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THE KYOTO GHG EMISSION TARGETS – WHAT CAN WE EXPECT FROM THE ROAD TRANSPORTATION SECTOR

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ABSTRACT

If strategies for reducing Greenhouse Gas (GHG) emissions are to be effective, they must address the significant CO_2 contribution made by road transportation. This paper examines the reductions possible through the deployment of specific ITS technologies, new vehicle technologies and 10 percent ethanol (E10) fuels.

The result so the analysis indicate that GHG emission reductions resulting from ITS implementation will be in the order of 2 percent of projected 2011 emissions. Significant reductions could be achieved through the implementation of hybrid vehicle technologies; however, the necessary number of such vehicles is not likely to be achieved due to their high cost. The implementation of E10 fuels could lead to reductions of up to 23 percent of projected 2011 emissions. However, none of the scenarios examined met the Kyoto emission reduction targets.

Introduction

The transportation sector consumes 30 percent of all energy used in Canada, with the vast majority of this energy derived from petroleum-based fuels. Road transportation accounts for almost 80percent of petroleum consumed by the transportation sector. Aside from the concern regarding the transportation sector's dependence on non-renewable petroleum, there is increasing concern regarding the pollution generated by burning these fuels with regards to their implications for climate change.

For strategies to be effective in reducing GHG emissions, they must address the significant contribution that road transportation makes annually. Many potential emission reduction strategies exist and this paper examines four such schemes: the introduction of hybrid vehicles, the introduction of electric or fuel cell vehicles, the implementation of ITS technology, and the implementation of 10 percent ethanol blended fuels (E10 fuel). These factors will be examined against a range of potential increases in total vehicle kilometres, likely to result from the demographic change and the on-going increase in vehicle use.

Several auto manufactures currently market hybrid gasoline/electric vehicles that consume significantly less fuel and produce significantly fewer tail-pipe emissions than conventional light-duty gasoline powered vehicles. For example, the 2002 Honda Insight has a reported EPA fuel consumption rate of 3.9L/100km and 3.2L/100km for city and highway driving respectively (Honda Canada, 2002). Honda also plans to begin sales of a hybrid Civic sedan in May 2003

(Wickens, C9). The Toyota Prius has a reported EPA fuel consumption rate of 4.5L/100km and 4.7L/100km for city and highway driving respectively (Toyota Canada, 2002). Additionally, over the next five years it is anticipated that other auto manufactures will introduce a greater variety of hybrid light-duty vehicles; however, precise fuel consumption rates for these vehicles are currently unknown (DeCicco, 2002). Ford has recently unveiled a hybrid Escape for the 2003 model year, while Chrysler "plans to launch at least two hybrids: a Durango V-6 hybrid sport utility vehicle . . . followed by a Ram pickup" (Wickens, C9).

Canada, as a signatory of the Kyoto Protocol, has committed itself to reducing total GHG emissions to 6 percent below 1990 levels by the year 2012 (Environment Canada, 2001). It has been suggested that the widespread adoption of hybrid engine technologies, ITS measures and fuel cell vehicles will result in a significant reduction in total fuel consumption and tail-pipe emissions by the light-duty vehicle sector, and that this reduction will be sufficient to meet the Kyoto commitment. However, in conjunction with changes in vehicle technology, the population profile in Canada is changing. The baby-boomers, representing 32 percent of the population, (those between the ages of 35 and 55) are ageing and their driving needs and driving characteristics are changing. In conjunction, the echo generation (those born in the 1980s), representing 20 percent of the population, is just now entering the work force and their per capita vehicle ownership and annual kilometres of driving are increasing significantly.

This paper presents a number of possible futures, and their resulting GHG emission, based on the expected changes in population driving characteristics and vehicle and fuel technology. The next section describes the analytical approach taken to estimate future year GHG emissions. The analysis examines separately and in combination the effects of the changing population profile, hybrid vehicle technology, increasing per capita annual driving, ITS strategies, and reformulated fuels. The analysis begins by quantifying emissions for the year 2001. Emission estimates are then made for 2011 and 2021 for several different scenarios. In the last section, conclusions and recommendations are made.

Analysis

The estimation of GHG emissions can be broken down into the estimation for the base year (2001) and for future years. The next section presents the method used to make estimates for the base year, while the following section describes the analysis for the 2011 and 2021 time horizons.

Estimating Current Year Emissions

As illustrated in Figure 1, the estimation of GHG emissions for the base year is determined on the basis of total annual km driven and a constant conversion from number of vehicle kilometres to mass of GHG CO_2 equivalent. The GHG conversion factor includes fuel emissions related to vehicle use, vehicle manufacture and upstream emissions from the production of the vehicle fuel. Each of the elements of the process is described below.

1. Population projections by age cohort for years 2001, 2011, and 2021 were obtained from Statistics Canada (*Population Projections*, 2001). The 2001 census indicated a population that was approximately one million persons lower than the projections for the year 2001, consequently the projections for 2011 and 2021 were adjusted downwards (Statistics Canada, *2001 Census On-line*).
2. Total vehicle-km driven, by age cohort, was obtained from the *Canadian Vehicle Survey: Annual 2000* (Statistics Canada, 2001). The data reflects km driven by private vehicles

weighing less than 4.5 tonnes (e.g. cars, SUVs, vans, but excluding off-road vehicles and motorcycles).

3. *Canada's Energy Outlook* (Natural Resources Canada (NRCan), 1997) indicates that annual km driven per vehicle is increasing at a rate of 0.2 percent per year.

4. Total vehicle-km driven for 2001 was estimated by applying the vehicle use growth factor of 0.2 percent from element 3.

5. Total vehicle-km was computed by summing vehicle-km driven across all age cohorts. The total vehicle-km driven by light-duty vehicles in Canada during the year 2001 is estimated to be 282.0 billion vehicle-km. This is equivalent to an average of 16,702 km/vehicle.

6. The average annual km driven per person was computed for each age cohort by dividing the total km driven by the cohort (element 4) by the population in the cohort. As illustrated in Figure 2 on average people between the ages of 35 and 55 drive more km per year than do people in any other age cohort. When changes in the population age profile are considered for estimating future GHG emissions, these different vehicle use characteristics become important.

7. The base year, 2001, GHG emissions were calculated by multiplying the number of kilometres driven by the total emissions per kilometre assigned to that fuel type. For example, approximately 97.19 percent of all passenger vehicle kilometres driven in the 3rd quarter of 2001 were in gasoline vehicles (*Canadian Vehicle Survey: Quarter 3, 2001*, 36). Thus the conversion rate of 298.32 g GHG/km was applied to 97.19 percent of the passenger kilometres. The remaining 2.69 percent of kilometres were driven in diesel fuelled vehicles, and therefore an emission rate of 231.82 g GHG/km was used. These conversion estimates were obtained from the report *Alternative and Future Fuels & Energy Sources for Road Vehicles.* A complete list of conversion estimates in included in Appendix A.

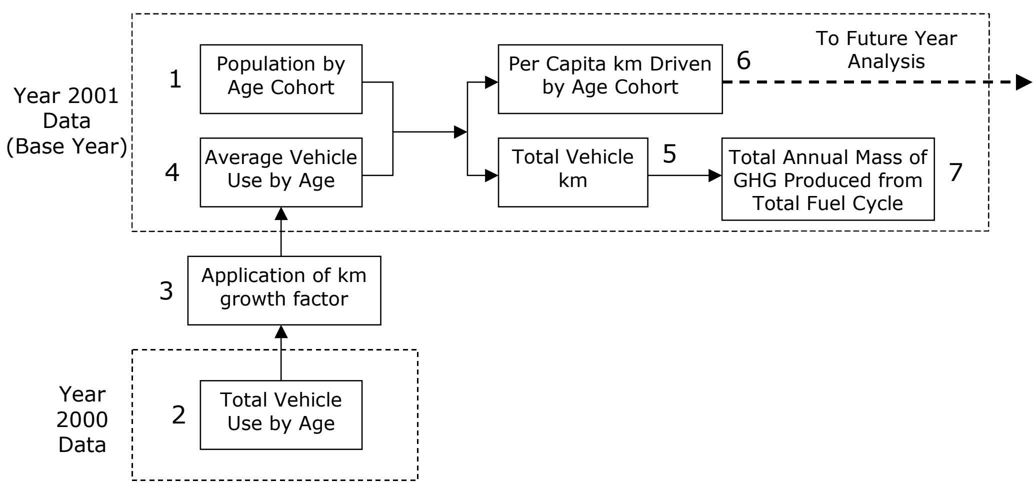

Figure 1: Flow chart of analysis method for computing Base Year GHG emissions

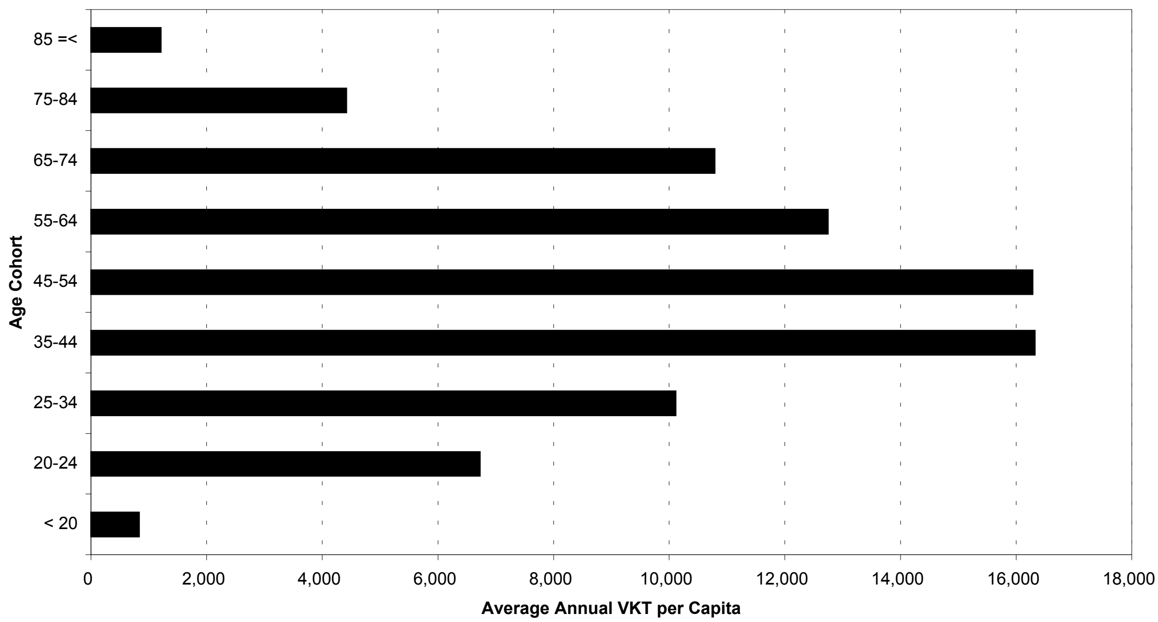

Figure 2: Average Annual VKT per Capita by Age Cohort for 2001

Estimating Future Year VKT

Three estimates of future year VKT were made by considering two influencing factors: a continued increase in kilometres travelled per vehicle, and a changing population profile.

The first scenario assumes a continuation of the existing trend of an annual increase of kilometres travelled per vehicle of 0.2 percent. This tend reflects continuation of urban sprawl and greater reliance of the automobile for most trips. Scenario 1 does not consider the impact of changes in population profile.

The second scenario considers the change in VKT that results from projected changes in the population profile. It does not consider the constant 0.2 percent increase in kilometres travelled per vehicle assumed in Scenario 1.

The VKT per capita was computed for each age category (Figure 2) on the basis of census data. As illustrated in Figure 2 the age categories of 35 to 44 and 45 to 54 have the highest per capita VKT. Predictions for the national population profile for 2011 and 2021 indicate a significant growth in the number of people above the age of 45 and a small reduction in the number of people below the age of 25. The consequence of this effect is that though the population is expected to increase from 2001 levels by only 5.9 percent and 14.6 percent, total VKT is expected to increase by 8.9 percent and 17.4 percent for the 2011 and 2021 years respectively.

The third scenario, and the one that is likely most realistic, considers both the effect of changes in the population profile and the constant increase in annual kilometres travelled per vehicle. The number of kilometres in each estimate are listed in Table 1.

Table 1: Estimates of Total VKT for Base Year and Future Years

Growth Scenario	2001	2011	2021
(1) 0.2 percent Growth	281,978,631,600	287,669,232,035	293,474,674,269
(2) Population Profile	281,978,631,600	307,002,862,786	331,152,887,818
(3) 0.2 percent + Population	281,978,631,600	313,198,476,314	344,653,725,476

Estimating Future Year GHG Emissions

The estimation of GHG emissions for the future considered the 2011 and 2021 time horizons. A number of different factors were considered in making these future year predictions. The "Business as usual" scenario, representing the do nothing option, considers three factors, namely, changes in population age profile, a continuation of the current trend of a constant increase in the average km driven per year, and continued growth of the vehicle fleet[1].

Three categories of intervention measures were considered: ITS strategies, vehicle technologies, and reformulated fuels. A number of separate scenarios were created from the selective combination of these intervention measures. In each scenario, the method of computing GHG emissions follows the general process illustrated in Figure 3.

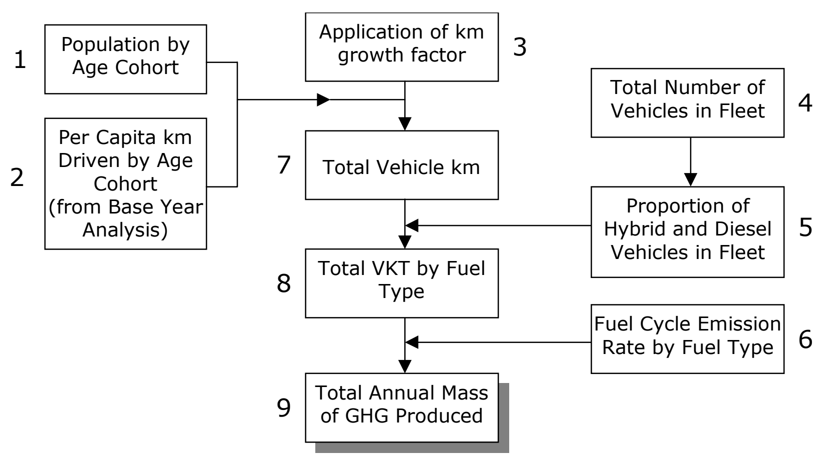

Figure 3: Flow chart of analysis method for computing future year GHG emissions

ITS Benefits

The implementation of ITS technology is anticipated to reduce total travel time and time spent in stop and go traffic. Both of these results will lead to a reduction in total fuel consumption and consequently in total GHG emissions. Three different types of ITS programs, and their associated emission reductions, were investigated as part of this project: Freeway Traffic Management Systems (FTMS), Advanced and In-vehicle Traveller Information Systems (A/IVTIS), and Advanced Signal Control (ASC). For the purpose of this analysis the 34 largest

[1] The size of the year 2000 fleet was taken from the *Canadian Vehicle Survey* (Statistics Canada, 2001) and was then grown by 1.7 percent per year to estimate the size of the light-duty vehicle fleet in future years (NRCan, *Canada's Energy Outlook*, 1997). The hybrid fleet size was then taken as a proportion of the fleet.

Census Metropolitan Areas (CMA) and Census Agglomerations (CA) listed in the 2001 census were grouped into three categories: *Large Centres*, defined as those CMA/CAs with a population over 1,000,000; *Medium Centres* with populations between 200,000 and 1,000,000; and *Small Centres* with populations of less than 200,000 (Appendix B). To be considered for analysis the CMA or CA had to have a population of over 100,000 persons in 2001. For the future period, population growth for each category of urban centre was estimated to grow at the average rate of growth for all cities in that category as experienced over the last five years. As the large centres are the fastest growing, their total share of the Canadian population will increase over time, and consequently so will the proportion of VKT associated with these centres.

For each population size category, an estimate was made of the proportion of total annual VKT on freeway and on urban arterial roadways. On the basis of limited data reported in the literature, it was assumed that 50 percent, 40 percent, and 30 percent of annual VKT occurs on freeways for Large Centres, Medium Centres, and Small Centres, respectively (IBI, 22). The total annual VKT on freeways was estimated for each category of CMA/CA on the basis of these assumed proportions and the proportion of the total Canadian population estimated to be living in those centres in the horizon years.

FTMS was assumed to consist largely of incident management programs designed to reduce the length of delays associated with collisions and other events on urban freeway systems. A search of the literature indicates a range of reported impact of FTMS. One study reported FTMS provided travel time savings of 185 hours per million vehicle kilometres of travel (IBI, 22). Assuming fuel consumption savings of 3.2 litres per vehicle-hour of operation, fuel savings can be estimated (IBI, 22).

When assessing the impact of FTMS it is not realistic to assume that the benefits, in terms of travel time savings, will be accrued on the basis of all freeway vehicle-km travelled. Clearly, travel outside of the peak periods is less likely to benefit from FTMS than travel during the peak periods and areas that implement FTMS are not likely to provide FTMS coverage on all freeway facilities. Therefore, using values reported in the literature, it was assumed that for 2001, only 70 percent of freeway travel accrue travel time savings (IBI, 21). It is assumed that the remaining 30 percent do not experience any travel time savings from the FTMS. For 2021 it was assumed that 85 percent of freeway travel accrued benefits (IBI, 21).

Total fuel consumption was also adjusted upwards, so as to include the emissions related to upstream and vehicle manufacturing sources. In order to achieve this, the fuel consumption was increased by 27.7 percent, equivalent to the proportion of GHG emissions assigned to the fuel processing and vehicle manufacturing for a conventional vehicle.

A/IVTIS was assumed to affect 25 percent of all vehicle kilometres in 2011 and 50 percent of all passenger kilometres in 2021. Total fuel consumption related to these vehicle kilometres was estimated by using the 2000 estimated fleet average of 10.7 l/100 km in 2011 and a reduction to 9.45 l/100 km in 2021 (McNally and Hellinga, 3; IBI, 35). A 2 percent reduction in fuel usage was used to estimate the total MT reduction in GHG emissions by converting the fuel to GHG as per above. Again, the fuel was broken out into gasoline and diesel fuel.

A variety of fuel efficiency gains have been noted from ASC, ranging from 0 to 13 percent in selected corridors with an average of 5.6 percent (Mitretek, 11-12, 14). In order to estimate the total GHG emission reductions associated with the broad implementation of ASC technology, the following calculations were undertaken. First, the proportion of kilometres travelled on arterial roads in urban centres was set at one minus the proportion of kilometres travelled on freeways (Large Centre = 50 percent, Medium Centre = 60 percent, Small Centre = 70 percent). Then the arterial road VKT for each class of urban centre was determined. Next, an ASC penetration factor was selected for each centre type, for the years 2011 and 2021. For large centres the penetration rates were set at 20 and 25 percent, for medium centres 10 and 15 percent and for small centres 5 and 10 percent. Next, it was assumed that ASC implementation of these corridors would bring about a 5.6 percent decrease in GHG emissions, with the MT of GHG being calculated based upon the previously discussed conversion estimates. The results of all three interventions can be viewed in Table 2

Table 2: Annual GHG Reductions as a result of Implementation of ITS Strategies (MT)

Intervention	2011	2021
FTMS	0.137	0.118
Signal Control	0.297	0.736
ATIS	0.144	0.359
Total	0.579	1.213

Vehicle Technology Benefits

A number of vehicle technologies are being developed as alternatives to current gasoline fuelled combustion engines. We considered three of these technologies, namely gasoline electric hybrid vehicles (hybrids), pure electric vehicles, and hydrogen fuel cell vehicles. Fuel cell powered vehicles can utilise hydrogen from a variety of sources. For the purpose of this paper we considered two options, the first being natural gas and the second being hydrogen gathered through electrolysis by electricity using the national mix of electrical power generating sources (coal, hydro, nuclear, etc.) The GHG emission factors for each of the new vehicle technologies are found in Table 3 below.

Table 3: GHG Emissions Factors for New Vehicle Technologies

	GHG Emissions (g/km)
Hybrid	195.77
Pure Electric	89.50
Hydrogen (Natural Gas)	142.32
Hydrogen (National Mix)	152.27

The data in Table 3 indicate that all four types of vehicle technologies provide similar GHG emission reduction rates. Nevertheless, the analysis carried out in the remainder of this paper assumes that only hybrid vehicle technology is deployed. Hydrogen vehicles were excluded from further analysis due to the large number of unsolved fuel distribution issues. While hydrogen may prove to be worthwhile in the long term, given that there are currently only nine years left until 2011, it is not likely that these issues will be overcome and fuel cell vehicles will be produced on a commercial scale. Electric vehicles, while a potential player in the urban commute market, were left out due to ongoing concerns related to cold weather charging and the relative advantage of the hybrid technology in the current market.

Based on the assumption that hybrid technology was the most likely technology to be used as part of Canada's strategy to reduce its GHG emissions, four different scenarios were examined. For the purpose of these scenarios it was assumed that 1, 2.5, 5.0, and 10.0 percent of all vehicle kilometres would be travelled by hybrid vehicles. In each case diesel fuelled vehicles travelled less than three percent of all vehicle kilometres, while the remaining vehicle kilometres were travelled by vehicles utilising conventional gasoline. Figure 4 highlights the results of this analysis, with the base case (no hybrid vehicles) being included for comparison purposes.

It should also be noted that a reduction in the current cost of hybrid vehicles would likely be necessary to obtain a modest penetration of this technology in the vehicle fleet. For example, the conventional Honda Civic has a suggested retail price of $16,900 (CAN), while the estimated price for the hybrid Civic is $28,500 (CAN) (Honda Canada, 2001; Wickens, C9). With such a substantial additional cost, fuel savings alone are not likely to result in a "payback" of the initial cost difference within the useful life of the vehicle.

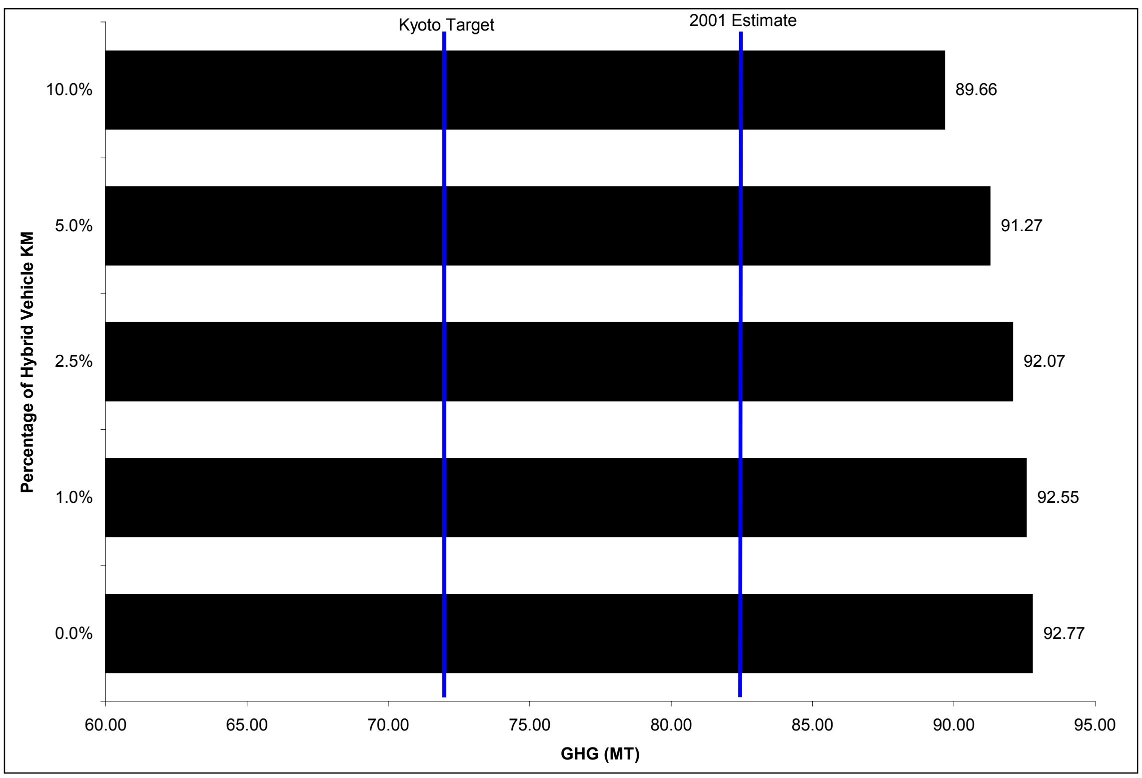

Figure 4: GHG Emissions for 2011,various levels of hybrid vehicle penetration

Fuel Composition Benefits

While a number of possible transportation fuel choices exist, many such as hydrogen require a complete change in engine technology. However, with current vehicle technology it is possible to use fuels blended with 10 percent ethanol, by volume, without any modifications to the vehicle engine. So called E10 fuels are already required by law for all fuels sold in the Sate of

Minnesota (Minnesota Ethanol Program). Here in Canada, Sunoco currently blends ethanol into its fuels. It was thus thought important to investigate the GHG emission reductions that could be brought about as a result of the implementation of an E10 fuel policy.

In order to examine the potential for achieving reductions in GHG emissions, four different levels of market penetration were assumed. The four conditions assumed that 10, 25, 50 and 100 percent of all regular gasoline was defined as being E10 gasoline and thus the emissions from the equal proportion of vehicle kilometres were recalculated using a rate of 282.16 g GHG/veh.-km. The results are summarised in Figure 5, with the 0 percent E10 fuel scenario being included for the purposes of comparison. It should be noted that it is assumed that fewer than three percent of all vehicle kilometres will be driven using diesel-fuelled vehicles.

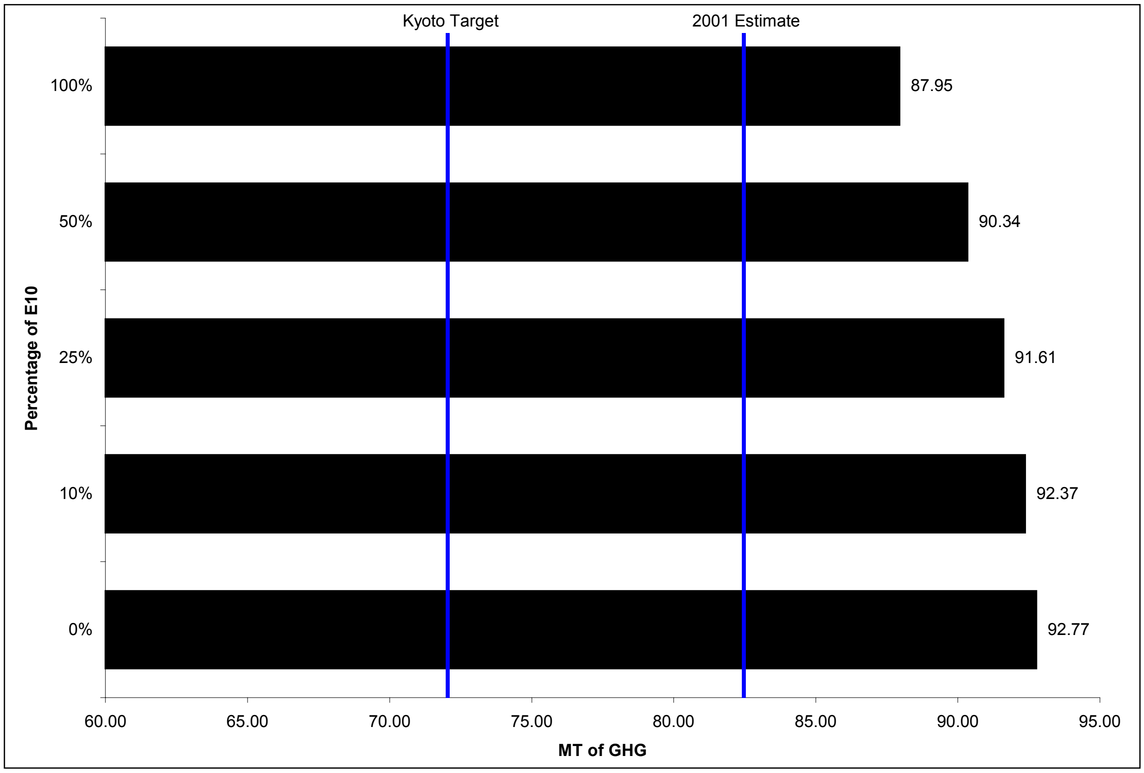

Figure 5: GHG Emissions for 2011 at various levels of E10 fuel market penetration

In order to assess the combined impact of the implementation of an E10 fuel policy and incentives to purchase low emission vehicles, the total emissions after joint implementation were calculated. Seven scenarios were designed to test the range of change in GHG emissions that may be observed under various levels of implementation. The conditions of the seven scenarios are outlined in Table 4. It should be noted that conditions C5 through C7 represent the implementation of 100 percent E10 fuel for all non-diesel and non-hybrid vehicles. It should also be noted that diesel was still considered the fuel choice of just under three percent of all vehicles.

Table 4: Combinations of Hybrid and E10 Implementation

Scenario	Percentage of Hybrid Vehicle km	Percentage of E10 Kilometres
Base	0.0	0.0
C2	10.0	1.0

C3	25.0	2.5
C4	50.0	5.0
C5	87.3	10.0
C6	96.3	1.0
C7	96.8	2.5

Figure 6 displays the resulting GHG emissions from the combined implementation of E10 fuel policy and an incentive program to encourage the purchase of hybrid vehicles.

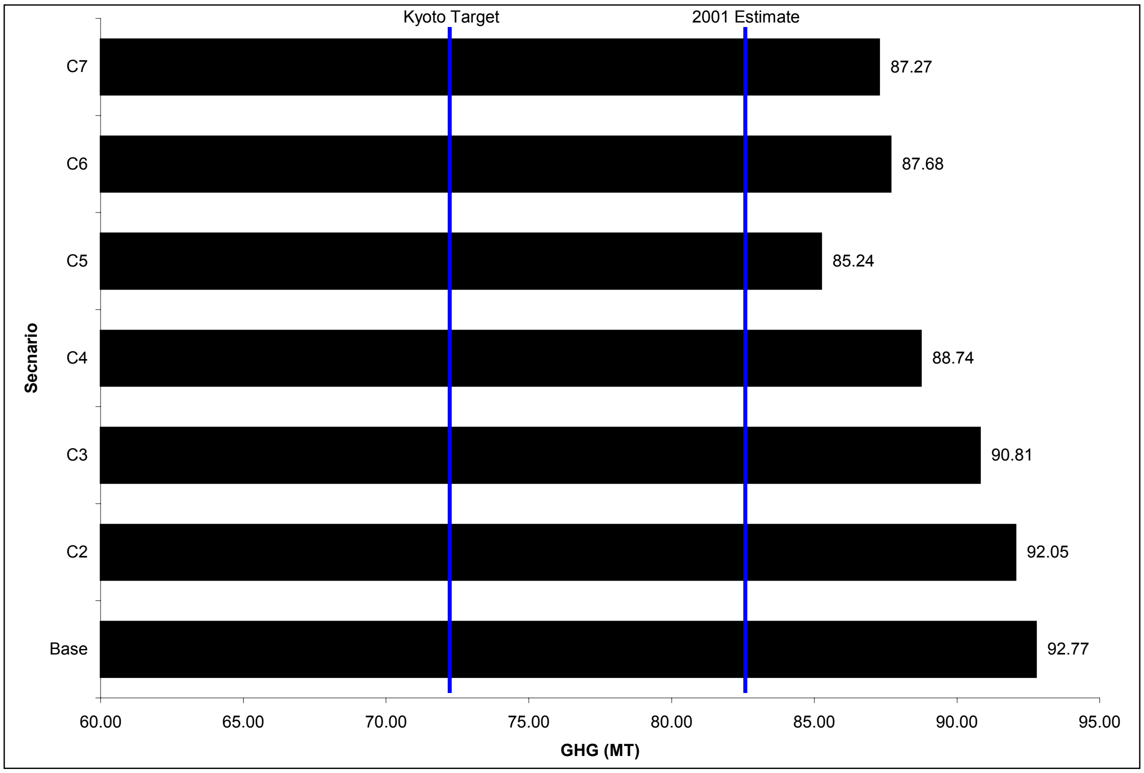

Figure 6 GHG Emissions for 2011 from Joint Implementation of Hybrid Incentive and E10 Fuel

Results

From the analysis of the implementation of a variety of ITS measures, it appears that they will have a very small overall impact on achieving the desired reductions in GHG emissions. Under the most likely scenario, with growth in vehicle kilometres resulting from both changing demographics and overall growth in per vehicle kilometres, implementation of ITS in terms of FTMS, advanced signal control and A/IVTIS will only result in a reduction of approximately 0.56 MT of GHG or 2.7 percent of the required reduction from estimated 2011 levels.

The most optimistic scenario for the acceptance of hybrid vehicles foresaw 10 percent of all vehicle kilometres travelled by hybrid vehicles in 2011. A corresponding reduction of 3.11 MT of GHG (16 percent of required reduction) would result from such widespread usage of hybrid vehicles. However, in order to reach such a level of use, the total hybrid fleet would be over two-million vehicles. Evenly spread over 10 years, the annual uptake of hybrid vehicles would need to be in excess of 200,000 vehicles. Based on the results reported by Statistics Canada, new passenger vehicle sales totalled 868,634 in 2001, and thus the total number of hybrid vehicles needed would represent approximately 25 percent of all new passenger vehicle sales.[2] As it can be assumed that this was not the case for 2001, the purchase of hybrid vehicles in the year 2002 to 2011 will have to represent an even larger percentage of total new vehicle sales. Given the current large price differential between conventional and hybrid vehicles, this level of sales appears very unlikely in the near future.

Based on Figure 3 it can be observed that the implementation of 100 percent E10 fuel would result in a decrease of approximately 4.82 MT of GHG (23 percent of required GHG reductions) over the base case with no E10 fuel. This is by far one of the largest reductions estimated as part of this paper. In Figure 6, the combined implementation of a 100 percent E10 fuel program and an incentive program for the purchase of hybrid vehicles would result in an estimated reduction of 7.53 MT of GHG.

The commitment that Canada made as part of the Kyoto Protocol is to reduce GHG emissions by 6 percent from the 1990 levels by the year 2012 (Environment Canada, 2001). The GHG emissions from private light-duty vehicles for 1990 are estimated to be 76.47 million tonnes. Therefore the target level of GHG emission to meet the Kyoto commitment is 72.15 million tonnes. It is evident from the results in Figure 7, below, that none of the scenarios considered in this paper meet the Kyoto commitment.

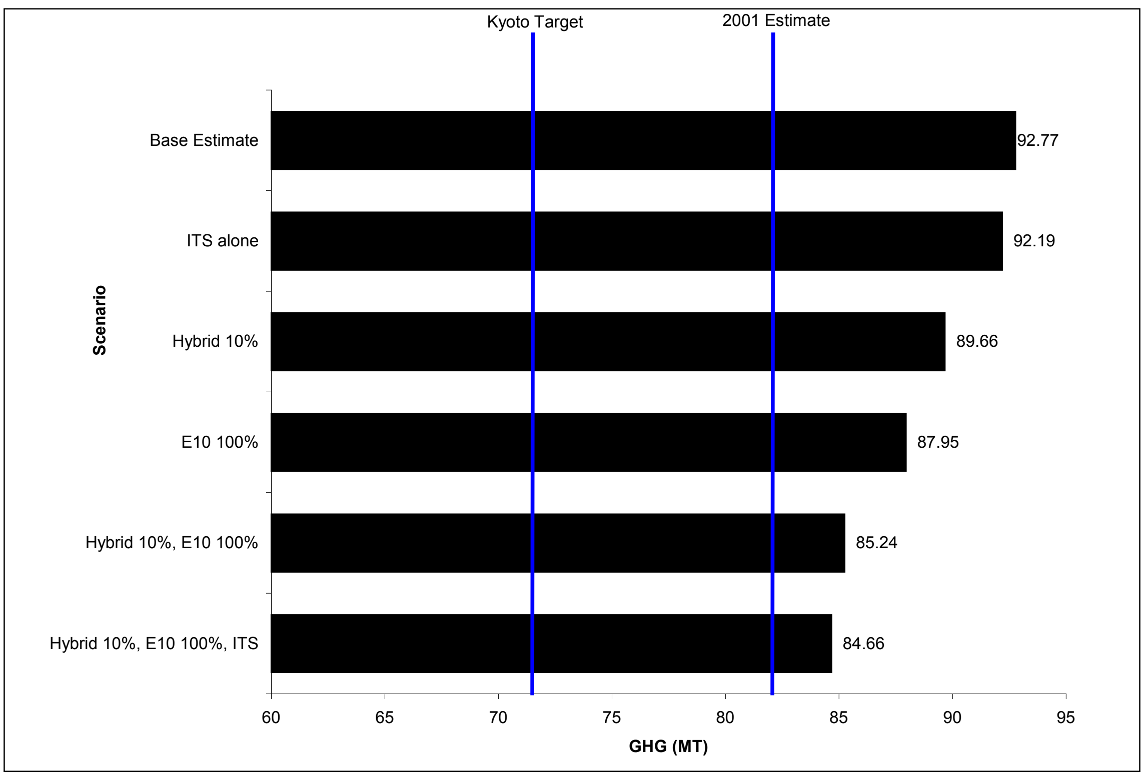

Figure 7 Comparison of Selected GHG Reduction Scenarios with Kyoto Target (2011)

[2] Passenger vehicles are all vehicles used to transport passengers. However, SUV, pick-up trucks and vans are not included in this number, but are reported with all other truck types (e.g. heavy trucks).

Conclusions and Recommendations

Changes in population age profile and the continued growth in vehicle kilometres will continue to reduce the effectiveness on GHG reduction strategies. ITS strategies do permit a reduction GHG based on current patterns of vehicle use, but these reductions will be quickly overwhelmed by increased vehicle use. It is also important to note that the reductions derived from broad implementation of ITS technology will result in a very small reduction in total GHG emissions.

Hybrid vehicles are another possible technology for achieving the committed reductions in emissions. They have several advantages over fuel cell vehicles in that the necessary fuelling infrastructure is in place, the vehicles are already being commercially produced and Canadian's are quickly becoming familiar with the technology. The same can not be said for fuel cell vehicles, and to a lesser extent with pure electric vehicles. However, it appears highly unlikely that hybrid vehicles will constitute a sufficient proportion of new vehicles to meet the Kyoto commitment. For this reason it is likely that the implementation of hybrid vehicle program alone will have only marginal implications for GHG reductions.

Of all the individual measures examined, a policy of requiring all fuel sold in Canada to be E10 fuel would result in the largest reductions in GHG emissions. The reduction would be almost twice that achieved with the next highest reduction (10 percent hybrid vehicles), and could be implemented with technology that is currently in use. There is also a related benefit, in that new employment may be generated at ethanol production facilities in rural areas of the country. However, even 100 percent E10 fuel will not reach the Kyoto commitment. In fact, even with the combined implementation of 100 percent E10 fuels, 10 percent hybrid vehicles, and the previously mentioned ITS benefits, the private vehicle transportation sector will still be12.7 MT or 18 percent above the required post Kyoto level. At this point the need to broaden the scope of research and action to include reductions derived by modal shift and changes in land use becomes clear.

Acknowledgements

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Appendix A: Conversion Estimates

Fuel Type	Conversion Estimate (g/km)
Conventional gasoline	298.32
Conventional Diesel	231.82
Hybrid-Electric, gasoline	195.77
E10 – Cellulose	282.16
Electric (pure)	89.50
Hydrogen (Natural Gas)	142.32
Hydrogen (National Mix)	152.27

Appendix B: Census Metropolitan Areas (CMA) and Census Agglomerations (CA)

Category	Name	Type	2001
Large Centres	Toronto (Ont.)	CMA	4,682,897
	Montréal (Que.)	CMA	3,426,350
	Vancouver (B.C.)	CMA	1,986,965
	Ottawa - Hull (Ont./Que.)	CMA	1,063,664
Medium Centres	Calgary (Alta.)	CMA	951,395
	Edmonton (Alta.)	CMA	937,845
	Québec (Que.)	CMA	682,757
	Winnipeg (Man.)	CMA	671,274
	Hamilton (Ont.)	CMA	662,401
	London (Ont.)	CMA	432,451
	Kitchener (Ont.)	CMA	414,284
	St. Catharines - Niagara (Ont.)	CMA	377,009
	Halifax (N.S.)	CMA	359,183
	Victoria (B.C.)	CMA	311,902
	Windsor (Ont.)	CMA	307,877
	Oshawa (Ont.)	CMA	296,298
	Saskatoon (Sask.)	CMA	225,927
Small Centres	Regina (Sask.)	CMA	192,800
	St. John's (Nfld.Lab.)	CMA	172,918
	Greater Sudbury (Ont.)	CMA	155,601
	Chicoutimi - Jonquière (Que.)	CMA	154,938
	Sherbrooke (Que.)	CMA	153,811
	Barrie (Ont.)	CA	148,480
	Kelowna (B.C.)	CA	147,739
	Abbotsford (B.C.)	CMA	147,370
	Kingston (Ont.)	CMA	146,838
	Trois-Rivières (Que.)	CMA	137,507
	Saint John (N.B.)	CMA	122,678
	Thunder Bay (Ont.)	CMA	121,986
	Moncton (N.B.)	CA	117,727
	Guelph (Ont.)	CA	117,344
	Cape Breton (N.S.)	CA	109,330
	Chatham-Kent (Ont.)	CA	107,709
	Peterborough (Ont.)	CA	102,423