ONTARIO ELECTRICAL SAFETY REPORT

2019

OESR

Electrical Safety Authority

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

The Ontario Electrical Safety Report (OESR) is the only document of its kind in Canada and one of the few in the world that compiles and publishes electrical safety data every year. The OESR is recognized as a standard of rigorous safety reporting. It offers a comprehensive collection of data and analysis that helps to drive our efforts to make Ontario a safer place to live, work, and play free from electrical harm.

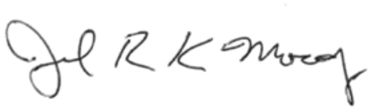
Most importantly, we must remember that behind these statistics are tragic events that changed lives forever. This report represents incidents that mean someone suffered a serious injury, lost a home or business in a fire, or lost a family member due to electrical contact. Focusing on the human element behind the data reinforces the need to reduce electrical incidents by providing a consistent and documented source of electrical harm data to identify and focus efforts on areas representing the highest risk.

The 2019 OESR demonstrates that fatalities from electrical incidents are rare, but we still have work to do. Powerline electrocutions continue to account for a significant percentage of all electrical-related deaths, with occupational settings representing the bulk of fatalities, and a steady rate of electrical-related fire deaths continues to be reported each year. Until that number is zero, the ESA will continue to work to improve electrical safety in Ontario.

I would like to recognize our safety partners without whom this report would not be possible. The OESR is compiled with the co-operation and participation from the Office of the Chief Coroner; the Ministry of Labour, Training and Skills Development; the Office of the Fire Marshal and Emergency Management; the Canadian Institute of Health Information; and the Workplace Safety and Insurance Board of Ontario. My sincere thanks to all of our partners who helped contribute to the report's content and ultimately to electrical safety in Ontario.

I would also like to express my appreciation for the electrical contractors, utility line crews, first responders, product manufacturers, and electrical inspectors who work every day to help keep Ontarians safe from electrical harm.

Finally, I would like to thank my colleagues at the ESA who consolidate, analyze, and provide this report to the safety community at large each year. I am proud of this report and of our contribution to reducing electrical harm in Ontario.



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

ELECTRICAL-RELATED FATALITIES AND INCIDENTS OVER THE PAST 10 YEARS

(2010–2019)

135 ELECTRICAL-RELATED FATALITIES

52 Electrical-related Fatalities

83 Fire Fatalities

Electrical-related Fatalities

2010–2014: **27** → 2015–2019: **25** → **7%** decrease

Utility-related Deaths

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

Deaths from Powerline Contact

2010–2014: **9**

2015–2019: **10**

Occupational Deaths

Outnumber non-occupational deaths by a ratio of **1.6:1**

Occupational Deaths

2010–2014: **18**

2015–2019: **14**

Non-occupational

The five-year rolling average rate of fatalities has increased from **0.13 per million** (2010–2014) to **0.15 per million** (2015–2019).

AN INCREASE OF **15%**

Fire Fatalities and Events

2009–2013 vs. 2014–2018 → **2%** increase

Cooking Fires

Most common type of fire with electricity as the ignition source

Number of Cooking Fires

2014: **836**

2018: **638**

24% decrease

Electrical Distribution Fires

Number of Electrical Distribution Fires

2014: **504**

2018: **434**

14% decrease

Priority Issues

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

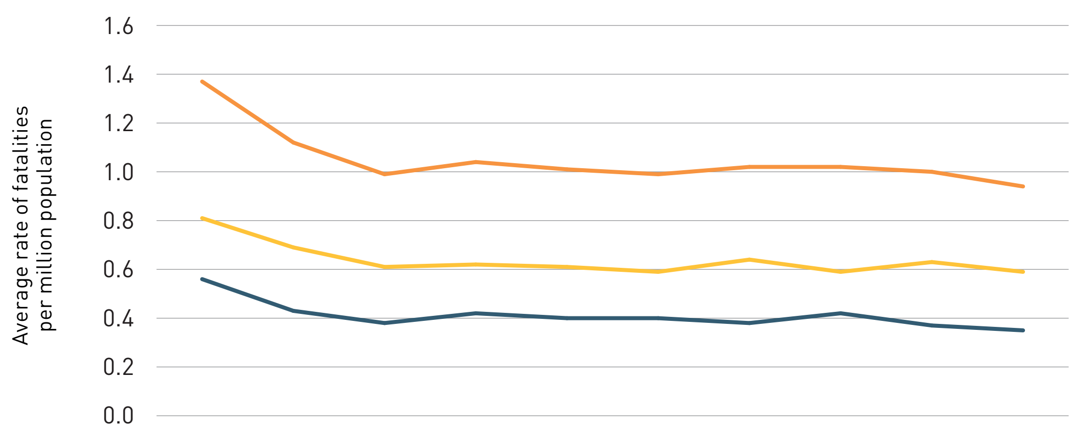
1. **Powerline contact**
2. **Electrical trade workers**
3. **Misuse of electrical products and unapproved/counterfeit products**
4. **Electrical infrastructure fires**

Executive Summary

The Electrical Safety Authority's Ontario Electrical Safety Report (OESR) was created to provide a comprehensive perspective of electrical fatalities, injuries, and incidents in Ontario. Data presented in this report have been collected from multiple sources, investigations, and root-cause analyses. Information is provided on potential electrical risks and high-risk sectors. 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 (2010–2019), there has been a downward trend in the total rate of electrical-related fatalities. The five-year average rate of electrocution and burn fatalities, and electrical fire fatalities (where the ignition source was identified to be electrical), have continued to decrease when compared 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, 2006–2019



Five-year period	2006–2010	2007–2011	2008–2012	2009–2013	2010–2014	2011–2015	2012–2016	2013–2017	2014–2018	2015–2019
Electrical fire fatalities	0.81	0.69	0.61	0.62	0.61	0.59	0.64	0.59	0.63	0.59*
Electrocution and burn fatalities	0.56	0.43	0.38	0.42	0.40	0.40	0.38	0.42	0.37	0.35*
Total electrical-related fatalities	1.37	1.12	0.99	1.04	1.01	0.99	1.02	1.02	1.00	0.94*

**Preliminary data subject to change*

Source: ESA, Coroner, and OFMEM records

Electrical-related Fatalities

In the past ten years, there were 135 electrical fatalities in Ontario. From 2010 to 2019, 52 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 electrical distribution equipment). In comparison, the previous ten-year period from 2009 to 2018 reported 54 deaths from electrocutions and burns, and 85 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		
2010–2014	• 27 electrical-related fatalities • Five-year rolling average of 0.40 per million population	**Rate decrease of 13%**
2015–2019	• 25 electrical-related fatalities • Five-year rolling average of 0.35 per million population	

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

Five-year period		
2010–2014	• 33% of all electrical-related fatalities (9/27) were from powerline contact • Five-year rolling average of 0.13 per million population	**Rate increase of 8%**
2015–2019	• 40% of all electrical-related fatalities (10/25) were from powerline contact • Five-year rolling average of 0.14 per million population	

In the past ten years, occupational electrical-related fatalities continue to outnumber non-occupational fatalities by a ratio of 1.6:1. However, in the past five years, there have been years where the number of non-occupational deaths has been the same as or has outnumbered occupational deaths:

Five-year period		
2010–2014	• 67% of electrical-related fatalities (18/27) were occupational • Five-year rolling average of 0.49 per million labour force	**Rate decrease of 24%**
2015–2019	• 56% of electrical-related fatalities (14/25) were occupational • Five-year rolling average of 0.37 per million labour force	

Electricians and apprentice electricians account for 28% 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/347 V lighting.

The non-occupational electrical-related fatality rate in 2019 decreased to 0.07 per million population from 0.28 per million population in 2018. However, the five-year average rate indicates that non-occupational deaths have been increasing:

Five-year period		
2010–2014	• Five-year rolling average of 0.13 per million population	Rate increase of 15%
2015–2019	• Five-year rolling average of 0.15 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 electrical distribution equipment) has increased by 102% when comparing the five-year rolling average in 2009–2013 and 2014–2018.

The number of structure fires where electricity was identified as the fuel of the ignition source has decreased by 29% between 2009 and 2018.

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

- In 2014, there were 836 cooking equipment fires;
- In 2018, there were 638 cooking equipment fires, a decrease of 24%.

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 decreased over the most recent five years:

- In 2014, there were 504 electrical distribution equipment fires;
- In 2018, there were 434 electrical distribution equipment fires, a decrease of 14%.

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 34% (11/32) of all occupational electrical fatalities between 2010 and 2019.
- Electrical trade workers accounted for 28% of all occupational-related fatalities between 2009 and 2018 (9/32). There were at least two critical injuries 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 2% from 2014 to 2018; however, the proportion of those with severe injuries has increased by 3%.
- 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) shows that the five-year average for electrical product structural loss fires (where electricity was identified as the fuel source) between 2009–2013 and 2014–2018 has decreased by 13%.
- An average of 1,320 electrical loss fires (where ignition sources were fuelled by electricity) occurred in residential structures in the past five years, with an average of eight fatalities per year.

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 the 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."

[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 19th 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 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 which 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 ESA 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 52 electrical-related fatalities reported in Ontario in the ten-year span between 2010 and 2019, which were two deaths fewer than the time period between 2009 and 2018. The majority of the electrical-related fatalities occurred in western regions of the province (west of Oakville) between 2010 and 2019.

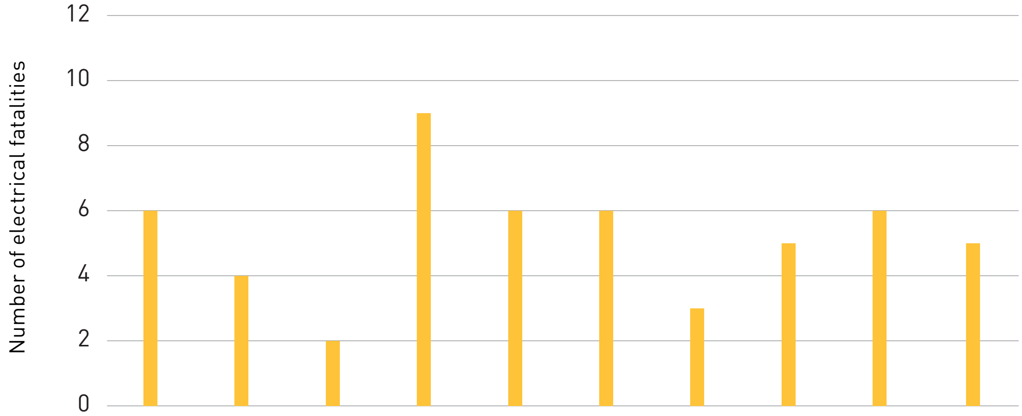
By age group, individuals aged 20–39 years accounted for the largest proportion of fatal injuries (40%), followed by individuals 40 to 59 years of age (32%). The majority of electrical fatalities occurred between the months of June and October (63%).

The five-year rolling average rate of electrical fatalities has decreased by 13% when comparing 2010–2014 (0.40 per million population) and 2015–2019 (0.35 per million population). In contrast, powerline fatalities have increased: when 2010–2014 (0.13 per million) and 2015–2019 (0.14 per million) were compared, there was a 8% increase in the five-year rolling average rate of powerline electrocutions.

Residential (40%), industrial (24%), and utility settings (12%) were the most common places for electrical-related fatalities between 2015 and 2019.

The five-year rolling average rate of occupational electrical-related fatalities per labour force has decreased 24% when comparing 2010–2014 (0.49 fatalities per million) to 2015–2019 (0.37 fatalities per million). Conversely, the five-year rolling average rate of non-occupational electrical-related fatalities per million population has increased by 25% between the same time periods (0.13 fatalities per million to 0.15 fatalities per million).

1 NUMBER OF ELECTRICAL-RELATED FATALITIES IN ONTARIO, 2010–2019

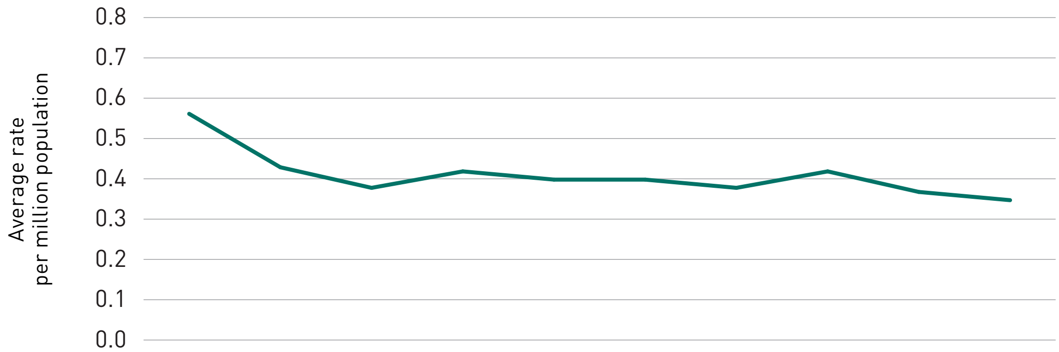


Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number of electrical fatalities	6	4	2	9	6	6	3	5	6	5

Source: ESA and Coroner records

Conclusion
The number of electrical-related fatalities in 2019 has decreased by one when compared to the previous year of 2018; however, there has been a **44%** 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, 2006–2019

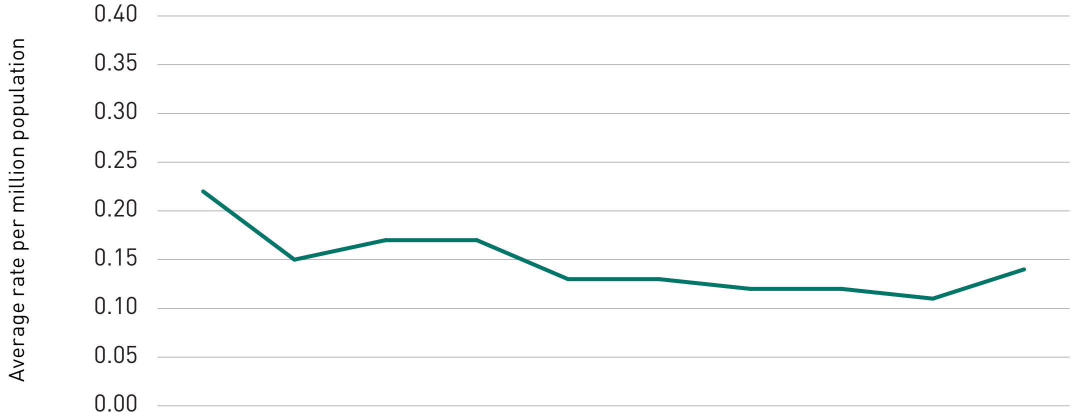


Five-year period	2006–2010	2007–2011	2008–2012	2009–2013	2010–2014	2011–2015	2012–2016	2013–2017	2014–2018	2015–2019
Rate of electrical-related fatalities (per million population)	0.56	0.43	0.38	0.42	0.40	0.40	0.38	0.42	0.37	0.35

Source: ESA and Coroner records

Conclusion
The rate of electrical-related fatalities has decreased when compared to the previous year of 2018.
There has been a **13%** decrease when comparing the average rate at 2010–2014 and 2015–2019.

3 FIVE-YEAR ROLLING AVERAGE RATE OF POWERLINE FATALITIES IN ONTARIO, 2006–2019

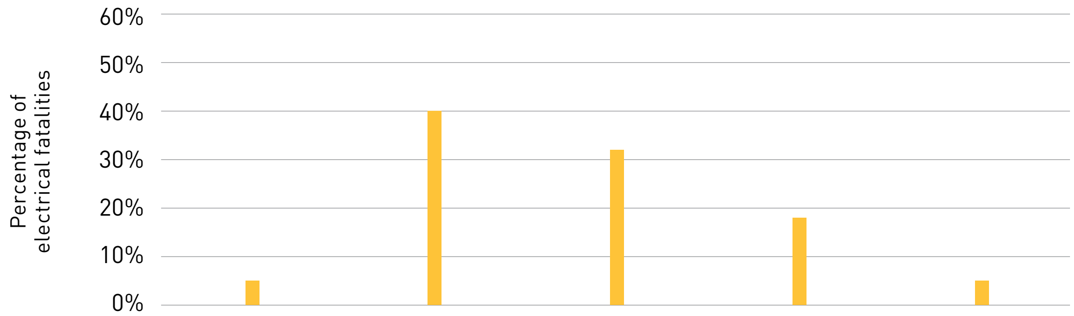


Five-year period	2006–2010	2007–2011	2008–2012	2009–2013	2010–2014	2011–2015	2012–2016	2013–2017	2014–2018	2015–2019
Rate of powerline fatalities (per million population)	0.22	0.15	0.17	0.17	0.13	0.13	0.12	0.12	0.11	0.14

Source: ESA and Coroner records

Conclusion
In 2019, there were four powerline fatalities. There has been a **8%** increase when comparing the rate at 2010–2014 and 2015–2019.

4 PERCENTAGE OF ELECTRICAL-RELATED FATALITIES BY AGE GROUP IN ONTARIO, 2010–2019

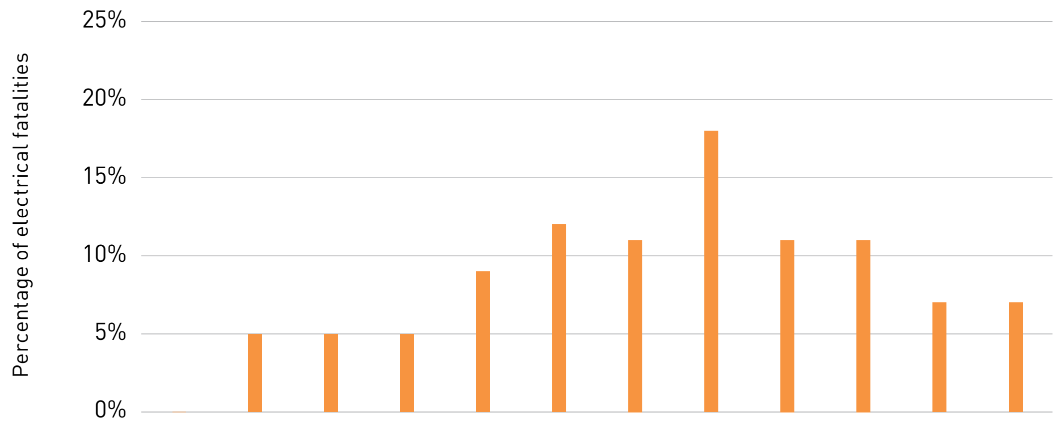


Age	0–19	20–39	40–59	60+	Unknown
Percentage	5%	40%	32%	18%	5%

Source: ESA

Conclusion
In the last ten years, **40%** of electrical-related fatalities occurred among the 20–39 age group, followed by the 40–59 age group (**32%**).

5 PERCENTAGE OF ELECTRICAL-RELATED FATALITIES BY MONTH IN ONTARIO, 2010–2019

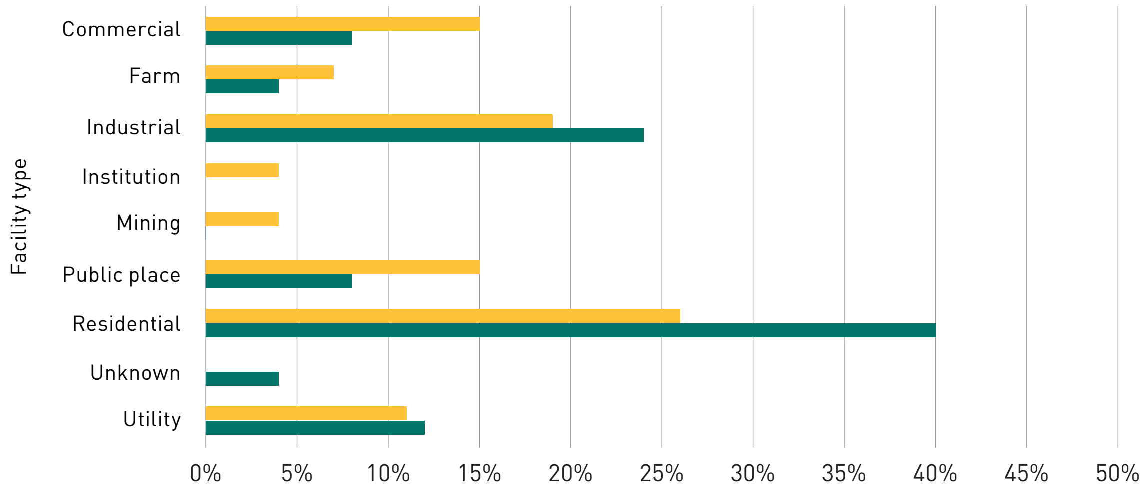


Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Percentage	0%	5%	5%	5%	9%	12%	11%	18%	11%	11%	7%	7%

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, 2010–2014 AND 2015–2019

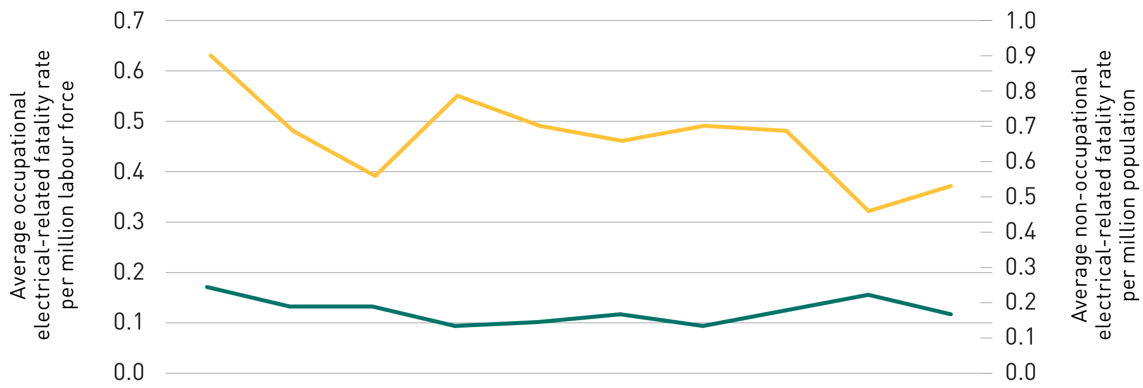


	Facility type	Commercial	Farm	Industrial	Institution	Mining	Public place	Residential	Unknown	Utility
Percentage of electrical fatalities	2010–2014	15%	7%	19%	4%	4%	15%	26%	0%	11%
	2015–2019	8%	4%	24%	0%	0%	8%	40%	4%	12%

Source: ESA and Coroner records

Conclusion
Residential settings were the most common settings where electrical-related fatalities occur.
In 2010–2014, residential industrial, public place, and commercial settings were the most common places for electrical-related fatalities; in 2015–2019, 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, 2006–2019



Five-year period	2006–2010	2007–2011	2008–2012	2009–2013	2010–2014	2011–2015	2012–2016	2013–2017	2014–2018	2015–2019
Occupational	0.63	0.48	0.39	0.55	0.49	0.46	0.49	0.48	0.32	0.37
Non-occupational	0.22	0.17	0.17	0.12	0.13	0.15	0.12	0.16	0.20	0.15

Source: ESA and Coroner records

Conclusion
The five-year rolling average rate of occupational electrical-related fatalities has decreased by **24%** when comparing 2010–2014 to 2015–2019 per million labour force. The five-year rolling average rate of non-occupational electrical-related fatalities has increased by **15%** 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. 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, a total of 1,651 workers died between 2007 and 2016 as a result of electrical injury (Campbell, 2018). The data also shows 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 occur 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 an 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).

Education and proper protection are essential in preventing electrical injuries at work. In 2020, Littelfuse, an international company in circuit protection, power control, and sensing, surveyed almost 600 people who worked directly with electricity on questions about their experience with electrical shock hazards. Seventy-eight percent of respondents said they have been shocked while on the job, where 37% were shocked by less than 221 V. This is in contrast with 85% of respondents, who felt they were highly confident in recognizing electrical hazards (Littelfuse, 2020). This highlights the need for ongoing and refresher training for those who work with electricity in an occupational setting.

Between 2010 and 2019, there were 32 occupational electrical-related fatalities (an average of 3.2 electrical-related fatalities per year), which was the same as the previous ten-year period. In 2019, there were four occupational electrical-related fatalities reported.

The five-year rolling average number of fatalities and critical injuries among workers (overall occupational safety) has increased by 15% between 2010–2014 and 2015–2019. However, the five-year rolling average number of fatalities and critical injuries among electrical trade workers shows a 44% decrease when comparing these two time periods.

When comparing the five-year rolling average rate, the occupational electrical-related fatalities have decreased from 0.49 per million labour force population in 2010–2014 to 0.37 per million labour force population in 2014–2018. This is a decrease of 24%.

In the 2015–2019 time period, industrial (43%), residential (14%), and commercial (14%) settings were the most common places for occupational electrical-related fatalities. Between 2010 and 2019, the most commonly cited causes of death were due to improper installation/procedure (28%) and lack of hazard assessment (13%), when excluding unknown causes.

Between 2010 and 2019, electrical tradespeople accounted for 28% of all occupational electrical-related fatalities. This percentage is an increase from what was reported in the previous ten-year period, where electrical tradespeople accounted for 25% of all occupational electrical-related fatalities.

A review of data provided by the WSIB from 2010 to 2019 shows that male workers continue to outnumber female workers with respect to occupational electrical injury, where 74% of WSIB lost claims were made by males in 2019. 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 a decrease of 8% in the number of injury claims between 2010–2014 and 2015–2019, but the number of claims for electrocution has increased by 7% between the time periods.

Section 2.5 provides a case study that is an example of the risk factors associated with electrical-related critical injuries for electrical contractors.

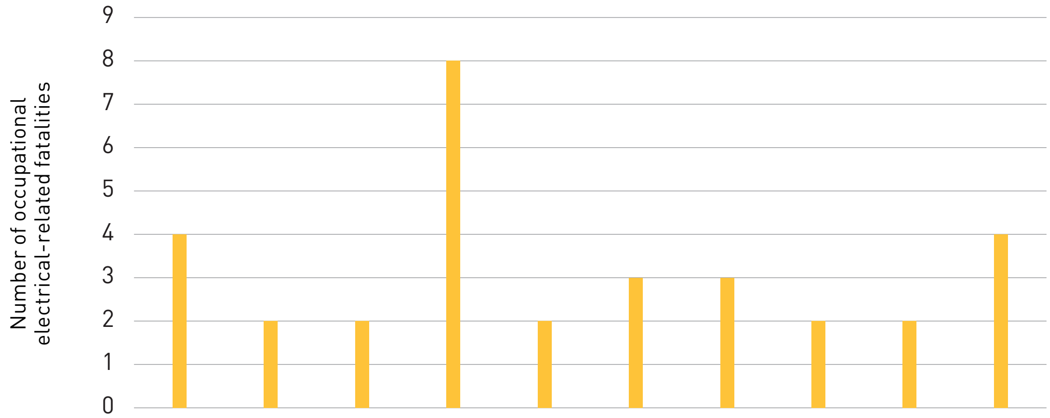
Statistics Directly Related to the ESA's Harm Reduction Priorities – WORKER SAFETY

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 Chief Coroner.

The worker safety five-year rolling average has increased by 15% between 2010–2014 and 2015–2019.

1 NUMBER OF OCCUPATIONAL ELECTRICAL-RELATED FATALITIES IN ONTARIO, 2010–2019

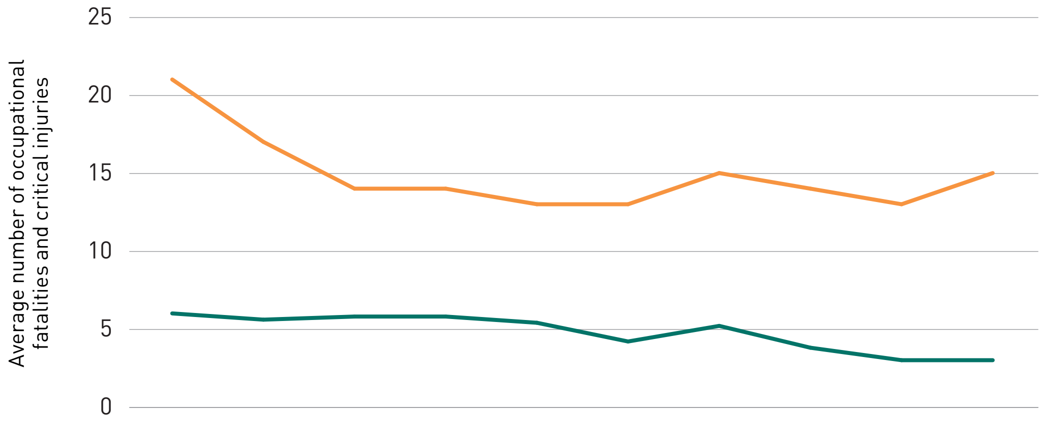


Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number of occupational electrical-related fatalities	4	2	2	8	2	3	3	2	2	4

Source: ESA and Coroner records

Conclusion
The number of occupational electrical-related fatalities has been between two and four deaths per year, aside from 2013, when eight deaths were reported.

2 FIVE-YEAR ROLLING AVERAGE OF OCCUPATIONAL FATALITIES AND CRITICAL INJURIES IN ONTARIO, 2006–2019

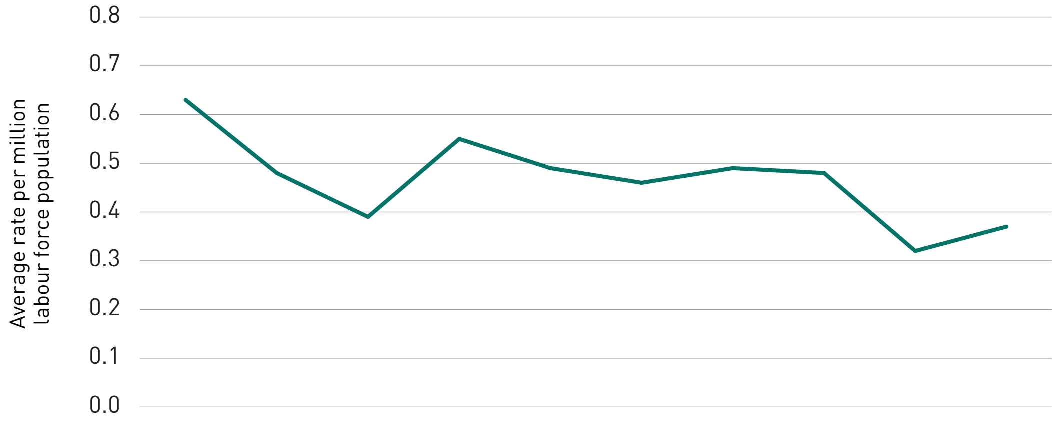


Five-year period	2006–2010	2007–2011	2008–2012	2009–2013	2010–2014	2011–2015	2012–2016	2013–2017	2014–2018	2015–2019
Occupational safety overall	21	17	14	14	13	13	15	14	13	15
Electrical trade	6.0	5.6	5.8	5.8	5.4	4.2	5.2	3.8	3.0	3.0

Source: ESA, Coroner, and MOLSTD records

Conclusion
The five-year rolling average number of occupational fatalities and critical injuries (occupational safety overall) has increased by **15%** between 2010–2014 and 2015–2019. However, there has been a **44%** decrease when comparing these two time periods among those reported by the electrical trade.

3 FIVE-YEAR ROLLING AVERAGE RATE OF OCCUPATIONAL ELECTRICAL-RELATED FATALITIES IN ONTARIO, 2006–2019

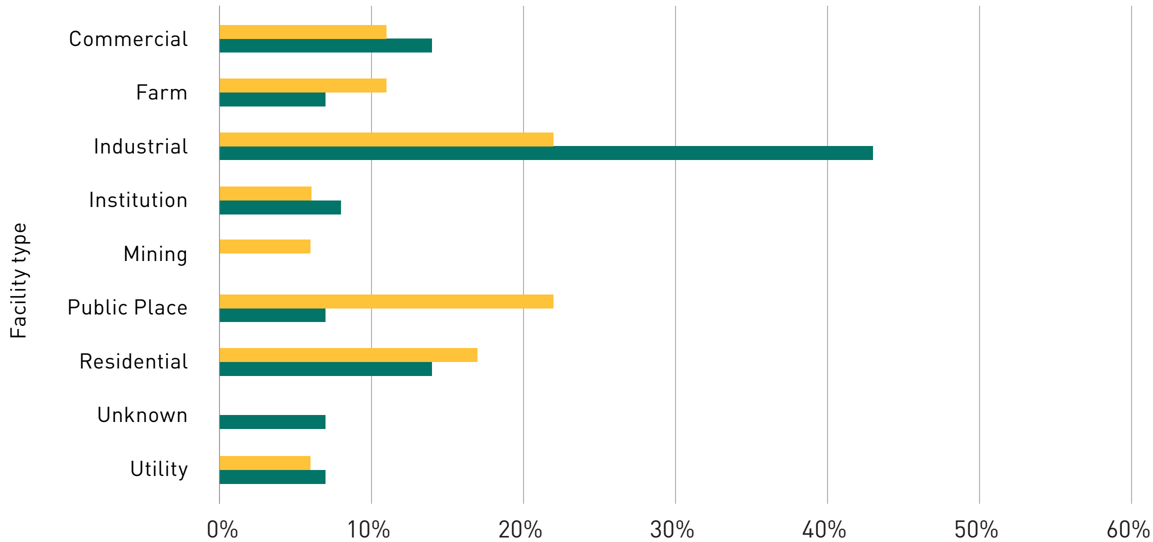


Five-year period	2006–2010	2007–2011	2008–2012	2009–2013	2010–2014	2011–2015	2012–2016	2013–2017	2014–2018	2015–2019
Occupational electrical-related fatality rate	0.63	0.48	0.39	0.55	0.49	0.46	0.49	0.48	0.32	0.37

Source: ESA and Coroner records

Conclusion
The rate of occupational electrical-related fatalities has decreased by **24%** when comparing 2010–2014 and 2015–2019.

4 PERCENTAGE OF OCCUPATIONAL ELECTRICAL-RELATED FATALITIES BY FACILITY TYPE IN ONTARIO, 2010–2014 AND 2015–2019

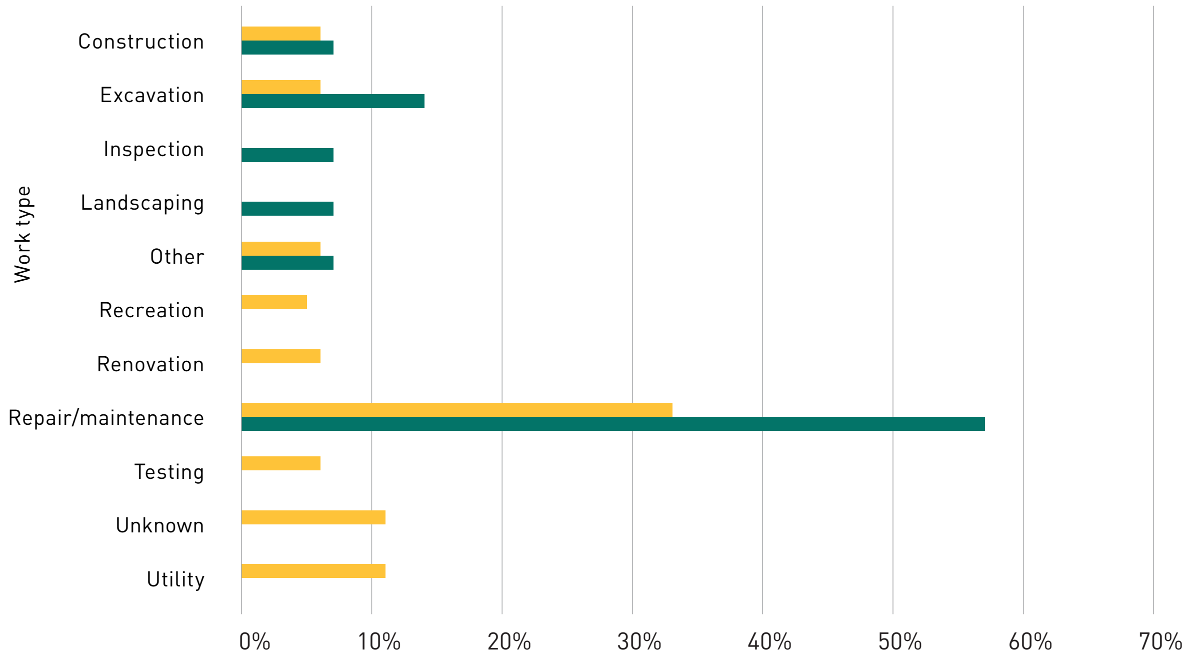


Percentage of occupational electrical-related fatalities — Facility type	Commercial	Farm	Industrial	Institution	Mining	Public place	Residential	Unknown	Utility
2010–2014	11%	11%	22%	6%	6%	22%	17%	0%	6%
2015–2019	14%	7%	43%	0%	0%	7%	14%	7%	7%

Source: ESA and Coroner records

Conclusion
In 2010–2014, the most commonly reported settings for occupational electrical-related fatalities were commercial, industrial, public place, and residential settings. In 2015–2019, there was a slight difference where industrial, residential, and commercial settings were the most commonly reported settings.

5 PERCENTAGE OF OCCUPATIONAL ELECTRICAL-RELATED FATALITIES BY TYPE OF WORK IN ONTARIO, 2010–2014 AND 2015–2019

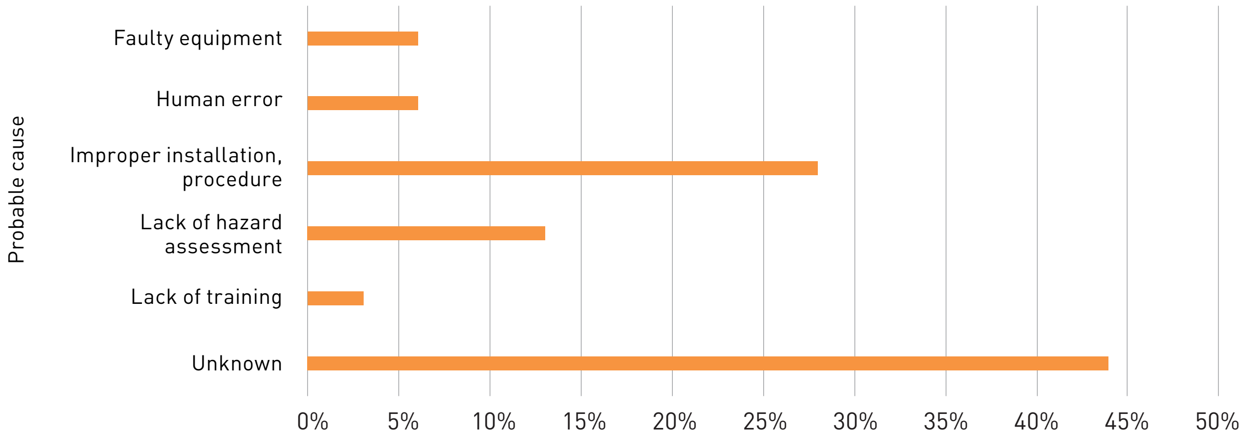


Percentage of occupational electrical-related fatalities	Work type	Construction	Excavation	Inspection	Landscaping	Other	Recreation	Renovation	Repair/ maintenance	Testing	Unknown	Utility
	2010–2014	6%	6%	0%	0%	6%	6%	6%	33%	6%	11%	11%
	2015–2019	7%	14%	7%	7%	7%	0%	0%	57%	0%	0%	0%

Source: ESA and Coroner records

Conclusion
In 2010–2014 and 2015–2019, 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, 2010–2019

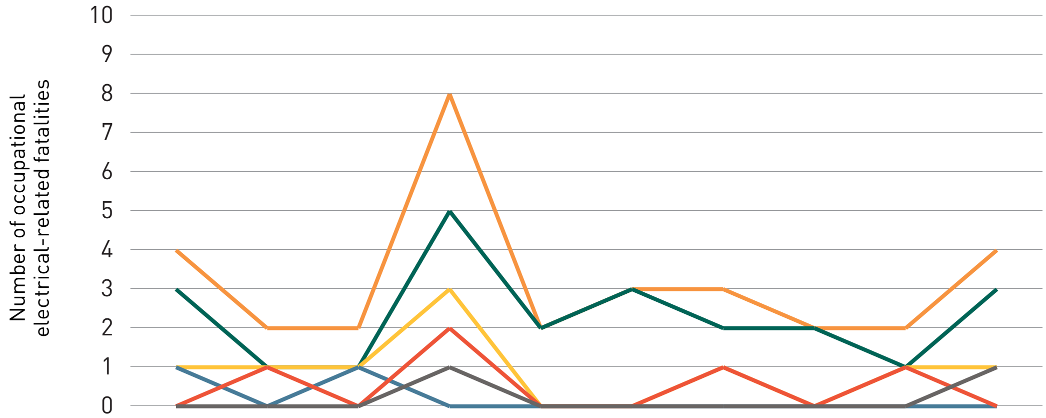


Probable cause	Faulty equipment	Human error	Improper installation, procedure	Lack of hazard assessment	Lack of training	Unknown
Percentage of occupational electrical-related fatalities	6%	6%	28%	13%	3%	44%

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, 2010–2019

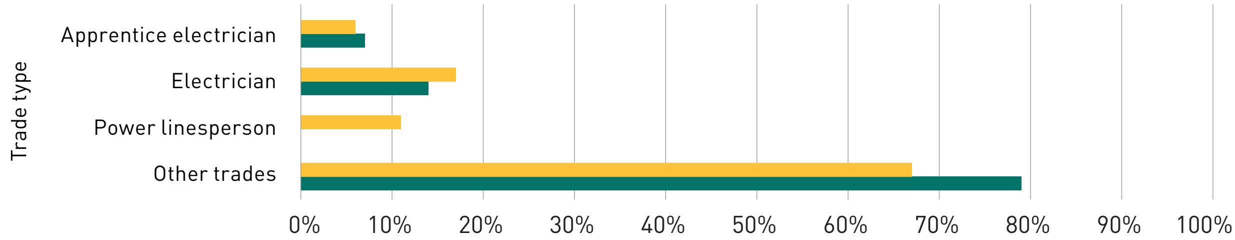


Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Apprentice electrician	0	0	0	1	0	0	0	0	0	1
Electrician	0	1	0	2	0	0	1	0	1	0
Power linesperson	1	0	1	0	0	0	0	0	0	0
Total electrical	1	1	1	3	0	0	1	0	1	1
Other trades	3	1	1	5	2	3	2	2	1	3
All occupational fatalities	4	2	2	8	2	3	3	2	2	4

Source: ESA and Coroner records

Conclusion
Since 2010, on average, there has been less than one electrical trade fatality per year. In contrast, there has been an average of 3.2 occupational fatalities (all trades) per year.

8 PERCENTAGE OF OCCUPATIONAL ELECTRICAL-RELATED FATALITIES BY TRADE, 2010–2014 AND 2015–2019

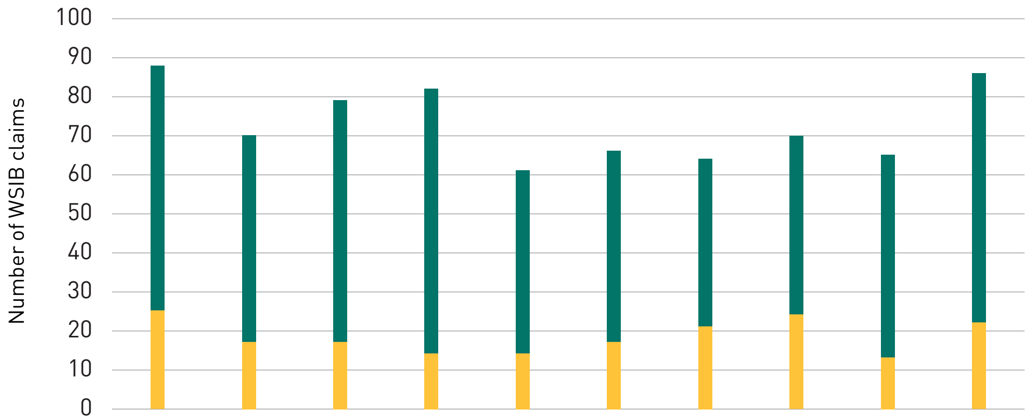


Percentage of occupational electrical-related fatalities	Trade type	Apprentice electrician	Electrician	Power linesperson	Other trades
	2010–2014	6%	17%	11%	67%
	2015–2019	7%	14%	0%	79%

Source: ESA and Coroner records

Conclusion
In the most recent five-year period (2015–2019), the number of occupational electrical-related fatalities among other trades has increased, while occupational electrical-related fatalities among power linespersons and electricians have decreased.

9 NUMBER OF ALLOWED WSIB LOST TIME ELECTRICAL INJURY CLAIMS BY SEX IN ONTARIO, 2010–2019

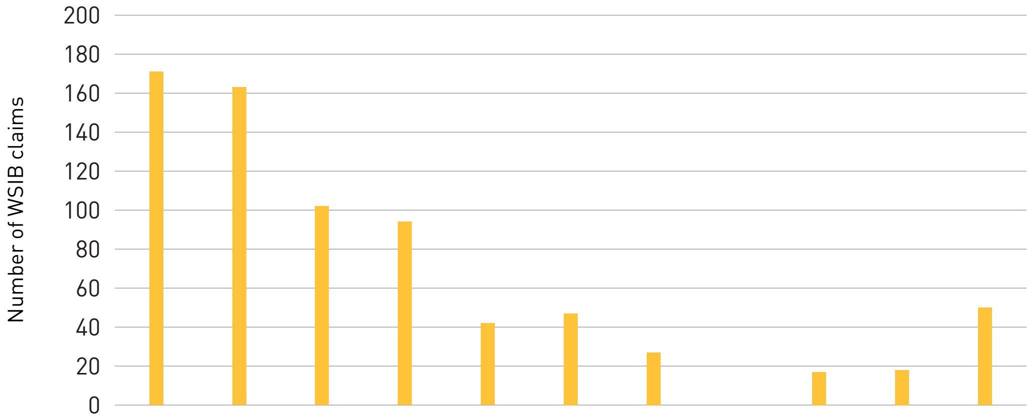


Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Male	63	53	62	68	47	49	43	46	52	64
Female	25	17	17	14	14	17	21	24	13	22

Source: Workplace Safety and Insurance Board

Conclusion
In 2019, the number of WSIB lost time electrical injury claims reported by males continued to outnumber lost time electrical injury claims reported by females. Most notably in 2019, **74%** of electrical injury claims were reported by males.

10 NUMBER OF ALLOWED WSIB LOST TIME ELECTRICAL INJURY CLAIMS BY SECTOR IN ONTARIO, 2010–2019



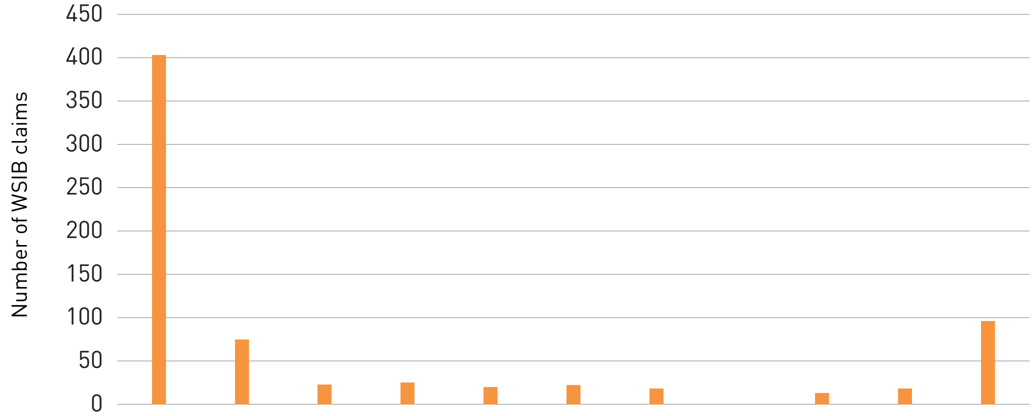
Sector type	Construction	Services	Manufacturing	Schedule 2*	Health care	Electrical	Transportation	Chemical/ process	Automotive	Food	Other
Number of WSIB claims	171	163	102	94	42	47	27	0	17	18	50

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 2010 and 2019.

*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 10 SOURCES IN ONTARIO, 2010–2019

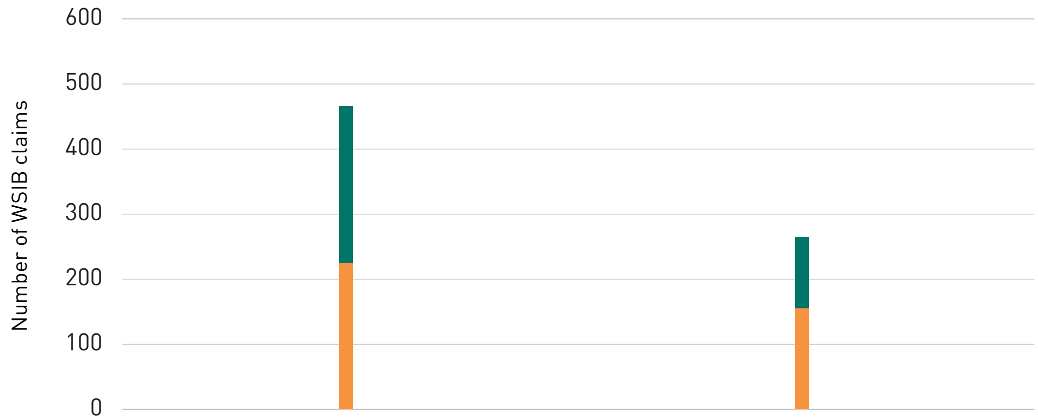


Source	Number of WSIB claims
Machine tool and electric parts	403
Heating, cooling, and cleaning machinery	75
Metal woodworking and plastic, rubber concrete and other processing	23
Misc. machinery (e.g., audio, video, televisions, telephones, snowblowers)	25
Hand tools, powered	20
Fire, flame, smoke	22
Special process machinery (e.g., food slicers, paper, printing, wrapping, sewing, pumps)	18
Unknown	0
Furniture and fixtures	13
Office and business machines	18
Other sources	96

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 2010 and 2019.

12 NUMBER OF ALLOWED WSIB LOST TIME ELECTRICAL INJURY CLAIMS BY NATURE OF INJURY IN ONTARIO, 2010–2014 AND 2015–2019



Nature of injury	Electrocutions, electric shock	Burns, electrical
2010–2014	225	155
2015–2019	241	110

Source: Workplace Safety and Insurance Board

Conclusion
There is an overall decrease of **8%** in the number of injury claims between 2010–2014 and 2015–2019; however, the number of electrocutions has increased by **7%**.

2.3 Non-occupational Electrical-related Fatalities and Injuries

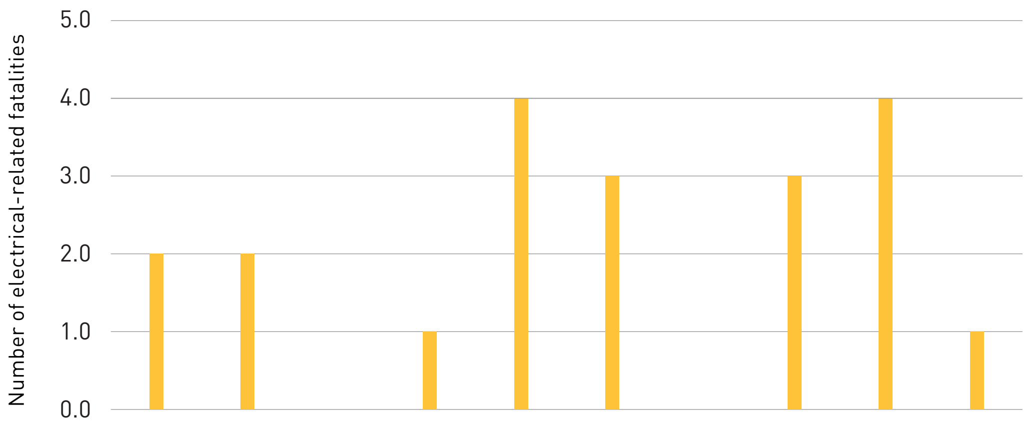
Injuries are a significant health problem. They are the leading cause of death for the young and contribute substantially to the burden on the health care system. Many injuries are predictable and preventable.

In 2019, there was one non-occupational electrical-related fatality. In the previous year, there were four non-occupational electrical-related fatalities.

Between 2010 and 2019, there were 20 non-occupational electrical-related fatalities (an average of 2.2 electrical-related fatalities per year). In the previous ten-year period (2009–2018), there were 22 non-occupational electrical-related fatalities (an average of 2.2 electrical-related fatalities per year). The five-year rolling average rate between 2010–2014 and 2015–2019 has increased by 15% from 0.13 per million population to 0.15 per million population.

In the past ten years, the residential setting (57%) was the most common place for non-occupational electrical-related fatalities. Recreation (25%), theft (20%), and landscaping, lawn cutting, and tree trimming (20%) were the most common activities associated with fatalities when excluding unknown activities.

1 NUMBER OF NON-OCCUPATIONAL ELECTRICAL-RELATED FATALITIES IN ONTARIO, 2010–2019

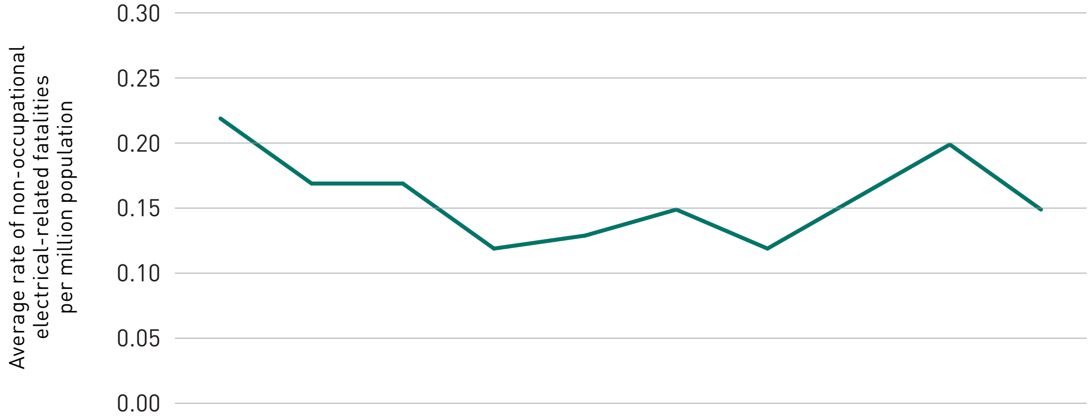


Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number of non-occupational electrical-related fatalities	2	2	0	1	4	3	0	3	4	1

Source: ESA and Coroner records

Conclusion
The number of non-occupational electrical-related fatalities has remained variable in the past ten years, ranging from zero to four deaths reported per year.

2 FIVE-YEAR ROLLING AVERAGE RATE OF NON-OCCUPATIONAL ELECTRICAL-RELATED FATALITIES IN ONTARIO, 2006–2019

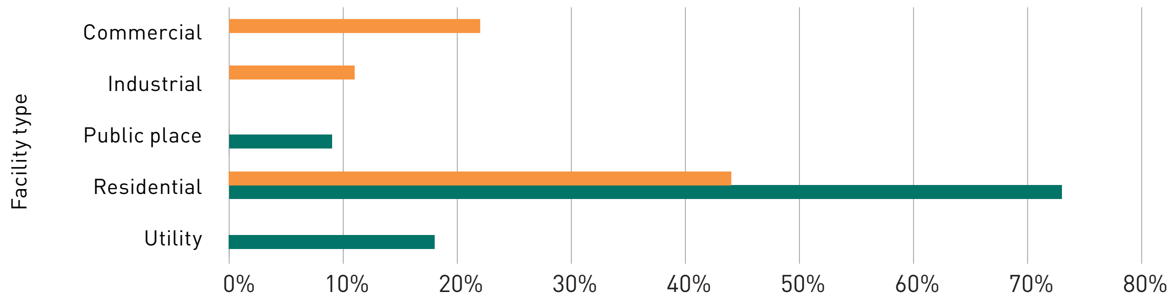


Five-year period	2006–2010	2007–2011	2008–2012	2009–2013	2010–2014	2011–2015	2012–2016	2013–2017	2014–2018	2015–2019
Rate of non-occupational electrical-related fatalities per million population	0.22	0.17	0.17	0.12	0.13	0.15	0.12	0.16	0.20	0.15

Source: ESA and Coroner records

Conclusion
The five-year rolling average rate of non-occupational electrical-related fatalities has increased by **15%** when comparing 2010–2014 and 2015–2019.

3 PERCENTAGE OF NON-OCCUPATIONAL ELECTRICAL-RELATED FATALITIES BY FACILITY TYPE IN ONTARIO, 2010–2019

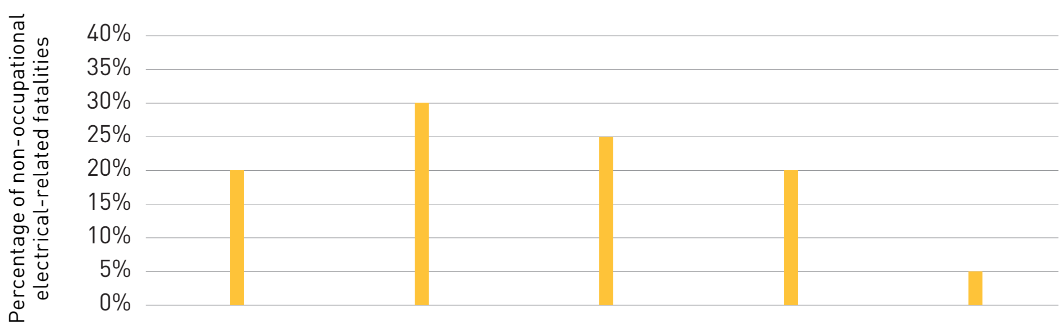


Percentage of non-occupational electrical-related fatalities	Facility type	Commercial	Industrial	Public place	Residential	Utility
	2010–2014	22%	11%	0%	44%	0%
	2015–2019	0%	0%	9%	73%	18%

Source: ESA and Coroner records

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

4 PERCENTAGE OF NON-OCCUPATIONAL ELECTRICAL-RELATED FATALITIES BY ACTIVITY TYPE IN ONTARIO, 2010–2019



Activity type	Landscaping, lawn cutting, tree trimming	Other	Recreation	Theft	Unknown
Percentage of non-occupational electrical-related fatalities	20%	30%	25%	20%	5%

Source: ESA and Coroner records

Conclusion
Recreation (**25%**), theft (**20%**), and landscaping, lawn cutting, and tree trimming (**20%**) were the most common activities associated with non-occupational electrical-related fatalities when excluding unknown activities.

2.4 Electrical Injury and Emergency Department Visits in Ontario, 2009–2018

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, respiratory arrest, head injuries, and fractures and dislocations (caused by being "thrown" or "knocked down") from the severe muscle contractions caused by the current (Duff and McCaffrey, 2011; Koumbourlis, 2002). Small or minor burns may be managed in an emergency department, but patients with severe burns may be transferred to regional burn centres for additional management (Koyfman and Long, 2020).

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 2009 to 2018, 11,600 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 69% of ED visits from males. Adults (age 20–64 at 79%) and children (age 0–19 at 18%) comprised 97% of all ED visits related to electrical injuries.

Using the Canadian Triage and Acuity Scale (CTAS), the severity of electrical injury was assessed upon each ED visit. In the past ten years, 83% 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 (Canadian Triage and Acuity Scale between 1 and 3). In 67% 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 16% of cases.

When excluding unspecified place of occurrence, the most common locations for electrical injury were the home (27%), followed by trade and service areas (21%), and industrial and construction locations (15%).

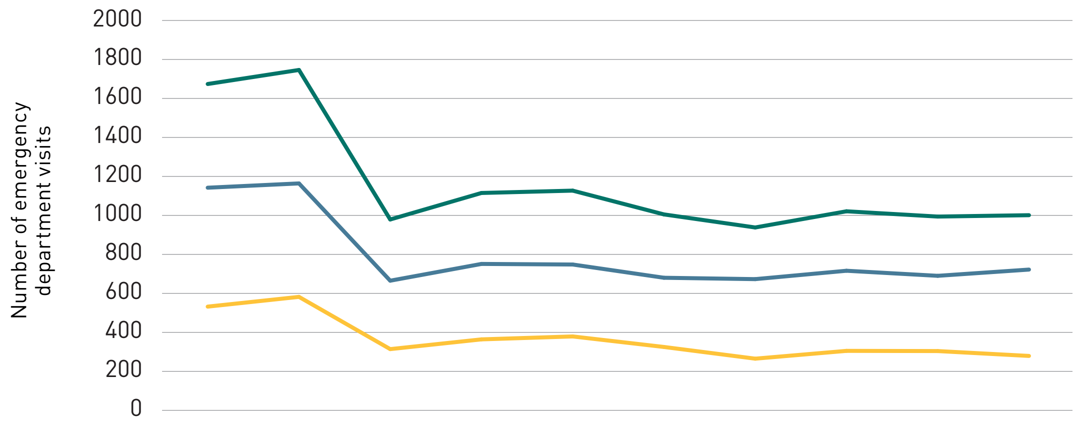
Statistics Related to the ESA's Harm Reduction Priorities – NON-OCCUPATIONAL ELECTRICAL SAFETY

Five-year Rolling Average Comparison

Number of emergency department visits due to critical electrical injuries (Canadian Triage and Acuity Scale 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 20% in the five-year rolling average between 2009–2013 and 2014–2018.

1 NUMBER OF EMERGENCY DEPARTMENT (ED) VISITS FOR ELECTRICAL INJURY BY SEX IN ONTARIO, 2009–2018

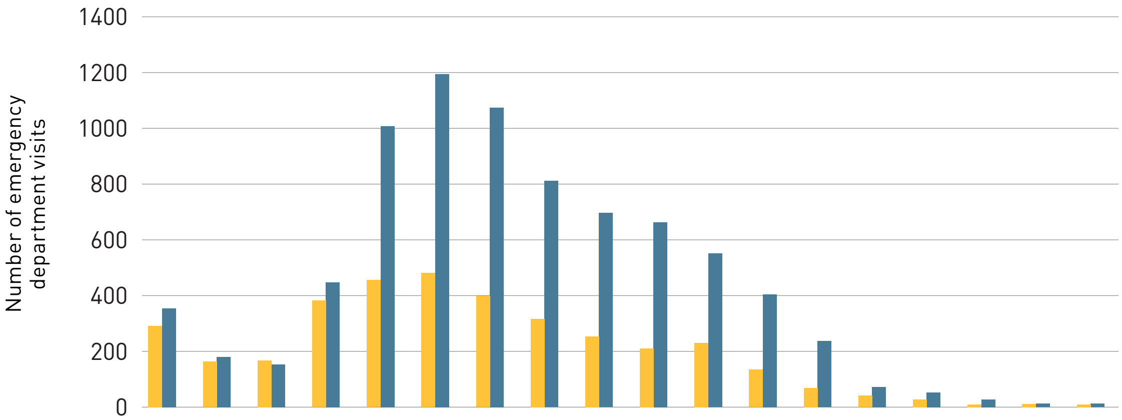


Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Female	532	582	314	364	379	325	265	305	304	279
Male	1142	1164	665	751	748	680	673	716	690	722
Total	1674	1746	979	1115	1127	1005	938	1021	994	1001

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 **40%** in the past ten years.

2 NUMBER OF EMERGENCY DEPARTMENT (ED) VISITS FOR ELECTRICAL INJURY BY AGE AND SEX IN ONTARIO, 2009–2018

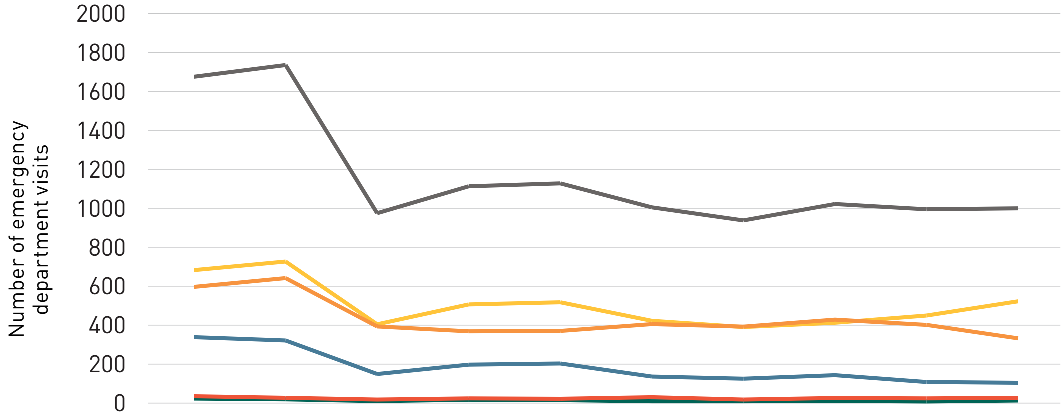


Age	0–4	5–9	10–14	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65–69	70–74	75–79	80–84	85+
Female	291	163	167	382	456	481	398	317	254	209	230	134	69	41	27	10	11	9
Male	354	180	153	448	1008	1195	1074	811	696	663	551	404	237	72	53	28	12	12

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 **79%**) and children (age 0–19 at **18%**) comprised **97%** of all ED visits related to electrical injuries.

3 NUMBER OF ED VISITS FOR ELECTRICAL INJURY BY CTAS IN ONTARIO, 2009–2018

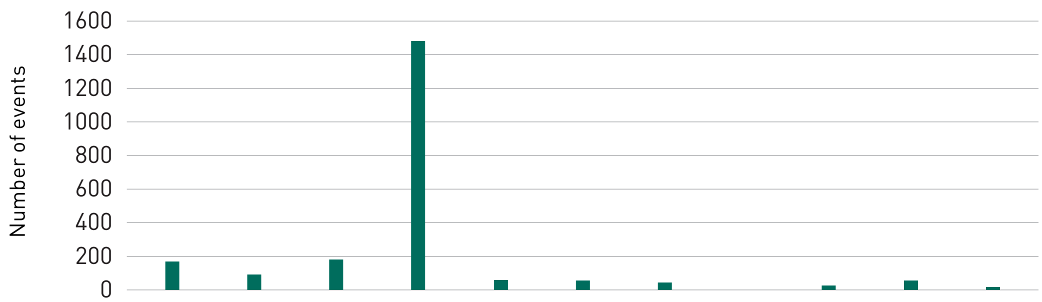


Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Resuscitation/ life threatening (level 1)	35	27	18	24	22	30	18	26	24	27
Emergent/potentially life threatening (level 2)	596	641	393	368	370	405	392	428	401	332
Urgent/potentially serious (level 3)	682	726	404	506	517	422	390	412	449	522
Less-urgent/ semi-urgent (level 4)	338	321	149	197	203	136	125	143	108	104
Non-urgent (level 5)	23	19	10	17	15	9	9	11	8	13
Total	1674	1734	974	1112	1127	1004	937	1021	994	999

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

Conclusion
83% of ED visits for electrical injury were classified on the Canadian Triage and Acuity Scale (CTAS) at levels 1–3 (Resuscitation, Emergent, Urgent).

4 LOCATION OF BURNS ASSOCIATED WITH ELECTRICAL INJURY IN ONTARIO, 2009–2018

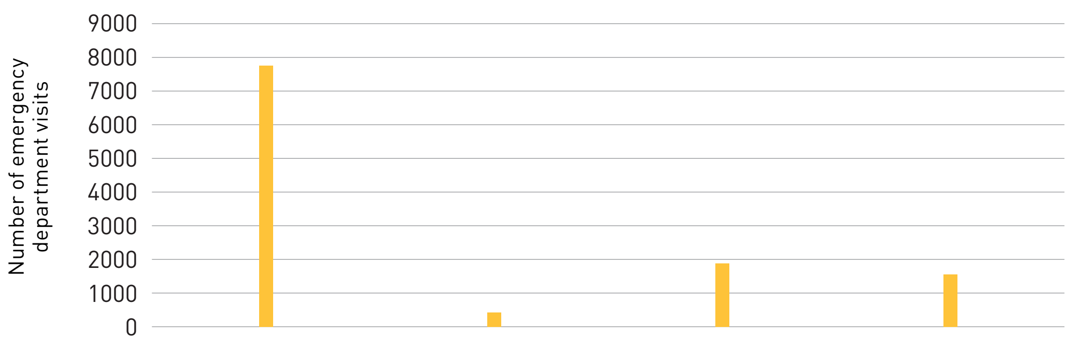


Location of burns	Head and neck	Trunk	Shoulder and upper limb, except wrist and hand	Wrist and hand	Hip and lower limb, except ankle and foot	Ankle and foot	Eye and adnexa	Respiratory tract	Other internal organs	Multiple body regions	Unspecified body areas
Total	168	90	179	1483	54	52	42	0	23	56	14

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, 2009–2018

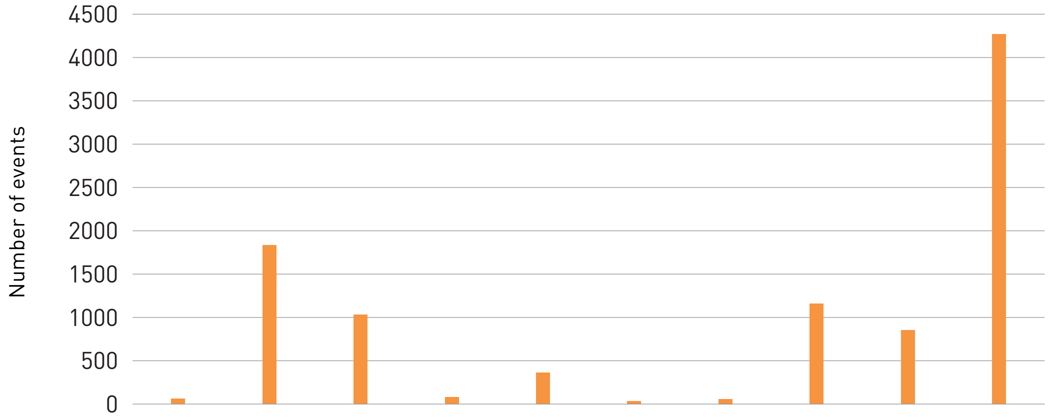


Primary diagnosis	Effects of electric current (T75.4)	Effects of lightning (T75.0)	Burns (T20–T31)	Other diagnoses
Number of ED visits	7739	428	1884	1549

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 (**67%**), followed by burns (**16%**).

6 PLACE WHERE ELECTRICAL INJURY OCCURRED IN ONTARIO, 2009–2018



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	62	1836	1030	79	361	34	59	1156	851	4267

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

While performing preventive maintenance to a motor control centre in an industrial facility, an electrician received a 4800 V shock that resulted in a critical injury.

The electrician (the victim) was one of a two-person crew working for an electrical contractor. The scope of work was to perform preventive maintenance (PM) on the motor control centre (MCC) powering the heating, ventilating, and air conditioning (HVAC) unit for the plant, a task electricians from this contractor had conducted for the facility many times prior without incident. The lead electrician had performed PM on this MCC prior to the day of the incident but performed the work alone.

To perform this task as part of the facility's safe work procedure, the crew must first obtain from the facility a safe work permit. The process requires a contractor to fill out the form, have it signed off by their contact person at the plant, then take the form and proceed with the work. Once the work is completed, the contractor would complete the checklist on the safe work permit, sign it, and return it to their contact person at the plant.

Figure 1: The contactor would be rolled out of the cell using the built-in rails in each compartment.

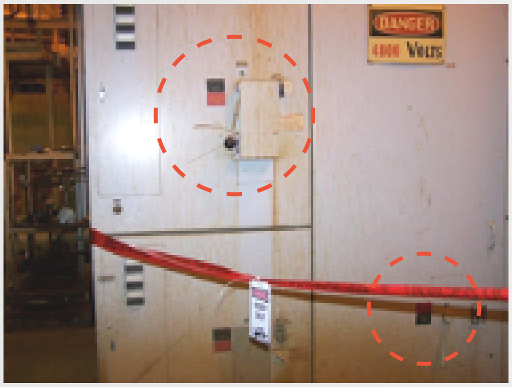


Figure 2: The highlight at the top left shows the racking handle for the R1 starter. The highlight at the bottom right shows the racking handle for the Q101 ("M" starter).

The lead electrician briefly discussed with the victim the task at hand before starting work. They performed PM on the first three cells without incident.

2.5 Case Study: Electrical Contractor (continued)

Next, while the victim rolled contactor "B" out of Cell 3L (Figure 3) and completed PM on it, the lead electrician did the same with contactor "A". The lead electrician completed PM on contactor "A", then rolled it back into Cell 2U. Then, he cleaned and checked Cell 3L while the victim was completing PM on contactor "B". The lead electrician then closed the door for Cell 2 and went to the truck to retrieve his face shield and gloves. When he returned with his personal protective equipment (PPE) on, he exercised the racking handle on Cell 2 two or three times. There was no discussion between himself and the victim about exercising the racking handle before proceeding to do so.

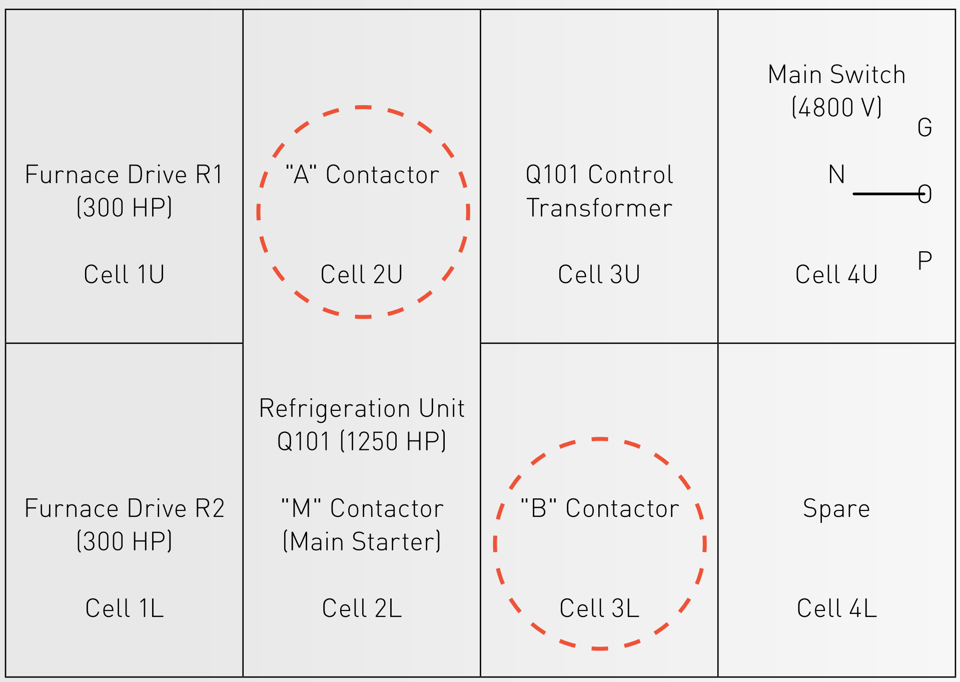


Figure 3: The highlight on Cell 2U shows where the lead electrician was when exercising the racking handle. The highlight on Cell 3L shows where the victim was crouching at the time of the incident.

After exercising the racking handle, the lead electrician dropped off his PPE at his truck and then came back to help the victim with his work. He found the victim on the floor as the victim had received a shock at some point while making contact with contactor "B" through the A and C phases (Figure 3 shows the burn marks on Phases A and C as a result). He performed CPR until some help arrived and emergency response was called in. The victim survived the incident but lost both arms as a result.

2.5 Case Study: Electrical Contractor (continued)

Additional information was revealed in the analysis:

- There was no line diagram of the MCC; the crew did not request to see a diagram before starting work.
- Contactors "M" and "B" shared the same branch in the circuit. When in closed (energized) position, the circuit was completed and the machine was energized.
- When contactor "M" was racked in, 4800 V was fed into contactor "B" through the exposed buss.
- When the door of Cell 3L was open, the buss mentioned above was still energized.
- No attempt was made to lock out the entire station. The main switch for the unit was located on Cell 4U (Figure 3). The workers assumed it was safe to work on the machine once they received the work permit.

CAUSAL FACTOR 1

The crew did not consider the hazards when there was a change in work method

According to the lead electrician, PM was performed on this equipment previously with no incident, and the PM had always been performed by one technician on one cell at a time. The electrician did not realize that working with two people introduced new hazards. The awareness of the associated hazards would have led to several other preventative measures (indicated below as other causal factors to this incident, such as reviewing electrical schematics as well as lockout and tag-out procedures).

CAUSAL FACTOR 2

The crew did not review schematics of equipment or line diagrams

It is unknown whether the line diagrams for MCC-42 were reviewed in previous visits by the contractor, but no one reviewed the electrical drawings for this particular job on the day of the incident. As well, the lead electrician indicated that the drawings in the control cell appeared to be a control diagram and not a line diagram.

CAUSAL FACTOR 3

No hazard assessment was performed by the client or contractor crew

Aside from a brief discussion of the work to be performed, no hazard assessment was conducted by the facility or contractor crew. No discussions took place between the contractor and customer regarding potential hazards involved with performing PM on the MCC.

2.5 Case Study: Electrical Contractor (continued)

CAUSAL FACTOR 4

The safe work permit failed to identify gaps in the contractor's work procedure

The facility owner's criteria for granting a safe work permit is unknown since the document was not available to review. Best practice for safe work permits typically includes identification, assessment, and control of the hazard. There appears to be a gap in either the criteria of granting a safe work permit and/or the review process of the safe work permit conducted by the facility owner.

CAUSAL FACTOR 5

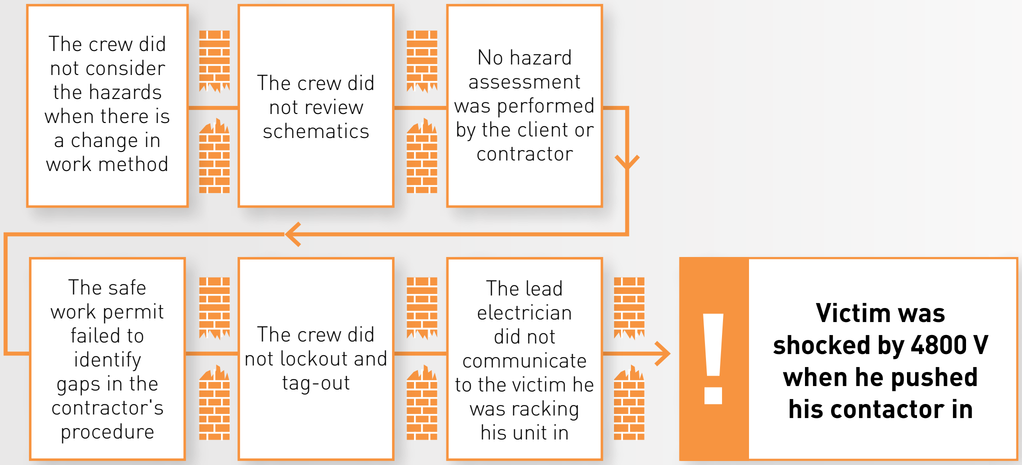
The crew did not perform lockout and tag-out (LOTO) in accordance with the *Occupational Health and Safety Act* (OHSA) and Regulations Requirements

OHSA and Regulations requires using LOTO methodology when two or more individuals are working on the same equipment. Both the customer and the contractor had written procedures for LOTO, but the procedures were not followed.

CAUSAL FACTOR 6

The lead electrician did not communicate to the victim that he was racking his unit in

While the victim was performing PM on contactor "B", the lead electrician racked his contactor in without informing the victim of his action. This action energized all the equipment which made contact with the buss across the MCC.



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 prevent exposure to electric shock hazards.

From 2010 to 2019, there were 26 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 increased by one death when compared to the previous ten-year period of 2009–2018.

Contact specifically with powerlines accounted for 19 of the electrical-related fatalities in the most recent ten-year period, which contributed to 73% of utility-related equipment fatalities. The five-year rolling average rate for powerline electrocutions has increased by 8% when comparing 2010–2014 and 2015–2019.

The five-year average number of utility-related electrical incidents has increased by 118% when comparing 2010–2014 and 2015–2019. Overhead powerline contact remains the leading cause of utility-related electrical incidents, yet all contact types have increased in the past five years. Among LDC workers (as a subset of the utility sector), there have been no reported incidents related to overhead powerlines in the past four years (2016–2019).

However, under-reporting is especially prevalent with utility contact incidents (especially in earlier years), and this information should be interpreted with caution. Injuries as a result of utility-related equipment have decreased over the past ten years, although property damage has been increasingly reported in the most recent five years.

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

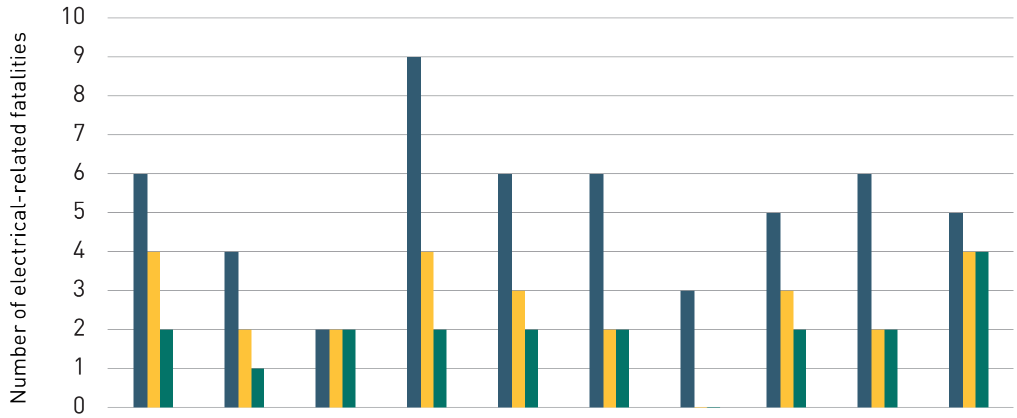
Statistics Directly Related to the ESA's Harm Reduction Priorities – POWERLINE CONTACT

Five-year Rolling Average Comparison

The statistics below represent the number of worker and non-worker powerline-related contact incidents based on data reported to the ESA.

The powerline safety five-year rolling average has increased by 18% between 2010–2014 and 2015–2019.

1 NUMBER OF UTILITY-RELATED EQUIPMENT ELECTRICAL-RELATED FATALITIES IN ONTARIO, 2010–2019

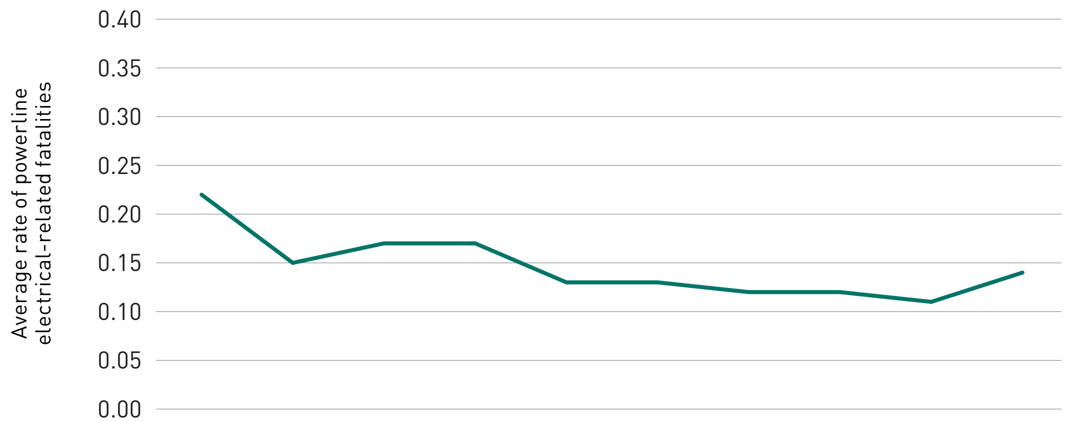


Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Electrical-related fatalities	6	4	2	9	6	6	3	5	6	5
Utility equipment electrical fatalities	4	2	2	4	3	2	0	3	2	4
Powerline electrical-related fatalities	2	1	2	2	2	2	0	2	2	4

Source: ESA and Coroner records

Conclusion
The number of utility-related equipment fatalities has been within a range of zero to four fatalities reported per year. In 2019, there were four powerline fatalities reported.

2 FIVE-YEAR ROLLING AVERAGE OF POWERLINE ELECTRICAL-RELATED FATALITIES IN ONTARIO, 2006–2019

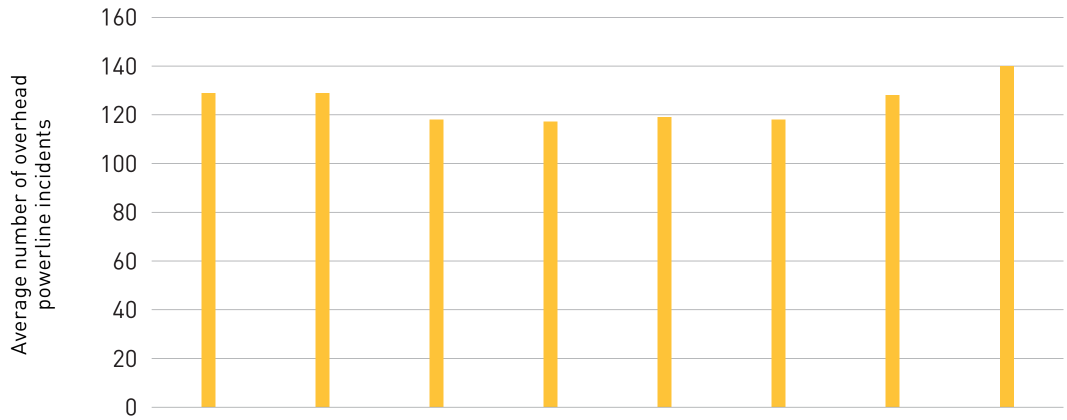


Five-year period	2006–2010	2007–2011	2008–2012	2009–2013	2010–2014	2011–2015	2012–2016	2013–2017	2014–2018	2015–2019
Rate of powerline electrical-related fatalities	0.22	0.15	0.17	0.17	0.13	0.13	0.12	0.12	0.11	0.14

Source: ESA and Coroner records

Conclusion
The rate of powerline electrical-related fatalities has increased by **8%** when comparing 2010–2014 and 2015–2019. The 2015–2019 rate has increased by **27%** when compared to the previous five-year period of 2014–2018.

3 FIVE-YEAR ROLLING AVERAGE NUMBER OF OVERHEAD POWERLINE INCIDENTS IN ONTARIO, 2008–2019

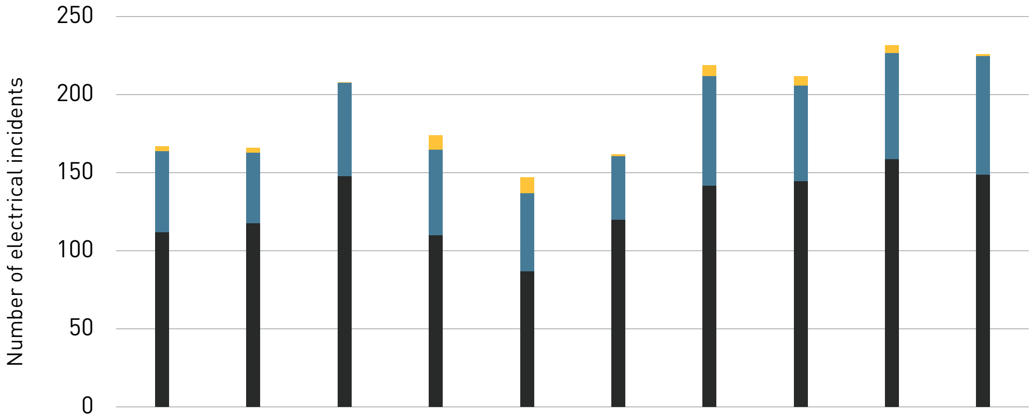


Five-year period	**2008–2012**	**2009–2013**	**2010–2014**	**2011–2015**	**2012–2016**	**2013–2017**	**2014–2018**	**2015–2019**
Number of overhead powerline incidents	130	130	119	118	120	119	129	141

Source: ESA records

Conclusion
The five-year rolling average number of overhead powerline incidents has increased by **18%** when comparing 2010–2014 and 2015–2019. The most recent five-year period of 2015–2019 shows a **9%** increase in overhead powerline contacts when compared to the previous time period of 2014–2018.

4 NUMBER OF UTILITY-RELATED ELECTRICAL INCIDENTS BY CONTACT TYPE IN ONTARIO, 2010–2019

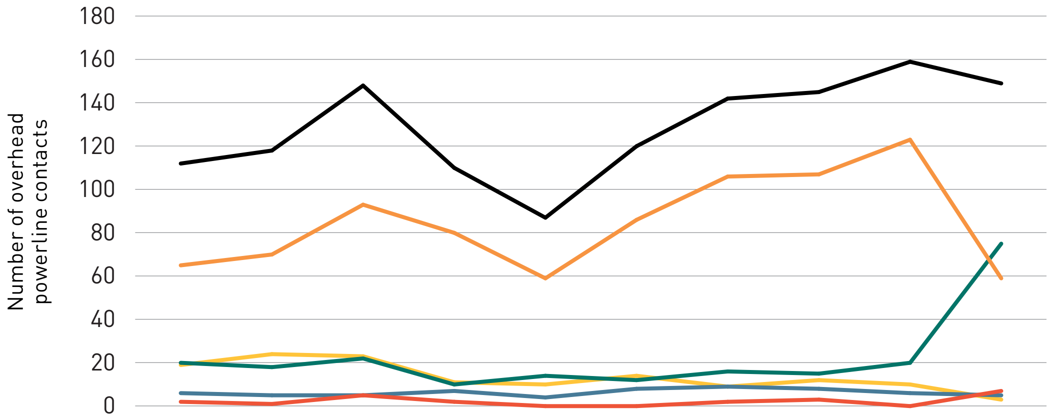


Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Vaults, substations, and padmounts	3	3	0	9	10	1	7	6	5	1
Underground powerline contact	52	45	60	55	50	41	70	61	68	76
Overhead powerline contact	112	118	148	110	87	120	142	145	159	149

Source: ESA records

Conclusion
Overhead powerline contact remains the leading cause in utility-related electrical incidents between 2010 and 2019 and has increased **33%**. The total number of utility-related electrical incidents has increased by **35%** when comparing 2010 and 2019.

5 NUMBER OF OVERHEAD POWERLINE CONTACTS BY SECTOR IN ONTARIO, 2010–2019

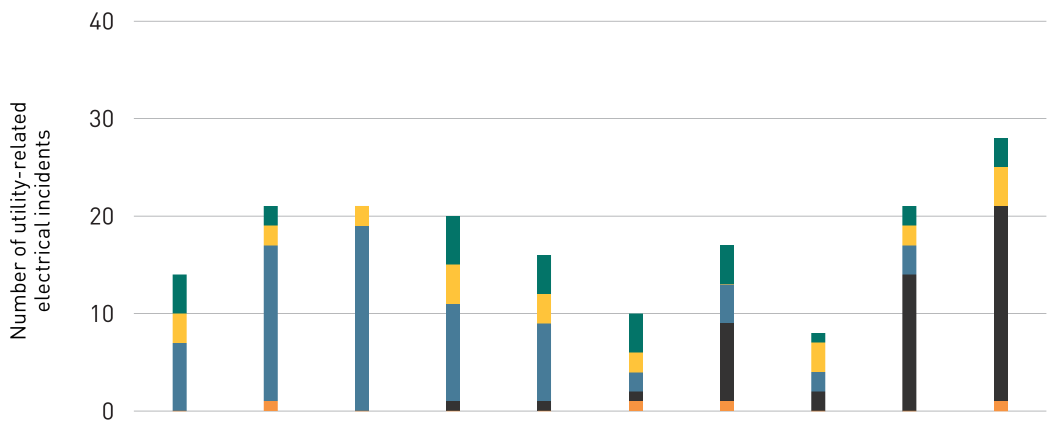


Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Construction	65	70	93	80	59	86	106	107	123	59
Farm	2	1	5	2	0	0	2	3	0	7
Public	20	18	22	10	14	12	16	15	20	75
Transport	6	5	5	7	4	8	9	8	6	5
Utility	19	24	23	11	10	14	9	12	10	3
Total	112	118	148	110	87	120	142	145	159	149

Source: ESA records

Conclusion
Construction has been the leading sector in powerline contacts in the past ten years. In the past four years (2016–2019), there have been no reported incidents involving LDC workers (as a subset of the utility sector).

6 NUMBER OF UTILITY-RELATED ELECTRICAL INCIDENTS BY OUTCOME IN ONTARIO, 2010–2019



Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Critical injury	4	2	0	5	4	4	4	1	2	3
Fatality	3	2	2	4	3	2	0	3	2	4
Non-critical injury	7	16	19	10	8	2	4	2	3	0
Property damage	0	0	0	1	1	1	8	2	14	20
Unknown	0	1	0	0	0	1	1	0	0	1

Source: ESA records

Conclusion
The number of utility-related incidents that resulted in fatality has increased when comparing 2019 to 2018. Likewise, the number of utility-related incidents that resulted in property damage has increased when compared to 2018.

3.1 **Case Study**: Powerline Safety

A grader blade operator was fatally injured when the dump truck attached to his grader contacted an overhead powerline. Unaware of the hazard, and instead of remaining on his device until the situation was safe, the operator stepped out of the machine, producing a difference in voltage potential, killing him instantly. The following is the chain of events.

As a country road was recently paved, the road shoulder required grading. The township was aware of overhead powerlines perpendicularly crossing over sections of the road. "Caution – Overhead Wires" signs could be seen near the area where the powerline crosses over the road.

The grading operation consisted of two vehicles and a device: a large dump truck, a grader, and a grader blade device that is attached to both the dump truck and the grader. The dump truck would slowly tilt its gravel and sand mix onto a two-elevation trough as part of the grading device. The two-elevation trough would regulate the flow of the mix onto the road shoulder, and the angle of the shoulder would be controlled by the blade on the device. The two vehicles and the device were all attached to each other and would all move as a unit at a walking pace (less than 5 km/h) to reconstruct the shoulder.

The county contracted an independent dump truck driver and his vehicle for the job. The remaining crew, the grader driver, and the grader blade operator were employees of the township. The work started at around 7:00 am on the day of the fatality. As can be seen in the photo, it was a clear day with clear visibility. Nothing obstructed the workers' views of the powerline.

Figure 1: The dump truck/grader combination device working on the shoulder of the road.

3.1 Case Study: Powerline Safety (continued)

As the work progressed, the angle of the dump truck was raised gradually to unload the mixture into the grader hopper. Around 30 to 40 minutes from the start of the day, the bucket of the dump truck was raised to exceed the clearance of the powerline. Because the operator was unaware of the powerline, the bucket of the dump truck contacted the powerline, energizing the bucket of the dump truck and the grader device.

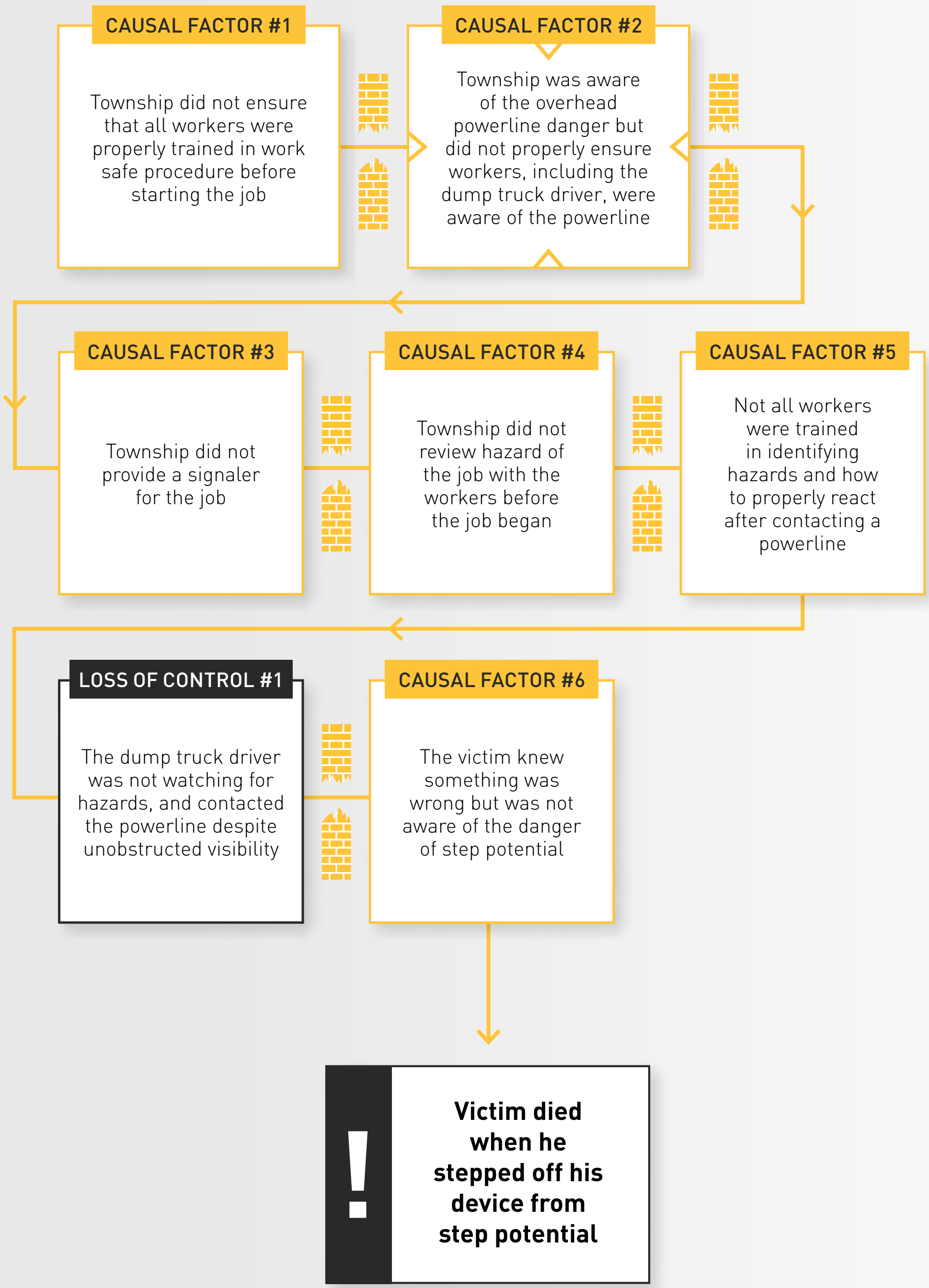
Figure 2: The dump truck bucket nears the powerline.

Realizing he had made contact with the powerline, the dump truck driver stopped. The dump truck and the grader drivers remained in their respective vehicles. Instead of remaining in his station, the grade blade operator dismounted. The voltage potential difference between the grading device and the ground caused current to flow through the victim, electrocuting him.

The following gaps were identified in the safety framework as a result of the analysis:

- Crew members need to review the job hazards prior to starting the work. Posting "Caution – Overhead Wires" signs alone is not sufficient to ensure awareness of the hazard and worker safety.
- Even though the vehicles were moving slowly and there were no visibility issues, it should not be assumed that danger would be detected easily and injuries averted.
- Workers must be educated on the danger of powerlines, electrocution by step and touch potential, and the safety procedure in the event of inadvertent contact with powerlines. In this event, had the victim acted properly and stayed on his device until the dump truck was manoeuvred away from the powerline, the injury would not have occurred.

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 35,160 structural loss fires (fires resulting in an injury, fatality, or dollars lost) between 2014 and 2018. This number is less than a 1% decrease from 35,351 structure-loss fires between 2013 and 2017. Residential-loss fires account for 73% of structural loss fires from 2014 to 2018. Stove-top fires (with electricity fuel only) account for 7% of structural loss fires and 10% of residential-loss fires. Since 2014, there has been a 3% increase in total loss fires, a 1% decrease in structural loss fires, and a 1% decrease in residential-loss fires.

For the period between 2009 and 2018, the OFMEM identified the following as the most common ignition sources for structural 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 (4%); and
- other electrical, mechanical (4%).

When comparing 2009–2013 and 2014–2018, the average number of structural loss fires per year by ignition source decreased 9% for cooking, 8% for electrical wiring, 17% for heating/cooling equipment, and 5% for appliances.

When structural 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 (41%);
- electrical distribution equipment (26%); and
- appliances (12%).

Electrical Products

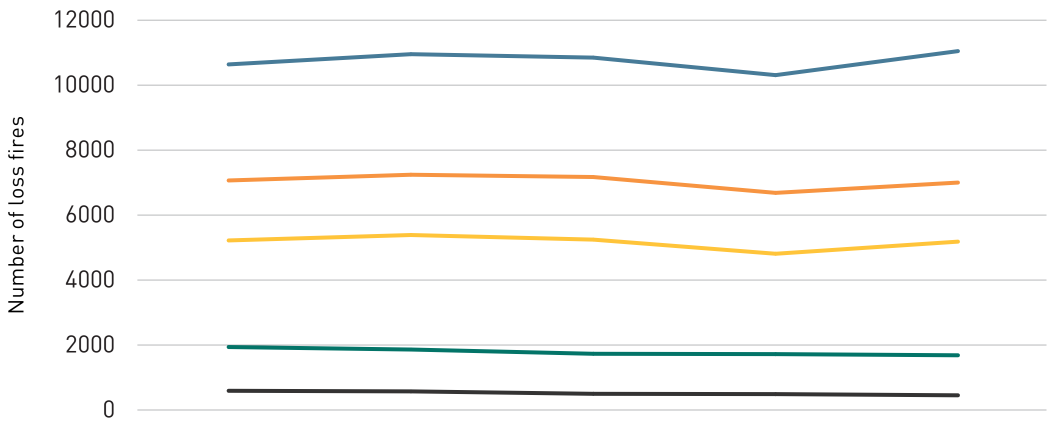
The ESA defines electrical products as appliances, cooking equipment, lighting equipment, other electrical and mechanical equipment, and processing equipment. Data from the OFMEM shows that the five-year average for electrical product fires (where electricity was identified as the fuel of the ignition source) between 2009–2013 and 2014–2018 has decreased by 13%.

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 Office of the Fire Marshal and Emergency Management data.

The product safety five-year rolling average has decreased by 13% between 2009–2013 and 2014–2018.

1 NUMBER OF LOSS FIRES IN ONTARIO, 2014–2018



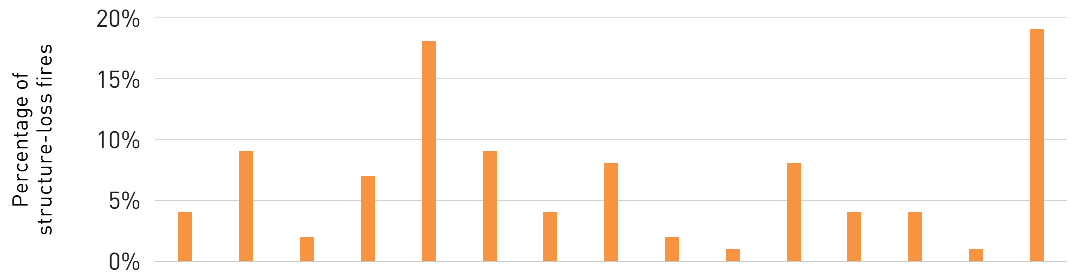
Year	2014	2015	2016	2017	2018
Total number of loss fires	10637	10952	10846	10307	11046
Structure-loss fires	7065	7241	7171	6683	7000
Residential-loss fires	5219	5386	5244	4809	5182
Structure-loss fires where electricity fuelled the ignition source	1938	1861	1730	1720	1684
Stove-top structure-loss fires	591	573	498	489	452

Source: OFMEM records

Conclusion

The number of total loss fires has increased, while structure-loss fires and residential-loss fires have decreased between 2014 and 2018. The number of fires where electricity fuelled the ignition source has decreased by **13%** in the most recent five-year period.

2 PERCENTAGE OF STRUCTURE-LOSS FIRES BY IGNITION SOURCE IN ONTARIO, 2014–2018

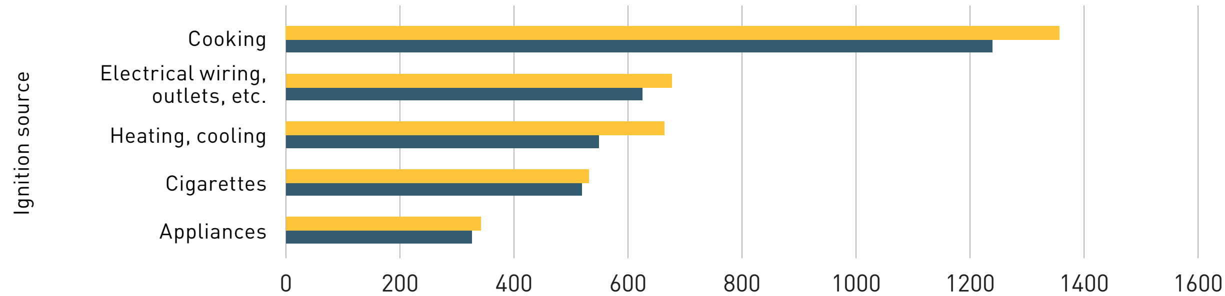


Ignition source	Appliances	Arson	Candles	Cigarettes	Cooking	Electrical wiring	Exposure	Heating, cooling	Lighting	Matches, lighters	Miscellaneous	Other open flame tools	Other electrical, mechanical	Processing equipment	Undetermined
2014–2018	4%	9%	2%	7%	18%	9%	4%	8%	2%	1%	8%	4%	4%	1%	19%

Source: OFMEM records

Conclusion
Aside from undetermined and miscellaneous sources, cooking (**18%**) and electrical wiring (**9%**) were the most common ignition sources for structure-loss fires between 2014 and 2018.

3 FIVE-YEAR AVERAGE NUMBER OF STRUCTURE-LOSS FIRES BY IGNITION SOURCE IN ONTARIO, 2009–2013 AND 2014–2018

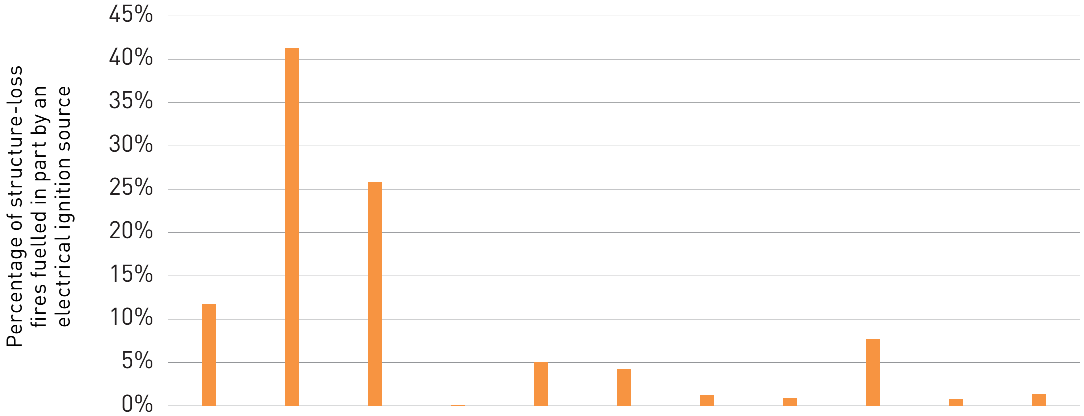


Ignition source		Cooking	Electrical wiring, outlets, etc.	Heating, cooling	Cigarettes	Appliances
Average number of structure-loss fires	2009–2013	1357	677	664	531	342
	2014–2018	1239	625	549	519	326

Source: OFMEM records

Conclusion
Cooking equipment remained the most common ignition source in 2009–2013 and 2014–2018, 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, 2014–2018



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	12%	41%	26%	<1%	5%	4%	1%	<1%	8%	<1%	1%

Source: OFMEM records

Conclusion
When the fire is from ignition sources that use electricity, cooking equipment (**41%**), electrical distribution equipment (**26%**), and appliances (**12%**) were the most common ignition sources between 2014 and 2018.

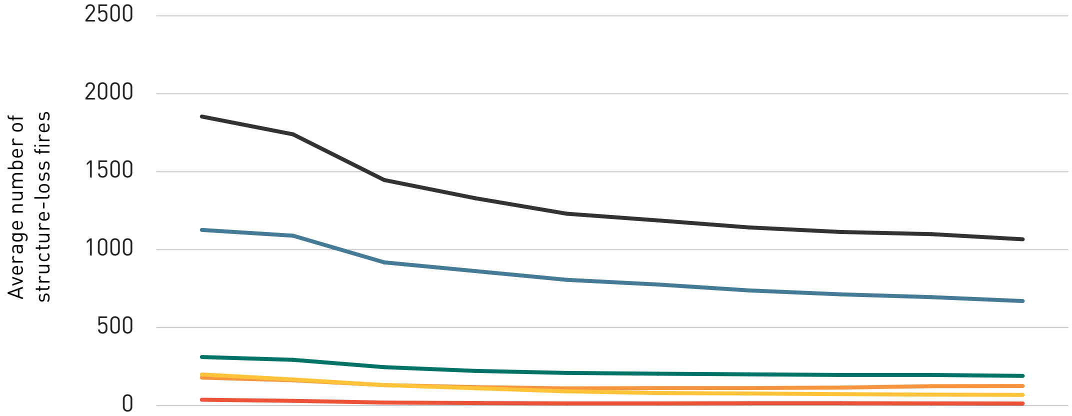
5 PERCENTAGE OF ELECTRICAL STRUCTURE-LOSS FIRES IN ONTARIO BY TIME OF DAY, 2009–2018

Time	Midnight – 8 a.m.	8 a.m. – 4 p.m.	4 p.m. – Midnight
Percentage	18%	38%	44%

Source: OFMEM records

Conclusion
Between 2009 and 2018, most of the electrical-related structural 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, 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
Appliances	311	293	246	222	209	204	200	196	196	190
Cooking equipment	1126	1089	918	862	806	776	738	713	695	670
Lighting	199	167	131	111	91	80	77	73	70	68
Other electrical, mechanical	179	162	131	118	110	112	112	115	124	125
Processing equipment	37	30	19	16	14	14	15	15	14	13
Product safety overall	1853	1739	1446	1329	1230	1187	1142	1113	1099	1066

Source: OFMEM records

Conclusion
Between 2009–2013 and 2014–2018, the five-year rolling average number of fires related to product safety has decreased by **13%**.

4.1 Fires Resulting in Fatalities

In 2007, British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, New Brunswick, Nova Scotia, and 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 deaths (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 deaths of between 4,000 and 5,000 Americans and injured an additional 20,000 each year (Baker and Adams, 1993).

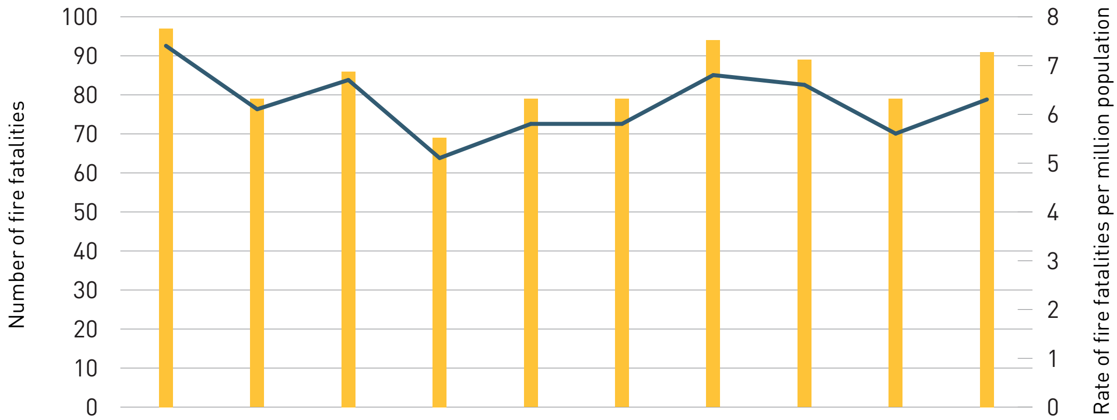
Ontario reported 843 deaths due to fires between 2009 and 2018. This number excludes fire deaths in vehicle collisions, fire fatalities among emergency response, or any fire deaths on federal or First Nations property. This number is less than what was reported between 2008 and 2017, where 851 deaths were reported. The OFMEM reported that in 2018, the fire death rate was 6.3 deaths per million population, which is a 15% decrease when compared to the fire death rate in 2009, which was 7.4 deaths per million population.

Structural-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 758 fire fatalities from structural-loss fires from 2009 to 2018. This is a 1% decrease when compared to the previous ten-year period of 765 fire fatalities from 2008 to 2017. The OFMEM reported that in 2018, the structural-loss fire death rate was 5.6 per million population, which is an 11% decrease when compared to the structural-loss fire death rate in 2009, which was 6.3 deaths per million population.

The OFMEM data identified 85 deaths in fires for which electricity was the fuel of the ignition source or were from electrical distribution equipment between 2009 and 2018. Since 2009, the death rate from this type of fire has increased 30% from 0.69 deaths per million population to 0.90 deaths per million population.

In these types of fires in which the investigations were considered closed, 96% were considered accidental between 2014 and 2018. Stove or range-top burners accounted for 44% of fire fatalities fuelled by electricity in the last ten years.

1 NUMBER AND RATE OF ALL FIRE FATALITIES IN ONTARIO, 2009–2018

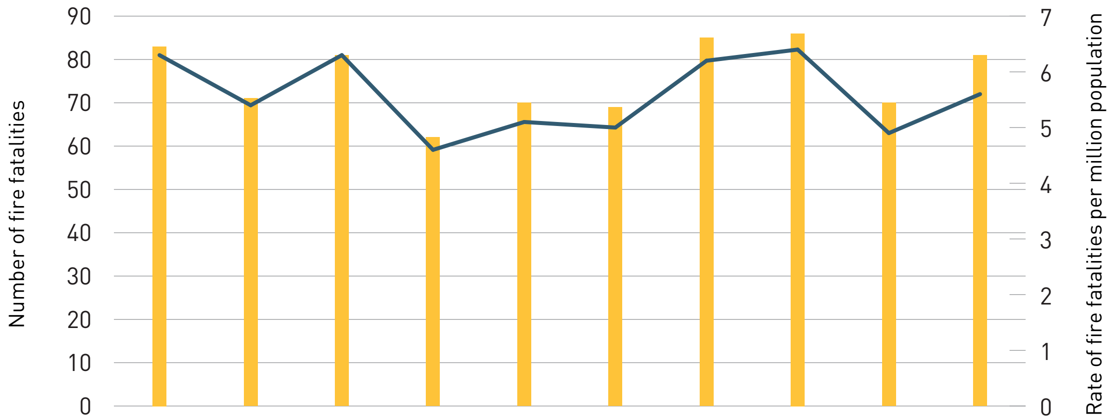


Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
All fire fatalities in Ontario	97	79	86	69	79	80	94	89	79	91
Ontario population in millions	13.1	13.2	12.9	13.4	13.6	13.7	13.8	13.4	14.2	14.4
Fire death rate in Ontario	7.4	6.0	6.7	5.1	5.8	5.8	6.8	6.6	5.6	6.3

Source: OFMEM records

Conclusion
The number and rate of fire fatalities have increased when comparing 2018 to 2017.

2 NUMBER AND RATE OF FIRE FATALITIES IN STRUCTURE FIRES IN ONTARIO, 2009–2018

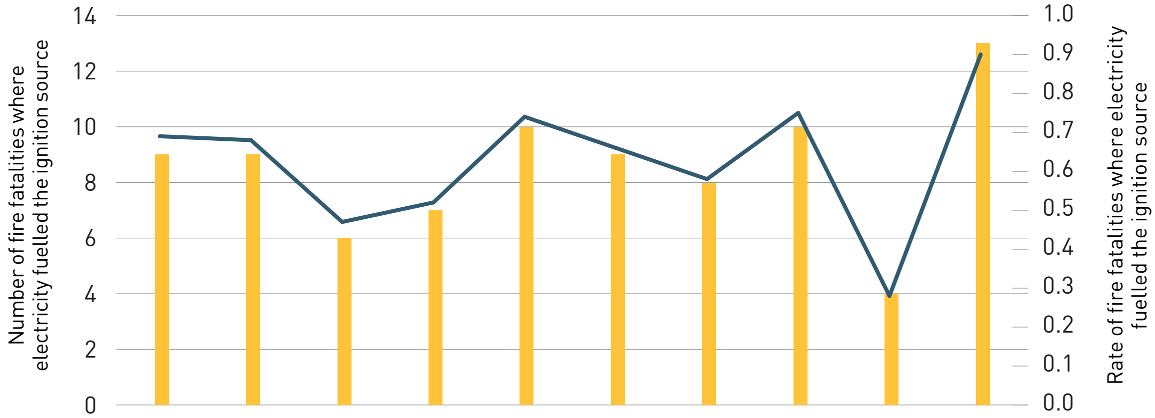


Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Number of fire fatalities from structure fires	83	71	81	62	70	69	85	86	70	81
Ontario population in millions	13.1	13.2	12.9	13.4	13.6	13.7	13.8	13.4	14.2	14.4
Rate of fire fatalities from structure fires	6.3	5.4	6.3	4.6	5.1	5	6.2	6.4	4.9	5.6

Source: OFMEM records

Conclusion
The rate of fire fatalities in structure fires has decreased when comparing 2009 to 2018.

3 NUMBER AND RATE OF STRUCTURE FIRE FATALITIES WHERE ELECTRICITY WAS THE FUEL OF THE IGNITION SOURCE IN ONTARIO, 2009–2018

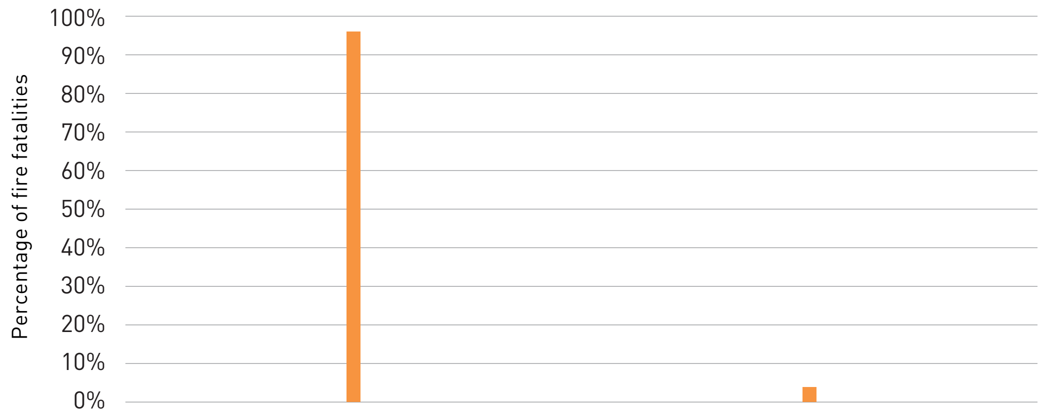


Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Number of fatalities where electricity fuelled the ignition source	9	9	6	7	10	9	8	10	4	13
Ontario population in millions	13.1	13.2	12.9	13.4	13.6	13.7	13.8	13.4	14.2	14.4
Rate of fatalities where electricity fuelled the ignition source	0.69	0.68	0.47	0.52	0.74	0.66	0.58	0.75	0.28	0.90

Source: OFMEM records

Conclusion
The rate of structure fire fatalities where electricity fuelled the ignition source or where fires were from electrical distribution equipment has increased **221%** when comparing 2017 to 2018.

4 PERCENTAGE OF STRUCTURE FIRE FATALITIES WHERE ELECTRICITY IS THE FUEL OF THE IGNITION SOURCE BY CAUSE CLASSIFICATION IN ONTARIO, 2009–2018 (CLOSED FIRE INVESTIGATIONS ONLY)

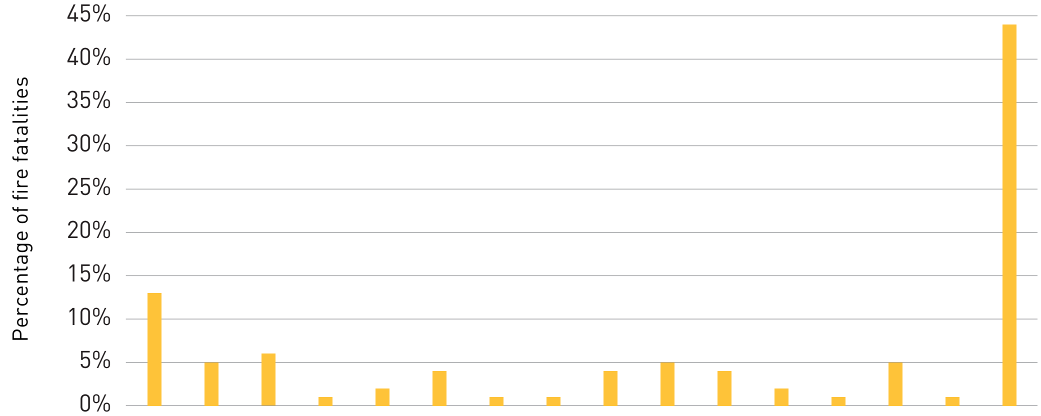


Cause classification	Accidental	Undetermined
2009–2018	96%	4%

Source: OFMEM records

Conclusion
Almost all structure fire fatalities (**96%**) where electricity fuelled the ignition source or where the fires were from electrical distribution equipment were accidental.

5 PERCENTAGE OF STRUCTURE FIRE FATALITIES WHERE ELECTRICITY WAS THE FUEL OF THE IGNITION SOURCE BY IGNITION SOURCE IN ONTARIO, 2009–2018 (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	13%	5%	6%	1%	2%	4%	1%	1%	4%	5%	4%	2%	1%	5%	1%	44%

Source: OFMEM records

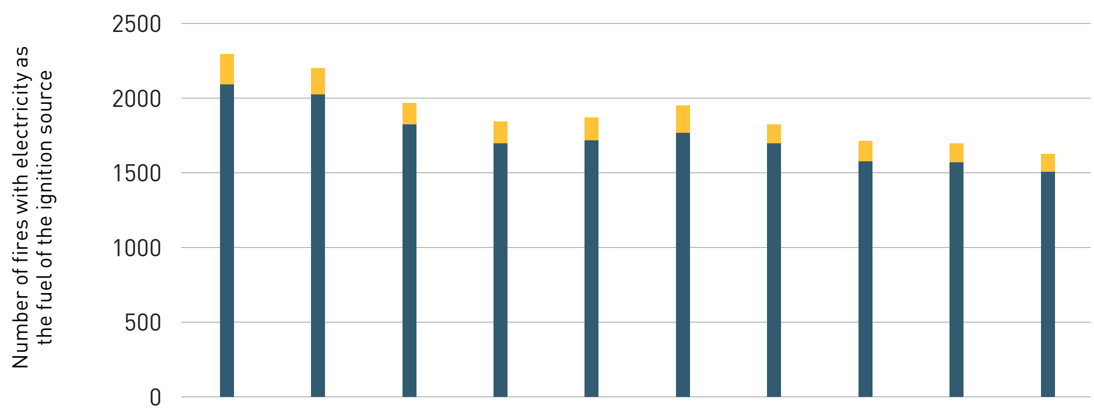
Conclusion
The stove (**44%**) remains the most common ignition source when examining structure fire fatalities where electricity fuelled the ignition source or where the fires were from electrical distribution equipment in the most recent ten-year period.

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 17,474 loss fires and 1,517 no-loss fires for a total of 18,991 structure fires from 2009 to 2018. Over the same time period, there was a 28% decrease in structure-loss fires and a 29% decrease in total structure fires.

Between 2014 and 2018, 81% of structure fires occurred in the residential setting. Cooking equipment (49%), electrical distribution equipment (23%), and appliances (12%) remained the most common ignition sources in these fires.

1 NUMBER OF STRUCTURE FIRES WITH ELECTRICITY AS THE FUEL OF THE IGNITION SOURCE IN ONTARIO, 2009–2018

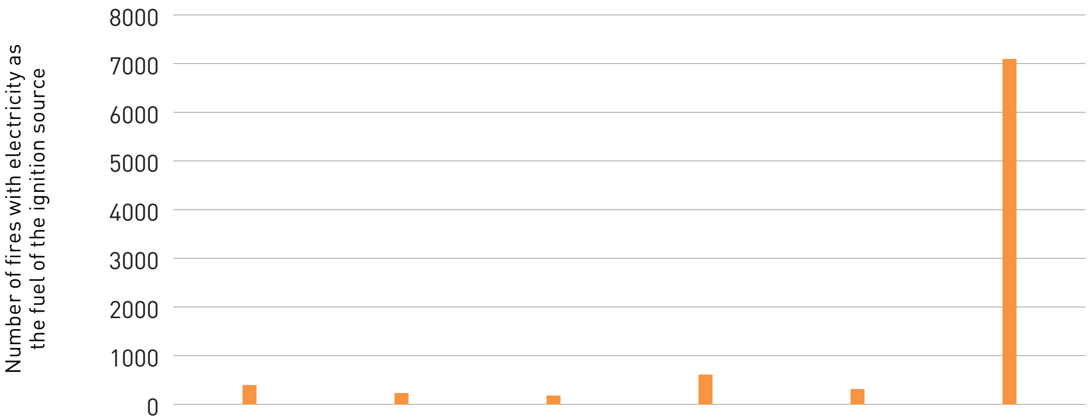


Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Number of fires with no loss	203	177	145	146	155	182	129	137	124	119
Number of fires with loss	2093	2025	1823	1697	1716	1768	1696	1578	1571	1507
Total fires with electricity as the fuel	2296	2202	1968	1843	1871	1950	1825	1715	1695	1626

Source: OFMEM records

Conclusion
In 2018, the total number of structure fires where electricity was the fuel of the ignition source decreased slightly by only **4%** when compared to 2017.

2 NUMBER OF FIRES WITH ELECTRICITY AS THE FUEL OF THE IGNITION SOURCE BY STRUCTURE CLASSIFICATION IN ONTARIO, 2014–2018

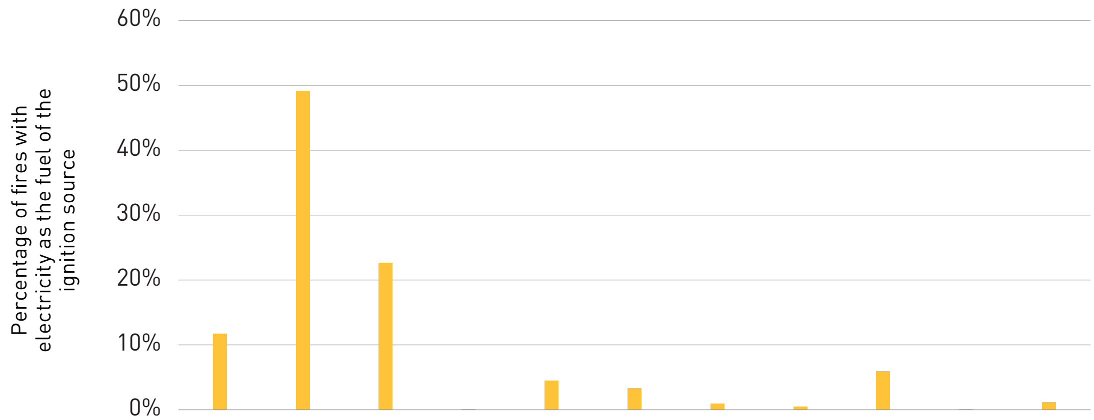


Structure classification	Assembly	Business and personal services	Care and detention	Industrial	Mercantile	Residential
Number of fires	396	234	183	615	314	7096

Source: OFMEM records

Conclusion
Residential structures were the most common structures (**81%**) for fires where electricity was the fuel of the ignition source between 2014 and 2018.

3 PERCENTAGE OF RESIDENTIAL FIRES WITH ELECTRICITY AS THE FUEL OF THE IGNITION SOURCE BY IGNITION SOURCE IN ONTARIO, 2014–2018



Ignition source	Percentage
Appliances	12%
Cooking equipment	49%
Electrical distribution equipment	23%
Exposure	<1%
Heating equipment, chimney, etc.	5%
Lighting equipment	3%
Miscellaneous	1.0%
Open flame tools, smokers' articles	<1%
Other electrical, mechanical	6%
Processing equipment	<1%
Undetermined	1%

Source: OFMEM records

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

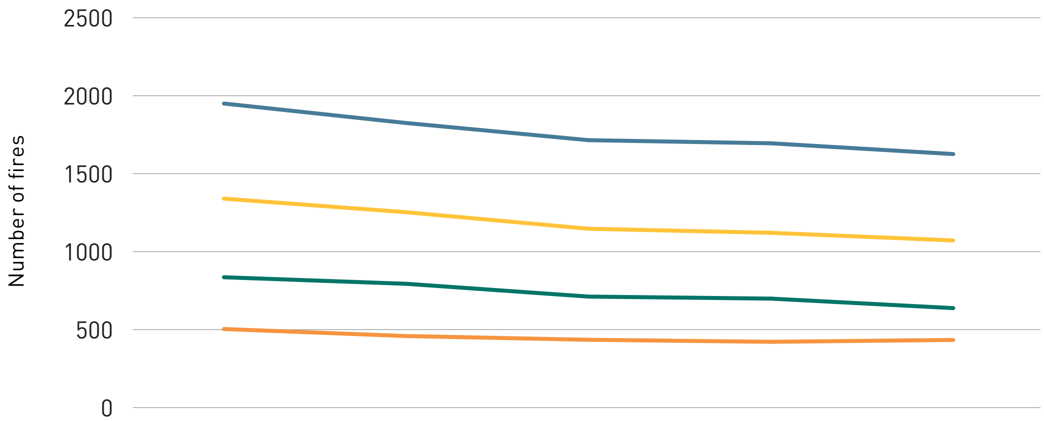
4.3 Cooking Fires with Electricity as the Fuel of the Ignition Source of the Fire

The National Fire Protection Association 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 2014 to 2018, there were 3,679 structure fires where the ignition source was cooking equipment fuelled by electricity. Of those, 3,484 occurred in homes. Since 2014, there has been a 24% 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 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 131 injuries among civilians and an average of four fatalities between 2014 and 2018. In this time period, cooking equipment was the leading ignition source in fires from electrical products or where electricity fuelled the ignition source.

1 NUMBER OF COOKING EQUIPMENT AND ELECTRICAL DISTRIBUTION EQUIPMENT FIRES IN ONTARIO, 2014–2018



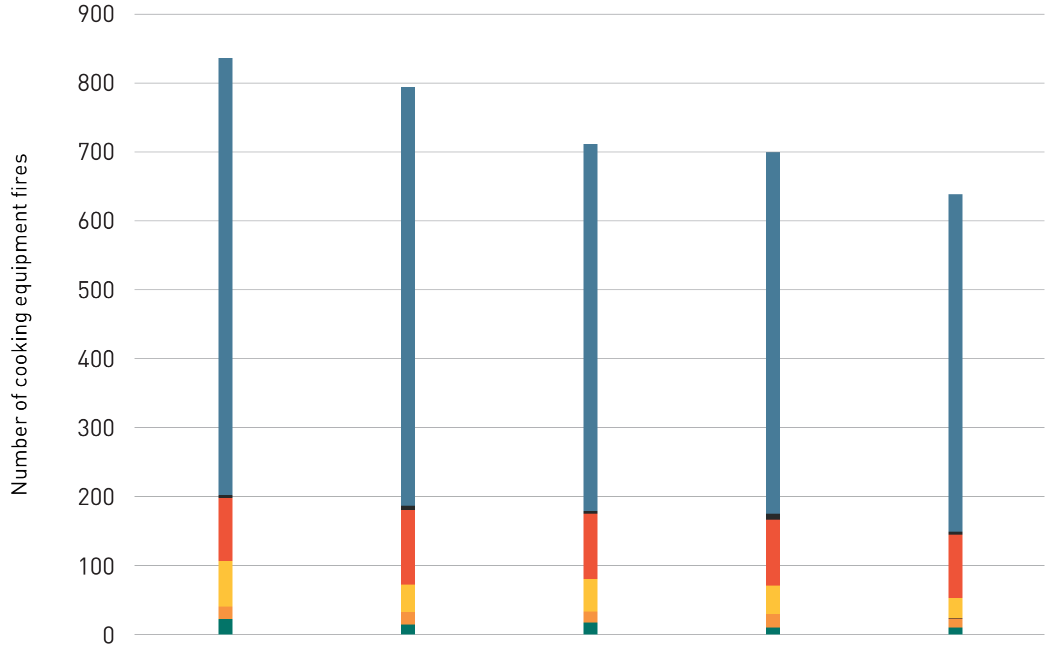
Year	2014	2015	2016	2017	2018
Cooking equipment	836	794	712	699	638
Electrical distribution equipment	504	459	435	422	434
Total cooking equipment and electrical distribution equipment fires	1340	1253	1147	1121	1072
Total fires with electricity as the fuel	1950	1825	1715	1695	1626

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 **20%** when compared to 2014.

2 NUMBER OF COOKING EQUIPMENT FIRES WITH ELECTRICITY AS THE FUEL OF THE IGNITION SOURCE BY SOURCE IN ONTARIO, 2014–2018

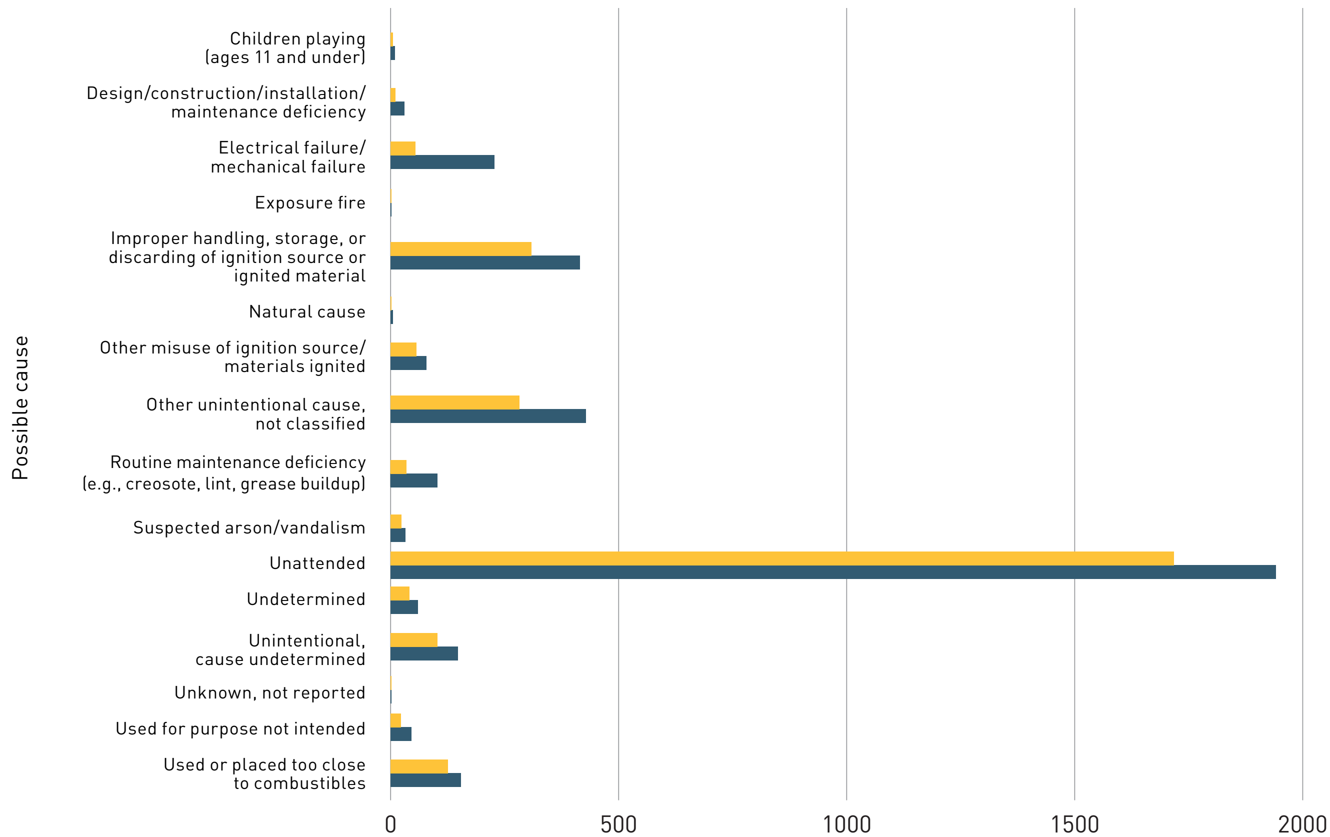


Year	2014	2015	2016	2017	2018
Stove, range-top burner	634	607	533	524	489
Range hood	4	7	4	9	4
Oven	92	108	95	95	92
Other cooking items	66	40	47	42	29
Open fired barbeque - fixed or portable	0	0	0	0	1
Microwave	18	18	16	19	13
Deep fat fryer	22	14	17	10	10

Source: OFMEM records

Conclusion
Stoves and range-top burners were the leading sources (**76%**) of cooking equipment fires between 2014 and 2018.

3 NUMBER OF STOVE-TOP FIRES VS. COOKING EQUIPMENT FIRES BY POSSIBLE CAUSE IN ONTARIO, 2014–2018



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	Other intentional cause, not classified	Routine maintenance deficiency (e.g., creosote, lint, grease buildup)	Suspected arson/vandalism	Unattended	Undetermined	Unintentional, cause undetermined	Unknown, not reported	Used for purpose not intended	Used or placed too close to combustibles
Stove-top fires	5	11	54	1	309	1	57	282	35	24	1717	41	102	1	22	125
Cooking equipment fires	9	30	228	1	415	5	78	428	103	32	1941	60	147	2	46	154

Source: OFMEM records

Conclusion
Leaving cooking fires unattended was the most common cause of stove-top and cooking equipment fires between 2014 and 2018.

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 2014 and 2018, the OFMEM identified 2,254 fires as electrical distribution equipment fires with electricity as the fuel of the ignition source, in which 93% were identified as loss fires. The five-year rolling average of electrical distribution equipment loss structure fires has decreased by 15% between 2009–2013 and 2014–2018.

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 16% when comparing 2009–2013 and 2014–2018. Electrical/mechanical failure is the most common possible cause in these types of fires.

Between 2012 and 2016, there was an estimated average of 35,150 home fires involving electrical distribution and lighting equipment in the U.S. This cause an estimated average of 490 deaths, 1,200 injuries each year in 2012–2016, as well as an estimated $1.3 billion in direct property damage per year (Campbell, 2019).

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).

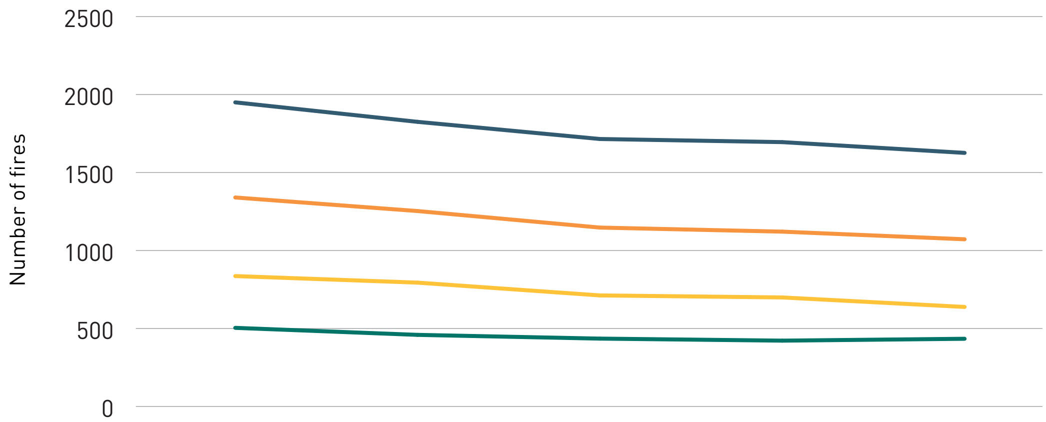
Section 4.5 provides a case study that is representative of the risk factors associated with electrical distribution equipment fires.

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 five-year rolling average for electrical distribution equipment structure loss fires related to aging infrastructure has decreased by 15% between 2009–2013 and 2014–2018.

1 NUMBER OF COOKING EQUIPMENT AND ELECTRICAL DISTRIBUTION EQUIPMENT FIRES IN ONTARIO, 2014–2018

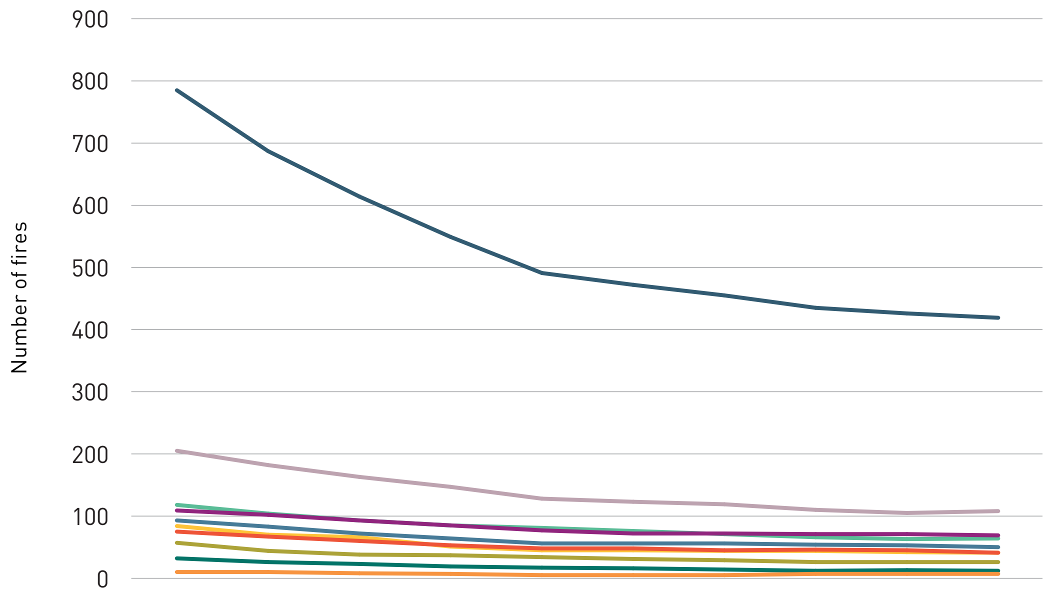


Year	2014	2015	2016	2017	2018
Cooking equipment	836	794	712	699	638
Electrical distribution equipment	504	459	435	422	434
Total cooking equipment and electrical distribution equipment fires	1340	1253	1147	1121	1072
Total fires with electricity as the fuel	1950	1825	1715	1695	1626

Source: OFMEM records

Conclusion
The total number of electrical distribution equipment structure fires has decreased **14%** since 2014.

2 FIVE-YEAR AVERAGE NUMBER OF ELECTRICAL DISTRIBUTION EQUIPMENT STRUCTURE-LOSS FIRES BY IGNITION SOURCE IN ONTARIO, 2005–2018



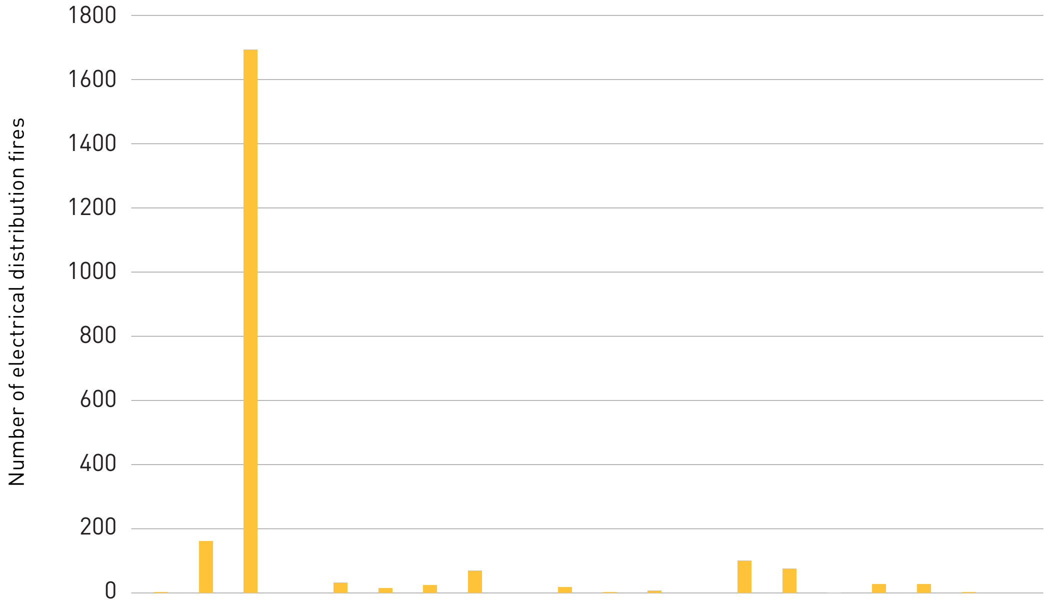
Five-year period	2005–2009	2006–2010	2007–2011	2008–2012	2009–2013	2010–2014	2011–2015	2012–2016	2013–2017	2014–2018
Circuit wiring – Al, Cu (includes conductors)	205	182	163	147	128	123	119	110	105	108
Cord, cable for appliance, electrical articles	109	102	93	85	77	72	72	71	71	69
Distribution equipment (includes panel boards, fuses, circuits)	118	104	93	85	81	76	71	66	63	64
Extension cord, temporary wiring	75	67	60	53	48	48	45	46	45	41
Metre	10	10	8	7	5	5	5	7	7	7
Other electrical distribution item	93	83	72	64	56	56	56	54	53	50
Service/utility lines (includes power/hydro transmission lines)	57	44	38	37	34	31	29	26	26	26
Terminations – Al, Cu (includes receptacles, switches, lights)	84	70	66	51	45	45	44	44	42	41
Transformer	32	26	23	19	17	16	14	12	13	12
Total	785	687	614	549	491	472	455	435	426	419

Source: OFMEM records

Conclusion

Circuit wiring – aluminum and copper remained the leading ignition source in electrical distribution equipment fires between 2005 and 2018. The five-year rolling average of electrical distribution equipment loss structure fires shows a **15%** decrease between 2009–2013 and 2014–2018.

3 NUMBER OF ELECTRICAL DISTRIBUTION EQUIPMENT FIRES BY POSSIBLE CAUSE IN ONTARIO, 2014–2018



Possible cause	Number of electrical distribution fires
Children playing (ages 11 and under)	1
Design/construction/installation/ maintenance deficiency	161
Electrical/mechanical failure	1693
Exposure fire	0
Improper handling/storage/discard of ignition source or ignited material	32
Natural cause	15
Other misuse of ignition source/ material ignited	24
Other unintentional cause, not classified	69
Rekindle	0
Routine maintenance deficiency (e.g., creosote, lint, grease buildup)	17
Suspected vandalism	2
Unattended	7
Under investigation	0
Undetermined	100
Unintentional, cause undetermined	76
Unknown, not reported	1
Used for purpose not intended	28
Used or placed too close to combustibles	27
Vehicle collision	1
Suspected youth vandalism	0

Source: OFMEM records

Conclusion
Electrical/mechanical failure was the leading cause of electrical distribution structure fires between 2014 and 2018.

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

A fire began in an electrical panel located near the stairway of a two-storey mixed business/residential building and resulted in $250,000 damage. The fire was investigated by the local fire department, police, and the OFMEM, and it was reviewed by the ESA. The only viable ignition source was electrical: the neutral bus bar in the electrical panel.

The building was estimated by the OFMEM to be between 50–100 years old. It consisted of a three-bedroom apartment on the upper level and a mini-mart on the main level.

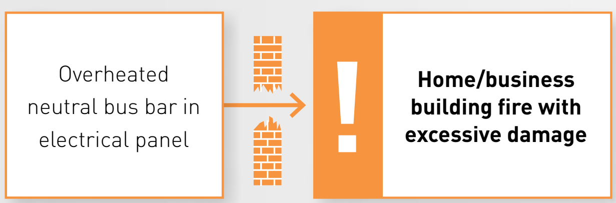
Some of the resulting damages in the building include the following:

- Exterior fire patterns were limited to two second-floor windows and the rear door at the back of the building. Smoke and soot deposits were found directly above the upper edge of the windows and the door. An outdoor metal staircase provided an exit from this doorway to the ground level.
- The main floor ceiling collapsed onto the floor of the retail space. The collapse was due to fire travel inside the ceiling cavity and fire suppression.
- At the rear of the retail space, the office and storage area sustained light smoke and water damage.
- The staircase to the upper floor showed soot deposits which were significantly heavier at the top of the staircase than at the bottom.
- The walls in the upper region of the staircase were blistered and showed fragmentation and consumption of the gypsum boards at the top.
- The electrical subpanel, which was located at the top of the staircase and fastened to a wooden plywood sheet, showed fire patterns at the rear of the panel.
- Plywood was consumed top down from the area of the neutral bus bar inside the panel in an upside down 'V' pattern.
- Fire damage was observed on a wooden structure around the electrical panel, which became progressively lighter further away from the panel.

4.5 Case Study: Fire from Electrical Distribution Equipment (continued)

Investigation findings:

- The fire travelled from the electrical panel to the stairs, through the cavity between the ceiling of the first floor and the floor of the second level.
- The tenant of the apartment on the second floor was out at the time of the fire.
- The call to 911 was made four hours after the mini-mart closed.
- The point of origin of the fire was determined to be in the electrical subpanel at the top of the stairs.
- No other viable or credible ignition sources were found.
- Fire breached the walls in the upper portion of the staircase, exposing wooden studs and consuming some of the wooden structure.
- Fire spread into the hallway and the kitchen of the second floor. When the fire breached the walls behind the kitchen cabinets, it added to the fuel.
- The cause was determined to be a failure in the neutral bus bar within the panel, causing overheating of the bus bar and heating the panel surface. The excessively hot surface of the panel resulted in the primary ignition sequence of the wooden sheet of plywood, followed by the surrounding wooden structure.



Due to the severity of the damage, it could not be determined whether the panel was wired properly. However, a typical cause of overheating the neutral bus bar is loose terminations. Regular maintenance of the electrical panel by a licensed electrical contractor (LEC), especially in older infrastructures, can prevent this incident. An LEC would also ensure all terminations are torqued properly.

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 specify 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.

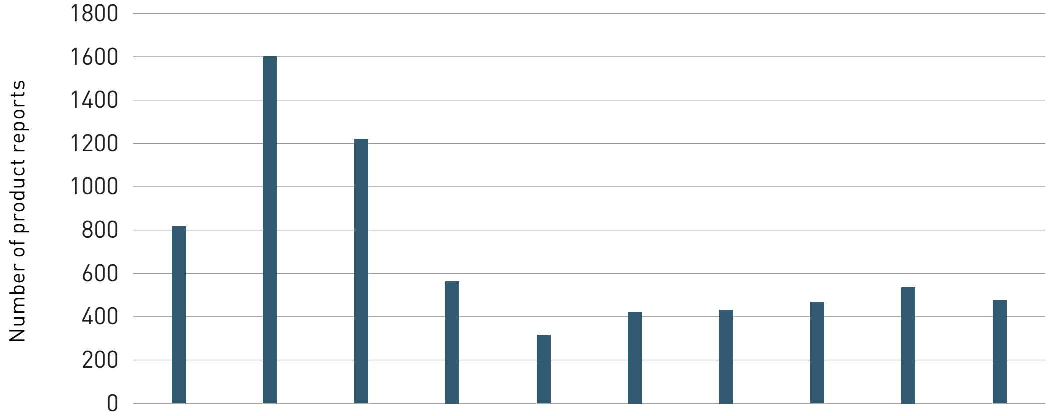
In 2019, Health Canada received 2,343 product reports, of which 141 reports were about electric ranges or ovens, where the top hazards included excessive heat/overheating, fire, and sharp edges or points. None of these reports were associated with deaths (Health Canada, 2020). Between 2009 and 2018, kitchen appliances were the most frequently reported electrical/electronic product, followed by heating and cooling appliances and lighting (LaRiccia, 2019).

Since 2010, there has been a 42% decrease to the number of product incidents reported to the ESA. During this time period, the highest number of incident reports occurred in 2011. In 2019, there were 475 reports. Compared to the previous year of 2018, this is a decrease of 11%.

In 2019, all product safety investigations initiated by the ESA were a result of voluntary reporting. Eighty-two percent (392 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 2019, 86% 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 reports 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, 2010–2019

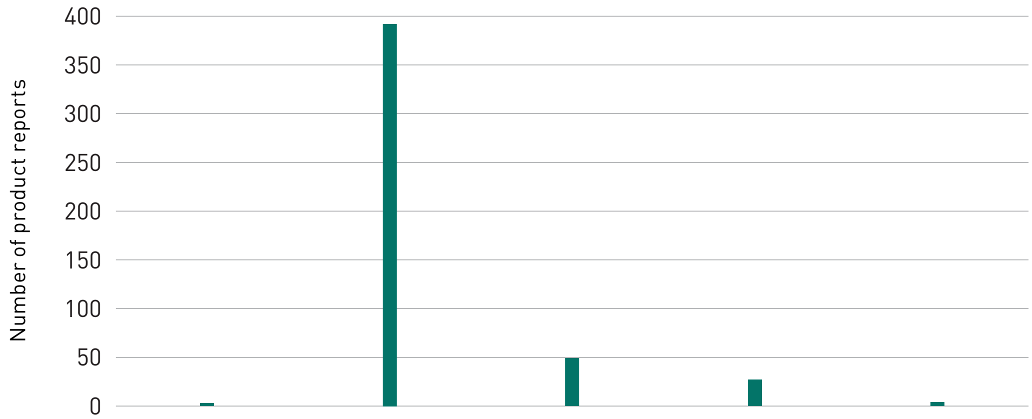


Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number of product reports	817	1601	1220	564	316	423	432	468	534	475

Source: ESA records

Conclusion
Since 2010, the number of product incident reports has decreased by **42%**. Compared to the previous year of 2018, the number of reports for 2019 has decreased by **11%**.

2 NUMBER OF PRODUCT INCIDENT REPORTS BY PRIORITY LEVEL IN ONTARIO, 2019



Priority level	Priority 1 (most important)	Priority 2	Priority 3	Priority 4 (least important)	Triaged by Health Canada
Number of product reports	3	392	49	27	4

Source: ESA records

Conclusion
In 2019, **82%** of electrical incident reports to the ESA were classified as Priority 2.

3 PERCENTAGE OF PRODUCT INCIDENT REPORTS BY TYPE IN ONTARIO, 2019

Investigation type	Certified	With suspected counterfeit label	Unapproved
Percentage of product reports	12%	2%	86%

Source: ESA records

Conclusion
In 2019, **86%** of electrical incident reports were from unapproved electrical products.

Acknowledgements

The ESA acknowledges and thanks the Ontario **Ministry of Labour, Training and Skills Development** (MOLTSD) 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 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, the MOLTSD, the Association of Workers' Compensation Boards of Canada (AWCBC), the OFMEM, and the WSIB. The ESA then cross-references these data with the Coroners' reports, 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 and projections from Ontario's Ministry of Finance (Historical and projected population for Ontario under three scenarios, 2018–2045, 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 14-10-0287-03) to determine occupational injury rates.

The 2010 to 2019 electrocution statistics are based on Ontario Coroners' reports, ESA records, and MOLTSD 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 reasons of stakeholder interest and to aid in identifying strategies to reduce 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, as of June 15, 2020, 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 May 13, 2020. Parts of this material are based on data and information provided by the Canadian Institute for Health Information. 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 2019 is unavailable and data for 2018 is presented instead. The number of fire incidents and fire fatalities are current as of January 25, 2020, 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 which 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 fires 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 build-up 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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