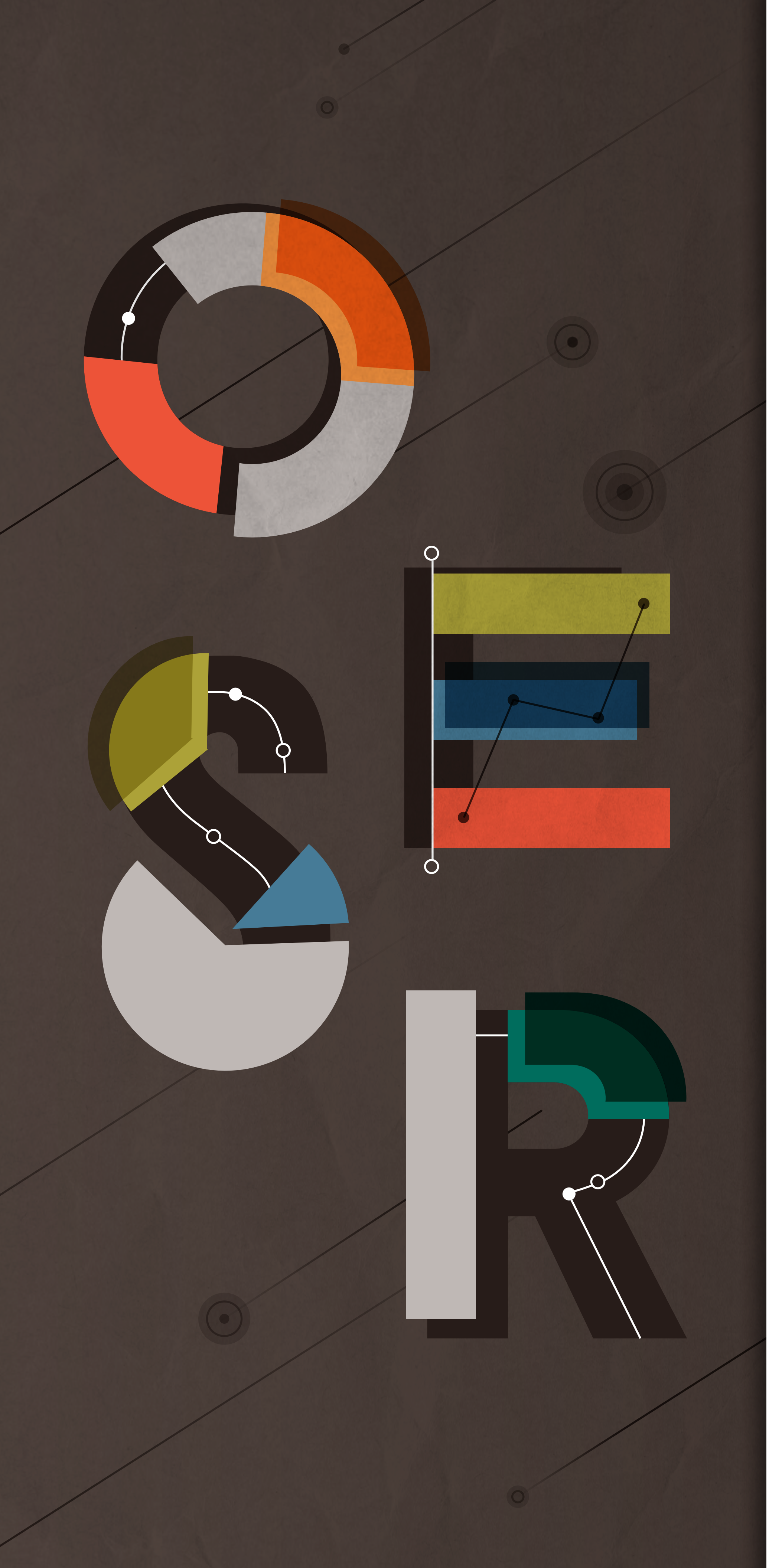


Electrical Safety Authority

Ontario Electrical Safety Report

2018

Contents

A Message from the Electrical Safety Authority's Chief Public Safety Officer

The only document of its kind in Canada and one of the few in the world, the Ontario Electrical Safety Report (OESR) presents the state of electrical safety in the province every year. The OESR is recognized as a standard of rigorous safety reporting; its comprehensive compendium of data and analysis provides the touchstone in the efforts to make Ontario a continuously safer place to live, work, and play free from electrical harm.

At the ESA, we never forget that behind each statistic, there is a human story. This story may be a serious injury, the loss of homes due to catastrophic fires, or a tragic death due to electrical contact. It is imperative that there is a consistent and documented source of electrical harm data, so we can anticipate and ultimately prevent these events.

Overall, the 2018 OESR shows a downward trend in electrical fatalities and electrical injuries in Ontario. But there is still more work to do. In 2018, there were two fatalities and one critical injury due to personally modified electrical products, and non-occupational deaths surpassed occupational deaths. Overhead powerline contacts continue to be reported, including contacts resulting in powerline fatalities. We need to take the same safety precautions when dealing with electricity at work and when we are at home. Electricity is unforgiving, and we cannot forget its lethal nature. Hospital data tell us that when electrical injuries occur, they are severe and serious in nature if not fatal.

This report is possible only through the cooperation and participation of the Office of the Coroner, Ministry of Labour, the Office of the Fire Marshal and Emergency Management, the Canadian Institute of Health Information, and the Workplace Safety and Insurance Board of Ontario. Thank you to all who helped contribute to the report's content. This collaboration translates into an electrically safer Ontario, protecting consumers and strengthening public safety.

My appreciation and gratitude to the electrical contractors, utility line crews, first responders, product manufacturers, and electrical inspectors. Thank you for all you do, every day, to keep Ontarians safe from electrical harm.

I would also like to thank the team at the ESA who consolidates, analyzes, and provides this report to the safety community at large. I am proud of the ESA's commitment to evidence-based decision-making.

Dr. Joel R.K. Moody
Chief Public Safety Officer,
Electrical Safety Authority

ELECTRICAL-RELATED FATALITIES AND INCIDENTS OVER THE PAST TEN YEARS

(2009–2018)

137 ELECTRICAL-RELATED FATALITIES

54 Electrical-related Fatalities

83 Fire Fatalities

Electrical-related Fatalities

2009–2013: 28 → 2014–2018: 26 → **7%** decrease

Utility-related Deaths

Accounted for **50%** of all electrical-related fatalities in the past ten years

Deaths from Powerline Contact

2009–2013: 11

2014–2018: 8

Occupational Deaths

Outnumber non-occupational deaths by a ratio of **2:1**

Occupational Deaths

2009–2013: 21

2014–2018: 12

Non-occupational

The five-year rolling average rate of fatalities has increased from **0.11 per million** (2009–2013) to **0.20 per million** (2014–2018).

AN INCREASE OF **181%**

Fire Fatalities and Events

2008–2012 → 2013–2017 → **3%** decrease in the five-year rolling average rate in fire fatalities

Cooking Fires

Most common type of fire with electricity as the ignition source

Number of Cooking Fires

2013: 774

2017: 699

10% decrease

Electrical Distribution Fires

Number of Electrical Distribution Fires

2013: 483

2017: 422

13% decrease

Priority Issues

Over **70%** of all electrical-related injuries and fatalities occur in four specific areas:

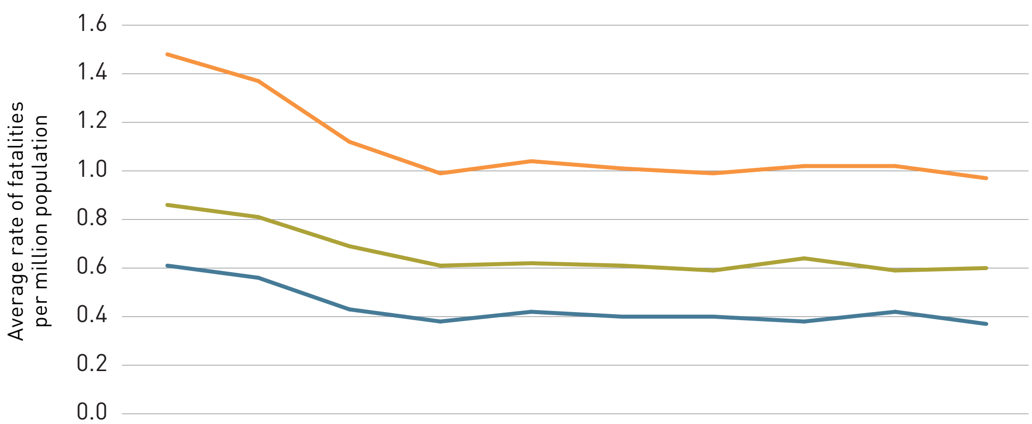
1. Powerline contact
2. Electrical trade workers
3. Misuse of electrical products and unapproved/counterfeit products
4. Electrical infrastructure fires

Executive Summary

The Ontario Electrical Safety Report (OESR) is produced by the Electrical Safety Authority (ESA) to provide a comprehensive perspective of electrical fatalities, injuries, and incidents in Ontario. Data presented in this report have been compiled from multiple sources, investigations, and root-cause analyses. Information on potential electrical risks and high-risk sectors are provided. This report is used by the ESA and others to better understand the dynamics of electrical safety and to encourage the development of initiatives to improve the status of electrical safety in the province.

Over the past ten years (2009–2018), there has been a downward trend in the total rate of electrical-related fatalities. While electrocution and burn fatalities have continued to decrease when compared to the previous year, electrical fire fatalities (where the ignition source was identified to be electrical) have remained similar to the previous year. Progress has been made to reduce the number of fatalities and injuries, yet the causes and contexts of serious incidents remain the same. Concerted efforts remain essential for rates to continue to decrease.

FIVE-YEAR ROLLING AVERAGE OF ALL ELECTRICAL-RELATED FATALITIES IN ONTARIO, 2005–2018



Five-year period	2005–2009	2006–2010	2007–2011	2008–2012	2009–2013	2010–2014	2011–2015	2012–2016	2013–2017	2014–2018
Electrical fire fatalities	0.86	0.81	0.69	0.61	0.62	0.61	0.59	0.64	0.59	0.60*
Electrocution and burn fatalities	0.61	0.56	0.43	0.38	0.42	0.40	0.40	0.38	0.42	0.37*
Total electrical-related fatalities	1.48	1.37	1.12	0.99	1.04	1.01	0.99	1.02	1.02	0.97*

**Preliminary data subject to change*

Source: ESA, Coroner and OFMEM records

Electrical-related Fatalities

In the past ten years, there were 137 electrical fatalities in Ontario. From 2009 to 2018, 54 people have died from electrocution (non-intentional death caused by contact with electricity) or by the effects of electrical burns, and 83 have died as a result of electrical fires (where the ignition fuel was identified as electricity and/or the ignition source was identified as electrical distribution equipment). In comparison, the previous ten-year period from 2008 to 2017 reported 54 deaths from electrocutions and burns, and 81 fire deaths where the ignition source was identified as electrical. The trend rate of electrical-related fatalities continues to decrease.

Electrocutions and Electrical Burn Fatalities

Below are the five-year rolling average rates of electrocutions and electrical burn fatalities, comparing the two most recent five-year periods:

Five-year period	
2009–2013	• 28 electrical-related fatalities • Five-year rolling average of 0.42 per million population
2014–2018	• 26 electrical-related fatalities • Five-year rolling average of 0.37 per million population

Utility-related electrocutions have accounted for 50% of all electrical-related fatalities in the past ten years:

Five-year period	
2009–2013	• 39% of all electrical-related fatalities (11/28) were from powerline contact
2014–2018	• 31% of all electrical-related fatalities (8/26) were from powerline contact

In the past ten years, occupational electrical-related fatalities continue to outnumber non-occupational fatalities by a ratio of 2:1. However, the most recent five-year period has seen an increase of non-occupational electrical-related fatalities.

Five-year period	
2009–2013	• 75% of electrical-related fatalities (21/28) were occupational
2014–2018	• 46% of electrical-related fatalities (12/26) were occupational

Electricians and apprentice electricians accounted for 15% of occupational electrical-related fatalities between 2009 and 2018 as they were critically injured on the job when working on energized electrical panels or Ballasts/347V lighting.

The non-occupational electrical-related fatality rate in 2018 has increased to 0.28 per million population compared to a rate of 0.21 per million population in 2017. The five-year rolling average rate also reflects this observation:

Five-year period		
2009–2013	• Five-year rolling average of 0.11 per million population	Rate increase of 181%
2014–2018	• Five-year rolling average of 0.20 per million population	

Fire Fatalities and Events

The rate of electrical fire fatalities (where the ignition fuel was identified as electricity and/or the ignition source was identified as electrical distribution equipment) has slightly decreased when comparing the five-year rolling average in 2008–2012 and 2013–2017. In the most recent five-year period, this rate has decreased 3% when comparing between 2008–2012 and 2013–2017.

The number of structure fires where electricity was identified as the fuel of the ignition source has decreased by 9% between 2008 and 2017.

Cooking-related fires continue to be the most common type of fire where electricity was the fuel of the ignition source:

- In 2013, there were 774 cooking equipment fires.
- In 2017, there were 699 cooking equipment fires (a decrease of 10%).

Electrical distribution equipment fires are fires from electrical wiring, devices, or equipment in which its primary function is to carry current from one location to another (e.g., wiring, extension cords, terminations, electrical panels, and appliance cords) with electricity as the fuel of the ignition source. This type of fire has slightly decreased over the past five years:

- In 2013, there were 483 electrical distribution equipment fires.
- In 2017, there were 422 electrical distribution equipment fires (a decrease of 13%).

Priority Issues

The ESA uses incident data from the OESR to identify areas that present the greatest risk to Ontarians, to monitor changes in incidence, and to identify emerging risks and trends.

Based on the data collected in the past ten years, the ESA has identified that the majority of electrical injuries and fatalities occur in the following specific areas. These areas have been identified as priorities for reducing electrical fatalities, serious injuries, damage, and loss in Ontario:

- Powerline contact while working accounted for 33% of all occupational electrical fatalities between 2009 and 2018.
- Electrical trade workers accounted for 21% of all occupational-related fatalities between 2009 and 2018. There is at least one critical injury to an electrical trade worker each year. Safety incidents tend to be associated with unsafe work practices.

- Non-occupational electrical injuries[1], identified from emergency department visits in Ontario, have decreased 12% from 2013 to 2017; however, the severity of these visits has remained relatively constant over the past five years.
- Misuse of electrical products and unapproved or counterfeit products account for a significant number of safety reports.
- The ESA defines electrical products as appliances, cooking equipment, lighting equipment, other electrical and mechanical equipment, and processing equipment. Data from the Office of the Fire Marshal and Emergency Management (OFMEM) show that the five-year rolling average for electrical product structure-loss fires (where electricity was identified as the fuel source) between 2008–2012 and 2013–2017 has decreased by 17%.
- An average of 1,349 electrical loss fires (where ignition sources were fuelled by electricity) occurred in residential structures in the past five years and resulted in a minimum of seven fatalities annually.

ESA Initiatives

Based on the information collected from the OESR, the ESA introduced a strategic plan (Harm Reduction Strategy 2.0) in 2015 to focus on addressing those harms that represent the majority of incidents and fatalities. The ESA is working towards a goal of a 20% reduction in electrical fatality and critical injury rate between 2015 and 2020. Additional details on the ESA's efforts can be found at *www.esasafe.com.*

The ESA cannot reach its goal without the significant work and support of its partners and stakeholders within the electrical safety system. We would like to acknowledge:

- those who generate and distribute electricity;
- electrical equipment manufacturers;
- standards organizations;
- safety organizations;
- installers of electrical equipment;
- educators;
- facility owners;
- injury response and treatment providers;
- government;
- researchers;
- injury prevention specialists;
- safety regulators and worker safety advocates; and
- those who are end users of electricity.

Working together, we seek to reduce the number of electrical fatalities, injuries and fires with the ultimate vision of "An Ontario where people can live, work, and play safe from electrical harm."

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[1] Non-occupational injuries were identified and calculated from emergency department visits data based on 'Responsibility for payment' code.

1.0 Purpose of This Report

This is the 18th report on the state of electrical safety in Ontario. It summarizes electrical incidents, electrical-related fatalities, injuries of an electrical nature, and death, injuries, and damage caused by fire incidents identified by the Office of the Fire Marshal and Emergency Management (OFMEM), as well as fires and fire fatalities identified by local fire departments where electricity was where electricity was identified as the ignition fuel and/or electrical distribution equipment was identified as the ignition source.

The purpose of this report is to provide stakeholders within the broad electrical safety system with an update and a longitudinal perspective of electrical safety in Ontario. Those stakeholders include:

- electrical utilities and those organizations that generate, transmit, and distribute electricity;
- organizations that design, manufacture, distribute, and supply electrical products;
- electrical contractors who install, repair, and maintain electrical wiring installations and products in our homes, workplaces, and public spaces;
- regulators and various levels of government that write policies and regulations to protect public safety;
- Canadian and international organizations that develop standards for electrical installation and products;
- academic and commercial organizations that focus on safety research and development;
- organizations, such as insurance companies, that create policies that drive organization and consumer behaviour to reduce risk;
- health care providers, workplace and community-based safety organizations, and education and training organizations that provide public communication and increase hazard-mitigation skills and awareness;
- consumers who purchase electrical products and use and rely on electricity every day in their homes, workplaces, and public spaces;
- and more.

All of these organizations have an important role in contributing to and improving electrical safety in Ontario.

This report intends to educate and inform members of the electrical safety system by identifying key electrical safety risks. This information can be used to develop and improve standards, identify areas for continued safety research, influence the development of workplace and community-based safety programs, and lead to improved training, education, and communication programs.

1.1 Role of the Electrical Safety Authority

The Electrical Safety Authority (ESA) is an administrative authority acting on behalf of the Government of Ontario with specific responsibilities under Part VIII of the *Electricity Act, 1998*, and the *Safety and Consumer Statuses Administration Act, 1996.* As part of its mandate, the ESA is responsible for administering regulation in four key areas:

- Ontario Electrical Safety Code (Regulation 164/99);
- Licensing of Electrical Contractors and Master Electricians (Regulation 570/05);
- Distribution Safety (Regulation 22/04); and
- Product Safety (Regulation 438/07).

The ESA operates as a private, not-for-profit corporation. Funding derives from fees for electrical oversight, safety services, and licensing of electrical contractors and master electricians. Activities include:

- ensuring compliance with regulations;
- investigating fatalities, injuries, and fire losses associated with electricity;
- identifying and targeting leading causes of electrical risk;
- promoting awareness, education, and training on electrical safety; and
- engaging with stakeholders to improve safety.

1.2 Case Studies

This report features several case studies of the ESA's root-cause investigations.

The ESA conducts these investigations on select and serious incidents (especially those that include fatalities, critical injuries, and/or serious fires) in order to determine the underlying root causes. The lessons learned from these investigations help to prevent future incidents and fatalities.

The ESA's investigations go beyond compliance with any code, regulation, or standard, and are not only limited to electrical safety dimensions, but also examine occupational health and safety and the role of the integrated safety infrastructure.

Root-cause investigations assess both the events leading up to the incident and the surrounding conditions, and the events or conditions that went wrong and contributed to the incidents.

The case studies presented have been modified to protect the privacy of the individuals involved. Details from case studies for fire-related incidents have been generously provided by the OFMEM.

2.0 Electrical-related Fatalities and Injuries

2.1 Electrocutions and Electrical Burn Fatalities

Electrocution occurs when a person is exposed to a lethal amount of electrical energy.

To determine how contact with an electrical source occurs, characteristics of that source before electrocution (pre-event) must be evaluated.

For death to occur, the human body must become part of an active circuit with an electric current that is capable of over-stimulating the nervous system and/or causing damage to internal organs. The extent of injuries depends on the current's magnitude (measured in amperes (Amps)), the path in which the current travels through the body, and the duration it flows through the body (event). The resulting damage to the human body and the emergency medical treatment ultimately determine the outcome of the energy exchange (post-event) (National Institute for Occupational Safety and Health, 1991).

There were 54 electrical-related fatalities reported in Ontario in the ten-year span between 2009 and 2018, which was the same as the period between 2008 and 2017. The majority of the electrical-related fatalities occurred in the Greater Toronto Area (Toronto, Durham, Halton, Peel, and York regions) between 2009 and 2018.

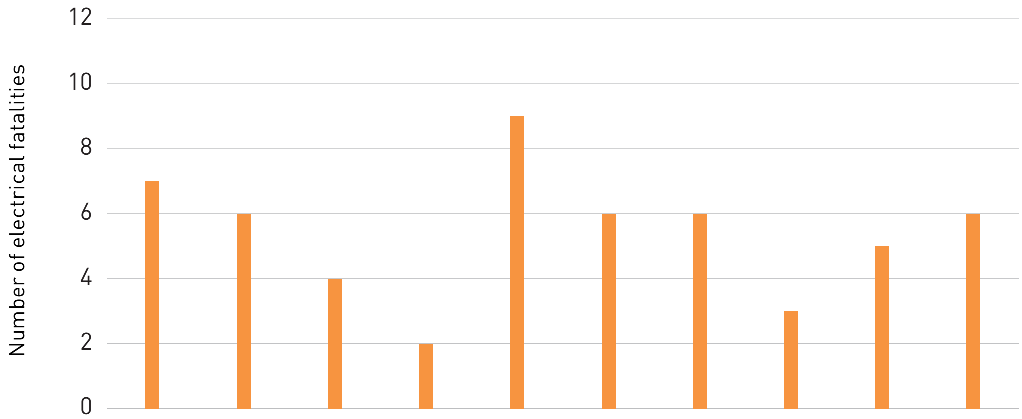
By age group, individuals aged 20–39 years accounted for the largest share of fatal injuries (38%), followed by individuals 40 to 59 years of age (34%). The majority of electrical fatalities (59%) occurred between the months of June and October.

The five-year rolling average rate of electrical fatalities has decreased by 12% when comparing 2009–2013 (0.42 per million population) and 2014–2018 (0.37 per million population). Powerline fatalities have also decreased: when 2009–2013 and 2014–2018 were compared, there was a 47% decrease in the five-year rolling average rate of powerline electrocutions.

Residential (46%), industrial (19%), and utility (15%) settings were the most common places for electrical-related fatalities between 2014 and 2018.

The five-year rolling average rate of occupational electrical-related fatalities per labour force has decreased 53% when comparing 2009–2013 to 2014–2018. Conversely, the five-year rolling average rate of non-occupational electrical-related fatalities per million population has increased by 181% between the same time periods.

1 NUMBER OF ELECTRICAL-RELATED FATALITIES IN ONTARIO, 2009–2018

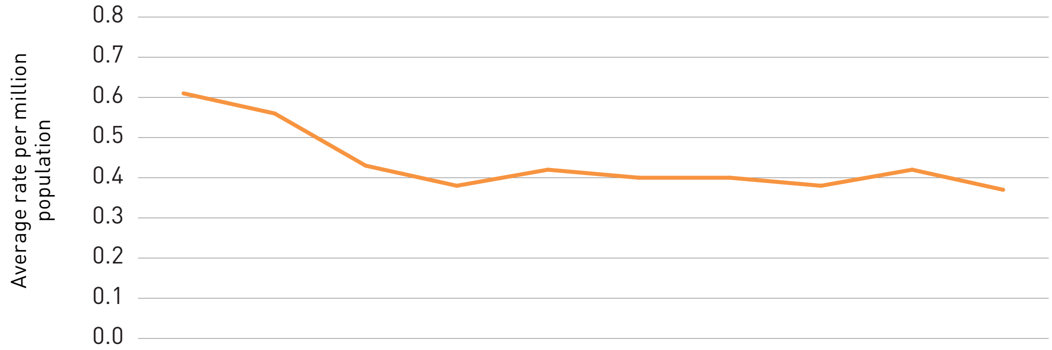


Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Number of electrical fatalities	7	6	4	2	9	6	6	3	5	6

Source: ESA and Coroner records

Conclusion
The number of electrical-related fatalities in 2018 increased by one when compared to 2017; however, there has been a **33%** reduction since 2013 (the year with the highest number of fatalities reported in the most recent ten-year period).

2 FIVE-YEAR ROLLING AVERAGE RATE OF ELECTRICAL-RELATED FATALITIES IN ONTARIO, 2005–2018

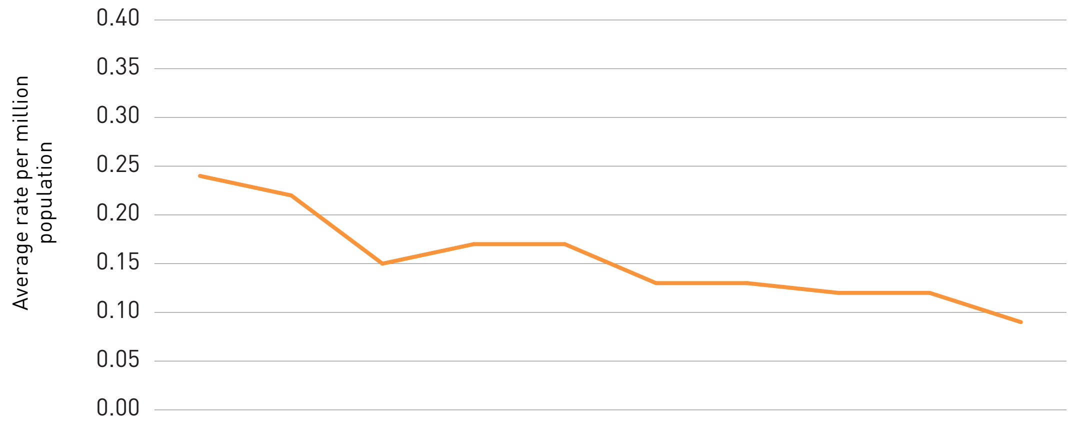


Five-year period	2005–2009	2006–2010	2007–2011	2008–2012	2009–2013	2010–2014	2011–2015	2012–2016	2013–2017	2014–2018
Rate of electrical-related fatalities (per million population)	0.61	0.56	0.43	0.38	0.42	0.40	0.40	0.38	0.42	0.37

Source: ESA and Coroner records

Conclusion
The rate of electrical-related fatalities has decreased when compared to the previous time period of 2013–2017. Additionally, there has been a **12%** decrease when comparing the average rate at 2009–2013 and 2014–2018.

3 FIVE-YEAR ROLLING AVERAGE RATE OF POWERLINE FATALITIES IN ONTARIO, 2005–2018

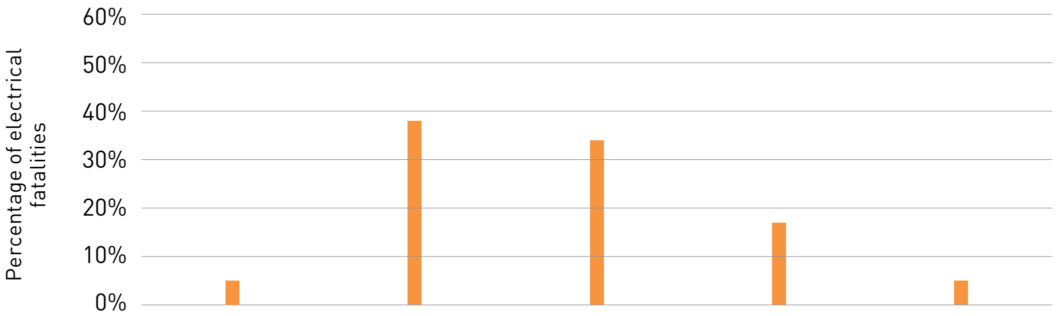


Five-year period	2005–2009	2006–2010	2007–2011	2008–2012	2009–2013	2010–2014	2011–2015	2012–2016	2013–2017	2014–2018
Rate of powerline fatalities (per million population)	0.24	0.22	0.15	0.17	0.17	0.13	0.13	0.12	0.12	0.09

Source: ESA and Coroner records

Conclusion
There has been a **47%** reduction when comparing the five-year rolling average rate of powerline fatalities at 2009–2013 and 2014–2018.

4 PERCENTAGE OF ELECTRICAL-RELATED FATALITIES BY AGE GROUP IN ONTARIO, 2009–2018

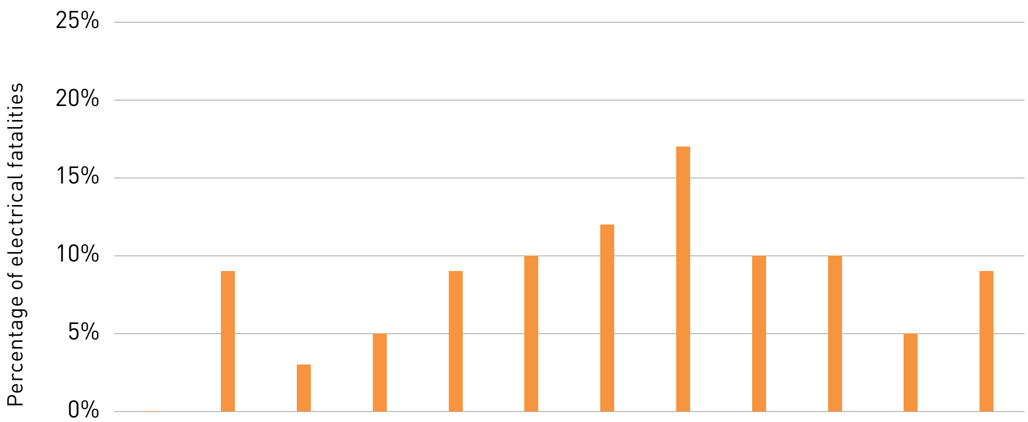


Age	0–19	20–39	40–59	60+	Unknown
Percentage	5%	38%	34%	17%	5%

Source: ESA

Conclusion
In the last ten years, **38%** of the electrical-related fatalities occurred among the 20–39 age group, followed by the 40–59 age group (**34%**).

5 PERCENTAGE OF ELECTRICAL-RELATED FATALITIES BY MONTH IN ONTARIO, 2009–2018

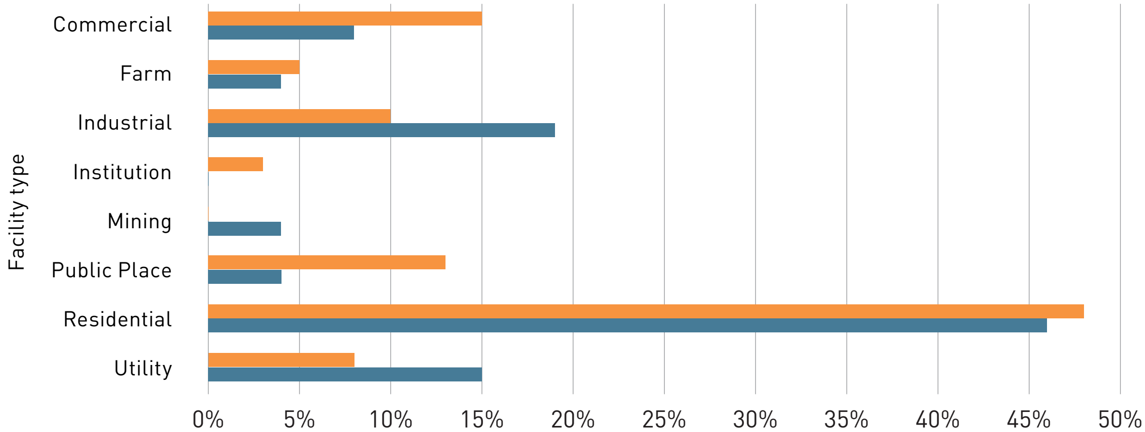


Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Percentage	0%	9%	3%	5%	9%	10%	12%	17%	10%	10%	5%	9%

Source: ESA

Conclusion
In the last ten years, August was the most common month for electrical fatalities to occur. No fatalities were reported for the month of January.

6 PERCENTAGE OF ELECTRICAL FATALITIES BY FACILITY TYPE IN ONTARIO, 2009–2013 AND 2014–2018

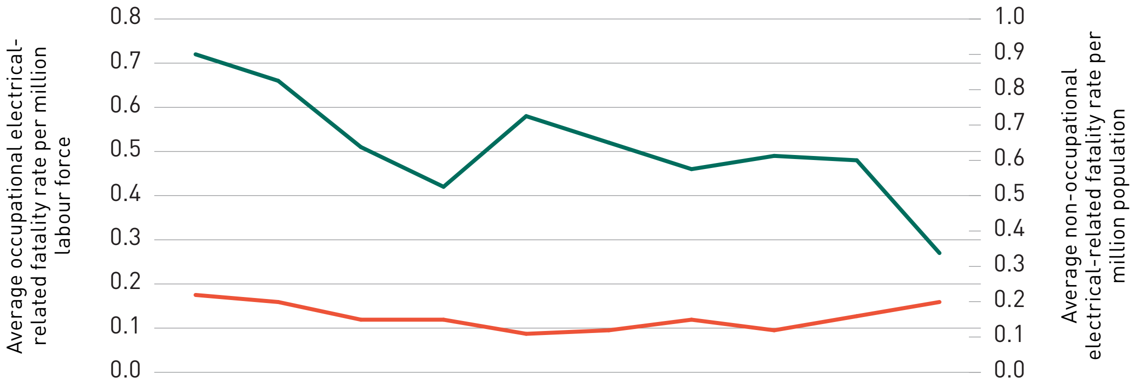


Percentage of electrical fatalities	Facility type	Commercial	Farm	Industrial	Institution	Mining	Public Place	Residential	Utility
	2009–2013	15%	5%	10%	3%	0%	13%	48%	8%
	2014–2018	8%	4%	19%	0%	4%	4%	46%	15%

Source: ESA and Coroner records

Conclusion
Residential settings were the most common settings where electrical-related fatalities occur. In 2009–2013, residential, public place, and commercial settings were the most common places for electrical-related fatalities; in 2014–2018, residential, industrial, and utility settings were the most common places for electrical-related fatalities.

7 FIVE-YEAR ROLLING AVERAGE RATE OF OCCUPATIONAL AND NON-OCCUPATIONAL ELECTRICAL-RELATED FATALITIES IN ONTARIO, 2005–2018



Five-year period	2005–2009	2006–2010	2007–2011	2008–2012	2009–2013	2010–2014	2011–2015	2012–2016	2013–2017	2014–2018
Occupational	0.72	0.66	0.51	0.42	0.58	0.52	0.46	0.49	0.48	0.27
Non-occupational	0.22	0.20	0.15	0.15	0.11	0.12	0.15	0.12	0.16	0.20

Source: ESA and Coroner records

Conclusion
The five-year rolling average rate of occupational electrical-related fatalities has decreased by **53%** when comparing 2009–2013 to 2014–2018 per million labour force. The five-year rolling average rate of non-occupational electrical-related fatalities has increased by **181%** per million population between the same time periods.

2.2 Occupational Electrical-related Fatalities and Electrical Injuries

Occupational electrical-related fatalities are a significant and ongoing problem, and they are a particular hazard to those who routinely work near electrical sources. According to the data from the U.S. Bureau of Labor Statistics (BLS), a total of 1,651 workers died between 2007 and 2016 as a result of electrical injury (Campbell, 2018). The data also show that 80% of fatal injuries from direct exposure to electricity occurred while workers were engaged in constructing, repairing, or cleaning activities (Campbell, 2018).

In Ontario, a study of occupational fatalities among construction workers between 1997 and 2007 found that electrical contact was responsible for 15% of fatalities; risk factors associated with occupational fatalities included direct contact with electrical sources, lower voltage sources, and working outdoors (Kim et al., 2016). Studies have shown that the greatest proportion of electrocution deaths occurs among electricians and electrical helpers, utility workers, and those working in construction and manufacturing industries. As well, electrical-related fatalities are more common among workers who are younger than the average age of occupational deaths overall. Contact with overhead power lines is reportedly by far the most frequent cause of fatal occupational electrocution injury (Taylor et al., 2002).

For those who survive electrical injury, the immediate consequences are usually obvious and often require extensive medical intervention. However, the long-term after-effects may be more subtle, pervasive, and less well-defined. Long-term effects are particularly difficult to diagnose, as the link between the injury and the symptoms can often go unrecognized by patients and their physicians (Wesner and Hickie, 2013; Theman et al., 2008). An Ontario study published in 2019 found that substantial acute and long-term neuropsychological and social outcomes existed among patients after an electrical injury, and were similar between patients exposed to low- and high-voltage injuries (Radulovic et al., 2019).

Research has also examined the challenges of returning to work after electrical injury. Three distinct categories of challenges have been identified:

1. physical, cognitive, and psychosocial impairments and their effects on work performance;
2. feelings of guilt, blame, and responsibility for the injury; and
3. having to return to the workplace or worksite where the injury took place.

The most beneficial supports identified by the injured workers include receiving support from family, friends, and co-workers, and undertaking rehabilitation services that specialize in electrical injury. The most common advice to others after electrical injuries includes:

1. avoiding electrical injury;
2. feeling ready to return to work;
3. completing a Workplace Safety and Insurance Board injury/claims report;
4. proactively being a self-advocate; and
5. garnering the assistance of individuals who understand electrical injuries to advocate on their behalf (Stergiou-Kita et al., 2014).

Between 2009 and 2018, there were 33 occupational electrical-related fatalities (an average of 3.3 electrical-related fatalities per year), which is the same as the previous ten-year period. In 2018, there were two occupational electrical fatalities reported.

The five-year rolling average number of fatalities and critical injuries among workers (overall occupational or worker safety) has slightly decreased between 2009–2013 and 2014–2018. The five-year rolling average number of fatalities and critical injuries among electrical trade workers has decreased when comparing these two time periods.

When comparing the five-year rolling average rate, the occupational electrical-related fatalities have slightly decreased from 0.55 per million labour force population in 2009–2013 to 0.32 per million labour force population in 2014–2018. This is a decrease of 42%.

In the 2014–2018 time period, industrial (50%) and commercial (17%) settings were the most common places for occupational electrical-related fatalities. The most commonly cited causes of death were due to improper installation/procedure (28%) and lack of hazard assessment (19%), when excluding unknown causes.

Between 2009 and 2018, electrical tradespeople accounted for 15% of all occupational electrical-related fatalities. This percentage has decreased from what was reported in 2008–2017, where electrical tradespeople accounted for 24% of all occupational electrical-related fatalities.

A review of data provided by the WSIB from 2009 to 2018 shows that males continue to outnumber females, with the most recent year showing 3:1 in the number of WSIB lost time injury claims related to electrical injuries. Workers in the construction and services sector contribute to the highest number of WSIB lost time injury claims. Machine tool and electric parts and heating, cooling, and cleaning machinery were the most common sources of injury. There is an overall decline of 26% in the number of injury claims between 2009–2013 and 2014–2018 where electrical burns are declining at a greater rate relative to electrocutions and electric shock.

Section 2.5 provides a case study that is an example of the risk factors associated with electrical-related injury and fatality for HVAC workers.

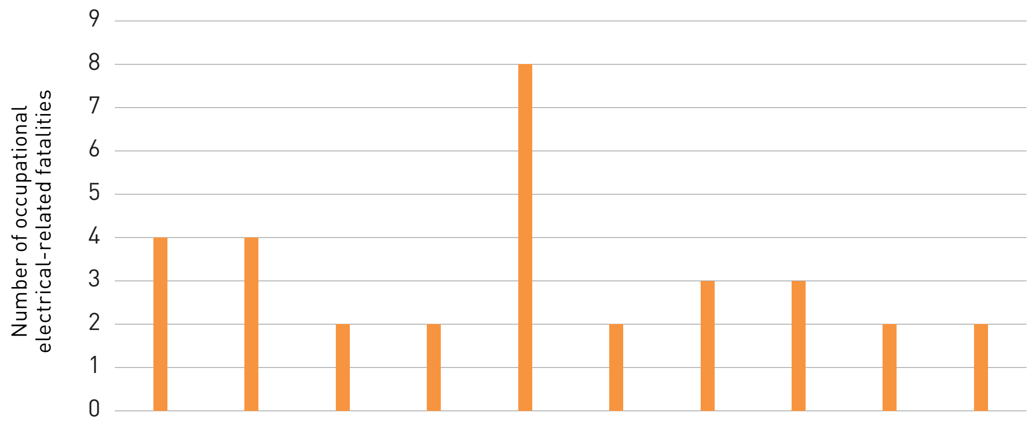
Statistics Directly Related to the ESA's Harm Reduction Priorities — WORKER SAFETY

Five-year Rolling Average Comparison

Number of worker-related electrical fatalities and critical injuries based on data reported by the Ministry of Labour, incidents investigated by the ESA and confirmed with the Office of the Coroner.

The worker safety five-year rolling average has decreased by 7% between 2009–2013 and 2014–2018.

1 NUMBER OF OCCUPATIONAL ELECTRICAL-RELATED FATALITIES IN ONTARIO, 2009–2018

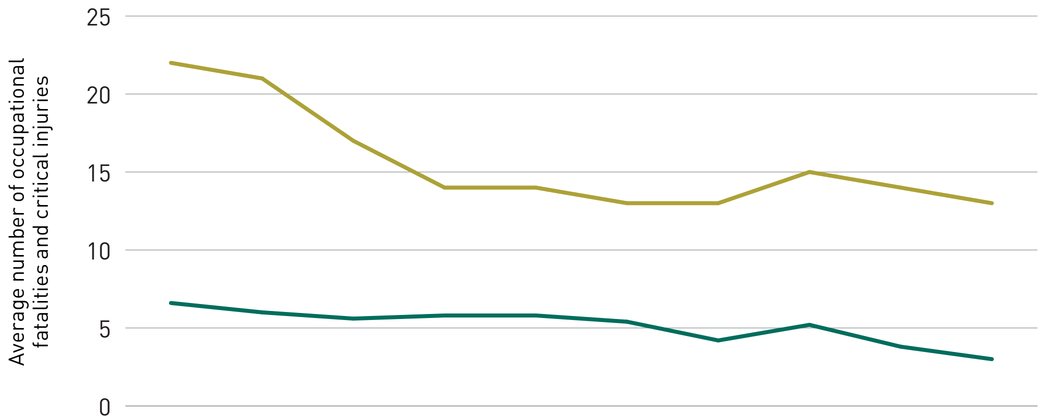


Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Number of occupational electrical-related fatalities	4	4	2	2	8	2	3	3	2	2

Source: ESA and Coroner records

Conclusion
The number of occupational electrical-related fatalities has decreased since 2009 with the exception of 2013, when eight cases were reported.

2 FIVE-YEAR ROLLING AVERAGE OF OCCUPATIONAL FATALITIES AND CRITICAL INJURIES IN ONTARIO, 2005–2018

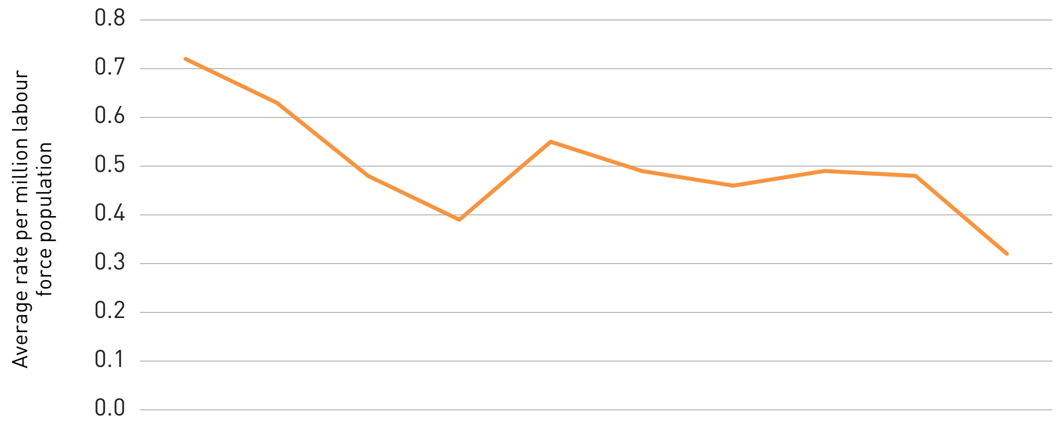


Five-year period	2005–2009	2006–2010	2007–2011	2008–2012	2009–2013	2010–2014	2011–2015	2012–2016	2013–2017	2014–2018
Occupational safety overall	22	21	17	14	14	13	13	15	14	13
Electrical trade	6.6	6.0	5.6	5.8	5.8	5.4	4.2	5.2	3.8	3.0

Source: ESA and Coroner records

Conclusion
The five-year rolling average number of occupational fatalities and critical injuries (occupational safety overall) has decreased **7%** between 2009–2013 and 2014–2018. There has also been a **48%** decrease of occupational fatalities and critical injuries among electrical trade workers.

3 FIVE-YEAR ROLLING AVERAGE RATE OF OCCUPATIONAL ELECTRICAL-RELATED FATALITIES IN ONTARIO, 2005–2018

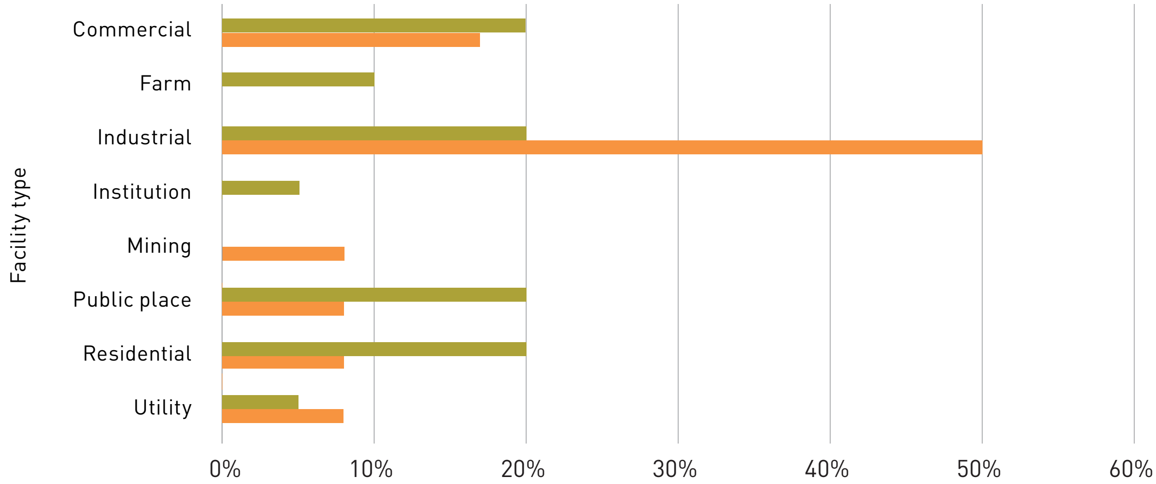


Five-year period	2005–2009	2006–2010	2007–2011	2008–2012	2009–2013	2010–2014	2011–2015	2012–2016	2013–2017	2014–2018
Occupational electrical-fatality rate	0.72	0.63	0.48	0.39	0.55	0.49	0.46	0.49	0.48	0.32

Source: ESA and Coroner records

Conclusion
The rate of occupational electrical-related fatalities has decreased by **42%** when comparing 2009–2013 and 2014–2018.

4 PERCENTAGE OF OCCUPATIONAL ELECTRICAL-RELATED FATALITIES BY FACILITY TYPE IN ONTARIO, 2009–2013 AND 2014–2018



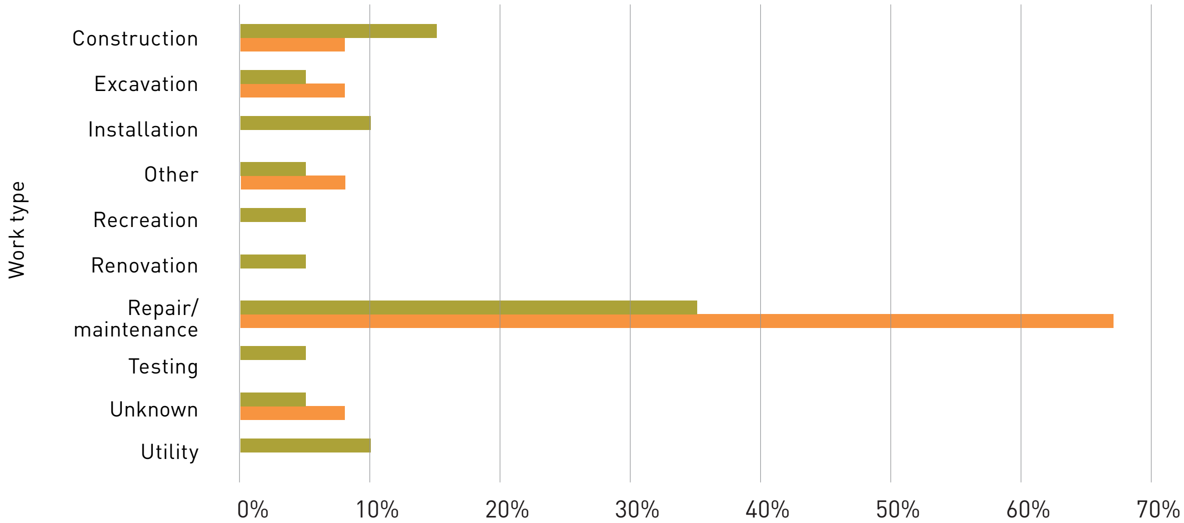
Facility type		Commercial	Farm	Industrial	Institution	Mining	Public place	Residential	Utility
Percentage of occupational electrical-related fatalities	2009–2013	20%	10%	20%	5%	0%	20%	20%	5%
	2014–2018	17%	0%	50%	0%	8%	8%	8%	8%

Source: ESA and Coroner records

Conclusion

In 2009–2013, commercial, industrial, public place, and residential settings made up for **80%** of places for occupational electrical-related fatalities. In 2014–2018, industrial and commercial settings made up **67%** of places for occupational electrical-related fatalities.

5 PERCENTAGE OF OCCUPATIONAL ELECTRICAL-RELATED FATALITIES BY TYPE OF WORK IN ONTARIO, 2009–2013 AND 2014–2018

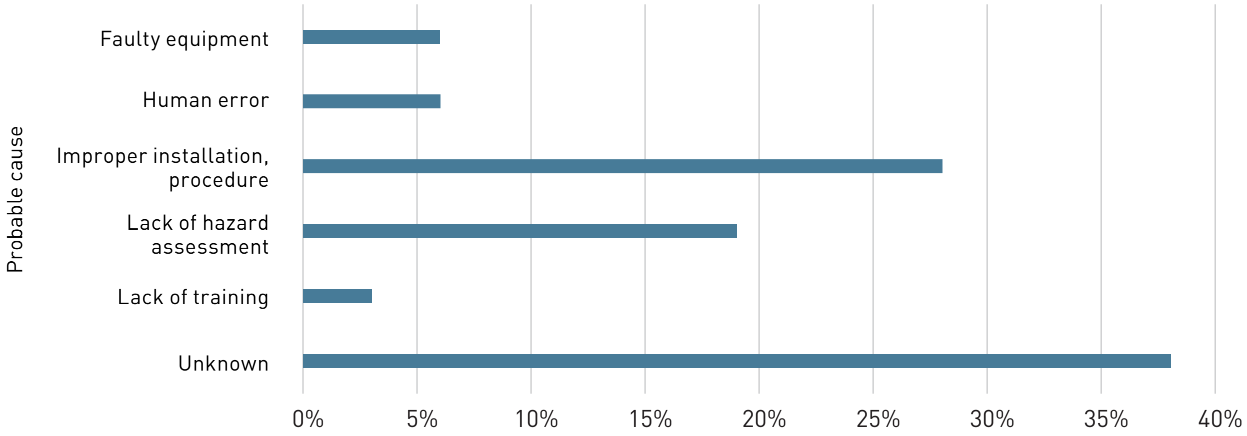


	Work type	Construction	Excavation	Installation	Other	Recreation	Renovation	Repair/ maintenance	Testing	Unknown	Utility
Percentage of occupational electrical-related fatalities	2009–2013	15%	5%	10%	5%	5%	5%	35%	5%	5%	10%
	2014–2018	8%	8%	0%	8%	0%	0%	67%	0%	8%	0%

Source: ESA and Coroner records

Conclusion
In 2009–2013 and 2014–2018, repair/maintenance activities were the most common types of work for occupational electrical-related fatalities.

6 PERCENTAGE OF OCCUPATIONAL ELECTRICAL-RELATED FATALITIES BY PROBABLE CAUSE IN ONTARIO, 2009–2018

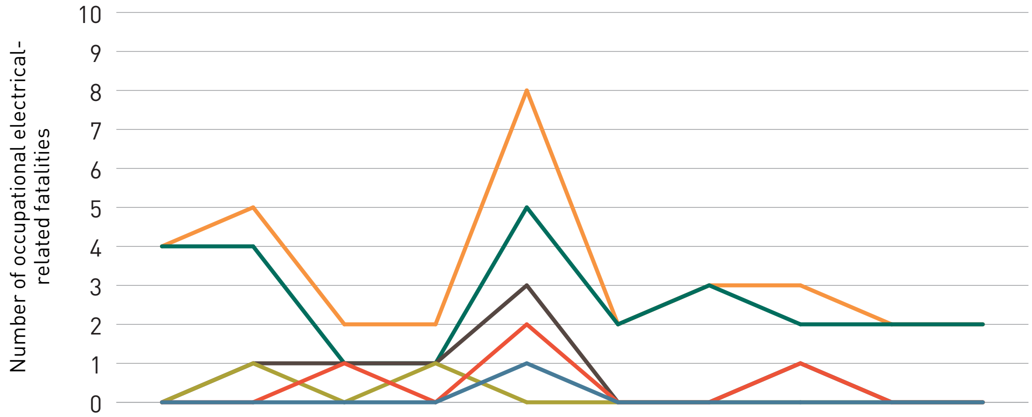


Probable cause	Faulty equipment	Human error	Improper installation, procedure	Lack of hazard assessment	Lack of training	Unknown
Percentage of occupational electrical-related fatalities	6%	6%	28%	19%	3%	38%

Source: ESA and Coroner records

Conclusion
Aside from unknown cause, the most commonly cited causes of occupational electrical-related fatalities were due to improper installation/procedure in the most recent ten-year period.

7 NUMBER OF OCCUPATIONAL ELECTRICAL-RELATED FATALITIES BY OCCUPATION IN ONTARIO, 2009–2018

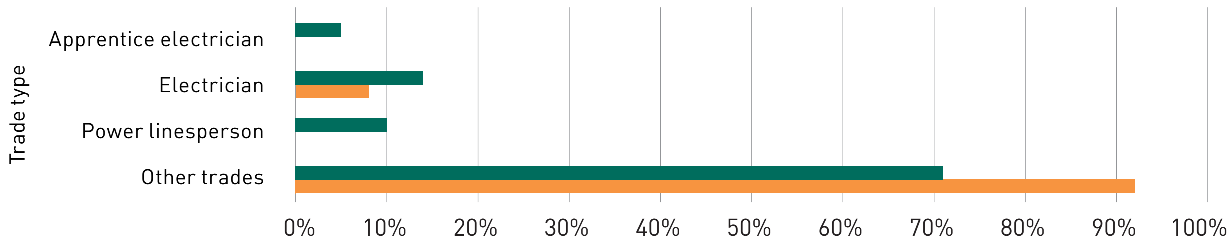


Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Apprentice electrician	0	0	0	0	1	0	0	0	0	0
Electrician	0	0	1	0	2	0	0	1	0	0
Power linesperson	0	1	0	1	0	0	0	0	0	0
Total electrical	0	1	1	1	3	0	0	1	0	0
Other trades	4	4	1	1	5	2	3	2	2	2
All occupational fatalities	4	5	2	2	8	2	3	3	2	2

Source: ESA and Coroner records

Conclusion
In general, the overall number of occupational fatalities has decreased since 2009, most notably amongst the electrical trade, where there have been no fatalities since 2017. However, the number of fatalities in other trades has remained constant in the past ten years.

8 PERCENTAGE OF OCCUPATIONAL ELECTRICAL-RELATED FATALITIES BY TRADE, 2009–2013 AND 2014–2018

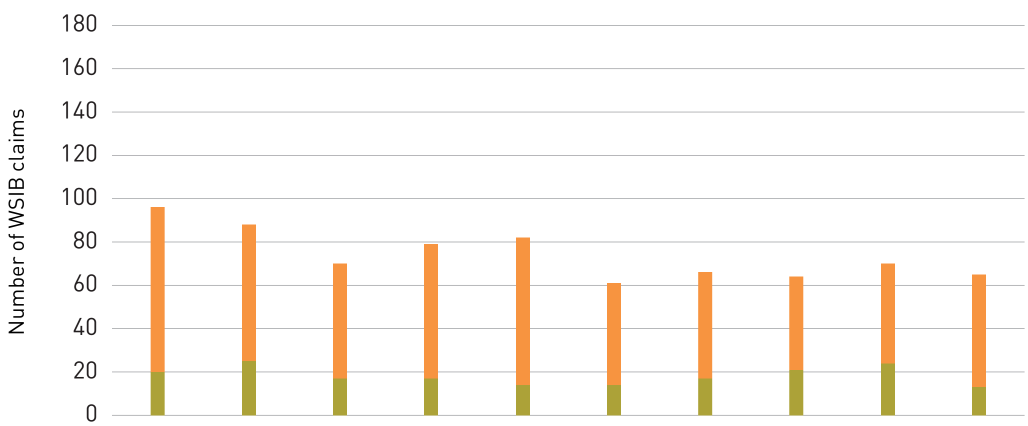


Percentage of occupational electrical-related fatalities	Trade type	Apprentice electrician	Electrician	Power linesperson	Other trades
	2009–2013	5%	14%	10%	71%
	2014–2018	0%	8%	0%	92%

Source: ESA and Coroner records

Conclusion
The percentage of electrical-related fatalities among power linespersons has decreased between the two time periods. Workers from other trades contribute to the largest proportion of electrical-related fatalities.

9 NUMBER OF ALLOWED WSIB LOST TIME ELECTRICAL INJURY CLAIMS BY SEX IN ONTARIO, 2009–2018

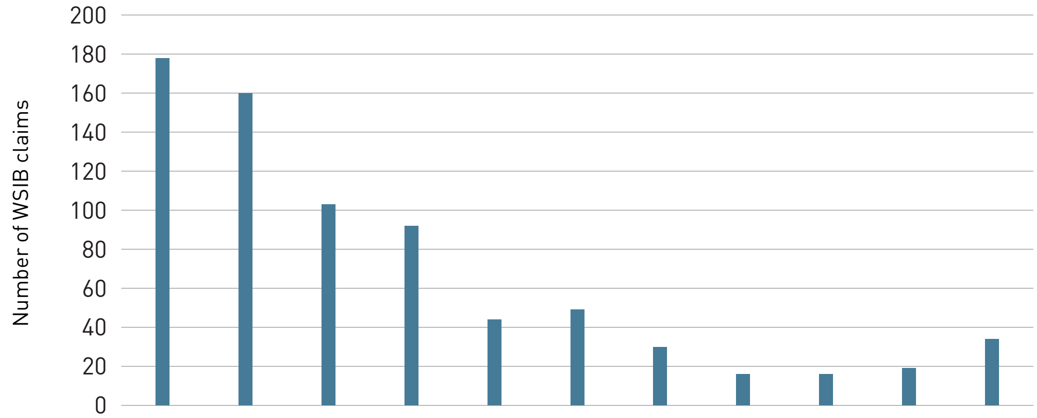


Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Male	76	63	53	62	68	47	49	43	46	52
Female	20	25	17	17	14	14	17	21	24	13

Source: Workplace Safety and Insurance Board

Conclusion
Since 2009, the number of WSIB lost time electrical injury claims reported by males continues to outnumber lost time electrical injury claims reported by females. Most notably in 2018, claims reported by males outnumbered claims by females 3:1.

10 NUMBER OF ALLOWED WSIB LOST TIME ELECTRICAL INJURY CLAIMS BY SECTOR IN ONTARIO, 2009–2018



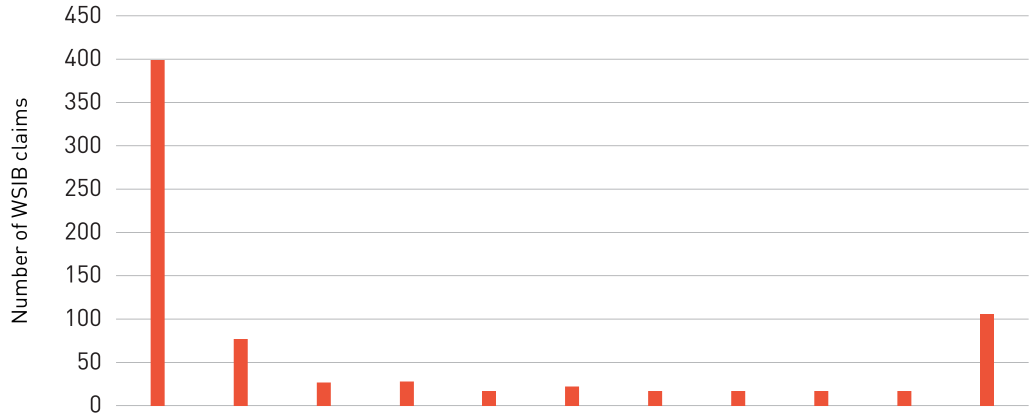
Sector type	Construction	Services	Manufacturing	Schedule 2*	Health care	Electrical	Transportation	Chemical/ process	Automotive	Food	Other
Number of WSIB claims	178	160	103	92	44	49	30	16	16	19	34

Source: Workplace Safety and Insurance Board

Conclusion
Workers in the construction and service sector contributed to the highest number of WSIB lost time electrical claims between 2009 and 2018.

*Schedule 2 workers are those that work in firms funded by public funds (federal, provincial, and/or municipal governments), firms legislated by the province but self-funded, or firms that are privately owned but involved in federally regulated industries such as telephone, airline, shipping, and railway.

11 NUMBER OF ALLOWED WSIB LOST TIME ELECTRICAL INJURY CLAIMS BY THE TOP TEN SOURCES IN ONTARIO, 2009–2018

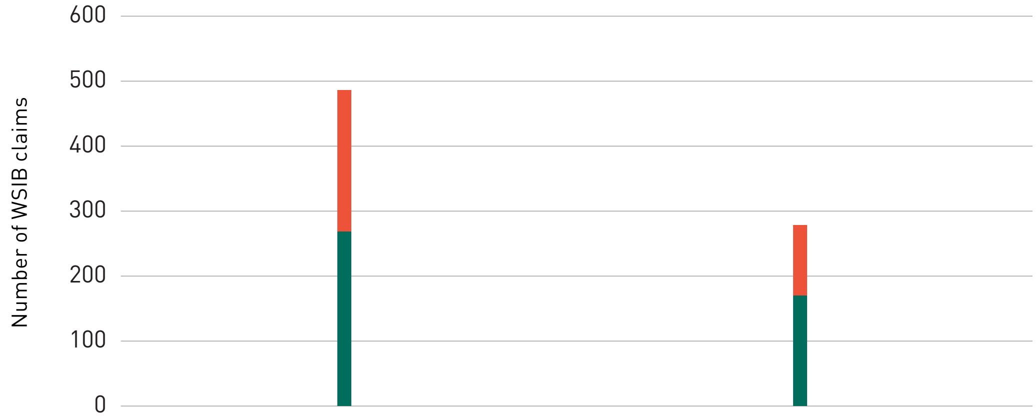


Source	Number of WSIB claims
Machine tool and electric parts	399
Heating, cooling, and cleaning machinery	77
Metal woodworking and plastic, rubber concrete and other processing	27
Misc. machinery (e.g., audio, video, televisions, telephones, snowblowers)	28
Hand tools, powered	17
Fire, flame, smoke	22
Special process machinery (e.g., food slicers, paper, printing, wrapping, sewing, pumps)	17
Unknown	17
Furniture and fixtures	17
Office and business machines	17
Other sources	106

Source: Workplace Safety and Insurance Board

Conclusion
Machine tool and electric parts and heating, cooling, and cleaning machinery were the most common sources of WSIB electrical injury claims between 2009 and 2018.

12 NUMBER OF ALLOWED WSIB LOST TIME ELECTRICAL INJURY CLAIMS BY NATURE OF INJURY IN ONTARIO, 2009–2013 AND 2014–2018



Nature of injury	Electrocutions, electric shock	Burns, electrical
2009–2013	268	170
2014–2018	218	108

Source: Workplace Safety and Insurance Board

Conclusion
There was an overall decline of **26%** in the number of injury claims between 2009–2013 and 2014–2018; of these claims, electrical burns are declining at a greater rate relative to electrocutions and electric shock.

2.3 Non-occupational Electrical-related Fatalities and Injuries

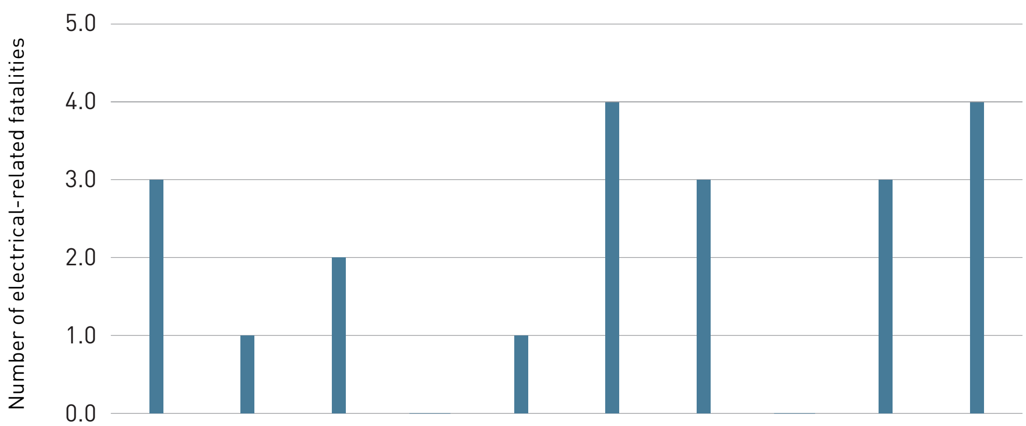
Injuries are a significant health problem. They are the leading cause of death for the young and contribute substantially to the burden on the health care system. Many injuries are predictable and preventable.

In 2018, there were four non-occupational electrical-related fatalities. In the previous year, there were three non-occupational electrical fatalities. With the exception of 2014, 2016, and 2018, occupational electrical-related fatalities outnumber non-occupational electrical fatalities.

Between 2009 and 2018, there were 21 non-occupational electrical-related fatalities (an average of 2.1 electrical-related fatalities per year). In the previous ten-year period (2008–2017), there were also 21 non-occupational electrical-related fatalities (an average of 2.1 electrical-related fatalities per year). The five-year rolling average rate between 2009–2013 and 2014–2018 has increased by 181% from 0.11 per million population to 0.20 per million population.

In the past ten years, the residential setting (57%) was the most common place for non-occupational electrical-related fatalities. Theft (17%), recreation (17%), and other (17%) were the most common activities associated with fatalities when excluding unknown activities.

1 NUMBER OF NON-OCCUPATIONAL ELECTRICAL-RELATED FATALITIES IN ONTARIO, 2009–2018

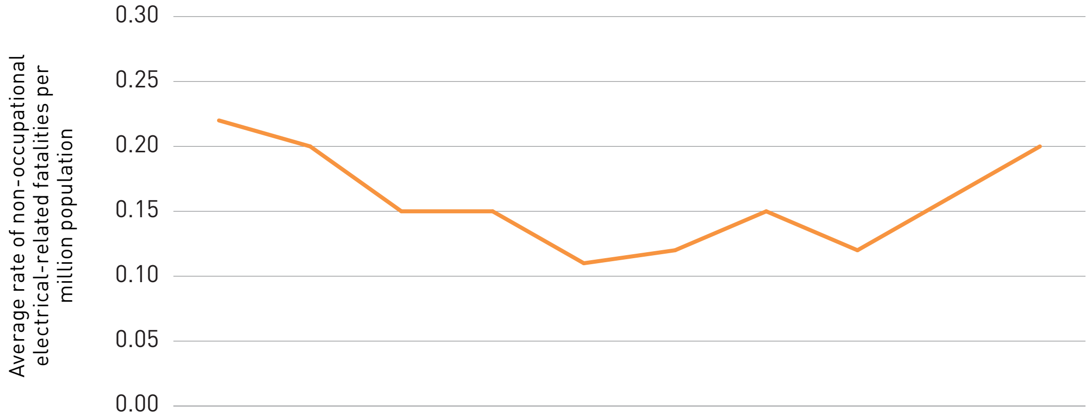


Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Number of non-occupational electrical-related fatalities	3	1	2	0	1	4	3	0	3	4

Source: ESA and Coroner records

Conclusion
In 2018, there were four non-occupational electrical-related fatalities, the highest it has ever been since 2014.

2 FIVE-YEAR ROLLING AVERAGE RATE OF NON-OCCUPATIONAL ELECTRICAL-RELATED FATALITIES IN ONTARIO, 2005–2018

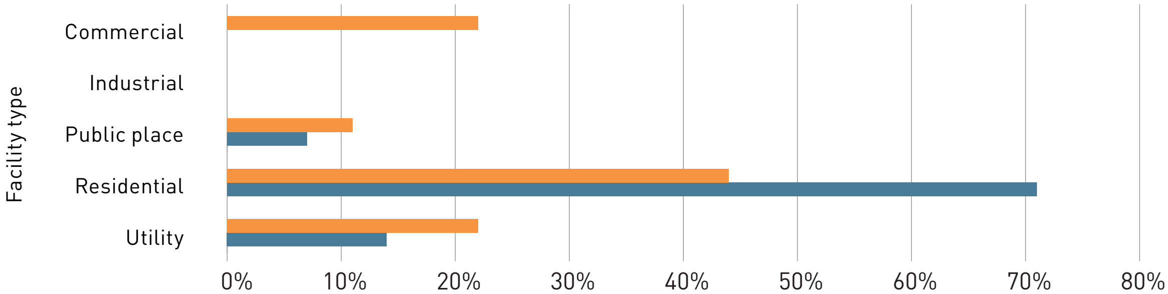


Five-year period	2005–2009	2006–2010	2007–2011	2008–2012	2009–2013	2010–2014	2011–2015	2012–2016	2013–2017	2014–2018
Rate of non-occupational electrical-related fatalities per million population	0.22	0.20	0.15	0.15	0.11	0.12	0.15	0.12	0.16	0.20

Source: ESA and Coroner records

Conclusion
The five-year rolling average rate of non-occupational electrical-related fatalities has increased by **181%** when comparing 2009–2013 and 2014–2018.

3 PERCENTAGE OF NON-OCCUPATIONAL ELECTRICAL-RELATED FATALITIES BY FACILITY TYPE IN ONTARIO, 2009–2018

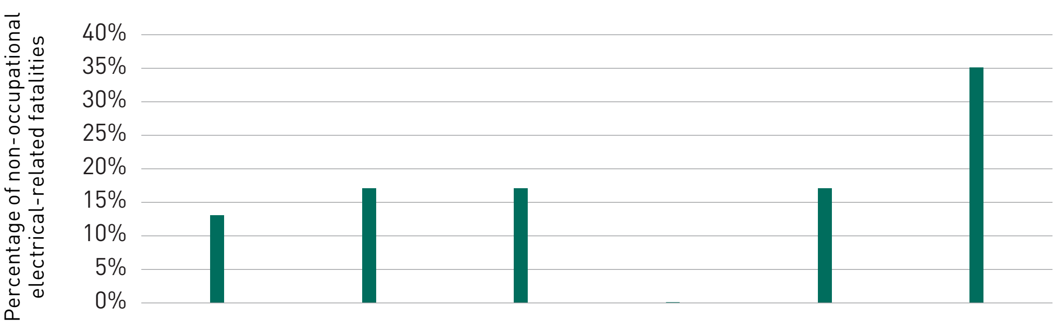


Percentage of non-occupational electrical-related fatalities	Facility type	Commercial	Industrial	Public place	Residential	Utility
	2009–2013	22%	0%	11%	44%	22%
	2014–2018	0%	0%	7%	71%	14%

Source: ESA and Coroner records

Conclusion
In the past ten years, the residential setting is the most common place for non-occupational electrical-related fatalities.

4 PERCENTAGE OF NON-OCCUPATIONAL ELECTRICAL-RELATED FATALITIES BY ACTIVITY TYPE IN ONTARIO, 2009–2018



Activity type	Landscaping, lawn cutting, tree trimming	Other	Recreation	Repair/ maintenance	Theft	Unknown
Percentage of non-occupational electrical-related fatalities	13%	17%	17%	0%	17%	35%

Source: ESA and Coroner records

Conclusion
Theft, landscaping, recreation, and other activities are the most common activities (excluding unknown) for non-occupational electrical-related fatalities.

2.4 Electrical Injury and Emergency Department Visits in Ontario, 2008–2017

Factors that affect the presence of electrical injury and its severity depend on the magnitude of the electric current, its transmission (direct or indirect), body entry and exit sites, the path the current takes through the body, and the surrounding environmental conditions (e.g., wet or dry environments) (Duff, 2001).

Exposure to electricity can result in a range of injuries. It can lead to cardiovascular system injuries (e.g. rhythm disturbances), cutaneous injuries and burns, nervous system disruption and respiratory arrest. Electric current can cause severe muscle contractions, thus may "throw" or "knock down" a person, resulting in head injuries, fractures, and dislocations (Duff and McCaffrey, 2011; Koumbourlis, 2002).

Approximately 20,000 electrical-related emergency department visits occur every year in North America (Singerman et al., 2008). These injuries are the most common form of occupationally related burn injury and the fifth leading cause of occupational fatality in the United States (Singerman et al., 2008).

From 2008 to 2017, approximately 12,384 visits to Ontario hospitals' emergency departments (ED) were due to electrical injury. The trend of males outnumbering females in electrical injuries is also observed in ED visits with 68% of ED visits from males. Adults (age 20–64 at 80%) and children (age 0–19 at 18%) comprised 98% of all ED visits related to electrical injuries.

Using the Canadian Triage and Acuity Scale (CTAS), the severity of electrical injury was assessed upon visit. In the past ten years, 82% of ED visits were classified as the most severe – that is, requiring resuscitation, conditions that are a potential threat to life, limb, or function requiring medical intervention or delegated acts, or conditions that could potentially progress to a serious problem requiring emergency intervention (CTAS between 1 and 3). In 68% of all ED visits, the principal diagnosis was identified as electrical current and 4% of visits were from effects of lightning. Burns were the principal diagnosis in an additional 15% of cases.

When excluding unspecified place of occurrence, the most common locations for electrical injury were the home (33%), followed by trade and service areas (21%), and industrial and construction locations (20%).

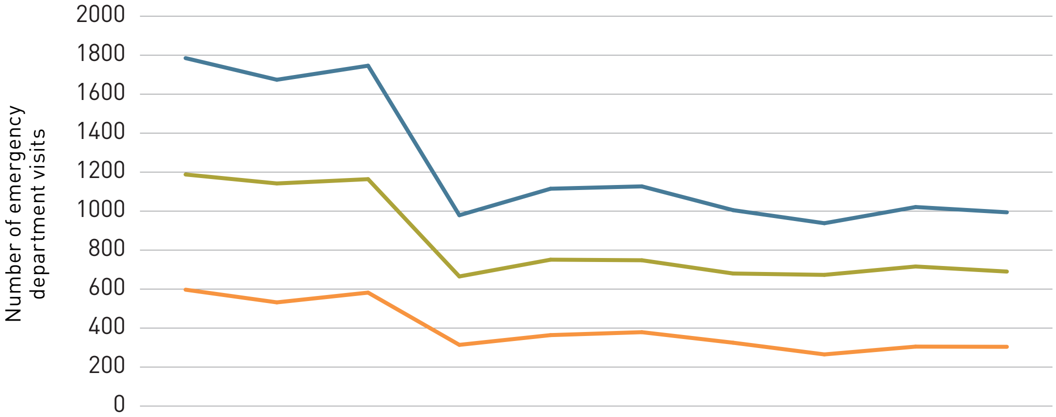
Statistics Related to the ESA's Harm Reduction Priorities — NON-OCCUPATIONAL ELECTRICAL SAFETY

Five-year Rolling Average Comparison

Number of emergency department visits due to critical electrical injuries (CTAS levels 1–3) reported to the Canadian Institute of Health Information.

The number of emergency department visits that were classified as critical visits has decreased by 26% in the five-year rolling average between 2008–2012 and 2013–2017.

1 NUMBER OF EMERGENCY DEPARTMENT (ED) VISITS FOR ELECTRICAL INJURY BY SEX IN ONTARIO, 2008–2017

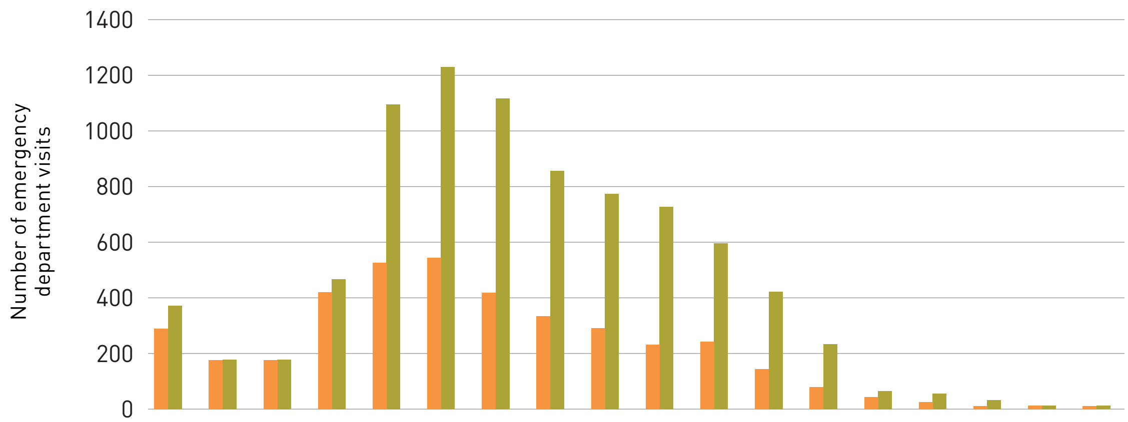


Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Female	597	532	582	314	364	379	325	265	305	304
Male	1188	1142	1164	665	751	748	680	673	716	690
Total	1785	1674	1746	979	1115	1127	1005	938	1021	994

Source: ED All Visit Main Table (CIHI), IntelliHEALTH, Ministry of Health and Long-Term Care (MOHLTC)

Conclusion
The total number of ED visits for electrical injury has decreased by **44%** in the past ten years.

2 NUMBER OF EMERGENCY DEPARTMENT (ED) VISITS FOR ELECTRICAL INJURY BY AGE AND SEX IN ONTARIO, 2008–2017

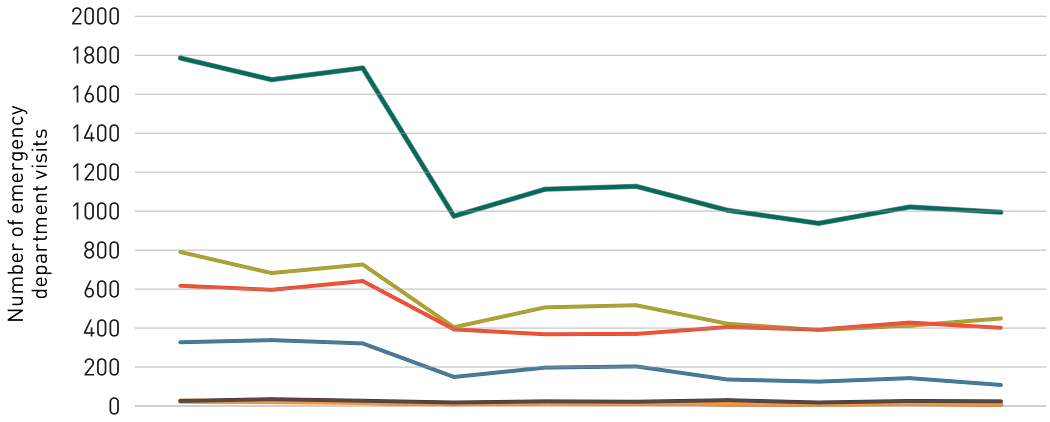


Age	0–4	5–9	10–14	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65–69	70–74	75–79	80–84	85+
Female	289	175	175	419	526	543	418	333	291	232	243	144	79	42	25	10	12	11
Male	371	178	177	466	1095	1229	1116	856	774	727	596	422	233	65	55	32	13	12

Source: ED All Visit Main Table (CIHI), IntelliHEALTH, MOHLTC

Conclusion
The number of males seen at the ED for electrical injury is greater than the number of females in all age groups in the past ten years. Adults (age 20–64 at **80%**) and children (age 0–19 at **18%**) comprised **98%** of all ED visits related to electrical injuries.

3 NUMBER OF ED VISITS FOR ELECTRICAL INJURY BY CTAS IN ONTARIO, 2008–2017



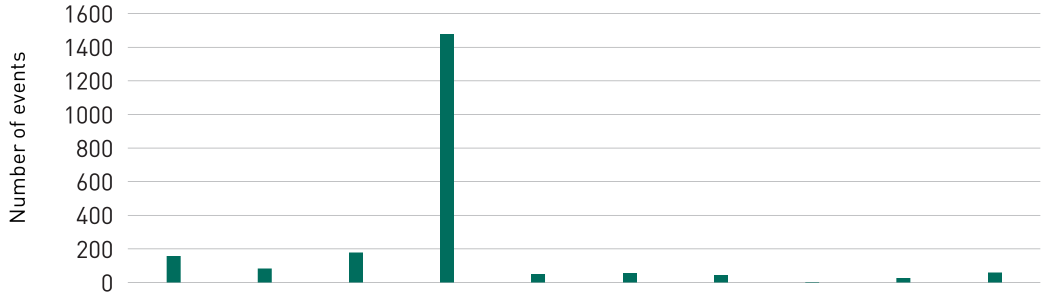
Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Resuscitation/ life threatening (level 1)	26	35	27	18	24	22	30	18	26	24
Emergent/potentially life threatening (level 2)	617	596	641	393	368	370	405	392	428	401
Urgent/potentially serious (level 3)	790	682	726	404	506	517	422	390	412	449
Less-urgent/ semi-urgent (level 4)	327	338	321	149	197	203	136	125	143	108
Non-urgent (level 5)	25	23	19	10	17	15	9	9	11	8
Total	1785	1674	1734	974	1112	1127	1004	937	1021	994

Source: ED All Visit Main Table (CIHI), IntelliHEALTH, MOHLTC

Conclusion

In the past ten years, **82%** of ED visits for electrical injury were classified on the CTAS at levels 1–3 (Resuscitation, Emergent, Urgent).

4 LOCATION OF BURNS ASSOCIATED WITH ELECTRICAL INJURY IN ONTARIO, 2008–2017



Location of burns	Head and neck	Trunk	Shoulder and upper limb, except wrist and hand	Wrist and hand	Hip and lower limb, except ankle and foot	Ankle and foot	Eye and adnexa	Respiratory tract	Other internal organs	Multiple body regions
Total	155	82	176	1476	49	55	42	0	24	59

Source: ED All Visit Main Table (CIHI), IntelliHEALTH, MOHLTC

Conclusion
Of the ED visits from an electrical injury that resulted in a burn, the majority of injuries were found on the wrist and hand.

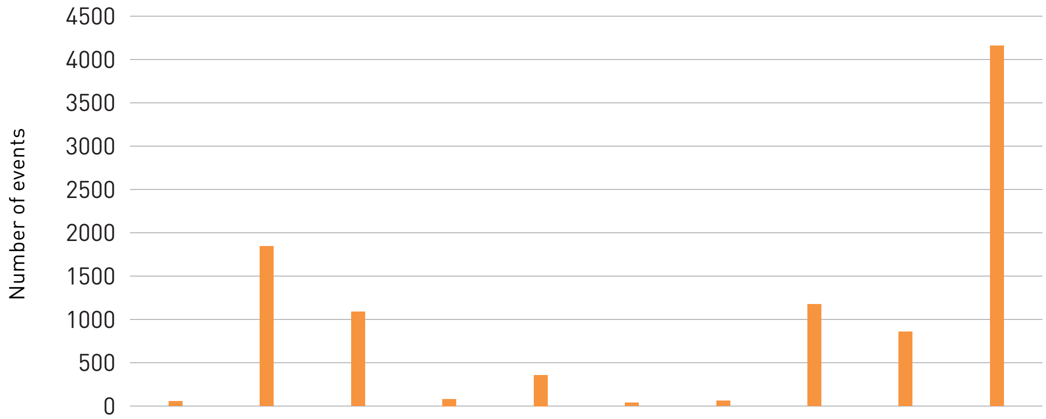
5 PRIMARY DIAGNOSIS OF EMERGENCY DEPARTMENT VISITS FOR ELECTRICAL INJURY IN ONTARIO, 2008–2017

Primary diagnosis	Effects of electric current (T75.4)	Effects of lightning (T75.0)	Burns (T20-T31)	Other diagnoses
Number of ED visits	8420	493	1894	1577

Source: ED All Visit Main Table (CIHI), IntelliHEALTH, MOHLTC

Conclusion
The majority of ED visits for electrical injury had a principal diagnosis of electric current (**68%**), followed by burns (**15%**).

6 PLACE WHERE ELECTRICAL INJURY OCCURRED IN ONTARIO, 2008–2017



Place	Farm	Home	Industrial and construction area	Residential institution	School, other institution and public area	Sports and athletics area	Street and highway	Trade and service area	Other specified place of occurrence	Unspecified place of occurrence
Total	57	1846	1089	81	358	39	63	1173	857	4160

Source: ED All Visit Main Table (CIHI), IntelliHEALTH, MOHLTC

Conclusion
While many ED visits from electrical injury were from unspecified places of occurrence, the most commonly reported places of injury were the home, industrial and construction areas, and trade and service areas.

2.5 Case Study: Electrical Contractor

The Incident

An electrical contractor received a severe electric shock while relocating switches for charging stations in an industrial plant. The worker shut off the incorrect disconnect switch, leaving the intended circuit energized.

Incident Details

This job was performed by an electrical contractor who was required to relocate charging stations in an industrial plant (old location labeled as 'A' and new location labeled as 'B' in Figure 1). The job included alterations to a 200A splitter[2] (at location 'B'). This splitter was formerly fed by a 200A disconnect switch marked 'Main' (at location 'C' in Figure 1). Through the years, reduction of machinery in the plant resulted in a decrease in electrical load. It precipitated downgrading of the disconnect switch to a lower rating, and the circuit was modified to be fed only by a 100A disconnect switch located in the main electrical room (highlighted in Figure 1).

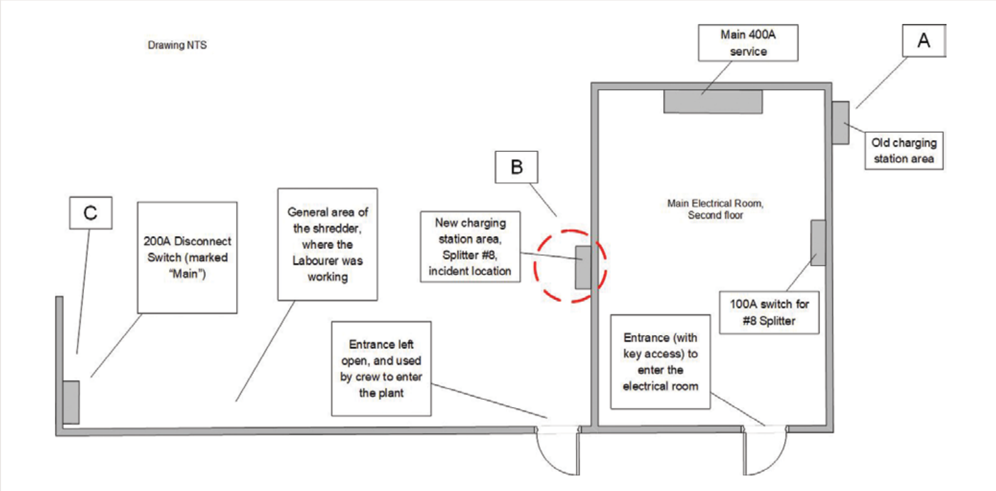


Figure 1: Plan view of the plant.

On the morning of the incident, the contractor crew, consisting of an electrician and an apprentice, arrived at the plant. The electrician walked around the plant with the apprentice to explain the job. The electrician then assigned the apprentice the installation of a new receptacle near the panel at Location A.

At approximately 7 a.m., with the apprentice observing, the electrician shut off the 200A disconnect switch at Location C and tested to ensure that there was no power at that switch. The apprentice then proceeded to Location A to work on the new receptacle while the electrician proceeded to Location B. Shortly thereafter, the

[2] The 2018 Ontario Electrical Safety Code defines a splitter as an enclosure containing terminal plates or busbars having main and branch connectors.

2.5 Case Study: Electrical Contractor continued

electrician returned to Location A and instructed the apprentice to assist him at Location B by running a BX cable (armoured cable) to a disconnect switch.

With assistance of the apprentice, the electrician then moved the disconnect switches for the chargers from Location A to Location B. They mounted the switches on the wall. A conduit was installed from one disconnect switch to the 200A splitter. No conductors were terminated into that disconnect switch yet. A BX cable was installed and conductors terminated into the second disconnect switch (see Figure 2).

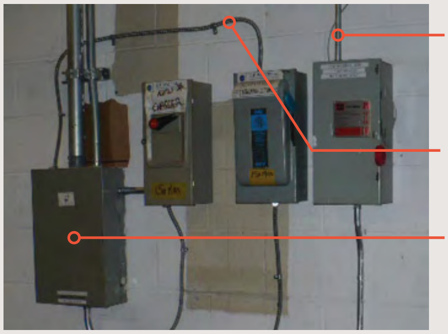


Figure 2: BX cable highlighted.

According to the apprentice, who was standing on a ladder adjacent to the electrician, the electrician was holding the conductors from the BX cable in his left hand when the bonding conductor came into contact with an energized terminal, resulting in a severe electric shock to the electrician. CPR was administered to the electrician until Emergency Medical Services (EMS) arrived.

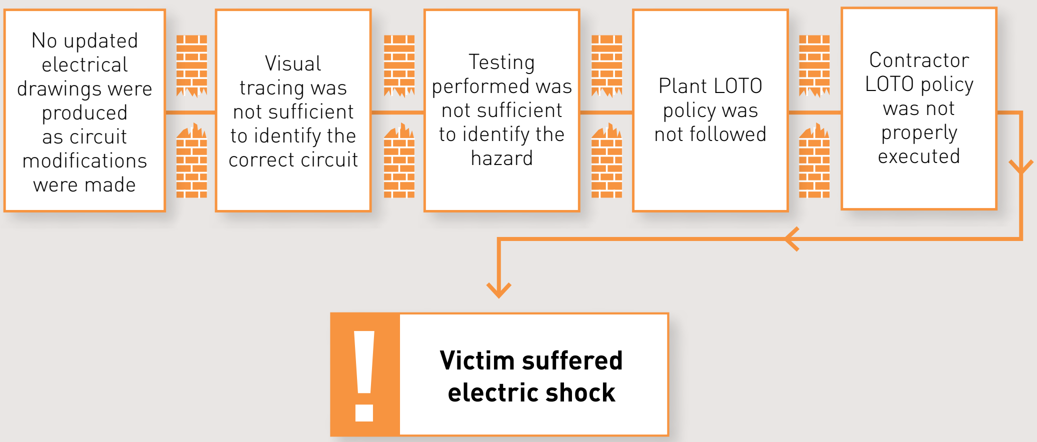
When later interviewed, the apprentice indicated he was not sure what task the electrician was performing at the disconnect switch at the time of incident. When the electrician recovered, he indicated in an interview that he suffered memory loss and could not remember any of the events from the entire week of the incident. Memory loss is not uncommon as a symptom resulting from an electric shock event.

Further investigation revealed the following:

1. **No updated electrical drawings were produced as circuit modifications were made** — Through the years, as the loads decreased in the plant, some major electrical modifications were made to accommodate these changes. New electrical drawings were never produced to reflect these modifications. These drawings would have facilitated tracking of switches and circuits.
2. **Visual tracing was not sufficient to identify the correct circuit** — Absence of electrical line drawings did not trigger a detailed hazard assessment despite changes made to the circuit. Visual tracing alone was not sufficient to identify that the 200A disconnect switch at Location C would not shut down the circuit at Locations A and B. Testing the circuit at the splitter would have been prudent to verify that the circuit was de-energized.

2.5 Case Study: Electrical Contractor continued

3. **Testing performed was not sufficient to identify the hazard** — According to the apprentice, he observed the electrician performing some testing. However, any tests performed by the electrician were not adequate to confirm that no hazard still existed. Testing the circuit at Locations A or B would have verified power at those locations after shutting off the 200A disconnect switch.
4. **Plant lockout/tagout (LOTO) policy was not followed** — The crew signed off on a plant LOTO policy prior to starting their work. The electrician could have shut off either the 400A main switch (shown in the electrical room in Figure 1) or the 100A switch feeding the circuit. Either would have de-energized the circuit and the worker would have followed the plant LOTO policy.
5. **Contractor LOTO policy was not properly executed** — The electrical contractor had a LOTO policy which indicated to de-energize a circuit before performing work. Though disconnection and testing was conducted at a disconnection switch, testing at the splitter would have resulted in LOTO of the proper equipment.



3.0 Utility-related Equipment

Utility-related equipment includes electrical equipment and devices used by Local Distribution Companies (LDCs), privately owned companies, or property owners that distribute electricity to customers' facilities or buildings. Examples of such equipment include overhead and underground powerlines (including most equipment on utility poles), substations, electrical chambers (vaults), high-voltage switchgear, and transformers. Utility-related equipment carries dangerous amounts of energy or power, and if barriers are breached, can be fatal. Overhead and underground equipment barriers are typically clearances above and below the ground, while substation barriers typically include fences and walls. Each barrier is designed to prevent public access and exposure to electric shock hazards.

From 2009 to 2018, there were 27 electrical-related fatalities associated with utility-related equipment, which made up 50% of the total electrical fatalities in Ontario in that period. This number has decreased by one death when compared to the previous ten-year period of 2008–2017.

Contact specifically with powerlines accounted for 19 of the electrical-related fatalities in the most recent ten-year period, which contributed to 70% of utility-related equipment fatalities. The five-year rolling average rate for powerline electrocutions has decreased by 47% when comparing 2009–2013 and 2014–2018.

The number of total utility-related electrical incidents has increased by 129% since 2009. Overhead powerline contact remains the leading cause of utility-related electrical incidents, yet all contact types have seen an increase in the past five years. However, under-counting is especially prevalent with utility contact incidents, and this information should be interpreted with caution. Injuries as a result of powerline and utility-related equipment have decreased over the past ten years.

Section 3.1 provides a case study that is an example of the risk factors associated with overhead powerline contact among workers.

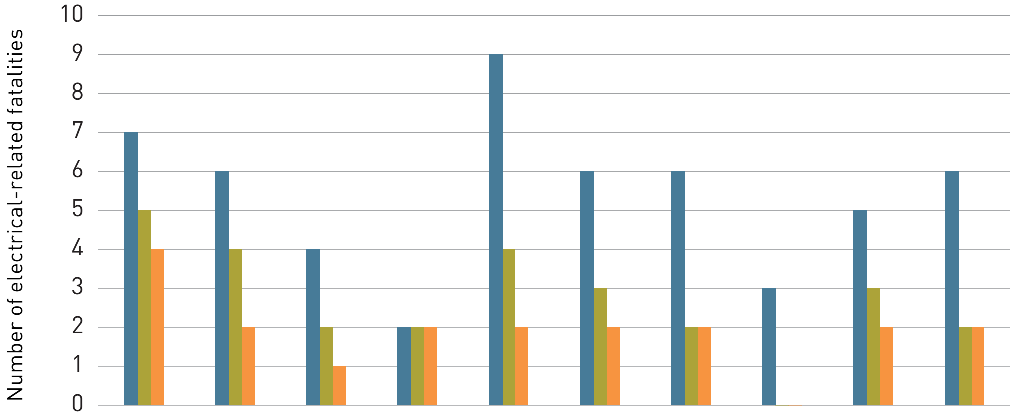
Statistics Directly Related to the ESA's Harm Reduction Priorities — POWERLINE CONTACT

Five-year Rolling Average Comparison

The statistics that follow represent the number of worker and non-worker powerline-related contact incidents from data reported to the ESA.

The powerline safety five-year rolling average has decreased by 47% between 2009–2013 and 2014–2018.

1 NUMBER OF UTILITY-RELATED EQUIPMENT ELECTRICAL-RELATED FATALITIES IN ONTARIO, 2009–2018

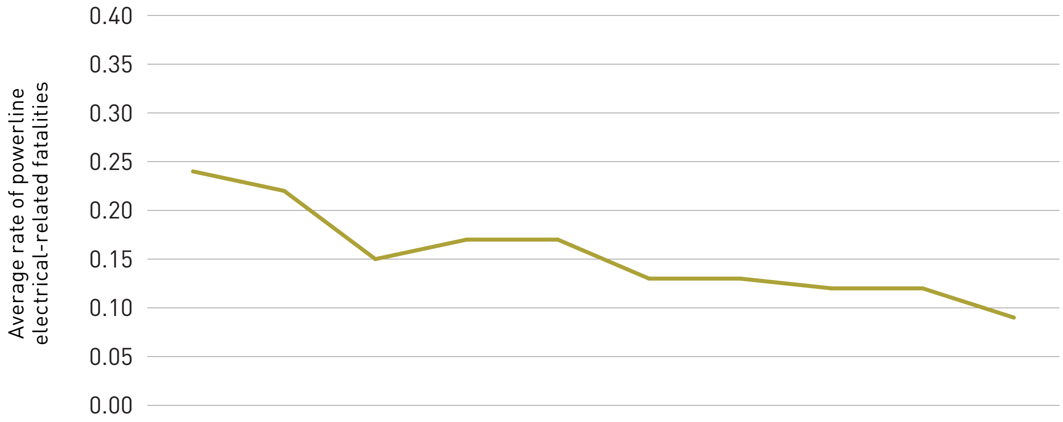


Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Electrical-related fatalities	7	6	4	2	9	6	6	3	5	6
Utility equipment electrical fatalities	5	4	2	2	4	3	2	0	3	2
Powerline electrical-related fatalities	4	2	1	2	2	2	2	0	2	2

Source: ESA and Coroner records

Conclusion
The number of utility-related equipment fatalities has been decreasing since 2009. In 2018, there were two powerline fatalities reported.

2 FIVE-YEAR ROLLING AVERAGE OF POWERLINE ELECTRICAL-RELATED FATALITIES IN ONTARIO, 2005–2018

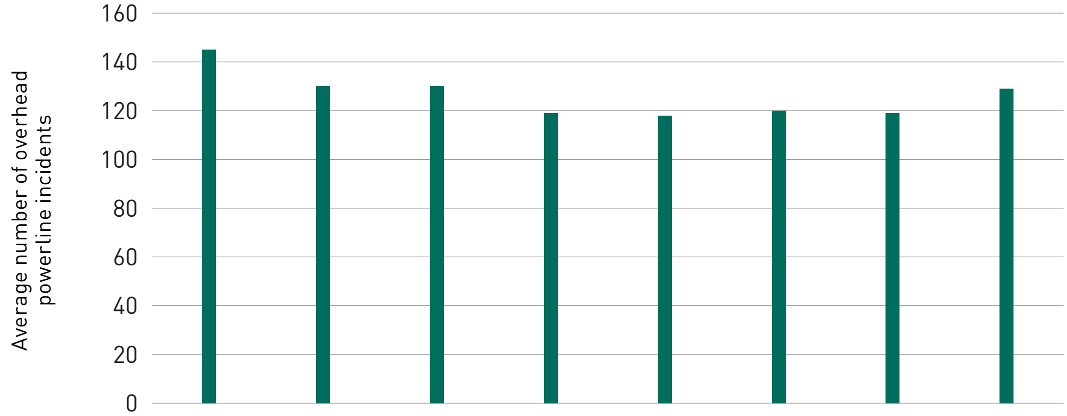


Five-year period	2005–2009	2006–2010	2007–2011	2008–2012	2009–2013	2010–2014	2011–2015	2012–2016	2013–2017	2014–2018
Rate of powerline electrical-related fatalities	0.24	0.22	0.15	0.17	0.17	0.13	0.13	0.12	0.12	0.09

Source: ESA and Coroner records

Conclusion
The rate of powerline electrical-related fatalities has decreased by **47%** when comparing 2009–2013 and 2014–2018. The 2014–2018 rate has decreased by **25%** when compared to the previous five-year period of 2013–2017.

3 FIVE-YEAR ROLLING AVERAGE NUMBER OF OVERHEAD POWERLINE INCIDENTS IN ONTARIO, 2007–2018

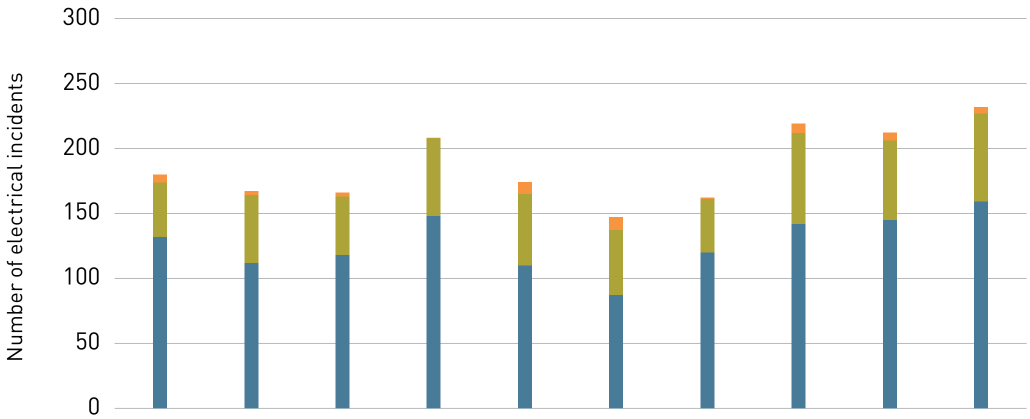


Five-year period	2007–2011	2008–2012	2009–2013	2010–2014	2011–2015	2012–2016	2013–2017	2014–2018
Number of overhead powerline incidents	145	130	130	119	118	120	119	129

Source: ESA records

Conclusion
The five-year rolling average number of overhead powerline incidents has stayed similar when comparing 2009–2013 and 2014–2018. The most recent five-year period of 2014–2018 shows an **8%** increase in overhead powerline contacts when compared to the previous time period of 2013–2017.

4 NUMBER OF UTILITY-RELATED ELECTRICAL INCIDENTS BY CONTACT TYPE IN ONTARIO, 2009–2018

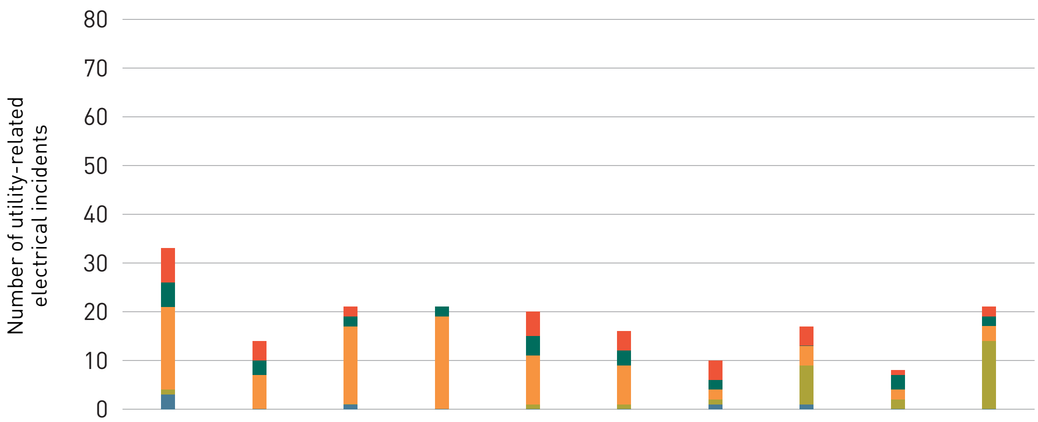


Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Vaults, substations and padmounts	6	3	3	0	9	10	1	7	6	5
Underground powerline contact	42	52	45	60	55	50	41	70	61	68
Overhead powerline contact	132	112	118	148	110	87	120	142	145	159

Source: ESA records

Conclusion
Overhead powerline contact remains the leading cause in utility-related electrical incidents between 2009 and 2018; however, the total number of utility-related electrical incidents has increased by **129%** when comparing 2009 and 2018.

5 NUMBER OF UTILITY-RELATED ELECTRICAL INCIDENTS BY OUTCOME IN ONTARIO, 2009–2018



Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Critical injury	7	4	2	0	5	4	4	4	1	2
Fatality	5	3	2	2	4	3	2	0	3	2
Non-critical injury	17	7	16	19	10	8	2	4	2	3
Property damage	1	0	0	0	1	1	1	8	2	14
Unknown	3	0	1	0	0	0	1	1	0	0

Source: ESA records

Conclusion
The number of utility-related incidents that resulted in fatality has decreased when comparing 2018 to 2017. However, the number of utility-related incidents that resulted in property damage has increased when compared to 2017.

3.1 Case Study: Powerline Safety

The Incident

While excavating to prepare for the installation of new utility poles, a Hydrovac (hydro vacuum) truck worker was electrocuted when a truck's boom arm was guided into existing 16,000 V (phase-to-ground) energized overhead powerlines. The wireless remote control device that guided the boom was carried by the operator. One of the device's toggles may have come into contact with either the operator's body or his clothing, causing the boom to contact the overhead powerlines, energizing the truck and electrocuting a second crew member.

Incident Details

A Local Distribution Company retained a contractor to install new poles for relocating existing powerlines that were crossing multiple lanes of two highways. The contractor subcontracted an excavating contractor to dig holes for the new utility poles by using Hydrovac excavation. Crews would use specialized Hydrovac trucks, consisting of a high-pressure water hose to break down the dirt, and a long articulating boom attached to a vacuum tube, which would remove the broken-down dirt to create the hole for a utility pole. A wireless remote control device operated the boom arm of the Hydrovac truck.

On this day, two crews arrived, each with a Hydrovac truck, and began setting up by installing dig tube extensions to allow the vacuum to reach the excavation depth areas. Each crew consisted of two members: one was an operator responsible for controlling the Hydrovac assembly, and the other was a helper who assisted in setting up and acted as the signaller during excavation. A designated signaller is a person whose task is to warn an operator each time any part of the vehicle, equipment, or its load approaches three metres from an energized overhead powerline.

While on the field side of the truck, one of the two-man crews discussed how many extension tubes were required to achieve the acquired depth. The operator, who had the activated wireless remote control device hanging by a strap around his neck, walked to the roadside of the Hydrovac truck, where the extension tubes were stored on the truck's undercarriage. As he leaned down to pick up an extension tube, one or more of the toggles on the device made contact with his body or snagged on his clothing. This inadvertently caused the boom to move and contact the existing overhead 16,000 V primary line. When he heard an explosion, the operator ran over to the other side of the truck, where he found the helper on the ground in distress.

Using the wireless remote control device, the operator guided the boom away from the powerlines so the worker could be safely aided. EMS were called. Unfortunately, after the helper was transported to the hospital, he later succumbed to his injuries.

3.1 Case Study: Powerline Safety continued

Figure 1: General incident scene.

Figure 2: Tire damage.

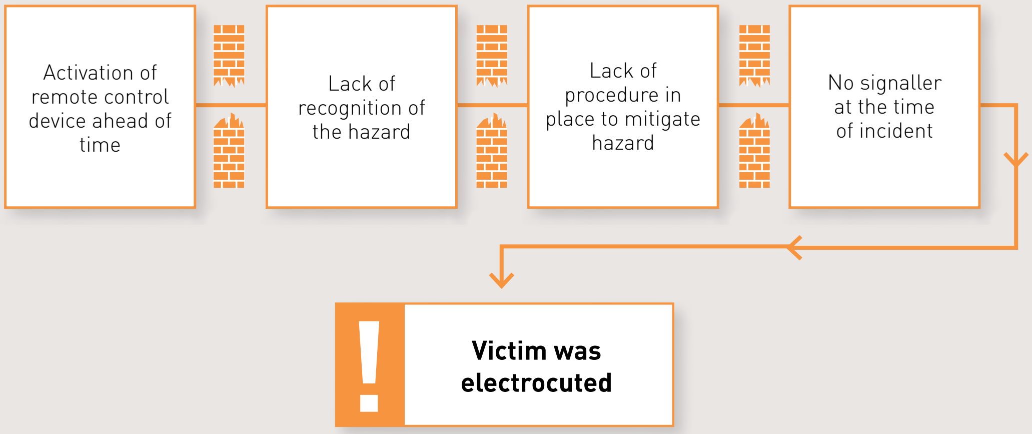
Figure 3: Wireless remote control device.

Figure 4: Extension tubes.

Further investigation revealed the following:

1. **Activation of the wireless remote control device ahead of time** – One of the crew members activated the remote control device ahead of time. This inadvertently created a potentially hazardous condition: the wireless remote control device could manoeuvre the boom upon triggering the toggles on this device, at a time when there was no signaller monitoring the boom.
2. **Lack of recognition of the hazard** – Upon activating the wireless remote control device, there was now the possibility of controlling the boom arm before the helper was free to perform signalling duties, as the helper was setting up at the time. This potentially hazardous condition was not accounted for when the remote control device was activated.
3. **Lack of procedure in place to mitigate hazard** – The procedure for performing the job did not take into consideration this risk. As such, there were no steps within safety procedures to indicate that a signaller should begin his watch duty the moment the wireless remote control device was activated.
4. **No signaller at the time of incident** – A signaller's sole purpose is to monitor the boom to ensure it does not come within the limits of approach of a powerline, which, in this scenario, would be three metres (ten feet). If the boom came too close, the signaller would immediately inform the operator that the boom was encroaching on the minimum distance allowed to the overhead powerline. At the time of incident, there was no monitoring or signalling for the distance between the boom and powerlines.

3.1 Case Study: Powerline Safety continued



4.0 Overview of Fires in Ontario

Fire remains a significant threat to life and property in urban and rural areas. In 2002 (the most recent national data in Canada), a total of 53,589 fires were reported in Canada. This number included 304 fire deaths, 2,547 fire injuries, and billions of dollars in property losses. Structural fires, especially residential fires, remain a critical concern. The high number of electrical incidents and the associated dollar loss, as well as the number of "deliberate" fires and their associated dollar loss, are the two other areas of major concern (Asgary et al., 2010).

Ontario reported 35,342 structure-loss fires (fires resulting in an injury, fatality or dollars lost) between 2013 and 2017. This number is a 2% decrease from 36,159 structure-loss fires between 2012 and 2016. Residential-loss fires account for 73% of structure-loss fires from 2013 to 2017. Stove-top fires (with electricity fuel only) account for 8% of structure-loss fires and 10% of residential-loss fires. Since 2013, there has been a 4% decrease in total fires, a 7% decrease in structure-loss fires, and a 9% decrease in residential-loss fires.

For the period between 2013 and 2017, the OFMEM identified the following as the most common ignition sources for structure-loss fires:

- cooking (18%);
- electrical distribution equipment – wiring (9%);
- heating and cooling equipment (8%);
- miscellaneous-includes fires – natural causes and chemical reactions (8%);
- cigarettes (7%);
- appliances (5%); and
- other electrical, mechanical (5%).

When comparing 2008–2012 and 2013–2017, the average number of structure-loss fires per year by ignition source decreased 8% for cooking, 11% for electrical wiring, 17% for heating/cooling equipment, and 5% for appliances.

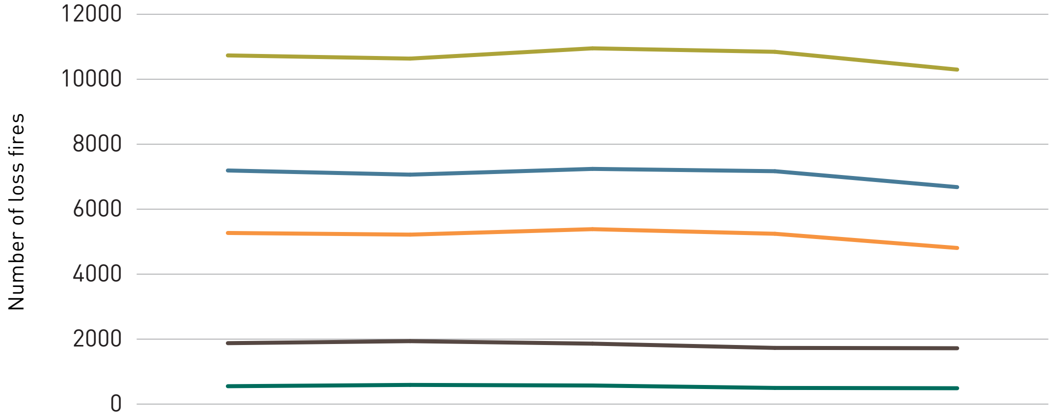
When structure-loss fires were limited to those where electricity was identified as the fuel of the ignition source (but not necessarily the primary fuel energy source), the most common electrical-related products involved were:

- cooking equipment (42%);
- electrical distribution equipment (26%); and
- appliances (12%).

Electrical Products

The ESA defines electrical products as appliances, cooking equipment, lighting equipment, other electrical and mechanical equipment, and processing equipment. Data from the OFMEM show that the five-year average for electrical product fires (where electricity was identified as the fuel of the ignition source) between 2008–2012 and 2013–2017 has decreased by 17%.

1 NUMBER OF LOSS FIRES IN ONTARIO, 2013–2017

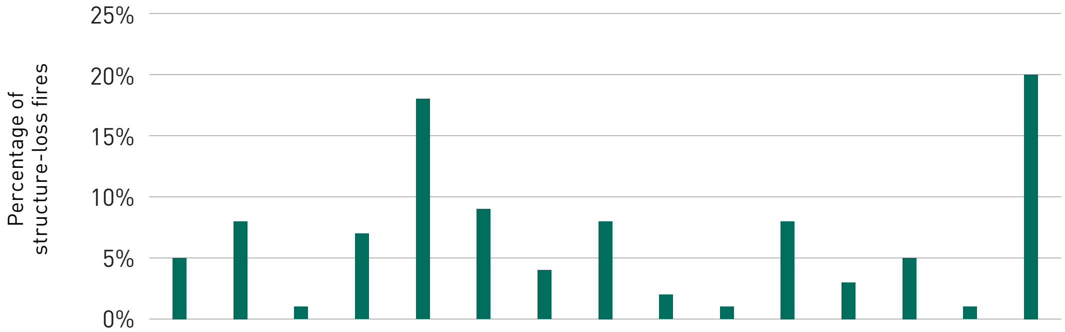


Year	2013	2014	2015	2016	2017
Total number of loss fires	10733	10635	10951	10844	10296
Structure-loss fires	7191	7063	7240	7169	6679
Residential-loss fires	5268	5217	5385	5243	4806
Structure-loss fires where electricity fuelled the ignition source	1876	1938	1861	1730	1720
Stove-top structure-loss fires	551	591	573	498	489

Source: OFMEM records

Conclusion
The number of loss fires (total, structure, residential, structure where electricity fuelled the ignition source, and stove-top) have decreased in the past five years.

2 PERCENTAGE OF STRUCTURE-LOSS FIRES BY IGNITION SOURCE IN ONTARIO, 2013–2017

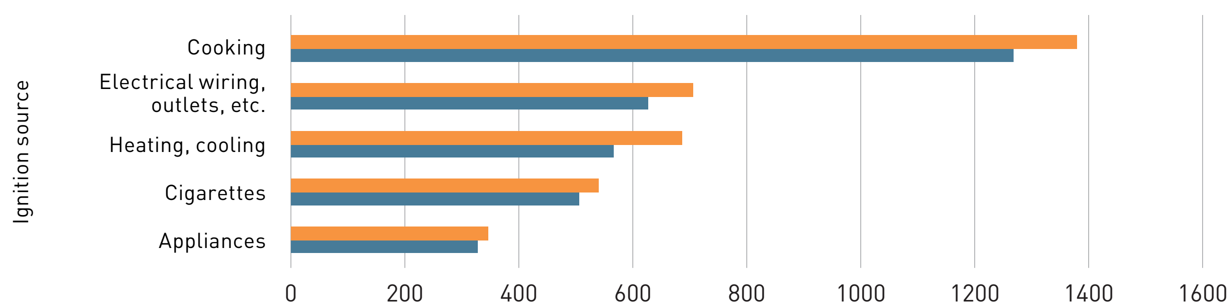


Ignition source	Appliances	Arson	Candles	Cigarettes	Cooking	Electrical wiring	Exposure	Heating, cooling	Lighting	Matches, lighters	Miscellaneous	Other open flame tools	Other electrical, mechanical	Processing equipment	Undetermined
2013–2017	5%	8%	1%	7%	18%	9%	4%	8%	2%	1%	8%	3%	5%	1%	20%

Source: OFMEM records

Conclusion
Aside from undetermined and miscellaneous sources, cooking and electrical wiring are the most common ignition sources for structure-loss fires between 2013 and 2017.

3 FIVE-YEAR AVERAGE NUMBER OF STRUCTURE-LOSS FIRES BY IGNITION SOURCE IN ONTARIO, 2008–2012 AND 2013–2017

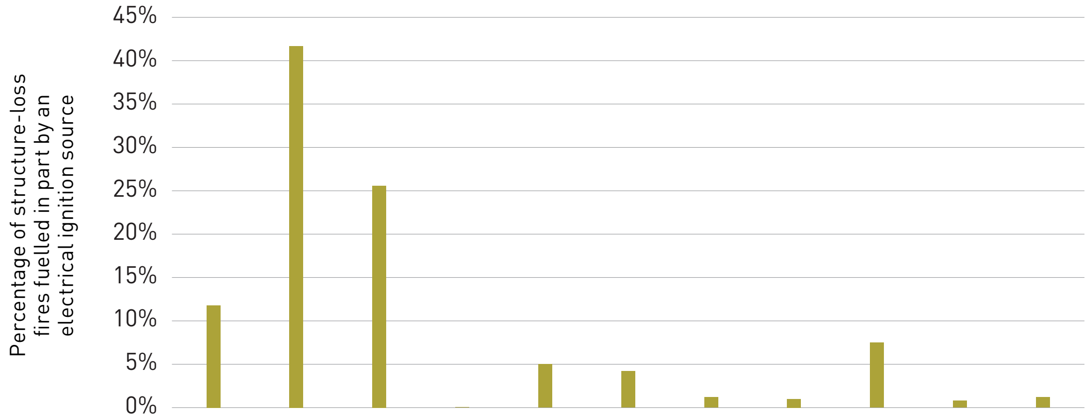


Ignition source		Cooking	Electrical wiring, outlets, etc.	Heating, cooling	Cigarettes	Appliances
Average number of structure-loss fires	2008–2012	1379	706	686	540	346
	2013–2017	1268	627	566	506	328

Source: OFMEM records

Conclusion
Cooking equipment remains the most common ignition source in 2008–2012 and 2013–2017, although the average number of structure-loss fires among cooking equipment, heating/cooling, electrical wiring, and appliances has decreased in the most recent time period.

4 PERCENTAGE OF STRUCTURE-LOSS FIRES FUELLED IN PART BY AN ELECTRICAL IGNITION SOURCE IN ONTARIO, 2013–2017



Electrical ignition source	Appliances	Cooking	Electrical distribution equipment	Exposure	Heating, chimney	Lighting	Miscellaneous	Open flame	Other electrical, mechanical	Processing equipment	Undetermined
Percentage of structure-loss fires	11.8%	41.7%	25.6%	0.05%	5%	4.2%	1.2%	1%	7.5%	0.8%	1.2%

Source: OFMEM records

Conclusion
When the fire is from ignition sources that use electricity, cooking equipment, electrical distribution equipment, and appliances were the most common ignition sources between 2013 and 2017.

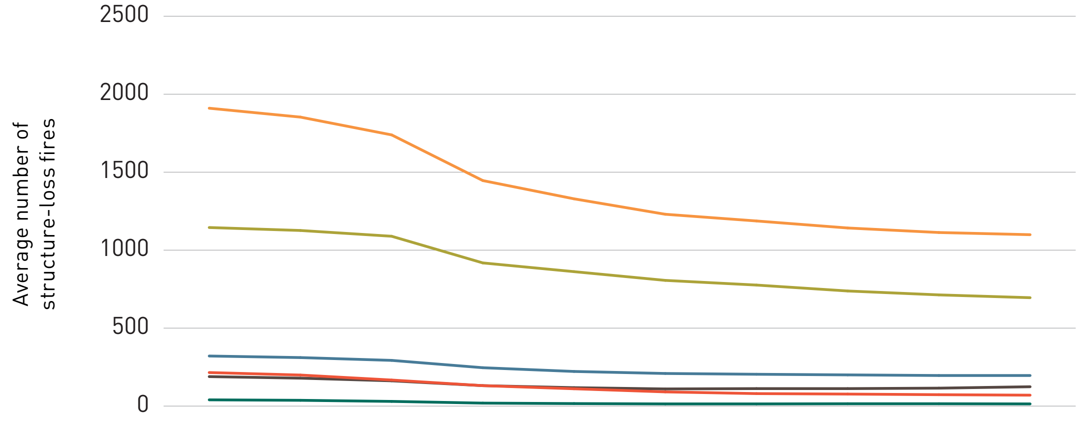
5 PERCENTAGE OF ELECTRICAL STRUCTURE-LOSS FIRES IN ONTARIO BY TIME OF DAY, 2008–2017

Time	Midnight – 8 a.m.	8 a.m. – 4 p.m.	4 p.m. – Midnight
Percentage	18%	39%	43%

Source: OFMEM records

Conclusion
Between 2008 and 2017, most of the electrical-related structure-loss fires occurred in the period from 4 p.m. to midnight.

6 FIVE-YEAR ROLLING AVERAGE NUMBER OF ELECTRICAL STRUCTURE-LOSS FIRES BY PRODUCTS IN ONTARIO, 2004-2017



Five-year period	2004–2008	2005–2009	2006–2010	2007–2011	2008–2012	2009–2013	2010–2014	2011–2015	2012–2016	2013–2017
Appliances	321	311	293	246	222	209	204	200	196	196
Cooking equipment	1145	1126	1089	918	862	806	776	738	713	695
Lighting	215	199	167	131	111	91	80	77	73	70
Other electrical, mechanical	189	179	162	131	118	110	112	112	115	124
Processing equipment	40	37	30	19	16	14	14	15	15	14
Product safety overall	1910	1853	1739	1446	1329	1230	1187	1142	1113	1099

Source: OFMEM records

Conclusion
Between 2008–2012 and 2013–2017, the five-year rolling average number of fires by total electrical products has decreased by **17%**.

Statistics Directly Related to the ESA's Harm Reduction Priorities — PRODUCT SAFETY

Number of electrical-product related fires: a product fire is defined as one involving appliances, cooking equipment, lighting equipment, and other electrical, mechanical, or processing equipment as classified by the OFMEM's data.

The product safety five-year rolling average has decreased by 17% between 2008–2012 and 2013–2017.

4.1 Fires Resulting in Fatalities

In 2007, British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, New Brunswick, Nova Scotia, and the Northwest Territories reported 226 fire deaths (Wijayasinghe, 2011). Many of these incidents involved residential properties. The frequency of residential fires is concerning because they are the most common source of fire-related death (Miller, 2005). In 2002, 82% of the 304 fire deaths were residential fires (Council of Canadian Fire Marshals, 2002). Similarly in 2006, 80% of Americans who died in a fire died in a residence (Karter, 2007). In the early 1990s, residential fires caused the deaths of between 4,000 and 5,000 Americans and injured an additional 20,000 each year (Baker and Adams, 1993).

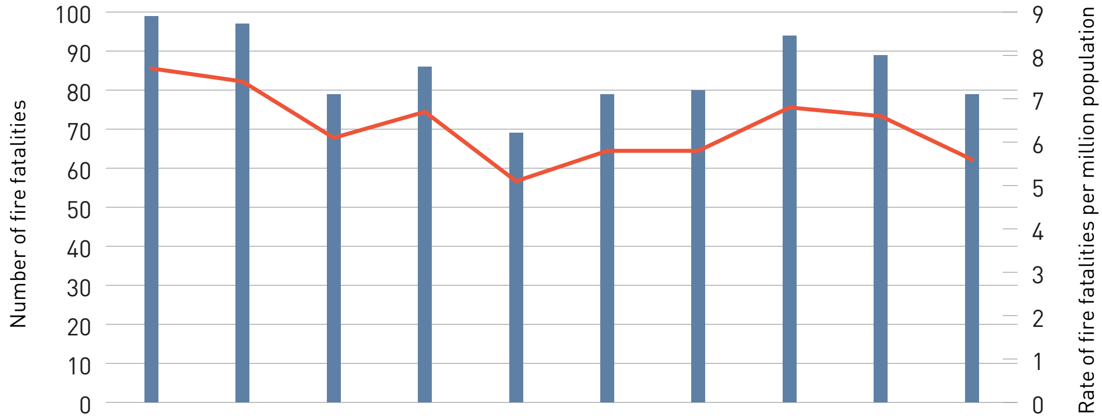
Ontario reported 851 deaths due to fires between 2008 and 2017. This number excludes fire deaths in vehicle collisions, fire fatalities among emergency response, or any fire deaths on federal or First Nations property. This number is less than what was reported between 2007 and 2016, where 864 deaths were reported. The OFMEM reported that in 2017, the fire death rate was 5.6 deaths per million population, which is a 27% decrease when compared to the fire death rate in 2008, which was 7.7 deaths per million population.

Structure-loss fires are fires that result in an injury, fatality, and/or financial loss that occur in structures (as opposed to vehicles or the outdoors). In Ontario, there were 765 fire fatalities from structure-loss fires from 2008 to 2017. This is a slight decrease (~2%) when compared to the previous ten-year period of 779 fire fatalities from 2007 to 2016. The OFMEM's reported that in 2017, the structure-loss fire death rate was 4.9 per million population, which is a 28% decrease when compared to the structure-loss fire death rate in 2008, which was 6.8 deaths per million population.

The OFMEM data identified 80 deaths in fires for which electricity was the fuel of ignition source or fires from electrical distribution equipment between 2008 and 2017. Since 2008, the death rate from this type of fire has decreased 54% from 0.62 deaths per million population to 0.28 deaths per million population.

In these types of fires in which the investigations were considered closed, 95% were considered accidental between 2013 and 2017. Stove or range-top burners accounted for 43% of fire fatalities fuelled by electricity in the last ten years.

1 NUMBER AND RATE OF ALL FIRE FATALITIES IN ONTARIO, 2008–2017

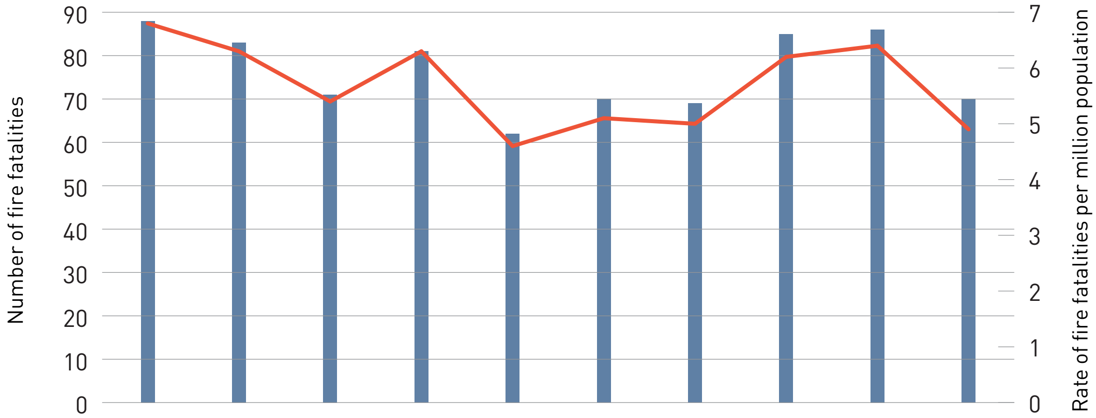


Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
All fire fatalities in Ontario	99	97	79	86	69	79	80	94	89	79
Ontario population in millions	12.9	13.1	13.2	12.9	13.4	13.6	13.7	13.8	13.4	14.2
Fire death rate in Ontario	7.7	7.4	6.1	6.7	5.1	5.8	5.8	6.8	6.6	5.6

Source: OFMEM records

Conclusion
The number and rate of fire fatalities have remained variable since 2008; however, the number and rate of fire fatalities have been slightly decreasing since 2015.

2 NUMBER AND RATE OF FIRE FATALITIES IN STRUCTURE FIRES IN ONTARIO, 2008–2017

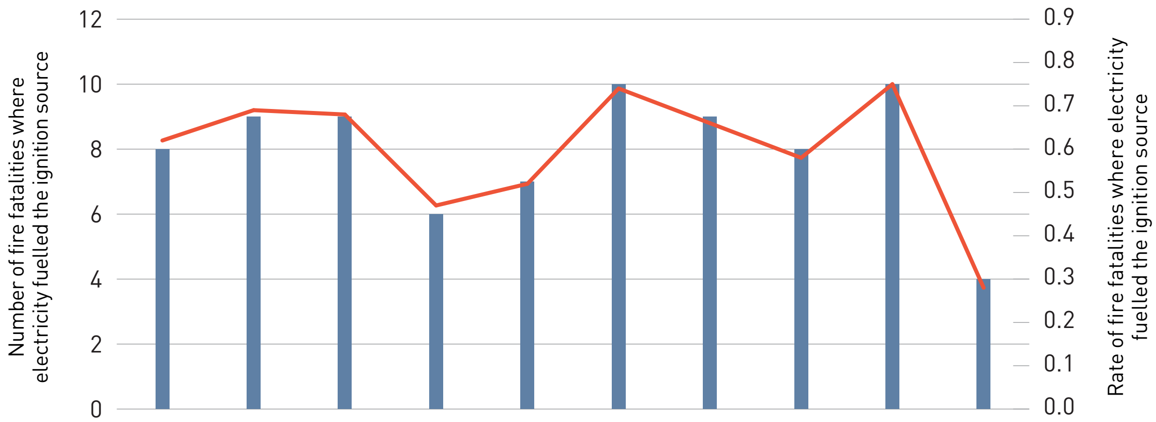


Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Number of fire fatalities from structure fires	88	83	71	81	62	70	69	85	86	70
Ontario population in millions	12.9	13.1	13.2	12.9	13.4	13.6	13.7	13.8	13.4	14.2
Rate of fire fatalities from structure fires	6.8	6.3	5.4	6.3	4.6	5.1	5	6.2	6.4	4.9

Source: OFMEM records

Conclusion
The rates of fire fatalities in structure fires have been showing an increasing trend since 2012; however, the number of fire fatalities decreased in 2017.

3 NUMBER AND RATE OF STRUCTURE FIRE FATALITIES WHERE ELECTRICITY WAS THE FUEL OF THE IGNITION SOURCE IN ONTARIO, 2008–2017



Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Number of fatalities where electricity fuelled the ignition source	8	9	9	6	7	10	9	8	10	4
Ontario population in millions	12.9	13.1	13.2	12.9	13.4	13.6	13.7	13.8	13.4	14.2
Rate of fatalities where electricity fuelled the ignition source	0.62	0.69	0.68	0.47	0.52	0.74	0.66	0.58	0.75	0.28

Source: OFMEM records

Conclusion

The rate of structure fire fatalities where electricity fuelled the ignition source or where the fires were from electrical distribution equipment has decreased from 2016 to 2017.

4 PERCENTAGE OF STRUCTURE FIRE FATALITIES WHERE ELECTRICITY WAS THE FUEL OF THE IGNITION SOURCE BY CAUSE CLASSIFICATION IN ONTARIO, 2013–2017 (CLOSED FIRE INVESTIGATIONS ONLY)

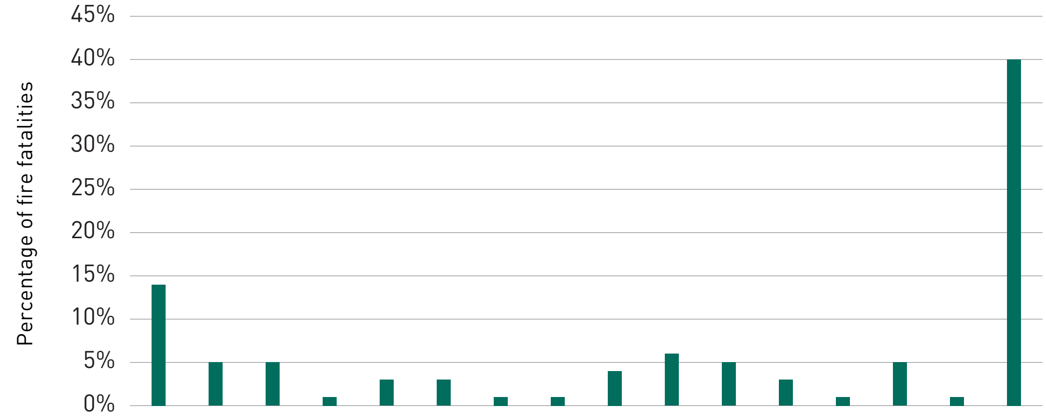
Cause classification	Accidental	Undetermined
2013–2017	95%	5%

Source: OFMEM records

Conclusion
Almost all structure fire fatalities (**95%**) where electricity fuelled the ignition source or where the fires were from electrical distribution equipment are accidental.

5

PERCENTAGE OF STRUCTURE FIRE FATALITIES WHERE ELECTRICITY WAS THE FUEL OF THE IGNITION SOURCE BY IGNITION SOURCE IN ONTARIO, 2008–2017 (CLOSED FIRE INVESTIGATIONS ONLY)



Ignition source	Circuit wiring – copper	Clothes dryer	Cord, cable for appliance, electrical articles	Deep fat fryer	Electric blanket, heating pad	Extension cord, temporary wiring	Incandescent lamp lightbulb, spotlight	Multiple competent ignition sources	Other cooking items (e.g., toaster, kettle)	Other electrical	Other electrical distribution items	Other heating equipment	Other lighting equipment	Oven	Space heater – portable	Stove, range-top burners
Percentage	14%	5%	5%	1%	3%	3%	1%	1%	4%	6%	5%	3%	1%	5%	1%	40%

Source: OFMEM records

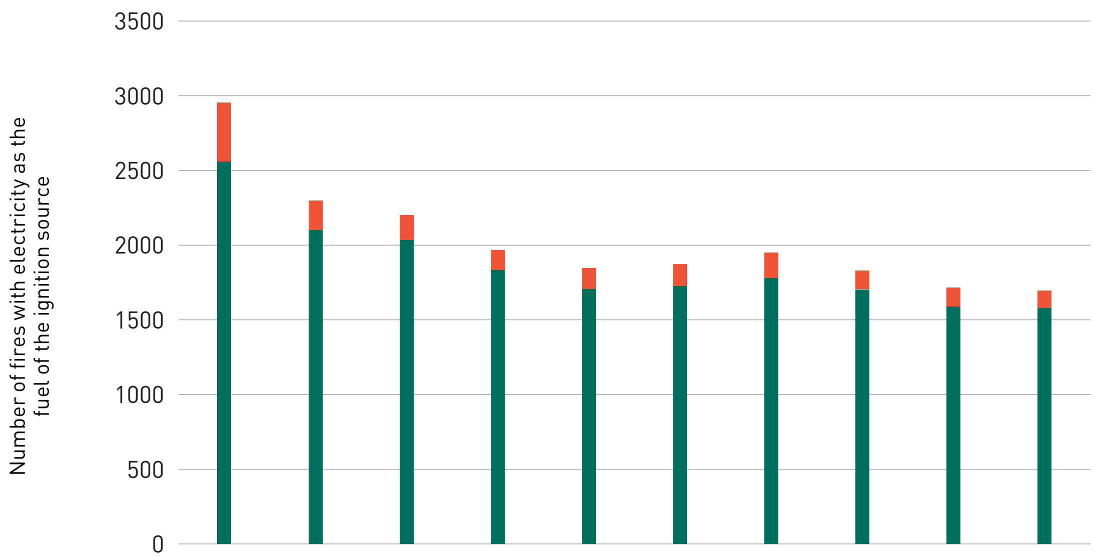
Conclusion
The stove remains the most common ignition source when examining structure fire fatalities where electricity fuelled the ignition source or where the fires were from electrical distribution equipment in the most recent ten-year period.

4.2 Fire Incidents with Electricity as the Fuel of the Ignition Source of the Fire

When electricity was the fuel of the ignition source of the fires, there were 18,520 loss fires and 1,801 no-loss fires for a total of 20,321 structure fires from 2008 to 2017. Over the same time period, there was a 38% decrease in structure-loss fires and a 43% decrease in total structure fires.

Between 2013 and 2017, 80% of structure fires occurred in the residential setting. Cooking equipment (50%), electrical distribution equipment (22%), and appliances (12%) remained the most common ignition source in these fires.

1 NUMBER OF STRUCTURE FIRES WITH ELECTRICITY AS THE FUEL OF THE IGNITION SOURCE IN ONTARIO, 2008–2017

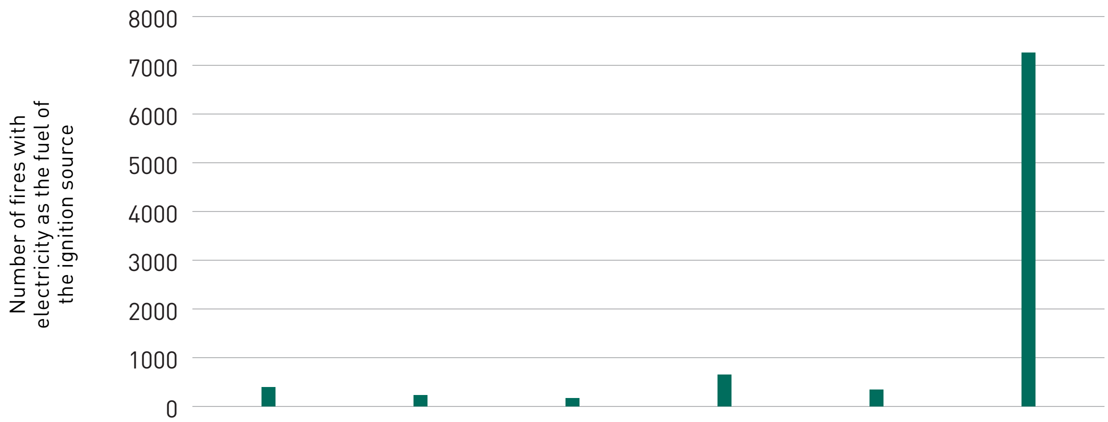


Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Number of fires with no loss	403	203	177	145	146	154	182	129	137	124
Number of fires with loss	2553	2093	2025	1823	1697	1716	1768	1696	1578	1571
Total fires with electricity as the fuel	2956	2296	2202	1968	1843	1871	1950	1825	1715	1695

Source: OFMEM records

Conclusion
In 2017, the total number of structure fires where electricity was the fuel of the ignition source decreased slightly by only **1%** when compared to 2016.

2 NUMBER OF FIRES WITH ELECTRICITY AS THE FUEL OF THE IGNITION SOURCE BY STRUCTURE CLASSIFICATION IN ONTARIO, 2013–2017

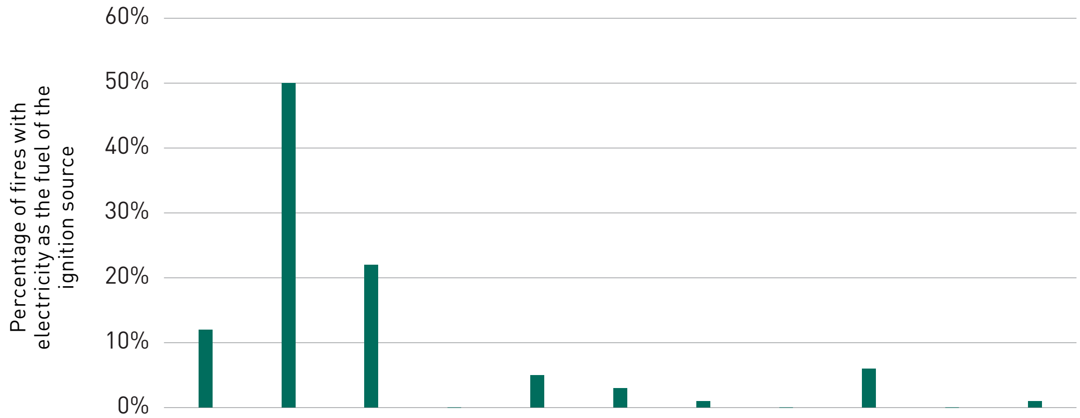


Structure classification	Assembly	Business and personal services	Care and detention	Industrial	Mercantile	Residential
Number of fires	396	236	174	650	340	7260

Source: OFMEM records

Conclusion
Residential structures were the most common structures (**80%**) in which fires where electricity was the fuel of the ignition source occurred between 2013 and 2017.

3 PERCENTAGE OF RESIDENTIAL FIRES WITH ELECTRICITY AS THE FUEL OF THE IGNITION SOURCE BY IGNITION SOURCE IN ONTARIO, 2013–2017



Ignition source	Appliances	Cooking equipment	Electrical distribution equipment	Exposure	Heating equipment, chimney, etc.	Lighting equipment	Miscellaneous	Open flame tools, smokers' articles	Other electrical, mechanical	Processing equipment	Undetermined
Percentage	12%	50%	22%	0%	5%	3%	1%	0%	6%	0%	1%

Source: OFMEM records

Conclusion
Cooking equipment and electrical distribution equipment were the leading sources in residential fires when electricity fuelled the ignition source.

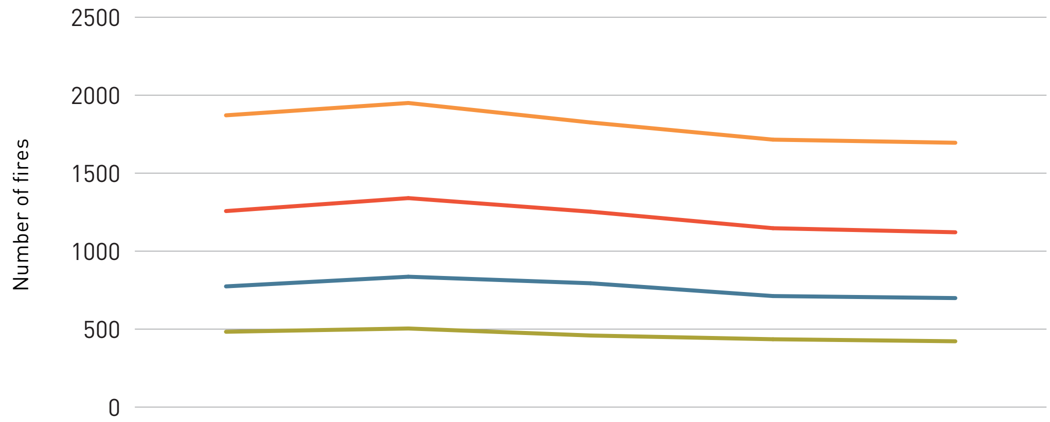
4.3 Cooking Fires with Electricity as the Fuel of the Ignition Source of the Fire

The National Fire Protection found that households that used electric ranges had a higher risk of cooking fires and associated losses than those using gas ranges. Their research also showed that a disproportionate share of home cooking fires were reported in apartments or other multi-family homes (Ahrens, 2017).

In 2007, the major cause of home fires in Canada from British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, New Brunswick, Nova Scotia, and the Northwest Territories were cooking fires (20%) (Wijayasinghe, 2011). In Ontario, from 2013 to 2017, there were 3,815 structure fires where the ignition source was cooking equipment fuelled by electricity. Of those, 3,618 occurred in homes. Since 2013, there has been a 10% decrease in this type of fire. Stove and range-top burners were the leading ignition source, followed by the oven and other cooking items. The overwhelmingly cited possible cause to these cooking fires was leaving the stove or range-top burner unattended.

The OFMEM's fire-loss reporting system identified cooking equipment as one of the leading ignition sources associated with preventable home injuries. Residential fires that were ignited from cooking equipment that used electricity accounted for an annual average of 133 injuries among civilians and an average of four fatalities between 2013 and 2017. In this time period, cooking equipment was the leading ignition source in fires from electrical products or where electricity fuelled the ignition source. These fires resulted in an average loss of $19.1 million annually.

1 NUMBER OF COOKING EQUIPMENT AND ELECTRICAL DISTRIBUTION EQUIPMENT FIRES IN ONTARIO, 2013–2017

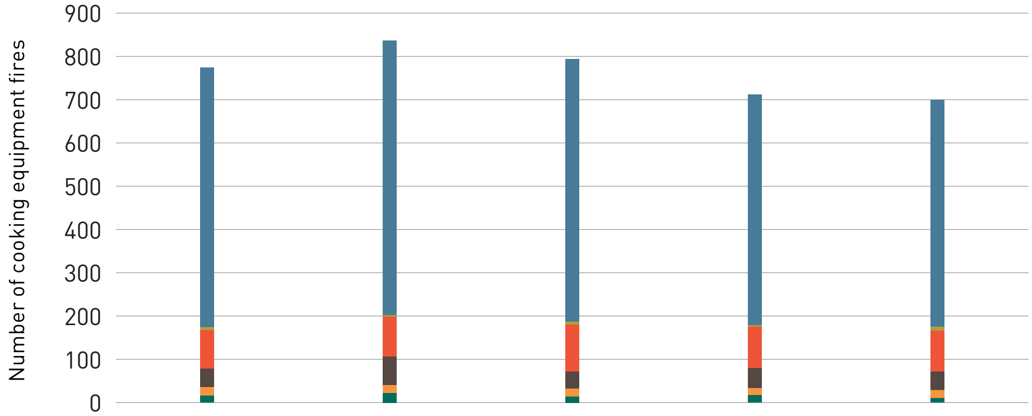


Year	2013	2014	2015	2016	2017
Cooking equipment	774	836	794	712	699
Electrical distribution equipment	483	504	459	435	422
Total cooking equipment and electrical distribution equipment fires	1257	1340	1253	1147	1121
Total fires with electricity as the fuel	1871	1950	1825	1715	1695

Source: OFMEM records

Conclusion
The number of structure fires from cooking equipment (where electricity fuelled the ignition source) and electrical distribution equipment (where electricity fuelled the ignition source) has decreased by **11%** when compared to 2013.

2 NUMBER OF COOKING EQUIPMENT FIRES WITH ELECTRICITY AS THE FUEL OF THE IGNITION SOURCE BY SOURCE IN ONTARIO, 2013–2017

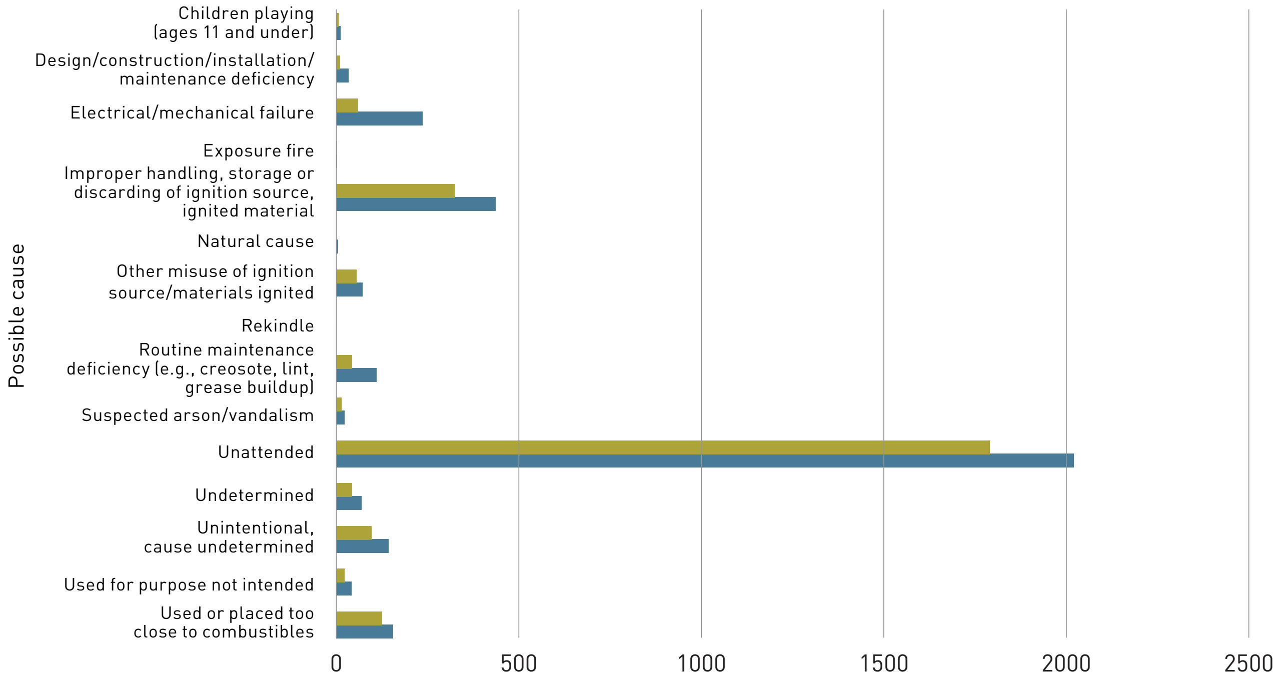


Year	2013	2014	2015	2016	2017
Stove, range-top burner	600	634	607	533	524
Range hood	6	4	7	4	9
Oven	90	92	108	95	95
Other cooking items	43	66	40	47	42
Microwave	19	18	18	16	19
Deep fat fryer	16	22	14	17	10

Source: OFMEM records

Conclusion
Stoves and range-top burners were the leading sources (**76%**) of cooking equipment fires between 2013 and 2017.

3 NUMBER OF STOVE-TOP FIRES VS. COOKING EQUIPMENT FIRES BY POSSIBLE CAUSE IN ONTARIO, 2013–2017



Number of fires / Possible cause	Children playing (ages 11 and under)	Design/construction/installation/ maintenance deficiency	Electrical failure/ mechanical failure	Exposure fire	Improper handling, storage or discarding of ignition source or ignited material	Natural cause	Other misuse of ignition source/ materials ignited	Rekindle	Routine maintenance deficiency (e.g., creosote, lint, grease buildup)	Suspected arson/vandalism	Unattended	Undetermined	Unintentional, cause undetermined	Used for purpose not intended	Used or placed too close to combustibles
Stove-top fires	6	10	60	2	326	1	56	0	43	15	1791	43	96	23	125
Cooking equipment fires	11	34	236	2	437	5	72	0	110	23	2021	69	143	42	156

Source: OFMEM records

Conclusion
Leaving cooking equipment unattended was the most common cause of stove-top and cooking equipment fires between 2013 and 2017.

4.4 Electrical Distribution Equipment Fires with Electricity as the Fuel of the Ignition Source of the Fire

The OFMEM defines electrical distribution equipment as electrical wiring, devices, or equipment where the primary function is to carry current from one location to another. Thus, wiring, extension cords, terminations, electrical panels, and cords on appliances are considered electrical distribution equipment. This is not to be confused with utility equipment from Local Distribution Companies.

In the five-year period between 2013 and 2017, the OFMEM identified 2,303 fires as electrical distribution equipment fires with electricity as the fuel of the ignition source. The five-year rolling average of electrical distribution equipment loss structure fires has decreased by 22% between 2008–2012 and 2013–2017.

The most common ignition source of electrical distribution equipment fires was circuit wiring – aluminum and copper, and the number of fires from this source has decreased by 28% when comparing 2008–2012 and 2013–2017. Electrical failure is the most common possible cause in these types of fires.

In the United States, it is estimated that local fire departments respond to an average of 35,150 home fires involving electrical distribution and lighting equipment per year. An estimate of 490 civilian deaths and 1,200 civilian injuries occur each year between 2012–2016, with an estimated cost of $1.3 billion in direct property damage.

Electrical distribution or lighting equipment accounted for 6% of home structure fires between 2003 and 2007, ranking fourth among major causes behind cooking equipment, heating equipment, and intentional home fires. Electrical distribution or lighting equipment also accounted for 12% of associated deaths, ranking behind smoking materials, heating equipment, and cooking equipment. (Hall, 2008).

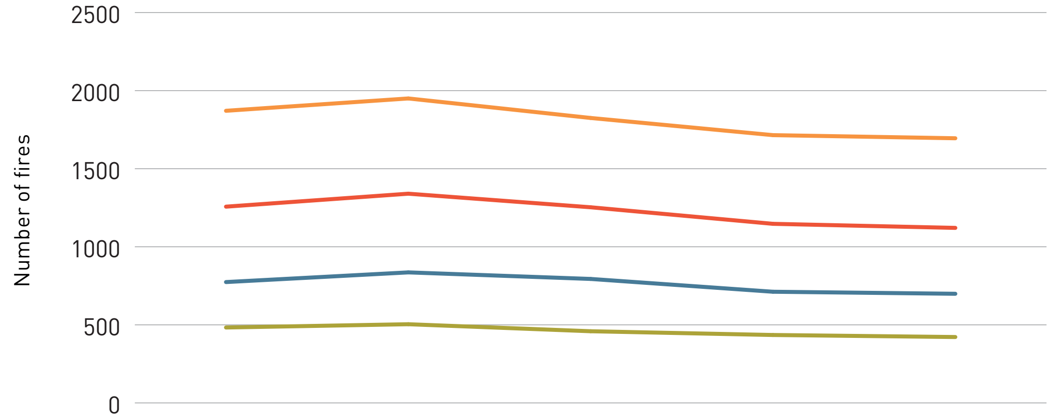
Section 4.5 provides a case study that is representative of the risk factors associated with electrical distribution equipment fires.

Statistics Directly Related to the ESA's Harm Reduction Priorities — AGING INFRASTRUCTURE AND DISTRIBUTION EQUIPMENT FIRES

Number of electrical wiring-related fires: this includes fires from copper and aluminum wiring, extension cords, appliance cords, terminations, and electrical panels — electrical devices categorized by the OFMEM as electrical distribution equipment.

The electrical distribution equipment loss structure fires related to aging infrastructure's five-year rolling average has decreased by 22% between 2008–2012 and 2013–2017.

1 NUMBER OF COOKING EQUIPMENT AND ELECTRICAL DISTRIBUTION EQUIPMENT FIRES IN ONTARIO, 2013–2017

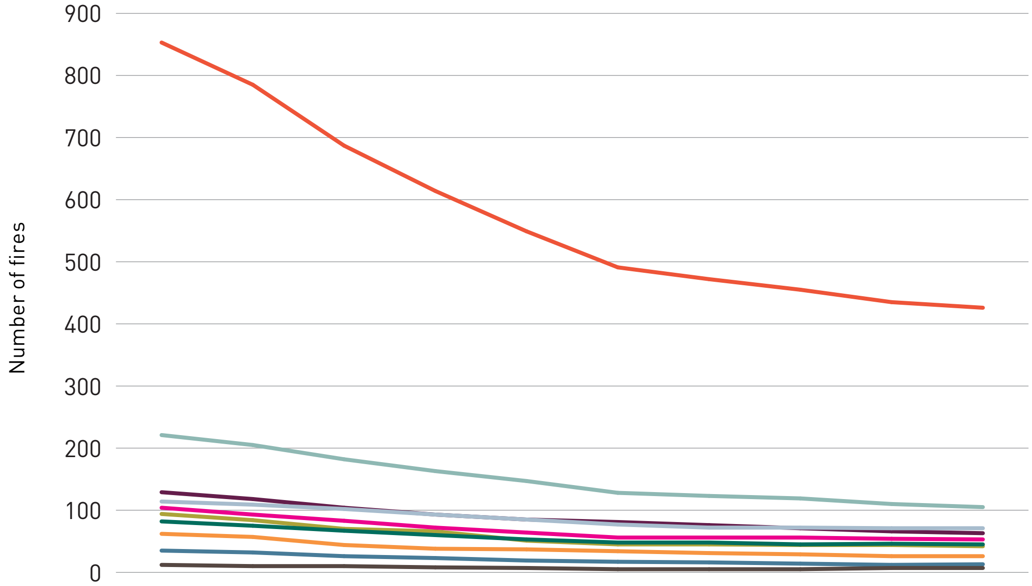


Year	2013	2014	2015	2016	2017
Cooking equipment	774	836	794	712	699
Electrical distribution equipment	483	504	459	435	422
Total cooking equipment and electrical distribution equipment fires	1257	1340	1253	1147	1121
Total fires with electricity as the fuel	1871	1950	1825	1715	1695

Source: OFMEM records

Conclusion
The total number of electrical distribution equipment structure fires has decreased **13%** since 2013.

2 FIVE-YEAR AVERAGE NUMBER OF ELECTRICAL DISTRIBUTION EQUIPMENT STRUCTURE-LOSS FIRES BY IGNITION SOURCE IN ONTARIO, 2004–2017



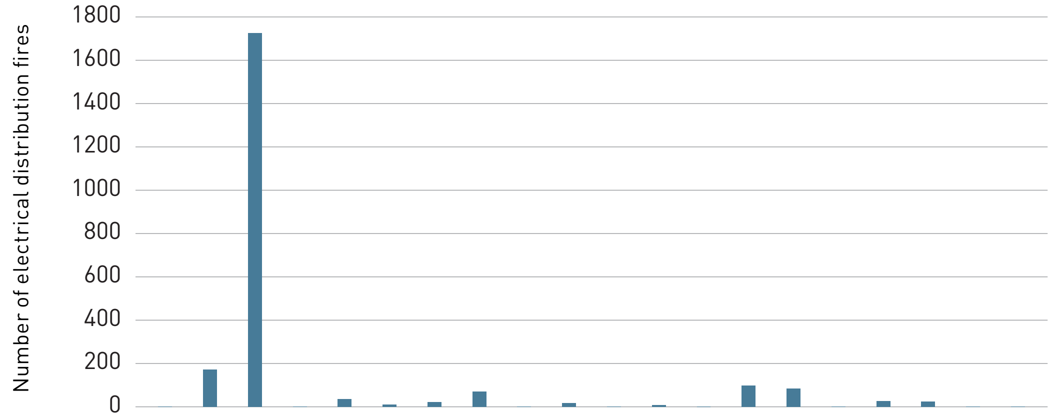
Five-year period	2004–2008	2005–2009	2006–2010	2007–2011	2008–2012	2009–2013	2010–2014	2011–2015	2012–2016	2013–2017
Circuit wiring – Al, Cu (includes conductors)	221	205	182	163	147	128	123	119	110	105
Cord, cable for appliance, electrical articles	114	109	102	93	85	77	72	72	71	71
Distribution equipment (includes panel boards, fuses, circuits)	129	118	104	93	85	81	76	71	66	63
Extension cord, temporary wiring	82	75	67	60	53	48	48	45	46	45
Meter	12	10	10	8	7	5	5	5	7	7
Other electrical distribution item	104	93	83	72	64	56	56	56	54	53
Service/utility lines (includes power/hydro transmission lines)	62	57	44	38	37	34	31	29	26	26
Terminations – Al, Cu (includes receptacles, switches, lights)	94	84	70	66	51	45	45	44	44	42
Transformer	35	32	26	23	19	17	16	14	12	13
Total	853	785	687	614	549	491	472	455	435	426

Source: OFMEM records

Conclusion

Circuit wiring — aluminum and copper remained the leading ignition source in electrical distribution equipment between 2004 and 2017. The five-year rolling average of electrical distribution equipment loss structure fires shows a **22%** decrease between 2008–2012 and 2013–2017.

3 NUMBER OF ELECTRICAL DISTRIBUTION EQUIPMENT FIRES BY POSSIBLE CAUSE IN ONTARIO, 2013–2017



Possible cause	Children playing (ages 11 and under)	Design/construction/installation/ maintenance deficiency	Electrical/mechanical failure	Exposure fire	Improper handling/storage/discard of ignition source or ignited material	Natural cause	Other misuse of ignition source/ material ignited	Other unintentional cause, not classified	Rekindle	Routine maintenance deficiency (e.g., creosote, lint, grease buildup)	Suspected vandalism	Unattended	Under investigation	Undetermined	Unintentional, cause undetermined	Unknown, not reported	Used for purpose not intended	Used or placed too close to combustibles	Vehicle collision	Suspected youth vandalism
Number of electrical distribution fires	1	172	1726	1	36	10	21	71	1	18	2	7	0	97	85	1	27	24	2	1

Source: OFMEM records

Conclusion
Electrical/mechanical failure was the leading cause of electrical distribution equipment structure fires between 2013 and 2017.

4.5 **Case Study**: Fire from Electrical Distribution Equipment

The Incident

A pantry closet fire causing a fatality and $230,000 damage to the property.

A fire in the pantry closet under the stairs in the basement of a 1.5-storey detached home resulted in a fatality and extensive damage. The fire was investigated by the local fire department, police, and OFMEM. The only viable ignition sources were electrical in nature — a light fixture, duplex receptacle, and associated wiring.

Incident Details

Some of the resulting damages to the house were:

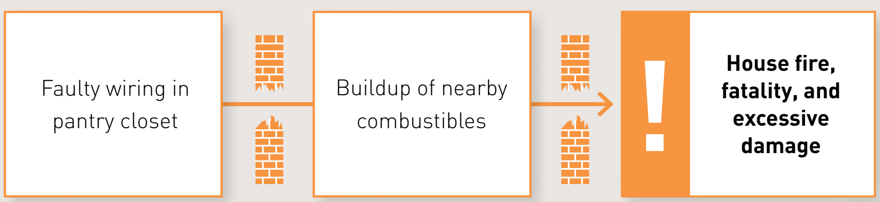
- The pantry under the stairs to the basement suffered the most damage. Most wood studs inside the pantry were heavily charred and some were consumed.
- Studs on the north and east walls, which were shared by the hallway and living room, were mostly consumed.
- There was a small amount of charring to the wood frame and wooden entry door to the pantry.
- The kitchen suffered some heat and fire damage, with fire damage more prominent closer to the doorway of the kitchen leading to the staircase down to the basement.
- In the hallway between the kitchen and leading to the front door, the ceiling and walls sustained fire damage, mostly towards the kitchen.
- Living and dining rooms suffered heat and fire damage.
- The staircase leading to the two bedrooms upstairs was excessively damaged and non-usable as a result of the fire.
- The front bedroom suffered the most damage with part of the ceiling and roof consumed, and the majority of the plaster was off the walls.
- The bedroom and bathroom situated at the rear of the house sustained some heat and smoke damage but to a lesser degree, with much of the plaster still intact on the walls.

The occupant of the house, who lived alone, was found in a bedroom with no vital signs. He had collected numerous articles from flea markets and yard sales (approximately three feet of clothing, debris, and assorted articles) that rescue personnel had difficulty manoeuvring through.

4.5 Case Study: Fire from Electrical Distribution Equipment continued

Investigation findings:

- Upon testing the scene and exhibits from the area of origin, no ignitable liquids or accelerants were found. Therefore, a hypothesis of intentionally set fire was credibly eliminated.
- The point of origin of the fire was determined to be faulty wiring in the pantry closet.
- No other viable or credible ignition sources were found in the closet.
- The backside of a duplex receptacle was found along the east wall of the pantry. The wires going into the receptacle were damaged and no longer intact. Some external heat damage to the receptacle and cover plate were observed.
- A BX electrical cable (armoured cable) originating from the basement fed a light fixture in the pantry. The cable had been fed through a drilled hole in the floor. Although it had suffered some external heat damage, it remained intact.
- Contributing factors were determined to be faulty wiring and a buildup of combustibles in the vicinity of the area of origin, which resulted in the fatality and severe damage across the house.



This incident highlights the importance of ensuring proper wiring in aging infrastructures. A condition can exist for some time, with the hazard neither apparent nor interfering with workings of electrical devices, before actually turning into a fire hazard. Although the exact cause could not be determined in this case, it is always best to ensure proper wiring in your house. Furthermore, it is important to ensure combustibles are not stacked on wiring or within close enough proximity to generate a dangerous amount of heat, which can result in a fire.

5.0 Product Safety

Ontario Regulation 438/07 *Product Safety* enables the ESA to address the safety of electrical products and equipment offered for sale, sold, and used in Ontario. Requirements outlined under O. Reg 438/07 as of July 1, 2008, specifies that manufacturers, importers, distributors, wholesalers, retailers, certification bodies, and field evaluation agencies are required to report serious electrical incidents and defects to the ESA.

O. Reg 438/07 authorizes the ESA to protect the public against potentially unsafe electrical products in the marketplace by:

1. responding to product safety reports;
2. removing potentially unsafe, counterfeit, and unapproved electrical products from the marketplace;
3. requiring manufacturers to notify the public of potentially unsafe products; and
4. implementing prevention-based and proactive detection activities.

The ESA has developed target response strategies for various potentially unsafe products.

The *Canada Consumer Product Act* in 2011 created concurrent product safety systems for consumer electrical products in Ontario, including mandatory reporting obligations to the ESA and Health Canada. In June 2013, the Ministry of Government and Consumer Services (MGCS) amended the O. Reg 438/07 *Product Safety* to revoke the mandatory reporting requirements. As a result, manufacturers, importers, distributors, wholesalers, retailers, certification bodies, and field evaluation agencies are no longer required to report serious electrical incidents and defects with consumer electrical products to the ESA. All incidents involving consumer electrical products are now handled by Health Canada.

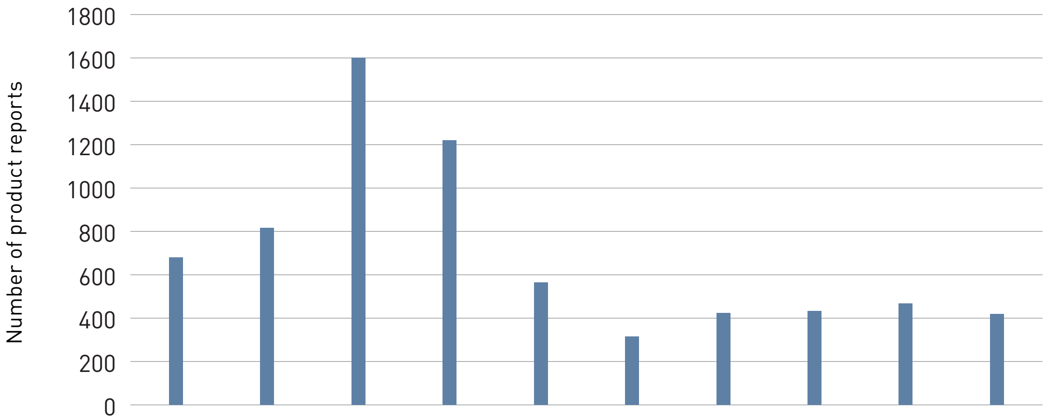
In the most recent ten years (2009–2018), Health Canada reported that consumer product incident reports came primarily from the industry, followed by the consumer and the media (LaRiccia, 2019). In 2018, Health Canada received 100 product reports on electric ranges or ovens, where the top hazards included excessive heat/overheating, fire, and sharp edges or points (Health Canada, 2019). Between 2009 and 2018, kitchen appliances were the most frequently reported electrical/electronic product, followed by heating and cooling appliances and lighting (LaRiccia, 2019).

Since 2009, there has been a 38% decrease to the number of product incidents reported to the ESA. During this time period, 2011 saw the highest number of incident reports. In 2018, there were 418 reports, a notable decrease, due to the decrease in reports of incidents and defects with consumer electrical products to the ESA.

In 2018, all product safety investigations initiated by the ESA were a result of voluntary reports. Of these reports, 79% (328 reports) were assigned to be Priority 2, which meant that the ESA could direct a range of corrective action plans to assure that no further serious incidents or accidents could occur.

In 2018, 80% of product incident reports were concerned with Unapproved Products (products that have not been tested and evaluated to the applicable Canadian Safety Standards and may not be safe to use). A smaller percentage of products dealt with Certified Products (products that were properly certified but reported to have a safety problem or a perceived safety problem) or Products with a Suspected Counterfeit Label.

1 NUMBER OF PRODUCT INCIDENT REPORTS SUBMITTED TO THE ESA IN ONTARIO, 2009–2018

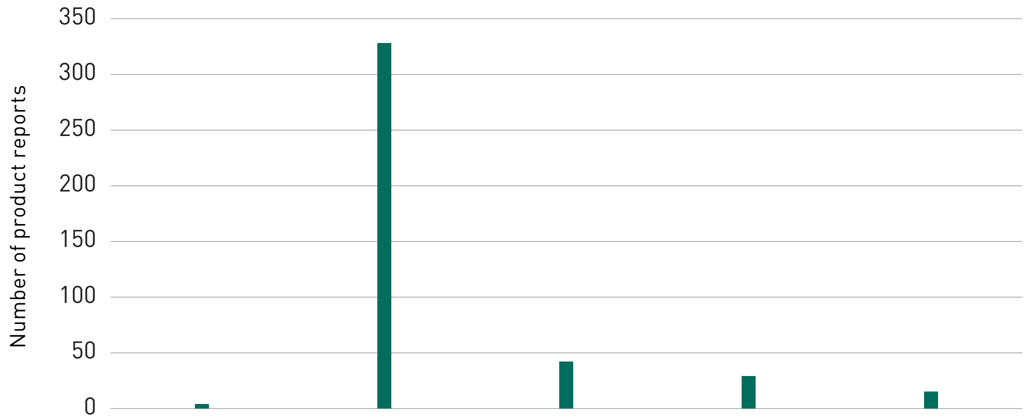


Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Number of product reports	679	817	1601	1220	564	316	423	432	468	418

Source: ESA records

Conclusion
Since 2009, the number of product incident reports has decreased by **38%**. Compared to the previous year of 2017, the number of reports for 2018 has decreased by **11%**.

2 NUMBER OF PRODUCT INCIDENT REPORTS BY PRIORITY LEVEL IN ONTARIO, 2018



Priority level	Priority 1 (most important)	Priority 2	Priority 3	Priority 4 (least important)	Triaged by Health Canada
Number of product reports	4	328	42	29	15

Source: ESA records

Conclusion

In 2018, **79%** of electrical incident reports to the ESA were classified as priority level 2.

3 PERCENTAGE OF PRODUCT INCIDENT REPORTS BY TYPE IN ONTARIO, 2018

Investigation type	Certified	With suspected counterfeit label	Unapproved
Percentage of product reports	15%	5%	80%

Source: ESA records

Conclusion

In 2018, **80%** of electrical incident reports were from unapproved electrical products.

5.1 **Notice**: Serious Injuries and Fatalities from Unsafe Use of Electrical Equipment to Pattern Wood and Other Materials

In 2017 and 2018, fatalities and critical injuries were reported to the ESA as a result of hobbyists using high-voltage energy to pattern wood and other materials.

The ESA is warning against using high-voltage energy sources such as microwave oven transformers or similar components to manufacture Lichtenberg generators. These generators are used to create art and abstract objects by burning fractal patterns into various materials such as wood and acrylic.

Do not attempt to assemble or use a Lichtenberg generator for any purpose. They are extremely dangerous, contain live accessible wiring and components, and are unsafe for any use or handling. Both homemade and pre-built Lichtenberg generators are considered to have the potential to seriously injure and/or kill the user.

- The ESA is now aware of three incidents in Ontario where these generators were used in an unsafe manner:
  - Two incidents resulted in a fatality.
  - One incident resulted in life-threatening critical injuries.
- All of these generators, whether homemade or purchased, are unapproved by certification bodies/inspection bodies, have not been evaluated or tested to any Canadian safety standards, and do not bear any recognized Canadian electrical safety certification marks.
- These generators are reportedly homemade, using instructions on the internet, and are assembled with parts and components that are obtained from a variety of sources and are not approved for this type of use.
- Some of these generators are marketed as complete products and indicate that they are built with approved/certified components. However, the overall product has not been evaluated to any known electrical safety standard(s) for this type of product, as applicable to Canadian consumers and the Canadian marketplace.
  - The risks associated with building and using a Lichtenberg generator include:
    - potentially unsafe construction and assembly methods;
    - both short- and long-term degradation of the product and components;
    - physiological effects of exposure to high-voltage/high-frequency energy sources;
    - lack of quality control processes and procedures; and
    - inadequate instructions pertaining to usage, storage, maintenance, required type(s) of personal protective equipment, etc.

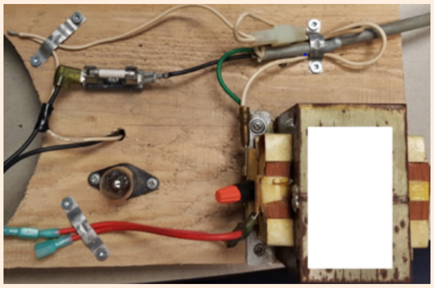
5.1 Notice: Serious Injuries and Fatalities from Unsafe Use of Electrical Equipment to Pattern Wood and Other Materials continued

Critical Hand Injury

The critical hand injury shown opposite (which was not the only injury that this hobbyist received) could have resulted in a fatality by electrocution had a resuscitation not been performed on the victim. Others in the immediate vicinity could have been killed or received a shock or serious injury.

Examples of Homemade Lichtenberg Generators

The combination of incorrect and/or unsuitable parts, dangerous assembly methods, and use of the finished product are considered to be major contributing factors resulting in reported serious injuries and fatalities.



How to Report Unsafe Electrical Products:

- The ESA is aware that generators exist in the marketplace and are offered for sale. When reported, suppliers within the ESA's jurisdiction will be contacted. Consumers/hobbyists are encouraged to contact the ESA at 1-877-ESA-SAFE or complete the online Product Safety Reporting Form at *https://www.esasafe.com/electricalproducts/reporting-an-incident/electrical-incident-report*.
- Lichtenberg generators may have counterfeit electrical safety approval labels applied to them to falsely indicate that they are safe. Should you find a generator that appears to have a certification or approval mark, do not purchase or use it, and please contact the ESA or Health Canada immediately with the supplier details.

The disassembling of products such as a microwave oven and/or similar devices or appliances with the purpose of removing the high-voltage transformer and other parts to build these generators are in breach of Ontario Regulation 438/07 *Product Safety* and 164/99 *Ontario Electrical Safety Code*. Please be advised that a person or company in Ontario that contravenes the foregoing regulation may be prosecuted and, upon conviction, subject to fines up to $50,000 and/or one year imprisonment.

Acknowledgements

The ESA acknowledges and thanks the Ontario **Ministry of Labour** (MOL) for providing information, notifying the ESA of occupational electrical injuries, and co-operating with the ESA in the investigation of these incidents.

The ESA thanks the **Office of the Fire Marshal and Emergency Management** (OFMEM) for its continuing support in providing information on fire-related electrical incidents, partnering with the ESA on stove-top fire initiatives, and notifying the ESA of electrical fire incidents.

The ESA also thanks the following organizations for their support:

- the Office of the Chief Coroner for Ontario for sharing coroners' information on electrical-related fatalities and other deaths in Ontario;
- the Workplace Safety and Insurance Board of Ontario (WSIB) for providing occupational injury information; and
- the Canadian Institute of Health Information (CIHI) for providing information on emergency department visits for electrical injury.

Development of this report was led by a team from the ESA, including Saad Pervez, Freda Lam, Said Ismail, and Joel Moody, with assistance from staff of the ESA's Utility Regulations, Product Safety, and Communications departments.

Methodology

The ESA receives data from various resources to compile this report. These include the Office of the Chief Coroner, MOL, the Association of Workers' Compensation Boards of Canada (AWCBC), OFMEM, and WSIB. The ESA then cross-references these data with the Coroners' reports, the OFMEM's reports, and the ESA's root-cause investigation data to ensure accuracy and understanding of the incidents. Data on non-serious incidents are taken as provided.

The Electrical Safety Authority's Data

The ESA uses Ontario population estimates from the Ontario Ministry of Finance (Historical and projected population for Ontario under three scenarios, 2006–2041, Part A and B: Estimates and Projections) to determine electrocution and death by fire as rate per population, and Statistics Canada labour force population estimates (Table 14-10-0018-01) to determine occupational injury rates.

The 2009 to 2018 electrocution statistics are based on Ontario Coroners' reports, ESA records, and MOL reports. At time of writing, OFMEM fire fatality information is only partially completed due to pending investigations and confirmations.

Data provided by the Office of the Chief Coroner takes precedence over other data in the event of discrepancies.

The electrocution and electrical burn fatality cases in the report are unintentional in nature. Suicide and deliberate attempts to injure are excluded, as well as deaths by lightning strikes. Electrocution from criminal activities such as theft of power, vandalism, pranks, or vehicles hitting a utility pole are counted as part of the statistics but are not included as part of preventable deaths. Death resulting from a fall but initiated by an electrical contact to a worker would not be recorded as an electrical-related fatality and therefore would not be accounted for in electrical injury data.

This report separates occupational and non-occupational (the general public) incidents for reason of stakeholder interest and to aid in identifying strategies to reduce the harm.

Workplace Safety Insurance Board Data

The WSIB defines lost time injuries (LTIs) as all allowed claims by workers who have lost wages as a result of a temporary or permanent impairment. LTI counts include fatalities. This data is provided by WSIB Enterprise Information Warehouse, data as of May 10, 2019, for all injury years.

Allowed LTIs for electrical burns and electrical-related fatalities are based on the following CSA Z795-96 nature of injury codes:

- 05200 Electrical burns;
- 05201 First-degree electrical burns;
- 05202 Second-degree electrical burns;
- 05203 Third-degree electrical burns;
- 05290 Electrical burns, N.E.C.; and
- 09300 Electrocutions, electric shocks.

Emergency Department Visits

Separations data from the National Ambulatory Care Reporting System were provided by the Canadian Institute for Health Information (CIHI). Emergency Department separation data used in this report are classified according to the Canadian Modification of the 10th revision of the *International Classification of Diseases* (ICD-10-CA). The inclusion criterion for the report was the presence of T75.4, T75.0, W85, W86, W87, or X33 codes indicating an electrical injury, including being a victim of lightning, among any of the diagnosis or external cause codes assigned to a record.

Reliability of Data

The numbers and figures in this report are based on current information provided to the ESA as of June 20, 2019. Parts of this material are based on data and information provided by the CIHI. However, the analyses, conclusions, opinions, and statements expressed herein are those of the author and not necessarily those of the Canadian Institute for Health Information. These numbers may change in subsequent reports due to additional information received after the publication of the report. These changes and explanations will be noted in future reports.

Fire Source Data

The OFMEM reports its data by calendar year. Data collection and verification for the year has a one-year lag in reporting in the OESR. The OFMEM does not publish Ontario statistics until all fire departments have reported. The larger departments — Toronto and Hamilton — generally do not finish their filing until June of the following year. At the time of writing, some OFMEM data for 2018 is unavailable and data for 2017 is presented instead. The number of fire incidents and fire fatalities are current as of February 25, 2019, and are considered to be the most accurate at this point in time.

The OFMEM provides information on all fire incidents except for those on federal or First Nations properties. Likewise, information on fire fatalities does not include those on federal or First Nations properties, nor fire deaths in vehicle accidents.

The ESA reports fire incidents based on data provided by the OFMEM to the ESA on:

- all fires where the ignition source was reported as "electrical distribution equipment" or the fuel of the ignition source was reported as "electricity"; and
- fire incidents and fire fatalities investigated by the OFMEM where the ignition source was reported as "electrical distribution equipment" or the fuel of the ignition source was reported as "electricity".

In addition, the ESA conducts its own investigation of fires when called by the local fire department to assist or when jointly investigating fire incidents with the OFMEM. The ESA presents data that are consistent with the reporting convention of the OFMEM. Fires are reported by ignition source where the fuel of the ignition source was reported as electricity. It is worth noting that with the exception of fires with distribution equipment and fires identified as electricity as the ignition source by the fire departments or the OFMEM, electricity was not the primary fuel associated with the fire. These situations are illustrated below.

In the OESR, these fires will be categorized into two types of fires. These are:

1. Fires caused by the ignition of combustibles (liquid and solids) around an electrical device, equipment, appliance, or installation, but were not the direct result of a failure of electrical equipment, devices, electrical current, or arc flash coming into contact with the object. When the primary fuel associated with the fire is not electricity (such as leaving a stove unattended with the oil catching fire), the OFMEM labels these fires as cooking fires rather than electrical fires. In addition, the OFMEM does not recommend using numbers of fire deaths to identify trends and key issues.

   Typically, these types of fire were the direct result of misuse of the equipment, device or appliance. Some examples of these types of fires are:

   - grease fires on an electrical stove-top as a result of cooking left unattended;
   - clothing catching fire while cooking;
   - clothes dryer catching fire caused by the appliance overheating due to improper cleaning of the lint cache; and
   - combustibles catching fire around heaters or electronics when they are placed too close to the heat source.

2. Fires caused by the ignition of combustibles around an electrical device, equipment, appliance, or installation and were the direct result of the failure of the device, equipment, or installation. In these cases, typical fires are caused by insulation surrounding electrical wiring failing and igniting a combustible in close proximity, or equipment or devices failing, causing them to overheat and later start a fire. Insulation failure could be caused by natural aging, premature aging resulting from overloading, or by mechanical breakdown of the insulation. Fires related to wiring and wiring devices are classified by the OFMEM as distribution equipment. Please note that the definition of distribution equipment in the fire section is quite different than the distribution equipment in the powerline section of the report.

   Examples of these fires are:

   - Carpet igniting caused by heat buildup of an extension cord placed under a carpet. Over time the insulation of the extension cord fails due to foot traffic on the cord, which leads to mechanical breakdown of the insulation.
   - Electrical wires poorly terminated and an installation performed without using any protective enclosure. Arcing occurs over time, resulting in a fire of combustibles around the wires.
   - Fire caused by a failure of a seized motor powered by electricity.

When fire fatality rates are calculated, the ESA displays data as it is calculated by the OFMEM, which uses Statistics Canada population estimates as the denominator. When fire fatality data is added to electrical-related death data, Ministry of Finance population estimates are used as the denominator.

In the fire section of the OESR, the ESA uses the OFMEM's method of categorizing types of ignition source class. By the OFMEM's definition, distribution equipment are electrical wiring, devices, or equipment whose primary function is to carry electrical current from one location to another. Thus, wiring, extension cords, terminations, electrical panels, and cords on appliances are considered distribution equipment. Please note that distribution equipment defined by the OFMEM is not the same as distribution equipment defined by the Local Distribution Companies.

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