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ENVIRONMENTALLY SUSTAINABLE TRANSPORT (EST)
PHASE 3: POLICY INSTRUMENTS FOR ACHIEVING EST

Volume 2
Case Study: provided by Canada

This document is part of the report on Phase 3 of the four-phase project on Environmentally Sustainable Transport (EST) [ENV/EPOC/PPC/T(99)6/FINAL]. The report on Phase 3 comes in two volumes: i) the synthesis report of the case studies with the different policy packages, and ii) as an annex volume, the compilation of the seven studies prepared by the participating countries. Phase 3 concerned the identification of policy instruments and measures for achieving EST. It is based on individual case studies carried out by ten countries.

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FOREWORD

This document is part of the report on Phase 3 of the four-phase project on Environmentally Sustainable Transport (EST) [ENV/EPOC/PPC/T(99)6/FINAL]. The report on Phase 3 comes in two volumes: i) the synthesis report of the case studies with the different policy packages, and ii) as an annex volume, the compilation of the seven studies prepared by the participating countries. Phase 3 concerned the identification of policy instruments and measures for achieving EST. It is based on individual case studies carried out by ten countries. These studies form the annex to the report on Phase 3 of the EST project, and are as follows:

ANNEX 1: **Alpine Region** - *EST Synthesis report* (Austria, France, Italy and Switzerland) [ENV/EPOC/PPC/T(99)6/FINAL/ANN1]

ANNEX 2: **Canada** - *Environmentally Sustainable Transportation Study - Québec Windsor Corridor* [ENV/EPOC/PPC/T(99)6/FINAL/ANN2]

ANNEX 3: **Germany** - *Environmentally Sustainable Transportation Study* [ENV/EPOC/PPC/T(99)6/FINAL/ANN3]

ANNEX 4: **Japan** - *A Meso-Scale Estimation of Future CO_2 Emissions in Transport* [ENV/EPOC/PPC/T(99)6/FINAL/ANN4]

ANNEX 5: **The Netherlands** - *Environmentally Sustainable Transportation: Implementation and Impacts for the Netherlands for 2030* [ENV/EPOC/PPC/T(99)6/FINAL/ANN5]

ANNEX 6: **Norway** - *Environmentally Sustainable Transport - Case Study: The Greater Oslo area* [ENV/EPOC/PPC/T(99)6/FINAL/ANN6]

ANNEX 7: **Sweden** - *An Environmentally Sustainable Transport System in Sweden* [ENV/EPOC/PPC/T(99)6/FINAL/ANN7]

The overall purposes of the OECD EST project are to characterise EST and to establish guidelines for the development of policies that would result in the achievement of EST. The basic techniques used are scenario construction and backcasting.

- **Phase 1**, of the EST project—completed in 1996—involved a review of relevant activities of Member countries as well as the development of the definition of and criteria for EST.

- **Phase 2**, carried out in 1997 and 1998, has been the scenario-development phase. It has mainly comprised construction by participating Member countries of a business-as-usual (BAU) scenario and three scenarios for 2030 consistent with the EST criteria. It has also involved some preliminary consideration of the backcasting and other analyses to be undertaken during Phase 3.

- **Phase 3**, carried out in 1999 comprised the core of the backcasting exercise. It mostly consisted of the identification of packages of policy instruments and measures whose implementation would result in achieving the EST3 scenarios constructed during Phase 2. Phase 3 involved also refinement of the EST3 scenario and assessment of the social and economic implications of the BAU and EST3 scenarios.

- **Phase 4**, conducted during 2000 comprised refinement of the definition and the criteria for achieving EST and the development of guidelines for policies for moving towards EST.

The work has been carried out by six teams of experts from nine countries, each with a separate geographical focus to describe how this environmentally desirable objective may be achieved. The six case studies include Sweden, the Netherlands, Germany, the Quebec-Windsor corridor in Canada, the Greater Oslo region and the Alpine region comprising parts of Austria, France, Italy and Switzerland. Related studies have been undertaken by Japan and for the Central and Eastern European region within the context of the Central European Initiative of Environment Ministers (CEI). The case study on EST for Japan is also included in the Annex, while the EST study for the CEI has been published separately.

The reports and expert papers of all Phases of the project are also available on OECD's Internet site (http://www.OECD.org/env/ccst/est).

ENVIRONMENT CANADA

OECD ENVIRONMENTALLY SUSTAINABLE TRANSPORTATION (EST) STUDY - QUÉBEC WINDSOR CORRIDOR

FINAL REPORT ON PHASE 3

(Updated Edition)

June, 2000

IBI Group

in association with

A.K. Socio-Technical Consultants (Ottawa) Incorporated
and with Frances Frisken

IBI
GROUP

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ENVIRONMENTALLY SUSTAINABLE TRANSPORTATION STUDY - QUEBEC WINDSOR CORRIDOR

1. Introduction

1.1 Study Overview

The Organization for Economic Co-operation and Development (OECD) started the Environmentally Sustainable Transportation (EST) Project in 1994 with its objective being "to characterize environmentally sustainable transport (EST) and to develop guidelines for policies and measures whose implementation would result in achievement of EST." In total, eight countries decided to participate in the project resulting in studies of six different regions.

The OECD project is comprised of four phases. Phase 1 of the project resulted in a definition of sustainable transportation and identification of potential criteria for EST. Although these definitions and criteria were not internationally or nationally agreed upon, participating countries were to use them for the purpose of the study in their own prospective research.

The criteria adopted by country teams participating in the study are as follows:

- **Carbon Dioxide (CO_2)** - Total emissions of CO_2 for transport purposes in 2030 are to be no more than 20% of 1990 levels;
- **Nitrogen Oxides (NOx) -** Total emissions of NOx from the transport system in 2030 are to be no more than 10% of 1990 levels;
- **Volatile Organic Compounds (VOC)**: Total emissions of VOC's from the transportation system are to be no more than 10% of 1990 levels.

PROJECT DEFINITION OF SUSTAINABLE TRANSPORTATION

Transportation that does not endanger public health or ecosystems and meets needs for access consistent with (a) use of renewable resources at below their rates of regeneration, and (b) use of non-renewable resources at below the rate of development of renewable substitutes.

Three additional criteria were deemed to be optional and were left to each country team to define within the scope of their study: particulate matter, land take and noise. Canada chose to focus primarily on the first three criteria for the study of the Québec City - Windsor Corridor (QWC).

1.2 Review of Phase 2 findings

Phase 2 of the project consisted of establishing a business-as-usual (BAU) scenario as a baseline, and developing three other scenarios for 2030 that could achieve the EST criteria. EST1 (Technology Scenario) assumes that the EST criteria will be achieved entirely through technological change; EST2

(Activity Reorganization Scenario) assumes the criteria will be achieved entirely through managing and reducing demand; and EST3 (Combination Scenario) assumes a combination of technology and demand management/activity reorganization to meet the EST targets.

Exhibit 1.1 provides an illustration of the importance of the task at hand for achieving the EST criteria in the Québec-City - Windsor Corridor. The complete results of QWC Phase 2 study are documented in an Annex to the OECD report entitled *Report on Phase II of the OECD EST Project*. To put the reduction proposed under the EST criteria into perspective, it is useful to compare the projected trends under the BAU Scenario vs. the EST criteria for the QWC. Under the BAU Scenario, total CO_2 emissions from transport activity are expected to **increase** by almost 50% between 1990 and 2030. Under the EST scenarios, an 80% **decrease** is the target.

EXHIBIT 1.1
EST CRITERIA

Parameter	Criterion	Target Levels (as % of 1990 values)	1990 Levels [2]	EST - 2030
BASE CRITERIA				
CO_2	Total Emissions of CO_2 for transport purposes in 2030 are to be no more than 20% of 1990 levels	20%	54876 kt	10975 kt
NO_X	Total Emissions of NOx from the transport system in 2030 are to be no more than 10% of 1990 levels	10%	387 kt	39 kt
VOC	Total Emissions of VOCs from the transportation system are to be no more than 10% of 1990 levels	10%	306 kt	31 kt
OPTIONAL CRITERIA				
Particulate Matter	Total emissions of particulates from the transportation system in 2030 are to be such that harmfull air levels are avoided	n/a	n/a	n/a
Land Take [1]	The use of land for movement, maintenance and storage of all transport vehicles is reduced to the extent that local and regional objectives for ecosytems protection are met.	n/a	n/a	n/a
Noise	Noise from transportation in 2030 is below levels that cause impairment of health or serious nuisance	n/a	n/a	n/a

One of the most important conclusions from the Phase 2 analysis was that achieving any of the EST scenarios would require very significant changes in transportation activity, land use and technology, all accompanied by a fundamental change in society's regard for the environment in general.

Two important concerns were also noted by experts consulted for the Canadian QWC study:

- As was noted in the Phase 2 report, using relative criteria (i.e. % reduction) was deemed to be unfair to those countries that have already achieved significant reductions prior to 1990. It was also felt that relative measures would result in different ambient concentrations at different locations and times. Future efforts may consider the development and inclusion of absolute sustainability criteria.

- Canadian experts were most uncomfortable with the CO_2 criterion, particularly in view of the large gap between the EST emissions reduction suggested for sustainability (-80%) and those committed by Canada in the Kyoto Protocol (-6%) to be reached by 2012. Although there is an acknowledgment that the Kyoto targets may only be a step towards greater reduction, the EST criteria was felt to be extremely ambitious particularly within the 2030 timeframe. Furthermore, some experts were reluctant to look at sustainability of the transportation sector

in isolation from other sectors. Some experts felt that it would be necessary to share the burden amongst sectors to meet the 80% reduction in CO_2 in the most efficient manner.

Notwithstanding these concerns, it was felt that the backcasting approach with its sustainability goal setting could shed light on the scope of societal changes required to move towards greater sustainability and on possible paths for achieving it. It was also felt that this exercise can provide a sound complementary long term view to current analytical efforts undertaken under the Canadian implementation strategy on climate change carried out in the context of the Kyoto Protocol.

To meet Canada's commitment under the Kyoto Protocol, Canada is currently developing a national implementation strategy on climate change. To facilitate the process, sixteen Issue Tables/Groups have been established, including a Transportation Table. The Transportation Table, led by Transport Canada, recently completed over 24 analytical studies worth over $1 million. The Table analyzed more than 100 different measures to reduce emissions from transportation. In late 1999, the Table released an options paper describing a range of potential measures to reduce greenhouse gas emissions within the transportation sector, along with summaries of the analytical studies. The options will be put forward for consideration in the development of an integrated National Strategy for Canada.[1]

1.3 Phase 3 objectives and approach

Phase 3 of the QWC study, which is the subject of this report, involves the identification of a broad range of public policy instruments whose implementation would result in achieving the scenarios constructed during Phase 2, with a focus on EST3 (the Combination Scenario). Phase 3 of the study also consists of an assessment of the social and economic implications of the BAU and EST3 scenarios. For the purpose of this report, the social and economic implications of the scenarios have been assessed largely qualitatively, using an evaluation grid supplied by the OECD as well as other methods. In addition, two separate independent economic analyses were carried out in conjunction with Phase 3 and the results are summarized in this report.

OECD EST PROJECT
PHASE 3

Phase 3 of the OECD EST Project involves the identification of packages of policy instruments whose implementation would result in achieving sustainable transportation as defined in by the project.

Phase 4 of the project, to be conducted by an OECD experts team, will involve the refinement of the definition and criteria for achieving EST and the establishment of guidelines for policy development in connection with environmentally sustainable transportation for the benefit of OECD countries.

Phase 3 of the EST study consists of backcasting the actions required to attain what is deemed to be the desirable future identified for EST3 (the Combination Scenario). The objective is to identify a package or packages of instruments whose implementation would result in the attainment of the EST3 Scenario. As discussed in the previous Phase 2

BACKCASTING VS FORECASTING

Forecasting involves extrapolation of current interactions and trends into the future. It involves determining what can be done to avoid an unwanted future.

In contrast, backcasting defines a desirable future and identifies the conditions for this future to materialize.

[1] Please visit this website for more information http://www.tc.gc.ca/envaffairs/english/climatechange.htm.

report, the intent of the OECD study and the backcasting approach is to identify what would be required to attain a future goal, which differs considerably from traditional forecasting approaches.

The method adopted by the participating countries to carry out this task has been named "structured brainstorming." This method involves expert judgement and consists of multiple iterations to determine the most appropriate instruments to achieve the various features of EST. The determination of the most appropriate instruments is based on an assessment of the instruments in terms of their relative ability to change transportation activity and/or the unit impact of transportation and their impacts on various socio-economic indicators.

This study, representing the Canadian contribution, was initially designed to follow the structured brainstorming approach in that a long list of instruments was identified and subjected to a review by experts. The review by experts produced a number of valuable suggestions. It was resolved that it would be difficult to reject any of the instruments put forward, given that almost all of the instruments would need to be employed in order to meet the EST criteria. As well, there could be instruments that prove to be ultimately very effective in reducing emissions, even though current information on their capabilities is limited at present. In fact, the brainstorming session resulted in more rather than fewer instruments being put forward for consideration. Despite this, the experts participating in the brainstorming also recognized the need to focus on a few key measures in order to limit the complexity of the study. Essentially, this report presents a first iteration of the identification and assessment of instruments.

2. Assessment of Instruments to achieve the Combination Scenario

2.1 Features of the Combination Scenario (EST3)

Essentially, the features of the EST3 scenario are as follows:

- All electric power sources are zero emissions.
- More people live in denser, mixed-used urban environments that facilitate the use of efficient public transit modes and reduce the need for private automobiles.
- If required, people drive vehicles that are light-weight and powered by fuel cells or very low emissions internal combustion engines.
- They travel between cities predominantly by High Speed Rail on trains that are entirely electrified.
- They choose more efficient travel modes, purchase more efficient vehicles and buy locally produced goods, because the prices of goods and services reflect more accurately the real cost of transportation, as well as, being more aware of the environmental consequences of their choices.

As described above, EST3 seeks to achieve the sustainability criteria through a combination of technological innovations and behavioral changes. As part of the Phase 2 study, OECD experts considered it relevant to define better the extent to which each approach (behavioral or technological) would contribute to reaching the EST criteria. It was decided to conduct an analysis aimed at estimating the level of effort required from each of these approaches. Looking at the EST3 scenarios for all case studies, the balance of effort analysis estimated the separate contribution of the following four main CO_2 emissions reduction strategies:

Technological approach:

- Reduced CO_2 per unit of transport activity from technological change or from vehicle downsizing; e.g. smaller more efficient vehicles.

Behavioral approaches:

- Reduced transport activity (passenger-kilometres or tonne-kilometres); e.g. avoiding travel through telecommunication, living at walking distance from shops, daycare, workplace etc.

- Reduced CO_2 emissions per unit of transport activity through use of more efficient vehicle types; e.g. shifting mode from truck to rail, from single occupancy vehicle to bus, from car to bike, etc.

- Reduced CO_2 emissions per unit of transport activity through better occupancy or loading of vehicles e.g. better use of existing modes, shifting from a single occupancy vehicle to car pooling, better loading of a given truck.

Exhibit 2.1 represents the results of the balance of effort analysis for the Canadian study. It indicates the share of efforts assigned to each method of CO_2 emissions reduction for the EST3 scenario. The balance of effort analysis shows that under the EST3 scenario, almost half of the emissions reduction effort would be achieved through technological changes, including a heavy reliance on vehicles powered by fuel cells and highly efficient internal combustion engine vehicles.

The other half of the emissions reduction effort would be achieved predominantly through less travel or more efficient travel, particularly for passenger transport. Less travel would be achieved by fewer and shorter trips; more efficient travel through higher vehicle occupancies (e.g. car pooling, car sharing, etc.) and through shifting trips to more efficient modes such as bus and rail.

EXHIBIT 2.1
BALANCE OF EFFORT ANALYSIS
TO ACHIEVE THE COMBINATION SCENARIO (EST3)

EST3 scenario **CO_2 emissions reduction strategy**	**Passenger Transport** (% share of reductions)	**Freight Transport** (% share of reductions)
Reduced emissions per unit of activity from same vehicle type through technological change or vehicle downsizing	46	47
Reduced activity, i.e. fewer passenger-kilometres or tonne kilometres	33	20
Reduced emissions per unit of activity through use of more efficient vehicle types, i.e. through mode shifts	7	26
Reduced emissions per unit of activity through using the same vehicle type more efficiently, i.e. higher occupancy or better loading	14	7

It is interesting to note that this same balance of effort was undertaken for each participating country and, despite significant differences in the physical make-up of Canada versus European countries, the Canadian balance of effort was very much in line with the European results.

Exhibit 2.2 summarizes key features identified in Phase 2 for the combination scenario (EST3):

EXHIBIT 2.2
FEATURES OF COMBINATION SCENARIO (EST3)

Technology Features	Activity Reorganization Features
• use of zero emission power sources • use of fuel cells for vehicles • use of other low emission vehicles • reductions in vehicle weight • electrification of rail modes • introduction of High Speed Rail	• more compact, mixed-use urban environment • reduced dependence on private autos • market incentives to purchase more efficient vehicles • pricing regimes for more efficient travel behavior • trip replacement through telecommuting • improved public transit • modal shifts to High Speed Rail • reallocation of road lane kilometres through modal shift • reduced air travel • greater reliance on local products • improved logistics • innovation and public participation

To some extent, there is an overlap between the features of EST3 and the possible instruments to achieve the specific feature. Essentially, "features" are used to describe what the future would look like in general terms (e.g. reduced dependence on private automobiles) while the instruments are what is required to achieve the feature (e.g. road pricing). It is reasonable to conclude that it will likely require a combination of several instruments to achieve a particular feature.

2.2 Instrument Identification

The initial task in this study was to identify a number of instruments that could be used to bring about the features of the EST3 scenario. Given the recent research that has been undertaken to date on sustainable transportation, there are literally hundreds of possible instruments that would have some positive influence on the features of EST3. This study has considered a sample of the most widely researched and published instruments to date, drawing on work such as that done by the Ontario Climate Change Collaborative,[2] the Victoria Transport Policy Institute[3] and others.

Exhibit 2.3 provides a long list of possible instruments that could be used to move towards EST3. Instruments were divided in the following categories: 1) Economic and Fiscal Instruments; 2) Regulatory Instruments; 3) Instruments intended to influence urban design and transportation demand; 4) Instruments aimed at promoting technological development; and 5) Instruments intended to influence consumer preferences. Each instrument is classified according to whether it has an impact on the technology features or activity re-organization features of EST3. Obviously, many of the instruments would have impacts on both technology and activity. A more detailed breakdown of this list of instruments is provided in Appendix A, which shows which instruments would impact each of the features of EST3 identified in Exhibit 2.2.

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[2] Ontario Round Table on the Environment and Economy, National Round Table on the Environment ad the Economy, ***A Strategy for Sustainable Transportation in Ontario, Report of the Transportation and Climate Change Collaborative,*** November, 1995.

[3] Victoria Transport Policy Institute, ***Win-Win Transportation Management Strategies to Reduce Greenhouse Gase***s, 1998.

EXHIBIT 2.3
LONG LIST OF POSSIBLE INSTRUMENTS TO ACHIEVE EST3

INSTRUMENTS	Primary Impacts On Technology	Primary Impacts On Activity Reorganization	Potential for CO_2 Reduction
Economic and Fiscal Instruments			
Road pricing	✓	✓	●
Fuel Pricing/taxation	✓	✓	●
Tradable CO_2 permits	✓	✓	●
Differentiated registration/insurance fees		✓	●
Tax incentives for transit/pass rail users		✓	•
Parking Pricing/Management		✓	●
Regulatory Instruments			
Mandatory emissions inspection	✓		•
Reductions in speed limits		✓	•
Urban Structure and TDM			
"Fuller Cost" land taxation		✓	●
Stricter Land Use Controls		✓	●
Environmental assessment of new developments		✓	●
Car Sharing	✓	✓	●
Employer sponsored trip reduction programs		✓	●
Programs to reduce school related auto trips		✓	●
Technological Development Initiatives			
Financial Incentives	✓		●
New CAFE standards/Feebates	✓		●
Better dispatching to improve truck load factors		✓	•
Promotion of alternative fuels	✓		●
Private/public technology development	✓		●
Develop MoU with veh manufacturers	✓		•
Transportation Supply Management			
Transit Service Expansion/Enhancement		✓	●
Transit service coordination/fare integration	✓	✓	•
Improved bicycle lanes/facilities		✓	●
Priority measures for transit/cycle/peds		✓	●
Rail incentives	✓	✓	●
HOV lanes/HOT lanes	✓	✓	●
Advanced technology applications	✓	✓	•
Traffic calming		✓	•
Consumer Preference Mechanisms			
Improved Education	✓	✓	●
Advertizing equity	✓	✓	●
Consumer/user awareness initiatives	✓	✓	•
Support for community/political "champions"	✓	✓	•
Administrative Measures			
Improved data collection/dissemination	✓	✓	●
Coordinated decision making	✓	✓	●

Potential for CO_2 reduction:		
	Low	•
	Moderate	●
	High	●

Exhibit 2.3 also provides a broad indication of the CO_2 reduction potential of each instrument. Where possible, the assessment of CO_2 reduction potential was based on evidence found in other research[4] [5]. Note that most of the recent and substantive work of Canada's Transportation Table process has not been taken into account in this report given timing issues. Due to the nature of some instruments, such as public education, it is not possible at this time to quantify the potential environmental benefits. In these cases, professional judgement was used to assign a broad indication of the environmental impacts. A more precise indication of the impacts of more promising instruments is presented in Section 3.4.

2.3 Methodology for the Qualitative Assessment of Instruments

As discussed previously, the methodology recommended by OECD for the assessment of instruments was described as a "structured brainstorming approach". This approach involves expert judgement and consists of multiple iterations to determine the most appropriate instruments to achieve the various features of EST. For the Canadian study, the structured brainstorming approach was modified slightly to reduce the burden on the time and resources of experts, who participated in the study as volunteers. Essentially, the assessment of instruments was conducted in two phases:

1. Elaboration of the assessment grid based on the proposed framework provided by the Netherlands. Key instruments were identified and evaluated by IBI Group according to criteria in the assessment grid (see description below).

2. Review of the preliminary assessment by a group of experts during a brainstorming session. Each instrument was discussed and assessed.

One of the tools used for the assessment of instruments was a framework provided by the Netherlands Study Team. For the purpose of this study, the framework was slightly modified. Exhibit 2.4 shows this modified form of this assessment grid. It provides the evaluation results for a subset of the larger number of instruments identified for consideration and listed in Exhibit 2.3. A more detailed summary of a larger selection of instruments using the same framework is provided in Appendix A. The assessment in Appendix A also provides an evaluation of instruments according to their impact on each EST3 feature.

As highlighted previously, nearly all of the instruments identified for consideration in this study would have some impact on reducing CO_2 and other air pollutants. Further, it is envisioned that in order to meet the stringency of the EST criteria, all reasonable measures would need to be deployed. Ideally, it would be advantageous to examine each instrument in detail to estimate its environmental, economic and social impacts; however, this is not possible within a broad study such as this.

Generally, the instruments shown on Exhibit 2.4 represent those instruments that:

- have the greatest potential for CO_2 reduction, as determined by previous research;
- impact the most EST features;
- have impacts on both activity and technology;

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[4] ***Backgrounder on Greenhouse Gas Emissions from Urban Transportation***, prepared by IBI Group and Management of Technology Services for the National Round table on the Environment and the Economy, 1998.

[5] ***A Policy Instruments Working Paper on Reducing CO_2 Emissions from the Transport Sector in Ontario***, prepared by Apogee Research for the Ontario Transportation and Climate Change Collaborative, 1995.

- enhance the impacts of other instruments.

Some of the key advantages and disadvantages of each instrument are highlighted on Exhibit 2.4. A more in-depth description of the instruments and their pros and cons is provided in Appendix A.

According to the assessment grid developed and presented in Exhibit 2.4 and in Exhibit A.2 of Appendix A, instruments were assessed according to the criteria discussed below. Additional categories were also added to address the context within which the instrument can be implemented; socially, economically and politically.

The **environmental effects** of the instruments listed in Exhibit 2.4 and Exhibit A.2 are expressed in terms of their ability to reduce transport activities (reducing number of vehicles, increasing load factors, reducing distance driven, etc.) and to reduce the amount of pollution (emissions per vehicle-km). A three point scale is used to assess the instrument: a blank indicates that there is little or no impact, a small black dot indicates that the impact would be small, and a large black dot indicates that the impact would be large.

The **cost-effectiveness** of choosing this instrument is measured in term of the estimated unit price per kilogram of emissions avoided. A five point scale is used: - = is a very expensive instrument to implement, - = is expensive, o = is cost-neutral, + = is cost effective, ++ = is highly cost effective.

The **impacts inside** the transport systems are measured in terms of the instrument's ability to shift use of conventional Internal Combustion Engine (ICE) vehicles towards vehicles which are more efficient and less polluting, shift use of conventional fuel towards alternative fuels and shift travel to more environmentally responsible modes (e.g. private automobiles to public transport).

The **impacts outside** the transport systems are measures in terms of the instrument's ability to reduce transportation activity by unsustainable modes through land use modification and life-style re-organization (e.g. choosing social activities which are closer to home) and the ability to modify the inherent popularity of car ownership and use.

The **macro-economic impact** assessment represents the instrument's impact on employment. Other impacts include those on the production and industry sectors, household incomes and Gross Domestic Product (GDP).

The impacts inside, outside and the macro-economic impact are measured also using a five point scale : Π = a large positive impact, π = small positive impact, blank = no or unknown impact, σ = small negative impact, Σ = large negative impact.

Finally, the **context** in which an instrument is implemented is critical for its effectiveness. The context is described in terms of its social and political acceptability and the general economic pre-conditions that are required to make the implementation of the instrument feasible.

EXHIBIT 2.4
ASSESSMENT OF SELECTED INSTRUMENTS

Which instrument is being assessed?	Effect of the instrument on:		Cost effective-ness	Impacts inside the transport system on			Impacts outside the transport system on			Macro-economic impacts		What are the advantages and disadvantages of implementing the instrument?	What are the social, economic and political contexts within which this instrument can be implemented?
	Activity	Unit Impact		Vehicles	Fuels	Infrastr.	Land Use	Social Activity	Psyc Factors	Empm't	Other Impacts		
Fuel (conv.) pricing	●	●	++	π	π	π	π	π	π	σ	σ	Adv: revenues put back into R&D Dis: may disavantage some groups	Political acceptance, strong economy
Road pricing	●	●	+	π		π	π	π	π		π	Adv: revenues help finance infrastr. Dis: high user costs	Social/Political acceptability, availability of alternatives
CO2 trading	●	●	0	π	π		π	π	π	σ	π	Adv: can be tied to reduction targets Dis: difficult to implement	Political acceptance, willingness of public to participate
Parking Pricing/ Management	●	•	0				π	σ				Adv: can promote telecommuting Dis: may hurt some areas in short term	Coordinated decision so that there are no negative secondary impacts
Land use controls	●		0			π	π	π	π		σ	Adv: potentially large impacts Dis: difficult to achieve equity	Reversal of society's desire for suburban housing
Financial incentives		●	--	π	π					π	π	Adv: high degree of control Dis: economically challenging	Strong economy
New CAFE Stds.		●	+	π	π					π	π	Adv: easy to implement Dis: sector specific	Private sector participation
Transit Expansion	●		+	π		π	π	π		π	π	Adv: accomodates displaced auto users Dis: Expensive and slow	Strong economy
Impr. Bike/Ped facilities	●		0			π	π	π				Adv: two-fold objective Dis: none	
Improved educ.	●	•	-	π			π	π	σ			Adv: Few negative impacts Dis: Can't be seen as "big brother" action	
Coordinated Decisions	●		-				π	π	π			Adv: has large impacts Dis: decisions may take longer	Strong political leadership with common goals

blank	Little or no impact	--	Highly cost intensive	π	Large positive Impact
•	Small impact	-	Somewhat cost intensive	π	Small positive impact
●	Large impact	o	Neutral	blank	No impact/unknown impacts
		+	Somewhat cost effective	σ	Small negative Impact
		++	Highly cost effective	σ	Large negative Impact

2.4 Assessment of Key instruments

The assessment of instruments was carried out using the framework described above. The purpose of this assessment was not to come up with a definitive set of instruments, but rather to highlight the advantages and disadvantages of each, and to determine an "appropriate" package of key instruments that would help to achieve EST.

Based on the assessment, economic instruments would seem to provide the most potential in moving towards sustainable transportation. According to the assessment, fuel pricing, road pricing and CO_2 emissions permits trading provide a great potential for large environmental benefits both on the activity side and the unit impact side. To the extent that these instruments are supported by alternatives to the single occupant vehicle and educational program to raise awareness they would do much to reduce the environmental burden of our transportation activities.

Economic instruments such as those listed above would also be effective in reducing the environmental burden of road freight, which is the sector with the fastest increase in term of activity. Care would need to be taken to ensure that pricing measures impacting road freight modes were put in place gradually, without undue burden, and that pricing of road freight did not translate directly into higher priced goods. The movement of goods is critical to the Canadian economy. In addition to direct user pricing, there are several economic instruments that could promote rail transport, for example, changing the taxation regimes related to right-of-ways used for rail transport and changing the tax laws pertaining to railway capital cost depreciation allowances.

In addition to pricing regimes, there would also be a need to enforce controls to limit urban sprawl and promote compact-mixed use development. The difficulty with measures that pertain to restructuring land uses is that they have a long implementation period before their impacts are felt. Land use controls also require very co-ordinated decision-making in order to ensure that equity is maintained for all members of society. In the long term, measures that involve distance-based pricing can be expected to have an impact on people’s live-work decisions and ultimately land-use patterns.

One instrument not included in the primary assessment of instruments is tele-working or telecommuting. This instrument would require further investigation to ensure that its implementation did not result in a “rebound effect”. This effect would occur, for instance, if by implementing tele-commuting, people found it more appealing to reside further away from their work because they no longer have to drive daily on congested roads. This could ultimately result in more kilometres travelled rather than less.

2.5 Interactions among instruments

Nearly all of the basic instruments are inter-related. If implemented individually the impacts of each instrument would not only be less but the impact may not be as desired. The classic example is that of fuel taxes. If fuel taxes were implemented without a corresponding increase in service levels and/or availability of other modes, people would either pay more for fuel and accept it, or they would object vigorously. On the other hand, if fuel taxes are used to pay for improved transit, improved bicycle/pedestrian facilities, and research into new technologies, the impacts are expected to be more significant.

Regardless of the specific package of instruments, it is essential that a broad combination of instruments are used in order to capitalize on synergies and also reduce the risk of failure of a single instrument. A package of instruments also spreads the burden and benefits across modes and across individuals.

3. Implementation considerations

3.1 Context

In a backcasting exercise such as this, the time it takes to implement various instruments is largely determined by the fact that the desired effect of the instrument must be fully achieved by the 2030 horizon.

Under current conditions, a minimum of 15-20 years would be required for total fleet replacement of auto, buses and on-road freight vehicles. Working backwards from 2030, it can be assumed that all vehicles sold after 2015 would need to be ultra-low or zero emission vehicles. For the purpose of this study, it was assumed that battery-powered electric vehicles and hybrid vehicles would have to be introduced by 2001, fuel cell vehicles by 2004 and high efficiency internal combustion engine (ICE) vehicles by 2007.

Typically full replacement of non-road vehicles such as trains, ships and airplanes requires a significant amount of time, probably 20 – 30 years. As a result, the replacement of these types of vehicles would need to begin early in this decade, suggesting that significant investment in research and development would be required in the very near term.

Although 2030 seems far away, the schedule for implementing the various instruments is very short and would require a fundamental shift in government objectives. Inter-provincial harmonization and cooperation between levels of government would be necessary to reach EST. Furthermore, several of the instruments would require the co-operation and the endorsement from the United States due to the closely linked economies of both countries.

3.2 Preliminary schedule and milestones

Exhibit 3.1 provides a possible schedule and milestones for implementing the key instruments for the attainment of EST. The schedule provides three phases in implementing instruments. The *first phase*, represented by a broken line, is one of investigation and testing. During this phase, more research is being conducted to verify the feasibility and political acceptance of the instrument. It may also be a time to conduct demonstration projects or promotional events to increase the social acceptability of the instrument.

The *second phase*, represented by a straight black line, shows the instrument's application duration. During that phase, the instrument is being implemented to its fullest and impacts are being felt, both positive and negative. During this phase, it is important that social and political acceptance of the instruments is high and is supported by a general endorsement of sustainable transportation principles. It is also expected that during that phase, fine tuning is taking place to ensure effectiveness or to avoid any negative "rebound effects", such as telecommuting in encouraging movement further away from the place of employment.

Short term implementation of instruments

Examples of instruments that could be implemented almost immediately while investigation of other instruments continues:

- Progressive fuel taxation/road pricing
- Improvement to bicycle/walking facilities
- Mandatory emission inspections
- Public education and awareness

The *third phase*, represented by a series of dots is the maintenance and preservation phase. Once an instrument has been implemented it is important to ensure that policies are put in place to ensure that the benefits gained during the implementation phase are not reversed.

The schedule also identifies several key actions and milestones. Instruments such as progressive fuel taxation, improvement to bicycle/walking facilities, tax incentives for transit and rail users, improved data collection, mandatory emissions inspections and public education and awareness can be implemented almost immediately while further investigation is being conducted on other instruments such as a tradable CO_2 emissions permits.

For some instruments or packages of instruments, it would be helpful to develop performance indicators. For example, Corporate Average Fuel Economy (CAFE) programs and feebate[6] programs could be tied to average fleet fuel efficiency targets, and in turn CO_2 reduction targets. In the same respect, fuel pricing and parking pricing could be tied to modal shift targets. Other measures, such as public participation, would be more difficult to evaluate.

[6] A feebate is an economic policy instrument under which vehicles are subject to taxes or rebates in proportion to how much they exceed or fall below a specified reference energy factor, typically the mean fuel economy rating for the vehicle fleet for a particular year.

EXHIBIT 3.1 SCHEDULE AND MILESTONES FOR IMPLEMENTING INSTRUMENTS

INSTRUMENTS	*Actions/Milestones*	1999	2000	2001	2005	2010	2015	2020	2025	2030
Economic and Fiscal Instruments										
Road pricing	Tolls on urban expressways (2001)									
	Tolls on urban arterials (2005)									
	Tolls on key intercity highways (2010)									
Fuel Pricing/taxation *	3 cent/litre annually on gas and diesel									
Tradable CO_2 permits *	Investigate feasibility									
	Establish mechanisms									
Tax incentives for transit/pass rail users *	Tax emp. parking, no tax on transit passes									
Differentiated registration/insurance fees *	Waive reg. fees for low emission veh. (2001)									
	Establish all incl. pay-at-pump system (2010)									
Parking Pricing/Management *	Set min. parking prices: urban (2001) rural (2005)									
	Reduce zoning requirements for parking									
Regulatory Measures										
Mandatory emissions inspection	Implement full program (1999/2000)									
Reductions in speed limits	Reduce speed limits on intercity routes (2003)									
Urban Structure and TDM										
Environmental assessment of new dev.	Legislate that all developments be assessed									
"Fuller Cost" land taxation	Restructure land taxation									
Stricter Land Use Controls *	Establish boundaries and min. density (2005)									
Employer sponsored trip red. programs *	Distribute information package/facilitate programs									
Programs to reduce school related auto trips	Implement walking bus programs uniformly									
Technological Development Initiatives										
Financial Incentives	rebates/tax credits for stock turnover									
New CAFE standards/Feebates *	2% per year improvement									
Promotion of alternative fuels	20% market penetration of Alt. Fuels. (2005)									
Private/public technology development	80% conversion of urban buses to fuel cells (2005)									
	subsidies to make fuel cells for HDV's viable									
Develop MoU with veh manufacturers	Enhanced "PNGV type" program									
Transportation Supply Management										
Transit service coordination/fare integration*	Establish full intregration in all urban areas (2000)									
Improved bicycle lanes/facilities *	30% of urban roads have bike lanes (2005)									
Designated funds for transit expansion *	5 km/yr expansion of R.T. in each urban centre									
Rail incentives	Revise Capital Cost Allowance for Railways									
HOV lanes/HOT lanes	all urban expressways to have HOT lanes (2005)									
Advanced technology applications	Mandate in-vehicle tech to modify driver behaviour									
Traffic calming	50% of downtown street to be "calmed" (2015)									
Consumer Preference Mechanisms										
Improved Education	Mandatory EST component for school curriculum									
Advertizing equity	50% of car/truck ads are for clean vehicles (2005)									
Consumer/user awareness initiatives *	Implement nation-wide awareness program (2000)									
Support for community/political "champions"	Establish funding and recognition program (2001)									
Administrative Measures										
Improved data collection/dissemination	Establish Central Data Centre (2000)									
Coordinated decision making	Establish Coordinating Board (2000)									

3.3 Refinement of instruments

Following the completion of the initial Phase 3 exercise, the OECD decided that it would be useful for Canada to select from the long list of 31 instruments initially identified and shown in Exhibit 3.1 the 12 most promising instruments to achieve EST3 and to define what portion of the EST objectives are met by these instruments for CO_2, NOx and VOC. This section presents a summary of the prioritization of instruments while the full analysis and explanation of criteria is described in Appendix B.

The criteria used to short-list the instruments, provided by OECD, are similar to those that were described in section 2.3 to initially identify the instruments. The criteria for short-listing instruments are listed below along with their assigned weightings in brackets. The weighting for the criteria was developed using a subjective approach. Reduction in GHG and air pollution is given the highest weight due to their emphasis in meeting EST. Additional details on the criteria are presented in Appendix B.

- Reduces GHG and air pollution (3).
- VKT reduction (autos and trucks) (1).
- Minimize investment cost (2).
- Improve economy (2).
- Minimize administration (1).
- Minimize social impacts (1).

It is also important to recognize that implementation considerations such as public support and political will were not included in these criteria. That said, the instruments that would show the most promise based on the above criteria are:

- Fuel pricing/taxation.
- Tradable CO_2 permits.
- Parking pricing/management.
- Designated funds for transit expansion.
- New CAFE standards/feebates.
- Differentiated registration/insurance fees.
- Consumer/user awareness initiatives.
- Tax incentives for transit/pass rail users.
- Stricter land use controls.
- Employer sponsored trip reduction programs.

- Improved bicycle lanes/facilities.

- Transit service coordination/fare integration.

3.4 Role of Short-listed Instruments in achieving the EST Criteria

Having identified the 12 most promising measures to move towards EST, the next obvious question is: "how close these 12 measures come to achieving the ultimate target reductions?" As discussed above, it was not the intention of Phase 2 or the initial Phase 3 study to precisely examine the impacts of specific instruments, but rather "backcast" what types of "features" would be required to achieve EST. Furthermore, the Phase 2 study did not get into the specifics of the intensity of the various features/instruments (e.g. a one-time 10 cent increase in fuel tax would produce different results than a continuous 2 cent/yr increase).

As described in Appendix B, limited original research was undertaken to assess the impacts of the 12 measures on emissions. Instead, this study is based on results of other recent research, namely a study prepared by IBI Group/MOTS for the National Round Table on the Environment and the Economy (NRTEE) in 1998[7]. Further details on the assumptions made regarding the measures and their impacts are provided in Appendix B.

As expected, the 12 selected instruments do not meet the EST criterion for CO_2 which is to achieve 20% of 1990 emission levels. Using fairly optimistic assumptions about the impacts of each measure, the 12 most promising instruments could potentially reduce CO_2 emissions to 56% of 1990 levels by 2030, compared to the goal of 20%. The additional emissions reduction (36%) would have to be achieved through implementation of the other 19 instruments and their synergistic interaction.[8]

4. Identifying gaps between current/planned and EST policy instruments

4.1 Overview

The purpose of this section is to identify the "gap" between instruments that are currently in use or are planned for and what would be required for EST3 to occur.

Exhibit 3.1 shown previously provides a summary of the instruments and action items that were identified in Phase 3 as being required for EST3. As stated in Section 2, even if all of these instruments were implemented, it is debatable whether we would achieve the very stringent EST criteria as defined in the OECD project. For each instrument, a specific action is specified together with its degree of implementation. A brief discussion of some of the efforts being made surrounding instruments, their likelihood to be made policy or even planned, and the gap between this and the requirement for EST is provided below.

Exhibit 4.1 provides a summary of the gaps assessment, while a full discussion of the analysis is provided in Sections 4.3 – 4.9. Also shown on Exhibit 4.1 is whether or not the instrument has been considered, whether it would take place under the business-as-usual (BAU) scenario and whether it has been planned. Although BAU and planned are similar, the planned distinction would include items such as goals in

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[7] ***Backgrounder: Greenhouse Gas Emissions from Urban Transportation***, IBI Group and Management of Technology Services for the National Round Table on the Environment and the Economy, November 1998.

[8] Refer to Appendix B for further explanation.

Official Plans, government strategies, and other non-legislative examples, while the BAU would only includes those instruments that are very likely to be implemented.

In identifying the gaps, several factors were considered:

- Degree of Implementation – Are there examples of the instruments, or similar initiatives, already in place?

- Implementation Timeframe – Could the instrument be reasonably implemented to the extent necessary in the next few years?

- Feasibility – How difficult would it be to implement the instrument in terms of political acceptance, enabling technologies, regulatory framework, economic impacts, etc.?

It should be noted that this gaps analysis is by no means comprehensive. It is important to understand that there were limitations to the data used, and assumptions were made where data was limited or non-existent.

EXHIBIT 4.1
IDENTIFICATION OF GAPS BETWEEN PLANNED INSTRUMENTS AND EST INSTRUMENTS

INSTRUMENTS	*Specific Actions and year of implementation*	Examples in Canada	Considered	BAU	Planned	Gap
Economic and Fiscal Instruments						
Road pricing	Tolls on urban expressways (2001)	Highway 407	✓	×	×	
	Tolls on urban arterials (2005)	None	×	×	×	
	Tolls on key intercity highways (2010)	Coquihala	✓	×	×	
Fuel Pricing/taxation	3 cent/litre annually on gas and diesel	Greater Vancouver Trans. Auth.	✓	×	×	
Tradable CO_2 permits	Investigate feasibility	Tradeable Permits Working Group	✓	×	×	
	Establish mechanisms	None	×	×	×	
Tax incentives for transit/pass rail users	Tax emp. parking, no tax on transit passes	Motion #360 House of Commons	✓	×	✓	
Differentiated registration/insurance fees	Waive reg. fees for low emission veh. (2001)	Considering Gas-Guzzler Tax	×	×	✓	
	Establish all incl. pay-at-pump system (2010)	None	×	×	×	
Parking Pricing/Management	Set min. parking prices: urban (2001) rural (2005)	None known	✓	×	✓	
	Reduce zoning requirements for parking	City of Toronto (informal)	✓	×	✓	
Regulatory Measures						
Mandatory emissions inspection	Implement full program (1999/2000)	AirCare in British Columbia	✓	✓	✓	
Reductions in speed limits	Reduce speed limits on intercity routes (2003)	None	×	×	×	
Urban Structure and TDM						
Environmental assessment of new dev.	Legislate that all developments be assessed	None	×	×	×	
"Fuller Cost" land taxation	Restructure land taxation	Development Charges	✓	×	×	
Stricter Land Use Controls	Establish boundaries and min. density (2005)	Most Urban Areas	✓	✓	✓	
Employer sponsored trip reduction programs	Distribute information package/facilitate programs	miscellaneous examples	✓	×	×	
Programs to reduce school related auto trips	Implement walking bus programs uniformly	see Walking Schoolbus	✓	×	×	
Technological Development Initiatives						
Financial Incentives	rebates/tax credits for stock turnover	None currently	×	×	×	
New CAFE standards/Feebates	50 mpg by 2005, 80 MPG avg. by 2010	None currently	×	×	×	
Promotion of alternative fuels	20% market penetration of Alt. Fuels. (2005)	Alt Fuel Act	×	✓	×	
Private/public technology development	80% conversion of urban buses to fuel cells (2005)	NRCan/UBC	✓	×	×	
	subsidies to make fuel cells more viable	NRCan/UBC	✓	×	×	
Develop MoU with veh manufacturers	Enhanced "PNGV type" program	Automotive Manufacturing Pollution Prevention Project	✓	×	×	
Transportation Supply Management						
Transit service coordination/fare integration	Establish full intregration in all urban areas (2000)	Greater Vancouver Trans. Auth.	✓	✓	×	
Improved bicycle lanes/facilities	30% of urban roads have bike lanes (2005)	in some larger centres	✓	×	×	
Designated funds for transit expansion	5 km/yr expansion of R.T. in each urban centre	Sheppard Subway (GTA)	×	×	×	
Rail incentives	Revise Capital Cost Allowance for Railways	None	✓	×	×	
HOV lanes/HOT lanes	all urban expressways to have HOT lanes (2005)	in some larger centres	×	×	×	
Advanced technology applications	Mandate in-vehicle tech to modify driver behaviour	some commercial vehicles	×	×	×	
Traffic calming	50% of downtown street to be "calmed" (2015)	in some larger centres	✓	×	×	
Consumer Preference Mechanisms						
Improved Education	Mandatory EST component for school curriculum	Environment Canada Website	✓	×	×	
Advertizing equity	50% of car/truck ads are for clean vehicles (2005)	None	×	×	×	
Consumer/user awareness initiatives	Implement nation-wide awareness program (2000)	NRCan Auto$mart	✓	×	✓	
Support for community/political "champions"	Establish funding and recognition program (2001)	MOST Program	×	×	×	
Administrative Measures						
Improved data collection/dissemination	Establish Central Data Centre (2000)	National Personal Vehicle Survey	✓	✓	✓	
Coordinated decision making	Establish Coordinating Board (2000)	National Climate Change Process	✓	✓	×	

LEGEND:

- Is unlikely to happen given current policy
- May happen, but will require some policy change
- Is likely to happen and does not require major policy intervention

4.2 roles and responsibilities

It is not the purpose of a conceptual study such as this one to assign roles and responsibilities. It is worthwhile, however, to identify each level of government's current role as it relates to the sustainable transportation agenda. Exhibit 4.2 lists current federal, provincial and municipal responsibilities pertaining to transportation in Canada.

It is anticipated that if any comprehensive sustainable transportation strategy were to be implemented the Federal Government would need to take a lead role in order to initiate any major changes related to sustainable transportation. The Federal Government would not be able to act alone, however, and would require the support of the provinces, municipalities, the private sector, non-governmental organizations, and most importantly, the Canadian public to put effective measures in place.

4.3 Economic and Fiscal Instruments

4.3.1 Road Pricing

Road pricing in Canada has usually been used to off-set the construction costs of a new facility as opposed to being a deterrent to auto use. Examples in Canada include the Coquihalla Highway in British Columbia, Highway 407 in Ontario, the Confederation Bridge to Prince Edward Island, Highway 104 in Nova Scotia and the Fredericton-Moncton Section of the Trans-Canada Highway in New Brunswick. Highway 407 is the only existing or planned highway with road pricing within the QWC. Imposing road pricing on existing urban expressways or arterials has not happened in Canada.

Despite recent interest on the part of governments and advocates to implement road pricing on various road facilities as a means for recovering maintenance or construction costs, the practice of road pricing is likely to remain limited to occasional new infrastructure developments under the BAU scenario. As shown on Exhibit 4.1, road pricing is rated as having some potential to happen, but a significant policy change would be required to move towards a wide spectrum of implementation on new and existing roads.

4.3.2 Fuel Pricing

Fuel pricing exists in Canada in the form of gasoline taxes. Traditionally, these taxes have been directed into the general reserves as opposed to being designated for roads or transit. Recently, there has been an active effort to use a portion of the existing federal gas tax, as well as new taxes, to fund transportation. The Montreal Transportation Agency (MTA) and the Greater Vancouver Transportation Agency (GVTA) have recently made progress in this respect. The MTA has implemented a 1.5cent/litre gas tax in the region while the GVTA draws 4 cents/litre from existing taxes and has recently implemented a new gas tax. These examples; however, are limited to selected urban areas and are largely implemented to off-set transportation costs as opposed to reducing demand.

An instrument such as a 3 cent per litre annual increase in fuel taxes would represent a significant change from the BAU scenario and as such the gap between BAU and EST is considered to be large.

In recent months, coinciding with an increase in fuel prices, the Canadian public, and certain industry groups, have called for the federal and provincial governments to reduce fuel taxes in order to reduce the price of fuel. At present, there would appear to be little political or public support for an increase in fuel

taxes in the near or long-terms. An unprecedented policy change would be required to change this position.

EXHIBIT 4.2
FEDERAL, PROVINCIAL AND MUNICIPAL JURISDICTION PERTAINING TO TRANSPORTATION

Area of Jurisdiction	Federal	Provincial	Regional/Municipal[9]
General	All inter-provincial and international transportation including almost all aviation and marine, and inter-provincial surface transport	Most intra-provincial transportation	Varies according to the level of delegation provided by the provinces
Transportation Infrastructure	Providing and maintaining infrastructure for the above	Providing and maintaining infrastructure for the above, including all aspects of highway facilities except on federally owned lands and inter-provincial and international bridges.	Local roads, sidewalks, biking and cycling paths and infrastructure
Transportation Policy, Regulation, Standards, programs, etc.	Regulating emissions, fuel efficiency, and safety standards for new vehicles Monitoring and evaluating performance against national air quality standards including health effects and impacts on ecosystems Greening of federal fleets	Regulating in-use vehicles such as licensing of vehicles and inspection and maintenance Public transit funding with delegation or operation to municipalities Greening of provincial fleets	Traffic demand management initiative (HOV, parking policies, etc.) Public transit operation Greening of municipal fleets
Finance	Taxing fuels and vehicle purchases	Taxing fuel and vehicle purchases, road tolls	Roads tolls, residences and commercial taxes, local improvement taxes, etc.
Land	Federally owned land	Land-use planning policies	Local land development and land-use planning, zoning, construction permits
Education	National public education and awareness programs	Provincial public education and awareness programs	Local public education and awareness programs
R&D	Technology development programs	Technology development programs	Testing of new technologies for mass transit
International	International protocols, agreements		

[9] Municipalities' responsibilities vary depending on the degree of delegation by provincial governments. Larger municipalities generally have more scope for action than smaller municipalities.

4.3.3 Tradeable CO_2 Permits

The concept that was considered for this EST study is that each individual over a certain age is given a specific amount of "CO_2 credits." People can spend these credits however they wish, but if a person runs out of credits, he/she must purchase credits from someone who has some extra credits. A similar concept could be implemented for industries, similar to that being done in the U.S. today.

Although relatively unknown, the concept of tradable permits has not gone unnoticed. A Tradeable Permits Working Group has been created by Environment Canada to manage work relating to options which would involve mandatory permit requirements for at least some sources of greenhouse gases. In December 1998, the Group released a Foundation Paper/Primer outlining the way a tradeable permits system might work. Furthermore, the NRTEE recently completed a project examining possible designs for a GHG emissions trading program for Canada with the advice from a Multistakeholder Expert Group.[10] In terms of actually implementing a CO_2 permit system for individuals, it is unlikely that this would be considered in the near or long term without a significant change in government policy.

4.3.4 Tax Incentives for Transit Users

At the present time, taxes are not collected on most employer parking in Canada while transit passes are. It has been argued that this strongly favours auto use for commuting. The concept of tax-exempt employer provided transit passes was one of the measures looked at by the Transportation Table of the National Climate Change Process and as a result has a status of "being considered." In fact, in April, 1999, Motion #360 received resounding support in the House of Commons as the vote carried 241 to 25. This motion, sponsored by Nelson Riis of the NDP, encourages the federal government to consider making employer provided transit passes an income tax-exempt benefit. As yet, there has been no action taken on this motion but the gap between the BAU and EST would seem relatively small in comparison to other instruments.

4.3.5 Differentiated Registration/Insurance Fees

The concept of pay-at-the-pump whereby registration fees and insurance fees are added to the price of fuel and therefore dependent on the amount of fuel consumed,.as proposed for EST3, has not been considered formally and is unlikely to occur under the BAU scenario.

4.3.6 Parking Pricing/Management

Traditionally municipal zoning by-laws have stipulated minimum parking standards but not maximum parking standards. This is beginning to change; however, in most urban areas. The City of Toronto for example promotes a reduced parking standard for developments in the downtown area, although this is not yet set by a formal policy; there is, however, a legislated maximum to the amount of parking that can be supplied. No examples of mandated parking price increases are known in Canada although at one point the Ontario Government did impose a tax on commercial parking spaces in the Greater Toronto Area.

[10] NRTEE, *Canada's Options for a Domestic Greenhouse Gas Emissions Trading Program*, 1999.

It seems likely that parking pricing and supply management policies will shift in focus to discouraging rather than promoting auto use. Significant effort will be required however, to solidify significant public support to achieve the changes that would be required for EST.

4.4 Regulatory Measures

4.4.1 Mandatory Emissions Inspection

Mandatory emissions inspection is becoming recognized as a cost-effective and easy way to reduce regulated vehicle emissions such as NOx and VOC. Although CO_2 emissions can be reduced through better engine tuning, the impact on CO_2 remains relatively small. AirCare in British Columbia, the Motor Vehicle Emissions Inspection and Maintenance Program has been law since 1992. "Drive Clean" – Ontario's mandatory vehicle inspection and maintenance program for cars, trucks and buses – was launched on schedule in the of Spring 1999.

Given current progress, the gap between BAU and EST with respect to emissions inspection is probably small. Efforts are required, however, to ensure proper enforcement. To significantly impact on greenhouse gases the program could be complemented by information on ways to improve fuel efficiency and relative fuel consumption levels of vehicle.

4.4.2 Reductions in Speed Limits

To our knowledge there are no current or planned initiatives to reduce speed limits. In fact, recent news papers in Ontario have reported that some government officials want to increase speed limits.

4.5 Urban Structure and Transportation Demand Management

4.5.1 Environmental Assessment of New Developments

Under this concept major developments would have to undergo an environmental assessment to consider and highlight their environmental impacts such as VKT per trip. Assessments would follow a similar process as traffic studies and land use impact studies. The barriers to this would be that it would be a significant additional cost for developers. It is doubtful that policies could be put in place to reject a development solely on the basis of global environmental concerns. Once a development gets to the stage of approvals, it is a difficult, lengthy and costly process to get it stopped. As such, the gap between BAU and EST is large.

4.5.2 "Fuller Cost" Land Taxation

The concept of development charges whereby developers are forced to contribute to the cost of roads and municipal services is an initial starting point for fuller cost land taxation. Development charges do not, however, take into account emissions based factors such as average trip distances and modal splits.

4.5.3 Stricter Land Use Controls

A recent survey carried out for the Transportation Association of Canada found that most urban areas have adopted policies on limiting urban development boundaries and promoting mixed-use nodal development[11]. In practice however, urban boundaries and urban sprawl appear to be proliferating in most areas. Better controls and significantly greater enforcement will be required to achieve the types of land use control required for EST.

4.5.4 Employer Sponsored Trip Reduction Programs

Various types of employer sponsored trip reduction programs have existed for some time. Most have been developed out of a need to reduce employee trips (e.g. due to a lack of parking). Mixed results have been achieved.

At the present time, there is no instrument that promotes employer initiatives. With proper promotion, widespread implementation of employer sponsored trip reduction programs is foreseeable in the future.

4.5.5 Programs to Reduce School Related Vehicle Trips

The *Walking School Bus* movement, in which parents organize themselves to supervise groups of children walking to school, has been implemented in a few locations in Canada, but is not a widespread initiative. While initiatives to reduce school related auto trips may become more popular, it is still felt that an advantage of these programs is that it is also a way to break the inherent reliance on autos at an early age; having a lifetime impact. A concerted effort would be required to accelerate the process to meet the EST objectives, but given the advantages and ease of implementation compared to other measures, the gap is deemed to be relatively small.

4.6 Technological Development Initiatives

4.6.1 Financial Incentives

At the present time, there are some isolated examples of funding for new technologies to reduce emissions from transportation sources, but to our knowledge there are no credits for vehicle stock turnover. The gap between the BAU scenario and that required under EST 3 is considered to be large.

4.6.2 New CAFE Standards

Given that CAFE standards are set by the United States, it is unclear at the moment as to how Canada will proceed to tighten new vehicle fuel efficiency standards. There are a variety of options which could be pursued such as implementing a voluntary fuel efficiency labeling program or tightening of the voluntary company average fuel consumption (CAFC) standards.

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[11] ***Transportation Urban Indicators Survey #2***, prepared by the IBI Group for the Transportation Association of Canada, 1999. (Unpublished at present).

4.6.3 Promotion of Alternative Fuels

Despite substantial continuing commitments of both the private and public sectors to the alternative fuel vehicle industry, market penetration has been limited, currently representing about 1% of total light duty vehicle fuel consumption. At present, one initiative is being implemented by Natural Resources Canada (NRCan) working with the alternative transportation fuel (ATF) industry and major vehicle manufacturers in Canada to promote ATFs, principally to fleet operators in both the public and private sectors, and to increase public awareness of ATFs.

There are at present no major market conditions or pending government policy interventions that are likely to substantially change market penetration of these fuels in the short term.

4.6.4 Public-Private Technology Development

Public private initiatives have and will continue to occur in Canada. For example, the federal government recently launched the *National Fuel Cell Research and Innovation Initiative*, announcing a $30 million investment to further strengthen the industry's research and development. As part of the Initiative, the Ministers inaugurated a new National Fuel Cell Research Facility at the National Research Council's (NRC) Innovation Centre on the University of British Columbia campus.

4.6.5 Development of a Memorandum of Understanding with manufacturers

Since the early 1990's, the Government of Canada has been involved in several MoU's on pollution prevention. For example, Environment Canada and the Ontario Ministry of the Environment are involved in an MoU with the Canadian Vehicle Manufacturer's Association and the three major vehicle manufacturer's in Canada to reduce the generation or release of persistent toxic substances by the participating companies. With this experience in government-industry partnerships, an MoU with the purpose of manufacturing vehicles that produce lower emissions, would seem feasible in the near to medium-term. The U.S. government is currently involved in a MoU of that sort, the Partnership for a New Generation of Vehicles, with vehicle manufacturers.

4.7 Transportation Supply Management

4.7.1 Transit Service Co-ordination/Fare Integration

There are on-going efforts in the Greater Toronto Area and elsewhere in the QWC to develop more integrated transit systems and a common fare system, possibly aided through the use of "smart-cards". For example, transit service co-ordination is a top priority of the recently established Greater Toronto Services Board. The Agence Métropolitaine de Transport has been set up to coordinate public transport investment and operations in the Montréal region. The gap between BAU and EST would seem to be relatively small with respect to this instrument.

4.7.2 Improved Bicycle Lanes

Bicycle lanes have been implemented in most urban areas within the corridor, but as yet are not constructed at the expense of automobiles. In most cases, bicycle lanes are on-street facilities shared with other vehicles.

Significantly more effort to develop safe and efficient bicycle facilities, while reducing the supply of automobile capacity would be required for EST.

4.7.3 Designated Funds for Transit Expansion

As discussed above, some urban areas in Canada have managed to obtain a portion of existing fuel taxes for transportation improvements, including transit expansion. For the most part, however, transit is not being expanded at a rate which is to cause a significant reduction in auto use.

4.7.4 Rail Incentives

One rail incentive would be to revise the capital cost allowance rates for railways in Canada so that capital improvements are more attractive. This has been studied[12], but no action has been taken.

Under the EST3, massive rail investment would have to be made to implement an electrified high-speed rail system in the Corridor. Studies have been underway for several years but it is unlikely that there would be an announcement of new infrastructure development in this area in the near or long-term.

4.7.5 HOV Lanes/HOT Lanes

To date high occupancy vehicle lanes have been implemented on a few selected facilities in some urban areas in the corridor. The level of implementation in most cases is discontinuous and is not sufficient to have a measurable impact on people's travel choices. In particular, most busy urban expressways in the corridor do not have HOV lanes and these are not planned for the future.

4.7.6 Advance Technology Applications

The use of technology, particularly with the advent of the electronically controlled engine, has assisted in modifying driver behaviour in some areas of the trucking industry and thereby reducing emissions. The electronic engine enables the trucking firms to verify fuel economy performance of the driver. With a display on the dashboard, the driver can detect his/her performance and when to shift for optimal fuel economy.

Advanced vehicle safety systems involving collision avoidance technology can reduce incident congestion from curtailed accidents and therefore associated emissions. The application of such technology is foreseen in the medium to long term. Other advanced technology systems such as those that apply to public

[12] ***Capital Cost Allowance Issues in Rail***, prepared by IBI Group for Transport Canada, 1998.

transportation, traffic management, and commercial vehicle operations (CVO) also have the potential to reduce emissions. Recently, Transport Canada announced funding for research in intelligent transportation systems demonstrating commitment to advancing such technologies.

It is unlikely that advanced technology applications will be mandated in the near future. Nevertheless, increased demand for such technologies is probable due to benefits gained through improved operational efficiency and safety.

4.7.7 Traffic Calming

Traffic calming is becoming more popular in built up urban areas as a means for slowing vehicles and providing a safer environment for pedestrians and cyclists. Due to the increase in popularity of traffic calming, the Transportation Association of Canada has recently released a manual to help guide traffic calming installations.

To date traffic calming is not being implemented on a widespread basis, but rather to address isolated local concerns. We have indicated on Exhibit 2.3 that the gap between BAU and EST is still significant.

4.8 Consumer Preference Mechanisms

4.8.1 Improved Education

To date, educating the Canadian public about the impacts of climate change has been relatively passive, for example, through various brochures and website materials. A more aggressive effort at raising awareness of the impact of climate change has been witnessed through a series of radio announcements on how to reduce energy consumption to reduce GHG emissions. However, to our knowledge, there are no formal education programs in school curricula or broad scale awareness programs for Canadians. Nevertheless, it is reasonable to expect that the gap between the current situation and that required for EST should not be difficult to overcome.

4.8.2 Advertising Equity

Advertising equity refers to the notion that vehicle manufacturers dispose of large communication budgets to advertise their products (ie. the freedom of movement through car driving) while there is very little money available for marketing social "goods" (ie. the safety of a car-free environment). A recent advertisement by General Motors aimed at University students used the slogan "the bus sucks…". The Canadian Urban Transit Association lobbied, and was successful to have this add discontinued. Certainly this is one area where there is a clear and significant gap between the present situation and any form of EST situation. Vehicle manufacturers have the full right to promote their products in any way. There are no plans to limit this right.

4.8.3 Consumer Awareness Initiatives

There are several examples of consumer awareness initiatives in Canada and within the QWC. For example, Natural Resources Canada has developed the Auto$mart Program to provide Canadian motorists with helpful tips on buying, driving, and maintaining their vehicles in ways that will reduce fuel consumption. Also, EnerGuide, which has helped consumers consider energy consumption and cost when shopping for household appliances, is now available for vehicles.

4.8.4 Support for Community Champions

Support for community champions is taking place at the individual, corporate, and municipal levels. In 1995, a National Action Program on Climate Change (NAPCC) was approved by federal, provincial and territorial governments. This initiative has resulted in more than 700 companies responsible for over one-half of total annual greenhouse gas emissions joining a national climate change Voluntary Challenge and Registry (VCR), and many have developed action plans to reduce their greenhouse gas emissions. It has also seen 37 Canadian municipalities joining the 20% Club. Members aim to reduce local greenhouse gas emissions by 20% from 1990 levels.

Another example involves the Climate Change Action Fund, which has been used to fund numerous community projects aimed at fighting climate change, including programs to encourage use of alternative fuels and to improve the efficiency of use of transportation fuels. As well, Transport Canada has established a ***Moving On Sustainable Transportation (MOST)*** Program that funds projects by organizations that promote sustainable transportation.

The National Energy Efficiency Awards recognize the achievements of individuals and organizations in innovation and progress in energy efficiency.

4.9 Administrative Measures

4.9.1 Improved Data Collection

Canada has made some progress over the last few years to improve data collection. For example, the 1996 Census was the first in Canada to collect data on modal shares concerning journeys to work, data which is immensely useful in research and decision making. Transport Canada has also launched initiatives costing $1 million per year to strengthen vehicle use information. This effort will, for the first time, provide consistent data on the use of different types of road vehicles across Canada. However, there are still gaps to be filled between that data currently collected and that which would be required for EST. For example, any CO_2 trading initiative would require substantially more data than is collected at the present time.

4.9.2 Coordinated Decision-Making

Following the agreement on the Kyoto Protocol, Canada made a major step in improving the coordination of decision-making. Specifically, Canada developed a national implementation strategy on climate change. To facilitate the process, sixteen stakeholder Issue Tables/Groups have been established to provide expert and detailed input to identify and analyze GHG reduction opportunities. These include some 450 experts

from all levels of government, the academic community, labour, environmental groups and business and industrial sectors from across the country. The Transportation Table recently completed over 20 analytical studies worth over $1 million.

5. Assessment of Social implications

In most societies, mobility is highly valued by individuals for both social and economic reasons. Increased mobility has generally been perceived as a "good thing". It has allowed individuals to experience greater freedom of movement, to enjoy products that come from distant locations and to interact with people from around the globe.

The concept of sustainable transportation implies that changes in transportation patterns to reduce environmental stresses are also beneficial to the general well-being the of individual and society at large. Although the OECD EST study focuses primarily on the environmental sustainability, OECD experts felt that it was important to provide a preliminary qualitative assessment of potential social impacts from both a business-as-usual growth and an EST scenario. Professor John Adams[13], an expert from the University College in London, was tasked to prepare a paper assessing the social implications of continuing on the current path (BAU scenario) as compared to adopting a sustainable combination scenario (EST3). For the purpose of the OECD project, participating countries were asked to respond to a questionnaire prepared by Professor John Adams. Countries' information will be summarized and presented in a separate document published by the OECD. Prof. Adams identified eight factors that can provide indications of how the social fabric may be affected by changes in our mobility patterns. These eight factors are listed below along with some preliminary discussion on the potential social impacts in Canada.

- **Material wealth:** It is expected that under the BAU scenario there will be a continuation of the close correlation between Gross Domestic Products (GDP) and the movement of people and goods. Under the EST scenarios, this close correlation may not exist. As this is an uncharted territory, it is uncertain what the impacts on material wealth would be. Many experts agree that it is likely that under the EST scenario, there would be a slower growth of the GDP, which may have negative social consequences. However, as GDP is not always perceived as a good indicator of well-being[14], the social consequences of a slower growth in GDP is difficult to assess.

- **Social polarization:** Under current trends, people without access to cars could suffer from decreased access to social and economic opportunities. Transportation system and land-use characteristics may limit access to, as examples, work and pleasure activities, child-care and medical needs. There is virtually no information on the trade-offs made by those that do not have access to an automobile, therefore it is difficult to estimate what the long-term social costs and the related economic costs of BAU will actually be. It can be speculated that without

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[13] Adams, John, *The Social Implications of Hypermobility: Speculations about the social consequences of the OECD Scenarios for EST and BAU*, in preparation.

[14] In recent years, there has been abundant literature critiquing the use of the Gross Domestic Product indicators as a measure of progress and well-being. These have noted that, for example, car accidents, major environmental disasters such as an oil spills, treatments of cancer patients, and divorces all generate economic activities that impact positively on the GDP.

accessible mass transit, social polarization will increase as land use becomes more dispersed under BAU. Under the EST3 scenario, these disparities would likely not be so pronounced.

- **Land use:** The BAU trend toward urban sprawl is expected to continue, fuelling the need for the use of cars and trucks for mobility. There continues to be economic pressures to maintain or strengthen policies that directly or indirectly promote sprawl. For example, pressures to encourage new home building as a way to maintain a strong construction industry, especially during periods of economic slowdown, and pressures to support the automobile industry, which is an important part of the economy of the QWC.[15] To the extent that land use patterns under EST3 makes public transit more viable and walking and cycling more possible, more compact land uses with multipurpose housings should level the playing field for people with and without cars.

- **Community relationships:** The general premise proposed by John Adams is that cars and the resulting dispersed land use patterns under the BAU diminish street life and make society more anonymous. The EST3 scenario provides more opportunities for face-to-face interaction. As such, it can promote street life and increase neighborhood activity, such as local shops and cafes. However, increased use of electronic communications technology could have a negative impact on community life, although this is open to debate. The assumptions is that electronic mobility can create new community structures that are widely dispersed resulting in more travel for social and recreational purpose.

- **Cultural diversity:** Technology and global mobility tend to reduce cultural diversity. As cities become more like each other, and more unpleasant to be in because of pollution, congestion, noise, etc., fewer people may want to visit them (i.e. international tourist travel may decline), however, business travel could significantly increase. Tourists may tend to seek out the more remote, less urbanized places, where cultural differences are likely to survive longer and the environment remains relatively more pleasant. The EST3 scenario may preserve cultural diversity if there was less travel and interaction between people in different parts of the world. However, John Adams' cautions that "EST is likely to be a weak restraint on this process [of culture homogenization] if the growth in electronic mobility continues unchecked".

- **Health and safety:** The health and safety impacts of road transportation are very significant, contributing to accidents, lack of exercise, and pollution related health problems. In Canada, there are over 3,000 people killed and 220,000 people injured in motor vehicle accidents annually. Recent research has also shown that two-thirds of Canadians are not physically active enough to meet the guidelines in the Canada's Physical Activity Guide. There is also increased evidence that transportation related pollution is causing or aggravating respiratory diseases.

[15] The automobile industry is not an important contributor to big city economies; however, of the seven automobile assembly plants listed in a study of the Greater Toronto Area economy prepared for the Greater Toronto Area Task Force, three were located within the GTA but outside Metropolitan Toronto (now Toronto); four were located outside the GTA altogether. Of the eight parts facilities listed, only two had their main facilities in Toronto. (The Boston Consulting Group. 1995. *The Fourth Era: The Economic Challenges Facing the GTA.* (Toronto: December 1), 22.

There is a general consensus that health and safety would improve in all areas under the EST3 scenario[16].

- **Crime and law enforcement**: In John Adams' study, which is based on United Kingdom data, it was found that the rise in car ownership was closely correlated with a rise in crime. It is suspected that the car culture is contributing to the disintegration of the social fabric which, in turn, results in a society that is less self-policing. To our knowledge, no such studies have been conducted in Canada. Although long term trends in Canada show a substantial increase in crime rates since the 1960's (from approximately 2,700 per 100,000 to more than 8,000 per 100,000), it is impossible to say whether this is due to the strengthening of the car culture and/or related to the disintegration of the social fabric. Other variables such as poverty, racial conflicts, and unemployment may play a more significant role than the automobile.

· What can be said though is that crime related to motor vehicles[17] has increased in Canada, particularly in Québec, over the last decade. The *Canadian Social Trends* of Autumn 1994 reported that the rate of vehicles stolen "increased from 8.4 per 1,000 registered motor vehicles in 1992 from 5.5 in 1988." Losses from motor vehicle thefts amount to $500 million annually in Canada. In contrast, bank robberies average $3.3 million annually. These vehicle related crimes are predominantly perpetrated by young men aged between 12-25 who steal vehicles for the purpose of joy riding or, as indicated by the Vancouver Police Department, to either commit a crime or simply to move from A to B. However, more research would need to be conducted to draw more significant conclusions on the link between criminal activity and transportation in the Canadian context.

- **The functioning of government**: John Adams contends that "as travel becomes faster, cheaper and easier under BAU". There will likely be deterrents to limit mass migration from poorer countries. Likewise, with globalization will come larger political structures which in turn could well reduce citizens' ability to fully participate in democracy.

· However in North America, countering the tendency to larger government, there is a tendency for people to form new political groups and find new means of political expressions (e.g. "social movements") to make their views known to governments. Moreover, the widespread use of public opinion polls, and their apparent influence on government decision-making may be making the cumulated voices of individuals more rather than less influential. The impact of the EST3 scenario on the functioning of government is difficult to determine.

· In this preliminary assessment, it is possible to envision that a Business-as-Usual scenario could place an important burden on the social fabric and the current definition of the quality of life of Canadians. On the other hand, an EST scenario could bring more conviviality, closer community relationships, healthier lifestyles, and less social polarization, and maintain or

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[16] A recent survey conducted on behalf of "Go for Green" and Health Canada, *1998 National Survey on Active Transportation* indicates that a majority of Canadians would like to increase their participation in walking (86%) and cycling (66%). A majority of respondents (53%) indicated that cycling is dangerous because of traffic. A large majority of respondents (82%) supported increased government spending on bike lanes and 70% indicated that they would cycle 30 minutes to work if such lanes were available.

[17] This includes stolen motor vehicles and theft of property from motor vehicles.

enhance cultural diversity. While individual mobility may be construed as a symbol of freedom and liberty, unchecked growth in our current mobility patterns may very well result in a general loss of quality of life and a real inability to experience this freedom and liberty of movement we wish for. It may be that in the future, under an EST scenario, the freedom of movement is no longer embodied in a car but rather in what we could call "transport freedom" (i.e. the ability to meet most of our needs without having to depend on a car to do so.) It is clear that strong change in public will is required if any progress towards EST is to be made.

6. Assessment of Economic Implications

As with the social impact assessment, this section aims at providing preliminary indications of the economic impact of both maintaining the current course and that of moving towards sustainable transportation. Assessing the economic impacts of EST is clearly one of the most difficult and uncertain aspects of the EST project. Even with the most sophisticated models and approaches, the assessment of the economic implications of the EST scenarios, and the business-as-usual scenario, is extremely complex. The EST scenario is an "uncharted territory". Part of the difficulty resides in the fact that the 2030 time horizon is far ahead and can hardly be predicted with accuracy. Another difficulty is the fact that EST would entail considerable changes; most conventional economic assessment methods usually deal with marginal changes.

6.1 Background and Previous Research

Several points are worth considering in regard to assessing the economic implications of the BAU and EST3 scenarios.

- There is a direct link between transportation and the economy. In Canada, transportation services and infrastructure account for 16% of the Gross Domestic Product (GDP)[18]. There is a need to begin to de-couple transportation from economic growth. That is, economic growth must be able to take place without a corresponding growth in transport activity. The degree to which the Canadian economy continues to depend on the exploitation of primary resources, most of which are dependent on heavy transport, is an important consideration. While it is likely that knowledge-based industries will grow, it is reasonable to assume that primary resources will remain an important aspect of the Canadian economy.

- The auto manufacturing industry fuels much of the economy in the QWC. In Canada, transport equipment, mainly automobiles and auto parts, accounts for 22% of all manufactured goods[19]. Most of the auto related industries and jobs are located in the QWC. On the other hand, there are questions about the future employment prospects for the car industry which are unrelated to the sustainable transportation agenda. A recent study conducted in Germany showed that the robotization and the globalization of production, as well as the just-in-time assembly process,

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[18] ***State of the Debate on the Environment and Economy: The Road to Sustainable Transportation in Canada***, National Round Table on the Environment and the Economy, 1997.

[19] ***Canada's Yearbook***, Statistics Canada, 1997.

have resulted in a long-term trend of job losses in this industry.[20] To the extent that Canada follows this trend, it is important to assess production issues for their impact on the QWC economy.

- Recent trends toward a globalized economy have resulted in greater transportation and mobility needs. It is unlikely that a single country would be able to attain EST and remain economically competitive unless other industrialized nations also followed suit. This is particularly true with Canada and the U.S., wherein trade and transportation sectors are highly linked.

In the literature to date, there have been many opinions expressed on the economic implications of climate change mitigation measures, but no consensus has been reached. In general, there is some agreement that economic benefits will be derived from energy efficiency gains if instruments to achieve sustainable transportation are put in place.[21]

With regard to economic competitiveness, a recent report commissioned by the Government of Canada concluded that "reducing CO_2 emissions will impose short to medium term transition costs on the Canadian economy". The study looked at a scenario of a greenhouse gases reduction of 6% and noted that after ten to fifteen years (post 2013) the Canadian economy is expected to produce about the same level of output, albeit at a reduced level of CO_2 emissions as it would have under business-as-usual conditions".[22] The study recognized, but did not address the issue of benefits associated with climate change mitigation, which could be significant depending on the extent to which climate change mitigation measures could circumvent the occurrence of massive environmental disruptions. It must be noted that the EST study is concerned with a reduction of greenhouse gases by 80%, therefore a large difference in scenario and quite possibly in economic impact.

6.2 Phase 3 Approach

As part of Phase 3, Canada decided to conduct two economic impact assessments using separate approaches. The first assessment used an approach that followed the guidelines recommended to the OECD country teams and consisted of "simplified cybernetic modelling" or "the Impact Path Approach (IPA)". This work was carried out by Dr. Richard Laferrière of the Transport Research Centre at the University of Montreal and is documented in a separate report dated January 24, 2000. Recognizing the uncertainties in assessing the economic impacts of EST, a second assessment was conducted using a distinctly different approach referred to as the "Surplus Value Model (SVM)". The second assessment was carried out by Professor David Nowlan of the University of Toronto and is summarized in a report dated May 9, 2000.

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[20] Frank Ebiner et.al., ***Chief Benefits for the Future, New Jobs Created with Environmentally-Compatible Traffic***, Institute for Applied Ecology, May 1998.

[21] Intergovernmental Panel on Climate Change (IPCC), Climate Change 1995, ***Economic and Social Dimensions of Climate Change***, Contribution of Working Group III to the Secondary Assessment Report of the IPCC, 1995.

[22] Standard and Poor's DRI***, Impacts on Canadian Competitiveness of International Climate Change Mitigation: Phase II***, prepared for Environment Canada, Natural Resources Canada, Industry Canada, Department of Finance, and Department of Foreign Affairs and International Trade, November 1997.

In order to help advance the "state of the debate" on the economic implications of EST and to identify the limitations of the two economic assessments, a meeting of experts was held on May 8, 2000 at the IBI Group offices in Toronto. This meeting provided the opportunity for the two economic consultants to receive feedback on the approaches and also helped to identify areas where future efforts need to be directed. A complete documentation of the experts meeting, including a participants list, is provided in a separate report dated May 11, 2000 and submitted to Environment Canada.

In addition to the quantitative assessment carried out by the two economic consultants, a qualitative assessment of the macro-economic impacts was also carried out using a framework supplied by the OECD and provided in Exhibit 2.4 shown previously as well as in Appendix A.

The remainder of this chapter focuses on the two independent economic assessments and their respective results.

6.3 Overview of the Impact Path Approach

The first independent assessment of the economic impacts of EST builds on the methodology developed by Professor Werner Rothengatter, economic consultant to the OECD on the EST project. The approach followed is classified as a ***Simplified Cybernetic Model***, which Professor Rothengatter has subsequently termed the ***Impact Path Approach (IPA).***

As described in the report by Dr. Laferrière, there are two parts to the impact path approach. The first one, the *Direct Impact Assessment*, consists in estimating the impacts of EST following a one-directional impact path from the micro, to the meso- and to the macro-economic levels, starting from the policy actions. The second part to the analysis, the *Interdependence Analysis*, consists in analyzing the interdependencies between major variables and the most important feedback mechanism.

In applying the model, several basic assumptions are important to note as they could have a significant impact on the actual outcome of the conclusions regarding EST:

- All EST3 country scenarios achieve the environmental targets in the year of projection (2030). (This rules out the environmental sector from the interactive part of the assessment).
- The policy actions are designed exogeneously. This means that "it is not necessary to foresee a feedback mechanism in which the policy actions are flexible and could be adjusted in the course of an interactive assessment scheme".
- There are no side effects of control technologies. This means that new technologies developed "do not produce additional environmental or social harm".
- The assessors are able to evaluate changes on a per cent scale starting from a defined base level for the variables.
- The analysis is restricted to economic impacts only.

In order to carry out the IPA, an input-output model was applied to generate the baseline economic information. In the economic assessment for the EST study, a model referred to as the Statistics Canada Inter-Provincial Input-Output (SCIPIO) was selected as the preferred model as it is the only model in Canada that takes into account inter-provincial flows. ***An important caveat of these models is that***

input-output models are typically used in the case where changes in the economy are relatively small and relative prices and technical coefficients can be assumed to be constant. Input-output models have also- been known to be heavily biased toward capital investment in primary sectors such as the auto industry. Input-output models do not take into account the fact that people could spend the money saved on vehicles on other aspects of the economy, some of which perhaps do not exist today.

In the independent assessment, the SCIPIO model was applied to three scenarios: the baseline scenario (to establish the current state of the economy as projected by the Conference Board of Canada), the BAU scenario (the baseline projections used for the EST study) and the EST3 scenario. Comparisons of the EST3 scenario with the BAU scenario were then made.

6.3.1 Results of IPA Model

Relative to the BAU scenario, the SCIPIO model used to execute the IPA approach projected that the gross industry output of both provinces would be lower under the EST3 scenario than the BAU scenario, a decrease of 0.4% in the year 2030. Most of the industries would experience a 0.1% to 0.3% decrease in output in 2030. As would be expected, the largest impacts are in the Transportation and Storage industry with a decrease of 6.6%. Exhibit 6.1 lists the industries and their projected annual growth rates. The "travel, advertising & promotion" sector would also be adversely affected. As highlighted in Exhibit 6.2, the specific transportation sectors that would experience negative growth are the air transport and trucking industries. Conversely, all transit and water transport sectors would experience significant positive spin-offs.

EXHIBIT 6.1
GROSS INDUSTRY OUTPUT OF THE BAU AND EST3 SCENARIOS

INDUSTRY	BAU (000,000$)	EST3 (000,000$)	Percentage change in 2030
agricultural & related services industries	11,744	11,734	-0.1%
fishing & trapping industries	178	178	-0.1%
logging & forestry industries	3,395	3,385	-0.3%
mining, quarrying & oil well industries	8,685	8,683	0.0%
manufacturing industries	261,977	261,690	-0.1%
construction industries	63,445	63,588	0.2%
transportation & storage industries	32,982	30,801	-6.6%
communication industries	16,124	16,072	-0.3%
other utility industries	17,257	17,279	0.1%
wholesale trade industries	34,656	34,586	-0.2%
retail trade industries	37,200	37,193	0.0%
finance insurance & real est. ind.	101,918	101,792	-0.1%
community, business, person. services	81,884	81,621	-0.3%
operating, office, cafet. & lab. supplies	19,240	19,225	-0.1%
travel, advertising & promotion	18,145	18,073	-0.4%
transportation margins	11,071	11,064	-0.1%
	719,902	716,962	-0.4%

EXHIBIT 6.2
GROSS INDUSTRY OUTPUT FOR TRANSPORT

INDUSTRY	BAU (000,000$)	EST3 (000,000$)	Percentage change in 2030
VEHICLES			
aircraft & parts industry	316.8	113.2	-64.3%
motor vehicle industry	802.0	799.4	-0.3%
motor vehicle engine & parts ind.	109.7	112.0	2.1%
truck, bus body & trailer industry	26.8	26.7	-0.5%
railroad rolling stock industry	53.7	49.0	-8.8%
shipbuilding and repair industry	13.5	14.0	3.6%
misc. transportation equipment ind.	10.8	10.8	-0.4%
INFRASTRUCTURE			
road, highway & airstrip const.	68.1	68.1	0.0%
highway & bridge maintenance ind.	7.1	9.7	36.8%
railway const	45.2	45.2	0.0%
ACTIVITY			
air transport & services incidental	2990.9	-491.0	-116.4%
railway transport & rel. services	261.9	279.4	6.7%
water transport & rel. services	110.3	128.2	16.2%
truck transport ind.	913.8	533.2	-41.6%
urban transit system industry	780.5	1693.8	117.0%
interurban & rural transit systems	139.9	572.6	309.4%
taxicab industry	73.7	70.7	-4.0%
travel & entertainment	468.4	438.7	-6.3%
transportation margins	433.6	426.1	-1.7%

As noted in the Laferrière report, "it is argued that the economic impact estimates obtained with the IPA analysis should be interpreted as upper bound estimates. In other words, it is very likely that a method that accounts for long term reactions from consumers and producers would yield lesser negative impact".

Recognizing the inherent limitations of the input-output model, a very preliminary assessment of the induced effects of environmental policies on changes in technology was carried using a macro-economic approach. The intent was to show that environmental policies can have various positive side effects; for example, technical progress may lead to saving production resources; revenues from ecological taxation may contribute to reduce labour costs, etc.

The preliminary macroeconomic assessment outlined in the Laferrière report suggests that the net impact of induced efficiency improvements could essentially cancel out the projected production growth rate losses of EST3 as compared with the BAU scenario.

6.4 Overview of the Surplus Value Model

The second approach used to examine the economic implications of EST is referred to as the ***Surplus Value Model*** (SVM) approach. The approach is based on the principles of cost-benefit analysis, as commonly used in evaluating the economic merits of a project or a policy proposal. It is frequently used, for example, in the evaluation of changes to regulated utility prices, and its use in evaluating major

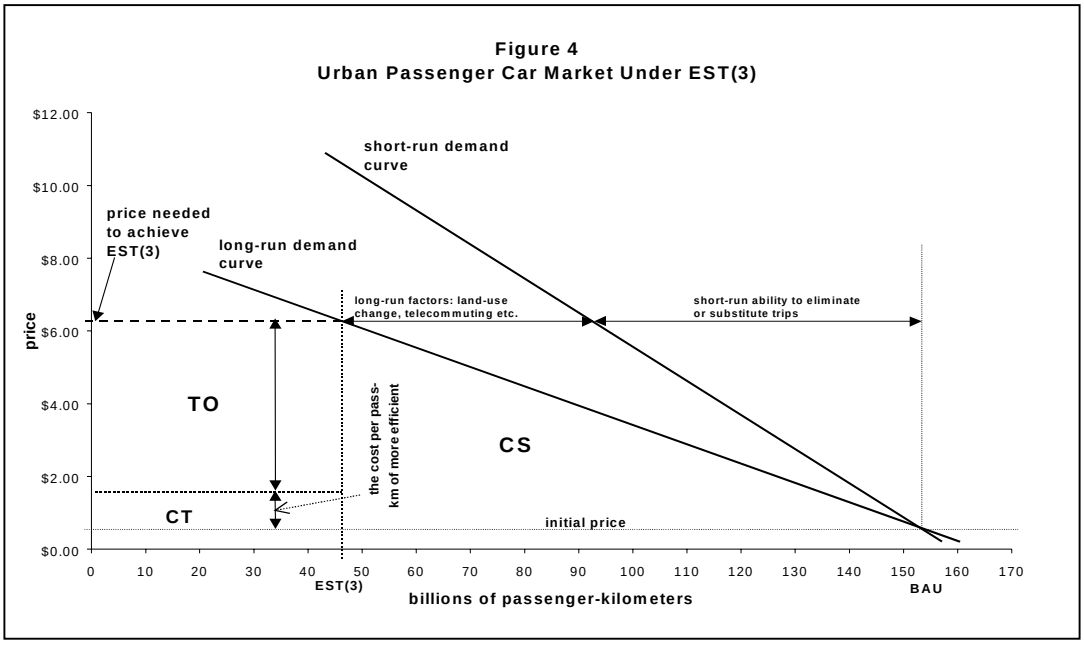
transportation and environmental projects is well known. In the case of the EST assessment, the principal benefit - the environmental benefit of achieving EST - is not part of the evaluation, but the concepts and the approach of cost-benefit analysis can be applied to an evaluation of the other cost and benefit components.

As discussed in the Nowlan report, to value the changes associated with large price movements, such as those that would occur under EST, cost-benefit analysis makes use of the notion of "surplus value," which is a dollar measure of the sum of consumer's surplus and producer's surplus. Consumer's surplus is a measure of the extent to which consumers in some given market would be willing to pay more rather than to go entirely without their purchase. Consumers in a market, like producers and sellers, enjoy benefits from the market transaction; they are not simply indifferent between making a purchase or a sale and not making it; each side to the transaction gains more than it gives. That's why markets work. This extra gain to the consumer is consumer's surplus; to the producer, it is producer's surplus.

In basic terms, the surplus value approach essentially attempts to establish what the government would have to pay out to people (or take back in the case of benefits incurred) to make them as well off under EST as in the BAU scenario. Alternatively this can be stated as the amount that individuals would be willing to pay to keep from switching to EST.

The analysis involves estimating how demand and supply curves of various sectors impacted by EST3 would shift. Exhibit 6.3 illustrates the basic demand curve relationships for the urban passenger car market, which describes the marginal benefits at different demand levels. Changes in areas under these curves are used to estimate costs and benefits to the impacted sectors of the economy.

EXHIBIT 6.3
URBAN PASSENGER CAR MARKET UNDER EST



Where:

TO = a transfer out, from the customers in a market
CS = an decrease or cost in consumer's surplus
CT = cost of improved technology

Fundamental to the analysis are the assumptions about demand elasticities, which describe how consumers will react to changes in price. Elasticities provide a considerable amount of information on what changes are likely to occur in the economy. One problem, however, is that it is very difficult to estimate what the long run elasticities might be, particularly over a 30 year period. As discussed in the Nowlan report, the assumptions about elasticities can have a significant impact on the estimated impacts of EST. However, based on the results of the experts meeting, it can be concluded that the elasticities used in the analyses are, in most cases, reasonable. The elasticities that are ultimately used in the calculations are strongly influenced by, where they are not completely based on, the well-known 1992 survey articles in the *Journal of Transport Economics and Policy*, one by Tae Hoon Oum *et al*, the other by P.B. Goodwin.[23]

6.4.1 Results of Surplus Value Model

The results of the surplus value model suggest a more substantial impact on the economy than the IPA model, although the two approaches are distinctly different. The results suggest that the net economic cost of introducing EST3 would be $51.91 billion annually in the year 2030, in 1994 prices. If real growth at 2 per cent a year is assumed through until 2030, the Ontario and Quebec GDP will be in that year about $977 billion, in 1994 dollars. The net cost of EST3 is therefore estimated to be 5.30% of GDP. It is estimated that this figure could be reduced if environmental taxes (e.g. tolls) are used to replace other taxes that have costly distortions. A conservative estimate of these savings would reduce the net economic cost of EST3 to $39.10 billion or 3.99% of the GDP.

One of the unique advantages of the SVM approach is that it allows one to determine whether the assignment of CO_2 reductions to different modes are reasonable. The results of the sensitivity tests suggest the urban car market may be taking a bit too much of the burden compared to other contracting markets such as trucking.

6.5 Comparison of IPA and SVM Models

The Impact Path Approach and the Surplus Value Model are two distinctly different approaches. One is based on a traditional input-output model and the other is based on the extrapolation of cost-benefit analysis principles to a 30 year macroeconomic assessment. Each approach clearly has certain limitations, but both are valid attempts at trying to model the impacts of EST3 on the economy. This is no small task.

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[23] [Oum 1992]: Oum, Tae Hoon, W.G. Waters II and Jong-Say Yong, "Concepts of Price Elasticities of Transportation Demand and Recent Empirical Estimates," *Journal of Transport Economics and Policy*, May 1992, pp. 139-154. [Goodwin 1992]: Goodwin, P.B., "A Review of New Demand Elasticities with Special Reference to Short and Long Run Effects of Price Changes," *Journal of Transport Economics and Policy*, May 1992, pp. 155-169.

Exhibit 6.4 provides a brief overview and comparison of the two approaches applied as part of Phase 3. Perhaps the biggest attraction to the IPA is that it is based on an input-output model that has been around for some time and tested in different situations. On the other hand, input-output models are not typically used to examine changes as large as that required under EST. The most attractive feature of the Surplus Value Model is that it is completely transparent and all assumptions are clearly discernible. The biggest gap in the SVM is the uncertainty regarding long term elasticities for the various sectors. Another limitation is that it does not consider the impacts of EST on non-transport market sectors, which may be either positive or negative.

The range on the results is somewhat surprizing. One model suggests that the impacts of EST will be almost negligible (0.4% reduction in GDP in 2030) while the other model suggests that the consequences will be similar to a significant recession (5% reduction in GDP in 2030). These results; however, must not be taken outside of the context of the models. For example, the IPA assumes that the changes in demand would occur in the QWC only. If an industry is not represented in the QWC economy, it would not be affected by EST. The IPA also assumes that any new investment is a benefit to the economy, whereas the cost-benefit analysis does not make the same assumption and, in fact, new investment required is a cost or disbenefit.

One of the most significant limitations of both approaches is that they do not attempt to estimate the economic benefits of reducing ground level air pollution, which has significant health impacts[24], or climate change, which may ultimately have catastrophic consequences.

A final point about the models is that the economic "indicators" used in both cases were GDP, and industrial output. There was no attempt to the use alternative measures of social and economic well-being that are currently under development. GDP is based on the assumption that *more is better* , ignoring the fact that things such as increased road congestion, noise and land consumption due to roads and parking have significant cost impacts. These changes in welfare are more difficult to measure but are nevertheless important tools to capture the new benefits from this scenario.

[24] A recent report estimates the number of deaths due to smog in Toronto alone at 1000 per year (Toronto Star, May 18, 2000).

EXHIBIT 6.3
COMPARISON OF IPA AND SVM APPROACHES

	Impact Path Approach (Input-output Model)	**Surplus Value Model**
Primary Use	Analyzing short-run market adjustments	Cost-benefit assessments
Basic Approach	Establishes relationship between GDP and demand in passenger and freight sectors and then calculates GDP with BAU and EST 3 demand	Uses demand curves (price elasticity) to describe how consumers will react to market changes
Primary Advantages	Considers impacts on all sectors of the economy Direct calculation of GDP impacts Based on existing Statistics Canada model	Makes it easy to identify winners and losers under EST Highly transparent approach Possible to optimize CO_2 reduction allocations by mode
Limitations	Assumes constant relative prices and technical coefficients for I-O model (e.g. economies of scale are ignored) Assumes new investment is a benefit to the economy, regardless of employment supply Typically used to examine small scale projects Does not examine non-market benefits and ancillary benefits such as improved health	Long run elasticities are difficult to estimate Approach is untested at macro-economic level Does not look at impacts on non-transport markets Does not examine non-market benefits and ancillary benefits such as improved health
Projected Impacts of EST 3 on GDP	**0.4% lower than BAU in 2030**	**5% lower than BAU in 2030**

6.6 Areas for Future Work

Regardless of how much work is carried out, the projected economic implications of EST will always be an uncertainty. This is due to the fact that the changes contemplated are very large and the economy in 2030 may be vastly different than today.

Nevertheless, there are several areas of research that could be pursued to help provide a better understanding of the possible implications of EST. These can be categorized as follows:

- further examine the technological costs of reducing emissions per vehicle-km;
- use results of economic analysis to optimize EST 3 veh-km and tonne-km reductions by mode;
- compare costs/tonne of CO_2 reductions in transportation vs. other sectors to optimize the mix of targeted reductions across sectors;
- quantify the environmental/health benefits of EST 3 vs. BAU;
- consider studying the behavioural impacts of gas rationing on civilian travel during WWII.

7. Conclusions

This report has presented the outcome of an exercise to develop and assess a package of instruments that may result in the achievement of the EST3 scenario. A summary of the assessment of instruments, key messages and challenges are provided below.

7.1 Summary of the Assessment of Instruments

Based on the assessment of instruments, the following describes in general terms the types of instruments that would be required to move towards a sustainable transportation system:

- **Increasing the variable costs of unsustainable modes:** Regardless of the instrument, increasing the cost of unsustainable modes to account for external costs is a fundamental prerequisite for change, both for the development and adoption of new technology and to influence travel behavior. In the context of this study, both road pricing and increasing fuel prices are seen as an essential elements, provided revenues are put back into providing new and improved infrastructure for alternative modes. Parking pricing and management are also key policy tools.

- **CO_2 emissions trading:** This instrument has the potential to significantly reduce emissions and to dramatically alter the way people travel. Even though it is now difficult to conceptualize how it could be successfully implemented within the transportation sector, it would probably create one of the best incentives for the development of new technology and for shifting travel towards more efficient modes. More research should be conducted on this potential instrument.

- **Restructuring land use into more efficient forms:** Restructuring land use into more compact, mixed use communities will be one of the most difficult features of EST to achieve. This is partially due to the fact that changes to land use require a long time to occur, and also because of society's current aspirations for more space. Several instruments have the potential to change land use including, restructured taxation (e.g. higher taxes in outer areas) and stricter development controls. Both of these are fairly draconian measures, but may be highly effective. The preferred approach would be to encourage more efficient urban structure land use by improving the attractiveness of urban areas (e.g. by providing high-quality affordable transit systems).

- **Refocus from roads to sustainable infrastructure:** If people are to reduce their use of cars and road freight, viable alternatives must be available. As a result, measures to replace some of the existing road capacity with exclusive transit and non-motorized facilities and improved transit service and coverage will be required to cause a significant change in mode choice. Several instruments are available for changing the focus of infrastructure development. In the short term, increasing the person capacity of existing roads through the use of HOV lanes and HOT lanes is a worthwhile initiative. In the longer term, replacement of roads with bicycle and pedestrian facilities would cause significant changes in travel choices. Through the transition period toward EST, transit expansion would be prominent. Experimentation with ideas such as the station-car (see Appendix A for more information) and alternative delivery for transit is suburban zone should be undertaken to broaden the scope of alternatives to car use.

- **Financial incentives:** Some use of financial incentives is likely necessary to achieve some of the features of the EST3 scenario, particularly those related to technology development. It is not recommended that the government simply pay people to use other modes. However, some specific initiatives that deserve consideration are tax benefits for transit users, credits for stock turn-over, funding for demonstration projects and reduced registration/user fees for sustainable modes.

- **Other Travel Demand (TDM) Measures:** There are a host of very attractive measures to encourage modal shifts and reduced travel demand. These include measures such as car sharing, replacement of work trips through telecommuting, tax-incentives for transit users, and traffic calming. All of these will be important in moving towards sustainable transportation. For the most part, many of the TDM measures could be implemented with minimal costs and significant economic and societal benefits. TDM may be the first realistic first step that can contribute to changing travel behavior.

  One caveat needs to be made regarding tele-working or telecommuting. Many experts are enthusiastic about the possibility of information technology to reduce travel demand. However, others feel that this measure requires further investigation to ensure that its implementation do not result in a "rebound effect". This effect would occur, for instance, if by implementing tele-commuting, people found it more appealing to reside further away from their work because they no longer have to drive daily on congested roads. This could ultimately result in more kilometres traveled rather than less.

- **Public Education:** On its own, public education is likely to achieve very little. However, proper public education is required for nearly all of the other measures to succeed. Ultimately,

changes will need to be brought forth by public demand, rather than being implemented from the top down.

7.2 Other Messages

Some of the key messages that emerged from this study are highlighted below:

- **Canada differs from other countries:** Canada is different from most other countries participating in this study in many ways. Physically, Canada is larger, less populated and more dispersed than European countries and, as a result, is highly dependent on road and heavy truck transportation. Within the QWC urban areas, there are existing transit and pedestrian infrastructure but the use of transit and non-motorized transportation is less ingrained, and in certain weather conditions less practical in our society than many European cities. Another difference between Canada and some other countries is that there are three levels of government having jurisdiction over some aspect of both transportation and the environment. Many of the instruments would have to be implemented nationally, as the QWC extends through two provinces. EST implementation would also require federal, interprovincial and municipal collaboration and negotiations.

- **A balanced approach is required**: The analogy to "sticks" and "carrots" has often been used to characterize the *regulatory* instruments and economic or other *incentives* that are used to change travel behavior. There is no question that some use of "sticks" will be required, at least in the short term, to achieve EST. The current political climate is not favourable to regulatory approaches. Although voluntary approaches are important to a comprehensive action plan, voluntary approaches have not proven to be effective in reducing emissions substantially. It is unlikely that, used alone, voluntary measures could lead us to EST.

- **Technological progress is as important as activity changes**: Amongst many experts, there is sound skepticism about the ability of technology to move us towards sustainable transportation. Many view technology as the primary reason why we moved away from sustainability in the first place. However, one cannot discount the possibility that in the future, unanticipated technology development may play a critical role in helping us "leap frog" towards sustainability in the transportation sector. In such a case, the changes required in travel behavior may be less significant or may become more acceptable than what is currently required under the EST scenarios.

- **Non-transportation sectors must also become more sustainable**: It is unlikely that significant progress towards sustainable transportation could be achieved without significant changes in the society at large. Sustainability of the transportation sector implies that other sectors are moving towards sustainability as well and vice versa. Despite the dramatic changes required to implement EST3, these changes are likely to be much less dramatic if other sectors such as the energy, the industry or the agriculture sectors, are moving in the same direction.

- **Linking transportation demands to general consumption patterns:** One could argue that there is a deeper link between why, when and how people travel and general environmental degradation. For instance, it is not only that "megastores" are located outside urban core that

may be cause for concerns, but their very existence. One expert noted that "a small car often cannot suffice to carry all the goods purchased in these large stores". From this point of view, the trip to the store may only be the "tip of the iceberg" in terms of environmental impacts. EST3 may simply not be achievable unless current consumption patterns are challenged.

- **Innovation can occur without regulatory measures:** Experts involved in this study were generally of the belief that given the right incentives, individuals will find ways of achieving some of the features of EST regardless of public policy. A conference on Moving the Economy (held in Toronto in 1998) brought together a number of individuals that have demonstrated that there are ways individuals can benefit economically from improved sustainability.

- **Changes would need to be radical**: In order to achieve the EST criteria developed for this study within the specified time frame (2030), changes could not simply be incremental. A whole new way of looking at transportation is required. One important barrier is the fact that billions of dollars have been invested to develop the current transportation infrastructure (roads and fuel). While EST would require important capital resources to succeed, there is currently pressure to re-invest in the existing infrastructure to maintain it, and improve it due to social (safety, connectedness) and economic (competitiveness, trade) considerations.

- **Action must begin immediately**: The first step in moving towards EST will be to reverse current trends, which are moving away rather than towards EST. Based on the initial timeline developed as part of this study, it is difficult to imagine how all instruments could be assessed, implemented and have the desired impacts within the required time frame (e.g. by 2030). Many of the changes required to move towards EST involve adoption of a sustainable development approach to land use practices. It would represent a commitment to changes that need to be in place over many years before results become significant. Given the importance of the changes required, critical decisions would need to be made now to have any significant impact by 2030.

- **International co-operation is essential:** It is highly unlikely that Canada, or the QWC for that matter, would be able to achieve EST without other nations following suit. Harmonization of EST policies between the United States and Canada would be particularly important considering the strong integration of both economies and automotive industry.

- **Equity must be maintained:** If EST is to be achieved, it should be done so by not burdening any particular geographic area or sector or class of society. Despite this, it is reasonable to suggest that measures should be implemented initially in areas where they would have the greatest impact, namely urban areas.

- **Improvements in efficiency may benefit economy:** The analysis of the economic impacts of EST are difficult to predict, although preliminary analysis suggests that there may be a reduction in the traditional measure of economic performance: gross industry output. What this doesn't take into account are the induced efficiency improvements that would likely occur along with EST as well as the potential economic benefits from reduced pollution and global warming.

Perhaps what has been made most clear as a result of this exercise is that achieving EST would require an enormous and co-ordinated effort on behalf of all members of society nationally and internationally. Moreover, the changes would have to start immediately in order to take effect by the horizon year 2030.

To achieve any significant changes, the public would need to be made aware that there is significant cause for concern regarding environmental issues and global warming. Thus, public education and awareness initiatives would seem the obvious immediate step in the road toward environmentally sustainable transportation.

APPENDIX A

Overview

The purpose of this Appendix is to provide a detailed description of the most promising instruments that could be used to move towards the EST3 scenario. In doing so, the advantages and disadvantages of each measure is also assessed. While the list of instruments presented here is comprehensive, it does not represent a complete list of all possible options that may lead to more sustainable transportation.

The development and assessment of instruments has been structured around two exhibits. Exhibit A.1 contains the complete list of instruments discussed in this Appendix and referenced in the main report. It indicates which features would be impacted by a particular instrument. The purpose of this exhibit is to identify a long list of possible instruments and to help determine how those instruments pertain to the features of EST3.

As discussed in the main report, an assessment grid based on the proposed framework provided by the EST team of the Netherlands has been used in this study. The completed assessment grid, shown as Exhibit A.2, summarizes the qualitative assessment of each instrument. As shown, each instrument may have a different impact on a particular feature of the EST3 scenario, and as such, instruments may be assessed more than once.

Economic and Fiscal Instruments

The economic and fiscal instruments considered are:

- **Road pricing:** Road pricing can be implemented in various forms. The most basic form is to implement tolls on major expressways or arterial roads, charging drivers for the use of the specific facility. Other forms, referred to as cordon pricing, charge drivers for entering a specific area (e.g. the downtown core). Yet another variation would be a comprehensive road pricing scheme whereby road users would carry an electronic transponder device and would be charged for the use of all roads, with prices varying by facility type, vehicle type and time of day. A recent variation of the road pricing concept that is being used in California charges drivers for the use of HOV lanes (or "HOT lanes") varying the toll according to how many people are in the vehicle. Although road pricing is usually restricted to urban areas, for the EST3 scenario road pricing could also be extended to key inter-city corridors.

Road pricing is becoming more politically acceptable in Canada and elsewhere. Depending on how it is implemented, road pricing can reduce demand, cause mode shifts, or spread travel to different times of the day. It may also encourage more compact, mix-use urban environment.

At the present time, road pricing systems in Canada are being implemented only on new highways and bridges. Road pricing on existing infrastructure will also be required if this instrument is to be effective.

– **Fuel pricing:** Fuel pricing would consist of raising the cost of conventional fuels to account for external costs (environmental costs, accidents, land take, etc.). This could be implemented on a gradual basis, increasing the price of petroleum-based fuels by a set amount each year until the desired objective is achieved. In order to cause a change in behaviour, suitable travel alternatives must be available to the auto user. A variation of fuel pricing is a carbon tax system whereby individuals or corporations would be taxed on how much carbon they use or produce.

  The primary advantage of fuel pricing is that it influences activity by reducing trips and shifting trips to sustainable modes, and it also influences the (unit impact) awkward as people switch to more fuel efficient vehicles and auto manufacturers strive to develop new and improved technologies. In the long term, fuel pricing may help to structure land use into a more compact form as people attempt to reduce trip lengths by optimizing their residential location. As highlighted in the assessment table (Exhibit 2.2), revenues from fuel pricing or fuel taxes could be used to fund the construction of suitable alternatives such as rapid transit.

  One drawback of fuel pricing is that there would be major opposition, given the controversial nature of fuel pricing. Opponents argue that fuel pricing is a blunt instrument that could limit global competitiveness as well as impact lower income persons and families. On the other hand, real gasoline prices in Canada are currently the third lowest out of 25 industrialized nations and less than one-half the price of gasoline in the United Kingdom[25]. It is unlikely that this instrument could be implemented within the Corridor alone. It may only be effective if implemented on a North American basis.

Proposal for an emissions trading scheme in the Netherlands

Each Dutch inhabitants (older than 12 years old) receives a CO_2 budget of 160 kg per person. People are free to spend this budget on various available travel modes. They can also buy or sell CO_2 permits on a "permit market".

If an individual wants to spend his/her entire budget on car use, he/she will be limited to 7,100 passenger kilometres, using a fuel efficient hybrid car. If a conventional car is used, roughly 1,400 passenger kilometres can be traveled. If the train is chosen, more than 46,700 rail km can be traveled.

– **Tradable CO_2 emission permits:** This is a unique concept whereby each individual over a certain age is given a specific amount of "CO_2 credits." People can spend these credits however they wish. If a person

[25] Based on information presented in ***Toward a Sustainable Future, Addressing the Long-Term Effect of Motor Vehicle Transportation on Climate and Ecology***, Transportation Research Board, Special Report 251 Washington, D.C. 1997.

runs out of credits, he/she must purchase credits from someone who has some extra credits. In the OECD EST Study, the Dutch have relied heavily on the CO_2 trading concept as a basis for achieving their EST3 criteria[26]. Box 1 describes the approach proposed by the Dutch.

The advantage of a CO_2 emissions permit system is that it is possible for governing bodies to set a target for CO_2 emissions and then issue only the amount of credits that would achieve this target. Initially, the amount of credits could be set at the current rate of CO_2 consumption to get people accustomed to the concept, decreasing the allowable credits each year thereafter. Another advantage of the CO_2 trading system is that it would apply to all modes, including aviation, whereas road pricing and fuel pricing typically target road modes.

The primary limitation of the CO_2 trading system is that it is difficult to conceptualize how this system would be implemented and enforced within the transportation sector. Clearly, it would require much better data collection and knowledge of the sources of air pollution than exists currently.

- **Differentiated insurance and registration fees:** This could involve a restructuring of the insurance and/or vehicle registration pricing systems such that insurance and registration fees could be based on a sliding scale depending on how many km a person or vehicle traveled per year. Under the current system, people who use their car more are in effect being subsidized by people who use their cars less. A variation of this concept is a "Pay-at-the-Pump" scheme whereby registration fees and insurance fees are added to the price of fuel and therefore dependent on the amount of fuel consumed.

  The advantage of differentiated user fees is that the impacts are very direct. If a pay-at-the pump system is used, the day-to-day costs of driving are increased and therefore the perceived costs of driving are also increased. Differentiated fees could be implemented such that the net impact on the public is revenue neutral. The downside of differentiated users fees is that it requires a significant change on the part of the private sector and would be interpreted as penalizing people who live in sparsely populated parts of Canada and therefore need to drive great distances for basic services. Some people might argue that fuel consumption is a poor proxy of distance travelled and could introduce a significant bias in the price system. Also, some insurance companies already discriminate in setting their insurance fees between people who use their car to commute and those who do not.

- **Parking pricing and management:** Most parking by-laws in urban municipalities tend to require developers to provide sufficient parking for the current demand leaving little flexibility to use parking supply as a transportation demand measure. Further, parking prices in most urban areas are demand driven and are not regulated by any by-laws. In order to achieve the EST3 criteria, a major re-thinking of parking by-laws will be required. Although it might be considered drastic, one option would be to mandate that all commercial developments over a certain size be required to charge for parking. Currently, most large retailers outside of downtown cores provide an abundant amount of free parking, for which

[26] Description of the combination scenario's instrument package and implementation time-path for the Netherlands, Memorandum for the OECD Expert Meeting on March 11, 1998, Paris, Karst Geurs, February 19, 1998.

the capital and operating costs are factored into the price of goods regardless of whether or not the consumer uses the parking.

- **Tax incentives for transit users:** Under the current tax laws, most automobile commuters receiving free parking are not required to pay tax on this benefit. This is not the case with employer provided transit passes which are taxed[27]. Redesigning tax policies to provide incentives for transit users would be required to achieve EST3.

Regulatory Instruments:

Possible regulatory instruments include:

- **Mandatory emissions inspection:** A program was implemented in Ontario in 1999. Vehicles not conforming with the emissions standards will be denied registration until the necessary repairs are made. Harmonization with the province of Quebec would be required to optimize results in the QWC. Furthermore, harmonization with adjacent Great Lake states may also be required.

- **Reduction in speed limits:** The amount of fuel consumed and CO_2 produced by vehicles is in part a function of speed. Lowering speed limits, with proper enforcement,- would improve fuel efficiency and reduce emissions. A secondary benefit would be that transit and passenger rail would become more attractive. However, this instrument is susceptible to receive much resistance as Ontario is currently giving consideration to raising the current highway speed limit.

Urban Structure and Transportation Demand Management

Transportation demand is dictated to a large extent by urban structure and land use. The fact that municipal governments have allowed urban areas to expand outward virtually unconstrained, makes it very difficult to implement some of the policies suggested in this report. Immediate and strong action will be required to change current land use and travel trends in order to meet the long term criteria for EST. Some possible instruments are discussed below:

- **"Full Cost" property taxes:** Land in suburban areas is typically taxed at a lower rate than land in urban areas because of lower market property values. There are few measures which take into account the fact that people living in less dense areas tend to make more auto trips, require more road and other infrastructure and contribute more to environmental problems. Full cost property taxation is one of the few instruments that are available which can structure land use and the potential impact of this instrument is very significant. The drawback of the system is that it would require a complete re-thinking of property taxation. There are many barriers to implementing fuller cost property taxes, not the least of which is putting a price on the external costs of low density suburban development. Several problems also surround the treatment of rural communities.

[27] ***Win-Win Transportation Management Strategies to Reduce Greenhouse Gases***, Victoria Policy Institute, Victoria, B.C.

- **Stricter land use controls**: This would involve placing restrictions on land development. For example, restricting new development to specific areas and/or setting minimum population and employment density targets for both new and existing urban areas. Land use controls have the advantage of being very effective at controlling urban sprawl but strong political intervention is required to ensure that the controls are enforced. There are many social issues that also surround the implementation of stricter land use controls and these would need to be recognized.

- **Environmental assessment of new developments:** Initially limited to public projects, this instrument would help to ensure that large developments, such as sports arenas, are located and designed so as to minimize motorized trips, particularly with the automobile. This would include site-specific transportation demand strategies.

- **Employer sponsored trip reduction initiatives:** This would include initiatives such as ride-share programs, improved facilities for cyclists, employer provided transit passes, employer supported telecommuting and teleconferencing, and other similar measures. These initiatives could be facilitated by a trip reduction tool kit designed specifically to help employers implement such programs. Benefits to the employer, such as deductions, for their efforts may also be appropriate.

- **Car-Sharing/Station Cars:** Car-sharing programs are well established in Europe and have been implemented in Québec, Montréal, Vancouver, Toronto. Essentially, car sharing clubs provide an individual with access to a car when required, with the burden of ownership being shared by several individuals. Car-sharing clubs often provide different vehicles for different trip purposes. Under an EST scenario one could conceive that a small highly efficient electric vehicle could be used for local trips and a larger vehicle such as a van could be used by the whole family for longer distance trips. Another interesting idea is the Station Car concept. Station cars are usually electric vehicles (EVs) driven to and from mass transit station by transit riders. They are conceived as a mass transit extension whereby individual can use them for short trips of any kind while outside the transit station. Several of these station cars are presently being demonstrated in the U.S. in the San Francisco Bay Area, New Jersey, Atlanta, Boston, Long Island. Sacramento, and Washington. Experimentation could also take place in the QWC.

- **Programs to reduce school related auto trips:** More and more parents are driving children to school. In the Greater Toronto Area, more than 10% of all a.m. peak period auto trips are made directly for school purposes[28]. Many of these trips are unnecessary. Programs to reduce school based auto trips would be an important component of achieving the EST criteria. One program that was mentioned previously in the Phase 2 report is the walking school bus program. Coordinating school transit with regular transit may also prove advantageous in some areas.

[28] Based on the 1996 Transportation Tomorrow Survey. Figure includes trips where school was reported as the primary purpose. The figure does not include extra trip segments made to drop students off at school.

Research and development Initiatives:

In the EST3 scenario, slightly less than one half of the required reductions is estimated to come from technological improvements. In order to achieve the penetration rates assumed for new technologies, very significant and timely policy instruments will be needed. A list of some possible measures is provided below:

- **Financial incentives for technology development**: In the early implementation period, it may be necessary to provide financial incentives for people to use new technologies. Examples of this include credits for stock turnover or reduced vehicle registration fees for clean vehicles. The potential advantages of financial incentives are in stimulating development of new technologies and in stimulating the economy if the technologies prove to be feasible. The obvious drawback to the use of financial incentives is that they require government funding, and therefore involve an increased cost to tax payers.

- **New Corporate Average Fuel Economy (CAFE) Standards:** In the 1970's CAFE standards showed significant potential for reducing greenhouse gas emissions. Essentially, CAFE standards attempt to ensure that vehicles used by public and private corporations are as fuel-efficient as possible. These standards are now voluntary in Canada, but should become mandatory under the EST scenario. As fuel cells and other technologies become commercially viable, CAFE standards could be increased to ensure that corporations take advantage of the new technologies. A variation of the CAFE standards theme would be to establish a requirement that government fleets be replaced with new technologies, perhaps hybrid vehicles in the short term and fuel cell vehicles in the longer term.

  Unlike fuel pricing, CAFE standards have a direct impact on fuel efficiency. Increases in fuel efficiency may also off-set the cost of vehicle replacement. With this instrument alone, however, in absence of any increase in fuel costs, there is no incentive to reduce the total number of km travelled.

- **Feebates:** A feebate is an economic policy instrument under which vehicles are subject to taxes or rebates in proportion to how much they exceed or fall below a specified reference energy factor, typically the mean fuel economy rating for the vehicle fleet for a particular year. Feebates can be designed to be revenue neutral, or to generate sufficient revenue to cover their administrative costs.

  Feebates have been extensively researched, especially in the U.S., but have not been implemented in a substantive way in any jurisdiction.

- **Promotion of alternative fuels**: Many fuels that are available today would reduce the impact of transportation if used properly. These include methanol and ethanol, natural gas and propane. Several barriers limit the use of these fuels, mainly pertaining to supply and distribution systems. The penetration of alternative fuels could be increased through more aggressive promotion and government support. Given that the use of alternative fuels alone would not result in reductions of the magnitude required for EST3, it is likely that they would be most useful as an interim measure until other technologies such as fuel cells became commercially viable. Furthermore, more analyses need to be conducted to assess the

environmental benefits of alternative fuels from a life-cycle perspective, including the assessment of the environmental impacts of production, transportation and consumption.

- **Private/Public technology development:** The development of new technologies such as fuel cells can be facilitated through public-private partnerships, demonstration projects and funding assistance for emerging companies. Recent examples of this type of initiative include the partnership between Ballard Fuel Cells, B.C. Transit, Chicago Transit Authority, and financial support from auto companies for Ballard's R&D programs. Under the EST scenario, the Federal government will need to play a much larger role in fostering the development of fuel cells and other technologies.

- **Develop Memorandum of Understanding (MoU) with vehicle manufacturers:** This would be similar to the Partnership for a New Generation of Vehicles (PNGV) currently in place in the U.S. where the U.S. Government and the Big Three auto manufacturers are working to develop vehicles that will achieve a threefold increase in fuel efficiency over the current technologies. Canada could follow this example and develop an MoU with auto manufacturers, as well as, those for heavy vehicles.

- **Demonstration projects**: Research and development, taken in its broader sense, could encompass work on travel behavior or technological innovations that go beyond direct vehicle technologies. For example, a concept such as the station car mentioned above provides a more holistic approach to transportation challenges and requires to be further investigated through demonstration projects. Experimentation with measures such as car sharing and car pooling needs to take place within communities to allow people to experience changes. Research at that level is also required to better document the environmental benefits and provide insight for larger scale implementation. Alternative transportation schemes need to be explored and studied with the assistance of government R&D funds.

Transportation Supply Management:

The supply of transportation is both a response to demand as well as an influence on demand. Several transportation supply measures have the potential to change both passenger and freight travel, as discussed below:

- **Transit service expansion and enhancement**: Significantly higher levels of transit service will be required to accommodate the modal shifts from auto. This would include the expansion of the existing bus, rapid transit, and regional rail networks as well as the introduction of entirely new transit modes such as intercity high speed rail. Emerging types of transit such as demand responsive transit and Personal Rapid Transit (PRT) or "people movers" could also be considered. While seen as a key instrument, transit service expansion will only result in emissions reductions where there is significant demand levels to support reasonable load factors.

  In order to provide the levels of transit service expansion required under EST, it would be necessary to fund improvements through the use of revenues from fuel taxes, road pricing, vehicle registration fees, etc. Funds would be "ear-marked" and used specifically for the expansion of transit and non-motorized transportation facilities.

- **Transit service coordination and fare integration:** For years governments have been supportive of transit integration. Some progress has been made, but several areas are still lacking a completely coordinated transit system. The adoption of "Smart Card" technologies would be a cost-effective way to achieve transit fare integration and ultimately increase ridership. A pilot project is currently underway in Hull with the Société de Transport de l'Outaouais.

- **Improved bicycle/pedestrian facilities:** In most urban and non-urban areas within the QWC, bicyclists and pedestrians are constantly put at risk of being killed or injured by automobiles. This is a significant deterrent to the use of these modes. Urban and rural roadways could be re-engineered to provide more protection and better facilities for bicyclists and pedestrians. In addition, existing or new corridors could be converted to "sustainable corridors" allowing only non-motorized and/or transit vehicles. These facilities would need to be designed to ensure safety for non-motorized modes.

- **Priority measures for transit, cyclists and pedestrians**: This would include signal pre-emption for transit, timing traffic signals for cyclists and pedestrians and other initiatives that would benefit these sustainable modes. In Muenster, Germany for example, intersections have been designed to allow cyclist to proceed to the front of the vehicle queue at traffic lights[29].

- **Rail Incentives:** Over the last 10-20 years, the modal share of goods and passengers transported by rail has declined significantly, in part due to changing legislation, such as modifications to regulations regarding road vehicle weights and dimensions, but mostly due greater flexibility provided by road vehicles. Legislation applying to rail and competing modes should be reviewed in light of EST requirements.

- **High Occupancy Vehicle (HOV) lanes**: Conversion of some existing lanes to HOV lanes can increase the occupancy rates of vehicles while at the same time reducing the road supply for Single Occupant Vehicles (SOV's). Policies could be implemented to ensure that HOV lanes are implemented on existing facilities wherever appropriate. The effectiveness of HOV lanes for reducing travel is significantly improved if existing lanes are converted to HOV lanes rather than adding new lanes.

- **Advanced technology applications:** Many intelligent transportation systems (ITS) related technologies could be used to reduce auto travel and improve freight efficiency. For example, trucks are now using mechanisms to tell drivers how to drive efficiently as well as where the shortest and least congested path is. Another example of an advanced technology application is the Internet where people can type in an origin and destination and receive information on the cost and service characteristics of travel by different types of modes.

- **Traffic calming:** Traffic calming refers to any approach taken to slow traffic in a given neighborhood such as speed bumps, stop signs, and lane narrowing. Traffic calming is becoming more accepted as a means for reducing or slowing auto travel in urban residential

[29] Pucher, J., ***Bicycling Boom in Germany: A Revival Engineered by Public Policy***, Transportation Quarterly, Vol. 51. No. 4, Fall 1997, pg. 31-46.

areas. Implemented on a widespread basis, the principles of traffic calming could have a significant impact on urban travel and mode choice. However, implementation of traffic calming measures should ensure that it does not result in diverting more traffic onto already congested arterial roads.

Consumer Preference Mechanisms

Changing consumer preferences will be key to achieving EST in several aspects. First, consumer preferences have a large impact on how political decisions are made. Second, consumer preferences have an influence on where innovation efforts are directed. There are a number of measures and instruments that could be used to influence consumer preferences:

- **Improved education**: The public needs to be made aware that there is a need to change current transportation and land use trends. In general, people rationalize their decisions to use the automobile by the fact that their individual travel habits are unlikely to have a significant effect on the broader picture. Initiatives by Natural Resources Canada , such as the "Auto$mart" Module[30] for new drivers, are attempting to change this by educating the public. In order to achieve the EST3 scenario, a much greater effort will be required including, education of people from a young age about "sustainable transportation issues", improved dissemination of information on climate change, and education of politicians and other key decision makers.

  If implemented effectively, public education can help build support for political decisions as well as stimulate new and innovative ideas on how to achieve sustainable transportation.

- **Advertising equity**: Auto manufacturers are well versed in the art of aggressive marketing while transit operators and promoters of sustainable tend to take a more passive approach. One of the authors of this report recently saw an ad for a car that read: "You may want to move farther from work." A memorandum of understanding (MoU) could be established with auto manufacturers to ensure that fuel efficient vehicles and new technologies are given a proper share of advertising and that advertising is sensitive to the environmental cause.

- **Consumer/user awareness initiatives:** Such initiatives could include CO_2 labelling on new automobiles and on-board diagnostic systems that would inform drivers how much pollution they are producing as they are driving. Similar initiatives could be used for freight transporters and air travellers. As an initial effort, households and corporations could be distributed a self-administered questionnaire which would allow them to rate their contribution to air pollution against other households and the national targets (if adopted). This would also demonstrate to the public the challenges facing policy makers.

- **Support for community/political "champions":** One person performing a significant act can have a large impact on the general public. Special recognition programs should be set up

[30] The "Auto$mart" Module for new drivers is a program aimed at encouraging motorists to make fuel-efficient decisions when purchasing, operating and maintaining their vehicles, Environment Canada, ***Federal Action on Climate Change- Next Steps***.

to reward individuals, schools, politicians, special organizations, etc. for work in the area of environmentally sustainable transportation.

Possible Administrative Measures:

The following are measures rather than instruments. It could be claimed that they are integral and critical precursors before other instruments can fully be implemented:

- **Improved data collection/dissemination:** Collection of data on transport activity, air pollution, vehicle emissions and climate change in Canada needs to be improved. Similarly, the dissemination of this data to policy makers is also in need of improvement so that informed decisions about sustainable transportation and full cost pricing can be made. One option could be to establish a centralized data and analysis centre to collect, maintain, analyze and distribute data on transportation activity and the environment.

- **Coordinated decision-making:** The EST scenario would require effective co-operation and co-ordination of decision making among all levels of government. Recent trends (i.e. in Ontario) that have resulted in the downloading of transportation responsibilities to local municipalities, may provide opportunities for "re-thinking" traditional decision-making processes.

EXHIBIT A.1: LONG LIST OF POSSIBLE INSTRUMENTS TO ACHIEVE FEATURES OF EST 3

	TECHNOLOGY FEATURES							ACTIVITY REORGANIZATION FEATURES											
INSTRUMENTS	Use of Zero Emissions Pwr	Use of Fuel Cells for Vehicles	Use of Other Low Emissions Tech	Reductions in Vehicle Weight	Electrification of Rail Modes	Introduction of High Speed Trains	Improved Veh Load Factors	Land Use and Community Planning	Reduced Emphasis on Private Autos	Inventives for Smarter Veh Choice	Pricing Regime as Revenue Source	Use of Tele-matics	Modal Shift to Improved Transit	Modal shifts to High Speed Rail	Reallocation of Road Lane Kms	Reduced Air Travel	Greater Reliance on Local Products	Improved Logistics	Innovation and Public Participation
Economic and Fiscal Instruments																			
Road pricing		●	●	●	●	●		●	●	●	●	●	●	●			●	●	●
Fuel Pricing/taxation		●	●	●	●	●	●	●	●	●	●	●	●	●			●	●	●
Tradable CO_2 permits	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Differentiated registration/insurance fees								●	●		●	●	●	●			●	●	●
Tax incentives for transit/pass rail users						●			●				●	●		●			●
Parking Pricing/Management								●	●		●	●	●	●			●	●	●
Regulatory Instruments																			
Mandatory emissions inspection			●							●									
Reductions in speed limits									●			●		●					
Urban Structure and TDM																			
"Fuller Cost" land taxation								●	●				●						●
Stricter Land Use Controls								●	●				●						●
Environmental assessment of new developments								●	●				●						●
Car Sharing		●	●						●	●			●	●				●	●
Employer sponsored trip reduction programs							●		●										●
Programs to reduce school related auto trips							●		●				●						●
Technological Development Initiatives																			
Financial Incentives		●	●			●				●		●	●				●	●	●
New CAFE standards		●	●	●						●									
Feebates		●	●	●						●									
Promotion of alternative fuels		●	●																
Private/public technology development	●	●	●	●	●	●			●	●			●	●					
Develop MoU with veh manufacturers		●	●	●						●									
Transportation Supply Management																			
Transit Service Expansion/Enhancement													●	●					●
Transit service coordination/fare integration							●		●				●	●	●				
Improved bicycle lanes/facilities								●	●										●
Priority measures for transit/cycle/peds								●	●				●		●				
Rail incentives					●	●								●					
HOV lanes/HOT lanes							●	●	●										
Advanced technology applications							●		●					●				●	●
Traffic calming								●	●						●				
Consumer Preference Mechanisms																			
Improved Education	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Advertizing equity									●	●									
Consumer/user awareness initiatives		●	●					●	●	●		●		●	●	●	●	●	●
Support for community/political "champions"		●	●					●	●			●			●		●		●
Administrative Measures																			
Improved data collection/dissemination	●	●	●					●	●	●	●	●	●	●	●	●	●	●	●
Coordinated decision making	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

EXHIBIT A.2 ASSESSMENT OF SELECTED INSTRUMENTS

Which instrument is being assessed?	Effect of the instrument on:		Cost effective-ness	Impacts inside the transport system on			Impacts outside the transport system on			Macro-economic impacts		What are the advantages and disadvantages of implementing the instrument?	What are the social, economic and political contexts within which this instrument can be implemented?
	Activity	Unit Impact		Vehicles	Fuels	Infrastr.	Land Use	Social Activity	Psyc Factors	Empm't	Other Impacts		
Fuel (conv.) pricing	●	●	++	π	π	π	π	π	π	σ	σ	Adv: revenues put back into R&D Dis: may disavantage some groups	Political acceptance, strong economy
Road pricing	●	●	+	π		π	π	π	π		π	Adv: revenues help finance infrastr. Dis: high user costs	Social/Political acceptability, availability of alternatives
CO2 trading	●	●	0	π	π		π	π	π	σ	π	Adv: can be tied to reduction targets Dis: difficult to implement	Political acceptance, willingness of public to participate
Parking Pricing/ Management	●	•	0				π	σ				Adv: can promote telecommuting Dis: may hurt some areas in short term	Coordinated decision so that there are no negative secondary impacts
Land use controls	●		0			π	π	π	π		σ	Adv: potentially large impacts Dis: difficult to achieve equity	Reversal of society's desire for suburban housing
Financial incentives		●	--	π	π					π	π	Adv: high degree of control Dis: economically challenging	Strong economy
New CAFE Stds.		●	+	π	π					π	π	Adv: easy to implement Dis: sector specific	Private sector participation
Transit Expansion	●		+	π		π	π	π		π	π	Adv: accomodates displaced auto users Dis: Expensive and slow	Strong economy
Impr. Bike/Ped facilities	●		0			π	π	π				Adv: two-fold objective Dis: none	
Improved educ.	●	•	-	π			π	π	σ			Adv: Few negative impacts Dis: Can't be seen as "big brother" action	
Coordinated Decisions	●		-				π	π	π			Adv: has large impacts Dis: decisions may take longer	Strong political leadership with common goals

blank	Little or no impact	--	Highly cost intensive	π	Large positive Impact
•	Small impact	-	Somewhat cost intensive	π	Small positive impact
●	Large impact	o	Neutral	blank	No impact/unknown impacts
		+	Somewhat cost effective	σ	Small negative Impact
		++	Highly cost effective	σ	Large negative Impact

APPENDIX B

Introduction

The purpose of this Appendix is to address an additional task that has come about since the original submission of the Phase 2 and Phase 3 reports in March 1998 and May 1999 respectively. Specifically, the objectives of this additional research is as follows:

- based on the long list of instruments presented in the Phase III report, to select the 12 most promising instruments to achieve EST3 and define what portion of the EST objectives are met for CO_2, NOx and VOC; and

The analysis presented in this Appendix and has been summarized in the main body of the report in Section 3.3 and 3.4.

Evaluation and selection of promising instruments

Context

The EST3 (Combination Scenario) relies on a combination of technological and behavioral (referred to as "activity reorganization") changes to meet the EST criteria. As identified in Chapter 2 of the main report, the technology features of EST 3 include use of zero emission power sources, use of fuel cell powered vehicles and other low emission vehicles, vehicle weight reductions, electrification of rail modes, and high speed rail. The primary activity reorganization features of EST3 were characterized by land use changes, reduced dependence on automobiles, pricing regimes, trip replacement, improved urban public transit, high speed rail, reallocation of road-km to other modes, reduced air travel, greater reliance on local products, improved logistics, and innovation and public participation.

Several policy instruments were also identified which could help to achieve the features of EST3. Exhibit 3.1 from the main report provides a summary of these instruments together with a possible implementation schedule. As discussed in the main report, it is debatable whether the EST criteria for CO_2 could be met even if all of the instruments identified were deployed. It is felt that it is possible to reach a limit at which point the implementation of additional instruments is neither feasible nor effective. It is expected that achieving the EST criteria would require a fundamental shift in the way we live and work and function as a society. This is not to say that EST is not achievable, only that the path towards EST is very difficult to define in terms of precise instruments and policies.

If EST is to be achieved by 2030, it will be necessary in the immediate future to start implementing realistic instruments and most importantly, identifying those that work best. Therefore, the remainder of this section focuses on developing a criteria to evaluate the instruments proposed and identify the 12 most promising instruments.

Criteria for Assessing Instruments

In Chapter 2 of the main report, each of the primary instruments were assessed based on a framework and criteria provided for the OECD study by the Netherlands Study team. Each instrument was assessed in terms of its environmental effects, cost-effectiveness, impacts inside the transportation system (e.g. technology) and impacts outside of the transportation system (e.g. activity). This framework provided a good means of highlighting the advantages and disadvantages of each instrument but did not allow for the rating and prioritizing of instruments.

Taking into consideration the OECD evaluation framework and assessment presented in the main report, a more simplified approach and criteria have been developed for the purpose of prioritizing instruments. These criteria are shown on Exhibit B.1. The criteria used in this approach to rate the instruments are:

- **Reduces GHG and air pollution**: Ultimately this is the bottom line indicator for EST. For the purposes of this evaluation, GHG and air pollution have been combined into a single criteria as an instrument impacting one is likely to affect the other in a similar manner. In prioritizing the instruments in terms of their GHG/pollution reduction potential as shown on Exhibit 2.1, we have made a subjective assessment of their impacts drawing on previous work from Phase 2 and from other more recent work carried out in Canada[31, 32, 33]. In the Phase 2 analysis, the emissions criteria where developed through the exploration of features (e.g. pricing regime) without specific reference to instruments (e.g. fuel taxes). Further, the Phase 2 analysis assumed that the features would be achieved by implementing measures with sufficient intensity to achieve the specific features. It is therefore somewhat difficult to link specific instruments to specific emissions reduction. However, a more detailed quantitative assessment of the impacts of the most promising instruments is provided in the following section of this Appendix.

- **VKT Reduction (autos and trucks)**: Another feature of EST is a reduced dependence on road for the movement of people and goods. A reduction of auto and truck vehicle-kilometres of travel (VKT) has many advantages in that it reduces traffic congestion and associated impacts including accidents, noise, parking requirements and land take. The VKT reduction criteria is a good way of distinguishing between instruments that just reduce the

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31 ***Backgrounder: Greenhouse Gas Emissions from Urban Transportation***, IBI Group and Management of Technology Services for the National Round Table on the Environment and the Economy, November 1998.

32 ***Investigation of Environment-Related Modal Shifts in Inter-city Passenger Traffic in the Quebec-Windsor Corridor***, IBI Group for Transport Canada, September 1998.

33 ***Strategies to Reduce GHG Emissions from Passenger Transportation in Urban Canada***, Final Report, prepared for the National Climate Change Process Transportation Table by Hagler Bailly, June 1999.

unit impact of vehicles but not the number of vehicles themselves (e.g. technology improvements) vs. those that address all impacts of vehicle use.

- **Minimize Investment Cost:** The availability of financial resources will be a major limiting factor to the implementation of any instrument that requires significant capital investment or has high operating costs. A key example is the construction of a high speed rail transit system in the QWC. Implicit within the cost minimization criteria is the recognition that some instruments may in fact generate a positive revenue stream which can then be used to finance other EST initiatives. These instruments have been given a high rating.

EXHIBIT B.1
PRIORITIZATION OF INSTRUMENTS TO ACHEIVE EST

	CRITERIA							
INSTRUMENTS	Reduces GHG and air pollution	Auto VKT Reduction	Minimize Investment Cost	Improve Economy	Minimize Administration	Minimize Social Impacts	Overall Evaluation	Rank
Weighting	3	1	2	2	1	1		
Economic and Fiscal Instruments								
Road pricing	✓✓ 2	✓✓✓ 3	✓✓✓ 3	✓✓ 2	✓✓ 2	✓✓ 2	23	17
Fuel Pricing/taxation	✓✓✓✓ 4	✓✓✓ 3	✓✓✓✓ 4	✓✓ 2	✓✓✓✓ 4	✓ 1	32	1
Tradable CO_2 permits	✓✓✓✓ 4	✓✓ 2	✓✓✓ 3	✓✓✓ 3	✓ 1	✓✓ 2	29	2
Tax incentives for transit/pass rail users	✓ 1	✓✓ 2	✓✓✓✓ 4	✓✓✓ 3	✓✓ 2	✓✓✓✓ 4	25	8
Differentiated registration/insurance fees	✓✓ 2	✓ 1	✓✓✓ 3	✓✓✓✓ 4	✓✓ 2	✓✓✓✓ 4	27	6
Parking Pricing/Management	✓✓✓ 3	✓✓✓ 3	✓✓✓ 3	✓✓✓ 3	✓✓ 2	✓✓✓ 3	29	2
Regulatory Measures								
Mandatory emissions inspection	✓ 1	✓ 1	✓✓ 2	✓✓✓✓ 4	✓ 1	✓✓✓✓ 4	21	21
Reductions in speed limits	✓ 1	✓ 1	✓✓✓ 3	✓ 1	✓ 1	✓✓✓ 3	16	30
Urban Structure and TDM								
Environmental assessment of new dev.	✓✓ 2	✓✓ 2	✓✓ 2	✓✓ 2	✓ 1	✓✓✓ 3	20	24
"Fuller Cost" land taxation	✓✓✓ 3	✓✓ 2	✓✓ 2	✓✓ 2	✓✓ 2	✓✓ 2	23	17
Stricter Land Use Controls	✓✓✓ 3	✓✓✓ 3	✓✓ 2	✓✓ 2	✓✓✓ 3	✓✓ 2	25	8
Employer sponsored trip reduction programs	✓ 1	✓✓ 2	✓✓✓ 3	✓✓✓✓ 4	✓✓ 2	✓✓✓✓ 4	25	8
Programs to reduce school related auto trips	✓ 1	✓ 1	✓ 1	✓✓✓ 3	✓✓ 2	✓✓✓✓ 4	18	28
Technological Development Initiatives								
Financial Incentives	✓✓ 2	✓ 1	✓ 1	✓✓✓✓ 4	✓ 1	✓✓✓ 3	21	21
New CAFE standards/Feebates	✓✓✓✓ 4	✓ 1	✓✓✓ 3	✓✓ 2	✓✓ 2	✓✓✓ 3	28	5
Promotion of alternative fuels	✓✓✓ 3	✓ 1	✓✓ 2	✓✓ 2	✓✓ 2	✓✓✓ 3	23	17
Private/public technology development	✓ 1	✓ 1	✓✓✓✓ 4	✓✓✓ 3	✓✓✓ 3	✓✓✓ 3	24	13
Develop MoU with veh manufacturers	✓ 1	✓ 1	✓✓✓ 3	✓✓✓ 3	✓✓✓ 3	✓✓✓ 3	22	20
Transportation Supply Management								
Transit service coordination/fare integration	✓ 1	✓✓✓ 3	✓✓✓ 3	✓✓✓ 3	✓✓✓ 3	✓✓✓✓ 4	25	8
Improved bicycle lanes/facilities	✓✓ 2	✓✓ 2	✓✓ 2	✓✓✓ 3	✓✓✓ 3	✓✓✓✓ 4	25	8
Designated funds for transit expansion	✓✓✓ 3	✓✓✓ 3	✓ 1	✓✓✓✓ 4	✓✓✓ 3	✓✓✓✓ 4	29	2
Rail incentives	✓✓ 2	✓✓ 2	✓ 1	✓✓✓✓ 4	✓✓ 2	✓✓✓✓ 4	24	13
HOV lanes/HOT lanes	✓✓ 2	✓✓ 2	✓✓ 2	✓✓✓ 3	✓✓✓ 3	✓✓✓ 3	24	13
Advanced technology applications	✓ 1	✓ 1	✓✓ 2	✓✓ 2	✓✓✓ 3	✓✓ 2	17	29
Traffic calming	✓ 1	✓✓ 2	✓ 1	✓ 1	✓✓✓ 3	✓✓ 2	14	31
Consumer Preference Mechanisms								
Improved Education	✓ 1	✓✓ 2	✓✓ 2	✓✓✓ 3	✓✓ 2	✓✓✓ 3	20	24
Advertizing equity	✓ 1	✓ 1	✓✓✓ 3	✓✓ 2	✓✓✓ 3	✓✓✓ 3	20	24
Consumer/user awareness initiatives	✓✓ 2	✓✓ 2	✓✓✓ 3	✓✓✓ 3	✓✓ 2	✓✓✓✓ 4	26	7
Support for community/political "champions"	✓ 1	✓ 1	✓✓✓ 3	✓✓✓ 3	✓ 1	✓✓✓✓ 4	21	21
Administrative Measures								

- **Improve Economy:** Economic impact is probably the most contentious and debated issue surrounding the achievement of EST. Traditional economic analyses such as input-output models, tend to under-estimate the economic benefits of climate change mitigation while ignoring the possibly significant environmental ramifications of the BAU scenario. Traditional economic analyses also often ignore the "efficiency improvements" that are spin-offs from environmental improvements[34]. For the purpose of short-listing instruments, this report takes a more general view of economic impacts and simply attempts to rate the instruments relative to each other.

- **Minimize Administration:** The administrative and human resources requirements associated with an instrument could be so large that it would make the instrument infeasible. Where possible, we have attempted to reflect the administrative burden associated with each instrument.

- **Minimize Social Impacts:** The social impacts of EST are well documented in the Phase 3 report. In the prioritization of instruments, we have attempted to highlight those instruments that would reduce social polarization, improve community relationships, promote cultural diversity, improve health and safety, reduce crime and maintain the functioning of government.

Refinement of the Instruments

The original Phase 3 exercise summarized in the main body of this report identified some 31 possible instruments that would help achieve the EST criteria under EST 3. Ideally, it would be desirable if all of these instruments could be implemented and have the desired impact on emissions without any other adverse impacts. Understandably, however, the OECD wishes to place emphasis on those instruments that have the greatest potential to achieve the desired result.

Exhibit A.1 provides a summary of the evaluation of each instrument according to the criteria described above. For each instrument, an overall evaluation is also provided. This is based on a weighting for the criteria as follows:

- Reduces GHG and air pollution 3
- Auto VKT Reduction 1
- Minimize Investment Cost 2
- Improve Economy 2
- Minimize Administration 1
- Minimize Social Impacts 1

These weightings for the criteria were developed using a subjective approach. Obviously, the high weighting for the GHG and air pollution criteria is reflective of the fact that the EST criteria are largely GHG/pollution based.

As was the case with the Phase 3 assessment described in the main body of this report, it is clear from the evaluation that pricing mechanisms have high potential for reducing GHG while minimizing other impacts. Tradable CO_2 permits also emerges as a promising measure, but this is likely something that could only be considered after a more detailed assessment.

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[34] ***A Roadmap for Natural Capitalism***, Lovins, A., Hunter, L., P., Hawken, Harvard Business Review, 1999.

Other instruments that emerge as having good potential are those which Litman refers to as "Win-Win" strategies[35]. These are instruments that can be easily implemented and are likely to produce positive economic and social benefits. Included are tax-benefits for transit users, differentiated registration/insurance fees and employer-sponsored trip reduction programs.

According to the evaluation shown in Exhibit B.1, the top 12 most promising instruments are:

- Fuel pricing/taxation
- Tradable CO_2 permits
- Parking pricing/management
- Designated funds for transit expansion
- New CAFE standards/feebates
- Differentiated registration/insurance fees
- Consumer/user awareness initiatives
- Tax incentives for transit/pass rail users
- Stricter land use controls
- Employer sponsored trip reduction programs
- Improved bicycle lanes/facilities
- Transit service coordination/fare integration

It is important to recognize that implementation considerations such as public support and political will were not included in the criteria for arriving at this list of most promising instruments.

Role of short-listed instruments in achieving the EST criteria

The purpose of this section is to estimate how close the 12 most promising measures come to achieving EST criteria.

As discussed above, it was not the intention of Phase 2 or Phase 3 to precisely examine the impacts of specific instruments, but rather "backcast" what types of "features" would be required to achieve EST. Furthermore, the Phase 2 study did not get into the specifics of the intensity of the various features/instruments.

Due to the time and resource limitations, it is not possible to explore every instrument in detailed terms. It is possible to gain a fairly accurate picture of the possible impacts of the instruments from other recent research, namely a study prepared by IBI Group/MOTS for the National Round Table on the Environment and the Economy (NRTEE) in 1998[36]. A discussion of the likely impact of each of the more promising instruments or packages of instruments is provided below:

Fuel Pricing

Fuel pricing has the advantage of impacting both behaviour as well as technology/vehicle choice. The impact of fuel pricing can be assessed using price elasticities. The IBI/MOTS NRTEE study estimated, through a review of literature, that the long term elasticity of VKT with respect to fuel price was -0.15

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35 Todd Litman, ***Win-Win Transportation Strategies***, Victoria Policy Institute, 1998.

36 ***Backgrounder: Greenhouse Gas Emissions from Urban Transportation***, IBI Group and Management of Technology Services for the National Round Table on the Environment and the Economy, November 1998.

while the elasticity of fuel efficiency, through a combination of technology improvements and vehicle fleet shifts, was -0.3 if fuel pricing is implemented North America-wide. Assuming a 3 cents increase per year and taking into account the fleet replacement time, the NRTEE study estimated that fuel pricing could lower emissions by 14 % from the BAU scenario in 2010, or 5% from 1990 levels. The reductions vary by mode and in fact transit emissions would increase. A summary of the potential reduction is shown in Exhibit B.2. These are based on a 3 cent per litre increase in fuel prices for all modes every year, or approximately 90 cents per litre over the next 30 years. Higher rates of increase could produce even greater results.

Tradable CO_2 permits

With tradable CO_2 permits, it is theoretically possible to set any target reduction for CO_2. The limitation is that too low of a limit would impeded people's ability to perform daily tasks. For the purpose of this exercise, it has been assumed that a CO_2 permit system would be put in place to reduce emissions by 10%.

Parking Pricing/Management

Parking pricing has been shown to be a very cost-effective means of reducing traffic in urban areas[37]. The NRTEE study estimated that parking pricing increases of 5% per year in urban areas could reduce emissions by 8% from the BAU scenario in 2010. Prorating this to 2030 suggests a 18% reduction for autos. This would be off-set only slightly by increased transit emissions.

Designated Funds for Transit Expansion

The Phase 2 EST analysis was fairly aggressive in its estimates of the impacts of improved public transit and estimated that emissions reductions of between 20 and 30% could occur as a result. This was based on the fact that where there is good transit within the QWC, it is highly utilized (e.g. the Toronto Transit Commission Subway system). In recent years, there have been relatively few investments in new or expanded systems.

New CAFE Standards/Feebates

Corporate Average Fuel Efficiency (CAFE) and feebates (e.g. rebates for efficient vehicles, increases for less efficient vehicles) can have very substantial impacts on auto manufacturers vehicle production as well as individuals vehicle purchases. Research presented in the NRTEE study indicated that CAFE standards (2% per year North American wide fuel efficiency target) could reduce emissions by 13% by 2020. Extrapolating this to 2030 would result in an even greater improvement of perhaps 20%. If implemented in combination with fuel taxes, the potential for the "take-back effect" (e.g. people drive more since they consume less fuel per-km) would be eliminated.

Based on research in the NRTEE study, it is estimated that feebates could result in emissions reductions of up to 11% from the 2010 baseline and probably a similar amount in 2030. These reductions would, however, not be exclusive of the reductions due to CAFE. For this exercise, we have simply increased the impact of CAFE by 25%.

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[37] ***Strategies to Reduce GHG Emissions from Passenger Transportation in Urban Canada***, Final Report, prepared for the National Climate Change Process Transportation Table by Hagler Bailly, June 1999.

EXHIBIT B.2: ESTIMATED IMPACTS OF SHORT-LISTED INSTRUMENTS

	Autos	Transit	Trucks	Rail Freight	Air	Marine	Total
BAU (CO_2 Emissions - MT)							
1990	35.8	0.9	11.4	1.5	4.9	0.4	54.9
2030	47.5	1.3	23.3	1.4	6.6	0.4	80.4
% change	33%	38%	104%	-3%	33%	5%	47%

	Percent Reduction from BAU					
	Autos	Transit	Trucks	Rail Freight	Air	Marine
Fuel Tax (3c/yr)	-39%	60%	-39%	23%	-39%	0%
Parking Pricing (5%/yr)	-18%	44%	0%	0%	0%	0%
Transit Expansion	-20%	193%	0%	0%	0%	0%
CAFE	-16%	0%	0%	0%	0%	0%
Differentiated Fees	-10%	97%	-10%	0%	0%	0%
Tax Incentives for Transit Users	-5%	48%	0%	0%	0%	0%
Land Use Controls	-10%	-10%	-10%	-10%	-10%	-10%
CO_2 Permits	-10%	-10%	-10%	-10%	-10%	-10%

	TOTALS
Total CO_2 in 2030 (MT) [(1)]	30.8
Total reduction from BAU (MT)	-49.6
Percent reduction from BAU	-62%
Total CO_2 as percent of 1990	**56%**

Notes:

(1) This is calculated from individual activity and efficiency estimates by mode. It assumes that for measures impacting auto activity (e.g. pass-km), 25% of the activity would be redistributed to transit with the remaining being accounted for by reduced trips, reduced trip lengths and mode shifts to non-motorized and higher occupancy factors.

Differentiated Registration/Insurance Fees

The concept of differentiated registration fees and insurance fees is that all fees would be proportioned to the amount of fuel purchased or amount of travel incurred by a vehicle. The advantage is that people feel the impact every time they use the vehicle as opposed to the current situation where once the registration/insurance is paid, there is little incentive not to use the vehicle. Based on previous literature we have assumed that the impacts of differentiated fees would be a 10% reduction from the BAU scenario.

Consumer/User Awareness Initiatives

The Phase 2 study "backcasted" that a public information program would need to account for a 10% reduction in emissions. Several possible public information initiatives were suggested and ideally all would be implemented. It is doubtful that, after implementing the above instruments, public information

programs could cause a further reduction in emissions; however, without public information and awareness programs, the above instruments are likely to fail.

Tax Incentives for Transit/Pass Rail Users

A recent study by IBI Group[38] examined the impact of tax-exempt employer provided transit benefits and found that emissions could be reduced by as much as 4.5% from the baseline projections, or about 0.3 MT in 2010. This reduction was in urban areas only and for commuter trips only. If the impacts were extended to include non-work trips, and projected to 2030, the reductions would be approximately 1 MT. This is a fairly small reduction, but nevertheless significant.

Stricter Land Use Controls

Stricter land use controls would involve measures such as limits on urban boundaries, limits on greenfield development, and other initiatives to promote more compact-mixed use developments. The Phase 2 study estimated that land use and community planning would have to account for a 5 - 10% reduction in emissions to achieve the EST criteria. We have assumed 5% reduction for this analysis assuming that not all land use initiatives considered in Phase 3 would be implemented.

Other Transportation Demand Management Measures

The remaining 4 of the 12 most promising instruments identified above can be categorized as various transportation demand management measures. These include:

- employer sponsored trip reduction programs;
- consumer awareness issues;
- improved bicycle lanes/facilities;
- transit service coordination/fare integration.

The likely impact of these instruments on their own are probably fairly small; however, it is these types of instruments that are required to off-set the regulatory type instruments. As a result, we have not estimated the specific impact of these measures, but have assumed that they are required for the other measures to succeed.

Summary and Impacts of Short-Listed Measures

Exhibit B.2 shows the estimated percentage impacts of each instrument on CO_2 emissions if implemented individually. In calculating the combined impacts of the individual measures, it was generally assumed that the total combined impact would be the product of the percentage of CO_2 emissions remaining after each instrument is applied. In the case of passenger modes, the same procedure was applied to instruments affecting activity only, together with a re-allocation of a portion of the passenger-km to transit. The

[38] Tax-Exempt Status for Employer Provided Transit Benefits, prepared by IBI Group for the National Climate Change Process, 1999.

instruments impacting fuel efficiency only were assumed to be additive, as was the case for the NRTEE study.

The impacts for CO_2 only have been examined in this report as criteria for the other emissions (NOx and VOC's) were found to be much easier to achieve. As expected, the 12 selected instruments do not meet the EST criterion for CO_2 which is to achieve 20% of 1990 emission levels. Using fairly optimistic assumptions about the impacts of each measure, the 12 most promising instruments could potentially reduce emissions to 56% of 1990 levels. Additional emissions reduction of 36% would have to be achieved through implementation of the other 19 instruments.