Cooking Fires:

The impact of HomeSafe activities on cooking fires in the City of Surrey

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CITY OF SURREY
FIRE SERVICES

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Executive Summary

Various international and North American studies determined that cooking activities are the leading cause of residential structure fires. A review of residential structure fires occurring in the City of Surrey between 1988 and 2007 showed the same trend with cooking as the top ignition source along with a steady decline in the rate of working smoke alarms. This review informed the inception of a community education program called HomeSafe, that is intended to reduce the residential fire rates and increase the fire safety mechanisms at residential properties by delivering messages of safe cooking practices and ensuring the presence of working smoke alarms.

The 2020 study by Thomas et.al. which evaluated the HomeSafe program in the City of Surrey demonstrated the program's success in reducing the fire rate, increasing the presence of functioning smoke alarms, and reducing fire-related casualties [1]. Building on the 2020 study, this research is focused on assessing the effectiveness of the HomeSafe program in lowering fire-related risks caused by cooking activities.

The evaluation uses the following metrics: the cooking fire rate per 100,000 residential units, the percentage of working smoke alarms detected at fires caused by cooking, the number of fatalities and injuries per 100,000 population as a result of cooking fires, and the average building loss in dollar value caused by cooking fires. This is not done by observing the city-wide trends of those metrics alone, but also by comparing the metrics before and after the HomeSafe program treatments on the properties within the various program cohorts.

The city-wide outcomes show the program's effectiveness in achieving success across cooking fire-related metrics. The study demonstrates a reduction of reported cooking fires by nearly 6 times of those reported since 2010, to the rate of 6.5 cooking fires per 100,000 residential units in the first half of 2022. This positive impact is also reflected by an increase in the presence of functioning smoke alarms detected at these fires. The current measure of 86% working smoke alarms at cooking fire incidents in 2022 is a marked increase from 46% reported in 2010. The higher rate of working smoke alarms has consequently led to a reduction of casualties and building losses. In the first half of 2022, no casualties have been reported and the average cost associated with building losses has decreased from just over $40,000.00 per cooking fire to its lowest point of just under $4,000 over the same 2022 period.

An evaluation of properties treated by HomeSafe shows a nearly 60% reduction of cooking fires, an 80% reduction in casualties related to cooking fires and a 40% increase to the rate of working smoke alarms. These outcomes prove the efficacy of community outreach programs such as HomeSafe in reducing fire risk by targeting specific risk behaviours present in human activities such as cooking.

Purpose of this Research

This research explores the effects of the HomeSafe community risk reduction program introduced in the City of Surrey in 2008 on the frequency and impact of residential cooking fires. An evaluation was conducted linking cooking fire rates with the delivery of targeted public education focusing on cooking safety and working smoke alarms. This is a longitudinal perspective of continuous HomeSafe initiatives on fire outcomes to increase the safety of Surrey residents over the last 13 years.

Background

Residential fires continue to be the leading cause of fire deaths and injuries, causing significant property damage and carcinogenic exposures to firefighters [2]. The most common ignition source has consistently been attributed to cooking. A report published by The National Fire Protection Association attributes 75% of fire deaths and 72% of injuries to residential structure fires [3]. This is similar to the global distribution 84% and 70% as reported by the International Association of Fire and Rescue Services [4]. This has prompted the development of targeted initiatives designed to affect residential fire outcomes by reducing the fire risk through regulatory changes and best practices. In recognition of the risks inherent in cooking practices, the National Institute of Standards and Technology (NIST) conducted a comprehensive review of cooking fires in the U.S. and recommended strategies to affect positive outcomes relating to risky human behaviours [5].

Compounding the risk associated with the high rate of cooking fires is the high percentage of non-working smoke alarms reported in single family dwellings [6]. In Canada, single family residential buildings are required by code to have interconnected hard wired smoke alarms at the time of building. However, over time smoke alarms can lose functionality presenting an elevated risk to those living within the home should a fire occur. As a non-inspectable building, it is up to the resident to ensure all smoke alarms are in working condition at all times. As reported by the BC Office of the Fire Commissioner ("OFC") in the Q1 and Q2 2022 reports, only 28% and 33% of fires occurring in BC, respectively had a known working smoke alarm at the time of the fire [7].

In 2009 the City of Surrey did a review of residential structure fires occurring in the city between 1988 and 2007 to create a strategy to mitigate the increasing death and injury rates [8]. The data showed cooking to be the highest ignition source along with a steadily decreasing rate of working smoke alarms as reported at the time of the fire or discovered through an investigation. Informed by this review and supported by global best practices, Surrey implemented a community education-based program called HomeSafe designed to reduce community risk and lower the residential fire rate. The objective of the program is to message safe cooking practices and verify the presence of working smoke alarms in a targeted demographic considered most at risk combined with those living in single family detached dwellings.

As a strategy to impact human behaviour and lower their fire risks, Surrey Fire Service reviewed educational initiatives which have produced positive outcomes in fire rates. This type of community risk reduction program has proven to effectively change behaviors and prevent residential fires as reported by the England Fire Brigade [9]. To ensure sustainable long-term outcomes, studies recommend ongoing educational initiatives to remain effective despite evolving risks compounded

by individuals' attitudes and behaviors relating to these risks [10]. Building on this, a 2007 Tridata study attributed the successful decrease in the residential fire rate to a door-to-door campaign meant to initiate meaningful discussions with residents on the need to have working smoke alarms as an early alerting mechanism to allow time to escape a fire [11]. The HomeSafe program in the City of Surrey was designed to utilize the door-to-door method to best affect behavioral change in residents to become more informed about fire risks.

Studies have linked cooking fires to the element of human behaviour resulting in lack of attention and habits thereby increasing the likelihood of fire occurrence [12]. Along with smoke alarm messaging, the HomeSafe program added safe cooking practices to the discussions to have a higher likelihood of affecting fire rates with the primary ignition source attributed to cooking.

Fire data demonstrated that fire risk at properties is a function of common resident characteristics such as;

- Children under the age of 6 years
- Adults over the age of 64
- Single parent families
- People who frequently move
- People of a low socio-economic status

By targeting the higher risk demographics in the areas experiencing a greater frequency of fires along with older homes, Surrey Fire Service was able to strategically utilize resources to have a greater ability to produce desired outcomes and lower the fire rates. Overtime, delivery of the HomeSafe program evolved to one in which fire crews provided safe cooking tips along with smoke alarm verifications and installations during attendance at low acuity incidents and through resident requests for a HomeSafe visit. For the targeted outreach, community engagement volunteers were utilized to go door-to-door on behalf of the fire services to deliver messaging previously done by fire crews as well as verify and install smoke alarms whenever they were found to be absent from the home during the campaign. Each of the six communities which make up the City of Surrey were analyzed separately to ascertain variations in fire rates as well as primary ignition sources. With most fires occurring in Whalley (City Centre) and Newton, this provided a geographical location to concentrate outreach efforts.

As a year-round initiative, the HomeSafe program has been shown to lower the fire rates and increase the rate of working smoke alarms in single family dwellings which has experienced a fire [13].

Methodology

To examine the impact of cooking fires in overall residential structure fires in the City of Surrey, this research uses the following metrics: fire rates per 100,000 residential units, the percentage of working smoke alarms detected at residential fires, the number of fatalities and injuries combined or

casualty rates per 100,000 population, and the building loss. The study also evaluates the impact of cooking fires in relation to the fire extent within or beyond the room of origin.

The research not only includes fire incidents that have been reported to the BC Office of Fire Commissioner (BCOFC), but also those which are considered non-reportable incidents. For the reportable incidents, cooking fires can be defined as fire incidents that are classified according to the igniting object of cooking equipment (BC reporting IG codes with prefix 1xxx from IG code 1020-stove, range, top burner area to code 1900-cooking equipment unclassified). The non-reportable cooking fires can be defined as those incidents with the actual incident types as fire stovetop or any structure fires with the incident notes containing terms such as barbeque, barbecue, stove, kitchen, oven, and cooking,

With respect to property classifications, the study specifically looks at residential properties which includes single-residential (classified with the BC reporting PC codes 3400-residential single detached, 3500 residential duplex, 3-plex, 4-plex, and 3800 residential mobile home/trailer park), and multi-residential (classified with the PC codes 3100 residential row, garden, town housing, condominium, 3200 residential apartment, 3900 residential with business/mercantile up to 3 stories), and excludes hotel/motel, educational institution, and camp site/RV park. The aggregate data regarding number of residential units in those different classifications have been provided by the City's Planning and Development department.

Relating to working smoke alarms, the study breaks down the fire incidents into two categories: fires with working smoke alarms (classified with the smoke alarm operation SD codes 1000 alarm activated assisted occupants in evacuating, 2000 alarm activated inaudible, 3000 alarm activated occupants unable to respond, 4000 alarm activated unnecessary to evacuate or unoccupied, 5000 alarm activated occupant action unknown, 6000 alarm not activated unsuitable location, 8000 alarm not activated AC power not connected, and 9000 alarm not activated mechanical failure), fires without working smoke alarms (classified with the SD codes 0000 cannot be determined, 7000 alarm not activated no battery or battery dead, 9500 alarm not activated unknown, 9900 no smoke alarm installed).

Regarding the fire extent, the statistics are broken down into two categories: within room of origin (classified with the Extent of Fire XF codes 1000 confined to object of origin, 2000 confined to part of room, 3000 confined to room of origin) and beyond room of origin (classified with the XF codes 4000 confined to floor level of origin, 5000 confined to building of origin, 6000 extended beyond property of origin, 7000 confined to roof/attic space).

As per the recommendation of BC OFC, fire investigators estimate the building losses for any structure fire by taking the BC Assessment value of the property of interest and multiplying it by the estimated percentage of loss. For example, if 50% of a building is lost then the building loss of that property will be 50% of the BC Assessment value. To align with the description above, a yearly comparison of building losses due to cooking fires at residential buildings should consider the inflation factor by adjusting the losses using housing price indexes from Statistics Canada (house component only). The index measures the change over time in the contractors' selling prices of

residential houses assuming detailed specifications pertaining to each house remain the same between two consecutive periods.

Similar evaluation metrics, i.e., the fire rates per 100,000 residential units, the percentage of working smoke alarms detected at residential fires, the number of fatalities and injuries combined or casualty rates per 100,000 population are also applied to measure the success of the HomeSafe program in its ability to impact cooking fires. This is done by comparing the metrics before and after the program treatments on the properties within the HomeSafe cohorts.

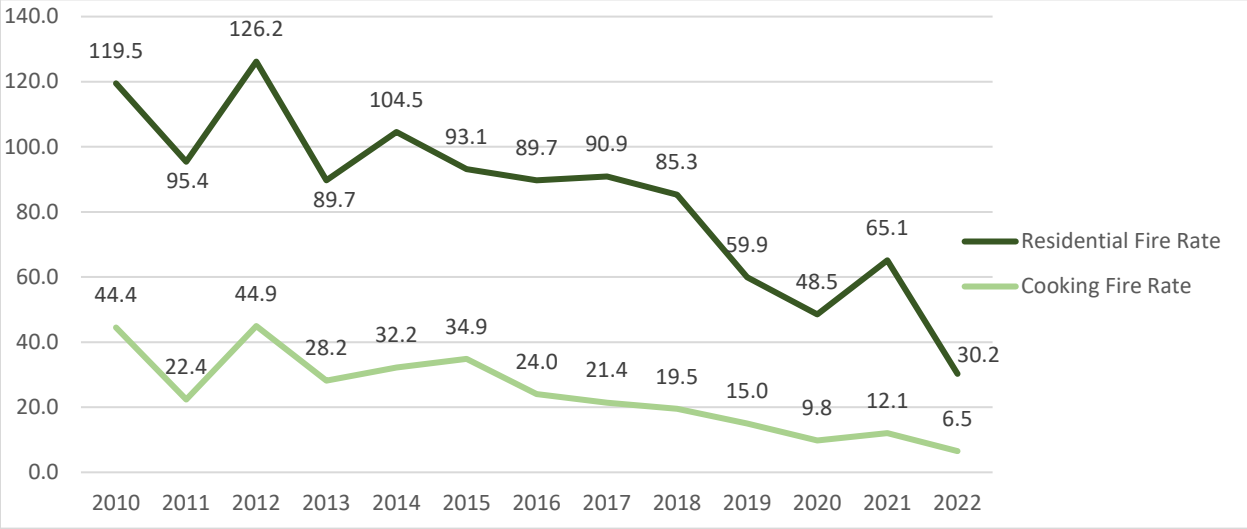
Discussions on City-Wide related Outcomes

The following discussion displays the contribution of cooking activities to fire-related outcomes at residential properties in the City of Surrey.

Residential Fire Rate

This metric measures the number of reported fires at residential structures as results of cooking activities described in the methodology section. The analysis shows the number of fires adjusted by the number of residential units from 2010 to 2022 year-to-date (up to second quarter of 2022).

Graph 1: Residential Fire Rate vs Cooking Fire Rate at Residential

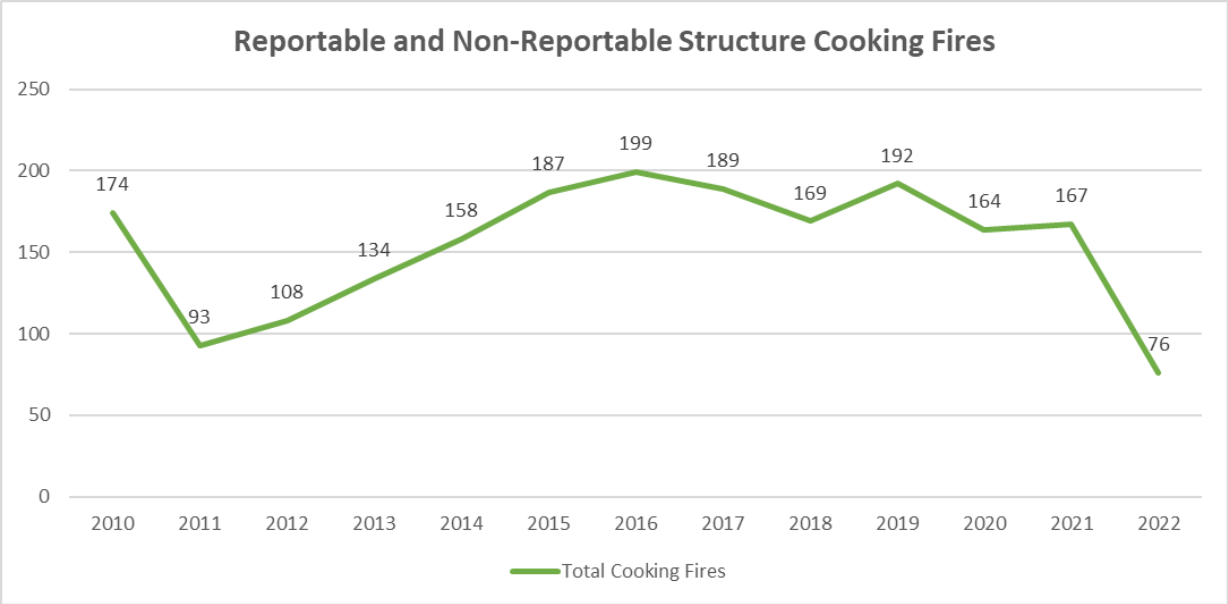


Graph 1 shows the continuous decline of fire rates in both fires at residential structures in general and fires caused by cooking activities at residential structures. Furthermore, a different analysis also illustrates the shift of cooking fires from the top cause of residential fires with nearly 40% of all residential fires in 2010 to the second top contributor in 2022 with only 21.5% of total residential fires.

Similar declining trends can also be seen in dispatched fire incidents from cooking activities. Graph 2 shows how the structure fires resulted from cooking have been declining since 2015 with the recent uptick in 2019 but declining again for 2020, 2021, and 2022 year-to-date. The analysis also

demonstrates that there are in total 2,350 dispatched fire incidents due to cooking activities from 2010 to June 2022 with 28.5% of which are reportable cooking fires.

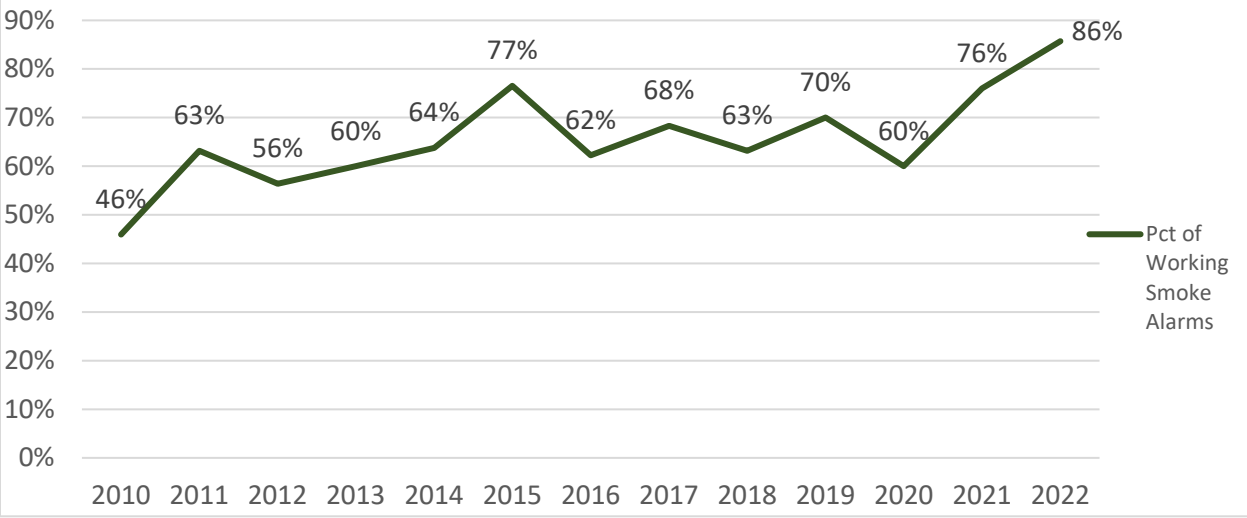
Graph 2: Structure Fires resulting from Cooking



Working Smoke Alarms

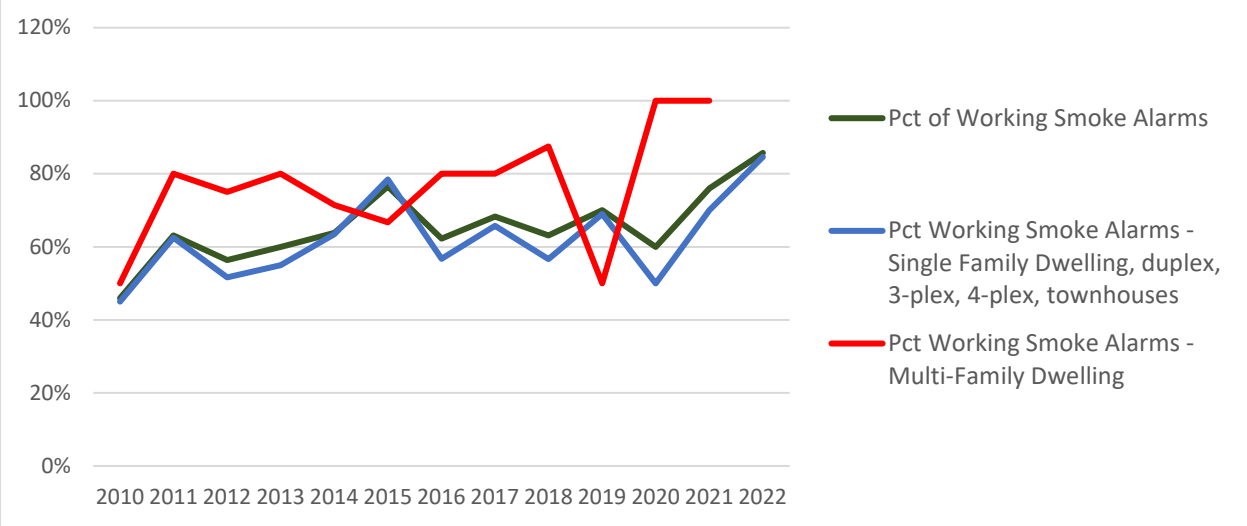
With respect to the presence of working smoke alarms found in residential properties that experienced a cooking fire, there is a slight increasing trend with the average of 60% over the last 10 years. A significant uptick in working smoke alarms is demonstrated in 2022 year to date with a rate of nearly 86% present for cooking fires at residential properties. This is significantly higher than the general rates prior to the period of HomeSafe program where the trend had been declining to the point where less than 33% of residential properties at fires had functioning smoke alarm [7].

Graph 3: Percentage of Working Smoke Alarms



Nevertheless, the percentage of working smoke alarms varies among different property classifications. The properties with the categories of single-family dwellings, duplex, 3-plex, 4-plex, or townhouses tend to have a lower rate of working smoke alarms than the multi-family residential properties such as units in apartments, high-rises, or condominiums. The properties in the category of single-family dwelling (including duplex, 3-plex, 4-plex, or townhouses) contributes to around 83% of cooking fires but only 62% of them occurred in properties with working smoke alarms. On the other hand, the multi-family residential properties (e.g., apartments, condominium, high-rises) contribute to only 19% of cooking fires but found in 80% of properties with working smoke alarms. This result is likely from the fact that those properties are equipped with fire safety mechanisms and required by law to be regularly inspected.

Graph 4: Percentage of Working Smoke Alarms in different property types



Fatality and Injury Rate

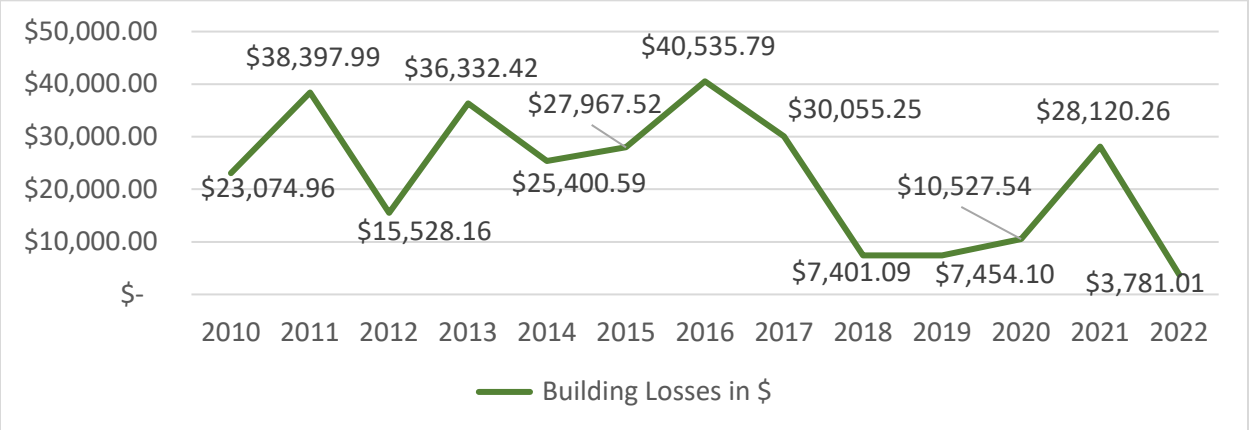
Graph 5 shows inconsistent trends on the fatalities and injuries (casualties) rates from 2010 to 2019. Nevertheless, decreasing casualty rates can be seen over the last 3 years reaching the lowest rate in 2021 of 0.5 casualties per 100,000 population. At the time of this study, there have been no reported casualties for 2022.

Graph 5: Cooking Fire related Casualty rate per 100,000 population

Building Loss

The next analysis displays the average of building losses caused by cooking fires at single-family dwelling category (including duplex, 3-plex, 4-plex, townhouses) after the adjustment by the house price indexes from Statistics Canada to enable yearly comparisons. It shows a significantly lower trend over the last 5 years since 2016 despite a recent uptick in 2021.

Graph 6: Adjusted Building Losses in $ from Cooking Fires at Single Family Dwelling Category

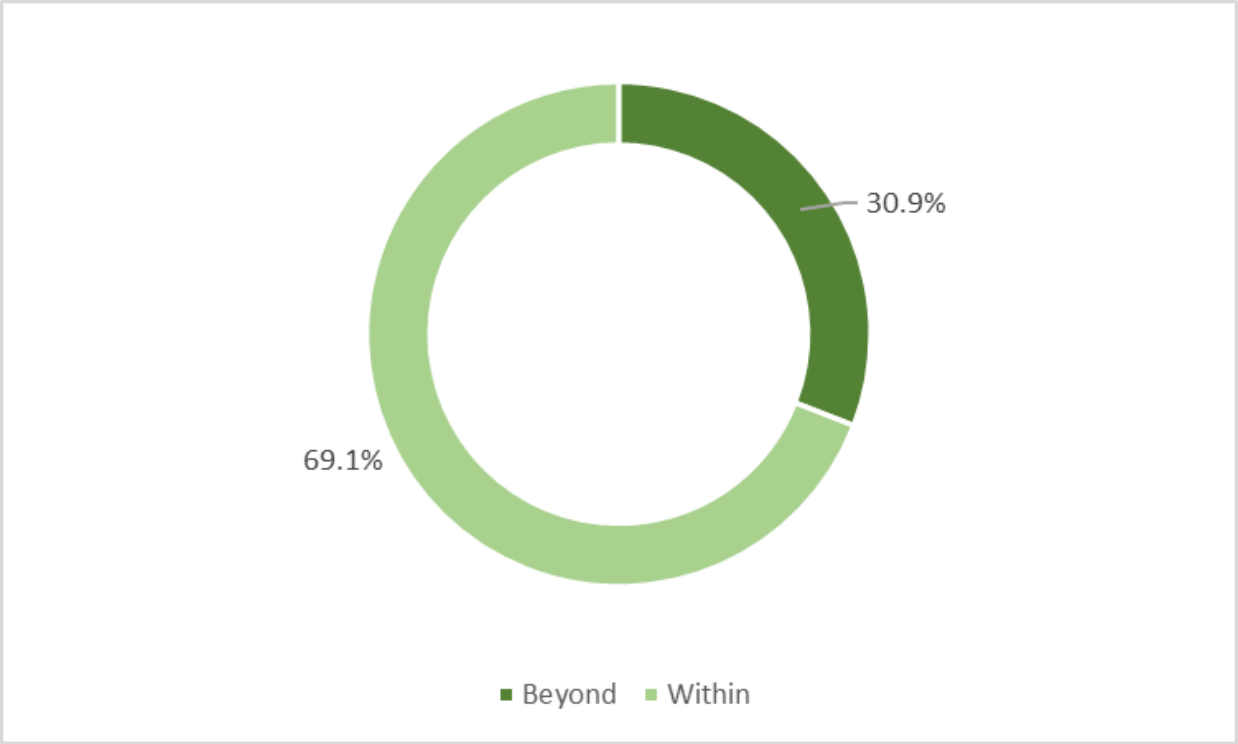


Fire Extent

With respect to the fire spread, the analysis below shows the frequency of cooking fires which extend beyond room of origin. It demonstrates that nearly 70% of cooking fires are contained within room of origin. The percentage of cooking fires contained within room of origin in the single-family properties /duplex / 3plex/ townhome (68%) is lower than other residential types such as apartment (75.5%). One of the reasons might be due to the lower percentage of working smoke

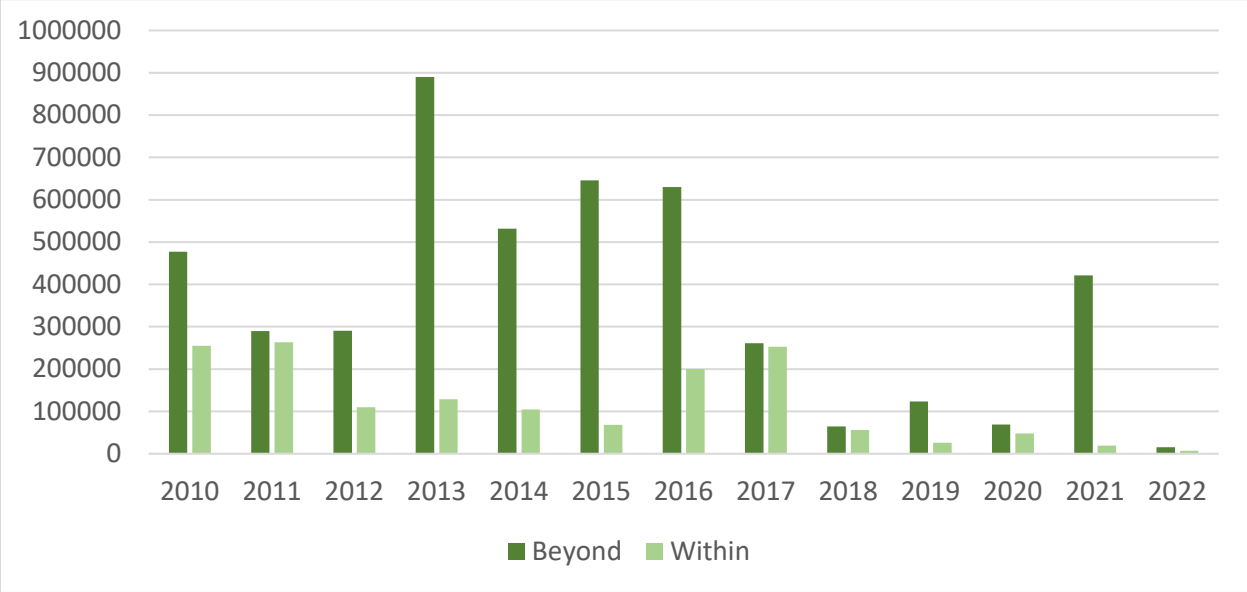
alarms (62.2%) compared to apartment/condominium/high-rises (78.5%) and the fact that multi-family residential properties are equipped with full or at least partial fire safety systems (alarm and/or sprinkler).

Graph 7: Extent of Cooking Fires in Single Family Dwelling Category



The next analysis demonstrates how the fire spread is positively correlated with the building losses. Graph 8 displays the average of adjusted building losses per cooking fire incident at single-family dwelling, duplex, 3-plex, 4-plex and townhouses broken down by fire spread (beyond or within room of origin).

Graph 8: Average Building Losses per Fire Incident at Single Family Dwelling by Fire Extent



Discussion on HomeSafe Cohorts related Outcomes

This section discusses the HomeSafe program impact on cooking fires. The impact can be evaluated by comparing fire-related metrics before and after properties included in the HomeSafe cohorts received a program intervention (treatment). Each cohort consists of a geographical cluster of properties as the targeted area for HomeSafe treatment based on fire-related risk. There are 24 temporal delivery cohorts consisting of over 44,000 properties since the beginning of the program in 2008 up until the time of this study.

Residential Fire Rate

Table 1 below shows the comparison of cooking fire rates on the residential properties in the HomeSafe cohort before and after treatments. To be consistent with the previous HomeSafe evaluation studies, a two-year time frame was used as denominator in the calculation of annual fire rate prior to HomeSafe treatments whereas the time range between the start and the completion of each cohort is included in the denominator to calculate annual fire rate after HomeSafe treatments.

Table 1: Cooking Fire Rates of Properties in HomeSafe Program Before and After Treatments

Cohort	Nr Properties	# Cooking Fire Before Treatments	Annual Cooking Fire Rate Before Treatments	# Cooking Fire After Treatments	Annual Cooking Fire Rate After Treatments	% Change
2008 - 2022	44293	61	0.7	173	0.3	-59%

It shows a declining fire rate by nearly 60% for those properties after HomeSafe treatments which again demonstrates the effectiveness of the HomeSafe program in reducing cooking fires at residential properties.

Working Smoke Alarms

Table 2 demonstrates the comparison of working smoke alarm rates at residential fires for properties in the HomeSafe cohort before and after treatments.

Table 2: Working Smoke Alarm Rates of Properties in HomeSafe Program Before and After Treatments

Cohort	Nr Properties	# Cooking Fires Before Treatments	Pct Working Smoke Alarm Before HomeSafe treatments	# Cooking Fires After Treatments	Pct Working Smoke Alarm After HomeSafe treatments	% Change
2008 - 2022	44293	61	46%	173	63%	37%

It shows an increasing rate of working smoke alarms found at the properties in the HomeSafe program by 37%.

Fatality and Injury Rate

Table 3 demonstrates the comparison of annual casualty rate (fatality and injury combined) at residential fires for properties in the HomeSafe cohort before and after treatments.

Table 3: Casualty Rates of Properties in HomeSafe Program Before and After Treatments

Cohort	Nr Properties	# Cooking Fires Before Treatments	# Casualty per 100 residential fires per year before Treatments	# Cooking Fires After Treatments	# Casualty per 100 residential fires per year after treatments	% Change
2008 - 2022	44293	61	7.4	173	1.5	-79%

It shows a declining casualty rate at fires in the properties within HomeSafe program by nearly 80%.

Conclusion

Previous studies have shown the prevalence of cooking fires as one of the leading causes of residential structure fires. Attributed to negligent human behaviours, studies have made a positive correlation between ongoing educational campaigns aimed at risky behaviours to lower fire casualty rates. Prior to the HomeSafe program, evidence showed a similar trend in the City of Surrey where cooking fires were consistently reported as the primary ignition source for residential fires. The 2009 study reviewed residential fires that occurred in Surrey over the previous 20 years to identify trends and inform the development of an educational campaign to alter behaviours and increase awareness regarding fire risks. Consistent with trends observed across Canada, the data showed most fires which resulted in casualty (death and injury) occurred in residential structures where cooking accounted as the ignition source for 39.9%. As well, an analysis of 3,594 residential structure fires occurring between the years of 1988-2007 showed the fire rate steadily increasing up to approximately 80-88 fires per year per 100,000 people.

To maximize the effectiveness of risk reduction activities using an educational approach to change negligent behaviour patterns, Surrey Fire Service designed a program called HomeSafe to target a population deemed more at risk to promote safer cooking practices and encourage the testing of smoke alarms to ensure early alerting should a fire occur. The population was targeted according to characteristics shown to increase risk such as homes with children under the age of 6, who have difficulty being alerted to an alerting smoke alarm or a senior adult over the age of 65 who may have more difficulty when attempting to escape. Other characteristics which have been linked to homes without working smoke alarms are low socio-economic status, single parent families, and those who experience high transiency.

The objective of this targeted educational approach was to find the most efficient way to distribute limited resources to deliver a community based educational campaign that was sustainable and created a safer community. The results of HomeSafe are constantly monitored to ensure expected outcomes are achieved as previously experienced. This was especially critical during the COVID-19 pandemic when modifications were made to limit in-home smoke alarm installations to fire calls only while continuing to educate citizens over the phone or from outside the home.

Throughout the last 13 years of providing the HomeSafe program including modifications and delivery adaptations, this study has demonstrated that the program has continually reduced the rate of cooking fires, increased the rate of working smoke alarms necessary to provide early notification not only for the properties within the cohorts but also across the City of Surrey. The notable influence of HomeSafe through the reduction of fire-related deaths, injuries, and economic losses has continued to have a positive impact on public welfare and contribute to the safety of the community.

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