

TRUCKING DANGEROUS GOODS IN CANADA, 2004 to 2012

Sagal Searag, Gregory Maloney and Lawrence McKeown
Statistics Canada

Introduction

Recent events have heightened public awareness concerning the transportation of dangerous goods. While economic regulation of Canada's transportation sector has been reduced over the last 25 years, the movement of dangerous goods continues to be carefully regulated. Compared to other freight, shipments of explosives, gases, flammable liquids, flammable solids, oxidizing substances, poisonous and infectious substances, radioactive materials, corrosives and other hazardous wastes pose public safety and environmental risks.¹ The consequences of accidents or spills can be severe, particularly if shipments travel through population centres or fragile ecosystems.²

Regulations on the movement of dangerous goods can vary by jurisdiction but generally require accurate classification, appropriate means of containment, and correct marking, labelling and documentation. In Canada, federal legislation currently prohibits the transportation of certain high risk dangerous goods unless an Emergency Response Action Plan (ERAP) has been submitted and approved. The plan outlines how emergency response personnel will react to an accident and their overall capacity to respond. As dangerous goods are likely to remain a significant portion of the overall freight moved across the country, there is a recognized need to further enhance the monitoring of these shipments.

For instance, in June of 2014 Transport Canada amended the *Transportation of Dangerous Goods Regulations* to clarify the criteria for displaying safety marks.³ The regulation now requires safety marks to be displayed on trucks, rail cars and bulk containers

used to transport dangerous goods, identifying the type of goods and the nature of the risk posed. And the Transport of Dangerous Goods Directorate, an arm of Transport Canada, continues to administer an accident reporting requirement pursuant to Section 8.3 of the aforementioned *Regulations*. The accident reports are compiled using the Dangerous Goods Accident Information System (DGAIS) and made available to the public through Statistics Canada.⁴

Surface transportation (i.e., road and rail excluding pipelines) is estimated to move almost 95% of the total tonnage of dangerous goods in Canada with trucking accounting for the largest share.⁵ The possibility that accidents might occur at any time or any location between the origin and destination raises questions concerning the nature of these types of shipments. To provide some perspective, this study examines the dangerous goods transported by the Canadian for-hire trucking industry from 2004 to 2012, focusing on tonnage, types of goods and average distance per shipment.

Data and Methods

Statistics Canada's Trucking Commodity Origin and Destination Survey (TCOD) targets large (annual revenue > \$1.3 million) establishments in the Canadian for-hire trucking industry (North American Industry Classification System, 484). It excludes foreign-based trucking establishments operating in Canada and non-trucking establishments with their own fleets (i.e., private trucking). As such, TCOD estimates should be considered as a lower boundary of total trucking activity in Canada.⁶

Over the study period, the number of TCOD target establishments ranged roughly from 2,100 to 2,900; in 2012, 92% of 2,196 establishments responded to the survey. Statistics Canada interviewers visit each establishment and, using a systematic sample of shipping documents, record information on the origin and destination of shipments as well as the weight and type of goods. The coefficient of variation (CV) by weight was calculated at less than 5% for all types of shipments in 2012.

Commodities are classified to about 500 groups using the Standard Classification of Transported Goods (SCTG). In many cases, all commodities in a group are dangerous. In other groups, some are dangerous while others are not and an algorithm based on Transport Canada information is used to assign a likelihood that the shipment includes dangerous goods. In 2012, 97% of shipments by weight flagged as dangerous goods were from SCTG groups in which all goods are dangerous, such as Petroleum products. Shipments of Glues and prepared glues were considered as dangerous 18% of the time.

Increasing Tonnage

In 2012, the combined weight of all commodities moved by Canadian for-hire trucking establishments reached over 650 million tonnes, a record amount culminating from steady growth experienced following the 2009 economic downturn (Figure 1). A key portion of these shipments in 2012 consisted of dangerous goods at just over 107 million tonnes (17% of all goods), up from the 81 million tonnes (or 14%) trucked in 2004. This represents an increase of one-third (32%) since 2004, almost twice the rate of growth of the industry's overall shipments (17%) during this same period.

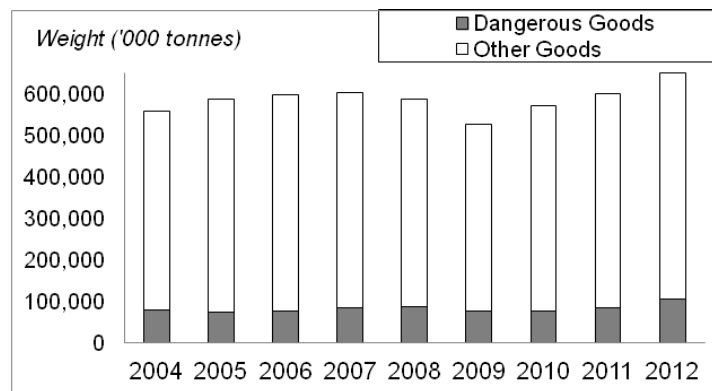


Figure 1: Total Goods Trucked by Type, Canada, 2004-2012
Source: Statistics Canada, Trucking Commodity Origin Destination Survey

Road versus Rail

Recent derailments have served to increase the level of scrutiny associated with the movement of dangerous goods by rail.⁷ However, a larger tonnage of dangerous goods is transported by truck. In 2012, the for-hire trucking industry handled approximately four times the dangerous goods by weight than did the mainline railways (Figure 2).⁸ In the United States, but including private trucking carriers, about 93% of the more than 1.6 billion tons of dangerous goods transported by surface moved by truck.⁹ Despite carrying more dangerous goods by weight, the consequences of an accident by truck are limited to a small number of trailers on a per truck basis. And moreover, the average shipments by truck involve shorter distances.¹⁰ Shipments of dangerous goods by truck and rail would be therefore more comparable on a per tonne-kilometre basis. However, it should also be noted that most accidents and spills of dangerous goods occur during handling rather than during actual transit.¹¹

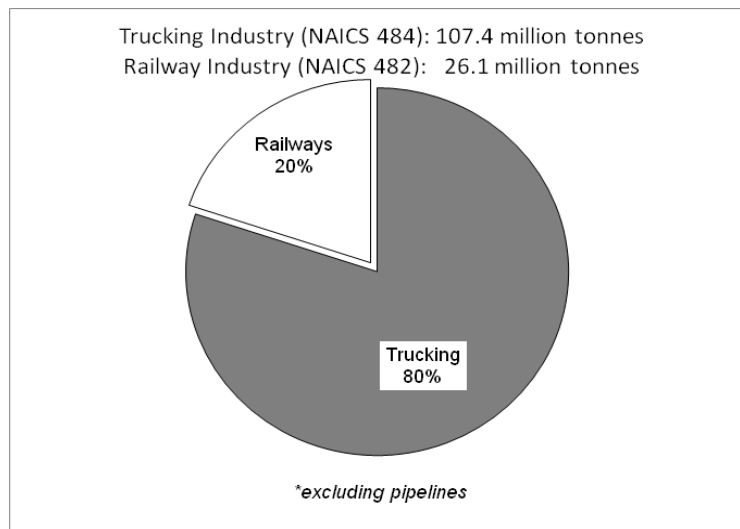


Figure 2: Dangerous goods by surface mode *, 2012
Source: Statistics Canada, TCO and Monthly Railway Carloadings Survey

The Top Four Dangerous Goods

Although the top four dangerous goods trucked by weight remained the same over the study period, they accounted for almost 80% of the total by 2012, up from 71% in 2004 (Figure 3). The increase was driven largely by the trucking of crude petroleum products, which more than doubled to reach over 40 million tonnes by 2012, accounting for more than one-third (38%) of the total. Over the same period, shipments of gasoline and aviation turbine fuel rose 11% to 26 million tonnes, while fuel oils increased 16% to 12.4 million tonnes and non-metallic minerals (such as sulphur) rose 43% to 5.2 million tonnes. Fertilizers and fertilizer materials (including nitric acid, sulphonic acids and ammonia), the fifth largest category of dangerous goods trucked in 2012 at 2.6 million tonnes, increased by approximately 180% over the study period.

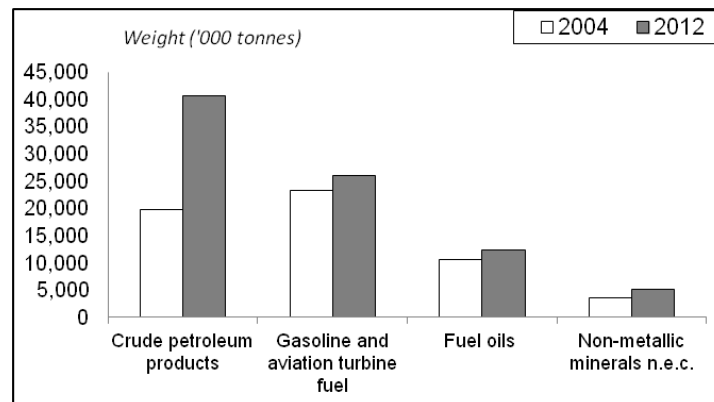


Figure 3: Top Four Dangerous Goods by Weight, 2004 and 2012
Source: Statistics Canada, Trucking Commodity Origin Destination Survey

Average Distance of Shipments

An interesting factor is the distance that dangerous goods travel to reach their destination. From 2004 to 2012, the average distance of all shipments trucked in Canada was estimated to have increased from 608 to 632 kilometres. However, shipments of dangerous goods declined from an average of 316 to 269 kilometres. This decline reflects an increase in energy related shipments, particularly crude petroleum products since, on average, shipments of these products travelled about one-third (35%) of the distance than did other dangerous goods (Table 1). A shorter average distance for trucking crude petroleum products is partly tied to extraction areas in Alberta and Saskatchewan and proximity to trans-loading facilities.

Table 1: Average distance trucked by type of shipment, Canada 2012

<i>Shipment type</i>	<i>kilometres</i>
Dangerous	
Crude petroleum products	110
Other dangerous goods	313
Non-dangerous Goods	665
All shipments	632

Source: Statistics Canada, Trucking Commodity Origin Destination Survey

For Alberta, the oil sands region in the north of the province has limited rail service and pipeline access. Consequently, heavy oil is often trucked to feeder pipelines which serve consolidation points in the Edmonton area for rail and further southeast for pipeline.¹² In 2012, shipments of crude petroleum products were trucked an average distance of 95 km in Alberta.

For Saskatchewan, although its Bakken region in the south of the province has extensive rail coverage, there has been insufficient feeder pipeline infrastructure. While the majority of crude is shipped out of the region by rail, it must first be trucked to a rail loading facility. On average, crude petroleum products were trucked a distance of 118 km in Saskatchewan.

Provincial Perspectives

By province of origin, Alberta accounted for almost half of the national total weight of dangerous goods transported by truck in 2012 (Figure 4). The province also experienced the largest growth, increasing by over 19 million tonnes from 2004 to 2012. Again, this growth was driven largely by crude petroleum products as shipments of these products that originated in Alberta more than doubled from almost 15 million tonnes in 2004 to over 30 million tonnes by 2012.

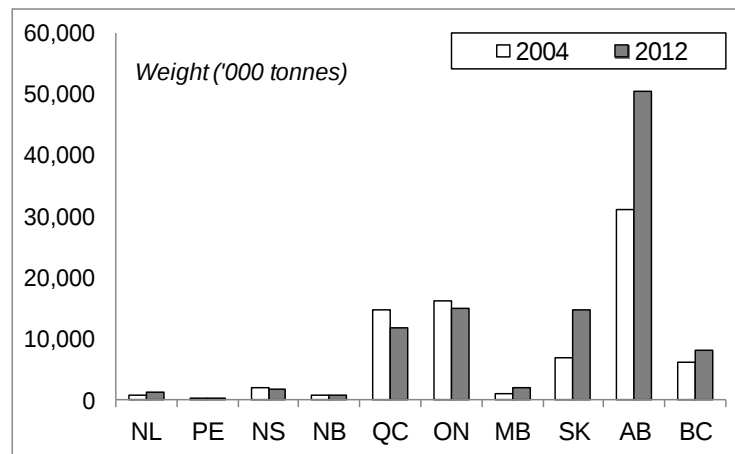


Figure 4: Dangerous Goods Trucked by Province, 2004 and 2012
Source: Statistics Canada, *Trucking Commodity Origin Destination Survey*

Similarly for Saskatchewan, crude petroleum products shipped by truck rose from about 5 million tonnes to over 9 million tonnes.

Combined with increased shipments of gasoline and aviation turbine fuel as well as fuel oils, fertilizers and fertilizer materials, the weight of dangerous goods shipped in the province reached 14.7 million tonnes by 2012. Over the study period, British Columbia and Manitoba experienced some growth in shipments while both Ontario and Quebec saw a decline in the tonnage of dangerous goods transported by truck.

Accidents

Despite the growth in the tonnage of dangerous goods shipped by the for-hire trucking industry from 2004 to 2012, there does not appear to have been a discernible increase in the number of dangerous goods reportable accidents by road either nationally or in Alberta during this same period (Figure 5).¹³ The total number of dangerous goods road accidents includes all reportable accidents occurring on roads and highways, including foreign carriers and private trucks as well as other types of vehicles.

Crude petroleum products are classified as Class 3 dangerous goods - flammable and combustible liquids - by the 1992 *Transportation of Dangerous Goods Act*. Despite the growth in the tonnage of crude oil products shipped by the for-hire trucking industry over the study period, there does not appear to have been a discernible increase in the number of Class 3 dangerous goods reportable accidents by road (Figure 6). However, this may not be the case for the total number of Class 3 dangerous goods reportable accidents.

Again, most accidents and spills of dangerous goods occur during handling rather than in transit. In 2012, the most frequent initiating events for Class 3 dangerous goods reportable accidents were 'improper loading, unloading and handling', 'overfills stemming from a miscalculation or valve closure failure' and 'loose or defective fittings, valves and coverings of the means of containment'. Further analysis of DGAIS¹⁴ data is required to determine the relationships among tonnage shipped and accidents for all modes of transportation.

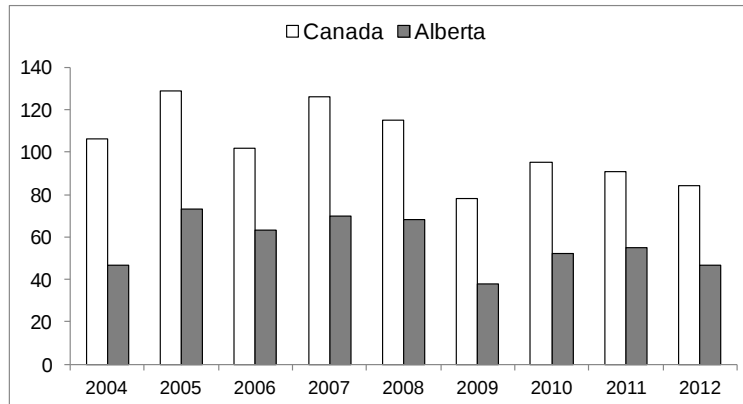


Figure 5: Dangerous Goods Reportable Accidents by Road, 2004-12

Source: Transport Canada DGAIS, Statistics Canada CANSIM 409-0002

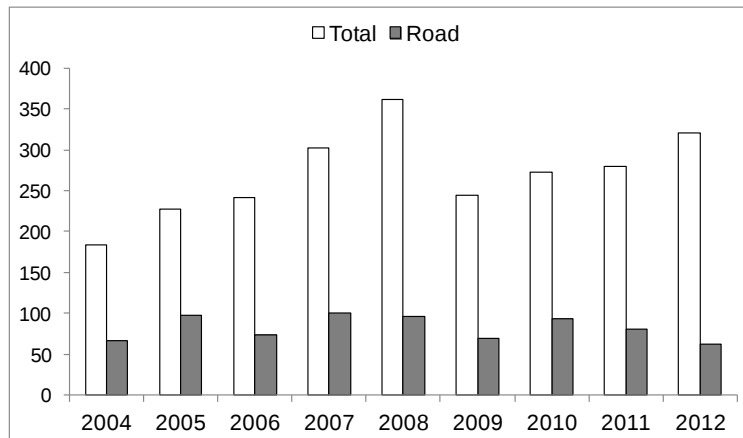


Figure 6: Dangerous Goods Reportable Accidents, 2004-12
Class 3 - Flammable and Combustible Liquids

Source: Transport Canada DGAIS, Statistics Canada CANSIM 409-0005

Summary

Recent events in Canada and elsewhere have heightened public awareness concerning the transportation of dangerous goods. In order to provide some perspective, this study examined dangerous goods transported by the Canadian for-hire trucking industry from 2004 to 2012. The study was based on data from the annual Trucking Commodity Origin and Destination Survey which excludes foreign-based trucking establishments operating in Canada and non-trucking establishments with their own fleets (i.e. private trucking). As such, these estimates should be considered as a lower boundary of total trucking activity in Canada.

The Canadian for-hire trucking industry moved 650 million tonnes of freight in 2012, of which almost 17% consisted of dangerous goods, up from 81 million tonnes (14% of the total) in 2004. During 2012, the for-hire trucking industry is estimated to have transported about four times the dangerous goods by weight than did the mainline railways. While quantity shipped is an important consideration in assessing the public safety and environmental risks, another is the type of commodity. Crude petroleum products accounted for the largest share of dangerous goods trucked in 2012 at over one-third (38%), up from one-quarter (25%) in 2004.

Further investigation is required to determine if this increase in the tonnage of dangerous goods transported by the Canadian the for-hire trucking industry from 2004 to 2012 had a discernible impact on the incidence of dangerous goods reportable accidents.

Endnotes

¹ Dangerous goods are defined by the *Transportation of Dangerous Goods Act, 1992* as products, substances or organisms in any of these nine classes. These goods are further classified from Packing Group I (great danger) to Packing Group III (minor danger).

² Estimated costs to clean-up the 2010 spill of diluted bitumen into Michigan's Kalamazoo River basin now exceed \$1-billion; De Souza, M. (2014), "The pipeline proposals feeding Harper's oil grid," *Power & Influence: The Business Issue*, 3 (3), Hill Times Publishing.

³ Government of Canada (2014), *Regulations Amending the Transportation of Dangerous Goods Regulations (Part 4, Dangerous Goods Safety Marks)*, P.C. 2014-684, June 12, 2014, SOR/2014-159, *Canada Gazette*, 148 (14), July 2, 2014.

⁴ See Transport Canada statistics, CANSIM Tables 409-0001 to 409-0010 (access from Statistics Canada at www.statcan.gc.ca/cansim).

⁵ Provencher, M. (2010), *The Movement and Handling of Dangerous Goods in Canada for the Year 2008*, Transport Canada, Transport Dangerous Goods Directorate, Ottawa.

⁶ For comparison, for-hire trucking establishments in the United States accounted for just 58% of dangerous goods trucked by weight in 2012, but averaged over 4.5 times the distance shipped.

⁷ For example, see Winter, J. (2014), Safety in Numbers: Evaluating Canadian Rail Safety Data, *SPP Communiqué*, 6 (2), University of Calgary, School of Public Policy.

⁸ The rail proportion is estimated from the Monthly Railway Carloadings Survey based on the U.N. dangerous good designation identified by Standard Transportation Commodity Codes for revenue-generated freight moved by the two mainline freight railways only.

⁹ U.S. Department of Transportation, Bureau of Transportation Statistics and U.S. Department of Commerce, U.S. Census Bureau, (2015), Hazardous Materials, 2012 Commodity Flow Survey (Draft, January), Washington.

¹⁰ In the United States, the average distance per hazardous material shipment by for-hire truck was 150 miles versus 808 by rail (2012 U.S. Commodity Flow Survey).

¹¹ According to Transport Canada, more than three-quarters (302 of 389) of the total number of reportable dangerous goods accidents in 2012 took place in facilities including terminals, ports, warehouses with the remainder occurring in transit (CANSIM Table 409-0001).

¹² Cairns, M. (2013), Crude Oil By Rail - Parts I and II: Potential for the Movement of Alberta Oil Sands Crude Oil and Related Products by Canadian Railways, Canadian Transportation Research Forum Proceedings (Halifax, June), 412-433.

¹³ The *Transportation of Dangerous Goods Regulations* require immediate reporting (and a 30 day follow-up) to Transport Canada of an accidental release of dangerous goods from a means of containment if the quantity is greater than a specified level by class. For example, in the case of Class 3 dangerous goods, the accident is reportable if the release exceeds 200 litres.

¹⁴ For example see, Bonvicini, S. and G. Spadoni (2005). Hazardous Material Transport Accidents: Analysis of the DGAIS Database. In *Environmental Health Risk II*, 331-140, WIT Press.