July 2018 | Volume 19, Issue 3

Nonresidential Building Fires (2014-2016)

These topical reports are designed to explore facets of the U.S. fire problem as depicted through data collected in the U.S. Fire Administration's National Fire Incident Reporting System. Each topical report briefly addresses the nature of the specific fire or fire-related topic, highlights important findings from the data, and may suggest other resources to consider for further information. Also included are recent examples of fire incidents that demonstrate some of the issues addressed in the report or that put the report topic in context.

Findings

- From 2014 to 2016, an estimated 100,300 nonresidential building fires were reported to United States fire departments each year and caused an estimated 90 deaths; 1,350 injuries; and $2.4 billion in property losses per year.
- National estimates for 2014 to 2016 show that nonresidential buildings accounted for 20 percent of the total dollar loss from all fires.
- Cooking was the leading cause of all nonresidential building fires (30 percent). Nearly all nonresidential building cooking fires were small, confined fires (94 percent).
- Outside and special properties accounted for the most nonresidential building fires (22 percent), while storage buildings accounted for the most nonresidential building fire deaths (24 percent).
- Nonresidential building fires occurred most frequently from 1 to 7 p.m.
- Nonconfined nonresidential building fires most often started in vehicle storage areas (9 percent).
- In 59 percent of nonconfined nonresidential building fires, the fire extended beyond the room of origin. The leading causes of these larger fires were other unintentional or careless actions (22 percent) and exposures (12 percent).
- Misuse of material or product (32 percent) was the leading category of factors contributing to ignition in nonconfined nonresidential building fires.
- Smoke alarms were not present in 52 percent of the larger, nonconfined fires in occupied nonresidential buildings.
- Automatic extinguishing systems (AESs) were reported as present in 20 percent of nonconfined fires in occupied nonresidential buildings.

Each year, from 2014 to 2016, fire departments responded to an estimated 100,300 fires in nonresidential buildings across the nation.[1,2] These fires resulted in an annual average of 90 deaths; 1,350 injuries; and $2.4 billion in property losses. Although national estimates for 2014 to 2016 show that nonresidential building fires represented only 8 percent of all fires, 3 percent of fire deaths and 9 percent of fire injuries, they accounted for 20 percent of the total dollar loss from all fires.[3] Nonresidential building fires can also have a significant economic impact on a community as they may lead to lost jobs and closed businesses. In addition, because many nonresidential buildings are places where a large number of people gather, they hold the greatest potential for a mass casualty incident to occur.

The term "nonresidential buildings," a subset of nonresidential structures, includes enclosed structures and fixed portable or mobile structures. The majority of nonresidential fires, deaths and injuries occur in buildings, and that is where prevention efforts are most often targeted. Specifically, nonresidential buildings include assembly places; eating and drinking establishments; educational and institutional facilities; stores and offices; detached garages; basic industry, manufacturing and storage facilities; as well as outside and other miscellaneous nonresidential buildings. They also include institutions, such as prisons, nursing homes, juvenile care facilities, and hospitals — though many people may temporarily reside there for short (or long) periods of time.

FEMA | U.S. Fire Administration
Working for a fire-safe America

National Fire Data Center
16825 S. Seton Ave.
Emmitsburg, MD 21727
https://www.usfa.fema.gov/data/statistics/

This report addresses the characteristics of all nonresidential building fires as reported to the U.S. Fire Administration's (USFA's) National Fire Incident Reporting System (NFIRS). The focus is on fires reported from 2014 to 2016, the most recent data available at the time of the analysis.[4] NFIRS data are used for the analyses throughout this report.

For the purpose of this report, the term "nonresidential fires" is synonymous with "nonresidential building fires." "Nonresidential fires" is used throughout the body of this report; the findings, tables, figures, headings and endnotes reflect the full category, "nonresidential building fires."

Type of fire

Building fires are divided into two classes of severity in the NFIRS: "confined fires," which are fires confined to certain types of equipment or objects, and "nonconfined fires," which are fires that are not confined to certain types of equipment or objects. Confined building fires are small fire incidents that are limited in extent — staying within pots, fireplaces or certain other noncombustible containers.[5] Confined fires rarely result in serious injuries or large content losses and are expected to have no significant accompanying property loss due to flame damage.[6]

Of the two classes of severity, nonconfined fires accounted for 52 percent of nonresidential fires. The smaller, confined fires accounted for the remaining 48 percent of nonresidential fires. Trash or rubbish fire was the predominant type of confined fire in nonresidential buildings (Table 1).

Table 1. Nonresidential building fires by type of incident (2014-2016)

Incident type	Percent
Nonconfined fires	52.1
Confined fires	47.9
Cooking fire, confined to container	18.3
Chimney or flue fire, confined to chimney or flue	1.3
Incinerator overload or malfunction, fire confined	0.5
Fuel burner/boiler malfunction, fire confined	1.9
Commercial compactor fire, confined to rubbish	0.7
Trash or rubbish fire, contained	25.2
Total	100.0

Source: NFIRS 5.0.

Loss measures

Table 2 presents losses, averaged over the three-year period from 2014 to 2016, of reported nonresidential and residential building fires.[7] The average number of fatalities and injuries per 1,000 nonresidential fires was notably lower than the same loss measures for residential building fires. Fire evacuation procedures may be more likely to be in place in nonresidential buildings than in homes, which may be one reason for the lower rates of death and injury. Additionally, fire codes often require inspections of nonresidential buildings. These inspections are not as prevalent for residential buildings (especially one- and two-family dwellings). This may be another reason for the lower rates of fire incidence, death and injury in nonresidential buildings. Finally, occupants of nonresidential buildings are more likely to be awake and alert during all hours of the day as they typically relocate to residential buildings to sleep. As a result, occupants of nonresidential buildings are better able to identify incidents and quickly take action or take preventive measures before an incident occurs.

Nonresidential fires, however, tended to be the most costly fires. This was especially true for nonconfined nonresidential fires. The higher property-loss values may be due to nonresidential buildings often being larger and therefore more expensive than residential buildings. In addition, the contents of nonresidential buildings are more likely to have a higher value than the contents of residential buildings.

Table 2. Loss measures for nonresidential and residential building fires (three-year average, 2014-2016)

Measure	Nonresidential building fires	Confined nonresidential building fires	Nonconfined nonresidential building fires	Residential building fires
Average loss:				
Fatalities/1,000 fires	1.1	0.0	2.1	5.8
Injuries/1,000 fires	8.7	2.1	14.8	25.6
Dollar loss/fire	$33,380	$460	$63,600	$17,490

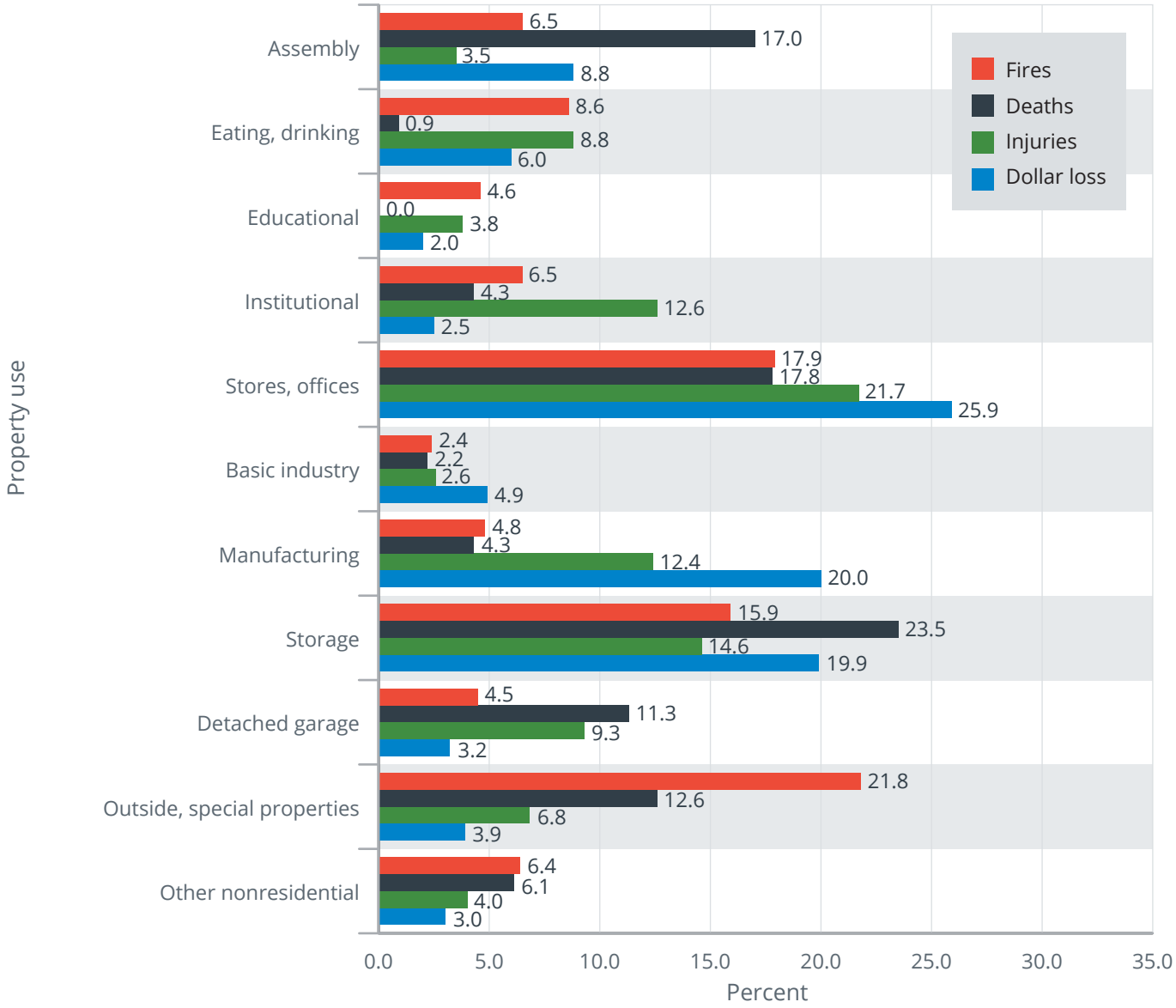
Source: NFIRS 5.0.

Notes: 1. Average loss for fatalities and injuries is computed per 1,000 fires; average dollar loss is computed **per fire** and is rounded to the nearest $10.
2. The 2014 and 2015 dollar-loss values were adjusted to 2016 dollars.

Property use

Figure 1 presents the percentage distribution of fires and fire losses by major nonresidential property use category (e.g., assembly places, eating and drinking establishments, educational facilities, etc.).[8] Buildings on outside and special properties accounted for 22 percent of nonresidential fires. The second and third leading property use categories, stores and offices (18 percent) and storage facilities (16 percent) respectively, accounted for an additional 34 percent of nonresidential fires. Storage buildings accounted for 24 percent of the fire deaths, followed by stores and offices (18 percent) and assembly buildings (17 percent).[9] In addition, 22 percent of injuries and 26 percent of dollar losses associated with nonresidential fires occurred in stores and offices.

Figure 1. Nonresidential building fires and fire losses by property use (2014-2016)

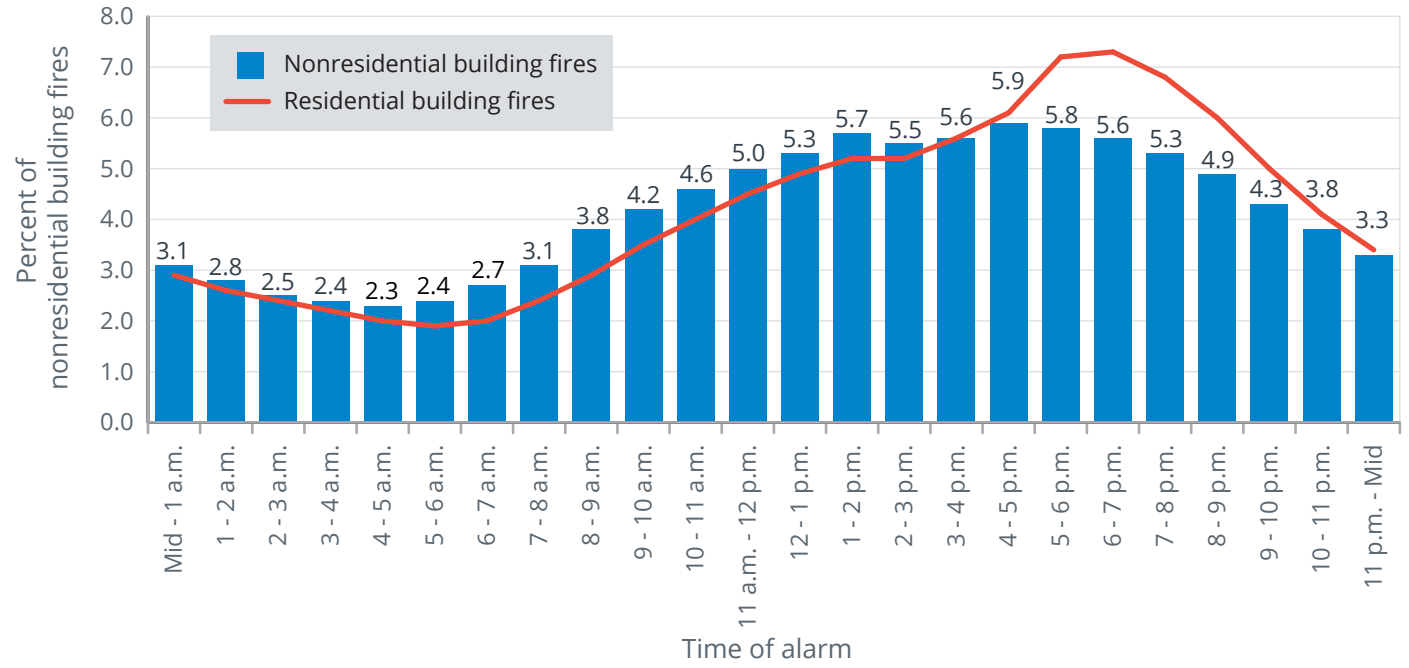


Source: NFIRS 5.0.
Notes: 1. Total percentages of fires, injuries and dollar losses do not add up to 100 percent due to rounding.
2. The 2014 and 2015 dollar-loss values were adjusted to 2016 dollars.

When nonresidential building fires occur

As shown in Figure 2, nonresidential fires occurred most frequently from 1 to 7 p.m., accounting for 34 percent of the fires.[10] Fires then declined throughout the night, reaching the lowest point during the early to midmorning hours (3 to 6 a.m.). Nonresidential fire incidence was similar to that of residential building fires, with the exception of residential building fire incidence peaking in the early evening hours.

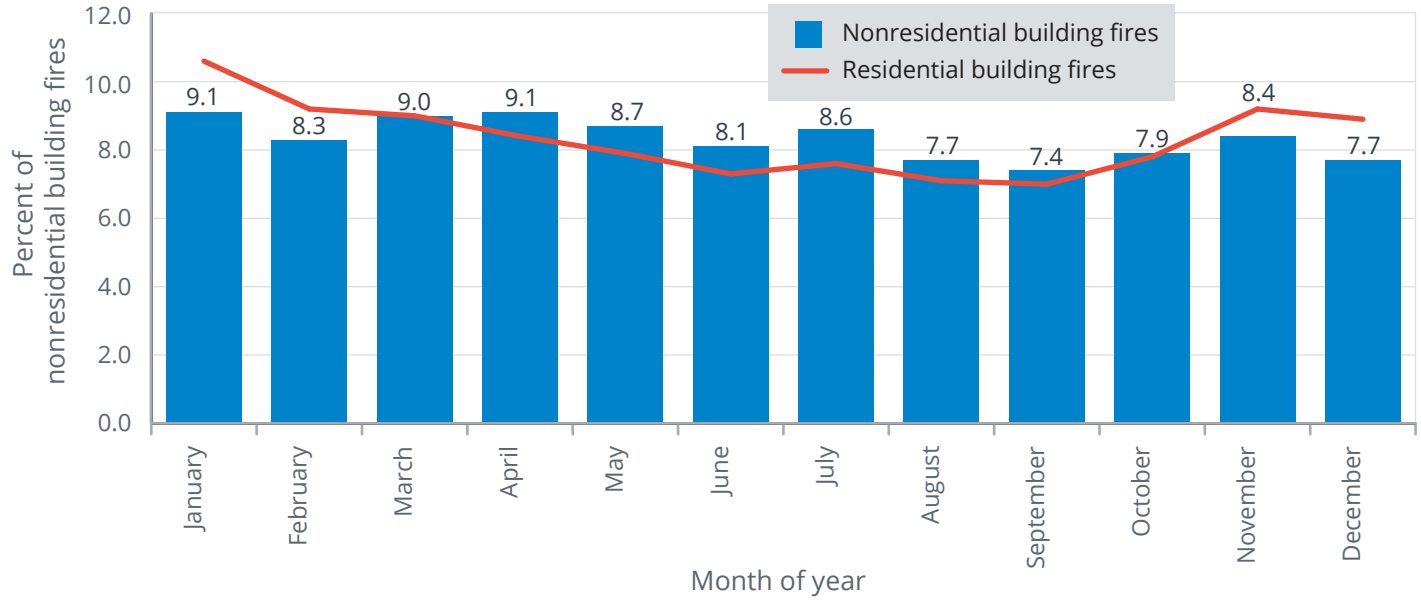
Figure 2. Nonresidential building fires by time of alarm (2014-2016)



Source: NFIRS 5.0.
Note: Total does not add up to 100 percent due to rounding.

Figure 3 illustrates that, unlike residential building fires which followed a seasonal trend and were markedly higher in the cooler months, nonresidential fires occurred without much variation throughout the year. Nonresidential fire incidence was only slightly higher in the months of January, March and April, and was lowest in September.

Figure 3. Nonresidential building fires by month (2014-2016)



Source: NFIRS 5.0.

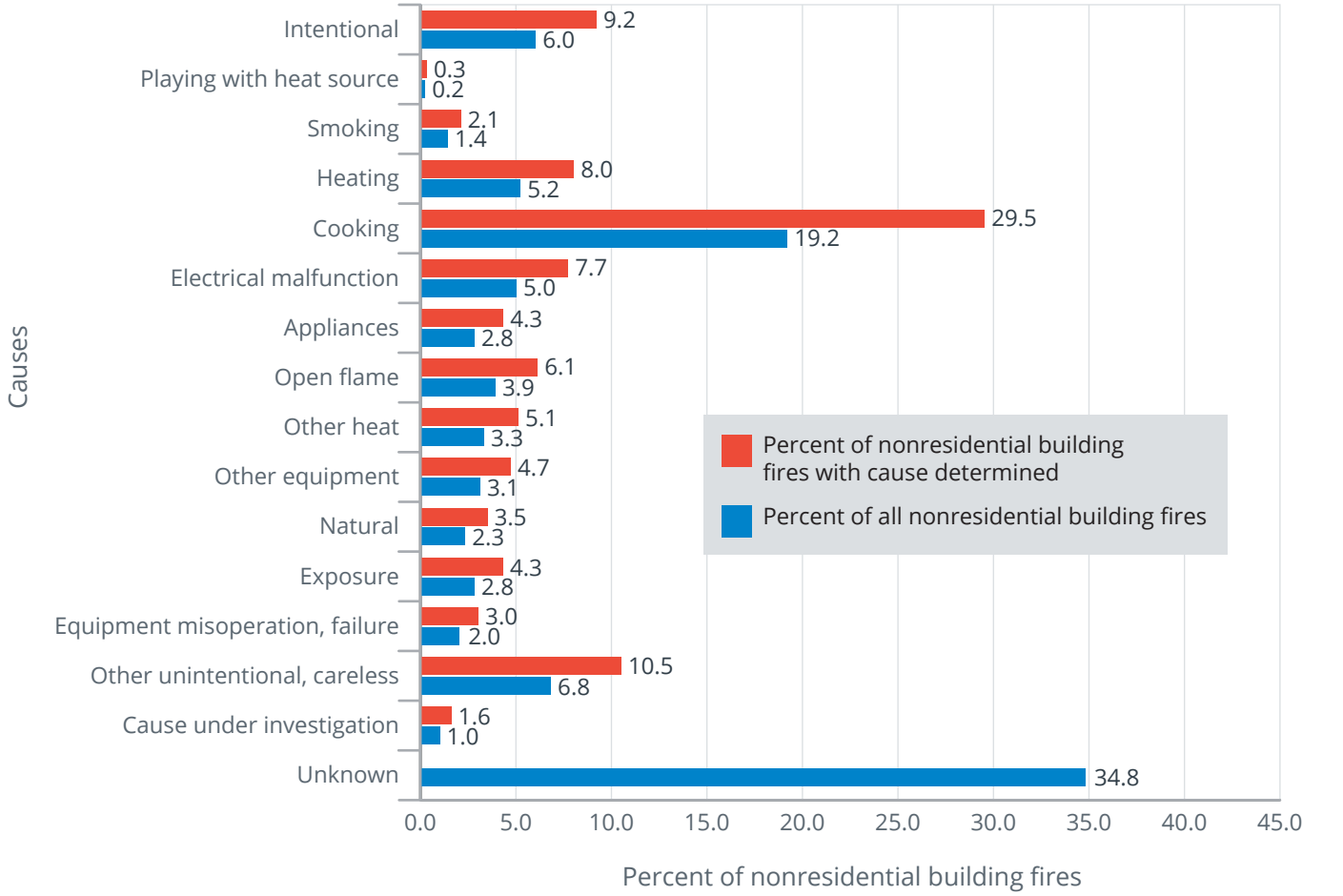
Causes of nonresidential building fires

Cooking was the leading cause and accounted for 30 percent of all nonresidential fires, as shown in Figure 4. Nearly all of these cooking fires (94 percent) were small, confined fires with limited damage.

The next four causes combined accounted for 36 percent of nonresidential fires: other unintentional or careless actions (11 percent); intentional actions (9 percent);[11] heating (8 percent); and electrical malfunctions, such as short circuits or wiring problems (8 percent).[12] Unintentional or careless actions include misuse of material or product; abandoned or discarded materials or products; heat source placed too close to combustibles; and other miscellaneous, unintentional actions.

Comparatively, cooking (50 percent) and heating (11 percent) were the leading causes of residential building fires from 2014 to 2016. However, a higher percentage of residential building fires resulted from cooking.

Figure 4. Causes of nonresidential building fires (2014-2016)



Source: NFIRS 5.0.

Notes: 1. Causes are listed in order of the USFA Structure Fire Cause Hierarchy for ease of comparison of fire causes across different aspects of the fire problem. Fires are assigned to one of 16 cause groupings using a hierarchy of definitions, as shown in this figure. A fire is included in the highest category into which it fits. If it does not fit the top category, then the second one is considered, and if not that one, the third, and so on. For example, if the fire is judged to be intentionally set and a match was used to ignite it, it is classified as intentional and not open flame because intentional is higher in the hierarchy.

2. Totals do not add up to 100 percent due to rounding.

When looking at the different categories of property use (e.g., assembly, eating and drinking, education, etc.), there were some differences in leading fire causes as shown in Table 3. As for all nonresidential fires, cooking was, by far, the leading cause for assembly (40 percent), eating and drinking (63 percent), educational (49 percent), institutional (70 percent), stores and offices (32 percent), and other nonresidential (27 percent) building fires. The leading causes for basic industry, manufacturing, storage, detached garage, and outside or special property fires, however, were different than cooking. The leading cause for industrial fires was other unintentional or careless action (16 percent). For manufacturing fires, the leading causes were heating (17 percent) and other equipment (17 percent). Other unintentional or careless actions (24 percent) were the leading causes of storage fires, while exposure (19 percent), other unintentional or careless actions (16 percent), and intentional actions (10 percent) were the leading causes of detached garage fires. Finally, intentional actions (25 percent) were the leading causes of outside or special property fires.

Table 3. Leading causes of nonresidential building fires by property use (2014-2016)

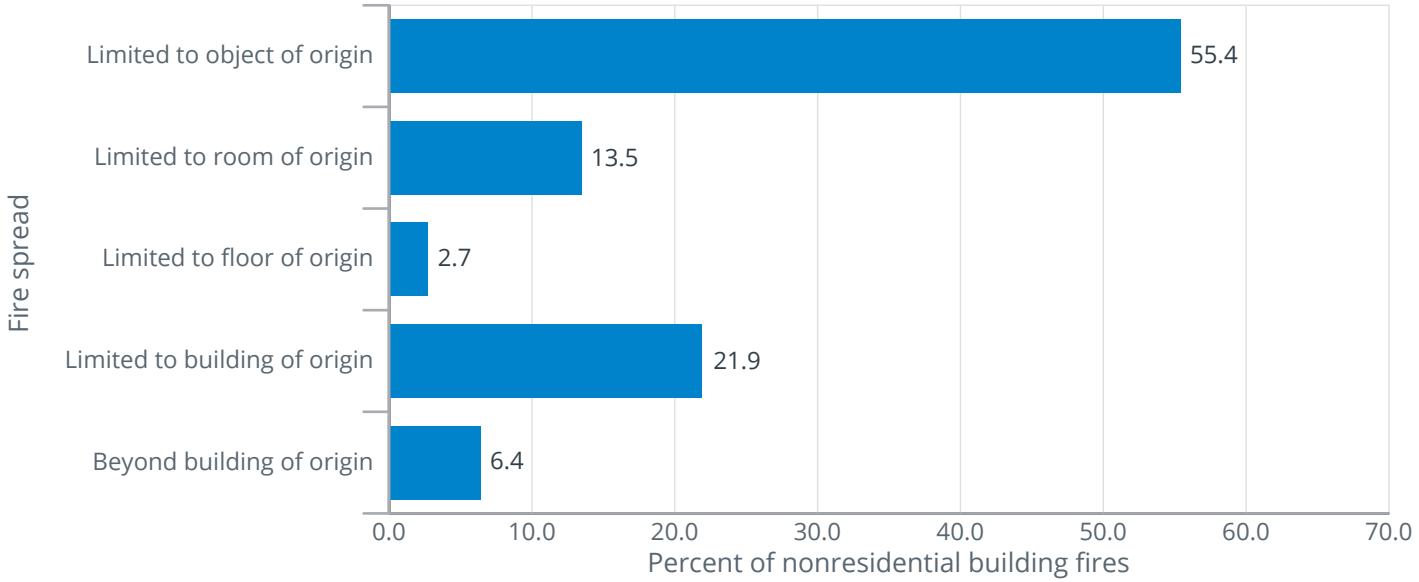
Property use category	Leading fire causes	Percent (unknowns apportioned)
Assembly	Cooking	39.8
	Intentional	11.0
	Heating	9.6
Eating, drinking	Cooking	62.9
	Heating	7.1
	Electrical malfunction	6.0
Educational	Cooking	49.4
	Intentional	15.0
	Heating	10.1
Institutional	Cooking	69.5
	Appliances	5.7
	Heating	4.9
Stores, offices	Cooking	31.6
	Electrical malfunction	11.4
	Heating	9.4
Basic industry	Other unintentional, careless	15.7
	Heating	13.7
	Electrical malfunction	12.8
Manufacturing	Heating	16.7
	Other equipment	16.5
	Equipment misoperation, failure	12.2
Storage	Other unintentional, careless	23.5
	Open flame	11.2
	Exposure	9.8
Detached garage	Exposure	19.4
	Other unintentional, careless	15.6
	Intentional	10.3
Outside, special properties	Intentional	25.0
	Cooking	14.8
	Other unintentional, careless	10.8
Other nonresidential	Cooking	26.6
	Other unintentional, careless	20.0
	Intentional	10.8

Source: NFIRS 5.0.

Fire spread in nonresidential building fires

In 55 percent of nonresidential fires, the fire was limited to the object of origin (Figure 5). Included in these fires are those coded as "confined fires" in the NFIRS. Additionally, 31 percent of fires extended beyond the room of origin.

Figure 5. Extent of fire spread in nonresidential building fires (2014-2016)



Source: NFIRS 5.0.
Note: Total does not add up to 100 percent due to rounding.

Confined fires

The NFIRS allows abbreviated reporting for confined fires, and many reporting details of these fires are not required, nor are they reported. (Not all fires limited to the object of origin are counted as confined fires.)[13] For example, a fire contained to a chair or clothes dryer is not defined as a "confined fire" in the NFIRS because of the greater potential for spread. Unlike fires in pots or chimneys, there is no container to stop the fire, even though the fire did not spread beyond the object of origin.

As previously discussed, it is known that confined fires accounted for 48 percent of all nonresidential fires (Table 1). Trash or rubbish fires accounted for 53 percent of these confined fires, while cooking fires — those cooking fires confined to a pot on the stove, for example — accounted for an additional 38 percent.

Confined nonresidential fires occurred most frequently in the late afternoon and evening hours from 4 to 7 p.m. In addition, like all nonresidential fires, confined nonresidential fires occurred without much variation throughout the year with a slight peak occurring in July.

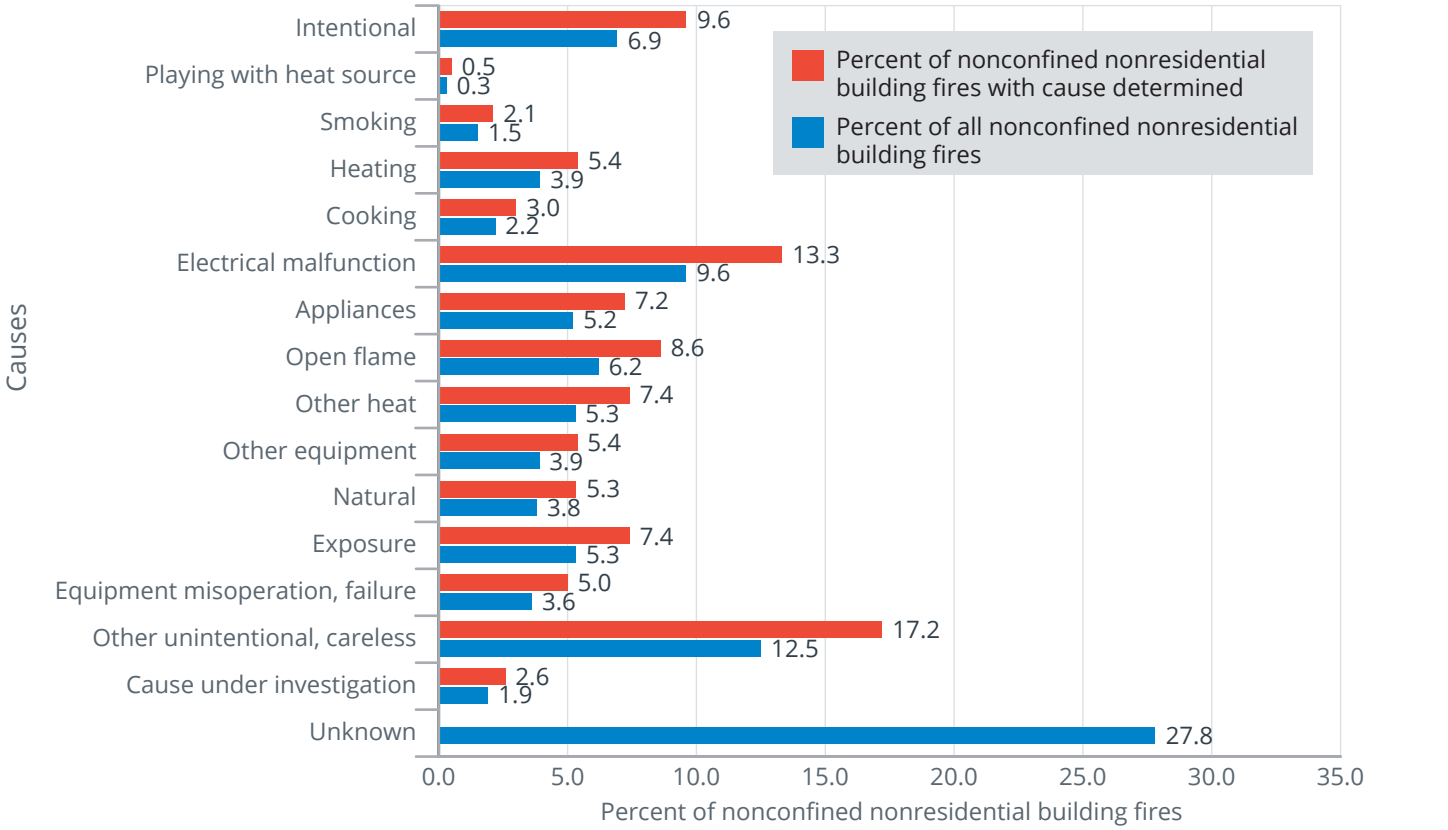
Nonconfined fires

The next sections of this topical report address nonconfined nonresidential fires — the larger and more serious fires — where more detailed fire data are available, as they are required to be reported in the NFIRS.

Causes of nonconfined nonresidential building fires

While cooking was the leading cause of nonresidential fires overall, it only accounted for 3 percent of all nonconfined nonresidential fires. Other unintentional or careless action (17 percent) and electrical malfunction (13 percent) were the leading causes of nonconfined nonresidential fires (Figure 6). Other leading causes of nonconfined nonresidential fires were intentional action, a group that includes fires commonly called arson fires (10 percent); and open flame, a group that includes candles, matches and lighters (9 percent).

Figure 6. Causes of nonconfined nonresidential building fires (2014-2016)



Source: NFIRS 5.0.

Notes: 1. Causes are listed in order of the USFA Structure Fire Cause Hierarchy for ease of comparison of fire causes across different aspects of the fire problem. Fires are assigned to one of 16 cause groupings using a hierarchy of definitions, as shown in this figure. A fire is included in the highest category into which it fits. If it does not fit the top category, then the second one is considered, and if not that one, the third, and so on. For example, if the fire is judged to be intentionally set and a match was used to ignite it, it is classified as intentional and not open flame because intentional is higher in the hierarchy.

2. Total of all nonconfined nonresidential building fires does not add up to 100 percent due to rounding.

There were also differences in leading fire causes for nonconfined nonresidential fires than for all nonresidential fires when looking at the different categories of property use (Table 4). For example, while the three leading causes of all nonresidential fires in assembly places were cooking (40 percent), intentional action (11 percent), and heating (10 percent), the three leading causes of nonconfined nonresidential fires in assembly places were electrical malfunction (19 percent), intentional action (17 percent), and other unintentional or careless action (10 percent). In addition, while the three leading causes of all nonresidential fires in institutional facilities were cooking (70 percent), appliances (6 percent), and heating (5 percent), the leading causes of nonconfined nonresidential fires in institutional facilities were appliances (21 percent), electrical malfunction (17 percent), and intentional action (11 percent).

Table 4. Leading causes of nonconfined nonresidential building fires by property use category (2014-2016)

Property use category	Leading fire causes	Percent (unknowns apportioned)
Assembly	Electrical malfunction	18.7
	Intentional	17.1
	Other unintentional, careless	10.4
Eating, drinking	Cooking	19.3
	Electrical malfunction	15.8
	Other unintentional, careless	10.8
Educational	Intentional	28.8
	Electrical malfunction	15.1
	Appliances	10.7
Institutional	Appliances	21.0
	Electrical malfunction	17.3
	Intentional	11.1
Stores, offices	Electrical malfunction	19.3
	Appliances	14.3
	Other unintentional, careless	11.2
Basic industry	Other unintentional, careless	20.0
	Electrical malfunction	16.5
	Natural	10.0
Manufacturing	Equipment misoperation, failure	16.4
	Other unintentional, careless	12.9
	Other equipment	12.6
Storage	Other unintentional, careless	24.8
	Open flame	11.5
	Exposure	10.4
Detached garage	Exposure	19.7
	Other unintentional, careless	15.9
	Intentional	10.2
Outside, special properties	Other unintentional, careless	20.1
	Exposure	14.8
	Intentional	11.5
Other nonresidential	Other unintentional, careless	34.0
	Intentional	11.6
	Other heat	11.4

Source: NFIRS 5.0.

Where nonconfined nonresidential building fires start (area of fire origin)

Vehicle storage area (9 percent) was the leading area of fire origin in nonconfined nonresidential fires, as shown in Table 5. Other storage areas (7 percent), cooking areas and kitchens (6 percent), and exterior wall surfaces (6 percent) were the next most common areas of fire origin in nonresidential buildings.

Table 5. Leading areas of fire origin in nonconfined nonresidential building fires (2014-2016)

Areas of fire origin	Percent (unknowns apportioned)
Vehicle storage area: garage, carport	8.6
Storage area, other	7.3
Cooking area, kitchen	6.3
Exterior wall surface	6.1

Source: NFIRS 5.0.

The leading areas of fire origin, however, varied among the different categories of nonresidential property use (Table 6). For example, the leading areas of fire origin for eating and drinking establishments, as expected, were cooking areas and kitchens (38 percent). Also as expected, the leading area of fire origin for detached garages was vehicle storage area (56 percent). For both assembly places and educational facilities, however, the leading area of fire origin was bathrooms, checkrooms and locker rooms (9 percent and 20 percent, respectively). In addition, laundry areas (14 percent) and bedrooms (14 percent) were the two leading areas of fire origin for institutional facilities, while processing and manufacturing areas (27 percent), machinery rooms (9 percent), and other service or equipment areas (8 percent) were the leading areas of fire origin for manufacturing buildings.

Table 6. Leading areas of fire origin in nonconfined nonresidential building fires by property use (2014-2016)

Property use category	Leading area of fire origin — percent (unknowns apportioned)	Second leading area of fire origin — percent (unknowns apportioned)	Third leading area of fire origin — percent (unknowns apportioned)
Assembly	Bathroom, checkroom, locker room 8.9	Cooking area, kitchen 7.9	Exterior wall surface 5.0
Eating, drinking	Cooking area, kitchen 37.8	Exterior wall surface 6.8	Exterior roof surface 4.8
Educational	Bathroom, checkroom, locker room 19.5	Cooking area, kitchen 6.4	Assembly area without fixed seats 5.8
Institutional	Laundry area 14.1	Bedrooms 13.5	Cooking area, kitchen 9.7
Stores, offices	Laundry area 7.1	Cooking area, kitchen 6.0	Office 5.3
Basic industry	Storage area, other 9.8	Structural area, other 7.8	Service or equipment area, other 6.5
Manufacturing	Processing/Manufacturing area 26.9	Machinery room or area 9.2	Service or equipment area, other 8.1
Storage	Storage area, other 17.9	Supplies or tools storage area 11.6	Vehicle storage area: garage, carport 10.4
Detached garage	Vehicle storage area: garage, carport 55.9	Exterior wall surface 12.0	Outside area, other 4.7
Outside, special properties	Outside area, other 8.6	Exterior wall surface 7.0	Storage area, other 6.5
Other nonresidential	Function area, other 14.8	Area of fire origin, other 9.7	Outside area, other 9.1

Source: NFIRS 5.0.

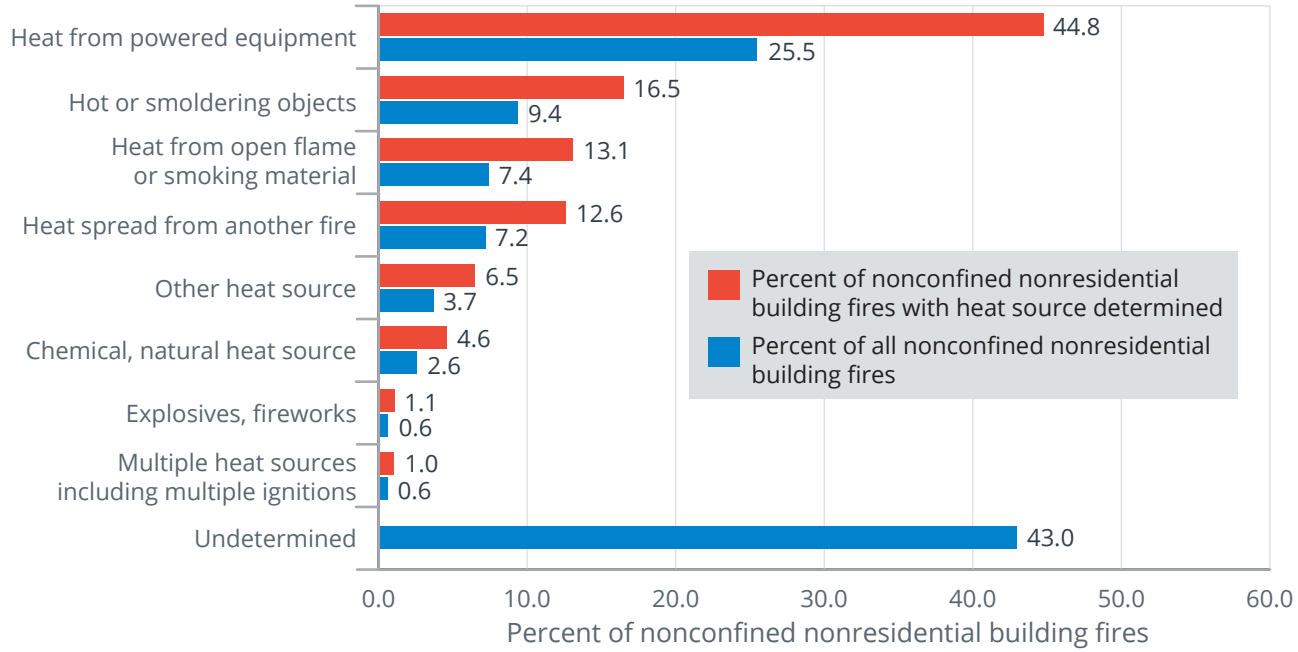
How nonconfined nonresidential building fires start (heat source)

Figure 7 shows sources of heat categories for nonconfined nonresidential fires. Heat from powered equipment accounted for 45 percent of nonconfined nonresidential fires. This category includes electrical arcing (15 percent); heat from other powered equipment (13 percent); radiated or conducted heat from operating equipment (10 percent); and spark, ember or flame from operating equipment (7 percent).

Hot or smoldering objects accounted for 17 percent of nonconfined nonresidential fires. This category includes such items as miscellaneous hot or smoldering objects (7 percent) and hot embers or ashes (7 percent).

Additionally, heat from open flames or smoking materials (13 percent) and heat spread from another fire (13 percent) accounted for 26 percent of nonresidential fires. The heat from open flame category includes such items as other miscellaneous open flames or smoking materials (4 percent), lighters and matches (combined, 4 percent), and cigarettes (2 percent). The heat spread from another fire category includes heat from direct flames (4 percent) and radiated heat from another fire (3 percent).

Figure 7. Sources of heat in nonconfined nonresidential building fires by major category (2014-2016)



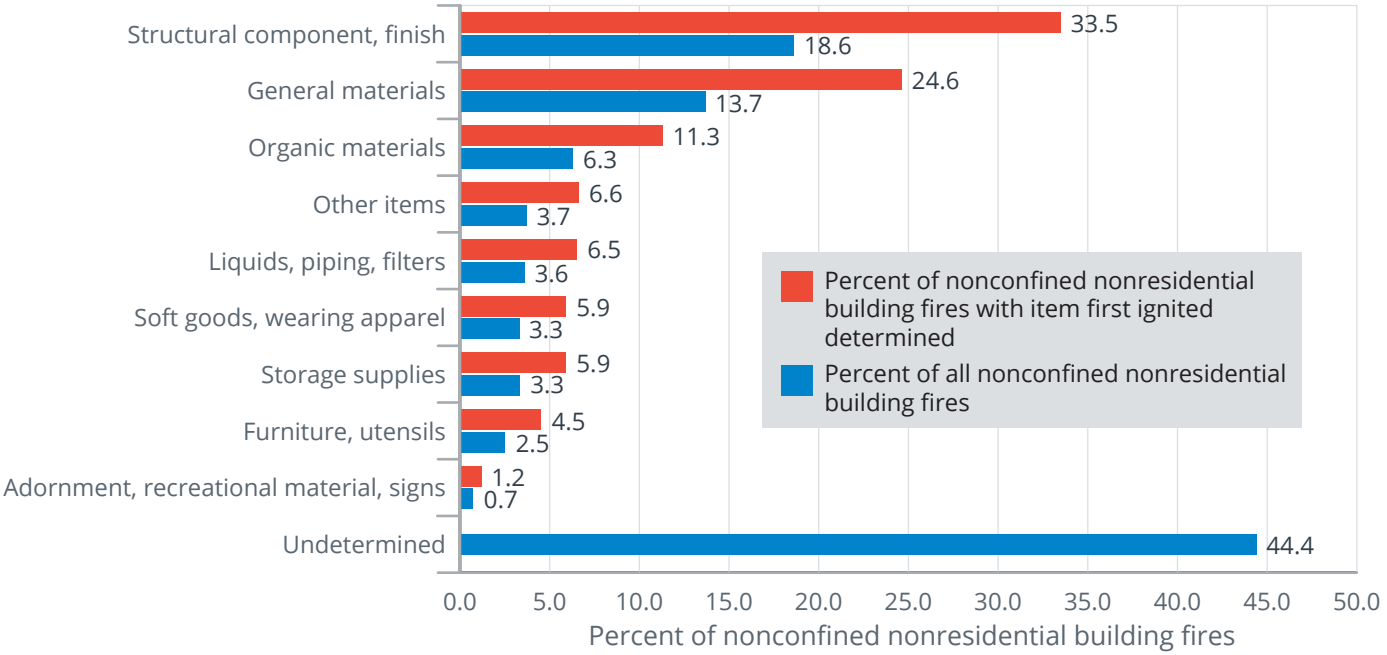
Source: NFIRS 5.0.
Note: Total of nonconfined nonresidential building fires with heat source determined does not add up to 100 percent due to rounding.

What ignites first in nonconfined nonresidential building fires

Of the items first ignited in nonconfined nonresidential fires where the item first ignited was determined, 34 percent fell under the structural component and finish category (Figure 8). This category includes structural member or framing and exterior sidewall covering. The second leading category of items first ignited in nonconfined nonresidential fires was the general materials category which accounted for 25 percent of these fires. The general materials category includes items such as electrical wire, cable insulation, and trash or rubbish. At 11 percent, organic materials was the next leading category of nonconfined nonresidential fires. This category includes items such as cooking materials and light vegetation, including grass and leaves.

Electrical wire, cable insulation (10 percent), exterior sidewall covering (10 percent), and structural member or framing (8 percent) were the specific items most often first ignited in nonconfined nonresidential fires.

Figure 8. Item first ignited in nonconfined nonresidential building fires by major category (2014-2016)



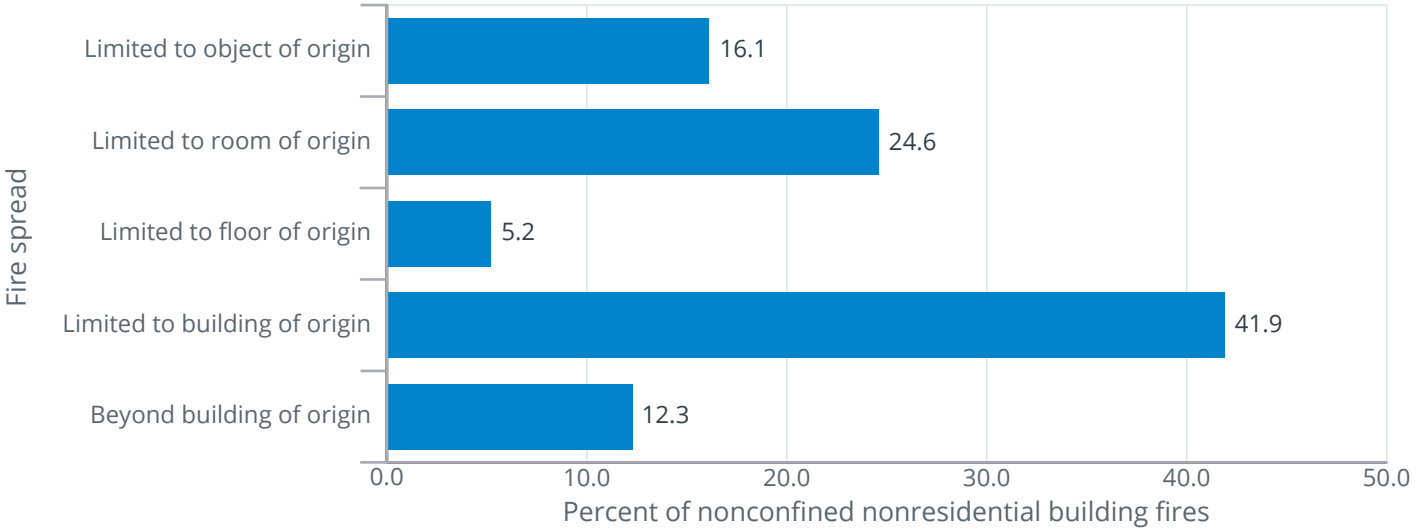
Source: NFIRS 5.0.
Note: Total of all nonconfined nonresidential building fires does not add up to 100 percent due to rounding.

Fire spread in nonconfined nonresidential building fires

Figure 9 shows the extent of fire spread in nonconfined nonresidential fires. Of these nonconfined fires, 41 percent were limited to the object or room of fire origin — in 25 percent of these fires, the fire was limited to the room of origin; in another 16 percent, the fire was limited to the object of origin. (Note that a fire contained to a sofa or bed is not defined as a confined fire because of the greater potential for spread. Unlike fires in pots or chimneys, there is no container to stop the fire, even though the fire did not spread beyond the object of origin.)

Additionally, 59 percent of nonconfined nonresidential fires extended beyond the room of origin. The leading causes of these larger fires were unintentional or careless actions (22 percent) and exposures (12 percent).

Figure 9. Extent of fire spread in nonconfined nonresidential building fires (2014-2016)



Source: NFIRS 5.0.
Note: Total does not add up to 100 percent due to rounding.

Factors contributing to ignition in nonconfined nonresidential building fires

Table 7 shows the categories of factors contributing to ignition in nonconfined nonresidential fires. The leading category was the misuse of material or product (32 percent). In this category, the leading specific factors contributing to ignition were a heat source too close to combustible materials (12 percent) and abandoned or discarded materials, such as matches or cigarettes (7 percent).

Electrical failures and malfunctions contributed to 21 percent of nonconfined nonresidential fires. Fire spread or control was the third leading category at 19 percent. Exposure was the leading specific factor in the fire spread or control category and accounted for 11 percent of all nonconfined nonresidential fires.

Table 7. Factors contributing to ignition for nonconfined nonresidential building fires by major category (where factors contributing to ignition are specified, 2014-2016)

Factors contributing to ignition category	Percent of nonconfined nonresidential building fires (unknowns apportioned)
Misuse of material or product	31.9
Electrical failure, malfunction	21.3
Fire spread or control	18.8
Mechanical failure, malfunction	10.9
Operational deficiency	8.9
Other factors contributing to ignition	5.9
Natural condition	5.3
Design, manufacture, installation deficiency	1.8

Source: NFIRS 5.0.

Notes: 1. Includes only incidents where factors that contributed to the ignition of the fire were specified.
2. Multiple factors contributing to fire ignition may be noted for each incident; the total will exceed 100 percent.

Alerting/Suppression systems in nonresidential building fires

Fire fatalities and injuries have declined over the last 35 years, partly due to new technologies to detect and extinguish fires. In addition, the installation of smoke alarms and fire sprinklers is generally required in nonresidential buildings where an increased risk to life is present, such as hospitals, prisons, or educational facilities. They're also required in nonresidential buildings that present an increased fire hazard to occupants and firefighters, such as high-rise buildings and industrial facilities.

Smoke alarm data is available for both confined and nonconfined fires, although for confined fires, the data is very limited in scope. Since different levels of data are reported on smoke alarms in confined and nonconfined fires, the analyses are performed separately. Note that the data presented in Tables 8 to 10 are the raw counts from the NFIRS dataset and are not scaled to national estimates of smoke alarms in nonresidential fires. In addition, NFIRS does not allow for the determination of the type of smoke alarm (i.e., photoelectric or ionization) or the location of the smoke alarm with respect to the area of fire origin.

Smoke alarms in nonconfined fires

Overall, smoke alarms were reported as present in only 24 percent of nonconfined nonresidential fires (Table 8). By comparison, because building codes generally require smoke alarms to be installed in locations where people sleep, smoke alarms were reported as present in 43 percent of nonconfined residential fires. In 56 percent of nonconfined nonresidential fires, there were no smoke alarms present. In another 20 percent of these fires, firefighters were unable to determine if a smoke alarm was present. Thus, smoke alarms were potentially missing in 56 to 76 percent of these fires with the ability to spread and possibly result in fatalities.

Table 8. Presence of smoke alarms in nonconfined nonresidential building fires (2014-2016)

Presence of smoke alarms	Percent
Present	23.8
None present	56.1
Undetermined	20.1
Total	100.0

Source: NFIRS 5.0.

While 21 percent of all nonconfined nonresidential fires occurred in buildings that are not currently or routinely occupied, these buildings — which are under construction, undergoing major renovations, vacant and the like — are unlikely to have alerting and suppression systems that are in place and, if in place, that are operational. In fact, only 4 percent of all nonconfined fires in unoccupied nonresidential buildings were reported as having smoke alarms that were present and that operated. As a result, the detailed smoke alarm analyses in the next section focus on nonconfined fires in occupied nonresidential buildings only.[14]

Smoke alarms in nonconfined fires in occupied nonresidential buildings

Smoke alarms were reported as present in 28 percent of nonconfined fires in occupied nonresidential buildings (Table 9). In 52 percent of nonconfined fires in occupied nonresidential buildings, there were no smoke alarms present. In another 20 percent of these fires, firefighters were unable to determine if a smoke alarm was present; unfortunately, in 55 percent of the fires where the presence of a smoke alarm was undetermined, either the flames involved the building of origin or spread beyond it. The fires were so large and destructive that it is unlikely the presence of a smoke alarm could be determined.

When smoke alarms were present (28 percent) and the alarm's operational status is considered, the percentage of smoke alarms reported as present consisted of the following:

- Present and operated — 16 percent.
- Present but did not operate — 8 percent (fire too small, 6 percent; alarm failed to operate, 2 percent).
- Present but operational status unknown — 4 percent.

When the subset of incidents where smoke alarms were reported as present was analyzed separately as a whole, smoke alarms were reported to have operated in 56 percent of the incidents and failed to operate in 6 percent. In 22 percent of this subset, the fire was too small to activate the alarm. The operational status of the alarm was undetermined in 15 percent of these incidents.[15]

Again, in at least 52 percent of nonconfined fires in occupied nonresidential buildings, there were no smoke alarms present — and perhaps more if fires without information on smoke alarms could be factored in.[16] A portion of reported fires without smoke alarms may reflect the effectiveness of the alarms themselves: Smoke alarms do not prevent fires, but they may prevent a fire from being reported if it is detected at an early stage and extinguished before the fire department becomes involved.

If a fire occurs, properly installed and maintained smoke alarms provide an early warning signal. Smoke alarms help save lives and property. The USFA continues to partner with other government agencies and fire service organizations to improve and develop new smoke alarm technologies. More information on smoke alarm technologies, performance, disposal and storage, training bulletins, and public education and outreach materials can be found at https://www.usfa.fema.gov/prevention/technology/smoke_fire_alarms.html.

Table 9. NFIRS smoke alarm data for nonconfined fires in occupied nonresidential buildings (2014-2016)

Presence of smoke alarms	Smoke alarm operational status	Smoke alarm effectiveness	Count	Percent
Present	Fire too small to activate smoke alarm		5,443	6.3
	Smoke alarm operated	Smoke alarm alerted occupants, occupants responded	9,672	11.2
		Smoke alarm alerted occupants, occupants failed to respond	389	0.5
		No occupants	2,678	3.1
		Smoke alarm failed to alert occupants	110	0.1
		Undetermined	805	0.9
	Smoke alarm failed to operate		1,430	1.7
	Undetermined		3,763	4.4
None present			44,627	51.9
Undetermined			17,111	19.9
Total reported incidents			86,028	100.0

Source: NFIRS 5.0.
Note: The data presented in this table are raw data counts from the NFIRS dataset summed (not averaged) from 2014 to 2016. They do not represent national estimates of smoke alarms in nonconfined fires in occupied nonresidential buildings. They are presented for informational purposes.

Smoke alarms in confined fires

Less information about smoke alarm status is collected for confined fires, but the data still give important insights about the effectiveness of alerting occupants in these types of fires. The analyses presented here do not differentiate between occupied and unoccupied nonresidential buildings, as this data detail is not required when reporting confined fires in the NFIRS. However, an assumption may be made that confined fires are fires in occupied buildings, as these types of fires are unlikely to be reported in buildings that are not occupied.

Smoke alarms alerted occupants in 27 percent of the reported confined nonresidential fires (Table 10). Occupants were not alerted by smoke alarms in 24 percent of confined nonresidential fires.[17] In 49 percent of these confined fires, the smoke alarm effectiveness was unknown.

Table 10. NFIRS smoke alarm data for confined nonresidential building fires (2014-2016)

Smoke alarm effectiveness	Count	Percent
Smoke alarm alerted occupants	27,108	27.0
Smoke alarm did not alert occupants	24,200	24.1
Unknown	48,962	48.8
Total reported incidents	100,270	100.0

Source: NFIRS 5.0.
Notes: 1. The data presented in this table are raw data counts from the NFIRS dataset summed (not averaged) from 2014 to 2016. They do not represent national estimates of smoke alarms in confined nonresidential building fires. They are presented for informational purposes.
2. Total does not add up to 100 percent due to rounding.

Automatic extinguishing systems in nonconfined fires in occupied nonresidential buildings

AES data are available for both confined and nonconfined fires; although, for confined fires, the data are also very limited in scope. In confined nonresidential building fires, an AES was present in only 2 percent of reported incidents.[18] As a result, the analyses here focus on nonconfined fires. In addition, the following analyses focus on occupied buildings since unoccupied buildings, such as those that are under construction, are less likely to have AESs present.

Although sprinklers are required by code in many nonresidential buildings that present an increased fire hazard or risk to life, full or partial AESs were reported as present in 20 percent of nonconfined fires in occupied nonresidential buildings (Table 11). AESs were not present in 70 percent of these fires.

Table 11. NFIRS automatic extinguishing system data for nonconfined fires in occupied nonresidential buildings (2014-2016)

AES presence	Count	Percent
AES present	16,688	19.4
Partial system present	894	1.0
AES not present	59,925	69.7
Unknown	8,521	9.9
Total reported incidents	86,028	100.0

Source: NFIRS 5.0.
Note: The data presented in this table are raw data counts from the NFIRS dataset summed (not averaged) from 2014 to 2016. They do not represent national estimates of AESs in nonconfined fires in occupied nonresidential buildings. They are presented for informational purposes.

Examples

The following are recent examples of nonresidential fires reported by the media:

- March 2018: A 10-story office building was evacuated around 10 p.m. in Rockville, Maryland, after smoke and haze filled several floors. Upon arriving at the scene, firefighters investigated the smoke inside the building and found that a heating, ventilating, and air conditioning (HVAC) unit had overheated and burned. Fire crews checked the remainder of the building and parking garage for other signs of fire or smoke before clearing the scene. No injuries were reported.[19]
- March 2018: A Rochester, New York, building was temporarily closed after a fire broke out in the area of the first-floor bar and restaurant around 3:50 a.m. Heavy smoke was coming from both floors of the two-story building when firefighters arrived at the scene. The building housed both a restaurant and a barber shop. According to fire department personnel, the fire was contained to the restaurant, which sustained substantial fire damage. There was no reported fire damage to the barber shop; however, it sustained minor water damage. No one was injured in the blaze. The cause of the fire is under investigation.[20]
- January 2018: Residents in Chartiers Township, Pennsylvania, were ordered to "Shelter in Place" as a precaution after a fire started inside a metal and wire manufacturing plant around 7:30 p.m. Upon arrival, emergency personnel found smoke coming from the building, and a piece of machinery on fire. Hazmat teams were also called to the scene as the fire was reported in a part of the building that housed various chemicals. Air quality monitoring was established, but no chemicals were detected in the air. The fire spread throughout the building and extended to the roof of the plant, resulting in a partial roof collapse onto the piece of machinery where the fire started. As it took crews several hours to contain the fire, the building sustained heavy damage. There were employees inside the facility when the fire broke out. However, everyone got out safely, and no major injuries were reported.[21]

- January 2018: The cause of a fire that broke out in a Boyle Heights church in Los Angeles, California, is being investigated as a possible arson. Firefighters responded to the incident just after 2 a.m. to find flames coming from the building. The fire was contained to the first floor of the church, burning the main entrance and vestibule area. Candles were lit in the vestibule, but firefighters reported that the candles were being burned properly according to fire code standards. After the fire was extinguished, vandalism was discovered on both the interior and exterior of the building, which prompted officials to investigate the fire as suspicious. No injuries were reported as a result of the blaze.[22]

NFIRS data specifications for nonresidential building fires

Data for this report were extracted from the NFIRS annual Public Data Release files for 2014, 2015 and 2016. Only Version 5.0 data were extracted.

Nonresidential building fires were defined using the following criteria:

- Aid Types 3 (mutual aid given) and 4 (automatic aid given) were excluded to avoid counting a single incident more than once.
- Incident Types 111 to 123 (excluding Incident Type 112):

Incident Type	Description
111	Building fire
113	Cooking fire, confined to container
114	Chimney or flue fire, confined to chimney or flue
115	Incinerator overload or malfunction, fire confined
116	Fuel burner/boiler malfunction, fire confined
117	Commercial compactor fire, confined to rubbish
118	Trash or rubbish fire, contained
120	Fire in mobile property used as a fixed structure, other
121	Fire in mobile home used as fixed residence
122	Fire in motor home, camper, recreational vehicle
123	Fire in portable building, fixed location

Note: Incident Types 113 to 118 do not specify if the structure is a building.

- Property Use 100 to 399, 500 to 999, 000 to 009, NNN and UUU:

Property Use	Description
100-159, 163-199	Assembly
160-162	Eating and drinking establishments
200-299	Educational
300-399	Health care, detention and correction
500-599	Stores and offices
600-699	Industrial, utility, defense, agriculture, mining
700	Manufacturing, processing
800-880, 882-899	Storage
881	Detached garage
900-999	Outside or special property
000-009, NNN, UUU	Property use, other

Note: For a complete listing of the NFIRS Property Use codes, view the NFIRS 5.0 Complete Reference Guide: https://www.usfa.fema.gov/data/nfirs/support/documentation.html (January 2015).

- Structure Type:
  - For Incident Types 113 to 118:
    - 1—Enclosed building, or
    - 2—Fixed portable or mobile structure, or
    - Structure Type not specified (null entry).
  - For Incident Types 111 and 120 to 123:
    - 1—Enclosed building, or
    - 2—Fixed portable or mobile structure.

The analyses contained in this report reflect the current methodologies used by the USFA. The USFA is committed to providing the best and most current information on the U.S. fire problem and continually examines its data and methodology to fulfill this goal. Because of this commitment, data collection strategies and methodological changes are possible and do occur. As a result, analyses and estimates of the fire problem may change slightly over time. Previous analyses and estimates on specific issues (or similar issues) may have used different methodologies or data definitions and may not be directly comparable to the current ones.

Information regarding the USFA's national estimates for nonresidential building fires, as well as the data sources used to derive the estimates, can be found in the document "Data Sources and National Estimates Methodology Overview for the U.S. Fire Administration's Topical Fire Report Series (Volume 19)," https://www.usfa.fema.gov/downloads/pdf/statistics/data_sources_and_national_estimates_methodology_vol19.pdf. This document also addresses the specific NFIRS data elements analyzed in the topical reports, as well as "unknown" data entries and missing data.

To request additional information, visit https://www.usfa.fema.gov/contact.html. To comment on this specific report, visit https://apps.usfa.fema.gov/contact/dataReportEval?reportTitle=Nonresidential%20Building%20Fires%20(2014-2016).

Notes:

[1]National estimates are based on 2014 to 2016 native Version 5.0 data from the NFIRS, nonresidential structure fire loss estimates from the National Fire Protection Association's (NFPA) annual surveys of fire loss, and the U.S. Fire Administration's (USFA) nonresidential building fire loss estimates: https://www.usfa.fema.gov/data/statistics/order_download_data.html. Further information on the USFA's nonresidential building fire loss estimates can be found in the "National Estimates Methodology for Building Fires and Losses," August 2012, https://www.usfa.fema.gov/downloads/pdf/statistics/national_estimate_methodology.pdf. For information on the NFPA's survey methodology, see the NFPA's report "Fire Loss in the United States During 2016," September 2017, https://www.nfpa.org/news-and-research/fire-statistics-and-reports/fire-statistics/fires-in-the-us/overall-fire-problem/fire-loss-in-the-united-states. In this topical report, fires are rounded to the nearest 100, deaths to the nearest five, injuries to the nearest 25, and losses to the nearest $100 million.

[2]In NFIRS Version 5.0, a structure is a constructed item of which a building is one type. In previous versions of the NFIRS, the term "nonresidential structure" commonly referred to buildings where people work, gather, learn, dine, shop, etc. To coincide with this concept, the definition of a nonresidential structure fire for the NFIRS 5.0 includes only those fires where the NFIRS 5.0 Structure Type is 1 or 2 (enclosed building and fixed portable or mobile structure) with a nonresidential property use. Such structures are referred to as "nonresidential buildings" to distinguish these buildings from other structures on nonresidential properties that may include fences, sheds and other various open structures. In addition, confined fire incidents that have a nonresidential property use, but do not have a structure type specified, are presumed to occur in buildings. Nonconfined fire incidents that have a nonresidential property use without a structure type specified are considered to be invalid incidents (Structure Type is a required field) and are not included.

[3]The percentages shown here are derived from the national estimates of nonresidential building fires as explained in Endnote 1 and the summary data resulting from the NFPA's annual fire loss surveys (Haynes, Hylton J.G., "Fire Loss in the United States During 2016," NFPA, September 2017; Haynes, Hylton J.G., "Fire Loss in the United States During 2015," NFPA, September 2016; Haynes, Hylton J.G., "Fire Loss in the United States During 2014," NFPA, September 2015).

[4]Fire department participation in the NFIRS is voluntary; however, some states do require their departments to participate in the state system. Additionally, if a fire department is a recipient of a Fire Act Grant, participation is required. From 2014 to 2016, 68 percent of the NFPA's annual average estimated 1,328,500 fires to which fire departments responded were captured in the NFIRS. Thus, the NFIRS is not representative of all fire incidents in the U.S. and is not a "complete" census of fire incidents. Although the NFIRS does not represent 100 percent of the incidents reported to fire departments each year, the enormous dataset exhibits stability from one year to the next without radical changes. Results based on the full dataset are generally similar to those based on part of the data.

[5]In the NFIRS, confined fires are defined by Incident Type Codes 113 to 118.

[6]The NFIRS distinguishes between "content" and "property" loss. Content loss includes losses to the contents of a structure due to damage by fire, smoke, water and overhaul. Property loss includes losses to the structure itself or to the property itself. Total loss is the sum of the content loss and the property loss. For confined fires, the expectation is that the fire did not spread beyond the container (or rubbish for Incident Type code 118), and hence, there was no property damage (damage to the structure itself) from the flames. However, there could be property damage as a result of smoke, water and overhaul.

[7]The average fire death and fire injury loss rates computed from the national estimates do not agree with average fire death and fire injury loss rates computed from the NFIRS data alone. The fire death rate computed from national estimates is (1,000 x (90/100,300)) = 0.9 death per 1,000 nonresidential building fires, and the fire injury rate is (1,000 x (1,350/100,300)) = 13.5 injuries per 1,000 nonresidential building fires.

[8]There are 11 major nonresidential building property use categories. "Assembly" buildings are places where people gather, such as fixed-use recreational facilities, places of worship, public or government buildings, and ballrooms and gymnasiums, but do not include eating and drinking establishments. "Eating and drinking" establishments include places specializing in on-premise consumption of food, including carryout and drive-thru restaurants, as well as bars and nightclubs. "Educational" buildings include schools for children and adults, such as daycare; preschool; elementary, middle, and high school; college; and adult education centers. "Institutional" buildings include health care, detention and correctional facilities. "Stores and offices" include stores, specialty shops, personal services and offices. "Basic industry" buildings include industrial, utility, defense, agriculture and mining facilities. "Manufacturing" buildings include processing facilities and factories. "Storage" buildings include outside material storage areas, livestock, poultry storage, warehouses, fire stations, and commercial parking structures for vehicles, such as buses and trucks. "Detached garages" include parking garages, detached residential garages and detached parking structures associated with multifamily housing. "Outside and special properties" include facilities, such as guard posts, outside kiosks and the like. "Other nonresidential" buildings include nonresidential buildings not classified with any other property use category.

[9]In 2016, in Oakland, California, a fire at a former warehouse that had been converted to mixed-use properties with an assembly area contributed to the large percentage of fire deaths in assembly buildings. Thirty-five fire deaths were reported to the NFIRS as a result of this incident.

[10]For the purposes of this report, the time of the fire alarm is used as an approximation for the general time at which the fire started. However, in the NFIRS, it is the time at which the fire was reported to the fire department.

[11]Fires caused by intentional actions include, but are not limited to, fires that are deemed to be arson. Intentional fires are those fires that are deliberately set and include fires that result from the deliberate misuse of a heat source and fires of an incendiary nature (arson) that require fire service intervention. For information and statistics on arson fires only, refer to the Uniform Crime Reporting Program arson statistics from the U.S. Department of Justice, FBI, Criminal Justice Information Services Division, https://www.fbi.gov/about-us/cjis/ucr/ucr.

[12]The USFA Structure Fire Cause Methodology was used to determine the cause of nonresidential building fires. The cause methodology and definitions can be found in the document "National Fire Incident Reporting System Version 5.0 Fire Data Analysis Guidelines and Issues," July 2011, https://www.usfa.fema.gov/downloads/pdf/nfirs/nfirs_data_analysis_guidelines_issues.pdf.

[13]As noted previously, confined building fires are small fire incidents that are limited in scope, are confined to noncombustible containers, rarely result in serious injury or large content loss, and are expected to have no significant accompanying property loss due to flame damage. In the NFIRS, confined fires are defined by Incident Type Codes 113 to 118.

[14]"Occupied" implies that the building is operational or in normal use. This includes properties that are closed or unoccupied for a brief period of time, such as businesses that are closed for the weekend.

[15]Total does not add to 100 percent due to rounding.

[16]Here, at least 52 percent of nonconfined fires in occupied nonresidential buildings had no smoke alarms present — the 52 percent that were known to not have smoke alarms and some portion (or as many as all) of the fires where the smoke alarm presence was undetermined.

[17]In confined fires, the entry "smoke alarm did not alert occupants" can mean no smoke alarm was present; the smoke alarm was present but did not operate; the smoke alarm was present and operated, but the occupant(s) was already aware of the fire; or there were no occupants present at the time of the fire.

[18]As confined fire codes are designed to capture fires contained to noncombustible containers, it is not recommended to code a fire incident as a small-, low- or no-loss confined fire incident if the AES operated and contained the fire as a result. The preferred method is to code the fire as a standard fire incident with fire spread confined to the object of origin and provide the relevant information on AES presence and operation.

[19]"Rockville Office Building Evacuated After HVAC Fire," bethesdamagazine.com, March 6, 2018, http://bethesdamagazine.com/Bethesda-Beat/2018/Rockville-Office-Building-Evacuated-After-HVAC-Fire/ (accessed May 7, 2018).

[20]Victoria E. Freile and Tina MacIntyre-Yee, "Fire Heavily Damages 3 Latinos Restaurant On West Ridge Road In Rochester," www.democratandchronicle.com, March 6, 2018, https://www.democratandchronicle.com/story/news/2018/03/05/restaurant-fire-west-ridge-road-rochester/394340002/ (accessed May 7, 2018).

[21]Amy Wadas, "Fire At Metal Manufacturing Plant Prompts 'Shelter In Place' Order In Chartiers Township," pittsburgh.cbslocal.com, Jan. 18, 2018, http://pittsburgh.cbslocal.com/2018/01/18/chartiers-township-dynamet-fire/ (accessed May 7, 2018).

[22]Erika Martin, Erin Myers, and Kareen Wynter, "Fire At Catholic Church In Boyle Heights Investigated As Suspicious After Vandalism Is Found," ktla.com, Jan. 25, 2018, http://ktla.com/2018/01/25/fire-at-catholic-church-in-boyle-heights-investigated-as-suspicious-after-vandalism-is-found/ (accessed May 7, 2018).