Electrical Safety Authority

2017

ONTARIO

Electrical Safety Report

Contents

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

The Ontario Electrical Safety Report (OESR) is the only document that provides a comprehensive, unbiased report on the state of electrical safety in Ontario. The OESR allows the Electrical Safety Authority (ESA) and our safety partners to identify electrical safety trends, and then target and tackle the toughest electrical safety problems. ESA readily shares this data with the sole purpose of increasing electrical safety in Ontario and beyond.

I am proud to report that we are at the point where electrical-related fatalities are rare. In Ontario, electrical-related fatalities occur at the rate of just one in a million. This is the result of steady and purposeful responses to electrical harms that are based on analytics and data.

Overall, the 2017 OESR shows a downward trend in electrical fatalities, electrical-fire fatalities and electrical injuries in Ontario. But there is still more work to do. In 2017, there were two fatalities due to powerline contact; and there has been an increase in the number of powerline contacts. One electrical worker will die each year from an electrical-related incident. For those who survive, the consequences can be painful and severe. We are also beginning to appreciate the unseen electrical injuries – medical treatment may be needed for pervasive cognitive, physical and psychosocial impairments.

This report is a collaborative effort, possible only through the cooperation and participation from multiple sources of data, including the Coroner, Ministry of Labour, the Office of the Fire Marshal and Emergency Management, the Canadian Institute of Health Information and the Workplace Safety and Insurance Board of Ontario. Thank you to all who helped contribute to the report's content.

I also want to thank the electricians, utility line crews, first responders, product manufacturers and electrical inspectors who keep Ontarians safe from electrical harm every day. Thank you for all you do to advance electrical safety for our province.

For the last 17 years, ESA has amassed an impressive archive of electrical safety data that continues to provide robust and detailed information for those on the front lines of electrical safety. I am confident that we will continue to add to this vast body of knowledge, well beyond the next 17 years to come.

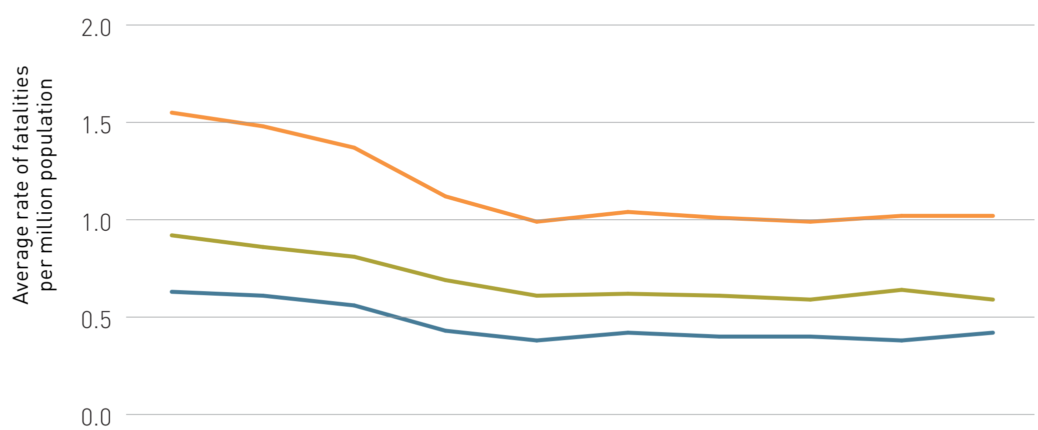
Scott Saint
Chief Public Safety Officer

Executive Summary

The Ontario Electrical Safety Report (OESR) is produced by the Electrical Safety Authority (ESA) to provide a comprehensive perspective of electrical fatalities, injuries, and incidents in Ontario. Data presented in this report have been compiled from multiple sources, investigations and root-cause analyses. Information on potential electrical risks and high-risk sectors are provided. This report is used by 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 (2008-2017), there has been a downward trend in the rates of electrical-related fatalities, electrical fire fatalities (where the ignition source was identified to be electrical), and electrical injuries in Ontario. While progress has been made to reduce the number of fatalities and injuries, 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, 2004-2017



Five-year period	2004-2008	2005-2009	2006-2010	2007-2011	2008-2012	2009-2013	2010-2014	2011-2015	2012-2016	2013-2017*
Electrical fire	0.92	0.86	0.81	0.69	0.61	0.62	0.61	0.59	0.64	0.59*
Electrocution and burn	0.63	0.61	0.56	0.43	0.38	0.42	0.4	0.4	0.38	0.42*
Total electrical	1.55	1.48	1.37	1.12	0.99	1.04	1.01	0.99	1.02	1.02*

Source: ESA, Coroner and OFMEM records.

* Preliminary data subject to change.

Electrical Related Fatalities

In the past ten years, there were 135 electrical fatalities in Ontario. From 2008 to 2017, 54 people have died from electrocution (non-intentional death caused by contact with electricity) or by the effects of electrical burns, and 81 have died as a result of electrical fires (where the ignition fuel was identified as electricity and/or ignition source was electrical distribution equipment). In comparison, the previous ten-year period from 2007 to 2016 reported 54 deaths from electrocutions and burns, and 89 fire deaths where the ignition source was identified as electrical. The rate of electrical-related fatalities continues to trend below historic levels.

Electrocutions and Electrical Burn Fatalities

Below are the five-year rolling average rate of electrocutions and electrical burn fatalities, comparing the two most recent 5-year periods:

5-year periods	
2008-2012	• 25 electrical-related fatalities • Five-year rolling average of 0.38 per million population
2013-2017	• 29 electrical-related fatalities • Five-year rolling average of 0.42 per million population

The number of utility-related electrocutions have accounted for 52% of all electrical-related fatalities in the past ten years:

5-year periods	
2008-2012	• 44% of all electrical-related fatalities (11/25) were from powerline contact
2013-2017	• 28% of all electrical-related fatalities (8/29) were from powerline contact

Occupational electrical-related fatalities continue to outnumber non-occupational fatalities by a ratio of 2 to 1 in the past ten years:

5-year periods	
2008-2012	• 60% of electrical-related fatalities (15/25) were occupational
2013-2017	• 62% of electrical-related fatalities (18/29) were occupational

Electricians and apprentice electricians account for 24% of occupational electrical-related fatalities between 2008 and 2017 as they are critically injured on the job when working on energized electrical panels or Ballasts/347V lighting.

The non-occupational electrical-related fatality rate in 2017 has increased compared to the previous year, where no deaths of this type were reported in 2016. The five-year rolling average rate also reflects this observation:

5-year periods	
2008-2012	• Five-year rolling average of 0.15 per million population
2013-2017	• Five-year rolling average of 0.16 per million population

Fire Fatalities and Events

The rate of electrical fire fatalities (where the ignition fuel was identified as electricity and/or ignition source was electrical distribution equipment) has decreased when comparing the five-year rolling average in 2007-2011 and 2012-2016. In the most recent ten year period, this rate has decreased 7% when comparing between 2007-2011 and 2012-2016.

The number of fires where electricity was identified as the fuel of the ignition source has decreased by 45% between 2007 and 2016.

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

- In 2012, there were 797 cooking equipment fires;
- In 2016, there were 712 cooking equipment fires, a decrease of 10%.

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

- In 2012, there were 471 electrical distribution equipment fires;
- In 2016, there were 435 electrical distribution equipment fires, a decrease of 8%.

Priority Issues

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

- Powerline contact while working accounted for 33% of all occupational electrical fatalities between 2008 and 2017.
- Electrical trade workers accounted for 24% of all occupational-related fatalities between 2008 and 2017. There is at least one critical injury to an electrical trade worker each year. Safety incidents tend to be associated with unsafe work practices.

- Non-occupational electrical injuries[1], identified from emergency department visits in Ontario, have decreased 16% from 2012 to 2016; however, the severity of these visits has remained relatively constant between the five years.
- Misuse of electrical products and unapproved or counterfeit products account for a significant number of safety reports.
- ESA defines electrical products as appliances, cooking equipment, lighting equipment, other electrical and mechanical equipment and processing equipment. Data from Office of the Fire Marshal and Emergency Management (OFMEM) shows that the five-year average for electrical product fires (where electricity was identified as the fuel source) between 2007-2011 and 2012-2016 has decreased by 23%.
- An average of 1377 electrical loss fires (where ignition sources were fuelled by electricity) occurred in residential structures in the past five years, and result in a minimum of seven fatalities annually.

ESA Initiatives

Based on the information collected from the OESR, 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. ESA is working towards a goal of a 20% reduction in electrical fatality and critical injury rate between 2015 and 2020. Additional details on ESA efforts can be found at www.esasafe.com.

ESA cannot reach its goal without 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 seventeenth 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) and the local fire departments identifying fires and fire fatalities from electricity that were the ignition fuel and/or electrical distribution equipment 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 organisations, education and training organizations each provide public communication, increase hazard-mitigation skills and awareness;
- Consumers who purchase electrical products, and use and rely on electricity every day in their home, workplaces, and public spaces;
- And more.

All of these organizations have an important role in contributing 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, 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).

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.

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.

ESA's investigations go beyond compliance with any code, regulations 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 determines the outcome of the energy exchange (post-event) (National Institute for Occupational Safety and Health, 1991).

There were 54 electrical related fatalities reported in Ontario in the ten-year span between 2008 and 2017, which was also similar in the period between 2007 and 2016. Majority of the electrical-related fatalities occurred in Greater Toronto Area (Toronto, Durham, Halton, Peel, and York regions) between 2008 and 2017.

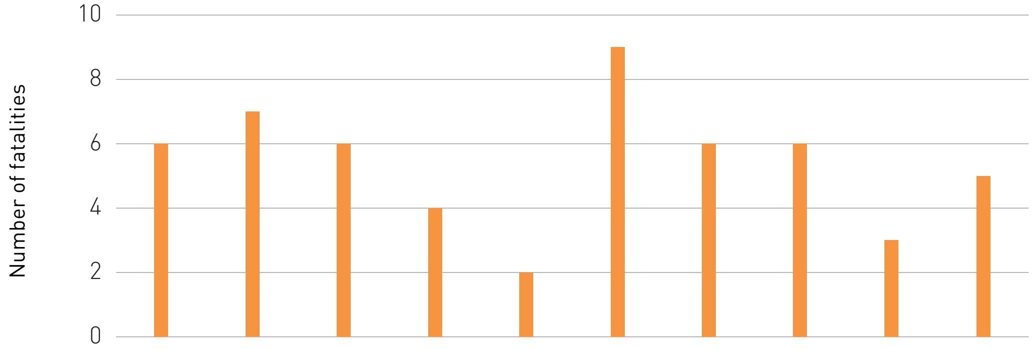
By age group, individuals aged 40-59 years accounted for the largest share of fatal injuries (42%), followed by individuals 20 to 39 years of age (40%). Also, we notice that majority of electrical fatalities (45%) occurred in the month of July, August and December.

The five-year rolling average rate of electrical fatalities has increased by 111% when comparing 2008-2012 (0.38 per million population) and 2013-2017 (0.42 per million population). However, powerline fatalities have decreased: when 2008-2012 and 2013-2017 were compared, there was a 29% decrease in the five-year rolling average rate of powerline electrocutions.

Residential (34%), industrial (28%) and utility settings (10%) were the most common places for electrical-related fatalities between 2013 and 2017.

The five-year rolling average rate of occupational electrical-related fatalities per labour force has increased slightly at 114% when comparing 2008-2012 to 2013-2017. The five-year rolling average rate of non-occupational electrical-related fatalities per million population has also increased by 107% between the same time periods.

1 NUMBER OF ELECTRICAL-RELATED FATALITIES IN ONTARIO, 2008-2017

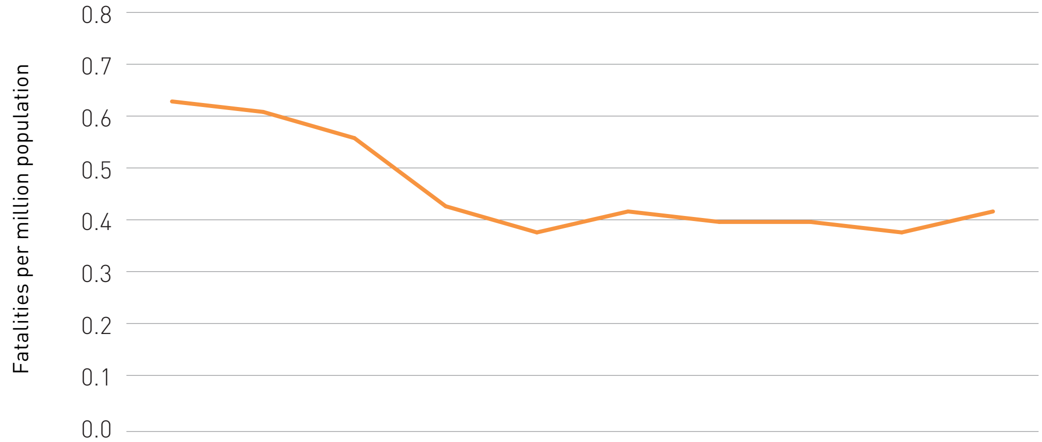


Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Number	6	7	6	4	2	9	6	6	3	5

Source: ESA and Coroners' records.

Conclusion
The number of electrical-related fatalities in 2017 has increased when compared to 2016; however, there has been a **44%** reduction since 2013 (the year with the highest number of fatalities reported in the most recent 10-year period).

2 FIVE-YEAR ROLLING AVERAGE RATE OF ELECTRICAL-RELATED FATALITIES IN ONTARIO, 2004-2017

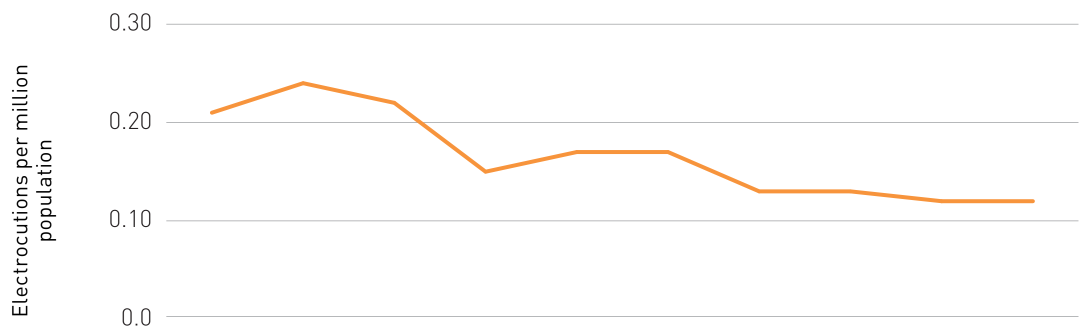


Five-year period	2004-2008	2005-2009	2006-2010	2007-2011	2008-2012	2009-2013	2010-2014	2011-2015	2012-2016	2013-2017
Rate	0.63	0.61	0.56	0.43	0.38	0.42	0.40	0.40	0.38	0.42

Source: ESA and Coroners' records.

Conclusion
The rate of electrical-related fatalities has slightly increased when compared to the previous year of 2016; there has been a **111%** increased when comparing the average rate at 2008-2012 and 2013-2017.

3 FIVE-YEAR ROLLING AVERAGE RATE OF POWERLINE FATALITIES IN ONTARIO, 2004-2017

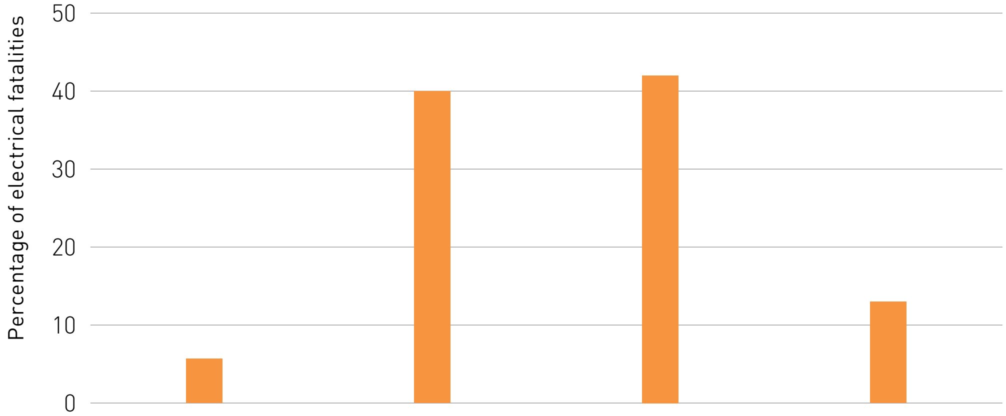


Five-year period	2004-2008	2005-2009	2006-2010	2007-2011	2008-2012	2009-2013	2010-2014	2011-2015	2012-2016	2013-2017
Rate	0.21	0.24	0.22	0.15	0.17	0.17	0.13	0.13	0.12	0.12

Source: ESA and Coroners' records.

Conclusion
In 2017, there were two powerline fatalities; there has been a **29%** reduction when comparing the rate at 2008-2012 and 2013-2017.

4 PERCENTAGE OF ELECTRICAL-RELATED FATALITIES BY AGE GROUPS IN ONTARIO, 2008-2017

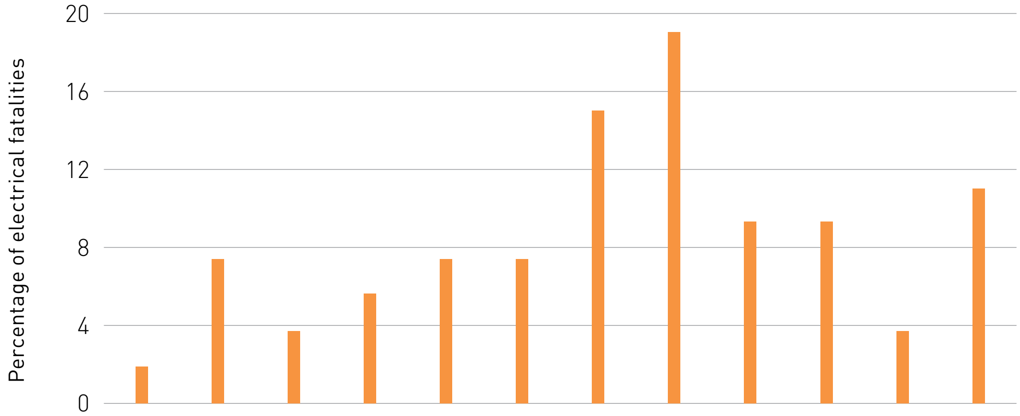


Age	0-19	20-39	40-59	60+
Percentage	5.7%	40%	42%	13%

Source: ESA

Conclusion
In the last 10 years, **42%** of the electrical-related fatalities occurred among 40-59 years old followed by 20-39 years old (**40%**).

5 PERCENTAGE OF ELECTRICAL-RELATED FATALITIES BY MONTHS IN ONTARIO, 2008-2017

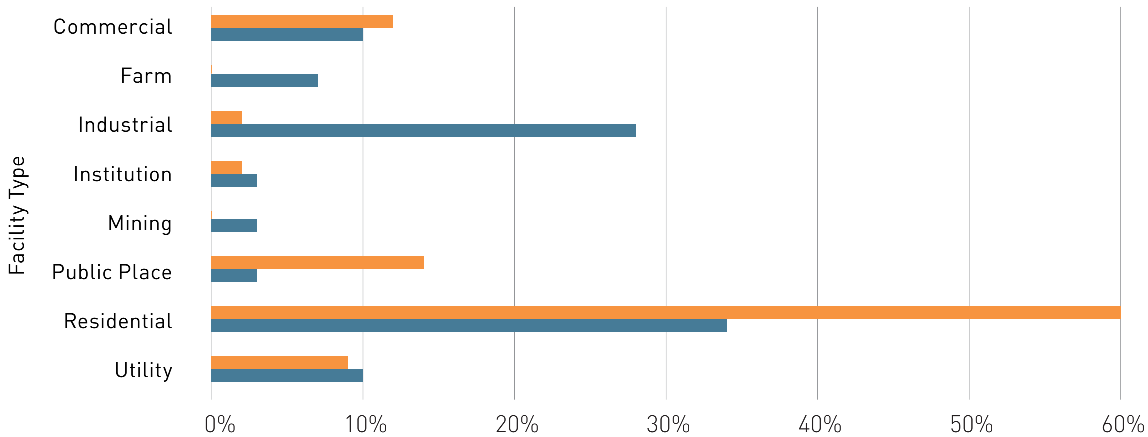


Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Percentage	1.9%	7.4%	3.7%	5.6%	7.4%	7.4%	15%	19%	9.3%	9.3%	3.7%	11%

Source: ESA

Conclusion
In the last 10 years, most of the electrical related fatalities occurred in the month of August (**19%**), July (**15%**) and December (**11%**).

6 PERCENTAGE OF ELECTRICAL FATALITIES BY FACILITY TYPE IN ONTARIO, 2008-2012 AND 2013-2017

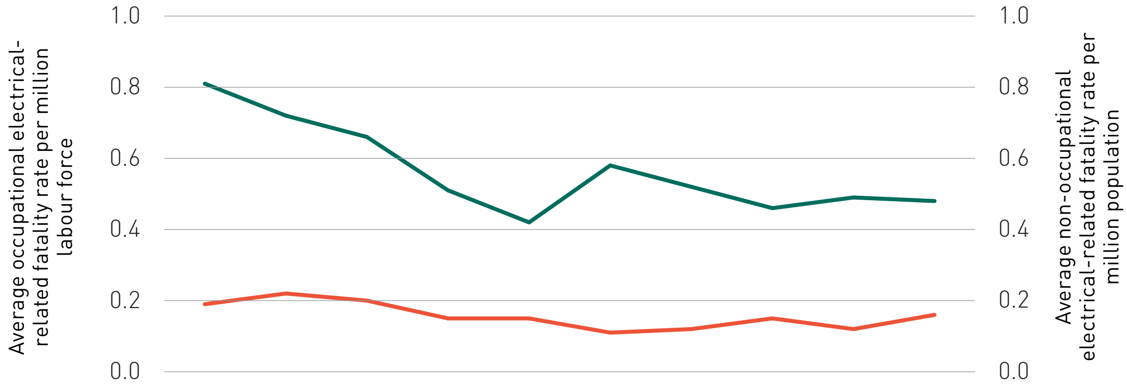


Percentage of electrical-related fatalities		Commercial	Farm	Industrial	Institution	Mining	Public Place	Residential	Utility
	2008–2012	12%	0%	2%	2%	0%	14%	60%	9%
	2013–2017	10%	7%	28%	3%	3%	3%	34%	10%

Source: ESA and Coroners' records.

Conclusion
Residential settings were the most common settings where electrical-related fatalities occur. In 2008-2012, residential, public place and commercial settings were the most common places for electrical-related fatalities; in 2013-2017, 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, 2004-2017



Five-year Period	2004-2008	2005-2009	2006-2010	2007-2011	2008-2012	2009-2013	2010-2014	2011-2015	2012-2016	2013-2017
Occupational	0.81	0.72	0.66	0.51	0.42	0.58	0.52	0.46	0.49	0.48
Non-occupational	0.19	0.22	0.20	0.15	0.15	0.11	0.12	0.15	0.12	0.16

Source: ESA and Coroners' records.

Conclusion

The five-year rolling average rate of occupational electrical-related fatalities has increased by **114%** when comparing 2008-2012 to 2013-2017 per million labour force. The five-year rolling average rate of non-occupational electrical-related fatalities has increased by 107% per million population between the same time periods.

2.2 Occupational Electrical-Related Fatalities and Electrical Injuries

Occupational electrical-related fatalities are a significant and ongoing problem, and a particular hazard to those who routinely work near electrical sources. According to the data from the U.S. Bureau of Labor Statistics (BLS), a total of 1,651 workers died between 2007 and 2016 as a result of electrical injury (Campbell, 2018). The data also 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).

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

1. Physical, cognitive, and psychosocial impairments and their effects on their 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 coworkers, and undertaking rehabilitation services that specialize in electrical injury. The most common advice to others after electrical injuries includes:

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

Between 2008 and 2017, there were 33 occupational electrical-related fatalities (an average of 3.3 electrical-related fatalities per year) compared to 36 electrical-related fatalities between 2007 and 2016 (an average of 3.6 electrical related fatalities per year). In 2017, there were two occupational electrical-fatalities reported. However, since 2013 there has been a 75% reduction in the number of occupational-related fatalities.

The five-year rolling average number of fatalities and critical injuries among workers (overall occupational safety) has remained same between 2008-2012 and 2013-2017; however, the five-year rolling average number of fatalities and critical injuries among electrical trade workers shown a decrease comparing these two time periods.

When comparing the five-year rolling average rate, the occupational electrical-related fatalities has slightly increased from 0.42 per million labour force population in 2008-2012, to 0.48 per million labour force population in 2013-2017. This is an increase of 114%.

In the 2013-2017 time period, industrial (44%), commercial (17%), and farm (11%) were the most common places for occupational electrical-related fatalities. The most commonly cited causes of death were due to improper installation/procedure (31%) and lack of hazard assessment (19%), when excluding unknown causes.

Between 2008 and 2017, electrical tradespeople accounted for 24% of all occupational electrical-related fatalities. This percentage is decreased from what was reported in 2007-2016, where electrical tradespeople accounted for 28% of all occupational electrical-related fatalities.

A review of data provided by the WSIB from 2008 to 2017 shows that males continue to outnumber females by approximately 3:1 in the number of WSIB lost time injury claims related to electrical injuries. Workers in the construction and services sector contribute to the highest number of WSIB lost time injury claims. Machine tool and electric parts, and heating, cooling and cleaning machinery were the most common sources of injury. There is an overall decline of 22% in the number of injury claims between 2008-2012 and 2013-2017 where electrical burns are declining at a greater rate relative to electrocutions and electric shock.

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

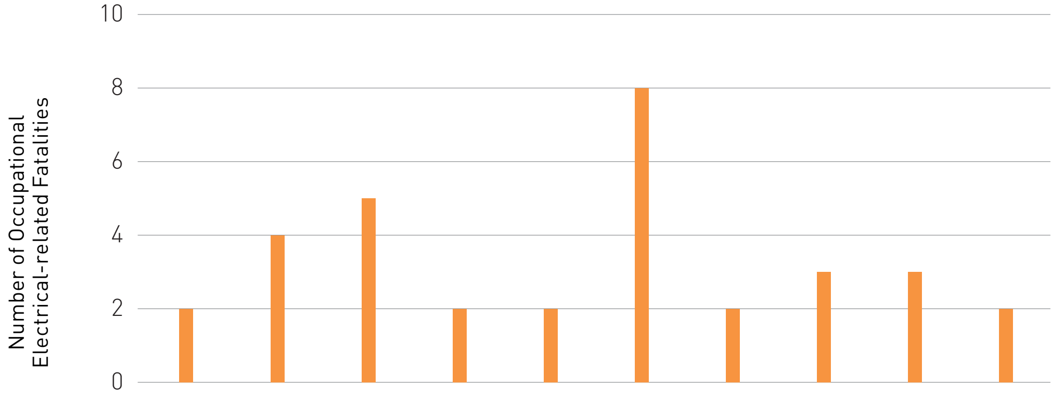
Statistics Directly Related to ESA's Harm Reduction Priorities – WORKER SAFETY

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 ESA, confirmed with the Office of the Coroner.

The worker safety five-year rolling average has remained same between 2008-2012 and 2013-2017.

1 NUMBER OF OCCUPATIONAL ELECTRICAL-RELATED FATALITIES IN ONTARIO, 2008-2017

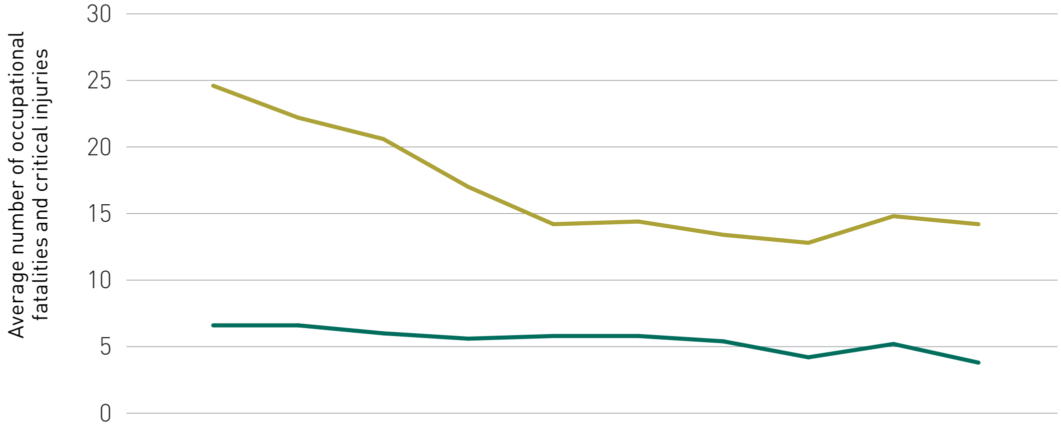


Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Number of Occupational Electrical-related Fatalities	2	4	5	2	2	8	2	3	3	2

Source: ESA and Coroners' records.

Conclusion
The number of occupational electrical-related fatalities has decreased since 2010 with an exception of 2013 where 8 cases were reported.

2 FIVE-YEAR ROLLING AVERAGE OF OCCUPATIONAL FATALITIES AND CRITICAL INJURIES IN ONTARIO, 2004-2017



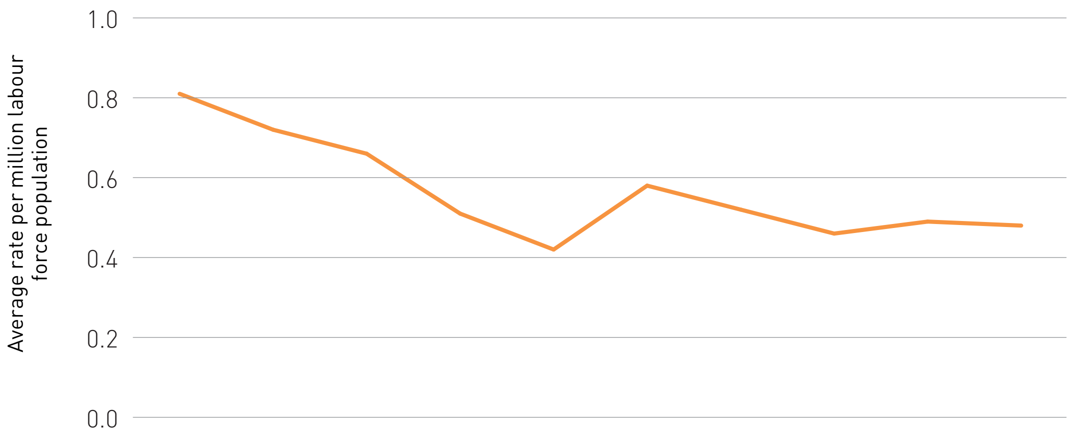
Average Number of occupational electrical related fatalities and critical injuries*	Five-year rolling average	2004-2008	2005-2009	2006-2010	2007-2011	2008-2012	2009-2013	2010-2014	2011-2015	2012-2016	2013-2017
	Occupational safety overall	25	22	21	17	14	14	13	13	15	14
	Electrical trade	6.6	6.6	6.0	5.6	5.8	5.8	5.4	4.2	5.2	3.8

Source: ESA and Coroners' records.

Conclusion
The five-year rolling average number of occupational fatalities and critical injuries (overall occupational safety) has remained the same between 2008-2012 and 2013-2017; however, there has been decrease (**34%**) of occupational fatalities and critical injuries among electrical trade workers.

*Critical injuries classified by Ministry of Labor

3 FIVE-YEAR ROLLING AVERAGE RATE OF OCCUPATIONAL ELECTRICAL-RELATED FATALITIES IN ONTARIO, 2004-2017

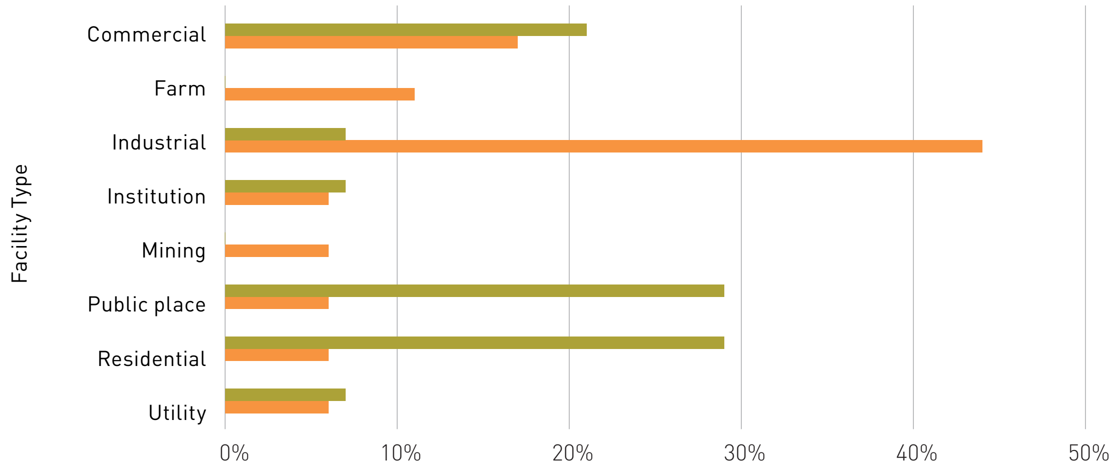


Five-year rolling average	2004-2008	2005-2009	2006-2010	2007-2011	2008-2012	2009-2013	2010-2014	2011-2015	2012-2016	2013-2017
Occupational electrical-fatality rate	0.81	0.72	0.66	0.51	0.42	0.58	0.52	0.46	0.49	0.48

Source: ESA and Coroners' records.

Conclusion
The rate of occupational electrical-related fatalities has increased by **114%** when comparing 2008-2012 and 2013-2017.

4 PERCENTAGE OF OCCUPATIONAL ELECTRICAL-RELATED FATALITIES BY FACILITY TYPE IN ONTARIO, 2008-2012 AND 2013-2017

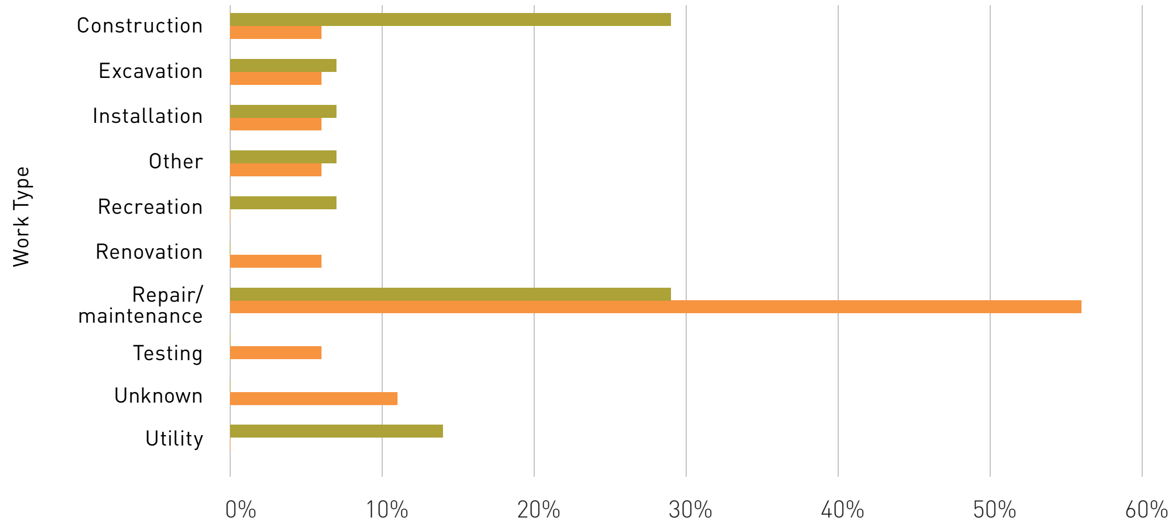


Percentage of occupational electrical-related fatalities		Commercial	Farm	Industrial	Institution	Mining	Public place	Residential	Utility
	2008-2012	21%	0%	7.1%	7.1%	0%	29%	29%	7.1%
	2013-2017	17%	11%	44%	5.6%	5.6%	5.6%	5.6%	6%

Source: ESA and Coroners' records.

Conclusion
In 2008-2012, residential, public place and commercial settings were the most common settings for occupational electrical-related fatalities. In 2013-2017, industrial, commercial and residential settings were the most common settings for occupational electrical-related fatalities.

5 PERCENTAGE OF OCCUPATIONAL ELECTRICAL-RELATED FATALITIES BY TYPE OF WORK IN ONTARIO, 2008-2012 AND 2013-2017

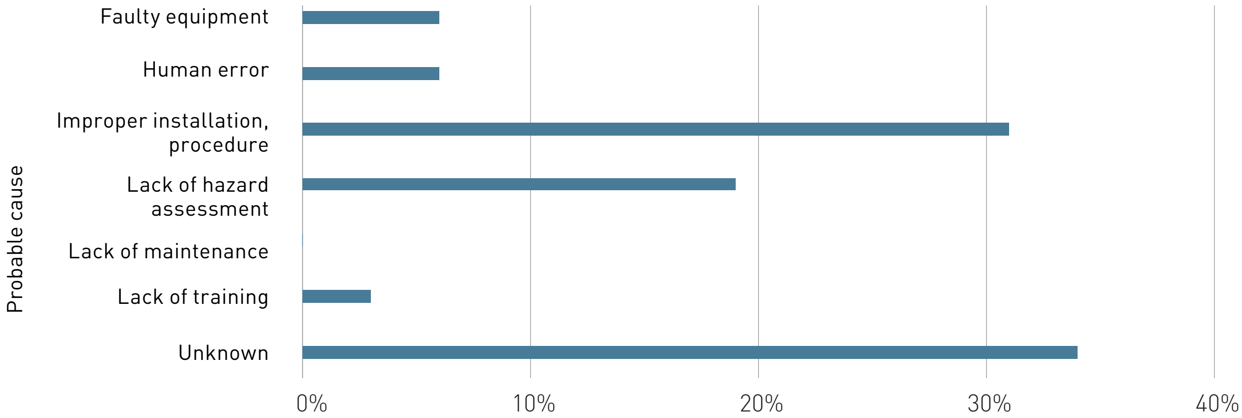


Percentage of occupational electrical-related fatalities	Construction	Excavation	Installation	Other	Recreation	Renovation	Repair/ maintenance	Testing	Unknown	Utility
2008-2012	29%	7%	7%	7%	7%	0%	29%	0%	0%	14%
2013-2017	5.6%	5.6%	5.6%	6%	0%	5.6%	5.6%	5.6%	11%	0%

Source: ESA and Coroners' records.

Conclusion
In 2008-2012, repair/maintenance and construction activities were the most common types of work for occupational electrical-related fatalities. In 2013-2017, repair/maintenance and excavation were the most common types of work for occupational electrical-related fatalities.

6 PERCENTAGE OF OCCUPATIONAL ELECTRICAL-RELATED FATALITIES BY PROBABLE CAUSE IN ONTARIO, 2008-2017

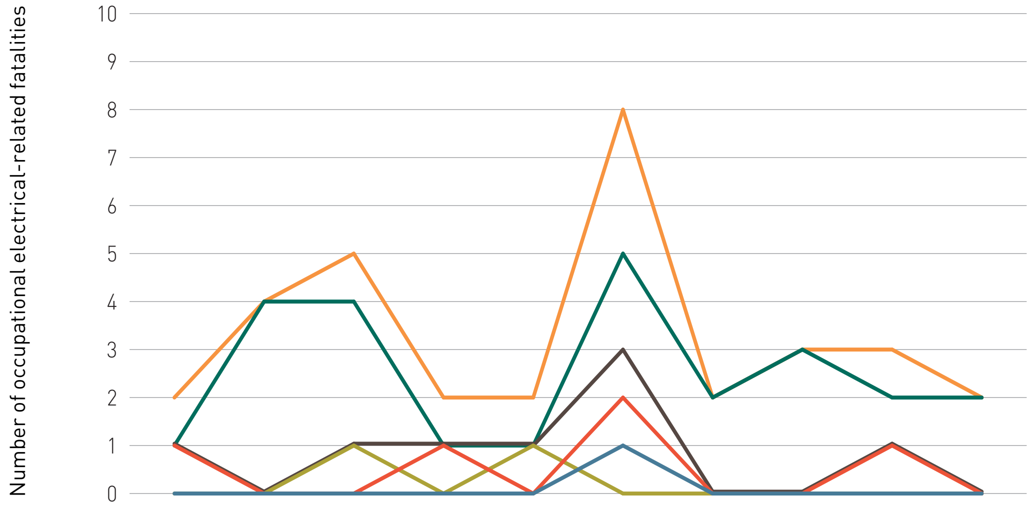


	Faulty equipment	Human error	Improper installation, procedure	Lack of hazard assessment	Lack of maintenance	Lack of training	Unknown
Percentage of occupational electrical-related fatalities	6.3%	6.3%	31%	19%	0%	3.1%	34%

Source: ESA and Coroners' records.

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

7 NUMBER OF OCCUPATIONAL ELECTRICAL-RELATED FATALITIES BY OCCUPATION IN ONTARIO, 2008-2017

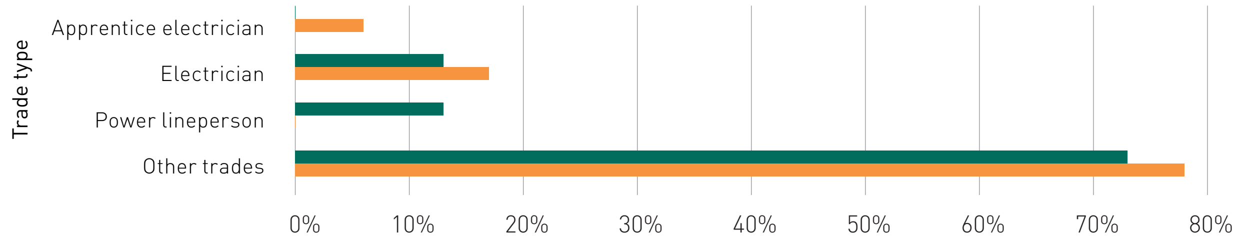


Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Apprentice electrician	0	0	0	0	0	1	0	0	0	0
Electrician	1	0	0	1	0	2	0	0	1	0
Power lineperson	0	0	1	0	1	0	0	0	0	0
Total electrical	1	0	1	1	1	3	0	0	1	0
Other trades	1	4	4	1	1	5	2	3	2	2
All occupational fatalities	2	4	5	2	2	8	2	3	3	2

Source: ESA and Coroners' records.

Conclusion
The overall number of occupational fatalities has decreased since 2009; most notably amongst the electrical trade where there have been no fatalities in 2017. However, the number of fatalities in Other Trades has remained constant in the past ten years.

8 PERCENTAGE OF OCCUPATIONAL ELECTRICAL-RELATED FATALITIES BY TRADE, 2008-2012 AND 2013-2017

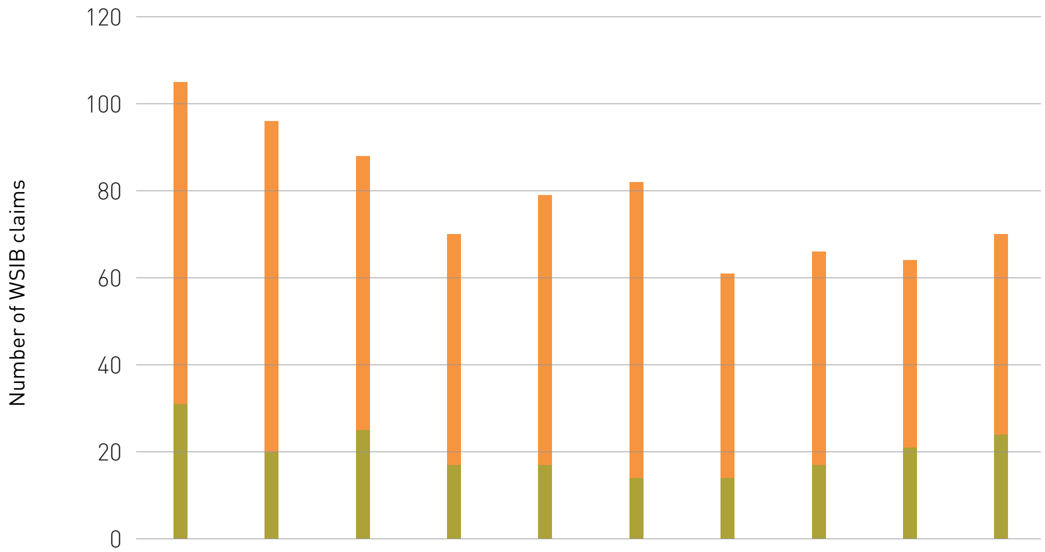


Percentage of Occupational Electrical-Related Fatalities		Apprentice electrician	Electrician	Power lineperson	Other trades
	2008-2012	0%	13%	13%	73%
	2013-2017	6%	17%	0%	78%

Source: ESA and Coroners' records.

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

9 NUMBER OF ALLOWED WSIB LOST TIME ELECTRICAL INJURY CLAIMS BY SEX IN ONTARIO, 2008-2017

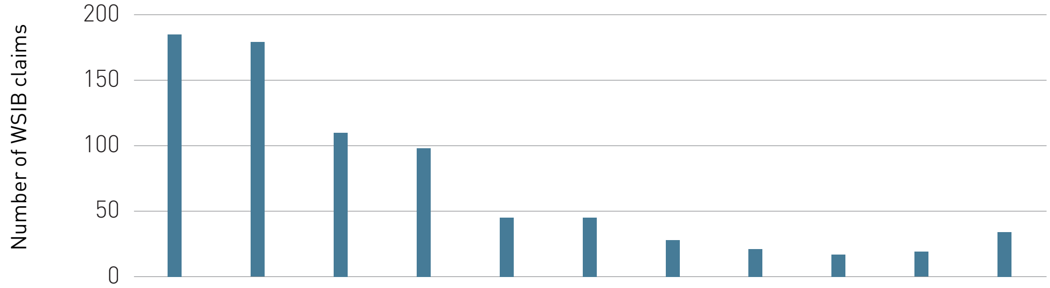


Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Male	74	76	63	54	62	68	47	49	43	46
Female	31	20	25	17	17	14	14	17	21	24

Source: Workplace Safety and Insurance Board.

Conclusion
Since 2008, males continue to outnumber females by approximately 3:1 in the number of WSIB injury claims related to electrical injuries.

10 NUMBER OF ALLOWED WSIB LOST TIME ELECTRICAL INJURY CLAIMS BY SECTOR IN ONTARIO, 2008-2017



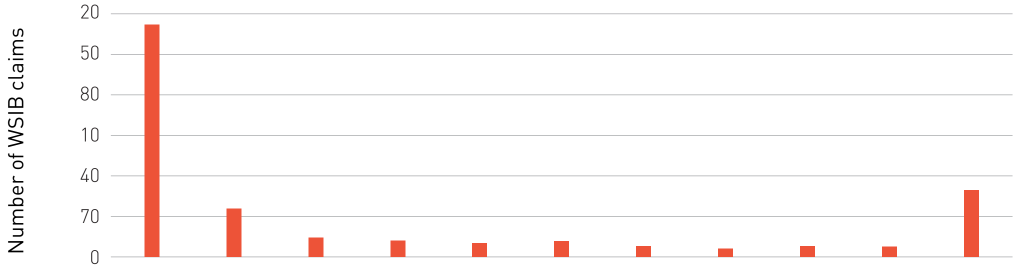
Sector Type	Construction	Services	Manufacturing	Schedule 2*	Health care	Electrical	Transportation	Chemical/ process	Automotive	Food	Other
Number of WSIB claims	185	179	110	98	45	45	28	21	17	19	34

Source: Workplace Safety and Insurance Board.

Conclusion
Workers in the construction and service sector contribute to the highest number of WSIB lost time electrical claims between 2008 and 2017.

*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 by 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, 2008-2017



Sector Type	Machine tool and electric parts	Heating, cooling and cleaning machinery	Metal woodworking and plastic, rubber concrete and other processing	Misc. machinery (e.g. audio, video, televisions, telephones, snowblowers)	Hand tools, powered	Fire, flame, smoke	Special process machinery (e.g. food slicers, paper, printing, wrapping, sewing, pumps)	Machinery unspecified	Furniture and fixtures	Office and business machines	Other sources
Number of WSIB claims	401	83	33	28	24	27	19	14	19	18	115

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 2008 and 2017.

12 NUMBER OF ALLOWED WSIB LOST TIME ELECTRICAL INJURY CLAIMS BY NATURE OF INJURY IN ONTARIO, 2008-2012 AND 2013-2017

Nature of injury	Electrocutions, electric shocks	Burns, electrical
2008-2012	268	170
2013-2017	220	123

Source: Workplace Safety and Insurance Board.

Conclusion

There is an overall decline of **22%** in the number of injury claims between 2008-2012 and 2013-2017 where electrical burns are declining at a greater rate relative to electrocutions and electric shock. In 2008-2012, electrical burns accounted for **39%** versus **36%** of the nature of injuries in 2013-2017.

2.3 Non-occupational Electrical-Related Fatalities and Injuries

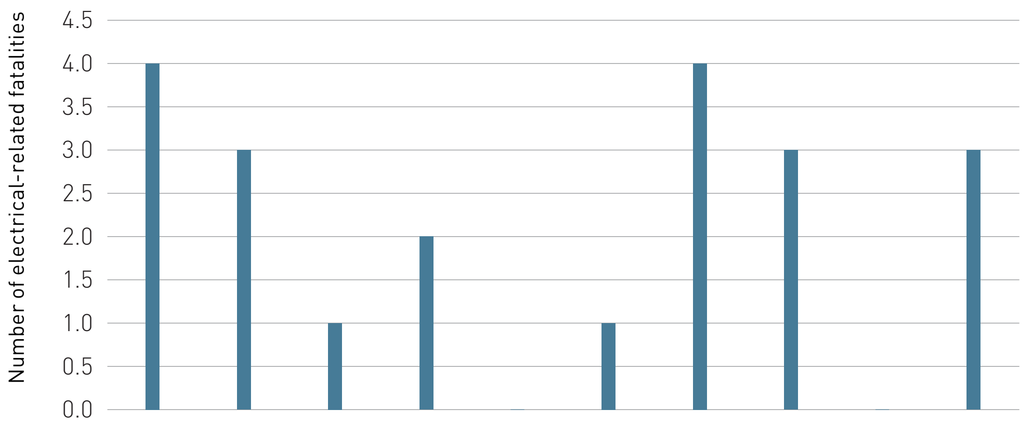
Injuries are a significant health problem. They are the leading cause of death for the young, and contribute substantially to the burden on the health care system. Many injuries are predictable and preventable.

In 2017, there were three non-occupational electrical-related fatalities. In 2016, there were no non-occupational electrical-related fatalities, and in 2015, there were 3 fatalities. With the exception of 2008, 2014 and 2016, occupational electrical-related fatalities outnumber non-occupational electrical fatalities.

Between 2008 and 2017, there were 21 non-occupational electrical-related fatalities (an average of 2.1 electrical-related fatalities per year). In the previous ten-year period (2007-2016) there were 18 non-occupational electrical-related fatalities (an average of 1.8 electrical-related fatalities per year). The five-year rolling average rate between 2008-2012 and 2013-2017 has increased by 107% from 0.15 per million population to 0.16 per million population.

In the past ten years, the residential setting (57%) was the most common place for non-occupational electrical-related fatalities. Theft (26%), and landscaping, lawn cutting and tree-trimming (13%) were the most common activities associated with fatalities when excluding unknown activities.

1 NUMBER OF NON-OCCUPATIONAL ELECTRICAL-RELATED FATALITIES IN ONTARIO, 2008-2017

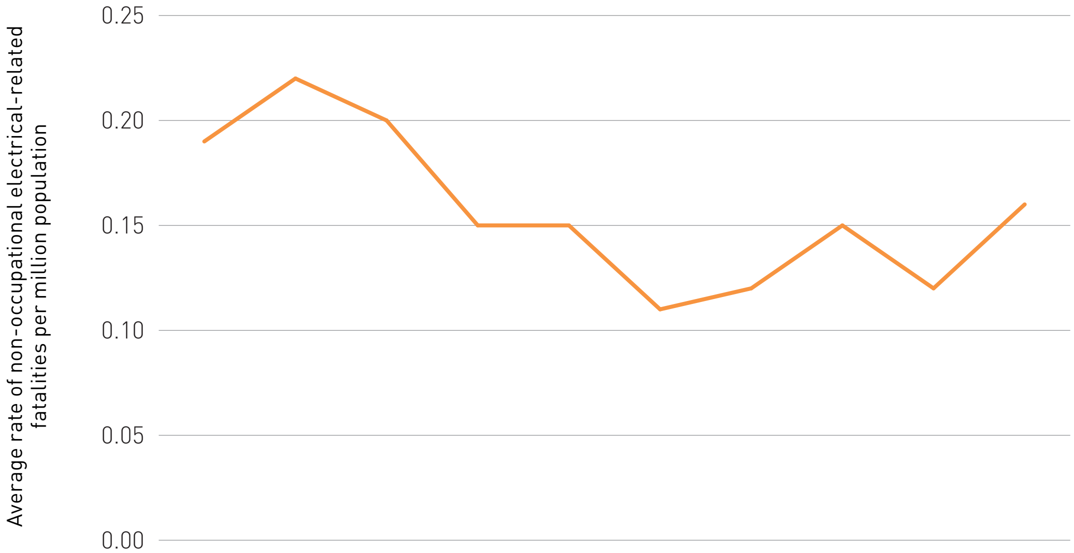


Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Number of non-occupational electrical-related fatalities	4	3	1	2	0	1	4	3	0	3

Source: ESA and Coroners' records.

Conclusion
The number of non-occupational electrical-related fatalities has remained variable in the past ten years.

2 FIVE-YEAR ROLLING AVERAGE RATE OF NON-OCCUPATIONAL ELECTRICAL-RELATED FATALITIES IN ONTARIO, 2004-2017

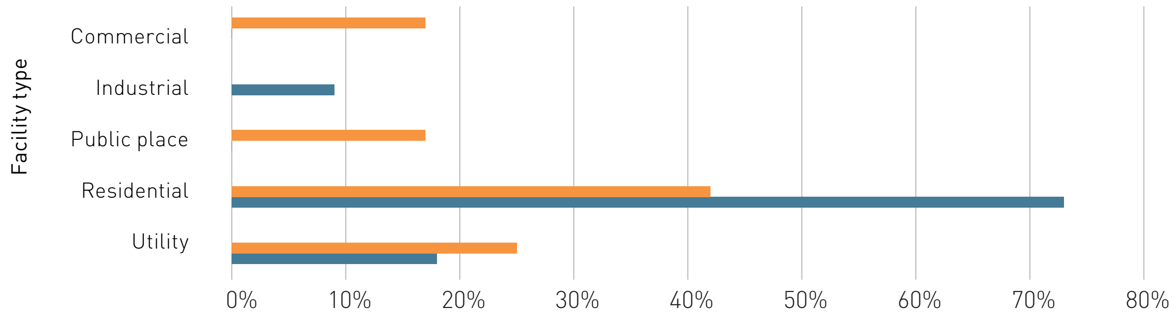


Five-year period	2004-2008	2005-2009	2006-2010	2007-2011	2008-2012	2009-2013	2010-2014	2011-2015	2012-2016	2013-2017
Rate of non-occupational electrical-related fatalities per million Ontario population	0.19	0.22	0.20	0.15	0.15	0.11	0.12	0.15	0.12	0.16

Source: ESA and Coroners' records.

Conclusion
The five-year rolling average rate of non-occupational electrical-related fatalities has increased by **107%** when comparing 2008-2012 and 2013-2017.

3 PERCENTAGE OF NON-OCCUPATIONAL ELECTRICAL-RELATED FATALITIES BY FACILITY TYPE IN ONTARIO, 2008-2017

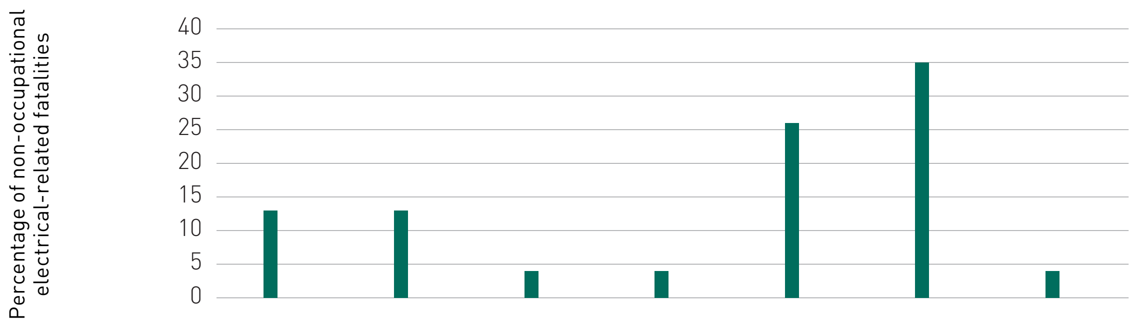


Percentage of non-occupational electrical-related fatalities	Commercial	Industrial	Public place	Residential	Utility
2008-2012	17%	0%	17%	42%	25%
2013-2017	0%	9.1%	0%	73%	18%

Source: ESA and Coroners' records.

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

4 PERCENTAGE OF NON-OCCUPATIONAL ELECTRICAL-RELATED FATALITIES BY ACTIVITY TYPE IN ONTARIO, 2008-2017



Type of activity	Landscaping, lawn cutting, tree trimming	Other	Recreation	Repair/ maintenance	Theft	Unknown	Vehicle
Percentage of non-occupational electrical-related fatalities	13%	13%	4.3%	4.3%	26%	35%	4.3%

Source: ESA and Coroners' records.

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

2.4 Electrical Injury and Emergency Department Visits in Ontario 2007-2016

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

Exposure to electricity can result in a range of injuries. It can lead to cardiovascular system injuries (e.g. rhythm disturbances), cutaneous injuries and burns, nervous system disruption and respiratory arrest, as well as 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).

Approximately 20,000 electrical-related emergency department visits occurred 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 2007 to 2016, approximately 13,182 visits to Ontario hospitals' emergency departments (ED) were due to electrical injury. The trend of males outnumbering females in electrical injuries is also observed in ED visits with 68% of ED visits from males. Adults (age 20-64 at 80%) and children (age 0-19 at 18%) comprised of 98% of all ED visits related to electrical injuries.

Using the Canadian Triage and Acuity Scale (CTAS), the severity of electrical injury was assessed upon visit. In the past ten years, 81.2% 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 69% of all ED visits, the principal diagnosis was identified was identified as electrical current, and 4% of visits were from effects of lightning. Burns were the principal diagnosis in an additional 15% of cases.

When excluding unspecified place of occurrence, the most common locations for electrical injury were the home (32%), followed by industrial and construction locations (21%), and trade and service areas (21%).

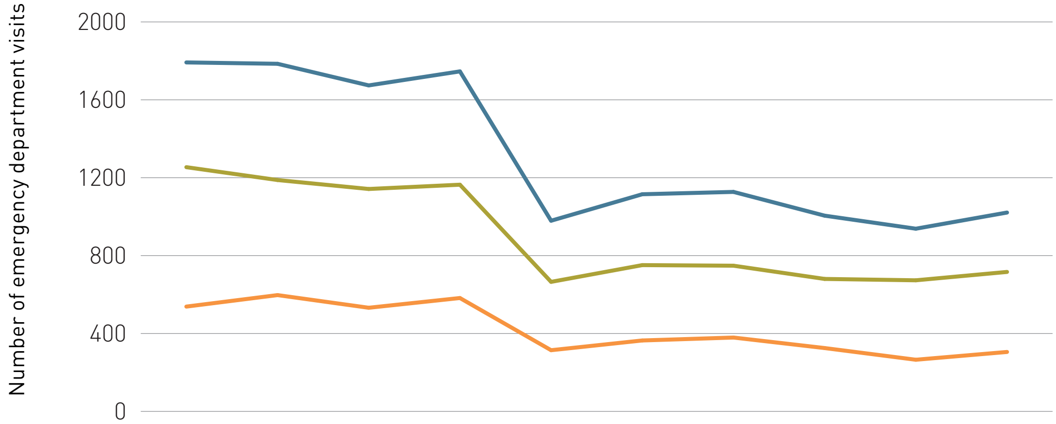
Statistics Related to ESA's Harm Reduction Priorities – NON-OCCUPATIONAL ELECTRICAL SAFETY

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 32% in the five-year rolling average between 2007-2011 and 2012-2016.

1 NUMBER OF EMERGENCY DEPARTMENT (ED) VISITS FOR ELECTRICAL INJURY BY SEX IN ONTARIO, 2007-2016

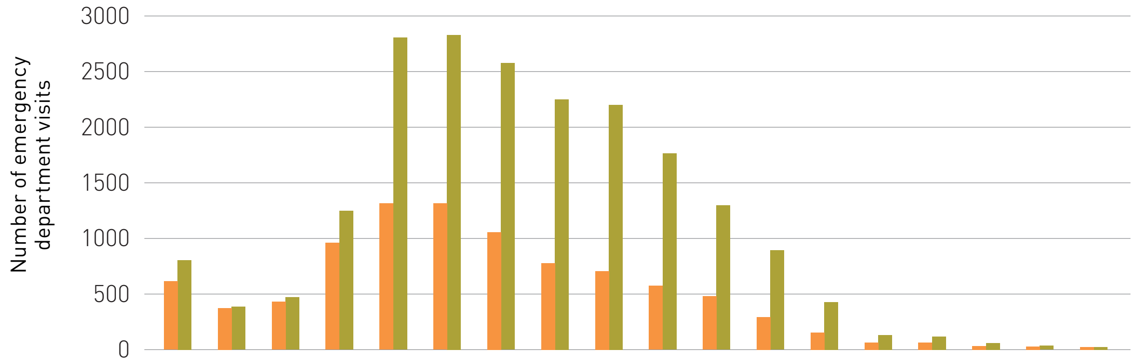


Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Female	538	597	532	582	314	364	379	325	265	305
Male	1254	1188	1142	1164	665	751	748	680	673	716
Total	1792	1785	1674	1746	979	1115	1127	1005	938	1021

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

Conclusion
The total number of ED visits for electrical injury has decreased by **43%** in the past ten years.

2 NUMBER OF EMERGENCY DEPARTMENT (ED) VISITS FOR ELECTRICAL INJURY BY AGE AND SEX IN ONTARIO, 2007-2016

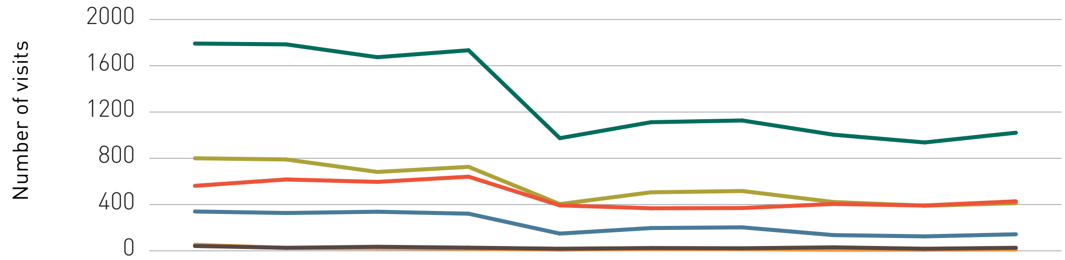


Age	0 – 4	5 – 9	10 – 14	15 – 19	20 – 24	25 – 29	30 – 34	35 – 39	40 – 44	45 – 49	50 – 54	55 – 59	60 – 64	65 – 69	70 – 74	75 – 79	80 – 84	85+
Female	615	373	430	960	1314	1315	1057	777	705	574	480	292	154	63	63	33	28	24
Male	804	385	470	1247	2805	2829	2576	2250	2202	1763	1296	892	427	131	117	61	35	23

Source: ED All Visit Main Table, NACRS, CIHI.

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

3 NUMBER OF ED VISITS FOR ELECTRICAL INJURY BY CANADIAN TRIAGE AND ACUITY SCALE (CTAS) IN ONTARIO, 2007-2016



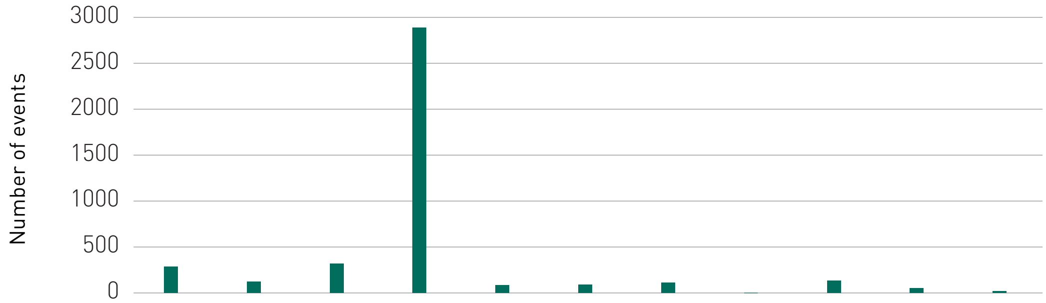
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Resuscitation/ life threatening (level 1)	42	26	35	27	18	24	22	30	18	26
Emergent/potentially life-threatening (level 2)	562	617	596	641	393	368	370	405	392	428
Urgent/potentially serious (level 3)	800	790	682	726	404	506	517	422	390	412
Less-urgent/ semi-urgent (level 4)	340	327	338	321	149	197	203	136	125	143
Non-urgent (level 5)	48	25	23	19	10	17	15	9	9	11
Total	1792	1785	1674	1734	974	1112	1127	1004	937	1021

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

Conclusion

81% 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, 2007-2016

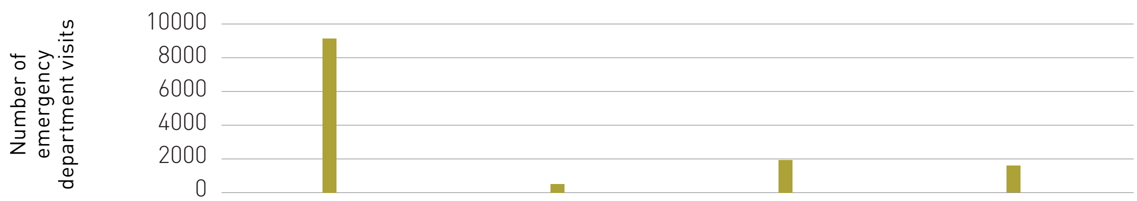


	Head and neck	Trunk	Shoulder and upper limb, except wrist and hand	Wrist and hand	Hip and lower limb, except ankle and foot	Ankle and foot	Eye and adnexa	Respiratory tract	Other internal organs	Multiple body regions	Unspecified body areas
Total	288	122	319	2887	82	92	111	0	113	52	20

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, 2007-2016

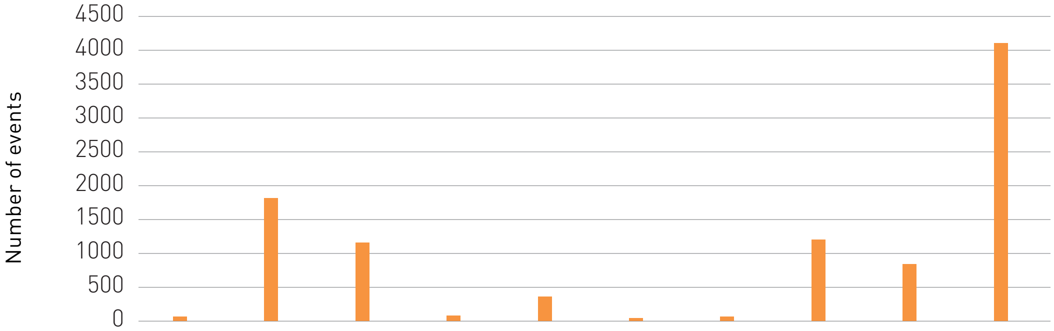


	Effects of electric current (T75.4)	Effects of lightning (T75.0)	Burns (T20-T31)	Other diagnoses
Number of ED visits	9145	512	1927	1598

Source: ED All Visit Main Table, NACRS, CIHI.

Conclusion
The majority of ED visits for electrical injury had a principal diagnosis of electric current (**69%**), followed by burns (**15%**).

6 PLACE WHERE ELECTRICAL INJURY OCCURRED IN ONTARIO, 2007-2016



	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	60	1815	1158	76	355	39	62	1196	840	4098

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

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

2.5 HVAC Worker

Incident Summary:

A worker was working in the attic of an old house while insulating ductwork. The worker was straddling the duct while performing their work. When they attempted to stand up, the back of their neck made incidental contact with a bare energized wire resulting in death by electrocution.

The Incident:

The incident occurred in a detached house, which had been built in the 1940s. The homeowner contracted the victim to insulate ductwork located in the attic. The duct came from a forced air furnace in the basement and split into four in the attic. Aside from the duct, there was a bare wire which hung over the trusses from one end of the attic to the other. It was a hot day and the victim was sweaty and dressed in shorts and a short sleeved shirt.

Figure 1: Attic with duct and a bare hanging wire

The homeowner had left the house for 45 minutes while the worker was in the attic performing his work. When the homeowner returned, they called up to the victim and heard no response. When they sent a friend to check up on the victim, the victim was found slouched over the ductwork. EMS was called and attended the site but the victim could not be revived.

Further analysis revealed the following:

- Improper wiring – The bare wire hanging across the attic was energized. Based on the age of the home and wiring, there is a strong probability that the bare conductor was once upon a time used as an aerial radio antenna. The design of the conductor is similar to those typically mounted in older homes to obtain transmission for older radio devices. The wire seems to have been mistaken for a conductor meant to be wired to the line side of the 120V circuit and was inadvertently connected to a branch circuit in the main floor.
- Lack of awareness of the hazard – Evidence suggested that the worker did not perceive there to be a hazard. A hazard assessment of the area of work may have identified this hazard.
- The homeowner's friend, EMS rescue team and investigators all went into the attic to rescue the worker while the bare conductor remained energized – initially, all who proceeded into the attic thought the worker had collapsed from the heat. None anticipated electrocution to be the cause. Furthermore, nobody suspected that the hanging wire had any association to the incident. Thus, the homeowner's friend, EMS rescue team, and finally the investigators who attended all proceeded into the attic while the hanging energized conductor depicted in Figure 2 remained energized. Fortunately there were no further casualties. It was not until the Coroner identified marks on the back of the victim's neck that further inquiry and a call to ESA was made. ESA's inspector attending the scene then established that the conductor was energized due to improper wiring.

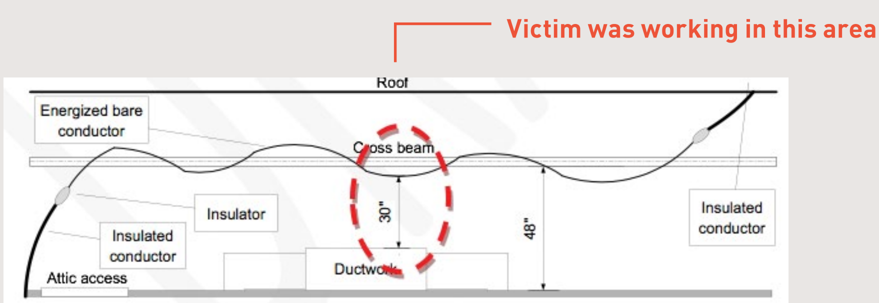
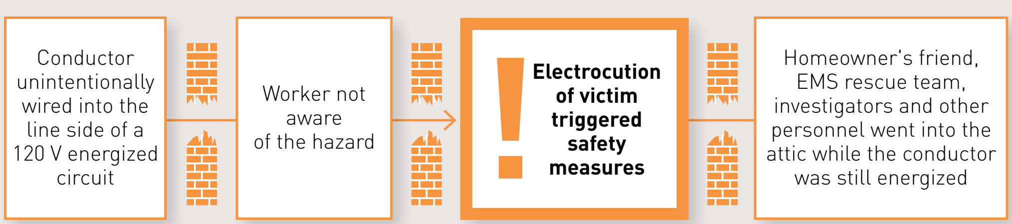


Figure 2: Depiction of the attic, ductwork and hanging wire



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 amount 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 2008 to 2017, there were 28 electrical-related fatalities associated with utility-related equipment, which made up of 52% 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 2007-2016.

Contact specifically with powerlines accounted for 19 of the electrical-related fatalities in the most recent ten-year period, which contributed to 68% of utility-related equipment fatalities. The five-year rolling average rate for powerline electrocutions has decreased by 29% when comparing 2008-2012 and 2013-2017.

The number of total utility-related electrical incidents has decreased by 10% since the 2008. Overhead powerline contact remains the leading cause of utility-related electrical incidents, where a slight increase of all contact incidents was reported to ESA when compared to previous five years. Most injuries as a result of powerline and utility-related equipment have also decreased over the past ten years. However, under-counting is especially prevalent with utility contact incidents, and this information should be interpreted with caution.

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

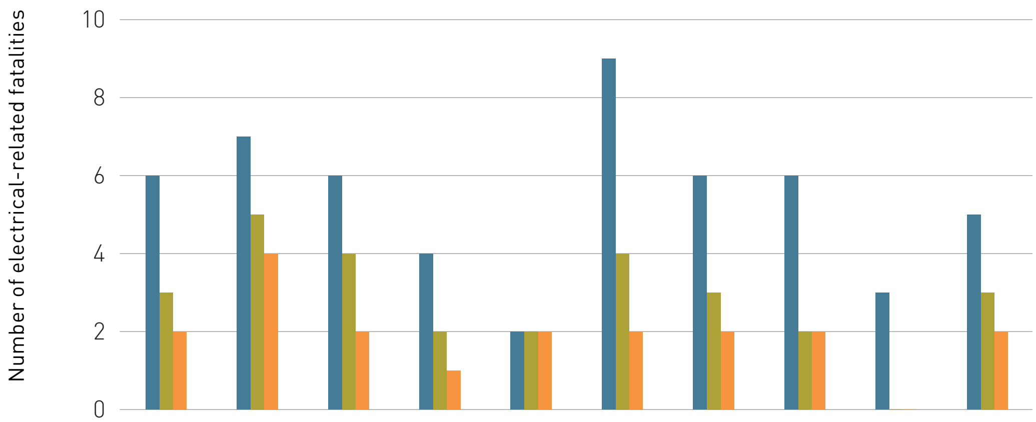
Statistics Directly Related to ESA's Harm Reduction Priorities – **POWERLINE CONTACT**

Five-year Rolling Average Comparison

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

The powerline safety five-year rolling average has decreased by 9% between 2008-2012 and 2013-2017.

1 NUMBER OF UTILITY-RELATED EQUIPMENT ELECTRICAL-RELATED FATALITIES IN ONTARIO, 2008-2017

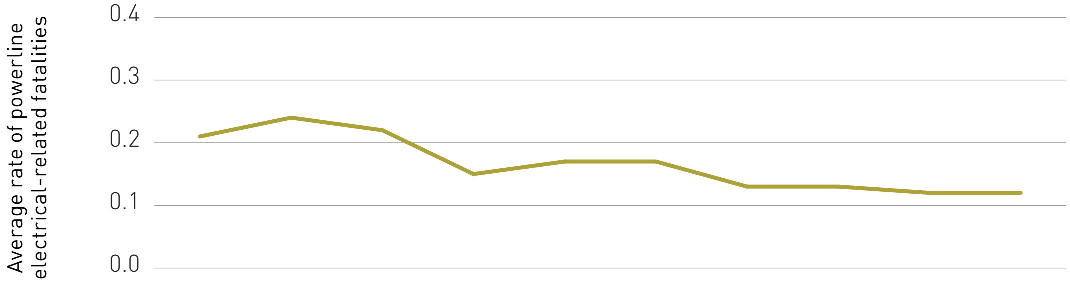


Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Electrical-related fatalities	6	7	6	4	2	9	6	6	3	5
Utility equipment electrical fatalities	3	5	4	2	2	4	3	2	0	3
Powerline electrical-related fatalities	2	4	2	1	2	2	2	2	0	2

Source: ESA and Coroner records.

Conclusion
The number of utility-related equipment fatalities has been decreasing since 2009, however, in 2017, there were two powerline fatalities reported.

2 FIVE-YEAR ROLLING AVERAGE OF POWERLINE ELECTRICAL-RELATED FATALITIES IN ONTARIO, 2004-2017

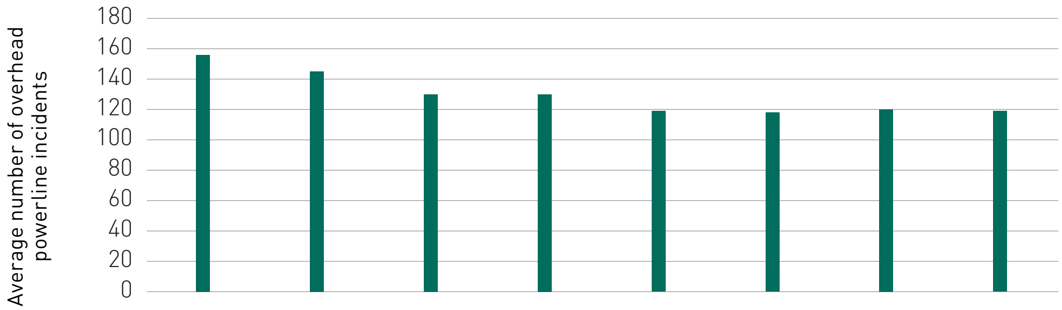


Five-year period	2004-2008	2005-2009	2006-2010	2007-2011	2008-2012	2009-2013	2010-2014	2011-2015	2012-2016	2013-2017
Rate of powerline-electrical related fatalities	0.21	0.24	0.22	0.15	0.17	0.17	0.13	0.13	0.12	0.12

Source: ESA and Coroner records.

Conclusion
The rate of powerline electrical-related fatalities has decreased by **29%** when comparing 2008-2012 and 2013-2017; the 2013-2017 rate has remained the same as the previous five-year period of 2012-2016.

3 FIVE-YEAR ROLLING AVERAGE NUMBER OF OVERHEAD POWERLINE INCIDENTS IN ONTARIO, 2006-2017

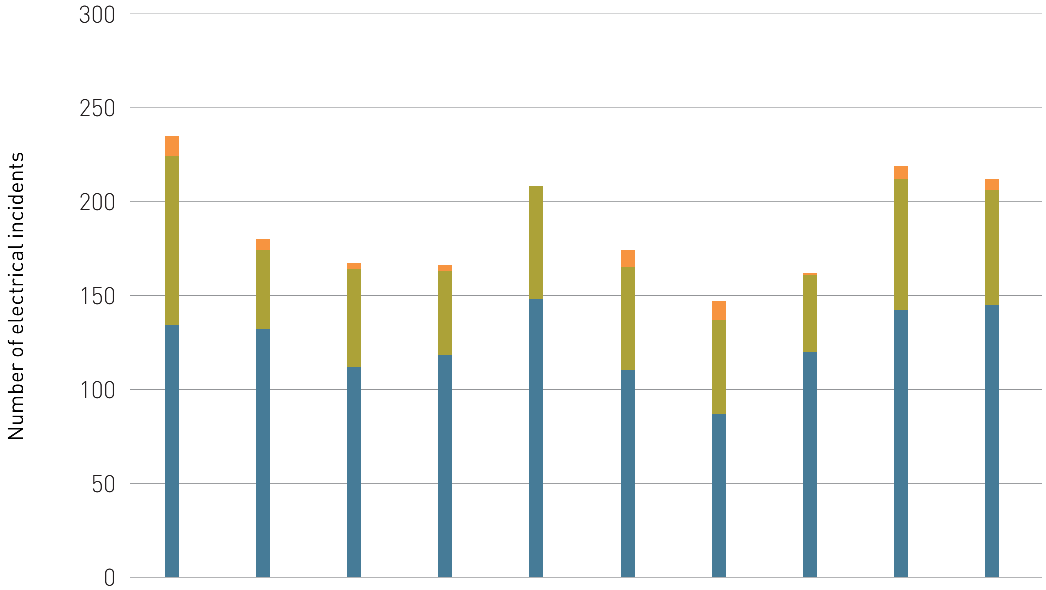


Five-year period	2006-2010	2007-2011	2008-2012	2009-2013	2010-2014	2011-2015	2012-2016	2013-2017
Average number of overhead powerline incidents	156	145	130	130	119	118	120	119

Source: ESA records.

Conclusion
The five-year rolling average number of overhead powerline incidents has decreased by **9%** when comparing 2008-2012 and 2013-2017. The most recent five-year period of 2013-2017 shows a slight decrease in overhead powerline contacts when compared to the previous time period of 2012-2016.

4 NUMBER OF UTILITY-RELATED ELECTRICAL INCIDENTS BY CONTACT TYPE IN ONTARIO, 2008-2017

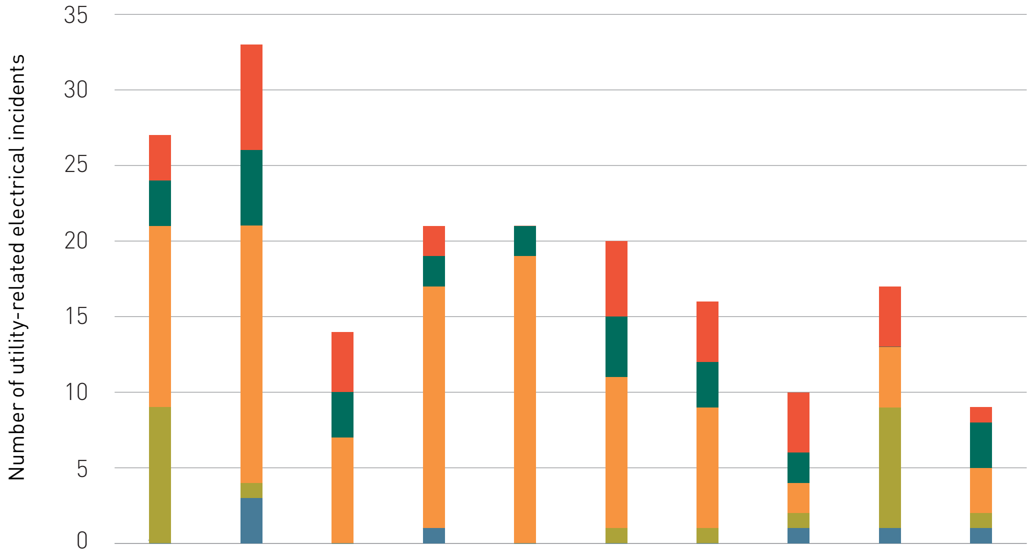


Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Vaults, substations & padmounts	11	6	3	3	0	9	10	1	7	6
Underground powerline contact	90	42	52	45	60	55	50	41	70	61
Overhead powerline contact	134	132	112	118	148	110	87	120	142	145

Source: ESA records.

Conclusion
Overhead powerline contact remains the leading cause in utility-related electrical incidents between 2008 and 2017; however, the total number of utility-related electrical incidents has decreased by **10%** when comparing 2008 and 2017.

5 NUMBER OF UTILITY-RELATED ELECTRICAL INCIDENTS BY OUTCOME IN ONTARIO, 2008-2017



Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Critical injury	3	7	4	2	0	5	4	4	4	1
Fatality	3	5	3	2	2	4	3	2	0	3
Non-critical injury	12	17	7	16	19	10	8	2	4	3
Property damage	9	1	0	0	0	1	1	1	8	1
Unknown	0	3	0	1	0	0	0	1	1	1

Source: ESA records.

Conclusion
The number of utility-related incidents that resulted in fatality has increased when compared to 2016. However, the number of utility-related incidents that resulted in property damage or non-critical injuries has decreased when compared to 2016.

3.1 Powerline Safety

The Incident:

A boom truck operator, delivering roofing material to a residential area, received a fatal shock when he inadvertently guided the boom of his truck into an overhead power line while unloading the material. The exact sequence of events remains unknown; however, based on evidence, it was determined that the driver used a remote control guiding the load into the power line after which the driver attempted to open the cab of the truck when he suffered the fatal shock. The driver's charred body was found near the driver side of the wheel well under the cab of the truck.

Incident Details:

A homebuilding centre dispatched a driver on a boom truck to deliver some homebuilding material to two houses under renovation, in a residential area. The driver completed unloading material for the first house without incident.

Then, a worker at the second house advised the driver to unload the material for that house on the property line between the two houses. The original position of the truck remains unknown. However, the driver was witnessed moving the truck into the position it was found at the time of incident. The driver parked it partially on the curb in diagonal fashion (shown in Figure 1).

Figure 1: Charred and some flat tires near burn marks on the sidewalk where the left outrigger had been set up at the time of incident

Figure 2: Tire damage shown

They then used the handheld wireless remote control to guide the boom, when it incidentally made contact with a 7200V, single phase, overhead power line, which ran along that side of the street. When the boom made contact with the power line, it energized the metallic components of the truck. The driver then proceeded to the cab of the truck and made contact with the truck leading to his electrocution. The boom of the truck was still in contact with the power line when emergency rescue arrived at the scene. EMS officials waited until the LDC arrived on scene and disconnected power to the circuit before recovering the body of the deceased. The driver's charred body was found partially under the driver side wheel well at the cab of the truck. The remote control was found nearby the body. Some of the tires were charred, smoking and flat and burn marks were observed underneath the tires and outriggers (Figure 1 and Figure 2).

Further investigation revealed the following:

1. Lack of awareness or attempt to control the hazard – It is unknown whether the driver was aware of the hazard from the overhead power line. The LDC was not contacted to de-energize that line. And as such, there was no indication that this hazard was controlled or whether it was identified.

2. No signaler was used – A signaler, by definition, is someone whose sole purpose is to monitor the boom and ensure it does not come within the limits of approach of a power line. If it does, the signaler would immediately inform the driver that the boom was encroaching on the minimum distance allowed to the overhead powerline. There is no evidence that suggests a signaler was requested nor used at the time of incident.

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 36,159 structural-loss fires (fires resulting in an injury, fatality or dollars lost) between 2012 and 2016. This number is a 1% decrease from 36,511 structural-loss fires between 2011 and 2015. Residential-loss fires account for 73% of structural loss fires from 2012 to 2016. Stove-top fires account for 8% of structural-loss fires and 11% of residential-loss fires. Since 2012 there has been a 4% decrease in total fires, a 4% decrease in structural-loss fires, and a 4% decrease in residential-loss fires.

For the period between 2012 and 2016, 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 (5%)
- Other electrical, mechanical (4%)

When comparing 2007-2011 and 2012-2016, the average number of structure-loss fires per year by ignition source decreased 9% for cooking, 14% for electrical wiring, 20% for heating/cooling equipment, and 10% 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 (42%)
- Electrical distribution equipment (26%)
- Appliances (12%)

Electrical Products

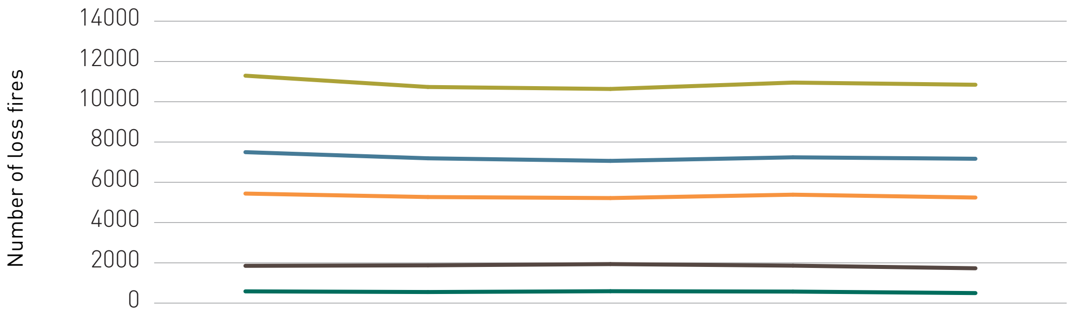
ESA defines electrical products as appliances, cooking equipment, lighting equipment, other electrical and mechanical equipment and processing equipment. Data from OFMEM shows that the five-year average for electrical product fires (where electricity was identified as the fuel of the ignition source) between 2007-2011 and 2012-2016 has decreased by 23%.

Statistics Directly Related to 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, 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 23% between 2007-2011 and 2012-2016.

1 NUMBER OF LOSS FIRES IN ONTARIO, 2012-2016

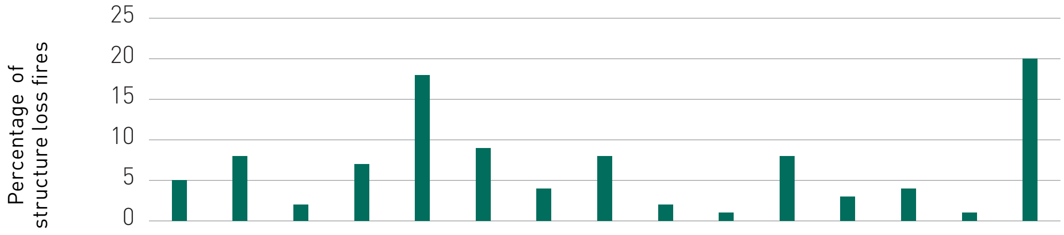


Year	2012	2013	2014	2015	2016
Total number of loss fires in Ontario	11294	10733	10635	10951	10844
Structure loss fires	7496	7191	7063	7240	7169
Residential loss fires	5400	5268	5217	5385	5243
Structure loss fires where electricity fueled the ignition source	1852	1876	1938	1861	1730
Structure loss stove-top fires	584	551	591	573	498

Source: OFMEM records.

Conclusion
The numbers of total fires, structure fires and residential fires have decreased between 2012 and 2016; however, the number of fires where the ignition sources were fuelled by electricity or from electrical distribution equipment has been more variable in the five-year period.

2 PERCENTAGE OF STRUCTURE LOSS FIRES BY IGNITION SOURCE IN ONTARIO, 2012-2016

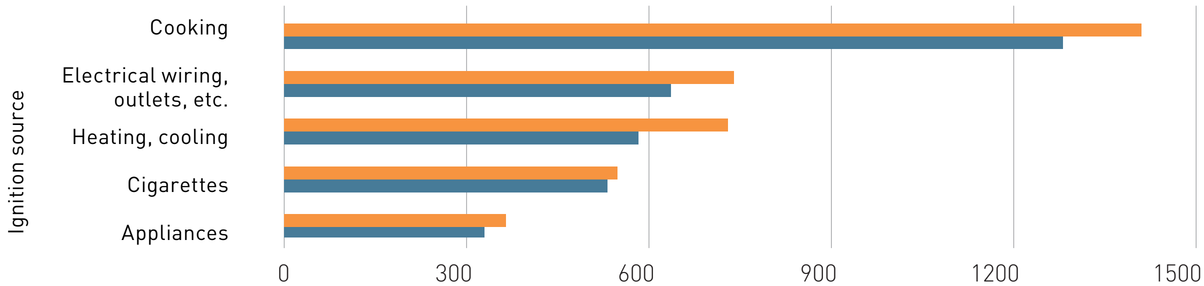


Ignition source	Appliances	Arson	Candles	Cigarettes	Cooking	Electrical wiring	Exposure	Heating, cooling	Lighting	Matches, lighters	Miscellaneous	Other open flame tools	Other electrical, mechanical	Processing equipment	Undetermined
2012-2016	5.0%	8.0%	2.0%	7.0%	18%	9.0%	4.0%	8.0%	2.0%	1.0%	8.0%	3.0%	4.0%	1.0%	20%

Source: OFMEM records.

Conclusion
Aside from undetermined and miscellaneous sources, cooking and electrical wiring are the most common ignition sources for structure loss fires between 2012 and 2016.

3 FIVE-YEAR AVERAGE NUMBER OF STRUCTURE LOSS FIRES BY IGNITION SOURCE IN ONTARIO, 2007-2011 AND 2012-2016

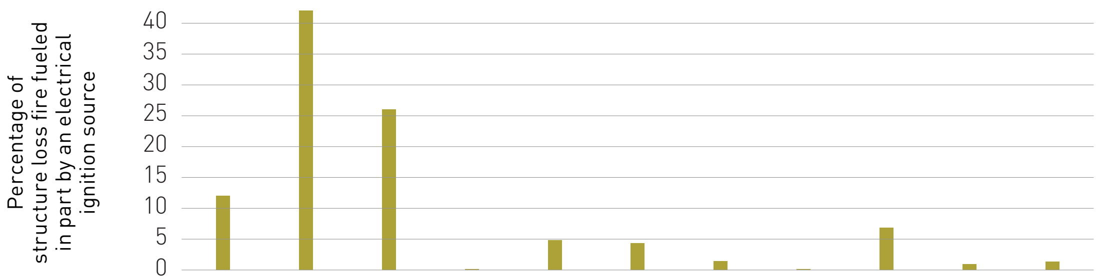


Average number of structure loss fires		Cooking	Electrical wiring, outlets, etc.	Heating, cooling	Cigarettes	Appliances
	2007-2011	1410	740	730	548	365
	2012-2016	1281	636	583	532	329

Source: OFMEM records.

Conclusion
Cooking equipment remains the most common ignition source in 2007-2011 and 2012-2016, 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 STRUCTURAL LOSS FIRES FUELLED IN PART BY AN ELECTRICAL IGNITION SOURCE IN ONTARIO, 2012-2016

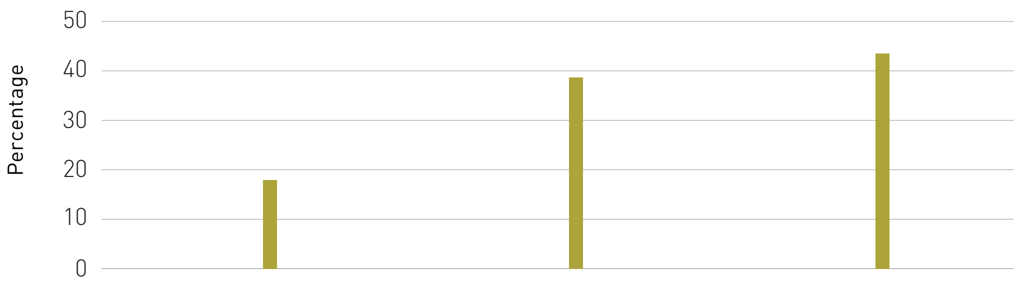


Electrical Ignition Source	Appliances	Cooking	Electrical distribution equipment	Exposure	Heating, chimney	Lighting	Miscellaneous	Open flame	Other electrical, mechanical	Processing equipment	Undetermined
Percentage of structure loss fires	12%	42%	26%	0.1%	4.8%	4.3%	1.4%	0.9%	6.8%	0.9%	1.3%

Source: OFMEM records.

Conclusion
When the fire is from ignition sources that uses electricity, cooking equipment, electrical distribution equipment, and appliances were the most common ignition sources between 2012 and 2016.

5 PERCENTAGE OF ELECTRICAL STRUCTURE LOSS FIRES IN ONTARIO BY TIME OF DAY, 2007-2016

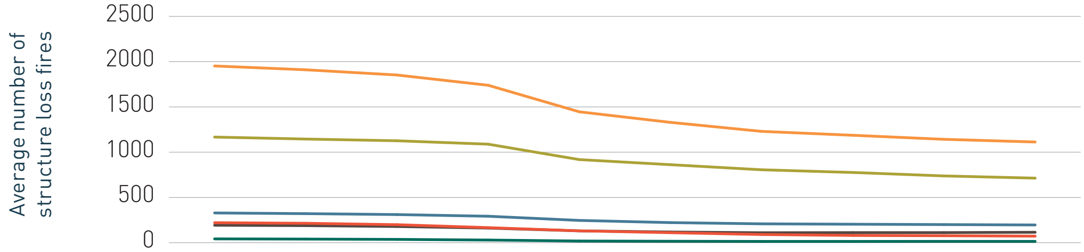


	Midnight – 8 a.m.	8 a.m. – 4 p.m.	4 p.m. – Midnight
Percentage	18%	39%	43%

Source: OFMEM records.

Conclusion
Between 2007 and 2016, 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, 2003-2016



Five-year Period	2003-2007	2004-2008	2005-2009	2006-2010	2007-2011	2008-2012	2009-2013	2010-2014	2011-2015	2012-2016
Appliances	329	321	311	293	246	222	209	204	200	196
Cooking equipment	1167	1145	1126	1089	918	862	806	776	738	713
Lighting	221	215	199	167	131	111	91	80	77	73
Other electrical, mechanical	193	189	179	162	131	118	110	112	112	115
Processing equipment	43	40	37	30	19	16	14	14	15	15
Product safety overall	1952	1910	1853	1739	1446	1329	1230	1187	1142	1113

Source: OFMEM records.

Conclusion
Between 2007-2011 and 2012-2016, the five-year rolling average number of fires by total electrical products has decreased by **23%**.

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). In many of these incidents, many of them involved residential properties. The frequency of residential fires is concerning because they are the most common source of fire-related death (Miller, 2005). In 2002, 82% of the 304 fire deaths were residential fires (Council of Canadian Fire Marshals, 2002). Similarly in 2006, 80% of Americans who died in a fire died in a residence (Karter, 2007). In the early 1990s, residential fires caused deaths of between 4,000 and 5,000 Americans, and injured an additional 20,000 each year (Baker and Adams, 1993).

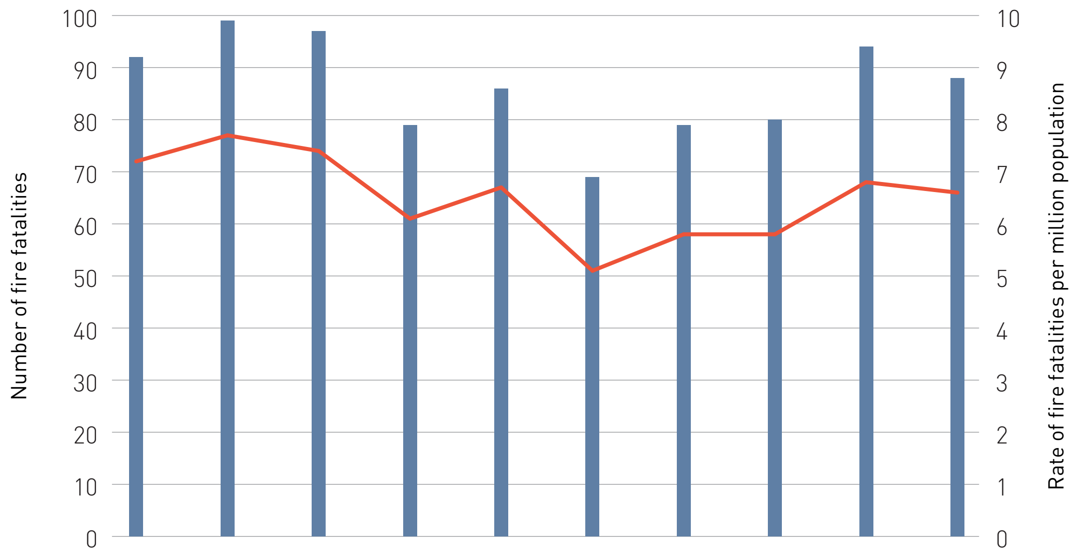
Ontario reported 863 deaths due to fires between 2007 and 2016. This number excludes fire deaths in vehicle collisions, fire fatalities among emergency response, or any fire deaths on federal or First Nations property. This number is more than what was reported between 2006 and 2015, where 856 deaths were reported. OFMEM reported that in 2016, the fire death rate was 6.6 deaths per million population, which is a 8% decrease when compared to the fire death rate in 2007, which was 7.2 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 778 fire fatalities from structural-loss fires from 2007 to 2016. This is a slight increase (~1%) when compared to the previous ten-year period of 768 fire fatalities from 2006 to 2015. OFMEM reported that in 2016, the structural-loss fire death rate was 6.3 per million population, which is a 5% decrease when compared to the structural-loss fire death rate in 2007, which was 6.6 deaths per million population.

The OFMEM data identified 85 deaths in fires for which electricity was the fuel of ignition source or were from electrical distribution equipment between 2007 and 2016. Since 2007, the death rate from this type of fire has increased 7% from 0.70 deaths per million population to 0.75 deaths per million population.

In these types of fires in which the investigations were considered closed, 95% were considered accidental between 2012 and 2016. Stove or range-top burners accounted for 38% of fire fatalities fuelled at least by electricity.

1 NUMBER AND RATE OF ALL FIRE FATALITIES IN ONTARIO, 2007-2016

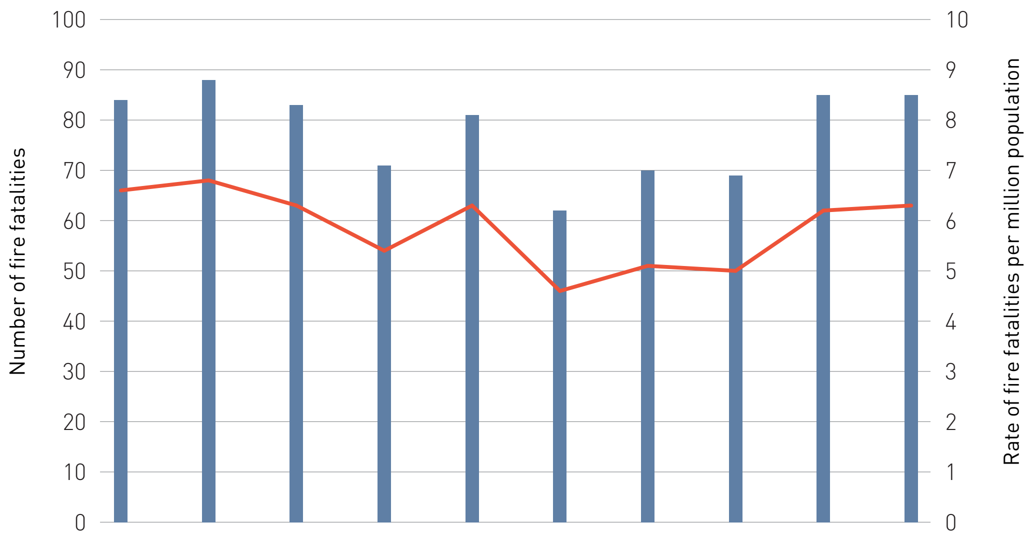


Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
All fire fatalities in Ontario	92	99	97	79	86	69	79	80	94	88
Ontario population in millions	12.8	12.9	13.1	13.2	12.9	13.4	13.6	13.7	13.8	13.4
Fire death rate in Ontario	7.2	7.7	7.4	6.1	6.7	5.1	5.8	5.8	6.8	6.6

Source: OFMEM records.

Conclusion
The number and rate of fire fatalities have remained variable since 2007; however, the number and rate of fire fatalities have been slightly increasing since 2012, with exception of 2016 where the number of fire fatalities decreased.

2 NUMBER AND RATE OF FIRE FATALITIES IN STRUCTURE FIRES IN ONTARIO, 2007-2016

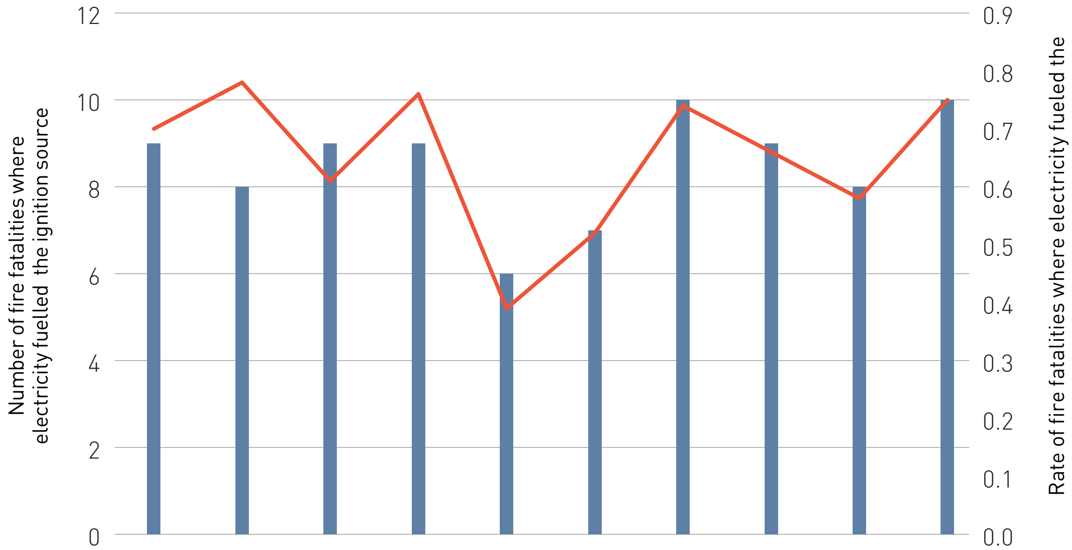


Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Fire fatalities in structure fires	84	88	83	71	81	62	70	69	85	85
Ontario population in millions	12.8	12.9	13.1	13.2	12.9	13.4	13.6	13.7	13.8	13.4
Structure fire death rate in Ontario	6.6	6.8	6.3	5.4	6.3	4.6	5.1	5.0	6.2	6.3

Source: OFMEM records.

Conclusion
The rates of fire fatalities in structure fires have been showing an increasing trend since 2012; however, the numbers of fire fatalities were same in 2015 and 2016.

3 NUMBER AND RATE OF FIRE FATALITIES WHERE ELECTRICITY WAS THE FUEL OF THE FIRE IN ONTARIO, 2007-2016



Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Fatalities where electricity was ignition source	9	8	9	9	6	7	10	9	8	10
Ontario population in millions	12.8	12.9	13.1	13.2	12.9	13.4	13.6	13.7	13.8	13.4
Rate of fatalities where electricity was the ignition source	0.70	0.78	0.61	0.76	0.39	0.52	0.74	0.66	0.58	0.75

Source: OFMEM records.

Conclusion
The rate of structure fire fatalities where electricity fuelled the ignition source or were from electrical distribution equipment has increased from 2015 to 2016.

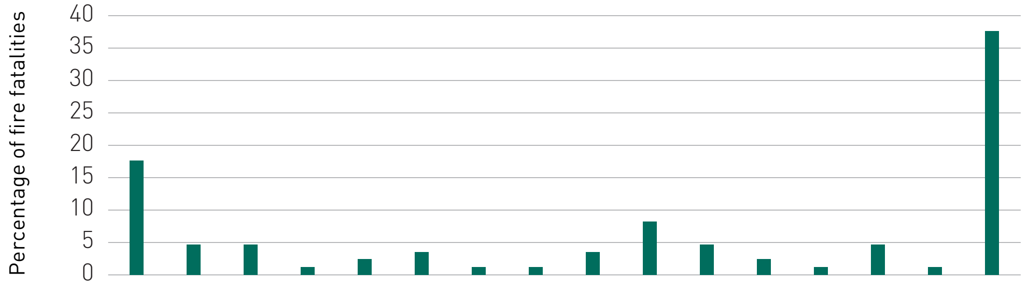
4 PERCENTAGE OF STRUCTURE FIRE FATALITIES WHERE ELECTRICITY IS FUEL OF THE IGNITION SOURCE BY CAUSE CLASSIFICATION IN ONTARIO, 2012-2016 (CLOSED FIRE INVESTIGATIONS ONLY)

	Accidental	Undetermined
2012-2016	95%	5%

Source: OFMEM records.

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

5 PERCENTAGE OF STRUCTURE FIRE FATALITIES WHERE ELECTRICITY IS FUEL OF THE IGNITION SOURCE BY IGNITION SOURCE IN ONTARIO, 2007-2016 (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 header – portable	Stove, range – top burners
	18%	4.7%	4.7%	1.2%	2.4%	3.5%	1.2%	1.2%	3.5%	8.2%	4.7%	2.4%	1.2%	4.7%	1.2%	38%

Source: OFMEM records.

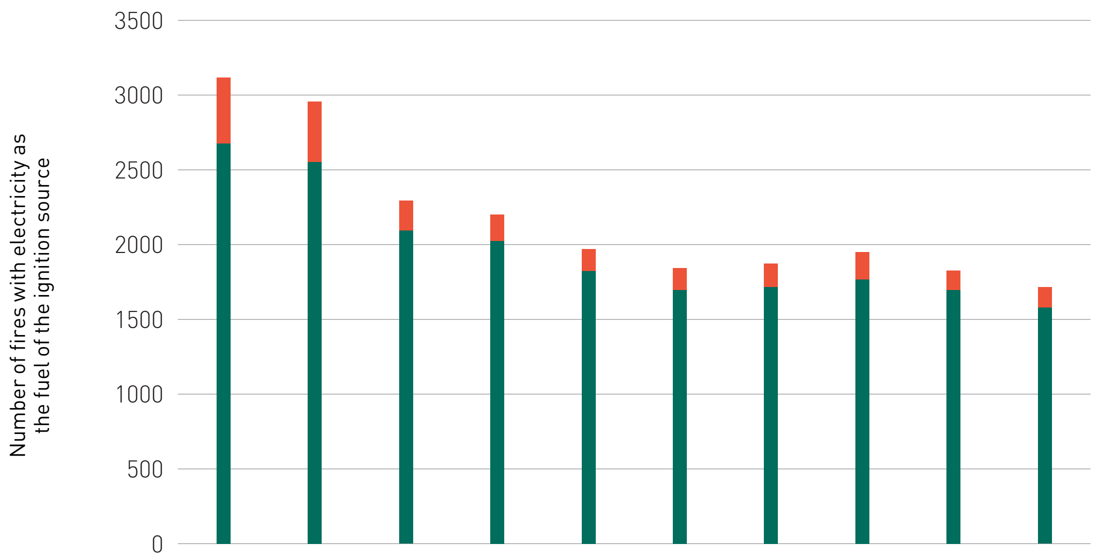
Conclusion
The stove remains the most common ignition source when examining structure fire fatalities where electricity fuelled the ignition source or from electrical distribution equipment in the most recent ten-year period.

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 19,625 loss fires and 2,118 no-loss fires for a total of 21,743 structure fires from 2007 to 2016. Over the same time period, there was a 41% decrease in structure loss fires and a 45% decrease in total structure fires.

Between 2012 and 2016, 81% of structure fires occurred in the residential setting. Cooking equipment (50%), electrical distribution equipment (22%), and appliances (11%) remained the most common ignition source in these fires.

1 NUMBER OF FIRES WITH ELECTRICITY AS THE FUEL OF THE IGNITION SOURCE IN ONTARIO, 2007-2016

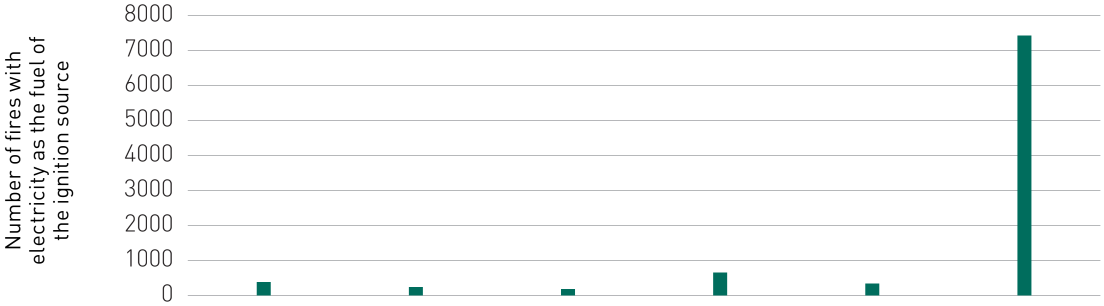


Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Number of fires with no loss	441	403	203	177	145	146	154	182	129	129
Number of fires with loss	2676	2553	2093	2025	1823	1697	1716	1768	1696	1578
Total fires with electricity as the fuel	3117	2956	2296	2202	1968	1843	1871	1950	1825	1715

Source: OFMEM records.

Conclusion
In 2016, the total number of structure fires where electricity was the fuel of the ignition source decreased slightly by **6%** when compared to 2015.

2 NUMBER OF FIRES WITH ELECTRICITY AS THE FUEL OF THE IGNITION SOURCE BY STRUCTURE CLASSIFICATION IN ONTARIO, 2012-2016

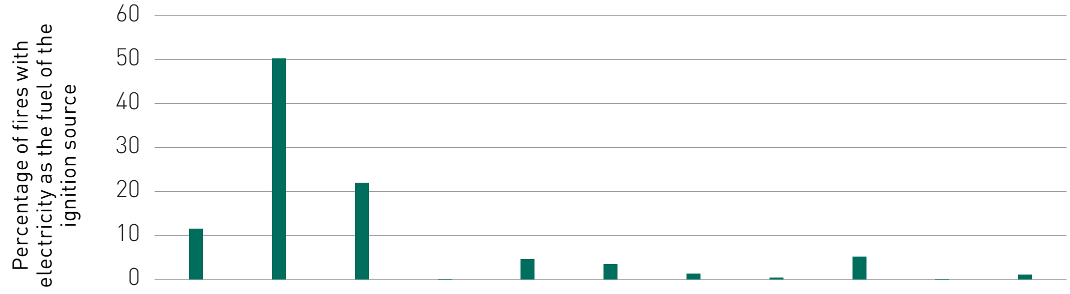


	Assembly	Business and personal services	Care and detention	Industrial	Mercantile	Residential
Structure classification	381	239	172	653	339	7420

Source: OFMEM records.

Conclusion
Residential structures were the most common structures (**81%**) in which fires where electricity was the fuel of the ignition source occurred between 2012 and 2016.

3 PERCENTAGE OF RESIDENTIAL FIRES WITH ELECTRICITY AS THE FUEL OF THE IGNITION SOURCE BY IGNITION SOURCE IN ONTARIO, 2010-2014



	Appliances	Cooking equipment	Electrical distribution equipment	Exposure	Heating equipment, chimney, etc.	Lighting equipment	Miscellaneous	Open flame tools, smokers' articles	Other electrical, mechanical	Processing equipment	Undetermined
Ignition source	11%	50%	22%	0.1%	4.6%	3.5%	1.3%	0.4%	5.2%	0.1%	1.1%

Source: OFMEM records.

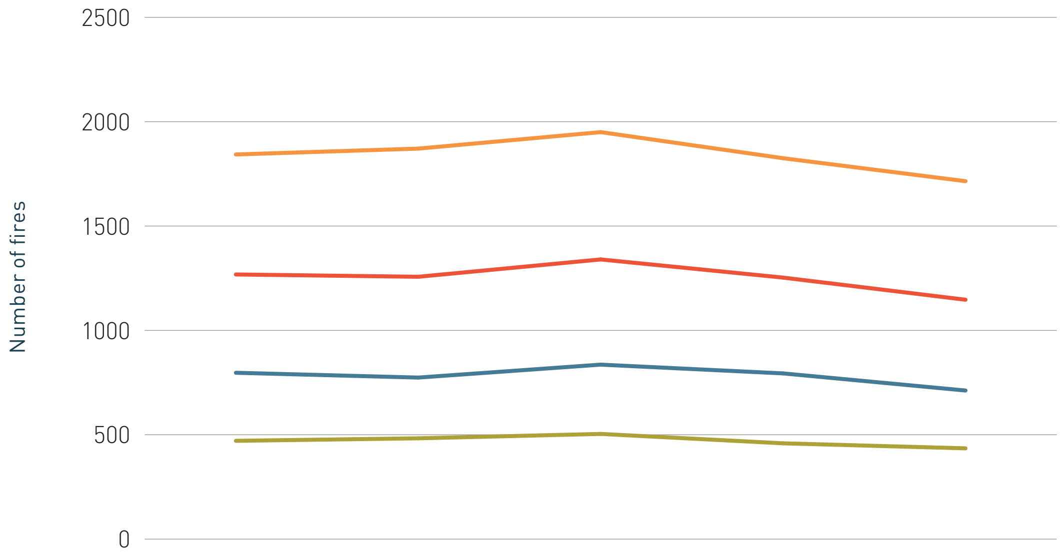
Conclusion
Cooking equipment and electrical distribution equipment are the leading sources in residential fires when electricity fuelled the ignition source.

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

In 2007, the major cause of home fires in Canada from BC, AB, SK, MB, ON, NB, NS and NT were cooking fires (20%) (Wijayasinghe, 2011). In Ontario, from 2012 to 2016, there were 3,913 fires where the ignition source was cooking equipment fuelled by electricity. Since 2012, there has been a 11% 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. For residential fires that were ignited from cooking equipment that used electricity, it accounted for an annual average of 136 injuries among civilians and an average of four fatalities between 2012 and 2016. In this time period, cooking equipment is the leading ignition source in fires from electrical products or where electricity fuelled the ignition source. These fires resulted in an average loss of $18.6 million annually.

1 NUMBER OF COOKING EQUIPMENT AND ELECTRICAL DISTRIBUTION EQUIPMENT FIRES IN ONTARIO, 2012-2016



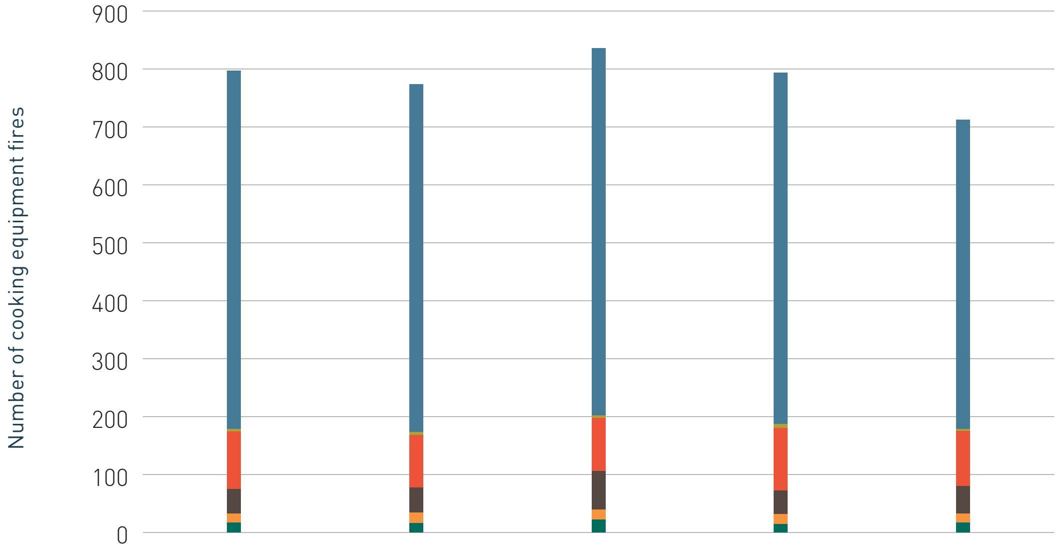
Year	2012	2013	2014	2015	2016
Cooking equipment	797	774	836	794	712
Electrical distribution equipment	471	483	504	459	435
Total cooking equipment and electrical distribution equipment fires	1268	1257	1340	1253	1147
Total fires with electricity as the fuel	1873	1871	1950	1825	1715

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 **10%** when compared to 2012.

2 NUMBER OF COOKING EQUIPMENT FIRES WITH ELECTRICITY AS THE FUEL OF THE IGNITION SOURCE BY SOURCE IN ONTARIO, 2012-2016

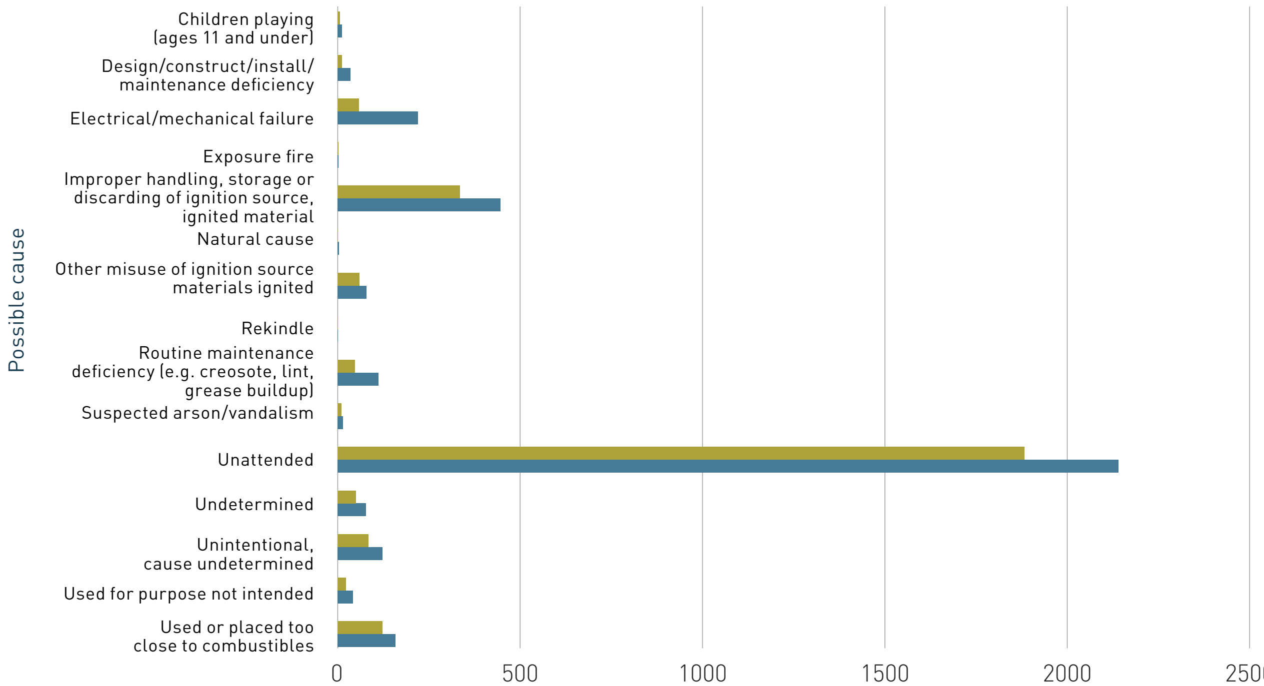


Year	2012	2013	2014	2015	2016
Stove, range-top burner	618	600	634	607	533
Range hood	5	6	4	7	4
Oven	99	90	92	108	95
Other cooking items	42	43	66	40	47
Microwave	16	19	18	18	16
Deep fat fryer	17	16	22	14	17

Source: OFMEM records.

Conclusion
Stoves/range-top burners are the leading sources (**76%**) of cooking equipment fires between 2012 and 2016.

3 NUMBER OF STOVE-TOP FIRES VS. COOKING EQUIPMENT FIRES BY POSSIBLE CAUSE IN ONTARIO, 2012-2016



Number of fires	Children playing (ages 11 and under)	Design/construction/installation/ maintenance deficiency	Electrical failure/ mechanical failure	Exposure fire	Improper handling, storage or discarding of ignition source or ignited material	Natural cause	Other misuse of ignition source/ materials ignited	Rekindle	Routine maintenance deficiency (e.g. creosote, lint, grease buildup)	Suspected arson/vandalism	Unattended	Undetermined	Unintentional, cause undetermined	Used for purpose not intended	Used or placed too close to combustibles
Stove-top fires	6	11	58	2	335	0	59	0	47	10	1883	50	84	23	123
Cooking equipment fires	12	35	220	2	446	4	79	1	112	14	2140	78	123	42	158

Source: OFMEM records.

Conclusion
Leaving fires unattended is the most common cause of stove top and cooking equipment fires between 2012 and 2016.

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

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, termination, electrical panels, cords on appliances etc. are considered electrical distribution equipment. This is not to be confused with utility equipment from Local Distribution Companies.

In the five-year period between 2012 and 2016, the OFMEM identified 2,352 fires as electrical distribution equipment fires with electricity as the fuel of the ignition source. The five-year rolling average of electrical distribution equipment loss structure fires have decreased by 29% between 2007-2011 and 2012-2016.

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 33% when comparing 2007-2011 and 2012-2016. Electrical failure is the most common possible cause in these types of fires.

In 2014, an estimated 37,900 reported non-confined home structure fires in the United States involved electrical distribution or lighting equipment that resulted in 535 deaths, 1,290 injuries, and $1433 million in direct property damage (Campbell, 2017).

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).

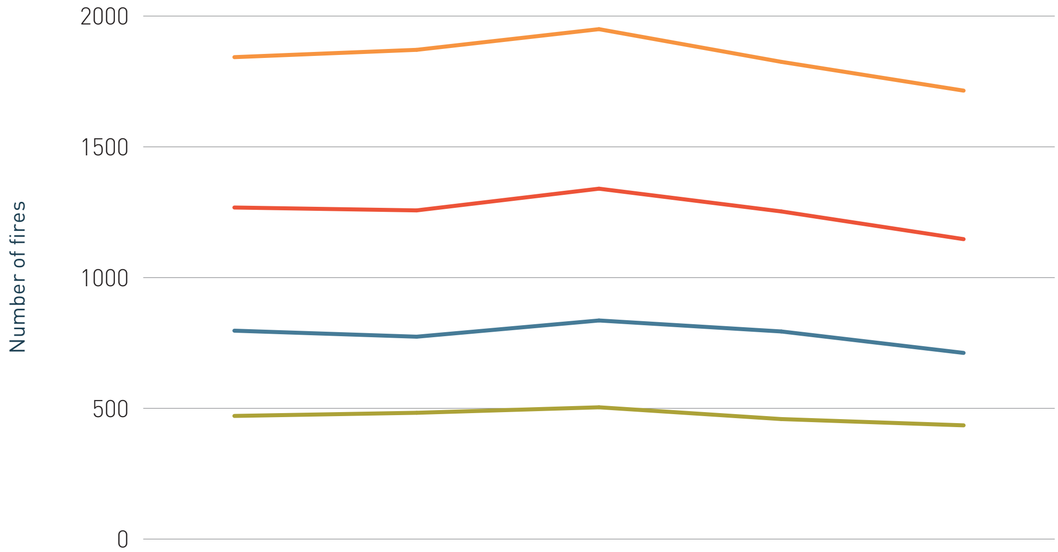
Section 4.5 and 4.6 provides a case study that is representative of the risk factors associated with electrical distribution equipment fires and cooking equipment fires, respectively.

Statistics Directly Related to 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 cord, appliance cord, termination and electrical panel – electrical devices categorized by OFMEM as Electrical Distribution Equipment data.

The electrical distribution equipment loss structure fires related to aging infrastructure's five-year rolling average has decreased by 29% between 2007-2011 and 2012-2016.

1 NUMBER OF COOKING EQUIPMENT AND ELECTRICAL DISTRIBUTION EQUIPMENT FIRES IN ONTARIO, 2012-2016



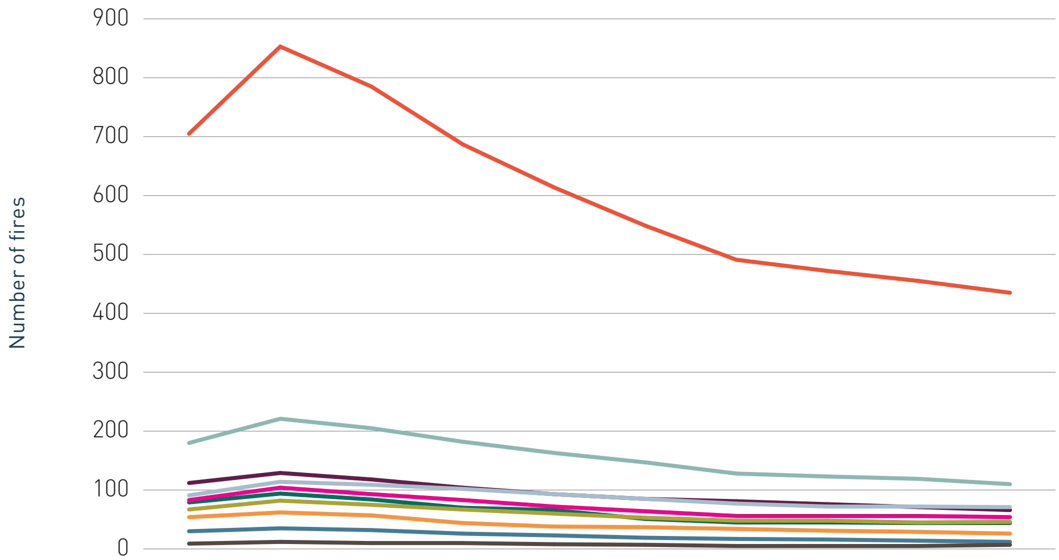
Year	2012	2013	2014	2015	2016
Cooking equipment	797	774	836	497	712
Electrical distribution equipment	471	483	504	459	435
Total cooking equipment and electrical distribution equipment fires	1268	1257	1340	1253	1147
Total fires with electricity as the fuel	1843	1871	1950	1825	1715

Source: OFMEM records.

Conclusion

The total number of electrical distribution equipment structure fires has decreased **8%** since 2012.

2 FIVE-YEAR AVERAGE NUMBER OF ELECTRICAL DISTRIBUTION EQUIPMENT STRUCTURAL LOSS FIRES BY IGNITION SOURCE IN ONTARIO, 2003-2016



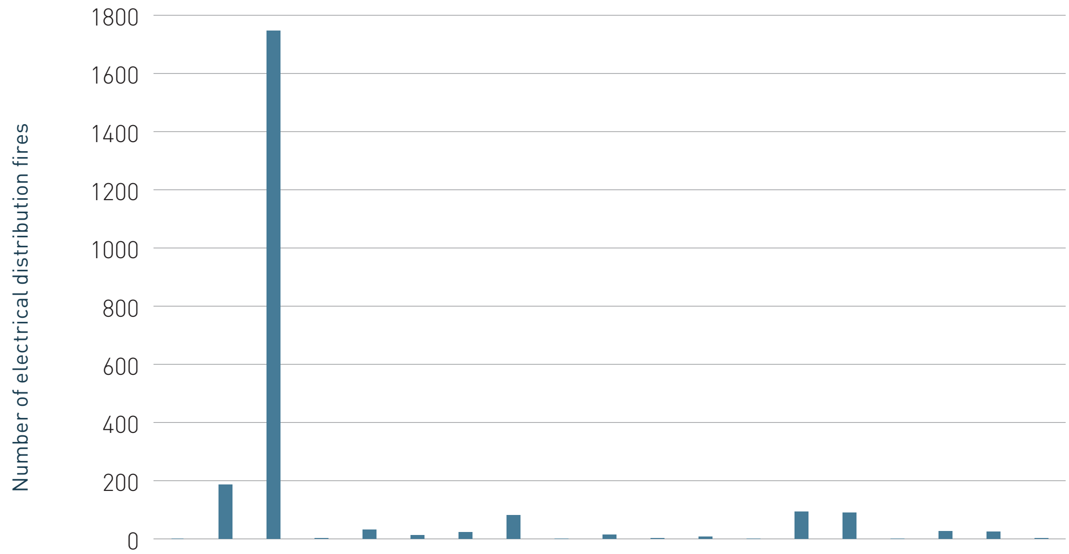
Year	2003-2007	2004-2008	2005-2009	2006-2010	2007-2011	2008-2012	2009-2013	2010-2014	2011-2015	2012-2016
Circuit wiring – Al, Cu (includes conductors)	180	221	205	182	163	147	128	123	119	110
Cord, cable for appliance, electrical articles	91	114	109	102	93	85	77	72	72	71
Distribution equipment (includes panel boards, fuses, circuits)	112	129	118	104	93	85	81	76	71	66
Extension cord, temporary wiring	67	82	75	67	60	53	48	48	45	46
Meter	9	12	10	10	8	7	5	5	5	7
Other electrical distribution item	83	104	93	83	72	64	56	56	56	54
Service/utility lines (includes power/hydro transmission lines)	54	62	57	44	38	37	34	31	29	26
Terminations – Al, Cu (includes receptacles, switches, lights)	79	94	84	70	66	51	45	45	44	44
Transformer	30	35	32	26	23	19	17	16	14	12
Total	705	853	785	687	614	549	491	472	455	435

Source: OFMEM records.

Conclusion

Circuit wiring – aluminum and copper, remains the leading ignition source in electrical distribution equipment between 2003 and 2016. The five-year rolling average of electrical distribution equipment loss structure fires show a **29%** decrease between 2007-2011 and 2012-2016.

3 NUMBER OF ELECTRICAL DISTRIBUTION EQUIPMENT FIRES BY POSSIBLE CAUSE IN ONTARIO, 2012-2016



Possible cause	Children playing (ages 11 and under)	Design/Construction/installation/ Maintenance Deficiency	Electrical / mechanical failure	Exposure fire	Improper handling/storage/discard of ignition source or ignited material	Natural cause	Other misuse of ignition source/ material ignited	Other unintentional cause, not classified	Rekindle	Routine maintenance deficiency, e.g. creosote, lint, grease buildup)	Suspected vandalism	Unattended	Under investigation	Undetermined	Unintentional, cause undetermined	Unknown, not reported	Used for purpose not intended	Used or placed too close to combustibles	Vehicle collision
Number of electrical distribution fires	1	187	1747	2	32	13	23	81	1	15	2	7	1	94	90	1	27	25	2

Source: OFMEM records.

Conclusion
Electrical/mechanical failure is the leading cause of electrical distribution structure fires between 2012 and 2016.

4.5 An Electrical Panel Fire

Improper securing of wire to a wooden joist causes fire, double fatality and $70,000 damage to the property.

A fire in the ceiling space of the basement under the main floor kitchen in a two-storey detached dwelling resulted in two fatalities and extensive damage. This fire was investigated by the local fire department and Office of the Fire Marshal and Emergency Management (OFMEM) and ESA. The only viable ignition source was electrical – improper securement of a conductor to a wooden joist by driving the securing metal staple into the conductor with excessive force. A relative was stopping by the next morning called 911 when he smelled smoke and observed heavy soot in the kitchen, where the fire was mostly contained.

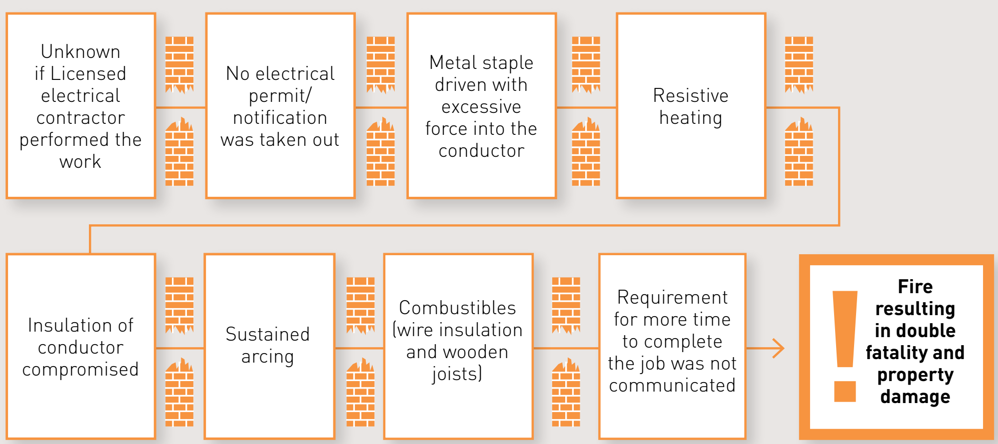
Some of the resulting damages in the house were as follows:

- Fire patterns were most prominent in the centre section of the main floor towards the east wall in the kitchen under the refrigerator
- Visible consumption of a small portion of the kitchen floor partially from the underside of the refrigerator. This caused a minimal fire to enter the kitchen and first floor.
- Below the consumed portion of the kitchen floor was the ceiling space of a former laundry room in the basement comprised of wooden joists which contained copper conductors running through that space, secured to the joist by metal staples
- The wooden joists displayed severe charring and arcing associated with the location of one of the staples which secured a conductor
- Smoke migration patterns were visible but less prominent throughout the first floor of the house
- The remainder of the house (interior and exterior) was void of fire patterns
- Electricity was the only source of energy in the area of origin. No other viable ignition sources were found

Investigation Findings:

- Three sources of ignition were considered in this investigation:
  - Intentionally set fire – Before the caregiver left the night before, she last saw the two occupants of the home retire to bed. Upon testing the scene and exhibits from the area of origin, no ignitable liquids or accelerants were found. Therefore, this hypothesis was credibly eliminated.

- Malfunction of the refrigerator – Failure of the electric motor of the refrigerator or associated wiring was considered. The equipment was examined and found no evidence of malfunction to neither the compressor nor appliance conductors and found no sign of overheating. Therefore, this hypothesis was eliminated
- Building electrical and lighting – From forensic laboratory examination of the copper conductor and metal staples, a severely deformed staple showed signs of continuous excessive heat that had been present for some time. Signs of melted copper on the metal staple along with signs of melted iron on the copper conductor indicated the two metals had made contact with one another. In addition, signs of arcing on both the staple and conductor indicate that once the conductor's insulation was compromised and contact was made between the staple and bare conductor a sustained arcing event occurred. Signs of severe fire patterns surrounding the location of the staple and conductor supported the hypothesis that resistive heating occurred and the ensuing arcing followed resulting in heating the combustibles in the vicinity (wooden joists and wire insulation becoming the fuel for the fire) to a point of ignition. This was the most likely hypothesis and determined to be the cause of fire.



This incident typifies what can occur from improper electrical installations. The condition can exist for some time, the hazard neither apparent nor interfering with workings of electrical devices before actually turning into a fire hazard. Excessive force driving the staples or improper placement of the staples to secure the conductors can damage the conductor insulation, create arcing and/or resistive heating and sparking which can result in fires.

Ensure proper installation methods when securing conductors using metal staples. Hire a Licensed Electrical Contractor and ensure an electrical inspection by ESA was performed.

4.6 A Stove-top Fire Causing Two Injuries and Extensive Damage to the Property

Investigation Summary:

A fire in the kitchen of an apartment residence in a high-rise building resulted in a fatality of a senior and minimal property damage. The fire was investigated by the local fire department, the police and the Office of the Fire Marshal and Emergency Management (OFMEM). The most credible ignition sequence was determined to be a cooking pot being left on an energized burner of a stove in the kitchen.

The Incident:

The individual called 911 and stated that their clothes were on fire. When the fire crew arrived they found the individual without vital signs in the living room on the couch with second and third degree burns to their body.

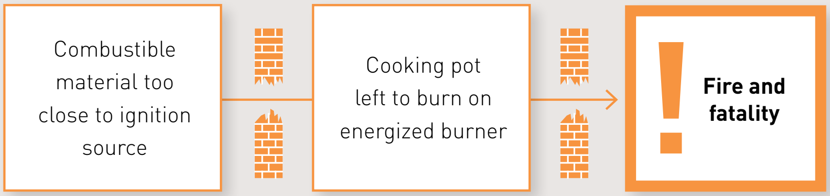
The building consisted of 13 floors and constructed of concrete with a flat tarred roof. There were two bedrooms on the south side of the apartment with a living room in the middle and the kitchen on the north side of the apartment.

Some of the resulting damages were as follows:

- No external fire patterns were present. Exterior walls all remained intact
- As you enter the front apartment door, a pile of burnt clothing were observed towards the kitchen
- The clothing consisted of a cotton house coat and a pair of cloth slippers
- Closer to the stove was a small section of a kitchen towel which was made of thin terry cloth material and was predominantly burnt
- A metal pot was observed in the sink with remains of a burned egg inside. The non-stick coating on the interior side of the pot was severely charred
- Some other unidentified burned material was observed in the sink
- There was minor some smoke damage in the apartment but no build-up of soot on the walls or ceilings
- Below the height of the top cooking surface of the stove, wood cabinets and other exposed surfaces were absent from fire damage other than smoke staining

Investigation Findings:

- The area of origin of the fire was determined to be the kitchen with the ignition of the Victim's clothes by the top burner of the stove top. No evidence could be found to indicate any other point of origin in the apartment
- The fuel for the fire was deemed to be the house coat as it incidentally made contact with either the hot cooking pot or the top burner of the stove.
- The control for the heating element was found to be at in the "ON" position. All other heating element controls were in the "OFF" positions
- Based on the call made by the victim, and investigator findings, it appears the victim who had physical disabilities, placed a pot of boiling water with an egg in it on the stove top element to boil and turned the control on "HIGH". After which it seems they went to another room to rest. In a panic, realizing they forgot about it and smelling the burning pot, they came back to find the water had evaporated and the egg and pot burned. As they tried to remove the pot and put it in the sink their house coat made contact with either the stove top element or the burning hot pot, which in turn ignited the house coat. The victim then appears to have tried to remove the house coat but by that point had suffered severe burns as they called 911.



The investigation found that there is a need to be attentive when cooking, and never to leave the stove unattended. It also indicates the need to be aware of keeping combustible items of clothing away from ignition sources as they can ignite easily at high temperatures required to boil a pot of water.

5.0 Product Safety

On August 1, 2007, the Ministry of Government and Consumer Services (MGCS) filed Ontario Regulation 438/07 *Product Safety*, enabling 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 ESA.

O. Reg 438/07 authorities the ESA to protect the public against potentially unsafe electrical products in the marketplace through;

1. Responding to product safety reports;
2. Removing potentially unsafe electrical products, counterfeit and unapproved products form the marketplace;
3. Requiring manufacturers to notify the public of potentially unsafe products; and
4. Implementing prevention-based and proactive detect activities.

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

The Canada Consumer Product Act in 2011 created concurrent product safety systems from consumer electrical products in Ontario, including mandatory reporting obligations to ESA and Health Canada. On June 26, 2013, the 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 ESA. All incidents involving consumer electrical products are now handled by Health Canada.

In 2017, a serious injury and fatality reported to ESA were a result of hobbyists using high voltage to pattern wood and other materials (ESA, 2018). ESA warns of unsafe use of electrical equipment to manufacture Lichtenberg Generators as they contain live accessible wiring and components, and are dangerous and unsafe for any use or handling. For more details, please see the section 5.1.

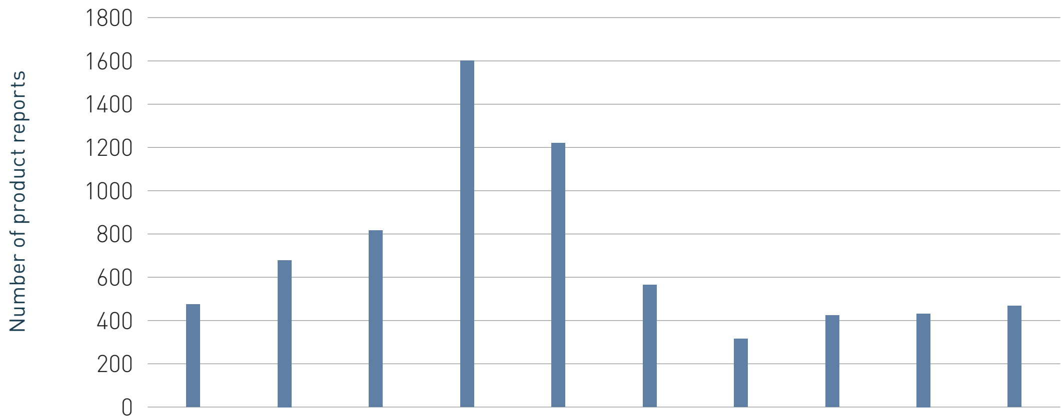
Since 2008, there has been a 1.5% decrease to the number of product incidents reported to the ESA. During this ten year period, 2011 reported the highest number of incident reports (1,601 reports). In 2017, there were 468 reports, a notable decrease when compared to the number of incidents reported in 2011 mainly due to the decrease in reports of incidents and defects with consumer electrical products to ESA.

In the most recent fiscal year (2016-2017), Health Canada reported a 23% increase of reports received on consumer electrical and electronic products when compared to the previous year (2015-2016). Kitchen appliances continued to be the most commonly reported product group to Health Canada, followed by telephone and accessories, and lighting goods. A large increase in the number of incidents involving products with lithium ion batteries have been reported this year (LaRiccia, 2017).

In 2017, all product safety investigations initiated by the ESA were a result of the voluntary reporting. Seventy-nine percent of reports were identified to be Priority 2 (only one percent classified as Priority 1), which meant that the ESA could direct a range of corrective action plans to assure that no further serious incidents or accidents could occur.

Product safety investigations are classified as Unapproved (a product that has not been tested and evaluated to the applicable Canadian Safety Standards and may not be safe to use), Certified (a product that was properly certified but reported to have a safety problem, or perceived safety problem), and With Suspected Counterfeit Label. In 2017, 82% of safety reports were classified as Unapproved products.

1 NUMBER OF PRODUCT INCIDENT REPORTS SUBMITTED TO ESA ONTARIO, 2008-2017

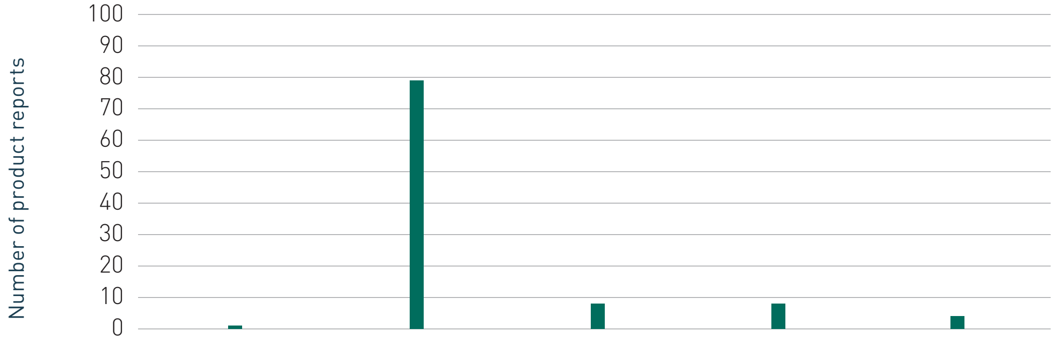


Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Number of product reports	475	679	817	1601	1220	564	316	423	432	468

Source: ESA records.

Conclusion
Since 2008, the number of product incident reports has decreased by **1.5%**. Compared to the previous year of 2016, the number of reports for 2017 has increased by **108%**.

2 NUMBER OF PRODUCT INCIDENT REPORTS BY PRIORITY LEVEL IN ONTARIO, 2017

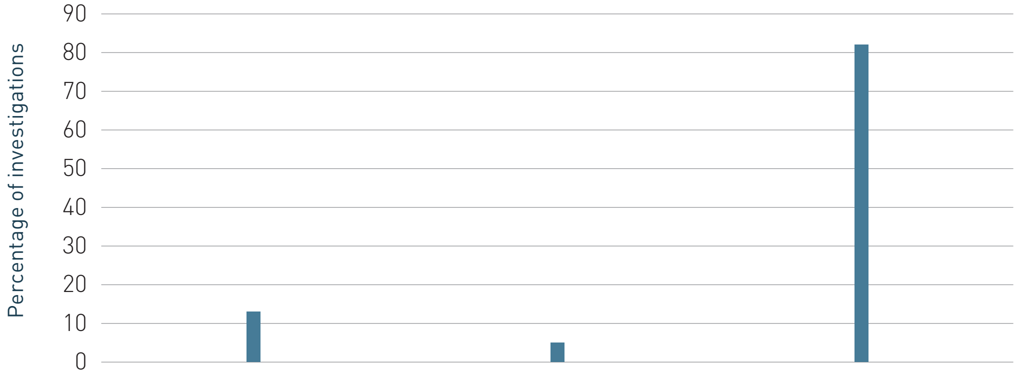


	Priority 1 (most important)	Priority 2	Priority 3	Priority 4 (least important)	Triaged By Health Canada
Number of product reports	1	79	8	8	4

Source: ESA records.

Conclusion
In 2017, **80%** of electrical incident reports to the ESA were classified as priority level 1 or level 2.

3 PERCENTAGE OF PRODUCT INCIDENT REPORTS BY TYPE IN ONTARIO, 2017



Investigation Type	Certified	With suspected counterfeit label	Unapproved
Percentage of product reports	13%	5%	82%

Source: ESA records.

Conclusion
In 2016, **82%** of electrical incident reports were from unapproved electrical products.

5.1 A Serious Injury and Fatality as a Result of Unsafe Use of Electrical Equipment to Pattern Wood and Other Materials

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

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

- ESA is aware of two incidents in Ontario involving these generators that were used in an unsafe manner:
  - One incident resulted in a fatality
  - One incident resulted in life threatening critical injuries
- All of these generators, whether homemade or purchased, are unapproved by Certification Bodies / Inspection Bodies, have not been evaluated or tested to any Canadian safety standards and do not bear any recognized Canadian electrical safety certification marks.
- These generators are reportedly homemade, using instructions on the internet, and are assembled with parts and components that are obtained from a variety of sources and are not approved for this type of use.
- Some of these generators are marketed as complete products and indicate that they are built with approved / certified components. However, the overall product has not been evaluated to any known electrical safety standard(s) for this type of product, as applicable to Canadian consumers and marketplace.

  The risks associated with building and using a Lichtenberg Generator include:

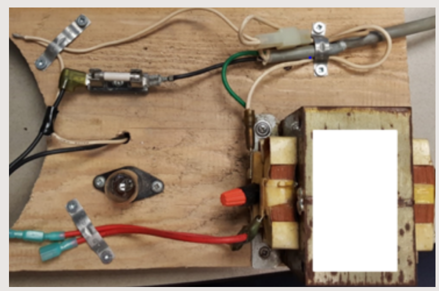
  - Potentially unsafe construction and assembly methods
  - Both short and long term degradation of the product and components
  - Physiological effects of exposure to high voltage / high frequency energy sources
  - Lack of quality control processes and procedures
  - Inadequate instructions pertaining to usage, storage, maintenance, required type(s) of personal protective equipment, etc.

Critical Hand Injury:

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

Examples of Homemade Lichtenberg Generators:

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



How To Report Unsafe Electrical Products:

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

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

Acknowledgements

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

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 ESA on stove-top fire initiatives, and notifying ESA of electrical fire incidents.

ESA also thanks the following organizations for their support:

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

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

Methodology

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

Electrical Safety Authority's Data

ESA uses Ontario population estimates from Ontario Ministry of Finance (Historical and projected population for Ontario under three scenarios, 2006-2041, Part A: Estimates) to determine electrocution and death by fire as rate per population, and Statistics Canada labour force population estimates (CANSIM, table 282-0002) to determine occupational injury rates.

The 2008 to 2017 electrocution statistics are based on Ontario Coroners' reports, ESA records and MOL reports. At time of writing, OFMEM fire fatality information is only partially completed due to pending investigations and confirmations.

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

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

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

Workplace Safety Insurance Board Data

The WSIB defines lost time injuries (LTIs) as all allowed claims by workers who have lost wages as a result of a temporary or permanent impairment. LTIs counts include fatalities. This data is provided by WSIB Enterprise Information Warehouse, data as of August 8, 2018 for all injury years.

Allowed lost time injuries 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.
- 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 ESA as of September 5th, 2017. 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 2017 is unavailable and data for 2016 is presented instead. The number of fire incidents and fire fatalities are current as of June 27th, 2018, 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 do not include those on Federal or First Nations properties, nor fire deaths in vehicle accidents.

ESA reports fire incidents based on data provided by the OFMEM to 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"
- fire incidents and fire fatalities investigated by OFMEM where the ignition source was reported as "electrical distribution equipment" or the fuel of the ignition source was reported as "electricity"

In addition, 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. 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 OFMEM, electricity was not the primary fuel associated with the fire. These situations are illustrated below.

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

1. Fires caused by the ignition of combustibles (liquid and solids) around an electrical device, equipment, appliance or installation, but were not the direct result of a failure of electrical equipment or devices or 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 label these fires as cooking fires rather than electrical fires. In addition, the OFMEM does not recommend using numbers of fire deaths to identify trend and key issues.

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

   - grease fires on an electrical stove top as a result of cooking left unattended;
   - clothing catching fire while cooking;
   - clothes dryer catching fire caused by the appliance overheating due to improper cleaning of the lint cache; and,
   - combustible 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, ESA displays data as it is calculated by 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***, ESA uses OFMEM's method of categorizing types of ignition source class. By 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 cord, termination, electrical panel, cord 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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