Note:
This document is not the official version of the Regulatory Impact Analysis Statement.

The official version will be published in a forthcoming edition of the *Canada Gazette*, Part II. Once available, interested parties will be able to access the official version at:
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REGULATORY IMPACT ANALYSIS STATEMENT

Heavy-Duty Vehicle and Engine Greenhouse Gas Emission Regulations

Statutory authority
Canadian Environmental Protection Act, 1999

Sponsoring department
Department of the Environment

1. Executive Summary

Issue: As a result of human activities, predominantly the combustion of fossil fuels, the atmospheric concentrations of greenhouse gases (GHGs) have increased substantially since the onset of the industrial revolution. In view of the historical emissions of GHGs from anthropogenic sources, and the quantity of emissions expected in the near future, GHGs, as significant air pollutants, are expected to remain a key contributor to climate change.

The transportation sector is a significant source of GHG emissions in Canada, accounting for 28% of total emissions in 2010. Within this sector, heavy-duty vehicles account for nearly 24% of GHG emissions, or approximately 7% of total emissions in Canada.[1] Heavy-duty vehicle emissions rose by nearly 3 megatonnes (Mt) of carbon dioxide equivalent (CO_2e) from 2005 to 2010.

Description: The objective of the *Heavy-duty Vehicle and Engine Greenhouse Gas Emission Regulations* (the Regulations) is to reduce GHG emissions by establishing mandatory GHG emission standards for new on-road heavy-duty vehicles and engines that are aligned with U.S. national standards. The development of common North American standards will provide a level playing field that will lead North American manufacturers to produce more advanced vehicles, which enhances their competitiveness.

The Regulations will apply to companies manufacturing and importing new on-road heavy-duty vehicles and engines of the 2014 and later model years for the purpose of sale in Canada including the whole range of on-road heavy-duty full-size pickup trucks, vans, tractors and buses, as well as a wide variety of vocational vehicles such as freight, delivery, service, cement, and dump trucks. The Regulations will also include provisions that establish compliance flexibilities which include a system for generating, banking and trading emission credits. The Regulations will include additional credits for hybrid vehicles and electric vehicles, as well as for innovative technologies to reduce GHG emissions. The Regulations will include further flexibilities for companies to use a phased-in approach for model year 2014 through 2016 tractors and vocational vehicles. Companies will also be required to submit annual reports and maintain records relating to the GHG emission performance of their vehicles and fleets.

Cost-Benefit Statement: The Regulations are estimated to result in a reduction of approximately 19.1 Mt of CO_2e in GHG emissions over the lifetime operation of vehicles produced in the model years 2014–2018 (MY2014–2018) cohort.

[1] Canada's Greenhouse Gas Inventory, 2009, 2010, http://www.ec.gc.ca/ges-ghg/default.asp?lang=En&n=8BAF9C6D-1

The present value of the total costs of the Regulations is estimated at $0.8 billion, largely due to the additional vehicle technology costs required by the Regulations. The total benefits are estimated at $5.3 billion, including GHG reductions valued at $0.5 billion and fuel savings of $4.8 billion. Over the lifetime of vehicles produced in MY2014–2018, the present value of the net benefit of the Regulations is estimated at $4.5 billion.

"One-for-One" Rule: In 2012, the Government of Canada implemented a "One-for-One" Rule to control the administrative burden that regulations place on business. Environment Canada has reviewed the administrative burden estimated to result from the proposed Regulation published in *Canada Gazette*, Part I to identify means of minimizing this burden, while achieving compliance. As of a result of this exercise and based on comments received during the consultation period, changes were made to the proposed Regulations to limit the increase in overall administrative burden. Notable changes include reduced administrative requirements for vehicles manufactured in stages and simplified reporting requirements.

Business and Consumer Impacts: Although owners and operators of heavy-duty vehicles will not be subject to the Regulations, they are expected to face higher purchase prices for new heavy-duty vehicles. The technologies embedded in the vehicles in order to comply with the Regulations will bring fuel savings that will outweigh the costs of these technologies. These available technologies were carefully selected to ensure broad industry support through the increased use of safe, existing technologies[2] to achieve significant GHG emissions and fuel consumption reductions. For all three heavy-duty vehicle regulatory classes, the payback period is less than one year. The increased fuel efficiencies of the vehicles are also expected to make the trucking industry more competitive with other modes of shipping. Despite their benefits, and while there will likely be some vehicle technology improvement, it is not expected that those technologies would be introduced to the same extent in the market place in the absence of the Regulations.

Domestic and International Coordination and Cooperation*:* Consultations were conducted with industry, provincial and territorial governments, other federal government departments and environmental non-governmental organizations (ENGOs). Environment Canada and Transport Canada co-hosted four consultation group meetings that included representatives from the above-mentioned stakeholders.

Environment Canada also released two consultation documents. [3] Comments received during consultation, both before and after the publication of the proposed Regulations in *Canada Gazette* Part I, served to inform the development of the Regulations. In addition, Environment Canada has conducted joint testing and research with the United States Environmental Protection Agency (U.S. EPA) to support the development of common standards.

[2] Federal Register, Vol. 76, No. 179, p. 57108, September 15, 2011, www.epa.gov/otaq/climate/regulations.htm#1-2.
[3] These consultations documents are available at http://www.ec.gc.ca/lcpe-cepa/default.asp?lang=En&n=A7A02DDF-1

2. Background

2.1. Background on policy development

2.1.1. National context

In 2009, the Government of Canada committed in the Copenhagen Accord and the Cancun Agreements to reducing, by 2020, total GHG emissions by 17% from 2005 levels, a target that is aligned with that of the United States. An important step toward meeting that goal included the 2010 publication in the *Canada Gazette*, Part II, of the *Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations* that are aligned with those of the United States.

On May 21, 2010, the Government of Canada and the Government of the United States each announced the development of new regulations to limit GHG emissions from new on-road heavy-duty vehicles. Canada announced that the Regulations would be made under CEPA 1999 and in alignment with those of the United States. On October 25, 2010, the Government of Canada released an initial consultation document describing the key elements being considered in the development of Canadian regulations to seek stakeholder views early in the process.

On August 9, 2011, Environment Canada published a second and more detailed consultation document to provide an additional opportunity for stakeholders to provide comments and to participate in the regulatory development process.

On April 14, 2012, Environment Canada published the proposed *Heavy-duty Vehicle and Engine Greenhouse Gas Emission Regulations* in the *Canada Gazette* Part I. This began a formal 60-day comment period. Environment Canada considered all comments received during the comment period in developing the Regulations.

2.1.2. Canada's collaboration with the U.S. EPA

Environment Canada, in partnership with Canada's National Research Council, has conducted joint aerodynamic testing and research with the U.S. EPA as well as heavy-duty vehicle emissions testing at Environment Canada facilities to support regulatory development. This collaboration is taking place under the Canada-U.S. Air Quality Committee and builds on the joint work with the United States on the development and implementation of GHG emission standards for vehicles. This collaboration served to inform the development of the Regulations in Canada.

2.1.3. Actions in other Canadian jurisdictions

Provinces and territories have not indicated any intention to regulate GHG emissions from new on-road heavy-duty vehicles. Furthermore, provincial environment ministries have communicated strong support for federal Canadian regulations aligned with those of the United Stated.

The provincial and territorial governments set requirements for in-use vehicles including tractor-trailer weights and trailer dimensions. All provinces will continue to be consulted to ensure a consistent pan-Canadian approach to regulating on-road heavy-duty vehicle emissions.

2.1.4. Actions in international jurisdictions

2.1.4.1. United States

On November 30, 2010, the National Highway Traffic Safety Administration (NHTSA) and the U.S. EPA jointly published a Proposed Rule describing a set of complementary new proposed regulations for heavy-duty vehicles and engines for model years 2014 and later. On September 15, 2011, the Final Rule was published in the U.S. *Federal Register*. The U.S. rules establish coordinated federal regulations to address the closely intertwined issues of energy efficiency and climate change under a joint Heavy-Duty National Program. In this joint rulemaking, the NHTSA implements fuel economy standards under the *Energy Independence and Security Act of 2007*, while the U.S. EPA regulations under the *Clean Air Act* implement the GHG emission standards for heavy-duty vehicles.

The U.S. National Program is based on a common set of principles, which includes, as stated in the Final Rule[4]: "increased use of existing technologies to achieve significant GHG emissions and fuel consumption reductions; a program that starts in 2014 and is fully phased in by 2018; a program that works towards harmonization of methods for determining a vehicle's GHG and fuel efficiency, recognizing the global nature of the issues and the industry; standards that recognize the commercial needs of the trucking industry; and incentives leading to the early introduction of advanced technologies."

In 2004, the U.S. EPA launched SmartWay, a voluntary program that encourages the trucking sector to identify strategies and technologies for reducing fuel consumption and CO_2e emissions and allows companies to be SmartWay certified.

The SmartWay program has allowed the U.S. EPA to work closely with heavy-duty vehicle manufacturers and fleet operators in evaluating numerous technologies and developing test procedures that achieve fuel and CO_2e reductions. The experience and knowledge acquired with SmartWay served in developing the Heavy-Duty National Program of the GHG regulations of the United States.

2.1.4.2. California

The California Air Resources Board adopted a GHG emission regulation for heavy-duty vehicles in 2008. This regulation is to reduce GHG by improving the fuel efficiency of heavy-duty vehicles through aerodynamic enhancement of vehicles and the use of low rolling resistance tires. This regulation covers tractors that pull a 53-foot or longer box-type semi-trailer, as well as covering the trailers themselves, and applies to the users of these tractor-trailer vehicles.

Since January 1, 2010, 2011 and later model year sleeper-cab heavy-duty tractors pulling a 53-foot or longer box-type trailer operating on a highway within California must be U.S. EPA Certified SmartWay, which requires certified aerodynamic equipment and low rolling resistance tires. As for day-cab tractors, the regulation requires that they be equipped with SmartWay verified low rolling resistance tires. The California regulation also requires that existing tractors,

[4] *Federal Register*, Vol. 76, No. 179, p. 57108, September 15, 2011, www.epa.gov/otaq/climate/regulations.htm#1-2.

mainly all 2010 model year and older sleeper-cab and day-cab tractors, be equipped with SmartWay verified low rolling resistance tires starting in January 2012. The regulation also includes similar requirements for 53-foot or longer box-type trailers.

2.1.4.3. Other international regulatory actions to reduce GHGs/fuel consumption of vehicles

Other international jurisdictions have established or are developing regulatory regimes that directly or indirectly serve to reduce GHG emissions from new heavy-duty vehicles.

Japan has implemented the Top-Runner Program, which identifies and designates as the "top-runner" the most fuel-efficient vehicle in each weight range. The program has the objective to improve the fleet average fuel-efficiency of all vehicles in a particular weight range to match that of its top-runner. In the case of heavy-duty vehicles, the most fuel-efficient vehicle of model year 2002 (excluding hybrids) was set as the baseline and regulation will start with model year 2015.

The European Commission is currently developing a new certification procedure and a strategy targeting fuel consumption and CO_2e emissions from heavy-duty vehicles. Simulation modelling is being considered. A draft regulation is expected to be completed by the end of 2012. [5] It is expected that mandatory reporting would be effective in 2013–2014 and that possible regulation would be in a 2018–2020 timeframe.

2.2. Sector Profile

2.2.1. Heavy-duty vehicle manufacturing and importing

The Regulations have divided these vehicles into three different categories:

1. Class 2B and Class 3 heavy-duty vehicles (full-size pick-up trucks and vans);
2. Vocational vehicles; and
3. Tractors.

Heavy-duty vehicles have a gross vehicle weight rating (GVWR) greater than 3,856 kg (8,500 lb.) and span several GVWR classes:

1. Tractors (often called combination tractors) are contained mainly within classes 7 and 8; and
2. Vocational vehicles, which span from class 2B through class 8, including various types of buses.

There are currently only two Canadian manufacturers of heavy-duty trucks, Hino and Paccar, which produce approximately 6,400 vehicles annually that are primarily exported to the United States. There is little to no manufacturing of heavy-duty engines in Canada although there are some Canadian body manufacturers that produce finished vocational vehicles. Canadian bus manufacturers hold an important share of the North American market, notably, MCI in Manitoba and Prevost in Quebec, which produce intercity buses; New Flyer and Nova Bus which produce

[5] The European Commission is due to adopt a strategy on HDV GHG emissions in 2013. For details, visit http://ec.europa.eu/clima/events/0054/index_en.htm

transit buses; and Girardin Minibus which produces school buses and smaller buses. All of these manufacturers sell in both American and Canadian markets.

2.2.2. Statistics of manufacturing and trade

The Canadian industry, classified in national statistics as Heavy-Duty Truck Manufacturing in the North American Industry Classification System (NAICS 33612), includes producers of complete heavy-duty vehicles and chassis, which are either tractors or vocational vehicles under the Regulations. Output of the industry has fallen sharply since the recent recession: from 11,321 vehicles in 2009 to 5,630 in 2010. [6] Most of the vehicles produced in Canada are exported to the United States: over 90% in 2009, and about 80% in 2010. The decline in output reflects a reduction in total vehicles purchased in the United States in consequence of reduced economic activity. The industry defined as Motor Vehicle Body Manufacturing (NAICS 336211) included 197 Canadian establishments producing vocational vehicles in 2009.

Manufacturing revenues for Heavy-Duty Truck Manufacturing decreased from $3.6 billion in 2001 to $1.9 billion in 2010, or at an average compound annual rate of 7.1% per year. Between 2009 and 2010, manufacturing revenues decreased by 14.9%.[7] The total number of employees in the sector decreased from 6,961 workers in 2001 to 4,985 workers in 2010, an average annual decrease of 3.6% over this time span. There was an increase of 4.5% in employment between 2009 and 2010. [8]

Exports of heavy-duty truck manufacturing declined 60% from $3.1 billion in 2007 to $1.2 billion in 2011, largely the result of reduced exports to the U.S., where approximately 97% of exports are destined, falling from $3 billion in 2007 to $1.2 billion in 2011. Imports of heavy duty truck manufacturing grew 23% from $4.3 billion in 2007 to $5.2 billion in 2011, largely originating in countries other than the U.S., the origin of 88% of our imports in 2007 and 78% of our imports in 2011.

2.2.3. Truck carriers

In 2009, there were some 750 thousand heavy-duty trucks of GVWR over 4,536 kg in operation in Canada (Canadian Vehicle Survey, 2009). There were approximately 435 thousand medium heavy-duty trucks below 14,970 kg GVWR and 314 thousand heavier heavy-duty trucks. The medium heavy-duty truck usage was 8.2 billion vehicle-kilometres, an average of 18 900 km per truck, while the heavy heavy-duty truck usage totalled 21.2 billion vehicle-kilometres, an average of 67,500 km per vehicle, as shown below in Table 1:

[6] Industry Canada, at http://www.ic.gc.ca/cis-sic/cis-sic.nsf/IDE/cis-sic33612tabe.html
[7] Source: http://www.ic.gc.ca/cis-sic/cis-sic.nsf/IDE/cis-sic33612prde.html
[8] Source: http://www.ic.gc.ca/cis-sic/cis-sic.nsf/IDE/cis-sic33612empe.html

Table 1: Heavy-Duty truck distance travelled in 2009, by weight class

Vehicle Type	**Weight**	**No. in Operation**	**Average Distance Travelled** (Kilometres)	**Combined Distance Travelled** (billions of Kilometres)
Medium-Heavy Duty Trucks	< 14,970 Kg	435,000	18,900	8.2
Heavy-Heavy Duty Trucks		314,000	67,500	21.2
Sum, all Heavy Duty Trucks	> 4,536 Kg	750,000		29.4

Source: Canadian Vehicle Survey, 2009, Statistics Canada

There were 194 thousand trucks described as "for-hire," only 26% of the total fleet, but responsible for 46% of total vehicle-kilometres. A further 128 thousand trucks were owned by owner-operators, responsible for 21% of total vehicle-kilometres. Such trucks are usually contracted to a larger carrier or company. Some 319 thousand vehicles were used in "private trucking," the term used to describe trucks that are not for hire, but are used to carry the owners' goods, including trucks owned by major manufacturers and retailers to transport the goods they own, and also trucks owned by farmers or tradesmen, for example. Such trucks were 43% of the fleet, but were used for only 23% of total vehicle-kilometres, at an average of only 21 thousand km per vehicle.

Table 2: Heavy-Duty truck distance travelled, 2009 by Ownership / Use

Ownership/Use	**Vehicles** (thousands)				**Kilometres Driven** (per vehicle)			**Vehicle-kilometres** (billions)			
	Medium	Heavy	Total	%	Medium	Heavy	Total	Medium	Heavy	Total	%
For-hire	51.8	142.5	194.3	26%	22 236	88,421	70,510	1.1	12.6	13.7	46.4%
Owner-operator	63.3	64.2	127.6	17%	28 436	70,093	49,373	1.8	4.5	6.3	22.1%
Private	240.0	79.0	319.0	43%	19 250	34,177	21,003	3.9	2.7	6.7	22.7%
Other	79.5	28.5	108.0	14%	17 610	49,123	25,926	1.4	1.4	2.8	9.5%
Total/Average	434.6	314.2	748.8	100%	18 868	67,473	39,391	8.2	21.2	29.5	100%

Source: Canadian Vehicle Survey, 2009, Statistics Canada

2.2.4. Trade by transport mode

Table 3 shows preliminary 2010 values of Canada's merchandise trade with the United States and Mexico, combining imports and exports. Trucking is responsible for the largest proportion of North American merchandise trade by value — 57% in 2010.

Table 3: Total North American merchandise trade by transport mode

Mode	Trade 2010 (millions of U.S. dollars)	Percentage
Road	298,832	58.1%
Rail	87,151	16.9%
Pipeline and other	71,652	13.9%
Air	29,267	5.7%
Marine	27,305	5.3%
Total	514,208	100%

Source: North American Transportation Statistics Database

In 2008, employment in the for-hire trucking industry in Canada was estimated at 415 thousand. It included 182 thousand full- and part-time employees of the medium and large for-hire carriers with annual operating revenues of $1 million or more; 26 thousand employees of small for-hire carriers with annual operating revenues between $30 thousand and $1 million; 104 thousand owner-operators with annual operating revenues of $30 thousand or more; and 103 thousand delivery drivers. Of this total for-hire trucking employment, 36% was in Ontario, 20% in Quebec and 27% in the Prairie Provinces, with smaller proportions in the other provinces and territories.

2.2.5. Bus carriers

Bus carrier companies operate in several sub-markets or sub-industries. A total of 1,371 companies earned service revenues of $6.4 billion, and received an additional $7.2 billion in Government contributions, primarily for urban transit services. Urban transit services earned 53% of total industry revenues excluding those contributions, and school bus services earned another 23%. Scheduled intercity, charter and shuttle services together earned 16% of total revenues.

3. Issue

As a result of human activities, predominantly the combustion of fossil fuels, the atmospheric concentrations of GHGs have increased substantially since the onset of the industrial revolution. In view of the historical emissions of GHGs from anthropogenic sources, and the quantity of emissions expected in the near future, GHGs are expected to remain a key contributor to climate change.

Across Canada we are witnessing the negative impacts of a changing climate first-hand. For example, a warming climate has been linked to the melting of permafrost in the north that has destabilized the foundations of homes and schools. While the specific impacts vary by region, all of Canada's provinces and territories are experiencing the effects of a changing climate.[9]

[9] Canada's Action on Climate Change, www.climatechange.gc.ca/default.asp?lang=En&n=036D9756-1.

While Canada accounts for just 2% of global GHG emissions, its per capita emissions are among the highest in the world and continue to increase. In 2010, GHG emissions in Canada totalled 692 megatonnes (Mt) of CO_2e as shown in Table 4 below:

Table 4: Canada's GHG emissions

Source (Mt)	2005	2010
Total	731	692
Transportation	193	195
Heavy-duty vehicles	44	47

Source: National Inventory Report: 1990–2010

As table 4 indicates, the transportation sector (air, marine, rail, road and other modes) is a significant source of GHG emissions in Canada, accounting for 28% of total emissions in 2010. Within this sector, heavy-duty vehicles account for nearly 24% of GHG emissions, or approximately 7% of total emissions in Canada[10]. Heavy-duty vehicle GHG emissions rose by nearly 3 Mt of CO_2e from 2005 to 2010.

Accordingly, taking action to reduce GHG emissions from new on-road heavy-duty vehicles and their engines is an essential element of the Government of Canada's strategy to reduce GHG emissions to protect the environment and the health of Canadians. CO_2 is the predominant GHG emitted by motor vehicles and is directly related to the amount of fuel that is consumed by vehicles. Vehicles also emit other GHGs, including tailpipe emissions of methane (CH_4), and the leakage of air conditioning system refrigerant, gases which all have higher global warming potential than CO_2. Reductions of those emissions are not related to or do not significantly contribute to fuel savings.

4. Objectives

4.1. GHG reductions

The Government of Canada is committed to reducing Canada's total GHG emissions to 17% below its 2005 levels by 2020 (i.e. from 731 to 607 Mt) — a target that is identified in the Copenhagen Accord and the Cancun Agreements. By establishing mandatory GHG emission standards for new on-road heavy-duty vehicles and engines beginning in 2014, Canada will move closer to its Copenhagen 2020 target.

The implementation of a comprehensive set of national standards reflecting a common North American approach for regulating GHG emissions from new on-road heavy-duty vehicles and engines will lead to environmental improvements for Canadians and provide regulatory certainty for Canadian manufacturers. Aligning Canadian standards with new U.S. regulations will also set a North American level playing field in the transportation sector.

[10] Canada's Greenhouse Gas Inventory, 2010, http://www.ec.gc.ca/ges-ghg/default.asp?lang=En&n=8BAF9C6D-1

The Regulations will require manufacturers selling heavy-duty vehicles and engines in Canada to deploy emission reduction technologies, which will benefit both the environment and Canadians.

4.2. Regulatory burden

The Regulations are designed to achieve the objectives above while minimizing the regulatory compliance burden of regulated Canadian industries through the alignment of heavy-duty vehicle regulations in Canada and in the United States. The reporting requirements were designed to assess the performance of the Regulations against the targets established in the Performance Measurement and Evaluation Plan (see section 14) while minimizing the reporting burden of industry. The Regulations will also allow regulatees to use the same GHG emissions model (GEM) as regulatees in the United States will use. This GEM is an accurate and cost-effective tool to assess compliance in either country (see section 5.4).

Implementation of a common Canada-U.S. approach to regulating GHG emissions from model year 2014 and later heavy duty vehicles not only benefits the environment, but also consumers and the competitiveness of the North American auto industry. Aligning North American regulations not only provides manufacturers and importers with regulatory certainty, but also ensures common standards in both countries, which minimizes the administrative burden on Canadian companies. Common Canada-U.S. standards are important to preserve the competitiveness of the Canadian heavy duty vehicle sector, due to the high-level of integration within the industry.

5. Description

5.1. Key elements of the Regulations

The Regulations introduce progressively more stringent GHG emission standards for new on-road heavy-duty vehicles and engines of the 2014 to 2018 model years in alignment with the national GHG emission standards and test procedures of the U.S. EPA. The Regulations apply to companies manufacturing and importing new on-road heavy-duty vehicles and engines for the purpose of sale in Canada.

5.2. Prescribed regulatory classes

The Regulations aim at reducing GHG emissions from the whole range of new on-road heavy-duty vehicles, comprising full-size pickup trucks and vans, tractors, and a wide variety of vocational vehicles such as school, transit and intercity buses to freight, delivery, service, cement, garbage and dump trucks.

The Regulations are aimed at all on-road vehicles with a GVWR of more than 3,856 kg (8,500 lb.), except medium-duty passenger vehicles and those vehicles that are subject to the *Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations*. Trailers are not subject to the Regulations.

The Regulations recognize the utility of vehicles and introduce GHG emission standards that apply to three prescribed regulatory classes of heavy-duty vehicles. Under the Regulations, the

full-size pickup trucks and vans would be regulated as “Class 2B and Class 3 heavy-duty vehicles,” and combination tractors as “tractors.” All other heavy-duty vehicles not covered by the two previously mentioned prescribed regulatory classes are regulated as “vocational vehicles,” which include buses. Furthermore, the Regulations establish a prescribed regulatory class for heavy-duty engines designed to be used in a vocational vehicle or a tractor.

5.3. Emission standards for CO_2, N_2O and CH_4

The standards in the Regulations address emissions of CO_2, N_2O and CH_4 from heavy-duty vehicles and engines. The Regulations also include measures to require reductions in leakage of the refrigerant used in cabin air-conditioning systems of tractors and class 2B and 3 vehicles.

For Class 2B and Class 3 heavy-duty vehicles, the Regulations include emission standards for CO_2, N_2O and CH_4. In regards to CO_2 emissions, the standard is a fleet average CO_2 emission standard for all vehicles of a company’s fleet and is determined based on a work factor, which is defined as a weighting of pay-load capacity, towing-capacity and four-wheel drive capability. The standard is different for gasoline and diesel-powered vehicles.

In regard to vocational vehicles and tractors, the Regulations include heavy-duty engine standards for CO_2, N_2O and CH_4, and also separate vehicle standards for CO_2. The vehicle emission standards are set according to the class of the vehicle, its characteristics, and the model year.

The standards are structured not to constrain the size and power of heavy-duty vehicles, recognizing that these vehicles are designed to perform work. The standards are expressed in grams per unit of work, therefore allowing a more powerful vehicle to proportionally emit more GHGs than a less powerful vehicle.

5.4. Compliance assessment and computer simulation model

For standards applicable to Class 2B and Class 3 heavy-duty vehicles, regulatees must measure the vehicle performance using prescribed test cycles on a chassis dynamometer, similarly to existing procedures for light-duty vehicles under the current *Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations*.

The performance of engines installed on vocational vehicles and tractors is measured using prescribed test cycles on an engine dynamometer, i.e. the same ones used to measure criteria air contaminants under the *On-Road Vehicle and Engine Emission Regulations*.

Compliance with the vehicle standards for vocational vehicles and tractors is assessed using the GEM computer simulation model. This model is readily available at no charge and assesses the emission reductions of a vehicle equipped with one or more non-engine-related technologies, such as aerodynamic fairings, low rolling resistance tires, a speed limiter, weight reduction technologies, and idle reduction technology. The simulation model also assigns to vehicles a pre-determined payload and engine size. As a result, Canadian manufacturers will not be disadvantaged compared to U.S. manufacturers due to the higher average payloads in Canada.

5.5. CO_2 emission credit system

The Regulations include a system of emission credits to help meet overall environmental objectives in a manner that provides the regulated industry with compliance flexibility. The system allows companies to generate, bank and trade emission credits. Under this system, companies are allowed to manufacture or import vehicles and engines with CO_2 emission levels worse than the applicable emission standard, and others performing better than the standard, provided that their average fleet emission level does not exceed the applicable emission standard.

In order to participate in the CO_2 emission credit system, a company must group into fleets its vehicles and engines and calculates its credits and deficits, expressed in units of megagrams of CO_2. Credits may be obtained by companies whose average fleet emission levels fall below the applicable standard, while deficits are incurred by companies whose fleet emissions exceed the applicable standard. A deficit must be compensated within three model years. Credits may be banked to offset a future deficit for up to five model years after the year in which the credits were obtained. Credits may also be transferred to another company.

5.6. Transitional measures and enhanced flexibilities for vehicles and engines covered by a U.S. EPA certificate

To provide additional flexibilities, companies will be exempt from the requirements the CO_2 emission credits system for all its 2014 model-year vocational vehicles and tractors that are covered by a U.S. EPA certificate. In addition, companies will also be permitted to exempt up to 50% of these vehicles of the 2015 model-year and up to 25% of these vehicles of the 2016 model year from these requirements. This exemption is not available for the 2017 and beyond model years. Some restrictions apply to the use of early action credits and credits obtained during the 2014-2016 model year if a company chooses to take advantage of the transitional measures.

The Regulations also provide additional flexibilities that exempt companies from having to participate in the CO_2 credit system if they import and manufacture engines that are covered by a U.S. EPA certificate with emission levels worse than the applicable standard. Whether companies can be exempted depend on the number of engines sold in Canada and on a ratio of the number of engines sold in Canada and in the United States.

Environment Canada's analysis indicates that these additional flexibilities will not significantly impact the final positive outcome of the Regulations, as discussed in greater detail in section 7.1.2. There is an inherent purchaser demand for fuel efficient vehicles and companies would only be expected to use the flexibilities if required to respond to unexpected market demand or to allow additional lead time to setup effective trading systems.

5.7. Additional emission credits

The Regulations allow companies that incorporate certain technologies that provide improvements in reducing CO_2 emissions to be eligible for additional emission credits when participating in the credit system.

Companies that manufacture or import, prior to the coming into force of the applicable standards, heavy-duty vehicles or engines that have emissions that are below the required emissions standards also have the possibility to generate early action credits.

The methods to calculate the additional credits are aligned with those of the United States. A company is not allowed to obtain additional credits more than once for the same type of GHG emission reduction technology.

5.8 Small Volume Companies

Companies that manufactured or imported in Canada, less than 200 vocational vehicles and tractors in 2011 and less than 200 vocational vehicles and tractors on average over the three most recent consecutive model years have the option to exempt their vocational vehicles and tractors of a given model year from complying with the CO_2 emissions standards.

5.9 Annual reporting requirements

Beginning with the 2014 model year, companies are required to submit to the Minister an annual end of year model report for all their heavy-duty vehicles and engines.

The report includes, for each type of vehicle or engine of a prescribed regulatory class, the number of heavy-duty vehicles and heavy-duty engines and all necessary information for the calculation of the company's credits or deficits when the company participates in the CO_2 emission credit system. This includes, amongst others, information such as the applicable emission standards, emission values or rates, and family emission limits.

5.10 Vehicles manufactured in stages

The Regulations introduce requirements for heavy-duty vehicles manufactured in stages so that when a company alters a heavy-duty vehicle that is in conformity with the Regulations in a way that may affect emissions, it must in respect of the work carried out to alter the vehicle, ensure that the vehicle still conforms to all applicable standards.

5.11 Other administrative provisions

Several administrative provisions are aligned with those under existing related regulations under the *Canadian Environmental Protection Act, 1999* (CEPA 1999), including provisions respecting the national emissions mark, maintenance and submission of records, the cost for test vehicles, application for exemptions and notices of defect.

In 2012, the Government of Canada implemented a "One-for-One" Rule to control the administrative burden that regulations place on business. EC has reviewed the administrative burden as it was proposed in the *Canada Gazette*, Part I in an attempt to identify areas in which the increase in burden could be reasonably minimized.

As of a result of this exercise and based on comments received during the consultation period, several changes were made to the proposed Regulations to limit the increase in overall administrative burden. Companies are no longer required to submit annual preliminary reports given that they were not intended to establish company compliance with the Regulations, but rather to orient regulators as to the initial actions of the regulated companies during a model year. Also, as a result of comments received from industry stakeholders, the deadline for submitting end-of-model year reports was postponed by several weeks. This will allow companies sufficient time to cull and submit the necessary information. Finally, administrative requirements for vehicles manufactured in stages were reduced given the low impact secondary manufacturers have on the emission performance of vehicles and given the relative small size of businesses involved in this sector.

Also, it should be noted that the Regulations incorporate all of the same test methods and procedures as used in the U.S. This provides clear direction to regulated companies and allows test data produced to demonstrate compliance under U.S. regulations to be used to demonstrate compliance in Canada.

6. Regulatory and Non-Regulatory Options Considered

6.1. Status quo approach

Currently, there is no federal requirement in Canada to reduce GHG emissions from new on-road heavy-duty vehicles. Heavy-duty vehicles are an important contributor to overall emissions and reducing GHGs from these vehicles is a key element in meeting the Government's climate change goals. Maintaining the status quo would make it more difficult for Canada to achieve this goal, while preventing Canadians from benefiting from the associated environmental improvements and economic benefits. Therefore, for the Government of Canada, maintaining the status quo is not an appropriate option for reducing GHG emissions from new heavy-duty vehicles in Canada.

6.2. Voluntary approach

New regulations in the United States will require manufacturers to adopt more GHG-reducing technologies in new heavy-duty vehicles sold in the United States beginning in 2014. However, because of the highly customized nature of the heavy-duty vehicle industry, manufacturers may

choose not to install those technologies in vehicles sold in Canada. Therefore, while a voluntary program could result in some emission reductions, it would not necessarily result to the same level of emission reductions as a Canadian regulatory regime will.

6.3. Regulatory approach

Given the importance of addressing climate change, most industrialized countries are moving to establish regulated requirements for the control of fuel consumption and/or GHG emissions from new vehicles. The implementation of a comprehensive set of national standards reflecting a common North American approach for regulating GHG emissions from new on-road heavy-duty vehicles and engines will lead to environmental improvements for Canadians, and provide regulatory certainty for Canadian manufacturers. Aligning Canadian standards with U.S. standards would also set a level North American playing field in the transportation sector.

6.3.1. Regulations under the *Motor Vehicle Fuel Consumption Standards Act*

The Government of Canada has previously considered reducing GHG emissions through the adoption of vehicle fuel consumption standards under the *Motor Vehicle Fuel Consumption Standards Act* (MVFCSA). When the *Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations* were developed in 2010, it was determined that significant amendments were required to the MVFCSA in order to be able to put in place regulations that would align with the U.S. fuel economy standards. Therefore, the approach of proceeding with Canadian fuel consumption regulations under the MVFCSA was then excluded in favour of regulating under CEPA 1999.

6.3.2. Regulations under CEPA 1999

CEPA 1999 enables the implementation of innovative compliance flexibilities such as a system for the banking and trading of emission credits to help meet overall environmental objectives in a manner that provides the regulated industry with maximum compliance flexibility.

This approach is also consistent with the existing use of CEPA 1999 to establish standards limiting smog-forming air pollutant emissions from new vehicles and engines, as well as to regulate GHG emissions from light-duty vehicles under the *Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations*.

The Government of Canada has determined that establishing regulated heavy-duty vehicle GHG emission standards under CEPA 1999 represents the best option to introduce these Regulations and to align Canada's requirements with the national regulated standards of the United States.

7. Benefits and Costs

The Regulations are estimated to result in a reduction of approximately 19.1 Mt of CO_2e in GHG emissions over the lifetime operation of new on-road heavy-duty vehicles sold between 2014 and 2018 (MY2014–2018), the period during which the Regulations first come into force (2014) and then are gradually phased into full effect (from 2015 to 2018). The Regulations are

also expected to reduce fuel consumption by 7.2 billion litres over the lifetime of the MY2014–2018 fleet.

Over the lifetime of MY2014–2018 vehicles, the present value of the cost of the Regulations is estimated at $0.8 billion, largely due to the additional vehicle technology costs required by the Regulations. The total benefits are estimated at $5.3 billion, due to the value of GHG reductions ($0.5 billion) and fuel savings ($4.8 billion). Over the lifetime of MY2014–2018 vehicles, the present value of the net benefit of the Regulations is estimated at $4.5 billion. The detailed analysis of benefits and costs is presented below.

7.0. Regulatory updates from *Canada Gazette*, Part I

The proposed Regulations underwent a number of changes following publication in *Canada Gazette*, Part I, to address formal comments received during the 60-day comment period (see section 10). Those changes include a phased-in approach to provide transitional measures over the 2014-2016 model years; reductions in the administrative requirements for vehicles manufactured in stages; added flexibilities for small-volume companies; delayed deadlines for submitting end of model year reports; and additional flexibilities for tractors that are not designed to operate mainly on highways, ("vocational tractors"). All of these changes are designed to provide greater flexibility, particularly in the first year of implementation.

Environment Canada's analysis has indicated that these changes will not significantly affect the impacts of the Regulations. Both technology costs borne by industry, and GHG emission reductions are expected to be slightly reduced, while costs and benefits are both likely to fall at the same ratio. As a result, the benefit to cost ratio of the Regulations remain essentially unchanged. The consistency of the benefit to cost ratio, the small magnitude of these changes and the uncertainty inherent in forecasting emissions, costs and benefits into the future have led EC to deem it neither necessary, nor cost-effective to quantify these minor changes in the analysis.

7.1. Analytical framework

The approach to cost-benefit analysis identifies, quantifies and monetizes, to the extent possible, the incremental costs and benefits of the Regulations. The cost-benefit analysis framework applied to this study incorporates the following elements:

> *Incremental impacts*: Impacts due to the Regulations are analyzed in terms of changes to vehicle technologies, emissions, and associated costs and benefits in the regulatory scenario compared to the business-as-usual (BAU) scenario. The two scenarios are presented in detail below. The incremental impacts are the differences between the estimated levels of technologies and emissions in the two scenarios, and the differences between the associated costs and benefits in the two scenarios. These differences (incremental impacts) are fully attributed to the Regulations (see section 7.2.3 on Key assumptions).
>
> *Timeframe*: The analysis considers new heavy-duty vehicles sold between 2014 and 2018 (MY2014–2018), the period during which the Regulations first come into force (2014) and then are gradually phased into full effect (2015 to 2018). The analysis assumes that new

vehicles survive for up to 30 years. This timeframe is consistent with other analyses, and with Canadian data that shows that few vehicles survive beyond 30 years. Thus the overall timeframe for the analysis is 35 years (2014 to 2048), the total lifespan of the MY2014–2018 new vehicle fleet. The impact of vehicles sold after 2018 is not considered in this analysis, but is expected to be similar to the impact for MY2018.

Benefits and costs have been estimated in monetary terms, to the extent possible and are expressed in 2011 Canadian dollars. Whenever this was not possible, due either to lack of appropriate data or difficulties in valuing certain components, incremental impacts were evaluated in qualitative terms. A social discount rate of 3% is used in the analysis for estimating the present value (2012 base year) of the costs and benefits under the central analysis. This level is within the range prescribed by the Treasury Board Secretariat's cost-benefit analysis (CBA) guidelines. This is consistent with discount rates used for other GHG related measures in Canada, as well as those used by the U.S. EPA. Table 5 summarizes the benefits and costs which were evaluated quantitatively, monetized and discounted.

Table 5: Monetized benefits and costs

Benefits	**Costs**
Pre-tax fuel savings	Technology costs and related admin burden
Avoided GHG damages	Noise, accidents, congestion
	Government administration

7.2. Analytical scenarios

This analysis considers two scenarios: a business-as-usual (BAU) scenario, which assumes the Regulations are not implemented, and a regulatory scenario, which assumes the Regulations are implemented. These two scenarios are based on the same volume of forecasted vehicle sales between 2014 and 2018. The differences between the scenarios are considered in terms of the estimated changes in vehicle technology choices in the regulatory scenario compared to the BAU, and the associated incremental changes in vehicle costs, GHG emissions, fuel consumption and related impacts.

7.2.1. Business-as-usual scenario

The business-as-usual (BAU) scenario assumes that the Regulations are not implemented and that vehicle technologies which affect GHG emissions will remain unchanged over the sales period of the analysis. This assumption may underestimate any "natural" technology changes that could occur throughout the North American market due to normal technological development in the absence of any regulations, or "complementary" technology changes that might occur in Canada either in response to similar regulations in the United States or in anticipation of the Regulations in Canada. These alternate rates of technology change are difficult to estimate, but are considered in a sensitivity analysis.

7.2.2. Regulatory scenario

The regulatory scenario assumes that certain GHG emission-reducing technologies will be chosen to comply with the Regulations. These are assumed to be existing technologies, and thus manufacturers can readily increase their usage in new vehicles in order to comply with the Regulations. It is also assumed that the costs of these technologies will be fully passed onto vehicle purchasers, and that vehicle sales will not be affected by technology changes. The analysis considers the same BAU projected vehicle sales for 2014 to 2018, and estimates the incremental impacts of the technical modifications to these vehicles in terms of changes in vehicle costs, GHG emissions, fuel consumption and related impacts.

7.2.3. Key assumptions:

Under the business-as-usual scenario, technology choices for MY2014–2018 remain the same as for MY2010. This assumption is further discussed in section 7.2.1 and in the "Rationale" section, and is evaluated in the "Sensitivity Analysis" section 7.8.

Under the regulatory scenario, all technology manufacturing costs will be passed onto vehicle purchasers, who will recoup these costs through fuel savings achieved by the technologies adopted to meet the Regulations. This assumption is evaluated in the payback analysis section.

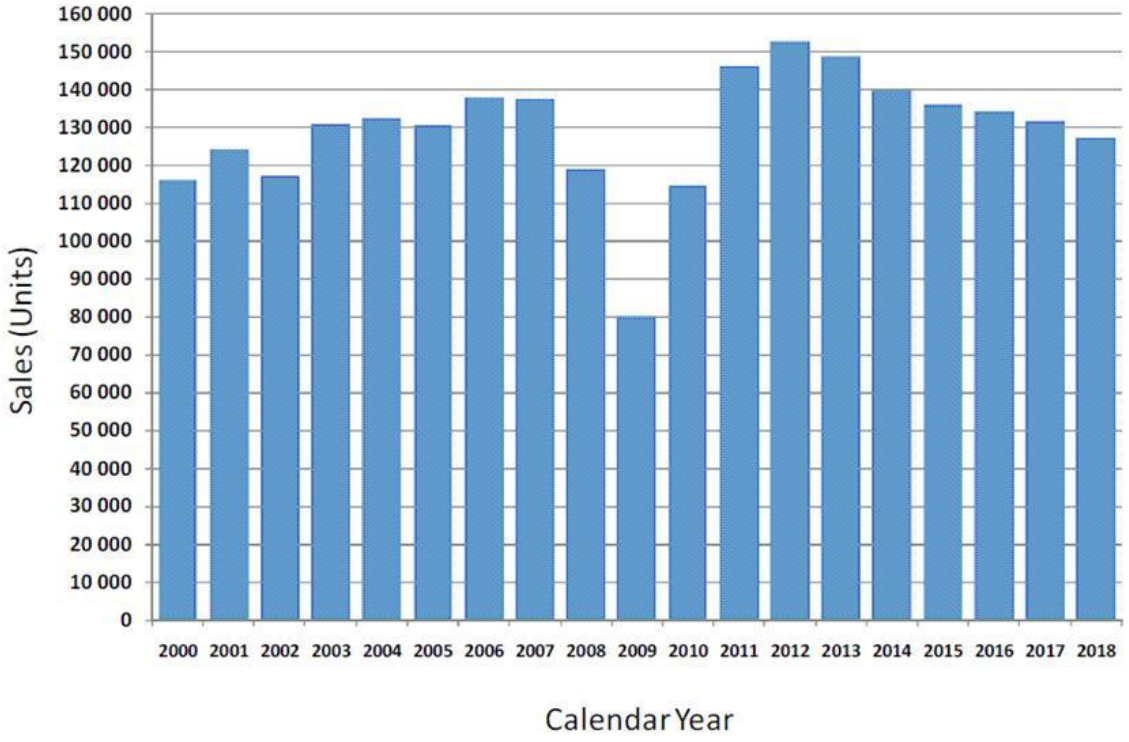
7.3. Key modeling and data

To assess the impact of the Regulations, it was necessary to obtain Canadian estimates of future vehicle sales, fuel prices and monetary values for GHG reductions; to identify the technologies that manufacturers would likely adopt and the costs they would incur in order to comply with the Regulations; and then to model future vehicle emissions, fuel consumption and distance travelled, with and without the Regulations. These key sources of data and information are described below.

7.3.1. Canadian sales forecast

For years 2011 through 2018, a vehicle sales forecast from DesRosiers Automotive Consultants (DAC) was used in the analysis. For the purpose of this study, all historical (calendar year 2005 through year-to-date June 2010) medium and heavy-duty vehicle data was provided by R. L. Polk (Polk). Using the Polk data file, DAC developed aggregate medium and heavy-duty historical registration data and forecast data using proprietary DAC forecasting methodologies and input from industry representatives. This study required an in-depth review of core Canadian economic variables. A database containing historical and forecast economic factors from calendar year 2000 through 2018 was provided by Environment Canada's Energy-Economy-Environment Model for Canada (E3MC) in March of 2011. DAC also considered provincial economic forecast data from Informetrica Limited (March 14, 2011), BMO Capital Markets Economics (March 14, 2011) and TD Economics (March 2011). The overall results of the DAC sales report are displayed below, with historical trends shown from 2000 to 2010, and projected trends shown from 2011 to 2018, based on DAC analysis and forecasts:

Figure 1: Sales forecast for Canadian medium and heavy-duty vehicles



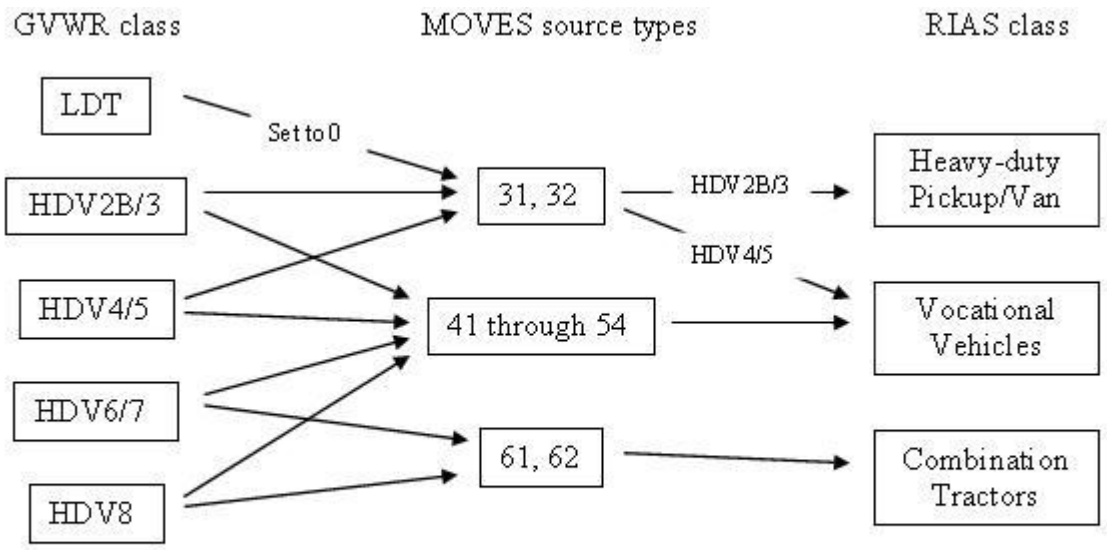
Source: R.L. Polk & Co. (data years 2000 – June 2010 new truck registration file), DesRosiers Automotive Consultants Inc. (2010–2018 Forecast Data)

The analysis of the Regulations incorporates the same detailed DAC sales estimates, for each vehicle regulatory class, into the modelling of vehicle population growth from 2010 to 2018 for both the BAU and policy scenarios. DAC estimated total sales per calendar year, which are used as a proxy for model year sales in this analysis.

7.3.2. Canadian vehicle emissions modelling

Estimates of Canadian vehicle emissions were developed using methods aligned with those initially developed by the U.S. EPA, together with key Canadian data to reflect the impact of the Regulations. The emissions selected were those linked to climate change, air quality and human health, such as GHGs and criteria air contaminants (CACs). The primary modelling tool used to calculate vehicle emissions was the Motor Vehicle Emissions Simulator (MOVES), which is the U.S. EPA's official mobile source emission inventory model for heavy-duty vehicles. Key data for Canadian heavy-duty vehicle populations and distance travelled were then incorporated into the most current version of MOVES (MOVES2010a) available in order to produce an analysis for Canada of the impacts of the Regulations. Vehicle data collected by gross vehicle weight rating (GVWR) was mapped into MOVES2010a and then categorized according to the vehicle classifications in the Regulations, as described in this RIAS and as shown in figure 2.

Figure 2: GVWR, MOVES and RIAS classes for this analysis



Canadian vehicle populations were estimated for all calendar years 2005 through 2050. For the purposes of this analysis, data purchased from Polk and Co. on the heavy-duty fleet in Canada for calendar years 2005 through 2010, were used by Environment Canada to develop vehicle population and age estimates for those years. After 2010, future vehicle populations are forecasted based on new vehicle sales and the number, age and estimated survival rates of existing vehicles. For years 2011 through to 2018, the DesRosiers sales forecast were used, as discussed above. For years 2019 and beyond, the default MOVES sales rates were used in the absence of Canada specific sales rates beyond 2018. Comprehensive validated survival estimates for Canadian heavy-duty vehicles were not available for this analysis. Instead, MOVES default vehicle survival rate estimates were generally used. These MOVES survival rate estimates appear similar to available Canadian data for vehicles less than 30 years old, but appear to underestimate survival for Canadian vehicles aged 30 years or more. Therefore, an adjustment was made in MOVES for the survival rate of vehicles aged 30 years or more, to make this rate more consistent with available Canadian data.

Along with vehicle populations, vehicle distance travelled is also important in overall emissions estimation for Canada. Estimates of Canadian vehicle kilometres travelled (VKT) and kilometre accumulation rates (KAR) were developed for all calendar years from 2005 through 2050. KAR is the product of VKT divided by the number of vehicles (the population). In 2010, Environment Canada contracted Stewart-Brown Associates (SBA) to generate KARs from inspection and maintenance (I/M) program data in Canada. Specifically, this was the Drive Clean program in Ontario, and the AirCare program in British Columbia. KARs generated in this manner from Ontario and British Columbia were then applied to Canada as a whole. This baseline Canadian KAR data was used to generate Canadian VKT estimates for each vehicle type and age, for all calendar years 2005 through 2010. Then the default MOVES growth rates were used to estimate VKT for the Canadian fleet for the calendar years 2011 to 2050.

7.3.3. The social cost of carbon (SCC)

The SCC is used in the modelling of the cost-benefit analysis of environmental regulations in a RIAS to quantify the benefits of reducing GHG emissions. It represents an estimate of the economic value of avoided climate change damages at the global level for current and future generations as a result of reducing GHG emissions. The calculations of SCC are independent of the method used to reduce emissions. The SCC is also used by the United States in their cost-benefit analysis of regulations. The values used by Environment Canada are based on the extensive work of the U.S. Interagency Working Group on the Social Cost of Carbon.

The estimated value of avoided damages from GHG reductions is based on the climate change damages avoided at the global level. These damages are usually referred to as the social cost of carbon (SCC). Estimates of the SCC between and within countries vary widely due to challenges in predicting future emissions, climate change, damages and determining the appropriate weight to place on future costs relative to near-term costs (discount rate).

SCC values used in this assessment draw on ongoing work being undertaken by Environment Canada[11] in collaboration with a federal interdepartmental working group, and in consultation with a number of external academic experts. This work involves reviewing existing literature and other countries' approaches to valuing GHG emissions. Preliminary recommendations, based on current literature and, in line with the approach adopted by the U.S. Interagency Working Group on the Social Cost of Carbon,[12] are that it is reasonable to estimate SCC values at $28.44/tonne of CO_2 in 2012, increasing at a given percentage each year associated with the expected growth in damages.[13] Environment Canada's review also concludes that a value of $112.37/tonne in 2012 should be considered, reflecting arguments raised by Weitzman (2011)[14] and Pindyck (2011)[15] regarding the treatment of right-skewed probability distributions of the SCC in cost-benefit analyses.[16] Their argument calls for full consideration of low probability, high-cost climate damage scenarios in cost-benefit analyses to more accurately reflect risk. A value of $112.37 per tonne does not, however, reflect the extreme end of SCC estimates, as some studies have produced values exceeding $1 thousand per tonne of carbon emitted.

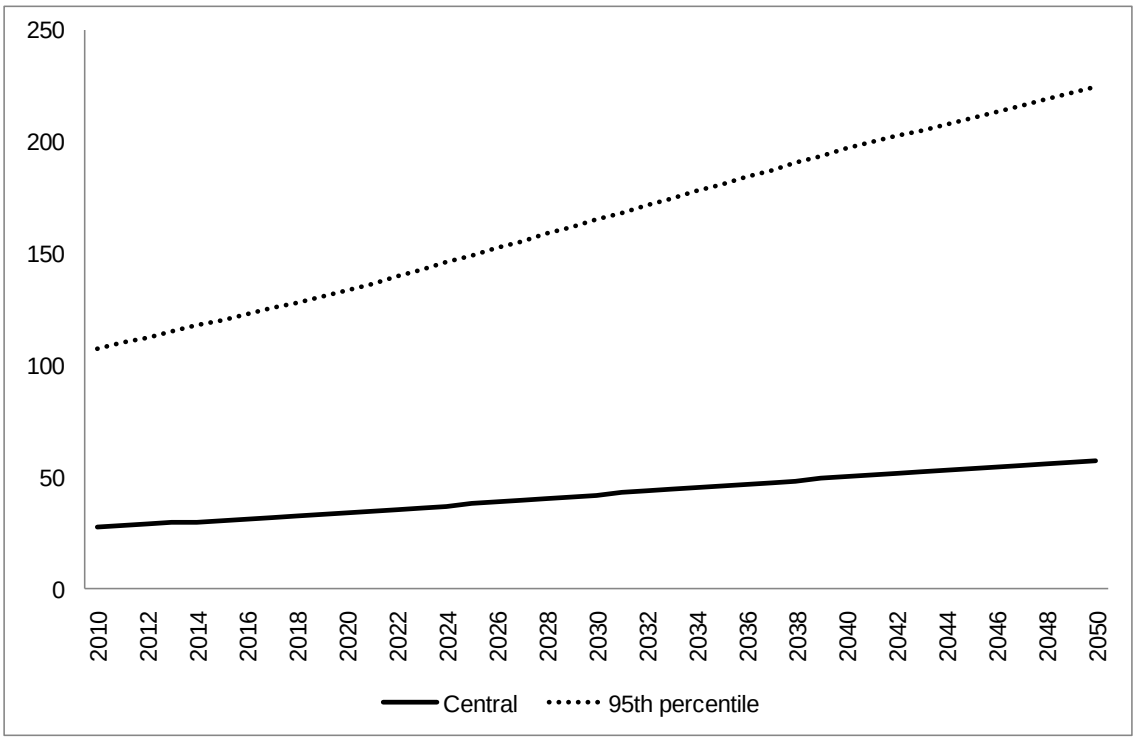
As shown in Figure 3 below, the social cost of carbon values increase over time to reflect the increasing marginal damages of climate change as projected GHG concentrations increase. The time-varying schedule of SCC estimates for Canada has been derived from the work of the U.S. Interagency Working Group.

The federal interdepartmental working group on SCC also concluded that it is necessary to continually review the above estimates in order to incorporate advances in physical sciences,

[11] Contact Environment Canada's Economic Analysis Directorate for any questions regarding methodology, rationale, or policy.
[12] U.S. Interagency Working Group paper on SCC: IWGSCC, 2010, "Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866," U.S. Government.
[13] The value of $28.44/tonne of CO_2 in 2012 (in 2011 Canadian dollars) and its growth rate have been estimated using an arithmetic average of the three models PAGE, FUND, and DICE.
[14] Fat-Tailed Uncertainty in the Economics of Climate Change," Review of Environmental Economic Policy, 5(2), pp. 275–292 (summer 2011).
[15] Fat Tails, Thin Tails, and Climate Change Policy," Review of Environmental Economics and Policy, summer 2011.
[16] The value of $112.37/tonne of CO_2 in 2012 (in 2011 Canadian dollars) and its growth rate have been estimated using an arithmetic average of the two models PAGE and DICE. The FUND model has been excluded in this estimate because it does not include low probability, high-cost climate damage.

economic literature, and modelling to ensure the SCC estimates remain current. Environment Canada will continue to collaborate with the federal interdepartmental working group and outside experts to review and incorporate as appropriate new research on SCC into the future.

Figure 3: SCC estimates (2011 CAN$/tonne)



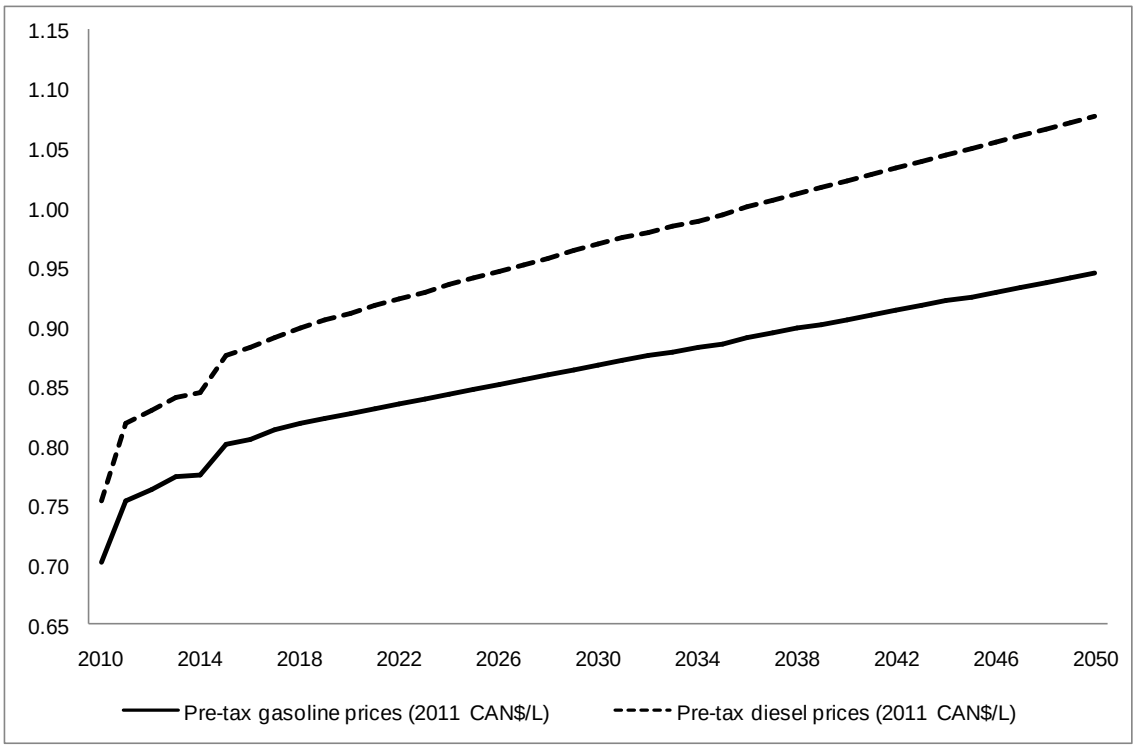
7.3.4. Fuel prices

Fuel price forecasts for both gasoline and diesel were adopted from Environment Canada's E3MC model for the period of 2011 to 2035. The E3MC model is an end-use model that incorporates the National Energy Board's (NEB) forecast for West Texas Intermediate crude oil price as reported in the NEB's *Energy Supply and Demand Projections to 2035 — Market Energy Assessment*.[17] The E3MC model uses this data to generate fuel price forecasts which are primarily based on consumer-choice modelling and historical relationships between macroeconomic and fuel price variables. Fuel prices beyond 2035 were projected based on the E3MC model average growth rate of fuel prices for the years 2020 to 2035. Uncertainty regarding these future fuel price forecasts was also considered in a sensitivity analysis.

Pre-tax fuel prices were used in the analysis as taxes are not generally considered in cost-benefit analyses given that they are a transfer rather than an economic cost. Post-tax gasoline and diesel price forecasts were used in a separate payback analysis. Due to regional variations in fuel taxes, post-tax fuel prices were calculated by weighting fuel sales by regional populations and then adding regional taxes accordingly.

Figure 4: Gasoline and diesel prices (2011 CAN$/L)

[17] www.neb.gc.ca/clf-nsi/rnrgynfmtn/nrgyrprt/nrgyftr/2011/nrgsppldmndprjctn2035-eng.html#s2_1



7.3.5. Vehicle technologies that reduce GHG emissions

Information on vehicle technologies, costs and adoption rates was obtained from the U.S. EPA's regulatory impact analysis of its *Final Rulemaking to Establish Greenhouse Gas Emission Standards for Medium- and Heavy-Duty Engines and Vehicles*.[18]

The technologies considered in this analysis are those most likely to be adopted during the period of the analysis (MY2014–2018) in response to the Regulations, having been developed and being available to some extent already and already shown by the U.S. EPA to be cost-effective. Table 6 below presents a list of technologies that manufacturers are likely to choose in order to comply with the Regulations.

[18] www.epa.gov/otaq/climate/documents/420r11901.pdf

Table 6: Potential key technologies

Combination trucks	Engine improvements, more use of low rolling resistance tires, mass reduction, improved aerodynamics, increased use of auxiliary power units, reduced air conditioning leakage
Vocational vehicles	Engine improvements, more use of low rolling resistance tires
Heavy-duty pick-up trucks and vans	Engine improvements, more use of low rolling resistance tires, mass reduction, improved transmissions, reduced accessory loads

7.4 Benefits

7.4.1. GHG emissions reductions

The MOVES emissions model was used to estimate the impact of the Regulations in terms of reductions in vehicle GHG emissions, as presented in Table 7 below (in Mt of CO_2e). The Regulations are estimated to result in a lifetime model-year reduction of 2.9 Mt beginning in MY2014 and increasing each year to 5.3 Mt for MY2018. Thus, as the Regulations come into full effect over the MY2014–2018 period, they will result in a cumulative lifetime GHG emission reduction of 19.1 Mt arising from new vehicles entering the market in these five years.

For MY2019 and subsequent model years, the Regulations will remain in full effect, and thus the lifetime reductions that would be observed under a regulatory scenario will likely be similar to the MY2018 level of 5.3 Mt for each subsequent MY, assuming similar sales and other modelling parameters. However, looking beyond MY2018, it also becomes more likely that some of these GHG emission reductions would have occurred even in the absence of the Regulations and could not therefore be fully attributed to the Regulations.

The estimated value of avoided damages from GHG reductions is based on the climate change damages avoided at the global level. Based on an estimated SCC[19] of $28.44/tonne, the present value of incremental GHG emission reductions under the Regulations is estimated to be approximately $0.5 billion over the lifespan of the MY2014–2018 new vehicle fleet. Under the $112.37/tonne SCC estimate, the present value of incremental GHG emission reductions would be estimated at over $1.9 billion for the 2014–2018 model year vehicles.

Table 7: Summary of GHG benefits, by model year, in millions of 2011 CAN$

	MY 2014	**MY 2015**	**MY 2016**	**MY 2017**	**MY 2018**	**Combined MYs 2014–18**
Reduction in GHG emissions — undiscounted (Mt CO_2e)	2.9	3.0	3.2	4.7	5.3	19.1
Present value of the reduction in GHG emissions (SCC at $28/tonne)	**77**	**78**	**84**	**120**	**135**	**493**
Present value of the reduction in GHG emissions (SCC at $112/tonne)	304	310	333	476	537	1,961

MY= lifetime (30 years) impacts for each year of vehicle sales. Due to rounding, some of the totals may not match. Present value in 2011 CAN$, using a 3% discount rate.

[19] See section 7.3.3

7.4.2. Fuel savings benefits

Manufacturers are expected to meet the requirements of the Regulations by adopting vehicle technologies that reduce GHG emissions. Most of these technologies (e.g. low rolling resistance tires and improved aerodynamics) will achieve these GHG emission reductions by improving vehicle energy efficiency. MOVES was used to estimate vehicle energy efficiency improvements due to vehicle technology improvements, and then these energy savings were converted to fuel savings using standard metrics. Thus these technologies are expected to reduce fuel consumption by 7.2 billion litres (undiscounted) over the lifetime of the MY2014–2018 fleet, as presented in Table 8 below.

Based on projected fuel prices, the benefits to vehicle owners arising from these fuel reductions are estimated to be nearly $4.8 billion in fuel savings, and these cumulative savings are estimated to outweigh the technology costs ($0.7 billion) by a ratio of more than 6:1 over the lifetime of the MY2014–2018 fleet. Fuel prices are calculated pre-tax, so vehicle owners could expect higher savings than those resulting from this analysis. A post-tax payback analysis for vehicle owners is also presented in section 7.9.

Fuel savings are also expected to reduce the frequency of refuelling, which is a time-saving benefit for vehicle operators. The analysis used refuelling fill rates to calculate the total time saved due to reduced fuel consumption. The value of these time savings was calculated using an estimated mean wage rate for a typical truck driver ($23.75 per hour in 2011 CAN$).[20] Using these values, the benefits of refuelling time savings due to the Regulations are expected to be $36 million over the lifetime of the MY2014–2018 fleet, as presented in Table 8.

Table 8: Summary of fuel-related benefits, by model year, in millions of 2011 CAN$

	MY 2014	**MY 2015**	**MY 2016**	**MY 2017**	**MY 2018**	**Combined MYs 2014–18**
Fuel savings — undiscounted (million litres)	1,080	1,111	1,215	1,758	2,015	7,179
Present value of fuel savings	760	767	817	1,156	1,291	4,791
Present value of reduced refuelling time	5	5	6	9	11	36
Present value of the sum of fuel benefits	**765**	**772**	**823**	**1,165**	**1,302**	**4,826**

MY = lifetime (30 years) impacts for each year of vehicle sales. Due to rounding, some of the totals may not match. Fuel savings are pre-tax. Present value in 2011 CAN$, using a 3% discount rate.

7.5 Costs

7.5.1. Vehicle technology and related administrative burden

[20] www.tc.gc.ca/media/documents/policy/report-final.pdf

The Regulations align with the national GHG emission standards of the U.S. EPA for the 2014 and later model years, in order to provide manufacturers with a common set of vehicle GHG emission standards. Therefore, the analysis of the Canadian Regulations assumes that manufacturers will likely adopt similar technologies to meet these common emission standards.

The U.S. EPA selected likely technology choices from existing technologies based on engineering analyses, estimated increased adoption rates for these technologies in order to comply with the U.S. EPA standards, and then estimated the redesign and application costs per vehicle for those technology packages. The U.S. EPA assessment of technologies that would be available for each of the engine classes and sub-categories of vehicles, the estimates of their effectiveness and costs were guided by published research and independent summary assessments. They first estimated the baseline emission and fuel consumption rates for each of the regulated subcategories of engines and vehicles. It was assumed that these rates would remain unchanged in the absence of the standards, then for each subcategory of engine, the U.S. EPA identified technologies which could be applied practically and cost-effectively. Effectiveness and costs of each technology were estimated and applied independently, then applied in combination. The availability and increase in penetration rates of technologies were assessed together with effectiveness and costs for each model year from 2014 to 2018. The technology costs reported by model year are incremental to the BAU costs. Under the regulatory scenario, technologies and compliance options are applied to vehicles in order for companies to meet their regulated standards. The estimated incremental cost per vehicle is calculated on this basis.

The Regulations will also include a CO_2 emission credit system to help meet overall environmental objectives in a manner that provides the regulated industry with compliance flexibility. As use of these credits is difficult to predict with any precision, the analysis did not model the benefits of these compliance flexibilities. It is therefore reasonable to conclude that the costs of vehicle technology may be somewhat overestimated.

There are also one-time costs largely associated with learning about new regulatory obligations and ongoing costs, largely associated with required record-keeping and reporting on technology compliance and use of regulatory flexibility options. These costs are collectively referred to as administrative costs, which are estimated to be highest in the first year of the Regulations (due to initial learning costs) and then constant in subsequent years (due to ongoing record-keeping and reporting costs, and an assumed rate of the use of compliance flexibilities). The present value of these administrative costs is shown in Table 9 below.

Given the integration of the North-American vehicle manufacturing sector and the alignment of the Canadian Regulations with the U.S. EPA standards, the same U.S. EPA-estimated vehicle technology choices and adoption rates were used in our analysis. This leads to the same proportional costs per vehicle, adjusted for exchange rates, as were used as in the U.S. EPA analysis. The resulting estimates of the present value of the costs of the technologies and the associated Canadian administrative requirements necessary to meet the Regulations are presented in Table 9.

Table 9: Summary of technology-related costs, by model year, in millions of 2011 CAN$

	MY 2014	MY 2015	MY 2016	MY 2017	MY 2018	Combined MYs 2014-2018
Present value of technology costs	142	136	139	141	154	712
Present value of administrative costs	0.2	0.1	0.1	0.1	0.1	0.5
Present value of total technology-related costs	**142**	**136**	**139**	**141**	**154**	**713**

MY = lifetime (30 years) impacts for each year of vehicle sales. Present value in 2011 CAN$, using a 3% discount rate.

The analysis of the Regulations assumes that manufacturers will pass the GHG emission-reducing vehicle technology costs to their purchasers. Because these technologies are estimated to also generate substantial fuel savings for vehicle owners and operators, the Regulations are assumed not to impact on the volume of new heavy-duty vehicle sales. No other potential operating cost impacts of new technologies (e.g. maintenance and repairs) were considered in the analysis, as any such incremental costs are expected to be quite small in relation to expected fuel savings.

7.5.2. Government costs

Costs of the Regulations to the Government of Canada fall into three principal categories: compliance promotion costs, enforcement costs, and regulatory program costs. The estimates of these are described below:

Compliance promotion: The overall present value of costs over the 2014–2018 period is estimated at approximately $94 thousand. Compliance promotion activities include information sessions for manufacturers and importers on the main requirements of the Regulations, in particular new emission standards and report submission. In subsequent years, the annual costs will be approximately $20 thousand (undiscounted) per year, and the compliance promotion activities will be adjusted according to the regulated community compliance level and to the compliance strategy.

Enforcement: The present value of overall costs over the 2014–2018 period is estimated at approximately $574 thousand and will be used for inspections (which includes operation and maintenance costs, transportation and sampling costs), investigations, measures to deal with alleged violations (including warnings, environmental protection compliance orders and injunctions) and prosecutions.

Regulatory administration: The present value of overall costs over the 2014–2018 period is estimated at approximately $8.6 million. These costs include regulatory administration and verification testing, and also include salaries, operation and maintenance. Regulatory administration will be used to develop and maintain a reporting system to compile data submitted by companies related to their fleet emissions and related credits or deficits for each model year fleet. The costs for verification testing will be used to deliver and administer the testing and emissions verification program, including associated laboratory costs and vehicle and engine acquisition. These costs also include an upgrade to the

testing facilities and associated equipment to accommodate heavy-duty vehicle and engine testing.

The present value of the costs related to these three categories are estimated to total $9.2 million over the 2014–2018 period in this analysis, and are presented in Table 10.

Table 10: Incremental cost to government, 2014–2018, in millions of 2011 CAN$

	2014	2015	2016	2017	2018	5-Year Total
Present value of compliance promotion costs	0.024	0.018	0.018	0.017	0.017	0.094
Present value of enforcement costs	0.122	0.118	0.115	0.111	0.108	0.574
Present value of regulatory program costs	1.767	1.709	1.728	1.699	1.650	8.554
Total Government Costs	**1.913**	**1.845**	**1.860**	**1.828**	**1.775**	**9.221**

Due to rounding, some of the totals may not match. Present value in 2011 CAN$, using a 3% discount rate.

7.5.3. Accidents, congestion and noise

As fuel savings lower vehicle operating costs, it is assumed that there will be some increase in vehicle distance travelled. The increase in vehicle distance travelled in response to lower vehicle operating costs is referred to as the “rebound” effect, and is measured here in vehicle-kilometres travelled (VKT). This rebound effect is expected to lead to more accidents, congestion and noise.

For heavy-duty vehicles, the U.S. EPA estimated the net rebound rate to be small overall and to vary by vehicle type: an approximate 0.5% to 1.5% increase in annual VKT per vehicle in response to total vehicle operating cost savings due to fuel savings. The Canadian analysis used the same rebound rates as the U.S. EPA, and applied them to annual Canadian fleet estimates of baseline VKT from MOVES in order to estimate the increase in VKT attributable to the rebound effect.

There are no identified Canadian estimates of heavy-duty vehicle costs per kilometre for accidents, congestion and noise. For Class 2B and Class 3 heavy-duty vehicles, this analysis used Canadian estimates for light-duty pickup trucks and vans. This is the same approach used by the U.S. EPA. The Canadian estimates for these vehicles are 46% lower than the U.S. EPA’s estimates. This analysis applied the U.S. EPA’s estimates per kilometre for heavy-duty vocational vehicles and tractors, assuming that Canadian estimates would also be 46% lower than the U.S. EPA’s estimates for the same heavy-duty vehicle classes. These per-kilometre cost estimates for accidents, congestion and noise were then applied to the Canadian VKT rebound estimates in order to obtain estimates of the overall value of accidents, congestion and noise for each vehicle class in this analysis. The results are presented below.

Table 11: Summary of costs of additional noise, accidents, and congestion, by model year, in millions of 2011 CAN$

	MY 2014	MY 2015	MY 2016	MY 2017	MY 2018	Combined MYs 2014–18
Present value of accidents, congestion, and noise	27	26	26	25	24	126

MY= lifetime (30 years) impacts for each year of vehicle sales. Present value in 2011 CAN$, using a 3% discount rate.

7.6. Non-quantified Impacts

7.6.1. Fuel savings impacts on upstream petroleum sector

Canada has a small, open economy and is a price-taker in the world petroleum market. The estimated reduction in domestic fuel consumption resulting from the Regulations will therefore not be expected to impact on the price of petroleum. Reduced domestic fuel consumption from any fuel savings resulting from the Regulations will therefore be expected to be redirected from domestic consumption to increased exports, with no incremental impact on the upstream petroleum sector.

7.6.2. Criteria air contaminant impacts

The Regulations are also expected to impact on criteria air contaminants (CACs) such as carbon monoxide (CO), nitrogen oxide (NO_x), particulate matter ($PM_{2.5}$, SO_x) and volatile organic compounds (VOCs). Overall it is expected that vehicle emissions of most CACs will decrease slightly in response to the Regulations, primarily due to anticipated fuel savings. Conversely, it is anticipated that emissions of $PM_{2.5}$ will rise slightly, primarily due to the expected increased use of diesel-powered auxiliary power units as a fuel saving measure for extended idling in tractors. The net impact of these changes in emissions of CACs on air quality, and the resulting impacts on human health are expected to be very minor. Given the small scale of the expected CAC emissions and the challenges in estimating their value, these impacts have not been quantified.

7.6.3. Regulatory certainty and reduced compliance costs for manufacturers

The Regulations are designed to align with similar regulations being introduced in the United States in 2014. The heavy-duty vehicle manufacturing sectors in Canada and the United States are highly integrated, so there are several benefits to regulatory alignment between the two countries. First, responding to new U.S. regulations with Regulations in Canada provides a degree of regulatory certainty for Canadian manufacturers, which should facilitate their investment decision-making.

Secondly, by aligning regulations, as opposed to establishing regulatory requirements different than in the United States, the Regulations will further benefit Canadian companies subject to these regulations. Canadian companies manufacturing and/or importing into Canada, vehicles that are concurrently sold in the United States, can use U.S. information and data, such as emission tests results, to demonstrate compliance with the standards. This significantly reduces

the companies' compliance assessment and administrative costs. Aligned regulations will also set a North American level playing field in the transportation sector by preventing any manufacturer from producing less expensive and higher emitting vehicles, and therefore putting other manufacturers in a competitive disadvantage. These benefits have been assessed qualitatively, as there are no available quantified estimates of the benefits of regulatory alignment.

7.7. Summary of costs and benefits

Over the lifetime operation of MY2014–2018 vehicles, the present value of the cost of the Regulations is estimated at $0.8 billion, largely due to the additional vehicle technology costs required by the Regulations. The total benefits for MY2014–2018 are estimated at $5.3 billion, due to the value of GHG reductions ($0.5 billion) and fuel savings ($4.8 billion). Over the lifetime operation of MY2014–2018 vehicles, the present value of the net benefits of the Regulations is estimated at $4.5 billion. The results of the cost-benefit analysis of the Regulations are presented in Table 12.

Table 12: Summary of main results, by model year, in millions of 2011 CAN$

Incremental Benefits and Costs	**MY 2014**	**MY 2015**	**MY 2016**	**MY 2017**	**MY 2018**	**Combined MYs 2014-2018**
Monetized benefits						
A. Sector benefits						
Pre-tax fuel savings	760	767	817	1,156	1,291	4,791
Reduced refueling time	5	5	6	9	11	36
B. Societal benefits						
Reduced GHG emissions (SCC at $28/tonne)	77	78	84	120	135	493
Total Benefits	**842**	**850**	**907**	**1,284**	**1,437**	**5,320**
Monetized costs						
A. Sector costs						
Technology-related costs	142	136	139	141	154	713
B. Societal costs						
Accidents, congestion, and noise	27	26	26	25	24	126
Government administration	2	2	2	2	2	9
Total Costs	**171**	**164**	**166**	**168**	**180**	**848**
NET BENEFIT SCC at $28/tonne	**671**	**686**	**741**	**1,117**	**1,257**	**4,472**
NET BENEFIT alternate SCC at $112/tonne	899	918	990	1,473	1,659	5,939
Qualitative and non-monetized impacts	Positive regulatory alignment impacts					
	No net criteria air contaminants impacts					
	No net upstream fuel impacts					

MY = lifetime (30 years) impacts for each year of vehicle sales. Present value in 2011 CAN$, using a 3% discount rate. Due to rounding, some of the totals may not match.

The analysis indicates that in the first years of the Regulations (MY2014–16), the total lifetime costs will range from $164 to $171 million, the lifetime benefits will range from $842 to $907 million, and the lifetime net benefits will range from $671 to $741 million. These values reflect the impacts of the initial levels of compliance standards in the Regulations, and the level of vehicles sales over this period. For MY2017–18, the Regulations introduce higher compliance standards, resulting in higher costs ($168 to $180 million), higher benefits ($1,284 to $1,437 million) and higher net benefits ($1,117 to $1,257 million).

For MY2019 and subsequent model years, the Regulations maintain the MY2018 compliance standards, and, all else being equal, results would be expected to be similar to those for MY2018, given similar volumes of annual vehicle sales.

Table 13: Summary metrics

	MY 2014	MY 2015	MY 2016	MY 2017	MY 2018	Combined MYs 2014-2018
Benefit to cost ratio - discounted at 3% (SCC at $28/tonne)	4.9	5.2	5.5	7.7	8.0	6.3
Fuel savings - undiscounted (billion litres)	1.1	1.1	1.2	1.8	2.0	7.2
Reduction in GHG emissions - undiscounted (Mt CO_2e)	2.9	3.0	3.2	4.7	5.3	19.1
Present value of CO_2e damages avoided (Mt CO_2e)						17.2
Present value of the socio-economic costs which equal total costs minus non-GHG benefits (in millions of 2011 CAN$)						-3,978
Present value of the socio-economic cost per tonne of CO_2e damages avoided ($/tonne)						-232

MY = lifetime (30 years) impacts for each year of vehicle sales. CO_2e damages are grown at 2% per year to reflect the growth in climate change damages over time as emissions cumulate in the atmosphere. Present value uses a 3% discount rate. Due to rounding, some of the totals may not match.

For the Regulations, the benefit to cost ratio is estimated to be 6.3 to 1 for the overall MY2014–2018 fleet of new heavy-duty vehicles. The benefit to cost ratio also increases from 4.9 to 1 for MY2014 to 8.0 to 1 for MY2018. This trend reflects the positive impact of fully implementing the Regulations.

Over the lifetime of the MY2014–2018 fleet, the Regulations are expected to reduce fuel consumption by 7.2 billion litres, and reduce GHG emissions (CO_2e) by 19.1 Mt.

In order to allow a comparison of social cost-effectiveness with other government climate change measures, we present the socio-economic cost per tonne of CO_2e emissions avoided. This ratio is calculated by subtracting the present value of the sum of all non-GHG benefits from the present value of the costs of the Regulations, and then dividing by the present value of the tonnes of CO_2e emissions avoided. This ratio measures the lifetime socio-economic costs of reducing GHG emissions if the Regulations are implemented over the MY2014–2018 analysis period, on a per tonne basis. For the Regulations, the ratio of –$232/tonne is negative, indicating that the carbon emission reduction under the Regulations will result in a net benefit rather than net cost.

7.8. Sensitivity analysis

A sensitivity analysis was done to consider the impact of uncertainty in key variables (i.e. changes in estimated sales, technology costs, fuel prices and discount rates). The sensitivity analysis shows that the results are robust in terms of demonstrating positive net benefits for the Regulations across a broad range of plausible values for variables and assumptions.

Table 14: Results of sensitivity analysis

Sensitivity Variables	Net Benefit		
	Lower	Central	Higher
1. Sensitivity to sales forecasts: (–30%, central, +30%)	3,130	4,472	5,813
2. Sensitivity to technology costs: (+30%, central, –30%)	4,258	4,472	4,685
3. Sensitivity to fuel prices: (–30%, central, +30%)	3,034	4,472	5,909
4. Sensitivity to discount rates: (7%, 3%, undiscounted)	2,943	4,472	6,394

All values are in millions of 2011 CAN$, using a 3% discount rate except where otherwise indicated.

A sensitivity analysis was also done to consider the impact of the assumption in the business-as-usual scenario (BAU) regarding the rate of technology change in the absence of the Regulations. Throughout the regulatory analysis, it is assumed that this rate is zero. This sensitivity analysis shows, however, that by assuming instead that some technology change would occur even in the absence of the Regulations, costs and benefits attributable to the Regulations would be reduced proportionately.

Table 15: BAU sensitivity analysis

BAU rate of technology adoption	**0%**	**25%**	**50%**
Costs	848	636	424
Benefits	5,320	3,990	2,660
Net benefit	4,472	3,354	2,236
Rate of technology adoption attributable to the Regulations	100%	75%	50%

All figures are in million 2011 CAN$, using a 3% discount rate.

The regulatory analysis provides information to the public and stakeholders about the costs they can expect to bear and the benefits they can expect to receive over the lifetime of new heavy-duty vehicles sold with more GHG emission reducing technologies. It is unclear whether some or many of the technologies would be adopted in the absence of the Regulations. To the extent that they would, the costs and the benefits attributed to the Regulations would be overstated. The sensitivity analysis shows that even if the BAU rate of technology adoption was as high as 50%, the Regulations would still result in a positive net benefit.

7.9. Distributional impacts

The automotive manufacturing sector is concentrated within Ontario and Quebec, with other plants in Manitoba, Saskatchewan, Alberta, and British Columbia.[21] The compliance costs of the Regulations are estimated to increase the production cost of vehicles for manufacturers by more than $136 million per year. These costs are expected to be distributed according to the future

[21] Canadian Industry Statistics, Industry Canada.

purchases and use of these regulated heavy-duty vehicles, and it is not expected that there will be significantly disproportionate impacts on any region within Canada.

The Regulations will require manufacturers to comply by adopting more GHG emission reducing technologies in new vehicles. The analysis of the Regulations assumes that manufacturers will generally be able to pass on all GHG emission reducing technology costs to vehicle purchasers, because these purchase costs can be shown to be quickly recouped through fuel savings. All new heavy-duty vehicle purchasers are assumed to be businesses, not consumers, given that heavy-duty vehicles are generally designed for commercial use. Businesses are expected to evaluate costs and benefits in terms of the expected payback on investment costs.

A simple payback analysis of MY2018 vehicle costs (Table 16) shows that average first-year fuel savings (including taxes) for owners and operators are expected to be greater than the manufacturer's average costs for adding new technologies. For all three heavy-duty vehicle regulatory classes, the payback period is less than one year.

Table 16: Average technology costs per new vehicle and fuel savings, in 2011 CAN$

MY2018	**HD pick-up trucks and vans**	**Vocation vehicles**	**Combination tractors**
Technology costs per new vehicle	1,082	410	5,837
First-year fuel savings per new vehicle	1,212	1,041	8,006
Net first-year savings	**129**	**631**	**2,169**

Fuel prices are post-tax, by MY2018 vehicle class. All figures are in 2011 CAN$.
Technology costs are a weighted average cost for vehicles in their respective RIAS class.

8. "One-for–One" Rule

The "One-for-One" rule was implemented to control new administrative burden imposed on businesses as a result of regulations. In summary, the rule requires that departments:

- restrict the growth of administrative burden by ensuring that new administrative burden on business introduced by a regulatory change (IN) is offset by an equal decrease in administrative burden on business from the existing stock of regulations (OUT); and
- control the number of regulations by repealing at least one existing regulation every time a new one imposing administrative burden on business is introduced.

Given that it is a new regulatory initiative, the changes that will be implemented through the Regulations will result in a net increase in administrative burden; therefore, the regulatory initiative is considered an "IN" under the rule. Increases in burden on the on-road heavy-duty sector will mainly take the form of reporting and record keeping requirements. The Regulations introduce a new administrative burden of $92 thousand (in 2012 CAN$) in annualized costs to the sector. These new costs will require equal and off-setting administrative cost reduction to existing regulations, and as this is a new Regulation, Environment Canada will also be required to repeal at least one existing Regulation.

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Based on calculations carried out using the Standard Cost Model methodology, these Regulations have been estimated to result in an annualized increase in total administrative costs to all businesses subject to the Regulations of approximately $92 thousand (in 2012 CAN$). The expected average annualized administrative costs per business subject to the Regulations is approximately $249 (in 2012 CAN$).

9. Small Business Lens

The regulated community comprises manufacturers and importers of new on-road heavy-duty vehicles and engines sold in Canada. It excludes companies or individuals that:

a) purchase vehicles or engines outside of Canada and import them into Canada for use or for a purpose other than sale;
b) sell used vehicles or engines; or
c) sell vehicles or engines that do not meet the definitions of “heavy-duty vehicle” or “heavy-duty engine”, as prescribed in the Regulations.

Most of the companies to which the Regulations apply are Canadian subsidiaries or branches of multinational manufacturers, and are not considered to be “small businesses”.

That said, there are small independent importers that import small numbers of vehicles and engines for the purpose of sale into Canada. There are also a number of small and specialized secondary manufacturers that import incomplete vehicles into Canada for the purpose of completing and then selling those vehicles to the end user. Collectively, these companies are responsible for a small fraction of all Canadian sales of heavy-duty vehicles.

Nevertheless, the Regulations recognize the unique challenges of companies that import or manufacture small volumes of new on-road heavy-duty vehicles and engines for sale in Canada. First, under the Regulations, the majority of these small businesses would have very limited requirements given the exemption for companies importing or manufacturing less than 200 vehicles of any given model year. Also, requirements for a company that alters heavy-duty vehicles or heavy-duty incomplete vehicles - even those that are not exempted - are limited compared to original equipment manufacturers.

10. Consultation

10.1. Consultations before the publication of the proposed Regulations in the *Canada Gazette*, Part I

The Government of Canada first announced its commitment to take regulatory action to reduce GHG emissions from 2014 and later model year heavy-duty vehicles and engines on May 21, 2010. The announcement indicated the Regulations would be aligned with the U.S. EPA, while considering unique Canadian circumstances where appropriate. In October 2010, Canada released a consultation document detailing the main elements of Canada's proposed Regulations to address GHG emissions from heavy-duty vehicles and engines. Canada subsequently released a second, more detailed consultation document in August 2011. Interested parties were invited to submit comments after the announcement and the release of the two consultation documents.

Environment Canada also held extensive consultation sessions with industry and other concerned stakeholders before the publication of the proposed Regulations. These included several meetings with manufacturers, vehicle owners, carriers, operators, ENGOs, provinces and territories. Environment Canada also co-hosted with Transport Canada three stakeholder working group meetings comprised of the above mentioned stakeholders, as well as other federal departments, such as Natural Resources Canada and Industry Canada.

The views of stakeholders provided during the above early consultations were taken into account in developing the proposed *Heavy-duty Vehicle and Engine Greenhouse Gas Emission Regulations* prior to *Canada Gazette*, Part I.

10.2. Consultations after the publication of the proposed Regulations in the *Canada Gazette*, Part I

Publication of the proposed *Heavy-duty Vehicle and Engine Greenhouse Gas Emission Regulations* in the *Canada Gazette,* Part I, on April 14, 2012, initiated a 60-day comment period where interested parties were invited to submit their written views on the proposed Regulations. The proposed Regulations were posted on Environment Canada's CEPA Environmental Registry website[22] to make them broadly available to interested parties. Environment Canada distributed an email to a broad range of interested parties to inform them of the formal consultation process. During the consultation period, Environment Canada held meetings with representatives of the provinces and territories, vehicle industry associations and ENGOs to provide an overview of the proposed Regulations, and answer questions to better inform possible written submissions. During the formal consultation period, Environment Canada also presented the proposed Regulations at the Heavy Duty Vehicle GHG Emissions & Fuel Efficiency in Canada Conference hosted by the University of Manitoba in Winnipeg, Manitoba. Environment Canada received comments at the event, and also invited participants to submit written comments during the consultation period.

[22] http://www.ec.gc.ca/lcpe-cepa/default.asp?lang=En&n=D44ED61E-1

Environment Canada received 19 written submissions from a range of commenters, including provinces, Canadian and U.S. based original equipment manufacturers, dealers, truck owners and operators, and ENGOs. Environment Canada has taken these views into account when developing the final Regulations. The following paragraphs summarize the major issues raised by interested parties on the proposed Regulations and Environment Canada's analysis leading to the development of the final Regulations.

10.2.1. Alignment with U.S. EPA's *Greenhouse Gas Emissions Standards for Medium- and Heavy-Duty Engines and Vehicles*

The vast majority of commenters generally expressed support for emission standards under the *Heavy-Duty Vehicle and Engine Greenhouse Gas Emission Regulations* aligned with the U.S. EPA's *Greenhouse Gas Emissions Standards for Medium- and Heavy-Duty Engines and Vehicles* Final Rule. Alignment of test procedures, vehicle classes, flexibilities and administration were also specifically highlighted as important by many commenters. Some U.S. based manufacturers, however, stated that alignment could possibly establish a more stringent approach in Canada, because:

1. Canadian regulatees (mostly importers) have smaller and less diverse fleets which do not allow them to certify vehicles across a broader range of emission performance standards, as compared to their U.S. counterparts who generally have larger and more diverse fleets;
2. The current penetration of GHG-reducing technologies is reportedly lower in Canada than in the U.S., which would require greater improvements to meet the standards in Canada compared to the U.S.; and
3. The lead time for complying with the Regulations is significantly less in Canada.

Response: Environment Canada has a long-standing policy of aligning transportation emissions standards with those of the U.S. EPA, as this provides significant environmental and economic benefits to Canada while minimizing compliance costs for industry and consumers. Alignment provides identical emission standards and test procedures to those of the U.S. EPA, which were found in the *Canada Gazette,* Part I publication.

The vast majority of vehicles are imported into Canada by large corporations with sufficient volume and diversity so as to not make the standards more stringent in Canada than in the U.S. Also, the Regulations' credit system allows Canadian companies to transfer credits amongst themselves, which effectively increases the pool of vehicles used for averaging and produce a similar fleet mix as the larger U.S. companies.

The data submitted by industry stakeholders suggest some differences in baseline vehicle performance between the U.S. and Canada, including a proportionally greater number of "vocational tractors" (see section 10.2.8 on vocational tractors for additional details on this issue).

In recognition of the transition to aligned standards, and to address industry concerns with a shorter lead time than the U.S., Environment Canada is taking a phased-in approach by providing transitional measures over the 2014-2016 model years for vocational vehicles and tractors, as outlined in the regulatory description. Some restrictions apply to the use of early action credits and credits obtained during the phase-in period to ensure companies do not overly take advantage of the transitional measures (see section 5.6 for details). To address concerns

specifically with regard to vocational tractors, Environment Canada has increased the threshold for vocational tractors (as described in section 10.2.8 below).

10.2.2. Low rolling resistance tires

There were many comments related to the safety, performance, availability and usage of low rolling resistance tires in Canada. Some U.S. based manufacturers raised concerns that weather conditions such as mud, snow and ice were more severe or frequent in Canada than in the United States. They also noted that on average, Canadian heavy-duty vehicles are purchased with tires that have a higher rolling resistance than in the United States. Some vehicle operators stated that in the limited testing of low rolling resistance tires they had already conducted, they had seen no evidence of safety concerns and had so far obtained positive cost-benefit results. In general, there was a desire by commenters to see more data on the safety and performance of low-rolling resistance tires. Some commenters also stated a desire to see a standardized way of communicating tire rolling resistance information to vehicle and replacement tire purchasers.

Response: In addition to the testing results and comments provided by industry, the Government has conducted additional testing on low rolling resistance tires. Transport Canada conducted a broad study comparing the performance of tires with different rolling resistance in winter conditions. The results of these studies demonstrate that low rolling resistance tires can offer a similar level of snow traction performance as conventional tires, while reducing fuel consumption and emissions. In developing its final rule, the U.S. EPA conducted independent tire testing in both conventional and winter weather conditions. The results from that testing indicated that current low-rolling resistance targets can be met by a wide variety of tires currently on the market. The U.S. EPA studies also indicated no statistical relationship between rolling resistance and snow traction. Given the currently available data, standards anticipating the same penetration level of low-rolling resistance tire technology in both Canada and the United States are appropriate.

10.2.3. Fuels

Some commenters felt that the proposed Regulations should aim to increase the penetration of various alternative fuels, particularly liquefied natural gas and biofuels. One commenter also stated that before any new fuel requirements are introduced, the compatibility of these fuels with existing emissions control technologies should be assured.

Response: Environment Canada is maintaining the standards of the proposed Regulations, which are fuel-neutral, and do not provide regulatory incentives or obstacles to any particular fuel including biofuel and liquefied natural gas. It should be noted that Environment Canada has separate renewable fuel standards in the *Renewable Fuels Regulations.*

10.2.4. Vehicles manufactured in stages

Many manufacturers and industry associations expressed concern that the administrative burden and documentation requirements for multistage manufacturers were unnecessary and overly onerous. The commenters stressed that the great majority of these companies did not alter components which would affect a vehicle's emissions value, principally the tires, engine and after-treatment system. They felt that for this reason, the reporting burden should be eliminated or substantially reduced. Some commenters advocated aligning multistage manufacturing requirements with those of the U.S. EPA.

Response: Environment Canada has reduced the administrative requirements for vehicles manufactured in stages, while maintaining the objectives of the Regulations. Environment Canada has modified the requirements of the proposed Regulations so that only manufacturers who alter components which will affect a vehicle's emission performance will be required to ensure that the vehicle conforms to all applicable standards in the new configuration. Those multistage manufacturers who do not affect a vehicle's conformity to the Regulations will not be subject to any data or documentation submission requirements.

10.2.5. Small volume companies

Some associations and companies stated that the threshold for companies to be considered for the provisions applying to small volume manufacturers and importers should be raised from 100, and some commenters also submitted data supporting this claim. Several other commenters also stated that the small volume provisions could lead to a proliferation of small volume companies in an effort to circumvent the standards, and one commenter stated that the provisions should be eliminated completely.

Response: Based on the data received, Environment Canada has increased the threshold for the small volume provisions to companies who manufactured or imported 200 or fewer vocational vehicles and tractors in 2011 and on average over the three most recent consecutive model years. Additionally, to address concerns that the exemption could lead to the proliferation of small-volume companies, Environment Canada has clarified in the regulatory text that a company must have been involved in the import or manufacture of less than 200 heavy-duty vehicles in 2011 (reference year) in order to be eligible for the small volume provisions. Finally, in response to the recommendation that the small-volume exemption be eliminated, Environment Canada is not eliminating this provision given its broad support from most commenters and in consideration of the unnecessary compliance burden for small businesses manufacturing and importing heavy-duty vehicles in Canada.

10.2.6. Reporting

Environment Canada received a number of comments related to several aspects of the reporting provisions contained in the proposed Regulations. Several commenters stated that the timing of the end of model year report should be later in the year, to allow Canadian subsidiaries to compile and prepare data from their American parent corporations.

Several large U.S. based manufacturers were critical of the information requirements for vehicle importers, stating that the importers were unlikely to possess the information necessary to comply with the proposed Regulations. They noted that given the current market structure involving numerous and generally small companies importing various brands and products, Environment Canada would likely subsequently receive many reports, often with duplicate vehicle information. An association and several U.S. based manufacturers advocated for the option of allowing large entities to report on behalf numerous small importers. One U.S. based manufacturer stated that reporting in this manner was not a suitable long-term solution to the issue of a high reporting burden.

Response: The deadlines for end of model year report submissions have been revised to June 30 of each year, to allow more time for Canadian regulatees to acquire information from their U.S. parent companies where necessary. Also, in order to further limit administrative burden and to streamline reporting requirements, the provisions contained in the proposed Regulations that required submitting an annual preliminary report for Class 2B and Class 3 heavy-duty vehicles were removed.

Under CEPA 1999 and the Regulations, companies are responsible for compliance including fulfilling all the regulatory reporting obligations. Regulatees may seek to establish an agreement with a third-party, such as the original equipment manufacturer, which has the expertise to submit the requisite regulatory reports on its behalf. Environment Canada recognizes that such an approach can limit the regulatory reporting burden, and in certain cases, such as submitting defect information, facilitate the dissemination of information.

10.2.7. Compliance flexibilities

Manufacturers, associations and ENGOs all commented on the compliance flexibilities contained in the proposed Regulations, in particular the CO_2 emission credit system. In general, U.S.-based manufacturers noted that Canadian regulatees (mostly importers) have smaller and less diverse fleets which do not allow them to certify vehicles across a broader range of emission performance standards, as compared to their U.S. counterparts who generally have larger and more diverse fleets. Because of this, they said, the CO_2 emission credit system provides less flexibility for Canadian regulatees compared to U.S. regulatees.

Some U.S. based manufacturers further commented that the proposed Regulations should not require companies to participate in the credit system if they import vehicles and engines covered by a U.S. EPA certificate, even if one or more of those vehicles and engines have emission levels worse than the standard. In the case of engines, these manufacturers also advocated this approach even if sales in Canada of one engine exceed sales in the U.S. of that same engine as stipulated in the proposed Regulations. Commenters further expressed concerns that, because of differences between the Canadian and U.S. engine markets, a small number of engines sold into a niche market segment could trigger a requirement for a company's entire engine line-up to be included in the CO2 emission credit system.

On the other hand, several ENGOs emphasized the importance of a well monitored CO_2 emission credit system to ensure that Canada does not become a pollution haven for high

emitting vehicles, and to ensure that the Government can verify the changes in technology and fuel efficiency at the fleet level.

Response: Participation in the CO_2 emission credit system is a compliance flexibility, and is not required unless one or more vehicles, including those covered by a U.S. EPA certificate, have emission levels worse than the applicable standard. The credit system cannot completely exclude U.S. EPA-certified vehicles and engines from its scope as this would reduce the Government's ability to ensure GHG emission reductions and properly evaluate the performance of the Regulations.

The requirement to participate in the CO_2 emission credit system for engines covered by a U.S.EPA certificate and with GHG emissions above the applicable standards is based on the number of engines sold in Canada and on a ratio of the number of engines sold in Canada and in the United States. The requirement for companies to track Canadian sales of heavy-duty engines is to ensure there are no significant differences between Canada and the U.S. in sales of low-volume engines. Environment Canada has modified the Canada/U.S. sales threshold for lower volumes of engines, to ensure that the requirement to participate in the CO_2 emission credit system for engines is only triggered when there are significant Canadian sales of high emitting engines.

10.2.8. Vocational tractors

The proposed Regulations contained provisions for vocational tractors, which are tractors that are not designed to operate mainly on highways, or that would not benefit from some of the technologies expected to be deployed for line-haul tractors. The proposed Regulations included an option for companies manufacturing or importing vocational tractors to comply with the CO_2 emissions standards applicable for vocational vehicles instead of those applicable for tractors, with a limit of no more than 2,100 vocational tractors, in any consecutive three model year period.

Several U.S. based manufacturers commented that Canada has a higher proportion of vehicles which would be considered vocational tractors than in the U.S. The majority of these tractors have a gross combined weight rating (GCWR) of 120 thousand lbs or greater, and are also known as heavy-haulers. Commenters also stated that there is a greater need in Canada for vocational tractors due to the relatively higher percentage of Canada's economy dedicated to resource extraction. Commenters proposed to raise the limit on the number of tractors a manufacturer or importer could declare as vocational tractors. Commenters suggested to raise the thresholds to between 4,500 to 12 thousand vehicles per 3 year period, instead of 2,100 vocational tractors as proposed in the proposed Regulations.

Response: Based on confidential market data received from U.S.-based manufacturers, Environment Canada has raised the limit on vocational tractors to 5,250 per three year period, from 2,100 for the same period.

10.2.9. Labelling

Some commenters recommended requiring manufacturers and importers to label tractors and vocational vehicles with the emissions values used for the U.S. certification, as an indicator to purchaser of emission performance. These commenters felt that this information would allow purchasers to make more informed purchases, and would also allow the Government of Canada to track the penetration of GHG reducing technologies. Other commenters felt that these certification values were confidential business information, and should not be shared with the general public.

Response: Placing GHG emissions values on tractors, vocational vehicles and engines would require additional Canada specific labels and is not in alignment with the requirements of the U.S. EPA. Environment Canada is not requiring GHG emissions certification values on labels under the Regulations.

11. Regulatory Cooperation

The Joint Action Plan for the Canada-United States Regulatory Cooperation Council indicated that: “In addressing climate change, both Canada and the U.S. have implemented aggressive emissions targets in the transportation sector. Continuing progressive and aligned action to reduce GHGs from vehicles is a priority for both countries. There is an opportunity for regulators to work more closely with the aim of better synchronizing implementation of regulations and leveraging existing expertise.”

Throughout the regulatory development process in both Canada and the United States, Environment Canada and the U.S. EPA worked to support each other. Environment Canada’s contributions included emissions and aerodynamic testing, conducted at facilities run by both Environment Canada and the National Research Council Canada. Canada’s contributions were explicitly mentioned by the U.S. EPA in their rulemaking documents, including the following excerpt. “We expect the technical collaboration with Environment Canada to continue as we implement testing and compliance verification procedures for this rulemaking. We may also begin to develop a knowledge base enabling improvement upon this regulatory framework for model years beyond 2018 (for example, improvements to the means of demonstrating compliance). We also expect to continue our collaboration with Environment Canada on compliance issues.”

Environment Canada expects collaboration with the U.S. EPA to continue and expand as both countries work to address GHG emissions from heavy-duty vehicles, especially in the areas of joint testing, knowledge sharing and the implementation of the Regulations.

12. Rationale

The Regulations will achieve the Government of Canada’s objective to continue to reduce GHG emissions from heavy-duty vehicles and engines for model years 2014 and beyond. The Regulations aligns with the national GHG emission standards of the U.S. EPA for model years 2014 and later, providing long-term regulatory certainty to the heavy duty vehicle and engine industry and common requirements in both jurisdictions, to allow for companies to take

advantage of economies of scale. The implementation of these national GHG emission standards will require significant technological improvements to new heavy-duty vehicles and engines, which will lead to significant GHG emission reductions and improved fuel efficiency. The present value to vehicle purchasers of benefits from reduced fuel consumption alone is estimated to be $4.8 billion over the lifetime operation of model year 2014 to 2018 heavy duty vehicles and engines.

In perfect markets, such fuel savings would be enough to motivate reductions in GHG emissions even in the absence of the Regulations. Accordingly, it may be reasonably asked why the Regulations are necessary in order to achieve these cost-effective results. To try to understand this issue, the U.S. EPA surveyed published literature and held discussions with numerous truck market participants. From these sources, five categories of possible explanations were derived.

First, comprehensive and reliable information on the effectiveness and efficiency of new technologies is not always available. Thus buyers may understandably be reluctant to spend additional money to purchase vehicles equipped with these new technologies.

Second, although it seems reasonable to assume that people are willing to pay more for better vehicles, new or used, it is not clear whether buyers of used vehicles can tell which are the better vehicles. As a result, the purchasers of original equipment may expect the resale market to provide inadequate compensation for the new technologies, even when those technologies would reduce costs for resale buyers.

Third, if for some reason a truck purchaser will not be directly responsible for future fuel costs, or the individual who will be responsible for fuel costs does not decide which truck characteristics to purchase, then those price signals (higher vehicle prices offset by lower fuel costs) may not be transmitted effectively, and incentives can be described as “split.”

Fourth, there may be uncertainty about future fuel prices. When purchasers have less than perfect foresight about future operating expenses, they may implicitly apply much higher discount rates to future potential fuel savings, due to their uncertainty.

Fifth, transaction costs of changing to new technologies may slow or prevent their adoption. If a conservative approach to new technologies leads truck buyers to adopt new technologies slowly, then successful new technologies are likely to be adopted over time without market intervention, but with potentially significant delays in achieving fuel saving and environmental benefits.

It is unclear whether some or many of the technologies would be adopted in the absence of the Regulations. There is, however, highly imperfect information in the original and resale markets, split incentives, uncertainty about future fuel prices, and adjustment and transaction costs. These market failures would limit the adoption of these technologies in the absence of the Regulations. Therefore, regulations that force the adoption of these technologies can bring net benefits to Canadians, as demonstrated in the summary cost-benefit table for the Regulations (Table 12).

13. Implementation and Enforcement

13.1. Implementation

Environment Canada currently administers a comprehensive program to verify compliance with the *On-Road Vehicle and Engine Emission Regulations* under CEPA 1999, which establish federal emission standards for smog-forming emissions. The Regulations will be implemented and enforced in a similar manner. Manufacturers and importers will be responsible for ensuring that their products comply with the Regulations and will be required to produce and maintain evidence of such conformity. The program will include:

- Authorizing and monitoring the use of the national emissions mark;
- Reviewing company evidence of conformity;
- Monitoring data submission for compliance with the applicable GHG emission standards for heavy-duty vehicles and engines and the banking or trading of emission credits;
- Registering company notices of defects affecting emission controls;
- Inspections of test vehicles and engines and their emission-related components;
- Laboratory emissions tests on a sample of new vehicles and engines that are representative of products offered for sale in Canada; and
- Laboratory emissions tests on a sample of typical in-use vehicles.

Environment Canada plans to coordinate monitoring efforts with the U.S. EPA by sharing information to increase program efficiency and effectiveness.

In administering the Regulations, Environment Canada will respond to submissions and inquiries from the regulated community in a timely manner taking into account the complexity and completeness of the request.

13.2. Enforcement

Since the Regulations will be made under CEPA 1999, enforcement officers will, when verifying compliance with the Regulations, apply the Compliance and Enforcement Policy implemented under the Act. The Policy sets out the range of possible responses to violations, including warnings, directions, environmental protection compliance orders, ticketing, ministerial orders, injunctions, prosecution, and environmental protection alternative measures (which are an alternative to a court trial after the laying of charges for a CEPA 1999 violation). In addition, the Policy explains when Environment Canada will resort to civil suits by the Crown for costs recovery.

When, following an inspection or an investigation, an enforcement officer discovers an alleged violation, the officer will choose the appropriate enforcement action based on the following factors:

- Nature of the alleged violation: This includes consideration of the damage, the intent of the alleged violator, whether it is a repeat violation, and whether an attempt has been made to conceal information or otherwise subvert the objectives and requirements of the Act.
- Effectiveness in achieving the desired result with the alleged violator: The desired result is compliance within the shortest possible time and with no further repetition of the violation. Factors to be considered include the violator's history of compliance with the Act, willingness to cooperate with enforcement officers, and evidence of corrective action already taken.

- Consistency: Enforcement officers will consider how similar situations have been handled in determining the measures to be taken to enforce the Act.

Environment Canada will monitor the GHG emission performance of heavy-duty vehicles and engines and their fleets and compliance with the Regulations. In the situation where a vehicle or engine is found to exceed applicable standards or exceed the family emission limit specified by the company, the normal course of events will be to perform sufficient engineering assessment to determine if a notice of defect should be issued by the company to the owners of the particular model of vehicle. This may result in a product recall to fix the defect. In the case of the emission credit system, companies will have three years to offset a deficit. In the situation where a company fails to meet this requirement, the issue will be referred to the Enforcement division to consider actions in accordance with its Compliance and Enforcement Policy for CEPA 1999.

13.3. Service standards

For the Regulations, Environment Canada, in its administration of the regulatory program, will provide these services in a timely manner:

- Reviewing applications and preparing authorizations to use the national emissions mark; and
- Assessing requests for exemptions from the Regulations.

In addition, Environment Canada will audit evidence of conformity for engines and vehicles and provide to manufacturers an acknowledgement of its receipt and whether it is presented “in a form and manner that is satisfactory” based on a set of criteria established by Environment Canada. Environment Canada intends to develop a technical guidance document describing the required evidence of conformity and the procedures to be followed when submitting required documentation.

14. Performance Measurement and Evaluation

The Performance Measurement and Evaluation Plan (PMEP) describes the desired outcomes of the Regulations and establishes indicators to assess the performance of the Regulations in achieving these outcomes. The PMEP package is composed of three documents:

- The PMEP, which details the regulatory evaluation process;
- The logic model, which provides a simplified visual walkthrough of the regulatory evaluation process; and
- The table of indicators, which lists clear performance indicators and associated targets, where applicable, in order to track the progress of each outcome of the Regulations.

The three documents complement each other and allow the reader to gain a clear understanding of the outcomes of the Regulations, the performance indicators, as well as the evaluation process.

14.1. Outcomes

The PMEP details the suite of outcomes for each unit as they comply with the Regulations. These outcomes include the following:

- Upon publication of the Regulations, the regulated community will become aware of the Regulations, start importing or manufacturing vehicles and engines that comply with the standards and meet the reporting requirements, when applicable (immediate outcome).
- Then, as fuel-saving technologies enter the market, owners and operators of heavy-duty vehicles will experience fuel savings (intermediate outcome), which directly translates into GHG emission reductions and economic benefits (final outcome).

As a key feature of the Regulations, companies will be subject to progressively more stringent standards during the 2014 to 2018 model year period. Also, the Regulations only target new vehicles. Existing vehicles are not subject to the Regulations. As a result, the outcomes, such as anticipated reductions in GHG emissions, will take place progressively and accumulate over time as the Canadian vehicle fleet turns over.

14.2. Performance indicators and evaluation

Clear, quantitative indicators and targets, where applicable, were defined for each outcome — immediate, intermediate, and final — and will be tracked on a yearly basis or every five years, depending on the indicator and outcome. Examples of performance indicators include: the annual percentage of regulatees who took advantage of compliance flexibilities, the annual percentage of total vehicles that are in compliance with the standards and the number of enforcement actions taken annually.

In addition, a compilation assessment will be conducted every five years starting in 2020 to gauge the performance of every indicator against the identified targets. This regular review process will allow Environment Canada to clearly detail the impact of the Regulations on the on-road heavy-duty vehicle sector as more and more low GHG-emitting vehicles enter the market, and to evaluate the performance of the Regulations in reaching the intended targets.

These performance indicators are available in the PMEP table of indicators, and make direct references to the outcomes listed in the logic model.

15. Contact

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