chapter four

Non-Residential Properties

This chapter addresses non-residential properties over the 10-year period from 1992 to 2001, with specific focus on 2001. Major variations from the last published statistics on non-residential properties—the 12th Edition, 1989–1998—are noted. Non-residential properties are discussed in three sections: structures, vehicles, and outside/other fires.

The non-residential property category includes industrial and commercial properties, institutions (such as hospitals, nursing homes, prisons), educational establishments (from preschool through university), mobile properties, and storage properties. Each category corresponds to one of the major divisions of property types. Each is quite different, and their cause profiles and magnitudes need to be examined separately.

Several changes in non-residential structure property types are reflected in this edition. Detached residential garages, a subset of non-residential storage properties, are included in this chapter. Vacant and under construction properties are no longer considered as a separate property type. Fires that occur on non-residential properties that are vacant or under construction are included in a separate discussion.

NON-RESIDENTIAL STRUCTURES

The terrorists' attacks on the World Trade Center and the Pentagon on September 11, 2001, killed 2,451 civilians (i.e., non-firefighters), injured 800, and caused $33.4 billion in property loss.[1] In large part, these losses are excluded from the following analysis of non-residential structures. The magnitude of such losses from a single event must be considered an outlier when studying fire events across an entire year and even 10 years. The omission of the September 11 losses from this report, however, is in no way meant to diminish the enormity of the event.

Magnitude and Trends

Significant public and private fire prevention efforts have focused on protecting non-residential structures. The results have proven effective in the main, especially relative to the residential fire problem. Non-residential structures annually account for only 7 percent of fires,

[1] NFPA's annual survey, 2001.

2 percent of deaths, and 8 percent of injuries. These properties, however, account for a disproportionately large annual dollar loss, 31 percent.[2]

The 10-year trends for fires, deaths, and injuries decreased from the 1989–1998 period, while property losses increased. Figure 55 shows that the trend for each of these measures is downward (fires, 22 percent; deaths, 48 percent; injuries, 46 percent; and dollar loss, 15 percent). In absolute numbers, fires, deaths, and injuries reached 10-year lows in 2001.

There were an estimated 80 deaths in non-residential structure fires in 2001. The 1995 peak (290 deaths) is attributed to the 168 people killed in the bombing of the Federal Building in Oklahoma City in 1995. The peak in injuries (3,950) in 1993 includes 1,024 injuries that occurred at the World Trade Center explosion and fire in New York City. Although difficult to discern from the chart, the $3.8 billion peak in property losses in 1995 includes $135 million for the Oklahoma City building, $200 million at a Georgia manufacturing plant fire, and $500 million at a Massachusetts industrial complex fire (values in 1995 dollars).

Figure 56 shows the relative magnitude of the fire problem in non-residential structures by each of ten property categories.[3] The eating/drinking property types are actually a subset of public assembly, and detached residential garages are a subset of storage properties, but it is useful to highlight these properties separately.

Fires in other/outside structures lead the property categories in 2001 at 23 percent, replacing stores and office fires, which led in 1994, 1996, and 1998. Stores/offices and storage facilities were the next highest property types for fires. Together, these three groupings represent 59 percent of all non-residential fires.

Fatalities were greatest at storage facilities in 2001 at 23 percent, notably higher than the 13 percent reported in 1998. Such a change, however, is not as drastic as might be first imagined because the total number of non-residential structure deaths reported in NFIRS in 2001 was quite small (47).

Stores/offices was the leading property type for both injuries (22 percent) and property loss (28 percent). Stores/offices, storage, and manufacturing properties accounted for over half of injuries (52 percent) and 65 percent of dollar loss in non-residential fires. Table 17 shows the per-fire property losses at each property type. The highest loss per fire was at manufacturing sites ($56,000). Industrial fires resulted in the second highest loss per fire ($45,000). Institutional fires had the smallest loss per fire at $5,000. The rankings (highest/lowest) of these three property types are unchanged from 1998. Only storage and outside/unknown structures had a lower loss per fire in 2001 than in 1998.

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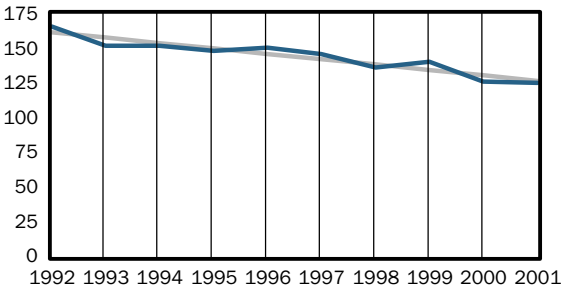
[2] These percentages are derived from summary data presented in NFPA's annual survey, 2001.

[3] In previous editions, vacant and under construction was a separate property category. In NFIRS 5.0, however, fires at under construction sites are allocated to the property category for which the building will be primarily used. Likewise, at vacant sites, the fire is allocated to the category for which it was once primarily used.

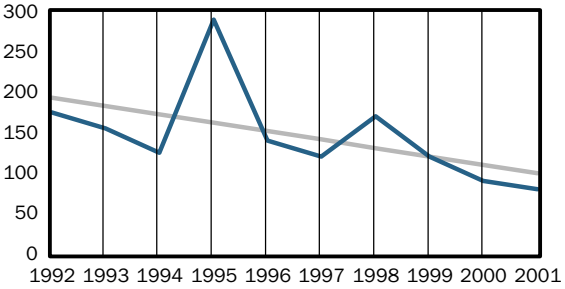
FIRES (in thousands)



1992	165.5	1997	145.5
1993	151.5	1998	136.0
1994	151.5	1999	140.0
1995	148.0	2000	126.0
1996	150.5	2001	125.0

10-Year Trend = –21.8%

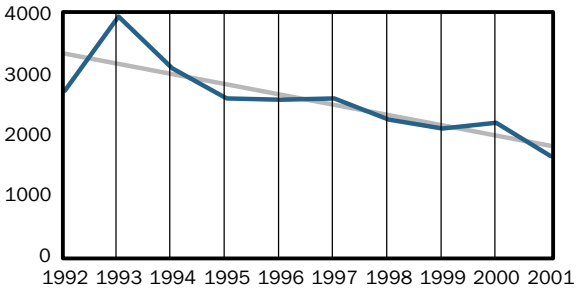
DEATHS



1992	175	1997	120
1993	155	1998	170
1994	125	1999	120
1995	290	2000	90
1996	140	2001	80
		2001 (incl. 9/11)	2,531

10-Year Trend = –48.4%

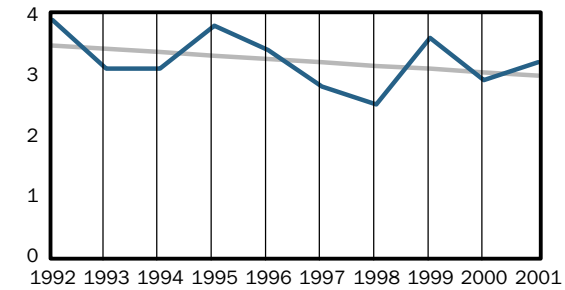
INJURIES



1992	2,725	1997	2,600
1993	3,950	1998	2,250
1994	3,100	1999	2,100
1995	2,600	2000	2,200
1996	2,575	2001	1,650
		2001 (incl. 9/11)	2,450

10-Year Trend = –45.7%

DOLLAR LOSS (in $ billions)*



1992	$3.9	1997	$2.8
1993	3.1	1998	2.5
1994	3.1	1999	3.6
1995	3.8	2000	2.9
1996	3.4	2001	3.2
		2001 (incl. 9/11)	36.7

10-Year Trend = –15.3%

*Adjusted to 2001 dollars

Sources: NFPA and Consumer Price Index

Figure 55. Trends in Non-Residential Structure Fires and Fire Losses

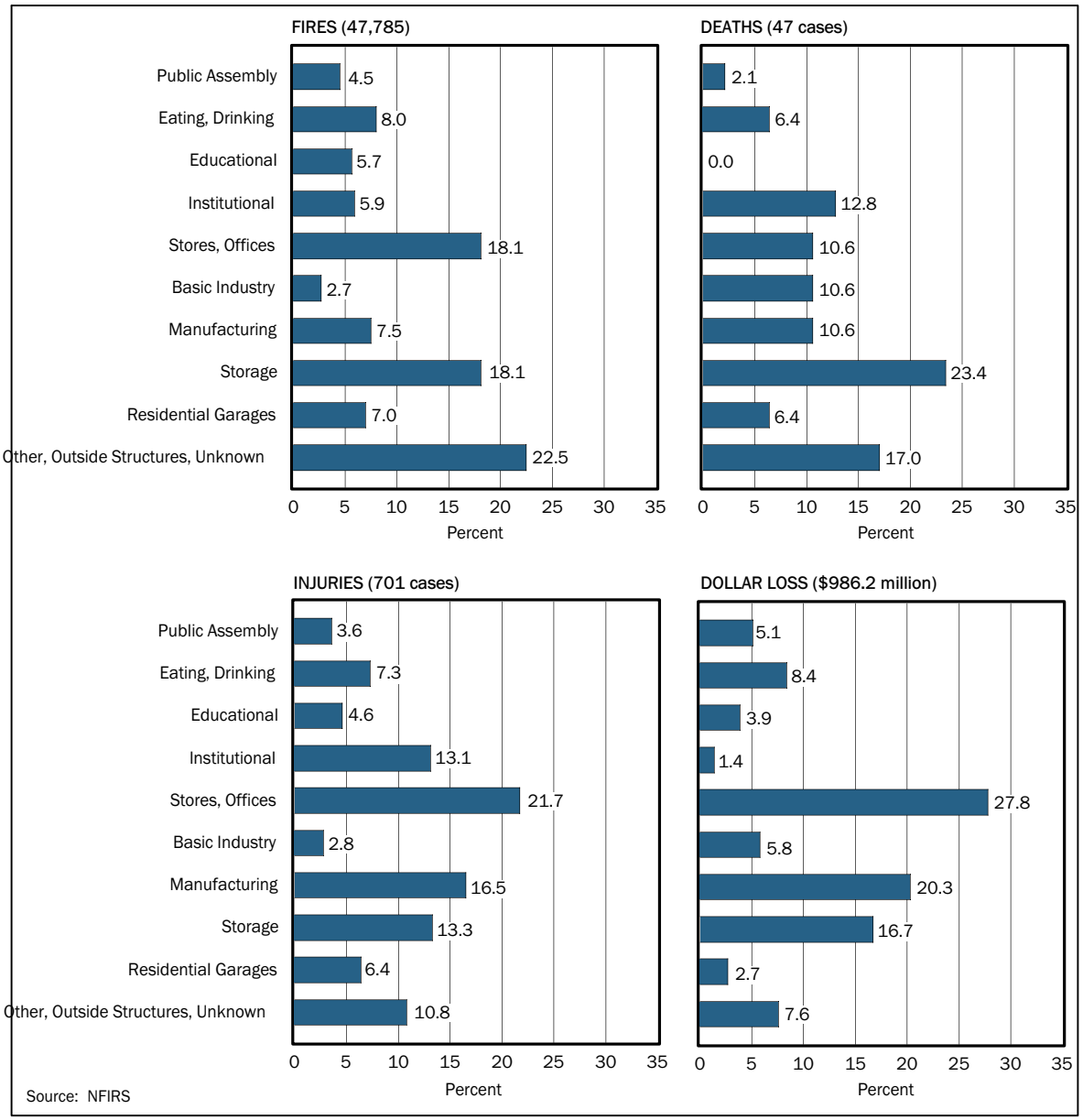


Figure 56. Non-Residential Structure Fires and Fire Losses by Property Type (2001)

The low rank ordering of some property categories should not obscure the fact that all of the categories have thousands of fires, multimillions of dollar loss, and hundreds of casualties. All parts of the fire problem need to be addressed. The relative magnitudes might help suggest where the greatest effort is needed.

When Fires Occur

TIME OF DAY. Non-residential structure fires increase in the afternoon from noon to 6 p.m. (Figure 57). Perhaps this is when workers are tired and are more accident prone or careless. Non-residential structure fires are a heterogeneous category, and the time of day when each of its

Table 17. Non-Residential Structure Dollar Loss Per Fire (2001)

Property Type	$ Loss/Fire
Public Assembly	$23,293
Eating, Drinking	21,867
Educational	14,371
Institutional	4,958
Stores, Offices	31,738
Basic Industry*	45,072
Manufacturing	55,793
Storage	19,024
Residential Garages	8,019
Outside Structures/Unknown	7,013

*Includes utility, defense, agricultural, and mining.

Source: NFIRS

different component property types peak may not agree with the overall picture. The incidence of all fires has the smoothest curve because it is based on the largest sample.

Fire deaths fluctuate wildly by time of day because of the relatively small number of deaths in most 1-hour intervals. Thirteen percent of fatalities (or six deaths) were recorded at 2 a.m. in 2001. Three other spikes (at 9 percent each) were at 4 a.m., 11 a.m., and 6 p.m., the latter at the heart of the dinner cooking period. No deaths were reported at 4 p.m. and 7 p.m.

Injuries begin to rise at 8 a.m., peak at 10 a.m., then begin to fall, and are somewhat steady from 2 p.m. to 10 p.m. Injuries are at their lowest at night, from 11 p.m. to 7 a.m.

Peak dollar losses occur after hours, especially between 9 p.m. and 5 a.m. The leading cause, incendiary or suspicious, occurs mostly at night. These fires often cause significant damage before they are detected and reported to the fire department. Property losses are lowest from 6 a.m. to 4 p.m. with a spike at 5 p.m.

MONTH OF YEAR. Fires in non-residential properties continue to be relatively uniform throughout the year (Figure 58). The pattern for deaths is erratic because of their relatively small numbers.

DAY OF WEEK. Non-residential fires are nearly uniform from Monday through Friday; they drop off slightly on weekends when fewer people are at work. The patterns for fire in the different subcategories, such as restaurants, however, would probably be less steady. Deaths by day of week are too few and too erratic from which to draw any conclusions.

Causes

Changes in NFIRS and the subsequent effects on the cause schema have slightly changed the cause distributions. The inclusion of confined fires, mostly due to cooking, and the changes in how arson and children playing are defined, have generally resulted in decreases in arson and

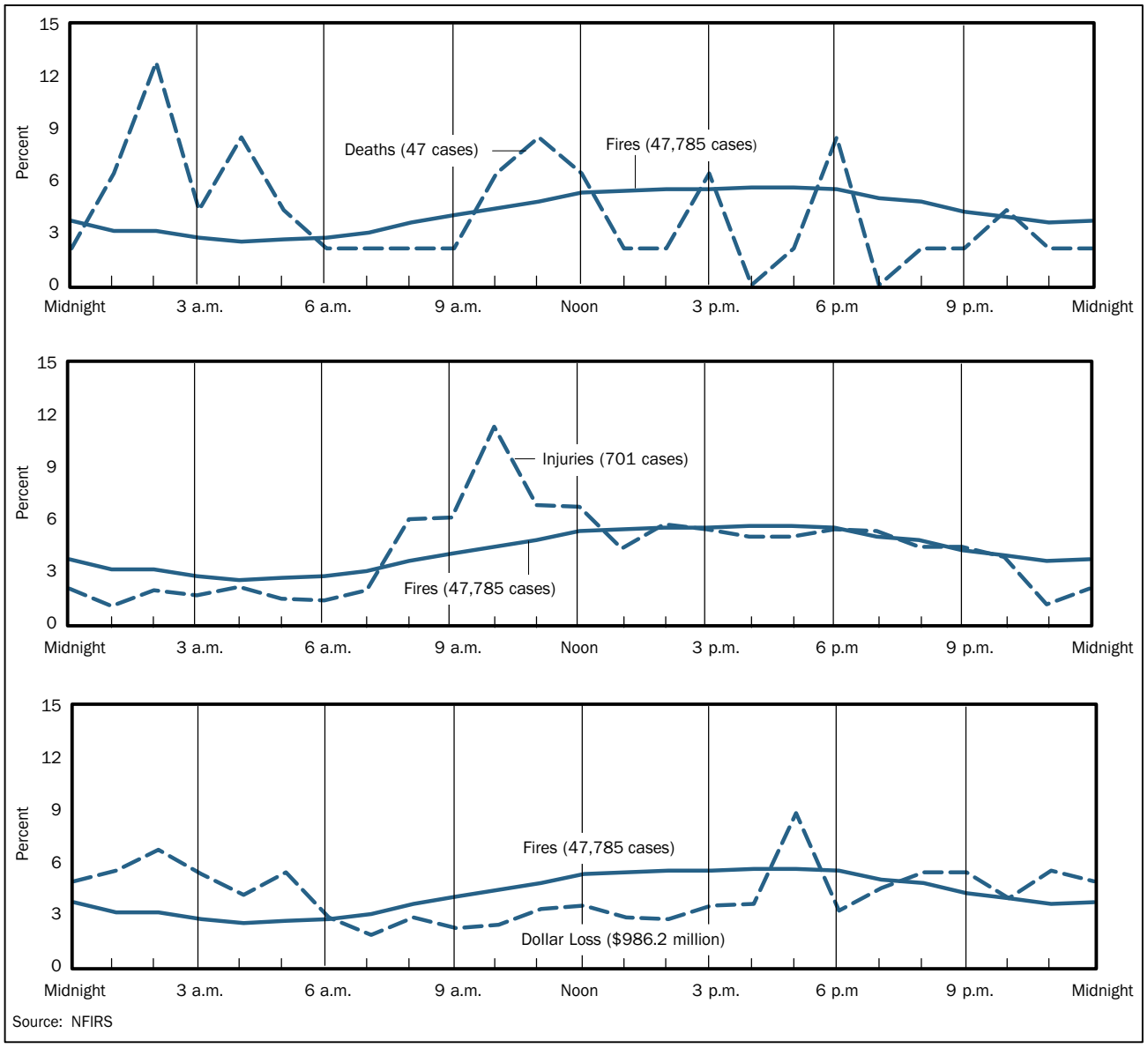


Figure 57. Time of Day of Non-Residential Structure Fires and Fire Losses (2001)

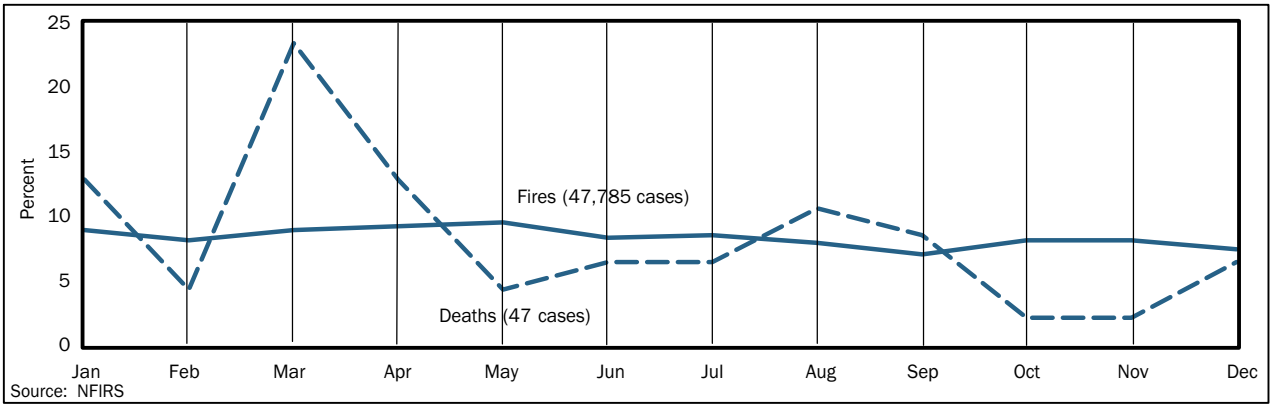


Figure 58. Month of Year of Non-Residential Structure Fires and Deaths (2001)

children playing fires and increases in cooking fires. Nonetheless, since the inception of NFIRS, incendiary/suspicious has been by far the leading cause of non-residential structure fires and dollar loss. In fact, arson property losses are twice those of the next leading cause category, and represent 30 percent of all property losses (Figure 59). Smoking accounts for 28 percent of deaths, a ninefold increase over 1998. None of these smoking deaths occurred in eating or drinking establishments, which may reflect an additional benefit of smoking bans in many of these facilities. The incidents, injuries, and dollar loss associated with smoking remain nearly the same as in prior years despite increased smoking bans in the workplace.

The 10-year trends of the top five non-residential fires, deaths, injuries, and dollar loss by cause are shown in Figure 60; the actual values for all causes are presented in Table B-6. The percentage increase or decrease for all 12 causes is presented in Table 18.

While arson has been the leading cause in the number of fires and the value of property losses, the gap between the number of arson fires and the second leading cause has narrowed considerably over the 1992–2001 period. Due to changes in NFIRS coding, definitions for arson fires changed slightly in the transition from NFIRS 4.1 to 5.0. Because suspicious fires are no longer captured directly and included in the arson totals, the proportion of arson fires have decreased. As shown in the table, arson trends decreased from 46 to 69 percent, depending on the measure. One final note regarding arson: In the 9 years before 2001, deaths from arson averaged 45; in 2001, only 3 deaths were attributed to arson.

The table also shows major increases and decreases in many of the cause trends. For example, the number of other heat fires has increased 136 percent and deaths 82 percent. Injuries from exposure fires have increased 134 percent. Fires, injuries, and dollar loss from children playing with fire have decreased sharply, but the definition of this cause has changed in NFIRS 5.0 so that an "apples-to-apples" comparison across the 10 years may not be valid.

Causes by Detailed Property Type

The number of fires and dollar loss in the non-residential occupancy categories are shown in Figures 61–71. (As with the other cause charts in this document, the gray bars represent the reported percentage and the solid bars represent the percentage when the unknowns are apportioned to the knowns.) Deaths and injuries are not presented because there are too few cases to draw meaningful conclusions. With minor variations, the data in 2001 are similar to 1998 data. Major changes in the 2001 profile from the 1998 profile are as follows:

- Institutional structures: The percentage of cooking fires nearly doubled in 2001 over 1998, and other equipment dollar loss is four times higher.
- Manufacturing structures: Heating fires went from 7 percent in 1998 to 13 percent in 2001. Dollar losses from open flame fires jumped from 7 to 34 percent and other equipment fire losses dropped from 42 to 11 percent.

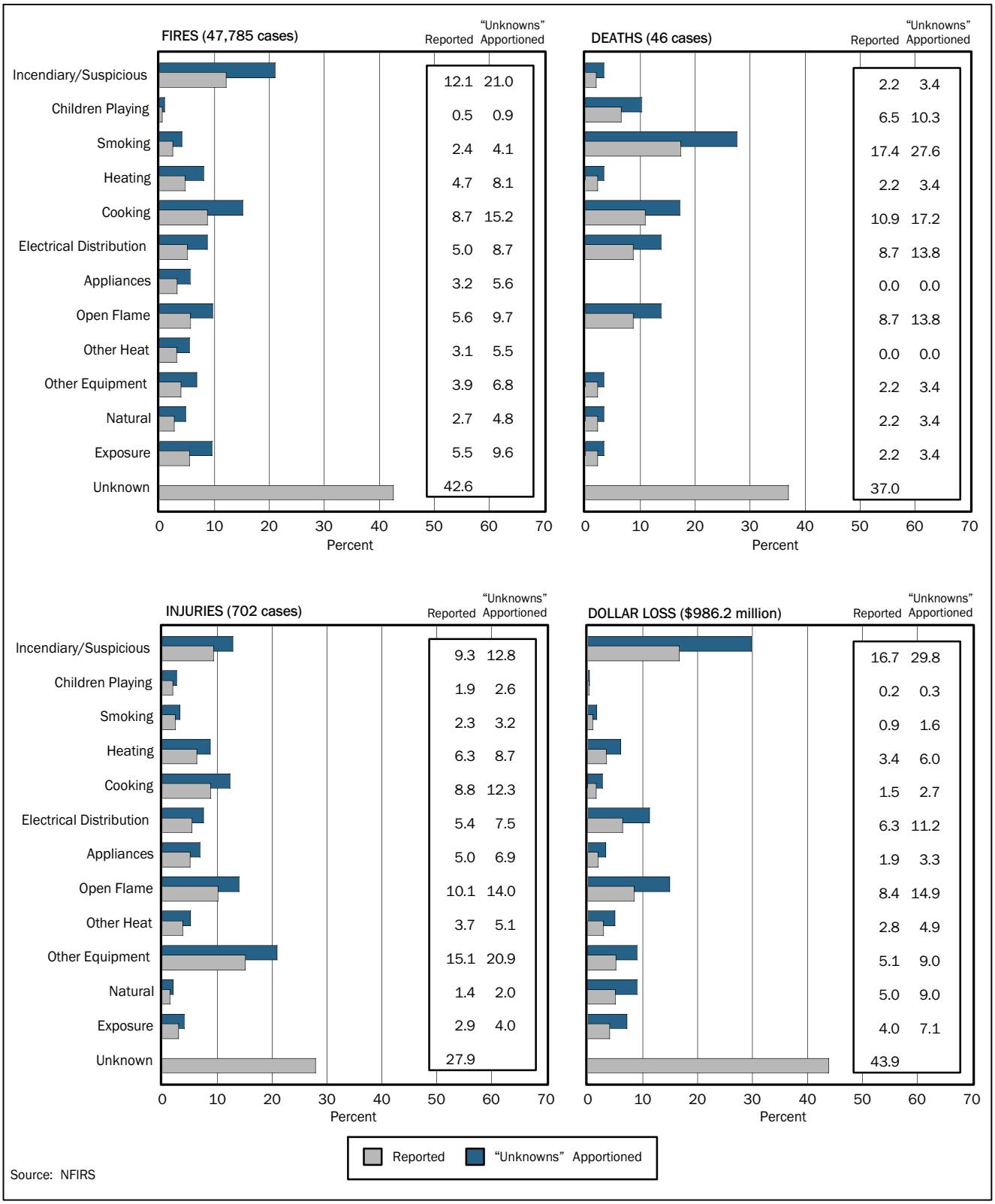


Figure 59. Causes of Non-Residential Structure Fires and Fire Losses (2001)

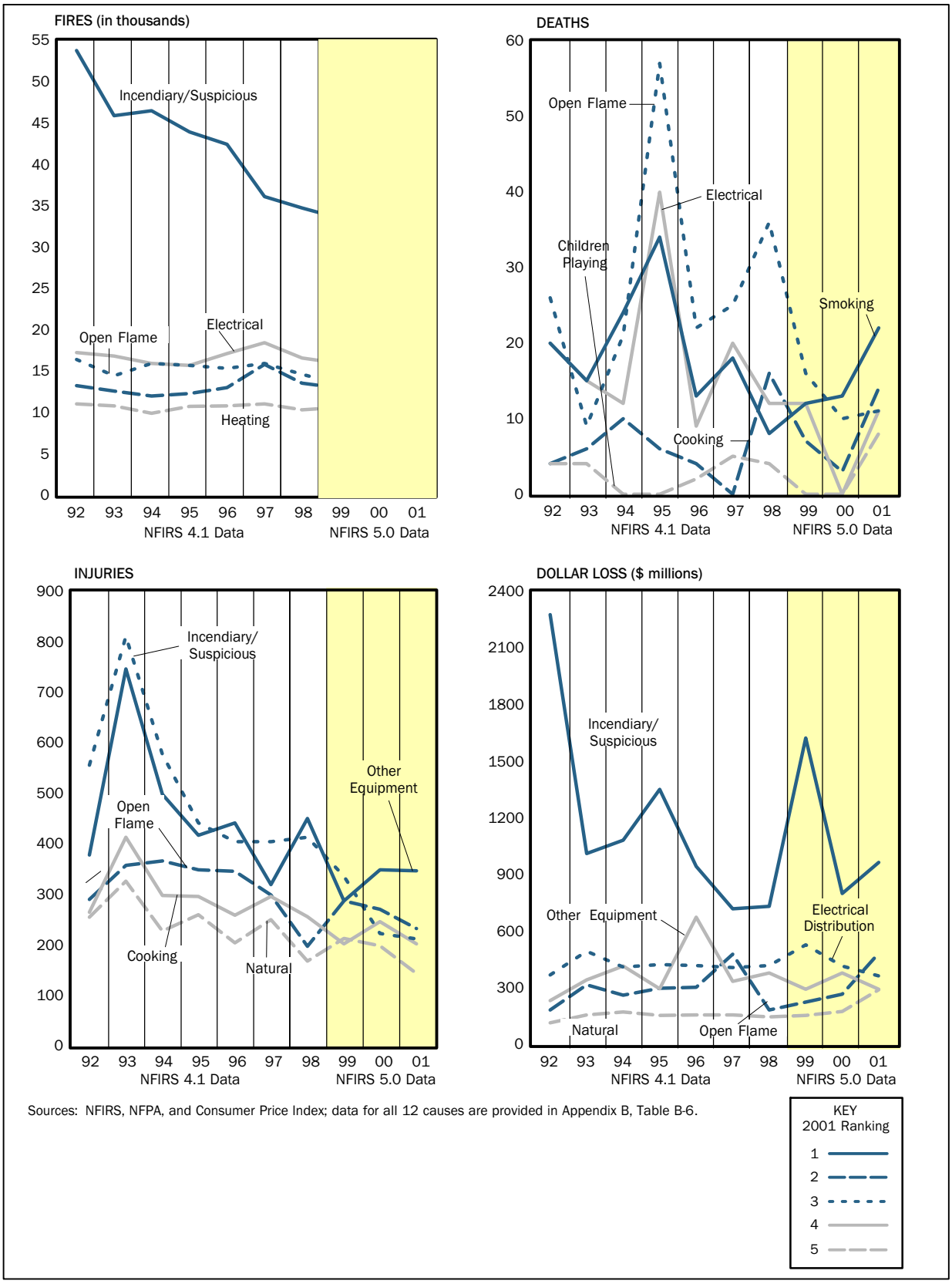
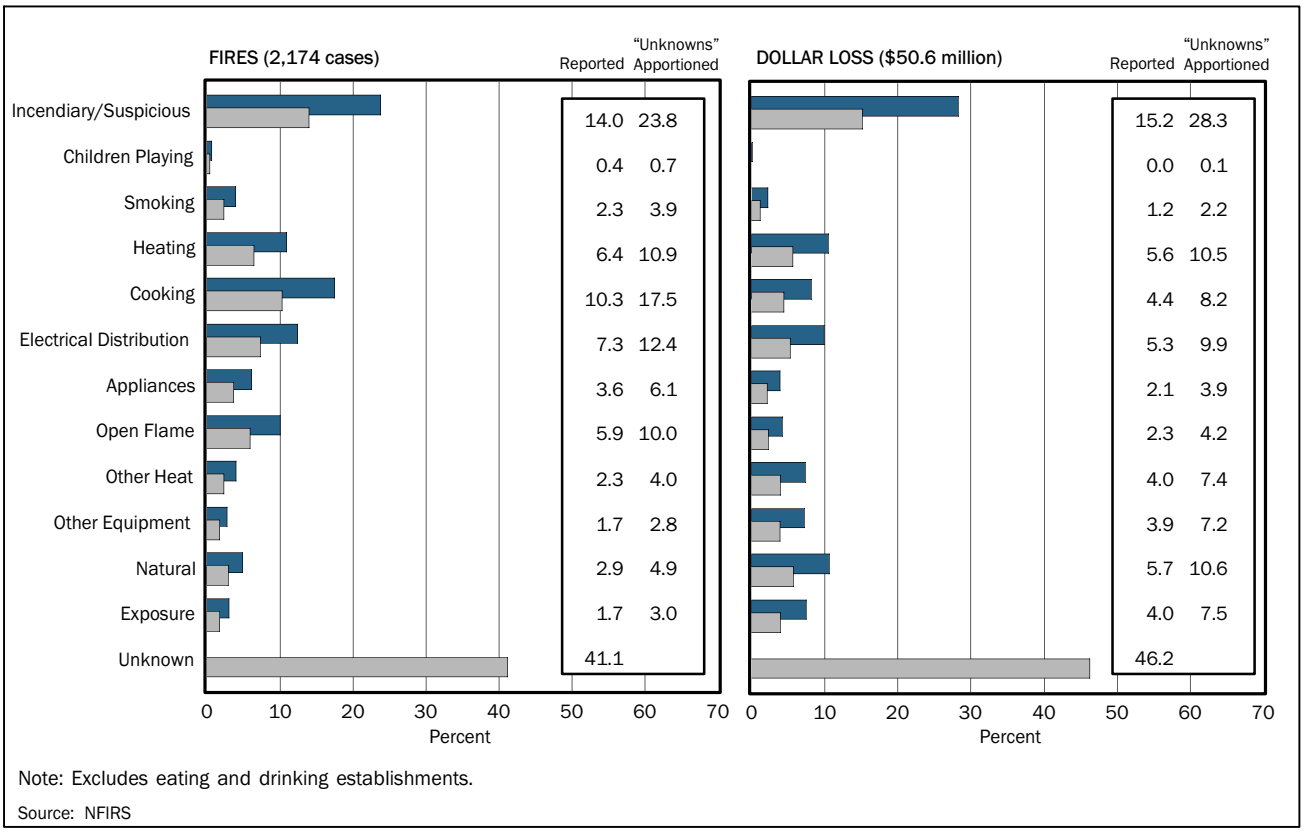


Figure 60. Trends in Leading Causes of Non-Residential Structure Fires and Fire Losses

Table 18. Trends in Causes of Non-Residential Structure Fires and Losses (1992–2001) (percent)

Cause	Fires	Deaths	Injuries	Dollar Loss
Incendiary/Suspicious	–49.0	–56.6	–69.3	–46.2
Children Playing	–74.3	+60.5	–61.3	–52.9
Smoking	–24.8	–32.9	–67.2	+8.6
Heating	–2.9	–71.2	–42.2	–1.3
Cooking	+30.1	+90.6	–37.2	–15.5
Electrical Distribution	–22.7	–63.7	–46.5	–0.2
Appliances	–22.2	–126.7	–34.8	+1.3
Open Flame	–24.8	–39.9	–31.2	+44.9
Other Heat	+135.5	+82.3	+52.9	+37.1
Other Equipment	–22.3	–60.6	–42.2	+1.6
Natural	+17.2	–84.8	–53.8	+70.7
Exposure	+23.5	–16.7	+133.5	–8.2

Sources: NFIRS, NFPA, and Consumer Price Index; data provided in Appendix B, Table B-6.



Note: Excludes eating and drinking establishments.

Source: NFIRS

Figure 61. Causes of Public Assembly Structure Fires and Dollar Loss (2001)

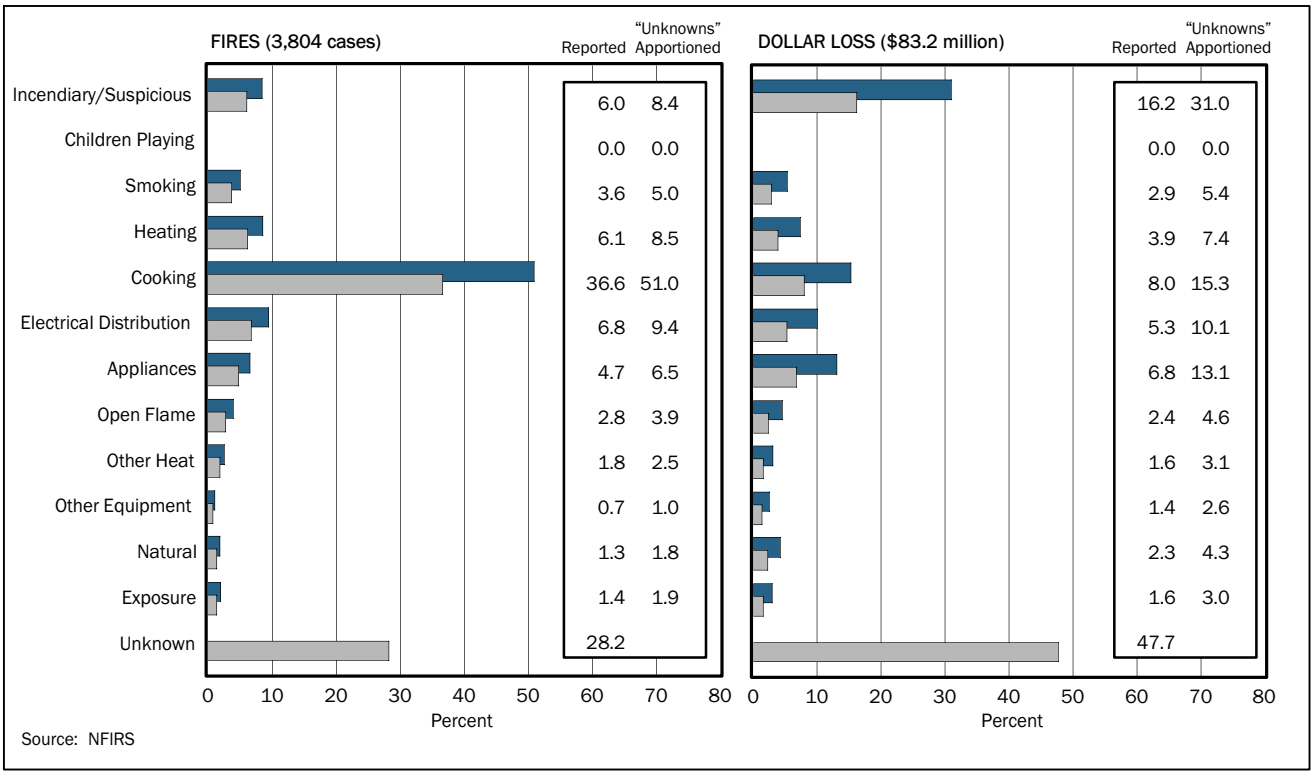


Figure 62. Causes of Eating and Drinking Establishment Fires and Dollar Loss (2001)

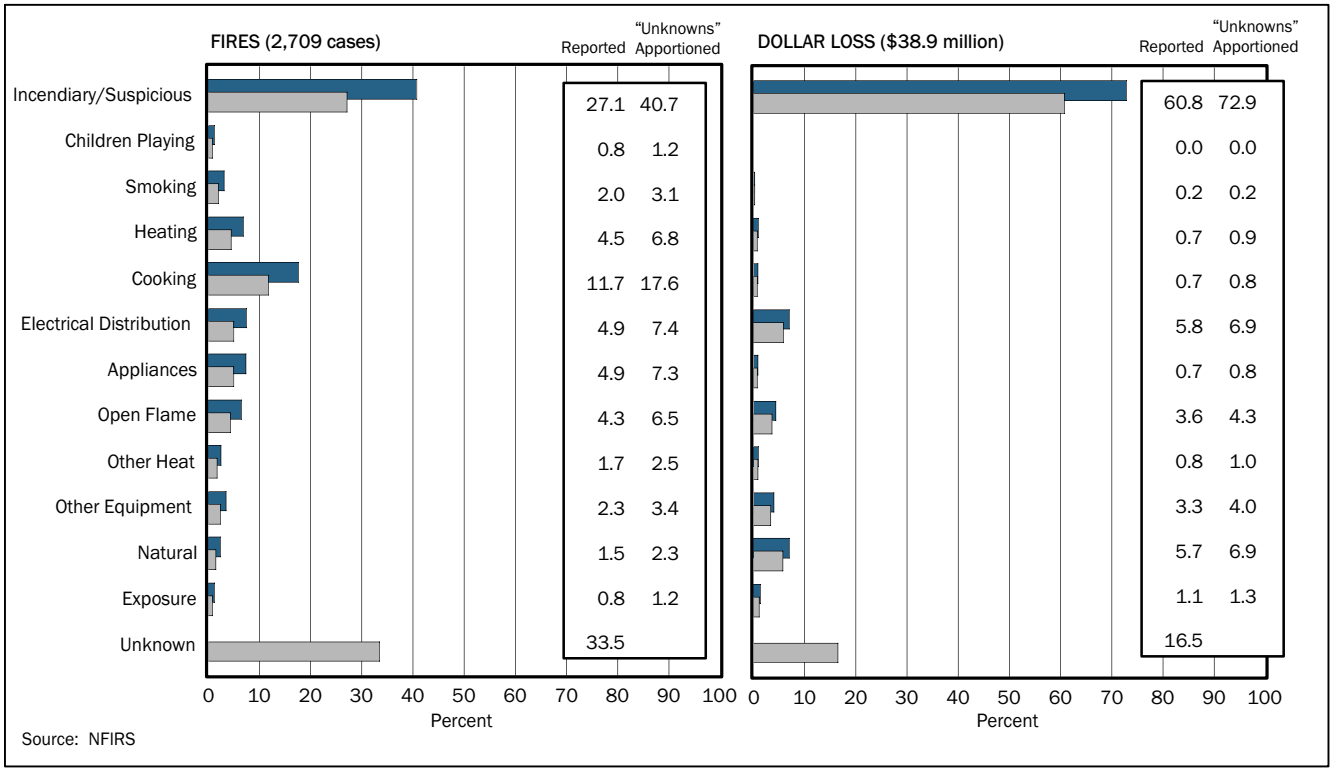


Figure 63. Causes of Educational Structure Fires and Dollar Loss (2001)

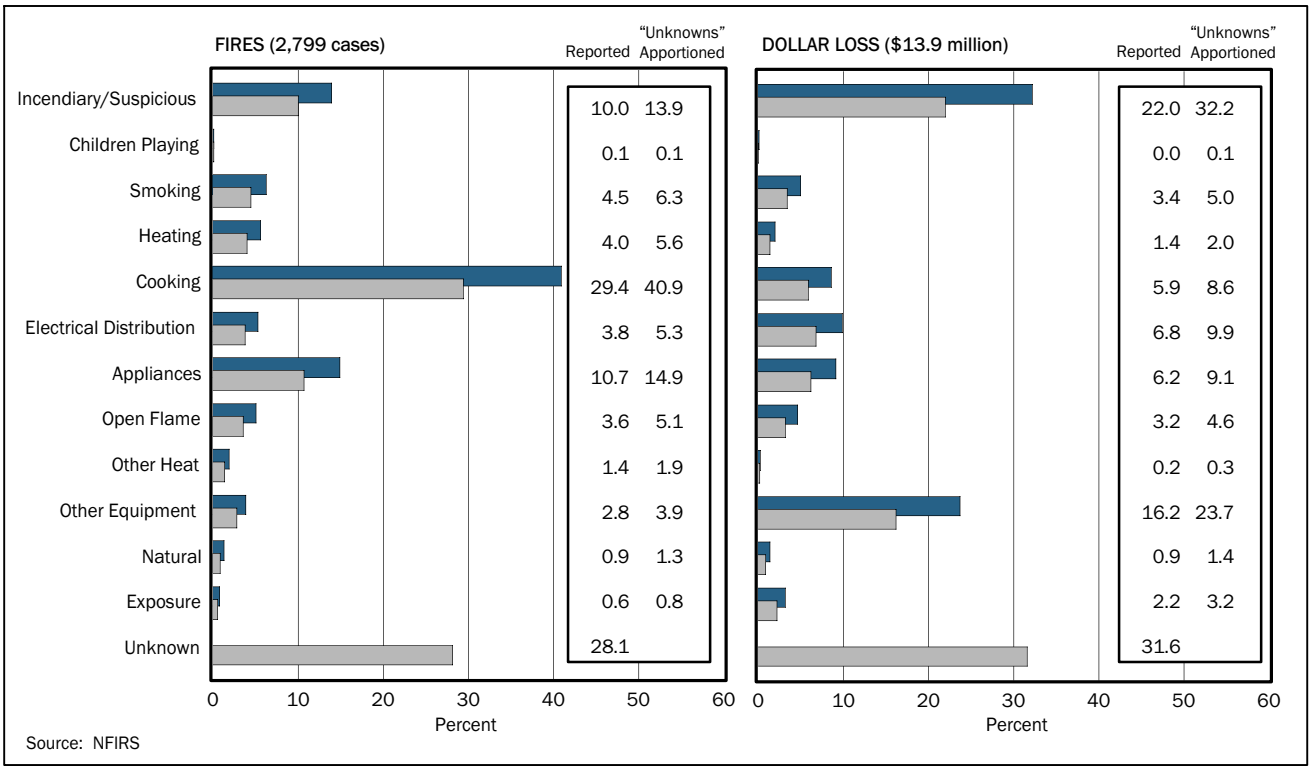


Figure 64. Causes of Institutional Structure Fires and Dollar Loss (2001)

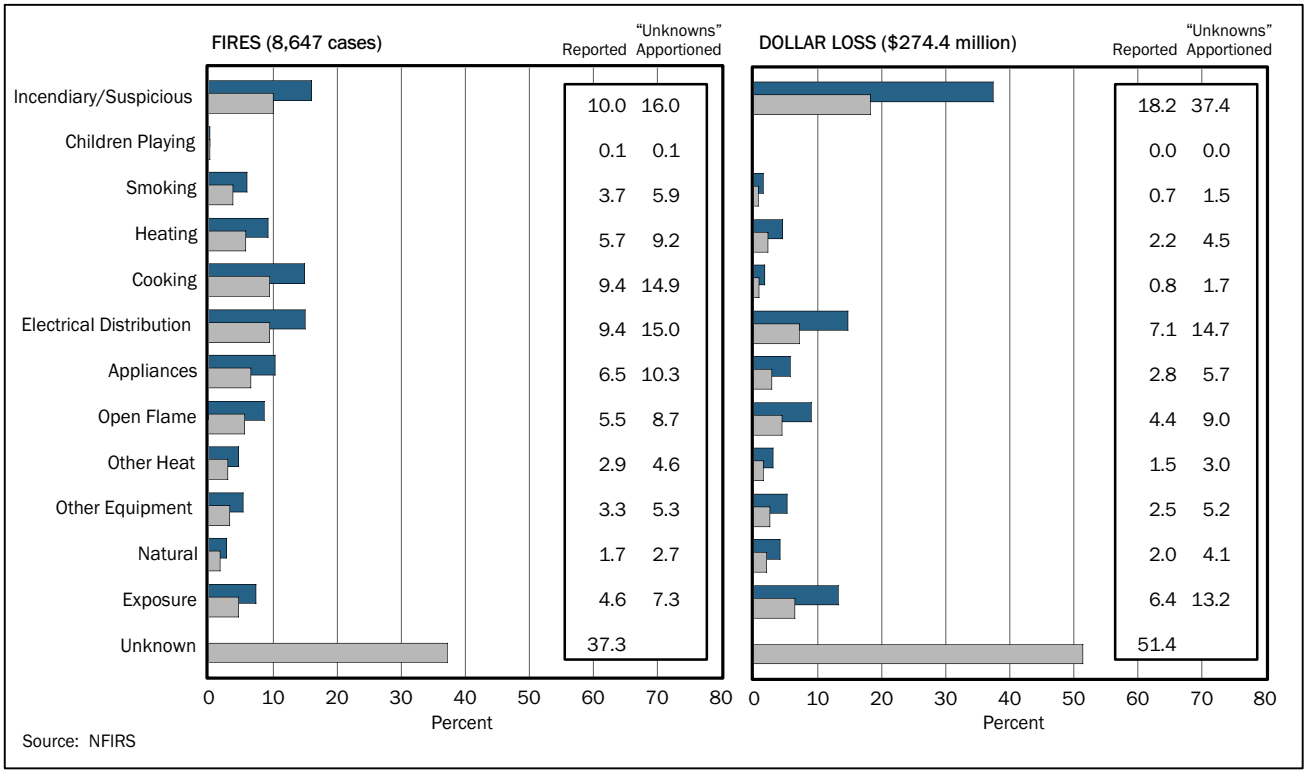


Figure 65. Causes of Store and Office Fires and Dollar Loss (2001)

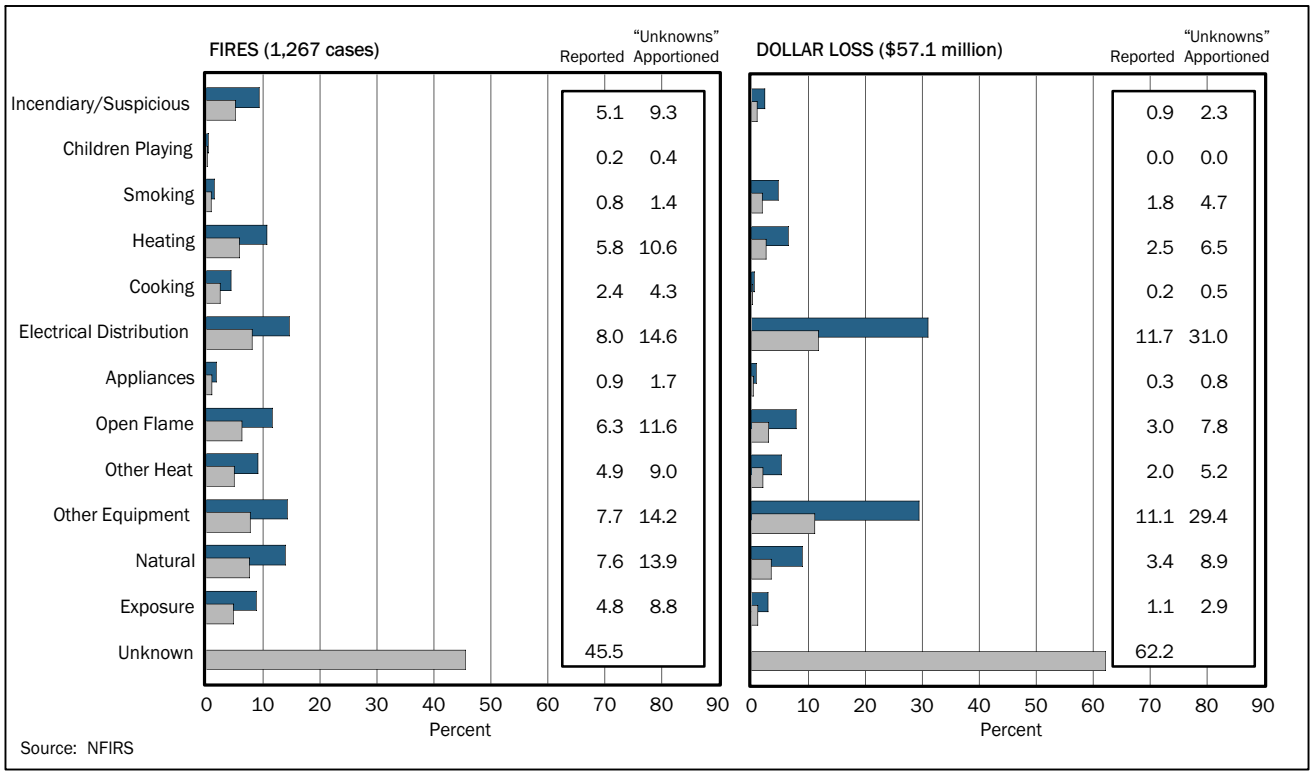


Figure 66. Causes of Basic Industry Structure Fires and Dollar Loss (2001)

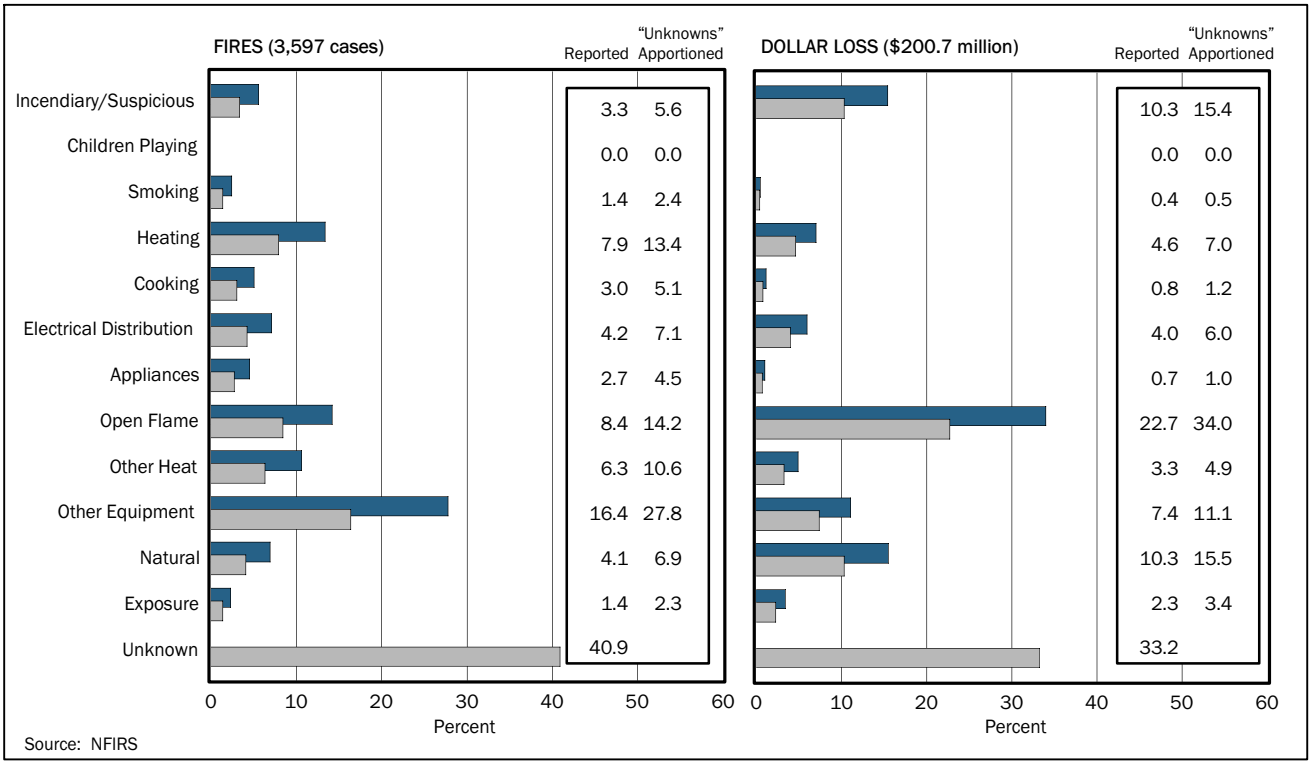


Figure 67. Causes of Manufacturing Structure Fires and Dollar Loss (2001)

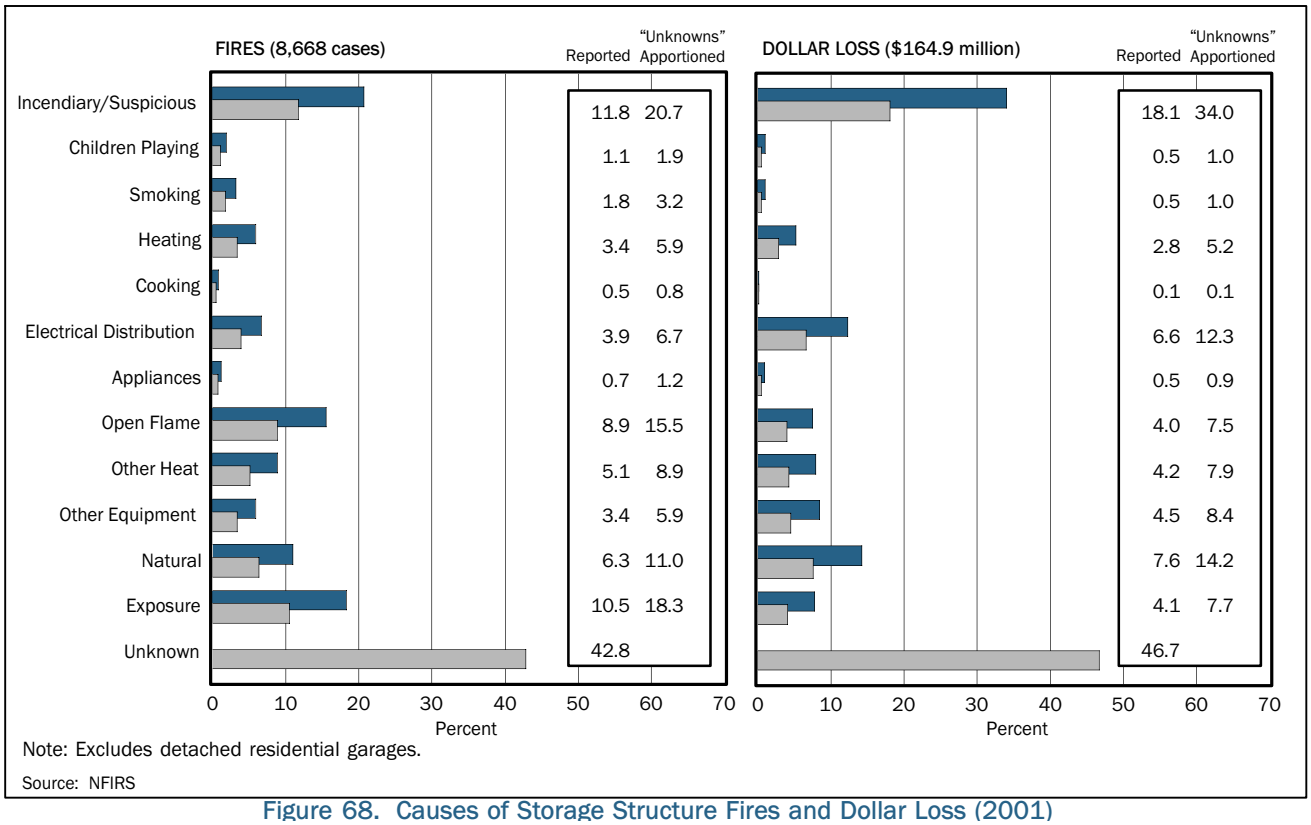


Figure 68. Causes of Storage Structure Fires and Dollar Loss (2001)

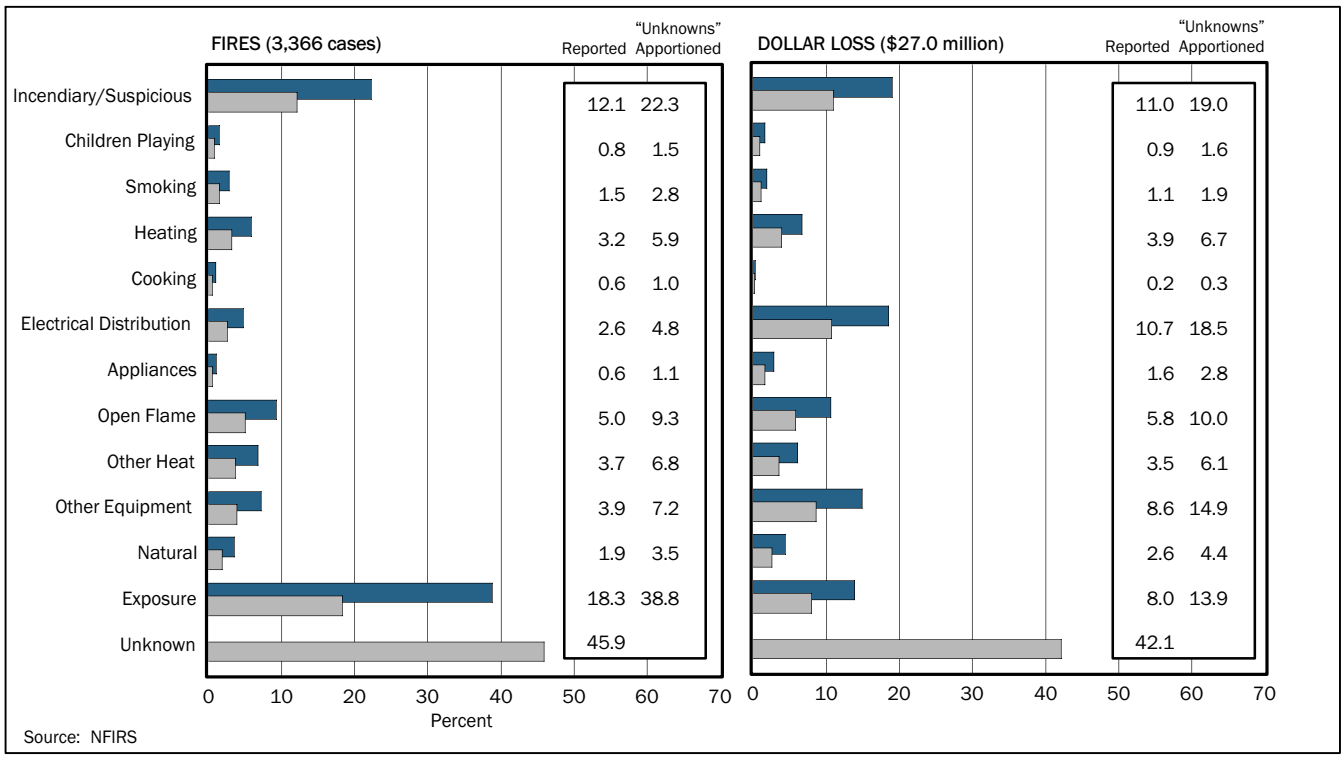


Figure 69. Causes of Detached Residential Garage Fires and Dollar Loss (2001)

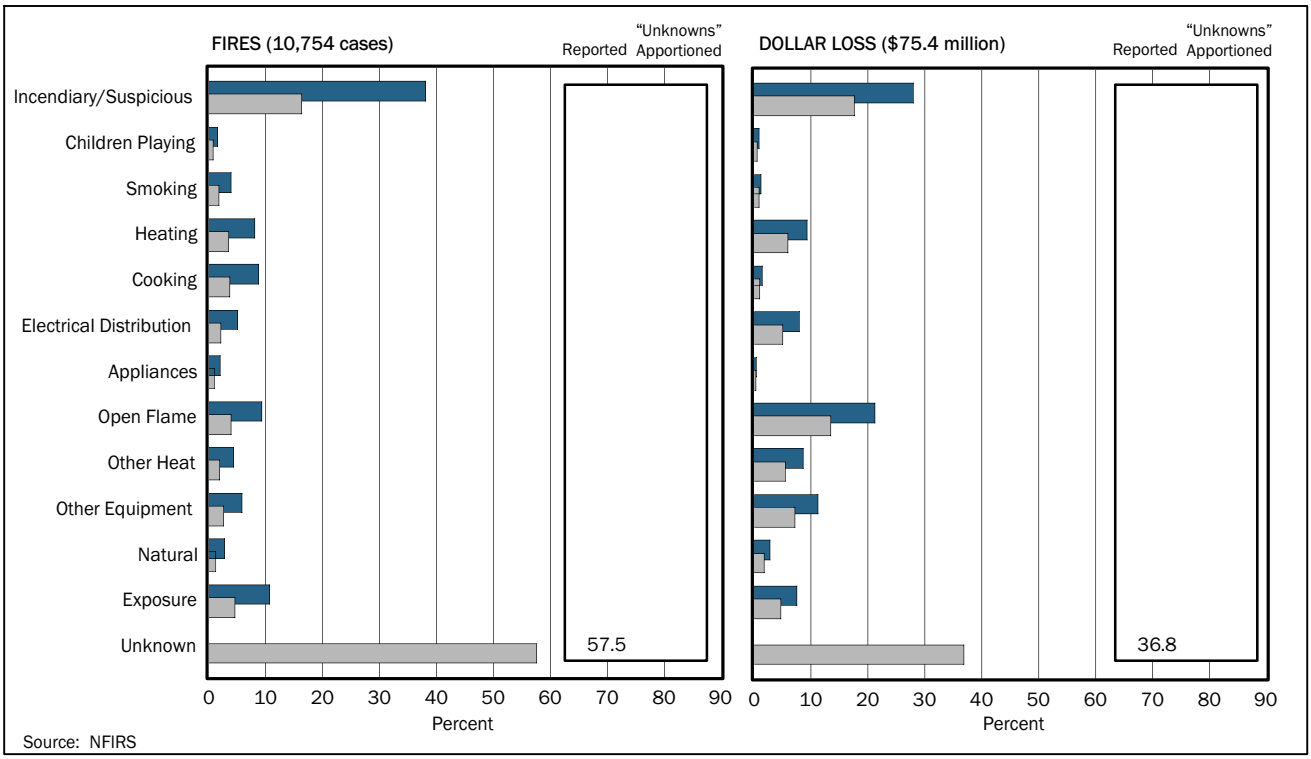


Figure 70. Causes of Outside Structure and Unknown Fires and Dollar Loss (2001)

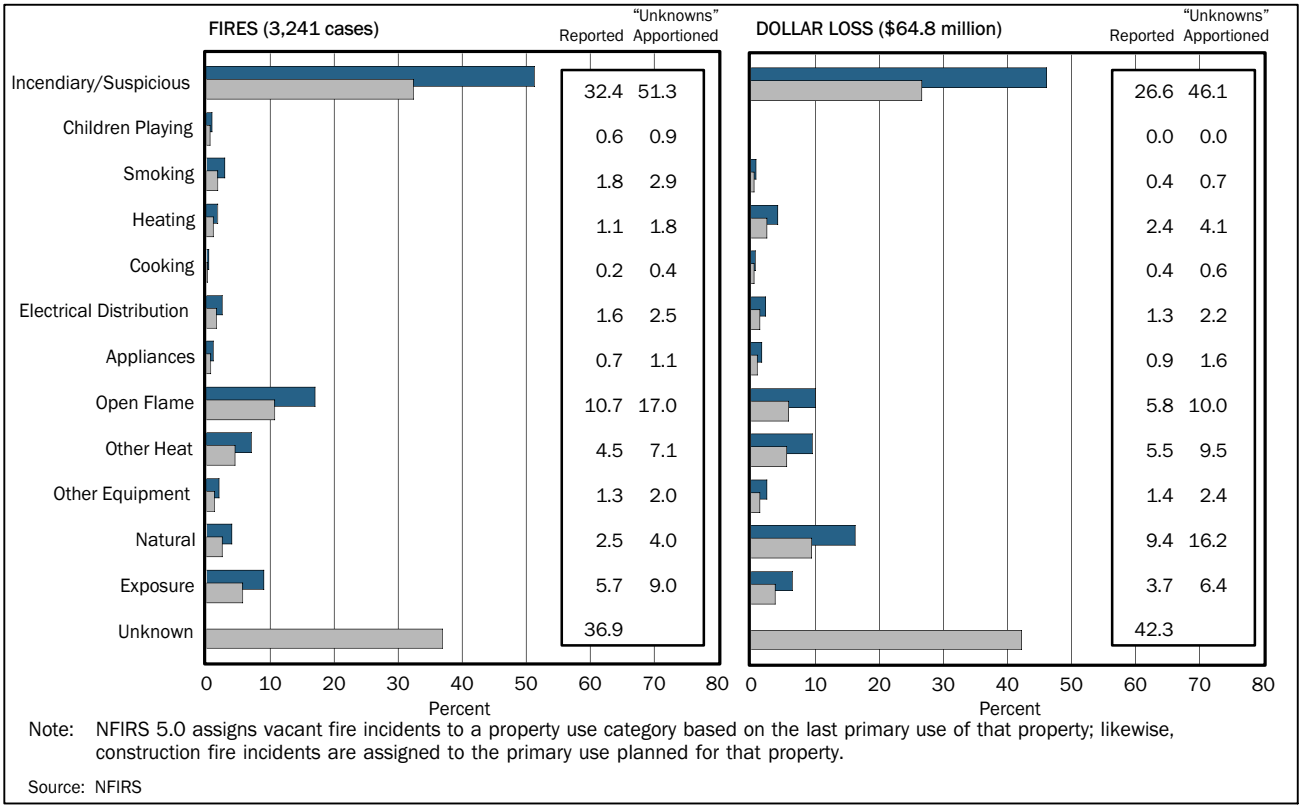


Figure 71. Causes of Vacant and Construction Fires and Dollar Loss (2001)

- Storage structures: Exposure fires increased from 10 percent in 1998 to 18 percent in 2001.
- Detached garages: Exposure fires increased from 20 percent in 1998 to 39 percent in 2001.
- Outside structure/unknown properties: Property loss from open flame fires quadrupled from 5 percent in 1998 to 21 percent in 2001.

Table 19 compares the leading cause of fires and dollar loss in 1996, 1998, and 2001 by each property type. Arson, the leading cause of fires and dollar loss in most property types, is clearly a major U.S. fire problem. Electrical distribution and open flame were also major contributors to fires and losses, and cooking was a factor in those non-residential structures that had kitchens.

Table 19. Comparison of Leading Causes of Non-Residential Structure Fires and Dollar Loss*

	Fires			Dollar Loss		
Property Type	1996	1998	2001	1996	1998	2001
Public Assembly	Arson	Arson	Arson	Arson	Arson	Arson
Eating, Drinking	Cooking	Cooking	Cooking	Cooking	Arson	Arson
Educational	Arson	Arson	Arson	Arson	Arson	Arson
Institutional	Arson	Arson	Cooking	Arson	Arson	Arson
Stores, Offices	Electrical Distribution	Electrical Distribution	Arson	Arson	Arson	Arson
Basic Industry	Electrical Distribution	Other Equipment	Electrical Distribution	Other Equipment	Appliances	Electrical Distribution
Manufacturing	Other Equipment	Other Equipment	Other Equipment	Other Equipment	Other Equipment	Open Flame
Storage	Arson	Arson	Arson	Other Equipment	Arson	Arson
Outside Structures, Unknown	Arson	Arson	Arson	Arson	Arson	Arson

*Detached residential garages and vacant/under construction properties not shown.

Source: NFIRS

Vacant and Under Construction

In previous editions, vacant and under construction properties were treated as a separate property type. Since 1999, fires at such sites have been categorized by their intended property use. Vacant and under construction is a property attribute that can now apply to properties of any use designation.

Vacant properties and properties under construction have long been a concern as the most dangerous fires often occur there. Many of these buildings are in areas that are not wholly secured. Fires are started when no one is around and the fire has the opportunity to grow

unchecked before the fire department is called. As shown in Figure 71, these fires are frequently arson-related as has been the case in previous years.

Presence of Automatic Extinguishing Systems

Figure 72 shows that automatic extinguishing systems (AESs) were present in 15 percent of reported fires in 2001 ("unknowns" apportioned). Although 15 percent is a relatively small number, it is considerably higher than what was found in one- and two-family dwellings (1 percent) and apartments (8 percent). This is not unexpected since commercial properties, institutions, and public assembly sites tend to occupy large structures that have been built to strict construction codes. Additionally, owners and proprietors of such sites have great incentive for protecting the structures' contents.

Figure 73 shows the property loss per fire when AESs are and are not present. When present, the property loss in 2001 was $38,800; when not present, the loss was valued at $32,900.

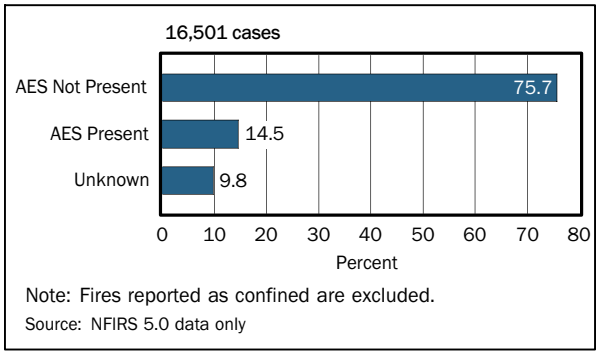


Figure 72. Presence of Automatic Extinguishing Systems in Non-Residential Structure Fires (2001)

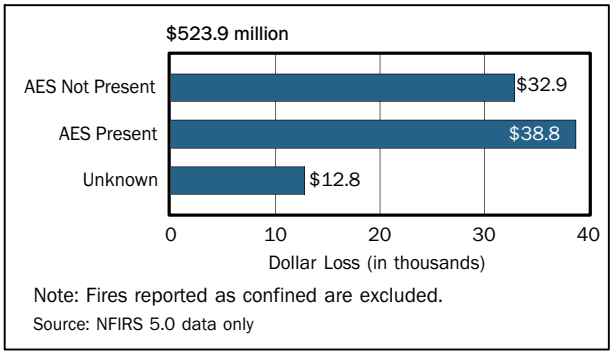


Figure 73. Dollar Loss Per Non-Residential Structure Fire as a Function of AES Presence (2001)

How effective are AESs? Empirically, Figure 73 does not seem to support the conclusion that AESs are effective in limiting dollar losses. However, comparisons need to be made for similar properties with similar fire loads, with and without comparable AESs, but NFIRS data alone are insufficient for this comparison. Since NFIRS combines properties of different sizes and values in the same fixed property class, the data need to be viewed cautiously. AESs are more likely to be installed in large and highly valued properties than in small, inexpensive ones. A system in a large warehouse may do an excellent job of containing a fire and yet the loss for the fire may be larger than for a fire in a systemless small storage building.

VEHICLES AND OTHER MOBILE PROPERTIES

Transportation fires account for a larger portion of the fire problem than many people realize. In 2001, vehicles accounted for 13 percent of fire deaths overall, 9 percent of fire injuries, 14 percent of dollar losses, and 20 percent of all reported fires—nearly one in every five fires.[4]

The vast majority of fires, casualties, and property losses from mobile property involve cars and trucks, with cars clearly dominating this group. Fire departments respond to about as many fires involving vehicles as they do to fires involving residences.

Overview of Trends

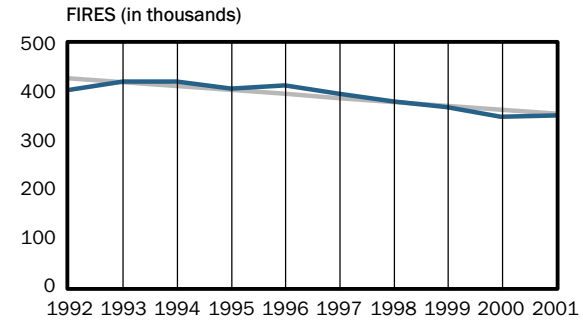
The trends in mobile property fires, fire deaths, injuries, and dollar losses are shown in Figure 74. The number of fires continues to decrease (17 percent) according to NFPA estimates. Fire deaths and injuries have trended down sharply (32 and 42 percent, respectively). The downward trend of mobile property fire deaths would have been even greater, but in 1996 the aviation industry suffered two catastrophes: the ValueJet crash in May, killing 109 people, and the TWA crash in July, resulting in 230 deaths. These two disasters account for nearly 48 percent of the 710 mobile property fire-related deaths reported in the NFPA 1996 annual survey. The mobile property dollar loss trend increased 19 percent even as the other trends declined. Each year, the costs of new vehicles increase. If these costs exceed inflation, they may help explain the rise in the property loss trend.

Types of Vehicles

Figure 75 shows that the vast majority of mobile property fires and losses are from highway vehicles. The complexity and ambiguity in counting losses associated with accidents are described in a later section titled "Special Data Problems." Although the 10-year trend in highway vehicle fires, deaths, and injuries show substantial decreases (19, 26, and 44 percent, respectively), the dollar loss has trended up 17 percent.

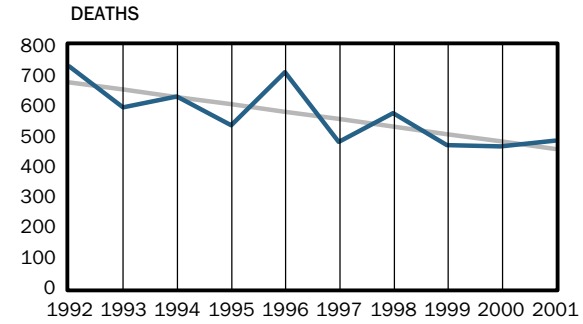
Figure 76 gives more details on the relative proportions of the reported fire problem by type of vehicle in 2001. Automobiles and other passenger vehicles such as vans and buses dominate the mobile property picture. Automobiles are involved in 12 times as many fires as trucks (freight) and result in larger numbers of casualties and a larger dollar loss. On a per-incident basis, however, trucks have the more serious problem with 50 percent more deaths per fire and well over twice the injuries and property loss per fire (Table 20).

[4] Percentages are derived from summary data presented in NFPA's annual survey, 2001.



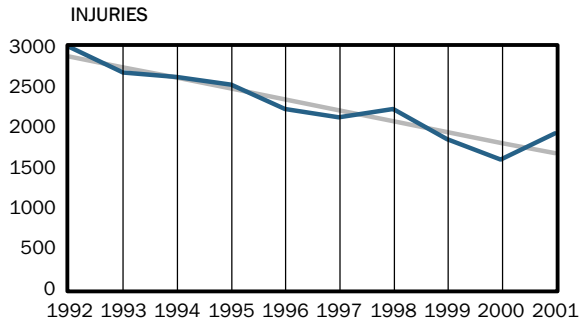
1992	405.0	1997	397.0
1993	420.5	1998	381.0
1994	422.0	1999	368.5
1995	406.5	2000	348.5
1996	413.5	2001	351.5

10-Year Trend = –17.1%



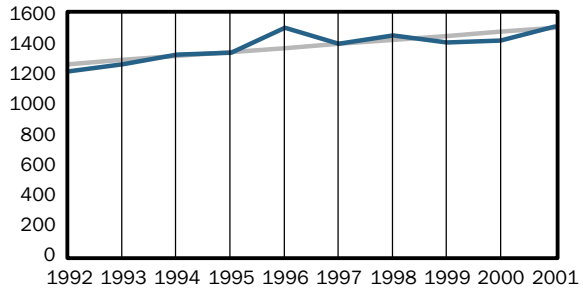
1992	730	1997	480
1993	595	1998	575
1994	630	1999	470
1995	535	2000	465
1996	710	2001	485

10-Year Trend = –32.4%



1992	3,000	1007	2,125
1993	2,675	1998	2,225
1994	2,625	1999	1,850
1995	2,525	2000	1,600
1996	2,225	2001	1,925

10-Year Trend = –41.8%



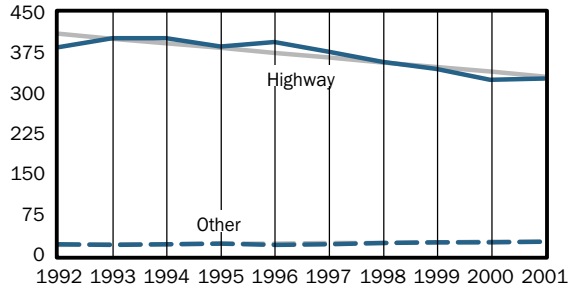
1992	$1.22	1007	$1.40
1993	1.26	1998	1.45
1994	1.33	1999	1.41
1995	1.34	2000	1.42
1996	1.51	2001	1.51

10-Year Trend = +18.9%

*Adjusted to 2001 dollars

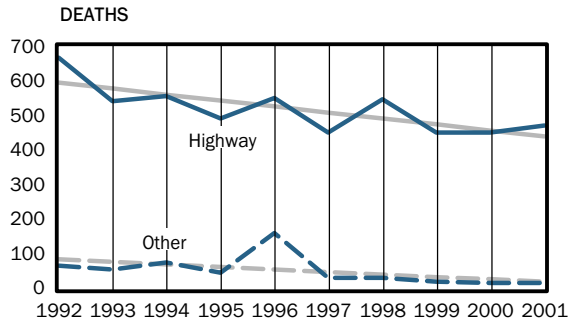
Sources: NFPA and Consumer Price Index

Figure 74. Trends in Mobile Property Fires and Fire Losses



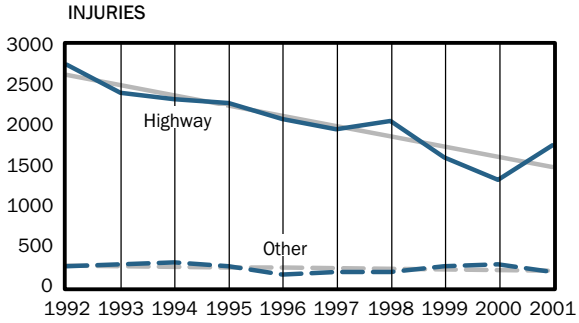
	Highway	Other		Highway	Other
1992	385.5	19.5	1997	377.0	20.0
1993	402.0	18.5	1998	358.5	22.5
1994	402.0	20.0	1999	345.0	23.5
1995	386.0	20.5	2000	325.0	23.5
1996	395.0	18.5	2001	327.0	24.5

10-Year Highway Trend = –19.3%
10-Year Other Trend = +31.4%



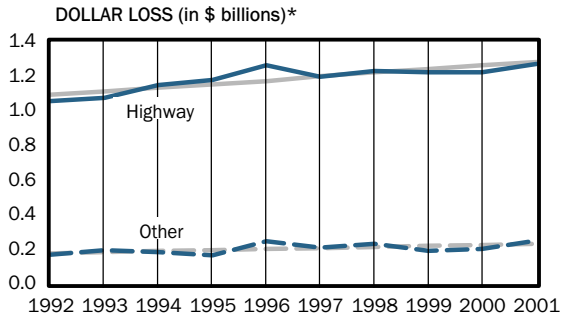
	Highway	Other		Highway	Other
1992	665	65	1997	450	30
1993	540	55	1998	545	30
1994	555	75	1999	450	20
1995	490	45	2000	450	15
1996	550	160	2001	470	15

10-Year Highway Trend = –26.1%
10-Year Other Trend = –77.4%



	Highway	Other		Highway	Other
1992	2,750	250	1997	1,950	175
1993	2,400	275	1998	2,050	175
1994	2,325	300	1999	1,600	250
1995	2,275	250	2000	1,325	275
1996	2,075	150	2001	1,750	175

10-Year Highway Trend = –43.6%
10-Year Other Trend = –23.8%



	Highway	Other		Highway	Other
1992	$1.05	$0.165	1997	$1.20	$0.204
1993	1.07	0.190	1998	1.23	0.226
1994	1.15	0.179	1999	1.22	0.186
1995	1.18	0.162	2000	1.22	0.200
1996	1.26	0.244	2001	1.27	0.245

10-Year Highway Trend = +17.4%
10-Year Other Trend = +30.7%

Sources: NFPA and Consumer Price Index

*Adjusted to 2001 dollars

Figure 75. Trends in Highway vs. Other Mobile Property Fires and Fire Losses

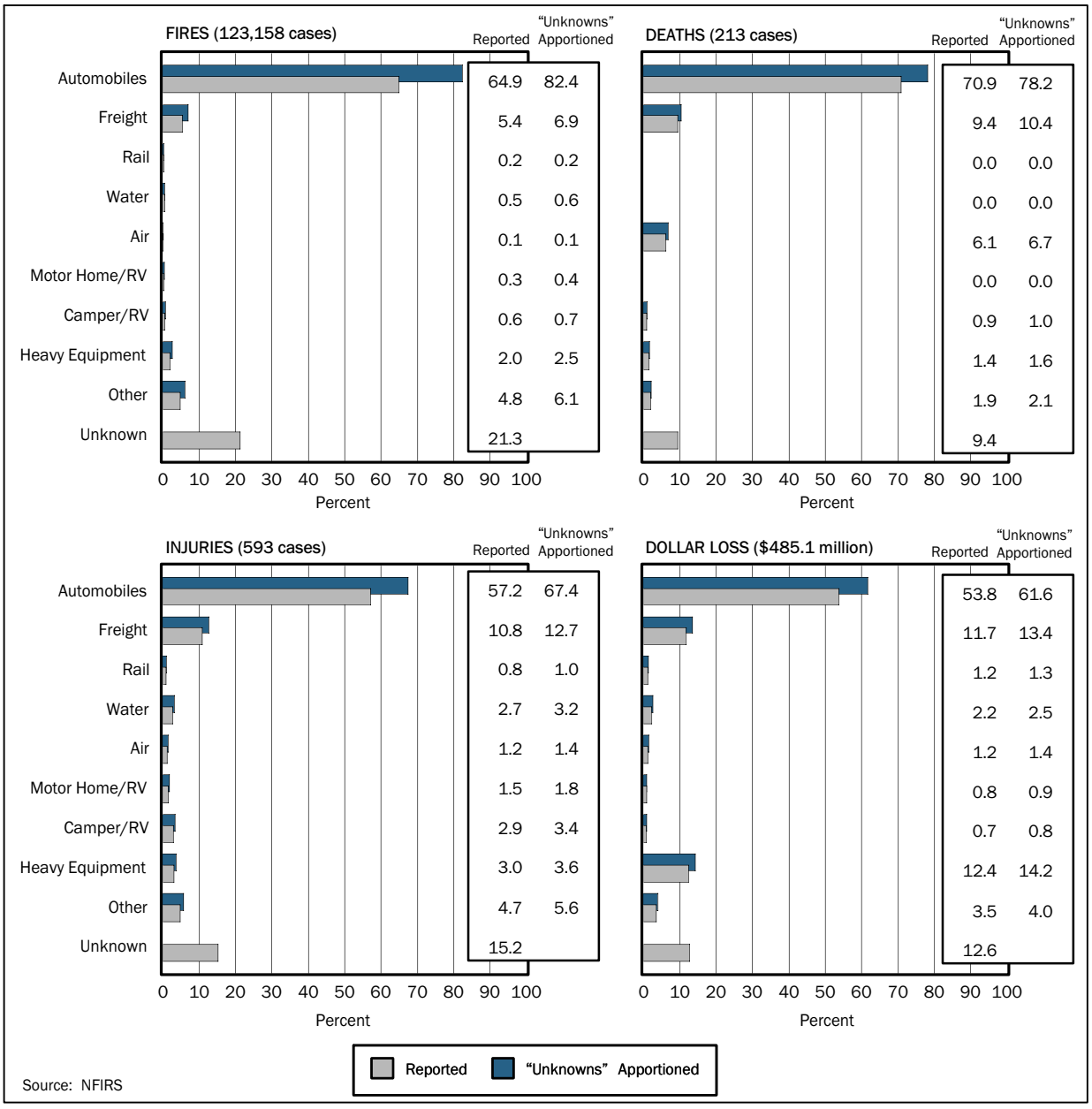


Figure 76. Mobile Property Fires and Fire Losses by Vehicle Type (2001)

Table 20. Casualty and Dollar Loss Rates for Passenger and Freight Vehicles (2001)

Vehicle Type	Deaths Per 1,000 Fires	Injuries Per 1,000 Fires	Dollar Loss Per Fire
Passenger	1.9	4.2	$3,300
Road, freight, or transport	3.0	9.6	$8,500

Source: NFIRS

Causes

For the most part, vehicle fires have one of four origins: the aftermath of a collision, the result of a mechanical failure, the result of an act of carelessness, or the result of arson. Most vehicle deaths are from trauma following a collision; only 2 percent of collision deaths are the result of fire.[5] However, 46 percent of mobile property fire deaths occur in vehicle collisions (Figure 77). Preventing such fires is largely the purview of the U.S. Department of Transportation, state and local motor vehicle agencies, and the police, but fire departments are almost always called to the scene when there is a fire or the potential for a fire.

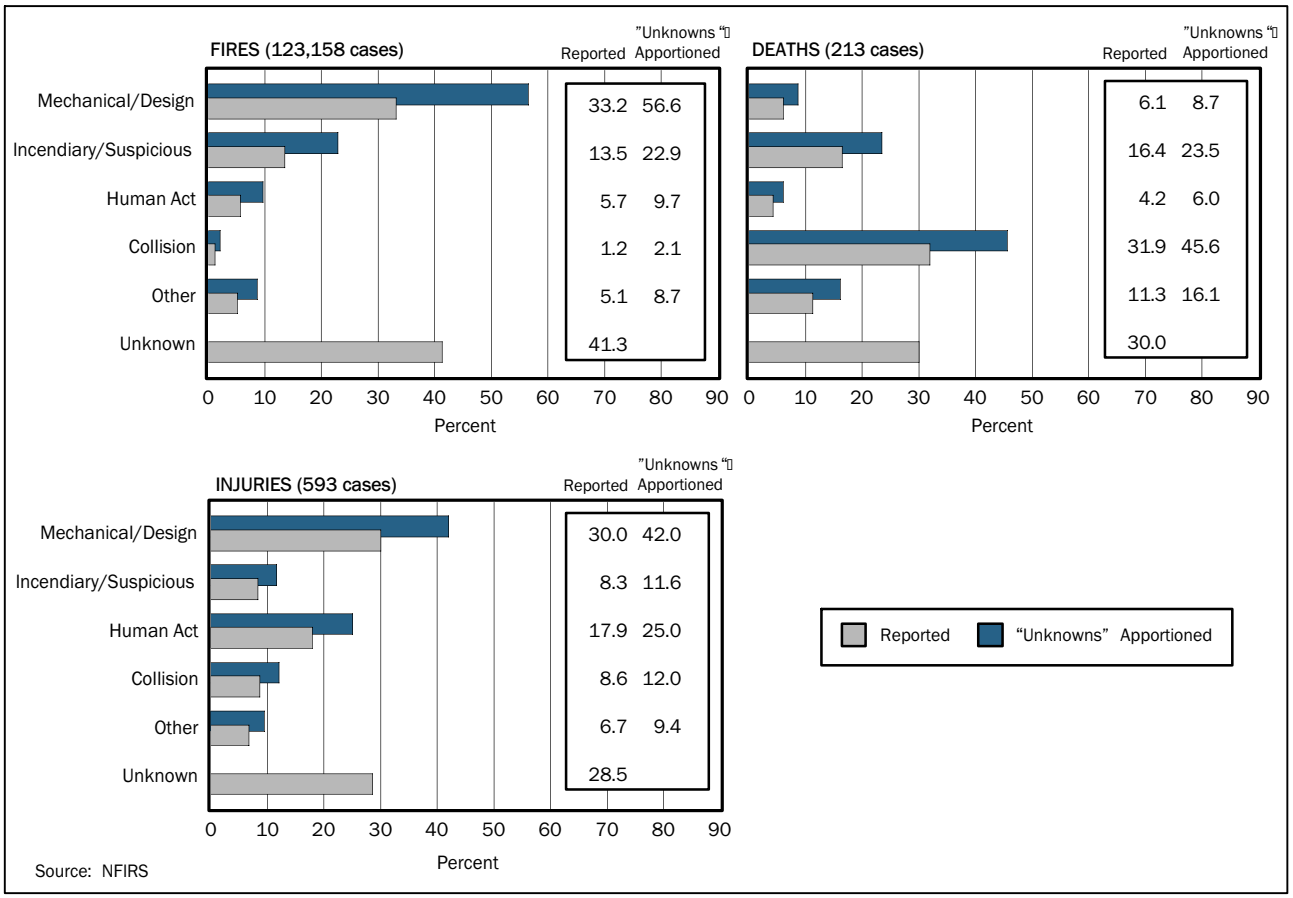


Figure 77. Ignition Factors for Mobile Property Fires and Fire Casualties (2001)

Mechanical or design problems, such as broken fuel lines, faulty catalytic converters, blown tires, and overheating, are the ignition factor for 57 percent of all fires in vehicles and 42 percent of the associated injuries.

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[5] National Highway Traffic Safety Administration, Research and Development, B.01.17 Fire Safety Research, updated 06/00, http://www-nrd.nhtsa.gov/departments/nrd-01/summaries/B0117.htmlThis 2000 research document notes that the National Highway Traffic Safety Administration (NHTSA) estimates that 310 deaths are caused by post-collision vehicle fires. This estimate is in the same order of magnitude of fire data estimates (46 percent of the 485 mobile property fire deaths or approximately 225 deaths).

Fires of incendiary or suspicious origin account for 23 percent of mobile property fires. Many vehicle fires are not investigated for arson, though some insurance companies are investigating the most suspicious or obviously incendiary fires before paying insurance claims. However, the arson problem may well be understated because of the limited effort available to spend on investigations of these incidents.

Carelessness (human act) includes causes such as cigarettes dropped on the upholstery, distractions such as eating or cell phone use, parking over dry leaves with a hot catalytic converter, and misuse of flammable liquids, especially gasoline, while servicing or maintaining the car. Carelessness in mobile properties accounts for 10 percent of fires, 6 percent of deaths, and 25 percent of injuries.

In each of the past 10 years, the top ignition factors for fires (mechanical/design), deaths (collision), and injuries (mechanical/design) have remained the same (Figure 78). Fire deaths and injuries from collisions fluctuate from year to year, but they reached 10-year lows in 2001 and their 10-year trends were down 49 and 57 percent, respectively (Table 21). Fires and deaths from mechanical or design factors dropped to their lowest levels in 2001. These encouraging results are partly because newer vehicles are equipped with improved safety features.

Table 21. Trends by Leading Causes of Ignition in Mobile Properties (1992–2001) (percent)

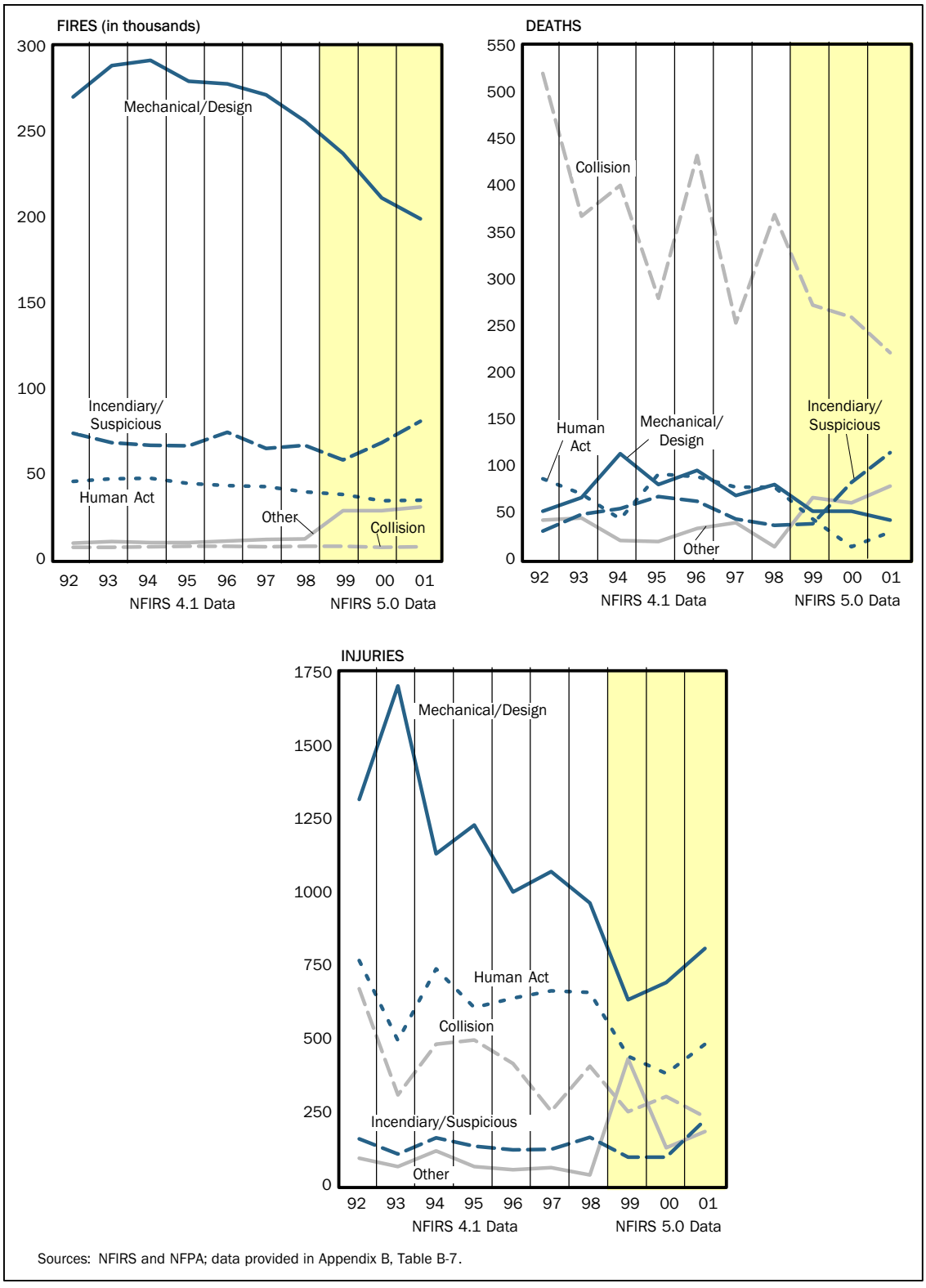
Ignition Factor	Fires	Deaths	Injuries
Incendiary/Suspicious	+1.0	+123.1	+10.9
Collision	+4.6	–48.8	–56.8
Human Act	–28.6	–59.8	–36.1
Mechanical/Design	–27.8	–34.0	–55.5

Sources: NFIRS and NFPA; data provided in Appendix B, Table B-7.

Because automobile fires are such a large part of the entire mobile property fire problem, the cause profiles for automobile fires in 2001 are very similar to those for mobile properties (Figure 79 compared to Figure 77).

Special Data Problems

When there are fatalities associated with a mobile property accident such as a collision between two cars, it is often difficult to determine whether the fatalities were the result of the mechanical forces or the fire that ensued. Because of the very large number of vehicle fatalities occurring in this country each year and the frequency of fires associated with these accidents, there can be a significant error in estimating the total number of fire deaths if this issue is not carefully addressed. A fire fatality should be counted only if a person was trapped and killed by the fire, rather than killed on impact and subsequently exposed to the fire.



Sources: NFIRS and NFPA; data provided in Appendix B, Table B-7.

Figure 78. Trends in Ignition Factor Causes of Mobile Property Fires and Fire Casualties

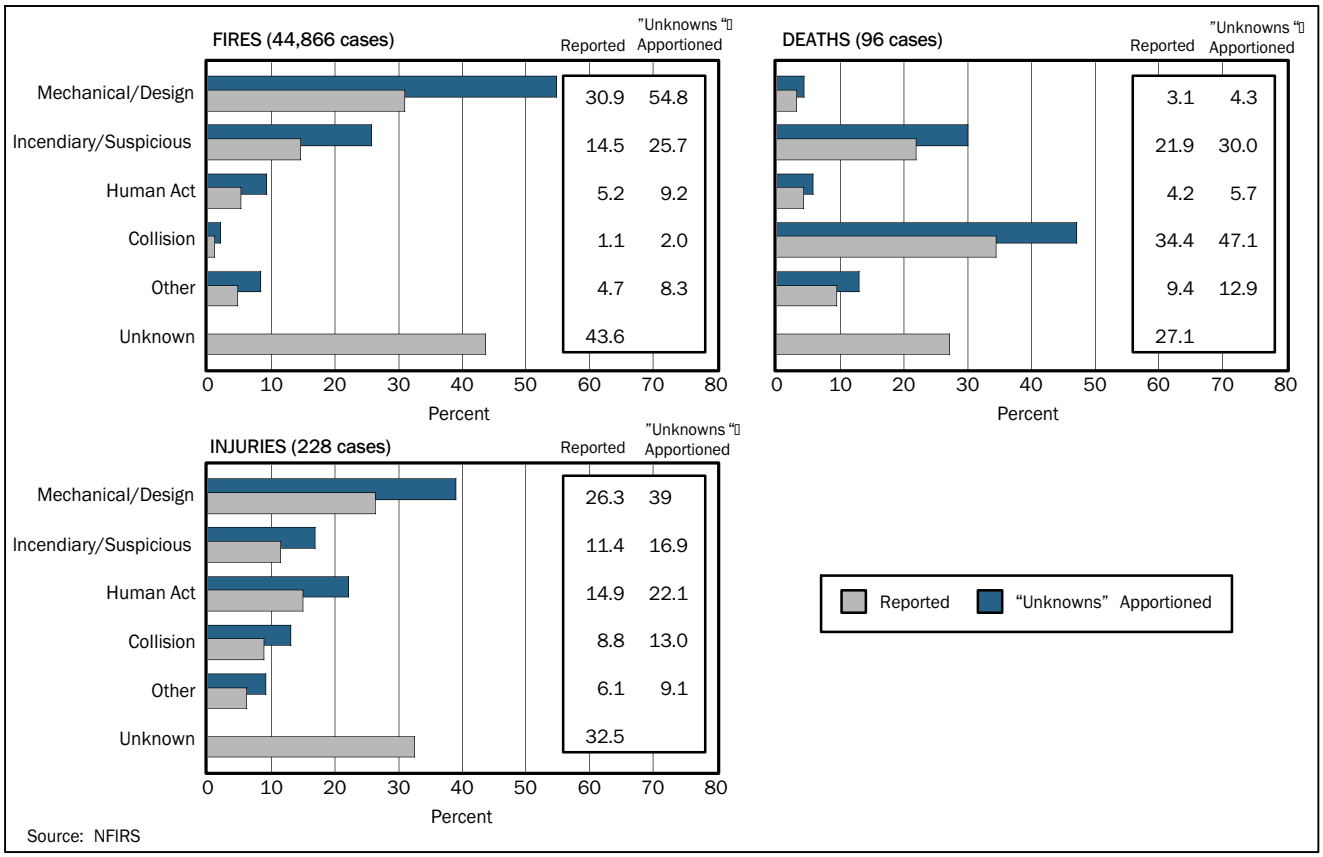


Figure 79. Ignition Factors for Automobile Fires and Fire Casualties (2001)

OUTSIDE AND OTHER PROPERTIES

The outside and other properties category includes all fires that are not structure or vehicle fires. In NFIRS terminology, this includes fires where the type of situation found is outside of the structure either where the burning material has a value or where the fire is confined to trees, brush, grass, or refuse. A subset of outside fires is wildland fires. Grouped in the "other" category are fires whose situation found is not classified, flammable liquid spills out of doors with ensuing fires, and explosions.

Outside and other fires comprise roughly 50 percent of all fires. This proportion has remained steady over the 10 years. Although large in number, they accounted for only 1 percent of fire deaths in 2001, 6 percent of reported injuries, and 2 percent of reported property losses.[6] These numbers may not, however, reflect the true nature of the problem because of underreporting and the difficulty in setting a pricetag on outside fires. Also, many wildland fires are not reported to agencies reporting to NFIRS or to the NFPA annual survey.

[6] These percentages are derived from summary data presented in NFPA's annual survey, 2001.

Overview of Trends

Figure 80 shows the trends in outside and other fires. The numbers of reported outside fires alone are enormous—averaging 776,000 each year. The other category of fires adds, on average, an additional 140,000 fires to this already large number of fires. Over 10 years, an average of 55 deaths resulted each year from outside fires plus the miscellaneous other properties not covered elsewhere; injuries averaged 1,360. Although deaths have a 10-year downward trend of 29 percent, this is due primarily to the fluctuations in the small numbers of deaths; injuries have trended upward 12 percent. Dollar loss for outside properties trended down 15 percent, even including a $390 million timber loss in 1998 Florida wildfires. The spike in 1992 reflects a $250 million timber loss.

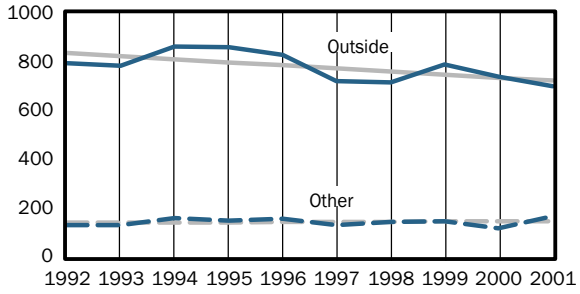
Estimating dollar loss for these fires is difficult. To illustrate this problem, consider Table 22, a comparison of property loss from outside fires derived from NFPA's annual survey and from NFIRS data. The average total loss reported in the NFIRS sample and the NFPA estimate is not remarkably different—$155 million vs. $190 million. The NFIRS sample, however, is slightly less than half the fires reflected in the NFPA survey. For 7 of the 10 years, in fact, the NFIRS total loss for outside fires exceeds the NFPA estimate. If NFIRS data were extrapolated to the NFPA estimate for fires, the NFIRS average loss for outside fires would be in the neighborhood of $300 to $350 million. Part of the difference in property loss estimates is because NFPA assigns property loss for outside fires "with value," whereas NFIRS permits property loss data collection for any fire. Which method is correct? Both are reasonable approaches but neither may be definitive.

Table 22. Comparison of NFPA and NFIRS Outside Fires Loss (millions of 2001 dollars)

	NFPA Estimates	USFA Raw Data
1992	$401.4*	$202.5
1993	77.2	194.0
1994	143.4	180.4
1995	89.5	142.7
1996	102.7	203.1
1997	109.2	165.9
1998	540.0*	133.8
1999	130.8	100.5
2000	220.1	159.5
2001	86.0	62.4
Average	$190.0	$154.5

*Includes large timber loss fires of $250 million (1992) and $390 million (1998) not reported to NFIRS.

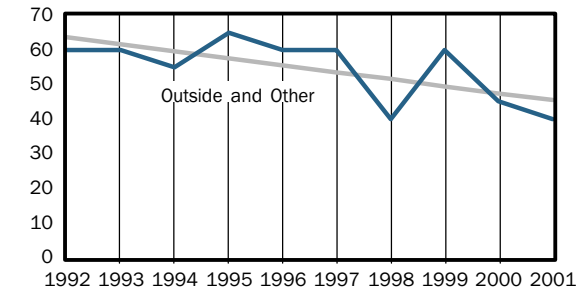
FIRES (in thousands)



	Outside	Other		Outside	Other
1992	793.5	128.5	1997	719.0	127.0
1993	783.5	127.0	1998	715.0	142.0
1994	861.5	157.0	1999	788.5	143.0
1995	838.5	147.0	2000	738.5	115.5
1996	828.5	154.5	2001	697.5	164.0

10-Year Outside Trend = –13.3%
10-Year Other Trend = +5.0%

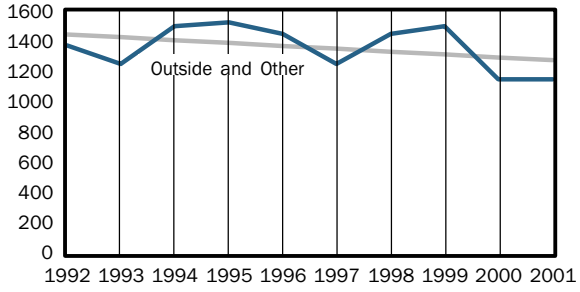
DEATHS



1992	60	1997	60
1993	60	1998	40
1994	55	1999	60
1995	65	2000	45
1996	60	2001	40

10-Year Outside and Other Trend = –28.7%

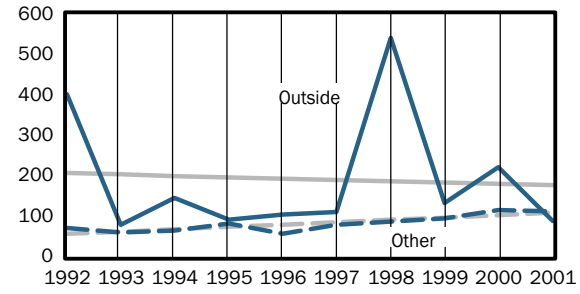
INJURIES



1992	1,375	1997	1,250
1993	1,250	1998	1,450
1994	1,500	1999	1,500
1995	1,525	2000	1,150
1996	1,450	2001	1,150

10-Year Outside and Other Trend = +11.9%

DOLLAR LOSS (in $ millions)*



	Outside	Other		Outside	Other
1992	$401.4	$69.4	1997	$109.2	$77.2
1993	77.2	57.6	1998	540.0	84.7
1994	143.4	63.3	1999	130.8	92.5
1995	89.5	80.2	2000	220.1	114.2
1996	102.7	55.3	2001	86.0	111.0

10-Year Outside Trend = –14.5%
10-Year Other Trend = +95.1%

Sources: NFPA and Consumer Price Index

*Adjusted to 2001 dollars

Figure 80. Trends in Outside and Other Property Type Fires and Fire Losses

Property Types

Figure 81 shows the relative proportions of the four components of reported outside and other fires for 2001. Trees, brush, and grass fires account for more than half of all outside fires. In a large portion of deaths, injuries, and dollar losses, the outside property type is undetermined.

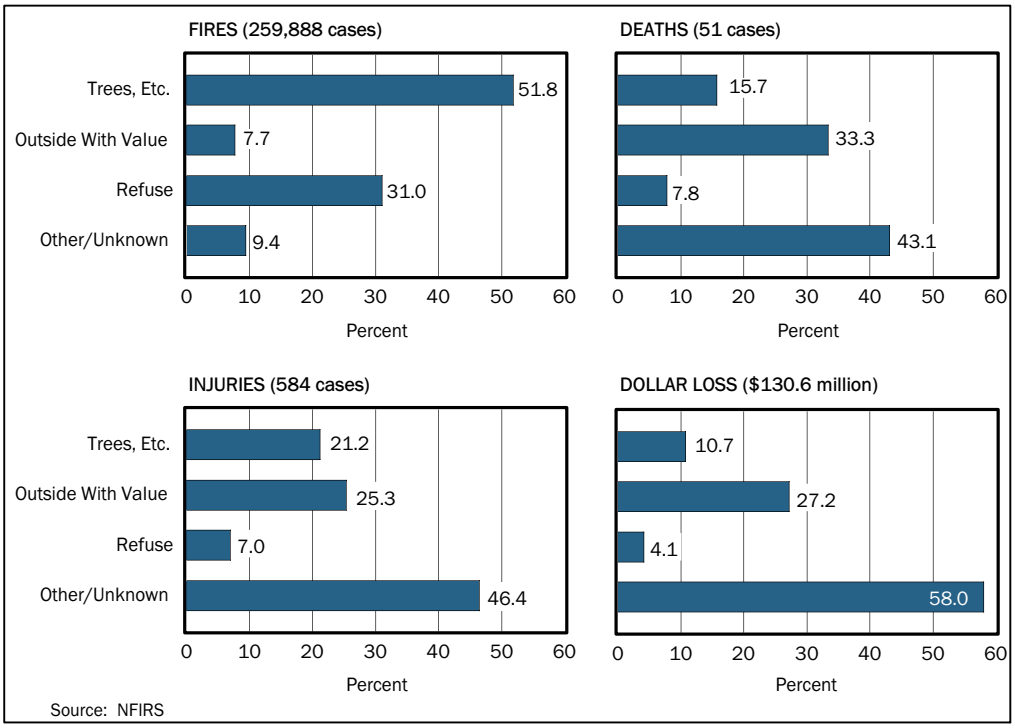


Figure 81. Outside Fires and Fire Loss by Property Type (2001)

When Fires Occur

TIME OF DAY. Figure 82 shows a very interesting and clear profile for when outside and other fires are reported. At 8 a.m., fires begin to increase. They steadily rise to a peak at 3 p.m., at which time they steadily drop until 6 a.m.

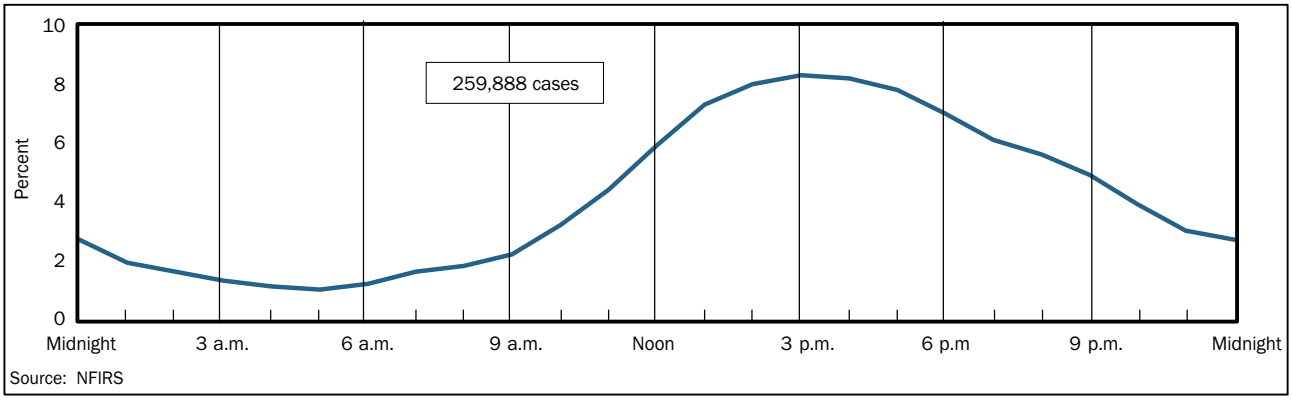


Figure 82. Time of Day of Outside and Other Fires (2001)

MONTH OF YEAR. Outside and other fires are usually lowest in the fall and winter months and highest during spring and summer (Figure 83). In 2001, April was the month with the highest number of fires. An increase in brush fires may have caused the July peak. In recent years, local and state governments have placed more rigorous restrictions on burning leaves, which help suppress autumn fires. Climate (rainfall, wind) also plays a major role in any one year on the number and severity of fires. What is known is that wildland fires tend to have two peaks—one in the spring and one in the fall.

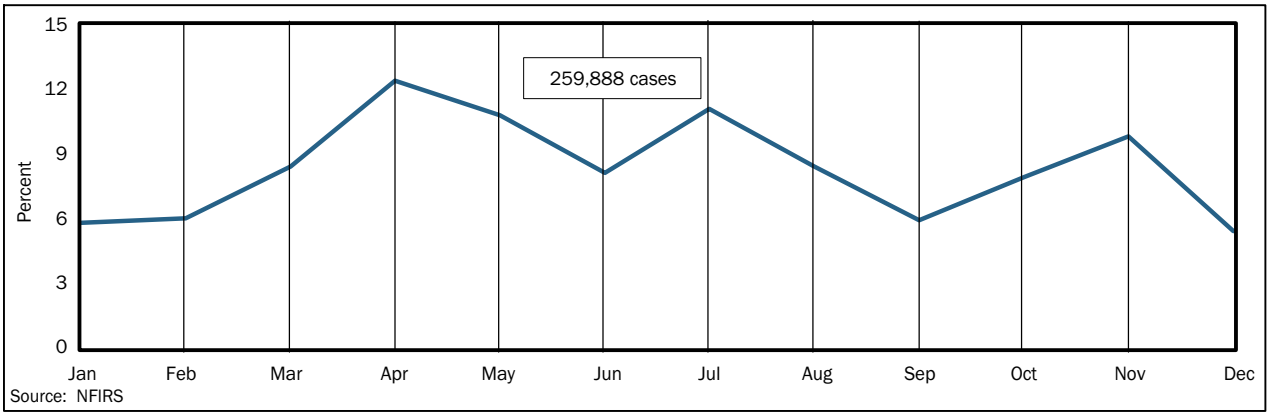


Figure 83. Month of Year of Outside and Other Fires (2001)

DAY OF WEEK. Outside fires are highest on the weekend, a time when more people are outdoors (Figure 84). This pattern is unchanged over the 10 years.

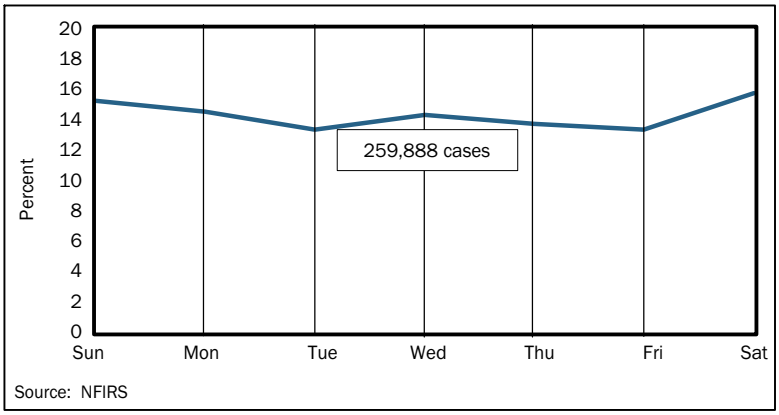


Figure 84. Day of Week of Outside and Other Fires (2001)

Causes

As in all years, the leading cause of all forms of outside fires is arson, with many thought to be set by children and adolescents. Figure 85 shows the cause profiles for each outside or other fire category. A high percentage of outside fires have unknown causes and, as discussed under

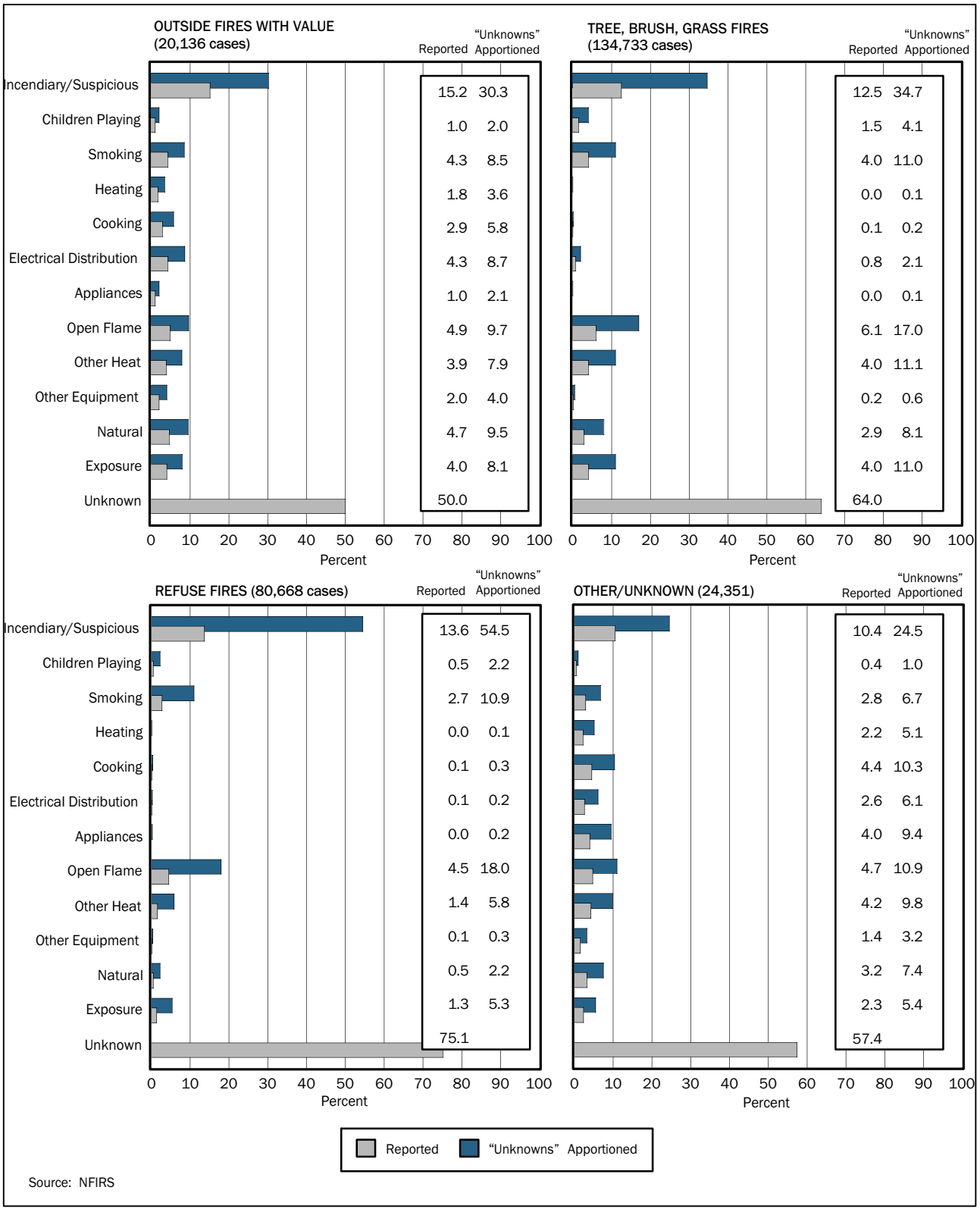


Figure 85. Causes of Outside Fires by Property Type (2001)

the "special data problems" section, there is little that can be done to improve this reporting. The 2001 statistics reflect that little has changed over the 10 years.

For outside fires with value, 30 percent of fires are attributed to arson. The rest of the fires are scattered across many categories, with open flame, natural (e.g., lightning strikes), and electrical distribution as other contributing causes.

Among the known causes of tree, brush, and grass fires, the two that stand out are arson and open flame, which includes open fires used for cooking. These two causes account for 52 percent of fires with cause. Following these are other heat, smoking, and exposure fires.

More than half of the reported causes of refuse fires were reported as arson, with another 18 percent from open flame (e.g., matches) and 11 percent from smoking. Note that refuse fires set inside buildings are structural fires, even if they do no damage, and are reported as part of the property type in which they occur.

Special Data Problems

Setting a value for outside fire damage is a perennial problem. It is difficult to assign a dollar value to grass, tree, and rubbish fires, yet the damage from these fires often requires labor beyond that of the fire department to clean up and restore the area. They also cause esthetic problems that are intangible. Some outside fires spread to structural properties and may be reported as structural fires rather than an outside fire with exposure to structures. Outside fires can have other indirect costs, such as the financial impact on agricultural communities where a fire destroys crops.

Forest fires and other wildfires to which local departments are not called will not be reported to NFIRS if the state or federal agency with principal authority for fighting the fire does not participate in NFIRS. To more fully analyze outside fires, NFIRS data need to be complemented with data from these other agencies.

Another problem with data on outside fires is determining their cause. Often the area of origin is obliterated, the people involved have fled, and one is not sure exactly what caused the fire—an unattended campfire, a discarded match or cigarette, lightning strikes, children playing, or even an intentionally set fire. Thus, the percent of causes determined as unknown is especially high for this category of fires.

USFA RESOURCES ON FIRES IN NON-RESIDENTIAL PROPERTIES

The USFA conducts special studies to address specific problems and current issues facing the nation's fire and rescue service. The technical reports produced under the Major Fires Investigations series analyze major or unusual fires with emphasis on sharing lessons learned. They are directed primarily to chief fire officers, training officers, fire marshals, and investigators as a resource for training and prevention.

The *Topical Fire Research* series for the non-residential fires problem can be downloaded from http://www.usfa.fema.gov/nfdc/inside-usfa/nfdc/pubs/tfrs.shtm:

2000 Wildland Fire Season
Agricultural Fires
Agricultural Storage Fires
Church Fires
Construction Site Fires
Day Care Center Fires
Fire Station Fires
Fires in the Wildland/Urban Interface
Grill Fires
Highway Vehicle Fires
Medical Facilities Fires
Landfill Fires
Lightning Fires
Nightclub Fires in 2000
Non-Residential Structure Fires in 2000
Outdoor Fires
Rail Terminal Fires
School Fires
Wildland Fires: A Historical Perspective

Major Fire Investigation reports on fires and other non-residential property incidents include:

$12 Million Dollar Fire at Dogwood Elementary School, Reston, VA, July 2002 (USFA–TR–135)
$15 Million Sight and Sound Theater Fire and Building Collapse, Lancaster County, PA (USFA–TR–097)
Amtrak Train Derailment, Nodaway, IA, September 2002(USFA–TR–143)
Bonfire Collapse, Texas A&M University, College Station, TX, November 1999 (USFA–TR–133)
Broward Marine Fire, Ft. Lauderdale, FL, September 1996 (USFA–TR–101)
Chicken Processing Plant Fires, Hamlet, NC, and North Little Rock, AR, September 1991 (USFA–TR–057)
Civil Disturbances, St. Petersburg, FL, October/November 1996 (USFA–TR–098)
Concept Sciences, Incorporated, Hanover Twp., PA, February 1999 (USFA–TR–127)
Conservative Approach to Chemical Plant Fire, Ventura County, CA, April 1989 (USFA–TR–029)
Crash of Two Subway Trains on the Williamsburg Bridge, New York City, NY (FA–163F)
CSX Tunnel Fire, Baltimore, MD, July 2001 (USFA–TR–140)
Derailment of the Sunset Limited, Big Bayou Canot, AL (FA–163B)
East Bay Hills Fire, Oakland–Berkeley, CA, October 1991 (USFA–TR–060)
Evacuation of Nanticoke, PA, Due to Metal Processing Plant Fire, March 1987 (USFA–TR–005)
Fire and Explosions at Rocket Fuel Plant, Henderson, NV, May 1988 (USFA–TR–021)
Fire Apparatus/Train Collision, Catlett, VA, September 1989 (USFA–TR–048)
Fire Department Response to Biological Threat at B'nai B'rith Headquarters, Washington, DC (USFA–TR–114)
Fires Involving Medical Oxygen Equipment: Special Report (USFA–TR–107)

Five-Fatality Highrise Office Building Fire, Atlanta, GA, November 1989 (USFA–TR–033)

Gasoline Tanker Incidents in Chicago, IL, and Fairfax County, VA: Case Studies in Hazardous Materials Planning, March/May 1989 (USFA–TR–032)

Hazardous Materials Response Technology Assessment (FA–199)

Highrise Office Building Fire, One Meridian Plaza, Philadelphia, PA, February 1991 (USFA–TR–049)

I-75 Multiple Vehicle Collision Mass Casualty Incident, Collier County, FL, January 2002 (USFA–TR–155)

Indianapolis Athletic Club Fire, Indianapolis, IN, February 1992 (USFA–TR–063)

Industrial Plastics Fire Major Triage Operation, Flint, MI, November 1988 (USFA–TR–025)

Industrial Silo Fire and Explosion, Iredell County, NC, December 21, 1997 (USFA–TR–122)

Interstate Bank Building Fire, Los Angeles, CA, May 1988 (USFA–TR–022)

Live Oak/Milstar Complex and Carpet Service Center, LaGrange, GA, January 1995 (USFA–TR–086)

Logan Valley Mall Fire, Altoona, PA, December 1994 (USFA–TR–085)

Major Propane Gas Explosion and Fire, Perryville, MD, July 1991 (USFA–TR–053)

Major Ship Fire Extinguished by Carbon Dioxide, Seattle, WA, September 1991 (USFA–TR–058)

Manufacturing Mill Fire, Methuen, MA, December 1995 (USFA–TR–110)

Massive Leak of Liquified Chlorine Gas, Henderson, NV, May 1991 (USFA–TR–052)

Multi-Agency Ocean Rescue Disaster Plan and Drill, Broward County, FL, December 6, 1994 (USFA–TR–079)

New York City Bank Building Fire: Compartmentation vs. Sprinklers, New York, NY, January 1993 (USFA–TR–071)

Phillips Petroleum Chemical Plant Explosion and Fire, Pasadena, TX, October 1989 (USFA–TR–035)

Safety and Health Considerations for the Design of Fire and Emergency Medical Services Stations (FA–168)

Santana Row Development Fire, San Jose, CA, July 2001 (USFA–TR–153)

Scrap and Shredded Tire Fires: Special Report (USFA–TR–093)

Search and Rescue Operations Following the Northridge Earthquake, Los Angeles, CA (FA–163C)

Search and Rescue Operations in California During Flooding (FA–163E)

Search and Rescue Operations in Georgia During Major Floods (FA–163D)

Seven Alarm Fire Boardwalk Stores, Wildwood, NJ, August 2000 (USFA–TR–029)

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Other works published by USFA of interest to the non-residential fire problem include:

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