UNIVERSITY OF CALGARY

THE SCHOOL OF PUBLIC POLICY
SPP Communiqué

Volume 6 • Issue 2
April 2014

SPP Communiqués are brief articles that deal with a singular public policy issue and are intended to provide the reader with a focused, concise critical analysis of a specific policy issue.

The University of Calgary is home to scholars in 16 faculties (offering more than 80 academic programs) and 36 Research Institutes and Centres including *The School of Public Policy*. Under the direction of Jack Mintz, Palmer Chair in Public Policy, and supported by more than 100 academics and researchers, the work of The School of Public Policy and its students contributes to a more meaningful and informed public debate on fiscal, social, energy, environmental and international issues to improve Canada's and Alberta's economic and social performance.

SAFETY IN NUMBERS: EVALUATING CANADIAN RAIL SAFETY DATA

Jennifer Winter†

After the horrific and deadly train explosion at Lac-Mégantic, Que. in the summer of 2013, there are serious questions being raised publicly about the safety of Canada's rail-transport system. Unfortunately, Canada's public rail-safety data are currently in no shape to provide the answers to those questions.

When Canadians ask, as many have in recent months, whether the rail-transport system is "safe," they surely want to know whether the accident record is low — compared to other countries and to other forms of transport — and whether it has been improving or getting worse over time. Yet, the statistics that might provide the answers are worryingly inaccessible, sometimes conflicting, and in certain cases not available at all.

The inability to publicly monitor airline safety statistics would be considered unacceptable. Yet trains transporting volatile goods across Canada arguably expose entire communities, as in Lac-Mégantic, to potentially catastrophic dangers. How is it, then, that the Transportation Safety Board, Transport Canada and Statistics Canada do not even publicly report something as basic as the number of train trips made every year in Canada? Nor do their statistics distinguish between incidents and accidents involving passenger trains and those involving freight trains. And how is it that the total number of accidents in some years is reported differently by these various monitoring organizations?

If Canadians are, as it appears, destined to see increasing volumes of goods, specifically dangerous goods, transported by rail, it is that much more important that the federal government significantly improve the reporting of rail-safety data. It is not only vital that our railroads are safe; it is just as vital for the public to have information showing exactly how safe they are.

† *I am grateful to two anonymous referees and Trevor Tombe for their very helpful comments, and Brian Conger for excellent research assistance.*

INTRODUCTION

The train derailment and subsequent explosion in Lac-Mégantic, Que. on July 6, 2013 brought the danger of rail transportation to the forefront of public consciousness. Given the increased public awareness and scrutiny of the issue of dangerous-goods transportation by rail, an important question being asked is "how safe are Canadian railroads?" Put another way, the question is "how risky is it to transport dangerous goods by rail?" While basic statistics on the number of "accidents" and "incidents"[1] are not hard to find, those two questions are not necessarily easy to answer due to data limitations. This communiqué briefly reviews the available data on rail activity and finds them insufficient for evaluating how safe Canadian railroads are. The communiqué concludes with recommendations for improving the quality and accessibility of rail safety data so that these questions can be answered.

In response to recent derailments and fires/explosions of crude-oil-bearing trains, Transport Canada and the Minister have initiated new safety measures[2] and regulations.[3] Minister Raitt has also requested a review of the transportation of dangerous goods (TDG) in Canada and safety management systems by the Standing Committee on Transport, Infrastructure and Communities.[4] The committee has been asked to consider the following questions:

- What additional measures could be taken to strengthen TDG safety across all modes of transportation?
- How does Canada's TDG regime compare to that of the United States?
- Should the implementation of Safety Management systems be adjusted to provide a greater focus on the transportation of dangerous goods?

There is an established literature and well-developed methodologies for safety performance assessment; typically, these methods begin with assessing whether safety goals and objectives are clearly articulated, and then assess performance against these objectives.[5] Transport Canada's website has several levels of legislation on rail safety, including acts, regulations, rules, standards, guidelines and policies. A critical component of safety assessments is the availability of sufficient data to compare performance to the stated goals. In addition, one should also want to know the impact and economic cost of an accident for determining acceptable risk. This communiqué provides some insight to answering the questions posed to the Standing Committee by assessing whether publicly available data is sufficiently detailed to evaluate rail safety in Canada.

---

1 See the appendix for definitions.

2 Transport Canada, "Minister Raitt responds to Transportation Safety Board recommendations following Lac-Mégantic," statement January 23, 2014, http://news.gc.ca/web/article-en.do?mthd=advSrch&crtr.page=5&crtr.dpt1D=6695&nid=811029.

3 Transport Canada, "Transport Canada moves to further improve the safe transportation of dangerous goods," news release January 10, 2014, http://news.gc.ca/web/article-en.do?mthd=advSrch&crtr.page=6&crtr.dpt1D=6695&nid=808769.

4 Hon. Lisa Raitt, letter to the Standing Committee on Transport, Infrastructure and Communities, http://www.parl.gc.ca/Content/HOC/Committee/412/TRAN/WebDoc/WD6308134/412_TRAN_reldoc_PDF/412_TRAN_reldoc-e.pdf.

5 As an example, the OECD provides a guide to developing safety performance indicators: *Guidance on Developing Safety Performance Indicators Related to Chemical Accident Prevention, Preparedness and Response,* http://www.oecd.org/chemicalsafety/risk-management/41269710.pdf. An overview of different assessment methods is available in E. Sgourou et al., "Assessment of selected safety performance evaluation methods in regards to their conceptual, methodological and practical characteristics," *Safety Science* 48, 8 (2010): 1019-1025.

CANADIAN DATA

The year 2013 was an average year for train incidents (with 216 incidents) and accidents (1,066), with slightly more incidents than the 2008–2012 average (209) and slightly fewer accidents (1,070).[6] Including the Lac-Mégantic derailment, 2013 had 11 accidents with fire or explosion, 93 incidents with a dangerous-goods leak, 145 accidents involving dangerous goods, and four accidents with a dangerous-goods release.[7]

Table 1 displays basic accident and incident statistics from 1998 to 2013. There is a substantial amount of detail provided by these summaries, in terms of the breakdown of accidents and incidents by type. Accidents involving dangerous goods averaged 15 per cent of all accidents over the period, while accidents with a dangerous-goods release averaged just 0.4 per cent of all accidents.[8] However, incidents with a dangerous-goods leak accounted for 43 per cent of incidents on average. Accidents with fire or explosion were only two per cent of all accidents. Figure 1 plots the trends for certain categories.

TABLE 1: RAILWAY OCCURRENCES IN CANADA (1998–2012)

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Accidents	**1,075**	**1,129**	**1,054**	**1,432**	**1,332**	**1,352**	**1,413**	**1,476**	**1,371**	**1,320**	**1,179**	**1,043**	**1,076**	**1,023**	**1,011**	**1,066**
Main-track collisions	14	10	9	7	9	6	5	6	2	9	7	5	4	3	6	4
Main-track derailments	108	119	122	131	124	156	160	198	139	159	128	67	80	103	63	83
Crossing accidents	273	283	265	280	260	250	236	269	243	218	221	188	181	169	187	189
Non-main-track collisions	114	100	113	108	131	111	123	98	110	102	91	95	93	88	101	92
Non-main-track derailments	388	403	387	713	664	695	713	758	703	631	570	497	541	485	499	519
Collisions/Derailments involving track units	13	27	16	19	11	23	26	19	17	30	27	50	34	33	24	41
Employee/Passenger accidents	10	13	13	8	8	7	12	8	16	18	12	12	9	11	7	8
Trespasser accidents	78	95	78	80	73	65	100	83	91	101	73	72	81	67	74	57
Fires/Explosions	51	53	32	36	25	23	15	17	25	25	12	20	30	23	17	11
Other accident types	26	26	19	48	27	16	23	20	25	27	38	37	23	41	33	61
Accidents involving dangerous goods	**240**	**224**	**249**	**205**	**221**	**226**	**208**	**212**	**185**	**190**	**153**	**133**	**141**	**118**	**118**	**145**
Main-track derailments	25	19	30	17	25	38	37	32	18	35	23	11	13	21	6	12
Crossing accidents	8	8	12	7	6	3	11	15	5	6	4	3	7	1	4	5
Non-main-track collisions	56	48	50	40	48	37	44	44	41	41	33	32	26	20	21	26
Non-main-track derailments	136	133	149	128	129	139	106	112	109	100	84	81	88	71	86	97
Other accident types	15	16	8	13	13	9	10	9	12	8	9	6	7	5	1	5
Accidents with a dangerous goods release	**5**	**9**	**7**	**5**	**5**	**9**	**7**	**7**	**4**	**3**	**3**	**3**	**2**	**3**	**2**	**4**

6 Transportation Safety Board, "Monthly Rail Occurrence Statistics," December 2013, http://www.tsb.gc.ca/eng/stats/rail/2013-12/r2013-12-t1.asp.

7 Transportation Safety Board, "Monthly Rail Occurrence Statistics," December 2013, http://www.tsb.gc.ca/eng/stats/rail/2013-12/r2013-12-t1.asp.

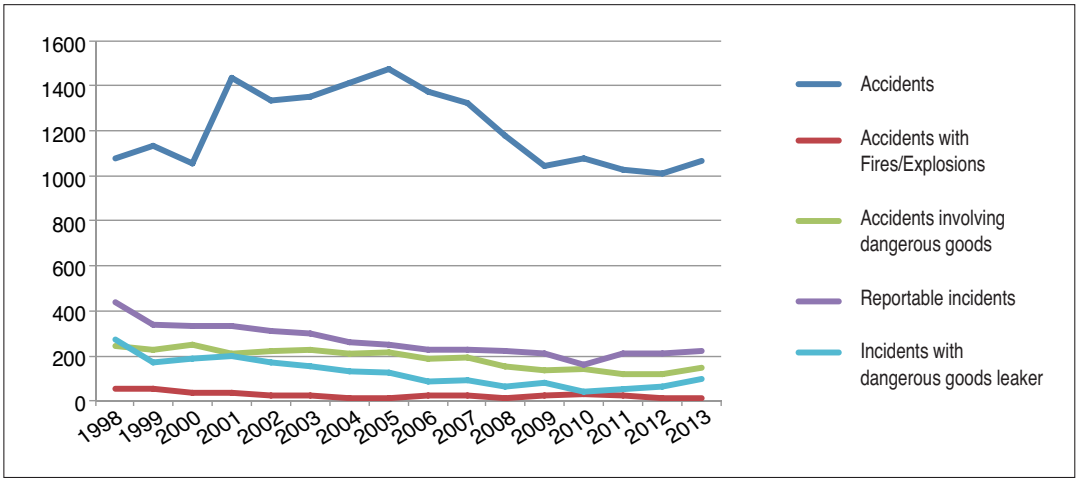
8 Accidents and incidents involving dangerous goods include occurrences where the train was not carrying dangerous goods but another vehicle involved in the occurrence — such as a tanker truck — was.

TABLE 1: RAILWAY OCCURRENCES IN CANADA (1998–2012) cont'd

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Reportable incidents	**438**	**333**	**330**	**329**	**308**	**294**	**257**	**245**	**220**	**223**	**216**	**207**	**160**	**204**	**204**	**216**
Dangerous goods leaker	272	167	188	194	167	150	131	123	82	88	64	78	40	51	63	93
Main-track switch in abnormal position	14	15	17	9	9	11	12	10	7	7	13	4	5	10	5	7
Movement exceeds limits of authority	107	115	102	101	99	102	95	91	101	106	111	106	102	118	120	95
Runaway rolling stock	20	15	9	10	18	13	11	16	12	13	16	11	5	15	9	10
Other reportable incidents	25	21	14	15	15	18	8	5	18	9	12	8	8	10	7	11

Source: Transportation Safety Board; Adapted from Table 1 in Rail Statistics, 2007, 2008, 2009, 2010, 2011, 2012.

FIGURE 1: SELECTED CATEGORIES OF RAILWAY OCCURRENCES (1998–2013)



Source: Transportation Safety Board; Adapted from Table 1 in Rail Statistics, 2007, 2008, 2009, 2010, 2011, 2012.

To answer the question "how safe are Canadian railroads?" one first needs to define what "safe" means. The most intuitive measure is the probability of an accident or incident occurring, or perhaps the probability of a derailment occurring. To find this, we would divide our chosen adverse occurrence by a measure of rail activity. For example, in the Transportation Safety Board's annual statistics, a number reported is main-track accidents per million main-track train miles (MMTTM). Train miles are the number of trains operated in a given year multiplied by the distance travelled. In 2012, there were 1.6 main-track accidents per million main-track train miles, and 80.1 million main-track train miles travelled.

This is a limited analysis in several respects. First, it only reports main-track accidents per MMTTM (million main-track train miles), while Table 1 shows non-main-track collisions and derailments are much more frequent. Second, the statistics reported in Table 1 do not distinguish between freight-train accidents and passenger-train accidents, which are very different classes of train.[9] Third, accidents per train mile are not directly comparable to other

[9] In 2009, the average number of cars per passenger train was 6.7, with a journey of 323 km per passenger ticket. In contrast, freight trains had on average 87 cars per train and the average haul length was 1,053 km. Source: Statistics Canada, CANSIM Table 404-0016.

modes of transportation.[10] An alternative to consider is accidents per tonne mile (or tonne km); this is the method used in the U.K. and the U.S.

Table 2 shows freight-train accident rates for several activity measures. A concern one should have in looking at Table 2 is that using these measures of activity to scale accident rates also obscures accident rates: if there are the same number of accidents in subsequent years, but train miles have increased, accident rates will appear better, though there was no absolute improvement in safety.

TABLE 2: MEASURES OF RAILWAY OCCURRENCE RATES

	Total Accidents	Accidents per				Main-track accidents per
		Million train kilometres	Thousand train hours	Million locomotive unit kilometres	Billion tonne kilometres	Million main-track train kilometres
1998	1,075	8.38	0.37	3.24	2.00	4.67
1999	1,129	8.89	0.39	3.75	2.02	4.83
2000	1,054	8.14	0.35	3.28	1.77	4.34
2001	1,432	11.16	0.48	4.58	2.43	4.99
2002	1,332	10.17	0.45	4.45	2.27	3.70
2003	1,352	10.33	0.44	4.45	2.22	4.18
2004	1,413	10.66	0.44	4.56	2.19	4.34
2005	1,476	10.82	0.45	4.65	2.19	4.67
2006	1,371	10.12	0.44	4.26	2.04	3.86
2007	1,320	9.97	0.41	4.21	1.95	4.83
2008	1,179	9.19	0.39	3.87	1.85	4.02
2009	1,043	9.64	0.44	4.04	1.82	3.70

Source: Author's calculations based on Statistics Canada, CANSIM Tables 404-0014 and 404-0015; Transportation Safety Board; Adapted from Table 1 in Rail Statistics, 2007, 2008, 2009.

The most important reason that the statistics in Table 2 provide only a limited analysis is that the aggregate statistic of accidents per million train miles, or million tonne km, ignores other contributing circumstances, such as season, origin and destination, tonnage carried, products carried, and average speed, all of which could affect the probability of an accident. For example, a train travelling from Calgary to Vancouver travels through much different geography than a train travelling from Calgary to Regina; all else being equal, this would affect the speed of the train and hence the probability of an accident.

It is possible to calculate a rough measure of the probability of an accident, under certain assumptions. Using the Transportation Safety Board's statistic of 1.6 main-track accidents per million main-track train miles in 2012, we know that there is one main-track accident per million main-track train kilometres. Based on this, if we think about a single train transporting all of Canada's rail cargo, the average distance between accidents is one million kilometres. Using this statistic, we can then calculate the probability of an accident occurring within a

[10] For example, a train can carry far more grain than can road vehicles, and so an equivalent volume of grain would require many more trucks.

given trip distance.[11] There is a 0.1 per cent chance a train has an accident within 1,000 km during a trip of at least 1,000 km, and a 63 per cent probability of a train travelling at least one million km in a single trip having an accident within one million km. Of course, this is a very rough measure, based on a single year, and does not include the accident rate for non-main-track activity, or other factors that can influence the probability of an accident occurring. Nor can we determine if trains with dangerous goods are more or less likely to have an accident relative to trains without dangerous goods cargo.

If one wanted to know the probability of a given train experiencing an accident, it would be impossible to determine using the currently available data. The Transportation Safety Board, Transport Canada and Statistics Canada do not publicly report the number of train trips in Canada. The best that is available is tonne km, train km or total train hours, but only up to 2009.[12] Average freight-train haul distances are reported,[13] so one could back out the average number of freight trains in a given year using train kilometres, and report accidents per average number of freight trains. However, this would overestimate accident rates, as the Transportation Safety Board does not distinguish between freight- and passenger-train accidents/incidents. Furthermore, as noted earlier, these data are only available to 2009, which is not very useful for evaluating current rail safety.

Compare this to publicly available data on airline travel available through the U.S. Bureau of Transportation Statistics: For every airline, there are data on flights by type of plane, origin and destination, including cause of delay, from 1987 to present, with a one-month delay. This sort of comprehensive data is what is required to adequately evaluate rail safety in Canada. The United States has comprehensive rail accident data; the Federal Railroad Administration Office of Safety Analysis has downloadable data including accident time, weather conditions, latitude and longitude, cars involved, and the determined cause, among other details. Presumably Canada's rail companies keep track of origin, destination, commodities carried, date of trip and whether the train was involved in an accident or incident for all train trips. Canada could become a world leader in transparency by requiring this reporting from the major rail companies and creating a public data portal.

OTHER ISSUES: DATA ACCESSIBILITY AND QUALITY

A centralized repository of data and statistics is an important part of evaluating research questions. The government of Canada could help, in a very basic way, by collating data available in public reports and making it available at the government's central data portal, data.gc.ca, or at a separate rail (or transportation) safety data portal.

---

[11] This assumes an exponential distribution for calculating the probability of an accident, and the single train is immediately repaired after a given accident.

[12] Source: Statistics Canada, CANSIM tables 404-0014, 404-0015 and 404-0016.

[13] Statistics Canada, CANSIM Table 404-0016.

Rail accident/incident data are available from three different government organizations: Statistics Canada, Transport Canada (TC), and the Transportation Safety Board (TSB). Statistics Canada produces tables on railway operations, freight and passenger transportation, and some accident data. Transport Canada produces an annual report on transportation in Canada, with an addendum that includes annual statistics on a variety of transportation subjects, including rail accident data. The Transportation Safety Board provides statistical summaries of railway occurrences; reports are available from 2007 to 2012, with monthly data for 2013 and 2014 (at the time of writing). The TSB also provides counts of federally regulated rail accidents and incidents, and occurrences and casualties by rail operator from 2003 to 2012.

The data from Statistics Canada are easy to access, manipulate and download. Transport Canada's data, however, are only in PDF form, which requires them to be laboriously translated into manipulable form. In addition, the reports from 2010, 2011 and 2012 are the only ones currently downloadable from the TC website; reports from 1996 through 2009 must be requested. In the reports themselves, only a 10-year span of data is reported, requiring researchers to utilize multiple reports to acquire historical data.

Data from the Transportation Safety Board are available in HTML or PDF form for the 2007 through 2011 annual statistical summaries; for 2012 they are only available in HTML form. The monthly data for 2013 and 2014 are available as HTML tables, PDF and the XLS format of Microsoft Excel; however, each month is a separate file. Currently, the monthly data report occurrences for 2013, 2012 and the 2008 to 2012 average.[14] Data from TSB also require laborious translation into a manipulable form.

These data can easily be made more accessible to the general public by creating one spreadsheet with all years of data, downloadable from Transport Canada's website, the Transportation Safety Board website, and data.gc.ca. A second option would be to create a rail safety or transportation safety data portal, similar to those in the U.S. and U.K.[15]

Surprisingly, there are differences in the railway-occurrence statistics reported by Transport Canada and the Transportation Safety Board. For example, the TSB reports fires/explosions as one category, while TC reports only fire, and does not report explosions. As another example, TC reports employee accidents and passenger accidents separately, while TSB aggregates them into one category. A third example: TSB utilizes the "other" category for accidents and incidents, while Transport Canada assigns a type to all occurrences reported. In addition, the total number of accidents reported by each organization differs in 2005 and 2006, and the number of incidents differs in 2006. This lack of consistency is concerning, as both organizations operate under the same legislation defining railway occurrences.

Rail-safety data from Statistics Canada are also different; they cover only accidents, not incidents, and dangerous goods or top commodities, rather than all accidents.

---

[14] It is not clear if the average is over all months in 2008–2012, or if it is the average for the month of the report for 2008–2012. This is when looking at the 2013 monthly data; the 2014 monthly data reports the 2009 – 2013 average.

[15] In the U.S., the Federal Railroad Administration's Office of Safety Analysis operates a data portal with downloadable and query-able rail safety data. In the U.K., the Office of Rail Regulation operates a data portal. In addition, the Rail Safety and Standards Board (RSSB) operates the Safety Management Information System that collects railway safety records for Great Britain; the RSSB produces annual reports and all data are available for download.

An additional area of concern is that the definitions of accident and incident, as defined by the Transportation Safety Board and reported in the appendix, are somewhat broad and not entirely clear to a non-expert. While it is important to have broad definitions in order to capture as many situations as possible, based on the definitions it is difficult to determine whether the derailment of a train not carrying dangerous goods is classified as an accident or an incident. Based on the definitions, a derailment must be coupled with either carrying passengers or transporting dangerous goods to be classified as an accident, though the derailment could be classified as an accident if the train "sustains damage that affects its safe operation" or "causes damage to the railway." It is not clear what type of incident a derailment of a non-dangerous-goods train falls under.

RECOMMENDATIONS

In addition to knowing (or being able to evaluate) how safe Canadian railroads are in the general sense, another key issue is being able to accurately measure changes in safety over time, and compare these changes to railways in other jurisdictions. Or, one may be interested in comparing transportation of specific products by rail to other modes of transportation. A recent report published by the Manhattan Institute compared modes of transportation crude oil, natural gas and petroleum products, and finds pipelines are safer than road or rail.[16] Similar analysis would be useful for Canada, but the current state of the data makes this challenging.

There are simple steps the federal and provincial governments can take to make answering the questions posed at the start of this communiqué possible. These are:

1. The government of Canada should take steps to develop a transportation data portal that consolidates the data on rail, road, pipeline, marine and air transportation.
2. Require Canada's main rail companies to report detailed trip information to Transport Canada, which is then available to the public through a data portal.
3. Distinguish between freight and passenger trains in current accident and incident statistics.
4. Develop consistent standards of reporting railway occurrences between Statistics Canada, Transport Canada and the Transportation Safety Board, to ensure data quality.
5. Clarify what situations lead to classification as an accident versus an incident.

Given that Minister Raitt has committed to reviewing rail safety and the transportation of dangerous goods in Canada, an important step the government can take is improving the quality of data available for assessing transportation safety. Making rail safety data more transparent and accessible at a finer level of detail can only improve policy and safety, something all Canadians can be in favour of.

---

[16] Diana Furchtgott-Roth, "Pipelines Are Safest for Transportation of Oil and Gas," Manhattan Institute for Policy Research, Issue Brief No. 23 (June 2013).

APPENDIX: REPORTABLE RAILWAY OCCURENCES[17]

A "railway occurrence" is:

1. Any accident or incident associated with the operation of rolling stock on a railway, and
2. Any situation or condition that the Transportation Safety Board has reasonable grounds to believe could, if left unattended, induce an accident or incident.

A "reportable railway accident" is an accident resulting directly from the operation of rolling stock, where:

1. a person sustains a serious injury or is killed as a result of:
   a. being on board or getting off the rolling stock, or
   b. coming into contact with any part of the rolling stock or its contents, or
2. the rolling stock:
   a. is involved in a grade-crossing collision,
   b. is involved in a collision or derailment and is carrying passengers,
   c. is involved in a collision or derailment and is carrying dangerous goods, or is known to have last contained dangerous goods, the residue of which has not been purged from the rolling stock,
   d. sustains damage that affects its safe operation, or
   e. causes or sustains a fire or explosion, or causes damage to the railway, that poses a threat to the safety of any person, property or the environment.

A "reportable railway incident" is an incident resulting directly from the operation of rolling stock, where:

1. a risk of collision occurs
2. an unprotected main track switch is left in an abnormal position
3. a railway signal displays a less restrictive indication than that required for the intended movement of rolling stock
4. an unprotected overlap of operating authorities occurs
5. a movement of rolling stock exceeds the limits of its authority
6. there is runaway rolling stock
7. any crew member whose duties are directly related to the safe operation of the rolling stock is unable to perform the crew member's duties as a result of a physical incapacitation that poses a threat to the safety of any person, property or the environment, or
8. any dangerous goods are released on board or from the rolling stock.

---

[17] Source: Transportation Safety Board, "Federally regulated railway accidents and incidents, by train operator, 2003 – 2012," http://www.tsb.gc.ca/eng/stats/rail/r13d0054/r13d0054.asp.

"Serious injury" is an injury that is likely to require admission to a hospital.

An accident is considered to have dangerous-goods involvement if any car in the consist carrying (or having last contained) a dangerous good derails, strikes or is struck by any other rolling stock or object. It does not mean that there was any release of any product. Also included are crossing accidents in which the motor vehicle involved (e.g., a tanker truck) is carrying a dangerous good.

About the Author

Jennifer Winter, (PhD) is a Research Associate in the Energy and Environmental Policy at The School of Public Policy. Her research is focused on the effects of government regulation on the development of natural resources. Jennifer has authored several research papers for The School, including three on Canadian energy literacy. Prior to joining The School, she worked at Human Resources and Skills Development Canada in Ottawa, analysing Canadian labour markets.