Office of Transport Safety Investigations

BUS SAFETY REPORT

Bus Fires in New South Wales in 2021

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THE OFFICE OF TRANSPORT SAFETY INVESTIGATIONS

OTSI is an independent NSW authority which contributes to the safe operation of bus, ferry and rail passenger and rail freight services in NSW by investigating safety incidents and accidents and transport safety risks, identifying system-wide safety issues, and sharing lessons with transport operators, regulators, and other stakeholders.

OTSI is empowered under the *Transport Administration Act 1988* to investigate rail, bus, and ferry accidents and incidents in accordance with the provisions of the *Passenger Transport Act 1990* and *Marine Safety Act 1998*. It also conducts rail investigations on behalf of the Australian Transport Safety Bureau under the *Transport Safety Investigation Act 2003* (Cth).

OTSI investigations are independent of regulatory, operator or other external entities. OTSI investigates using a 'no-blame' approach to understand why an occurrence took place and to identify safety factors that are associated with an accident and incident, to make recommendations or highlight actions that transport operators, regulators and government can take to prevent recurrence and improve safety.

Evidence obtained through an OTSI investigation cannot be used in any subsequent criminal or disciplinary action. However, a regulator can undertake its own investigation into an incident OTSI has investigated and coronial inquiries can obtain access to OTSI information.

OTSI does not investigate all transport safety incidents and accidents but focuses its resources on those investigations considered most likely to enhance bus, ferry, or rail safety. Many accidents result from individual human or technical errors which do not involve safety systems so investigating these in detail may not be justified. In such cases, OTSI will not generally attend the scene, conduct an in-depth investigation, or produce an extensive report.

OTSI may request additional information from operators or review their investigation reports which may lead to several actions, such as the release of a Safety Advisory or Alert to raise industry awareness of safety issues and action.

OTSI investigators normally seek to obtain information cooperatively when conducting an investigation. However, where it is necessary to do so, OTSI investigators may exercise statutory powers to conduct interviews, enter premises and examine and retain physical and documentary evidence.

Publication of the investigation report

OTSI produces a written report on every investigation for the Minister for Transport, as required under section 46BBA of the *Passenger Transport Act 1990*.

Investigation reports strive to reflect OTSI's balanced approach to the investigation, explaining what happened and why in a fair and unbiased manner. All Directly Involved Parties will be given the opportunity to comment on the draft investigation report.

The final investigation report will be provided to the Minister for tabling in both Houses of the NSW Parliament in accordance with section 46D of the *Passenger Transport Act 1990*. The Minister is required to table the report within seven days of receiving it.

Following tabling, the report is published on the OTSI website – www.otsi.nsw.gov.au – and information on the safety lessons promoted to relevant stakeholders.

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EXECUTIVE SUMMARY

This is the ninth annual summary report into bus fires in New South Wales. This year, 2021, saw an overall increase in the number and severity of bus fires and thermal incidents. The key takeaways from this summary report are:

- No passengers or staff were injured resulting from bus fires or related events in 2021.
- There were 106 fire and thermal incidents reported in 2021. This represented a 45% increase from 2020.
- There were nine fire incidents in 2021, up from seven in 2020.
- There was a significant increase in thermal events to 97 in 2021, up from from 66 in 2020. It should be noted that the low number of incidents 2020 was an outlier. The number of incidents reported in 2021 appears broadly consistent with that observed in 2018 and 2019.
- Three buses were destroyed by fire in 2021, up from nil in 2020.
- Two fires resulted in major damage which was an increase from one in 2020.
- Three buses were saved from major damage by the activation of the engine bay fire suppression (EBFS) system.
- Most fire and thermal incidents (62%) originated in the wheel well area, 22% originated in the engine bay and 16% originated in the body of the bus.
- The majority of incidents (72) were the result of a mechanical issue (including issues with brakes), 18 were caused by a fault in the electrical system, 14 were caused by fluid leakage and 2 incidents were the result of arson.
- OTSI conducted full investigations into two bus fires that occurred in 2021 – Campbelltown and Glebe.
- OTSI published a Safety Alert and Safety Advisory Notice relating to the Campbelltown and Glebe bus fires.
- All NSW buses under TfNSW contract in the Sydney metropolitan area are now fitted with EBFS systems.
- Under a recent program coordinated and funded by TfNSW, Greater Sydney bus contract operators and supply contractors retrofitted 72 of their 88 double deck buses with enhanced water mist systems.

BUS FIRES IN NEW SOUTH WALES IN 2021

Introduction

Bus fires present a significant risk to passenger and driver safety in NSW. The Office of Transport Safety Investigations (OTSI) reports annually on the extent, origins and causes of bus fires in NSW to assist the transport safety sector in identifying significant issues or trends in relation to bus fire safety.[1]

In 2021 there were nine bus fire incidents in NSW, two of which were subject to a full investigation by OTSI. These two incidents, at Campbelltown and Glebe, are discussed in more detail later in this report.

In line with previous reports, the 2021 Bus Safety Report is concerned with both bus fire and thermal incidents. Thermal incidents are those characterised by excessive heat and the generation of smoke but which do not progress to a fire.[2] As thermal incidents are likely precursors to fire events, an understanding of these incidents is critical when identifying bus fire safety risks and preventing bus fires.

When OTSI receives notification of a fire or thermal incident, bus operators are asked to provide further details of the event through completing OTSI's *Bus fire/thermal incident information collection form.*[3] The 2021 Bus Safety Report contains a summary of the information gathered by OTSI in 2021 and provides comparisons with the information reported in previous years.

The NSW bus fleet

In 2021 there were 496 bus operators accredited under the Passenger Transport Act to provide public passenger transport services.[4] Collectively these operators managed

1 All OTSI investigation reports are available at www.otsi.nsw.gov.au

2 Fire incident: Visible fire seen by driver, passengers, or witnesses. Fire or flames are reported and flaming combustion has occurred (Rapid oxidation of gases and vapours that generate detectable heat and light). The level of damage was such that it was likely that an actual fire occurred.
Thermal incident: No mention of fire or flames seen by driver, passengers, or witnesses. An excessive heat event, possibly accompanied by smoke. A likely precursor to a fire.

3 Bus Operator Investigations | OTSI (nsw.gov.au)

4 Under the Passenger Transport Act 2014 a bus is defined as any motor vehicle that seats more than 12 adults.

a fleet of more than 8000 buses, coaches and minibuses which travelled approximately 300,000 services kilometres.

Fire and thermal incidents

In 2021 OTSI received 145 notifications of fire or thermal incidents on buses in NSW, of which 106 were classified as 'notifiable occurrences' under the NSW Passenger Transport Act. Of these 106 notifiable occurrences, nine were fire incidents and 97 were thermal incidents.

This represents a 45% increase in notifiable occurrences from 2020 and includes a marked increase in thermal events. However, as shown in Figure 1, it appears 2020 was an outlier in terms of there being a low number of fire and thermal events. The number of incidents reported in 2021 appears broadly consistent with that observed in 2018 and 2019.

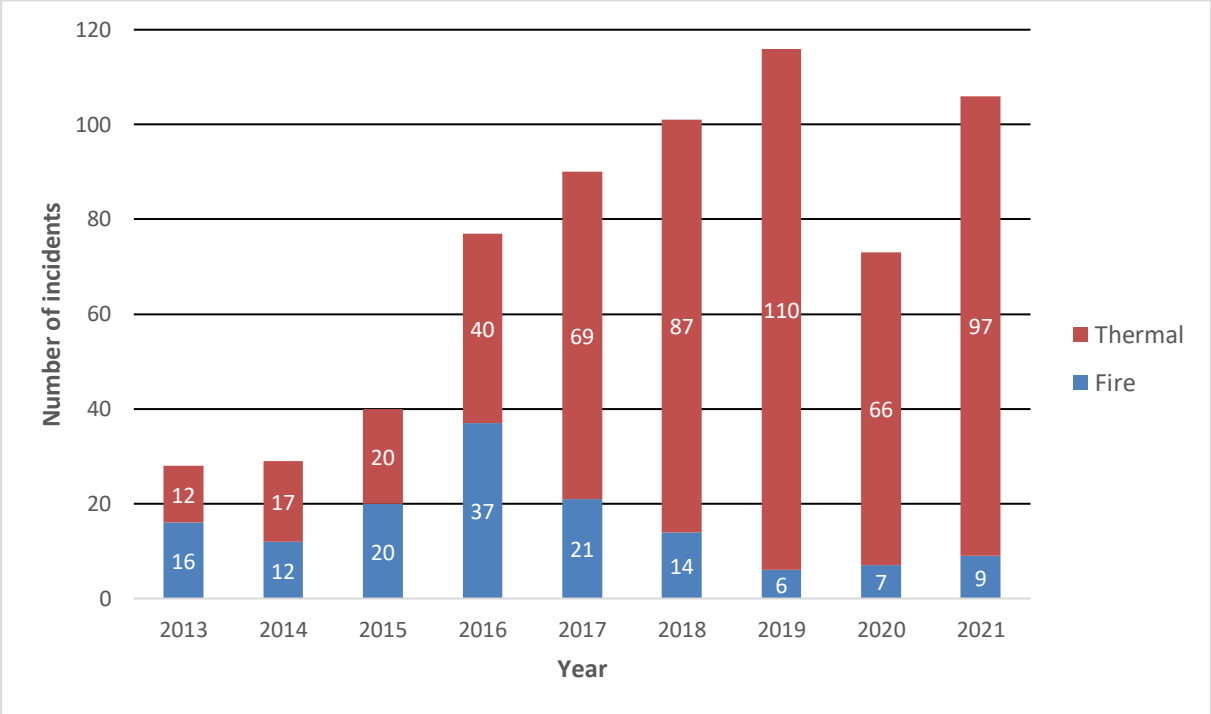

Figure 1: Number of fire and thermal incidents 2013-2021

Damage levels

Incidents were classified into the following levels with respect to the damage incurred to the bus as a result of the fire or thermal event:

- Destroyed
- Major

- Minor
- Smoke damage
- Nil damage (see Appendix B for a more detailed description).

Based on OTSI assessment and operator reports, three buses were destroyed, two suffered major damage, 38 minor damage, 52 smoke damage and 11 buses incurred nil damage (Figure 2).

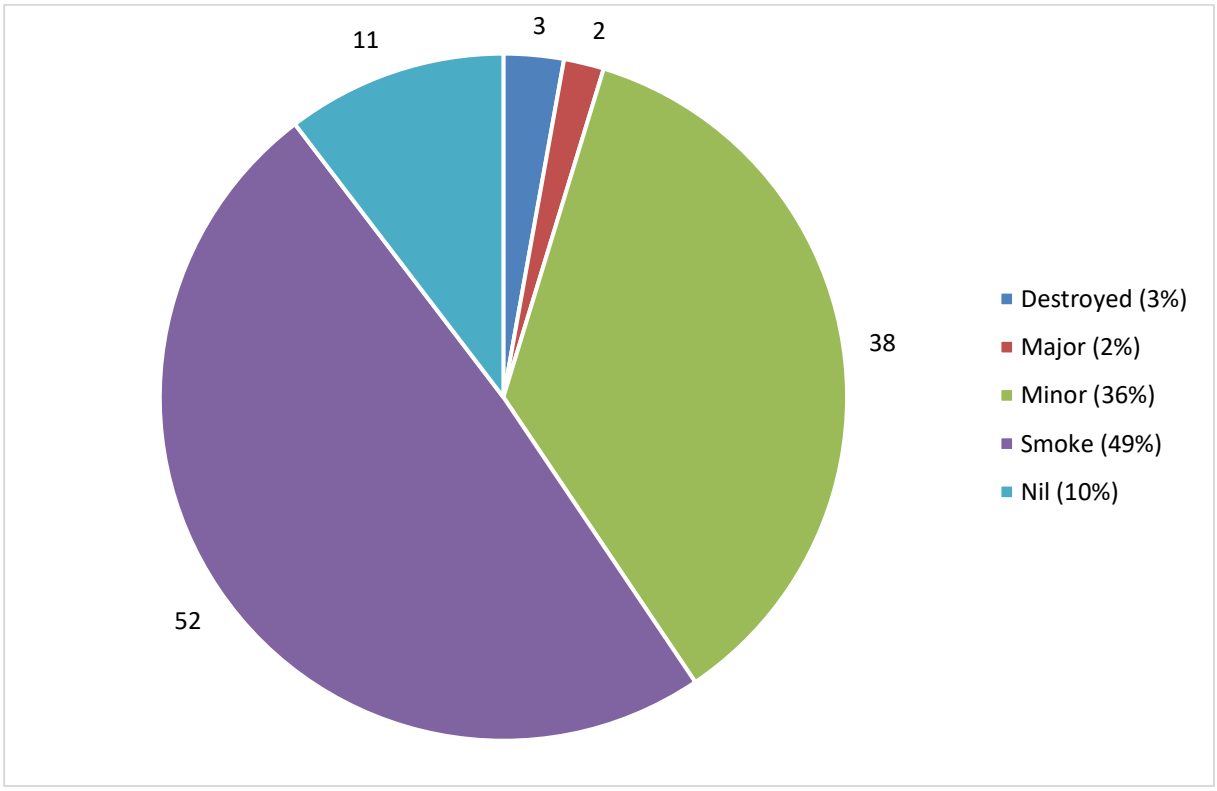

Figure 2: Damage level of incidents 2021

As per Figure 3, there were three buses destroyed in 2021 compared to none in 2020, four in 2019, three in 2018, five in 2017 and seven in 2016.

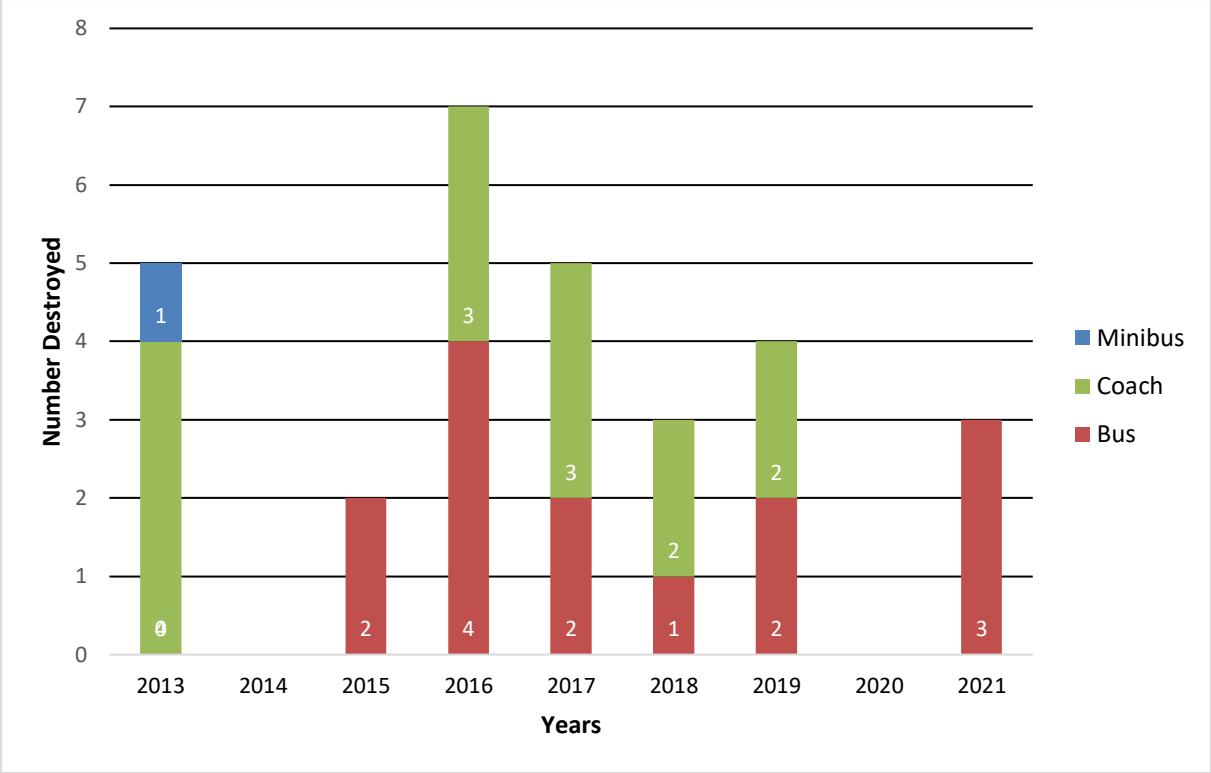

Figure 3: Buses Destroyed by Fire 2013-2020

The number of incidents resulting in major damage to a bus has remained reasonably static since 2013 except for a peak in 2016: 2013 (two), 2014 (two), 2015 (two), 2016 (seven), 2017 (two), 2018 (one), 2019 (one), 2020 (one) and 2021 (two). Buses being destroyed or suffering major damage as a result of fire represent only 13% of all fire and thermal incidents reported in 2021.

Injuries

There were no reported injuries to any person because of a bus fire or thermal event in 2021.

Origins and causes

Overall origin

The origin of fire and thermal incidents has been divided into 3 categories:

- Engine bay
- Wheel well
- Body

As shown in Figure 4, in 2021, most fire and thermal incidents (65; 62%) originated in the wheel well area, 24 (22%) originated in the engine bay and 17 (16%) originated in the body of the bus.

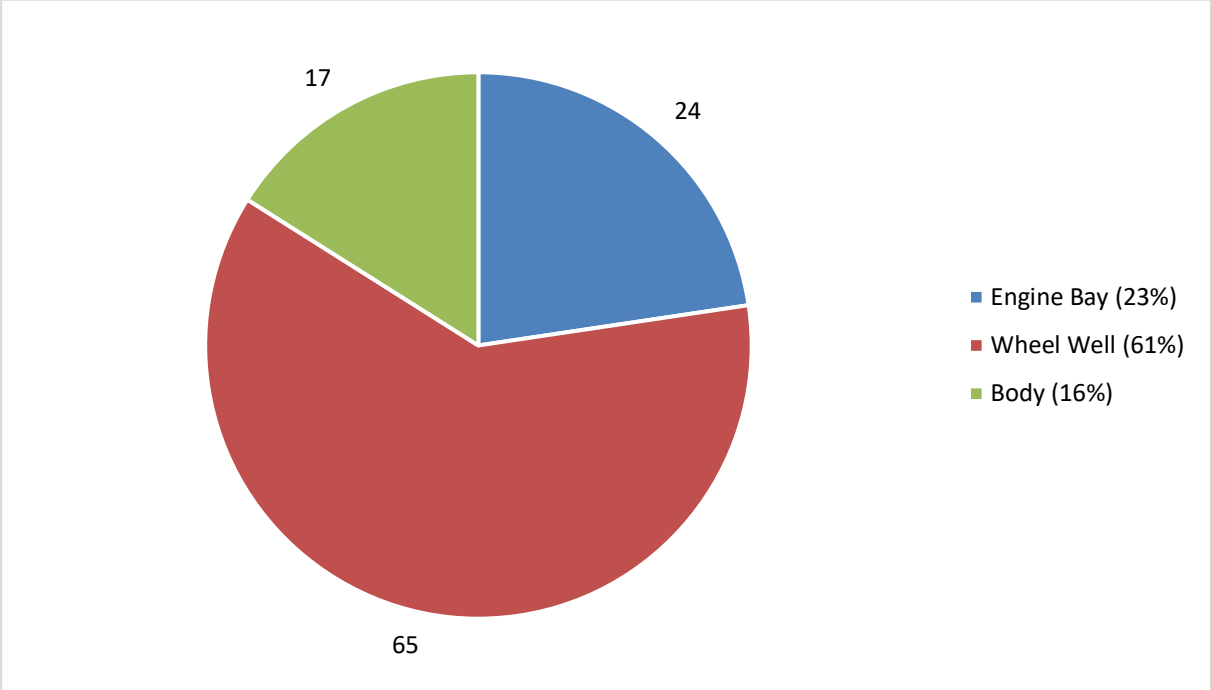

Figure 4: Fire and thermal incident origin 2021

Overall causes

Figure 5 shows the causes of bus fire and thermal incidents in 2021 – 72 incidents (68%) were the result of a mechanical issue (including issues with the bus brakes), 18 (17%) were caused by a fault in the electrical system, 14 (13%) were caused by fluid leakage and 2 incidents were the result of arson.

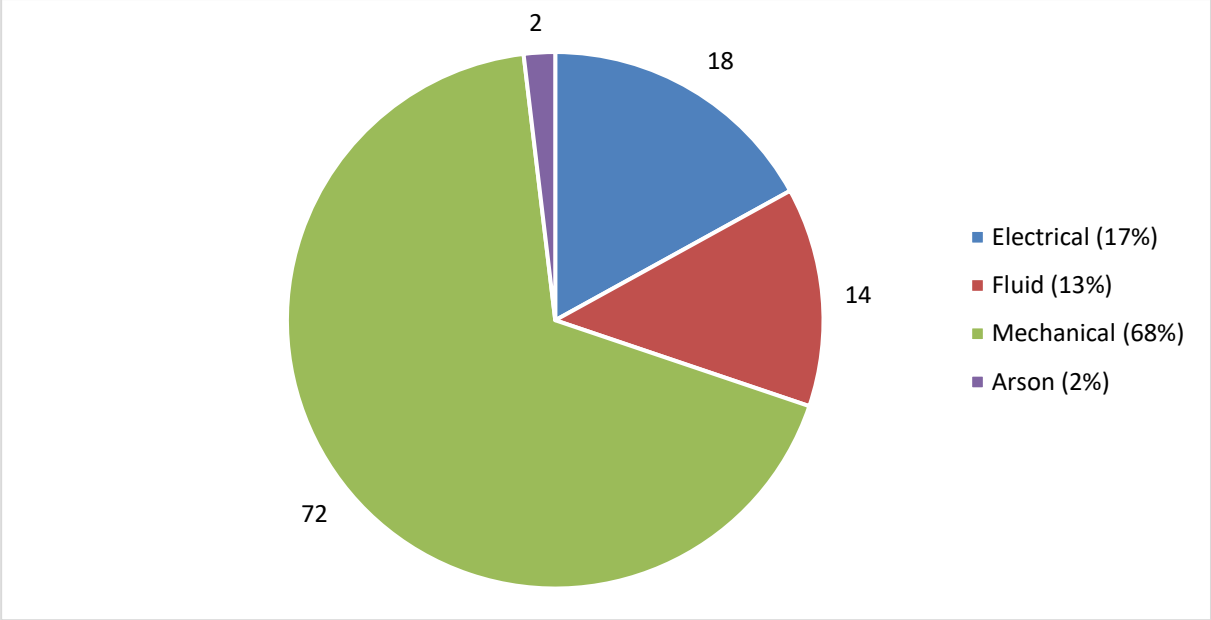

Figure 5: Causes of incidents 2021

Mechanical issues (including brake issues) were also the leading cause of incidents in 2020, representing 70% of all incidents.[5] The proportion of incidents caused by fluid leakage has risen from 5% of all incidents in 2020 to 13% in 2021 (4 incidents in 2020, 14 in 2021). OTSI will monitor this trend in future reports.

NB In previous reports, incidents where brake issues caused the fire or thermal event were classified as a separate category - 'brakes'. For simplicity, from 2021 onwards, brake issues will be reported under the category 'mechanical'.

Number of engine bay incidents

In 2021, 24 incidents (23% of all incidents) originated in the engine bay. This is an increase of six incidents from 2020 (Figure 6).

5 Bus Fire Summary 2020.pdf (nsw.gov.au)

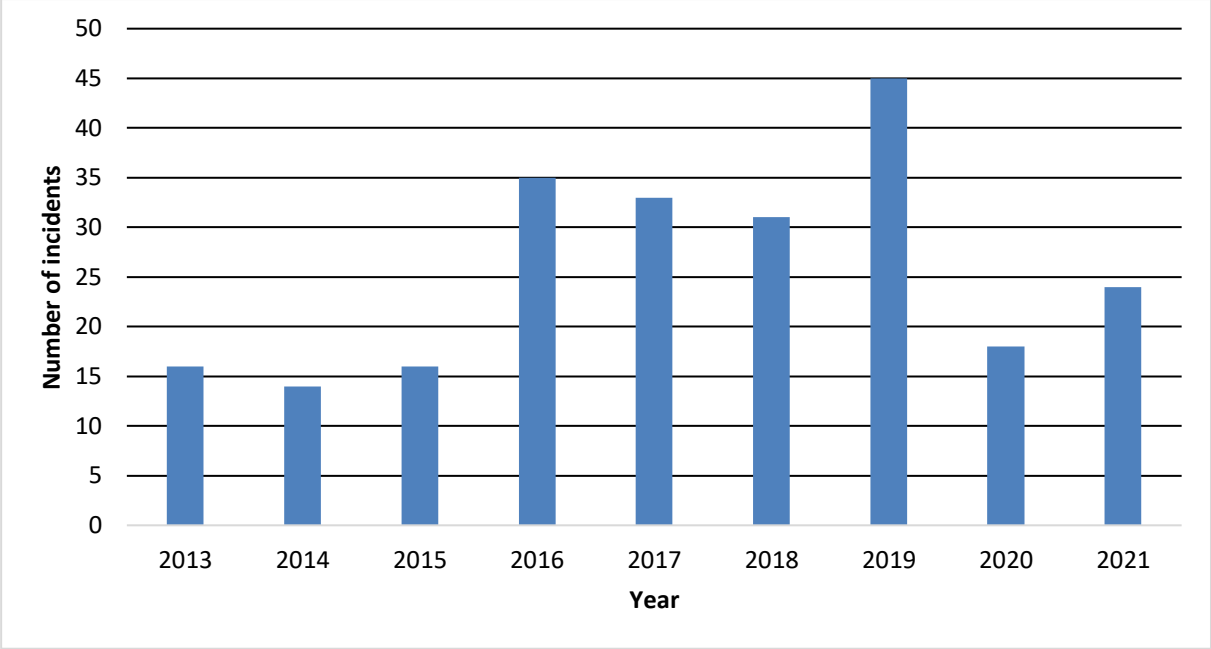

Figure 6: Number of engine bay incidents 2013-21

Cause of engine bay incidents

The primary cause of the engine bay incidents in 2021 was fluid leakage (14), mechanical malfunction (7), and electrical malfunction (3) (Figure 7).

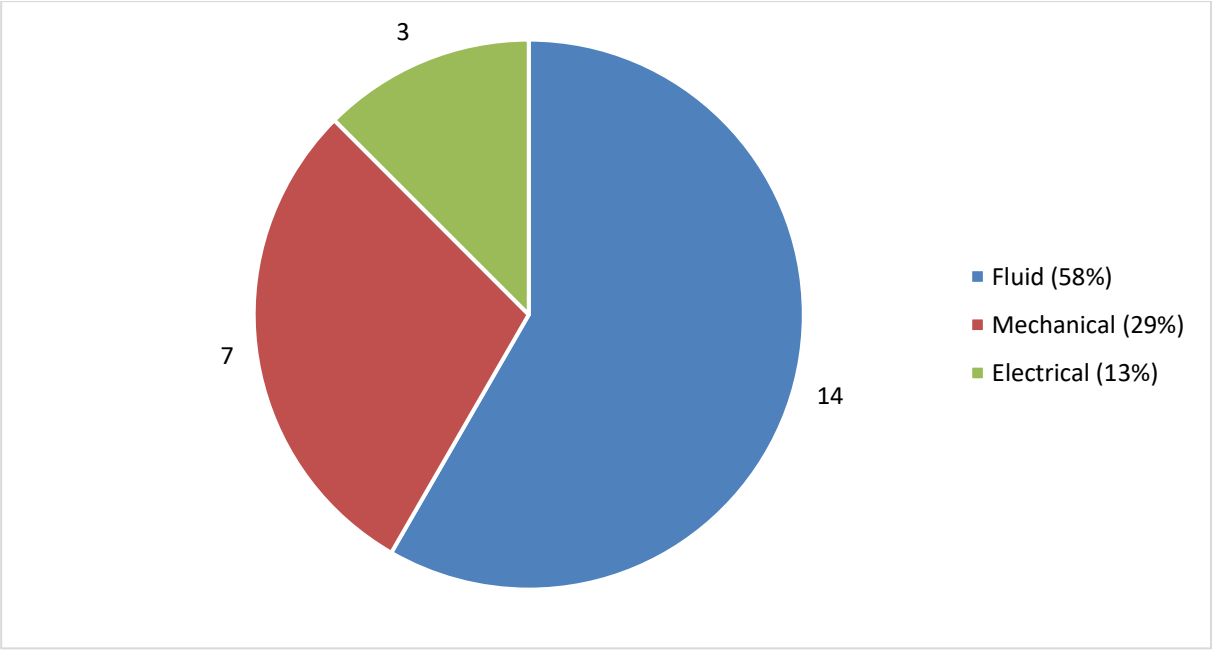

Figure 7: Cause of engine bay incidents 2021

Number of wheel well incidents

In 2021, 65 incidents (61%) originated around the wheel well. The numbers show a steady increase in wheel well incidents from five in 2013 to 59 in 2019 with a decrease to 43 in 2020 (Figure 8). The number of wheel well incidents in 2021 is the highest recorded since 2013. It is noted that 95% of wheel well incidents resulted in smoke damage only, or other minor damage to the bus. However, as noted in last year's report, wheel well events can be precursors to serious bus fires.

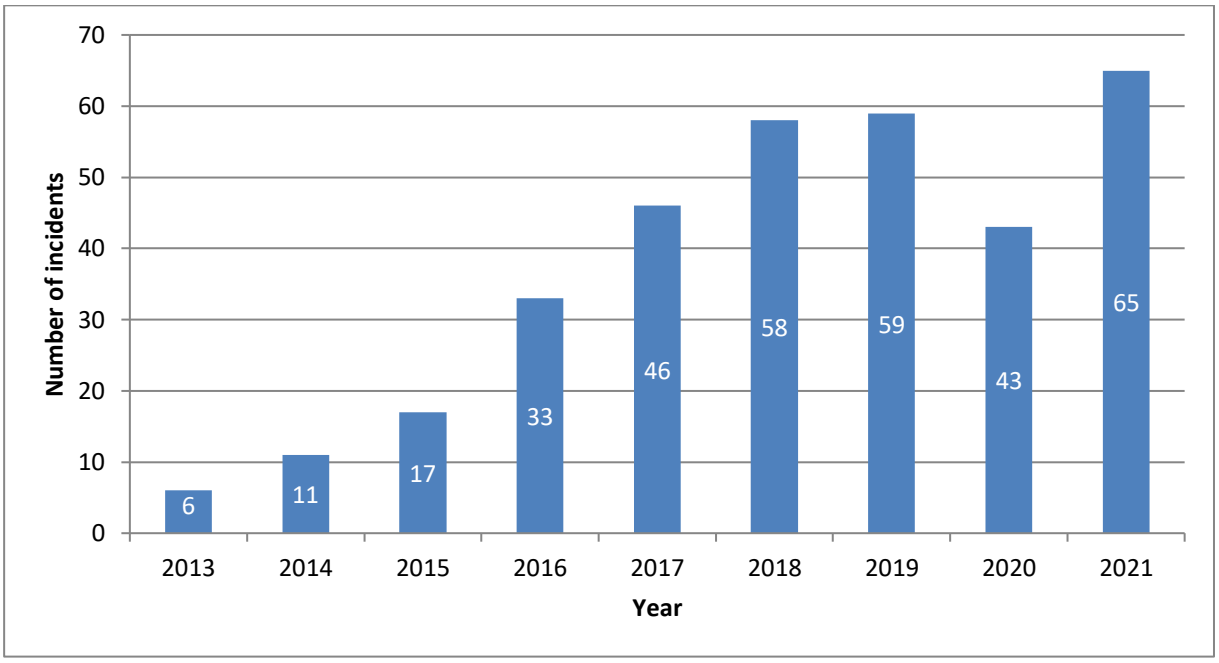

Figure 8: Number of wheel well incidents 2013-21

Cause of wheel well incidents

All of the 65 incidents originating in the wheel well with a known cause (63; 97%) were caused by brake issues: 22 involved the front brakes, 38 the rear brakes, and one the centre axle on an articulated bus. The cause of the wheel well incident was unknown in two cases, and in two cases was caused by brake issues but the location of the brakes was not specified. Of the 63 brake-related wheel well incidents, nine were directly attributed to disc brake calliper faults.

Number of incidents originating in the body of the bus

A smaller number of incidents (17) originated within the body of the bus. There has been a steady increase in body incidents from 2014, with a marked increase in 2021 (Figure 9).

Cause of body incidents

Most (88%; 15) of these incidents were caused by electrical faults. The two remaining body incidents were attributed to arson with one of these cases resulting in the destruction of the vehicle. The 15 electrical incidents had a wide variety of origins: wiring insulation abrading, air conditioning (A/C) control gear, high resistance connections, water ingress to electrical components and faulty wiring. It is noted that two of the incidents attributed to electrical faults resulted in the buses being destroyed.

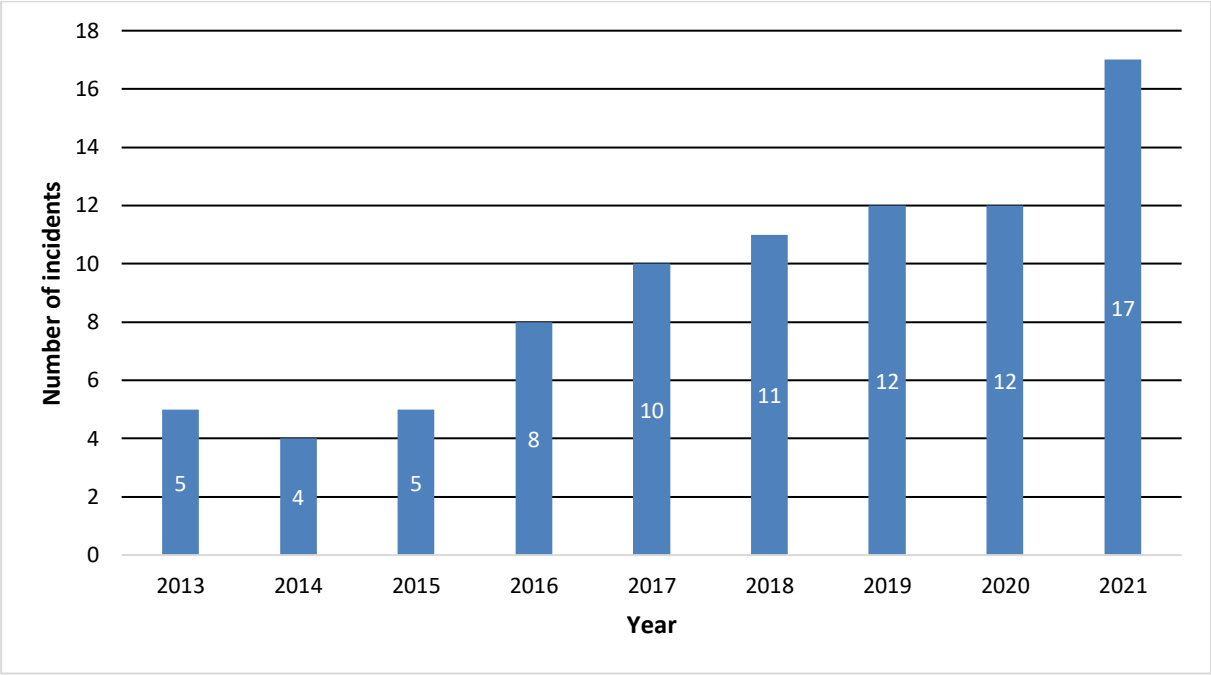

Figure 9: Number of body incidents 2013-21

Age of buses and number of incidents

The age of the buses involved in fire and thermal incidents in 2021 ranged from almost new to 25 years. The highest frequency of incidents occurred in buses that were manufactured in 2009 (Figure 10). This is also the year with the greatest number of buses in service. From the graph below it is evident that there is a correlation between the number of buses from a particular year and the number of incidents involving buses from that year.

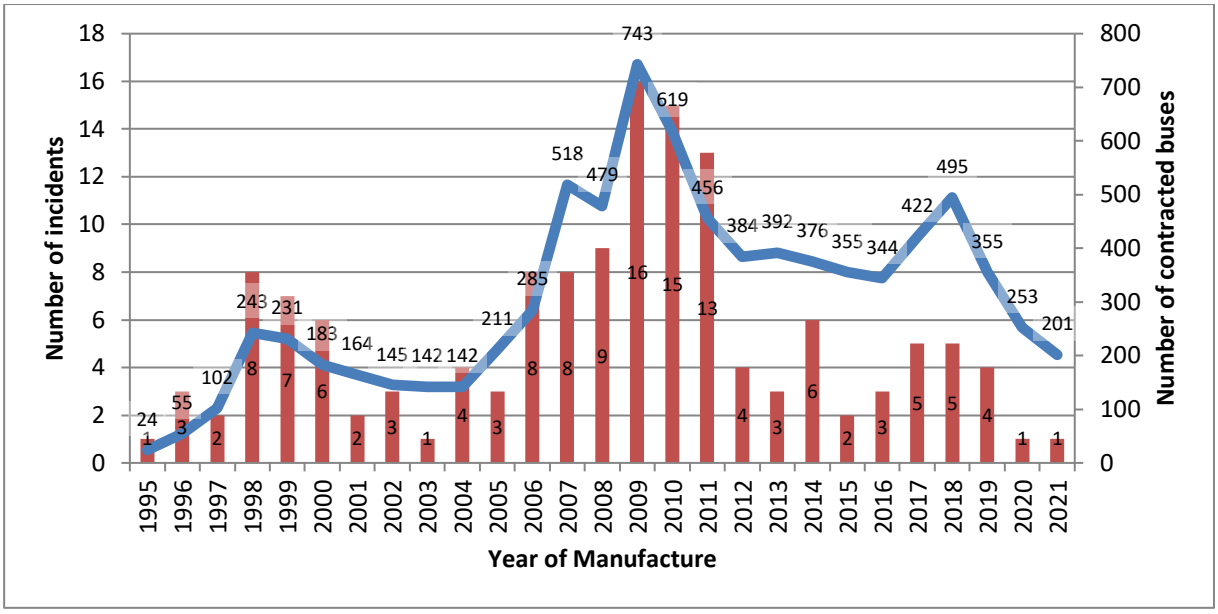

Figure 10: Year of manufacture and incidents in 2021

Damage level and age of buses

From 2016 to 2021 the average age of destroyed buses was 15.2 years, major damage 15.0 years, minor damage 11.3 years and smoke damage 10.9 years. The damage level and the average age of buses involved in incidents between 2016 and 2021 are shown below in Figure 11.

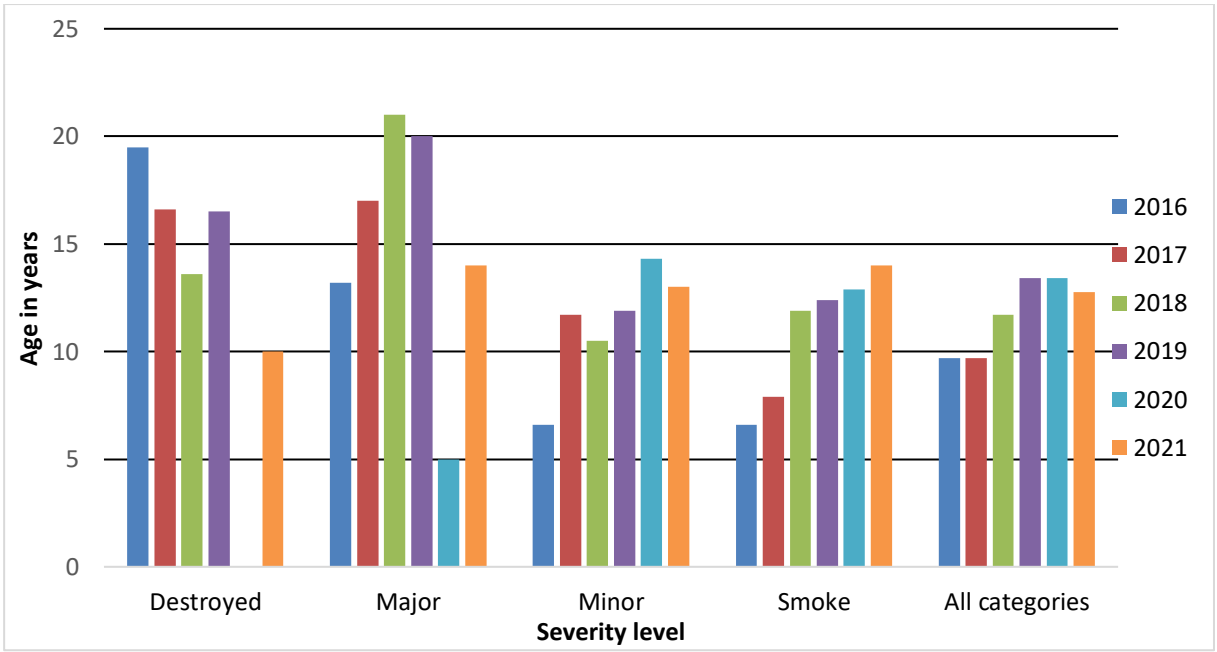

Figure 11: Damage level and age of bus 2016-2021

Fuel type and fire and thermal incidents

The predominant fuel type used on buses in the NSW fleet is diesel, other fuel types include Compressed Natural Gas and Electric (Figure 12). It is expected that the use of electric and other fuel sources will increase in future in line with government policy to utilise more sustainable fuels.

Fuel type	Number in fleet
Diesel	7972
Compressed Natural Gas	257
Electric	74
Petrol	14
Hybrid	2
Total	8319

Figure 12: Fuel type 2021 bus fleet

Diesel Incidents

In 2021, there were 99 incidents involving diesel buses. Proportionally, this has remained relatively constant since 2013.

Compressed Natural Gas (CNG) incidents

In 2021, there were seven incidents involving CNG-fuelled buses. The number and causes of fire and thermal incidents involving CNG-fuelled buses is shown in Figures 13 and 14. There was a decrease in incidents involving CNG buses from 2019, likely contributing to this is the continued retirement of CNG buses from the bus fleet. Five of the incidents on CNG-fuelled buses were caused by brake issues unrelated to the fuel characteristics of the bus.

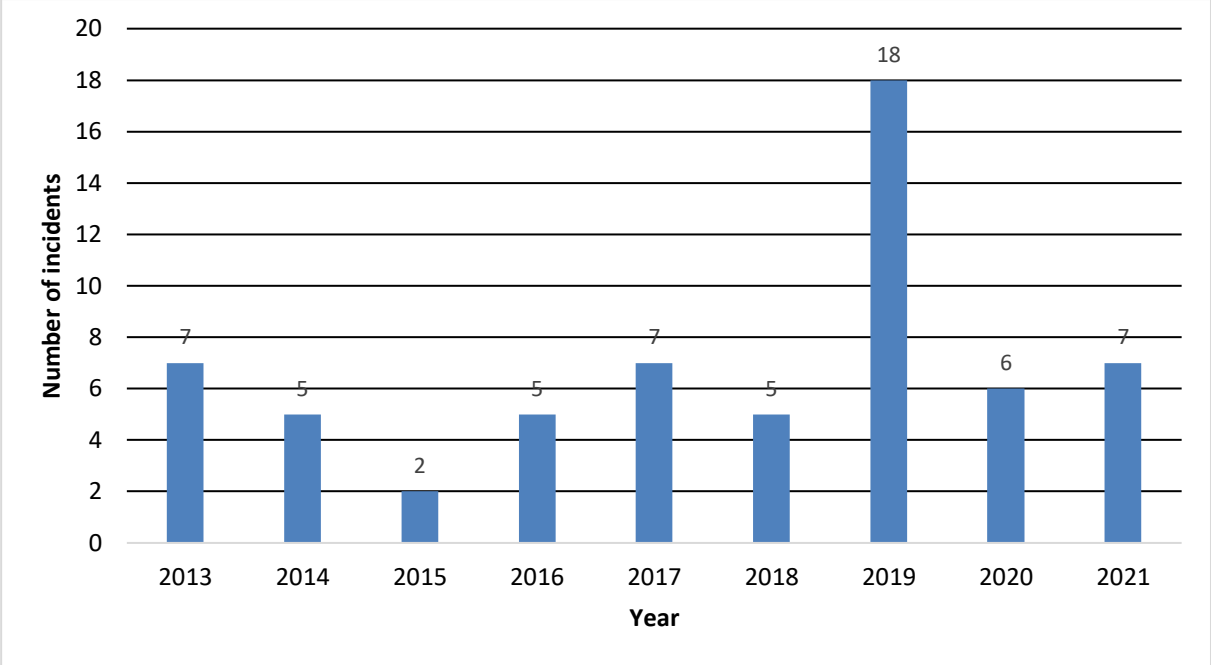

Figure 13: Number of CNG bus incidents 2013-21

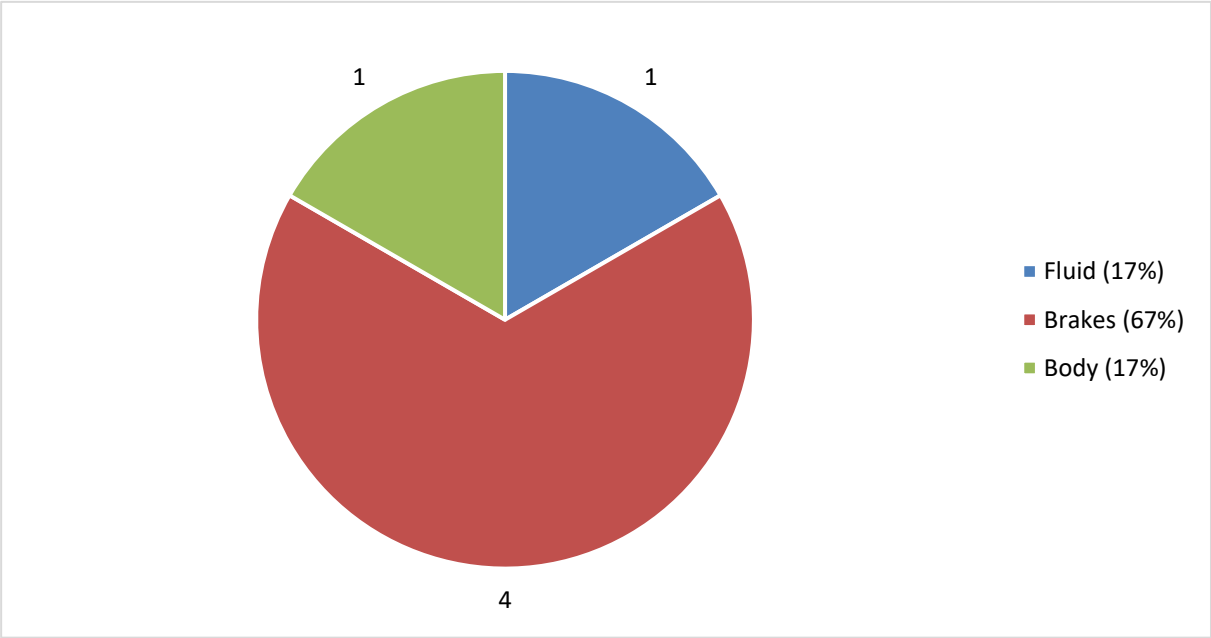

Figure 14: Causes of CNG bus incidents 2021

Electric vehicle (EV) incidents

There were no EV incidents reported to OTSI in 2021.

The NSW government has recently released its "*Zero Emission Bus Transition Strategy*" in which the intention is to replace the bus fleet with Zero Emission Buses (ZEBs).

To ensure bus fire safety as the fleet of ZEBs increases, OTSI suggests a focus on:

- adequate training for operational and maintenance staff
- that ZEBs meet industry design and build standards
- protection for the driver and passenger compartments in the event of a thermal runaway
- protection for the passengers and staff in relation to high voltage electric shock.

According to research, most EV fires are the result of thermal runaway of lithium-ion batteries.[6] A thermal runaway occurs when a battery cell short circuits and starts to heat up uncontrollably, adjacent battery cells become affected, and the generation of heat becomes self-sustaining. The common causes include fire during the charging process, self-ignition while driving, or fire after a collision. The propensity of self-ignition during normal activities due to the thermal runaway of the lithium-ion batteries make EV fires different from internal combustion engine vehicles.

Detection of fire

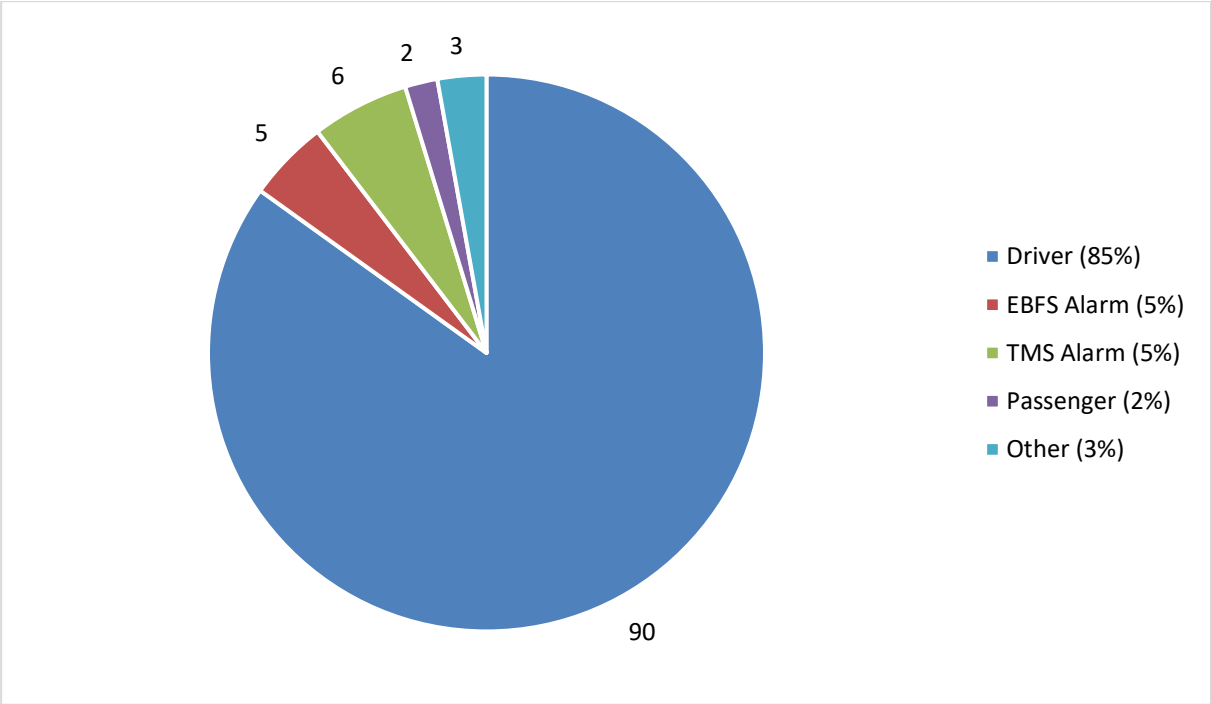

Figure 15: Detection of incidents 2021

Of the 106 notifiable occurrences in 2021, bus drivers were the first to either see or smell smoke or see flames on 85% of occasions (Figure 15). This highlights the importance of the driver's role in detecting bus fires and thermal incidents. In the

[6] *A review of battery fires in electric vehicles.* Sun. P, Bisschop. R, Niu. H, Huang. X. Fire Technology, 56. (2020)

remaining 15% of cases, the driver was alerted by the activation of the EBFS alarm on five occasions, by the TMS alarm system on six occasions, and by others (including passengers) on five occasions.

Fire fighting

Portable fire extinguishers were used on 12 occasions (11%). The use of portable extinguishers was successful on 10 of those occasions. When reviewing overall occurrences, the importance of the role of fire extinguishers, their location, and the ongoing training for bus operators in limiting fire damage is noted as important.

An extinguisher was unsuccessful in defeating a fire on two occasions.

In 2021, NSW Fire and Rescue was called upon to attend on 11 occasions. The percentage of occasions that NSW Fire and Rescue attended for the past seven years is shown in Figure 16.

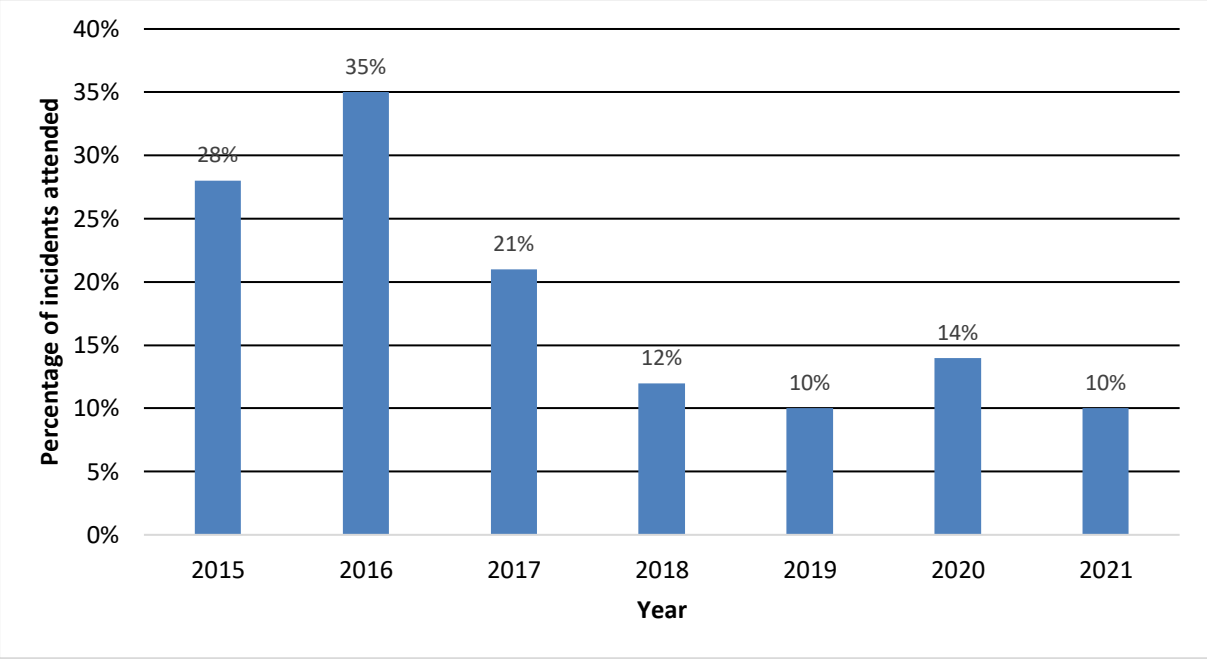

Figure 16: NSW Fire and Rescue: percentage attended 2015-2021

Effectiveness of Engine Bay Fire Suppression systems

In 2021, of the 106 buses involved in incidents reported to OTSI, 101 had an EBFS system fitted. As shown in Table 17, an activation of the EBFS system was recorded for five of these incidents. On three of these occasions, a bus was likely saved from

more damage owing to the activation of the EBFS: on two occasions the system successfully extinguished a fire and on one occasion it suppressed hot exhaust gases.

There were also two instances of EBFS activations where the event did not meet the definition of a thermal incident (one was a false activation, and the other was caused by a short circuit).

Description	Damage level
A major engine oil leak caused engine oil to contact hot engine parts igniting the oil. The EBFS activated and extinguished the fire activity.	Major
A faulty diesel injector line caused fuel to leak and encounter hot engine parts. The subsequent vapourised fuel was ignited by an unknown source. The EBFS activated and extinguished the fire activity.	Minor
Fire suppression system was activated by a faulty exhaust flex pipe which directed hot exhaust gases towards the fire suppression system detection line.	Nil
Minor leak at coolant hose sprayed coolant onto fire detection line which activated the fire suppression system.	Nil
Minor leak at coolant hose sprayed coolant onto fire detection line which activated the fire suppression system.	Nil

Figure 17: Engine bay fire suppression system activations 2021

Reporting of fire incidents

In NSW, OTSI receives reports from accredited bus operators conducting public passenger services, as required by the NSW *Passenger Transport Act*.

It is a legislative requirement that: '*An operator of a bus service who becomes aware that a bus being used to provide the service has been involved in an accident or incident must notify the Chief Investigator of the accident or incident … if the accident or incident involves a mechanical or electrical fire or an explosion on the bus*.' and in

certain other circumstances, such as if the incident results in the bus not being able to continue its journey.[7]

Since 2010, all accredited bus operators have also been required to create an electronic record in the Bus Incident Management Database (BIMD), which is operated and administered by TfNSW.

It was found that on twenty occasions OTSI were not notified of a thermal incident. The incidents were instead reported solely in the BIMD, classified as a breakdown. In compiling data for this report, OTSI regularly cross references with the BIMD to monitor reporting and to ensure it is aware of all fire and thermal incidents. It is important that the legislative requirement is met by all operators to ensure that OTSI is made aware of all notifiable occurrences when they occur and can gather a complete record of incidents for analysis. This enables a more comprehensive safety picture to be collated and understood thereby assisting in safety improvement.

Progress on improving bus fire safety

All NSW buses under TfNSW contract in the Sydney metropolitan area are now fitted with EBFS systems, including double deck buses.

Under a recent program coordinated and funded by TfNSW, Greater Sydney bus contract operators and supply contractors retrofitted 72 of their 88 double deck buses with enhanced water mist systems bringing the entire TfNSW double deck bus fleet up to this new standard. The new systems have increased fire suppression agent capacity by using larger tanks.

This increased tank capacity has extended the discharge duration to exceed 100 seconds. This has advantages including suppressing any fire for longer and alerting the driver and allowing additional time for evacuation of passengers. This is seen as advantageous due to the additional time generally needed to evacuate passengers from the upper deck space.[8]

7 NSW Passenger Transport Regulation 2007 clause 88.

8 *Experimental study on evacuation behaviour of passengers in a high-deck coach: A Chinese case study: April 2021*

Bus fire investigations conducted by OTSI in 2021

Two bus fires that occurred in 2021 led to full investigations by OTSI: Glebe (January) and Campbelltown (August).

Four investigative reports were published by OTSI in 2021, one relating to the Glebe event above, and three relating to earlier fire events: Heatherbrae (September 2019), Tongarra (September 2018) and Surry Hills (November 2017).

Glebe, January 2021

On 11 January 2021 the driver of articulated bus 2001ST observed smoke emanating from the engine bay. When the driver pulled over at the intersection of Broadway and Glebe Point Road in Glebe, Sydney, the event escalated to a fire which caused extensive damage to the bus before being extinguished by NSW Fire and Rescue. The five passengers and driver safely evacuated.

On 21 January 2021, OTSI issued a Safety Alert with respect to the risks of electrical fires on Volvo Buses with Volgren CR228L bodies. The alert advised relevant operators to ensure that adequate controls were in place to minimise the risk of electrical fires, specifically:

- inspection of jump start cabling
- review of maintenance regimes
- review of emergency response procedures and training protocols relating to bus fires and evacuations.

OTSI's investigation report into this incident published in March 2022[9] found the fire to have been caused by an electrical issue, specifically the abrasion of the high amperage cable. The report notes that the securing of bus wiring cables, looms, and harnesses, to prevent movement, chafing or vibration while in service, and regular inspection of electrical wiring, are integral factors in the prevention of thermal events. The report also notes that in this incident the main battery isolation switch could not be safely accessed by the driver. The bus in question was manufactured in 2009.

[9] FINAL Investigation Report 210111 Glebe Bus Fire 2001ST.pdf (nsw.gov.au)

In its report, OTSI's specific recommendations include that:

- bus and coach operators incorporate ongoing routine inspection of high amperage electrical circuits into their maintenance regime; and
- TfNSW consider improvements to bus accreditation requirements to ensure battery isolation switches on buses can be easily accessed when required.

Campbelltown, August 2021

On 16 August 2021 a bus driving route 896 from Oran Park to Campbelltown was destroyed by fire near MacArthur Square Shopping Centre in Campbelltown. The three passengers and driver safely evacuated.

On 5 November 2021 OTSI issued a Safety Advisory reporting that the fire was likely caused by a faut in the air conditioning system. The advisory suggested that for all buses configured with a DENSO A/C system controlled by a Thoreb M2 programmable node, operators should:

- inspect cabling associated with the Thoreb M2 node and ensure wiring is undamaged and secured correctly.
- inspect the S2 connector block terminals for discolouration, any evidence of heat damage and ingress of contaminants.
- review maintenance regimes to ensure inspections adequately address and remedy any issues with wiring integrity, security and overall cleanliness of the A/C system.

The Campbelltown bus fire report will be published in the second quarter of 2022.

Reports into the three earlier fire events were also published in 2021: Heatherbrae (September 2019), Tongarra (September 2018) and Surry Hills (November 2017). These legacy investigations were all engine bay fires and although the reports were released well after the event, OTSI thought it important to communicate the investigation details to all bus operators.

OTSI found that the Surry Hills fire initiated from a coolant leak emanating from a failure of a flexible coolant hose that delivers coolant to the roof mounted air conditioning unit. The hose exhibited a defect consistent with a failure of the inner rubber liner. The Tongarra fire initiated from a diesel fuel supply line leak perpetuated by a short circuit

of the air conditioning wiring. The initiation of the Heatherbrae fire was unable to be conclusively determined due to extensive damage to the engine bay components. The investigation determined it was likely either a diesel fuel line leak or an electrical short circuit in a high amperage cable.

Two buses were fitted with an Engine Bay Fire Suppression system. They both activated, but despite likely initially suppressing the fire were not able to prevent severe damage. The third coach was not fitted with a fire suppression system.

Each investigation report makes recommendations to improve maintenance and inspection systems. One report (Heatherbrae) makes a recommendation about the placement of fire extinguishers and the expansion of the requirement for the fitting of engine bay fire suppression systems.
The full version of all reports can be found at www.otsi.nsw.gov.au

APPENDIX A – SUMMARY OF BUS INCIDENTS 2021

MONTH	VEHICLE TYPE	YEAR OF MANUFACTURE	LIKELY FIRE SOURCE	DAMAGE	ONBOARD FIRE EQUIPMENT USED
Jan	Bus	2009	Wiring abrasion in jump start circuit	Destroyed	Yes*
Jan	Bus	1997	Smoke from rear offside wheel area	Smoke	No
Jan	Bus	2011	Smoke from starter motor	Nil	No
Jan	Bus	2005	Faulty air conditioner condenser fan	Nil	No
Jan	Coach	2009	Faulty fuel injector	Major	Yes*
Jan	Bus	2007	Smoke from rear nearside tyres	Smoke	No
Feb	Bus	2011	Smoke from the front nearside tyre	Smoke	No
Feb	Bus	2014	Smoke from offside front wheel	Smoke	No
Feb	Bus	2011	Smoke from offside rear brakes	Smoke	No
Feb	Bus	2010	Coolant leak	Nil	No
Feb	Bus	1996	Smoke from rear offside tyre	Smoke	No
Feb	Coach	1999	Fire in top of engine bay	Minor	Yes
Feb	Bus	2013	Smoke from offside rear tyre	Smoke	No
Feb	Bus	2006	Smoke from brakes	Nil	No
Feb	Bus	2018	Smoke from inside the bus around the steering wheel	Minor	No
Feb	Bus	2018	Smoke from the rear of the bus	Smoke	No
Feb	Bus	2009	Smoke from bus dashboard	Minor	No
Feb	Bus	2009	Faulty node for air conditioning controller	Minor	No
Feb	Bus	2011	Front and rear brake pads changed during last service but were not chamfered to fit worn serviceable brake rotors as per service information	Minor	No

Mar	Bus	2017	Smoke from the nearside rear wheel area	Smoke	No
Mar	Bus	2009	Ad blu leak on exhaust manifold	Minor	No
Mar	Bus	2015	Locked brakes front near side wheel	Minor	Yes
Mar	Bus	2009	Smoke from rear of the bus	Smoke	No
Mar	Coach	2020	Fire commenced within the onboard rest room at the rear of the bus.	Destroyed	No
Mar	Bus	2017	Smoke from rear nearside tyre	Smoke	No
Mar	Bus	2002	Smoke from the nearside back wheel	Smoke	No
Mar	Bus	2007	Engine bay fire alarm activated, and the system discharged	Major	No
Mar	Bus	2001	Back brake calliper seized	Smoke	Yes
Mar	Bus	1996	Smoke from the dashboard demister area	Minor	No
Mar	Bus	1996	Smoke from the rear offside tyre	Smoke	No
Mar	Coach	1999	Starter motor fault	Minor	Yes
Mar	Bus	2012	Smoke from the offside front wheel	Smoke	No
Apr	Bus	2010	Smoke from nearside rear wheel	Smoke	No
Apr	Bus	2019	Electrical sparking to earth from underneath the steering wheel area of the bus	Minor	No
Apr	Bus	2006	Engine Bay Fire Suppression System alarm warning with smoke coming from rear of bus	Minor	No
Apr	Bus	2010	Smoke from the rear wheels, side not reported	Smoke	No
Apr	Bus	2010	Smoke from rear nearside tyres from brake fault	Smoke	No
Apr	Bus	2000	Smoke from nearside front wheel	Minor	No
Apr	Bus	2008	Rear brakes dragged resulting in heat and smoke	Smoke	No
Apr	Bus	2010	Smoke from front nearside wheel	Smoke	No
Apr	Bus	1998	Smoke from nearside wheel well	Minor	No

Apr	Bus	2002	Smoke from nearside wheel well	Minor	No
Apr	Bus	2017	Nearside rear brake fault	Minor	No
Apr	Bus	2019	Engine Bay Fire Suppression System alarm with smoke from front offside tyre	Smoke	No
Apr	Bus	1999	Smoke from rear wheel arch	Minor	No
May	Bus	2009	Diesel leak with smoke at rear of bus. Engine Bay Fire Suppression System discharged	Minor	No*
May	Bus	2019	Smoke from nearside rear wheel area	Minor	No
May	Bus	2004	Smoke from front nearside wheel arch area	Smoke	No
May	Bus	2007	Smoke from nearside front wheel	Minor	Yes
May	Bus	1998	Smoke from nearside front wheel arch	Minor	No
May	Bus	2005	Smoke from nearside rear wheel area	Smoke	No
May	Bus	2006	Smoke and flames from offside front wheel arch	Minor	Yes*
May	Bus	2012	Smoke from the offside front wheel arch	Minor	No
May	Bus	2014	Smoke from nearside rear wheel - air leak in rear brakes	Smoke	No
May	Bus	2014	Passenger ignited fire in newspaper on seats	Minor	Yes*
May	Bus	1997	Failed turbocharger allowed engine oil to enter and burn within exhaust system	Smoke	No*
Jun	Bus	2010	Smoke from under steering wheel	Minor	No
Jun	Bus	2004	Leaking hydraulic hose above engine	Smoke	No
Jun	Bus	2009	Smoke from nearside rear brakes	Smoke	No
Jun	Bus	2004	Smoke from nearside front wheel	Smoke	No
Jun	Bus	2019	Seized alternator causing belt to slip and smoke	Minor	No
Jun	Bus	2006	Seized A/C pulley resulting in torn belt	Minor	No
Jun	Bus	2007	Smoke from offside brakes locked on	Minor	No

Jun	Bus	1998	Sparks and smoke from engine bay	Smoke	No
Jun	Bus	2003	Smoke from nearside rear wheel well	Minor	No
Jul	Bus	2016	Smoke from nearside outer rear brakes	Smoke	No
Jul	Bus	2007	Oil pipe on top of the engine failed with oil flowing onto side of engine	Smoke	No
Jul	Bus	2001	Engine failure resulting in connection rod to create hole in engine block. Engine oil contacted hot surfaces of turbo charger	Minor	Yes*
Jul	Bus	2017	Smoke from front nearside wheel	Smoke	No
Aug	Bus	2014	Park brake valve leak resulting in rear brakes to grabbing and overheating	Smoke	Yes
Aug	Bus	2009	Brakes locked on with smoke from rear	Smoke	No
Aug	Bus	2006	Air drier failure in rear brakes	Minor	No
Aug	Bus	2010	Coolant leak	Nil	No
Aug	Bus	2010	Nearside rear brakes locked on	Smoke	No
Aug	Bus	2012	Electrical failure in area of control node in roof mounted air conditioning system	Destroyed	No*
Aug	Bus	2011	Smoke from the offside rear tyre	Minor	No*
Aug	Bus	2000	Offside front wheel brakes locked on	Smoke	No
Aug	Bus	2011	Leaking offside rear brake chamber	Smoke	No
Sep	Bus	2010	Seized alternator	Minor	No
Sep	Bus	2014	Exhaust flex pipe leak	Nil	No
Sep	Bus	2011	Brakes overheated	Smoke	No
Sep	Bus	2011	Nearside rear brakes locked on	Minor	Yes
Oct	Bus	2006	Evaporating degreaser residue from engine clean	Nil	No
Oct	Bus	2011	Blower fan failed causing smoke	Minor	No
Oct	Bus	1998	Air compressor failed and leaked oil	Smoke	No*

Oct	Bus	2008	Brakes overheated due to brake ECU failure	Smoke	No
Oct	Bus	2008	Coolant hose split causing steam	Nil	No*
Oct	Bus	2011	Faulty ABS module caused brakes to drag	Smoke	No
Oct	Bus	2014	Minor leak at coolant hose sprayed coolant onto fire detection line which activated the Engine Bay Fire Suppression System	Nil	No
Oct	Minibus	2018	Brake fault	Smoke	No
Oct	Bus	2010	Coolant leak onto fire detection line causing Engine Bay Fire Suppression System activation	Nil	No
Oct	Bus	2006	Smoke from nearside front wheel	Smoke	No
Oct	Bus	2008	ABS modulator fault resulted in inoperative retarder	Smoke	No
Nov	Bus	1999	Rear destination inverter short circuit	Minor	No
Nov	Bus	1998	Overheated brakes	Smoke	No
Nov	Bus	1999	Electrical short in test plug wiring due to wiring abrasion	Nil	No
Nov	Bus	2008	Brake ECU failure	Smoke	No
Nov	Bus	2007	Overheated brakes	Minor	No
Nov	Bus	2002	Smoke from nearside front brake	Smoke	No
Dec	Bus	2016	Nearside brake calliper failure	Minor	No
Dec	Bus	2004	Rear offside brakes locked on	Smoke	No
Dec	Bus	2018	Faulty quick release brake valve	Smoke	No
Dec	Bus	2015	Short circuit from electrical wiring rubber abrasion	Minor	No
Dec	Bus	2011	Smoke from centre axle wheel arches	Smoke	No
Dec	Bus	2009	Brake calliper failure	Smoke	No
Dec	Bus	2016	Brake booster failure on offside rear wheel	Smoke	No

***** Denotes attendance by NSW Fire and Rescue.

APPENDIX B – SEVERITY LEVEL DESCRIPTIONS

DESTROYED

Due to damage sustained in the fire, the bus cannot be repaired. There was significant destruction to one or more sections. Examples of this category are:

- The bus is completely burnt out.
- The engine bay is burnt out and the rear passenger area of the bus is partially damaged.
- It is no longer economically viable to repair the bus.

MAJOR

Damage to one large section of the bus or multiple parts where the bus can be repaired by replacing the panel or part. Examples of this category are:

- The engine bay sustains a fire, but the fire is contained to that area and the rest of the bus is undamaged.

MINOR

One part of the bus is damaged, but that part can be repaired or replaced. Examples of this category are:

- An oil leak from a cracked pipe onto a hot engine part creating a small fire.
- Brake callipers sticking generating intense heat and the need for complete replacement or components thereof.
- An electrical fuse which generates heat to that local area.

SMOKE DAMAGE

No physical damage to any part except smoke stains/residue. No parts need replacing. Examples of this category are:

- Brake callipers sticking generating intense heat and do not need replacing but require some components replaced.
- Smoke from another bus on fire.

NIL DAMAGE

No physical damage to any part, no smoke staining and/or no parts which need replacing. Examples of this category are:

- Tyre lockup and smoke generated.
- Water leak generating steam.
- Brake callipers sticking generating intense heat which do not require repair.