Resource Conservation Manitoba

Vehicle Standards and Beyond

ACHIEVING GREENHOUSE GAS REDUCTIONS IN PRIVATE VEHICLE USE – A Preliminary Analysis –

A brief submitted to the
Minister of Science, Technology, Energy and Mines
Province of Manitoba

November 2008

About Resource Conservation Manitoba

Resource Conservation Manitoba is a non-profit, non-governmental centre for sustainable living. RCM is directed by an elected community board. Volunteers and professional staff deliver our programs. Projects are funded by contributions from individuals, foundations, governments, and businesses.

Programs include
Active and Safe Routes to School,
Commuter Challenge,
Workplace Transportation Demand Management,
Manitoba Student Transportation Network,
Community-Based Travel Marketing,
Winnipeg Car Share Feasibility Study,
Environmental Speakers Bureau,
Compost Action,
Waste Reduction Week, and
Living Green, Living Well.

Resource Conservation Manitoba
303 Portage Avenue, 3rd Floor
Winnipeg, MB R3B 2B4

Tel. (204) 925-3777
Fax (204) 942-4207
E-mail: rcm@resourceconservation.mb.ca

www.resourceconservation.mb.ca
www.LivingGreenLivingWell.ca

RESOURCE CONSERVATION MANITOBA

Vehicle Standards and Beyond: Achieving Greenhouse Gas Reductions in Private Auto Use
– A Preliminary Analysis [*] –

November 2008

Introduction

The creation of Manitoba's Vehicle Standards Advisory Board as stipulated in *The Climate Change and Emissions Reduction Act* demands a rapid review of sustainable transportation policies to achieve the intent of the Act. RCM has undertaken this preliminary analysis to provide some insight into the nature and magnitude of the challenge to meet the transportation sector's share of the legislated greenhouse gas reduction target. The intent is to stimulate further research, modeling and deliberation on policy initiatives commensurate with the size of the challenge. To this end, RCM proposes a set of recommendations for consideration to get the ball rolling.

The Challenge

Emission reduction targets

Section 3(1) of *The Climate Change and Emissions Reduction Act* states that the initial emissions reduction target for Manitoba is to reduce Manitoba's emissions by December 31, 2012 to an amount that is at least 6 per cent less than Manitoba's total 1990 emissions.

Section 3(2) of the Act contemplates further emission reduction targets beyond 2012. Examples of later deeper cuts from other jurisdictions include 33% below 2007 levels by 2020 by British Columbia, 32% below 2004 levels by 2020 by Saskatchewan, 20% below 2006 levels by 2020 by the government of Canada, 15% below 2005 levels by 2020 by the Western Climate Initiative, and 80% below 1990 levels by 2050 by California (with intermediate targets for 2010 and 2020).[†]

---

[*] We have based our analysis on publicly available data presented in different formats with varying terminology. In some cases we have inferred approximate equivalency between categories used in registration data and differently named categories used in sales data. The more in-depth research and modeling effort that we call upon the Province to support should review and update these assumptions.

[†] *Next Steps: 2008 Action on Climate Change – Beyond Kyoto: Manitoba's Green Future*, p. 6 and *80in50 Scenarios for Deep Reductions in Greenhouse Gas Emissions from California Transportation* at http://steps.ucdavis.edu/research/Thread_6/80in50

Thus Manitoba is committed to early and continuing "decarbonization" of its economy. The transportation sector, responsible for 37% of Manitoba's total GHG emissions, appears to be the sector with the greatest potential for emissions reduction.[‡] It is difficult to see how Manitoba could achieve its global target if transportation fails to shoulder its share.

Hence Manitoba should be committed to achieving at least a 6% reduction in GHG emissions from 1990 levels in the transportation sector by 2012 in a manner that enables even deeper reductions beyond 2012.

Meeting the targets

If the Government intends to apply a 6% GHG reduction target to the transportation sector of the Manitoba economy, then the latest National Inventory Report on Canada's greenhouse gas emissions would indicate the following required reductions:

Table 1: GHG Emissions (kilotonnes of CO_2 equivalent) from the Transportation Sector and Reductions Required to Meet the Climate Change Targets

Type of Vehicle	1990 Level of GHG Emissions	Climate Change Target	2006 GHG Levels	Reductions Required	
				Total kt	Per cent
Gas Powered	2,934.8	2,758.7	3,206.6	447.9	14%
Diesel Powered	918.9	863.8	1,743.5	879.7	50%
Total	3,853.7	3,622.5	4,950.1	1,327.6	27%

Source: Environment Canada, *National Inventory Report 1990-2006*.

These Greenhouse Gas (GHG) emission reduction targets can also be expressed in terms of the reductions in the amount of gas and diesel fuel that would have to be consumed, based on the average amount of GHGs emitted per litre of fuel consumed between 2001 and 2006, using Statistics Canada data on fuel consumption in Manitoba (see Appendix, Table A.1).

Table 2: Litres of Fuel Consumed and Reductions Required to Meet the Climate Change Targets

Type of Vehicle	Litres of Fuel Consumed in 2007 (000's of litres)	Target Fuel Consumption (000's of litres)	Reductions Required	
			Litres (000's of litres)	%
Gas Powered	1,364,554	1,206,780	157,774	12%
Diesel Powered	692,065	282,461	409,604	59%
Total	2,056,619	1,489,241	567,378	28%
Gas Only	1,364,554	783,801	580,752	43%

Source: Statistics Canada CANSIM Table 405-0002.

The required reductions for diesel powered vehicles is much greater because of the much higher growth in emissions from these vehicles. However, if Government decided to exempt this sector from emissions reduction targets, due to its importance to the provincial economy and the

[‡] *Next Steps*, p. 23.

increasing emphasis on making Winnipeg a transportation hub, then the burden that gasoline burning vehicles would have to bear would rise from a 12 per cent to a 43 per cent reduction in the amount of gasoline consumed. This is an unachievable target for this sector over the near term and a major challenge over the medium-to-long term, thus raising the question of what kind of GHG reductions the provincial government is hoping to achieve from the Transportation sector with its stated menu of initiatives.

Approaches to Meeting the Challenge

The following two equations offer a comprehensive way of approaching the challenge of reducing GHG emissions from the transportation sector:

Total GHG emissions = Total Fuel Consumed x (GHGs per litre of fuel) (1)
Total Fuel Consumed = Total Vehicles x Average Kms per vehicle x #Litres/Km. (2)

The first equation tells us that if we use fuels that have lower GHG emissions per litre of fuel, then the total GHG emissions will fall. The second equation tells us that if we reduce the number of vehicles, the average # kms driven by vehicles or the number of litres consumed per km driven, we will lower GHG emissions.

Thus, the potential policy solutions are four-fold:

1. Use of cleaner fuels;
2. Fewer vehicles being used;
3. Less intensive use of vehicles; and,
4. Use of more fuel efficient vehicles.

Historical Trends

Table A.2 shows the trend in the number of vehicles and average kilometres driven in Manitoba over the last eight years. It shows several relevant facts. First, light vehicles comprise 96 per cent of all vehicles. Second, the market share occupied by light trucks over 4.5 tonnes has not changed much between 2000 and 2007. Third, there is no discernible trend in average distances per vehicle driven but there is a strong growth in the number of vehicles being operated.

These facts indicate that, given the strong growth in the number of vehicles being operated, there will have to be substantial increases in the use of cleaner fuels, reductions in the distances driven by motorists and improvements in the fuel efficiency of the vehicles being operated in order to achieve significant reductions in GHG emissions from the transportation sector.

Projected Impacts of Improvements in Fuel Efficiency and Kilometres Driven

To enable a preliminary grasp of the magnitude of the challenge we face, RCM modeled growth in the Light Vehicle sector (up to 4.5 tonnes) 10 years out.

Table A.3 (in Appendix) shows the results of a modeling exercise that used the historical trends in light vehicle growth between 2000 and 2007 and projected them over 10 years. The assumptions used in this modeling exercise are the following:

1. The total number of light vehicles grows annually by the average annual increase between 2000 and 2007 = 8,524 vehicles.
2. The number of *new* light vehicles increases annually by the average number of new light vehicles purchased each year between 2000 and 2007 = 20,242.
3. The average annual fuel economy of the entire fleet is 9.0 litres per 100 kms in year 1.
4. In Scenario #1, the Business-as-Usual Scenario, the average annual fuel economy remains at 9.0 litres per 100 kms and the average number of *passenger kms* (#kms x # passengers) driven remains constant at the historical average of 27,700 kms. per year.
5. In Scenario #2, the CARB standards scenario, the average number of passenger kms driven remains constant but the improvements in fuel efficiency for new private vehicles are equivalent to those adopted by the California Air Resources Board (CARB):
    a. 8.8 l/100 km in year 2 = (323 grams of GHGs/mile) = CARB standard.
    b. 8.2 l/100 km in year 3 = (301 grams of GHGs/mile)
    c. 7.3 l/100 km in year 4 = (267 grams of GHGs/mile)
    d. 6.3 l/100 km in year 5 = (233 grams of GHGs/mile)
    e. 6.2 l/100 km in year 6 = (227 grams of GHGs/mile)
    f. 6.0 l/100 km in year 7 = (222 grams of GHGs/mile)
    g. 5.8 l/100 km in years 8 through 10 = (213 grams of GHGs/mile)
6. In Scenario #3, the distance-reduction and efficiency scenario, the average number of passenger kms driven declines by 2 per cent per year and the average fuel economy improves as in Scenario #2.

Table 3 summarizes the results of this modeling exercise.

Table 3: Changes In Total Kms driven, Gas consumed and GHGs emitted under the Three Scenarios

Outcome	Scenario #1: Business-as-Usual	Scenario #2 CARB Standards	Scenario #3 Distance Reduction + CARB Standards
Total Kms Driven	+12.0%	+12.0%	-6.7%
Gas Consumed	+12.0%	+4.6%	-12.8%
GHGs Emitted	+12.0%	+4.6%	-12.8%

The Business-as-usual scenario results in a 12 per cent increase in all outcomes over the next 10 years. Under Scenario #2, the growth in GHG emissions drops by 7.4 percentage points to a 4.6 per cent increase over the 10 year period. Thus, the improvements in the fuel economy of the fleet only slow the growth of GHGs. Alone, they are not sufficient to offset the growth in GHGs due to the increased total distances being driven by the larger number of vehicles on the road.

However, Scenario #3 shows that a 2 per cent per year reduction in *average* distances driven results in a decline in *total* distances driven by the 10th year (- 6.7%). This gradual decline in total distances driven coupled with the gradual improvement in the fuel economy of the entire fleet results in a drop in the total amount of gasoline consumed and a corresponding decline in

GHG emissions. By year 10, GHG emissions have declined by 12.8 per cent, thereby reaching the Climate Change target of 6% below 1990 levels. However the target is not reached until 6 years beyond the 2012 legislated target date. Even supposing that similar results could be achieved for the entire non-diesel sector, given that diesel fuel consumption will likely continue to rise, this 13 per cent reduction will fall far short of the overall 43 per cent reduction required from private gas powered vehicles to meet the overall required reductions from the transportation sector, as shown in Table 2 above.

This modeling exercise clearly demonstrates that if Manitoba is to achieve substantial reductions in GHG emissions from just the privately owned and gas powered transportation sector (the scope of the Vehicle Standards Advisory Board), then policies will have to be implemented that impact not only on the fuel efficiency of vehicles but also on the other determinants of transportation GHGs, represented here by distances driven. Even aggressive improvements in fuel economy alone will not result in reductions in GHG emissions.

Policy Implications

We can generalize the results of the above modeling to conclude that there is no silver bullet or single-factor solution such as CARB standards to meet the GHG reduction challenge. This is not an excuse to abandon a particular measure or the attempt to meet Manitoba's target in the transportation sector. Rather it means that aggressive application of multiple complementary strategies, a portfolio approach, will be required.

The results of RCM's modeling exercise parallel those of a more complete study of California's transportation sector, which concludes:

> An *80in50* [80% by 2050] reduction in GHG emissions from the California transportation sector is challenging but potentially feasible. While no one mitigation option can singlehandedly meet the target, the goal can be met in multiple ways, utilizing a combination of technological and behavioral options.[§]

A quick review of the California study is instructive of the type of analysis, alternative solutions and kinds of results that might be considered for Manitoba.

The study first modeled a reference scenario and six single-factor GHG mitigation solutions and concluded: "None of the Silver Bullet scenarios achieve the *80in50* reduction goal, implying that no single technology can successfully meet California's 80% emission reductions goal; a portfolio approach is necessary." The scenarios considered are tabulated below.

[§] *80in50 Scenarios for Deep Reductions in Greenhouse Gas Emissions from California Transportation* at http://steps.ucdavis.edu/research/Thread_6/80in50

Scenario Name	Scenario Summary
Reference scenario	Doubling of population, slight increase (23%) in transport intensity, slight efficiency improvement (35%) and similar carbon intensity relative to 1990
Moderate efficiency SB	Uses modest advances in conventional technologies to achieve doubling of vehicle efficiency from 1990
High efficiency SB	Breakthroughs in conventional technologies to achieve nearly triple (270%) vehicle efficiency from 1990
Biofuel-intensive SB	Low-carbon biofuels are the primary fuels in conventional vehicles (Reference vehicle efficiency) in all transport sectors
Electricity-intensive SB	Electric vehicles and very low-carbon electricity (BEVs and PHEVs) are applied across many sectors except marine and aviation.
Hydrogen-intensive SB	Applies FCV and low-carbon hydrogen fuels aggressively across most sectors, except aviation
PMT SB	Reductions in travel demand for LDVs and aviation, Reference vehicle efficiency, no alternative fuels

SB = Silver Bullet; BEV = Battery Electric Vehicle; PHEV = Plug-in Hybrid Electric Vehicle; FCV = Fuel Cell Vehicle; LDV = Light Duty Vehicle; PMT = Passenger Miles Travelled

Next the study constructed three ***80in50 Scenarios,*** each of which contained a portfolio of measures that together were capable of achieving the 80% GHG reduction target from 1990 levels by 2050, as follows:

Scenario Name	Scenario Summary
Efficient Biofuels 80in50	Advanced technologies are developed for biofuel production. *Reference* scenario travel demand. Low-carbon biofuels are the primary fuel in efficient vehicles (2x vehicle efficiency) across all sectors. Petroleum accounts for only 3% of fuel used.
Electric-drive 80in50	Advanced technologies for electric-drive vehicles and very low-carbon electricity and hydrogen are developed. *Reference* travel demand. Higher efficiency (3x) electric drive vehicles (EVs, PHEVs and FCVs) used in most sectors, except marine aviation and off-road where biofuels are used. Petroleum accounts for only 10% of fuel used.
Actor-based 80in50	High prices reduce travel demand and lead to smaller, high efficiency vehicles. Reduced travel demand, very high efficiency vehicles, increased carpooling and use of transit. Fuels are not as decarbonized as in other scenarios. Biofuels used in aviation and marine. Petroleum still accounts for 35% of fuel used.

In order for the Province to meet its GHG emission reduction targets, RCM believes it is crucial to envision, systematically and thoroughly, a variety of plausible policy options and quantify the results that may be anticipated, as the California study and our own preliminary analysis attempt to do. The Province needs to engage appropriate research and modeling support for this task. Until this is done, the VSAB and Province will have to proceed on a more intuitive basis to recommend and implement a complementary set of measures strong enough to do the job.

In recommending and choosing GHG mitigation measures singly and in combination, the VSAB and the Province will need to assess the alternatives in terms of their ability to reach the target, cost-effectiveness, feasibility, fairness, and provision for transportation requirements of various constituencies.

What follows is a preliminary review of the general policy options identified earlier.

Policy Option #1: The Use of Cleaner Fuels

The Manitoba Government's climate change action plan backgrounder on Transportation initiatives, *Transportation: Greening our Transportation Sector*, indicates several measures which have been taken to promote the use of cleaner fuels. They include the mandated 8.5 per cent replacement of gasoline needs with clean burning ethanol, the elimination of the 11.5 cent fuel tax on biodiesel, a 10-point action plan to promote biodiesel, the promotion of biodiesel use and the use of plug-in hybrid electric vehicles (PHEVs).

Of these, Resource Conservation Manitoba believes the promotion of biodiesel use and PHEVs offers the greatest hope for significant reductions in GHGs because the degree to which the ethanol produced in Manitoba, largely from corn imported from the U.S., actually reduces GHG emissions on a life-cycle basis is very questionable. By comparison, biodiesel has a very favorable GHG profile as do the PHEVs. Biodiesel also holds the promise of reducing GHGs from the existing diesel fleet, if issues of fuel quality, engine compatibility and adequate and sustainable production can be addressed satisfactorily. In particular, impacts on the environment and food supply must be considered.

In addition, we believe that a major market replacement by straight electric vehicles (EVs) may offer the best opportunity for GHG emission reduction. Current models, like the ZENN car, are suitable for neighborhood use in urban areas (NEVs), while future models promise highway performance. It is not inconceivable that a local economic initiative building EVs and/or EV conversions could be developed if a strong provincial market could be created. Passenger heating, battery performance, and vehicle safety are technical issues that need to be assessed. **Low-cost options are also important for EVs to be considered as replacements for scrapped beaters.**

Policy Option #2: The Reduction in the Number of Vehicles Being Used

The following table shows the annual *change* in the total number of light vehicles operating in Manitoba each year between 2000 and 2007 and the number of new passenger cars purchased

each year. By subtracting the number of new cars from the total change, one gets a count of number of vehicles withdrawn from the market each year.

Table 4: Annual Change in Total Vehicles, Number of New Passenger Cars and Total Cars withdrawn each year in Manitoba – 2000 to 2007

Year	Total Change in Light Vehicles[1]	Total New Cars Purchased	Total Vehicles Withdrawn[1]
2000	-2,666	18,625	21,291
2001	+19,016	19,716	700
2002	-7,075	22,434	29,509
2003	+18,218	20,914	2,696
2004	+11,613	20,045	8,432
2005	+8,559	20,253	11,694
2006	+12,002	19,736	7,734

Source: Statistics Canada, CANSIM Tables 405-0056, 079-0003. Note: [1] Calculations by the author.

Table 4 reveals a fairly constant level of new vehicles being purchased each year but wildly fluctuating numbers of total vehicles and of vehicles withdrawn.

What factors are behind the wide fluctuations in total vehicles and those withdrawn from the roads each year and how amenable are these to being influences by policies?

One factor is inter-provincial migration. Manitoba lost population heavily to other provinces between 2000 and 2002 but has since gained population due to an aggressive immigration policy. Accordingly, this factor likely explains a large amount of the fluctuation; and, given Manitoba's strong commitment to promoting immigration over the medium term, it is going to drive upwards the growth in the total number of vehicles on the road. A growing provincial population will mean a growth in the number of vehicles.

A second factor is the state of the economy. Slow economic growth or a recession will reduce the number of new vehicles being purchased, resulting in a reduced rate of growth of the total number of vehicles on the road. However, it will have the negative effect of encouraging owners to hang onto less fuel efficient older vehicles.

In comparison to the strength of these demographic and economic forces, there are likely few government policies that can be enacted that will have much effect on the total number of vehicles on the road over the near term. One that has promise, though, and deserves strengthening is the older vehicle retirement program with significant rewards such as free annual transit passes and bicycles. The rewards could be enhanced in value with the possibility of adding a credit towards an NEV, EV, or PHEV.

However, to discourage continued growth in the number of vehicles over the longer-term, what are needed are land-use policies that strongly encourage higher density settlements, a vastly improved public transportation system, a strong push for removing older vehicles and the strong encouragement of car sharing.

Policy Option #3: The Less Intensive Use of Vehicles

As Table A.2 below shows, the average number of passenger kilometres driven over the last 7 years has remained fairly constant – at 27,668 for light vehicles and 24,539 for light trucks. And, as Table A.3 clearly demonstrates, obtaining appreciable reductions in GHGs from the transportation sector will require measures which encourage people to drive less. Just improving the fuel efficiency of the fleet will not suffice.

There are a range of measures which could be undertaken to reduce the amount that people drive. They include both carrots and sticks.

The **sticks** are financial measures which directly affect the *variable* cost of operating a vehicle. They include higher excise taxes on fuel, pay-as-you-drive automobile insurance, tolls on key highways, higher parking costs, etc. None of these measures are featured in the Government's green transportation background document.

Rather, the background document features only **carrots** in the form of promoting the use of alternative transportation modes. Increased funding for transit infrastructure improvements, the promotion of active transportation measures such as bike paths, the expansion of Winnipeg Transit's Eco-Pass program are the measures featured in the backgrounder.

In RCM's estimation, carrots alone will not result in the level of reductions in distances driven by Manitobans that are required to achieve appreciable reductions in GHGs emitted. They are necessary to provide citizens with alternatives. However, the use of the private vehicle has to be made more expensive in order to induce people to use these alternatives. Furthermore, linking the funds generated from sticks like higher excise taxes to improvements in alternative modes of transportation would increase the public's willingness to pay those higher fees.

Note that in the earlier cited California Actor-Based 80by50 scenario "High prices reduce travel demand and lead to smaller, high efficiency vehicles" as we advocate here. Moreover, higher prices reflect the fact that consumer choices in vehicles and vehicle usage impose variable social and environmental costs on society that require mitigation.

RCM believes there is a need for a systematic investigation of potential regulations, positive and negative incentives, and investments to promote a transition to more sustainable transportation alternatives. Since a number of key measures involve municipal planning, operations, finances and infrastructure, engaging municipal governments is critical and they too will need appropriate carrots and sticks for their cooperation.

A crucial test of the ultimate combination of measures that Manitoba adopts is whether or not they are able to achieve the objectives of *The Climate Change and Emissions Reductions Act* and more. Regrettably, our province and nation have so far fallen short.

Policy Option #4: The Use of More Fuel Efficient Vehicles

This policy option is the clear focus of section 13 of the recently proclaimed *The Climate Change and Emissions Reduction Act*. The Act indicates that, by January 31, 2009, the Vehicle Standards Advisory Board (VSAB) must make recommendations to the minister for achieving

a) the most cost-effective efficiency improvements and emissions reductions that are feasible for new private vehicles in each year from 2010 to 2016 inclusive; and,
b) further feasible and cost-effective efficiency improvements and emissions reductions for new private vehicles in 2017 and afterwards.

In carrying out its mandate, the advisory board must consider recommending targets, programs and measures to significantly increase

a) the proportion of new private vehicles that use low-emissions technologies; and,
b) the proportion of new private vehicles that are high-efficiency private vehicles.

In formulating its recommendations, the advisory board must consider using the same methodology used by the California Air Resources Board in establishing vehicle emission standards for the State of California.

However, the ambit of the VSAB covers only *newly* purchased *private* vehicles and this reduces considerably the potential of this section of the Climate Change Act to achieve any reductions in the overall level of GHG emissions from the transportation sector, for two reasons.

First, *newly* purchased light vehicles represent only 3.3 per cent of the total number of vehicles in Manitoba. Thus, even very ambitious emissions reduction targets for new vehicles will make a very small yearly impact on total emissions from the transportation sector and will take many years to make an impact on the total fleet.

Second, the legislation is restricted to *private* vehicles, thus excluding almost all of the diesel powered vehicles in the province.[**] Thus, if we put all of the required reductions in GHG emissions onto the gasoline powered vehicles in the province, then the total *reductions* in the number of litres of gasoline required to meet the Climate Change target for the transportation sector becomes 580.7 million litres of gasoline which represents 43 per cent of the gasoline purchased in Manitoba in 2007!

Given these two key restrictions of section 13 of the Climate Change Act, it is clear that other substantial measures are required to achieve the Climate Change targets for the transportation sector.

[**] Table A11-14 of Environment Canada's latest National Inventory Report on GHG emissions shows that 92 per cent of GHG emissions in 2006 from diesel fuel came from heavy-duty diesel vehicles, almost all of which would be commercially owned.

Size Matters

Paul Hawken and Amory and L. Hunter Lovins observe in Natural Capitalism (1999, p. 24):

> The contemporary automobile, after a century of engineering, is embarrassingly inefficient: Of the energy in the fuel it consumes, at least 80 percent is lost, mainly in the engine's heat and exhaust, so that at most only 20 percent is actually used to turn the wheels. Of the resulting force, 95 percent moves the car, while only 5 percent moves the driver, in proportion to their respective weights. Five percent of 20 percent is one percent - not a gratifying result from American cars that burn their own weight in gasoline every year.

The inefficiency of most auto travel is glaringly evident during morning and evening rush hours when thousands of commuters are transported by vehicles that are vastly oversized and overpowered for the task of getting their single occupants to and from work. Consumers appear to choose vehicles for their most demanding possible use rather their most common actual use. Thus one key focus of attention for the province and the VSAB should be how to address the solo commute and similar journeys.

Public transit and active transportation are important alternatives, but for many they are unlikely to replace the availability, timeliness and convenience of a car for personal transportation in a sprawling city and beyond. To achieve more efficient personal transportation, vehicle standards are critical too.

The most direct and lower-cost path to greater fuel-efficiency for personal transportation is to downsize (or downweight) the average passenger car. Compact cars *already* achieve in 2008 the fuel-efficiency to which the manufacturers aspire for the entire light-duty fleet by 2020, i.e. 35 mpg (slide 38 of CVMA presentation to VSAB Nov. 7, 2008). On those rare occasions when a larger vehicle is needed, rentals, loaners and car-share arrangements provide options that could be more widely encouraged and developed. Such arrangements would enable vehicles to be sized more appropriately to their use to make the fleet as a whole more fuel-efficient. Of course there are people in some trades and very large families in rural areas and car-dependent neighborhoods who may need somewhat larger vehicles on a more regular basis, but not most individuals or families.

In addition to a proper mix of sizes to meet actual vehicle use, continuing innovations in design, materials, and technology can further drive fuel-efficiency. Electric and hybrid-electric propulsion systems within appropriately designed and sized vehicles appear to be the most energy- and GHG-efficient.

Measures to Achieve Improvements in Fuel and GHG Efficiency

The Climate Change Emissions Reduction Act directs the VSAB to "consider recommending targets, programs and measures" that promote low-emissions and high efficiency in new private vehicles. In this section we consider three types of measures that may be employed: regulated CAFE standards, economic incentives in the form of feebates, and marketing and vehicle replacement programs in cooperation with the auto dealers. Each of these could function as a

stand-alone program, but, properly designed to complement one another, they could be more effective together.

A Regulatory Model – Enforcement of CAFE Standards

Section 14(1) of the Act contemplates government prescribing efficiency or emissions standards for new private vehicles and for the aggregate of vehicles sold by dealers. BC's *Greenhouse Gas Reduction (Vehicle Emissions Standards) Act*, passed last May, illustrates how to do that.

BC's Act requires manufacturers selling into the province to "ensure that the fleet average GHG emissions of a vehicle fleet does not exceed the applicable fleet emissions standard" or else produce sufficient credits purchased from manufacturers who are under the standard to match their excess. The Act also contains analogous provisions for quotas of Zero Emission Vehicles (ZEVs). (See http://www.leg.bc.ca/38th4th/3rd_read/gov39-3.htm.)

CAFE standards thus provide positive and negative incentives to manufacturers and their dealers to promote and sell the more fuel-efficient models in their fleets.

An Economic Model – Feebates

Another key measure that Manitoba could introduce to improve the fuel efficiency of privately operated vehicles is a 'feebate' that applies at the level of the individual vehicle purchaser or owner. A feebate is an economic instrument under which vehicles are subject to taxes or rebates in proportion to how much they exceed or fall below a specified level of fuel efficiency.

For example, in Canada, the average fuel consumption rating for light-duty vehicles is approximately 9.0 litres per 100 km. A single-class feebate of $500 per litre per 100 km would mean:

- A fuel-efficient vehicle that achieved 5.0 litres per 100 km would receive a rebate of $2,000.
- A vehicle with poor fuel efficiency that achieved 13.0 litres per 100 km would pay a fee of $2,000.

In 2005, the National Roundtable on the Environment and the Economy commissioned a technical analysis of feebates, using data compiled by Transport Canada[††]. It offers an excellent basis for the design of an optimal feebate program in Manitoba.

The report describes the kind of decisions that have to be made in designing a feebate program including,

- The rate basis. Options include targeting fuel consumption (litres per 100 km); targeting fuel economy (kilometres per litre); targeting GHG emissions directly; or, targeting specific technologies such as advanced hybrid vehicles. It opts for the first in its modeling.
- Form of the feebate function. The function can be linear, non-linear with or without caps.

[††] National Roundtable on the Environment and the Economy, *Development of Options for a Vehicle Feebate in Canada*. At: www.nrtee-trnee.com/eng/publications/feebates.

- Rate. The amount of rebate or tax per unit of improvement. Higher rates are more effective in promoting fuel-efficient choices but may be more disruptive.
- Number of vehicle classes. The options are a single system – the most efficient; two-tiered system such as cars and trucks; multiple classes with the pivot point being different for each class – the least efficient.
- Application and Exemptions. Exemptions could be made, as is the case with the Climate Change Act, exempting commercial vehicles.
- Revenue Neutrality. The pivot point would be determined by the requirement for revenue neutrality and would change annually as vehicles become more efficient. However, the value would not be known until after the fact requiring proxy values to be used.
- Phase-in Period. It would alleviate concerns about fairness and market disruptions but would also delay the benefits.
- Paid at Purchase or Annually. An annual feebate would act as a continual incentive to replace less fuel-efficient vehicles but would incur additional administrative costs relative to a paid at purchase system.

The report then models the impacts of 12 different scenarios and concludes that,

> "Overall, **a feebate of $1,000 per 100 km would appear to be the most promising** since it delivers the greatest economic benefit, and avoids the large shifts in market share associated with higher rates. . . However, starting with a rate of $500 per litre per 100 km would be helpful in three ways:
> - It would give greater weight to the fairness criterion, while still being reasonably environmentally effective and economically efficient;
> - It would give firms time to adjust;
> - It would contribute to a risk management strategy by providing the opportunity to: gather better information on factors such as elasticities and valuation; assess issues regarding the import of used cars, etc; and, assess other implementation problems.
> - Depending on the results, the rate could eventually be increased to the optimal level justified by the information gained."

The report also describes a key shortcoming of a feebate system – that of encouraging people to drive longer distances given the greater fuel economy of the new vehicles. It estimates this 'rebound' effect to be in the order of 23 per cent! A more recent U.S. study puts the rebound effect at 4 per cent over the short-run and 22 per cent over the long-run.[‡‡] Given the modeling described above which demonstrated the need for aggressive policies aimed at curbing distances driven, this is of concern. It further underscores the need for complementary measures which encourage people to drive less.

Most proposals for implementing feebates focus solely on new vehicle purchases, with the feebate applied at the point of purchase. However, the modeling presented in this paper shows the very limited impact of focusing just on new and privately-owned vehicles. Accordingly, RCM recommends that serious consideration be given to applying the feebate to the purchase of used private vehicles, with the option of an annual feebate applied to all private vehicles.

[‡‡] Small. K. and K. Van Dender. 2005. *The Effect of Improved Fuel Economy on Vehicle Miles Traveled: Estimating the Rebound Effect Using U.S. State Data, 1966-2001.* Economic Working Paper No. 05-06-03. www.ucei.berkeley.edu/PDF/EPE_014.pdf

One method for administering a feebate program for the purchase of both new and used vehicles would be the use of MPIC as the delivery agent. Its computers could be programmed to use a look-up table of the rated fuel efficiency of all models and years and calculate the value of the feebate based on the pivot points and rates established by government. The value of the feebate either could be folded into the assessed vehicle insurance or presented as a separate amount. Using MPIC as the delivery agent and assessing the feebate at the point of purchasing insurance would eliminate the slippage due to Manitobans buying new vehicles outside the province to avoid paying the fee assessed at the point of sale.

A Cooperative Model – Marketing and Incenting Efficiency

2012 is only four years away – not much time to achieve the transportation sector's share of legislated 6% reduction in GHG emissions in Manitoba from the 1990 baseline. A comprehensive, multipronged approach that enlists the efforts of all parties will be required to approach or achieve this target. Moreover this effort must address the inefficiencies and emissions from the existing fleet as well as new vehicles. The end result should be a more efficient and cleaner fleet, more efficiently used.

Guided by legislated vehicle and fleet standards with accompanying incentives at the dealer and individual level, a comprehensive, cooperative effort would see dealers promoting efficient vehicles sized for their dominant actual use. A car purchase or lease might include a provision for a loaner or substitute on rare occasions when greater vehicle capacity was required. Rental agencies, building supply centres, and carshare programs could all support the right-sizing trend with the provision of suitably sized vehicles on the occasions when they are needed.

Complementary to dealer promotion of right-sized, fuel-efficient and cleaner vehicles, an enhanced older vehicle scrappage program would also contribute to better fleet efficiencies and stimulate new car sales at the more efficient end of the range, thus benefitting dealers and manufacturers. The authors of *Natural Capitalism* propose a variant of the feebate for scrappage programs – "basing the rebate for a new car on how much more efficient it is than the old car that's scrapped rather than traded in" (p. 38).

RCM's Recommendations for Achieving Substantial Reductions in GHG Emissions from the Transportation Sector in Manitoba

Promote the Use of Cleaner Fuels

1. Put more effort into promoting the production and use of biodiesel fuel than ethanol.
2. Promote the use of Plug-in Hybrid Electric Vehicles (PHEV) and electric vehicles (EVs), including lower-cost options.

Reduce the Growth in the Number of Private Vehicles

3. Promote higher-density urban development, and an expanded public transportation system.
4. Promote an expanded program for scrapping older, fuel inefficient vehicles.

Promote the Less Intensive Use of Vehicles

5. Implement measures which increase the variable cost of using private vehicles like higher excise taxes on gasoline and pay-as-you-drive car insurance and use the revenues from these to pay for improvements to the public transit systems, active transportation routes.
6. Complement economic incentives with education and social marketing to promote alternatives to private vehicle use.

Promote the Use of More Fuel Efficient Vehicles

7. Consider regulatory enforcement of CAFE standards modeled on B.C.'s *Greenhouse Gas Reduction (Vehicle Emissions Standards) Act*.
8. Implement a feebate program in Manitoba which gradually lowers the 'pivot' point (litres per 100 km) below which rebates are provided and above which fees are assessed.
9. Set the fees and rebates sufficiently high to encourage a shift in consumer demand.
10. Give serious consideration to using MPIC as the administrative tool for delivering feebates for new private vehicles.
11. Once the feebate program for new vehicles has been implemented, expand it to include the purchase of used private vehicles and/or to an annual feebate for all vehicles.
12. Partner with dealers and others to promote and incent
    - right-sized, fuel-efficient and clean vehicles adequate for their most common actual use.
    - supplemental loaners, rentals or car-shares for occasional higher capacity vehicle needs.
    - scrappage programs with incentives for the least efficient trade-ins.
    - ecodriving and vehicle maintenance to reduce emissions.

APPENDIX

Key Transportation Trends in Manitoba

A.1 Greenhouse Gas (GHG) Emissions and Net Sales of Fuel, by Type of Fuel

Year	Gasoline			Diesel		
	GHG Emissions[1]	**Net Sales[2]**	**GHGs/ Litre[3]**	**GHG Emissions[1]**	**Net Sales[2]**	**GHGs/ Litre[3]**
1990	2,934.8	- -	- -	918.9	- -	- -
2000	2,982.2	1,304,807	0.002285	1,386.5	459,958	0.0030
2001	2,982.8	1,322,522	0.002255	1,428.2	469,804	0.0030
2002	3,036.3	1,360,651	0.002231	1,463.0	486,941	0.0030
2003	3,076.9	1,363,185	0.002257	1,487.1	488,185	0.0030
2004	3,161.4	1,347,594	0.002346	1,613.9	525,835	0.0031
2005	2,950.9	1,328,805	0.002221	1,674.1	545,585	0.0031
2006	3,206.6	1,331,046	0.002409	1,743.5	560,428	0.0031
2007	- -	1,364,554	- -	- -	692,065	- -
2000-2006 Average			**0.002286**			**0.003053**

Sources: Environment Canada, National Inventory Report 1990-2006
Statistics Canada, CANSIM Table 405-0002

Notes: [1] Expressed as Kilotonnes of CO_2 equivalent (1 tonne= 2,200 lbs.)
[2] Expressed as Thousands of Litres
[3] Expressed as Tonnes of GHGs per litre

Key Underlying Trends:

1. The growth in GHG emissions from gasoline vehicles was due entirely to the growth from light-duty gasoline trucks. Their GHG emissions grew from 859 kt in 1990 to 1,790 kt in 2006 while the GHG emissions from light- and heavy-duty vehicles fell from 2,069 kt in 1990 to 1,408 kt in 2006.
2. The vast majority (92-94%) of GHG emissions from Diesel comes from heavy-duty vehicles, most of which would be commercially owned.

Key Trends:

1. The growth in GHG emissions from gasoline has been very small, due to the offsetting reductions from light- and heavy-duty vehicles and increases from light trucks.
2. There has been a continued and rising rate of growth in GHG emissions from diesel fuel consumption.

A.2 Number of Vehicles and Average Passenger Kilometres[1] Driven by Type of Vehicle

Year	Light Vehicles[2]		Light Trucks[3]		Heavy Trucks[4]	
	Number	Average Kms	Number	Average Kms	Number	Average Kms
2000	581,789	26,606	8,994	- -	10,732	- -
2001	579,123	27,255	8,568	31,081	11,816	122,537
2002	598,139	25,392	9,239	26,691	12,612	107,421
2003	591,064	31,992	9,251	23,749	13,239	95,974
2004	609,282	26,046	9,406	17,648	14,243	116,352
2005	620,895	25,058	9,371	22,858	15,291	130,842
2006	629,454	27,422	9,217	22,730	15,893	112,949
2007	641,456	31,738	10,625	27,021	16,446	123,215

Source: Statistics Canada, CANSIM Tables 405-0056, 405-0057.

Notes: [1] These are the *sum* of distances traveled by individual passengers in the vehicle, including the driver. One vehicle traveling 30 kms with 3 passengers would equal 90 passenger kms.

[2] Vehicles up to 4.5 tonnes; [3] Trucks from 4.5 to 14.9 tonnes; [4] Trucks 15+ tonnes.

Key Trends:

1. There is no discernible upward trend in the average distances driven, over time, for these three types of vehicles.
2. However, the number of vehicles in all three categories has grown, such that the total kilometres driven by all types of vehicles has risen steadily.

A.3 Projected Growth of Light Vehicles and the Impacts of Improvements in Fuel Efficiency and Kilometres Driven on GHG Emissions

Year	Total Light Vehicles	Cumulative New Light Vehicles	Total Old Light Vehicles
1	641,456	20,185	621,271
2	649,980	40,427	609,553
3	658,504	60,669	597,835
4	667,029	80,911	586,117
5	675,552	101,153	574,399
6	684,076	121,395	562,681
7	692,600	141,637	550,963
8	701,124	161,879	539,245
9	709,648	182,121	527,527
10	718,172	202,363	515,809

Scenario #1 (Business As Usual)			
Average Fuel Economy	**Tot. Kms. Driven (000,000s)**	**Total Litres Of Gas (000,000s)**	**Total GHGs (kt)**
9.00	17,768.3	1,599.1	3,655.7
9.00	18,004.4	1,620.4	3,704.2
9.00	18,240.6	1,641.6	3,752.8
9.00	18,476.7	1,662.9	3,801.4
9.00	18,712.8	1,684.1	3,850.0
9.00	18,948.9	1,705.4	3,898.5
9.00	19,185.0	1,726.6	3,947.1
9.00	19,421.1	1,747.9	3,995.7
9.00	19,657.2	1,769.2	4,044.3
9.00	19,893.4	1,790.4	4,092.9

Scenario #2 (CARB Standards)			
Average Fuel Economy	**Tot. Kms. Driven (000,000s)**	**Total Litres Of Gas (000,000s)**	**Total GHGs (kt)**
9.00	17,768.3	1,599.1	3,655.7
8.99	18,004.4	1,617.6	3,697.8
8.97	18,240.6	1,633.2	3,733.6
8.92	18,476.7	1,646.1	3,763.0
8.84	18,712.8	1,656.1	3,785.9
8.76	18,948.9	1,663.4	3,802.5
8.67	19,185.0	1,667.8	3,812.6
8.58	19,421.1	1,669.4	3,816.3
8.49	19,657.2	1,670.8	3,919.4
8.40	19,893.4	1,672.7	3,823.8

Scenario #3 (CARB Standards and Reductions in TKD)			
Average Fuel Economy	**Tot. Kms. Driven (000,000s)**	**Total Litres Of Gas (000,000s)**	**Total GHGs (kt)**
9.00	17,768.3	1,599.1	3,655.7
8.99	17,644.4	1,586.9	3,627.6
8.97	17,518.2	1,571.3	3,592.0
8.92	17,390.1	1,550.8	3,545.0
8.84	17,260.1	1,525.5	3,487.3
8.76	17,128.3	1,499.9	3,428.8
8.67	16,994.9	1,473.9	3,369.4
8.58	16,860.0	1,447.3	3,308.6
8.49	16,723.7	1,420.1	3,246.5
8.40	16,586.0	1,393.7	3,185.9