Vehicle Emissions Team

Report to the CASA Board

Prepared by the
Vehicle Emissions Team

August 31, 2010
Final Report

Acknowledgements

Members of the Vehicle Emissions Team thank their organizations and sectors which provided them with the support needed to be dedicated and committed to this project. In addition, the Vehicle Emissions Team acknowledges the valuable input it received from many stakeholders.

About CASA

The Clean Air Strategic Alliance (CASA) is a non-profit association composed of stakeholders from three sectors – government, industry and non-government organizations such as health and environmental groups. All CASA groups and teams, including the board of directors, make decisions and recommendations by consensus. These recommendations are likely to be more innovative and longer lasting than those reached through traditional negotiation processes. CASA's vision is that the air will have no adverse odour, taste, or visual impact and have no measurable short- or long-term adverse effects on people, animals or the environment.

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Executive Summary

In urban areas where people commute daily to work, school and other pursuits, vehicle emissions can result in air quality issues, affecting human health and aesthetics. Vehicle emissions were recognized as an issue by the Clean Air Strategic Alliance (CASA) upon it formation in the early 1990s. CASA created its first team to look at this issue in 1996.

Addressing vehicle emissions is complex. The current CASA Vehicle Emissions Team (VET) has reviewed the success of several CASA vehicle emissions initiatives and provided a summary of them. It has also looked at the work of other federal, provincial and municipal stakeholders to address this issue in Alberta.

Finally, the team assessed work done to date, including data gaps, and where CASA could focus future efforts. Upon completion of this report, the VET believes it has met its project objectives, as per its terms of reference, and a new team with a new mandate should undertake any future work on vehicle emissions.

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1 Introduction

Although they provide many benefits, vehicles run by internal combustion engines result in the combination of carbon-based fuels with air. Air is made up of 21% oxygen, 78% nitrogen and other gases. Vehicle fuels are made up of carbon, hydrogen and contaminants such as sulphur. When air and fuels are combined as vehicle emissions, they can include carbon-based gases (e.g., carbon monoxide (CO), carbon dioxide (CO2)), nitrogen oxides (NOx), sulphur oxides (SOx), particulate matter (PM) and volatile organic compounds (VOC).

In urban areas where people commute daily to work, school and other pursuits, emissions can result in air quality issues, affecting human health and aesthetics. In North America, motor vehicle emissions were first recognized as a contributing factor to air quality issues in the 1960s. Since then, public interest in reducing emissions has increased. This trend was also observed in Alberta in the 1990s, when CASA was formed to establish a forum to discuss air quality issues. Vehicle emissions, as a percentage of the total air emissions in Alberta in 2007, can be seen in Figure 1 below:

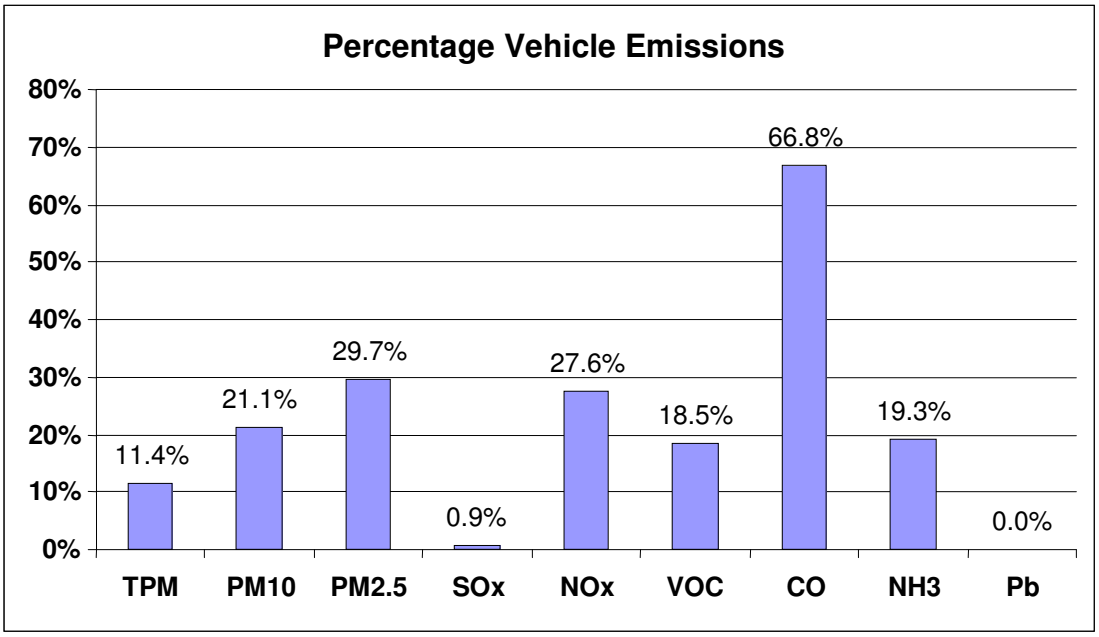

Figure 1. Vehicle emissions as a percentage of the total emission in Alberta in 2007. Emissions do not include Open and Natural Sources. Vehicles include heavy and light vehicles, motorcycles and off-road vehicles. (Source: Environment Canada, *2007 Total Air Pollutants Emissions for Alberta.*)

2 Vehicle Emissions Team

2.1 Team History

CASA established theVehicle Emissions Working Group in 1997 to recommend initiatives to protect public health and the environment from vehicle emissions produced in Alberta. The team looked at three main areas where action could be taken including:

- Fuel Technology (e.g., fuels, bio-fuels and fuels with low levels of by-products)
- Vehicle Design Technology (e.g., engine, pre- and post-catalysers and efficiency in car design)
- Use of vehicles (e.g., non-technical solutions such as Social Education, Transit-oriented Development, Transportation Demand Management, Scrappage programs and efficient use of vehicles).

The group agreed to focus on light duty vehicles used in urban centres. They examined and assessed mandatory, voluntary and economic approaches, developing a series of recommendations to realistically and cost-effectively reduce vehicle emissions and improve air quality. While many of the recommendations would also reduce greenhouse gases, this was not the focus of their work.

The CASA board endorsed the group's recommendations in June 1998, including the establishment of the Vehicle Emissions Implementation Design team, which undertook nine actions from the 1991 Clean Air Strategy (For a list of the nine actions, see Appendix C). Several of the recommendations involved close collaboration with other agencies.

In 2009, CASA renewed the VET to review and recommend initiatives to protect public health and the environment from vehicle emissions in Alberta. See Appendix A for a list of members of this team and those before it. The current team's mission is to recommend initiatives to reduce vehicle emissions and support the CASA vision of clean air.

2.2 Team Objectives

As per its Terms of Reference (Appendix B), the current Team's objectives are as follows:

1. Identify, evaluate and recommend areas of further action to reduce vehicle emissions.
2. Implement initiatives approved by the CASA board.
3. Influence/advocate implementation of policies and programs that reduce transportation emissions.
4. Serve as a resource/provide expertise to CASA teams and other organizations.
5. Identify and recommend communication/public education on vehicle emissions.
6. Identify gaps and make recommendations to fill gaps.

The VET's terms of reference also identifies a number of priority actions. The table below briefly describes these actions, as well as which projects were carried out to achieve them. Greater detail on each individual project is included in the next section.

Table 1. The VET's Priority Actions, as per their terms of reference, and how they were met.

Team Priority Actions	Carried out by:
1. Identify potential reduction opportunities for on- and off-road heavy-duty vehicles	Two projects were carried out to meet this action: • Retrofitting of Diesel Particulate Filters (DPF) on urban buses and the evaluation of this technology • Off-Road Big Industrial Truck (ORBIT), an analysis of off-road truck emissions related to industrial activity.
2. Upgrade modelling for current and future vehicle emissions forecasts.	VET members have evaluated, assessed and contributed with the Canadianization of the MOBILE6 Vehicle Emission Modeling Software[1]. Today, this EPA model is a reference for vehicles emissions in North America. In addition, the Roadside Optical Vehicle Emissions Reporter (ROVER) projects have contributed to this action by: • Improving how data is input into the model. • Estimating vehicle emissions inventories in Calgary and Edmonton. • Comparing the measured vehicle inventory with that predicted by Mobile 6.2. • Estimating the actual in use CO2 emissions inventory from vehicles and the emissions profile by vehicle age and type. Similarly, the DPF project has also contributed to the better understanding of emissions and economic issues in bus transportation.
3. Identify and promote transportation demand management measures.	The Transportation Demand Management (TDM) project evaluated and assessed TDM measures for employer-based programs.
4. Review the list of emission reduction opportunities for passenger vehicles considered by the VEWG in 1998.	Appendix C presents the list of nine emission reduction opportunities originally approved by CASA in 1998.These initiatives were reviewed periodically. During the VET meeting #23 (February 2003), an assessment of the progress of these initiatives determined that no further work was required, except for the Data Requirement initiative. The Data requirement initiative aims to better understand the link between ambient air quality and human health. This initiative took the form of a new project at CASA with a broader scope: the Human and Animal Health Implementation Team.
Implement initiatives already approved by the CASA board.	The VET successfully implemented five projects (described in more detail in Section 2.3 below).
5. Promote the idea of	The VET participated fully in CASA's first two coordination

[1] MOBILE is a model developed by the U.S. Environmental Protection Agency for estimating pollution from highway vehicles. MOBILE calculates emissions of hydrocarbons, CO, NOx, CO2, PM and air toxics from Gas, diesel, and natural-gas-fuelled cars, trucks, buses, and motorcycles for the calendar years between 1952 and 2050. MOBILE is the most recognized model for estimating Criteria Air Contaminant emission from road sources; it includes over 25 vehicle classifications. The most recent version is MOBILE6.2, which has been adapted by Environment Canada to Canadian conditions as MOBILE6.2C.

CASA sponsoring an integration workshop for constituent groups and teams.	workshops. In May 2000, Vehicle Emissions Implementation Design Team held its own two-day workshop which resulted in its reformation into the VET.
6. Influence/advocate implementation of policies and programs that reduce transportation emissions.	Through the information it generated in its projects, the VET influenced CASA members, the public, and other stakeholders. The Breathe Easy Project (BEP), DPF and ROVER projects have contributed to the development of new standards, regulations and policy development (see appendix D).
7. Gather information on travel demand patterns.	In the course of its work, the VET has acquired information and received presentations from many different sources (e.g.: Clean Commute Survey, 2005 Edmonton Transportation survey, survey ROVER II, Canadian Vehicle Surveys, EPA surveys, etc). These data sources have contributed to a greater understanding of vehicle use and emissions in Alberta and across Canada.
8. Understand driving behaviour and attitudes of Albertans.	ROVER, BEP and Scrappage projects have contributed to a better understand of the driving behaviour and attitudes of Albertans. The VET has reviewed, summarized and discussed several provincial and national surveys for the better understanding of the vehicle emission trends.
9. Promote the team's initiatives and projects.	All team members were champions of CASA vehicle emissions projects and promoted these to their sectors and others.

2.3 CASA Vehicle Emissions Projects

To ensure the team met its terms of reference, the VET reviewed its past and current projects to reduce vehicle emissions and evaluated their success. The team also looked at the initiatives of other stakeholders before making recommendations on where CASA might focus in the future to further reduce vehicle emission. CASA VET projects are described and evaluated briefly below. More details on each project can be found in Appendix D.

2.3.1 Roadside Optical Vehicle Emissions Reporter (ROVER) Project

Before recommendations on initiatives to reduce emissions could be made, as per the Team's first objective, a better understanding of vehicle emissions in Alberta was required. Hence the ROVER project was designed and implemented in 1998. This project utilized a survey to assess actual in-use vehicle emissions using a remote sensing van equipped to measure exhaust emissions. The survey has provided valuable data increasing the knowledge of vehicle emissions in Alberta.

While this new information filled an important data gap, the project was also used as an opportunity to communicate with Albertans about vehicle emissions. In total, 66,002 light duty vehicles were tested in four municipalities and registration information was obtained on 91% of the vehicles. The project was repeated in 2006 (ROVER II), testing over 50,000 vehicles in Edmonton, Calgary, Red Deer and Canmore; this time measuring exhaust emissions of carbon dioxide, hydrocarbon, carbon monoxide, nitrogen oxide and particulate matter. This second survey found that emissions per kilometer are falling but vehicle use is increasing.

As a result of the findings from the ROVER II study, Alberta Environment conducted a jurisdictional review of existing programs and policies aimed at reducing the impact of emissions from gross emitting vehicles was commissioned in 2009. Programs such as inspection and maintenance, enhanced vehicle scrappage and remote sensing were investigated. The report is currently in the publication process and could be a valuable tool to inform future policy development regarding vehicle emissions reduction.

2.3.2 Breathe Easy Program (BEP)

The result from the ROVER project led to the creation of the BEP in 2001. This pilot project tested the use of incentives in getting gross emitters off the road in Alberta. The Scrappage Management Committee convened in mid-2001 to initiate an incentive program which accepted 1987 or earlier model year vehicles. The incentives were offered to applicants who surrendered their approved roadworthy vehicles for scrappage.

The BEP took over 500 high-polluting cars off the road and proved the value of incentive programs in shaping driver behaviour. Climate Change Central built on the findings and developed the longer-term *Car Heaven* program, ultimately removing over seven thousand vehicles. In 2009, BEP results were considered during development of the federal government's *Retire Your Ride* program. Hence, this project was successful in initiating programs to remove high emitters off the road, educating the public, and reducing vehicle emissions.

2.3.3 Diesel Particulate Filter (DPF) Project

In January 2003, the VET undertook a demonstration project to assess pollution control technology for heavy-duty vehicles in Alberta's climate. The Team and several partners focused on evaluating if diesel particulate filters (DPFs) can reduce emissions from heavy-duty diesel-powered vehicles, particularly during Canada's winter months.

Two Edmonton Transit System (ETS) buses were retrofitted with DPFs. Environment Canada tested the buses without the filters and then again with the filters using one-of-a-kind on-board testing equipment. Testing was conducted to see if there were significant reductions in the total hydrocarbons, carbon monoxide, and total particulate matter emissions while the buses were operated with the filters. (For an update on this work, see the *Report on Diesel Particulate Filter Technology Adoption in Diesel Bus Fleets, Report to the CASA Board, August 30, 2010.*)

2.3.4 Transportation Demand Management (TDM) – Clean Commute Package

In November 2004, CASA Board Members, as employers in the Edmonton and Calgary regions, agreed to evaluate and assess their use of employer-based TDM measures. They also agreed to consider implementing an employer-based program or modifying an existing one. In support, the VET worked with CASA communications to create a package of materials that would assist members in carrying out this task. The package also provides direction to employers who would like to implement a TDM program and suggests further resources. In addition, Alberta municipalities agreed to promote these measures within their jurisdictions.

These employers were asked to report to the VET in 2007 regarding their progress in the use of employer based TDM programs. The VET reported to the CASA Board in 2007 on the extent of CASA member response and the Board determined that no further action was required. The information provided by the VET showed that CASA, as a reliable information source of expertise, can influence others to undertake actions to reduce emissions.

2.3.5 Off-Road Big Industrial Truck (ORBIT) Project

The above four VET projects were focused on reducing vehicle emissions in urban areas and major roadways. The VET also examined off-road vehicle emissions, specifically truck emissions related to industrial activity in medium and major developments (e.g. mining and oil sands equipment such as crawlers, excavators, etc.). Off-road heavy vehicles are a source of emissions in Alberta.

The ORBIT Sub-group reported a trend in industry to reduce emissions due to off-road heavy vehicles. New emission standards have also been produced for this sector. The first USA Federal standards (Tier 1) for off-road diesel engines were adopted in 1994 for engines over 50 hp, to be phased-in from 1996 to 2000. In 1996, a Statement of Principles (SOP) pertaining to off-road diesel engines was signed between the United States Environmental Protection Agency (EPA), California Air Resources Board and engine makers (including Caterpillar, Cummins, Deere, Detroit Diesel, Deutz, Isuzu, Komatsu, Kubota, Mitsubishi, Navistar, New Holland, Wis-Con, and Yanmar).

On August 27, 1998, the EPA signed the final rule reflecting the provisions of the SOP. The 1998 regulation introduced Tier 1 standards for equipment under 50 hp and increasingly more stringent Tier 2 and Tier 3 standards for all equipment with phase-in schedules from 2000 to 2008. The Tier 1-3 standards are met through advanced engine design, with no or only limited use of exhaust gas after-treatment. Tier 3 standards for NOx and HC are similar in stringency to the 2004 standards for highway engines. However, Tier 3 standards for PM were never adopted.

On May 11, 2004, the EPA signed the final rule introducing Tier 4 emission standards, which are to be phased-in over the period of 2008-2015. Tier 4 standards require that emissions of PM and NOx be further reduced by about 90%. Such emission reductions can be achieved through the use of control technologies—including advanced exhaust gas after-treatment.

2.4 Project Summary and Analysis

In summary, since 1998, the CASA VET has organized five major projects to meet their mission to recommend initiatives to reduce vehicle emissions and support the CASA vision of clean air. These projects have contributed to achieving the Team's objectives of filling information gaps, and identifying, implementing and promoting actions to reduce vehicle emissions. These have also involved and influenced other stakeholders and educated the public on how to reduce vehicle emissions.

3 Stakeholder Emission Reduction Activities

CASA is not the only organization looking at vehicle emissions in Alberta. Many stakeholders are also carrying out their own initiatives. In determining a path forward, the VET also looked at these initiatives, some involving social marketing aspects, others looking to improved technology.

3.1 Social Marketing

At the national level, the Canadian Automobile Association (CAA), working with Natural Resources Canada and others, is focusing on eco-driving (fuel-efficient driving, vehicle maintenance and responsible energy consumption). This work supports government and industry initiatives on climate change (See *Making the Shift to Eco-Driving*[2] and a *Primer of Automobile Fuel Efficiency and Emissions*[3]). Additionally, the National Comprehensive Air Management System is looking at air zones and how they can address vehicle emissions.

At the provincial level, the Government of Alberta (GOA) continues to regulate large point-source industrial facilities but has also turned its attention to non-point sources (NPS) of emissions through new policies such as the Land-use Framework and Cumulative Effects Management System. The province has also developed a cross-ministry group to develop a new *Clean Air Strategy* with a focus on policy options for NPS.

Other work by the Provincial Government includes that done by Alberta Transportation (AT) and Alberta Environment (AENV). AT is the implementer of the GOA capital plan for transportation infrastructure. It has partnered with the cities of Calgary and Edmonton on a common approach to environmental management for capital works. AT with AENV has three party Memorandums of Understanding with the Alberta Motor Transport Association and Alberta Roadbuilders & Heavy Construction Association, looking at ways to improve energy efficiency and reduce GHGs. In addition, AENV is developing tools for idle free zones and is developing social marketing programs in the Calgary area (e.g., to increase carpooling between Calgary and Airdrie).

[2] www.caa.ca/eco
[3] http://www.caa.ca/primer/

Also at the provincial level, the Alberta Motor Association has developed and conducted several green driving initiatives including materials such as *Use Less, Save More*[4], to educate and raise awareness of its members on topics relating to energy saving and emissions reduction. Surveys show that Albertans drive more in comparison to other Canadians. Additionally, they show low consumer awareness of how much fuel they use, how much it costs over time, and how to improve fuel efficiency. (For a picture of Albertan's vehicle use, as provided by the 2007 Canadian Vehicle Survey, see appendix E).

In particular, the Edmonton-Calgary corridor is a major area of focus in the province. In November 2006, AENV notified the Edmonton, Calgary and Red Deer areas of the need to develop ozone management plans. This was in response to the 2001-2003 particulate matter and ozone assessment, which placed these three regions in the Management Plan Action Level for ozone. Plans were submitted by the Airsheds to AENV in December of 2008.

At the municipal level, the City of Calgary undertook a very large public consultation exercise involving 20,000 Calgarians. The purpose of this exercise was to develop a 100-year vision for their community[5]. Results showed that Calgarians have a concern about air quality. In response, the City of Calgary set 30-year targets related to criteria air contaminants.

The City of Edmonton has established the following strategic objectives around air quality:

- continually reduce total air pollutant emission levels from City of Edmonton operations;
- strive to ensure that Edmonton's ambient air quality meets or surpasses national and provincial air quality standards; and
- Provide guidelines for encouraging community action.

To meet these objectives, the City of Edmonton has established programs to reduce vehicle emissions for both its own fleet and the community. The City has been actively promoting its *Be Idle Free: a Minute or Less is Best* campaign. In the coming years, the City of Edmonton will continue to focus on the promotion of active transportation (biking and walking), increasing transit ridership through the expansion of its light rail transit system, and developing a more compact urban form. Combined, these activities are expected to contribute to reductions in overall vehicle emissions.

3.2 Improving Technology

While current regulations in Alberta create some uncertainty about the future of alternative fuels, the GOA has included a new program to develop capacity for biofuels as part of the provincial energy strategy[6]. This program provides for renewable fuel standards of 5% ethanol and 2% biodiesel[7]. In

[4] http://www.caa.ca/eco-mobility/english/pdf/AMA_Use_Less_Save_More_Checklist.pdf
[5] http://www.imaginecalgary.ca/
[6] http://www.renewablediesel.ca/pdf/ARDD%20Final%20Report.pdf
[7] http://www.energy.alberta.ca/BioEnergy/1517.asp

addition, the GOA has started a $2M rebate program to improve performance practices for truck operators[8].

A policy gap in terms of fuel economy is the exemption for vehicles over ¾ ton. These vehicles are popular for a variety of uses in Alberta, so to be effective policy needs to recognize and match such consumer decisions. Some vehicles on the road are older than 30 years[9]; they still work but they are high emitters. In Alberta, 25,000 companies have commercial vehicle trucks heavier than 4500 kg[10].

In general, vehicle emission reduction has a clear relationship with the evolution of fuel technology and using fuels as efficiently as possible is a strategy for improving air quality. In Alberta, universities and institutes (e.g., Canadian Petroleum Product Institute) are conducting research on improving fuel quality (e.g., low sulphur gas, blend with biofuels). These programs support environmental initiatives to improve fuel quality economically. Improvements are more related to fuel by-constituents than to low-carbon fuel approaches. Appendix F presents the percentage of foreseen vehicle emission reduction (gr/km) due to technological advances between 2006 and 2026.

4 Potential CASA Opportunities for Vehicle Emissions Reduction

As seen above, through CASA projects and other stakeholder activities, there is much good work being done to address vehicle emissions in Alberta. Technology has evolved, and knowledge and awareness of vehicle emissions has risen. However, new challenges are also present. In the future, meeting the challenges of transportation emissions reduction might also be pursued through improved urban design, alternative transportation modes and innovative transportation technologies.

4.1 Developing a Provincial Vehicle Emissions Framework

A more comprehensive, strategic approach may be required to reduce vehicle emissions. A framework with goals and objectives and the strategies to achieve them, could provide the overarching coordination required to make significant progress. The framework could showcase Alberta as a leadership jurisdiction and could provide an "umbrella" linking several initiatives. This would lead to greater synergies between agencies and better leveraging of resources.

Development of a framework is appropriate work for CASA to champion as it would support the new Clean Air Strategy. It would be a provincial strategic approach to vehicle emissions. The framework timeframe would be about three years, but it could be longer to match other long-term planning initiatives (e.g. World Business Council 40 year transportation plan).

[8] http://alberta.ca/acn/201005/28458EEE151F0-A75F-553E-6BF213FED4AFF1AC.html

[9] In Alberta, 26,796 (20.9%) of trucks between 4.5 and 14.9 tonnes are older than 1990.
197,069 (7.7%) of vehicles up to 4.5 tonnes are older than 1990. (Canadian Vehicle Survey, 2008)

[10] In Alberta, 127,982 (4.61%) of vehicles are trucks between 4.5 and 14.9 tonnes. (Canadian Vehicle Survey, 2008)

Thus, the VET envisions the development of a coordinated and collaborative provincial framework. Under this framework, all stakeholders would strive towards the same-shared goals. They make take advantage of synergistic opportunities to collaborate, or they may carry out their own projects, knowing that they support the larger picture.

Underneath this provincial framework, several projects could be identified: some to be undertaken by CASA, others to be carried out by other stakeholders. In looking forward at where CASA could focus its efforts in the future, many factors should be taken into consideration in the evaluation of different options, such as return on investment, public perception and different trends. In addition, important prioritization criteria have been evaluated for the different options including:

- Political acceptability;
- Implementation timeframe;
- Economics;
- Impact on emissions (e.g.: GHGs, CACs);
- Co-benefits (e.g.: safety, health);
- Stakeholder resource availability;
- Duplication (effort, capacity); and
- Opportunities for synergy.

The VET recognizes there are many new initiatives that could be considered for implementation, but when examined under the VET scope, these possibilities become narrower. Under a new provincial emissions framework, CASA might consider undertaking initiatives in Social Marketing and Electric Vehicles[11].

Recommendation 1: CASA Provincial Vehicle Emissions Reduction Framework project

The Vehicle Emission Team recommends that *a Statement of Opportunity for a Vehicle Emissions Reduction Framework be presented by representatives of Government, Industry and NGOs at a future CASA Board meeting after the new Clean Air Strategy has been finalized.*

5 Conclusion

The VET has contributed to the CASA vision and mission by carrying out several successful initiatives over its fifteen years of work. It has identified several emission reduction opportunities, and designed and implemented several successful projects. In addition, the work of the VET has contributed to many CASA values including raising awareness, improving knowledge, being pro-active, educating Albertans, leveraging resources, and involving stakeholders.

[11] See section 5.1

The VET team feels that their work, as per their original terms of reference, is complete. Should the team's recommendation that a provincial framework for vehicle emissions be developed, a new team, with a new terms of reference and the appropriate membership, should be formed.

5.1 CASA Board decision

At the CASA Board meeting on September 30, 2010, the Board replaced Recommendation 1 with the following consensus statement:

1. **Transportation-related air emission issues continue to exist.**
2. **Understanding the Clean Air Strategy and its guidance will be important in developing future work on transportation emissions.**
3. **Stakeholders are encouraged to bring a statement of opportunity to CASA, at an appropriate time, to address these issues.**

Appendix A - Past and Present Vehicle Emissions Team Members

Current members:

Name	Membership
Rob Bioletti	Government (Alberta Environment)
Maureen Brown	Government (City of Calgary)
Peter Dzikowski	Government (Alberta Transportation)
Gustavo Hernandez	CASA
Myles Kitagawa	NGO (Toxics Watch Society)
Mike Mellross	Government (City of Edmonton)
Mayne Root	Industry (Alberta Motor Transport Association)
Petra Rowell	CASA
Ron Schafer	Government (City of Calgary)
Ted Stoner	Industry (CPPI)
Don Szarko	NGO (Alberta Motor Association)
Kyle White	Government (City of Calgary)
Scott Wilson	NGO (Alberta Motor Association)

Former members:

Jennifer Allan	CASA
Janet Annesley	Shell Canada Limited
Dianne Atkins	City of Calgary
Elaine Babiy	Edmonton Motor Dealers Association
David Backstrom	City of Edmonton
Margaret Bailey	Natural Resources Canada
Trent Bancarz	Alberta Transportation
Greg Bartlett	ATCO Gas
Larry Begoray	Alberta Environment
Alan Brownlee	City of Edmonton
Carol Burelle	Environment Canada
Mark Campbell	City of Calgary
Casey Chan	Alberta Environment
Cindy Chiasson	Environmental Law Centre
Kerra Chomlak	CASA
Matthew Dance	CASA
Louise Durocher	Environment Canada
Gerry Ertel	Shell Canada Limited
Graeme Feltham	Atco Gas
Jim Guthrie	Citizens for Better Transit
Lenore Harris	Chemical Producers Association
Lynda Harvey	Natural Resources Canada

Sharon Hawrelak	CASA
Stewart Henderson	ATCO Gas (corresponding member)
Jill Hendren	Environment Canada
Paul Hunt	Enbridge
Robyn Jacobsen	CASA
Lane Kranenburg	Alberta Trucking Association
Allan Lowe	The Alberta Roadbuilders & Heavy Construction Association
Josee Maillette	Environment Canada
David McKenna	Alberta Environment
Joanne McLeod	Motor Dealers Association of Alberta
Kevin McLeod	CASA
Barrie McPhalen	Alberta Road Builders' Heavy Construction Association
Sonja Martins	Sierra Club
Bettina Mueller	Alberta Environment
Rick Paul	City of Edmonton, Edmonton Transit
Sarah Pinto	Alberta Environment
Dave Reynolds	City of Calgary
Greg Rideout	Environment Canada
John Rilett	Climate Change Central
Kim Royal	Alberta Motor Transport Association
Marie Schingh	Environment Canada
Lawrence Schmidt	Alberta Transportation
Herman Schwenk	Alberta Beef Producers
Rob Shymanski	City of Calgary
Colin Smigelski	City of Edmonton, Mobile Equipment Services
Lidia Stefaniw	Alberta Health and Wellness
Gene Syvenky	Alberta Road Builders and Heavy Construction Association
Terrence Taylor	Fleetguard Emission Solutions
Jack Thompson	Calgary Motor Dealers' Association
Rod Thompson	Alberta Infrastructure and Transportation
Reed Turner	Alberta Agriculture and Food
Kerry Van Camp	ATCO Gas
Dan VanKeeken	Alberta Motor Association
Bob Vilas	Edmonton Motor Dealers Association
Geoff Williams	CASA

Appendix B - VET Terms of Reference

Mission Statement: Recommend initiatives to reduce vehicle emissions and support the CASA vision of clean air.

Objectives:

1. Identify, evaluate and recommend areas of further action to reduce vehicle emissions.
2. Implement initiatives approved by the CASA board.
3. Influence/advocate implementation of policies and programs that reduce transportation emissions.
4. Serve as a resource/provide expertise to CASA teams and other organizations.
5. Identify and recommend communication/public education on vehicle emissions.
6. Identify gaps and make recommendations to fill gaps.

Priority Actions:

1. Identify potential reduction opportunities for on- and off-road heavy-duty vehicles.
2. Upgrade modelling for current and future vehicle emissions forecasts.
3. Identify and promote transportation demand management measures.
4. Review the list of emission reduction opportunities for passenger vehicles considered by the VEWG in 1998.
5. Implement initiatives already approved by the CASA board.
6. Promote the idea of CASA sponsoring an integration workshop for constituent groups and teams.
7. Influence/advocate implementation of policies and programs that reduce transportation emissions.
8. Gather information on travel demand patterns.
9. Understand driving behaviour and attitudes of Albertans.
10. Promote the team's initiatives and projects.

Appendix C – Vehicle Emissions Working Group Initiatives

The Vehicle Emissions Working Group originally had 9 projects approved by the CASA Board of Directors in 1998 to reduce vehicle emissions in urban areas. These projects are listed below:

1. Standards for vehicle conversion

AB should develop standards for converting vehicles to run on alternative fuels, and should examine work in BC as an appropriate model to use. Voluntary or regulatory implementation should be considered.

2. SMOG free

CASA should support Alberta Lung Association in its efforts to refocus and revitalize the SMOG FREE program, with the goal of running it effectively at less cost and with less administration.

3. Pilot remote sensing

CASA should endorse a pilot remote sensing project planned for September 1998 to gather baseline data that can be used to create public awareness and against which future measurement can be compared.

4. Data gathering on tampering

To gather data on the extent and seriousness of vehicle tampering in Alberta prior to enacting any legislation, CASA should ask Alberta Transportation and Utilities to consider inspecting for systems that have been tampered with as part of the inspection process for vehicles coming into Alberta from other jurisdictions for sale or permanent registration.

5. Emissions inspections

a) As an enhancement to the existing safety inspection program for out-of-province vehicles, Alberta Transportation and Utilities should consider emissions testing for at least two gases (carbon monoxide and hydrocarbons) to determine the volume of gross pollution and to indentify if there is any reason for concern.

b) Opportunities should be sought to encourage fleet owners and administrators who are already doing regular safety inspections to voluntarily include emissions testing as part of their inspection process.

6. AutoSmart

As follow-up to the initial involvement of CASA in promoting the AutoSmart program, the Vehicle Implementation Design Team should work with the CASA Secretariat to distribute materials to drivers who have not yet been made aware of the program, and should maintain contact with Natural Resources Canada regarding evaluation and monitoring of the program in Alberta.

7. FleetSmart

CASA should assist in promoting FleetSmart in Alberta by asking the Vehicle Emissions Implementation Design Team to identify suitable promotional opportunities. Further, Alliance Board members should actively support FleetSmart by enrolling their own company or

departmental fleets and encouraging the associations with which they are affiliated to endorse and participate in the program.

8. Pilot scrappage program in Calgary

CASA should support the implementation of a pilot scrappage program in Calgary, using the BC program as a model. As a means of improving public awareness and reducing emissions, transit passes or new and used car credits would be offered as incentives for owners to voluntarily retire their older, high-emitting vehicles.

9. Data requirements

As a first step in furthering understanding between ambient air quality and human health, it is recommended that Alberta Environment Protection undertake an emissions inventory by gathering data on emissions from vehicles, percentage of overall emissions from vehicles, and linkage of emissions and human exposure with ambient air quality.

Appendix D - CASA Vehicle Emissions Projects

TABLE #1	
Project Name:	**Roadside Optical Vehicle Emissions Reporter Projects (ROVER, ROVER II)**
Project Description/Goal:	To assess Alberta-specific in-use vehicle emissions using a remote sensing van equipped to measure exhaust emissions. The first project was completed in 1998. It was repeated in 2006.
Meets Team Objectives:	#1(Identification), #3 (Advocate), #4 (Experience), #5 (Education) and #6 (Fill data gaps).
Date of last CASA Board Review	December 6, 2002
CASA Decision	Approved the release of the Rover II report to the public. Approved the key messages for communicating the release to the public.
Project Assessment:	This project was successful in generating Alberta-specific emissions data. It found that a small number of vehicles caused most of the emissions. It also showed Albertans are aware of and interested in knowing about, vehicle emissions. • Specific test results for Alberta in 1998 showed 7% of vehicles were responsible for 54% of carbon monoxide (CO) emissions while 81% of the vehicles only accounted for 18% of CO emissions. • On-road emissions per vehicle were lower in the 2006 survey. • 20% of light duty vehicles (LDV) account for 80% of exhaust emissions of HC, CO, NO and PM. • The characteristics of survey gross emitters are older, heavier or fueled by propane. • The gross emitter rate among 1996 and newer models is less than 2% vs. 20-40% for 1989 and older models. Asian vehicles had lower rates of gross emitters. Public awareness and interest in vehicle emissions was evident. The ROVER II survey was very well received by municipalities, the media, and the public. As a result of the findings from the ROVER II study, Alberta Environment commissioned a jurisdictional review to evaluate existing programs and policies aimed at addressing emissions from gross emitting vehicles. The report is currently in the publication process.

TABLE #2	
Project Name:	**Breathe Easy Program (BEP)**
Project Description/Goal:	To remove older, higher emitting vehicles from the road by incenting owners to scrap them. The program offered two different incentives: • 300 incentives of $500 each for the purchase or lease of a replacement vehicle of model year 1994 or later, plus a tax receipt for a $50 donation. • 300 sets of 12 monthly Calgary Transit passes (worth $720) plus a tax receipt for a $50 donation.
Meets Team Objectives:	#1 (Evaluate), #2 (Implement), #3 (Advocate), #4 (Experience), and #5 (Educate)
Date of last CASA Board Review	March 20, 2003
CASA Decision	The VET recommends that the CASA board of directors acknowledge that the Scrappage Management and Steering Committees have successfully implemented the pilot project. Approved.
Project Assessment	A total of 14 agencies, businesses and associations contributed to the BEP, which operated in Calgary between March 21 and November 30, 2002. During the application phase, 782 applications were received between March 21 and June 10, 2002. There were 712 approved applications. BEP distributed 351 transit passes and 185 vehicle credits, for a total of 536 incentives. Applications were closed on June 10 because there was a waiting list for both vehicle credit and transit pass incentives. The Breathe Easy pilot program showed the value of incentives that took over 500 high-polluting cars off the road. Climate Change Central built on the findings and developed the longer-term *Car Heaven* program, ultimately removing over seven thousand vehicles. In 2009, results of *Breathe Easy* were considered during development of the federal government's *Retire Your Ride* program. Hence, this project was successful in initiating programs to remove high emitters off the road, educating the public, and reducing vehicle emissions.

TABLE #3	
Project Name:	**Mass Transit Emissions (Diesel Particulate Filter Project)**
Project Description/Goal:	In 2003, CASA partnered with Edmonton Transit to test diesel particulate filters in cold weather.
Meets Team Objectives:	#1 (Evaluate), #2 (Implement), #3 (Advocate), #4 (Experience), #5 (Educate), and #6 (Fill information gaps).
Date of last CASA Board Review	June 16, 2005
CASA Decision	1. The CASA Vehicle Emissions Team recommends that the Diesel Particulate Filter final report be distributed to Alberta diesel fleet managers and other appropriate parties. 2. The Vehicle Emissions Team will assess the adoption of Diesel Particulate Filter technology in Alberta and report back in 3 years.
Project Assessment:	This pilot project showed that the use of filters resulted in substantial decreases in total hydrocarbons, carbon monoxide and total particulate matter. Following this work, ETS decided to purchase conventional buses with diesel particulate filters and exhaust gas recirculation, meeting the stringent 2007 EPA standards. Thus, the CASA project was successful in testing filters in Alberta and influencing their use by others to reduce emissions.

TABLE #4	
Project Name:	**Transportation Demand Management - Clean Commute Package**
Project Description/Goal:	Provide communications materials for employers wanting to design transportation demand management programs for staff.
Meets Team Objectives:	#1 (Evaluate), #2 (Implement), #3 (Advocate), #4 (Experience), #5 (Educate), and #6 (Fill information gaps)
Date of last CASA Board Review	November 25, 2004
CASA Decision	The CASA board approved recommendations to promote employer-based transportation demand management including asking CASA board members with employees in the Edmonton and Calgary regions to evaluate and assess their current use of employer-based transportation demand management measures. They were then asked to consider implementing an employer-based program or modifying an existing employer-based program as appropriate.
Project Assessment:	CASA board members with employees in Edmonton and Calgary undertook the above actions. In addition, Alberta municipalities agreed to promote these measures within their jurisdictions. The information provided by the CASA VET showed that CASA, as a reliable information source of expertise, can influence others to undertake actions to reduce emissions.

TABLE #5	
Project Name:	**Off-Road Big Industrial Truck Emissions Mitigation Project (Orbit)**
Project Description/Goal:	Examine emissions from off-road industrial vehicles and look for ways to reduce. The ORBIT project has been looking for an opportunity in the oil sands to retrofit off-road heavy-duty vehicles with an after-market emissions treatment technology. This technology would decrease the emissions from those vehicles not compliant with Tier III emissions standards. Although there has been a commitment from several oil sands companies to investigate and participate in retrofit demonstration projects, there has not been an appropriate technology to test to date.
Meets Team Objectives:	#1 (Evaluate), #3 (Advocate), #4 (Experience), #5 (Educate), and #6 (Fill information gaps).
Date of last CASA Board Review:	N/A
CASA Decision:	N/A
Project Assessment	N/A

Appendix E - Key Findings of the 2007 Canadian Vehicle Survey

Alberta's population is 10.5% of the Canadian population:

- Albertans consume 13.9% of the Canadian gasoline consumption
- Albertans consume 24.7% of the Canadian diesel consumption

- The Alberta fleet:
  - Is 0.75 vehicles per capita, the highest rate among Canadian provinces.
  - represents 13.4% of the Canadian fleet
    - 12.7% of light vehicles;
    - 27.2% of medium trucks; and
    - 26.3% of heavy trucks.
- Albertans driving behavior represents:
  - 14.4% of passenger-km in Canada.
  - 13.7% vehicle-km in Canada.
  - Albertans drive 13,759 vehicle-km by population use, the highest among Canadian provinces.
- Albertans average fuel consumption:
  - Gasoline for light vehicles is 11.9 l/100 km; the highest rate in Canada.
  - Diesel for medium trucks is 21.6 l/100 km; the lowest rate in Canada.
  - Diesel for heavy trucks 34.2 l/100 km; the third lowest rate in Canada.

Appendix F - Vehicle Emission Reduction due to Technology Evolution

Vehicle	CAC	G	D	P	CNG	E10	E85	M85	PHEV	HYB
LDPV-A	CO	-48.0	-48.8	-48.0	-48.1	-48.0	-48.0	-48.0	-48.0	-48.0
	NOx	-80.5	-96.2	-80.5	-80.4	-80.6	-80.4	-80.5	-80.5	-80.5
	SO2	-9.9	-87.8	-9.6	-9.3	-9.9	-10.0	-9.9	-10.5	-9.7
	VOC	-72.2	-83.8	-72.3	-72.2	-72.3	-72.3	-72.3	-72.3	-72.2
	TPM	-3.2	-72.6	-3.3	-3.4	-3.3	-3.3	-3.2	-3.2	-3.1
	PM10	-3.2	-72.9	-3.1	-3.4	-3.4	-3.2	-3.3	-3.2	-3.2
	PM2.5	-6.2	-82.2	-6.2	-6.7	-6.3	-6.2	-6.1	-6.1	-6.4
LDPV-T	CO	-55.2	-69.0	-55.1	-55.2	-55.1	-55.2	-55.2	-55.1	-55.2
	NOx	-77.0	-92.3	-77.0	-77.0	-77.0	-77.1	-77.0	-77.1	-77.1
	SO2	-8.6	-88.5	-8.3	-9.1	-8.6	-8.5	-8.7	-8.3	-8.3
	VOC	-70.9	-84.8	-70.9	-70.9	-70.9	-70.9	-71.0	-70.8	-70.8
	TPM	-4.4	-79.7	-5.0	-4.8	-5.2	-4.9	-4.9	-4.9	-5.0
	PM10	-5.1	-79.9	-4.8	-4.9	-4.6	-4.8	-4.8	-4.9	-4.5
	PM2.5	-8.8	-87.0	-8.7	-8.9	-8.9	-8.6	-8.7	-8.5	-8.7

Table C.1: Percentage of foreseen vehicle emission variation between 2006 and 2026 due to the technology evolution. Source: Transport Canada.

Where:

LDPV-A Light-duty passenger vehicles-Automobiles (less than 6,000 lbs)
LDPV-T Light-duty passenger vehicles- Trucks (less than 6,000 lbs)
CAC Criteria Air Contaminant
G Gasoline
D Diesel
P Propane
CNG Compressed Natural Gas
E10 Ethanol
E85 Ethanol
M85 Methanol
PHEV Plug-in Hybrid
HYB Hybrid