Behind the Wheel

Opportunities for Canadians to drive less, reduce pollution and save money

Cherise Burda, Katie Laufenberg, Alison Bailie, Graham Haines

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The Pembina Institute
Box 7558
Drayton Valley, Alberta
Canada T7A 1S7
Phone: 780-542-6272

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About the Pembina Institute

PEMBINA institute *Leading Canada's transition to a clean energy future*.

The Pembina Institute is a national non-profit think tank that advances clean energy solutions through research, education, consulting and advocacy. It promotes environmental, social and economic sustainability in the public interest by developing practical solutions for communities, individuals, governments and businesses. The Pembina Institute provides policy research leadership and education on climate change, energy issues, green economics, energy efficiency and conservation, renewable energy, and environmental governance. For more information about the Pembina Institute, visit www.pembina.org.

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Behind the Wheel

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Behind the Wheel

What we drive, how much we drive and how we drive impacts our use of oil, the greenhouse gases we produce, and our wallets. This report examines opportunities that Canadians have to reduce these impacts, lightening their load on the environment and saving fuel costs.

Transportation is responsible for a quarter of the greenhouse gas emissions in Canada, and personal vehicles contribute the majority of these emissions.[1] Reducing the impact of our transportation choices will require proactive government policy and industry leadership. Vehicle efficiency and fuel quality standards, along with investment in transit and electric vehicle infrastructure, are some of the policy actions required by governments and vehicle manufacturers. We also need smarter planning strategies to limit urban sprawl and reduce the need for long commutes.

However, Canadian drivers can also take the issue — and the steering wheel — into their own hands by making choices that reduce their personal environmental impact while saving money at the pump.

This report focuses on three types of actions Canadians can take:

1. Leave the car at home: Canadians have the greatest opportunity to reduce their transportation impacts by driving less, making use of public transit, car-pooling, walking or cycling for commuting and shopping.
2. Choose a cleaner vehicle: If no realistic options exist for driving less, drivers can reduce their impact by choosing more efficient vehicles, or even vehicles running on alternative fuels, such as electricity.
3. Drive smarter: In addition to the above, drivers can reduce their use of fuel by utilizing more fuel-efficient driving techniques.

Each of these opportunities is examined in detail in this report. In addition, we discuss how government and industry can help with policies, technologies and incentives to encourage Canadians to take the high road to less costly, more environmentally friendly mobility.

Easy steps out of the car

Looking for a way to get started on driving less, reducing pollution and saving money? Try these easy first steps:

- Talk with your employer about telecommuting once or twice a month.
- Try cycling or walking to your nearest regular destinations. You'll be surprised at how quickly you get there!
- Make a point of checking your tire pressure every month.
- Test drive an electric vehicle.
- Browse the fuel consumption guide to see how much you could save with a different vehicle.
- Find out if your employer or municipality has a carpool program that you can join. Try it for a month.

1. Impacts of driving in Canada

According to Canada's national greenhouse gas inventory, the transportation sector is the largest emitter of greenhouse gas (GHG) emissions in Canada (Figure 1). In 2010, the transportation sector accounted for 24% of greenhouse gas emissions in Canada. Between 2010 and 2020, emissions from the sector are expected to grow by about 3%.[2] It is critical for Canada — and Canadian drivers — to determine ways to reduce greenhouse gas emissions from this sector.

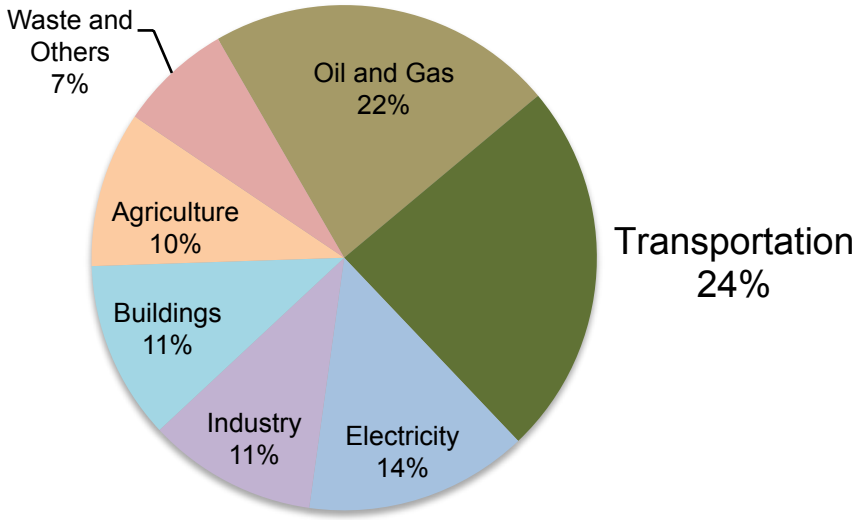


Figure 1: GHG emissions by sector 2010

Calculated using data from Environment Canada[3]

1.1 Getting personal with emissions

Each year, Canadians drive over 300 billion kilometres in their cars, trucks and motorcycles,[4] with the average Canadian household driving around 26,460 kilometres per year.[5] Much of this driving is commuting, with the average Canadian spending close to an hour getting to and from work by car each day.[6] The remaining driving is for other reasons such as shopping, recreation, getting to hockey practice, going to the gym, and driving for vacations.

All of this driving means our personal cars and trucks emit a lot of greenhouse gases — over 50% of all transportation greenhouse gas emissions,[7] or more than 10% of Canada's total emissions. By comparison, freight trucks and other heavy-duty vehicles account for about 31% of total transportation emissions. See Figure 2.

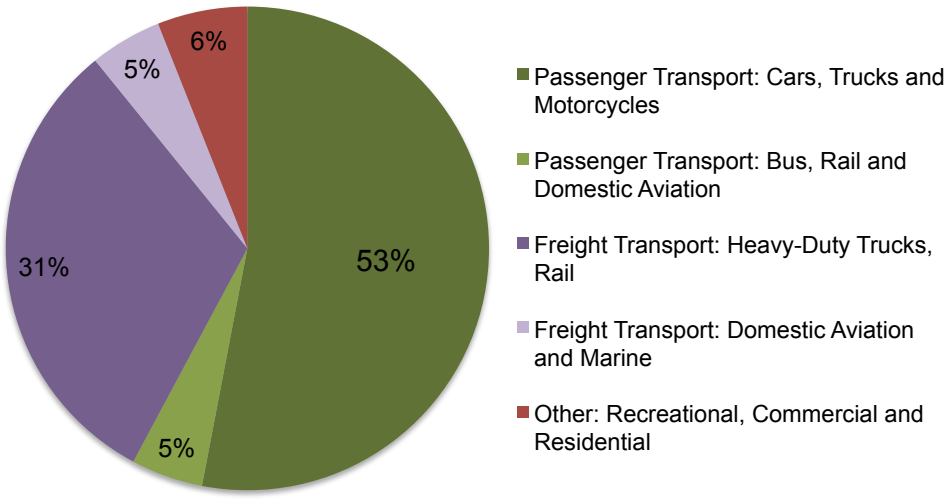


Figure 2: Transportation GHG emissions by mode

Calculated using data from Environment Canada[8]

Emissions from our cars, trucks and motorcycles are expected to decrease 16% by 2020 as a result of more efficient vehicles and continued urbanization.[9] Despite this decrease in emissions, personal transportation will remain the largest portion of our total transportation emissions in 2020. And it is one of the components of our personal emissions profile with the greatest potential for reduction through individual practices and decisions.

1.2 The impacts of driving

All of this driving adds up on a personal level. For the average Canadian, driving produces about 4.6 tonnes of CO_2e per year per vehicle[10] — about the same as the total emissions from cooking for 4,000 summer parties using a propane barbeque![11] It also amounts to a lot of gas in the tank. Collectively Canadian drivers consume over 36 billion litres of fuel a year, which equals about 243 million barrels of oil a year,[12] thereby contributing to the impacts of oil extraction and production in Canada and elsewhere, from Alberta's oilsands to offshore drilling.

Figure 3 below illustrates the relative greenhouse gas emissions per kilometre from various modes of travel. It is clear that the choice to drive cleaner vehicles, drive more efficiently or not drive at all has a large impact on individual emissions.

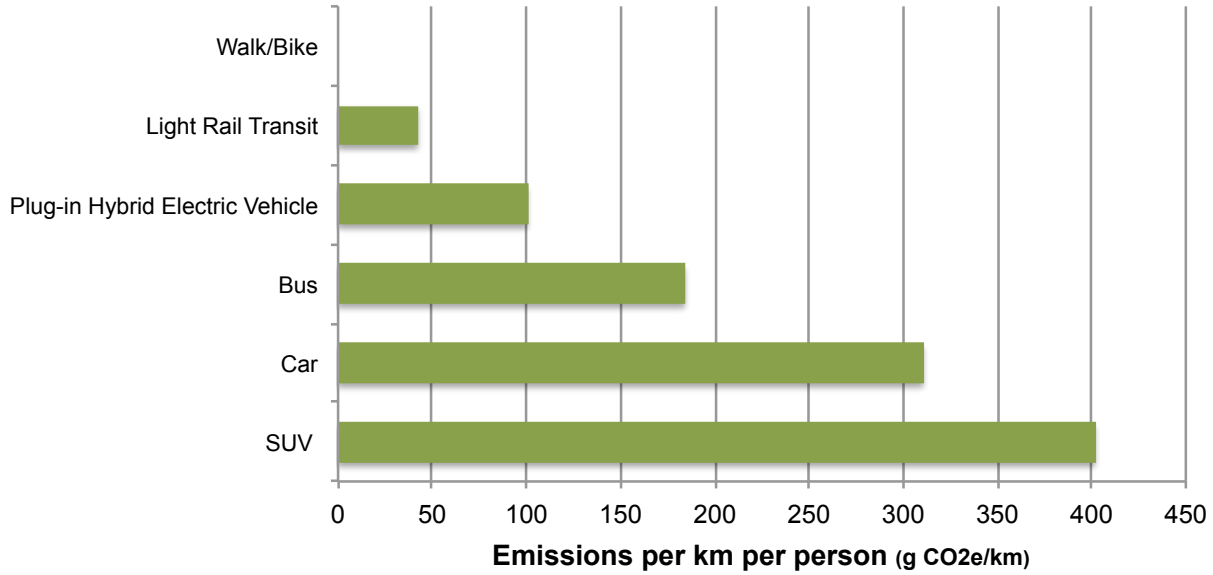


Figure 3: Emissions per kilometre by transportation mode

Calculated using data from Transport Canada[13]

However, greenhouse gas emissions are not the only issue at hand; road transportation — cars, trucks and buses — is one of the largest sources of the local air pollution, such as smog, that is linked to negative health effects including asthma. Unlike other sources of air pollution such as power plants or factories that can be located away from population centres, road traffic occurs where we live, work and play everyday. Studies in Canada, the United States, and Europe show that children living in areas with high road traffic volumes have greater respiratory illness symptoms than other children, along with a host of other lung and heart illnesses in adults.[14] These impacts pose a major cost to society; the U.S. Environmental Protection Agency estimates that car crashes and air pollution from cars cost American society between $535 and $4,214 per person per year.[15]

Driving affects our pocketbooks as well as the planet and our health. Gasoline costs the average Canadian car-owner about $2,465 a year, but that's only the start:[16] owning and operating a new mid-size car costs between $10,000 and $11,000 per year.[17] This includes insurance, registration and licensing, vehicle depreciation, vehicle loan payments, fuel, tires and maintenance.

The Dirt on the Drive

On the Road: The average Canadian spends an hour commuting by car each day.

In the Tank: The average Canadian consumes about 1,926 litres of gasoline and spends an average of $10,500 per year driving a car.

Out the Pipe: The average Canadian vehicle emits about 4.6 tonnes of CO_2e per year.

1.3 Reducing impacts from driving — profiles of four drivers

Reducing how much we drive, what we drive and how we drive can reduce the environmental effects from Canada's transportation sector, not to mention reducing costs for Canadians.

The following chapters in this report present actions and choices Canadians can make to reduce both the amount of time we spend behind the wheel and the emissions from our vehicles when we do drive. To illustrate and quantify the potential outcomes from Canadians taking one or more of these three main actions — leaving the car at home, choosing a cleaner vehicle and driving more efficiently — we present four driver profiles to represent the diverse circumstances of Canadians. For example, many of us live in urban centres and have options to get to work other than driving alone, while many other Canadians live further from their destinations or have travel patterns where transit is impractical and driving is required.

We considered four types of drivers:

A: The Urban Dweller – Lives in the metropolitan centre of a city or town, with an average one-way commuting distance of five kilometres.

B: The Metro Motorist – Lives within the city limits but outside of the downtown core (possibly an inner suburb), with an average one-way commute distance of 15 kilometres.

C: The Suburbanite – Lives in an outer suburb of an urban region beyond the limits of the main city (the census metropolitan area or CMA), with an average one-way commuting distance of 30 kilometres.

D: The Rural Rover – Lives and/or works in a location with dispersed population and jobs, and although the one-way distance is not excessive (10 kilometres), the commute is not conducive to cycling (e.g. it may be hilly or face dangerous traffic). Workers with late night/early morning shifts may also fall into this category.

As the objective of this analysis is to find ways for commuters to reduce their impacts from driving, for these profiles we assume that all of these commuters currently own a car and drive it five days a week to work and back. The options discussed in the next chapters provide ways each of these commuters — who represent four different types of Canadian drivers — can reduce the amount they drive and/or switch to more efficient vehicles and apply better driving skills. Table 1 below presents the starting point for each of these profiles — the type of car they drive and its assumed fuel efficiency, as well as current fuel costs and greenhouse gas emissions.

Table 1: Profiles of four Canadian drivers[18]

Commuter	Urban Dweller	Metro Motorist	Suburban-ite	Rural Rover
Commute distance (km/day one way)	5	15	30	10
Total annual distance driven (km)	7,800	18,000	25,200	15,600

Vehicle	Year 2006 compact car	Year 2012 SUV	Year 2012 pickup truck	Year 2000 pickup truck
Fuel efficiency (city/highway L/100 km)	9.6 / 7.2	10.4 / 7.2	15.0 / 10.0	17.0/11.7
Commuting days per week	5	5	5	5
Annual fuel consumption (L)	665	1,613	3,213	2,280
Annual fuel cost	$853	$2,071	$4,126	$2,928
GHG emissions (tonnes CO_2e / year)	1.59	3.86	7.69	5.46

Each of the following three chapters includes an illustration of how the different actions taken by each of these drivers can affect their transportation costs and emissions. In Section 5, we look at the effects of combining a package of options for each driver, and we review the results if a large number of Canadians did the same.

2. Leave the car at home

Depending on where you live, there are a number of opportunities to reduce how much and how often you drive. Finding opportunities to leave the car at home for both commuting and non-work travel can significantly reduce vehicle kilometers travelled, associated emissions and other environmental impacts, and personal costs.

Five key opportunities to reduce time behind the wheel are to:

- Take transit
- Carpool
- Telecommute
- Walk or bike
- Live closer to work

Tables 2 through 6 present the potential cost savings and greenhouse gas reductions annually that a driver could achieve based on these strategies. Cost calculations for auto-related savings are based on the average distance a car is driven in Canada (18,000 km/year) and includes insurance, maintenance, gas, and depreciation for an average-sized car. Depreciation costs are approximately $0.05/km while the other costs (gas, insurance, maintenance) add up to approximately $0.20/km.[19] In situations where a car is replaced, the savings are based on the total cost of vehicle ownership — estimated at $10,450 per year, which includes additional costs such as car loans and licensing/registration.[20] Greenhouse gas reductions are calculated from reduced gasoline use and increased use of fuel from other forms of transportation.[21]

In addition to these five strategies, car sharing is also described as an alternative for drivers who only occasionally need a car. Car sharing can eliminate the need to own a car by filling in the gaps that might remain after a commuter has adopted one or more of the above travel options and decided to become car-free.

2.1 Take transit

Riding transit is a cost-effective and low-impact method of commuting. However, transit is not an option for everyone. Canadians living in rural or suburban areas have little or no access to reliable and efficient transit; even within Canada's major cities there are significant gaps in transit service.

However, 80% of Canadians live in urban regions, and nearly 70% of Canadians who live in metropolitan areas have access to nearby public transit.[22] Currently, seven Canadian metropolitan areas (Montreal, Toronto, Ottawa, Calgary, Edmonton, Winnipeg and Vancouver) have rapid transit systems — subway, light rail, rapid busway or commuter train (such as GO train) — while most other urban centres have bus service.

For those with access to reliable transit, riding transit to and from work just one day a week can reduce personal transportation emissions by about 1 to 4%,[23] reduce gas consumption by over 91 litres and save $215 in auto-related costs (gas, maintenance and depreciation) per year.[24] If taking transit can help you replace a vehicle, thus eliminating vehicle ownership and use costs, these savings increase dramatically. See Table 2 for estimated savings.

Electric buses are popping up in some urban areas, but even a standard diesel bus is better for the environment, emitting less pollution per passenger kilometre than driving when there are more than five passengers on the bus.[25]

Commuters with the opportunity to ride rail-based transit can decrease their emissions even further. Road-based passenger travel produces two to four times more pollution per kilometre than rail-based travel, whether it be greenhouse gas emissions or smog-causing pollutants.[26]

Reduced use of parking offers a further costs saving. Parking costs in the downtown of a major city range from $152 per month in Winnipeg to over $450 in Calgary.[27]

Table 2: Potential annual savings from riding transit

Action	$ Savings	GHG ↓
Ride the bus to and from work once per week, but using the car the other four days (and weekends)	$215	1%
Ride the bus to and from work three times a week, but still maintaining a car	$646	4%
Ride rail transit to and from work three times a week, still maintaining a car	$646	13%
Replace all driving with transit (50% diesel bus, 50% electric rail), giving up a car[28]	$9,688[29]	60%

2.2 Telecommute

Telecommuting is a simple and cost-effective opportunity that can reduce the need to commute to and from work by allowing working from home. In addition to eliminating the commute, telecommuting carries a number of benefits for employees and employers:

- **Time savings:** The average Canadian commuter spends about an hour on their round trip to and from work.[30] Telecommuting gives this time back.
- **Cost savings:** Telecommuting two to three times a week could reduce costs of driving (based on an average sized car) by roughly $480 per year.[31] This again does not include the cost of parking (see Section 2.1).
- **Improved work-life balance:** Teleworking gives you more control over when and how you work, making it easier to meet personal and family commitments, and making for a happier employee.[32]

- **Greater productivity:** A variety of surveys have shown that telecommuting improves productivity. These include surveys by Cisco,[33] Telus,[34] and a study by Brigham Young University involving IBM employees.[35] Overall, based on a synthesis of studies, telework days are estimated to be 20% more productive than office work days.[36]

The benefits of telecommuting extend beyond you and your employer. By keeping yourself off of the road you help everyone else enjoy less stressful commutes; a study in Tokyo showed that telecommuting can help reduce congestion by 6.9–10.9%.[37]

While telecommuting comes with many benefits, it is unfortunately not an option for all Canadians; many Canadians must be at their place of employment every day because of the nature of their job. Across Canada we estimate that approximately 40% of Canadians could occasionally telecommute based on their jobs.[38] This is in line with a 2011 survey, which found that between 41% and 47% of jobs are compatible with working at home.[39]

Table 3: Potential annual savings from telecommuting

Action	$ Savings	GHG ↓
Telecommute once per week	$215	5%
Telecommute 2 -3 days days per week (but maintain a car)	$538	12%

Beyond the work-week, Canadians can also reduce the amount of driving they do by "tele-purchasing," meaning buying goods online. This might be a great option for Canadians who live in remote, rural and non-transit-connected communities. In urban areas it may be more practical to walk to stores and support the local economy.

2.3 Carpool

Work commutes are more frequently single-occupant trips (only the driver in the car) than non-commuting travel.[40] Carpooling provides an opportunity to reduce single-occupant trips, vehicle emissions and fuel consumption by increasing the number of passengers in vehicles for trips to work. Carpooling may involve passengers starting from similar nearby neighbourhoods and/or ending at nearby workplaces. There are an increasing number of programs that help connect carpool partners. For example, Smart Commute is a program of Metrolinx and the municipalities in the Greater Toronto and Hamilton Area that actively helps local employers and commuters find carpool services (as well as options to cycle and take transit).[41] Direct Energy in Toronto offers a vanpool to drive employees to and from work. This vanpool has reduced vehicle kilometres travelled by about 8,000 kilometres per month.[42] Vancouver Coastal Health Authority launched a two-year "Clean Commuter" campaign to encourage their employees to commit to more sustainable modes of transportation in getting to work.[43] Many employers also offer other benefits such as financial incentives, flexible work hours and preferential parking.

Carpooling is one of the simplest and cost-effective ways to reduce personal impacts of driving and save money, without making big lifestyle changes. Carpooling results in less emissions and personal savings both in terms of money and time:

- A carpooling review in Calgary found that 143 carpools formed in 2003 reduced annual greenhouse gas emissions by 854 tonnes.[44]
- A survey completed in 2005 by the Ontario Ministry of Transportation found that drivers using the high-occupancy vehicle (HOV) lane along Highway 404 reduced their travel time on the highway from 26 minutes to nine minutes, and in the year it was introduced increased participation in carpooling from 16% to 37%.[45]
- Carpooling can reduce auto-related costs by sharing commuting costs among carpool participants.
- Carpoolers often take advantage of perks and incentives provided by employers or local municipalities such as preferential or free parking.[46]

Table 4 below assumes that employees in a carpooling program will carpool daily. However, the degree of cost savings may depend on whether or not the commuter maintains a personal vehicle or gives it up in favour of using another mode of travel for non-work trips or using another car in the household.

Table 4: Potential annual savings from carpooling

Action	$ Savings	GHG ↓
Carpooling 5 days a week, but maintaining ownership and operation of a car for non-work[47]	$537	12%
Carpooling 5 days a week and giving up one car.[48]	$9,215	88%

2.4 Walk or bike

Many trips to work or shopping can be made by walking or biking. Choosing to live closer to work and common destinations (as discussed below) increases the opportunities to commute to work and travel to non-work destinations by foot or pedal and results in tremendous benefits:

- **Healthier lifestyle:** Walking and biking offer an opportunity to get exercise while commuting or running errands. A recent Toronto study found a correlation between body mass index and neighbourhood walkability.[49]
- **Cost savings:** Apart from the cost of your shoes and bike, active transportation offers free transportation which can you help you save significant amounts of money every year. Based on average auto-related costs, biking or walking to work just once a week can save $215 per year (see Table 5).
- **Cleaner air:** By walking or biking you are helping contribute to improved local air quality in your neighbourhood. Walking or biking once per week reduces your transportation-related greenhouse gas and smog producing emissions by 7%.

Table 5: Potential annual savings from active transportation

Action	$ Savings	GHG ↓
Bike or walk to work once per week, but maintaining a car	$215	5%
Bike or walk to work five times per week, still maintaining a car	$1,077	24%
Bike or walk to work every day and and give up a car	$10,452	100%

2.5 Live closer to work and daily destinations

Many Canadians opt to live in distant suburban neighbourhoods that require them to use a vehicle to get to work and most other regular destinations, because transit is infrequent, slow or non-existent. Recent research in the Greater Toronto Area indicates that this location choice is often driven by housing prices rather than by pure preference for this location.[50] However, a case study in GTA shows that it can be more cost effective overall to live closer to work and daily destinations and within easy access of rapid transit, because the costs of transportation — such as the long commute — are reduced. Moving to a location that allows you to eliminate one household vehicle provides savings equivalent to $200,000 on a 25-year mortgage.[51]

A study by the Neptis Foundation discovered that while housing purchase prices decrease with distance from the city centre, the amount spent on other housing costs (like maintenance, property taxes, utilities and insurance) increases. More importantly, however, as housing expenditures rise as one moves out from the centre, transportation expenditures rise even faster.[52] Those who choose to live in more "location-efficient" neighbourhoods — locations that are walkable, mixed-use, have access to rapid transit and provide real options to get around by mode other than car — tend to have lower transportation expenses as well as greater financial resiliency. Owners of location-efficient housing who choose to commute via car for convenience may be able to switch to lower-cost transit in the event of a job loss or other financial interruption.

The level of impact and benefit of moving to a more location-efficient neighbourhood depends on where you are moving from and to. A variety of neighbourhood features can help reduce automobile dependence in comparison to a typical neighbourhood; simply living along a transit corridor is associated with reducing travel distances by 5%, while living in a neighbourhood with residential and commercial mixed-use development around transit centres can reduce travel distance by up to 20%.[53]

A study in Portland supports these numbers, having found that density, neighbourhood type and proximity to transit all helped reduce auto travel by between 1% and 20%.[54] A more recent study in Portland found that residents in mixed-use neighbourhoods with good transit drove 43% less than the rest of the county.[55]

Another analysis of U.S. cities examined the impact of new infill developments — building homes and businesses in unused lands within urban regions, such as converting parking lots, old

factory lands or railway lands into new mixed-use neighbourhoods. They found that these urban, mixed use and walkable locations lead to much lower vehicle use than suburban neighbourhoods: from 15% to over 50% less vehicle use.[56]

Based on the research cited above it is estimated that living in a city or neighbourhood that has location-efficient attributes (walkable, mixed use and access to transit) can reduce your auto dependence by about 20%. Moving closer to work but still driving everyday can save hundreds of dollars a year on gas. But moving close enough to work to get rid of the car entirely can save roughly $10,000 per year.

Table 6: Potential annual savings from location-efficient living

Action	$ Savings	GHG ↓
Move closer to where you work, but still maintain a car*	$909	20%
Move closer to where you work, give up a car and commute by transit[57]	$9,036	68%
Move closer to where you work, give up a car and walk or bike	$10,452	100%

*Annual auto-related cost-savings based on 20% reduction of vehicle kilometres travelled

2.6 Car sharing

The popularity of car sharing is growing across many cities in Canada and abroad. In 2011, the 17 car-sharing organizations in Canada shared 2,342 vehicles among 85,439 members.[58]

Car sharing is a type of car rental that targets those who want to use a vehicle for a short period of time (a few hours) and only pay for the actual usage of the car (duration of rental and distance travelled). Vehicles in a car share fleet are typically parked all around town in various locations and are accessible 24 hours a day. Members typically pay an annual fee plus per-use charges.

Many drivers do not consider all aspects of car ownership into their household budget and would actually save money by using a shared car. As discussed above, car ownership costs around $10,000 per year. Car sharing can help reduce these costs while maintaining regular access to a vehicle. Car sharing for non-work travel can make it possible for work commuters to give up their car and carpool, take transit or ride/walk to work on a daily basis, but have access to a part-time vehicle for shopping or recreation.

A recent study[59] that surveyed about 10,000 car share members across the U.S. and Canada showed that overall net annual greenhouse gas emissions of participating households decrease from pre-sharing levels. The average car-sharing household ended up driving less because of their choice and reduced their greenhouse gas emissions by 0.58 tonnes per year. If you added in the avoided emissions from choosing to share a car rather than purchase your own, then the study showed household greenhouse gas emissions reduced by 0.84 tonnes.

Leave the car at home: What our profiled drivers can do

There are a number of options to leave the car at home, and many of these can be done in combination to lead to significant cost savings. For example, moving to a more location-efficient neighbourhood and telecommuting three days a week might make taking transit more attractive the other two days.

Table 7: Commuter scenarios for driving less

Options to leave the car at home	Urban Dweller	Metro Motorist	Suburban-ite	Rural Rover
Number of work days using a no-fossil fuel option – biking, walking or telecommuting	2	0	2	0
Number of work days taking transit	3	0	0	0
Number of work days using a carpool	0	2-3	0	0
Move 20% closer to work	no	no	yes	no
↓ in driving (reduced km travelled)	**100%**	**10%**	**38%**	**0%**
$ saved per year	**$9,688**	**$414**	**$2,691**	**$0**
↓ GHGs per year	**83%**	**10%**	**38%**	**0%**

A. The Urban Dweller

Living in the downtown core provides the most practical options for leaving the car at home or giving up a car entirely. Canada's largest cities all have rapid transit options in the city centre that are efficient and reliable. Living in the downtown core is often a choice for Canadians who want to live close to work and therefore have the option to bike or walk. Drivers in the downtown core in our scenario give up their car entirely, as this provides the greatest cost savings. Even if an urban dweller were to commute to work by bike three or four days a week but still own a car, their cost savings are $500 per year compared with up to $9,000 per year when eliminating car ownership.

The Urban Dweller has less need to telecommute or carpool, so these options are not included in this scenario. Nor is there a need to move closer to work. Actions for the Urban Dweller focus on taking advantage of rapid transit and active transportation.

B. The Metro Motorist

Canada's metropolitan areas are large and spawned the original "inner" suburbs, such as Scarborough in metropolitan Toronto or Burnaby in the Vancouver CMA. While these locations are still part of the city, they are not always well linked to the core by practical transit. Transit improvements to these areas are underway in many cities, but commuters predominantly rely on personal vehicles. Until these rapid transit lines are built, metro drivers can reduce their driving times by carpooling. Even one day a week makes a difference. However, if commuters and/or employers put the effort into organizing or participating in a carpool or work vanpool, it is more cost and time effective to carpool more than once a week to take advantage of the benefits. For our scenario, the Metro Motorist takes action by carpooling two to three times a week.

C. The Suburbanite

Most outer suburban regions lack fast and practical public transit. Transit expansion into these suburban communities is beginning in some CMAs, but the timeframe is long term. Currently, the majority of commuters rely on a vehicle. Carpooling is becoming common among suburban workers, but it may be more challenging for employee vanpools to round up employees dispersed throughout a region in different suburbs. For our scenario, the Suburbanite is most likely to take action by telecommuting, as well as moving closer to work. Research shows that residents prefer living closer to work over having a large house and yard. Residents in the distant suburbs may find that the cost of transportation — owning and operating a vehicle — may nullify the lower cost of a suburban home.[60] The Suburbanite has the potential to move closer to work and find other options to commute and save on these transportation costs.

D. The Rural Rover

Some commuters have limited options for leaving their vehicles at home due to nature of their jobs or commutes. Those living or working where there are not many other workers on the same workdays will have few opportunities for transit or carpooling. Telecommuting is impossible for some jobs and active transportation may be challenging due to hills or safety considerations. These commuters will continue to drive to work each day, but have other options for reducing their driving costs and pollution, as described in the next two sections.

3. Choose a cleaner vehicle

In 2010, the Canadian federal government introduced new regulations for automakers to reduce greenhouse gas emissions from personal vehicles. While this is an important first step, the regulations are much weaker than they could be and contain loopholes that will allow automakers to make little improvement until at least 2015.[61] The new standards regulate efficiency by class and vehicle footprint. This approach, however, does not encourage automakers to produce and drivers to purchase smaller (and more-efficient) vehicles, or to shift to cars from light trucks where appropriate.[62]

However, Canadian drivers have choices in the showroom, along with the information to select more fuel-efficient vehicles and to consider purchasing a vehicle of the right size and with features that can improve efficiency, reduce emissions and save money at the pump. This chapter refines these choices down to:

- **Fuel choice** — Technological advancements now allow consumers to consider vehicles that run on more than just gasoline, such as electric vehicles.
- **Right size** — Choosing the smallest vehicle that can accommodate most everyday driving needs. Smaller vehicles are more efficient than larger ones, making them cheaper to purchase and fuel.
- **Best efficiency in class** — Some jobs or hobbies require larger vehicles, but drivers can still make efficient choices, ensuring the design and features of larger vehicles are as energy efficient as possible.

3.1 Fuel choice

Automakers are busy creating new vehicle technologies that do not use gasoline but still allow drivers to achieve excellent driving performance. Vehicles currently on the market in Canada include electric vehicles, natural gas vehicles, ultra-efficient diesels capable of running on biodiesel, and flex fuel vehicles capable of running on E85 (i.e. a blend of 85% ethanol and 15% gasoline). Canadian automakers are also currently developing and manufacturing hydrogen-fueled electric cars, which emit only water vapour from the tailpipe. A technology such as compressed natural gas for light duty vehicles can reduce emissions by about 25% relative to gasoline.[63]

Our analysis focuses on electric vehicles as they are currently widely available to consumers across Canada, and the required infrastructure is quickly expanding in key markets, such as British Columbia, Quebec and Ontario.

3.1.1 Go electric

Imagine needing to visit the gas station only once a month, or not at all. That's the experience of many Canadian drivers who have embraced electric mobility. Electric vehicles (EVs) are powered, in whole or in part, by electricity, with three categories:

- A battery EV (BEV) is solely powered by batteries;
- A plug-in hybrid EV (PHEV) can run on electricity, fuel or a combination of the two;
- A hybrid-electric vehicle (HEV) — currently the most popular EV on the roads today — is never plugged into an electrical outlet, but is fuelled by gasoline and uses a battery-powered motor to improve efficiency.

The benefits of using electricity for a portion or all of a vehicle's "fuel" are:

- Lower fuel costs
- Higher efficiency
- Low to zero tailpipe emissions[64]

Many of the new technologies mentioned here have a higher price tag than an equivalent gasoline-powered car. But many consumers are choosing an EV for both the benefit of the environment and for the fuel cost savings over the lifetime of the vehicle. An average Canadian would spend only $38 per month to fuel up an electric vehicle, compared to $128 per month for a mid-sized gasoline powered car.[65] That adds up to annual fuel cost savings of over $1000 and reduces personal greenhouse gas emissions by 2.8 tonnes per year.[66]

EVs provide the greatest environmental benefits in provinces where the electricity system does not run on dirty energy such as coal. For example, a battery electric vehicle operated in B.C. emits 80% fewer greenhouse gases in its lifetime than a conventional vehicle, while the savings are almost negligible in a province like Alberta with its currently coal-intensive grid.[67] B.C., Ontario and Quebec are leading the way in green electricity and support of electric vehicles.

> *I've been driving electric cars for about eight or nine years. Primarily I bought an electric car for environmental reasons, but also because electric cars are fun to drive and they are different then the mainstream. I'm not really a car guy, but electric cars have sort of taken my interest….*
>
> *I think it's taking a long time for this perception to disappear, that electric cars are not very fast, they're not very powerful or whatever. I think I drive faster now than I did before; It handles nicely, and it just feels right.*
>
> — Phil Dayson, electric vehicle owner[68]

3.2 Go smaller

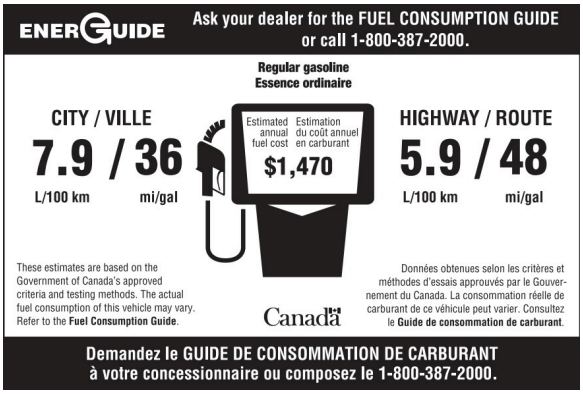
While EVs are becoming more affordable every year, they may still be out of the price range of many Canadians, particularly those who live in locations that lack EV infrastructure. Fortunately, Canadian drivers can also experience significant fuel savings by choosing more efficient gas-powered models — the smaller the better.

Smaller vehicles are often less expensive and more fuel efficient than larger vehicles; therefore, choosing the smallest vehicle that can accommodate everyday driving needs can save money in

the showroom *and* at the pump. The average fuel economy of an SUV (e.g. the Hyundai Santa Fe) is 9.0 L/100 km, while an average mid-size car (e.g. the Chevy Cruze) is 6.6 L/100 km.[69] Going for the smaller vehicle in this situation can save the average Canadian driver $538/year in fuel costs (see Table 8 for details) and an additional savings of about $10,000 off the sticker price.[70]

3.3 Go efficient

All classes of vehicles in Canada have efficient models and makes from which to choose, so it is possible to get better efficiency regardless of the vehicle size. Even large four-wheel drive pickup trucks — a necessity in some jobs and locations in Canada — are available in more efficient models. Choosing a more efficient pickup can save about one trip to the gas station per month. Table 8 below presents fuel efficiency information for a number of classes of new vehicles in Canada.[71]



Example of Ener-Guide Label

Canadian drivers have the choice to select a vehicle based on its size and best fuel economy. Very fuel-efficient vehicles do exist and they are affordable. One helpful program the federal government has created to support this choice is a labeling system for all new vehicles. The EnerGuide Label provides a quick visual indication of a vehicle's fuel efficiency in easy-to-understand terms. Similar to the labels on household appliances like clothes dryers, these labels make vehicle efficiency comparison easy.

The table below shows a variety of makes and models of vehicles available in 2012 to illustrate the range of efficiencies across vehicle classes in Canada. This data on fuel efficiency and emissions is available to the general public for every vehicle for sale in Canada via Natural Resources Canada's Fuel Consumption Guide.

Table 8: Comparison of vehicle fuel efficiency[72]

Vehicle				Fuel cost	Tailpipe emissions (tonnes CO_2 per year)
Model	Trans-mission	Fuel efficiency (L/100 km) City	Highway		
Compact cars					
Toyota Prius c	continuously variable automatic	3.5	4	$861	1.6
Honda Civic	automatic	7.2	5	$1,435	2.7
Volkswagen Golf	automatic	9.1	6.5	$1,833	3.4
Dodge Challenger	manual	14	8.5	$2,664	4.9
Mid-size cars					
Nissan Leaf*	electric	2.2	2.6	$456	0.0
Chevy Cruze	automatic	7.8	5.2	$1,532	2.8
Toyota Camry	automatic	8.2	5.6	$1,625	3.0
Ford Fusion AWD	automatic	12.3	8	$2,396	4.4
Pickup trucks					
Toyota Tacoma	manual	10	7.7	$2,072	3.8
Dodge Ram 1500	automatic	15	10	$2,947	5.5
Ford F-150 4X4	automatic	18.5	12.7	$3,673	6.8
SUVs					
Ford Escape Hybrid	automatic	5.8	6.5	$1,413	2.6
Hyundai Santa Fe	automatic	10.4	7.2	$2,071	3.8
Chevrolet Suburban 4WD HD	automatic	20.7	13.1	$3,994	7.4

*Nissan Leaf efficiency is equivalent litres per 100 kilometres

Another great resource for additional efficiency tips related to the features and design of your new vehicle is Natural Resources Canada's buying guide website.[73] The impact of vehicle features on efficiency is significant, as the following examples illustrate:

- Power seats can add between 40 and 60 kilograms to a 1,200-kilogram vehicle, resulting in a 2 to 3% increase in fuel consumption.
- Air conditioning can increase fuel consumption by more than 20% under city driving conditions. Look for a system with an "economy" mode to help minimize the impact of air conditioning use.
- Aluminum wheels are lighter than conventional wheels, thus requiring less energy to move.

- Four-wheel drive and all-wheel drive offer superior traction under slippery conditions. But there's a tradeoff. The weight and friction of their additional drivetrain parts can increase fuel consumption by as much as 10% as compared with two-wheel drive vehicles. All-wheel drive is the least fuel-efficient choice because all four wheels continually draw power from the engine. Four-wheel drive engages all four wheels only when extra traction is needed.
- Manual transmissions are generally more fuel-efficient than automatic ones, especially when used with a tachometer or shift indicator. There are exceptions, however, which makes checking the Natural Resources Canada's Fuel Consumption Guide helpful.
- For automatic transmission, the more gears, the better. Generally speaking, extra gears are better able to keep the engine running at or near its most efficient level. To get the most gear ratios possible, consider a continuously variable transmission, which uses belts and pulleys to allow for an infinite number of gears.

Choose a cleaner vehicle: What our profiled drivers can do

There are a number of options when choosing a cleaner vehicle. Our scenarios presented below take into consideration location factors that might determine the type of vehicle that makes sense for different Canadians. Note that these scenarios are independent of the scenarios in Section 2; to see results from combined scenarios, see Section 5.

Table 9: Commuter scenarios for choosing a cleaner vehicle

Options to choose a cleaner vehicle	Urban Dweller	Metro Motorist	Suburban-ite	Rural Rover
Go electric	no	no	no	no
Go smaller	no	yes	yes	no
Go more efficient (same type of vehicle)	no	no		yes
↓ in fuel consumption	**0%**	**26%**	**52%**	**13%**
$ saved per year (fuel costs only)	**$0**	**$539**	**$2,147**	**$374**
↓ GHGs per year	**0%**	**26%**	**52%**	**13%**

A. The Urban Dweller

In our scenario, we assume that the Urban Dweller does not make any changes to her vehicle choice as she is already driving a compact car.

B. The Metro Motorist

Drivers in the busy city have many choices for improving fuel efficiency though vehicle selection. For our scenario, we assume that the Metro Motorist will choose a smaller vehicle. In urban areas it makes sense to go small and efficient to maneuver around busy streets, stop and go, and fit into parking spaces. A reduction in vehicle size is assumed to increase fuel efficiency by 26% for the Metro Motorist's switch to a cleaner gasoline car.[74] Driving an electric vehicle is becoming more feasible in cities where infrastructure like recharging stations are being built in new buildings and in public spaces. However, the initial purchase price remains prohibitive for many drivers.

C. The Suburbanite

In our scenario we assume the Suburbanite will either choose a smaller or more efficient vehicle. Since the vehicle assumed for the Suburbanite is a large pickup truck or SUV, we assume he buys a hybrid SUV, improving fuel efficiency by over 50%.

D. The Rural Rover

For the Rural Rover, we assume a reluctance to change vehicle types but note significant savings can be made from replacing the pickup with a more efficient option. Savings of 13% could be achieved if the commuter is able to purchase a more efficient vehicle.[75]

4. Drive smarter

Many Canadians currently have no other option than to drive to get to work and other daily destinations. Many of us live in rural or suburban areas where transit systems do not exist or are slow and unreliable, and there are no options to carpool or telecommute. Others need to drive as part of their job. Driving a fuel-efficient vehicle is an excellent choice for Canadians who do not have access to alternatives, but not everyone can afford to buy a new car, and may be stuck driving their older, less efficient vehicle for years to come. But all Canadian drivers can reduce their personal car pollution and save money by driving more efficiently.

4.1 Ten tips to smarter driving

Driving smarter is a simple and effective way to reduce fuel consumption in the immediate term, with no cost, no investment in another vehicle and no planning a carpool. In fact, drivers can save money at the pump immediately by adopting these tips to smarter driving:[76]

1. Drive smoothly — Aggressive driving (speeding, quick acceleration and hard stops) can increase fuel consumption by up to 25%.

2. Service your vehicle regularly — Change the air filter, spark plugs, engine oil and other fluids according to the manufacturers recommendations to ensure you get optimum performance and fuel efficiency.

3. Lighten your load — Added weight of heavy items in your trunk and the decreased efficiency of your vehicle's aerodynamics caused by roof or bicycle racks contribute to increased fuel consumption.

4. Avoid excess idling — Idling gets you nowhere but still burns fuel. Unless you're at a stop light or stuck in traffic, turn the engine off when you're in a motionless lineup, or waiting for someone and expect to be stopped for more than 10 seconds.

5. Plan and combine trips — Avoid rush hour or construction zones to save time on the road. Combine several short trips into one longer one; since trips of less than five kilometres don't allow the engine to reach its optimal operating temperature, fuel consumption and exhaust emissions will be higher when driving a cold engine than when driving the same distance with a warm engine.

6. Avoid high speeds — The faster you drive, the more wind resistance you'll encounter and the more fuel your vehicle will consume to maintain speed. Reducing your speed to 90 km/h from 110 km/h can save up to 20% of your fuel. Follow the speed limit and use cruise control on flat highway terrain to prevent inadvertent speeding and help save fuel by keeping your speed constant when conditions are safe.

7. Measure your tire pressure once a month — Properly inflated tires last longer, make your vehicle safer to drive and save fuel. Inflate cold tires to the recommended pressure.

8. Use air conditioning sparingly — Due to the extra load on the engine, air conditioning can increase your vehicle's fuel consumption by up to 20%.

9. Keep your distance — Leave distance between yourself and the car ahead to give you time to brake evenly. Hard braking uses more fuel than controlled smooth braking does.

10. Choose high quality fuels and lubricants — Using the manufacturer's recommended fuel and lubricants will help to clean and protect your engine as you drive and allow the engine to work more efficiently.

Using simple techniques to drive more efficiently and practicing effective maintenance can reduce fuel consumption and greenhouse gas emissions by about 10% and as much as 30%, as shown in the table below.

Table 10. Potential savings from smarter driving

Estimated fuel savings	Source
32%	Shell Smarter Driver Challenge[77]
30%	Fleet Challenge Ontario[78]
5-10%	City of Hamilton[79]

Based on the sources noted above, this analysis assumes a conservative estimated fuel savings from smarter driving of 10%.

CASE STUDY: Shell Smarter Driver Challenge

Shell Canada initiated the *Smarter Driver Challenge*™ to demonstrate how everyday Canadians can reduce their fuel consumption, reduce their emissions and save money by making small adjustments to how they drive. In June 2012, eight drivers received "behind the wheel" training on how to be smarter drivers during a cross-country trip from Halifax, Nova Scotia to Vancouver, B.C. By implementing the smarter driving techniques, all eight drivers, including Pembina's own executive director Ed Whittingham, reached a minimum of 20% improvement in their fuel economy. Driving a 2012 Volkswagen Passat, Ed and the other drivers outperformed the vehicle manufacturer's fuel consumption rating of 6.7 (highway) to 9.6 (city) L/100 km, reaching an average rating of just 5.59 L/100 km. Using only 4.69 tanks of fuel in total to travel 6339 kilometres, the team set a world record for the most fuel-efficient drive across Canada.[80]

The drivers were coached by Helen and John Taylor, an Australian couple who specialize in training drivers to improve efficiency and reduce fuel use. Smarter driving techniques include accelerating slowly and smoothly, looking ahead to better anticipate changes in speed, and braking less. This last factor is important as the physics of bringing a car up to the required cruising speed uses more fuel than actually cruising: if you brake less, you reduce the amount of overall acceleration required and save fuel. Other considerations are not driving at high speed when the engine is cold, reducing the number of stops, avoiding rush-hour traffic and reducing speed when faced with strong headwinds. John Taylor notes that "basic tips save on average 10 to 30 per cent, and you can start them today without having to do anything to your car."

Contribution by Pembina Institute Artist-in-Residence, Dick Averns

See the Smarter Driver Challenge website for more details[81]

Drive smarter: What our profiled drivers can do

All drivers can drive more efficiently, regardless of location and class of vehicle. In the scenarios in Table 11, we assume that drivers have not made any changes to their commuting choices (still commuting five times a week and have not changed their vehicles). Each commuter will then save 10% of fuel and greenhouse gas emissions per year, which leads to different cost savings for each — up to $413 for our Suburbanite.

Table 11: Commuter scenarios for driving smarter

Driving smarter	Urban Dweller	Metro Motorist	Suburban-ite	Rural Rover
Total annual distance driven (km)	7,800	18,000	25,200	15,600
Vehicle	Year 2006 compact car	Year 2012 SUV	Year 2012 pickup truck	Year 2000 pickup truck
Annual fuel consumption (L) prior to driving smarter	665	1,613	3,213	2,779
↓ in fuel consumption	**10%**	**10%**	**10%**	**10%**
$ saved per year	**$85**	**$207**	**$413**	**$357**
↓ GHGs per year	**10%**	**10%**	**10%**	**10%**

See Section 5 below to see scenarios that combine changes to commuting, vehicle choice and smarter driving.

5. Mobilizing Canada

As presented in this report, Canadians have many options for reducing fuel consumption, leading to less air pollution and significant cost savings. While such actions can be important for one's individual wellbeing — from saving money to getting more exercise and spending less precious time behind the wheel in traffic — the actions of many Canadians together can make an enormous difference. If 10% of Canadians were to make some modest and simple changes, like those presented in this report, we could reduce our greenhouse gas pollution by 3 million tonnes, and if 50% of Canadians were to do so we could reduce greenhouse gas pollution by 14.4 million tonnes. That is equivalent to shutting down about two large coal-fired power plants.

5.1 Combined actions from each of our drivers

We begin first with a tally of the individual driver. Sections 2 through 4 of this report illustrated how the different actions taken by each of these drivers — leaving the car at home, choosing a cleaner vehicle or driving smarter — can affect their transportation costs and emissions. Here we combine all three actions for our four profiles. Results are presented in Table 12 below.

Because Canadians live in diverse places and circumstances, it's challenging to come up with a number to quantify how much money and pollution can be saved by leaving the car at home, choosing a cleaner vehicle or driving better. Therefore, our four profiles were chosen to represent the diverse circumstances of Canadians, and we selected reasonable actions for each to take.

A: The Urban Dweller – Lives in the downtown core and currently drives a compact car.

If our Urban Dweller were to commute to work by bike three or four days a week but still own a car, she would save $500 per year. If she sells her compact car, however, she would save up to $9,000 per year.

- Therefore, the Urban Dweller takes action by giving up her car entirely, as this provides the greatest cost savings.

B: The Metro Motorist – Lives in the city limits but not in the core, and currently drives a mid-sized car.

Metropolitan locations are still part of the city but are not well linked to the core by practical transit. Transit improvements to these areas in underway in many cities, but commuters predominantly rely on a vehicle. Until these rapid transit lines are built, metro drivers can reduce their driving times by carpooling.

- Our Metro Motorist takes action by carpooling two to three times a week, switching to a compact car and practicing smarter driving.

C: The Suburbanite – Lives in suburban regions not connected by practical transit and relies on a vehicle.

Carpooling is becoming common among suburban workers, but it may be more challenging for employee vanpools to round up employees dispersed throughout a region in different suburbs.

- Our Suburbanite takes action by moving closer to work and telecommuting twice a week. As well, he trades in his SUV or pickup for a smaller, more efficient mid-size car and practices smarter driving.

D: The Rural Rover – Lives in rural region or community and drives a large pickup.

Because of the nature of her job and home location, she has limited options for alternatives to driving.

- Our Rural Rover continues to drive to work each day, but chooses a more efficient model of pickup and practices smarter driving.

Table 12. Effects of actions our drivers have chosen

All options	Urban Dweller	Metro Motorist	Suburban-ite	Rural Rover
Leave car at home				
Number of days using non-fossil option (walk, bike, telecommute)	2	0	2	0
Number of days using transit	3	0	0	0
Number of days using carpool	0	2-3	0	0
Move 20% closer to work and services	no	no	yes	no
Choose cleaner vehicle				
Go electric	no	no	no	no
Go smaller	no	yes	yes	no
Go more efficient (same type of vehicle)	no	no		yes
Smarter driving				
Use smarter driving habits	yes	yes	yes	yes
Total GHG savings from all actions	**83%**	**40%**	**73%**	**21%**
Total GHG savings (tonnes CO_2e per year)	**1.32**	**1.55**	**5.64**	**1.17**
$ saved per year	**$9,688**	**$1,037**	**$4,138**	**$629**

5.2 A picture of Canada: The difference collective action can make

What if a quarter of Canadian car commuters were to drive smarter, and what if half of urban dwellers were to give up their cars and get around easily on transit or by foot? What if every Canadian driver chose a more efficient vehicle?

It's not uncommon for individuals to think: I'm only one driver, what difference will it make? However, if better driving habits became the norm for Canadian drivers, more efforts were made to encourage the manufacture and uptake of smaller and more fuel-efficient vehicles, and commuters left the car at home a couple times a week, we could collectively reduce the pollution we generate by 10 to 35%.

Table 13 below presents approximations for collective action by drivers across the country — the results when the four driver scenarios in this report are scaled across all Canadian drivers. The values are approximate; further analysis into travel behaviour and vehicle choices is recommended. The assumptions we used are noted below the table.

Generally, we can conclude:

- If 50% of Canada's driving commuters took action to leave the car at home, the combined annual greenhouse gas savings would be in the order of 4 million tonnes or 5% of emissions from all of Canada's personal vehicles.
- If 50% of all Canadian drivers switched to a smaller, more fuel-efficient or electric vehicle, combined greenhouse gas reductions could reach 9 million tonnes, or 10% of the current emissions.
- If 50% of all Canadian drivers drove smarter, it could be possible to reduce our emissions by 4 million tonnes CO_2e, or 5% of today's emissions.
- If 50% of Canadian drivers took all these actions our savings could be in the order of 16 million tonnes CO_2e. That's equivalent to taking 3.5 million cars — almost one out of five — off Canada's roads.

Table 13. Annual greenhouse gas pollution reductions by percentage of Canadians taking action

Actions	% of Canadians taking action					
	25%		50%		100%	
	↓ GHGs		↓ GHGs		↓ GHGs	
	tonnes	%	tonnes	%	tonnes	%
Commuters reduce car commuting[a]	2 million	3%	4 million	5%	9 million	10%
Choose a cleaner vehicle[b]	4 million	5%	9 million	10%	17 million	20%
Drive smarter[c]	2 million	3%	4 million	5%	9 million	10%
Combining these actions	8 million	10%	16 million	19%	30 million	35%

Notes:

[a] Assuming 40% of Canada's population works full-time and 72% of workers drive to work.[82] Using the commuter profiles and actions described in Table 7 (leaving the car at home or trading it in for a bike or transit pass), we estimated that 11% of Canadian commuters would have savings similar to the Urban Dweller commuter profile, 34% could achieve savings of the Metro Motorist, 23% similar to the Suburbanite's savings and 32% like the Rural Rover..

[b] Based on 20% savings from choosing more efficient vehicle

[c] Based on 10% savings in fuel from driving smarter

6. Getting government in the driver's seat

The large majority of Canadians believe climate change and air pollution are critical issues that require serious action. The options presented in this report provide real alternatives that Canadians can embrace both behind the wheel and out of the car to help combat global warming —not to mention save money.

But the responsibility for stopping climate change cannot just be in the hands of Canadian drivers. Our political and business leaders must show the way. Automakers must not only comply with regulations, but lead the charge with cleaner, lighter-weight, more-efficient and electric vehicles. The oil and gas sector has a role to play as well by making alternative fuel choices accessible to the general public. Our governments must enact tough efficiency laws, while investing adequately in realistic alternatives to driving. Policy change needs to occur at the federal, provincial and municipal levels; however, for the purpose of this national report, this section briefly presents seven key policy actions for personal transportation that need to start on Parliament Hill:

1. Build transit for Canadians

Millions of Canadians in our urban regions do not have access to reliable and effective rapid transit, and as the population ages, more and more seniors will not have the means to get around safely. Canada is the only G8 country without a national transit strategy,[83] which includes long-term dedicated funding for public transit in our cities. A bill for such a strategy is being proposed in the House of Commons.[84]

The federal government also has an opportunity to prioritize transit investment when it designs its new infrastructure investment plan. Over 40% of federal investment in municipalities will expire soon, and our public transit systems require a $53.5 billion investment over the next five years for infrastructure expansion, replacement and renewal.[85]

In addition to being the only G8 country without a national transit strategy, Canada is also the only one without any high-speed rail lines.[86] High-speed rail can help replace intercity driving and flying. Two separate studies, one examining a high-speed line between Calgary and Edmonton[87] and another examining a line between Toronto, Ottawa and Montreal,[88] both found that the lines would generate positive economic returns. In addition, a recent survey found that 80% of Canadians support high-speed rail, with 62% strongly supportive.[89]

2. Power our rides

More Canadians would consider buying electric and other alternative fuel vehicles if refueling stations (like gas stations) and other necessary infrastructure were available wherever they

needed to drive. The Canadian government has made some initial first steps to encourage the production of electric vehicles through investments in technology research, including $11 million to McMaster University[90] and a repayable loan of $71 million to Toyota for production of the electric RAV4.[91] But broader investment in alternative fuel infrastructure is needed with a focus on pilot markets in key cities, along with education and incentives to encourage the production and purchase of these vehicles.

3. Make more efficient, smaller vehicles

The federal government has introduced new regulations to make Canada's cars and trucks more efficient.[92] Unfortunately, Canada has chosen to harmonize its regulations with those of the United States, which results in weaker standards for Canadian cars than those that will be applied in the EU or even China.[93] This is for two reasons: Canada's fleet is already smaller and more efficient than the U.S. fleet, so there is less room for improvement; and a number of loopholes will allow manufacturers to continue to build inefficient vehicles, such as large SUVs, which Canadians will continue to buy.[94] Our vehicle regulations should be stronger and more suited to our fleet, resulting in the production and purchase of smaller, more efficient vehicles.

4. Support cleaner choices

Right now Canadians can claim monthly transit passes on their income tax. The federal government could also amend the Income Tax Act to introduce tax-exempt status for employer-provided green transportation benefits. These could include offering employees a choice between parking and transit benefits, refunding non-drivers for the savings of not having to provide parking, and supporting carpooling services and end-of-trip facilities (e.g., bike racks and showers).[95] Government support for telecommuting could also be stepped up; currently, Canada is lagging behind countries such as the U.S.A., the U.K., Japan and Australia in this area.[96] Other opportunities for public support include mandating the development of designated bike lanes in roadway planning; integrating cycling, car-sharing and other alternatives in public transit node and business core parking developments; and implementing congestion charges and other targeted disincentives to driving into the downtown core.

In the absence of stronger standards that regulate vehicle emissions, Canadians have the option to choose more efficient vehicles when purchasing a new car. The federal government can support this choice by offering incentives such as feebates for very efficient models, similar to the provincial rebate programs in Ontario, B.C. and Quebec for clean vehicles[97] but extended to highly efficient gas-powered vehicles as well. This would make these vehicles more affordable to more Canadians.

5. Help Canadians drive smarter

Most Canadians learn how to drive and get a driver's license. To do this, candidates must pass written and driving tests. This is a perfect time to not only learn the rules of the road, but to learn how to drive more efficiently to reduce pollution from vehicles and save money. The federal government and large fleet owners should incorporate efficient driving techniques into driver training and testing, making it part of the criteria for getting a driver's licence for all new and renewing drivers who take road tests.

6. Explore and implement pay-as-you-drive insurance

Pay-as-you-drive insurance ties insurance rates and premiums to the amount of driving you do. Drivers are financially rewarded for reducing how much they drive, providing a further tangible benefit for making changes such as carpooling, riding transit, or living closer to work.[98]

Pay-as-you-drive insurance is used in the U.S., Europe and around the world.[99] In the U.S., for example, Progressive Insurance offers optional pay-as-you-drive insurance in 39 states, with an average savings for customers of 10 to 15%.[100] There are currently no offerings in Canada. Since car insurance varies from province to province, provincial governments would have to individually reform insurance regulations and/or work with insurance providers to help setup pay-as-you-drive offerings. The federal government can help with this by coordinating efforts between provinces.

7. Encourage mortgage reform to include transportation costs

The government should work with financial institutions to reform the mortgage risk assessment process to include location costs. Current mortgage assessments do not fully take into account all living expenses (housing and transportation) and can give more favourable treatment to applications from those who spend less on the cost of a home and more on transportation.[101] Instead, all transportation and location-related costs should be factored into mortgage assessments, including not just car payment debt but also the costs associated with vehicle use such as gas, insurance, parking and maintenance.

In the absence of more extensive mortgage assessment reforms, the government should encourage lenders to offer location efficient mortgages, which allow increased borrowing limits for homes in areas with reduced transportation costs. The higher purchase price of a location-efficient home is often outweighed by decreased transportation costs over the life of a mortgage.

Endnotes

[1] Government of Canada, *National Inventory Report 1990-2010* (2012). Executive summary available at http://www.ec.gc.ca/publications/default.asp?lang=En&xml=A91164E0-7CEB-4D61-841C-BEA8BAA223F9

[2] By 2020, transportation will be the second largest emitter in Canada. Emissions from the oil and gas sector will grow faster in this time frame and the oil and gas sector is projected to have the largest share of emissions by 2020.

Environment Canada, *Canada's Emissions Trends 2012* (2012) http://www.ec.gc.ca/Publications/default.asp?lang=En&xml=253AE6E6-5E73-4AFC-81B7-9CF440D5D2C5

[3] *Canada's Emissions Trends 2012.*

[4] Based on data for 2009; 91.1% of the 334 billion kilometres travelled in Canada in 2009 were by light vehicles. Natural Resources Canada, *Canadian Vehicle Survey: 2009 Summary Report* (2009), 6. http://oee.rncan.gc.ca/publications/statistics/cvs09/pdf/cvs09.pdf

[5] Based on 1.47 vehicles per household Office of Energy Efficiency, *2009 Canadian Vehicle Survey Summary Report.* Available at: http://oee.nrcan.gc.ca/publications/statistics/cvs09/chapter2.cfm?attr=0 and distance calculated at 18,000 km/vehicle based on Natural Resources Canada (2012), Comprehensive Energy Use Database tables – Transportation sector Tables 32 and 60. http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/trends_tran_ca.cfm?attr=0. 18,000 km/vehicle also used by CAA, *Driving Costs* (2012). http://www.caa.ca/working-for-you/driving-costs

[6] Car drivers take 59 minutes for their round trip. Statistics Canada (2005), *General Social Survey: Commuting times.* Available at: http://www.statcan.gc.ca/daily-quotidien/060712/dq060712b-eng.htm

Car drivers take 24 minutes to get to work; Statistics Canada (2011), "Study: Commuting to work". Available at: http://www.statcan.gc.ca/daily-quotidien/110824/dq110824b-eng.htm

[7] *Canada's Emissions Trends 2012*.

[8] *Canada's Emissions Trends 2012.*

[9] *Canada's Emissions Trends 2012.*

[10] Assumes 18,000 km/vehicle/year; fuel efficiency of 10.7 l/km [NRCan (2009), Canadian Vehicle Survey 2009 Summary Report] and 2392 gCO2e per litre (2385 g/l for cars, 2404 g/l for trucks).

[11] Based on EPA, Greenhouse Gas Equivalencies Calculator, http://www.epa.gov/cleanenergy/energy-resources/calculator.html. Assumes each propane cylinder contains enough propane for 30 barbeques.

[12] Estimated based on 18.6 million cars and light trucks in Canada, each consuming 1,926 litres per year of gasoline per vehicle. Conversion factors: 159 litres per barrel; 1.08 barrels of oil required to produce one barrel of gasoline.

[13] Emissions are for typical vehicle of each type. Bus is assumed to have 10 passengers, light rail transit to have 23.6 passengers. Emission factors based on those from Transport Canada, *Urban Transportation Emissions Calculator*. Available at: http://www.apps.tc.gc.ca/prog/2/UTEC-CETU/menu.aspx?lang=eng

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[15] Federal Highways Administration, *Addendum to the 1997 Federal Highway Cost Allocation Study Final Report* (2000). http://www.fhwa.dot.gov/policy/hcas/addendum.htm

[16] Assumes 1926 litres per vehicle at $1.28 per litre. Fuel prices the average of August 2012 across Canada http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/econ154a-eng.htm

[17] Based on average mid-sized car driving 18,000 km per year. CAA, *Driving Costs* (2012). http://www.caa.ca/working-for-you/driving-costs/

[18] From left to right the vehicle stats are based on: VW Golf, Hyundai Santa Fe, Dodge Ram 1500 and Ford F-150. All data from Natural Resources Canada, "Fuel Consumption Ratings," http://oee.nrcan.gc.ca/transportation/tools/fuelratings/ratings-search.cfm.

Fuel price of $1.28/L assumed which was the average across Canada in August 2012, see http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/econ154a-eng.htm

[19] Based on cost of a Toyota Camry LE. CAA, *Driving Costs* (2012).

[20] Ibid.

[21] Fuel efficiency is 10.7 litres/100 km. GHG reductions are based on difference from 4.6 tonnes per driver. 2392 g CO_2e is produced per litre of gasoline burned. Emissions from transit and electricity mix is based on Canadian average (per the Urban Transportation Emissions Calculator).

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