The SMART Report
Blowing the numbers out of Canada's tailpipes
Blowing the whistle on the lack of action

Introducing a New Environmental Indicator — The SMART Factor and The SMART Factor Solution to help reduce Greenhouse Gases

By SMART (OPIRG) McMaster
Student Math Action Research Team
Making mathematics matter more for the environment
An Ontario Public Interest Research Group
McMaster University
March 2006
Revised April 3, 2006
What gets measured gets done. Successful companies across Canada and around the world are now measuring everything from customer satisfaction, to on-time delivery, to innovation, to the cost of quality. They know that the more they measure, the more that they can recognize when and how plans need to be adjusted to help them meet important objectives.

For Canada and the world to be more effective at reducing the greenhouse gases that contribute to global warming, and to help meet the important Kyoto Protocol objectives, we all need to measure more, and also what we measure, we need to measure more often.

Urban sprawl, traffic congestion and the ever-increasing number of cars in Canada and the world are directly connected and all have an impact on human health and the natural environment. In Canada, transportation sources are responsible for 59 per cent of the emissions of smog-causing nitrogen oxides and 27 per cent of volatile organic compounds. Greenhouse gas emissions from transportation sources, primarily cars and light trucks, account for approximately 26 per cent of the Canadian total.

Many municipalities are already taking action on measures to combat congestion costs and health effects of continued urban traffic growth. Most municipal master plans, particularly for larger urban centres, address traffic demand management in some form, including pedestrian/bicycle infrastructure enhancements, transit improvement and other measures to influence driving behaviour. There are also private sector and NGO initiatives, such as commute trip-reduction programs, active transportation promotion campaigns and car-sharing programs. While these initiatives all yield appreciable benefits, their scope is not broad enough to counter the trend of increasing urban car use.

Therefore, to help Canadians, and especially all Canadian politicians, and governments around the world understand and focus more on the damage our transportation systems are doing to the world’s environment every day. SMART (Student Math Action Research Team) OPIRG McMaster is pleased to present the following report.

Sincerely,

SMART (OPIRG) McMaster

Bob Hicks  Mike Hicks  Tony Zhang  Desmond Yao  Nick Boukas  Adrian Bartha

Important note:

SMART would like to thank Natural Resources Canada Office of Energy efficiency for providing their CO₂ Calculator statistics that have made this report possible. The 1998 database enabled SMART to calculate the SMART Factor for 551 Canadian cities. In February 2006 NRCan provided the same database details updated and based on all light duty vehicle registrations in 4826 cities and small communities across Canada in 2003.

Since the statistics in this report are based on all vehicle registrations in over 4800 communities and the fuel efficiency ratings for over 15 million vehicles in 51 categories of engine size and model, SMART believes the data presented in this report can be considered as reliable and valuable to Canada and also to the world. However, please note that we cannot guarantee the accuracy of these details and recommend appropriate caution when using this data.

The comparison of the 1998 and 2003 data will also be meaningful and valuable. Therefore, SMART intends to issue part 2 of this report after NRCan publishes the 2003 data via an update to the CO₂ Calculator statistics on the NRCan website. Part 2 will present the percent change of the SMART Factor for approximately 500 cities over the 5 year period between 1998 and 2003 and report on what these changes will indicate (in our view) to Canada and the world. Since NRCan has not yet published the 2003 data for each city we (SMART) will not show the year 2003 SMART Factor numbers by city in this report.
The Smart Report

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Please Note

To obtain a pdf copy of this report for download and printing or for distribution to others, please visit the website of OPIRG McMaster University at:
www.opirg.org/mcmaster

SMART will post the complete report and also a condensed version on the OPIRG site.

Please distribute widely.

SMART can be contacted at:
smartgroup@cgasco.ca

If you would like to assist SMART to cover the costs of printing this report
SMART (OPIRG) McMaster can accept tax deductible donations and provide a tax receipt.

Thanks – The SMART guys
Introduction

Everyone will agree that in every community across Canada we need to reduce the greenhouse gases we produce everyday by just sitting and idling in Canada’s 16 million light duty cars and trucks.

The problem of needless idling has been a hot topic across Canada for 6 or 7 years. SMART believes there is a lack of clarity and understanding about this environmental problem that needs to be addressed. Therefore to bring this issue up-to-date and into clearer focus we are pleased to present:

The SMART Report
Blowing the numbers out of Canada’s tailpipes
Blowing the whistle on the lack of action
What the world can do and must do now

To begin we wish express our thanks to Natural Resources Canada - Office of Energy Efficiency for their cooperation and assistance that has made this report possible. NRCan has been a world leader in bringing attention to this issue. Canada can be proud of their efforts.

The problem of needless idling, the needless generation of greenhouse gases and the needless waste of fuel is a big one. How big of a problem is it? Answer: “Very big!” As this report will make very clear!

The transportation sector is the largest single contributor to GHG emissions in Canada (about 25% of total emissions). Measures that will begin to slow the growth in transportation GHG emissions will be a key element in achieving Canada’s GHG emissions target under the Kyoto Protocol. Total transportation energy demand is expected to rise by more than 50 per cent, between 1990 and 2020. There will be major increases in demand for gasoline and traffic congestion will steadily increase.

Canada is increasingly urban; 80 per cent of Canadians now live in urban areas. Urbanization, together with steadily rising amounts of economic activity originating in urban centres, is putting pressure on road infrastructure. The total number of vehicles on our roads is growing every year. Our production of greenhouse gases by transportation is going up every year, not down. The greenhouse gases we produce every day is a major problem and the fine airborne particles and ground-level ozone that accompanies those gases produces smog which is a major health concern.

Congestion is an example of an impact that has environmental, social and economic costs. Economic costs include lost time and productivity, wages foregone, and extra fuel costs. Environmental costs include increased emissions of greenhouse gases and air pollutants. Social costs include increased stress.

A major challenge of sustainable transportation is to control or prevent air emissions from transportation, such as GHGs, nitrogen oxides, volatile organic compounds and particulate matter. Improved air quality and reduced GHGs are goals, but how are we doing? The answer is, unfortunately, “not well enough”.

The following is an important story that all Canadians and millions of others around the world need to listen to. We hope this report will drive this important issue home and bring about greater understanding.

SMART wishes to express thanks to the United Nations Framework Convention on Climate Change for providing the melting globe artwork. With artistic license we have turned the melting globe into the tires on the SMART Report Car to represent the impact our vehicles have on our delicate planet and its atmosphere.
EXECUTIVE SUMMARY

We are producing massive amounts of Greenhouse Gases every second of every day and the world is warming up. We have a very big and very urgent problem on our hands. If we fail to act to slow down global warming we will impose on our children the enormous impacts it will have on human health, world coastlines, agriculture and the infrastructure society depends upon. We'll see major conflict over diminished resources, including water and food. We will see lives lost to heat waves, infectious disease, and extreme weather. We'll see many millions of environmental refugees and terrible human suffering. Yet, governments and industry is not addressing the problem in a well-coordinated, systematic, expeditious and effective way.

So what can we do about it? Answer: "Plenty!"

This report suggests we can do far more than we are presently doing, and that what we are doing now we can do far more effectively, by taking just one step – playing music. What we mean by that is the "Music of Reason" – Mathematics. This report is based on the premise that "what gets measured gets done" - the more we measure, and the more often we measure, the more likely we are to succeed. Most importantly, in this report we are presenting to the world a new tool to measure with – and we call that new tool the SMART Factor.

The SMART Factor is a new empirical environmental emissions indicator that will move up or down over time based on actual world inventories of vehicles – many millions of them – by community – and the fuel efficiency ratings for each as those ratings also change over time. It measures the tonnes of GHG that all of these vehicles would produce, and the amount of fuel they would burn, in a year, for every second each day they idle needlessly in parking lots and by needless delays in traffic. That's right – every second. We can't think of a more significant or valuable number. It therefore also represents the amount GHG and fuel we could save, in every community, and the world as a whole, for every second each day that we can reduce the needless idling of vehicles.

The world can use this SMART Factor in many important ways to help make many important decisions. We believe it can serve the world as a very powerful tool. In our view the SMART Factor should be viewed as a break-through-indicator that can help the world measure, monitor and reduce the Carbon dioxide (CO2) produced every day by transportation. We suspect physicists, mathematicians, statisticians and all number-crunchers around the globe will recognize, understand and appreciate its value. We hope world leaders will read this report and act on it (fast). We challenge all automobile industry executives to commit to the pledge written for them within it (quickly), and we ask you to read it (completely) and then pass it along to others.

Cont'd.....
EXECUTIVE SUMMARY

Cont'd

We believe the suggestions put forward in this report would be prudent and responsible things to do and we encourage people to debate their merits. We also believe that a computer system could be designed by governments to maximize the use of the SMART Factor, (see The SMART Factor Solution steps one and two) and could be working for all governments by the end of this year. We believe the theory behind it, and the reasons for doing it, are solid. If you read page 14 of this report with the heading “Looking at the future” you will understand why this is important.

So the important question now becomes; will world governments focus on the “Music of Reason” found in this report? If so great! If not - why not? SMART and about 6.2 billion others will be looking for their answers very soon.

We did not write this report to irritate auto industry executives, or to annoy some politicians - although we expect that it will - we wrote it to give young people another reason for hope that the grown-ups living today can make better decisions tomorrow so that young people can have more reason for a positive outlook on their future.

To help ensure that, this report presents 14 SMART recommendations. We believe 1 through 13, if enacted, would ensure the world makes significant contributions to reducing greenhouse gas emissions, in the most responsible and effective ways. Number #14 is a special recommendation to give young people more hope that the world can work together more effectively. It also asks young people for their help. Without their help we will not succeed. SMART believes we can count on them. We know they are counting on us.

SMART will not stop here. We are already working on our next report. SMART Report #2 will compare the SMART Factors of over 500 Canadian cities for the years 1998 and 2003. We will let you know what our views are about what that comparison tells us, and we will not stop there either. Our next report is just around the corner – please watch for it.

SMART
Student Math Action Research Team
“Making mathematics matter more for the environment and the community”

OPIRG
Ontario Public Interest Research Group
“Linking Research with Action”
Mathematics is the music of reason
James Joseph Sylvester 1814-1897

C Major

CO₂ Major

The C Major Scale

Canada's Kyoto CO₂ Target – A Major Scale

The SMART Factor Rhapsody in CO₂ Major

C Major is one of the most commonly used key signatures in music.
CO₂ Major must become one of the most commonly used key signatures in new environmental music.

Referring to The SMART Report as a Rhapsody is appropriate. A rhapsody is an exalted or excessively enthusiastic expression of feeling in speech or writing or a literary work written in an impassioned or exalted style. In music it is usually instrumental composition of irregular form that often incorporates improvisation. It also means an ancient Greek epic poem or a portion of one suitable for uninterrupted recitation.

Referring to this music as being written in CO₂ Major is appropriate. In music Major refers to designating a scale or mode having half steps between the third and fourth and the seventh and eighth degrees. A Major is equivalent to the distance between the tonic note and the second or third or sixth or seventh degrees of a major scale or mode: a major interval, and based on a major scale it is referred to as a major key. The SMART Factor measures were we are going per second and the opposite direction we need to go by the second.

Therefore we wish to refer to this report as "The SMART Factor Rhapsody in CO2 Major" because:

This SMART Report is written with feeling and in an impassioned style. The beat of our fragile planet can be found within it. The message it contains deserves uninterrupted recitation. Just as the measurements of time will shape melody, harmony, phrases and a whole composition of music, our measurements of time and energy consumed each and every day will now shape the future of the whole planet. In Vivaldi’s Four Seasons, there is nature in the music if you listen for it. In this report there is music in the mathematics and in the message if you listen for it. The music in this report must be played long, it must be played loud, and it must be played now, all over the world.

Mathematics does not choose between the environment and the economy

- Environmentalists will, with passion in their hearts, choose the environment over the economy.
- Business people will, with dollars in their eyes, choose the economy over the environment.
- Mathematics does not choose between the environment and the economy. It is concerned only with the enumeration and comparison of relations. Mathematics can reveal hidden patterns that help us understand the world around us and make better decisions. In this report, we believe it has.
- "As a science of abstract objects, mathematics relies on logic rather than observation as it standard of truth, yet employs observation, simulation, and even experimentation as means of discovering truth." From Everybody Counts: A Report to the Nation on the Future of Mathematics Education 1989 National Academy

SMART admits to having the passion

The Student Math Action Research Team (SMART) admits to having passion in our hearts. We also admit that we do stand on the side of the environment and today’s young people and future generations. But, we are also willing to let the numbers have their say.

We know that truth can be found in logic and that mathematics can be the music of reason we seek for the environment. We also know that if the world is melancholy about global warming and the future, the music of mathematical reason has the ability to transform that melancholy into visionary optimism.

It is not our intent to deliver melancholy news in this report. It is our intent to make mathematics matter more for the environment and the community. It is also our goal to ensure a robust discussion and debate generated by this report.

It is our hope we will succeed. Please let us know if we did. Please send your comments to SMART at:

smartgroup@cogeco.ca
Fiction

No Ontario vehicle drives clean. Why would we pretend that they do?

Why would we put a halo over an object that is killing our environment? Also, why would the Ontario government continue with a program that does not provide a good benefit to cost ratio?

While Drive Clean does help reduce harmful vehicle emissions, does it reduce enough to warrant the high cost? Could that money be put to better use? That is an important question!

Vegetable foods are the largest domestic source of smog-causing pollutants in Ontario. Smog-causing pollutants include nitrogen oxides and volatile organic compounds such as hydrocarbons. Drive Clean reduces (does not eliminate) emissions of smog-causing pollutants as well as other pollutants by requiring designated vehicles to have their emissions tested before their licence plates can be renewed or ownership is transferred. The test identifies vehicles with emissions problems and Drive Clean requires them to be repaired.

From 1999 through 2003 Drive Clean say the program has reduced smog-causing emissions by more than 81,200 tonnes. Overall, smog-causing emissions from Light Duty Vehicles are estimated to have been reduced by more than 140,000 tonnes from 1999 through 2003 due to replacement of older cars, new emissions technology and cleaner fuel as well as repairs to some vehicles that fail a Drive Clean test. Drive Clean says this means that Drive Clean is responsible for nearly 60 per cent of the overall reduction figure.

Also, from 1999 to 2003 emissions of the climate-change gas carbon dioxide (CO2) were reduced by more than 100,000 tonnes, as a result of improved vehicle fuel efficiency of light duty vehicles due to emissions system repairs required by Drive Clean. But that is only an average of only 20,000 tonnes per year. The same 20,000 tonnes could be saved if all of Ontario's light duty vehicles idled just 9 seconds less each day.

Drive Clean says it is progressively reducing emissions by cleaning up existing vehicles, encouraging environmentally-friendly vehicle maintenance habits, and expediting the replacement of gross polluters with vehicles that have better emissions control technologies. While these latter two benefits have not been quantified, they have undoubtedly made a positive impact in cleaning up the Ontario fleet.

However, this reduction from the approximate 12% of vehicles that failed test cost the people of Ontario up to 2003 a total of over $687 million. Think about how this money could have been spent to improve the overall travel efficiency of all Ontario vehicles via traffic management systems upgrades. Should we continue to spend an additional estimated $2.2 billion up to 2015 on this program? Would this be wise? In SMART's view, this question needs to be debated. Such a debate could conclude that there are better uses for this money that could benefit our environment even more. Sources: Ontario Drive Clean website * Based on Natural Resources Canada Office of Energy Efficiency 2003 unpublished spreadsheet.

Truth

Every litre of fuel we burn produces 2.4 kg of CO2 GHG.*
Every 417 litres of fuel we burn produces 1 tonne of GHG.

While there is no technology to scrub CO2 from our cars' exhausts, we can make them pollute less not just by making them more fuel-efficient, but also by making them move more efficiently or preferably not move at all. Efforts to make them not move at all have been significant across Canada. Considerable time and effort has been spent encouraging people to drive less by using public transit, car-pooling, cycling and walking. However, our efforts to move vehicles more efficiently have been inadequate as best and when we consider our responsibility to future generations close to criminal.

Therefore, we need to look closer at the damage every vehicle does to the environment every day and what steps we can take to reduce that damage.

Based on the total registrations of all 4, 6 and 8 cylinder light duty vehicle in Ontario in 2003, and also the fuel economy ratings for every engine, we know how many litres of fuel would be burned by all Ontario vehicles idling for just one second. * From this, we know that all Ontario vehicles idling for one second every day for a year would burn 940,762 litres of fuel and produce 2256 tonnes of CO2.

Therefore, 2256 is the SMART Factor for Ontario for the year 2003. It simply means every second less each day of idling would represent 2256 savable greenhouse gas tonnes, and over 940,000 savable litres of fuel valued at $846,000.00 @ 90 cents per litre.

Based on this, every one minute less a day would save over 135,000 tonnes of CO2, and burn over 56 million less litres of fuel and save close to $51 million.

Every five minutes less each day would save over 678,000 tonnes of greenhouse gases plus save 282 million litres of fuel and save over $255 million.

Therefore, Ontario should be doing everything possible to reduce the equivalent of every engine idling by a minimum of 5 minutes less each day. An even better target would be 10 minutes (average) less each day.

If all levels of government are serious about wanting to meet Canada's Kyoto Protocol commitments then it is time for all levels of government to become more serious and more expedient in their efforts.

The total SMART Factor for all of Canada is 6099 savable tonnes per second. That means for every five minutes less idling each day Canadians would save over 1,829,000 tonnes of greenhouse gases plus save 762 million litres of fuel, and save over $655 million. These 5 minutes would go a long way to help slow the rate of global warming. We should also think about the value of these fuel savings to the next generation.

* Natural Resources Canada Office of Energy Efficiency
The SMART Factor and Canadian Cities

Smart (OPIRG) McMaster calculated the SMART Factors (savable greenhouse gas tonnes per second) for over 500 Canadian cities in early 2005 based on 1998 data provided by NRCan Office of Energy Efficiency. The data provided was the same data used by OEE to produce the CO2 calculator available on the OEE website. The excel spreadsheet provided the fuel usage statistics for each community based on all light duty vehicle registrations in each city in 1998.

In February 2006 SMART received an updated spreadsheet from NRCan containing the same data for the year 2003 for over 4,800 Canadian cities. This sheet told us how many litres of fuel would be burned in each city, in one year, if all light duty vehicles in that city idled for one minute each day.

Since one tonne of GHG is produced by every 417 litres burned, we then only needed to divide the total litres burned by 417, and then divide again by 60 to obtained the number of GHG tonnes produced in one year for every second all vehicles idle each day. We decided to call this second the SMART Factor.

Since this data took into consideration the fuel efficiency ratings of 61 different classifications of vehicles and how many of each are registered in each city, the end result could accordingly be considered to have a high degree of accuracy.

The Top Ten City SMART Factors in Canada

Savable Greenhouse Gas Tonnes Per Second for every second that all vehicles in the community idle less each day for a year.

For every second all vehicles idle needlessly in parking lots or driveways the same number of tonnes will be produced to add to the world's concerns about global warming. Therefore, one value of the SMART Factor is that it can serve as a measure of the relative significance, and importance, of community no idling bylaws or campaigns in each city.

Note: SMART has promised NRCan we will not publish each city's 2003 SMART Factors until after NRCan OEE updates their website CO2 calculator. They hope to complete this work soon. However, we will list below the top 10 Cities by name for 2003.

<table>
<thead>
<tr>
<th>City</th>
<th>1998 SMART Factor</th>
<th>2003 City</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Calgary</td>
<td>187</td>
<td>1) Calgary</td>
</tr>
<tr>
<td>2) Edmonton</td>
<td>125</td>
<td>2) Montreal</td>
</tr>
<tr>
<td>3) Mississauga</td>
<td>117</td>
<td>3) Edmonton</td>
</tr>
<tr>
<td>4) Winnipeg</td>
<td>102</td>
<td>4) Winnipeg</td>
</tr>
<tr>
<td>5) North York</td>
<td>95</td>
<td>5) Mississauga</td>
</tr>
<tr>
<td>6) Montreal</td>
<td>93</td>
<td>6) Toronto</td>
</tr>
<tr>
<td>7) Scarborough</td>
<td>82</td>
<td>7) Vancouver</td>
</tr>
<tr>
<td>8) Toronto</td>
<td>78</td>
<td>8) Ottawa</td>
</tr>
<tr>
<td>9) Vancouver</td>
<td>74</td>
<td>9) Scarborough</td>
</tr>
<tr>
<td>10) Hamilton</td>
<td>66</td>
<td>10) Hamilton</td>
</tr>
</tbody>
</table>

Note: The 2003 data North York for requires a correction due to a postal input error on the 2003 spreadsheet and therefore does not appear in the Top Ten city list for 2003. North York should be on this list and Hamilton would therefore drop to number 11.

The SMART Factor for Canadian Provinces

In 2003 (4826 total Cities towns and villages) all registered light duty vehicles idling one second each day for a year

<table>
<thead>
<tr>
<th>Province</th>
<th>SMART Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ontario</td>
<td>2256</td>
</tr>
<tr>
<td>Quebec</td>
<td>1285</td>
</tr>
<tr>
<td>British Columbia</td>
<td>776</td>
</tr>
<tr>
<td>Alberta</td>
<td>758</td>
</tr>
<tr>
<td>Saskatchewan</td>
<td>298</td>
</tr>
<tr>
<td>Manitoba</td>
<td>247</td>
</tr>
<tr>
<td>Nova Scotia</td>
<td>173</td>
</tr>
<tr>
<td>New Brunswick</td>
<td>164</td>
</tr>
<tr>
<td>Newfoundland</td>
<td>97</td>
</tr>
<tr>
<td>Prince Edward Island</td>
<td>29</td>
</tr>
<tr>
<td>Other</td>
<td>16</td>
</tr>
</tbody>
</table>

Total Canada 6,099 GHG tonnes Per Second

Equivalenl to 6099 Canadians achieving the One Tonne Challenge

Litres 2,540,000

Value $2,184,000 @ .86 cents per litre

The SMART Factor is a very valuable number. It can be used to help find solutions everywhere to the problem of GHG produced by transportation.

A major value of the SMART Factor is that it can be used to more easily estimate the GHG impact of traffic control management improvement projects, of every size, in every community of the world.

The formula for that calculation would be as follows:

\[(\text{the estimated number of vehicles expected to be affected by the project on an average day over the total number of vehicles registered in the community}) \times (\text{the SMART Factor for that community}) \times (\text{the average number of seconds of expected additional delay, or reduced delay, that is expected to occur as a result of the project})\]

In Canada, since traffic control is a municipal responsibility, the Federation of Canadian Municipalities could, and with very little difficulty, perform 1000's of simple and fast SMART Factor calculations for every community in Canada. A summary of the results of those calculations could be reported to communities, and provincial and federal governments on a monthly basis.

The Environmental Protection Agency (EPA) could organize the same effort, for every U.S. State, and the United Nations Framework Convention on Climate Change (UNFCCC) could help administer this program to ensure that it takes place in every country in the world.

This could be Step-One of a three-step process to help achieve the world's Kyoto Protocol targets.
The SMART Factor Solution

Step One

In Step One we are saying that every community can easily, and quickly, calculate the tonnes of GHG that can be saved, in a one year period, when they take such steps as: installing new traffic control technology, or making improvements to transportation infrastructure.

1) An example of just one positive step that could be encouraged would be as follows:

New technology can be installed at a stop-light to reduce the delay of vehicles. Vehicle waiting times can be reduced by turning the light green as soon as there are no vehicles approaching from the other direction. This may seem like a small step however many of these small steps can add up very quickly to have a significant overall impact. Using the SMART Factor the overall number of litres of fuel likely to be saved by this intersection upgrade and the overall yearly value of the fuel at present day prices and the greenhouse gases that could be saved each year can be determined.

2) An example of just one negative step that could be discouraged would be as follows:

If a proposed commercial development on an already congested road would require the installation of a new traffic signal and therefore slow down traffic and further add to congestion, the approximate number of additional GHG tonnes that would likely be produced in that community over a one year period as a result of that new development could be determined. The corresponding additional litres of fuel burned over one year and its cost could be determined at the same time using the SMART Factor.

With the help of the information provided in the above examples the community could then make better decisions about the positive and/or negative benefit/costs ratios.

The community could make hundreds of these calculations every year and provide monthly reports summarizing measures proposed and/or taken each month and what the overall impact of those projects would be on the community’s yearly production of Greenhouse Gases.

All levels of government could monitor this data to make better investment decisions about what measures should be financed to produce maximum benefits to the community and also to the environment.

In SMART’s view, Step One could be put into place and operating before the end of this year, not only in Canada, but also in other countries. The only thing needed to make that happen would be the political will to do so. The reason this should be done will become clear later in this report.

The SMART Factor Solution

Step Two

Much can now be done to help achieve the ambitious goals of better-managed traffic and major emissions reductions, but the problem may become deciding which projects to move on first, and where, in order to maximize the return on the dollars available to invest.

Deciding how to move traffic more efficiently is a very difficult job for Traffic Engineers and Planners but it is a job that must be mastered due to its extreme importance. With appropriate training on up-to-date software and technology, traffic industry professionals can maximize the use of existing infrastructure to help save billions of dollars and help to substantially reduce the damage our vehicles do to the environment every day. We believe The SMART Factor could serve these professionals as another important tool to add to the many they already have.

Examples of some positive breakthroughs that can help the world deal more effectively with the ever growing number of vehicles on earth (we estimate there will be 1 billion vehicles on earth by the year 2030) and the problems of ever increasing traffic congestion will follow after Step Three.

The SMART Factor Solution

Step Three

Steps One and Two are steps that could be taken, and we believe should be taken, now in every country of the world.

Our recommended Step Three will likely be controversial and some people may think we are crazy to suggest it. However, we will suggest it anyway, and gladly take any criticism for it.

For Step Three, SMART recommends that the world bring to an end the production of 8 cylinder engines for passenger vehicles.

The reason for this is that the world needs to reduce the size of the average engine on earth in order to obtain “faster” increases in the average fuel efficiency of all vehicles on earth.

Automakers have succeeded in cleaning up most of the harmful substances emitted by vehicles, but one element in tailpipe emissions can’t be cleaned up – carbon dioxide (CO₂). Every litre of fuel that is burned produces about 2.4 kg of CO₂. The bottom line: the more fuel you use, the more CO₂ you produce. The more CO₂ you produce, the more you contribute to Global Warming. Every 10 minutes of idling costs you at least one-fifth of a litre in wasted fuel – and up to two-fifths of a litre (double) if your vehicle has an eight-cylinder engine. Source: NRCan
The average engine size in Canada

3.36 Litre Engine*


down

Europe CANADA USA

down

* Natural Resources Canada Office of Energy Efficiency unpublished spreadsheet

The average engine size of all light duty vehicles in Canada in 2003 was a 3.36 litre engine.* The total number of vehicles was 15,901,000 with small cars being 43%, large cars 30% and light trucks 30%*. Canada and other countries need to increase their percentage of small cars and decrease their percentage of large cars. The average engine size on earth must be lowered.

SMART does not have these exact numbers available for the US or Europe. However we would expect that the average engine size would be slightly larger in the US, due to the likely dominance of large cars, and considerably lower in Europe due to the expected higher percentage of small 4 cylinder engines.

The SMART Factor (savable greenhouse gas tonnes per second) for every country, and every community in every country, can be determined by knowing two things; (a) the total quantity of light duty vehicles by make and model (b) the fuel efficiency ratings for each of those vehicles.

The excel spreadsheet provided to SMART by NRCan provided the litres of fuel burned per minute for the total number of vehicles registered in 4826 Canadian cities in 61 fuel efficiency categories. SMART is therefore confident in the accuracy of the SMART Factor calculations made for each city, each Province and the total for Canada.

For the following calculation we will assume however that Canada’s SMART factor can be used as a good indicator to estimate the SMART Factor for the entire world.

The World’s SMART Factor

300,000 savable greenhouse gas tonnes per second

In 2003 the world’s passenger car fleet hit 589 million. Total World vehicles in 2003 including heavy-duty trucks and buses hit 813 million.

Since we know that Canada’s total fleet was 15.9 million vehicles in 2003, that means that Canada has about 1/37th of the world’s light duty vehicles and about 1/60th of all vehicles on earth including heavy trucks and buses.

Since we know that heavy-duty trucks and buses are less fuel efficient we know that it would be very conservative to add the number of these heavier and less efficient vehicles to the total.

Therefore the SMART Factor for all of the world’s light duty vehicles could be estimated as 6099 x 37 = 225,663 GHG tonnes per second.

Also, the world’s SMART Factor including heavy duty vehicles could be conservatively estimated to be over 300,000 savable greenhouse gas tonnes on a yearly basis for every second that all vehicles on earth idle less each day. (6099 x 50 = 304,950)

How significant is 300,000 tonnes per second?

The world’s SMART Factor of 300,000 tonnes per second converts to 18 million tonnes per minute, or 90 million tonnes of greenhouse gases for every 5 minutes each day that all vehicles on earth idle while parked or while sitting in traffic.

The world would only need to reduce idling by 1 minute and 40 seconds each day to be equivalent to 30 million Canadians meeting Canada’s One Tonne Challenge.

Under the Kyoto Protocol, Canada has agreed to reduce its annual emissions over the period 2008-2012 to a level 6 percent below our actual emissions in 1990. Since our emissions in 1990 were about 596 Mt, this means that over the 2008-2012 period our emissions should not, on average, exceed 560 Mt. Since Canada’s economy is performing better than had been projected, the emissions gap is more likely in the area of 270 Mt, and could be greater. Our emissions in 2010 could be about 38 percent above 1990 levels (810 Mt), or about 45 percent above our Kyoto 555 MT target, in the absence of any action to reduce them. This means in 2010 we could be about 245 million tonnes above target. This clearly demonstrates the magnitude of our challenge.*

Using a SMART Factor of 300,000 tonnes per second the world could wipe-out Canada’s 245 Mt over-target projection by idling about 14 minutes less each day.

(Note; Canada’s SMART Factor of 6091 would be 2% of the world’s 300,000 tonnes per second. This is in line with Canada’s contribution of about 2% of total global greenhouse gas (GHG) emissions produced by the world each year.)

The US SMART Factor is over 88,000 tonnes

The U.S. emits approximately 25 per cent of the world’s greenhouse gases. In 2003 the US had a total fleet of 135,669,897 automobiles and 94,943,551 trucks for a total of over 230,612,000 vehicles.** This is 14.5 times greater than Canada’s total 15.9 million vehicles. Therefore, we can estimate the SMART Factor for the US would be 6091 x 14.5 or over 88,000 tonnes per second.

The US National Transportation Operations Coalition (NTOC) says that if the US invested as little as $4.00 per vehicle per year to upgrade the nation’s traffic signal systems this would save up to 10% of the Nation’s fuel or almost 17 billion gallons per year (64.345 billion litres). Therefore, this one measure would save approximately 155 million tonnes of GHG per year or about 63% of Canada projected 245 MT over-target.

The NTOC states that would cost $965 million in the year 2000 and each year thereafter. (about 1.1 billion Canadian per year) On April 13, 2005, Ottawa unveiled Moving Forward on Climate Change and pledged to spend $10 billion to help Canada cut its average greenhouse gas emissions by 270 megatones a year in the five years 2008 to 2012. Therefore, that 10 billion Cdn would pay for 9 years of the U.S. saving 155 Mt or about 1400 Mt and 2008 to 2012 is 5 years at 270 Mt or 1350 Mt, which is about the same.

This comparison helps to show the significance of needless idling while not only sitting in parking lots and driveways but also idling while sitting and waiting needlessly in traffic due to outdated and poorly managed traffic control systems.

Source: *Natural Resources Canada ** Source: US Department of Transportation
The US and the “not very ambitious” goal

On February 14, 2002, President Bush also announced a goal to reduce U.S. greenhouse gas (GHG) emissions intensity—the ratio of emissions to economic output by American industry—by 18 percent over the next 10 years without sacrificing economic growth. Source: http://www.climatevision.gov/programmission.

That is not very ambitious goal when you consider that the EPA has stated that a voluntary program called the Smart Way Transport Partnership can achieve nearly ten percent of this goal.

The EPA set up this program with 52 freight shippers and carriers from around the nation. The EPA says Smart Way Transport partners can achieve fuel efficiency in a variety of ways, including automatic tire-inflation systems, the use of low-viscosity lubricants, reducing truck idling time, and improving routing and scheduling. SmartWay Transport fuel savings will result in reductions of at least 33 million metric tons of greenhouse gas. (If they meet their goals.)

Source:http://yosemite.epa.gov/opa/admpress.nsf/0/3ac20befcabc730685256e35004c1e3d?OpenDocument

Therefore, from the above, we can draw the following conclusions:

- Since heavy transport contributes about 20% of the total GHG produce by the total transportation sector, but they can meet 10% of the total US goal, then the other 80% of the sector should be able to easily meet the other 8% of the entire US target.
- Since the transportation sector is capable of achieving the entire US target of 18% this means the other sectors would need to do nothing at all to reduce emissions. And yet, in the US fossil fuel combustion from stationary sources, such as electricity generation, represents more than half of energy-related emissions, while combustion of fossil fuels by mobile sources, such as automobiles, represents approximately one-third. (*Source EPA In Brief- The U.S. Greenhouse Gas Inventory) This mean the 18% target is far too small and far to easy for the US to reach.
- This helps to put the significance of GHG production from idling engines into perspective. It also blows-away the following statement by the Coalition for Vehicle Choice (a coalition created and sponsored by General Motors, Ford and other auto makers):
  "Contrary to what some may think, fuel economy is not an environmental issue. Automotive gas mileage does affect a vehicles emissions of carbon dioxide (CO2), a non-toxic *greenhouse gas*— but it's just a minuscule share of worldwide CO2, with little or no effect on global climate."
  Source: Environmental Defence – Automakers' Corporate Carbon Burdens

George Bush’s “as science justifies” statement

Also on February 14, 2002 George Bush said:

"I reaffirm America's commitment to the United Nations Framework Convention and its central goal, to stabilize atmospheric gas concentrations at a level that will prevent dangerous human interference with the climate."

"(We will) set America on a path to slow the growth of our greenhouse gas emissions, and *as science justifies*, to stop and then reverse the growth of emissions."

As evidence grows that human activity is accelerating dangerous changes in the world's climate, the Bush administration's excuses for inaction are running out. The warnings are coming from melting ice and changing ocean currents, and from scientists and responsible politicians around the world. And yet what is the United States government doing about global warming? The answer, essentially, is not enough.

In the US GHG production continues to climb (despite some successful voluntary efforts from a variety of forward looking companies and States, acting on their own) — and will only decrease through better (and perhaps mandatory) governmental policies and greater and faster investment in ITS technology.

If science can't provide enough “justification” for George Bush perhaps the SMART Factor can

We hope the SMART Factor can be used to provide the Bush administration with some additional common sense and motivation to reduce more US GHG emissions faster.

We have estimated the total US SMART Factor would be approximately 88,000 savable GHG tonnes per second. The Bush administration could easily calculate the actual US SMART Factor by examining the same data for the US that NRCan has examined for Canada.

We therefore estimate US cars and light duty trucks will burn 37 million litres of fuel by idling for just one second each day for a year.

This means if all US vehicles could idle 5 minutes less each day they would save over 11 billion litres, or 2.9 billion US gallons, of fuel in one year. The value of that fuel is a very large number for the Bush administration to to focus on. (Note: 3.7854118 litres = 1 US gallon)

The average US citizen may idle needlessly for 5 minutes each day while parked. (NRCan estimates the average Canadian does this.) Another 5 minutes each day could be saved by investing more in Intelligent Transportation Systems to double this savings to 5.8 billion gallons of fuel per year. This huge savings should be appealing to the Bush Administration.

As a bonus that could save 10 minutes each day for the average US citizen to be more productive, or to enjoy more leisure time. This would help the US complete more effectively in world markets. That should be appealing to the Bush administration also.

At the same time the US would reduce GHG production by another 52 million tonnes per year and this would help the US move closer to the targets of Kyoto.
Comparison of Canadian and U.S. light duty vehicle GHG Emissions as a percentage of the total Transportation Sector

Canada's GHG Emissions from Transportation Sources in 2003

Source: Natural Resources Canada Office of Energy Efficiency

FIGURE 1
Global, U.S., and U.S. transportation sector carbon emissions

<table>
<thead>
<tr>
<th>Global Carbon Emissions</th>
<th>U.S. Carbon Emissions</th>
<th>U.S. Transportation Carbon Emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States 25%</td>
<td>Transportation 33%</td>
<td>Heavy Trucks</td>
</tr>
<tr>
<td>Germany</td>
<td>Commercial 33%</td>
<td>Clean Air</td>
</tr>
<tr>
<td>Rest of the World</td>
<td>Residential 40%</td>
<td>Water</td>
</tr>
<tr>
<td>Russia</td>
<td>Industrial 27%</td>
<td>Off-Road</td>
</tr>
<tr>
<td>India</td>
<td></td>
<td>Highway</td>
</tr>
<tr>
<td>China</td>
<td></td>
<td>Highway</td>
</tr>
<tr>
<td>Japan</td>
<td></td>
<td>Highway</td>
</tr>
</tbody>
</table>

U.S. cars and light trucks account for 20% of the nation’s CO2 emissions and 5% of the world total. This level is more than all fossil fuel CO2 emissions from India, which ranked 5th among countries.

Source: Automakers’ Corporate Carbon Burdens – Reframing Public Policy on Automobiles, Oil and Climate by Environmental Defence 2002 Cars and trucks in context page viii

Note:

US cars and light trucks total 62% of US transportation sector emissions.

Canadian cars and light trucks total 51% of Canada transportation sector emissions.

This 11% difference means the SMART Factor for each city in the U.S. would carry an even greater weight of significance for encouraging investments in new technology to help reduce travel time, travel delay and needless idling.
The auto industry is not doing enough to help reduce Greenhouse Gas

A report prepared by the staff of the Office of Integrated Analysis and Forecasting of the Energy Information Administration in March 2002 states:

"Transportation. Section 1211 Subsection (b)(3) calls for the development of government and industry partnership programs that will enable dramatic efficiency improvements in highway vehicles. By 2010, these provisions would require a passenger car to achieve 80 miles per gallon (mpg) and a light truck to achieve 60 mpg. By 2010, these provisions would also triple the efficiency (ton-miles per gallon) of medium freight trucks, and double the efficiency of heavy freight trucks.

The light vehicle fuel economy goals defined in this provision echo a recent Federal program. The Partnership for a New Generation of Vehicles (PNGV) was a cooperative research and development program among seven Federal agencies and the United States Council for Automotive Research (USCAR), which comprises Daimler Chrysler, Ford Motor Company, and General Motors Corporation.

The program was initiated in 1993 and stated as one of its goals, the tripling of fuel efficiency for midsize cars without sacrificing affordability, performance or safety. In 2000, concept cars were demonstrated to show that the PNGV fuel economy goals could be met without sacrificing other vehicle attributes. Although the concept vehicles achieved the PNGV fuel economy goals, it was reported that the incremental cost of producing these vehicles would exceed $7,500, making them impractical for most consumers.

While the PNGV program made progress in the development of advanced technologies to enable a cost effective tripling of light vehicle fuel economy, the limited focus embodied in R&D programs led to the demise of the program early in 2002. It was replaced by the Freedom CAR program, which maintains a long-term goal of increasing fuel economy through fuel cell technology and adds additional funding to support the development of a hydrogen infrastructure.

Without the PNGV program and its mid-term efficiency goals coupled with product development lead times, the apparent consumer preference for increased vehicle power rather than efficiency, tripling fuel economy from today's level by 2010 seems highly improbable.

Although it is plausible that manufacturers could institute commercial-scale production of such vehicles, it is highly unlikely that all new light vehicles could achieve this goal cost effectively."

SMART wishes to point out that if it is "plausible" it can be done. That was 4 years ago and technology has advanced considerably this then. To help the world confront global warming it needs to be done, and therefore it should be done. If it is "not" being done the auto industry should explain to the general public why they feel they cannot do it. We believe they can do it.

Source: A report prepared by the staff of the Office of Integrated Analysis and Forecasting of the Energy Information Administration. - Impacts of Energy Research and Development (S.1766 Sections 1211-1245, and Corresponding Sections of H.R.4 With Analyses of Price-Anderson Act and Hydroelectric Relicensing - March 2002 page 6 and 9

What are Auto Industry executives thinking?

On February 17 2005 a Canadian Press article published by the Hamilton Spectator titled - Brain and Brawn - New muscle cars outpace their gas-guzzling, pollution-spewing predecessors. - On the day the Kyoto environment treaty took effect, Canada's auto industry introduced a new generation of muscle cars.

The article stated that: "during a media preview of the new muscle cars, executives argued they're working hard to overcome the belief that their products are a danger to the environment. What they're trying to do, they said, is strike a balance between reducing vehicle-related air pollution while still offering products the public wants. Some of the difficulty of that balancing act was highlighted by new figures from Statistics Canada (published the day before) which reported sport utility vehicles, which many environmentalists attack as fuel-wasting monsters, remain highly popular with drivers."

That article quotes 3 Canadian automakers presidents as saying the following:

1) Re: the Ford Mustang - Joe Hinrichs, Ford of Canada's new president said: "I think it is appropriate because it looks at what our industry is capable of doing, putting on an exciting, beautiful product that consumers demand and want, while at the same time not abusing the environment and not dismissing our other responsibilities as citizens."

SMART wishes to point out that the industry is capable of doing much more to help the environment and by not doing so they are, indirectly for that reason alone, abusing the environment, and by not doing more they are, in reality, dismissing their responsibilities as citizens.

2) Re: the Dodge Charger - Mark Norman, president of Daimler-Chrysler Canada said: "We try to offer a range of products. In an environment where customers have 200 some odd vehicles to choose from, having the most efficient, highest value option in every segment we think is a winning option for Canada and a responsible position in the global market-place."

SMART wishes to point out that the words "most efficient" are relative. If a vehicle is the most efficient, among many inefficient GHG spewing vehicles, that does not say much for the efficiency of the most efficient.

3) Re: the Hummer – When unveiling the new Hummer – (the tank-like vehicle that started life as a small army truck), - GM of Canada's president Michael Grimaldi said: "Our strategy is to ultimately remove the automobile from the environmental debate." and "We say let's offer a complete portfolio of products and make some of those larger vehicles more fuel efficient."

In SMART's view GM President Michael Grimaldi was not thinking clearly when these statements were made. To imply, or even think, that the auto industry will ever be able to remove the automobile from the environmental debate is wrong-headed at best. Also, by saying "and make some of those larger vehicles more fuel efficient" is the same as saying it is acceptable to leave some of those larger vehicles alone with no attempt to make them more efficient.

SMART does not agree with the above three auto industry presidents. We respectfully request they commit to the pledge presented for their consideration in this report.
What the auto industry can do now

In SMART's view newer technologies, such as "Idle Stop" and Adaptive Cruise Control (ACC) need to be taken-up faster, and spread from top-of-the-range models to cheaper ones as quickly as possible.

What is ‘idle-stop’?

Idle stop can help save millions of tonnes of GHG and millions of litres of fuel and millions of dollars

The key to lowering Canada's and the world’s production of GHG is turning the key off as often as possible.

To stop idling is simply the action of turning off car engine when car drivers do not actually need it, such as when they stop at a signal or an intersection, etc. Not only does this reduce emissions, but also reduces fuel consumption.

In Japan "Idle Stop" is getting considerable attention and it is a focus in there 2005 Energy Report. Why? Because studies in Japan indicate potential 13.4% fuel savings in urban areas and 5.8% on average nationwide.

According to the U.S. Department of Energy, running a vehicle at idle speed dramatically reduces engine life. Just 60 minutes of idling time is equivalent to 80 to 120 minutes of driving time and excessive idling can waste up to 800 gallons of fuel annually for the average truck! Perhaps that is why GM is now boldly claiming that they can improve the fuel economy of trucks by 10% and in 2007.

The leads us to this important question. Why not introduce Idle Stop technology on more models much faster?

If governments are serious about "achieving" sustainable transportation targets, reducing greenhouse gas emissions and ensuring intergenerational equity, why don’t they make "Idle Stop technology a mandatory feature on all new vehicles within a 5 year period. Through the use of tax incentives and a "this-must-happen" approach this could likely be achieved.

A belt-driven/alternator-motor design might be the best way to go, and a universal approach across all manufacturers would likely be best for market acceptance and also to enable easy and traditional long term maintenance procedures.

It may also be possible to retro-fit existing cars with "Idle Stop" at an affordable and acceptable price for environmentally concerned people. That is a guess, since we (SMART) are not automotive engineers, but if that is correct it would be a good idea for governments to provide tax incentives to push this idea forward.

What is Adaptive Cruise Control (ACC)?

Adaptive Cruise Control (ACC) is a system that uses a forward radar sensor to determine the distance between the host vehicle and a target vehicle. The system is intended to match the speed of the target vehicle by reducing the throttle and/or applying the brakes without requiring the driver to adjust the cruise control settings.

If the distance to a vehicle in front is below a pre-set value, the ACC system is designed to slow the car down, using brakes if required, to track the speed of the vehicle in front, then returning the car to its pre-set speed once the lane ahead is clear.

The industries main motivation for bringing ACC to market has been safety and it is already a feature on some high-end vehicles.

What people have not been talking very much about is the significant benefit of ACC’s ability to help dissolve traffic jams. And at the same time it can provide an increase in fuel efficiency due to very gradual speed increase / decrease in traffic.

A study published in the June 2004 issue of the journal Physical Review E, Physicist L. Craig Davis at University of Michigan, Ann Arbor, concludes that many traffic jams could be prevented if a mere (20%) one in five vehicles on the road used this new technology rather than being piloted by their human driver alone. In other words, humans make avoidable traffic-jam-causing moves that a computer does not.

Prof. Davis is the latest physicist to weigh in on a subject that has long been dominated by traffic engineers and "operations research" scientists. A little more than a decade ago, scientists realized that vehicles behave like molecules in a gas. In the most notorious similarity, cars ahead of you that stop or merely slow down can cause a compression wave -- a patch where the cars are jam-packed -- to propagate backward until it reaches you. The wave can persist for hours after the initial bunch of cars hit their brakes, with the result that drivers who never saw that deceleration are totally clueless about why they aren’t moving. An estimated 75 percent of traffic jams are like this, having no visible cause.

Physicists are exploring whether adaptive cruise control can prevent this. In ACC, a radar sensor gauges the distance between cars, automatically adjusting speed to maintain a safe distance. Because ACC, which has become standard on some luxury vehicles, can adapt instantly if the lead car brakes (humans take about 0.75 second to react), cars can tailgate safely. ACC can therefore pack more cars into a mile of highway, increasing a road’s capacity.

Also, according to civil engineer Hani Mahmassani of the University of Maryland, College Park. "With ACC, by eliminating the spacing you need because of driver reaction time, you can get four times more volume on a road by letting vehicles follow each other closely at high speed." Source: A few computer-controlled cars can help traffic, The Wall Street Journal Friday, July 30, 2004

So although the main reason for developing ACC was safety related, why are governments not accelerating this technology for its immediate deployment, across many models of vehicles? The added benefit of its’ ability to help dissolve traffic jams and reduce the many millions of tonnes of greenhouse gas that traffic jams produce should be acknowledged and taken advantage of immediately.

What are we waiting for?
Traffic jams + ACC = less GHG

Having the letters ACC on the back of your car could become a proud symbol of a concern for safety and also environmental responsibility. After all ACC would be a symbol of:

- Reduction in accident rate for vehicles fitted with collision avoidance type systems
- Reduction in driver fatigue
- Increase in fuel efficiency due to very gradual speed increase/decrease in traffic
- One of the "good cars" on the highway that can help to dissolve traffic jams. Other vehicles will want to get behind you.
- A vehicle that can help the world achieve Kyoto Protocol targets by helping to reduce the GHG caused by traffic jams

It may be possible that vehicles that already have cruise control can be retrofit and upgraded with more advanced ACC. If a retrofit system can be brought to market governments should provide tax incentives to encourage people to install them.

Since the physics of traffic indicates that a surprisingly small number of vehicles equipped with ACC could go a long way to help dissolve traffic jams governments should be jumping all over this technology to get it to market quickly. And by quickly, we mean quickly in our view of the meaning of the word., not how the auto industry might define the word quickly. If they wish to repeat comments such as "it takes "X" years to bring these improvements to market", SMART's response to that would be - "Hogwash auto industry executives can achieve whatever ambitious objectives they feel like setting."

With the skills and talent of bright and very hard working auto industry employees at their disposal, combined with the desire of governments to lower greenhouse gases, the auto industry can achieve almost anything they set their minds to.

It is time that auto industry executives and the millions of people who work in the auto industry open their hearts much wider and get down to working 24/7 to more substantially and more quickly lower the greenhouse gases produced the transportation industry.

CAW-TCA - the largest private sector union in Canada says;

"We want to keep our good jobs and make and work with products that contribute to society, not that do society harm. We demand that the corporations we work for produce, service and operate environmentally and socially responsible products."

Source: http://www.caw.ca/whoweare/cawpoliciesandstatements/policystatements/cawtrans_index.asp

The auto industry has a guiding principle to promote environmental protection and contribute to a better society. They say they are fully committed to a policy of minimizing pollution and conserving world resources. In SMART's view the auto industry must work harder, and also move faster toward fulfilling this commitment.

What is our government thinking?

On March 22, 2006: Traffic jams cost $3.7 billion a year, study says - Transport Minister says congestion causes delays and wasted fuel in nine top cities – an article by Jeff Gray;

"Federal Minister of Transport Lawrence Cannon said on March 21 that in addition to the government pledging $2 billion for highway and border crossing improvements his department was also funding projects with the City of Toronto to "study" what is known as "intelligent transportation systems" or using computers and technology to help traffic flow. He said the congestion "study" was first step toward a standardized measurement of congestion."

SMART agrees totally that – What gets measured gets done – but in this situation – considering the fuel wasted and the GHG produced by congestion – we don’t have time for studies anymore and business and industry already know far more about how they can ‘act fast’ than the government could ever take the time to listen too. The world needs action NOW!

There is an abundance of research data available about ACC. Minister Cannon should try to make some efforts to be aware of technologies available in the market that could potentially help both environment and transport efficiency.

Why would our government want to do more “costly” congestion defining studies? SMART is happy to give this report, and the new SMART Factor Indicator, to Minister Cannon for “FREE”. If our government thinks that things that are FREE have no value then that would help explain (in part) why they keep wasting so many taxpayer dollars every year. In SMART’s view our government should stop paying for many expensive studies and start calling in favours in the name of societal, environmental and intergenerational responsibility for studies to be done at lower cost if not for free.

In the U.S. an Urban Mobility Study dated May 2005, by the Texas Transportation Institute, concluded that congestion delayed travelers 79 million more hours and wasted 69 million “more” gallons of fuel in 2003 than in 2002, causing 3.7 billion hours of travel delay and “2.3 billion gallons” of wasted fuel.

SMART would like to point out to 2.3 billion gallons of wasted fuel x 3.785 = 8.7 billion litres divided by 417 litres burned per tonne gives us over 20 million tonnes of greenhouse gas in 2003 just from traffic jams.

With numbers like those to focus on SMART hopes our government will get together with the U.S. government and others to instruct the auto industry to bring ACC and Idle Stop to market in a big way in the next few years.
There will be much heavier traffic in the years ahead

A study by the Neptis Foundation completed in 2002 titled:

**Toronto-Related Region Futures Study - Impacts of Business-As-Usual Development** - states as follows:

Between 2000 and 2031, under the Business-As-Usual scenario, the total number of trips made by automobile or transit in the peak morning period will increase by 50%, from 2.7 million a day to 4.0 million a day.

Of these additional 1.3 million trips: 14% will originate in Toronto; 65% will originate in the rest of the inner study area; 21% will originate in the outer study area. The growth in transportation demand will, however, outstrip the growth in transportation capacity.

By 2031, the number of vehicles in the study area will have increased by 43%, from 3.7 million to 5.6 million, and the number of vehicle kilometres travelled each day by residents of the area will increase by 64%, from 157 million to 258 million. Yet the highway network is expected to expand by only 30% and the arterial road network by a mere 6%. As a result, road congestion and travel delays on the transportation network will increase.

(Congestion is defined as a volume-to-capacity ratio of 80%.)

The hours of delay experienced by auto drivers on a typical weekday are projected to rise from about 300,000 hours a day to 1.2 million hours a day, or 300%.

The study calculated the expected levels of increase in auto delay during the morning peak period for automobile trips leaving from a traffic zone. The study area covered 2052 traffic zones. Delay is defined as the difference in time between traveling with and without traffic.

Given the continued high level of automobile use and the increase in the time that people spend in their cars, fuel use is expected to rise, despite improvements to the fuel efficiency of automobiles. At the same time, carbon dioxide emissions per capita are estimated to increase by 42% on average throughout the study area between 2000 and 2031.

Meanwhile, transit will not gain much ground. Although the modal share for GO rail service will increase, that growth will be offset by a decrease in the modal share of municipal transit, because much of the population growth is occurring in areas with low transit services levels. In 2000, about 50% of the region’s population lived in areas dense enough to make bus service economic; in 2031 under the Business-As-Usual scenario, that proportion will increase to only 55%.

There will be little or no increase in the percentage of population living in areas suitable for rapid transit. However, density is not the only determinant of transit viability, which are also affected by the supply, quality, and pricing of transit services and of roads and parking for private automobiles.

Those are “chilling” predictions. How chilling? Consider these numbers

In 1998 the City of Burlington had a population of about 150,000 and the cities total fleet of registered light duty vehicles produced a SMART Factor of 30.

In other words, Burlington’s vehicles would produce 30 tonnes of GHG in a year, for every second each day that all light duty vehicles idled. This is equivalent of 6 minutes and 5 seconds total.

Now imagine a fleet of vehicles, similar to the number of vehicles in the city of Burlington, sitting on the Queen Elizabeth Way (QEW) in a traffic jam for 6 minutes and 5 seconds. That would also produce 30 tonnes of GHG and waste about 12,500 litres of fuel valued at about $12,000 at today’s prices of just under a dollar a litre.

For “every” 6 minutes that a similar number of vehicles is delayed in traffic, on any combination of highways and arterial roads, anywhere, the tonnes of GHG produced, and the waste of fuel and associated cost will rise accordingly.

With the above example in mind now think about the Neptis Foundation projections. In the year 2031, if the projected 5.6 million vehicles sit in traffic for these same 6 minutes and 5 seconds, that could produce over 1000 tonnes of GHG and waste over 400,000 litres of fuel valued at $400,000 (if fuel was $1.00 per litre).

And, that is just for 6 minutes - what if those vehicles sit in traffic for 30 minutes every day? That 30 minutes would then produce approximately 5,000 tonnes of GHG and waste more than 2 million litres, and $2 million at $1 per litre.

Now think of that happening on congested roads all across Canada and in other countries as well. In 2003 the world fleet of vehicles was approximately 589 million and when you add in heavy trucks and buses the total was approximately 813 million. By 2030 we could reach 1 billion vehicles on the fragile earth.

Therefore, we need to move existing and future traffic more efficiently, and it would be wise to move faster on this now.
Looking at the future
A telling and important Table of projected increases in Transportation Energy Consumption

Table 3. Transportation Energy Consumption and Total Oil Consumption by Region, 2002-2025
(Quadrillion Btu)

<table>
<thead>
<tr>
<th>Region</th>
<th>2002</th>
<th>Projections</th>
<th>Average Annual Percent Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mature Market Economies</td>
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<tr>
<td>Transportation Energy</td>
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<td>Total Oil</td>
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<td>Total Oil</td>
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<td>13.1</td>
<td>13.9</td>
</tr>
<tr>
<td>Emerging Economies</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transportation Energy</td>
<td>26.2</td>
<td>39.1</td>
<td>46.1</td>
</tr>
<tr>
<td>Total Oil</td>
<td>59.2</td>
<td>83.6</td>
<td>95.5</td>
</tr>
<tr>
<td>Total World</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transportation Energy</td>
<td>85.3</td>
<td>105.5</td>
<td>116.8</td>
</tr>
<tr>
<td>Total Oil</td>
<td>159.4</td>
<td>193.1</td>
<td>210.6</td>
</tr>
</tbody>
</table>


The above table shows a projected total world transportation energy increase between 2002 and 2025 as being from 85.3 to 137.2. This means transportation energy usage and GHG production is expected to increase by 61% in that 23 year period.

Much of the growth in worldwide energy use is expected in the countries with emerging economies. However, strong projected economic growth will drive the demand for energy in all regions. Therefore, new technologies will need to be supported and brought quickly to market in all regions of the world. But the challenge is even more pronounced in many developing countries, which are moving toward an explosive burst in energy demand.

The consumption projections above should be presenting a flashing "red-light" today, so that a "green-light" can be available for generations to follow. But it appears much of the world is blind or refuses to see this flashing-red-light.

On November 16, 2005, in an opening speech to the United Nations Climate Change Conference in Montreal, Stéphane Dion, P.C., M.P. Minister of the Environment said the following:

"The world's energy needs will be almost 60% higher in 2030 than they are now, especially with respect to fossil fuels. They represent about 80% of the energy mix today and they will still be 80% of the energy mix in 2030. The vulnerable sources of energy, even with our best efforts, will increase by 3%, which is good, but they started at 2%, so if you triple this, they will reach 6%. Two thirds of the increase in these energy demands will come from developing countries whose technology is not very efficient in terms of pollution. By 2030, they will account for almost half of the energy demand and that means that in 2030, greenhouse gas emissions will increase by 62%, while scientists have asked us to decrease this by 60%.

Clearly then, keeping traffic safe and on the move, while at the same time reducing environmental impact, is an ambitious goal but one that requires urgent attention. Besides ACC and Idle Stop it is now clear that intelligent traffic control programs can shorten travel times, reduce congestion and decrease traffic-related emissions. With proper management, traffic jams can be prevented. When they do occur they can also be minimized and dissolved. The equipment available today is already capable of dealing with the traffic demands of tomorrow. Therefore, it should be obvious, governments need to help "expedite" the process of bringing new technology to market and the public needs to become more informed about what can be done.

We must focus our attention on the mathematics of the above and what this may mean to the subject of peak oil, upward pressure on oil prices, and a runaway growth of GHG produced by transportation. This page in The SMART Report, by itself, should open-up debate on many difficult but very important questions. To help start these many important debates, SMART (OPIRG) McMaster wishes to put forward these questions:

1) Why is General Motors allowed to make, advertise, and sell the Hummer?
2) Why is Ford allowed to make, advertise, and sell the Shelby Mustang GT500?
3) Why is Daimler/Chrysler allowed to make, advertise, and sell the Dodge Charger with a 5.7-liter HEMI V8 engine?
4) Why is the world allowing the manufacture of any fuel inefficient, 8 cylinder engine passenger vehicles – at all?
The need for a joint statement from
Auto Industry Presidents

SMART believes the auto industry has a responsibility to the
world to discuss more openly how the industry and its products
impact the environment every day.

SMART believes it would be appropriate for the auto industry to
set tougher targets for itself, to make those targets public and
pledge to the world they will report on progress annually for
the next 25 years, to ensure the world they will meet those targets.

We therefore challenge all auto industry presidents to step
forward with a joint statement and a pledge to the world that:

- The industry will speed up efforts and bring new
technologies to market faster with an aim to
significantly reduce the greenhouse gases that are
produced every day by the world’s fleet of vehicles.

- The industry will do this willingly motivated by a
responsibly and concern for the ability of today’s youth
and future generations to inherit a healthy planet.

- The industry will set ambitious targets and do whatever
is necessary to achieve them and will also ask all auto
industry suppliers and their employees to do the same.

- The industry will become more aggressive in
designing, producing and promoting more
environmentally responsible vehicles, and will, if
necessary, focus less on what consumers want,
to give the world more of only what it needs.

It is not SMART saying that the above pledge is both important
and appropriate. It is the "mathematics" in this report saying this.

Mathematics does not choose between the environment and the
economy. It is concerned only with the enumeration and
comparison of relations. Mathematics can reveal hidden
patterns that help us understand the world around us and make
better decisions.

It is clear, in our view, that the "mathematics" in this report is
saying the auto industry must make better, and also faster,
decisions to reduce greenhouse gases and to help the world
ensure inter-generational equity.

"Inter-generational equity is a notion that views the human
community as a partnership among all generations. Each
generation has the right to inherit the same diversity in natural
and cultural resources enjoyed by previous generations and to
equitable access to the use and benefits of these resources. At
the same time, the present generation is a custodian of the
planet for future generations, obliged to conserve this legacy so
that future generations may also enjoy these same rights. In this
way, intergenerational equity extends the scope of social justice
into the future." Source: Earth & Peace Education Associates
International

SMART acknowledges that mathematics is not concerned about
intergenerational equity. However we know that humans are.
We also know that governments and industry must work with
numbers more, and more effectively, to help us ensure it.

There is no acceptable excuse
for not moving faster

Taking the First Step: Climate Change, the Kyoto Protocol, and
Canada’s role - A Policy Paper of the Canadian Autoworkers
(CAW) Council dated December 2002 states:

"The federal government has proposed that the auto industry
improve the fuel efficiency of new vehicles sold in Canada by 25
percent by the end of this decade, as part of Canada’s Kyoto
implementation plan. This is a reasonable and realistic overall
target for the industry. The European auto industry has already
committed to improving average fuel efficiency by 33 percent by
2008. And the Japanese auto industry has committed to a 23
percent improvement in fuel efficiency by 2010 (and since
European and Japanese vehicles are more fuel-efficient to start
with, it will be harder for them to meet this target). Existing
technologies exist which would allow average fuel efficiency
to improve by 25 percent; we don’t need to count on future
breakthroughs to meet that target. And economic studies
indicate that the added cost of fuel-saving innovations would be
roughly offset by fuel savings over the life cycle of the vehicle, so
the net cost of driving will not increase. It will form a agreement
between government and the auto industry, however, to ensure
that these technologies are implemented: if the choice is left solely
to individual consumers, then the higher up-front cost of
fuel-efficient technologies will deter most buyers."

So, there is no acceptable excuse for not moving faster to
immediately bring to market the benefits of new technology.
Governments have both the responsibility and the ability to bring
people together to address large problems and to assist in the
financing of large undertakings. It is time for world governments to
come together to do just that. Considering the size of the threat of
global warming and a world SMART Factor of over 300,000 tonnes
of greenhouse in a year for every second each day all vehicles idle
needlessly, it is long overdue.

Transportation is presently responsible for about 27% of the
world’s total GHG production each year. SMART estimates there
will be 1 billion vehicles (including heavy trucks and buses) by the
year 2030. We are moving in the wrong direction and simply not
moving fast enough to address that fact.

Governments and industry must therefore stop talking and start
spending. If we fail to act to slow down global warming we will
impose on our children the enormous impacts it will have on
human health, world coastlines, agriculture, and infrastructure.
We’ll see major conflict over diminished resources, including water
and food. We will see lives lost to heat waves, infectious disease,
and extreme weather. We’ll see many millions of environmental
refugees and terrible human suffering.

All levels of governments and industry must do “immediately”
whatever they can to help combat climate change. If that means
holding emergency meetings and spending more money than
previously budgeted, then that is what should be done.

Please see the recommendations in this report that SMART thinks
need to be acted upon now.
Traveling on existing road systems needs to become more efficient with the help of technology.

*We need to see (and people want to see)*
*many more examples of technology in action, such as the following:*

**Examples of success**

* In North York Ontario, improvements from signal network updates resulted in time and cost savings to motorists estimated at $17,169,516.00 when measured against the annual expenditures for performing the upgrades, as well as operating costs for the Central system. A benefit/cost ratio of 30.7 to 1 was achieved. This demonstrates an effective operation and what can be achieved in many more communities.

* In Los Angeles California, about 3,000 of the 4,200 traffic signals are controlled by computers linked to sensors in the road that constantly monitor traffic volume and adjust automatically, deciding on their own how long to stay green based on the demand at the moment instead of following pre-programmed timing. Los Angeles traffic engineers have tweaked an extra 10 percent capacity out of the city’s major streets without building or widening roads.

* In Houston Texas, more than 360 traffic-surveillance cameras pan more than 90 percent of the lanes on area highways and send continuous images to Houston TranStar, a high-tech operations centre filled with rows of computer consoles and plasma TV screens that display accidents and traffic knots. The 9-year-old TranStar facility and traffic equipment deployed on the roads, including about 150 electronic changeable-message signs to alert motorists about problems ahead, cost $24 million annually to operate but the benefits delivered to motorists total $168 million a year in quicker commutes, less fuel consumed and cleaner air. Plans are in the works to synchronize more traffic signals and double the number of traffic-surveillance cameras.

*The efficiency improvements and the greenhouse gas emissions savings achieved by each of the above examples are both significant and essential to help meet the Kyoto targets. They should be celebrated and they need to be emulated in as many communities as possible across Canada and in every country of the world.*

Moving traffic as efficiently as possible is an everyday goal in every community for economic, pollution reduction and quality of life reasons. A communities improved capacity to adapt to occurrences of extreme weather through greater investments in ITS also needs to be examined more closely. Extreme weather events put additional stresses on every community’s ability to move traffic efficiently. Better use of technology can help communities reduce their vulnerability to the increased frequency and severity of rainstorms, snowstorms and ice conditions that are expected in the future due to global warming.

The above is taken from SMART’s presentation at Natural Resources Canada Conference - Adapting to Climate Change in Canada 2005: Understanding Risks and Building Capacity May 4 - 7, 2005 Montreal, Quebec. A copy of SMART’s complete power-point presentation can be view at [http://www.adaptation2005.ca/posters/hicks_e.html](http://www.adaptation2005.ca/posters/hicks_e.html)

**Important note:** Our first priority should always be to promote public transit, car-pooling and less driving. After that, our second priority must always be to minimize the waste that is inherent in our transportation systems. There is a very urgent need to do so, and all governments on earth should be working 24/7 on this problem.
In 1998
The SMART Factor *
Saveable GHG tonnes per second
for every second that all registered light duty vehicles in a community idle less each day for a year while in driveways and parking lots or while sitting in traffic.**

**The SMART Factor is a new CO₂ emissions factor and environmental indicator that describes the quantity of Greenhouse Gas (GHG) tonnes that would be released (or saved) when all light duty registered vehicles in a community idle for just one second (less) each day for a year. Based on 1998 vehicle registrations. Source Natural Resources Canada CO₂ calculator data converted by SMART.* For a copy of the final SMART Factor Report expected in June 2006 send email to: SMARTgroup@cogeco.ca.

World Auto Fleet in Millions
1950 - 2002* plus 2003**
Billions of stops and starts per day
means billions of opportunities to be more efficient

In 2002, the world’s passenger car fleet hit 531 million. A quarter of these cars were in the United States, a country with just five percent of the world’s population. The carbon emissions of U.S. automobiles are roughly equivalent to those of the entire Japanese economy - the fourth largest carbon emitter.***

Only four nations in the world emit more total heat-trapping carbon dioxide emissions from burning fossil fuels than U.S. autos release alone.****

*Source : Ward’s World Motor Vehicle Data from the U.S. Highway Administration
**Source : Ward’s Communications
***Source : Compiled by the Worldwatch Institute with statistics from the U.S. Highway Administration
****Source : The Union of Concerned Scientists Washington March 2005
14 SMART Recommendations

1) That the new Canadian government call an immediate world summit to discuss the implications of a world SMART Factor of over 300,000 Greenhouse Gas tonnes per second.

It is urgent to get global understanding and acceptance of the magnitude of this problem. All countries must act together to address it. We must move faster on this issue and we must make, and take, every opportunity to do so.

2) That Natural Resources Canada Office of Energy Efficiency host the summit, and that this summit be held before the end of 2006. That if the new Canadian government decides not to move quickly on this recommendation that the Canadian Green Party step forward to organize the summit.

3) That representatives of all automakers and ITS companies be asked to attend the summit to talk about what they can do to bring new technologies to market faster and what government assistance they will need to succeed in meeting new and more aggressive time targets.

4) That an international task force be established, made up of Mathematicians, Traffic Engineers, Traffic Planners and ITS Professionals, to advise and assist national, state, regional and local governments on how to maximize the use of new technologies to address traffic congestion, reduce delay and improve traffic flow efficiency to the greatest extent possible.

5) That a national transportation policy be established and agreed to by the federal and provincial governments that contains a specific comprehensive policy statement to address transportation flow efficiency directly. Federal and provincial approaches need to be harmonized to help facilitate accelerated upgrading of municipal traffic management systems in every community across Canada.

6) That new roads not be built, and existing roads not be expanded, until all efforts have been taken to improve the efficiency of existing infrastructure.

7) That new commercial or residential developments not be permitted on lands that could be used for new, or expanded, public transit systems, services or facilities.

8) That the Ontario government conduct an immediate cost/benefit analysis of the Ontario Drive Clean Program to determine if the 2.2 billion in projected spending to the year 2015 can better invested to improve the daily travel flow efficiency of all vehicles in all areas of Ontario.

9) That restrictions be placed on the advertising of vehicles models with the lowest fuel efficiency ratings.

10) That bicycles sales across Canada immediately become tax exempt and that all Canadians be asked to buy one and ride it.

14 SMART Recommendations

11) That NRCan Office of Energy Efficiency add to their CO2 Calculator website the total number of vehicles in each community that generate the number of litres of fuel burned in one minute each day, for viewing by the public and community traffic planners.

This number will be needed by every community to perform the calculations referenced in this report under SMART Factor Solution Step One. As a “stand alone number” the SMART Factor is a useful and very valuable environmental indicator. The exact number of vehicles in each community that generate that number is needed to maximize the value of the SMART Factor for both traffic planners and the public at large.

Note: NRCan would not release this information to SMART stating they could not do so due to contractual obligations.

12) That NRCan Office of Energy Efficiency add to their website the average engine size in each community to enable communities to recognize the impact that a communities average engine size has on the SMART Factor. This would help raise public awareness of extent by which smaller and more fuel efficient engines can help reduce the size of community SMART Factors.

13) The world is no longer naïve and no longer has an acceptable excuse or alibi for not solving all of the world’s problems, but the help of all people on earth is needed. Therefore, we recommend that, in the name of societal and environmental responsibility, social justice and inter-generational equity, all military forces in the world put down their weapons and pick up their calculators, to help the world do the needed math, take the measurements and the steps that must now be taken, and monitor world progress for the benefit of all.

Recommendation #14 is for children

That all children of the world come together and commit to learn the math they must learn to help us. You will be better at this math than your parents. We will need your help to fix our mistakes, but you can have faith in the future.

Remember

What gets measured gets done.

+ × ÷ = Accomplished

We can make mathematics matter more for the environment, and the community, and your future.

How wonderful it is that nobody need wait a single minute before starting to improve the world.  
– Anne Frank from The Diary of Anne Frank

How wonderful it is that you now have the SMART Factor to help you measure more effectively the value of every second.

SMART (OPiRG) McMaster
The SMART Factor is a new environmental indicator for the world - Methodology

The SMART Factor is a new quantitative emissions factor and environmental indicator developed by SMART (Student Math Action Research Team) OPIRG McMaster University, Hamilton, Ontario Canada - a working group of the Ontario Public Interest Research Group OPIRG.

An emissions factor is a representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant. Environmental indicators are scientific measurements that track environmental conditions over time.

The SMART Factor defined: The SMART Factor is a new CO2 emissions factor and environmental indicator that describes the quantity of Greenhouse Gas (GHG) tonnes that would be released by all light duty vehicles in a community idling for just one second each day for a year. Since it is based on actual vehicle registrations in communities across Canada and since it also takes into account the engine size mix, and efficiency statistics for those engines, we believe it is a valuable indicator and a factor that will closely represent the truth when calculating the tonnes of CO2 emissions that all vehicles in a community produce idling for one second each day for a year.

Since the SMART Factor for a community will go up or down over time as a result of the increase or decrease in the number of vehicles registered in each community and as determined by changes in engine size mix and engine efficiency over time, it promises to become a valuable indicator of our progress and ability to lower greenhouse gases that contribute to climate change.

An indicator is something that helps you to understand where you are, which way you are going and how far you are from where you want to be. A good indicator alerts you to a problem before it gets too bad and helps you recognize what needs to be done to fix the problem. They allow you to see where the problem areas are and help show the way to fix those problems.

Good indicators describe current conditions and trends, help to discuss the challenges governments face, they are accompanied by supporting technical information and they can be circulated for public review and comment and they educate and raise public awareness. The SF fulfills these requirements perfectly. Indicators can be used for strategic planning and performance-based management and the Smart Factor can help in these areas.

The SMART Factor is does all of the above and more. It is an indicator that addresses the carrying capacity of our natural resources (non-renewable fuel) that our communities rely on. It is an indicator that measures a link between the economy and the environment. It is an indicator that measures a link between the environment and society. And finally, and most importantly, it is an indicator that can help measure GHG production in a simplified and yet more detailed way and a way that can serve every community in Canada and globally.

Empirical indicators are increasingly important. They focus policy-making and provide concrete measures of effectiveness and, hence, accountability. Unlike economic and social indicators, which are well developed and widely used, indicators for the environment are just beginning to be formulated. SMART believes the SMART Factor can serve the world well as an important empirical indicator.

The math in this report is it based on the following: Every litre of fuel burned produces 2.4 kg of GHG. This applies to all vehicles. That is why it is important that all vehicles on earth travel as many kilometers as possible on every litre of fuel. Every 417 litres of fuel burned x 2.4 kg per litre = 1000.8 (One Tonne of Greenhouse gas).

Provided below is our data to support the statement 1 litre= 2.4 kg of carbon dioxide*:

The 2.4 kg of carbon dioxide emissions per litre of gasoline is a nationally recognized factor for emissions from transportation fuels and is used/published by Environment Canada Greenhouse Gas Inventory - the report that is provided to the United Nations Framework Convention on Climate Change - for reporting on our GHG emission targets.

This emission factor is derived as follows:

The 2.4 kg CO2 per 1 litre of gasoline is based on fuel density. For gasoline, the density is 0.74 kg/L with the fraction of carbon in the fuel at 86%. This means for every litre of gasoline you have 0.64 kg of Carbon per L. When this carbon is "burned" in the engine it combines with oxygen to make CO2 - all of which is omitted out of the tailpipe. The molecular weight of Carbon is 12 and the molecular weight of oxygen is 32; therefore, you have 2.35 kg of CO2 omitted for every litre of gasoline. The lube oil present in the engine results in an additional 0.03 kg of CO2 being omitted per litre of gasoline. In the end the factor is 2.38 kg/L, which is rounded up to 2.4 kg/L in messaging.

Provided below are the equations to this explanation:

Amount of Carbon in Gas (kg/L) = Fuel Density x Fraction of Carbon = 0.64 kg of C/L
Where Gas Density = 0.74 kg/L & Carbon Fraction = 0.86

Amount of Carbon Dioxide (CO2) in Gas (kg/L) = Amount of Carbon in Gas x CO2 Molecular Weight/Carbon Molecular Weight = 2.35 kg/L

Where Carbon Molecular Weight =12 & CO2 Molecular Weight = 44

Total CO2 from 1 litre of Fuel = CO2 from Gas + CO2 from Oil = 2.38 kg/L

Where CO2 from Gas = 2.35 kg/L and CO2 from Oil = 0.03 Kg/L

*Source: Transportation Energy Use Division Office of Energy Efficiency

In this report we have blown the numbers out of Canada's and the world's tailpipes, and we have blown the whistle on the lack of action everywhere. We hope we have blown you away. If you would like to blow away others, visit the OPIRG McMaster website for a copy of this report, and please distribute this report widely.

Thank you – The SMART Guys
IF YOU THINK IDLING IS HARMLESS...

Think Again.

Every time you start your vehicle, it produces pollutants that contribute to climate change, smog and acid rain. So when your engine runs for no reason—after all, idling gets you nowhere—it needlessly harms the environment.

If you're going to be stopped for more than 10 seconds, except in traffic—don't idle—turn off the engine.

The SMART Report Blowing the numbers out of Canada's tailpipes

SMART (OPIRG) McMaster University Canada