GOVERNMENT OF MANITOBA
Local climate change planning services project

FACT SHEET – FLEET MANAGEMENT

RELEVANCE OF THE PROPOSED ACTION

Fleet vehicles are used intensively; on average, they produce nearly double the mileage, fuel consumption and emissions of personal vehicles. Fleets are not only expensive to operate but are a major source of greenhouse gas (GHG) emissions in municipalities.

This fact sheet:

- provides guidance on conducting a fleet renewal study;
- discusses potential actions to reduce GHG emissions from fleet vehicles; and,
- suggests on-line tools to assist with fleet renewal studies and assessments of potential action items.

GHG EMISSION REDUCTION POTENTIAL

The potential for GHG emissions reduction from changing fleet management practices is HIGH. The actual reductions achieved will vary depending on the actions implemented within the municipality. The most appropriate GHG emission reduction measures must be determined based on the needs and characteristics of the municipal fleet. To be effective, a measure must be adapted to the socio-economic and natural environment in which it will be applied.

FLEET RENEWAL STUDY

The best way to determine the appropriate actions for a municipality is to begin with a fleet audit or renewal study. A fleet audit can be conducted for operations with as little as one or as large as hundreds of fleet vehicles.

The results of a fleet renewal study will guide the municipalities in taking greener decisions regarding their fleet which could yield cost benefits including:

- Reduced GHG emissions;
- Reduced fuel costs;
- Reduced maintenance and registration/insurance costs (due to the elimination of underutilized vehicles).

The potential of reduction measures identified through a fleet audit can be used not only for municipalities' vehicle fleets, but also for public transportation fleets. The development and the management of public transportation are fundamental in a green planning process.

IMPLEMENTING A FLEET AUDIT

A fleet renewal study is relatively easy to implement. The most difficult task is the data collection phase. A municipality that already keeps an updated database will already have the most of the task complete.

The ease of implementation also depends on the scope of the study. A municipality could consider the following possibilities (in order of increasing difficulty):

- Only their fleet of passenger vehicles (cars and pickup trucks used primarily for transportation);
- Their fleet of passenger vehicles and other on-road vehicles (public transit vehicles, garbage trucks, fire trucks, street sweepers, etc.);
- Their entire motorized fleet including all off-road equipment (lawn mowers, ATVs, etc.).

Once the data is collected, the municipality can do the analysis in-house, turn to specialized consultants or, for a modest price, make use of tools available on the internet (see sample tools noted on page 10 of this fact sheet).

The typical fleet renewal study has five main components:

1. The development of a detailed fleet inventory and vehicle usage database;
2. Calculation of annual greenhouse gas emissions per vehicle;
3. Identification of vehicles that could potentially be reassigned, replaced with more efficient models or disposed of;
4. Discussion with stakeholders (department heads, vehicle users, mechanics);
5. For all identified vehicles determine whether they should be disposed, replaced, retained or reassigned.

♦ Infrastructure and resources required

In order to conduct a fleet audit, staff must be assigned to the task of data collection.

The data required for the typical green fleet study is presented in the table below (* indicates an essential piece of information).

Vehicle information
Make*
Model*
Year*
Government fuel efficiency ratings
Engine type/size
Transmission type
Fuel type*
Purchase price and purchase date

Vehicle usage information	Description
Department and/or person(s) responsible	List of all departments/employees that normally use the vehicle.
Current odometer reading*	Current odometer reading and the date that it was taken.
Past odometer readings*	List data available on past odometer readings as well as the dates they were taken.
Distance driven in past year*	Calculate the distance the vehicle was driven over the past year. Note that not all vehicles need to have their distances calculated on the same time frame. For example if vehicle A has a November 2008 to November 2009 distance calculated but vehicle B has a December 2008 to December 2009 distance calculated this would be acceptable. If several years of data are available and if the distance travelled fluctuates significantly from year to year, an average could be taken.
Fuel usage in last year*	If not available this can be estimated using the fuel efficiency and the distance driven in the past year. If the data from fuel logs or invoices are used, the time range should match up (approximately) with the time range used for the distance calculation.
Maintenance and repair history	List all maintenance and repair activities on the vehicle since its acquisition as well as associated costs.
Idling requirement?*	Does the vehicle spend excessive amounts of time idling? For example a boom truck that needs to idle in order to power the hydraulic lift system. If yes, estimate the number of hours per year that the vehicle spends idling and describe why the idling is necessary. This information is useful to determine if the vehicle should be equipped with an Auxiliary Power Unit or replaced by a hybrid unit to eliminate idling.
Usage*	Description of how the vehicle is used (the department of persons responsible for the vehicle should be contacted). If the vehicle is brought home each night by an employee this should be indicated here as well as any other pertinent information regarding the use of the vehicle.

If any piece of essential information cannot be found or estimated with a certain degree of certainty, the data must be collected. The data doesn't need to be collected over an entire year; a representative sample can estimate the usage of the vehicle over the entire year. For example, in the case of a public works vehicle used for general staff transport, the usage is fairly constant over the entire year (as opposed to a riding lawn mower which is only used in the summer). Therefore, two months of data could be collected, averaged, and then multiplied by 12 to estimate the yearly use.

Once the data is collected and tabulated the municipality must decide the scope of the study (which vehicles it will include and exclude from the study.) Due to the extremely specialized and critical emergency services that the police, fire department and paramedics provide, some green fleet studies will exclude these vehicles. However, it is up to the municipality whether or not to include these vehicles in their study; this might depend on data availability and budget allowances. Nevertheless, all non-emergency vehicles associated with these departments should be included (e.g. fire-marshal inspection vehicle, special investigations vehicles, etc.)

GHG emissions should be calculated for all vehicles in the study. Vehicles that have not been in the fleet for an entire year can have their GHG emissions estimated by multiplying the average monthly fuel usage (or mileage if fuel usage data is not available) by 12 months.

Emissions calculations are easily done in an Excel spreadsheet by multiplying the yearly fuel usage for each vehicle by the appropriate emissions factor. An example is provided below.

Vehicle information	
Make	Chevrolet
Model	Cobalt
Year	2005
Government fuel efficiency ratings	9.9 L/100 km (city); 6.6 L/100 km (highway)
Fuel type	87 octane gasoline
Vehicle usage information	
Current odometer reading	200,235 km (2010-03-09)
Past odometer readings	160,235 km (2009-03-06) 110,235 km (2008-03-11)
Distance driven in past year	200,235 – 160,235 = 40,000 km
Fuel usage calculation	
Fuel usage in last year	Information from fuel logs are not available Estimation (assuming 80% city use): $\frac{9.9L}{100km}$ x 40,000 km x $\frac{80}{100}$ = 3,168 L Estimation (assuming 20% highway use): $\frac{6.6L}{100km}$ x 40,000 km x $\frac{20}{100}$ = 528 L Total fuel usage = 3,168 + 528 = 3,696 L
Emissions factor calculation	
Emissions factors for gasoline-powered vehicles are listed in Annex 12 of the *Environment Canada National Inventory Report 2007*: For a tier 0 gasoline-powered vehicle: CO_2 emission factor = 2,289 g/L of fuel.[1]	
Emissions calculation	
Emissions per annum = (emissions factor) x (L of fuel consumed) = (0.0023 tonnes CO_2e/L) x 3,696 L **= 8.50 tonnes CO_2e**	

Next, the data must be analyzed to identify:

- vehicles that could be replaced, eliminated or reassigned;
- opportunities for improved maintenance practices; or
- opportunities for driver training.

[1] For results more precise, it is possible to take into account the CH_4 and N_2O emission factors. From the same source, we have:

Emission Factor (g/L of fuel)		
CO_2	**CH_4**	**N_2O**
2,289	0.32	0.66

To convert into tonnes of CO_2e per L of fuel:

$$CO_2e \text{ emissions factor} = \frac{1}{1000000}\left[x_{CO2} + 21 \cdot x_{CH4} + 310 \cdot x_{N2O}\right]$$

$$= \frac{1}{1000000}\left[2{,}289 + (21 \times 0.32) + (310 \times 0.66)\right] = 0.0025 \text{ tonnes/L of fuel (instead of 0.0023 t/L).}$$

The following table contains a list of considerations and questions to ask.

Consideration	Questions to ask	Potential action(s) to take
Vehicles with the highest GHG emissions per km (i.e. the lowest efficiency)	n.a	Consider replacing the vehicle with a more efficient model or reassigning it to less kilometre intensive tasks.
Vehicles with the highest annual usage	What is the nature of the task the vehicle performs and is the task essential?	Review work practices in order to identify any mileage saving opportunities.
	What is the nature of the task the vehicle performs? Is the right sized vehicle being used for the job? Too small: ex. A compact car is used to transport a worker and his tools and materials; however, due to the limited capacity of the vehicle an extra 3 trips are made to the depot each day to pick up additional supplies. Too big: ex. A full-sized pickup truck or SUV is being used for general transportation purposes.	Consider replacing the vehicle with a smaller or larger model depending on the needs. Old vehicle can be reassigned or disposed depending on needs and the efficiency of the vehicle.
Older vehicles or ones with a history of problems and high maintenance costs	n.a	Consider replacing the vehicles with newer and more fuel efficient (if possible) models. Savings in maintenance and downtime costs could be significant.
Vehicle maintenance	Are the vehicles in the fleet being properly maintained? Are the mechanics properly trained to maintain vehicles for maximum efficiency?	Review maintenance program to ensure that all preventative maintenance measures being taken such as regular oil changes, maintenance of proper tire pressure and regular air filter changes.
Vehicle use	Is the vehicle brought to the home of an employee? Is the vehicle used for personal use by the employees?	Review policies governing acceptable vehicle use.
Driver training	Have the employees been trained on how to drive for maximum fuel efficiency?	Consider training all employees for fuel efficient driving.
Biofuel	Is biofuel currently being used in the fleet? If not, is it locally available?	Determine the effect of blending the fuel with bio-fuel using the appropriate emissions factors or calculators available on the internet. Ex: Biofleet's detailed calculator available at http://biofleet.net/component/option,com_wrapper/Itemid,58/

Stakeholders should be involved in the decision making process as much as possible. It is important that they be at least consulted before any final decisions are made. For example, deciding to replace a department's truck with a compact car could be problematic if that department regularly needs that truck to tow a trailer.

♦ Cost range

The cost of such a study depends on the amount of data available and the size of the fleet. If the municipality has no pre-existing inventory database, fuel usage records, odometer readings in an easy to access centralized location, considerable amounts of staff time may be required to assemble or estimate all of this information.

Analyzing the data could be done in house, which would involve staff time, or could be contracted out. Retaining an external firm to do the analysis would cost about $2,000-$5,000 for a fleet with fewer than 50 vehicles.

♦ Time to implement

The time required for the fleet management study depends on the amount of data available, the accessibility of the data and the size of the fleet. A municipality that has kept a complete and easily assessable database will be able to start the study almost immediately. However, it could take weeks or months to track down all of the data required if the municipality has not kept up a database.

Once the database has been completed the fleet management study could be done within a month depending on how much staff time can be dedicated to the project.

EXAMPLES OF GHG EMISSION REDUCTION MEASURES

The following are several reduction measures municipalities can implement to reduce GHG emissions from municipal vehicle and public transportation fleets.

Reduction measure 1: **Switching to more fuel-efficient models and fuels**

Examples:

- Right-sizing: by using the correct size vehicle for the job (ex. A smart car could be used for bylaw enforcement instead of an SUV or a pickup truck)
- Using a higher blend of biodiesel
- Switching to alternative-fuel vehicles:
  - Hybrids
  - Electric vehicles
  - E-85 (a special fuel made of 85% ethanol)[i].

How to calculate potential emission reductions:

Emissions savings in tonnes of $CO_2e/a = \frac{m\{[\alpha_1 \cdot \beta_1] - [\alpha_2 \cdot \beta_2]\}}{100}$

Data	Where to find it
m = annual mileage (km)	Vehicle mileage records
α_1 = fuel economy of vehicle to be replaced (L/100 km)	Natural Resources Canada Fuel Consumption Guide http://oee.nrcan.gc.ca/transportation/tools/fuel-consumption-guide/fuel-consumption-guide.cfm
α_2 = fuel economy of replacement vehicle to be replaced (L/100 km)	
β_1 = the emissions factor for the fuel used in the vehicle to be replaced (in tonnes of CO_2e/L of fuel)	Source (for all but diesel and biodiesel): Environment Canada National Inventory Report 2007 (Annex 12)* http://www.ec.gc.ca/pdb/ghg/inventory_report/2007/full_inv_2007_eng.cfm *NB: To get an emissions factor in CO_2e (in tonnes/L) $= \frac{1}{1000000}[x_{CO2} + 21 \cdot x_{CH4} + 310 \cdot x_{N2O}]$ where x = emissions factor in g/L Source (for diesel and biodiesel emissions factors)[ii]: http://biofleet.net/component/option,com_wrapper/Itemid,58/
β_2 = the emissions factor for the fuel used in the replacement vehicle (in tonnes of CO_2e/L of fuel)	

Calculation examples:

Action	Assumptions	Annual reductions (t CO_2e)
Replace a mid-sized vehicle with a hybrid vehicle	▪ 2005 Ford Taurus city fuel efficiency is 11.8 $^{L}/_{100\ km}$ ▪ 2010 Honda Insight city fuel efficiency is 3.9 $^{L}/_{100\ km}$ ▪ 40,000 km annual mileage ▪ 0.0025 $^{t\ CO2e}/_{L\ gasoline}$	$40{,}000km \times (11.8 - 3.9)\frac{L}{100km} x0.0025\frac{t}{L}$ $= 7.9$
Replace a compact vehicle with a hybrid vehicle	▪ 2005 Chevrolet Cobalt city fuel efficiency is 9.9 $^{L}/_{100\ km}$ ▪ 2010 Honda Insight city fuel efficiency is 3.9 $^{L}/_{100\ km}$ ▪ 40,000 km annual mileage ▪ 0.0025 $^{t\ CO2e}/_{L\ gasoline}$	$40{,}000km \times (9.9 - 3.9)\frac{L}{100km} x0.0025\frac{t}{L}$ $= 6.0$
Replace a full-size truck with a smaller truck	▪ 2005 Ford F150 4x4 city fuel efficiency is 17.3 $^{L}/_{100\ km}$ ▪ 2010 Ford Ranger city fuel efficiency is 9.5 $^{L}/_{100\ km}$ ▪ 40,000 km annual mileage ▪ 0.0025 $^{t\ CO2e}/_{L\ gasoline}$	$40{,}000km \times (17.3 - 9.5)\frac{L}{100km} x0.0025\frac{t}{L}$ $= 7.8$
Replace a full-size truck with a hybrid vehicle	▪ 2005 Ford F150 4x4 city fuel efficiency is 17.3 $^{L}/_{100\ km}$ ▪ 2010 Toyota Prius city fuel efficiency is 3.7 $^{L}/_{100\ km}$ ▪ 40,000 km annual mileage ▪ 0.0025 $^{t\ CO2e}/_{L\ gasoline}$	$40{,}000km \times (17.3 - 3.7)\frac{L}{100km} x0.0025\frac{t}{L}$ $= 13.6$
Replace petro-diesel with 10% biodiesel	▪ 6,000 L of diesel consumed annually ▪ Similar fuel economy using 10% biodiesel ▪ Biodiesel source is canola ▪ 0.0037 $^{t\ CO2e}/_{L\ diesel}$ ▪ 0.0034 $^{t\ CO2e}/_{L\ bio\text{-}diesel}$	$6{,}000L \times (0.0037 - 0.0034)\frac{t}{L}$ $= 1.8$

Reduction measure 2: Reducing annual distance travelled

Examples:

- Planning municipality activities to optimize travel paths and reduce motor vehicle use
  - Rationalizing travel: examine the possibility of doing several tasks during a single trip to minimize the use of motor vehicles.
  - Centralizing the municipality offices or depots in order to shorten travel distance between departments and enhance alternative modes within the organization (walk, bike, etc.);
  - Travel planning: Road links with congestion during particular time periods should be avoided and alternative routes used without significantly elongating the distance traveled. For public transportation, a reserved bus lane network could be implemented to reduce idle time.
  - Reduction of trips: reducing unnecessary vehicle trips by encouraging employees to carpool or use videoconferencing where possible.

- Change work methods in order to reduce or eliminate the need to use motorized vehicles or equipment
  - Examples:
    - Cutting grass bi-weekly instead of weekly at municipal offices.
    - Maximizing various inspections in the spring, summer and fall when enforcement officers can get around on bike or on foot.

How to calculate potential emission reductions:

Emissions savings in tonnes of CO_2e/a = $\frac{m \cdot \left(\frac{p}{100}\right) \cdot \alpha \cdot \beta}{100}$

Data	Where to find it
m = annual mileage (km)	Vehicle mileage records
p = percentage decrease in annual mileage	n/a
α= fuel economy of vehicle (L/100 km)	Natural Resources Canada Fuel Consumption Guide http://oee.nrcan.gc.ca/transportation/tools/fuel-consumption-guide/fuel-consumption-guide.cfm
β= the emissions factor for the fuel used (in tonnes of CO_2e/L of fuel)	Source (for all but diesel and biodiesel): Environment Canada National Inventory Report 2007 (Annex 12)* http://www.ec.gc.ca/pdb/ghg/inventory_report/2007/full_inv_2007_eng.cfm *NB: To get an emissions factor in CO_2e (in tonnes/L) $= \frac{1}{1000000}\left[x_{CO2} + 21 \cdot x_{CH4} + 310 \cdot x_{N2O}\right]$ where x = emissions factor in g/L Source (for diesel and biodiesel emissions factors)[iii]: http://biofleet.net/component/option,com_wrapper/Itemid,58/

Calculation example:

Action	Assumptions	Annual reductions (t CO_2e)
Decrease annual mileage (of a mid-sized vehicle) by 10%	▪ 2005 Ford Taurus city fuel efficiency is 11.8 $^{L}/_{100\ km}$ ▪ 40,000 km annual mileage ▪ 0.0025 $^{t\ CO2e}/_{L\ gasoline}$	$40,000\ km \times \frac{10\ \%}{100} \times (11.8)\ \frac{L}{100\ km} \times 0.0025\ \frac{t}{L} = 1.2$

Reduction measure 3: Maintenance and operations policy:

- Develop an anti-idling policy for municipal fleets

- Develop a maintenance policy to keep the vehicles well-maintained (poorly maintained vehicles are less fuel-efficient)
  - Examples of maintenance policy actions:
    - Switching to synthetic oils and maximizing the time between oil changes (being investigated by the City of Toronto)[iv]
    - Scheduling regular air-filter changes
    - Requiring users to check tire pressure on a set timetable
    - Removing roof racks or other accessories when not needed

- Eco-Driver training
  - Teaches drivers to drive in a manner that saves fuel
  - Some techniques include:
    - Avoiding jackrabbit acceleration
    - Coasting to stop
    - Driving the speed limit
    - Reducing unnecessary weight in the vehicle
  - An extremely useful online training video is available from the Environmental Defence Fund Innovation Exchange (See the Tools to assist in implementing a project assessment).

Reduction measure 4: Public transportation

- For public transportation, agencies can develop programs to optimize the use of their fleets. For example, the number of busses on the road can be adapted to suit the demand during each period of the day.
  - An integrated study using global positioning units (GPS) and geographical information system (GIS) software. GPS data from the busses is integrated into GIS software to calculate travel time for each corridor. This can help optimize the overall network exploitation.
  - Such studies are generally done by specialized consultants. Due to cost and capacity issues, in-house studies are usually reserved for large transit agencies.

TOOLS TO ASSIST IN IMPLEMENTING A PROJECT ASSESSMENT

Name	Website	Information
E3Fleet	www.e3fleet.com	This is a paid service which provides tools for fleet managers to review their fleet's economic and environmental performance. Some basic tools are available for free such as: • The idling cost calculator • The fuel GHG emissions calculator • The biodiesel calculator Membership (for a modest price) gives access to: • The fleet review lite tool (Lifecycle emissions and intensity, fuel efficiency and consumption vehicle utilization) • E3 Fleet Rating Handbook Fleet review services are also available which includes the comprehensive performance analysis of a fleet.
GreenFleets BC	http://greenfleetsbc.com/component/option,com_frontpage/Itemid,1/	This is an independent non-profit program which contains information for fleet operators. A fuel (and multi-fuel) emissions calculator is available on the website.
The Hybrid Experience	http://www.hybridexperience.com/	The Hybrid experience contains information on hybrid vehicles. Some basic tools are available for free such as: • The hybrid savings tool • The vehicle cost comparison tool • The lifecycle cost tool
Biofleet	http://www.biofleet.net/	This website contains information on biodiesel. The biodiesel Carbon Reduction Calculator (downloadable detailed calculator in Excel format) is available. This tool estimates both GHG and other tailpipe emissions reductions from using biodiesel.
Environmental Defence Fund Innovation Exchange: Fleet Vehicles	http://innovation.edf.org/page.cfm?tagid=30617	Provides some basic information on managing GHG emissions in passenger, delivery and freight fleets. This site provides some online, interactive driver training videos to educate them on: • Global warming and GHGs • The role of drivers in reducing GHG emissions • Fuel-smart driving skills The site also offers a fleet greenhouse gas calculation tool.

FUNDING

- Green municipal fund
  - Funds to conduct studies related to fleet management, ex: introducing electric vehicles, introducing a central fleet management plan.
- Provincial Tax Exemption for biodiesel under The Motive Fuel Tax Act[v]
  - Expires March 31, 2011
  - Gives a Provincial Tax exemption on biodiesel
  - Only exemption on the biodiesel portion of the fuel (ex. For a 20% blend of biodiesel with regular diesel, the credit would only apply to the biodiesel portion)

- Ideas:
  - Extra fees levied on non-hybrid or green vehicles
  - Incentives for departments who reduce vehicle use/mileage by changing work methods
  - Central fleet management (all vehicles must be rented/shared)

CASE STUDY OVERVIEW

1) Hybrid vehicle for by-law enforcement in Caledon, ON[vi]

In 2007, a hybrid vehicle was purchased by the Town of Caledon for by-law enforcement. The vehicle is reportedly saving 1,473 L of gasoline per year which represents approximately 3.5 tonnes of CO2e.

2) Green Fleet Implementation Plan Phase II – Hamilton, ON[vii]

Since the release of the initial Green Fleet Implementation Plan in 2005, the City of Hamilton has added 371 "green" vehicles to their fleet, which includes 142 hybrid vehicles. This represents 23% of the overall fleet. Excluding hybrid vehicles in Transit, Police and EMS, each hybrid user pays on average $1,177 more per year into the Fleet replacement reserve. This cost is offset by $601 per year in lower fuel costs; therefore, the net increase in cost is $576 per hybrid vehicle.

GHG emissions were reduced by 546 tonnes over the three-year timeframe of Phase I, which is like reducing the fleet by 45 vehicles or 5%. Phase I of the Green Fleet Implementation Plan increased the use of hybrids by 105 (46 was the target) which reduced GHG emissions by 210 tonnes. Furthermore, 2.8 million litres of 5% biodiesel was used which reduced GHG emissions by 336 tonnes.

Phase II of the Green Fleet Implementation Plan aims to reduce GHG emissions by 958 tonnes between 2009 and 2011 (454 tonnes due to hybrid vehicles and 504 tonnes due to biodiesel use).

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[i] The total lifecycle must be taken into account. The feedstock of the ethanol is important to consider. There is considerable controversy surrounding corn-based ethanol and its real impact on GHG emissions.
[ii] In order to extract emissions factors for diesel and biodiesel download the biodiesel calculator, choose a blend percentage and a biodiesel source (feedstock), and enter a value of 10,000 L. Then scroll down to "Lifecycle Greenhouse Gas Amounts" and then divide the number listed under diesel only and biodiesel blend by 10,000. These two numbers represent the emissions factor for diesel and biodiesel respectively.
[iii] ibid.
[iv] City of Toronto: Fleet Services – Green Fleet Plan Actions; http://www.toronto.ca/fleet/gfp_actions.htm; April 6th, 2010
[v] The Motive Fuel Tax; http://web2.gov.mb.ca/laws/statutes/ccsm/m220e.php; March 22nd, 2010
[vi] Source: Federation of Canadian Municipalities
[vii] Source: City of Hamilton – Green Fleet Plan; http://www.hamilton.ca/citydepartments/publicworks/fleetservices/green+fleet+plan.htm; March 9, 2010