

REDUCING RESIDENTIAL STOVETOP FIRES IN ONTARIO

August 26, 2009

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1. Executive Summary

In the last decade, cooking equipment was identified by the Office of the Fire Marshal's (OFM) fire loss reporting system as the number one ignition source, accounting for one in four preventable home fires in Ontario. It was also the leading reported ignition source attributed to home fire injuries and the second leading ignition source attributed to home fire deaths. Recognizing this, the Ontario Fire Marshal's Public Fire Safety Council established the Stovetop Technical Subcommittee to examine stovetop fires and to develop and implement stovetop fire prevention strategies.

Electric powered ranges are currently used in nearly 91% of all households. The remaining households use ranges that are fuelled predominantly by natural gas. Electric ranges can be further subdivided into two main categories, namely those equipped with conventional coil elements and smoothtop models. Although coil ranges are found in the vast majority of homes, smoothtop ranges have been gaining significant market share in recent years.

To gain further insight into the nature of stovetop fires, the OFM developed the Ontario Stovetop Fire Survey. This survey was distributed to fire departments to gather information on all stovetop fires they attended within a one-year period. An analysis of the survey results generated the following key findings:

- Unattended cooking accounted for 69% of the fires.
- "Distracted/forgot" was the leading reason given on why cooking was left unattended, accounting for 51% of the fires.
- Oil and grease was the object first ignited in half of the fires.
- Sixty-one per cent (61%) of the fires did not spread beyond the stovetop.
- Forty-six per cent (46%) of the fires were extinguished by the occupant.
- Occupants who attempted to extinguish the fire were 67% more likely to be injured.
- Stovetop fire incident rates in multi-unit buildings were more than two times higher than in detached dwellings.
- Stovetop fire incident rates in subsidized residential dwellings were three times higher than in non-subsidized residential dwellings.
- The number of stovetop fires peak at 5:00 p.m. Most fatal stovetop fires occur between 11:00 p.m. and 6:00 a.m.
- The 20-29 years age group accounted for the highest fire incident rate.

An analysis of stovetop fire fatalities from 1995 to 2004 resulted in the following key findings:

- Seniors (age 65+) represented 41% of stovetop fatalities.

- Seniors are much more likely to die as a result of clothing ignition when compared to adults (age 16 to 65). Sixty-nine per cent (69%) of senior deaths involved clothing ignition compared to only five per cent of adult deaths.
- Adult fatal stovetop fires involve alcohol more than half of the time.

Various stovetop fire mitigation technologies have been introduced in recent years to provide an alternative approach to reducing stovetop fires. In 2001, the consultant, Arthur D. Little conducted an evaluation of 22 different technology classes that were available at that time. The study concluded that the following technology categories had the highest potential:

- Detect and Extinguish Surface Cooking Fires
- Prevent Unattended Cooking, Warning and Control (motion sensors, power level sensors, timer)
- Prevent Food Ignition in Pan

The aforementioned technology categories are generally consistent with the strategies derived from the NFPA's Fire Safety Concepts Tree analysis, which is a useful tool for evaluating how an overall objective such as mitigating stovetop fires can be achieved. Applying this tool to stovetop fires identified the following as being potentially effective strategies for preventing or managing these fires:

- Prevent stovetop fires by controlling the element's heat output;
- Prevent stovetop fires by controlling the interaction between element and fuel (public education);
- Prevent stovetop fires by eliminating or controlling the fuel (public education);
- Manage stovetop fires by detecting and extinguishing it at an early stage; and,
- Manage stovetop fires by containing the fire to the cooking area and protecting nearby combustible exposures.

As part of the subcommittee's work, the OFM conducted demonstrations regarding possible ignition scenarios using an electric coil range versus a smoothtop range. It was determined that smoothtops had a distinct advantage over coil elements with respect to mitigating clothing ignition through direct contact with the element set at "maximum" power. However, no significant difference between the two could be established with respect to preventing oil ignition in an unattended cooking scenario. Demonstrations also revealed that clothing ignition can occur at power settings just below "maximum" levels for both range types.

A literature review on the cost of deaths and injuries in combination with recent fire loss statistics revealed that stovetop fires cost Ontarians an estimated \$48 million annually.

The following key recommendations are presented to reduce fatalities and serious injuries that originate from stovetop fires in Ontario:

1. Provide information to homeowners/building managers to raise their awareness of stovetop fire mitigation technologies and encourage them to retrofit their existing appliances with these products. .
2. Work collaboratively with cooking appliance manufacturers to reduce the number of cooking fires.
3. Request standards development organizations to incorporate performance requirements into their range construction standards to address the prevention of stovetop fires.
4. Interact with the insurance industry to provide financial incentives to homeowners that voluntarily take action to mitigate residential cooking fire incidents.
5. Target high-risk/high impact populations for public education, installing stovetop fire mitigation technologies, and protecting combustible cabinetry adjacent to the range with fire resistant materials.
6. Direct public education efforts toward high-risk/high impact populations with appropriate cooking safety messages.

2. Introduction

In the last decade, cooking equipment ¹ was identified by the Office of the Fire Marshal's (OFM) fire loss reporting system as the number one ignition source, accounting for one in four preventable home fires in Ontario. It was also the leading reported ignition source attributed to home fire injuries and the second leading ignition source attributed to home fire deaths. Fires that originate on the stovetop are of primary concern as they account for the vast majority of all cooking equipment fires. This theme is generally consistent throughout other parts of Canada as well as in other countries around the world.

In recognition of these concerns, the Ontario Fire Marshal's Public Fire Safety Council established the Stovetop Technical Subcommittee to gain a better understanding of the stovetop fire problem. The Stovetop Technical Subcommittee consists of representatives from the fire service, Electrical Safety Authority (ESA), Canadian Standards Association (CSA), Underwriters Laboratories Canada (ULC), Health Canada, Canadian Appliance Manufacturers Association (CAMA), along with the Office of the Fire Marshal (OFM).

To gain further insight into the nature and extent of stovetop fires, the Subcommittee gathered information to address the following questions:

- Historically, how significant a problem have stovetop fires been in Ontario, Canada and other countries?

- Where and when do most stovetop fires occur?
- Who are the high-risk populations involved in stovetop fires?
- What occupant behavioural factors lead to stovetop fires?
- How do occupants react when stovetop fires occur?
- What factors contribute to stovetop fire spread?
- What technologies are currently available for mitigating stovetop fires?
- How much do stovetop fires cost society with respect to property and casualty losses?
- What are the most effective strategies to prevent and deal with stovetop fires?

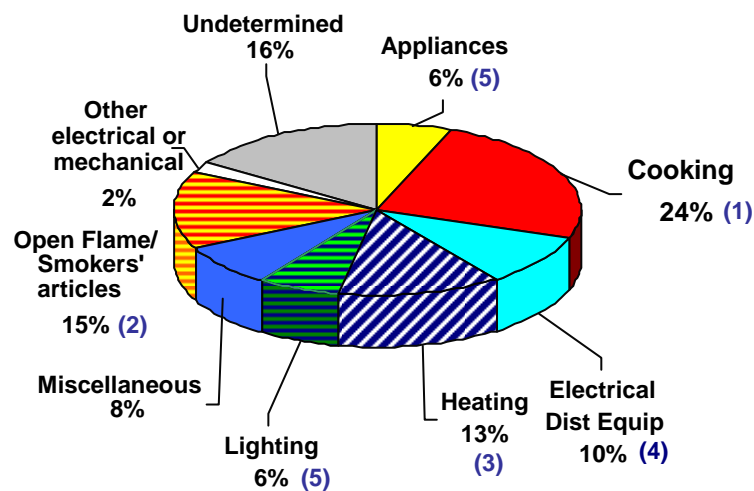
The Stovetop Technical Subcommittee agreed that a thorough understanding of the stovetop fire problem would better assist them with the development and implementation of effective prevention strategies.

3. Cooking Fire Loss Statistics

3.1. Ontario

A review of fire losses for the 10-year period between 1998 and 2007 revealed that Ontario averaged approximately 6,046 preventable home fires annually.² During this period, cooking equipment was identified as the leading ignition source attributed to preventable home fires, averaging 1,494 cooking equipment fires annually or 24% of all preventable home fires.

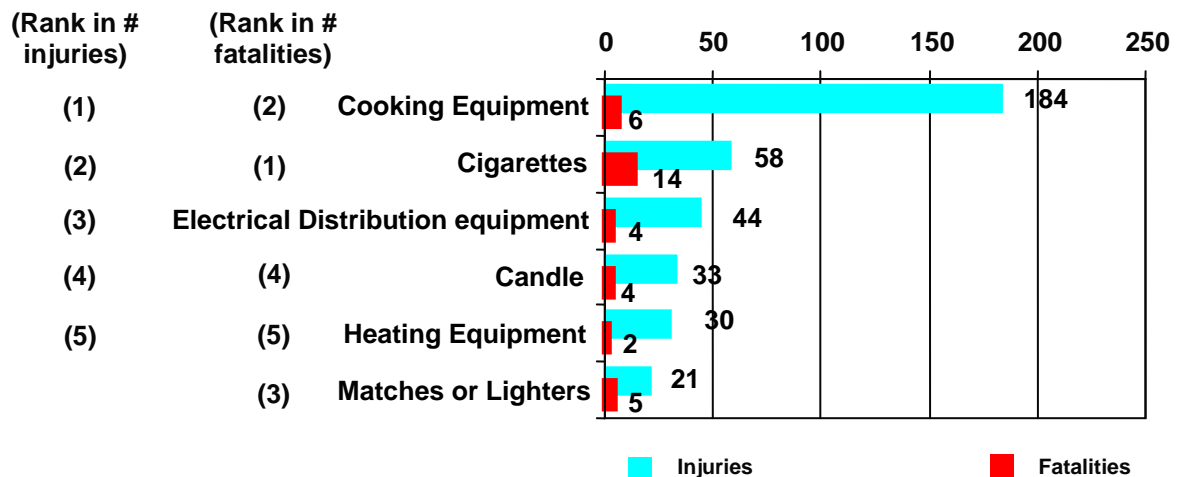
**Figure 1: Preventable Residential Fires-Ignition Source
1998 to 2007**



The OFM fire loss reporting system identified cooking equipment as the leading ignition source associated with preventable home injuries, accounting

for an annual average of 184 injuries between 2003 and 2007. With an annual average of six fatalities, cooking equipment was the second leading ignition source associated with preventable residential fire fatalities during this five-year period. These fires resulted in an average loss of \$23.1 million annually.

**Figure 2:
Ontario Preventable Residential Fires 2003 to 2007 -
Average # of Injuries and Fatalities per year**



Preventable home fires—fires in residential properties that have NOT been deliberately started

The vast majority of cooking equipment related fire losses originated on the stovetop. Between 1998 and 2007, 74% of total cooking related fires were attributed to stovetops. In the five-year period between 2003 and 2007, Ontario averaged 986 stovetop related fires that resulted in five deaths, 155 injuries and \$17.6 million in property losses annually. Nearly 47% of cooking related deaths were attributed to the ignition of clothing.

There has been much progress made in the reduction of stovetop fires in the last decade as occurrences have declined 32% over this period. Despite this, it is recognized that stovetops are still the leading factor associated with preventable, residential fires and there is considerable room for improvement.

3.2. Beyond Ontario

Although the preceding statistical analysis relates only to the Province of Ontario, clearly the cooking fire problem extends well beyond provincial boundaries. It exists throughout Canada as well as in all other countries that use cooking appliances. In other words, losses due to cooking fires is a global problem. The following is a synopsis of the stovetop fire problem experienced in other jurisdictions.

Canada

The following table summarizes recently reported cooking equipment related fire losses within Canada. These totals were compiled from the latest “Fire Losses in Canada” annual reports published by the Council of Canadian Fire Marshals and Fire Commissioners.³ The number in parenthesis represents cooking equipment as an overall percentage of all ignition sources.

Table 1: Canadian Fire Losses Attributed to Cooking Equipment

Year	No. of Fires	Injuries	Deaths	Dollar Loss
1998	6,230 (10.8%)	603 (22.4%)	31 (9.2%)	\$69.9 M (5.9%)
1999	6,143 (11.1%)	493 (21.6%)	34 (8.8%)	\$76.1 M (6.2%)
2000	5,527 (10.3%)	510 (20.5%)	32 (9.8%)	\$69.2 M (5.8%)
2001	5,625 (10.2%)	492 (21.3%)	41 (12.1%)	\$87.7 M (6.2%)
2002	5,541 (10.3%)	557 (21.9%)	17 (5.6%)	\$81.7 M (5.5%)
Average	5,813 (10.5%)	531 (21.5%)	31 (9.1%)	76.9 M (5.9%)
Overall Rank	2	2	2	4

In comparison to other ignition sources, cooking equipment is the second leading cause of fires, injuries and deaths behind “smokers material and open flame” and the fourth leading cause of dollar losses in Canada.

It is noteworthy that these totals represent all cooking equipment related fires, including those that occurred in non-residential buildings. Residential fire loss data sorted by ignition source are unavailable at the federal level. However, a survey of various provinces in Canada indicates that approximately 90% of all cooking fires originate in the home.^{2,4} Due to the inclusion of non-residential data, the actual totals for residential fire losses are expected to be slightly less than those in Table 1. However, the overall loss percentages would be significantly higher by excluding non-residential data.

United States

According to the American-based National Fire Protection Association’s (NFPA) study, “Home Fires Involving Cooking Equipment”, cooking equipment was involved in an estimated 146,000 “reported” U.S. home structure fires in 2005, accounting for 40% of total home fires.⁵

These fires resulted in an estimated 4,690 civilian injuries, 480 civilian deaths, and \$876 million in property losses. In addition, the report estimated that

cooking fires accounted for another 12.3 million “unreported” home fires annually, which represents 55.3% of all unreported fires. Although the vast majority of these “unreported” fires resulted in no dollar loss, the study estimated that this translated into an additional 642,000 injury cases per year. This estimate represents 140 times the number of reported home cooking related injuries. While this research is based on an estimate of the differences between reported and unreported fires, it can be used as an indicator of how large the problem is.

In 1999, the U.S. began compiling statistics on the numbers of cooking fires that remained confined to the pan through the use of a new fire statistics reporting form (NFIRS 5.0). Between 1999 and 2005 an average of 71% of total cooking fires were reported to have been confined to the pan. These confined fires accounted for 32% of total cooking related injuries, 4.4% of direct property loss and 0% of deaths.

Table 2: U.S. Reported Home Cooking Structure Fires

Year	No. of Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage as Reported
1999	84,100 (37,400)	310 (310)	2,600 (1,710)	\$512 M (\$484 M)
2000	69,800 (22,300)	240 (240)	3,020 (2,040)	\$521 M (\$479 M)
2001	121,200 (38,900)	500 (500)	4,400 (2,930)	\$531 M (\$508 M)
2002	206,800 (61,400)	150 (150)	4,900 (3,340)	\$680 M (\$653 M)
2003	143,600 (35,900)	520 (520)	4,480 (3,080)	\$770 M (\$740 M)
2004	150,600 (36,100)	620 (620)	4,820 (3,310)	\$725 M (\$699 M)
2005	146,400 (37,600)	480 (480)	4,690 (3,300)	\$876 M (\$845 M)
Average	131,785 (38,514)	403 (403)	4,130 (2,816)	\$659 M (\$630 M)

Note: Numbers in parentheses exclude confined fires. Confined fires are reported as confined to a cooking vessel and involving cooking equipment.

The cooking range was involved in 68% of all home cooking fires. The number one factor contributing to these fires is “equipment unattended”, which represents 38% of home cooking fires. In another study conducted by the U.S. Consumer Products Safety Commission (CPSC), involving follow-up investigations of range fires attended by the fire service, it was determined that 58% of range related fires started in unattended situations.⁶ This figure is more in line with what is currently being experienced in Ontario.

Finally, the aforementioned NFPA study concluded that households using electric ranges have higher rates of fire incidents (47%), civilian injuries (118%) and direct property damage (133%) when compared to those that use gas ranges. On the other hand, gas ranges are riskier when it comes to civilian deaths (15%).

United Kingdom

According to a 2004 report published by the United Kingdom Office of the Deputy Prime Minister, cooking appliances is the leading ignition source responsible for accidental dwelling fires.⁷ During that year, this ignition source accounted for 57% (27,200) of all accidental dwelling fires and resulted in 54% (5,377) of injuries and 16% (52) of deaths. “Chip/fat pan fires” is one of the causes tracked in the U.K. fire loss reporting system. This category accounted for 15% (7,400) of accidental dwelling fires that resulted in 26% (2614) of the injuries and 10% (32) of the fatalities.

New Zealand

According to the New Zealand Fire Service, in 2005, the country experienced 912 residential cooking equipment fires, which represents 21% of total fires reported in the home.⁸ “Stove, cook top unit, range top” were involved in 72% of cooking equipment fires.

In another study conducted by the New Zealand Fire Service Commission, between 1991 and 1997, 14% of unintentional domestic fire deaths were linked to a stovetop or an oven.⁹ The vast majority (93%) of these fatalities were attributed to the ignition of food that was left on the stovetop. The number of fatal fire incidents caused by abandoned cooking materials has been relatively constant over time.

4. Residential Ranges in Canada

4.1. Range Types

According to 2006 market data provided by CAMA cooking ranges can be found in 99% of the 12.7 million households across Canada.¹⁰ Electric powered stovetops are predominantly used in these households, accounting for 91.1% market saturation of households, whereas natural gas fuelled stovetops account for approximately 8%. Ontario’s market data is similar with a household saturation rate of 86.9% for electric range versus 12.3% for gas ranges.

Electric stovetops are divided into two categories: those equipped with conventional electric coil heating elements and the more recently introduced smoothtop (also called “ceran” top) models. Although coil ranges are generally

found in the vast majority of homes, the smoothtop ranges have been gaining significant market share in recent years. According to 2008 CAMA data, electric smoothtop ranges accounted for 57% of total sales of ranges in Canada. Electric coil and gas ranges accounted for 34% and 9% of total sales respectively.

4.2. Residential Range Standards

The Canadian Electrical Code (CEC) requires that electric-powered ranges for domestic use in Canada meet the construction requirements of the standard CAN/CSA-C22.2, No. 61-Household Cooking Ranges.

The Ontario Technical Standards Safety Act requires that domestic gas powered ranges be approved to an appropriate construction standard applicable to such an appliance. The ANSI Z21.1-Household Cooking Gas Appliances standard is one commonly used by natural gas-fuelled range manufacturers.

4.3. The Nature of Stovetop Fires

The stovetop is designed such that the elements operate at the selected temperature to heat the cookware, which in turn cooks the food.

Demonstrations undertaken by the OFM have shown that electric coil elements can reach temperatures in excess of 700 C, whereas smoothtops attain a lower cooking surface temperature of approximately 500 C.²⁸ Natural gas elements can produce an open flame that reaches a temperature of nearly 600 C.

These element temperatures can far exceed the ignition temperature of household materials typically found around the kitchen. When these materials are heated beyond their respective ignition temperatures or inadvertently come in contact with a hot element, ignition occurs.

Table 3: Typical Household Materials and Ignition Temperatures^{11,12,13,14}

Typical Materials	Ignition Temperatures (C)
Cooking oils (corn, olive, cotton seed, palm, peanut, soybean)	316-445
Natural Cellulosic Fibers (cotton, hemp, jute, linen, sisal, etc.)	255-400
Natural Protein Fibers (wool, mohair, cashmere, camel hair, etc.)	570-600
Plastics	416-580
Rubber	260-316
Paper	218-246
Various woods	190-260

Incidents involving the ignition of oil, grease and other food items represent the vast majority of cooking fire scenarios. The aforementioned U.S. Consumer Products Safety Commission range fires study estimated that in cooking oil and other food ignition scenarios, two-thirds of these incidents occurred within the first 15 minutes of cooking. The oil ignition time can be further reduced when reused cooking oils are involved. Heating reused oil leads to degradation and an increase in the free fatty acid content and results in a reduction in its smoke, fire and ignition temperatures. Therefore the more the oil is reused, the greater the fire risk.

4.4. Coil versus Smoothtop Ranges

Electric stovetop oil ignition demonstrations undertaken by the OFM have shown that ignition times vary based on a number of parameters including oil volume.³⁰ In a demonstration involving 50mL of oil in a frypan heated at the “maximum” power setting, ignition occurred in less than four minutes. Ignition times involving larger quantities of oil (250 and 500mL) heated in appropriate sized pots ranged from 10 to 16 minutes. A relative comparison between coil and smoothtop ranges revealed that there were no significant differences in oil ignition times between the two types of stovetops. It should be recognized that these ignition times may vary depending on the pan material, thickness, design and ambient conditions.

A separate demonstration involving the ignition of clothing materials (cotton, polyester and cotton/polyester blend) through direct contact with the elements was also conducted.³⁰ It was determined that the coil elements at the

“maximum” setting ignited the material samples immediately upon contact. In contrast, it took the smoothtop elements several seconds to ignite the cotton and cotton/polyester blend materials. The smoothtop was unable to ignite the polyester material within the demonstration’s 30-second time parameters.

Further demonstrations were conducted to study how elements set below their “maximum” settings impact the ignition of cotton and cotton/polyester blend materials.²⁸ It was revealed that the materials ignited within 30 seconds with the coil element set at Levels 7 and 8 (out of nine settings). Similarly, the materials ignited within 30 seconds with the smoothtop element, set at Level 6 (out of seven settings).

Although a smoothtop element will not necessarily prevent the ignition of clothing that comes in contact with it, the additional ignition lag time it has over a coil element provides the user with a window of opportunity to either complete the task at hand (i.e. reaching over an element) or recognize/react to the situation to prevent ignition.

5. 2005-2006 Ontario Stovetop Fire Survey

The Ontario Stovetop Fire Survey was developed by the OFM in consultation with industry stakeholders to gain further insight into the nature and extent of stovetop fires. The survey posed questions on residence information, stove/element details, extent of fire spread, type of cooking, and details relating to occupant characteristics and behaviour. A copy of the survey is provided in Appendix B.

This survey was distributed to fire departments throughout the province for completion. Fire department suppression staff were requested to complete the survey for every residential stovetop fire they responded to for a one year period between August 1, 2005 to July 31, 2006.

At the end of this period, 1,244 surveys were completed by the fire service. Fire losses reported included 205 injuries, one death and \$10.2 million in property damage. Although the response rate was high, these numbers do not represent all stovetop fires that occurred in Ontario during this period.

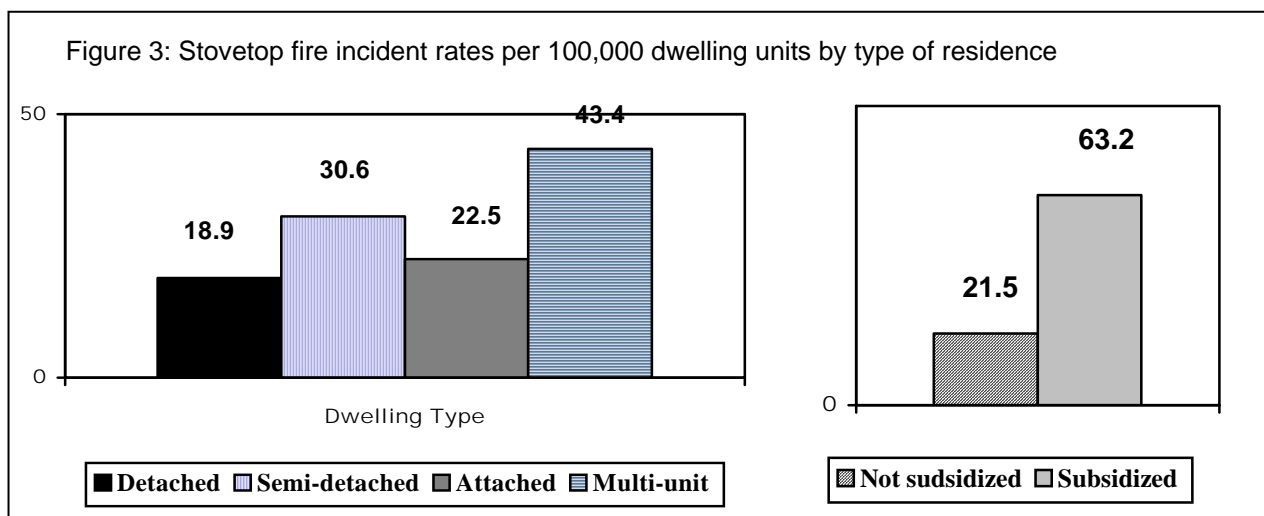
5.1. Key Survey Findings

The following are the key findings obtained through the analysis of this data:

- In 69% of the fires, fire departments reported that cooking left unattended was the key factor contributing to the ignition or spread of fire.
- “Distracted/forgot” was the leading reason why cooking was left unattended, accounting for 51% of the fires.

- Oil or grease was the object first ignited in 50% of the fires while other food items were responsible for igniting an additional 28% of fires.
- Sixty one per cent (61%) of fires did not spread beyond the stovetop, 32% of fires spread into the kitchen, and five per cent (5%) spread beyond the kitchen.
- Forty-six per cent (46%) of the fires were extinguished by the occupant, 21% self extinguished, 25% were extinguished by the fire department, 0.2% (two fires) were extinguished by an automatic system.
- Occupants who attempted to extinguish the fire were twice as likely to be injured.
- The incident rate of stovetop fires in multi-unit dwellings was over twice the rate of those in detached dwellings.
- The average dollar loss in detached dwellings was reported at \$12,588 compared to \$3,670 in multi-unit dwellings.
- The incidence rate of stovetop fires in subsidized dwellings was almost three times higher than that of non-subsidized dwellings.

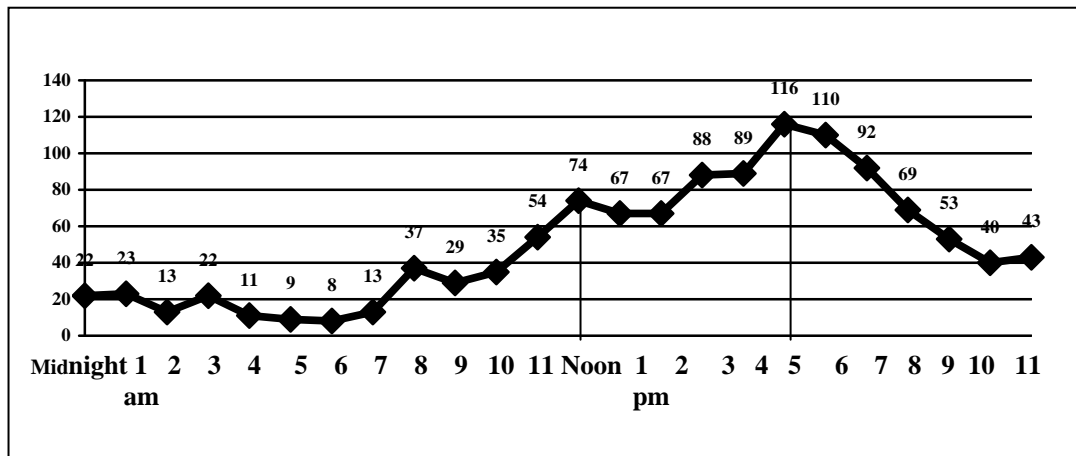
5.2. Where Fires Occur: Type of Residence



5.3. When Fires Occur

- Stovetop fire incidents peak at 5:00 p.m. Fatal fire data for prior years indicate that there are more cooking related fatalities in fires that start later in the evening or at night. Fifty-two per cent (52%) of fatal stovetop fires (1995-2004) occurred between 11:00 p.m. and 6:00 a.m.

Figure 4: Stovetop fires by time of day



- Although there is a slightly lower proportion of stovetop fires in the summer months, it is marginal, and likely reflects activities taking occupants away from the stovetop (e.g. vacation) rather than a significant change in cooking behaviour (e.g. cooking out of doors).

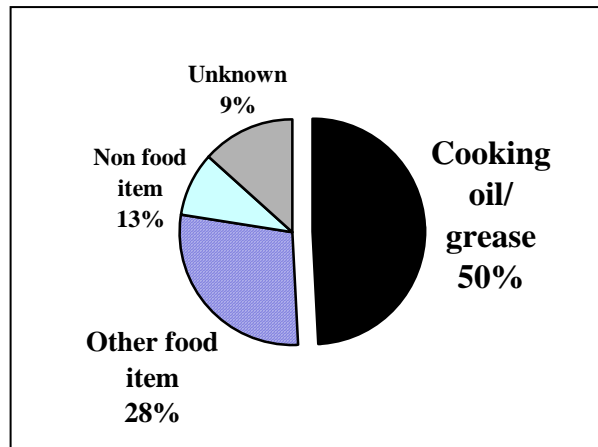
5.4. Equipment Involved

- While human behaviour is the key factor in preventable fires, the fact that stovetops in homes can heat cooking oil to its ignition temperature and beyond is a significant factor.
- The survey results showed that only five per cent (5%) of gas stoves are involved in fires although they represent 12% of the stoves in use.
- Twenty-one per cent (21%) of users of electric coil stoves were reported as “unaware of the risk” compared to eight per cent (8%) of gas stove users and 31% of electric glass top stove users.
- Consumer trends show increased purchasing of smooth top electric stoves - 57% in 2008. These are currently involved in six per cent (6%) of reported fires. This may be a positive trend as these stoves do not heat to as high a temperature as standard stovetops (electric coil or gas). However, like all stoves, these stoves heat above oil ignition temperatures.
- Future trends in consumer purchases are toward burner controls on the front of the appliance. This may have the potential benefit of reducing the risk of loose clothing catching fire when a person reaches for the controls. While this design may increase accessibility of the controls to children, the survey results show less than one per cent (1%) of the fires were started by children playing around the stove.
- The front burners were reported as igniting more fires than rear burners.
- To assess the extent of a situation identified in fatal cooking fires, the survey specifically asked whether the victim was attempting to reach a

control in situations where wearing apparel was ignited. There were only two cases of clothing ignited, neither of which reported that the victim was reaching for the burner controls at the time of ignition.

5.5. What is ignited?

Figure 5: Object first ignited



- Cooking oil or grease was the object first ignited in half of the fires. Of the non-food items, plastic items accounted for five per cent (5%) of the objects ignited, pots/pans or kettle left on the burner two per cent (2%) and paper items two per cent (2%).
- In 63% of the fires no secondary item was ignited, and in 27% of the fires the cabinetry ignited from the stovetop fire.

5.6. Type of Cooking

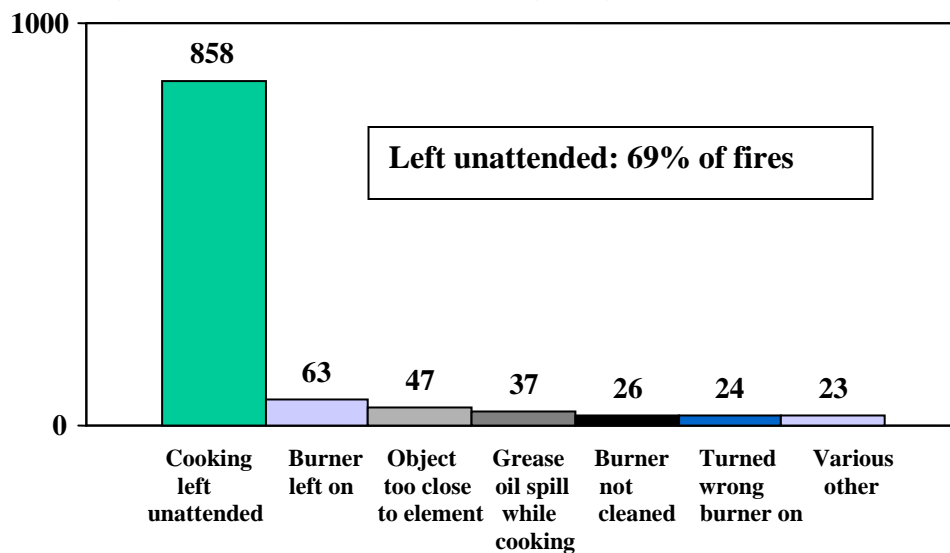
- Oil heated to ignition as a result of unattended deep fat frying has been reported as a cause of fatal fires. The types of cooking in most stovetop fires were:
 - 27%-pan frying
 - 23%-deep fat frying and
 - 23%-simmering in pot (e.g. soup, sauces, etc.)
- In 86% of the fires the object first ignited was on the burner. In 44% of the fires, the igniting burner was set on High, 13% on Medium, two per cent (2%) on Low, 38% Unknown and three per cent (3%) not reported.
- In boiling water fires, the key spread factor was reported as cooking left unattended, but other factors reported were wrong burner turned on or burner left on, grease or cooking spills that were not cleaned up and objects on the stovetop too close to the element.

- In addition to the cooking responses, seven per cent (7%) of fires were reported where no cooking was occurring (e.g. burner left on, no pot on stove, non-cooking items on stove, wrong burner turned on or burner left on). Where no cooking was occurring, fire departments reported that objects were placed too close to the element, burner was left on after cooking and in two cases, there was a power outage while the stove was in use and the burner came on when the power was restored.

5.7. Human behaviour

The survey asked the fire department to report the key factor contributing to the ignition or spread of fire.

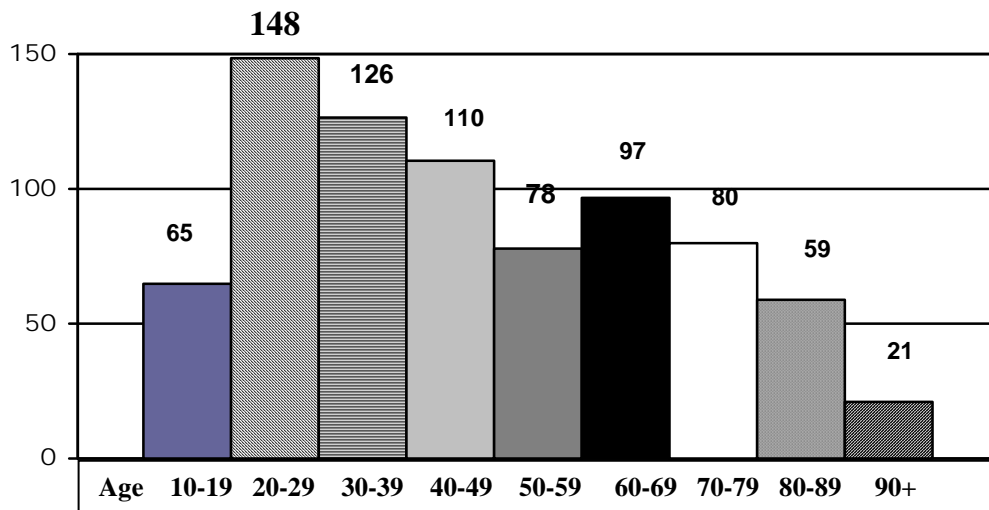
Figure 6: Key factor contributing to ignition or spread of fire



- In the 858 cases where cooking was left unattended, 54% of the persons responsible for the cooking were in another room at the time of the fire, nine per cent (9%) were outside but on the premises, seven per cent (7%) were in the kitchen and 20% were away from home.
- In almost 50% of the cases where the person was away from home, the fire department reported that the type of cooking was simmering, while 18% had been boiling water. In an additional 13% of cases, the fire department reported that the burner had been left on after cooking. Although the cook was reported to be away from home, most of these fires did not spread-82% of the fires were confined to the stove and 31% of these fires self-extinguished. Typically, neighbours either smelled smoke or heard a smoke alarm and contacted the fire department. Forty-three per cent (43%) of these fires were extinguished by the fire department.

- Fire departments were asked to provide information on the person cooking at the time of the fire (e.g., their age, gender, where they were at the time of the fire and the physical condition at the time of the fire).

Figure 7: Fires per million population by age group

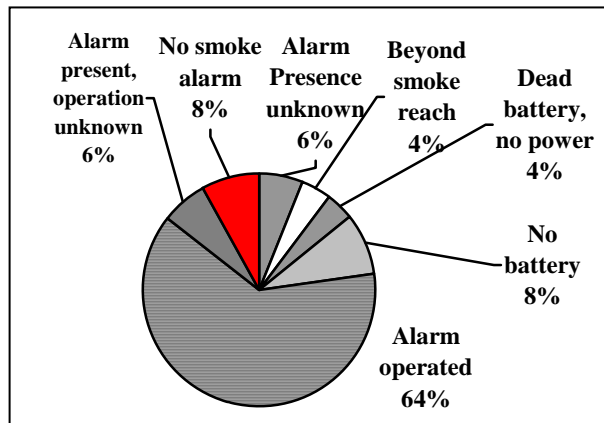


- The highest incidence of stovetop fires per million population occur in 20 to 29 years age group. Fifty-nine per cent (59%) of the cooks were female and 39% were male.
- The most common conditions or behaviours reported as possible factors in the fire were:
 - 51%-distracted/forgot
 - 21%-unaware of hazard
 - 10%-person asleep
 - 5%-possible impairment, alcohol (1% possible impairment, drugs)

5.8. How was the occupant first alerted to the fire?

- In 30% of the fires, the occupants were alerted by seeing fire or smoke.
- In 16% of the fires, the occupants were alerted by smelling smoke.
- In 25% of the fires, the occupants were alerted by the activation of the smoke alarm.
- In 20% of the fires, the occupants were not alerted to the fire (e.g. occupant away from home, neighbours alerted, fire department arrived or fire had self extinguished).
- The smoke alarm operated in 64% of the fires.

Figure 8: Smoke alarm presence and operation in stovetop fires.



- An issue of particular concern is the removal of batteries due to nuisance alarms. Where there was no battery, the survey included a question on whether the smoke alarm had been removed due to nuisance alarms. In eight per cent (8%) of the fires there was no battery in the smoke alarm. In one quarter of these or two per cent (2%) of all surveys, the occupant said they had removed the battery due to nuisance alarms.

5.9. Action taken by Occupant and Injuries

- In 61% of the fires the occupant(s) attempted to extinguish the fire. In 70% of these fires, the occupant succeeded in extinguishing it, 14% of the fires self extinguished, and 11% were put out by the fire department.
- No attempt to extinguish the fire resulted in 12 injuries per 100 fires. Attempting to extinguish the fire resulted in significantly higher injury rates as outlined in the table below.

Table 4: Occupants who attempted to extinguish the fire:
Method and Injury Rate

Occupant method of extinguishment	Injury Rate (per 100 fires)	% Using method of extinguishment
smothered with lid, chemical, or cloth	13	27
moved pot	30	19
water	20	30
fire extinguisher	14	17

5.10. Fatal fires, stovetop ignition:

During the survey period the OFM investigated seven stovetop fire fatalities. Due to this limited sample size, a larger 10-year analysis was performed using OFM investigation reports.

- In Ontario, from 1995 to 2004 there were 91 fatal fires starting on the stovetop resulting in 96 fatalities. Forty-one per cent (41%) of the victims were seniors, 58% were adults and one per cent (1%) were youth under 16.
- Cooking oil or grease was reported in 10% of the fatal fires as the object first ignited. Other flammable liquids were higher at 19%.
- In 69% of the fatal fires claiming the life of a senior, wearing apparel was the first object ignited compared to five per cent (5%) of the adult fire fatalities.
- In fatal stovetop fires where an adult under 65 died, 53% of the fatalities were alcohol impaired at the time of the fire.

5.11. Survey Summary

Most stovetop fires are preventable as they are almost always caused by human behaviour. The impacts of stovetop fires range from minor inconvenience to injury and even death. The fatality rate per 1,000 fires is lower than other residential fires, but the injury rate is significantly higher.

There are specific population groups that are at greater risk. The incident rate of stovetop fires is highest in the 20 to 30 years age group, while the risk of fatality is greatest among older adults (65 years +).

Injuries, deaths and losses resulting from stovetop fires can be reduced through effective public education that targets these populations, and raises awareness about safe cooking practices.

6. Fire Safety Concepts Tree

The Fire Safety Concepts Tree is a visual tool developed by the NFPA to assist fire safety practitioners (e.g. designers, engineers, code officials) with communicating fire safety and protection concepts.¹⁵ It uses a hierarchical structure to describe how a high-level fire safety objective can be achieved by accomplishing a combination of multiple level sub-objectives.

This is a useful tool for evaluating how an overall objective such as mitigating stovetop fires can be achieved. It can also be effectively used to identify where new stovetop fire mitigation technologies and public education strategies should be directed.

An explanation of the fundamental concepts of the Fire Safety Concepts Tree is provided in Appendix B.

Applying the Fire Safety Concepts Tree to stovetop fires highlights potentially effective strategies for mitigating the stovetop fires problem. This exercise also eliminates certain approaches that are impractical for such an application. In summary, the following strategies are identified as being the most effective options for mitigating stovetop fires:

- Prevent stovetop fires by controlling the element's heat output. This can be achieved by:
 - ensuring the element is not capable of heating cooking material to it's ignition temperature or
 - limiting cooking duration through the elimination of unattended cooking.
- Prevent stovetop fires by controlling the interaction between element and fuel. This can be achieved through enhanced cooking safety related public education programs.
- Prevent stovetop fires by eliminating or controlling the fuel. This can be achieved through enhanced cooking safety related public education programs.
- Manage stovetop fires by detecting and extinguishing the fire at an early stage.
- Manage stovetop fires by containing the fire to the cooking area and protecting nearby combustible exposures.

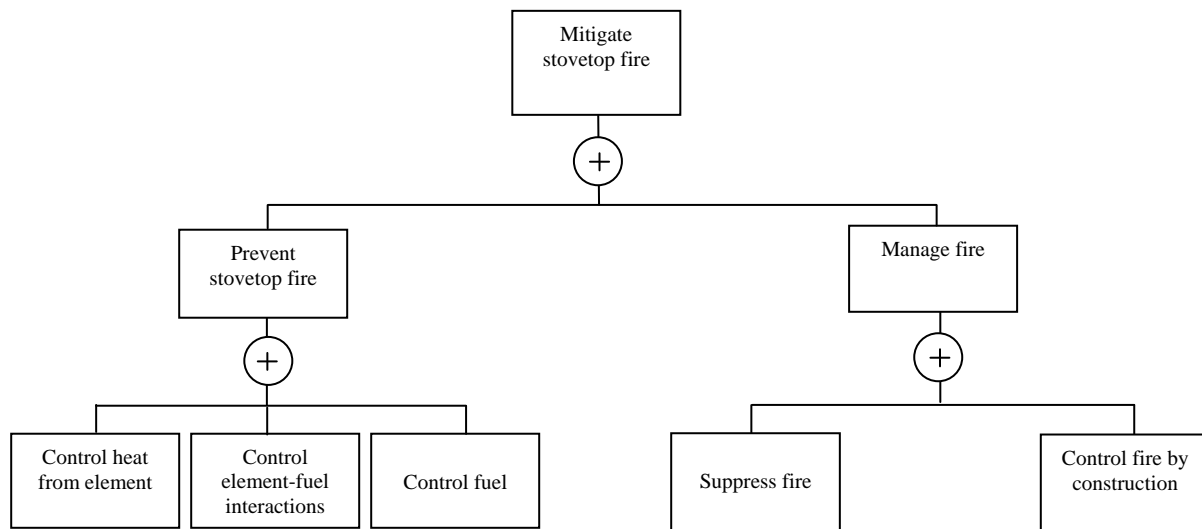


Figure 9: Fire Safety Concepts Tree for Stovetop Fires

7. Stovetop Fire Mitigation Technologies

The Ontario Stovetop Fire Survey results clearly indicate that occupant behaviour plays a significant role with respect to cooking-related fires. Although enhanced public education programs have been effective in reducing losses over the years, it is recognized that it is difficult to reach all high-risk groups and to ensure that everyone within those groups are effectively educated about cooking fire prevention.

The use of new technologies specifically designed to mitigate these types of fires is a potentially effective approach for complementing public education programs. Stovetop fire mitigation technologies effectively “engineer out” the problem irrespective of occupant behaviour.

7.1. History

Since the mid-1990s, the U.S. Consumer Products Safety Commission (CPSC) has sponsored work to study developing technology that has the potential to reduce the risk of stovetop fires. CPSC engaged the National Institute of Standards and Technology (NIST) to conduct early phases of this work.

The CPSC in conjunction with the Association of Home Appliance Manufacturers (AHAM) engaged the consultant Arthur D. Little to conduct a study to evaluate the technical, practical and manufacturing feasibility of 22 classes of range technologies intended to address the ignition of cooking materials. The findings were presented in a May 2001 report, “Technical, Practical and Manufacturing Feasibility of Technologies to Address Surface Cooking Fires”.¹⁶

In the meantime, companies have continued to develop new products to address surface cooking fires. Some of these concepts involve the use of automatic extinguishing systems, fire separations around the stove to contain a fire, motion sensors to prevent unattended cooking and other sensors that monitor and control heat input.

7.2. Technology Evaluation

One of the major areas to consider with any evaluation of mitigation techniques that are tied to the electric range is the average useful life of this appliance. Information provided by the Association of Home Appliance Manufacturers (AHAM) and Natural Resources Canada data show that electric ranges have an average lifespan of approximately 18 to 22 years.^{31,32} Any technical solution built into the range will need to consider the lifespan of the range in order that the safety mechanism not fail before the range’s end of life. The range’s long lifespan also means that it will take many years for any new built-in technology to be fully integrated into homes.

Currently, hundreds of stovetop mitigation technologies are in existence as consumer products or patents. Little evaluated products that utilize these technologies by developing screening criteria that rated the following categories:

- Cooking Performance
 - Effect on cooking process and cooking time
- Cooktop Operability
 - Effect on consumer behaviour
 - Noticeable differences in product features
 - Maintenance requirements
 - Restrictions on cookware
 - Cooktop performance after system actuation
- Reliability/Durability
 - Operate over product life without failure
 - Operate under misuse conditions
- Safety
 - Risk of safety system components to consumer
- Manufacturability/Installation/Service
 - Applicability to different cooktop types
 - Parts availability
 - Ease of installation
 - Ease of serviceability
- Effectiveness in Mitigating Surface Cooking Fires
 - Percentage of cooking fires addressed
 - Percentage of new product sales covered by technology
 - Degree of fire mitigation (prevent, extinguish or warning)
 - Ease of system operation verification
 - Potential for false actuation
 - Effect of system actuation

Numerical scores were totaled based on a rating scale of “High”, “Medium” or “Low” assigned to each category. Technologies that were effective in mitigating surface cooking fires with limited impact on other aspects of the product were earmarked to warrant further detailed evaluation. The following categories of technology were identified as having the highest potential and warranting further detailed study.

7.2.1. Detect and Extinguish Surface Cooking Fires-Fusible Link or Temperature Sensor for Fire Detection

This technology involves detecting the presence of a fire and activating a fire extinguishing system. A fusible link or temperature sensor (thermocouple, diode or thermistor) located above the cooktop activates the extinguishing system. Some systems incorporate a combination of both smoke and temperature sensors to determine the presence of a cooking fire. The extinguishing agent

can be liquid or powder. The system can be combined to include the actuation of an alarm or power source cut-off.

- Advantages:
 - Applicable to all range types
 - No effect on cooking processes, cooking time, consumer behaviour, cooktop features or cookware applicability
 - Proven technology in military housing and commercial applications
- Disadvantages:
 - Does not prevent fire from starting
 - Installation issues over cooktops with integral downdraft ventilation (no hood) and those located on islands or peninsula
 - Owner must contact third party for installation and periodic maintenance
 - Space constraints
 - Lack of “fail safe”-no interconnect to ensure range is shut down if cylinder pressure level is low
 - Messy to clean up if actuated
 - Onus on owner to periodically test and maintain cylinders and electronics batteries

7.2.2. Prevent Unattended Cooking, Warning & Control-Motion Sensors

This technology is intended to ensure that a person is present when the cooktop is being used. It uses a motion sensor located at the front of the appliance to detect the presence of a user nearby. The system sounds an alarm if no one is detected after a defined period of time. The user can reset the stove without any effect on the cooking process. A variation of this concept includes a control component that can reduce the heat input or power off if no one responds to the alarm. Another variation adds a pan contact temperature or power sensor that actuates the motion sensor only when the stove’s power level or pan temperature exceeds a pre-set level. Hence, a person does not have to be present unless the pan temperature is nearing pre-ignition levels.

- Advantages:
 - Designed to prevent fire from occurring
 - Technology can be integrated into range
 - No impact to cooking time if user responds to alarm
 - No effect on cooktop features or cookware applicability
 - Minimal system maintenance required
- Disadvantages:
 - Significant impact on human behaviour may not be acceptable to consumers.
 - Increases cooking time if user does not respond to alarm.
 - Currently there is no existing system that provides an accurate power level sensor for gas stoves.

- Current motion sensor technology has only 10-year product life.
- False readings triggered by pets and children.
- Setting an appropriate time on the timer may present a challenge

7.2.3. Prevent Unattended Cooking, Warning and Control-Power Level Sensor and Timer

This technology is another variation on the previous concept with the exception that it does not use a motion sensor. Instead, an alarm will activate based on the power level selected and a timer that initiates after the stove has been turned on. When the alarm is triggered, the user can reset it to establish user presence around the cooktop or the control will power off.

- Advantages:
 - Similar to previous “Prevent Unattended Cooking” technology.
 - In addition:
 - Timer has longer lifespan than motion sensor.
 - No false readings due to motion sensor.
- Disadvantages:
 - Significant impact on human behaviour may not be acceptable to consumers.
 - Increases cooking time if user does not respond to alarm.
 - Currently there is no existing system that provides an accurate power level sensor for gas stoves.
 - Current motion sensor technology has only 10-year product life.
 - False readings triggered by pets and children.
 - Setting an appropriate time on the timer may present a challenge
 - Nuisance alarms even if user is nearby

7.2.4. Prevent Food Ignition in Pan-Contact Temperature Sensor

This technology was added to Little’s list even though it did not score well in their evaluation due to its incompatibility with electric smoothtop ranges. The reason for its inclusion is due to the fact that there had already been a significant amount of work conducted on this technology, and cooking products manufactured and sold in Japan currently use this approach.

This technology monitors the pan temperature and prevents the pan contents from igniting. It combines a pan bottom temperature sensor with electrical/mechanical controls to prevent content temperatures from rising to the ignition level. The temperature is monitored with a thermocouple or IR sensor and controls adjust the heat input to limit maximum temperatures.

- Advantages:
 - Designed to prevent fire from starting
 - Technology may be integrated into range
 - No change to consumer behavior

- Disadvantages:
 - Current temperature sensor technology does not read pan bottom temperature accurately
 - Sensors have poor reliability and durability
 - Increases cooking time
 - Cookware material affects reliability
 - Sensor subject to abuse and exposure grease or dirt
 - Design not feasible for electric smoothtop cooktops due to thermal inertia of ceramic glass surface
 - Relatively short product lifespan

In 2004 the American National Standards Institute (ANSI)/Underwriters Laboratories (UL) Standards Technical Panel No. 858, which included representatives from CSA, developed Technical Feasibility Performance Goals (TFPG) to evaluate cooking fire mitigation techniques for ranges.²⁹ The TFPG provides guidance to designers of devices that could be incorporated into an element/burner and that would interface with a cooking vessel to sense an over temperature condition. Any new technologies designed based on this principle should consider this TFPG.

Finally, a variation on this “Prevent Ignition in Pan” concept involves thermostatically controlled heating elements that limit operating temperatures. One such product that is currently available on the market permits electric coil stoves to be retrofitted with elements that limit cooking temperatures to 350 C. This safeguard prevents the ignition of an unattended pot of oil left on the stovetop.

7.2.5. Induction Cooktops

Induction cooktops were not one of the products reviewed in the Little report. Nevertheless, this is a relatively new technology that is worthy of consideration due to its increasing acceptance in Japan and Europe, since its introduction in the early 1990s.

Induction cooktops incorporate electromagnetic technology to permit the user to cook food safely, quickly, and efficiently. The appliance directly heats up the cookware with magnetic fields rather than relying on a hot or open flame element. This allows the cooking surface to remain relatively cool to the touch, reducing burn and ignition of nearby combustible scenarios generally associated with conventional cooking appliances. In addition, some models incorporate built-in safety features such as an auto-shutoff if it detects that there is no cookware placed on the cooking surface or if there is an abnormal rise in cookware temperature generally associated with heating an empty pot.

- Advantages:
 - Heating surface remains cool to the touch, thus eliminating clothing ignition and burn hazards associated with hot elements.

- Higher cooking efficiency. Studies have shown that induction cooktops are 80% efficient versus 50% efficiency for electric coils and 30% efficiency for gas elements.
- Cooks food faster. Tests have shown that it takes two minutes to boil eight cups of water with an induction cooktop versus 14 minutes with a conventional gas stove.
- Quicker heating and more accurate temperature control than conventional electric and gas cooktops.
- Built-in shutoff features.
- Disadvantages:
 - Does not prevent the unattended pot of oil ignition scenario.
 - Only works with cookware that is constructed of ferrous material such as cast iron and stainless steel. Non-magnetic material such as copper, aluminum, pyrex glass and ceramic will not heat up.
 - Considerably more expensive than conventional cooking equipment.
 - Few models available for consumers to choose from in Canada.

7.3. Technology Summary

Implementing the aforementioned technologies may be an effective means of reducing stovetop fires because it eliminates the human behaviour factors that contribute to these incidents. However, each technology requires evaluation in combination with the cooking appliance and in a household environment for safety, functionality, durability, and to ensure that it accomplishes the objectives of mitigating stovetop fires without a major disruption to consumers. Technology solutions must be proven effective and applicable to all types of cooking. Those that relate to the “Prevent Food Ignition in Pan-Contact Temperature Sensor” technology should meet the TFPG’s and their components should have a lifespan that match that of the current range.

It is noteworthy that the technologies that were identified as having the highest potential for success are consistent with some of the most effective strategies derived from the Fire Safety Concepts Tree analysis.

Table 5: Stovetop Mitigation Technologies vs. Fire Safety Concepts Tree

Stovetop Mitigation Technologies	Fire Safety Concepts Tree Strategies	Sample Products
Detect and extinguish surface cooking fires	Manage stovetop fires by detection and extinguishment	Fixed extinguishing systems for residential stoves or kitchens
Prevent unattended cooking	Prevent stovetop fires by controlling interaction between element/fuel	Stove shutoff products based on motion sensor and/or timer
Prevent food ignition in pan	Prevent stovetop fires by controlling the element's heat output	Thermostatically controlled heating elements

Although these could be practical solutions for reducing cooking fires, the real challenge is incorporating these technologies into all homes. These products could be incorporated into the appliance either at the manufacturing stage or as an aftermarket retrofit product. Consideration must also be given to the additional monetary costs and impact to consumer cooking activities associated with these products to gain market-wide acceptance.

Finally, the use of technology to prevent or mitigate cooking fires is well summarized by the following statements from the U.S. Fire Administration study, "Behavioral Mitigation of Cooking Fires":

"Technology can be used to prevent ignition or to mitigate the effects if a fire should occur. For example, technological systems that limit a stove's heat or shut off the cooking equipment before or when a fire occurs have some obvious advantages. While it is imperative that individuals adhere to safe cooking behaviours, technology may be the best long-term solution to dealing with the cooking fire problem. However, any technology solution must be proven effective and applicable to all types of cooking. In addition, to gain wide market acceptance, it must be inexpensive". The study further concludes, *"At this time, there are no implications for behavioural strategies on using technology to address the cooking fire problem".*²⁵

8. Cost of Stovetop Fires

8.1. Total Cost of Fire in Canada and Ontario

During the early 1990s, the National Research Council (NRC) initiated a comprehensive study to estimate the total economic cost of fire in Canada. They subsequently published the 1995 report, "Total Cost of Fire in Canada: An Initial Estimate".¹⁷ The report estimated total fire related costs, which included direct losses attributed to injuries, deaths and property damage as well as indirect costs associated with maintaining the fire service, fire protection in structures, vehicles,

equipment, insurance overhead, and other miscellaneous expenses. The results of this study estimated that the total annual cost of fire in this country is in the order of \$11 billion (based on 1991 dollars), with the direct losses portion amounting to \$2.9 billion (or 26%).

At the same time, the OFM commissioned a further study to establish the total cost of fire to Ontario using the same methodology developed for Canada. This was included as an appendix to the aforementioned main report.¹⁸ The total cost of fire in Ontario was estimated to be \$4.2 billion (based in 1991 dollars), with the direct losses portion amounting to \$940 million (or 22%).

In both studies, values of \$2.4 million per death and \$56,000 per injury were applied to fire casualties. These numbers were based on an analysis of cost factors relating to medical, funeral, pain/suffering, lost income and legal expenses. They are generally in line with statistical values established in similar cost of injury/death studies conducted by other jurisdictions.^{19,20,21,22}

8.2. Total Cost of Stovetop Fires in Ontario

As previously mentioned, between 2003 and 2007, Ontario averaged 986 stovetop related fires that resulted in five deaths, 155 injuries and \$17.6 million in property losses annually. Applying the NRC statistical values of life and injury estimates, actual reported property loss numbers, and Bank of Canada's inflation rate calculator, the average annual direct cost attributed to stovetop fires is approximately \$48 million in 2009 dollars.²³

Table 6: Annual Direct Costs Attributed to Stovetop Fires in Ontario

Type of Fire Loss	2003-2007 Average	Cost Estimate (1991 Dollars)	Cost Estimate (2009 Dollars)²³
Fatalities (\$2.4 M/death)	5	\$12 M	\$17 M
Injuries (\$56,000/injury)	155	\$8.7 M	\$12 M
Property Loss	\$17.6 M	N/A	\$19 M
TOTAL			\$48 M

It is noteworthy that this is a very conservative total, as it excludes the overhead type expenses that were captured in the NRC report. As these direct costs represent only 22% of the total cost of fire in Ontario, the \$48 million estimate would be significantly increased if an appropriate portion of indirect costs were allocated to stovetop fires.

9. Conclusions

- Stovetop cooking fires continue to be a leading ignition source associated with preventable residential fires, injuries and deaths in Ontario as well as in other parts of the world.
- The predominant root cause of residential stovetop cooking fires is unattended cooking due to homeowner distractions (i.e. answering phone, unexpected visitors, attending to child, falling asleep, etc.) and forgetfulness. The 20 to 30 years age category is the highest risk group when it comes to starting stovetop fires.
- The development of effective strategies and public education materials for mitigating such fires must consider the unattended cooking scenario.
- Applying the Fire Safety Concepts Tree to analyze the mitigation of stovetop fires identified the following strategies as being the most effective:
 - Prevent stovetop cooking fires by controlling the element's heat output.
 - Prevent stovetop cooking fires by controlling the interaction between element and fuel;
 - Prevent stovetop cooking fires by eliminating or controlling the fuel;
 - Manage stovetop cooking fires by detecting and extinguishing it at an early stage.
 - Manage stovetop cooking fires by containing the fire to the cooking area and protecting nearby combustible exposures.

These strategies are generally consistent with stovetop cooking fire mitigation technologies that were identified as having the highest potential for success. Where situations cannot be addressed through technology, public education programs need to be developed.

- The technology solutions identified in Section 7 of this report, while representing significant challenges, should still be pursued as an option to mitigate the impact of stovetop cooking fires.
- An analysis of the Ontario Stovetop Fire Survey results generated the following key findings:
 - Unattended cooking accounted for 69% of the fires.
 - "Distracted/forgot" was the leading reason given why cooking was left unattended and account for 51% of the fires.
 - "Cooking oil and grease" were responsible for half (50%) of the fires while "other food item" accounted for 28%.
 - In 61% of the fires, the occupant attempted to extinguish the fire. The injury rate was 67% higher in situations where the

- o occupant attempted to extinguish the fire. Moving the pot as a method to extinguish the fire resulted in the highest injury rate.
 - o Multi-unit buildings experienced over twice the fire incident rate of detached dwellings.
 - o Fire incident rates in subsidized dwellings were three times higher than in non-subsidized dwellings.
 - o The 20 to 29 age group accounted for the highest fire incident rate followed by the 30 to 39 and 40 to 49 age groups.
 - o Stovetop fires peak at 5:00 p.m. whereas most fatal stovetop fires occur between 11:00 p.m. and 6:00 a.m.
- An analysis of stovetop fire fatalities between 1995 to 2004 resulted in the following key findings:
 - o Forty-one per cent (41%) of the victims were seniors (65 years and older), 58% were adults (under age 65), and one per cent (1%) youth under 16 years.
 - o In seniors-related fatal stovetop fires, 69% involved clothing as the object first ignited. This compares to only five per cent (5%) for adult fatalities.
 - o In fatal stovetop fires involving an adult (under age 65), 53% of the fatalities were alcohol impaired at the time of the fire.
- It is estimated that stovetop fires cost Ontarians at least \$48 million annually based on injuries, deaths and property loss.

10. Recommendations

1. Provide information to homeowners/building managers to raise their awareness of stovetop fire mitigation technologies and encourage them to retrofit their existing appliances with these products. Focus on products that work on the principles of preventing unattended cooking, thermostatically controlled cooking and detect/extinguish systems. Products designed to prevent ignition are preferable to those designed to manage a fire after ignition.
2. Work collaboratively with cooking appliance manufacturers to reduce the number of cooking fires.
3. Request standards development organizations to incorporate performance requirements into their range construction standards to address the prevention of stovetop fires. Performance goals should include:
 - a) Reduce the likelihood of unattended cooking.

For example, consideration should be given to modifying the following standards:

- i) *CAN/CSA-C22.2 No. 61-M89-Household Cooking Ranges
-4.21 Switches and Controls*

Provide a timer feature that allows the user to manually preset cooking duration. At the end of the cooking cycle this feature should sound a continuous audible signal to alert the user and shut off the power to the element. The user must manually deactivate this audible signal and restore power if a longer cooking duration is necessary.

- ii) *ANSI Z21.1-2005-Household Cooking Gas Appliances
-1.2 General Construction and Assembly*

Provide a timer feature that allows the user to manually preset cooking duration. At the end of the cooking cycle this feature should sound a continuous audible signal to alert the user and shut off the power to the element. The user must manually deactivate this audible signal and restore power if a longer cooking duration is necessary.

- b) Reduce the likelihood of clothing ignition due to being placed in contact with the heating element.

For example, consideration should be given to modifying the following standards:

- i) *CAN/CSA-C22.2 No. 61-M89-Household Cooking Ranges
-4.14 Heating and Heater Elements or 4.21 Switches and Controls*

Limit the maximum surface element temperature to ensure that 100% cotton clothing material does not ignite within 5 seconds when placed in contact with the heating element.

Note: Demonstrations undertaken by the OFM with a smoothtop range resulted in 100% cotton material ignition at 8 seconds or longer at element temperatures near 530 C.³⁰ Further analysis may be required to meet a 5 second criteria.

- ii) *CAN/CSA-C22.2 No. 61-M89-Household Cooking Ranges
-4.21 Switches and Controls*

Revise 4.21.10 to increase the minimum height (currently 140 mm above element surface) of the backsplash element controls. Alternatively, relocate the controls to the front of the range with child resistant safety features incorporated into them.

- iii) *ANSI Z21.1-2005-Household Cooking Gas Appliances
-1.2 General Construction and Assembly*

Revise 1.2.16 to increase the minimum height (currently 152 mm above element surface) of the knobs and buttons located on the backguard. Alternatively, models designed with knobs and buttons located at the front or top surface of the range should incorporate child resistant safety features.

- c) Improve the durability of appliances that have shown superior fire safety performance.

Research conducted in developing this report indicates that smoothtop ranges may provide enhanced fire safety benefits from the perspective of reducing the risk of clothing ignition.³⁰ However, the durability of the “ceran” top in certain environments has been identified as a concern. Improvements in the smoothtop’s cooking surface durability will enhance marketability.

For example, consideration should be given to modifying the following standard:

- i) *CAN/CSA-C22.2 No. 61-M89-Household Cooking Ranges*
-6.9.2 Investigation of Glass-Ceramic Cook Top-Physical Abuse
Increase the steel ball mass and/or drop height used in test to improve the cooking surface’s durability.

- d) Raise public awareness on the hazards of cooking fires.

For example, consideration should be given to modifying the following standards:

- i) *CAN/CSA-C22.2 No. 61-M89-Household Cooking Ranges*
-5.1 Marking
Provide visible labels/markings on the front of the stove cautioning consumers on the hazards of unattended cooking, tipovers and placing combustible materials too close to the heating surface.
- ii) *CAN/CSA-C22.2 No. 61-M89-Household Cooking Ranges*
-5.17 Marking
Provide a statement in the operating instructions, cautioning consumers on the hazards of unattended cooking, tipovers and placing combustible materials too close to the heating surface.
- iii) *ANSI Z21.1-2005-Household Cooking Gas Appliances*
-1.28 Instructions
Provide a statement in the operating instructions cautioning consumers on the hazards of unattended cooking, tipovers and placing combustible materials too close to the heating surface.
- iv) *ANSI Z21.1-2005-Household Cooking Gas Appliances*

-1.29 Marking

Provide visible labels/markings on the front of the stove cautioning consumers on the hazards of unattended cooking, tipovers and placing combustible materials too close to the heating surface.

Any technological solutions used to meet these performance goals should not severely impact cooking performance or introduce other safety issues. Where technologies designed to sense an over temperature condition are involved, the guidance provided in the Technical Feasibility Performance Goals (TFPG) developed by UL and CSA should be considered.²⁹

4. Interact with the insurance industry to provide financial incentives to homeowners that voluntarily take action to mitigate residential cooking fire incidents (i.e. install stovetop mitigation technology devices).

Note: Currently, insurance companies in the State of Texas have the option to offer insurance premium discounts for policyholders who install stovetop fire suppression devices.
5. Target high risk/high impact populations (i.e. subsidized housing, appropriate age groups, multi-unit dwellings, etc.) for public education, installing stovetop fire mitigation technologies, and protecting combustible cabinetry adjacent to the range with fire resistant materials.
6. Direct public education efforts toward high risk/high impact populations incorporating the following messages:
 - a) stay in the kitchen when frying, grilling or boiling and be attentive to all cooking activities;
 - b) turn off the stove when distracted from cooking for any reason (e.g. by the telephone, doorbell, children, pets), or when leaving the kitchen even for a short time;
 - c) use thermostatically controlled deep fat fryers rather than heating oil in pots on the stove;
 - d) use electric kettles with built-in shut-offs instead of traditional stovetop models;
 - e) keep a proper fitting lid nearby when cooking, in case there is a stovetop fire;
 - f) wearing an oven mitt, carefully slide the lid over the burning pan to smother the fire, then shut off the element. Leave the pan alone until it has cooled. Never move a burning pan;
 - g) wear tight-fitting sleeves or short sleeved clothing when cooking. This can avoid ignition of clothing by contact with hot stove elements;

- h) know what to do if clothing catches fire. Stop, drop to the ground and roll over and over or back and forth to smother the flames. If this is not possible, keep a towel nearby to smother or pat out the flames;
- i) cool a burn by putting it under cool water for three to five minutes;
- j) cook only if free of alcohol, illegal drugs, medication or drowsiness;
- k) keep stovetops and surrounding areas clear of combustible items (i.e. towels, rags, utensils, drapes, etc.);
- l) keep stovetops and surrounding areas free of accumulations of grease;
- m) use lower heat settings for cooking whenever possible;
- n) use timers when baking, roasting, or broiling in the oven;
- o) keep children and pets away from the stove while cooking;
- p) use back burners to keep hot cookware out of the reach of children;
- q) turn pot handles toward the back of the stove to prevent pot and hot food from being accidentally knocked over;
- r) install and maintain smoke alarms on every storey of the home and outside sleeping areas;
- s) suggest procedures to address nuisance alarms (i.e. proper location of smoke alarms, ionization vs. photoelectric technology, smoke alarms with a “hush” feature).

Appendix A: References

1. According to the Ontario Fire Loss reporting system “cooking equipment” includes stove, range-top burner, oven, microwave, open fire barbeque (fixed or portable), range hood, deep fat fryer, other cooking items (e.g. toaster, kettle, electric frying pan, etc.)
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Appendix B: Fire Safety Concepts Tree

B1. Introduction

The Fire Safety Concept Tree uses boxes and logic gates to define hierarchical relationships between multiple objective levels. Two types of logic gates namely, “or” gates and “and” gates are used for linking these levels. An “or” gate is represented by a circle with a plus sign in it while an “and” gate is represented by a circle with a dot in the middle. The “or” gate indicates that achieving any one of the sub-goal(s) will accomplish the outcome. The “and” gate indicates that achieving all of the sub-goals is necessary to accomplish the outcome.

In an example of an “or” gate, objective A is achieved if any one of sub-objectives B1, B2 or B3 can be achieved.

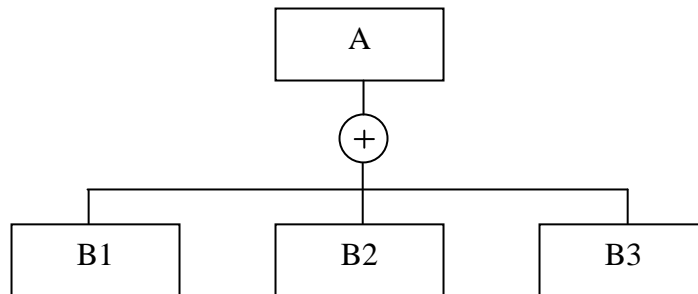


Figure B1: Example of an “or” gate

In an example of an “and” gate, objective A is achieved if all of objectives B1, B2 and B3 are achieved.

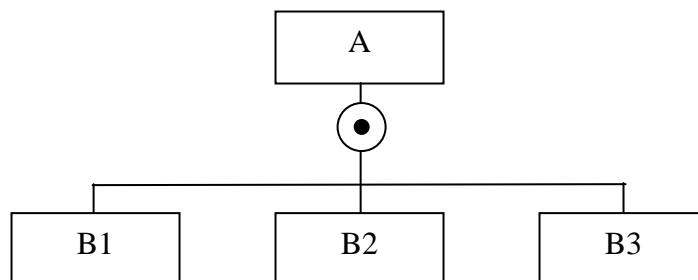


Figure B2: Example of an “and” gate

The following diagram represents the top gates of the Fire Safety Concepts Tree as provided in NFPA 550.

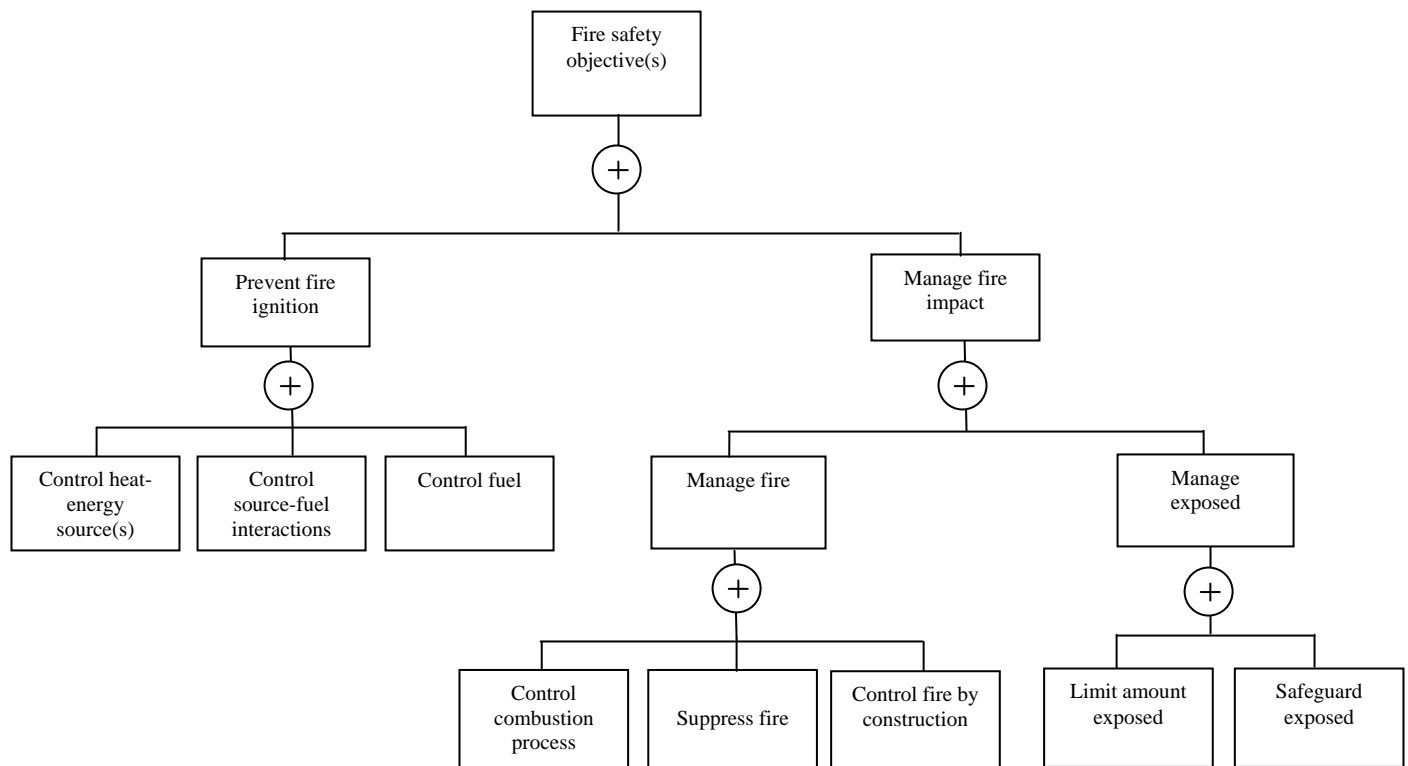


Figure B3: Fire Safety Concepts Tree

The tree's top box is labeled "Fire Safety Objectives" and represents the ultimate goal that needs to be achieved. According to the tree's logic, this task can be accomplished by either:

- Preventing the fire from starting or
- Managing the fire's impact if one were to start.

Prevent Fire Ignition

To prevent a fire from igniting, one of the following must occur:

- *Control heat-energy source*
The heat or energy source can be controlled by either eliminating it or reducing it to a level such that it cannot ignite the fuel.
- *Control source-fuel interactions*
Source-fuel interactions can be controlled by preventing the heat source from moving too close to combustibles, limiting heat transfer to the fuel, and preventing combustibles from moving too close to the heat source. All three of these conditions must be satisfied simultaneously.

- *Control fuel*
The fuel can be controlled by either eliminating it, altering its inherent ignition properties or creating an environment such that ignition cannot occur.

Manage Fire Impact

To manage the impact of a fire one of the following must occur:

- *Manage the fire*
Where ignition occurs, the fire can be managed and mitigated by limiting its growth and spread. This can be accomplished by altering the fuel or the environment, extinguishment, or through appropriate venting and/or physical containment.
- *Manage exposed*
Where ignition occurs, measures can be taken to limit or safeguard the number of individuals and property exposed.

B2. Mitigating Stovetop Fire Application

The following is a reproduction of the Fire Safety Concepts Tree as provided in NFPA 550 with some minor wording revisions to reflect the overall goal of mitigating stovetop fires.

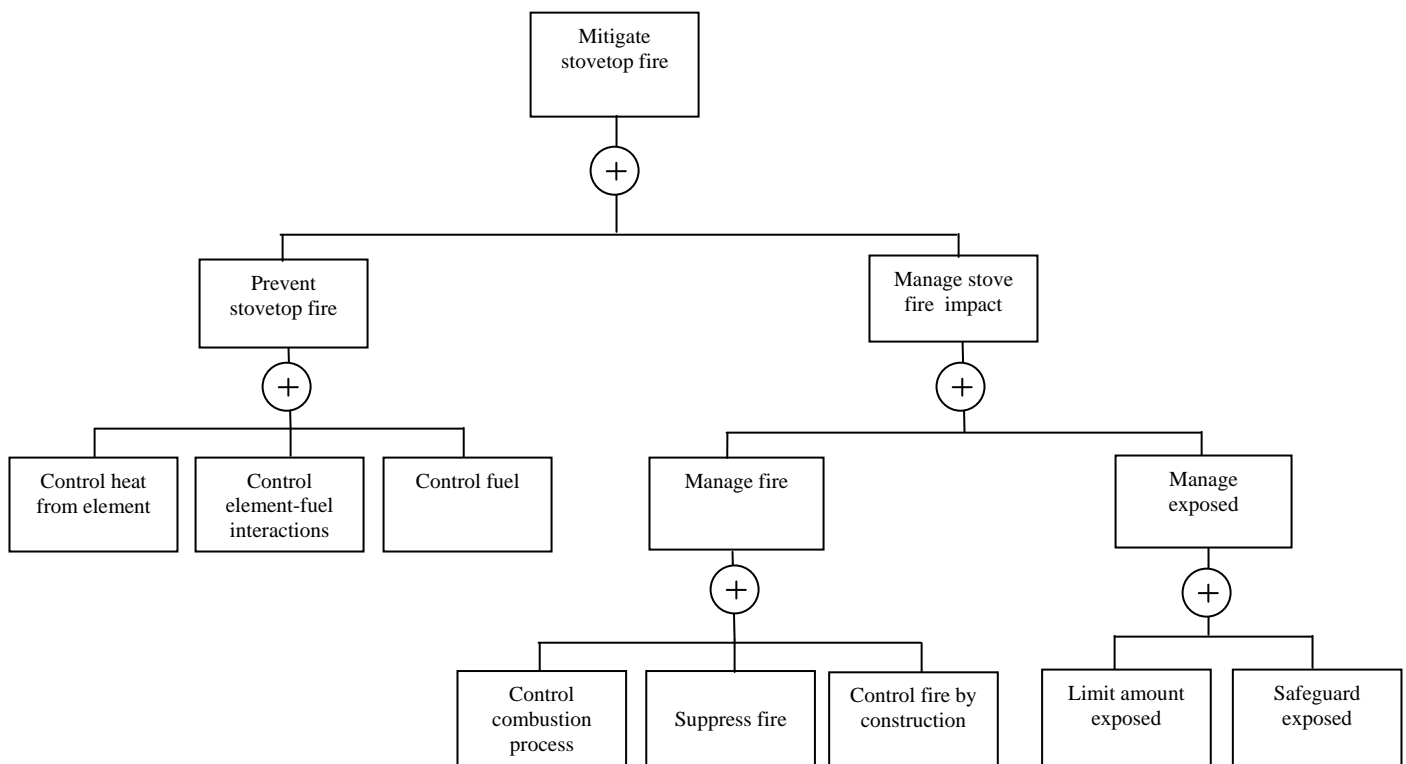


Figure B4: Top Gates of Fire Safety Concepts Tree

The top box of the Fire Safety Concepts Tree represents the overall objective, which is to “mitigate stovetop fire”. To achieve this, the sub-objectives of “Prevent stovetop fire” and “Manage fire impact” are identified and connected to the overall objective through an “or” gate. This represents the concept that stovetop fires can be mitigated through either preventing the fire or managing the fire’s impact if one were to occur. Although only one of the two is required to achieve this, in reality satisfying both principles increases the likelihood of achieving this overall objective.

Prevent Stovetop Fire

The “Prevent Stovetop Fire” branch of the tree is subdivided into three other categories through an “or” gate. Carrying out the strategies of either controlling the heat from the element, controlling the interaction between the element and fuel (i.e. cooking oil, food, nearby combustibles, etc.) or controlling the fuel is sufficient to prevent a stovetop fire.

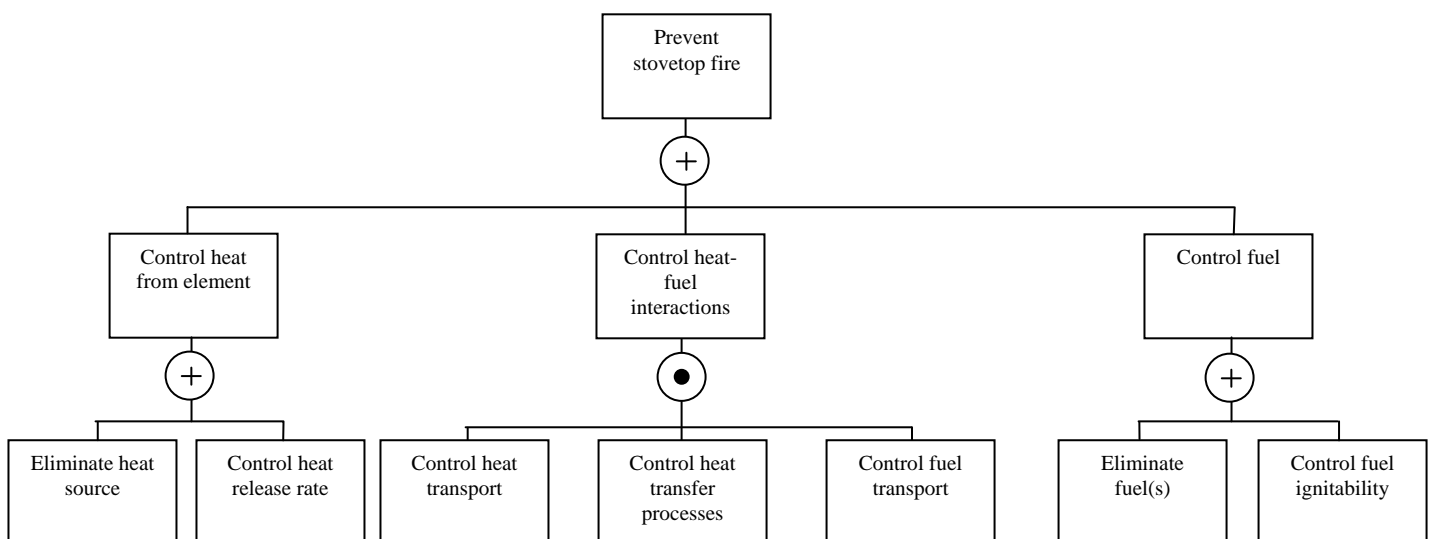


Figure B5: Prevent Stovetop Fire Branch of Fire Safety Concepts Tree

Control Heat from Element

The heat emitted from a cooking element can be controlled by either limiting its energy output or limiting the cooking duration such that food items cannot be raised to its ignition temperature. This can be achieved manually by the homeowner, automatically by technology built into the appliance, or a combination of both.

Raising public awareness on the hazards of unattended cooking or encouraging homeowners to cook at lower temperatures through public

education is effective to a degree. However, its dependance on appropriate human behaviour makes this an unreliable solution. Implementing stovetop technologies that automatically limit cooking temperatures or reduce the likelihood of unattended cooking are potentially effective solutions.

Control Heat-Fuel Interaction

This component is connected to “Control heat transport”, “Control heat transfer process”, and “Control fuel transport” through an “and” gate. This means that the element should not be allowed to move too close to combustible materials, excessive heat should be prevented from being transferred to combustible materials, and combustible materials should not be allowed to move too close to the element. These input must all co-exist simultaneously in order to control the interaction between the element and combustibles.

With cooking operations, although one can limit the heat transfer process to a degree as discussed earlier, the fuel and heat source must remain in close proximity to each other at sufficient energy and duration due to the static nature of cooking activities. Hence, all three conditions cannot be simultaneously satisfied and the “Control element-fuel interaction” approach is not a practical solution when it comes to preventing oil/food ignition.

Where the control heat-fuel interaction component may be applied is in situations that involve the ignition of combustible non-food items that come into contact with the elements. This includes common accidental scenarios such as a person’s loose bathrobe sleeve, tea towels, or oven mitts brushing across a heated element. The “Control heat transport” sub-component is addressed by the fact that the element is stationary and cannot move towards combustible materials. The “Control fuel transport” and “Control heat transfer” sub-components can be simultaneously satisfied by ensuring combustible non-food items are not placed in close proximity to the elements. This action is highly dependent on appropriate human behaviour and is best addressed by raising homeowner awareness through improved public education programs.

Control the Fuel

The fuel can be controlled through elimination or by controlling its ignitability. Eliminating the fuel means removing all combustible food and non-food items from around the heating element. Although eliminating food over a stovetop appears to be an impractical solution, one can still achieve this by considering alternative and safer cooking practices. For example, baking french fries in the oven instead of deep frying over the stovetop is a means of eliminating the fuel.

The ignitability of non-food items can be controlled by using those that are constructed of non-combustible materials. For example, using metal rather than wooden or plastic utensils is a means of achieving this. Newer Teflon™

based oven mitts are less ignitable than cloth oven mitts. These themes can best be conveyed through improved public education programs.

Manage Fire Impact

In the event of a fire, the “Manage Fire Impact” branch achieves the overall goal of mitigating the spread or size of stovetop fires. This component is subdivided into two categories, “Manage fire” and “Manage exposed” through an “or” gate.

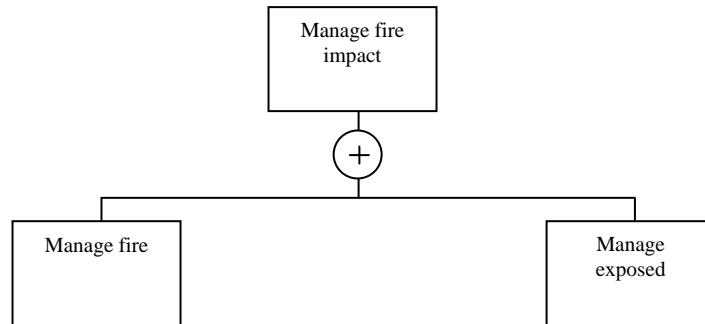


Figure B6: Top Branches of Manage Fire Impact

Manage Fire

The objective of managing a fire is to reduce hazards associated with fire growth and flame/smoke spread. According to the Safety Concept Tree, this can be accomplished by controlling the combustion process, suppressing the fire at its early stages, or controlling the fire by construction.

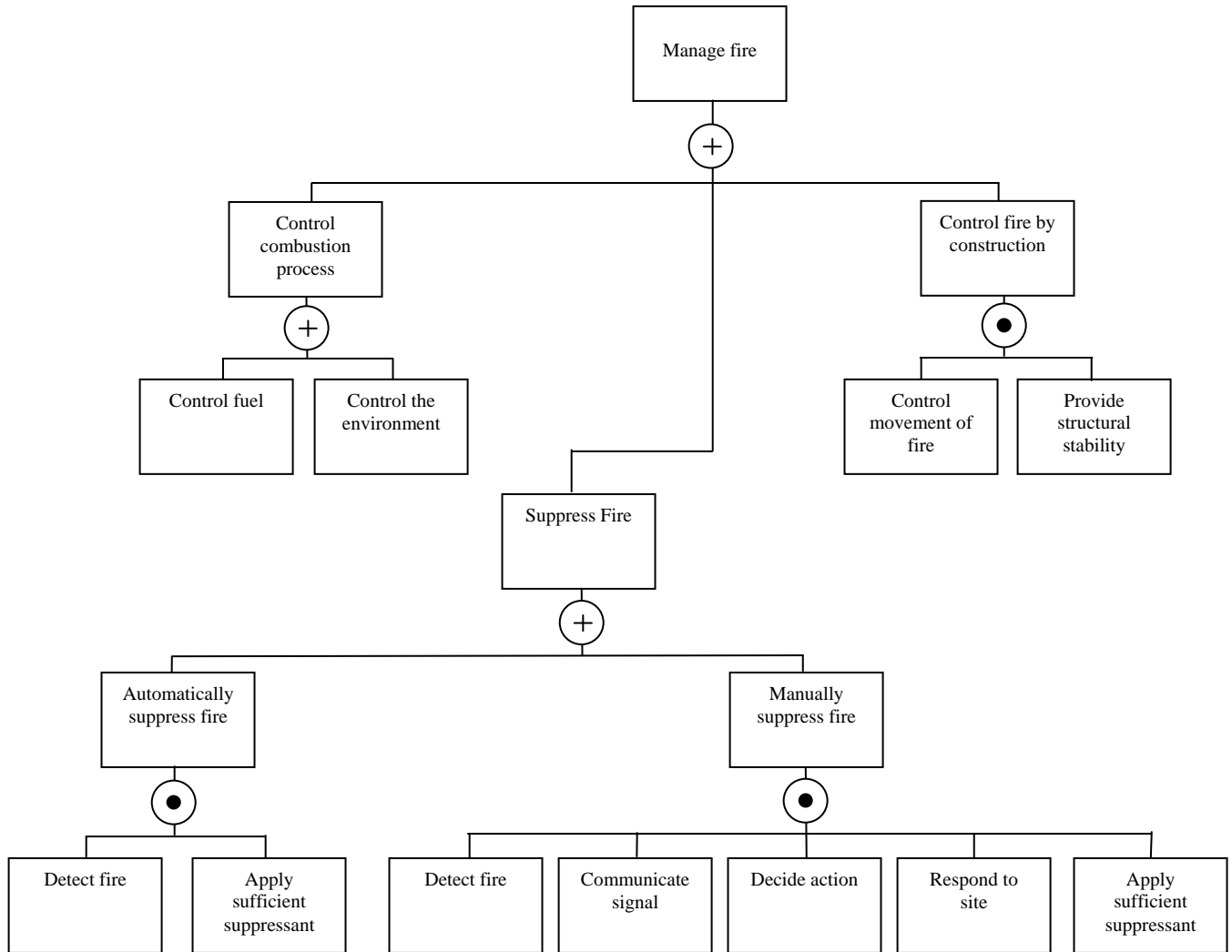


Figure B7: Manage Fire Branch of Fire Safety Concepts Tree

Controlling the Combustion Process

Controlling the combustion process involves controlling the rate of smoke and heat production by altering the fuel or the environment. As discussed earlier, the ignition properties of various food items are inherent to it and cannot realistically be altered. Changing the chemical composition of the kitchen environment, such as reducing normal oxygen levels is not a feasible solution either as this is habitable space. Hence controlling the combustion process is not an effective solution for managing stovetop fires.

Suppress Fire

Extinguishing a stovetop fire in its early stages is an effective means of managing fire impact. Fire suppression can be performed either automatically or manually. Automatic extinguishing systems that quickly detects and

suppresses cooking fires is proven technology that is commonly used in commercial establishments as well as military housing. Transferring this technology to the home is a potentially effective solution for mitigating stovetop fires.

For manual fire suppression to be effective, a number of simultaneous events must occur in a timely manner including detecting the fire, deciding action, communicating the signal to the fire department, response time and suppressing the fire. In all cases, it takes significantly more time to manually suppress a fire than an automatic suppression system, making this a riskier, less reliable and less effective solution.

Control Fire by Construction

The third option for controlling stovetop fires is by constructing barriers or ventilation systems to physically contain the fire within a defined area or vent the fire to a safe location. As kitchen cabinets are often the secondary objects ignited, an effective strategy may involve protecting these and other areas vulnerable to secondary ignition. Controlling a fire by construction is an effective means for buying more time to take appropriate action, but it does not address the extinguishment of the fire.

Manage Exposed

The “Manage Exposed” branch is achieved by limiting the number of individuals and amount of property that are exposed to a stovetop fire. Alternatively, safeguarding these exposures will also achieve this goal. As the focus of this paper is on residential properties, there are limitations on how much personal property can be practically safeguarded in a home. Protection of vulnerable occupants within the home will need to be considered on a case by case basis. In general, the “Manage Exposed” branch is more applicable to an institutional building with vulnerable occupants rather than a home.

B3. Summary

Applying the limitations within a stovetop fire situation to the Fire Safety Concepts Tree results in the following:

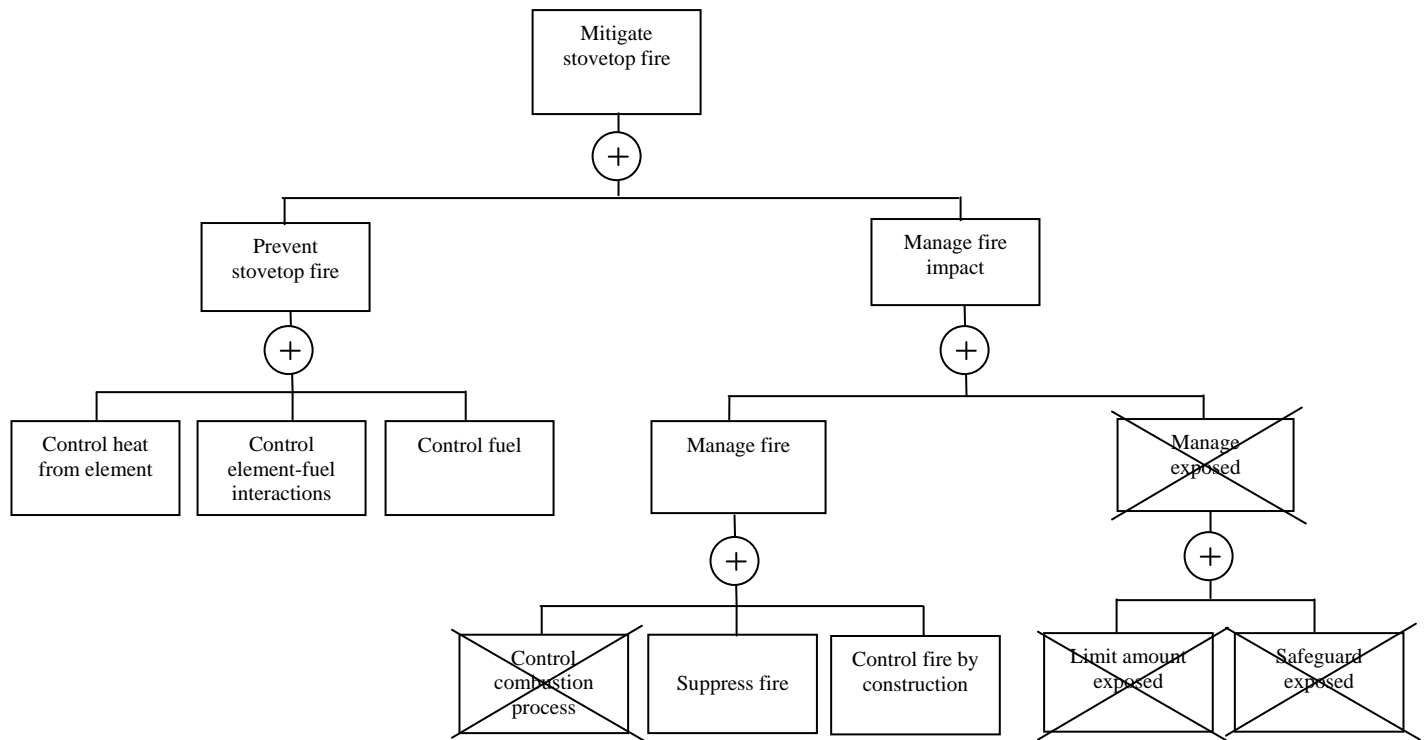


Figure B8: Fire Safety Concepts Tree for Mitigating Stovetop Fires

Hence the most appropriate strategies for mitigating stovetop fires include:

- Prevention by controlling the element's heat output. This can be achieved by
 - limiting heat output such that it is incapable of heating the fuel to ignition or
 - limiting cooking duration by eliminating unattended cooking.
- Prevention by controlling the interaction between combustible non-food items and the element
- Prevention by eliminating or controlling the ignitability of food and non-food items
- Managing a fire that has initiated by detecting and extinguishing it at an early stage.
- Managing a fire by containing it to the cooking area and protecting nearby combustible exposures.

Appendix C:

2005-2006

Stovetop Fire Survey

2005-2006 STOVETOP FIRE SURVEY



Complete the survey below for **all residential fire incidents where a fire started on a stovetop**. The OFM requires this survey to be completed for all stovetop fires occurring between the dates of August 1, 2005 to July 31, 2006.

Advise the occupant that you are collecting information for the Office of the Fire Marshal to help the fire service better understand the causes of stovetop fires. All information is confidential, and no address or names will be included with the information.

Check the appropriate boxes or print clearly in the space provided. Please mail completed forms **monthly** to: Office of the Fire Marshal, 7th Floor 5775 Yonge Street, Toronto, ON M2M 4J1

NOTE: This form does not replace the Standard Incident Report for this incident.

1. Municipality	2. Fire Dept ID Code	3. Fire date: Year (YY) Month (MM) Day (DD)	4. Alarm time Hour Minute Sec am/pm
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5. Type of Residence <input type="checkbox"/> Detached <input type="checkbox"/> Multi unit dwelling <input type="checkbox"/> Semi detached <input type="checkbox"/> Rooming/boarding/lodging <input type="checkbox"/> Attached (row/townhouse) <input type="checkbox"/> Other, please describe:	6. Is residence government subsidized? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unknown	7. Estimated dollar loss	8. Total injuries	9. Total fatalities
	10. Estimated number of persons in dwelling or suite at time of fire			

11. Extent of fire <input type="checkbox"/> Confined to appliance <input type="checkbox"/> Confined to part of room of appliance <input type="checkbox"/> Multi unit dwellings: Confined to suite of origin <input type="checkbox"/> Confined to same floor <input type="checkbox"/> Confined to building <input type="checkbox"/> Spread beyond building	12. Action taken <input type="checkbox"/> Burned out with no action taken <input type="checkbox"/> Extinguished by occupant <input type="checkbox"/> Extinguished by automatic system <input type="checkbox"/> Extinguished by fire department <input type="checkbox"/> Action taken unclassified	13. Area of Origin <input type="checkbox"/> Kitchen <input type="checkbox"/> Other, please describe: <input type="checkbox"/> Unknown
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14. Type of Stove <input type="checkbox"/> Electric coil <input type="checkbox"/> Gas <input type="checkbox"/> Electric plate <input type="checkbox"/> Portable electric unit <input type="checkbox"/> Electric glass top <input type="checkbox"/> Portable gas unit (not BBQ) <input type="checkbox"/> Other, please describe: <input type="checkbox"/> Unknown	15. Location of burner controls <input type="checkbox"/> On panel at back of stove <input type="checkbox"/> On panel at front of Stove <input type="checkbox"/> On burner surface <input type="checkbox"/> Other, please describe: <input type="checkbox"/> Unknown	16. Element involved with ignition <input type="checkbox"/> Back left <input type="checkbox"/> Back right <input type="checkbox"/> Front left <input type="checkbox"/> Front right <input type="checkbox"/> Other, please describe: <input type="checkbox"/> Unknown	17. Heat setting of element <input type="checkbox"/> High <input type="checkbox"/> Medium <input type="checkbox"/> Low <input type="checkbox"/> Unknown
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18. Object first ignited <input type="checkbox"/> Wearing apparel on a person (go to a and b) → <input type="checkbox"/> Cooking oil/grease <input type="checkbox"/> Other food item <input type="checkbox"/> Tea towel/dish cloth/pot holder <input type="checkbox"/> Cooking utensil (spatula, spoon, etc) <input type="checkbox"/> Other paper item <input type="checkbox"/> Other plastic item <input type="checkbox"/> Other, please describe: <input type="checkbox"/> Unknown	18a. Apparel ignited: What was the person doing? <input type="checkbox"/> Victim was attempting to reach a control <input type="checkbox"/> Victim was reaching for pot or pan <input type="checkbox"/> Other, please describe: <input type="checkbox"/> Unknown	18b. Apparel ignited: Type of material ignited <input type="checkbox"/> Cotton <input type="checkbox"/> Wool <input type="checkbox"/> Polyester <input type="checkbox"/> Rayon <input type="checkbox"/> Silk <input type="checkbox"/> Combination of fibres <input type="checkbox"/> Other, please describe: <input type="checkbox"/> Unknown
	18c. Where was item when ignited? <input type="checkbox"/> On burner <input type="checkbox"/> On stovetop near burner <input type="checkbox"/> Other, please describe <input type="checkbox"/> Unknown	

Continue on back of page

19. Type of cooking:

- ☐ Deep fat frying
☐ Pan frying
☐ Simmering in pot
 (e.g. soup, sauces, etc.)
☐ Unknown
- ☐ Boiling water
☐ Heating non food materials (e.g. melting wax)
☐ No cooking was occurring (e.g. burner left on, no pot on stove)
☐ Other, please describe:

20. Secondary Object ignited

- ☐ Cabinetry
☐ Curtains
☐ Clothing
☐ Unknown
- ☐ None
☐ Other, please describe:

21. Factor contributing to ignition or spread of fire: check key factor only

- ☐ Cooking left unattended
☐ Children playing with/around stove
☐ Loose fitting clothing
☐ Unknown
- ☐ Burner left on (after cooking)
☐ Appliance malfunction
☐ Object placed too close to the element
- ☐ Inappropriate use of appliance (e.g. lighting a cigarette)
☐ Other, please describe:

Information on the person who was responsible for cooking at the time of the fire:

22. Age (approx)

23. Gender

- ☐ Male
☐ Female

24. Where was the person at the time the fire started? Check one only

- ☐ At the appliance
☐ In the room
☐ Other room
☐ Unknown
- ☐ On premises, outside
☐ Away from home
☐ Other, describe:

25. Check any of the following which may have been a factor in this fire. Check all that apply

- ☐ Person asleep
☐ Unaware of hazard
☐ Distracted/forgot
☐ Physical disability
- ☐ Mental disability
☐ Possible impairment - alcohol
☐ Possible impairment - drugs
☐ Other, please describe:

26. How was occupant FIRST alerted to fire?

- ☐ Occupant saw fire/smoke
☐ Occupant smelled smoke
☐ Smoke alarm sounded
☐ Occupant not alerted to fire (e.g. were not at home)
☐ Other, please describe:
☐ Unknown

27. Was smoke alarm present, did smoke alarm operate?

- ☐ No smoke alarm
☐ Alarm present, operation unknown
☐ Alarm operated
☐ Alarm did not operate – no battery
☐ Alarm did not operate – dead battery, no power
☐ Alarm did not operate – beyond smoke reach
☐ Unknown

27a. No battery: Was battery removed due to nuisance alarms?

- ☐ Yes
☐ No
☐ Other reason, Please describe:
☐ Unknown

28. Action taken by occupant(s) at time of fire. Check all that apply

- ☐ Occupant(s) attempted to extinguish fire
☐ Did not attempt to extinguish fire
☐ Evacuated
☐ Other, please describe:
☐ Unknown

28a. How did occupant attempt to extinguish fire?

- ☐ Used pot/pan lid
☐ Fire extinguisher
☐ Unknown
- ☐ Water
☐ Other, please describe:

29. Impact of fire on occupant(s) (describe impact of fire, e.g. displaced from residence, hospitalization for injuries, etc)

Other comments:

Date completed: _____

Mail completed forms to: Office of the Fire Marshal, 7th Floor 5775 Yonge Street, Toronto, ON M2M 4J1

Appendix D: Public Education Resources to Prevent Cooking-related Fires

The Office of the Fire Marshal (OFM) has developed a number of public education resources and materials to increase public awareness of cooking-related fire hazards, safe cooking practices and fire safety.

These resources include the *Put a Lid on It!* educational program and a variety of television, radio and print public service announcements the fire service can distribute to local media. More information about these resources can be found by visiting:

www.ofm.gov.on.ca

www.firesafetycouncil.com

www.makeitstop.ca, or by calling the OFM at 416-325-3100



**STAND BY
YOUR
PAN.**



Cooking is the #1 cause of home fires. Don't leave your cooking unattended. Keep an eye on your fries!




**BBQ
SAFELY**

When lighting your propane barbecue, open the lid and strike your match or lighter before turning on the gas.

Follow the manufacturer's instructions for the safe use and maintenance of your barbecue.




**LOOK
WHILE YOU
COOK**



A stovetop fire can start in a flash, so keep a close eye on your cooking at all times.

