensing of vehicles, fuel taxes, safety, policing and regulation of the insurance industry. Provinces also have jurisdiction over land use planning.

There have been a number of initiatives at the provincial level targeted at sustainable transportation. British Columbia has adopted its Clean Vehicles and Fuels policy which contains a variety of measures, and which it expects will result in air quality levels in the Lower Fraser Valley to be approximately the same in 2020 as they are now, despite the projected growth in vehicle use in that time frame.

The range of initiatives under consideration in the B.C. Clean Vehicles and Fuels Program include:

- AirCare - improved emissions test levels and manufacturer emission performance warranties;
- Heavy duty vehicle inspection program for heavy duty trucks and buses;
- Old vehicle scrap program - a voluntary scrap program for high polluting vehicles;
- Natural gas and propane vehicle conversions - encouragement, and requirement that converted vehicles meet low-emission standards;
- B.C. low-emission standards - similar to California standards, encouraging low and zero emission, fuel efficient and alternative fuelled vehicles.

- Alternative Fuelled Vehicles - encouragement of OEM manufacture of alternative fuelled vehicles, especially for fleet and heavy duty applications
- government fleet changes and demonstration programs;
- emissions labelling of new vehicles
- cleaner diesel including improved diesel performance and diesel fuel standards for off-road markets;
- cleaner gasoline including CGSB gasoline standard, minimum detergent standards, and the elimination of MMT
- gasoline vapour pressure including reduction of allowable vapour pressure in gasoline in summer and broadening the area of vapour pressure reduction to areas outside the Lower Fraser Valley
- reformulated gasoline
- renewable alternative fuels such as ethanol, ETBE and MBTE as gasoline additives;
- tax relief for alternative transportation fuels, including natural gas, propane and methanol; and
- Stage I and II gasoline vapour recovery in the Lower Fraser valley.

With respect to climate change, the three approaches of the B.C. Clean Air Strategy for reducing transportation emissions are:[9]

- reducing the need for transportation through such actions as land use planning and telecommuting;
- encouraging alternatives to the automobile, such as public transit, carpooling and cycling; and
- reducing emissions per vehicle kilometre travelled through the use of cleaner vehicles and fuels

[9] *Clean Vehicles and Fuels for British Columbia, A Policy Paper,* Ministry of Environment, Land and Parks, April 1995, page 14

In addition to its participation in the NOx/ VOC Management Plan, Ontario is " pursuing initiatives that will address emissions originating in the transportation sector..."[10].Among the newer initiatives described in this report was the evaluation of the results of the pilot I&M program that has been in operation in Metro Toronto for the past year. The government is developing options for an expanded I&M program in Ontario. The government has estimated that a program for the GTA, in addition to reducing ground level pollutants, would result in a reduction of carbon dioxide emissions by 400 kilotonnes a year, approximately one percent of total emissions from transportation in Ontario.

Ontario is currently working on a Smog Plan, aimed at reducing ground-level ozone and particulates. It should be noted that international work on this issue is important to Canada, since approximately 50 percent of such emissions in Eastern Canada come from the U.S.

The province has initiated the development of a Greater Toronto Area Transportation Plan in co-operation with the regional municipalities within the city-region. "The plan is to ensure that appropriate choices are made in transportation investments to yield optimum benefits for the community, the environment and the economy. The plan will address the requirements associated with the preservation and rehabilitation of existing infrastructure, as well as opportunities for optimizing the use of existing facilities. Opportunities for selective expansion of the transportation network will also be assessed."[11]

Some of the statements in an Ontario MTO document describing the new GTA Transportation Plan, indicate a degree of ambivalence between the objectives of continuing past policies of meeting forecast demand for transportation and the new objectives of sustainability and more compact urban form. The following statement suggests that the traditional model of demand responsive transportation planning may still be driving the effort in MTO.

> "The dynamic growth of population and employment in Halton, Peel, York and Durham will result in significant travel increases within these regions. Their city centres and development nodes will attract many new trips. Other major trip destinations will include large industrial parks and low density commercial development. As a result, outbound commuters from Metro will also form an important and growing component of future travel demand."[12]

[10] *Meeting the Challenge of Climate Change, A Status Report on initiatives in Ontario to reduce greenhouse gas emissions*, Ontario MOEE, November 1995.

[11] Ibid.

[12] *Towards a Greater Toronto Area Transportation Plan, The Challenges,* Ontario MTO Brochure, August 1995, page 4

On the other hand the document also contains statements such as:

> "Significant advances in terms of integrating land use and transportation decisions at the Official Plan level have been made by regional and provincial governments. An urban structure concept consisting of designated transit supported centres and corridors has been endorsed for future development."

There is nothing in the public documents describing the GTA Transportation Plan which suggests that the plan will be based on any particular environmental objective. Among the five objectives of the plan is the following:

> "Support the goals of sustainable urban development and transportation in the GTA by taking a balanced approach to social, economic and environmental issues".[13]

On the surface, this does not appear to be a commitment to sustainable transportation which requires at a minimum, substantial reductions in transportation energy consumption. In the same document, however, is the following statement as part of *A Transportation Vision for the GTA:*

> "Respects the environment by reducing the impact of harmful emissions through declining use of single occupancy vehicles, and by taking pressure off green-fields development".

At this stage in the process, it is not possible to assess the likely contribution of the GTA Transportation Plan on progress towards sustainable transportation in Canada, since the project is not complete. However, the directions that the Ontario government and the regional municipalities take in developing and implementing land use and transportation plans for the GTA in the years ahead will have a profound effect on the country's ability to achieve sustainable transportation.

Municipal Governments

There are many initiatives underway at the local level across Canada. The Transportation Association of Canada published an *Urban Vision Sampler* in February 1996, which highlights about 110 provincial and municipal initiatives. These cover a very broad range of strategies and individual measures and plans for improving the environmental, social and economic impacts of local transportation.

[13] *Towards a Greater Toronto Area Transportation Plan, Framework and Approach,* Ontario MTO, August 1995

One recent initiative of note was the Clean Air "Summit" sponsored by Metro Toronto's Blue Ribbon Committee on June 4, 1996. The Committee passed a resolution urging all municipalities in the GTA to:

- support a mandatory enhanced vehicle Inspection & Maintenance program to be implemented by the province;
- reduce automobile use and emissions from their own operations;
- develop sustainable transportation planning policies with timetables for implementation;
- commit to public education programs to combat air pollution;
- establish a Clean Air Committee to co-ordinate clean air initiatives and to advise the province of local concerns; and
- endorse the resolution and inform the premier.

To date, about one third of municipalities, including Metro and the City of Toronto, have endorsed the resolution, and more are expected to do so. Formation of the Clean Air Committee is at the planning stage.

3. UNSUSTAINABILITY OF TRANSPORTATION MODES

The unsustainability of transportation has many elements, key among them:

- health impacts and environmental degradation including crop and forest damage resulting from ground level air pollution;
- climate change impacts from greenhouse gas emission from the burning of fossil fuels;
- land use for transportation infrastructure, particularly roads and highways, resulting in loss of natural habitat, including wetlands, and land for agricultural and recreational purposes, and in some cases, displacement of individual citizens and whole communities;
- economic inefficiency, and loss of regional competitiveness due to continued low density,
- single use urban sprawl, which is linked to automobile dependency;
- social isolation from the barrier effects of roads and other transportation infrastructure, and from everyday activities for those who do not have direct access to cars;
- other environmental impacts related to the life cycle production, use and disposal of transportation vehicles and infrastructures;
- death and injury from accidents;
- congestion;
- increasing time and distances required for commuting and travel for other purposes;
- deteriorating transit services;
- water pollution from runoff from roads and other infrastructure;
- noise and vibration;
- limited access to open countryside; and
- et cetera.

Many estimates of the "external" costs of these impacts have been presented in the literature. While it is unlikely that precise values can ever be developed, these costs have been clearly shown to be substantial. The OECD estimates that these costs represent approximately 5 percent of GDP in OECD countries. The most comprehensive study of external costs and full cost pricing for transportation in Canada to date was the Full Cost Transportation Pricing Study by IBI Group of the Transportation and Climate Change Collaborative, in March 1995.[14]

The IBI report draws conclusions from this table concerning basic net costs of basic subsidies by mode to governments. The report further concludes that:

- only buses come close to paying their full costs in the passenger transportation mode...
- both intercity car and airplane travellers pay less than the full cost of their transportation mode...
- the rail mode is by far the most heavily subsidized mode.
- total subsidies for intercity truck and train freight operations(excluding fuel taxes, and license fees) at 2.19 cents per tonne-km, are considerably higher than they are for rail freight, which amounts to 0.40 cents per tonne-km.
- Urban transit, while it produces much lower external costs than auto travel in urban areas, also receives a considerable subsidy from provincial and municipal governments, amounting to 12.4 cents per passenger kilometre. The corresponding public subsidy for urban automobile travel in Canada amounts to 12 cents per passenger-km. However, external costs for urban auto(10.3 cents per passenger-km) are much higher than externalities associated with public transit.(1.36 cents per passenger-km).

The primary focus of attention on sustainable transportation in Canada at present, relates to the impacts of ground level air pollution and greenhouse gases. Of particular concern are the impacts of increasing concentrations of ground level ozone, airborne particulates and emissions of carbon dioxide.

There is also much attention being paid to the economic and social implications for continuing trends in human settlement, particularly in the major urban areas of Canada. There has been less emphasis, until relatively recently, on the connections between the unsustainability of transportation and patterns of land use.

[14] *Full cost Transportation Pricing Study,* IBI Group for the Transportation and Climate Change Collaborative, March 1995, page 4.46 to 4.48

3.1 Health Outcomes from Air Pollution

In a recent assessment of health effects of air pollution in Canada, two expert panels concluded that " health effects of ground level ozone at levels that occur in Canada include pulmonary inflammation, pulmonary function decrements, airway hyperactivity, respiratory symptoms, possible increased medication use and physician/ emergency room visits among individuals with heart or lung disease, reduced exercise capacity, increased hospital admissions and possibly increased mortality"[15].

At a Conference on Transportation, Air Quality, and Human Health, co-sponsored by Pollution Probe and York University in April 1996, Dr. David Bates, Professor Emeritus of the Department of Medicine at the University of British Columbia, pointed to tropospheric ozone and particulates as the pollutants with which we confront the most severe challenges. Road transportation, in particular, is a primary source of these pollutants. Dr. Bates cited the work of Dr. Rick Burnett of Health Canada in establishing close association between hospital admissions of infants below one year of age with a diagnosis of "infections", and ambient ozone levels in summer. This conclusion was drawn from a study of hospital admissions in 168 hospitals in Ontario, and is corroborated by studies in other regions and countries. There is also good evidence that ozone exposure "enhances the response to a subsequently delivered allergen in asthmatics.... There is independent evidence that both ozone and fine particulate pollution (PM10), are associated with increased symptoms in asthmatics, and increased hospital admissions for pneumonia..."[16]

Independent studies of data on large numbers of Americans in seventeen year longitudinal studies by the American Cancer Society and the Harvard School of Public Health have shown a strong association between elevated levels of sulphates in the atmosphere and cardiopulmonary deaths.

Sulphates and related fine particulates are particularly associated with the burning of diesel fuels.

A report prepared for the B.C. Ministry of Environment, Land and Parks concluded that for each ten micrograms per cubic meter increase in the level of PM10, the following health effects are estimated to occur:[17]

- a 0.8 percent increase in hospitalizations;

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[15] Reported in *Transportation, Air Quality and Human Health, Issues and Perspectives*, K.B. Ogilvie, Pollution Probe for Health Canada, March 1996(Unpublished Draft)

[16] *The Inconvenient Implications of Current Data on Air Pollution,* presentation of Dr. David Bates, Professor Emeritus, Dept. of Health Care & Epidemiology, University of British Columbia to the Conference on Transportation, Air Quality and Human Health, York University, April 25, 1996

[17] Ibid., page 8

- a 1.0 percent increase in emergency room visits for respiratory illness;
- a 9.5 percent increase in days of restricted activity due to respiratory symptoms;
- a 4.1 percent increase in school absenteeism;
- a 1.2 percent increase in reporting of cough.

To put the above impacts in context, B.C. Environment and the GVRD have adopted an objective of 50 micrograms per cubic metre, 24 hour average. Preliminary indications, from recently improved monitoring of fine particulates, are that the objective is regularly not being met in many B.C. urban areas. The Provincial Medical Health Officer has recently indicated that health concerns are evident at levels as low as 20.[18]

"A national air quality objective for PM10 is currently being developed by Health Canada, since the current objective, which is based on Total Suspended Particulates, is not an accurate indicator of either health effects or the source of air pollution. An urban air quality indicator may be available by 1997. Health researchers are also showing increasing interest in even finer particles in the 2.5 micron size or less...since these particles are believed to be responsible for the majority of health effects in the respirable particle category."

Studies in the U.S. have estimated the following health outcomes of air pollution from highways, in 1991:

- approximately 20,000 - 46,000 cases of chronic respiratory illness,
- roughly 50 - 70 million respiratory-related restricted activity days(RRADs), of which about 43 - 60 million of these can be attributed to particulate matter alone,
- an estimated 530 cases of cancer from air toxics associated with highway use. Estimates of cancer risk, however are highly uncertain...
- about 852 million headaches from carbon monoxide associated with motor vehicle use,
- an estimated 40,000 premature deaths in the U.S. - of which 33,000 can be attributed to particulate matter - a number comparable to the number of deaths from motor vehicle accidents.[19](ed. note: These numbers are of the same order of magnitude as the number of Americans killed in the Vietnam war.)

[18] *Clean Vehicles and Fuels for British Columbia, A Policy Paper*, April 1995, page 11

[19] *Health Effects of Motor Vehicle Air Pollution(in the U.S.)*, D. McCubbin and M. Delucchi, 1995 as cited in *Indicators of the Environmental Impacts of Transportation*, for the U.S. EPA, June 1996

Other estimates, according to the U.S. EPA, put the total number of premature deaths due to air pollution from all sources at about 70,000 annually. This death rate is higher than that due to cancer or car accidents. More than half of these deaths from air pollution are attributed to road transportation.[20]

We leave the last comment on the health outcomes of air pollution from transportation to Dr. Bates. "There is no task confronting us that more cogently demands our full attention, than to ensure that we are building a sustainable society for the future; such a society , at the very least, has to have air pollution levels below those which injure its members."

3.2 Global Climate Change

Global climate change is an issue with potentially even greater risk to the human species. The IPCC has concluded that increasing concentrations of greenhouse gases in the atmosphere from the burning of fossil fuels, appears to be causing warming of the ecosphere and destabilizing global and regional climate.

"Unless there is major policy intervention (ed. note: and massive changes in individual and collective behaviour world-wide), transportation energy use could increase 40 to 100% by 2025 and as much as 400% by 2100.[21]

Continued increases in concentrations of greenhouse gases in the stratosphere are expected to impact "unmanaged ecosystems (coral reefs, boreal forests), human health(ed. note: for example, increases in health impacts from more frequent ozone events associated with higher ambient temperatures), effects of sea level rise and the potential for more severe natural disasters."[22] Other studies of specific regional effects suggest dramatic impacts from a doubling of carbon dioxide concentration in the atmosphere. One such effort was conducted for the Ontario Transportation and Climate Change Collaborative[23].

While transportation systems world-wide consume a very wide range of resources, the one of greatest concern is the use of fossil fuels, and in particular, oil. " World-wide, the transport sector accounts for more than 60 percent of oil products, which constitutes about 98 percent of transport energy use. The latter percentage has increased from 92 percent in 1960 in spite of efforts by many governments to encourage substitution of other fuels, both non-renewable and renewable. In OECD countries, road vehicles are responsible for more than 80 percent of oil use

[20] *Transportation, Air Quality and Human Health,* K.B. Ogilvie, page 4

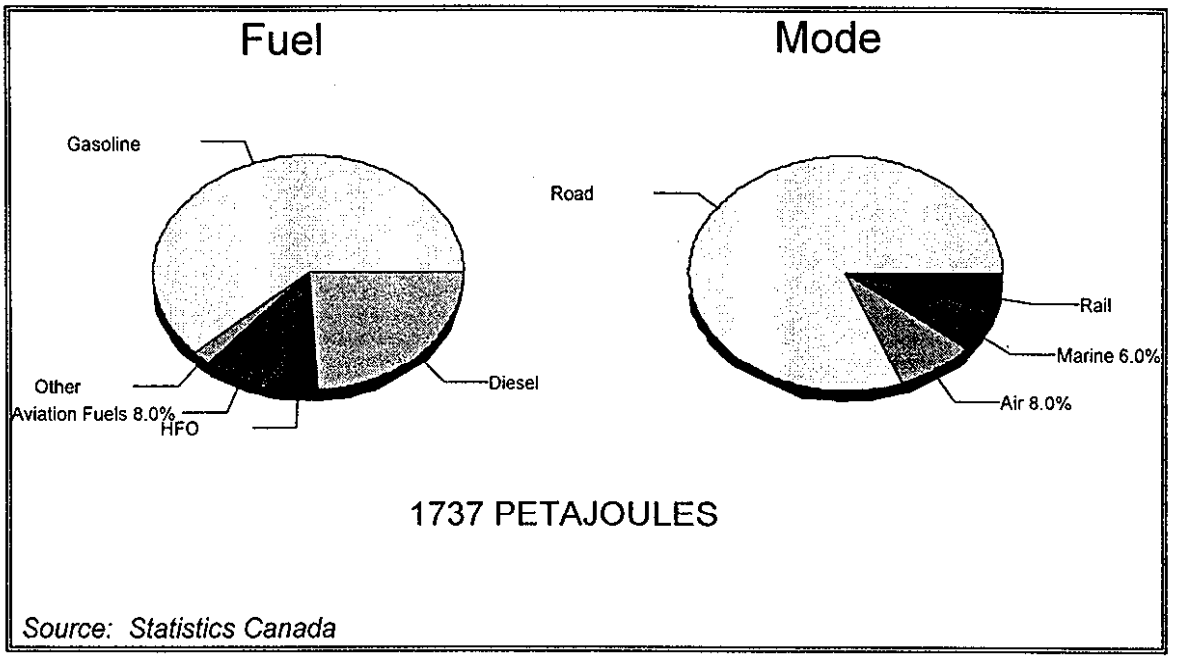
[21] *Drivers for Change,* presentation of James. P Bruce, Environment Canada, to Conference "Towards Sustainable Transportation," Vancouver March 1996.

[22] Ibid.

[23] *Climate Change Impacts: An Ontario Perspective,* Environment Canada, Smith and Lavender, Sustainable Futures, for Transportation and Climate Change Collaborative, August 1995

for transportation. Most of the remainder is used by air transport. Railways and shipping consume no more than five percent." Comparable figures for Canada are shown in Exhibit 3.1[24]

Exhibit 3.1
Transportation Energy Demand (1991)



Projections of growth of transportation energy use, assuming no major new policy interventions or unanticipated shifts in consumption from changing market forces, whether at the global, domestic, or provincial levels in Canada, all point to increasing energy consumption by the transportation sector as shown in Exhibit 3.2.

[24] *Canada's Energy Outlook, 1992 to 2020,* Natural Resources Canada, September 1993, page 22

Exhibit 3.2
Projections of Transportation Energy Consumption

Geographic Region	Time Period	Percent Increase
Global[25]	1990 - 2030	73
OECD Countries	1990 - 2030	18
Canada[26]	1991 - 2020	52
British Columbia[27]	1990 - 2010	21
Ontario (Road)[28]	1990 - 2015	43
United States[29]	1990 - 2015	45

Natural Resources Canada projects that overall transportation energy demand in Canada will increase by approximately 52 percent between 1991 and 2020. This estimate is based on current trends and admittedly speculative assumptions by NRCan about the impacts of such factors as economic growth, impacts of technologies and market forces on transportation fuel efficiencies, shifts to alternative fuels, as well as reductions of automotive use from shifts to public transit and telecommuting.[30] These assumptions attempt to reflect expected impacts from the range of current policies and programs of governments to reduce the negative impacts of transportation. In fact transportation energy consumption could be higher than forecast if current trends in declining urban transit ridership are not successfully reversed, or if the much hoped for reduction in automobile use as a result of increased telecommuting does not in fact become a reality. The projections are shown in more detail in Exhibit 3.3.

[25] *Motor Vehicle Pollution: Reduction Strategies beyond 2010, OECD, 1995*

[26] *Canada's Energy Outlook, 1992 to 2020,* Natural Resources Canada, September 1993, modified to reflect revisions to forecast demand in Update 1994, NRCan, October 1994, table 3.1, page 9

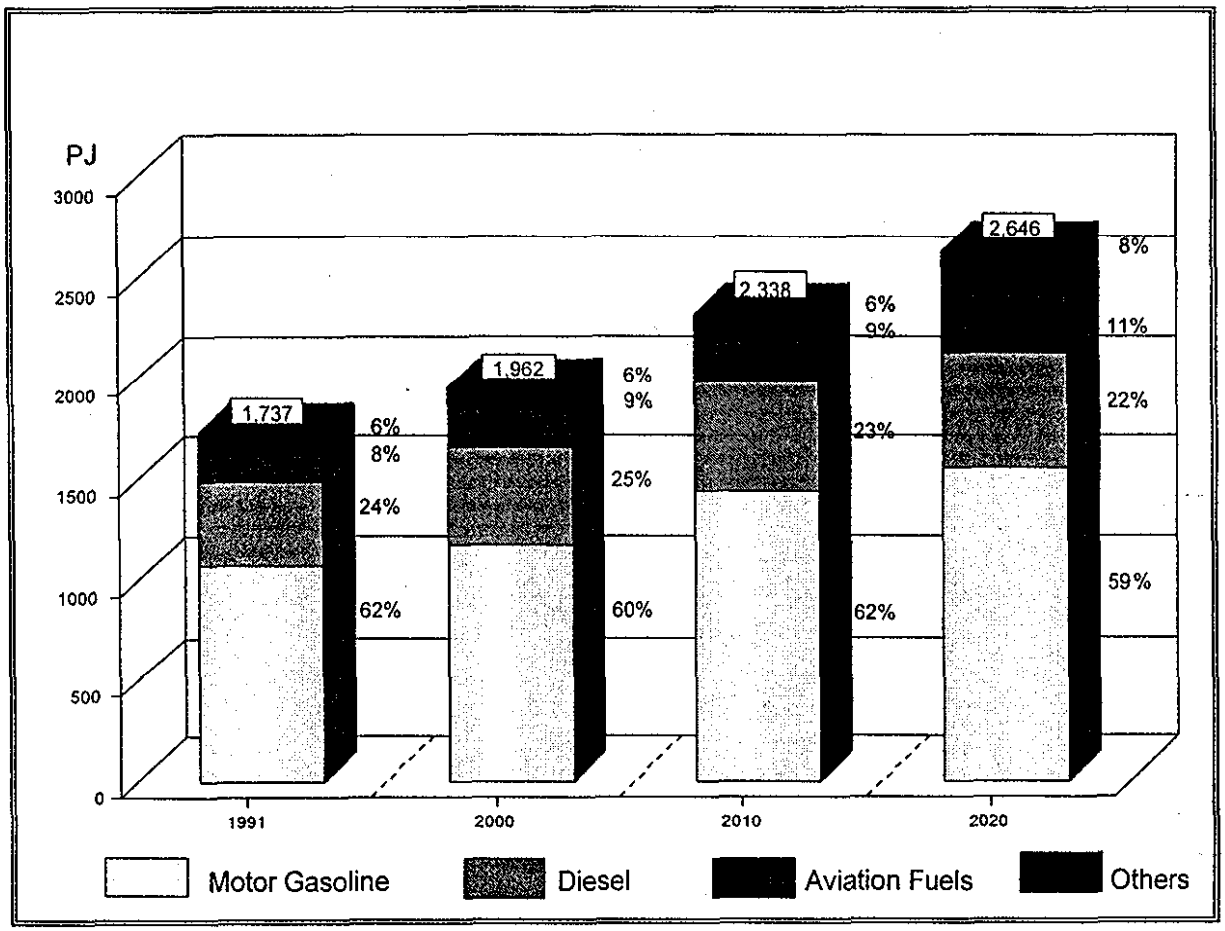
[27] *Clean Vehicles and Fuels for British Columbia, A Policy Paper,* Ministry of Environment, Lands and Parks, April 1995

[28] *A Policy Instruments Working Paper on Reducing CO_2 Emissions from the Transportation Sector in Ontario,* Apogee Research, for the Transportation and Climate Change Collaborative, November 1995, page 21

[29] *Notes from the U.S. Car Talk Group*, provided by General Motors Canada, June 1995

[30] Ibid., page 25, modified to revisions to forecast demand in CEO 1992 to 2020, Update 1994, NRCan, October 1994, table 3.1, page 9

Exhibit 3.3
Transportation Energy Demand (1991-2020)



Clearly, even if these forecasts only tell us accurately about the direction of current trends in transportation demand in Canada, conditions for sustainable transportation will not be met in this country over the next quarter century, simply because our use of fossil fuels in transport will continue to increase.

The above projections are reasonably consistent with those of other countries. The OECD has recently forecast that the consumption of fuels for transportation will increase world-wide by 73 percent between now and the year 2030. Within OECD countries, fuel consumption is expected to increase by 18 percent, taking into account likely changes in fuel efficiency, fuel types, and modal shifts.[31] Any increase, however relative to current consumption rates must be considered unsustainable since maintaining current emission levels of greenhouse gases, for

[31] *Environmental Criteria for Sustainable Transportation*, OECD, 1996, Table 2, page 22.

example, will result in a continuing build up in the concentration of these gases in the atmosphere.

Much of the debate about sustainable transportation centres around the problem of automobile dependence, which includes "loss of community, reduced air quality; climate change; consumption of large amounts of space for roads and parking; intrusion of automobiles into neighbourhoods; boredom in the suburbs; and in some countries, guarded communities. On a global scale, the imminent peaking in the next century of global oil production is also cause for concern."[32]

3.3 Relative Modal Contributions to Unsustainability

Transportation in Canada in 1994, was responsible for 31.4 percent of carbon dioxide emissions from all sources of human activity.[33] The percentages of emissions from various modes, by fuel are summarized in Exhibit 3.4.

Road transport clearly dominates the transportation use of energy and the emissions of carbon dioxide in Canada, with gasoline powered vehicle use (the majority of which takes place in urban areas) being the largest single contributor, followed by diesel powered trucks and other vehicles such as buses. In the case of heavy duty trucks, the majority of fuel is consumed for intercity movement of goods.

[32] *Automobile Dependence in a Global Sample of Cities: Learning from the Best and the Worst,* Dr. Jeffrey Kenworthy, Murdoch University, Australia, presentation to the National Conference on Sustainable Transportation, Vancouver, October, 1995

[33] *Canada's Greenhouse Gas Emissions: Estimates for 1990*, Environment Canada Report EPS 5/AP/4, December 192, Table S.2 updated by unpublished data for 1994 from Environment Canada.

Exhibit 3.4
Percentage of Carbon Dioxide Emissions from Transportation By Mode - Canada - 1994

Transportation Sources	Emissions - Kilotonnes	Emissions - Percent of Total	Emissions - Percent of Transportation
Road - Gasoline			
- Automobiles	50,471	10.47	
- Light duty trucks	23,778	4.93	
- Heavy duty trucks	2,301	0.48	
Other	153	0.03	
Subtotal Gasoline	**76,703**	**15.92**	**51.0**
Road - Diesel			
Light duty trucks	136	0.03	
Heavy duty trucks	25,383	5.27	
Other	14,744	3.06	
Subtotal - Diesel	**40,288**	**8.36**	**27.0**
Road - Gaseous Fuel			
Natural Gas Vehicles	256	0.05	
Propane Vehicles	2,030	0.42	
Subtotal - Gaseous Fuel	**2,286**	**0.47**	**1.0**
Total Road	**119,278**	**24.75**	**79.0**
Off Road			
Rail	6,305	1.31	4.2
Marine	7,669	1.59	5.0
Aircraft	12,233	2.54	8.1
Off road gas	5,773	1.20	3.7
Total Transportation	**151,258**	**31.4**	**100.0**

Sales of cars in Canada, have been stable or declining in recent years, while those of vans, sport utility vehicles and light trucks have been growing at a faster rate than the decline in automobile sales[34,35]. As a result, not only are total motor vehicle registrations growing, but the average fuel consumption per vehicle is increasing because of the market trend to larger vehicles.

[34] *A Strategy for Sustainable Transportation in Ontario,* Report of the Transportation and climate Change Collaborative, November 1995, page 10.

[35] *Statistical Review of the Canadian Automotive Industry - 1996 Edition,* Industry Canada, July 1996 Table 1.1

Energy demand is expected to grow in all transportation modes. The projections of NRCan are based on assumptions about increasing fuel efficiency and anticipated increases in demand for each mode. Projected annual growth rates to the year 2020 are shown in Exhibit 3.5.

Exhibit 3.5
Annual Average Growth Rates for Transportation in Canada
1991 to 2020[36]

Mode	Percent Growth
Road	1.6
Air	3.1
Rail	2.9
Marine	1.4
Total	1.8

These projections and the assumptions behind them were revised by NRCan in their 1994 Update. They will no doubt change again in future. The general conclusions that energy demand is expected to grow for all modes, and that growth in aviation will be the fastest, still hold, if there are no significant changes in societal behaviours and/or government policy interventions. Again, by any definition of sustainable transportation, Canada is headed in the wrong direction.

Trends Away from High Energy Efficiency Modes

A useful way of looking at the sustainability of different modes is to consider the total life cycle greenhouse gas emissions, expressed in carbon dioxide equivalents, per unit of transport delivered (either grams per passenger-kilometre or grams per tonne-kilometre for freight). Exhibits 3.6 and 3.7 provides such modal comparisons, from one study, for passenger and freight transport respectively[37].

[36] *Canada's Energy Outlook - 1992 - 2020,* NRCan, September 1993

[37] *Research and Technology Strategy to Help Overcome Environmental Problems in Relation to Transport* David Martin and Laurie Michaelis, U.K. Atomic Energy Authority, March 1992

Between 1988 and 1994, ridership on the Toronto Transit Commission network has declined by about 16 percent. This trend is unlikely to be reversed in the near future, given the fare increases and rationalization of services which the TTC has had to impose to make up for lost revenue.

In the Greater Vancouver area, where large transit investments have been made in the past, absolute levels of transit ridership increased by about 22 percent in the period 1985 to 1992. In the same seven year period, however, trips by car drivers increased by about 43 percent. As a result, transit mode share decreased by 11 percent. Furthermore, average trip speeds in the GVRD, in the same period, decreased by about 8 percent.[41]

Such are the powers of the market and the aspirations of citizens for "mobility" that they have, acting rationally and in their own interests, used the personal transportation freedom of the automobile, as well as increasing disposable income to create expanding urban sprawl, and to increase the distances among activities. While the benefits of road transport are embedded in the public psyche and have driven much political action in past generations, the disbenefits of continuously expanding transportation and low density land use, are only recently emerging into public consciousness.

Interurban Truck vs Rail

In Canada, the rail mode carries the greatest share of freight tonnage (54.3 percent or 479 million tonnes in 1992), followed by marine, truck and air modes.[42] By comparison, trucking in Ontario carries the greatest share of freight, at 40.1 percent or 100 million tonnes. This is followed by rail(37 percent or 92 million tonnes, marine(22.9 percent and 57 million tonnes) and air (0.1 percent and 250 thousand tonnes).

The most important trend in the past two decades, has been the growth of the truck mode. Between 1980 and 1990, tonnage moved by truck increased by 56 percent, This growth appears to have come at the expense of rail, since overall freight tonnage experienced little net change in this period. By 1989, the Canadian Institute of Guided Ground Transport reports the modal split between rail and truck, using three different measures shown in Exhibit 3.8.[43]

[41] Clean Vehicles and Fuels for British Columbia, page 11

[42] *Ontario Freight Movement Study,* Transmode Consultants for the Transportation and Climate Change Collaborative, June 1995, page 5.

[43] *Estimation of Railway Freight Market Shares - 1989*, Canadian Institute of Guided Ground Transport for CN Rail Intermodal, February 1993, page 3

For example, how could the automobile manufacturers, their suppliers and governments work together to develop incentives for suppliers to locate factories in closer proximity to their customers to reduce the tonne-km of Just In Time truck delivery of parts to auto assembly plants? Or, how could the advanced logistics management techniques used by major companies to reduce their end-to-end logistics costs, be used more generally to reduce the number of vehicle movements per tonne of goods transported? Or how could urban planning, tax policy and technology advances be combined to shift more goods movement to intermodal truck/rail services?

4. POLICY OPTIONS AND ASSOCIATED JURISDICTIONAL AND TIMING ISSUES

4.1 Where is the Sustainable Transportation Issue on the Policy Development Spectrum?

In a phrase: *Just out of the Starting Gate.*

The essence of the challenge that we face in transportation was expressed in the following extract from a presentation by Professor William Rees of the University of British Columbia to the National Conference on Sustainable Transportation, in Vancouver in November 1995.

> *It seems that humankind, thoroughly alienated from nature, is set on an unsustainable course which certainly degrades the natural "environment" and which could plausibly end with the ecological razing of the Earth. As Cambridge economist Terry Barker(1994) points out, this sobering conclusion: "..is not that of a 'deep green' minority. It is the scientific, political and economic consensus as expressed by the UN Intergovernmental Panel on Climate Change, The Brundtland Report, the (UN) Conference on Environment and Development in Rio De Janeiro, the Business Council for Sustainable Development, and the World Resources Institute".*[46]

Despite major advances in technologies in the past two decades in all modes of transportation, the transportation sector remains the fastest growing sector in terms of a broad range of negative environmental, social and economic impacts.

In terms of policy response, governments, at least in North America, continue to focus on combinations of regulation and technology policy options in the technology sector. Few steps have been taken to implement stronger packages of policies which can affect a broad range of consumer and business decisions.

More specifically, progress has been made in acid deposition from air pollutants. Lead has been eliminated from gasoline. There has been progress in reducing oxides of nitrogen, volatile

[46] *Transportation, Urban Form, and Sustainability,* Presentation to the National Conference on Sustainable Transportation, by Professor William Rees, UBC School of Community and Regional Planning, Vancouver October 1995

organic compounds and carbon monoxide. Major strides have been made in transportation safety in all modes, although trucking is a major cause for current concern.

However, smog, ground level ozone, particulates, sulphates and air toxics are continuing problems.

Governments are financially constrained and can no longer base infrastructure investment decisions primarily on demand growth by individual mode. More care is required in evaluating the most cost effective transportation alternatives including accounting for externalities. An interesting current example is the confused debate in Ontario about the future of the Sheppard subway line in Metro Toronto.

There are however, many signs of change in the way decisions are being made. Regional metropolitan governments in all parts of Canada are beginning to rethink the way urban transportation systems will be developed in future in support of new land use planning approaches. Some municipalities are adopting the generic vision and principles for urban transportation that have been articulated by TAC. While TAC acknowledges that the approaches that they have advocated will not lead to true sustainablility, they are steps in the right direction.

However, Canadian efforts have not coalesced into a well formed national strategy and set of integrated actions around which there is broad consensus for tackling urban sustainability. So far, there has been less attention focused on the sustainability of intercity freight movement, and very little action to address the aviation and marine modes.

Climate change is essentially in its infancy as an area for attention of policymakers. Specific targets have not yet been made beyond stabilising emissions at 1990 levels. Canada does not have policies in place which would ensure that transportation could meet this modest goal.

Recent protocols of the United Nations, to which Canada is a signatory, have focused international attention on the policy directions which will be required if sustainable development, including sustainable transportation is to be achieved. Habitat II, and the U.N. Conference on Sustainable Development in Rio, are the most recent expressions of the beginnings of a global commitment to policies for sustainability.

New organisations such as the International Council for Local Environmental Initiatives, which has been in existence only since 1990 is becoming a force in the local sustainability movement. Toronto based ICLEI now has about 200 member municipalities world-wide and expects its growth to continue."[47] By 1995, fifteen Canadian municipal governments had become members of ICLEI.

[47] *Biennial Report,* The International Council for Local Environmental Initiatives, page 5

The OECD has been a very active participant in sustainable transportation research and policy development. They have sponsored a number of international conferences on the subject, the latest being the Conference "Towards Sustainable Transportation" co-sponsored with Environment Canada, in Vancouver in March 1996.

In 1994, the OECD and the European Conference of Ministers of Transport endorsed a comprehensive strategy approach to sustainable urban transport. This strategic framework is one of the most advanced proposed to date. It will be used by European national governments as they develop their own policy responses. It could be used as a starting model for a comprehensive strategy, at least for dealing with the challenges for urban Canada. This integrated strategy approach is discussed further in the next section.

In the United States efforts to move towards sustainable transportation are rooted in a strong legislative framework which includes the Clean air Act Amendments of 1990 and the Intermodal Surface Transportation Act of 1991(ISTEA).

In summary, although there are a number of initiatives which will contribute towards sustainable transportation in Canada, there is as yet, no focused strategy or program that will get us there.

4.2 *Integrated Policy - What has Worked and What Has Not Worked*

What has Worked

Urban air quality has, with the exception of ground-level ozone, coefficient of haze and nitrogen oxide, improved for some pollutants in the past 25 years. Sulphur dioxide, nitrogen dioxide and carbon monoxide annual mean concentrations have all declined. Particulate lead has declined by 96 percent since 1974 because of the ban on lead in gasoline. Total suspended particulates have declined, although this measure is now understood not to be a good indicator of health effects or pollutant sources. Particulates, in fact remain an area of concern.[48]

Routine monitoring results from the National Air Pollution Surveillance (NAPS) network for the period 1970-1994 are shown in Exhibit 4.1. The NAPS network consists of air monitoring stations in most Canadian cities with populations of greater than 100,000. The NAPS data represent pollution levels at individual sampling sites and may not necessarily represent community-wide air quality.[49]

[48] *Transportation, Air quality and Human Health - Issues and Perspectives*, Pollution Probe, for Health Canada, March 1996 (Draft), page 9

[49] Ibid.

Exhibit 4.1
Summary of Seven Air Pollutants Measured by the NAPS Network

Pollutant	1990 Annual Mean Concentration	Percent Decline 1981 - 1990	Percent Decline 1974 - 1990
Sulphur Dioxide	6 ppb	21	53
Nitrogen Dioxide	21 ppb	8	26
Carbon Monoxide	0.8 ppm	45	67
Total Suspended Particulate	38 ug/m3	34	51
Particulate lead	0.02 ug/ m3	93	96
Coefficient of Haze	0.29 COH	no change	24
Ozone	18 ppb	+ 20	n/a

These improvements have been the result of changes in automotive technology and improvement in fuels in response to emissions standards imposed by the U.S. and Canadian governments.

The federal and B.C. governments have been financially supporting Ballard Power Systems of Vancouver in their development of electric propulsion systems for transportation applications using hydrogen fuel cell technology to generate electricity. Ballard is currently a world leader in the development of fuel cell technology. The technology is at the prototype/ demonstration stage. If it can be successfully commercialized for broad application in transportation, the fuel cell could make important contributions to reducing air pollutant emissions. At present, however, it is not possible to predict the extent to which the technology will penetrate the transportation market, and it would therefore be premature to attempt to predict the long term impact of the technology on sustainable transportation..

In 1992, the province of British Columbia introduced a mandatory Inspection & Maintenance program called AirCare, for the one million light duty vehicles in the Lower Fraser Valley. Under this program, emissions of oxides of nitrogen have been reduced by 3 percent, VOC's by 18 percent, and carbon monoxide by 24 percent. B.C. is planning improvements to this program to increase its effectiveness, and also plans to introduce mandatory I&M for heavy duty vehicles. For this latter initiative, the B.C. government has overwhelming public support.

What has not Worked

National Level

With the exception of ground-level ozone, coefficient of haze and nitrogen dioxide, urban air quality has improved considerably since 1970. However, ozone, particulates and nitrogen dioxide continue to be of concern, particularly in view of emerging data on their negative health impacts. As shown in Exhibit 4.1, ozone concentration has increased by about 20 percent since 1981:

Virtually all growth trends point to more frequent use of automobiles with longer trips at lower speeds. Therefore further gains in automobile emissions control will be required just to hold emissions at today's levels."(ed. note: This also appears to be the limited long range goal of the current B.C. Policy on Clean Vehicle and Fuels).

Since ground level ozone appears to be increasing and since particulates are a source of increasing concern because of the findings of epidemiological research, despite reductions in total suspended particulates over past decades, we must conclude that, from a health perspective, sustainable transportation has not been achieved. Moreover, current policies are unlikely to get us there.

In 1994, the Federal Government announced a one time increase in the excise tax on gasoline of 1.8 cents per litre. The tax was justified on the basis of its expected effect on reducing automobile fuel consumption. Given the elasticities of demand for automotive fuels, it was clear from the outset that the new federal tax would have little impact on overall fuel consumption in Canada. In theory, the tax could reduce demand in the range of 1 percent. However, it should be noted that the increase was well within the range of short term variations in the market price for the fuel.

In contrast, the British government, in 1993, as one measure to meet its commitments for mitigating climate change, initiated a policy of increasing fuel taxes by a minimum of 5 percent in real terms per year, indefinitely. This move was intended to send a strong and long term signal to allow consumers, industry and governments to adjust a wide range of decision criteria and behaviours in the expectation of continuously rising fuel prices.

The OECD projects that a 7 percent annual real price increase would be required for the next 20 years, in combination with an integrated package of other instruments, to meet the IPCC target of 60 to 80 percent decrease in greenhouse gas emissions.[50]

The Voluntary Challenge and Registry is one of the principal initiatives of Canada's Climate Change Action Program, 1995. The VCR is targeted at large corporations and government

[50] *Urban travel and sustainable development,* OECD and European Conference of Ministers of Transport, page 25

institutions. It does not address small and medium enterprises. Nor does it address individual consumers. The impact of the VCR on transportation energy demand in Canada will be therefore be negligible, since the program does not involve significant numbers of transportation users.

To the extent that the Oil and Gas sector participates in the VCR, its contributions to GHG mitigation could in theory contribute to GHG mitigation of the life cycle emissions from the transportation sector. However, reviews of the VCR to date provide no evidence that there will be reductions in GHG emissions from the extraction of crude oil and natural gas, or from the production of transportation fuels.[51,52]

On the contrary, based on the plans of Imperial Oil, Canada's largest producer, SGA Consultants concludes that "The upstream oil production sector will become more energy intensive and GHG intensive in the future by virtue of the depletion of fossil fuel resources in the west. As conventional oil and bitumen (tar sands) reserves are depleted, more and more energy is expended trying to extract declining resources. For conventional oil production, processing and reinjection of increasing volumes of water produced along with the oil requires increased energy use per barrel of oil produced."

Exhibit 4.2, extracted from Imperial Oil's submission to the VCR, reflects these trends:

Exhibit 4.2
CO_2 Equivalent Emissions per Unit of Production from Imperial Oil Upstream Operations
(tonnes/ '000 bbl oil equivalent production)

Segment	1990	1994	2000
Conventional Oil	14	16	18
Natural Gas/ NGL	30	30	30
Bitumen	64	67	69

Thus, in future, if the projections of Imperial Oil are indicative of industry trends, it can be expected that life cycle carbon dioxide emissions per unit of transportation energy consumption will increase. This will reinforce the growth of carbon dioxide emissions projected to result from increasing consumption of transportation fuels.

[51] *An Analysis of Comprehensive Action Plans Received under the Canadian Voluntary Challenge and Registry Program,* SGA Consulting for Global Air Issues Branch, Environment Canada, November 1995

[52] *Canada's Voluntary Challenge and Registry Program: An Independent Review,* Pembina Institute, November 1995

Provincial and Municipal Levels

In 1990, the government of Ontario introduced a graduated feebate system called the Tax for Fuel Conservation. This program taxes purchases of high fuel consuming gas guzzlers that ranges from $75 to $7000, for vehicles with fuel economy ratings above 9 litres/ 100 km. It also provides $100 rebate for vehicles with fuel economy ratings below 6 litres/ 100 km. Purchasers of the approximately 90 percent of vehicles which fall with these two limits, a flat tax of $75 applies. The TFFC thus provides an incentive to alter purchase decisions for about 10 percent of annual new vehicle sales. New vehicle sales represent approximately 8 percent of the on-the-road fleet in any given year. Therefore, the TFFC is likely to impact the fuel efficiency of less than one percent of vehicles each year.

There is no mechanism in place to measure the impact of Ontario's TFFC program. However, in its November 1995 status report, Meeting the Challenge of Climate Change, the MOEE estimated that by 2000, the program is expected to reduce annual carbon dioxide emissions by 200 kilotonnes.[53] This would represent a reduction in fuel consumption form the Ontario fleet of approximately one half of one percent of the projected transportation energy consumption in Ontario in 2000. The TFFC has been estimated to raise between $32 and $55 million in tax revenue annually.[54]

In a presentation to the Centre for Transportation Studies at the University of Minnesota, in February, 1995, Dr. Richard Soberman, then Chair of the Department of Civil Engineering at the University of Toronto, made important observations on what has worked and what has not worked in the development of urban transportation in the GTA. Some of his key remarks would could apply to any major urban region:

- Centralized controls on zoning during periods of rapid population growth encouraged high land use densities along designated transit corridors within Metro Toronto. Outside Metro, residential and employment patterns that emerged in the absence of strong planning controls led to automobile dependent urban sprawl.

- Had it not been for the intervention of the Ontario government in 1971, Toronto today would have had more expressways, a poorer transportation system, and less renown as a good place to live;

- The concept of balanced transportation does not work. If a plan really offers true choices between transit and automobiles, transit will not survive;

[53] *Meeting the Challenge of Climate Change, A Status Report on Initiatives in Ontario to Reduce Greenhouse gas Emissions,* Ontario MOEE, for CCME and CEM, November 20, 1995, page 32

[54] *A Policy Instruments Working Paper on Reducing CO_2 Emissions from the Transportation Sector in Ontario,* Apogee Research, for the Transportation and Climate Change Collaborative, November, 1995, page 40

- Toronto's early successes with subway construction in obvious transit intensive corridors led to attitudes that now preclude any serious consideration of less capital intensive transit alternatives that may be more appropriate to emerging spatial patterns;

- Cost based subsidy policies encourage transit inefficiency in all aspects of construction, operation and procurement...;

- Although Toronto is known as an example of the impact of transit investment on land use, expressways within and near Metro have had tremendous influence on patterns of land development as well.

Opportunities and Conflicts

International efforts to develop effective approaches to sustainable transportation have, until very recently, focused on regulation and reliance on technology fixes. It is no coincidence that the first few OECD conferences convened to address widespread negative impacts of transportation were focused primarily on technology and using regulation to force the adoption of technologies which would make vehicles cleaner and more fuel efficient. Less attention has been paid to policies which reduce the need for transportation. There is now an opportunity to shift policy attention towards more holistic approaches to modifying behaviours.

Clean Air legislation and North American introduction of Corporate Average Fleet Efficiency/ Corporate Average Fuel Consumption Standards led to improved fuel efficiency of new cars and, to a more limited extent, new light trucks in the !970,s up to the mid 1980's. While these standards helped to constrain growth of fuel consumption across the continent, gasoline and diesel consumption continued to increase, as a result of growth of disposable income, cheap fuel and larger numbers of vehicles and larger vehicles being driven longer distances.

To date there are very few industrialised countries in the world, with the possible exception of Singapore, where growth in transportation fuel consumption has been halted. The reasons are many but include the following:

- Fuel prices are at historically low levels in North America. The relatively fixed percentage of disposable income used by consumers for transportation, has allowed consumers to purchase new vehicles and to drive them longer distances. There is a well established relationship between gasoline price and vehicle use. Fuel prices in European countries are typically two to three times higher than in North America. Per capita fuel consumption in the EC is also in the range of one third of that in North America consumption.

- It is argued that population densities in European cities are much higher than in North America, and that public transportation systems are more highly developed in Europe. The counter is that it has been the availability of "cheaper" fuels, and land, in North America over many decades, that has enabled the wide use of the automobile, and the low density urban development. Perhaps the time is coming , when to meet sustainability objectives, we in North America will be forced to look seriously at European patterns of urban development for models of how we can have vibrant liveable cities with less dependence on the automobile;

- The availability of inexpensive land, economic policies of governments over past decades and the advances in road transport technologies have resulted in massive investments in single use urban development, road infrastructure and personal and commercial vehicle fleets which have overwhelmed public transportation systems in urban areas and intercity transport of goods by rail.

- Government policies at all levels, and market forces, have favoured developments in road and air transport at the expense of passenger rail and urban transport. Governments have subsidized low density urban and suburban development with land use policies which preclude financially viable transit systems and foster automobile dependence. The fact is that governments are now fiscally constrained. This may offer an opportunity to move to more compact, mixed use urban form which is more cost effective and affordable from an overall infrastructure investment perspective, but which can also improve the financial viability of public transportation systems.

One of the major limitations of efforts to date to develop approaches to sustainable development has been that policy development has largely taken place in response to do those things "which are worth doing anyway"- for economic or other reasons in addition to environmental protection. There has generally been no specific target that governments in Canada have been seriously committed to which would ensure real progress toward sustainable transportation - i.e. transportation that, among other things, will not result in environmental damage beyond the capacity of the ecosystem to absorb. As a result, there have, to date, been no targets set in any Canadian jurisdiction for specific reductions of fuel consumption and , therefore of carbon dioxide emissions. Moreover, there has been limited meaningful analysis in the Canadian literature, of the relative effectiveness of the various policy options for reducing the latter.

One prominent commentator, at the OECD Conference, *Towards Sustainable Transportation,* in Vancouver in March of this year, suggested that policymakers should consider the following relative weighting of the effectiveness of the different classes of policy instruments:[55]

[55] *Sustainable Transportation as a Dead End - Sustainable Transportation - A Reality Check*, Eric Britton, EcoPlan, Presentation to OECD Conference - Towards Sustainable Transportation, Vancouver, March 1996

- technology improvements in vehicles (ca. 1)
- shifting from solo cars to "efficient" transport (ca. 10)
- shifting to non-motorised transport (ca. 100)
- elimination of "unnecessary" travel (ca. 1000)

Policy development in the transportation field has been dominated in the past by initiatives in Category 1. Substantial investments have been made in urban transit infrastructure and services in Canada, but these investments have been overwhelmed by investments in road transport by all sectors of society. Limited research, and even more limited policy and public investment has been focused on categories 3 and 4, where the most substantial leverage seems possible. Mr. Britton's numbers are admittedly rough but they convey an idea about where priorities will likely have to be placed if truly sustainable transportation is to be achieved.

Various commentators at the Vancouver Conference addressed the last two categories in their own ways:

- It is unlikely that governments will be able to achieve sustainable transportation through policy measures alone, even if co-ordinated approaches are taken by all levels pursuing integrated strategies. It will also take informed action by the majority of citizens in their choices as consumers and by businesses seeing it to be in their commercial best interests to offer goods and services that contribute to sustainable transportation. Hence governments have a responsibility to educate and to engage in dialogue with people about the risks and about how they can change their behaviours to enable real change to occur. Many observers suggest that efforts to date have been very much at the margin and unlikely to result in real progress in sustainability of our transportation systems;

- Measures which promote use of compact urban form and mixed land use as well as non-motorised forms of transport, have the potential to reduce the social isolation, barrier effects, public safety and health impacts and to increase the economic efficiency of society as well as reducing the environmental impacts of transport;

In the Report of the GTA Task Force to the Premier of Ontario in January 1996 (The Golden Report), the Task Force estimated that capital investment in new road, sewer and water infrastructure could be reduced by $12.2 billion over the next 25 years from the $55 billion which will be required, if a more compact mixed use development pattern was adopted for the region.[56] When capital, operating and maintenance, as well as external costs are taken into account, the Task Force estimates that annual cost savings of containing urban sprawl would be about $1.0 billion. This, it is argued, would reduce the cost burden on governments as well as increasing the economic competitiveness of the city-region in the global market.

[56] *Greater Toronto, Report of the GTA Task Force,* January, 1996, page 111

In the subsequent public debate about the merits of the many recommendations of the Golden Report, there has been little discussion about the collateral benefits which could be obtained towards sustainable transportation by the reduction of automobile use that could accompany the more economic compact mixed use settlement pattern.

Similar conclusions have led the Greater Vancouver Regional District to adopt more compact urban settlement as an element of its long range planning strategy.

4.3 Policy Instruments for Sustainable Transportation

Policy instruments are the levers by which governments can encourage or mandate the changes required to create a sustainable transportation system.

Major Objectives of Policy Instruments

For policy instruments to enable Canada to achieve sustainable transportation, they will have to effect numerous and substantial changes to the ways we live and do business. Of these changes, five appear to be most important.

Control Air Emissions: Direct controls on vehicle emissions is the traditional and most common approach to reducing air emissions from the transportation sector. Controls generally target tailpipe emissions. However, a major source of VOCs remains evaporative emissions from engine and refuelling.

Emission controls can achieve significant reductions in emissions in the medium-term with foreseeable technologies. However, as the number of vehicles grow and VKmT increases, total emissions will inevitably increase. Increasingly stringent emission controls can provide a means of reducing emissions, while longer term solutions are sought.

Improve Fuel Quality: Use of reformulated fuels can significantly affect emissions of a range of pollutants. Reformulations can involve changes to a range of fuel characteristics such as levels of lead, benzene, aromatics and oxygenates in gasoline and sulphur and aromatics content, volatility and cetane number of diesel fuels. In some cases, reformulated fuels are essential to allow enhanced emissions control technologies to function effectively.

Like emission controls, fuel quality offers short to medium term opportunities to reduce vehicle emissions. In the long-run, however, increased numbers of vehicles and VKmT will necessitate other actions if total emissions are to be reduced significantly.

Increase Fuel Efficiency: Lowering the amount of fuel consumed per VKmT can conserve fossil fuels and reduce emissions. Changes to vehicle weight, aerodynamic drag, tire rolling resistance, transmissions, ignition systems and other vehicle components can improve fuel efficiency.

Until alternative fuels and perhaps changes in transportation patterns are viable, increased fuel efficiency is one of the least disruptive means of lowering CO2 emissions. However, higher fuel efficiency also lowers vehicle operating costs and, therefore, could increase VKmT.

Develop Alternative Fuels: Even with stringent emission controls and fuel efficiency, petroleum-fuel vehicles will continue to be major sources of air emissions. However, further significant emission reductions can result from use of alternative fuels such as such as alcohols, natural gas, propane, hydrogen, electricity and solar energy. Choices in alternative fuels should be driven by a life cycle analysis of the total environmental effects of producing, transporting and consuming each fuel.

From these alternative fuels, it is unlikely that one clear "winner" will emerge for everyone or for every region. Fuel markets dominated by one or two fuels may be superseded by an era of significantly greater choice in fuels. The rate and extent of market penetration potential for alternative fuels is constrained by the state of technology, operational issues, low prices of conventional fuels and the massive investment already made in gasoline and diesel fuels.

Reduce and Shift Transportation Demand: Substantial reductions and shifts in transportation demand may be the only way of achieving truly sustainable transportation in the long run. There are at least three changes in transportation demand that would contribute to sustainability: reductions in total VKmT; driving conditions (congestion); and inter-modal substitution away from higher energy intensive modes such as cars, trucks and aircraft.

A Menu of Policy Instruments

Exhibit 4.3 offers a menu of major policy instruments to help effect the above five changes. The menu is not exhaustive. There are other aspects of sustainable transportation beyond the scope of this menu, such as the environment effects of building, maintaining and disposing of vehicles and providing of transportation infrastructure (highway runoff, wetlands drainage, dust, etc.).

Exhibit 4.3
Examples of Policy Instruments for Sustainable Transportation

Policy Instrument	Primary Objectives: Emissions Control	Fuel Quality	Fuel Efficiency	Alternative Fuels	Transportation Demand	Jurisdiction F=Federal P=Provincial M=Municipal	Time Horizon for Effect
Regulatory Instruments ("Command-and-Control")							
Tailpipe Emission Standards	✓					F	Medium
Mandatory I&M	✓					P	Short
Fuel Quality Standards		✓				F	Medium
Fuel Efficiency Standards			✓			F	Medium
Evaporative Emissions Standards	✓					F/P	Short/Med.
Reduce Speed Limits			✓			P/M	Short
Enforce Speed Limits			✓			P/M	Short
Idling Restrictions			✓			P/M	Short
Economic Instruments							
Corporate Avg. Fuel Efficiency Standards			✓			F	Medium
Emissions Trading (Vehicle Manufacturers)	✓					F	Medium
Fuel Tax			✓	✓	✓	F/P	Short/Long
Fuel Tax Differentiation (eg. carbon tax)			✓		✓	F/P	Short/Long
Emission-Based Surcharge on Insurance			✓		✓	F/P	Short
Emission-Based Vehicle Registration Fee			✓		✓	P	Short
CAFE Tax/Rebates			✓			F/P	Short
Feebates	✓		✓			F/P	Short
Vehicle Scrappage Incentives	✓					F/P	Short
Government Procurement	✓	✓	✓	✓		F/P/M	Short
Weight-Distance Road Pricing					✓	P	Medium
Congestion Pricing					✓	P	Medium
Parking Pricing					✓	F/P/M	Short
Tax Incentives for Transit Use					✓	F/P/M	Short
Transit Subsidies					✓	P	Med./Long
Level Property Taxes on Rail & Road			✓		✓	P	Short/Med.
Alternative Fuel Incentives	✓					F/P	Long
Fines for Failing I&M Tests	✓					P	Short
Eliminate Prov. Subsidies for Municipal Roads	✓					P	Short

Policy Instrument	Primary Objectives: Emission Control	Fuel Quality	Fuel Efficiency	Alternative Fuels	Transportation Demand	Jurisdiction F=Federal P=Provincial M=Municipal	Time Horizon for Effect
Public Education							
Promote Transit Usage					✓	F/P/M	Short/Med.
Promote Ride-Sharing					✓	F/P/M	Short/Med.
Promote Local Commodities					✓	F/P/M	Short/Med.
Voluntary I&M	✓					P	Short
Reduce Idling	✓					F/P/M	Short
Fuel Efficiency Labelling			✓			F	Short
Environmental Codes of Practice	✓		✓			F/P	
Improve Driving Habits			✓			F/P/M	Short
Transportation and Land Use Planning							
Transit Supportive Land Use Planning					✓		
HOV Lanes					✓	M	Medium
Telecommuting Programs					✓	M	Med./Long
High Density Multi-Use Development					✓	M	Long
Cycling & Pedestrian Infrastructure					✓	M	Short/Med.
Inter-Municipal Transit Integration					✓	P/M	Short/Med.
Intermodal Freight Infrastructure					✓	P/M	Med./Long
Limit New Road Construction					✓	P/M	Med./Long
Employer Work Reduction Programs					✓		Short
Flexible Work Schedule					✓		Short
Technology Development							
Government Research	✓	✓	✓	✓			Med./Long
Government/Private Programs	✓	✓	✓	✓			Med./Long
R&D Grants and Incentives	✓	✓	✓	✓			Med./Long

The sustainable transportation literature discusses frequently the need to apply the policy instruments using specific approaches that we have called are:

- "integrated";
- "co-ordinated"; and
- "phased".

Below, each element of the approach is described in more detail.

An Integrated Approach: Packaging the Policy Instruments

Achieving sustainable transportation will require an integrated package of policy instruments. No one policy instrument is a panacea. The problem is too complex and multi-faceted to be addressed by one or even a small number of policy instruments. Combining different policy instruments, each with its own strengths, weaknesses and objectives, into an integrated package is needed.

Some examples of integrated packages of policy instruments already exist, such as the Greater Vancouver Regional District's Air Quality Management Plan and the NO_x/VOC Management Plan.[1] On the other hand, the National Action Plan on Climate Change is not an integrated package. It does not present a comprehensive package of policy instruments to exploit the full range of emission reduction opportunities.

An effective integrated package is likely to contain policy instruments that rely on different approaches, including "command-and-control" regulations, economic instruments, education and information provision, transport and land use planning, and technology development. Understanding how these approaches interact is essential to developing an effective package.

Regulatory Instruments

Regulatory instruments are policy instruments that: 1) command people and companies to change their behaviour in specified ways; and 2) specify the penalties that will be imposed if they do not obey. Examples include vehicle emission standards, fuel standards, mandatory fuel conversion of vehicle fleets and speed limits.

Regulatory instruments work best when there are only a small number of players, such as petroleum refiners or auto makers, to be regulated. When the behaviour of millions of people and companies needs to change, "command-and-control" approaches become less enforceable.

costs and benefits of their actions.[2] Frequently, they also rely on moral suasion to encourage change.

Achieving sustainable transportation will require sustained public education for several reasons.

- The unsustainability of current transportation trends is not well understood. Public education can build a better and more widespread understanding of the environmental impacts and costs associated with transportation infrastructure decisions and personal behaviour.

- Current patterns of transportation, particularly our heavy reliance on the automobile, are deeply ingrained. Behavioural change will not come without significant changes in our way of thinking.

- Public support for some of the tougher policy instruments that will be needed is currently weak. Public education regarding the benefits of tough measures can provide support for political action.

Education encompass a wide range of policy instruments suitable for encouraging different types of behavioural change. Policy instruments include vehicle fuel efficiency labelling, environmental codes of practice, incorporating sustainable transportation into school curricula, media campaigns, driver training, highway signs, etc.

Transportation and Land Use Planning

Altering transportation demand will require significant changes in our lifestyles and business operations. These changes can only occur within a new transportation and land use infrastructure. Planning practices related to transportation and land use will, therefore, be important to achieving long term transportation sustainability. Decisions related to public infrastructure investments, urban development approvals, traffic control and other planning issues will be affected.

Technology Development

There are two strains of thought regarding government's role in technology development. One position is that governments should focus strictly on using regulatory instruments to mandate the private sector to develop new technologies that meet increasingly stringent standards.[3] Government cutbacks and the geographical focus of research in the U.S. can be cited as reasons to adopt a "laissez-faire" approach.

Another position sees government playing a more active role in encouraging new technologies. If government is to play an active role, it could act in several ways:

- offer tax incentives, grants and other financial incentives for private sector research;

- participate in joint research programs, such as the Ballard Fuel Cell program in Canada aimed at developing a vehicle propulsion system using a hydrogen fuel cell to produce electricity, or the U.S. Program for a New Generation of Vehicles (PNGV) aimed at developing a mid-sized car with a fuel economy rating of 80 miles per gallon; and/or

- conduct in-house research through government agencies and institutes.

Of course, governments are already using all three policy instruments. The question is whether their use should be expanded.

To illustrate an integrated approach to policy instruments, the OECD study *Urban Travel and Sustainable Development* offers an example.[4] This study concluded that integrated strategies were not only necessary but that "their benefits -- economic, environmental and social -- will greatly outweigh their costs." The proposed integrated approach have been approved by the European Conference of Ministers of Transport.

Exhibit 4.4
Integrated Approaches to Sustainable Transportation: An OECD Example for Urban Travel

The OECD integrated policy approach contains three main strands:

- **Best Practice**: raise the effectiveness of current land use planning and traffic management measures...to the level of those in the best managed cities;
- **Policy Innovations**: develop new policies aimed at bringing demand for car travel into balance with road capacity;
- **Sustainable Development**: introduce repeated annual increases in motor fuel taxation to promote more economical vehicles, shorter and fewer car trips, a shift in travel away for solo driving and greater use of environmentally friendly modes.

"All three strands of the policy package are necessary to reduce car travel...to improve accessibility for those without cars and to achieve sustainable urban development. Together they could reduce substantially the economic, environmental and social costs of travel in OECD countries, currently estimated to be equivalent to about 5 percent of Gross Domestic Product."

All three strands should be pursued starting immediately. Applying **Best Practices** would have its major impact in the period to the year 2000. The **Policy Innovations** strand is projected to be in place and effective by the year 2015. The effect of the first two strands would be to slow but not stop the growth in transport energy consumption and other impacts of transportation.

"Only the **Sustainable Development** strand, combined with the other policies, lowers urban car travel generally and reduces overall car travel, allowing CO_2 emissions to meet the IPCC [Intergovernmental Panel on Climate Change] target value [of a 60 to 80 percent reduction in CO_2 emission levels] by about 2030."

Source: Organisation for Economic Co-operation and Development (1995) *Urban Travel and Sustainable Development*. Paris: OECD.

A Co-ordinated Approach: A Role for Everyone

All levels of government and other stakeholders will likely be involved in developing and implementing the package of policy instruments. A co-ordinated approach to the assessment, selection, design and implementation of the package is essential for several reasons.

First, co-ordination is required to create an effective package consistent with jurisdictional responsibilities. Each level of government has different policy instruments available to it and is constrained in different ways in how they apply the instruments.

Second, co-ordination can avoid duplication of policy instruments. Avoiding duplication will be particularly important if a full costing approach is adopted. Under full costing, the total costs paid by transportation users through vehicle registration fees, user fees, fuel taxes and other payments should equal the full public, private and external costs.

Third, a co-ordinated package will allow exploitation of synergies between policy instruments. For example, an increase in fuel prices may cause some people to use public transit instead of private vehicles. However, coupling a fuel tax increase while increasing the attractiveness of public transit may have a much greater effect.

Finally, a co-ordinated package will counter some of the undesirable effects of individual policy instruments. As examples, consider the following.

- Policy instruments that mandate increases in fuel efficiency will decrease fuel consumption per VKmT. However, lower fuel costs could mean people travel more, thereby offsetting some of the benefits of fuel efficiency. More stringent fuel efficiency standards could be combined with higher fuel taxes to maintain a constant fuel cost per VKmT.

- Policy instruments that decrease congestion will lower travel time and cost, thereby encouraging more travel. Higher parking prices might offset any tendency for more travel on less congested roads.

A Phased Approach: Do What We Can Now and Prepare for a Sustainable Future

Given the magnitude and complexity of the change involved, a sustainable transportation system will evolve only over several decades or more. Changes to urban forms and lifestyles will occur slowly. Some technologies now on the horizon will gradually emerge as the new practicable technological standard.

Nonetheless, there are immediate reforms that can improve or avoid further deterioration of the current situation. Furthermore, long run changes will only occur if pushed by policy instruments implemented in the short run.

Logical starting points for short run actions include:

- provide education regarding the unsustainability of current transportation practices, the consequences if no actions are taken, the actions to take to encourage sustainability, and the costs and benefits of those actions;
- implement reforms in regions most affected by unsustainable transportation (air quality non-attainment zones);
- incorporate targets for sustainability into today's infrastructure investment and land use planning decisions that will determine transportation patterns in the years to come;
- implement more stringent standards to fully exploit the emissions control and fuel efficiency opportunities available now; and
- raise fuel prices to encourage fuel efficiency improvements and alternative fuel technologies, mode shifting and reduced vehicle use, a policy instrument shown in the 1970s to be effective.

5. TOWARDS A FRAMEWORK FOR A SUSTAINABLE TRANSPORTATION STRATEGY

Through the Program on Sustainable Transportation, the NRTEE hopes to assist the Government to prepare a reference framework for the development and implementation of a sustainable transportation strategy in Canada.

While it is not the purpose of this report to suggest a framework, we do offer some suggestions about the elements the framework should contain. The suggested elements are presented in Exhibit 5.1.

Finally, it is important to note that unsustainable trends are continuing daily. While the framework and comprehensive strategy are under development, people are making decisions to invest in unsustainable transportation infrastructure, to build and purchase homes in the urban hinterland and to buy fuel inefficient vehicles. The longer we delay taking action, the more difficult it will be to reverse unsustainable trends and achieve a more sustainable transportation system.

No stakeholder should use the lack of a finalized framework and strategy as a reason to avoid taking action now. We already know much about the changes needed for more sustainable transportation and the policy instruments to effect those changes. Short term actions are clear and should not be delayed.

Exhibit 5.1
Suggested Elements of a Framework for Sustainable Transportation

Vision Statement
- To guide decision making and be used to increase awareness of what we are trying to achieve in working towards sustainable development

Definitions
- To provide operational links between the vision and actions to realize the vision

Decision Making Principles
- To assist decision making at all relevant levels, including:
  - municipal land use planning
  - provincial and municipal transportation investment and planning
  - federal and provincial regulatory departments
  - federal and provincial tax departments
  - private sector stakeholders

Measurable Performance Indicators
- To track and evaluate progress

Goals and Targets
- To set realistic expectations of interim progress (e.g. 5-years interim targets) and final achievement of goals

An Integrated, Co-ordinated and Phased Package of Policy Instruments
- To achieve the goals and targets

Allocation of Responsibilities
- To implement and monitor the package of policy instruments

Mechanism to Evaluate and Modify the Framework, Strategy, Goals and Targets
- To ensure appropriate revisions in the course towards sustainable transportation

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[1] Other examples of integrated packages, include Organisation for Economic Co-operation and Development (1995) *Urban Travel and Sustainable Development.* Paris: O.E.C.D.

[2] Andreasen (1995) and Kotler and Roberto (1989) provide good entry points into the literature on social marketing.

[3] See, for example, Chapter 4 of Organisation for Economic Co-operation and Development (1995) *Motor Vehicle Pollution: Reduction Strategies Beyond 2010.* O.E.C.D.: Paris.

[4] Organisation for Economic Co-operation and Development (1995) *Urban Travel and Sustainable Development.* Paris: OECD.

APPENDIX A

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APPENDIX A - BIBLIOGRAPHY

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APPENDIX B

EXTRACTS FROM THE HABITAT AGENDA

Appendix B - Extracts From Habitat Agenda: Advance, Unedited Text (15 June 1996)

C. Sustainable human settlements development in an urbanizing world

[...]

77. The sustainability of the global environment and human life will not be achieved unless, among other things, human settlements in both urban and rural areas are made economically buoyant, socially vibrant and environmentally sound, with full respect for cultural, religious and natural heritage and diversity. Urban settlements hold a promise for human development and for protection of the world's natural resources through their ability to support large numbers of people while limiting their impact on the natural environment. Yet, many cities are witnessing harmful patterns of growth, of production and consumption, of land use, of mobility and of degradation of their physical structure. Such problems are often synonymous with soil, air and water pollution, waste of resources and destruction of natural resources. [...] Demographic factors, combined with poverty and lack of access to resources and unsustainable patterns of production and consumption, can cause or exacerbate problems of environmental degradation and resource depletion and thus inhibit sustainable development. Therefore, a largely urbanized world implies that sustainable development will depend very largely on the capacity of urban and metropolitan areas to manage the production and consumption patterns and the transport and waste disposal systems needed to preserve the environment.

[...]

79. Increasingly, cities have a network of linkages that extends far beyond their boundaries. Sustainable urban development requires consideration of the carrying capacity of the entire ecosystem supporting such development, including the prevention and mitigation of adverse environmental impacts occurring outside urban areas. [...]

[...]

2. Sustainable land use

82. Land is essential for the provision of food, water and energy for many living systems, and is critical to human activity. In rapidly growing urban areas, access to land is rendered increasingly difficult by the potentially competing demands of housing, industry, commerce, infrastructure, transport, agriculture and the need for open spaces and green areas, and the protection of fragile ecosystems. The rising costs of urban land and other factors prevent persons living in poverty and members of other vulnerable and disadvantaged groups from gaining access to suitable land, the location of which does not pose particular economic, environmental or health risks to the residents for such reasons as its proximity to polluting industrial facilities,

inappropriate geographical conditions or its susceptibility to natural disasters. Bringing the development of urban areas into harmony with the natural environment and the overall system of settlements is one of the basic tasks to be undertaken in achieving a sustainable urbanized world.

[...]

83. Many cities are using peripheral land for urban-related purposes in a wasteful manner while existing serviced land and infrastructure may not be adequately developed and used. To avoid unbalanced, unhealthy and unsustainable growth of human settlements, it is necessary to promote land-use patterns that minimize transport demands, save energy and protect open and green spaces. Appropriate urban density and mixed land-use guidelines are of prime importance for urban development. [...]

Actions

84. Governments at the appropriate levels, including local authorities and other interested parties, with the support of the relevant international and regional institutions, should support the efforts of human settlements to establish sustainable urban land-use patterns and planning and, to that end, should:

[...]

(b) Promote efficient and accessible land markets that are responsive to demand and meet community needs;

(c) Develop, where appropriate, fiscal incentives and land-use control measures, including land-use planning solutions for more rational and sustainable use of limited land resources;

(d) Focus greater attention on meeting the capital investment requirements of human settlements through resource mobilization strategies and policies that facilitate greater flows of private investment in urban development in locations that contribute to sustainable land-use patterns;

[...]

(g) Promote the integration of land-use, communications and transport planning to encourage development patterns that reduce the demand for transport;

[...]

environmental performance of existing modes of transport, and adopting appropriate pricing and other policies and regulations.

103 bis. Non-motorized transport is a major mode of mobility, particularly for low-income, vulnerable and disadvantaged groups. One structural measure to counteract the socio-economic marginalization of these groups is to foster their mobility by promoting affordable, efficient and energy-saving modes of transport.

Actions

104. In order to achieve sustainable transport in human settlements, Governments at the appropriate levels, in partnership with the private sector, the community sector and other relevant interested parties should:

(a) Support an integrated transport policy approach that explores the full array of technical and management options and pays due attention to the needs of all population groups, especially those whose mobility is constrained because of disability, age, poverty or any other factor;

(b) Coordinate land-use and transport planning in order to encourage spatial settlement patterns that facilitate access to such basic necessities as workplaces, schools, health care, places of worship, goods and services, and leisure, thereby reducing the need to travel;

(c) Encourage the use of an optimal combination of modes of transport, including walking, cycling and private and public means of transportation, through appropriate pricing, spatial settlement policies and regulatory measures;

(d) Promote and implement disincentive measures that discourage the increasing growth of private motorized traffic and reduce congestion, which is damaging environmentally, economically and socially, and to human health and safety, through pricing, traffic regulation, parking and land-use planning and traffic abatement methods, and by providing or encouraging effective alternative transport methods, particularly to the most congested areas;

(e) Provide or promote an effective, affordable, physically accessible and environmentally sound public transport and communication system, giving priority to collective means of transport with adequate carrying capacity and frequency that support basic needs and the main traffic flows;

(f) Promote, regulate and enforce quiet, use-efficient and low-polluting technologies, including fuel-efficient engine and emissions controls and fuel with a low level of polluting emissions and impact on the atmosphere and other alternative forms of energy;

(g) Encourage and promote public access to electronic information services.

[...]

8. Improving urban economies

[...]

110. Cities have traditionally served as economic centres and have become the primary providers of services. As engines of economic growth and development they function within a network of supporting economic activities located in their peri-urban and surrounding rural areas. For this reason, specific actions also need to be taken to develop and maintain efficient and affordable transport, information and communications systems and linkages with other urban centres and with rural areas and to seek reasonably balanced patterns of development, both geographically and economically. Rapid changes in production technologies and in trade and consumption patterns will lead to changes in urban spatial structures that, notwithstanding their nature, need to be addressed.

[...]

APPENDIX C

ENVIRONMENTAL INDICATORS FOR TRANSPORTATION

SUMMARY OF NATIONAL INDICATORS QUANTIFIED: HIGHWAY TRANSPORTATION

Activity	Outcome Indicators Health or Ecological Results Measure	Output Indicators Emissions, Habitat Change, or Exposure Measure	Activity Indicators Infrastructure, Travel, or Other Action Measure	Notes
1. Road Construction and Maintenance				
Habitat disruption and land take for road and right-of-way	• States reporting highway-related wetland losses	• Cumulative land area covered by roads • New land area taken for roadway use	• New road mileage and lane mileage constructed.	National estimates of fragmentation and other impacts are not available. Some useful state data are available.
Emissions during construction and maintenance	• *Percent of surface waters* degraded from land development projects (not just highways)	• *Changes in surrounding water* quality conditions near typical construction site • States reporting contamination problems at maintenance facilities	• *Acres sprayed with herbicide* • Energy used in construction	Emissions result from use of heavy machinery, pesticide application, and discovery of hazardous material in the right-of-way.
Releases of deicing compounds	• *States reporting degraded* wetlands integrity due to salinity • States reporting road salting as a significant source of ground water contamination	*(Data unavailable)*	• *Quantity of road salt used*	Deicing creates costs in terms of installing corrosion protection features during bridge construction and maintenance. Data is available on the number of roadside trees killed per year due to salting typical road.
Highway runoff	• River miles, lakes, and ocean shore miles impaired by urban runoff (not just highways)	• Average pollutant concentrations of various metals, suspended solids, and toxic organics in road runoff • Quantity of oil and grease *loading via road runoff*	• Percentage of roads that are paved	Road runoff's share of pollutant loading to nearby water bodies has been estimated locally.
2. Motor Vehicle and Parts Manufacture				
Toxic releases and other emissions	(Data unavailable)	• Quantity of reported releases of toxic chemicals included in TRI database • Quantity of CO, NO_2, PM-10, TP, SO_2, VOC released to air		Impacts of imported products/components are not included in statistics.

Activity	Outcome Indicators Health or Ecological Results Measure	Output Indicators Emissions, Habitat Change, or Exposure Measure	Activity Indicators Infrastructure, Travel, or Other Action Measure	Notes
3. Road Vehicle Travel				
Tailpipe and evaporative emissions	• Cases of chronic respiratory illness, cancer, headaches, respiratory restricted activity days, and premature deaths due to motor vehicle pollution	• Quantity of CO, NO_X, VOC, SO_2, PM, Pb, CO_2, CH_4, N_2O, Benzene, Butadiene, and Formaldehyde released		Health and welfare impacts have been estimated. Road transport's share of total national emissions and loadings to lakes and bays have also been estimated.
Fugitive dust emissions from roads	• Cases of chronic respiratory illness, asthma attacks, respiratory restricted activity days, and premature deaths due to particulates associated with motor vehicles	• Quantity of fugitive dust (PM-10) emitted		Health and welfare impacts have been estimated. Road transport's shares of total national emissions of fugitive dust and PM-10 have also been estimated.
Emissions of refrigerant agents from vehicle air conditioners	(Data unavailable)	• Quantity of CFCs, HFCs emitted from all sources • % of emissions attributable to motor vehicles	• Quantify of CFCs consumed in autos	CFCs are being phased out.
Noise	• % of population exposed to levels of roadway noise associated with health and other effects (1980 only)	• Typical noise emissions levels by vehicle type and road type		Since noise dissipates from its source, a national aggregate noise emissions level is not meaningful. Recent exposure estimates are not available.
Hazardous materials spills during transport	(Data unavailable)	• Type and quantity of material reported spilled		Some of the quantity spilled is generally recovered, and is not a permanent release to the environment. Amount recovered is not measured.
Roadkill	• Approximate number of animals killed			

Activity	Outcome Indicators Health or Ecological Results Measure	Output Indicators Emissions, Habitat Change, or Exposure Measure	Activity Indicators Infrastructure, Travel, or Other Action Measure	Notes
4. Motor Vehicle Maintenance and Support				
Releases during terminal *operations: tank truck cleaning,* maintenance, repair, and refueling	(Data unavailable)	• Quantity of VOCs emitted	• Number of terminals and types *of materials used during* terminal operations	
Releases during passenger vehicle cleaning, maintenance, repair, and refueling	(Data unavailable)	(Data unavailable)	• Percent of transit agencies that wash bus fleets daily	
Leaking underground storage tanks containing fuel	• States reporting leaking USTs to be a significant source of ground water contamination	• Number of confirmed releases from storage tanks	• Number of active petroleum USTs	Some of the quantity released is generally recovered or cleaned-up, and is not a permanent release to the environment. Amount recovered is not measured.
5. Disposal of Vehicles and Parts				
Scrappage of vehicles	(Data unavailable)	(Data unavailable)	• Number of vehicles scrapped, quantity of various materials in vehicle, percentage of mass landfilled	Percentage of all landfilled material is known.
Motor oil disposal	(Data unavailable)	(Data unavailable)	• Quantity of used motor oil improperly disposed	Improperly disposed oil's share of total motor oil disposed has also been estimated.
Tire disposal	(Data unavailable)	(Data unavailable)	• Quantity of used tires landfilled or stockpiled	Recovery/recycle rate for used tires and their share of the solid waste stream have also been estimated.
Lead-acid batteries disposal	(Data unavailable)	(Data unavailable)	• Quantity of lead-acid batteries discarded into municipal waste stream	Recovery/recycle rate for spent batteries and their share of lead and total tonnage in the solid waste stream have also been estimated.

Summary of National Indicators Quantified: Rail Transportation

Activity	Outcome Indicators Health or Ecological Results Measure	Output Indicators Emissions, Habitat Change, or Exposure Measure	Activity Indicators Infrastructure, Travel, or Other Action Measure	Notes
1. Railway Construction, Maintenance, and Abandonment				
Habitat disruption and land take	(Data unavailable)	• Cumulative land area covered by surface track • New land area taken for track	• Track mileage constructed and abandoned • Number of rail stations	National estimates of habitat fragmentation and other impacts are not available. Rail track may be elevated, surface, or underground.
Emissions during construction and maintenance	(Data unavailable)	(Data unavailable)	• Number of crossties laid • Tons of rail laid	Creosote is a toxic preservant that is applied to rail crossties.
2. Rail Car and Parts Manufacture				
Toxic releases	(Data unavailable)	• Quantity of reported releases of toxic chemicals included *in TRI database*		Impacts of imported products/components are not included in statistics.
3. Rail Travel				
Exhaust emissions	(Data unavailable)	• Quantity of CO, NO_X, VOC, SO_2, PM-10, CO_2, CH_4, N_2O, and Ammonia released		Rail's share of total national emissions has also been estimated.
Noise	• % of population exposed to levels of roadway noise associated with health and other effects (1980 only)	• Typical noise emissions levels for trains		Since noise dissipates from its source, a national aggregate noise emissions level is not meaningful. Recent exposure estimates are not available.
Hazardous materials spills during transport	(Data unavailable)	• Type and quantity of material reported spilled		Some of the quantity spilled is generally recovered, and is not a permanent release to the environment.

SUMMARY OF NATIONAL INDICATORS QUANTIFIED: AVIATION TRANSPORTATION

Activity	Outcome Indicators Health or Ecological Results Measure	Output Indicators Emissions, Habitat Change, or Exposure Measure	Activity Indicators Infrastructure, Travel, or Other Action Measure	Notes
1. *Airport Construction, Maintenance, or Expansion*				
Habitat disruption and land take	(Data unavailable)	(Data unavailable)	• Number of airports constructed • Length of runways constructed • Cumulative number of airports	Potential impacts on existing wetlands, vegetation, and wildlife habitat.
Emissions during construction and maintenance	(Data unavailable)	(Data unavailable)	• Number of airports constructed • Length of runways constructed	Construction related activities generally result in temporary visual, noise, air quality, erosion, water quality, and solid waste impacts.
Releases of deicing compounds	(Data unavailable)	• Percent of urea discharged directly to surface waters	• Quantity of deicing agents used	Glycol and urea may mix with runway runoff and other local sources of stormwater resulting in overland flow, and release to surface waters.
Airport Runoff	(Data unavailable)	(Data unavailable)	• Cumulative number of airports • Number/percent of airports with paved runways	
2. *Aircraft and Parts Manufacture*				
Toxic releases	(Data unavailable)	• Quantity of reported releases of toxic chemicals included in TRI database	• Number of new jet aircraft delivered	Impacts of imported products/components are not included in statistics. Emissions of non-toxic air pollutants are unknown.

Activity	Outcome Indicators Health or Ecological Results Measure	Output Indicators Emissions, Habitat Change, or Exposure Measure	Activity Indicators Infrastructure, Travel, or Other Action Measure	Notes
3. Aviation Travel				
High altitude emissions	(Data unavailable)	• Quantity of CO_2, CH_4, and N_2O released	• Fuel consumption	There are cases where fuel dumping in the atmosphere has occurred. For most pollutants, altitude of emissions is unknown, although damage is known to differ depending on altitude.
Low altitude/ground level emissions	(Data unavailable)	• Quantity of CO, NO_X, VOC, SO_2, PM, and Butadiene released		For most pollutants, altitude of emissions is unknown.
Noise	• % of population exposed to levels of aircraft noise associated with health and other effects	• Typical noise emissions levels by aircraft type during takeoff and landing		Improvements in aircraft design has reduced noise despite tremendous growth in airline traffic.
Hazardous material spills during transport	(Data unavailable)	• Type and quantity of material reported spilled		Some of the quantity spilled is generally recovered, and is not a permanent release to the environment. Amount recovered is not measured.
4. Airport Operation				
Emissions from ground support equipment	(Data unavailable)	• Quantity of CO, NO_X, VOC, and PM released		
5. Disposal of Aircraft and Parts				
Airplane and parts disposal	(Data unavailable)	(Data unavailable)	• Number of aircraft ordered	Longevity of the airline fleet, exportation, and recycling result in relatively low rates of aircraft scrappage.

SUMMARY OF NATIONAL INDICATORS QUANTIFIED: MARITIME TRANSPORTATION

Activity	Outcome Indicators Health or Ecological Results Measure	Output Indicators Emissions, Habitat Change, or Exposure Measure	Activity Indicators Infrastructure, Travel, or Other Action Measure	Notes
1. Construction and Maintenance of Navigation Improvements				
Direct deterioration of habitats and water quality from dredging or other navigation improvements	• States reporting dredging-related wetland losses	• Quantity of dredged material	• Commercially navigable channel mileage	Direct effects of navigation improvements vary widely with the scale and type of project. Physical impacts of one dredging project may cause little harm, while another may alter an ecosystem. The reported total amount of material dredged fluctuates among various sources.
Habitat disruption and contamination from disposal of dredged material	• States reporting disposal of dredged material as a source of direct wetlands losses	• Quantity of dredged material disposed at various sites (e.g., ocean, coastal waters) and used for various purposes (e.g., wetlands creation)		
Habitat disruption and land take for ports and marinas	(Data unavailable)	(Data unavailable)	• Number of U.S. ports and marinas	Allocating the amount of habitat loss caused by a port is difficult, because shoreline habitat losses may be caused by a wide variety of factors.
2. Manufacture of Maritime Vessels and Parts				
Toxic releases during manufacture of maritime vessels and parts	(Data unavailable)	• Quantity of reported releases of toxic chemicals included in TRI database		
3. Maritime Travel				
Air pollutant emissions	(Data unavailable)	• Quantity of CO, NO_X, VOC, SO_2, PM, CO_2, CH_4, and N_2O released		

Activity	Outcome Indicators Health or Ecological Results Measure	Output Indicators Emissions, Habitat Change, or Exposure Measure	Activity Indicators Infrastructure, Travel, or Other Action Measure	Notes
Habitat disruption caused by wakes and anchors	(Data unavailable)	(Data unavailable)	(Data unavailable)	Given the highly local nature of this problem, national outcome indicators, and even output indicators are unavailable.
Introduction of nonnative species	(Data unavailable)	• Number of species introduced into the Great Lakes by vessels		Total environmental impacts caused by introduction of nonnative species are difficult to estimate, since effects may take an extremely long time to occur.
Hazardous materials spills during transport	(Data unavailable)	• Quantity of oil and other hazardous wastes spilled in U.S. waters		
Wildlife collisions	• Numbers of certain endangered species killed by collisions with vessels	(Data unavailable)		No national indicators of animal losses from vessel collisions are available, but studies have been conducted for individual species..
Overboard dumping of solid waste	• Numbers of certain species killed by entanglement in plastic marine debris	(Data unavailable)	• Quantity of garbage generated by the maritime sector (amount disposed at sea is unknown)	
Sewage dumping	• Percent of shellfish waters reported contaminated due to sewage dumping	(Data unavailable)	• Percent of commercial vessels with on-board sanitation devices	
4. Maritime Vessel Maintenance and Support				
Releases of pollutants during terminal operations	(Data unavailable)	• Quantity of hazardous air pollutants emitted	• Number of marine repair establishments	
5. Disposal of Maritime Vessels and Parts				
Scrappage of old vessels and dilapidated parts	(Data unavailable)	(Data unavailable)	(Data unavailable)	Boat scrappage estimates are unavailable, but changes in fleet size may provide some information.