DOCKET ITEM

For the

SPECIAL INVESTIGATION REPORT

Safety Risks to Emergency Responders from Lithium-Ion Battery Fires in Electric Vehicles

NTSB DATA REPORT

Prevalence of Electric Vehicle Battery Fires

November 27, 2018

(16 pages)

NATIONAL TRANSPORTATION SAFETY BOARD

Safety Research Division
Washington, DC 20594

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DATA REPORT:
Prevalence of Electric Vehicle Battery Fires

Specialist's Data Report
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1. DATA REQUEST

The NTSB Office of Highway Safety (OHS) is investigating a series of events that involved battery fires in electric vehicles. As part of the safety report, OHS requested information on the prevalence of fires in electric vehicles (EV). The specific request included the following questions:

- What data sources allow for the study of vehicle fire incidence or trends by fuel type?
  - What relevant information is available in each of these data sources?
  - Are EVs more or less likely than internal combustion engine (ICE) vehicles to experience fires?

2. DATA SOURCES EVALUATED

- NHTSA Fatality Analysis Data System
- NHTSA Complaint Database and Manufacturer Communication Database
- Highway Loss Data Institute Database
- US Fire Administration National Fire Incident Reporting System
- National Fire Protection Association Survey
- Towing Traffic Incident Reporting System

3. METHODOLOGY

- Staff reviewed each data source and summarized following:
  - Description of the data source and method of collection
  - Available information, including summary data on vehicle fires
  - Data limitations by source

4. RESULTS

NHTSA FATALITY ANALYSIS REPORTING SYSTEM (FARS)

Description: The NHTSA Fatality Analysis Reporting System (FARS) contains data on all vehicle crashes in the United States that occur on a public roadway and involve a fatality. The data come primarily from police accident reports filled out by local law enforcement officers. NHTSA FARS analysts verify and supplement the data from the police reports.

Available Information: Information about a vehicle's fuel system and, if applicable, the battery type may be encoded in the vehicle's identification number (VIN). The FARS employs a VIN decoder system from R.L. Polk that can provide information about the vehicle fuel type ("FUEL_T") and battery type ("BATTYP_T"). VIN decoding underwent a substantial change in 2013; consequently, data presented here are from 2013 onward.[1]

2013-2017 FARS data, shown in table 1, revealed that 1,765 vehicles involved in fatal crashes were coded as being electric-and-gasoline hybrid, 51 vehicles were coded as electric only, and 6 were coded as electric-and-diesel hybrid.[2] Among the electric-and-gasoline hybrid fueled vehicles, about 87 percent used nickel metal hydride batteries and about 13 percent used lithium-ion or lithium-ion polymer batteries. Of the 51 vehicles coded with electric fuel type, 47 had lithium ion batteries while 1 vehicle had lead acid battery and 3 vehicles had no VIN decoded battery type. None of the electric-and-diesel hybrid vehicles had VIN decoded battery type. Overall, fuel type data were missing or unknown in about 14 percent of all vehicles in fatal crashes for this period.

Table 1. 2013-2017 vehicles involved in fatal highway crashes in the US by fuel type and battery type (Source: NHTSA FARS).

	Lead Acid	Lithium -ion	Lithium-ion Polymer	Nickel Metal Hydride	N/A	No VIN decode Value	Total
Compressed Natural Gas	0	0	0	0	4	149	153
Convertible	0	0	0	0	0	134	134
Diesel	0	0	0	0	1419	26736	28155
Electric	1	47	0	0	0	3	51
Electric-and-Diesel Hybrid	0	0	0	0	0	6	6
Electric-and-Gasoline Hybrid	0	162	75	1528	0	0	1765
Flexible	0	0	0	0	6515	7631	14146
Gasoline	0	0	0	0	11323	159897	171220
Hydrogen Fuel Cell	0	0	0	0	0	1	1
Propane	0	0	0	0	0	5	5
Unknown	0	0	0	0	0	26	26

[1] NHTSA (National Highway Traffic Safety Administration). 2018. Fatality Analysis Reporting System (FARS): Analytical User's Manual 1975-2017. DOT HS 812 602. Washington, DC: US Department of Transportation, NHTSA. (Appendix G, Page 66)

[2] All six diesel and electric vehicles were trucks based on VIN-decoded vehicle type.

No VIN Decode Value	0	0	0	0	0	35384	35384
Total	1	209	75	1528	19261	229972	251046

FARS also includes a code (FIRE_EXP) that identifies whether a fire related to a crash occurred in an involved vehicle. Table 2 depicts presence of fire by fuel type for the 2013-2017 period. Overall, 3.2 percent of vehicles in fatal crashes experienced a fire. The fuel type associated with the highest incidence of fire was diesel (4.7 percent). This difference might be partly attributable to the fact that diesel fuel use is more common among large trucks. Gasoline-fueled vehicles, electric-and-gasoline vehicles, and electric vehicles had fire rates of 3.2 percent, 1.4 percent, and 2.0 percent, respectively. However, it's important to note several caveats: 1) the FARS database does not provide enough information to know whether the source of the fire was in the fuel system, 2) it is likely that the age range for conventionally fueled vehicles (diesel or gasoline) was much greater than that for alternatively fueled vehicles (hybrid or electric), and 3) because of the small number of electric-and-gasoline hybrid and electric vehicles in the population (less than 1 percent, overall), fire prevalence estimates for this group are less likely to be reliable.

Table 2. Vehicles involved in fatal highway crashes in the US between 2013-2017 that experienced fires by fuel type (Source: NHTSA FARS).

Fuel Type	**All Model Years**			**Model Year 2013 and Later**		
	Fire	**Total**	**Percent**	**Fire**	**Total**	**Percent**
Compressed Natural Gas	4	153	2.61%	4	86	4.65%
Convertible	1	134	0.75%	0	7	0.00%
Diesel	1,318	28,155	4.68%	311	6,439	4.83%
Electric	1	51	1.96%	1	41	2.44%
Electric-and-Diesel Hybrid	0	6	0.00%	0	4	0.00%
Electric-and-Gasoline Hybrid	24	1,765	1.36%	12	543	2.21%
Flexible	422	14,146	2.98%	104	3,798	2.74%
Gasoline	5,508	171,220	3.22%	644	20,315	3.17%
Hydrogen Fuel Cell	0	1	0.00%	0	1	0.00%
Propane	0	5	0.00%	0	4	0.00%
Unknown	0	26	0.00%	0	14	0.00%
No VIN Decode Value	661	35,384	1.87%	178	10,413	1.71%
Total	7,939	251,046	3.16%	1,259	41,665	3.02%

Limitations: The FARS database only includes crashes that result in a fatality and does not include fire events that are unrelated to crashes. There is also no data about the sources of fires. It is not clear what proportion of VINs on vehicles include information about fuel type.

NHTSA OFFICE OF DEFECTS INVESTIGATION (ODI) DATABASES

Description: The NHTSA Complaint Database and Manufacturer Communication Database are systems that NHTSA's ODI uses to gather information about potential vehicle defect information from consumers either directly or through consumer communications with manufacturers. According to NHTSA, "Complaint information entered into NHTSA-ODI's vehicle owner's complaint database is used with other data sources to identify safety issues that warrant investigation and to determine if a safety-related defect trend exists. Complaint information is also analyzed to monitor existing recalls for proper scope and adequacy."[3]

Available Information: The complaint database includes firsthand accounts from vehicle owners or users about safety problems they have encountered. The data typically includes identifying data about the vehicle itself (manufacturer, model, year) as well as a narrative field describing the complaint. A search of this database using keywords uncovered fewer than 10 cases in which fires were reported in electric vehicles. Below is a sample case that was found in the database.

> 695374 10244197 General Motors LLC CHEVROLET S10 1997 N
> 20080424 Y 0 0 ELECTRICAL SYSTEM MESA AZ
> 1GCDE14H1V8 20081002 20081002 15000 1 I AM FILING THIS REPORT ON BEHALF OF THE VEHICLE OWNER. OWNER NAME IS HANS LARSEN. I AM A PRIVATE ELECTRIC VEHICLE SERVICE PERSON, AND HAVE IDENTIFIED TWO SOFTWARE DEFECTS IN THE BATTERY PACK MANAGEMENT SYSTEM USED IN THE 1997-1998 MODEL CHEVROLET S-10EV ELECTRIC TRUCK. THE VEHICLE NOTED IN THIS COMPLAINT HAD BEEN COMPLETELY DESTROYED BY A FIRE THAT BEGAN WHILE THE VEHICLE WAS CHARGING IN THE CUSTOMER DRIVEWAY. I BELIEVE THE FIRE WAS A RESULT OF ONE OF THE TWO KNOWN SOFTWARE PROGRAM DEFECTS. I HAD PREVIOUSLY CONTACTED GENERAL MOTORS REGARDING THESE SUSPICIONS, AND HAVE NOT RECEIVED A REPLY AS TO WHETHER THEY HAVE INTEREST IN INVESTIGATING THE FIRE, AND IF THE SOFTWARE PROGRAM DEFECTS WILL BE RESOLVED. THIS IS THE FIRST OF THREE VEHICLE FIRES OCCURRING DURING CHARGING WITHIN A SIX MONTH PERIOD. *TR
> IVOQ Y, N, N , N, 0, V

There were several cases in the database that described Tesla battery fire issues, some of which also describe problems with "fragile alloy suspension parts" that could lead to battery damage.

Limitations: Although the Complaint Database has the potential to serve as an early indicator of a potential systematic vehicle problem or defect, the data it contains is not a representative sample of events and relies completely on self-report from consumers and manufacturers. This database may also be less likely to contain information about postcrash issues. The search tool capability for the manufacturer tool communication database made it very difficult to search for cases that may have involved EV battery fires.

[3] https://webapi.nhtsa.gov/Default.aspx?Complaints/Metadata/81 Accessed November 8, 2018.

HIGHWAY LOSS DATA INSTITUTE DATABASE

Description: The Highway Loss Data Institute (HLDI) is associated with the Insurance Institute for Highway Safety. HLDI gathers and reports on vehicle insurance claim data representing human and economic losses from crashes and other events related to vehicle ownership. Data are provided by its supporting member companies that comprise approximately 85 percent of the US private passenger auto insurance market. HLDI uses those data to provide information to the insurance industry and to the public to improve vehicle safety. For example, HLDI publishes research describing the effects of vehicle safety technologies or state laws and how they influence vehicle insurance claims.

Available Information: HLDI has published several reports that discuss the incidence of noncrash fire claims. They define noncrash fire losses as fire damage to a vehicle not caused by a collision or vandalism. For example, in 2017 the organization published a report describing the effectiveness of fire safety recalls on reducing the risk of fire losses in affected vehicles.[4] In 2018, at the request of NHTSA, the organization published a report on noncrash fire losses for passenger vehicles produced in model years 2015-2017.[5] The report described overall claim frequency defined as the number of claims for a group of vehicles per 1,000 insured vehicle years. The report also reported on the average loss payment per claim and the average loss payment per insured vehicle year. More than 300 vehicle make/series combinations were evaluated.

Tables 3 and 4 depict hybrid and electric vehicle data extracted from the 2018 HLDI report, showing their relative claim frequencies, relative claim severities, and relative overall losses compared to the average rate for all passenger vehicles, which is represented as 100. For example, a claim frequency of 200 would indicate that the claim frequency for the vehicle make/series was twice as frequent as that of all passenger cars.

Table 3. Relative claim frequencies, severities, and overall losses for model year 2015-17 hybrid vehicles relative to all passenger cars (comparison value for all passenger cars = 100)

Hybrids	Exposure (insured vehicle years)	Claims	Relative Claim Frequency	Relative Claim Severity	Relative Overall Losses
Ford Fusion plug-in hybrid	45,924	13	188	101	190
Ford C-Max plug-in hybrid	28,291	7	156	73	114
Hyundai Sonata hybrid	27,295	6	146	75	109
Toyota Prius c hybrid	87,962	17	145	70	102
Honda Accord hybrid	59,731	11	120	72	87
Lexus ES 300h hybrid 4dr	40,305	8	119	113	135
Lexus CT 200h hybrid 4dr	53,532	9	119	113	135

[4] Highway Loss Data Institute (2017). Noncrash fire safety recall losses- for automobiles and motorcycles: 2007-2017, Bulletin, 34 (38).

[5] Highway Loss Data Institute (2018). Noncrash fire losses: 2015-17 Passenger Cars, Pickups, SUVs, and Vans.

Toyota Prius v hybrid	71,935	11	96	83	80
Toyota Camry hybrid	91,622	12	96	56	54
Ford C-Max hybrid	32,067	4	85	75	64
Ford Fusion hybrid	71,375	9	80	47	38
Toyota Prius hybrid	430,959	48	72	80	57
Highlander hybrid 4dr 4WD	28,566	3	63	74	46
Toyota Avalon hybrid	36,550	3	52	157	82
Lincoln MKZ hybrid 4dr	34,445	0	0	0	0

Table 4. Relative claim frequencies, severities, and overall losses for model year 2015-17 electric vehicles relative to all passenger cars (comparison value for all passenger cars = 100)

Electrics	Exposure (insured vehicle years)	Claims	Relative Claim Frequency	Relative Claim Severity	Relative Overall Losses
Tesla Model X 4dr electric 4WD	28,784	9	224	354	794
Fiat 500 Electric	25,536	8	219	88	191
BMW i3 electric station wagon	27,293	9	203	136	276
Tesla Model S 4dr electric 4WD	72,468	17	169	259	437
Chevrolet Volt Electric	49,943	12	158	124	196
Nissan Leaf Electric	100,954	20	126	73	92
Tesla Model S 4dr electric	24,311	3	97	196	189

Limitations: Losses due to noncrash fires are covered under comprehensive coverage. Comprehensive coverage insures against theft and physical damage to insured people's own vehicles that occurs for reasons other than crashes. Although the data provided to HLDI includes noncrash fire claims, no information is provided about causes or sources of the fires. Consequently, although it appears that electric vehicles have a higher noncrash fire claim frequency, severity, and losses than all passenger cars, we cannot conclude that the differences were related to the fuel sources without additional information.[6]

[6] Furthermore, we cannot definitively say that the fires were initiated in the vehicle. Although fires from vandalism are excluded, the data do include fires started outside of the vehicle, such as by a wildfire.

U.S. FIRE ADMINISTRATION'S (USFA) NATIONAL FIRE INCIDENT REPORTING SYSTEM (NFIRS)

Description: According to the USFA, the NFIRS, established in 1975, is a voluntary reporting system used by fire departments across the country. It includes not just fire event data but also emergency medical service incidents. State participation is voluntary and reporting requirements vary by state.[7] More than 24,000 fire departments or about 80 percent of all fire departments in the US report data to the NFIRS.[8] Yet, it is not considered a fully representative sample. The National Fire Protection Association (NFPA, described in a separate section) uses data from a national survey of fire departments to complement the NFIRS and create national estimates.

Available Information: Basic data is collected for each incident (basic module), including the type, location, and duration of the incident and whether there were casualties. There are several additional modules depending on the type of incident. (See table 5). The fire module includes fields that describe "mobile property" fires, which includes highway vehicles as well as vehicles in other modes. The fields in the module include the mobile property type, make, model, year, license plate number, state, and vehicle identification number (VIN). However, these data elements are optional fields.

Table 5. National Fire Incident Reporting System (NFIRS) data modules

Basic Module	General information for each incident
Fire Module	Fire incident information
Structure Fire Module	Information on structure fires
Civilian Fire Casualty Module	Fire-related injuries or deaths to civilians
Fire Service Casualty Module	Injuries or deaths to firefighters
EMS Module	Medical incidents
Hazardous Materials Module	Hazardous materials incidents
Wildland Fire Module	Wildland or vegetation fires
Apparatus/Resources Module	Apparatus-specific information
Personnel Module	Personnel associated with apparatus
Arson Module	Intentionally-set fire information

Each year, USFA staff create public data release files with data from all the modules. They also periodically create Topical Reports, including a report on Highway Vehicle Fires. The most recent highway vehicle fire report, published in 2018, covers fires from 2014-2016.[9] The cause of about one-third of vehicle fires during that period was coded as either "undetermined" or "still under investigation". Additionally, unintentional actions accounted for 38 percent of

[7] The Department of Defense (DOD) and the Native American Tribal Authority also participate in NFIRS. DOD data are not released at a national level.

[8] https://www.usfa.fema.gov/data/nfirs/support/nfirsgrams/nfirsgram_3_reasons.html (Accessed November 27, 2018)

[9] https://www.usfa.fema.gov/downloads/pdf/statistics/v19i2.pdf (Accessed November 27, 2018).

highway vehicle fires and about 21 percent of fires were attributed to a failure of equipment or heat source.

According to the 2018 report, the source of most vehicle fires (93 percent) is the vehicle itself. The most common sources within the vehicle are shown in table 6.

Table 6. Areas of fire origin in highway vehicle fires (2014-2016) Source: NFIRS 5.0

Areas of Fire Origin	Percent of Highway Vehicles (Unknowns Apportioned)	
Transportation, vehicle areas	93.1	
Engine area, running gear, wheel area		62.2
Operator/Passenger area of transportation equipment		12.3
Other vehicle areas		8.7
Cargo/Trunk area - all vehicles		4.6
Exterior, exposed surface of vehicle		3.4
Fuel tank, fuel line		1.6
Separate operator/control area of transportation		0.3
All other areas	6.9	
Total	100.0	

The most common heat source for vehicle fires, among the 43 percent of cases with available data, was “heat from powered equipment” followed by “hot or smoldering objects.” The items that first ignited, among the 35 percent of cases with available data, were “general materials” and “liquids, piping, and filters.” The most common factors contributing to ignition for highway vehicles were “mechanical failure, malfunction” and “electrical failure, malfunction.”

The data fields that might allow users to know whether fires occurred in electric, hybrid, or internal combustion engine vehicles include the VIN field (MOB_VIN-NO), and the make, model, and year of the vehicle (MOB_MAKE, MOB_MODEL, MOB_YEAR). According to staff from the US Fire Administration, they do not analyze these fields for their periodic reports.

NTSB staff obtained a copy of the public data release for 2016, the most current year available. Staff restricted the data set to focus on mobile property fires in passenger vehicles, road freight or transport vehicles, self-propelled motor homes or recreational vehicles, and towed campers.[10] Excluded from the data set were fires initiated by vehicles in which the vehicles themselves did not burn. Within that set, there were 8,286 vehicle fires. As shown in table 7,

[10] Off-road recreational vehicles such as snowmobiles were excluded as well as agricultural and construction vehicles.

VIN data were available for nearly half of all vehicle fires and make, model, and year data for about 99 percent, 70 percent, and 61 percent, respectively.

Table 7. Vehicle identification number (VIN), make, model, and year data availability for vehicle fire data in the 2016 NFIRS database.

	Missing	Available	% Available
VIN	4222	4064	49.0%
Make	107	8179	98.7%
Model	2530	5756	69.5%
Year	3235	5051	61.0%

Limitations: The USFA cautions that the database is not a census and does not comprise a representative sample of incidents. According to the agency, "historically, not all states participate in NFIRS each year, and all fire departments that report to NFIRS within a state do not necessarily report all of their fire incidents. Additionally, some fire departments that report fire incidents do not report associated casualties. States and/or fire departments that report in one particular year may not report to NFIRS the following year. Thus, NFIRS is not representative of all fire incidents in the United States and is not a census of fire incidents or casualties."[11] Furthermore, because many of the fields of interest relating to vehicles are optional, these fields are often left blank. Finally, unlike the NHTSA FARS database, the NFIRS database does not incorporate the VINA software program from R. L. Polk & Co. that deciphers the VIN data. As a result, it is difficult to determine the fuel type and battery type for the vehicles listed in the NFIRS.

[11] US Fire Administration, "The National Fire Incident Reporting System and the Public Data Release File" document from the 2016 NFIRS Public Data Release.

NATIONAL FIRE PROTECTION ASSOCIATION

Description: The National Fire Protection Association (NFPA) is a nonprofit organization that works to eliminate injuries and losses due to fire, electrical, and related hazards. The NFPA provides training and education on fire safety. The organization also conducts research and analyzes and reports on fire safety data. They have done some exploratory research on electric vehicle fires by following up with individual fire departments after media reports of fires.

Available Information: Each year, the NFPA conducts a "fire experience survey." The 4-page survey is sent to a representative sample of fire departments across the US. It requests information about several topics, including but not limited to:

- Fire service personnel
- Population area, and community type protected
- Number of fires in structures by property use
- Number of civilian fire deaths and injuries for each fire type
- Estimated property damage amounts

Within the fire topic, there are fields for collecting information about the number of fires in highway vehicles. NFPA uses data from its own survey and data from the NFIRS to produce national estimates of various fire statistics such as the total number of fires, the number of fires in structures, and the number of fires in highway vehicles. NFPA publishes these statistics in a variety of reports, such as its annual Fire Loss in the United States report.[12] The data presented in table 8 and figures 1 and 2 are from a 2018 NFPA report.[13] The data generally show a reduction in fires and fire-related casualties over the 38-year period; however, there has been little change over the past decade. During the period from 2008 to 2017, there was an average of 178,850 vehicle fires per year that resulted in an average of 320 civilian fatalities and 1,176 injured civilians per year.

Table 8. Estimated vehicle fires and civilian deaths, civilian injuries, and financial losses associated with vehicle fires in the United States for the years 1980 to 2017. (Source: NFPA)

Year	Fires	Civilian Deaths	Civilian Injuries	As Reported (Billions)	2017 Dollars (Billions)
1980	456,000	650	2,850	$0.50	$1.50
1981	453,000	770	2,900	$0.50	$1.30
1982	433,000	575	3,250	$0.50	$1.20
1983	435,500	670	3,400	$0.60	$1.50
1984	437,000	530	3,250	$0.60	$1.40
1985	437,000	770	3,250	$0.70	$1.60
1986	438,000	665	2,850	$0.70	$1.50

[12] See https://www.nfpa.org/News-and-Research/Data-research-and-tools/US-Fire-Problem/Fire-loss-in-the-United-States (Accessed November 14, 2018.)
[13] *Fire Loss in the United States 2017*, Ben Evarts., NFPA, September 2018.

1987	451,000	755	2,900	$0.70	$1.50
1988	459,000	800	2,750	$0.80	$1.60
1989	415,500	560	2,750	$0.80	$1.60
1990	415,000	645	3,025	$0.80	$1.50
1991	406,500	530	2,675	$0.80	$1.40
1992	385,500	665	2,750	$0.80	$1.40
1993	402,000	540	2,400	$0.90	$1.50
1994	402,000	555	2,325	$1.00	$1.60
1995	386,000	490	2,275	$1.00	$1.60
1996	395,000	550	2,075	$1.10	$1.70
1997	377,000	450	1,950	$1.10	$1.60
1998	358,500	545	2,050	$1.10	$1.60
1999	345,000	450	1,600	$1.10	$1.60
2000	325,000	450	1,325	$1.20	$1.70
2001	327,000	470	1,750	$1.30	$1.80
2002	307,000	540	1,700	$1.20	$1.60
2003	286,000	455	1,400	$1.10	$1.40
2004	266,500	520	1,300	$1.00	$1.30
2005	259,000	500	1,450	$1.00	$1.20
2006	250,000	445	1,075	$1.00	$1.20
2007	227,500	365	1,500	$1.10	$1.30
2008	207,000	350	850	$1.20	$1.30
2009	190,500	260	1,455	$1.00	$1.10
2010	184,500	285	1,440	$1.00	$1.10
2011	187,500	270	1,020	$1.00	$1.10
2012	172,500	300	800	$1.30	$1.40
2013	164,000	300	925	$1.10	$1.10
2014	167,500	310	1,275	$1.10	$1.10
2015	174,000	445	1,550	$1.20	$1.20
2016	173,000	280	1,075	$0.90	$0.90
2017	168,000	400	1,370	$1.40	$1.40

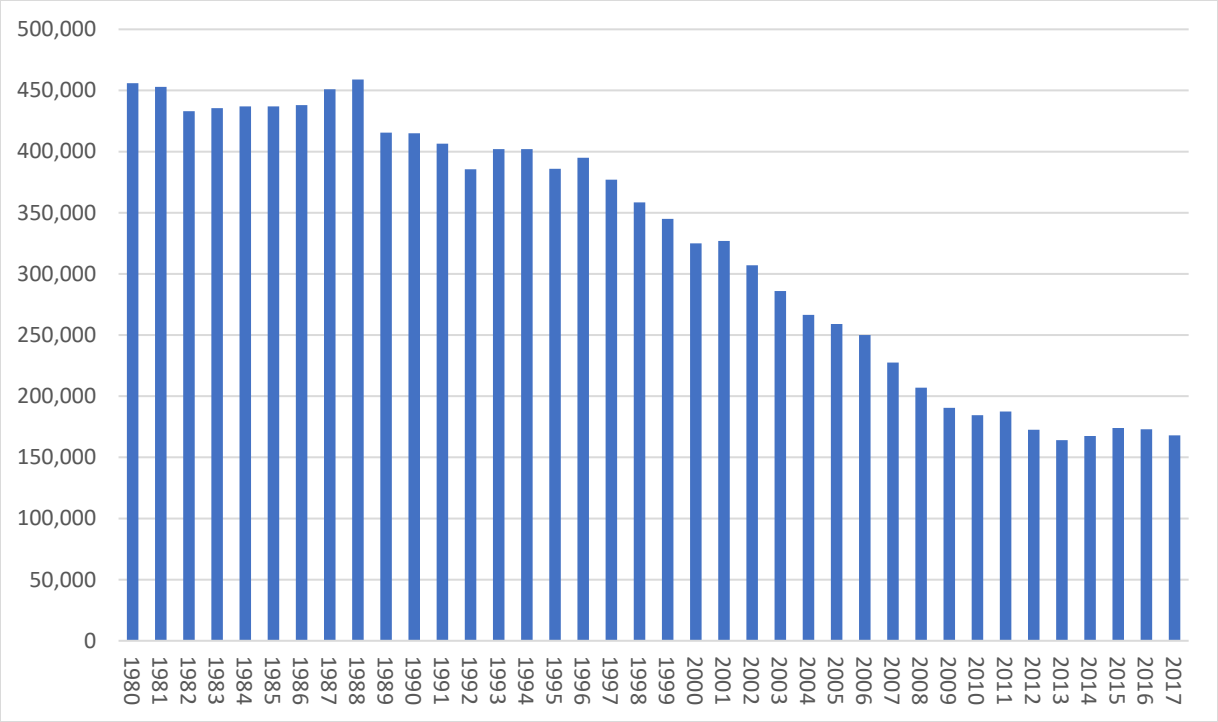

Figure 1: US highway vehicle fires by year (Source: NFPA)

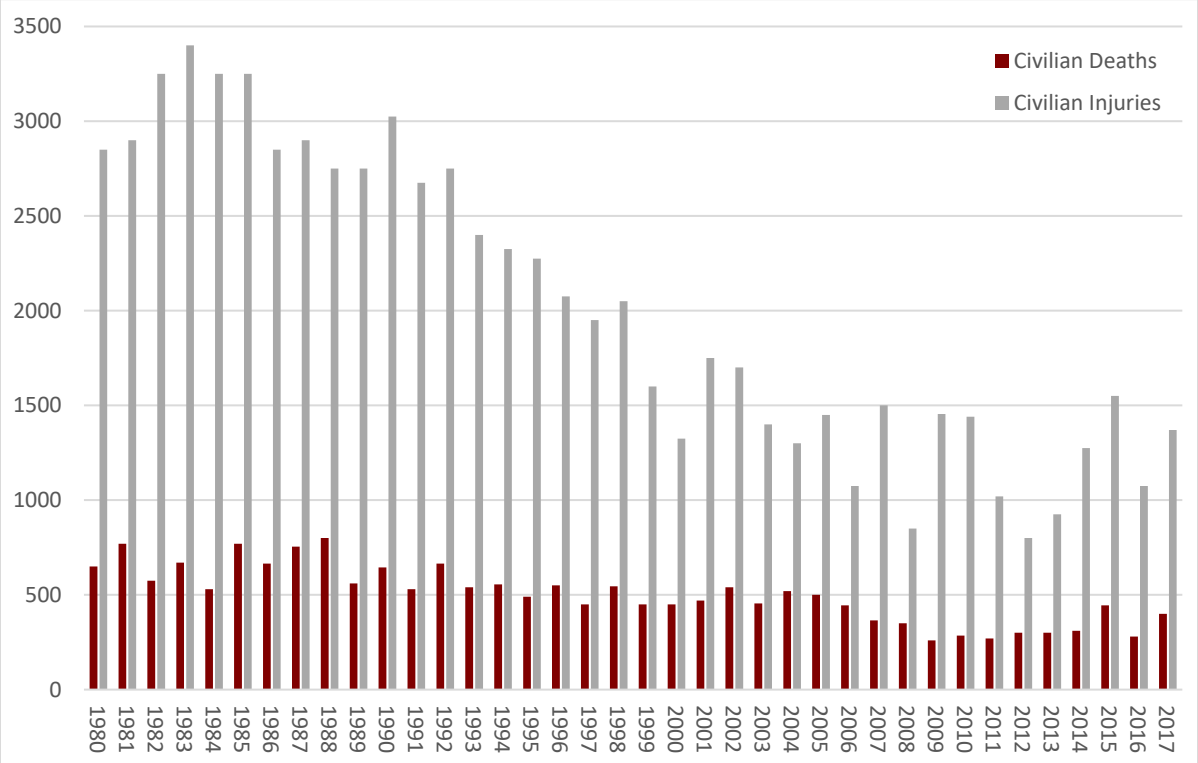

Figure 2: Civilian deaths and injuries associated with US highway vehicle fires by year (Source: NFPA)

Limitations: The NFPA does not collect detailed information about fire causes. Although the NFIRS does include fields for vehicle make, model, model year and VIN for vehicle fires., NFPA has chosen not to conduct analyses using those vehicles. Their staff noted that because those data were voluntary fields and because some may consider VINs as personally identifying information, those data may be filled out infrequently.

TOWING TRAFFIC INCIDENT REPORTING SYSTEM

Description: The Statewide Towing Association established the Towing Traffic Incident Reporting System (TTIRS) in 2015. According to the website overone.org, the TTIRS is an online voluntary reporting system that allows members of the towing industry report events such as crashes and near-miss events involving tow operators.[14]

Data Available and Limitations: According to the founder of the TTIRS, the database was designed to capture reports of towers struck on the roadway. The TTIRS doesn't include vehicle data except for its size; that is, it does not contain make, model, year or VIN of the involved vehicles. It is also not designed to address safety events that take place in the towing yard.

[14] http://overone.org/ttirs/ (Accessed November 15, 2018).

5. SUMMARY OF AVAILABLE DATA

Table 9 contains a summary of the four main sources of vehicle fire data examined and details about the type of information they can provide about the incidence and rate of fuel-source-related fires by vehicle fuel source type.

Table 9. Summary of available data on vehicle fire events, fuel types, fire sources, and exposure measures in four databases.

	NHTSA FARS	**NHTSA ODI Databases**	**HLDI Database**	**US Fire Administration NFIRS Database and NFPA Survey**
Population Addressed	All fatal roadway crashes	Anecdotal reports about vehicle problems from consumers and manufacturers	Insurance claims data representing 85% of insurance market	Reports from 80% of fire depts. (combined with NFPA survey data for national estimates)
Fuel Type Documentation	Most cases contain make, model, model year, and VIN	Make, model, VIN, and fuel type	Make model, series, and model year reported	Identifying data (Make, model, model year, VIN) in about half of reports
Fire Documentation	Fire presence coded, but not cause or source	Fire presence coded, but not cause or source	Fire presence coded, but not cause or source	Fire cause and source data codes available, but incomplete in many cases
Exposure Measures	Vehicle age	Vehicle age and mileage at time of event	Vehicle age and insured vehicle years	Vehicle age