



Fuel-efficient Driver Training for Municipal Heavy-duty and Transit Vehicles

Overview

Transit and heavy-duty vehicles, such as snowplows, graders and sanitation trucks, make up the majority of the Canadian municipal fleet. These types of vehicles consume large amounts of fuel and are also in service many more hours per day than other types of municipal vehicles, leading to higher maintenance costs than smaller light- to medium-duty vehicles.

As more and more Canadian municipalities recognize the importance of long-term sustainability planning to cut costs and improve quality of life, many municipal fleet managers have been asked to find ways to improve the performance of these vehicles.

Purchasing new, more fuel-efficient models or switching to alternative fuels are viable options, but one of the quickest and lowest-cost measures to cut fuel consumption, operational costs and greenhouse gas (GHG) emissions is to train drivers in fuel-efficient driving techniques.

This issue paper explores a number of driver training programs and policies that can help fleet managers cut costs, while meeting their municipality's long-term environmental goals.

Selected Resources

Natural Resources Canada's *Smart Driver* and *FleetSmart* programs. <http://fleetsmart.nrcan.gc.ca/index.cfm>

Gas Addict, *Fuel Efficient Driving: The Qualitative Tests, Experiments, Case Studies*.
<http://www.gasaddict.ca/casestudies/FuelSmartCaseStudies.pdf>

The Issues

Those in the green building sector will often tell you that, regardless of how energy efficient a building is, maximum savings will not be reached if occupants are not trained to spot energy-saving opportunities.

The same holds true for fleets. Although new vehicle technologies can dramatically reduce fuel consumption, driving style also has an impact on fuel use. Studies by the Organisation for Economic Co-Operation and Development and the U.S. Department of Energy (*see the*

Resources section) show that driving behaviour can improve fuel economy between 5% and 25%, depending on the type of vehicle, road conditions, etc. Fuel-efficient driver training, therefore, is an important element in keeping fuel costs and GHG emissions under control.

Health issues

The transportation sector as a whole is responsible for about one-quarter of Canada's GHG emissions. With respect to transportation emissions, the health exposure to smog—a mixture of ozone and particulate matter from vehicle exhaust and smokestacks—is of particular concern.

The Canadian Medical Association reports that about 2,700 people die each year as a result of acute short-term exposure to air pollution and a further 21,000 Canadians die from long-term exposure, with Ontario and Quebec having the largest proportion of acute premature deaths. The associated economic costs are estimated at \$8 billion, a figure that could rise to \$250 billion by 2031.

Canada's municipal fleet

There are roughly 3,700 municipal governments in Canada, ranging in population from the millions to just a few hundred.

On average, the Canadian municipal fleet accounts for about 5% of total municipal-wide GHG emissions, and can cost a municipality millions of dollars a year in fuel costs (Transport Canada).

However, depending on the size of the municipality and what fleet services it operates, the percentage of emissions from transportation can range a great deal.

Municipal and transit vehicles in Edmonton, for example, account for 20% of the city's corporate emissions (Transport Canada), whereas Halifax's municipal fleet, which includes transit, accounts for only 8% of all corporate emissions.

Benefits to municipalities

Training municipal fleet operators in fuel-efficient driving behaviours can reduce fuel consumption. Even small decreases in fuel consumption, depending on the size of

the fleet, can have a major impact on the amount of money a municipality spends on fuel.

Fuel-efficient driver training can also lead to lower maintenance costs (e.g. fewer brake replacements), fewer on-road accidents and improved comfort for transit passengers.

In addition, fleet drivers who are trained in fuel-efficient behaviours often apply their on-the-job training to their personal driving habits, cutting their own costs and further reducing community-wide GHG emissions.

Fuel-Efficient Techniques

Driver behaviour can have a tremendous impact on fuel efficiency as well as on the cost to maintain certain vehicle parts, particularly brake pads.

Organizations that encourage fuel-efficient driving all promote similar techniques, all of which can be applied to most types of vehicles. The most common are:

1. Pulse and coast (also known as pulse and glide). This technique involves using the vehicle's own momentum and coasting to reduce fuel.
2. Extend the buffer space between cars from 1 second to 3.
3. Anticipate traffic flow by keeping eyes on the horizon, coasting to gradual stops and changing lanes to avoid upcoming obstacles.
4. Drive under 200 revs per minute, i.e., smoother and slower acceleration and braking.
5. Drive uphill at 10 km/hr under the speed limit.
6. Keep tires properly inflated as per vehicle specifications.
7. Drive 10 km/hr under the posted highway speed limit.
8. Reduce aerodynamic drag by keeping windows closed while driving.

In one study, all of these techniques were tested for Gas Addict (an interactive website devoted to improving fuel-efficient driving) by members of the Environmental Youth Alliance.

Each technique was tested independently (not in combination with other techniques) and, in most cases, only once and not repeated. Results are preliminary, at best, but overall fuel efficiency improved by about 25% (Auto\$mart). A link to the full study can be found in the **Selected Resources** section above.

Fuel-Efficient Driver Programs

Several training programs, including train-the-trainer programs, are available to municipal fleet and transit managers.

SmartDriver

Natural Resources Canada (NRCan) *SmartDriver* is one of the oldest programs in Canada, originally developed in the mid-1980s for the freight industry. Today, NRCan offers fuel-efficient driver training programs for highway driving, the forestry sector, urban driving, motor coaches, and school buses. In addition, the Canadian Urban Transit Association operates NRCan's *SmartDriver for Transit* program (see below). Training costs varies depending on the type of course, but typically NRCan covers the cost of sending a driver trainer to a site, classroom rental (if required) and the shipping of course materials.

All of their courses offer fleet managers information and workshops that show how fuel consumption, vehicle wear and tear, and costs can be reduced through more efficient driving techniques.

"Each of the programs address the same issues, but in a different way depending on the type of fleet," says Lynda Harvey, Senior Manager, Fleet Vehicles. "The highway



trucking course, for example, is delivered as four modules of two hours each. The workshop can be done in one day or can be spread out."

Each of the programs look at how different engines run, how fuel burns, the importance of maintenance and repair, then moves into driving skills, such as route planning and speed management.

"All of our programs educate drivers about fuel-efficient driving, but also give drivers a refresher in defensive driving," says Harvey.

To date, NRCan boasts a database of more than 7,000 members in the *SmartDriver* programs.

"We are starting to see a pattern across all sectors of about 5%-8% fuel reduction," she says. "The other important thing is that idling time has been reduced. When municipalities or companies start to look at the impacts of driver behaviour, they often put in idling policies which further reduce consumption."

SmartDriver for Transit

NRCan's *SmartDriver for Transit* has been run by the Canadian Urban Transit Association (CUTA) since 2001 and is the only *SmartDriver* program that offers drivers an on-road practicum.



CUTA's one-day program begins with transit drivers driving a predetermined route in their regular driving style. Information from the bus's electronic control module (ECM) is downloaded to a handheld computer (the QC5100 system, pictured at left) for later study.

Drivers then receive four modules of theory that includes factors that affect fuel efficiency, vehicle care and inspection, defensive and fuel-saving driving techniques.

Once training is complete, transit drivers do a post ride on the driving course and apply the skills they have learned. They are also coached by an on-board instructor. The ECM data is then uploaded to the *SmartDriver* database and instructors review the results with the drivers.

Moudakis says that fuel efficiency improves by up to 10% during training because the training is conducted on a set course and drivers have access to an on-board instructor. In actual driving conditions, fleet managers can expect fuel efficiency improvements of about 5%.

"Using a results record and tracking data through the onboard computers of the buses, the database provides fleet-wide information on a large number of parameters and events and broad-based data that can be used in a number of ways related to costing and projections, fleet and driver performance," explains John Moudakis, CUTA's Acting Director of Education and Training. "Data are integrated into three reporting streams: individual operators, system-wide comparative and custom selective reports that allow you to quantify the return on investment of your driver training program."

In October 2009, CUTA amended the program to focus on train-the-trainer workshops, rather than training courses for individual drivers. "We want to cascade the information from the master trainer to the trainers and then to the on-site operators," says Moudakis. To date, 18 transit fleet managers from across Canada have been certified as master trainers.

DriveWise

DriveWise Canada, a private sector company, works with drivers in several sectors including commercial fleets, law enforcement, emergency management, municipal works and airport operations.



Specific to municipalities, DriveWise offers fuel-efficient driver training for many of the most common municipal vehicles including snowplows, dump trucks, fire and other emergency vehicles, and garbage trucks.

DriveWise developed a simulator that simulates actual driving conditions and displays, in graph format, the vehicle speed, acceleration and brake pressure, fuel consumption and following distance (buffer space).

The simulator module, which uses driver simulation technology from MPRI, a communications company, was developed for NRCan. It promotes five key driving tips: accelerate smoothly; keep a steady speed; anticipate traffic; coast to decelerate; and reduce high speeds.

"Using the simulator we can create a training program for virtually any type of vehicle," explains Jerry Power, DriveWise's Sales and Marketing Coordinator. "We have yet to experiment with hybrid vehicles, but if such a service is required we can provide it."

The District Municipality of Muskoka, Ontario used DriveWise to train their emergency management drivers.

"It was integral in changing the driving habits of our paramedics," says Terri Burton, Muskoka's Director of Emergency Services. "DriveWise was able to customize the training to include our unique landscape, terrain, weather and animals."

Power reports that, on average, fleets that use the DriveWise program decrease fuel and maintenance costs by about 5%.

Corporate Success Stories

Bison Transport

Bison Transport of Winnipeg is one of Canada's largest freight trucking firms with more than 850 trucks that operate across the country.

It has used the MPRI driver simulation technology since 2002 and each new driver receives at least two hours of training on fuel-efficient driving techniques.

Rob Penner, Bison's Vice-President of Operations, reports that fuel-efficient driver training saves the company more than \$1 million in fuel costs every year. "We've also seen a huge improvement in safety, which has helped us boost recruitment and retain drivers," he says.

Over the past several years, all new tractors have been equipped with in-dash fuel economy readouts so drivers can note their fuel economy instantaneously as they are driving.

"Each improvement of 0.5 litres per 100 km reduces our fuel bill by about \$280,000 a year," says Jon Sigurdson, Bison's Fuel Manager. "That is a strong incentive to improve fuel economy. We believe we can improve our

fleet fuel economy by at least another 2.2 litres per 100 km."

Instinct Trucking Ltd.

Instinct Trucking Ltd. of Edmonton specializes in the transport of bulk liquids, operating 30 tractors and 90 tank trailers.

A combination of on-board computers, fuel-efficient driver training, incentive programs, and policies that limit vehicle idling and speed are among the measures that the company has implemented over the last decade.

Owner Jerry Semen estimates that the use of the on-board computers has improved fuel efficiency by about 5% and that the initial cost to install the system (\$100,000) was repaid in only six months. Its vehicle maintenance and driver training programs have improved efficiency by another 2%.

NFI Industries

New Jersey-based NFI Industries, a heavy-duty trucking firm, improved its fuel efficiency by 3.5% between 2008 and 2009, and cut idling time by 44% using a variety of fuel-efficiency initiatives. The savings have translated into a carbon dioxide reduction of more than 130,000 metric tonnes, 16.7 tonnes of which was particulate matter.

Mechanical changes included adding auxiliary power units to its vehicles, lowering the horsepower on all engines and purchasing lower horsepower engines to achieve greater efficiency. The company also tested different mud flaps, which allow air and water to flow through and reduce drag, and are experimenting with "airtabs," small plastic devices that mount on the back of the trailer. This technology redirects air flow and breaks up suction in the back of the truck.

"Driver behaviour, however, is the single greatest contributor to fuel efficiency," says Rob Barron, Senior Vice-President at NFI Industries.

NFI's *Maximize Miles* program trains drivers in fuel-efficient techniques and keeps drivers engaged using letters, posters and newsletters. The company also targets drivers where they are: behind the wheel. Dashboard stickers remind drivers of four key steps: 1) shift gears in the right RPM for maximum power and efficiency; 2) start trucks in the most fuel-efficient gear; 3) eliminate unnecessary idling; and 4) check tire pressure before each trip.

Transit success stories

CUTA ran a pilot study beginning in January 2009 with five transit systems (North Bay, Windsor, Nanaimo, Halifax and Brampton). "We wanted to see if the program really does give fuel and costs savings," he says. "We had drivers from those five agencies and did a pre-run of all of their systems. We then downloaded all the information, did the training and then a post-run five times over the course of a year to ensure that the operators were properly trained. Once the year was finished, we found that it works!"

North Bay Transit, for example, reduced its fuel consumption by 15.7%, the amount of fuel used by idling vehicles by more than 22%, and the number of brake replacements by 14%. Halifax Transit saw a 34.5% reduction in services to brakes.

Windsor Transit also saw big reductions in fuel consumption (24.5%) and, with route planning and other driving techniques, reduced total trip distance travelled by operators by 7%. In Nanaimo, average vehicle speed decreased by 6.5% and fuel use by 10%.

Training for this pilot project was performed on a closed course, so these figures are somewhat higher than what most transit or municipal fleet managers can expect in actual driving conditions. In addition, drivers had access to an on-board coach, who reminded drivers of particular fuel-efficiency behaviours.

Ottawa, Ontario

Raymond Bedard of Ottawa's OC Transpo transit agency completed his master training with *SmartDriver for Transit* in 2008. Since then, has helped to train more than 1,800 OC Transpo drivers in fuel-efficient driving techniques.

OC Transpo has seen fuel consumption fall by about 3%. "This is normal and when you're talking about millions of dollars spent in fuel costs, that's pretty good," says Bedard. "We've also seen a reduction in brake pad replacements. Our mechanics say that the parts are sitting on the shelf for longer." Bedard reports that customer complaints of rough driving have also decreased.

Bedard says that the techniques he learned through *SmartDriver for Transit* can be applied year round to traditional diesel-fueled buses as well as hybrid vehicles.

Of its total 850-bus fleet, OC Transpo operates about 200 hybrid diesel-electric buses. Although *SmartDriver for Transit* does not offer any specific techniques with respect to hybrid buses, Bedard says that drivers are taught the same techniques for hybrids as they are for diesel buses.



One of OC Transpo's Orion VII Hybrid buses. Photo courtesy of OC Transpo.

"Our hybrids come with SmartDriver 'brains,' if you will, so they do some of the work that we would teach in non-hybrid buses," he says. "For example, in terms of training drivers to go slower uphill, the hybrid buses do it themselves, so we tell drivers to listen to the bus and check its performance against what they've been taught in the classroom."

Bedard says that the training doesn't stop at work. "Many of our drivers have applied the principles to their personal vehicles and have taught their teenaged children and their spouses," he says. "It's a key message in terms of what's in it for them—they save money, too."

Montreal, Quebec

From 2004 to 2009, the Société de Transport de Montréal (STM) trained most of its 2,500 bus drivers in fuel-efficient techniques through the *SmartDriver for Transit* program.

STM drivers received a one-day training session divided into three periods: road pre-test, theory, road post-test. Software compares the results of both road tests and, during the training day, drivers typically achieve average fuel savings of about 12%.

In addition to the training, mechanical decelerators have also been installed in STM's diesel-fueled buses. When the accelerator is released, the mechanical decelerator is activated. STM reports that brakes last two to three times longer as a result.

STM also installed the mechanical decelerators on its hybrid diesel-electric buses. These types of vehicles combine an internal combustion engine with an electric motor, rechargeable batteries and a regenerative braking system that captures and reuses the energy that is lost during traditional vehicle braking. STM reports that the decelerators help to recharge the bus's batteries even more than the use of brakes, leading to even greater fuel economy on hybrid buses.

Like Ottawa, STM has found that smoother acceleration provides better passenger comfort and that driver training has helped to reduce the risk of traffic collisions.

"Drivers stick their new driving habits when they see their own fuel savings," says Patrice Labreche, STM's Head of Training.

Lethbridge, Alberta

Lethbridge Transit operates 40 buses on 15 routes. All of their drivers have been trained in *SmartDriver for Transit* techniques.

"The training does mean that most operators had to change their driving behaviour," says John King, Transit Manager, "but operators can see the results immediately on the day of training so that, after the training, they can do their best to drive smart." During the training, King says that drivers reduced fuel by 8%-10%. In actual driving conditions Lethbridge Transit drivers have consistently achieved fuel reductions of about 3%.

Victoria, BC

BC Transit in Victoria began using the *SmartDriver for Transit* techniques in 2005 and recently completed refresher training for 470 of its operators.

"After both sessions, we've seen significant reductions in on-road incidents and preventable accidents," says Steve New, Senior Vice-President of Municipal Systems, BC Transit. "With fuel prices rising, there's never been a better time to implement *SmartDriver*."

Edmonton's FuelSense

Originally developed as the DECAT program (Driver Energy Conservation Awareness Training), the City of Edmonton's *FuelSense* program has been in effect for more than 30 years.

City policy requires all full-time municipal drivers to under a four-hour training program on fuel-efficient driving practices that includes both on-road and classroom training. To date, more than 800 fleet drivers have been trained, resulting in fuel savings of about 10% (200,000 litres a year).

"Heavy-duty vehicle drivers are included in the training," says Mike Humen of the city's Corporate Services, Fleet Services & Fleet Safety. "They don't take the on-road course in a heavy-duty vehicle, they take it in one of our *FuelSense* vehicles, but the concepts and training is basically the same."

Where the concepts differ, says Humen, is in the weight of the vehicles. Since heavy-duty municipal vehicles have more mass, the following distance (buffer space) is longer compared to smaller vehicles and, consequently, stopping distance is longer. "The advantage in a larger vehicle is that your line of sight is better," he says. "Anticipating

traffic flow and obstacles is one of the things we teach, so in larger vehicles drivers are higher up and have a greater line of sight. Heavy-duty vehicle drivers are also downshifting more and that saves fuel and brake replacements.”

The program also offers incentives to department heads to eliminate or downsize their fleet vehicles. City departments are charged a fixed fee for each vehicle, and an additional charge per hour or kilometre (based on fuel, maintenance and repair expenses). Each department gets to keep any financial savings. As a result, total fleet size has dropped and vehicles purchased have generally been the smallest and most efficient models that can meet department needs.

Other Heavy-Duty Vehicles

For municipalities, the two most common heavy-duty vehicles are snowplows and garbage trucks, which have several stops and starts along their routes.

Even though many of the driving practices are the same regardless of the type of vehicle, very little research has been done to assess the impact that driver training has on these types of heavy-duty vehicles.

One study (Arizona Department of Transportation), however, did examine how driving behaviour affects the fuel efficiency of snowplows.

The goal of the study was to identify the benefits of simulator-based training on fuel efficiency. The simulator was set for a 168-mile (270-km) round trip on a winding route with many steep grades.

Five newly hired drivers were tested before and after fuel-efficiency training in both automatic and manual-shift snowplows. After training, a 4.5% improvement in fuel economy was found in the manual-shift vehicles.

The department concluded that better driver training was required for manual gear shifting and a review of best practices was required for automatic gear shifting.

Winter Driving

Fuel efficiency is affected by the season. In Canada, where winter lasts for several months, cold engines often mean thicker oil, which takes longer to circulate and can increase engine wear. NRCan’s Office of Energy Efficiency offers fuel-efficiency tips for winter driving:

- Use automatic timers to switch on block heaters two hours before the vehicle is to be driven.
- To prevent window fogging, drivers should open a window as soon as they enter the vehicle. This avoids the use of the energy-using defroster.
- Since added weight can adversely impact fuel efficiency, snow should be cleared off of wheel wells and bumpers.

- Cold temperatures decrease tire pressure, which adds to the rolling resistance caused by ice and snow. Drivers should check tire pressure frequently, especially after a major temperature change.

Engaging Key Stakeholders

Any program to change driver behaviour relies on a variety of people: fleet managers, senior staff responsible for training budgets, and perhaps most importantly, the drivers themselves.

Fleet and transportation program managers

NRCan’s Harvey says that one of the most important things a program manager can do—even before offering driving training—is to create a fuel management plan.

“We developed our *Fuel Management 101* course specifically for managers who don’t know where to start,” she explains. “The workshop provides the fundamentals of developing a business plan about fuel use, how to collect data from your fleet and how to develop a baseline. You can’t tell how well you’re doing in any program unless you know where you’re starting from.”

Once transit agencies or municipalities have a fuel management plan and have chosen the issues they want to work on first, Harvey says that it’s important to do things one at a time.

“Managers should also look at vehicle idling time and implement anti-idling policies. If you implement simple things like that, you can work on scheduling and getting your business lined up to take driver training because now you have an understanding of what those other practices are delivering.”

OC Transpo’s Bedard says that the first thing any fleet manager should do when considering a driver training program is to get the drivers’ union on board.

Edmonton’s Humen says that driver trainers should have a good understanding of a driver’s current behaviour in order to engage drivers effectively. “If you look at a driver’s age, their driving history and the type of vehicle they are going to be driving, you can teach them exactly what to expect,” he says.

Senior managers and municipal planners

Obtaining senior management approval is also high on Bedard’s list of advice.

“The impetus for the program has to come from upper management—the municipality, the union or the transit agency—because there are resources that need to be directed toward the training,” he says. “For example, you need to send trainers to the train-the-trainer sessions offered by CUTA. If it’s in-house, it’s not that expensive, but you do need to buy some equipment like the QC5100 [each unit costs \$1,300]. There is also the cost of taking

people off their shift to do the training itself, which is a full day. When you take a driver off the road, you have to pay overtime for another driver to cover those routes.”

NFT’s Barron acts as his company’s ‘fuel efficiency czar.’ He meets monthly with other members of his staff to discuss ways to improve fuel efficiency.

“Having a good program requires a recognition on the part of the company as a whole that this has to be a priority,” he says.

Drivers

No one likes to be told that they’re not doing a good job. Bedard says that a good publicity campaign beforehand will help to alleviate that as well as alert drivers to what’s coming.

“Most transit drivers are good drivers. We’re not asking them to drive in a brand new way, but in a *different* way. That has to be the key message.”

Humen believes that on-road training—not just classroom training—is essential for most drivers to understand the concepts. “Our drivers respond very well to the training especially when they can see it for themselves between the first and second course runs,” he says. “Any hands-on course, when you can get out and actually do something, tends to be better received.”

Policy Resources

Municipalities can benefit from other communities that have already implemented fuel or energy management plans, or climate change strategies that include fleet issues.

Fleet Challenge Ontario, for example, lists several workshop presentations (www.fleetchallenge.ca/projects.html) that cover a variety of these issues, and also provides a best practices manual that covers all fleet-related issues (www.fleetchallenge.ca/pdfnew/FCOntario_MunicipalBestPracticesManual2008.pdf).

The Federation of Canadian Municipalities recently launched its Enviro-Fleets initiative (www.sustainablecommunities.fcm.ca/Enviro-Fleet/). This new site will eventually include best practices guides, information on webinars and other resources for fleet and transit managers.

Conclusion

Fuel-efficient driver training can be one of the quickest and most cost-effective ways to reduce fuel and maintenance costs. In addition, since many training programs include a review of defensive driving techniques, the incidence of collisions is often reduced and, with respect to transit, fuel-efficient driver training also results in increased passenger comfort.

These benefits do not only accrue to local governments. Many fleet drivers who have taken fuel-efficient driver training apply those same techniques to their own personal vehicles, increasing road safety for all Canadians.

Resources

Arizona Department of Transportation. *Snowplow Simulator Training Evaluation*.

http://www.azdot.gov/TPD/ATRC/publications/project_reports/PDF/AZ635.pdf.

Canadian Medical Association. *No Breathing Room: National Illness Costs of Air Pollution*. August 2008.

http://www.cma.ca/multimedia/cma/content/Images/Inside_cma/Office_Public_Health/ICAP/CMA_ICAP_sum_e.pdf.

City of Edmonton. *FuelSense Project*. <http://www.edmonton.ca/environmental/documents/CityGov/FuelSenseProject.pdf>.

City of Whitehorse. *Local Action Plan for Climate Change*.

http://www.city.whitehorse.yk.ca/index.asp?Type=B_BASIC&SEC=%7B4107BA9A-F21B-4308-B0B7-F2C168ADBCC0%7D.

DriveWise Canada. <http://www.drivewisesafety.com/drivewise/>. For a video of the program, see:

<http://www.youtube.com/watch?v=zDzptF0ImHo>.

Federation of Canadian Municipalities. *Enviro-Fleets*. <http://www.sustainablecommunities.fcm.ca/Enviro-Fleet/>.

Fleet Challenge Ontario. <http://www.fleetchallenge.ca/projects.html>. Scroll down to view workshop presentations that cover fuel management, green purchasing, idling policies and driver training. *Best Practices Manual 2008*.

www.fleetchallenge.ca/pdfnew/FCOntario_MunicipalBestPracticesManual2008.pdf.

Halifax Regional Municipality. *Corporate Local Action Plan to Reduce Greenhouse Gas Emissions*.

<http://www.halifax.ca/environment/documents/HRMCorporateClimateLocalActionPlan.pdf>.

Natural Resources Canada. *FleetSmart Profiles: Municipalities and Utilities*.

<http://fleetsmart.nrcan.gc.ca/index.cfm?fuseaction=docs.view&id=municipal-edmonton>. AutoSmart Thinking—Driving and Maintaining Your Vehicle. <http://oee.nrcan.gc.ca/transportation/personal/driving/autosmart-maintenance.cfm#winter> and <http://oee.nrcan.gc.ca/transportation/business/documents/drivers-educators/winter-2007.cfm?attr=16>.

Organisation for Economic Co-Operation and Development. *The Environmental Impacts of Increased International Road and Freight Transportation*. <http://www.oecd.org/dataoecd/10/62/41380980.pdf>.

Science Daily. *Improving Fuel Economy of Tractor-Trailers, Buses, Work Trucks*.

<http://www.sciencedaily.com/releases/2010/03/100331122658.htm>.

SmartDriver for Transit. <http://www.smartdriverfortransit.com/>.

Technical University, Madrid, Spain. *A Human Factor-based Approach for the Effective Use of Driving Simulators and E-Learning Tools in Driver Education and Training*. <http://www.conference.noehumanist.org/articles/Proceedings-HUMANIST-S4.4.pdf>.

Transport Canada. *Biodiesel in Transit and Municipal Fleets*. <http://www.tc.gc.ca/eng/programs/environment-utsp-biodieselintransitandmunicipalfleets-1067.htm>.

Transport Canada. *Fuel Sense: Making Fleet and Transit Operations More Efficient*.

<http://www.tc.gc.ca/eng/programs/environment-utsp-fuelsense-1166.htm>.

Trucking Info. *The Fuel Efficiency Czar*. [http://www.truckinginfo.com/clean-green/news-](http://www.truckinginfo.com/clean-green/news-detail.asp?news_id=70834&news_category_id=62)

[detail.asp?news_id=70834&news_category_id=62](http://www.truckinginfo.com/clean-green/news-detail.asp?news_id=70834&news_category_id=62).

U.S. Department of Energy. *Heavy-Duty Truck Emissions and Fuel Consumption*.

http://www1.eere.energy.gov/vehiclesandfuels/pdfs/deer_2005/session5/2005_deer_erkkila.pdf