Gas Safety Trust

DIDR

Carbon Monoxide Incident Report

A detailed review of carbon monoxide incident information, for 2013/14, produced from the investigation of domestic incidents which involved mains natural gas and piped LPG in Great Britain, including an assessment of incidents involving solid fuel and oil appliances

Working in partnership

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Funded by the Gas Safety Trust
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This report has been prepared by Downstream Gas and is funded by the Gas Safety Trust as a continuation of the work established during a Joint Industry Programme (JIP) addressing carbon monoxide (CO) issues in 1996. This work identifies common concerns involved in CO incidents legally required to be reported by the Gas Safety Management Regulations (GSMR) 1996 and the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR) that are related to factors such as appliance and system design, the home environment, installation, servicing and maintenance. The conclusions reached are intended to help further improve safety, to target investment in CO incident prevention and to identify future research work.

This is the eighteenth report in a series that began with the publication of a first annual report in 1996 and covers the 12 months between 1st July 2013 and 30th June 2014. During this period details of 29 domestic mains gas incidents were submitted to Downstream Gas and their analysis constitutes the main part of the report. This report also appends the analysis of reported solid fuel and heating oil domestic incidents.

The Gas Safety Trust is pleased to fund the report in the knowledge that the information and data within will help reduce fatalities and serious injuries from accidental CO exposure.

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EXECUTIVE SUMMARY

This report has been prepared by Downstream Gas and is the eighteenth annual report devoted to an analysis of accidental carbon monoxide (CO) poisoning incidents in Great Britain (GB) associated with the use of mains natural gas and piped Liquid Petroleum Gas (LPG) in the home. Since 2011, information, albeit less extensive than that for mains gas, has also been collected concerning CO incidents associated with the domestic use of solid fuel and oil.

This annual report covers the period from 1st July 2013 to 30th June 2014 inclusive.

This year 29 incidents which involved the use of domestic mains natural gas or piped LPG and resulted in 58 casualties (non-fatal) and three fatalities were reported by investigators. These numbers are very similar to those reported in the last two years (2011/12 and 2012/13) and represent a significant reduction from the 21 to 24 fatalities and 70 to 104 incidents reported annually during the period 1996 to 2000. The number of non-fatal casualties has fallen from 62 last year to 58 this year.

Two fatalities resulted from one incident involving a free-standing cooker[1]; a further incident[1] which claimed another life involved a floor-standing non-condensing central heating boiler.

Conclusions and recommendations from this year's report include the following:-

- This year the third lowest number of fatalities was recorded since detailed records began in 1996 within the mains natural gas and piped LPG sectors and maintains a continuing trend of fewer fatalities compared with those experienced in the early 2000s. There is no doubt that the industry has to remain vigilant in order that such a trend continues and factors such as operative competence, CO alarm effectiveness and open flue installation maintenance are important in this respect.
- The number of incidents reported involving boilers with open flues has again been disproportionate to the number of installations nationwide and their investigation has highlighted the importance of regular servicing for this particular appliance type. Boilers with open flues posed a risk of 7.3 times that of room sealed boilers.
- An evaluation of those CO incidents involving room sealed installations has revealed that flue related issues tend to be the predominant cause of failure. This indicates that, even for appliance types considered to be of relative safe design, regular flue maintenance is important.
- The double fatality involving the use of a gas cooker is the latest in a series of incidents that have resulted in personal injury over a number of years.
- This year, a significant number of incidents involving space heaters (gas fires) were caused by debris which had resulted in blockage of the flue. This demonstrates the importance of regularly maintaining such installations to reduce the associated safety risk.
- This year, unlike incident information gathered in the solid fuel sector since 2011, a lack of regular servicing has been reported by investigators as the primary cause of a CO incident. This is the first year this has been noted.
- There are a sizable number of incidents that are not fully investigated and this is for a variety of reasons. One case of concern serves to illustrate the need to investigate fully even if part of the evidence has been disturbed. The potential cause of the exposure could have been any of four possible appliances present (a gas boiler, a gas water heater, a gas cooker or solid fuel fire). Before the investigator could arrange a visit to investigate, the occupant had the boiler replaced and no further action was taken as the evidence was disturbed. This would only have been acceptable were the boiler to have been confirmed as the only cause.

[1] Full details are not available as legal proceedings are pending.

1 Introduction

1.1 Context

In GB, Downstream Incident Data Report (DIDR) forms are completed by investigators following the investigation of accidental CO poisonings associated with the use of mains natural gas or piped LPG in the home. The information received has been gathered, placed on a database, analysed and presented in a series of consecutive annual reports from 1996/7 to 2012/13. The initial reports were funded by the Health and Safety Executive (HSE) with the CORGI Trust taking over the funding for the reporting period starting in April 2006.

This is the eighteenth report in the series and is the seventh produced by Downstream Gas for the Gas Safety Trust (formerly The CORGI Trust). It covers incidents reported and confirmed during the 12 months between 1st July 2013 and 30th June 2014.

1.2 Scope

The gas industry has clear mandatory obligations and responsibilities in terms of reporting gas related CO incidents. These are specified in the Gas Safety Management Regulations (GSMR) 1996 and in particular place duties upon the supplier of mains natural gas and piped LPG.

Regulation 7(14) of GSMR states that: -

Where an incident notifiable under regulation 6(1) of the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995 has arisen as a result of an escape of carbon monoxide from incomplete combustion of gas in a gas fitting, the person who supplied the gas shall, as soon as is reasonably practicable after receiving notice of the incident, cause an investigation to be carried out so as to establish, so far as is reasonably practicable, the cause of the escape and accumulation of the carbon monoxide gas.

The Reporting of Injuries, Diseases and Dangerous Occurrences Regulations are frequently referred to as the RIDDOR regulations and on the 1st October 2013 these regulations were updated to the 2013 version. The content of regulation 6(1) has been modified and is now contained in regulation 11(1).

Regulation 11(1) states that:-

Where a conveyor of flammable gas through a fixed pipe distribution system, or a filler, importer or supplier (except by retail) of a refillable container containing liquefied petroleum gas, receives notification of the death, loss of consciousness or taking to hospital of a person because of an injury arising in connection with that gas, that person must-

(a) notify the Executive of the incident without delay; and

(b) send a report of the incident to the Executive in an approved manner within 14 days of the incident.

The Executive is the Health and Safety Executive.

The main difference between the reporting requirements of 6(1) in RIDDOR 2005 and 11(1) in RIDDOR 2013 is that the reference to the term “Major Injury” has been removed and the more specific statement of “taking to hospital” has been included. The definition of “Major Injury” had included “an acute illness requiring medical treatment, which included hospital treatment, treatment by a GP or a firm’s medical and nursing staff”.

Based on the gas industry’s duty to investigate CO related incidents, the DIDR process was set-up to achieve the systematic gathering of details from incident investigations in order to help identify trends and common underlying features.

When the gas emergency service provider or a registered gas operative attends the site of a possible RIDDOR reportable incident involving CO poisoning, the incident is first notified and an investigation organised by the gas supplier. It should be noted that such incidents will usually be a result of acute poisoning, i.e. exposure to significant levels of CO and not be a consequence of exposure to low levels of CO over a prolonged period which is frequently described as chronic CO poisoning.

The statistics in the main body of the report include an analysis of the data collected for confirmed CO incidents that relate to the use of mains gas or piped LPG in the home.

The reporting of LPG incidents is limited to those associated with piped LPG from permanent tanks or cylinders. Incidents related to portable LPG cylinders are not RIDDOR reportable but occasionally completed reporting forms are received by Downstream Gas and these are included in Appendix A for completeness.

Incidents that occur in domestic properties attached to shops, offices, restaurants, etc are only included if the causes were related to the domestic use of gas. Incidents involving multiple residential properties such as student accommodation and sheltered housing are included but care homes are excluded as the latter are work related premises. Occasionally, DIDR forms are received from incidents in non-domestic premises and so for completeness, any received are included in Appendix B and do not feature in the main statistical analysis of data of the report.

There may be occasions when an investigation report is delayed, for example whilst waiting on the result of an inquest or a trial. No reports were received in this reporting year that provided incident information from previous years.

An incident investigation and systematic reporting scheme developed for heating oil, kerosene and solid fuels based on the gas forms was started in July 2010. It is a cross-industry initiative co-ordinated by Downstream Gas between the Gas Safety Trust, OFTEC and HETAS. HETAS is the solid fuel advisory service and competence assessor for operatives who install, commission, service and maintain appliances and OFTEC represents the interests of homeowners, registered technicians and trade association members, providing advice and information on oil-fired heating and cooking.

Provisional assessments of risk for domestic CO incidents caused by installations fuelled by solid fuel and oil are presented in Appendix D. This information has been gathered by investigators working on behalf of HETAS and OFTEC.

1.3 Coverage

The information gathered during an incident investigation relies on the investigators, working on behalf of gas suppliers, completing a DIDR form for each CO incident and sending it to Downstream Gas for entry onto the database. Fatalities resulting from those incidents confirmed to have been caused by accidental exposure to CO and reported to Downstream Gas via DIDR forms have been reconciled with information recorded by the HSE via RIDDOR.

Non-fatal casualties are reported to the HSE and the gas supplier in the same way. However, the gas supplier carries out an initial assessment of the incident (usually by contacting the gas user) in order to determine whether CO was likely to have been involved. A decision is then taken to either carry out a full investigation or record it as non-CO related and hence not take any further action.

The HSE does not conduct any such checks and logs all such RIDDOR reports as CO related. It is inevitable, therefore, that this results in the number of non-fatal CO incidents recorded by the HSE being significantly greater than the number of incidents that are actually confirmed as being CO related.

The primary aim of the work in analysing those incidents that are confirmed as CO related is to examine in detail the circumstances of all such incidents to reveal any common concerns and conclusions that will help to improve gas safety in the future. It is therefore important that detailed investigations are carried out on as many incidents as possible that meet the legal criteria for an investigation. There is a duty in law on the gas supplier to carry out such investigations and it should be recognised by both HSE Inspectors and the gas suppliers alike that this needs to happen irrespective of whether the HSE intends to take any further legal action or not.

There are instances in this report where a particular demographic factor relating to the risk of being involved in a CO incident (for example the number of incidents reported to have occurred in a particular type of occupancy) is compared to the number that would have been expected if every classification (in the case of occupancy type this is owner-occupied, rented in the social sector and privately rented) had been equally at risk.

Sometimes the number of reported incidents was lower than expected, in which case the demographic factor indicated lesser risk than would be expected, and vice versa. In this way, commentary can be given on whether demographic factors such as housing sector, property type, period of property construction, glazing type, casualty age range, etc indicated levels of risk that were greater than or less than those anticipated. As an example, if gender was the demographic factor and 40 females had been reported as non-fatal casualties during the year compared to 20 males, then because the population is split 50:50, corresponding to an expected number of 30 for each gender, this would indicate that females are more at risk of being casualties than males.

The risk of an accidental CO poisoning associated with the use of natural gas has been calculated and expressed in terms of fatalities, casualties or incidents per million people deemed to be at risk per year. People considered at risk are those living in properties with at least one gas appliance (i.e. those supplied with mains natural gas nationwide). Risk rates associated with particular appliance types have been estimated by taking the number of people at risk as those living in homes with the particular appliance type installed.

In order to report annual trends, fatality, casualty and incident rates are presented for the yearly periods starting from the 1st July 1996.

Section 2 of this report analyses data in the same sequence as it is featured on the DIDR form and interprets information making use of appliance and other population statistics, where available. Section 3 then draws conclusions and where appropriate makes recommendations.

- Appendix A covers incidents involving portable refillable LPG that are reported to Downstream Gas.
- Appendix B covers non-domestic incidents which may have been reported to Downstream Gas.
- Appendix C covers details of incidents that occurred in previous years for which information was made available this year.
- Appendix D covers detailed information and provisional risk assessment for domestic CO incidents caused by installations fuelled by solid fuel and oil. This information has been gathered by investigators working on behalf of HETAS and OFTEC, the trade associations for solid fuel use and oil use.
- Appendix E features charts which present summarised information for 2013/14 which enables the reader to assess elements of this year's data and compares these with data from previous years.

1.4 Media reporting

CO fatalities and injuries are tragic events which can be avoided so we should never become complacent in the pursuit of a zero injuries target.

Quite often CO incident figures reported in the media quote around 50 fatalities per year, although Public Health England has reduced this figure to 40 more recently. It should be remembered, however, that this figure is the total of all CO fatalities across the range of fossil fuels such as solid fuel, oil, portable bottled LPG, wood and natural gas and involves a wide variety of equipment e.g. boilers, fires, garage compressors, generators, barbecues and stoves.

The data contained within this report originates from the information captured within the RIDDOR process that is collated carefully by Downstream Gas to ensure only confirmed CO incidents are included.

It is nonetheless important, however, to ensure the numbers of injuries reported in the media, fatal or otherwise, accurately reflect those associated with the specific fuel sector concerned. This will go some way towards making sure the lessons learned and implemented in the mains natural gas and piped LPG sectors are adopted to promote safer practices in other fuel sectors, most if not all of which are far less regulated.

This issue has now been taken on board by the HSE. Historically, HSE has quoted a figure for fatal injuries in the mains natural gas and piped LPG sectors of 30 per year. Given the numbers have fallen significantly over recent years, the HSE has now agreed to use the average number over the last five years and in so doing provide a more accurate perspective. The average number of fatalities associated with the use of mains natural gas over the last five years, including 2013/14, is now four.

It should be borne in mind that the legal drivers for investigating and reporting CO related incidents in these other energy sectors are far less than those compelling investigation and reporting in the mains natural gas and piped LPG sectors.

The solid fuel and oil sectors are working with the gas industry to help reduce the number of injuries, both fatal and non-fatal, from CO and by providing detailed incident information for this report are expressing their commitment in this respect.

Since August 2013, Downstream Gas has been undertaking media monitoring in order to identify articles in the Press that report CO incidents. The media reporting exercise has revealed some serious incidents, specifically in the solid fuel sector, which have not been investigated by HETAS and reported to Downstream Gas. One reason for this is believed to be the lack of legal obligations to investigate, both in the solid fuel and oil sectors, and who is expected to pay for any investigation.

1.4.1 Factors acknowledged to have reduced incidents

The current situation regarding CO incidents clearly shows how the numerous safety initiatives implemented over the last 25 years have resulted in a significant reduction in the number of reported fatalities and injuries. The following initiatives are all considered to have contributed to this downward trend in incidents linked to mains natural gas and piped LPG.

- The introduction of the flue gas analyser
- The removal of open flued water heaters from bathrooms and bedrooms
- Increased user awareness enhanced by the OFGEM supplier licence review
- Landlord legislation
- Boiler scrappage schemes
- The requirement for new gas boilers to be condensing from April 2005
- The use of CO alarms
- Gas Distribution Networks making use of CO detection
- The focus of CO Charities, industry and government
- UK legislation that maintains the gas quality of distributed mains natural gas to within Wobbe Number limits that have been shown to minimise the potential for CO incidents to occur (see GSMR, 1996)

2 Analysis of DIDR Forms

2.1 Preliminary overview

There were 28 domestic mains natural gas incidents and one piped LPG incident reported to Downstream Gas that met the criteria for inclusion during the 12 month reporting period (1st July 2013 to 30th June 2014).

Gas related incidents reportable under RIDDOR are usually acted on by gas suppliers and the HSE so that investigations can be arranged promptly. British Gas and CORGI Technical Services provide an incident investigation service for gas suppliers. On occasion the HSE engages Gas Safe Register to investigate incidents. There have also been rare occasions when HSE has requested the support of the Health and Safety Laboratory (HSL) with incident investigation. During this year, 20 confirmed CO related incidents were investigated by British Gas, five by CORGI Technical Services and four by Gas Safe Register.

A fully detailed DIDR report is submitted following an investigation by a trained investigator, who completes as many sections as possible thereby providing detailed information on the circumstances of an incident including, for example, the appliance installation, safety devices found on site and dwelling characteristics. This year fully detailed reports were received for 17 of the 29 mains natural gas and piped LPG incidents.

Short reports only feature key facts such as the incident date, geographical location, casualty details and the suspected cause together with the type of appliance involved and were not necessarily fully investigated by a qualified investigator. This year 12 such short reports were submitted by incident co-ordinators.

The reasons for not providing full investigation reports this year were:

- Precautionary advice to attend hospital from ESP (1)
- HSE advised no investigation required as ‘faulty’ cooker was a tenant’s own appliance (1)
- CO alarm triggered, gas user and child attended hospital but no elevated COHb recorded. Engineer deduced only appliance that could have produced elevated CO in property was the hob. Did not strictly meet the RIDDOR reporting criteria at the time (1)
- Occupant of property took themselves to hospital (making it non-RIDDOR reportable as a result) although engineer identified elevated levels of CO from grill and turned off appliance (1)
- Couple attended hospital following exposure to elevated levels of CO in air due to a flue blockage. Servicing company had been contacted to rectify fault and HSE deemed incident investigation was not required (1)
- Engineer called to check appliance and only became aware of an incident following rectification of fault making an investigation impossible (1)
- Incident was post-Oct 2013 and upon re-examination it did not fulfil the reporting criteria (1)
- Following activation of a CO alarm, precautionary advice for occupants to seek medical attention. Cooker burner components dislodged during cleaning and thought to have caused the alarm to sound (1)
- Full investigation not possible as occupant had already arranged for own engineer to attend the property and the evidence had been disturbed (1)

- Three reports had legal proceedings pending and so full reports have not yet been received (3)

Full reports formed 59% of the total submitted in 2013/14 and this was a little lower than last year (62%)[2] and the previous year (75%)[3].

It should be stressed that once reported as a RIDDOR incident and confirmed as likely to have involved CO, the gas supplier has a legal duty to investigate and the HSE has confirmed that this means investigating fully.

There were various reasons why only short reports were received for some incidents this year. One was the result of a tenant owning a faulty cooker rather than it being owned by, and hence the responsibility of, the landlord. GSMR does not distinguish between the ownership of an appliance and requires a full investigation to be carried out whenever possible. The full investigation of any RIDDOR reportable incident that is CO related should not be prevented because, for example, it will not result in a prosecution.

This year, there was one incident of particular concern which involved five people, one of whom was transferred to an oxygen stabilization unit, where a full investigation was not carried out because the evidence had been disturbed. During the initial attendance by the emergency service responder several appliances were found at the property: a gas central heating boiler, a gas water heater, a gas cooker and hob and a solid fuel fire. No particular appliance exhibited obvious signs of spillage. When contact was subsequently made with the occupier to arrange an investigation it was reported the boiler had already been replaced and so no further action was taken. This is worrying because without a full investigation to determine which of the five installations produced the excessive CO the specific cause could not be identified and may, indeed, have still been operating at the premises. It is possible, however, that the occupier's operative who replaced the boiler found it to have been at fault and that no other installations were faulty.

There may be occasions when an investigation report is delayed, for example whilst waiting on the result of an inquest or a trial. No reports were received in this reporting year that provided incident information from previous years.

Each of the following sections includes an assessment of the information retrieved from the CO incident database for 2013/14 and, where appropriate, a discussion of the data. This discussion may compare this year's information with that from previous years or qualify this in terms of a wider context.

2.2 Incident details

The numbers of CO incidents recorded each month, i.e. those involving fatal and/or non-fatal casualties between 1st July 2013 and 30th June 2014 inclusive, are plotted in Figure 1. For brevity in this report this will be referred to as the 2013/14 year. Figure 2 shows how these monthly figures break down in terms of fatalities and non-fatal casualties. The so-called heating season typically runs throughout the winter between September/October and April/May and the majority of CO incidents tend to occur during this period.

[2] Ref 1
[3] Ref 2

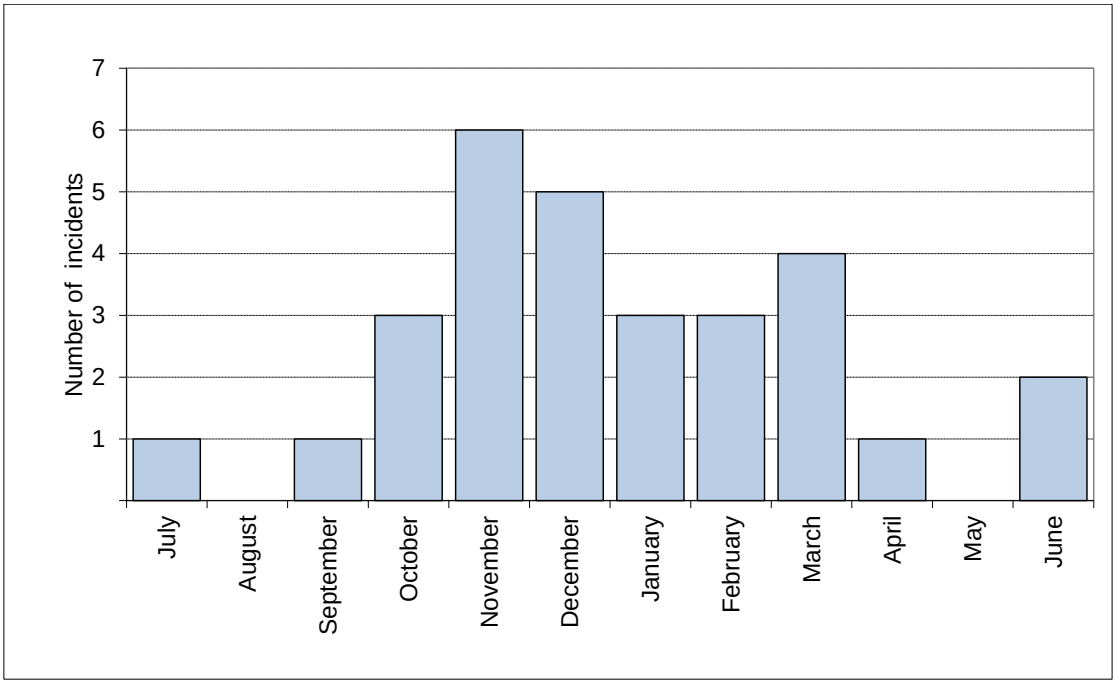

Figure 1 Monthly incident numbers

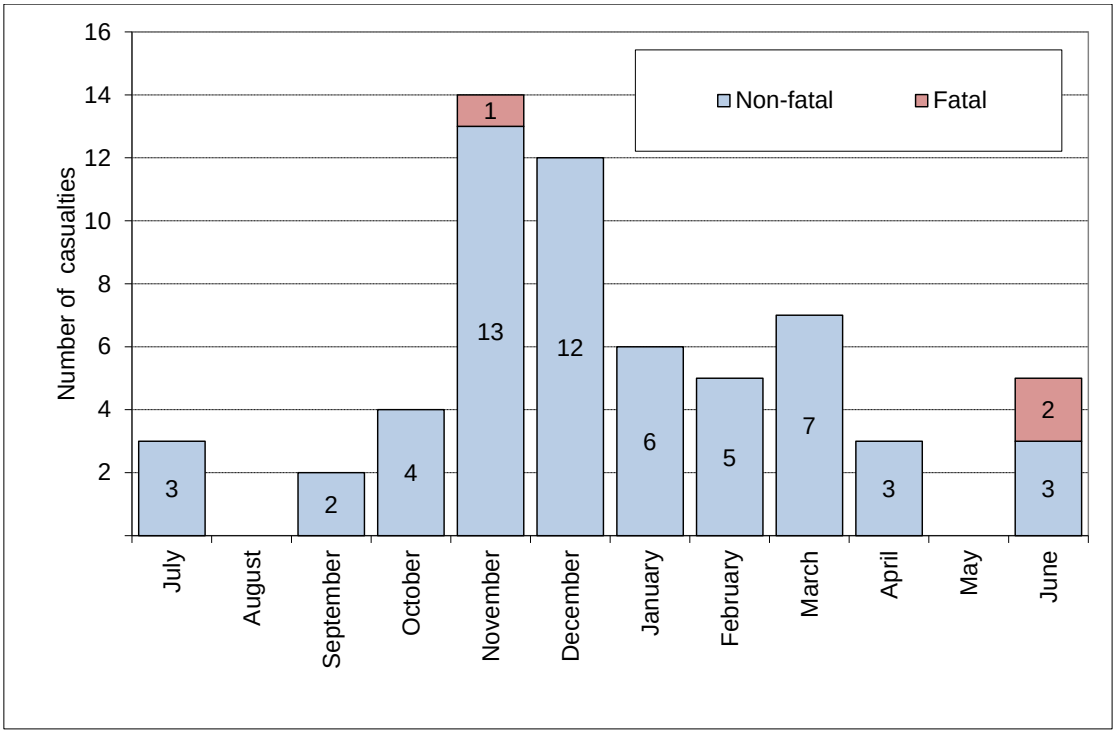

Figure 2 Monthly casualty numbers

For 2013/14 there were 29 separate CO incidents reported by investigators relating to mains natural gas and piped LPG. These affected 61 people, of whom three died.

For the year April 2013 to March 2014, the HSE website[4] lists one individual who was reported to have died from suspected CO poisoning. The details have been scrutinised and correspond in terms of the single fatality reported by the HSE in November 2013. The HSE are aware of the double fatality that occurred in June 2014 which falls outside their reporting year.

2.2.1 Geographic coverage

Of the 119 postal areas in Great Britain, 90 were incident free and 29 had a single incident. Therefore there is no evidence of geographical clusters this year.

2.3 Casualty details

2.3.1 Fatalities, non-fatal casualties and incident numbers

A breakdown of those persons (58) non-fatally injured during the reporting year 2013/14 is presented in Table 1 and in Figure 3, with the severity of the casualties classified into four groups.

[4] Ref 3. Note the five yearly figures quoted by HSE (Ref 4) include suicides.

Table 1 Classification of non-fatal casualties

Classification	N1	N2	N3	N4	Not stated	Total
Number of casualties	8	42	6	2	0	58

Table Notes:
The classifications N1 to N4, as used on the DIDR form, are:-

N1 - requiring immediate hospitalisation for more than 24 hours
N2 - requiring immediate hospitalisation for less than 24 hours, and/or hospital tests
N3 - requiring other medical treatment (e.g. GP or Paramedic)
N4 - receiving no medical treatment (e.g. treatment refused)

2.3.1.1 Discussion

This year, of the 58 casualties whose severity classification had been reported, eight (14%) were classified as not requiring hospitalisation. This compares with last year's figure of 39% and only 2.5% in 2011/12. In 2008/9, 2009/10 and 2010/11 the proportion had been close to 20% (see Figure 4).

The total number of incidents (29) reported in 2013/14 was the same as in 2012/13 whilst the total number of non-fatal casualties fell from 62 to 58.

The average number reported over the four years 2009/10 to 2012/13 was 40 incidents and 81 non-fatal casualties. The normal spread expected in 19 out of 20 years is between 27 and 54 incidents and 81 and 101 casualties and therefore this year's figures are not different in the statistical sense than the previous four years. This indicates that the total number of non-fatal casualties and incidents reported for the years 2009/10 to 2013/14 is levelling off.

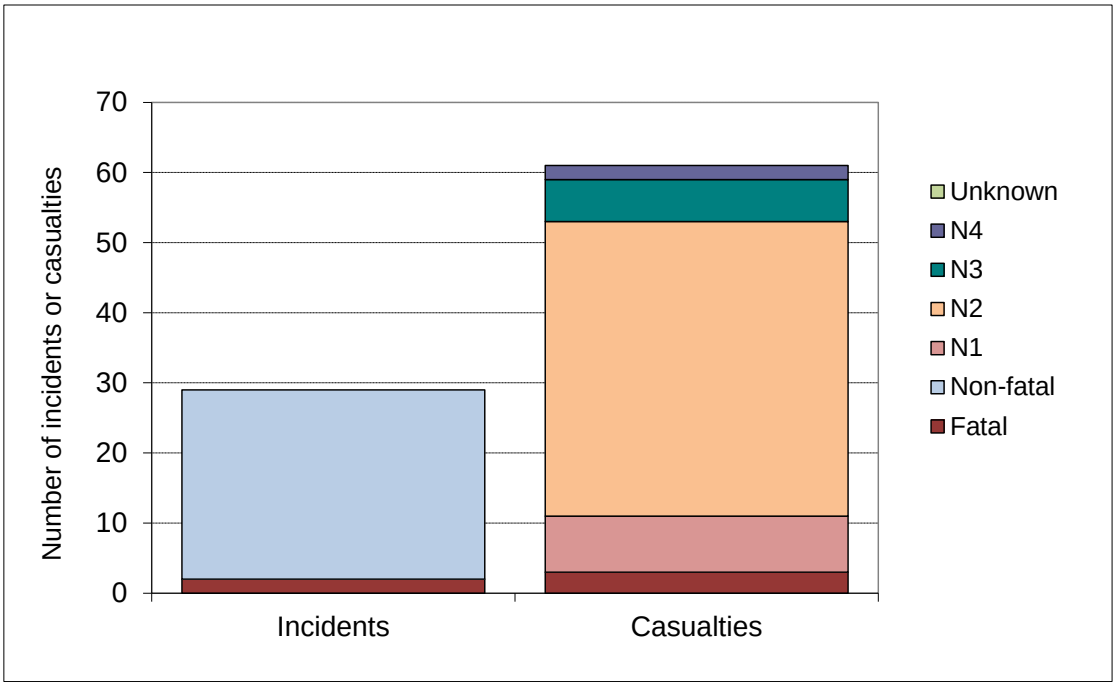

Figure 3 Reported incident and casualty numbers

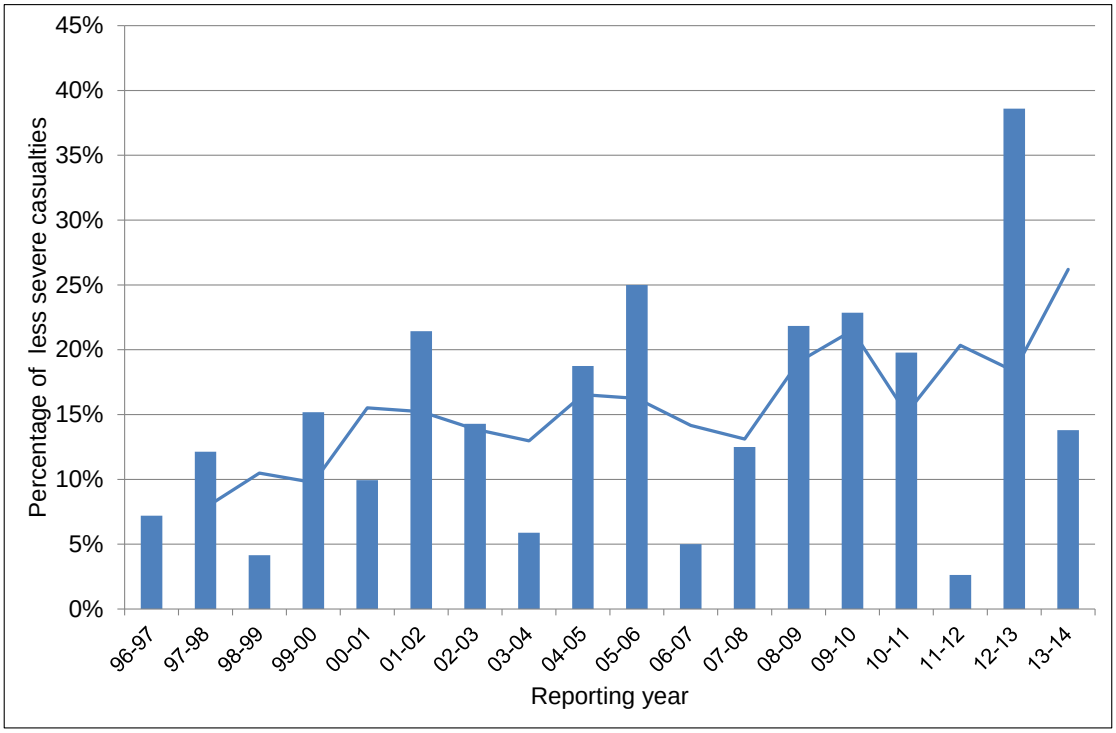

Figure 4 Percentage of casualties not requiring hospital treatment

A study of 1768 patients at four hospitals in England in 2010 with symptoms of CO poisoning found that 16% had CO alarms installed[5].

It should be noted that this is considerably lower than the 31% (9 in 29) of CO incidents investigated in 2013/14 where it was reported a CO alarm was present.

As pointed out in the 2012/13 report, alarm activation may be increasing the likelihood of someone seeking medical treatment thereby increasing the proportion of incidents associated with CO alarms. In 2013/14, 3 of the 7 (43%) incidents involving alarm activation had the classification N3 and no N2 or N1 classifications[6]. In homes with CO alarms that did not activate, and for those homes without CO alarms, only 10% had the classification N3 and no N2 or N1 classifications.

CO alarms are supplied with user instructions. These generally advise users that, in the event of an alarm sounding, they should get medical help immediately for anyone suffering headache or nausea. In addition, when attending sites where alarms have activated, gas emergency service providers may also advise those feeling unwell to seek medical assistance. In this way, it is possible that an incident is reported under RIDDOR even though blood levels of COHb do not turn out to be particularly elevated and serious injury has not occurred.

[5] page 6 of Ref 5.
[6] No incident in 2013/14 involved only N4 classified casualties.

2.3.2 Overall risk and trends

Table 2 shows the likelihood of someone being involved in a CO incident during 2013/14. The risk rates were calculated by dividing the number of incidents, casualties or fatalities by the number of people at risk per year. The exact number of people at risk is open to debate but in this report, it has been taken to be the number of people that live in homes with at least one gas appliance (i.e. the number of households with mains gas multiplied by the average number of people living in a household).

The calculated risk presented in Table 2 is based on the number of people at risk (51.9 million) in 21.88 million households supplied with gas in GB at the end of 2013 with an average occupancy of 2.37[7].

Note the 21.88 million figure is derived from, but not the same as, the number of properties in GB that are classified as using less than 73,000 kWh per annum[8] as published by UK's Department of Energy and Climate Change (DECC) (see Ref 7). The DECC published figure is higher because it relates to the number of dwellings and not the number of households. There are fewer households than dwellings because some properties are empty. For example 4.4% of dwellings were empty in England in 2012 (Ref 6).

Table 2 CO incident numbers and risks for 2013/14

Total Incidents	Numbers of people affected		Incidents, fatalities or casualties per million people at risk per year		
	Fatal	Non-fatal	Incident	Fatality	Non-fatal
29	3	58	0.56	0.06	1.12

The risk rates calculated for previous years are given in Table 3. Yearly trends recorded for fatality and incident rates are also shown in Figure 5 and Figure 6 respectively. The trend is defined as a moving average over three years centred on the middle year. For the 2013/14 year the trend is represented as the average of 2012/13 and 2013/14 only.

[7] Table 5: Households by size United Kingdom, 1996-2013, Ref 6

[8] This is the traditional boundary between domestic and non-domestic used by the gas industry. Some of these domestic properties will include small business properties that consume less. However, the number of such properties is much smaller than the number of residential properties.

Table 3 Yearly data (July 1st to June 30th)

Reporting year	Number per year			Overall rate per million people per year		
	Incidents	Fatalities	Casualties	Incidents	Fatalities	Casualties
96/97	70	21	142	1.64	0.49	3.33
97/98	94	24	206	2.21	0.56	4.83
98/99	107	24	241	2.49	0.56	5.61
99/00	70	23	150	1.68	0.55	3.60
00/01	85	16	206	2.01	0.38	4.86
01/02	52	11	107	1.19	0.25	2.44
02/03	36	11	66	0.79	0.24	1.44
03/04	38	8	85	0.84	0.18	1.89
04/05	25	5	48	0.55	0.11	1.05
05/06	19	11	20	0.39	0.22	0.41
06/07	27	8	40	0.54	0.16	0.80
07/08	42	12	67	0.84	0.24	1.34
08/09	57	17	97	1.13	0.34	1.93
09/10	56	4	115	1.10	0.08	2.27
10/11	51	10	101	1.00	0.20	1.98
11/12	24	1	46	0.47	0.02	0.90
12/13	29	2	62	0.56	0.04	1.20
13/14	29	3	58	0.56	0.06	1.12

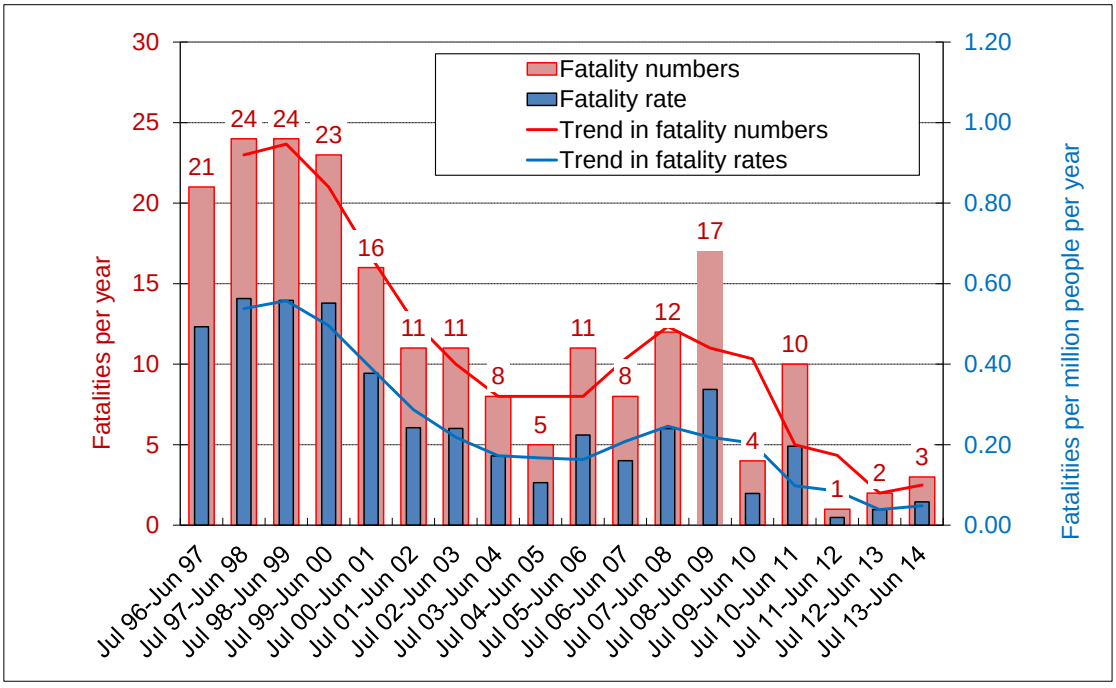

Figure 5 Fatality data

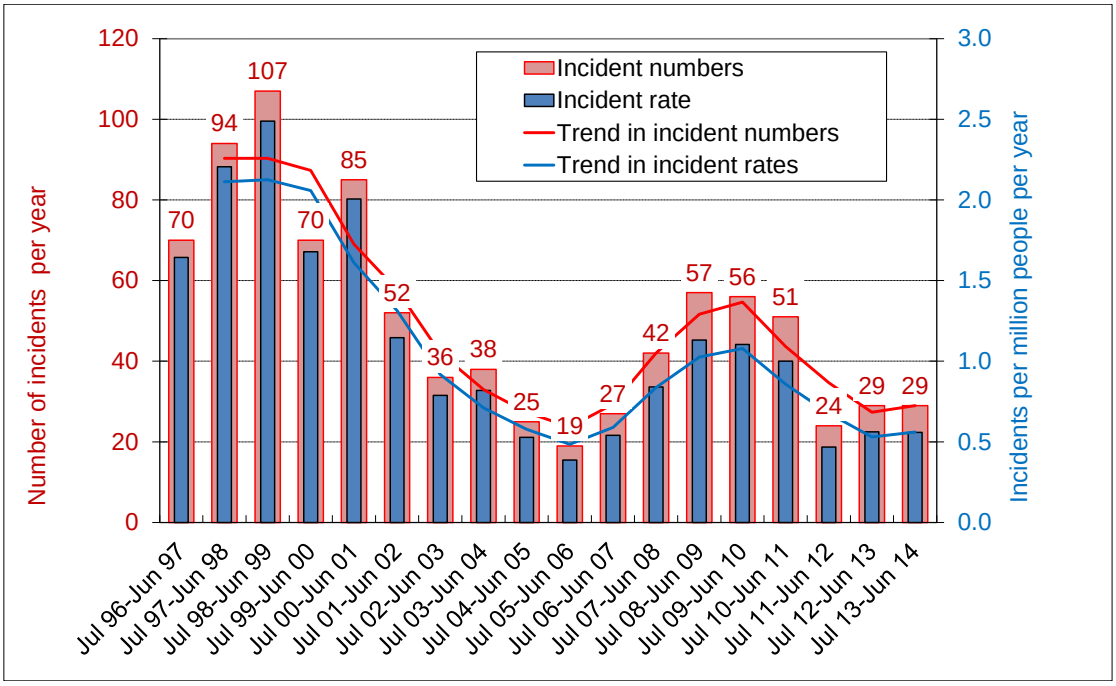

Figure 6 Incident data

2.3.2.1 Discussion

The number of fatalities reported annually has reduced since the incident database was established in 1996 from a peak in the late nineteen nineties of 24 to an average of four per year over the past four years (2010/11 to 2013/14).

The number of incidents reported annually has reduced since the incident database was established in 1996 from a peak of just over 100 in the late 1990s to 29 in the last two years.

An average of 40 incidents per year occurred over the four twelve month periods 2009/10 to 2012/13. Statistically, if the long term average was 40 incidents per year, the latest period's total of 29 incidents falls within the expected range of 29 to 50 incidents anticipated 95% of the time and so the figure of 29 is statistically consistent with a long-term average of 40 incidents per year.

However, the average of the latest four years has declined to 33 incidents per year, but it remains to be seen if this is the result of a decline in the long-term average as there was a lower average over four consecutive years during 2003/4 to 2006/7.

2.3.3 Casualty ages

The three fatalities reported this year were two men aged 47 and 54 (same incident) and one woman aged 85.

The age ranges of non-fatal casualties are presented in Figure 7. The proportion of people in each age group in GB[9] is:

- 18.8% for those under 16
- 11.6% from 16 to 24
- 26.6% from 25 to 44
- 25.4% from 45 to 64 and
- 17.7% for 65 or over.

[9] Average of mid-2013 and mid-2014 projections, Ref 8.

These ranges have been deliberately chosen to represent age groups with perceived differing vulnerabilities and potential for exposure to CO. The expected numbers of incidents by age range are also shown in Figure 7. The expected number is the percentage of those within each age range resident in GB in 2013/2014 multiplied by the total number of casualties with an age recorded. In effect, the expected number is the average number that would occur if all ages were equally susceptible to CO poisoning and exposed to the same level of risk.

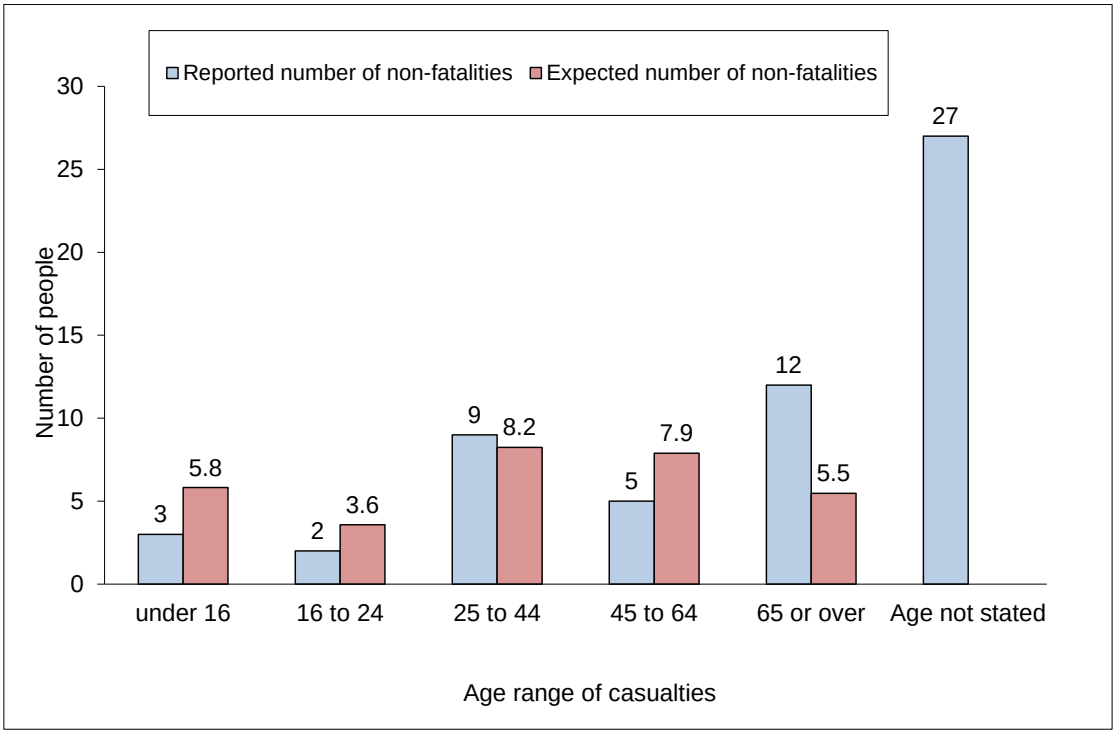

Figure 7 Casualty age profile

2.3.3.1 Discussion

From Figure 7 it appears that there are some differences between the age profiles of non-fatal casualties, most notably those over 65 appear to be more at risk. It is not possible to say whether the higher than expected numbers age 65 or over is significant due to the low numbers involved.

2.4 Incident location details

This section examines whether the relative risk of an incident varies with occupancy type, dwelling type, year of construction, double glazing and floor construction.

2.4.1 Housing sector

A breakdown of English dwellings with a main gas supply by housing sector[10] is shown in Table 4. This is considered to be a reasonable measure of the breakdown of homes supplied with mains gas in GB because a) England accounts for 85% of the homes in GB, b) the percentage of homes with a gas supply in Wales and Scotland is similar to England.

[10] In some previous reports the term occupancy type was used. Housing sector is now the preferred term as this is more widely used in demographic publications.

Table 4 Distribution of gas dwellings by housing sector in England 2013[11]

Housing sector	Distribution of homes with a gas supply, %
Owner occupied	66.5
Rented privately	17.0
Rented from council	8.0
Registered Social Landlords (RSL)	8.5
ALL	100

Figure 8 shows the number of reported and expected incidents by housing sector. The expected number is the national proportion by housing sector (Table 4) multiplied by the total number of reported incidents of known housing sector and represents the number expected assuming all housing sectors pose equal risk.

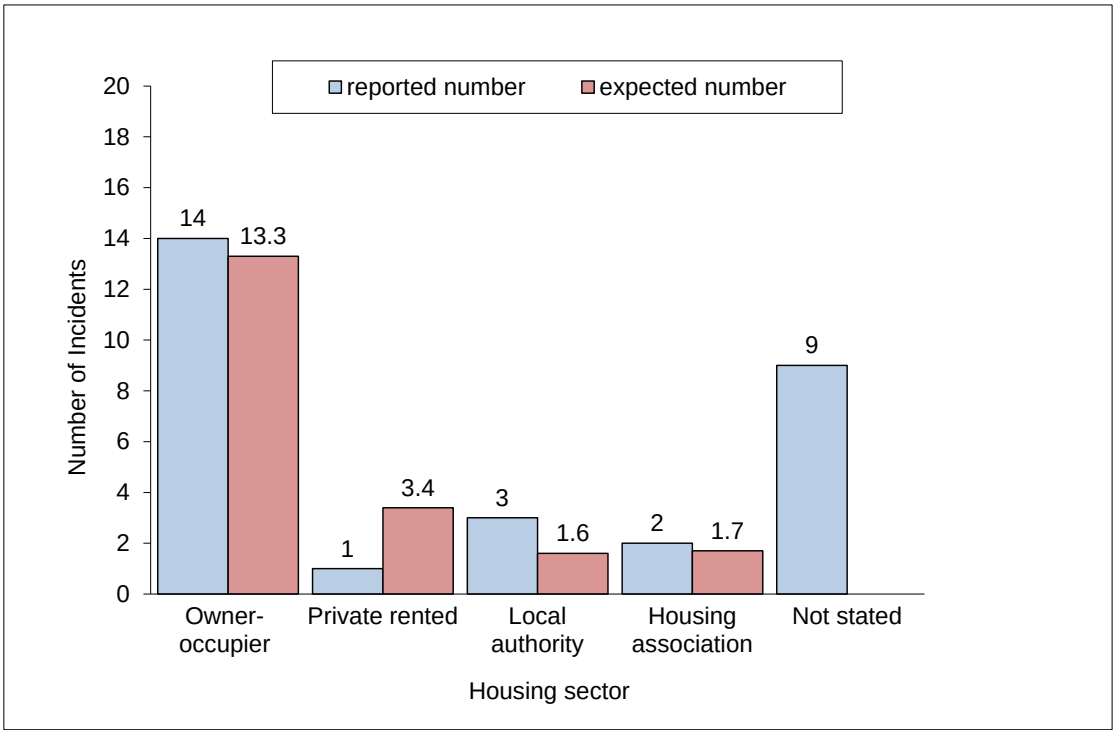

Figure 8 Incidents by housing sector

[11] Projected forward using 2010 to 2012 data sourced from Table DA2201, Ref 9.

2.4.1.1 Discussion

2.4.1.1.1 Risk

This year the risk of an incident occurring in the privately rented sector was less than expected and did not follow the trend measured since 1998/99. Nonetheless, the pattern of incidents occurring in such properties continues to prevail when the data is assessed on a three yearly basis.

Figure 9 shows the risk associated with the private rented sector over the last 15 years. Annual figures have been averaged every three years to minimise year-on-year fluctuations from obscuring the overall trend and this shows the risk has historically remained fairly constant at around twice that in any other housing sector.

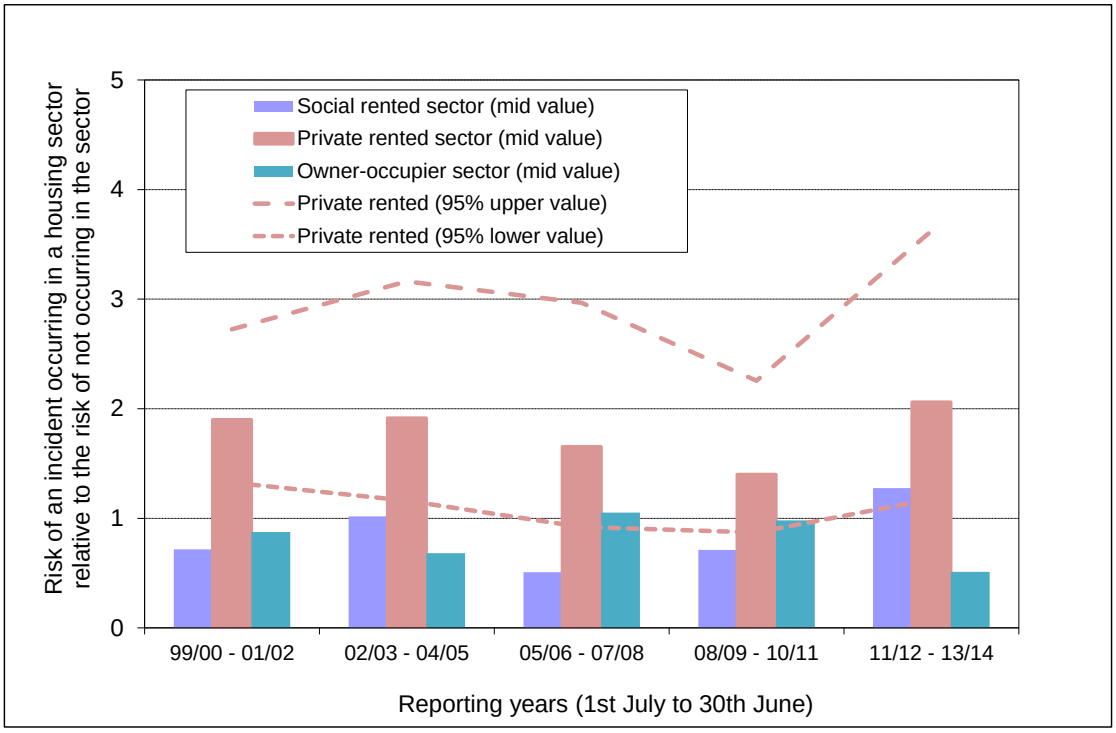

Figure 9 Historical risk of an incident by housing sector

2.4.1.1.2 CO alarms

In 2012/13 it was reported that the breakdown by housing sector for homes without alarms was similar to the national picture indicating equal risk across sectors. This appeared at odds with figure 9 and would require further investigation were it to have been repeated in 2013/14.

Table 5 shows the breakdown of incidents by housing sector for homes where CO alarms were installed and those without alarms. The proportion of incidents without alarms is not massively at odds with the national breakdown. However, given that 36% of such incidents are of “unknown housing sector” little can be deduced.

Table 5 Housing sector incidents and CO alarms

Housing sector	All incidents	Incidents with CO alarms	Incidents without CO alarms	National proportion of housing sector
Owner/occupied	14 (70%)	4 (67%)	10 (72%)	66.5%
Social rented	5 (25%)	2 (33%)	3 (21%)	16.5%
Private rented	1 (5%)	0 (0%)	1 (7%)	17.0%
Totals of known sectors	20 (100%)	6 (100%)	14(100%)	100%
Unknown sector	9	1	8	n/a

2.4.2 Dwelling type

Table 6 shows the distribution of dwelling types in England with a mains gas supply.

Figure 10 provides a breakdown of incidents reported this year by dwelling type and compares the expected number based on the national profile, were an incident in one type of dwelling to be equally as likely as in another type. The reported numbers of incidents by dwelling type were similar to the proportion of properties supplied with gas for terraced houses, flats and bungalows but not for semi-detached houses, where more were reported than would have been expected. However, no deviations from expected incident numbers compared with those reported were sufficiently different to constitute statistical significance for any dwelling type.

Table 6 Distribution of dwelling with mains gas in England in 2012[12]

Dwelling type	Proportion of dwelling types, %
Detached house	16.5
Semidetached house	28.1
Terraced housed	30.5
Bungalow	8.5
Flats purpose built	12.7
Flats converted	3.7
Total	100

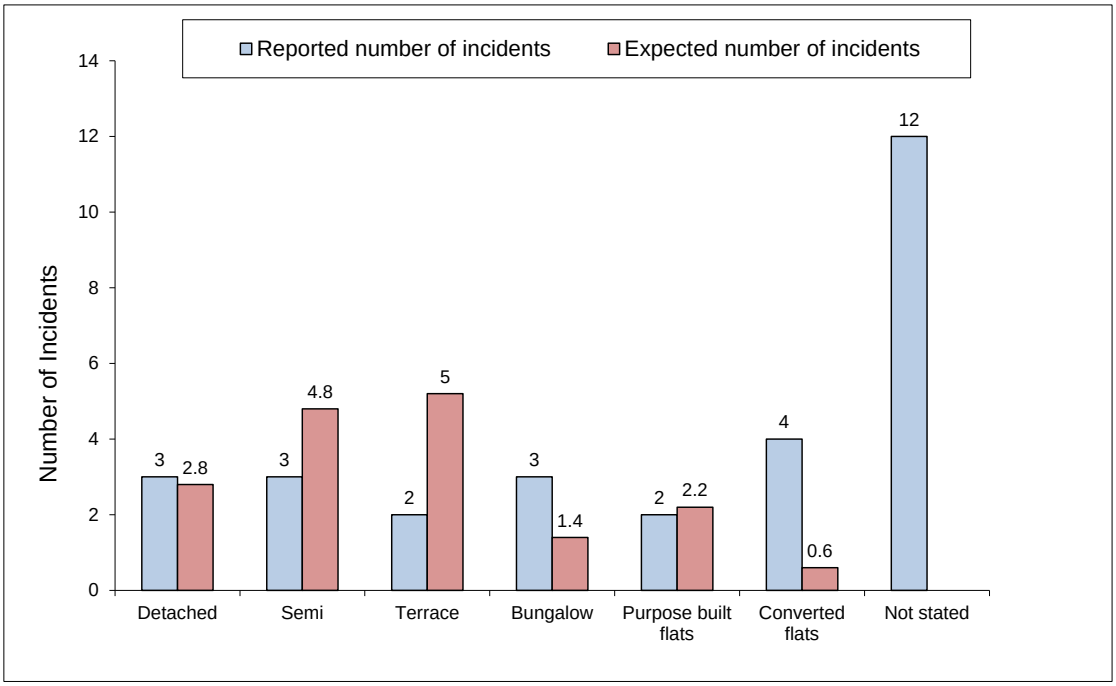

Figure 10 Incidents by dwelling type

2.4.2.1 Discussion

Figure 10 shows the expected number of incidents assuming all property types pose an equal risk. There is little evidence to suggest different property types pose different risks.

12 of the incidents occurred the dwelling type was not reported. These are unlikely to be biased towards any particular dwelling type because the reasons for not fully investigating are unrelated to dwelling type.

[12] Table DA2201 Parking and mains gas - dwellings, 2012, Ref 9.

2.4.3 Property construction period

Table 7 gives the national breakdown of properties built in each of five periods for those property types listed on the DIDR form.

Figure 11 shows how the reported number of incidents compared with those expected assuming properties within all construction periods pose an equal risk of being involved in an incident by property age based on the data presented in Table 8.

Table 7 Percentage of dwellings with mains gas in England 2012 by built period[13]

Built period	Distribution of gas properties by built period in England 2012, %
Pre 1945	18.9
1945 to 1965	18.2
1966 to 1980	21.3
1981 to 1990	20.6
Post 1991	21.0
Total	100

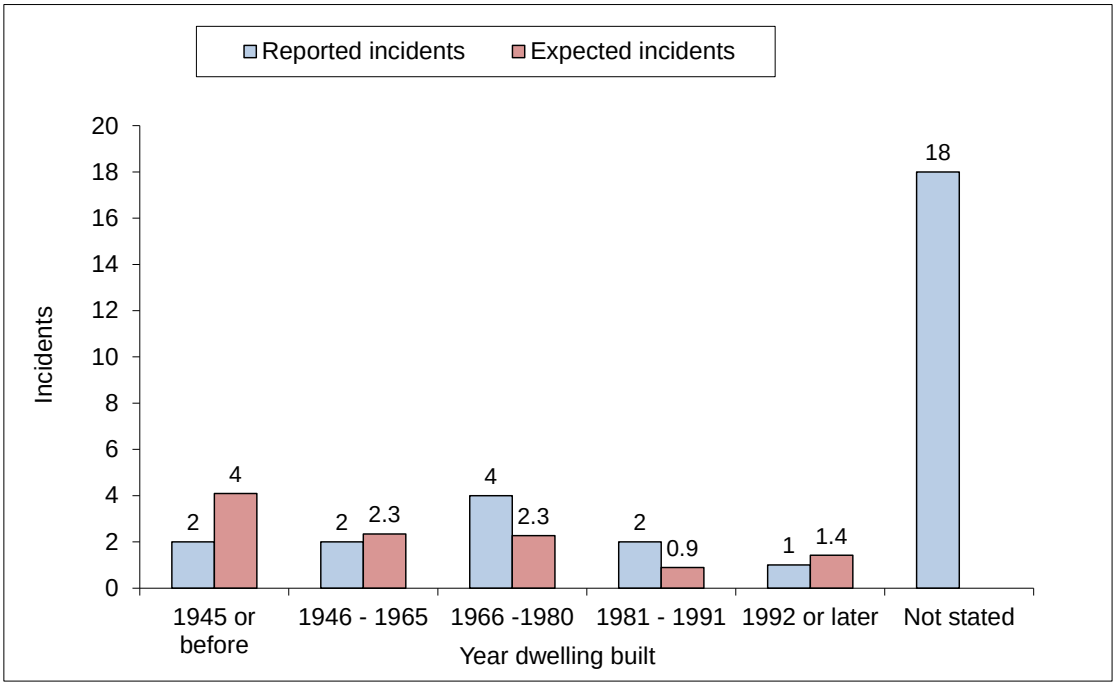

Figure 11 Incidents by property built period

2.4.3.1 Discussion

Older properties, particularly those built in 1945 or before, generally have higher levels of background ventilation which may help to reduce the chance of a dangerous build-up of CO.

Figures for this year do not show that CO exposure is related to property age.

[13] Table DA2201 Parking and mains gas - dwellings, 2012 ref 9.

2.4.4 Glazing type

The percentage breakdown of homes by glazing type in the latest English Housing Survey was 8.5% single-glazed only, 15.3% mixed single-glazed and double-glazed and 78.9% fully double-glazed in 2012[14]. There was a slight increase in the percentage of properties with double glazing in 2012.

Figure 12 compares the number of reported incidents with those expected from the national figures for glazing categories assuming each category is equally at risk. In 2013/14, there were a similar number of reported incidents to those that would be expected if each category posed an equal risk.

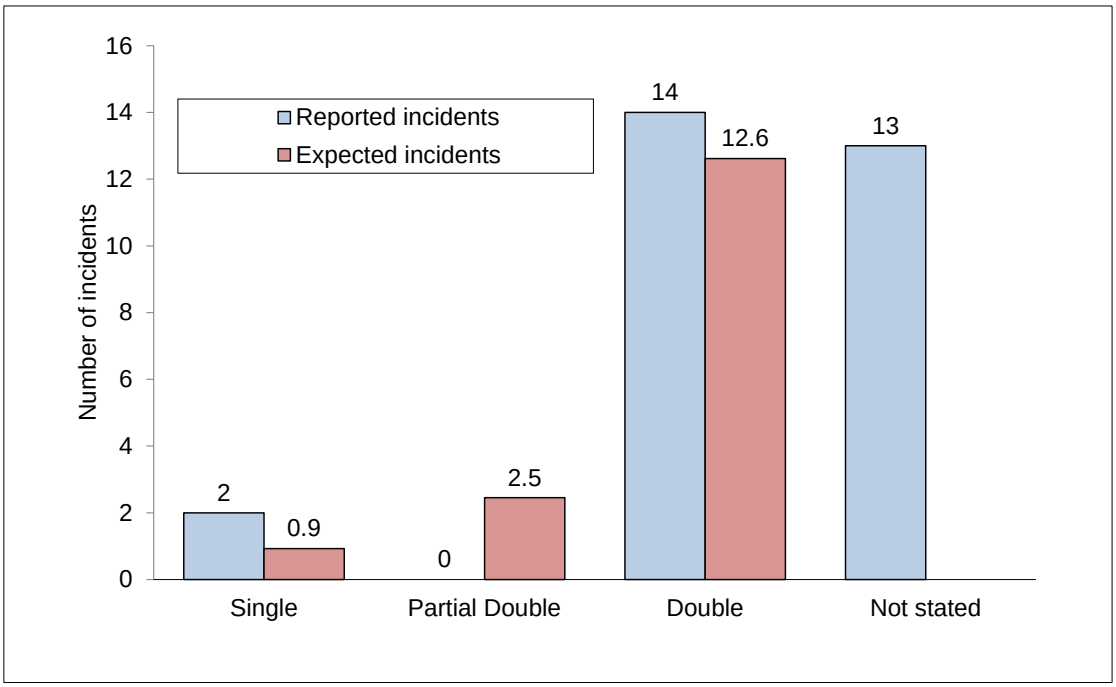

Figure 12 Incidents by glazing details

2.4.4.1 Discussion

The number of incidents in properties with double glazing was in line with those expected indicating that properties with double glazing are not at an increased risk compared with those having single glazing. This has now been the theme for six years and is contrary to the suggestion that double glazed properties are more at risk because they tend to have lower background ventilation rates.

2.4.5 Floor construction

Table 9 shows a breakdown of CO incidents reported by ground floor construction.

Table 8 Incidents by floor construction

Ground floor construction	Reported number of incidents
Solid	12
Suspended	4
Partial solid	0
Not stated	13
Total	**29**

[14] Table D6203, Insulation and households Ref 9.

2.4.5.1 Discussion

National statistics on floor construction are not readily available. However, an estimate in England based on property age is that 72% have solid floor construction[15]. A similar estimate made assuming all properties with cavity walls have solid floors also produces a very similar result of 68.6% with solid floors[16]. If 70% was taken as the figure for properties with solid floors and each floor type posed a similar risk of an incident, the expected number of incidents in properties with a suspended floor construction would be five and for solid floor construction would be 11. In fact, there were four and 12 reported respectively and like previous years these are not significantly different. As a consequence, the type of floor construction is not considered to have a bearing on the likelihood of a CO incident occurring.

2.5 Appliance and casualty locations

This section covers the reported location (eg room or compartment) for both the incident appliance and those injured. No reports implicated more than one appliance. Details of the incident appliance locations, by floor level, are given in Table 9.

Table 9 Incident appliance location by floor level

Floor on which the appliance was situated	Number of incident appliances
Roof space	0
Second or higher	3
First	1
Ground	12
Below ground	0
Not stated	13

Table 10 lists where the incident appliances were reported to have been located together with the numbers of non-fatal casualties at each location. The most common location for an incident appliance was the kitchen.

Table 10 Appliance and casualty locations

	Number of appliances at each location	Number of casualties at each location
Hall/landing	3	1
Kitchen	8	4
Living rooms	3	6
Bathroom	0	0
Utility	1	0
Bedroom	1	8
Other	0	1
Not stated	13	38

The most common location for casualties was the bedroom. Only one injured person was located in the hall/landing (same as last year).

[15] This assumes dwellings built before 1919 and half of those built during 1920-1945 were of suspended floor construction and those built after 1945 were of solid floor construction, which is reasonable for England and Wales. Scotland has different historic construction practices.
[16] DA6201, Insulation, dwellings, Ref 9.

A further analysis was carried out on the number of incidents involving central heating appliances that were fitted in compartments. This excludes back boiler units which should never be fitted in compartments. This data is presented for this year (see Figure 13) and historically since 1996 (see Figure 14).

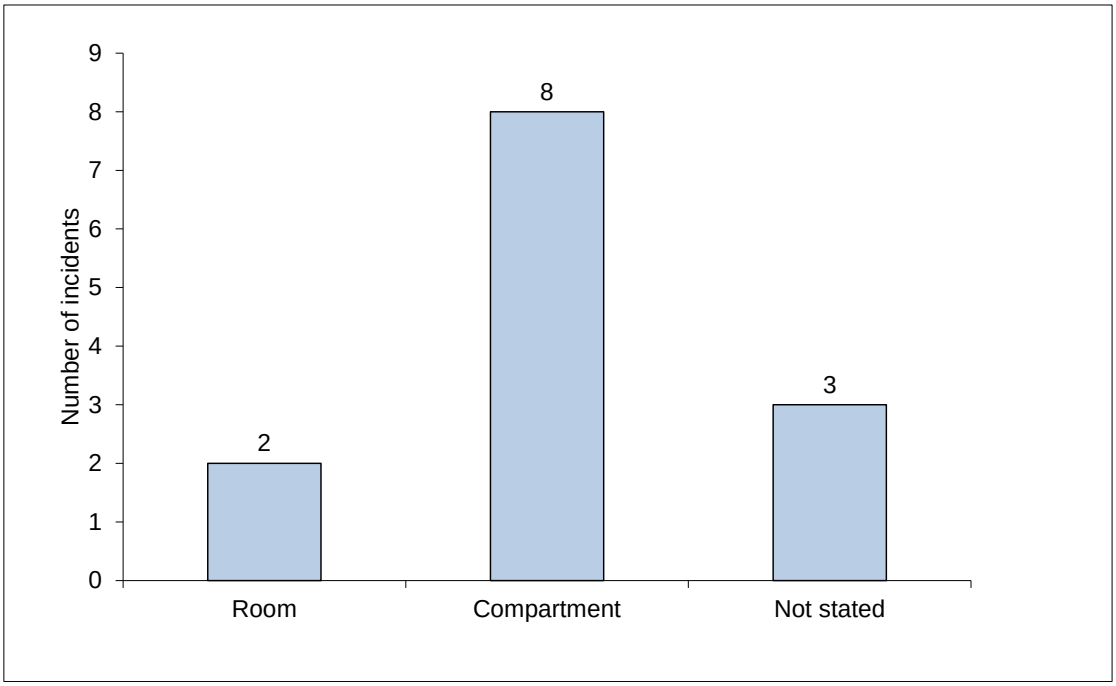

Figure 13 Incident appliances installed in compartments

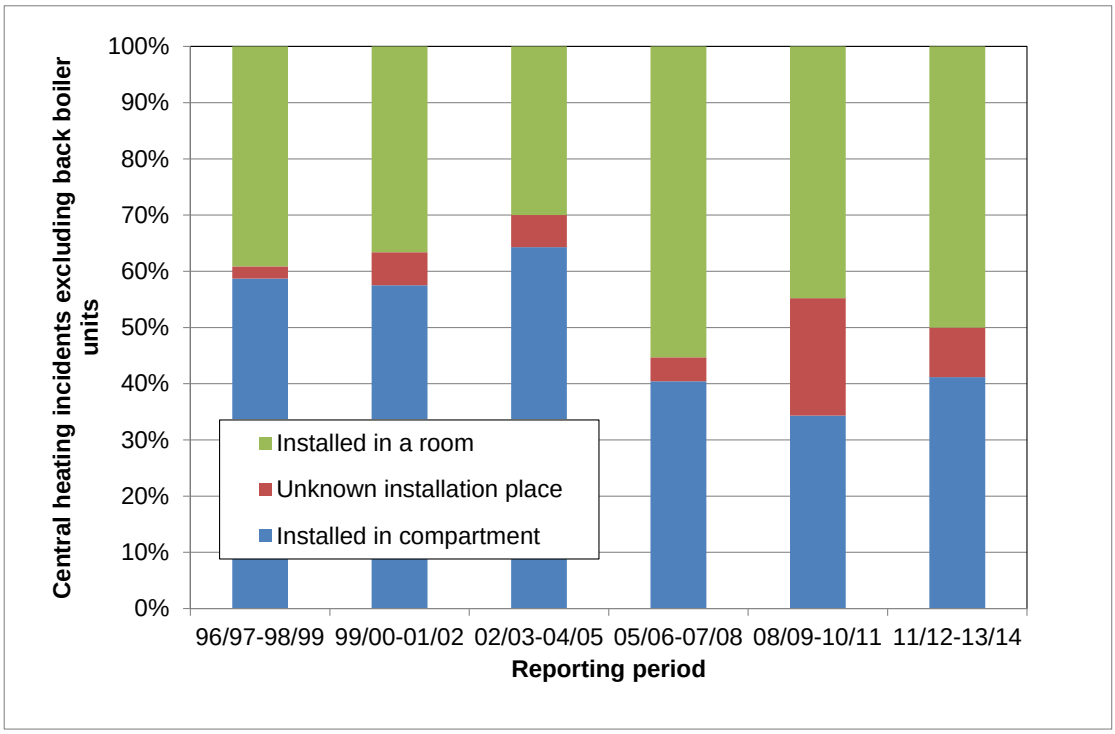

Figure 14 Historical compartment installation data

Of the 19 reports that provided a response to the question “was the casualty and incident appliance located in the same or an adjacent property?” all but two specified that they were located within the same property as the incident appliance. There were two reports of casualties being located in adjacent properties, both terraced houses. One incident was caused by a badly sited flue terminal in a covered passageway. It is unclear how the CO migrated in the other incident.

2.5.1 Discussion

Without data on the nationwide breakdown of appliance installations by room, it is not possible to judge the significance, if any, of the incident appliance location. The location of casualties reported during the year was not surprising given people tend to spend most time in the bedroom and living room and indeed may go to bed if they feel unwell (as may be the case when suffering symptoms of CO poisoning). Without the knowledge of how many appliances are installed in compartments nationwide, it is not possible to gauge the significance or otherwise of whether compartment installations are more at risk of being involved in an incident.

Installing appliances in compartments can in some circumstances exacerbate the rate at which CO is produced and spreads around a property following appliance/installation malfunction as carbon dioxide can build up within a compartment more rapidly and hence can adversely affect combustion more quickly. However, none of the causes of incidents this year involving appliances fitted in compartments related to the compartment aspect of the installation. One fatal incident involved a boiler fitted within a cupboard/compartment but this was caused by a blocked flue and was note a consequence of it having been installed in a compartment.

2.6 Incident appliance details

This section examines incident appliance details to see if there are any factors that could help influence future installation and maintenance guidance.

2.6.1 Appliance type

The numbers of incidents reported by the appliance type are given in Figure 15.

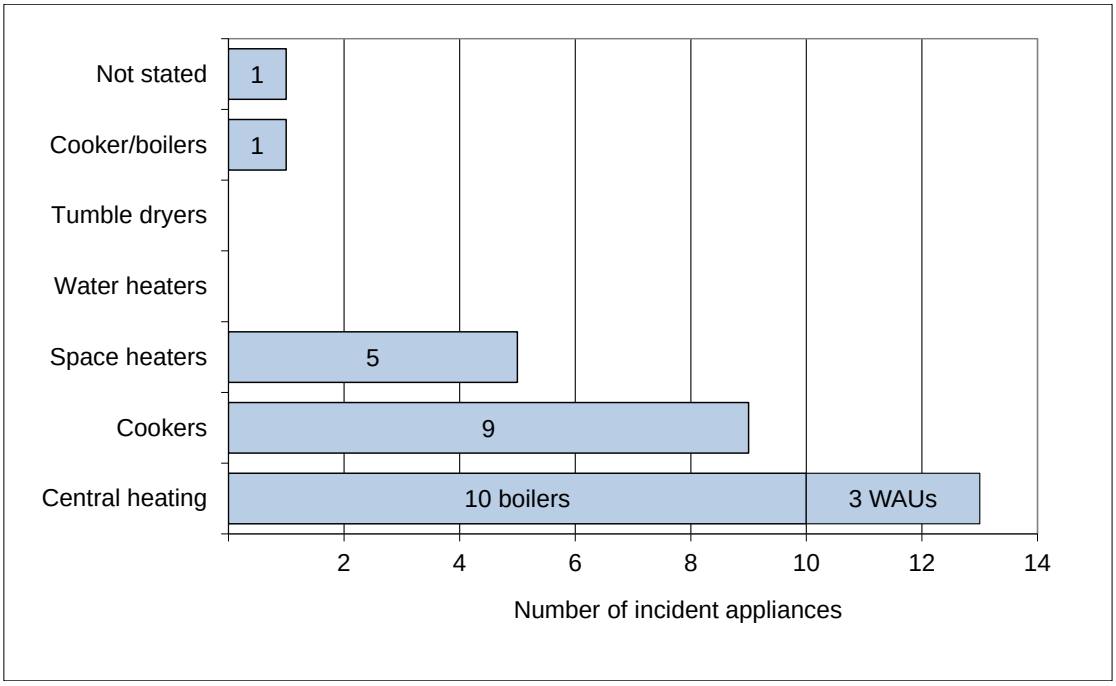

Figure 15 Incidents by appliance type

Most incidents involved central heating appliances (13), three of which were warm air heaters (there were one, zero, four and two incidents involving a warm air heater in 2012/13, 2011/12, 2010/11 and 2009/10 respectively). Central heating appliances would be expected to figure prominently given their prevalence, their larger heat input compared to other domestic appliances and the fact that they tend to be in operation for substantial periods of time.

There were nine incidents reported this year involving cookers and five involving space heaters.

2.6.2 Central heating and boiler type

The incident numbers involving central heating appliances are sub-divided further in Figure 16.

There was one fatality involving a floor-standing regular boiler. (Note a regular boiler is a boiler that is not a combination boiler).

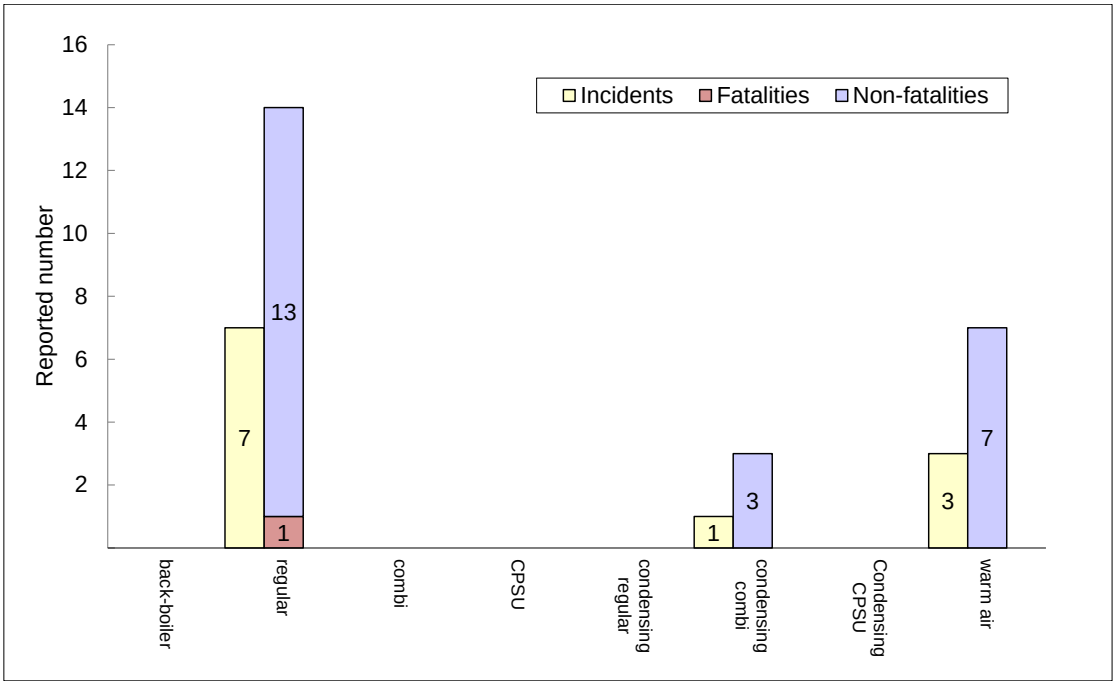

Figure 16 Incidents by central heating type[17]

In order to establish the relative risk presented by each boiler type, the boiler population by boiler type is required. Given the latest English Housing Survey is typically 18 months behind the current reporting period, the last published boiler population was projected forwarded 18 months using a best fit quadratic equation to the data for 2009 to 2012.

Table 11 shows the resultant percentage breakdown for England which has been assumed to apply to GB as a whole. Figure 17 illustrates the projected proportions of each boiler type.

Table 11 Boiler populations by type for England

Boiler type	Boiler population at end of March (%)[18]				Projection at end of 2013
	2009	2010	2011	2012	
Regular	32.7	29.2	26.1	24.3	23.2
Back-boiler	6.6	5.7	5.1	4.2	2.8
Combi-boiler	24.6	21.6	19.4	16.8	15.6
Condensing regular boiler	6.0	7.9	9.6	11.9	15.1
Condensing combi-boiler	18.2	23.7	28.3	31.6	32.7
No boiler	11.9	11.8	11.5	11.2	10.7

[17] CPSU are combination boilers that heat and store water to feed the central heating circuit and a plate heater to provide domestic hot water. They are also called thermal storage systems when the boiler and storage water are in separate appliances.
[18] 2009 to 2012 figures, sourced from DA6101 Heating dwellings, Ref 9.

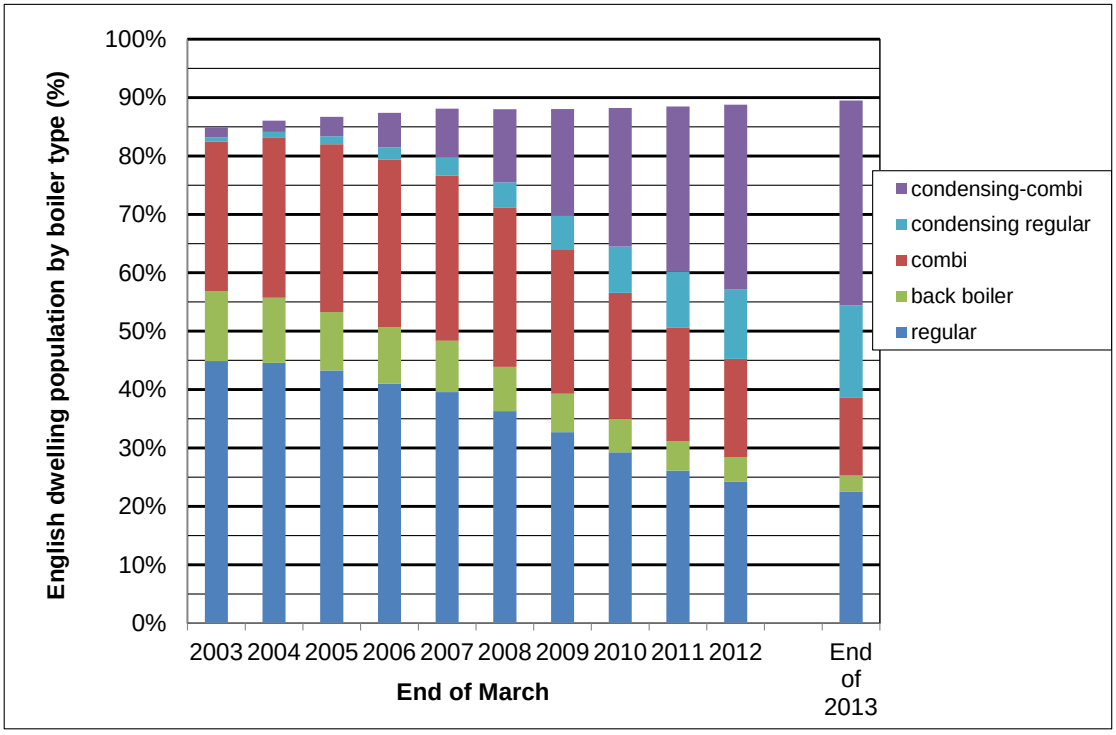

Figure 17 Boiler population and projected figures

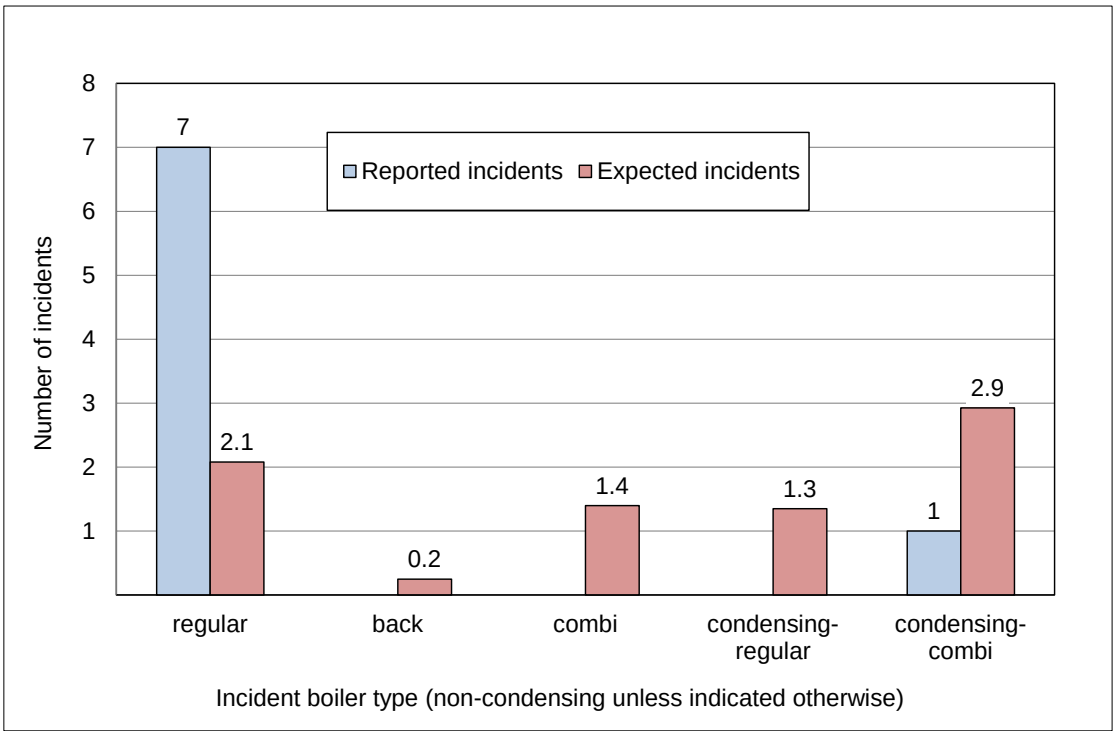

Figure 18 Incident numbers by boiler type

Figure 18 compares the eight CO incidents reported with a known boiler type with those expected given the prevalence of each boiler type in the general population and assuming each poses an equal risk[19]. There are higher than expected numbers of incidents involving regular boilers and lower than expected numbers of incidents involving condensing boilers. However, the numbers are too low this year to draw any firm statistical conclusions.

2.6.2.1 Discussion

Figure 19 shows the calculated risk relative to the safest boiler type (all condensing boilers) for the years 2009/10 to 2013/14. The associated upper and lower estimates of relative risk are shown in Table 12.

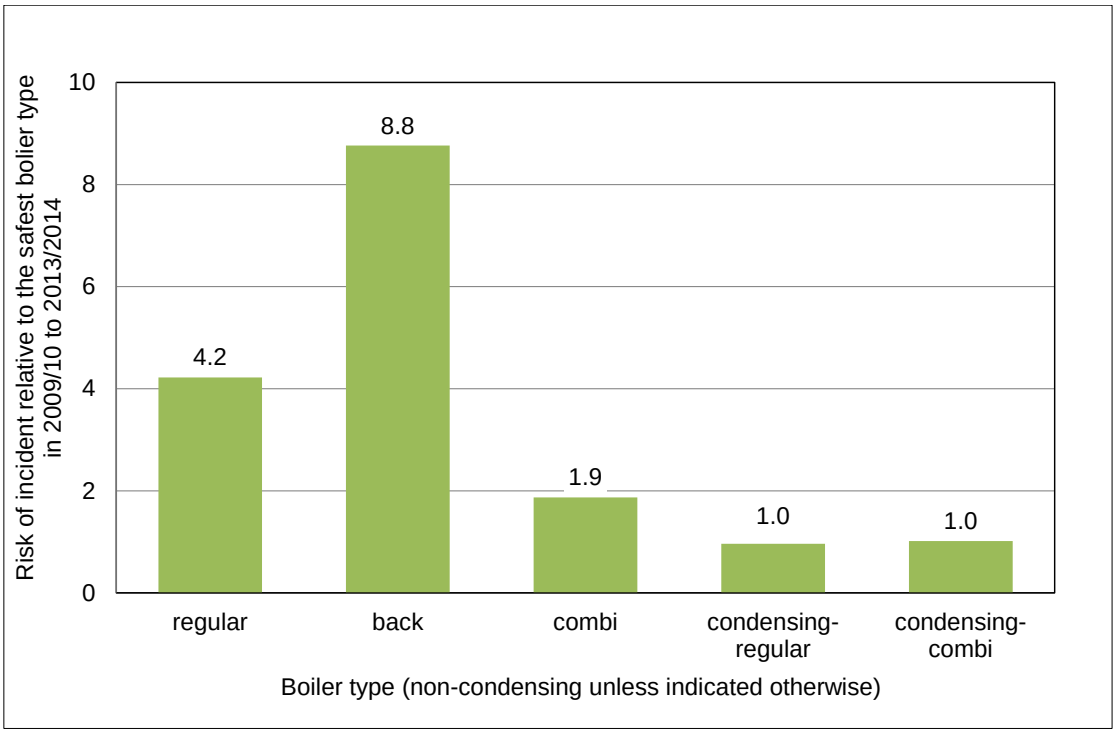

Figure 19 Relative risk of incident by boiler type for recent years

Table 12 Estimate of risk relative to safest boilers (2009/10 to 2013/14[20])

Boiler type	Lower estimate of risk	Mostly likely value of of risk	Higher estimate of risk
Regular	3.9	4.2	4.5
Back-boiler	8.0	8.7	9.4
Combi-boiler	1.7	1.8	2.0
Condensing regular	0.8	1.0	1.2
Condensing combi-boilers	0.9	1.0	1.1

[19] The expected number is the total number of incidents reported with a known boiler type multiplied by the percentage breakdown of boiler types in the general population.
[20] This table illustrates the range in the expected value of the risk using the conventional criteria of 95% confidence, which means if the analysis were to be repeated on further samples, 95% of the samples would have a risk in this range.

There is no statistically significant difference between the risks associated with condensing models.

Back boilers posed the highest risk of being involved in a reportable CO incident in the past five years as a whole with this risk calculated to have been 8.2 times that associated with condensing boilers. The factors contributing towards this high risk are likely to have been:

- the tendency towards them being older appliances
- they have an open flued design
- they are very near the floor which means their burners can become linted without regular servicing and
- the fact they are two appliances in one (i.e. a gas fire in front of a boiler) offering more chance of malfunction compared with a single appliance, especially when regular servicing is not carried out.

In the past five years, non-condensing regular boilers pose the next highest risk with a risk 4.2 times greater than condensing boilers. They tend to be older appliances and are a mixture of open flued and room sealed models.

Non-condensing combi-boilers pose a risk 1.8 times (Table 13) that of condensing boilers. These combi-boilers were developed later than regular boilers and so are generally newer and more likely to be room sealed than non-condensing regular boilers. Hence they tend to pose less of risk than non-condensing regular boilers.

2.6.3 Appliance age

Table 13 lists the numbers of incidents reported this year by appliance type and age.

Boilers of indeterminate age tend towards being older boilers. It is frequently the case that older boilers are more difficult to assess for age than those installed more recently. For example, older boilers are more likely to have been installed in properties where the occupancy has changed and hence installation date information is less likely to be known.

More appliances were reported this year of unknown age than those of known age making any detailed risk analysis by appliance age unreliable. Therefore no firm conclusions about appliance age and associated risk can be deduced. However, Table 15 suggests there seems to have been a disproportionate number of incidents involving appliances more than 12 years old.

Table 13 Incident numbers by appliance age

	Appliance age (years)			
	Under 3	**3 – 12**	**Over 12**	**Unknown**
Central Heating	0	1	2	10
Cooker	1	0	1	7
Space Heater	0	0	0	5
Cooker-boiler	0	0	0	1
Unknown	0	0	0	1
Total	1	1	3	24

No reliable conclusions about appliance age and associated risk can be deduced due to the number of incidents reported of indeterminate age.

2.6.4 Trends in incident appliance rates

Figure 20 and Table 14 show the annual numbers of fatalities involving different appliance types since July 1996. The three fatalities this year were associated with a cooker (2 victims) and a central heating boiler. Figure 21 shows the historical number of reported incidents, both fatal and non-fatal, by appliance type.

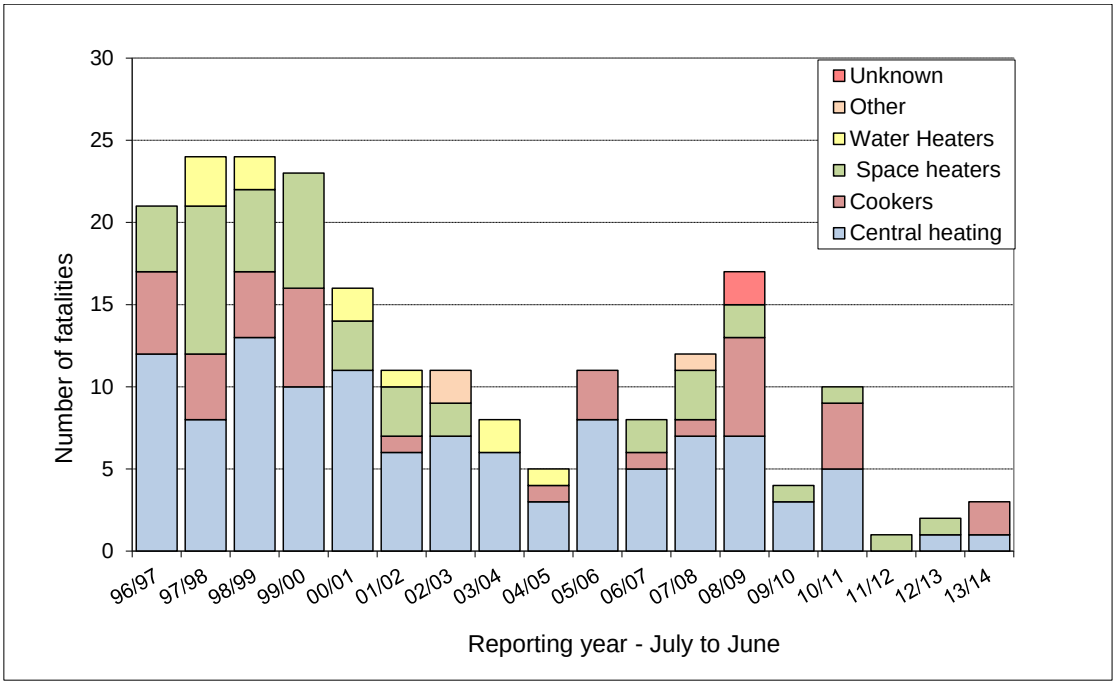

Figure 20 Fatalities by appliance type since 1996

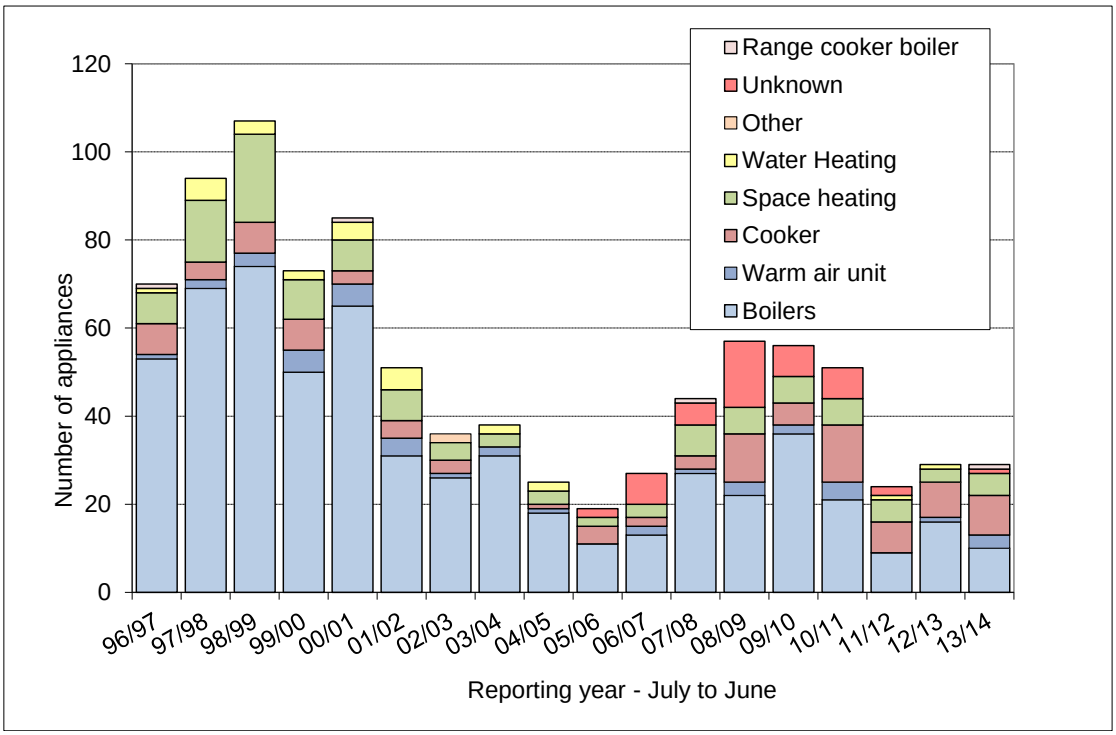

Figure 21 Incidents by appliance type since 1996

Table 14 Fatalities per year by appliance type since 1996

Year (July to June)	Not known	Cookers	Water Heaters	Space heaters	Central heating	Other	Total
96/97	0	5	0	4	12	0	21
97/98	0	4	3	9	8	0	24
98/99	0	4	2	5	13	0	24
99/00	0	6	0	7	10	0	23
00/01	0	0	2	3	11	0	16
01/02	0	1	1	3	6	0	11
02/03	0	0	0	2	7	2	11
03/04	0	0	2	0	6	0	8
04/05	0	1	1	0	3	0	5
05/06	0	3	0	0	8	0	11
06/07	0	1	0	2	5	0	8
07/08	0	1	0	3	7	1	12
08/09	2	6	0	2	7	0	17
09/10	0	0	0	1	3	0	4
10/11	0	4	0	1	5	0	10
11/12	0	0	0	1	0	0	1
12/13	0	0	0	1	1	0	2
13/14	0	2	0	0	1	0	3
Average 96/97 to 00/01		3.8	1.4	5.6	10.8	0	21.6
Average 04/05 to 13/14		1.8	0.1	1.1	4.0	0.1	7.3
Average 10/11 to 13/14		1.5	0.0	0.8	1.8	0.0	4.0

2.6.4.1 Discussion

The total number of fatalities due to accidental CO poisoning associated with domestic natural gas use has declined from an average of 22 during 1996/7 to 2000/1 to an average of four per year over the last four years, the turning point being around the start of the millennium. The average number of fatalities associated with central heating appliances has declined to 1.8, space heaters to 0.8 and for cookers to 1.5 (see Table 16) over the four years ending in 2013/14.

The number of non-fatal incidents involving cookers unlike other appliances has not declined from the levels seen the late 1990s. The numbers dipped around 2005 but have increased levels slightly higher than late 1990s level.

The number of cooker related fatalities has declined since the late 1990s but there are still occasional fatalities as reported in 2008/09 and 2010/11 and this year there has been a double fatality involving a gas cooker.

2.6.5 Absolute risk of a CO incident by appliance type

This section quantifies the overall risk associated with different appliance types and determines whether it falls within generally accepted safety guidelines. It requires a reliable estimate of the appliance population nationwide. Such reliable appliance population estimates are only available for boilers, warm air units and cookers.

2.6.5.1 Absolute risk of a CO incident involving boilers

For 2013/14, the number of people estimated to live in properties with gas central heating boilers in GB was 50.9 million[21] and this figure is used to estimate the absolute incident rate related to gas boilers (see Table 15).

Table 15 Incident data for gas boilers

	July 1st 2013 to June 30th 2014		
	Incidents	**Fatalities**	**Non-fatal casualties**
Boilers	10	1	19
Unknown appliance	1	0	5
	Incident rate	**Fatality rate**	**Non-fatality rate**
Per million people per year excluding unknowns	0.20	0.020	0.37
Per million people per year including unknowns	0.22	0.020	0.45

Note the unknown appliance is one of a gas boiler, a gas water heater, gas cooker or a solid fuel fire and calculation have been carried out assuming it was a boiler and was not a boiler.

The risk of a fatality associated with gas boilers in GB occurring during the reporting year 2013/14 was appreciably less than the commonly accepted health and safety criterion of one fatality per million people at risk per year. More particularly it is 0.02 fatalities per million people at risk per year (or two per 100 million people per year).

The risk of becoming a non-fatal casualty is also less than one per million people per year at 0.37 per million people at risk per year, excluding unknown appliances and 0.45 per million people at risk per year including unknown appliances (or less than five per 10 million people per year).

2.6.5.2 Absolute risk of a CO incident involving warm air units

For 2013/14, the number of people estimated to live in properties with gas warm air units in GB was 1.067 million[22] and this figure is used in Table 16 to estimate the absolute incident rate related to gas boilers.

[21] 26.6 million UK households at the end of 2014 (Ref 11 figures projected forward) x (97.3% of dwellings in the UK are in GB (Ref 10 and 11) x 83.3% of dwellings with gas boilers (Table DA6101, 2012 Ref 9) x 2.37 occupants per household in 2013 (Ref 6)

Table 16 Incident data for gas warm air units

	July 1st 2013 to June 30th 2014		
	Incidents	**Fatalities**	**Non-fatal casualties**
Warm air units	3	0	7
	Incident rate	**Fatality rate**	**Non-fatality rate**
Per million people per year	3.75	<0.94	11.3

There were no fatal casualties associated with warm air units in GB during the reporting year 2013/14. The risk of a fatality can never be zero as there will be a small risk of a fatality even if one does not occur during the year (risk is about potential). All that can be usefully said about the risk in this case is that the risk is less than one person divided by the population at risk per year.

2.6.5.3 Absolute risk of a CO incident involving cookers

The estimated gas hob and gas oven populations for GB are shown in Table 17.

Table 17 UK cooking appliance population estimates

	Source data DUKES[23]			Inferred populations		
	Electric ovens millions	**Electric hobs millions**	**Households millions**	**Gas hob and oven millions**	**Electric hob and oven millions**	**Gas hob and electric oven millions**
UK households	16.6	12	26.6	10.0	12.0	4.6
GB population			61.3 [24]	23.0	27.7	10.6

Table 17 assumes:

i) Homes without an electric oven have a gas hob and gas oven (i.e 26.6 – 16.6 = 10.0 million).
ii) Very few homes have an electric hob and gas oven which means homes with an electric hob will have an electric oven (i.e. 12 million). This leaves 26.6 - 10 - 12 = 4.6 million with a gas hob and electric oven.
iii) Percentage ownership of cooking appliances is the same in the UK as in Great Britain.

The risk of an incident, fatality or non-fatality involving a cooker is shown in Table 18.

[22] 450,000 (Johnson and Starley estimate) x 2.37 = 1,067,000
[23] Table 3.11, Ref 12.
[24] UK households (26.6) x 97.3% of dwellings in the UK are in GB (ref 11) x 2.37 people per household (ref 6).

Table 18 Incident data for cooking appliances

	July 1st 2013 to June 30th 2014		
	Incidents	**Fatalities**	**Non-fatal casualties**
Free standing gas cooker or separate gas hob [25]	8	2	13
Unknown appliances	1	0	5
	Risk of an Incident	**Risk Fatality risk**	**Risk of a non-fatal casualty**
Free standing gas cooker or separate gas hob population base			
Per million people per year excluding unknown appliances	0.24	0.06	0.39
Per million people per year including unknown appliances	0.27	0.06	0.51
Free standing gas cooker population base			
Per million people per year excluding unknown appliances	0.35	0.09	0.56
Per million people per year including unknown appliances	0.39	0.09	0.74

2.6.5.4 Discussion

Risk rates for fatalities involving cookers or boilers in 2013/14 were well below one tenth of the generally accepted risk criteria of one fatality per million people at risk per year. Rates for non-fatal casualties were about half the generally accepted risk criteria.

The risks associated with warm-air units in 2013/14 were three incidents per million people at risk per year and between six to ten non-fatal injuries per million people at risk per year.

No reliable population estimates of gas fires are known. Hence information about absolute risks cannot be estimated for this appliance type.

[25] There were eight incidents involving cooking appliances one of which was inbuilt gas oven. Population data for inbuilt gas oven is unknown and hence the inbuilt oven incident is excluded from this table.

2.7 Individual appliance types and models

Detailed information about the incident appliances is presented below as it was stated on the DIDR form. This included the manufacturer's name and model which has been provided for the record. No significance can be attributed to models or manufacturers without relating this to the numbers of such appliances installed nationwide. For example, the most frequently occurring manufacturer's name featured in the incident reports may be there simply because it is the most common manufacturer in the general population or, alternatively, that the incident may have had nothing to do with the design or performance of the appliance, but as a consequence of poor installation, maintenance or servicing practice.

2.7.1 Fatal incidents

2.7.1.1 Central heating appliances

A single fatality and two non-fatal casualties involved floor standing non condensing boiler. The flue was blocked. No further details have been released.

2.7.1.2 Space heaters

None

2.7.1.3 Cooking appliances

A double fatality involved a Beko Flavel Milano 50 free standing cooker.

2.7.1.4 Water heating appliances

None

2.7.2 Non-fatal incidents

The following sub-sections describe those appliances involved in incidents with non-fatal casualties that were fully investigated. One investigation could not establish which of the four appliances installed were responsible.

2.7.2.1 Central heating appliances

These were involved in 13 incidents. Three of these incidents did not have the make detailed. The ten makes specified are:

- Back boiler units (BBU)
  None
- Condensing regular boilers
  Baxi Powermax HE 115
- Condensing combi-boilers
  Promax Combi HE
- Condensing combined primary storage unit
  None
- Combi-boilers (non-condensing)
  None
- Regular boilers (non-condensing)
  Glow-worm, Fuelsaver
  Halstead Wickes 40
  Vokera Mynute 16e
  Glow-worm, EPS50c
  Idea Classic RS40

- Warm air heaters

  Johnson and Starley J55-65
  Johnson and Starley JT 19-25 Mk 2
  Johnson and Starley JT 19-25 Mk 2

2.7.2.2 Space heaters

Space heaters were involved in five incidents. One of these was of unknown make and type. The makes and types of the space heaters were:

- Inset live fuel effect fire

  Kinder Kalahari Kd

- Radiant convector fire

  Robinson Willey Fire Crown Super 5
  Braby Economic, Gold Monarch
  Radiation High Speed G

2.7.2.3 Cooker/boilers

One incident involved a Stanley GE Range cooker/boiler open flued appliance.

2.7.2.4 Cooking appliances

Nine incidents involved free standing cookers or separate gas hobs. Make and model names were only supplied for the four listed below:

Leisure, Victoriana EL (grill)
Main Honey Mink S
Parkinson Cowan SIG306CN
Zanussi ZCG682GNG

2.7.2.5 Water heating appliances

None

2.8 Appliance installation details

Table 20 provides information relating to the person reported to have installed the appliance involved in an incident and whether the appliance installation was to standard.

Table 19 Appliance installation details

Installer details	To current standards	To standards current at time of installation	Not to any appropriate standards	Unsure/don't know	Total
Registered	1	1	1	1	4
Non-registered	0	0	0	0	0
DIY	0	0	0	0	0
Unknown	5	2	3	15	25
Total	6	3	4	16	29

The vast majority of appliances had unknown installers (25 out of 29) so an analysis of those carrying out the appliance installation is not possible.

2.9 Flue details

A breakdown of the 25 incidents where the flue type was reported is shown in Figure 22.

Nine incidents involved cooking appliances and all of these were flueless apart from one which was an open flue range cooker-boiler.

Ten incidents involved open flues and six involved room-sealed flue systems. Of the ten with open flues: five were connected to space heaters, three to warm-air units and two to boilers. All six room-sealed systems were connected to boilers.

There were 11 incidents with a known flue installation standard status of which eight were not installed to current standards or those existing at the time of installation (see Figure 22). This was considerably more than last year.

One of the two fatal incidents involved a flueless cooker and the other involved an open flued boiler. The installation standard status of the boiler's flue was not reported.

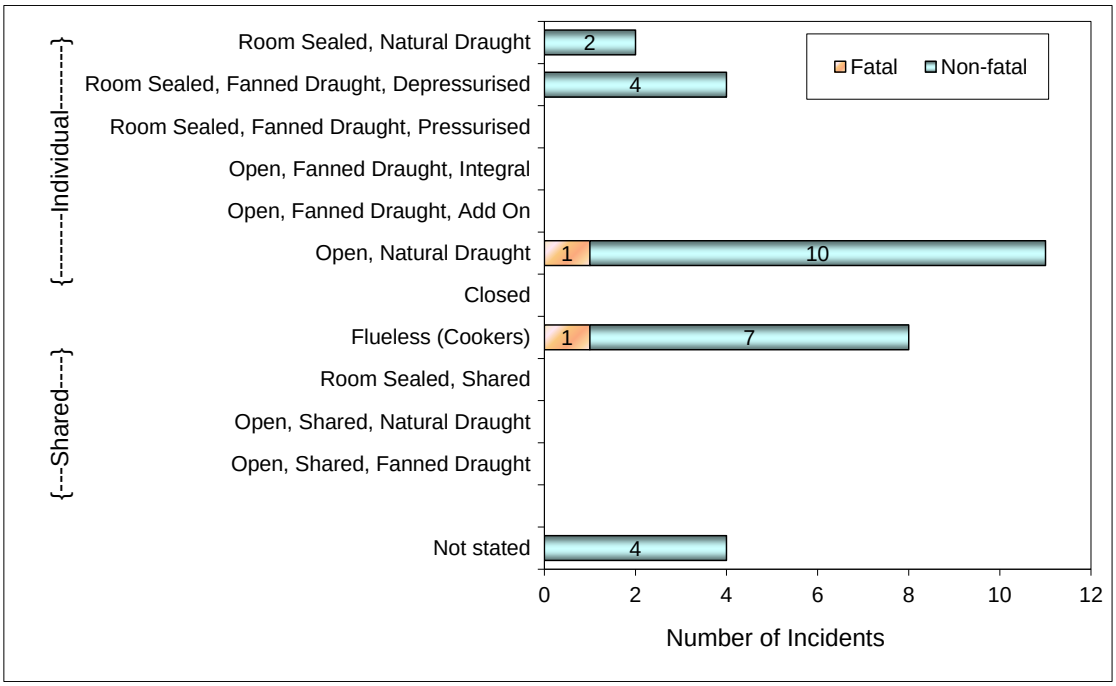

Figure 22 Incidents by flue type

In May 2005 it was estimated that 19% of boilers had open flues[26]. Knowing the boiler population by type in 2005 (50% were non-condensing regular boilers, 33% were non-condensing combination boilers and 12% were back boilers[27]), it can be concluded that 9.1% of non-condensing regular and combination boilers in April 2005 had open flues.

[26] Ref 13.
[27] DA6101 Heating dwellings, Ref 9.

Energy efficiency legislation introduced in April 2005[28] means that well over 95% of replacement boilers installed since have been condensing boilers (all room-sealed systems). So, if since 2005 non-condensing boilers with room-sealed and open flues have been replaced at the same rate, then knowing the yearly non-condensing boiler population and the proportion of non-condensing boilers with open flues in 2005, the yearly proportion of all boilers with open flues was estimated (see results in Table 20)[29].

Table 20 shows the numbers of boiler incidents reported where the flue type was specified as compared with the expected number. The expected number assumes an equal risk between flue types and the estimated boiler population by flue type.

Table 20 Reported and expected incident numbers for boilers by flue type

12 month period July to June	***Open flue population***	***Open flue***		***Room-sealed flue***	
		Reported number	***Expected number***	***Reported number***	***Expected number***
2005/6	18.6%[30]	6	2	4	8
2006/7	17.3%	8	2	3	9
2007/8	15.6%	16	4	8	20
2008/9	13.8%	8	2	10	16
2009/10	12.2%	16	4	18	30
2010/11	10.7%	10	2	10	18
2011/12	9.3%	4	1	5	8
2012/13	8.0%	6	1	7	12
2013/14	6.8%	2	1	6	7
Total		76	19	71	128

Note columns may not add up exactly due to rounding errors.

Table 20 shows that more incidents were reported involving boilers with open flues than expected. If boilers with open flues and room-sealed flues were equally likely to be involved in an incident, the probability in 2013/14 of two or more incidents occurring by chance is small (i.e. it is less than 5%). It is therefore concluded from Table 20 that boilers with open flues expose occupants to a higher risk of a CO incident, either fatal or non-fatal. Based on the 2005/6 to 2003/14 data, boilers with open flues expose occupants to a risk of between 5.3 and 10.1 times that of a room sealed flues, and 7.3 times on average.

[28] Ref 14.

[29] This percentage is: the percentage of the yearly population that are non-condensing regular or combination boilers x proportion of non-condensing regular or combination boilers that were open flued in 2005 (i.e 9.1%) + the yearly percentage of back boilers (all taken to have open flues).

[30] The data is interpolated to the end of the December for the appropriate period to bring it into line with the incident reporting period.

2.9.1 Discussion

As previously reported, the proportion of incidents involving appliances with open flues changed from 55% in 2009/10 to 63% in 2010/11, 64%[31] in 2011/12 and 59% in 2012/13. It was 65%[32] in 2013/14 and almost certainly represents a risk which is disproportionately high compared to room-sealed systems.

The five causes of the incidents involving space heaters were all attributed to a partially blocked chimney caused by a build-up of debris. This shows the importance of regular appliance servicing.

Of the three incidents involving warm-air units, one had a partially obstructed return air vent with evidence of sub-standard servicing, another had a partially obstructed air vent and a blocked flue and the third had a disconnected flue terminal.

Of the two incidents involving open flued boilers, one was caused by a blocked flue and the other by a short flue termination and a fly screen on the air vent.

These faults illustrate the particular vulnerability of open flue systems to a build-up of debris in the flue and accidental blockage/obstruction of air vents. These factors can then cause excessive levels of CO to be produced inside a property and illustrate why regular servicing of appliances with open flues is especially important.

Of the six incidents involving room-sealed boilers, four involved failures associated with the flue system as follows:

1) a loose fitted flue pipe in the loft;

2) a corroded connection between the flue and the appliance;

3) an incorrectly replaced flue section causing the disconnection of the flue duct;

4) A flue terminal fitted too close to the soffit allowing CO, produced by poor combustion as a result of excessive burner pressure, to re-enter the property.

These illustrate the kind of problems that can occur with room-sealed appliances.

One further incident involving a room-sealed boiler indicated there had been a lack of servicing which was evident by shale and soot on the heat exchanger and lint on the burner. The cause of the remaining incident is unknown.

[31] 69% was stated in error in the 2011/12 report, Ref 2.
[32] This calculation excludes cookers and appliances whose flue type was not stated.

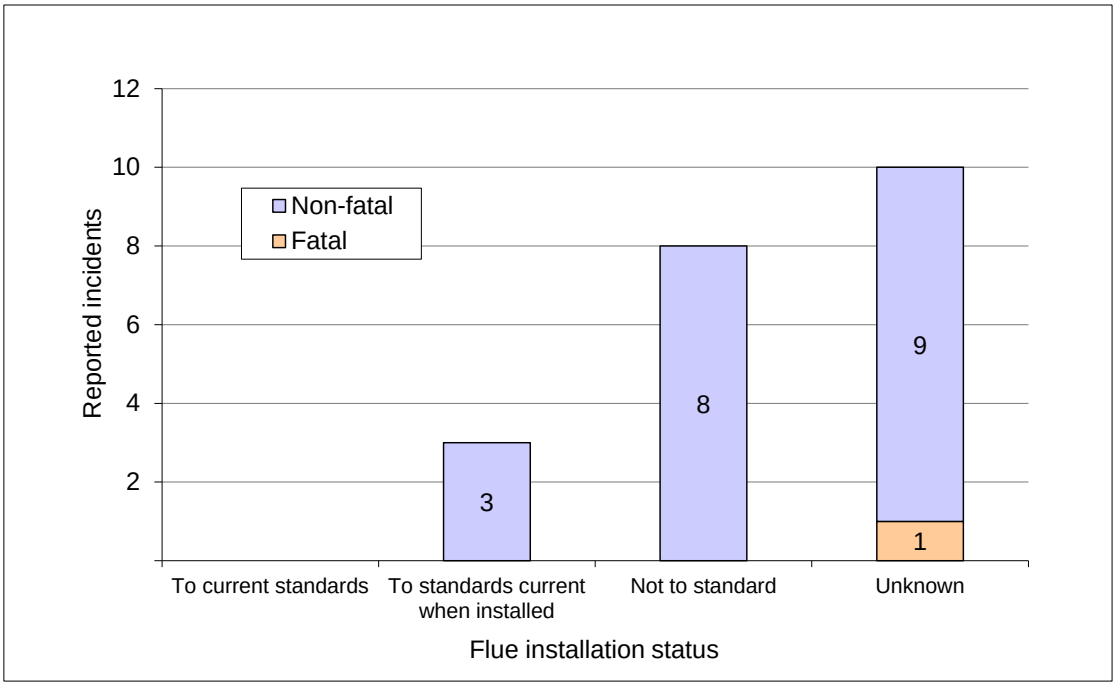

Figure 23 Incidents by flue standards

2.10 Permanent ventilation

For nine incidents, investigators reported that permanent room ventilation was inadequate and Figure 24 shows a summary of the ventilation provision reported. In five of the six reports, the ventilation was described as 'not to standard' either at the time of investigation or appliance installation (or was not specified at all).

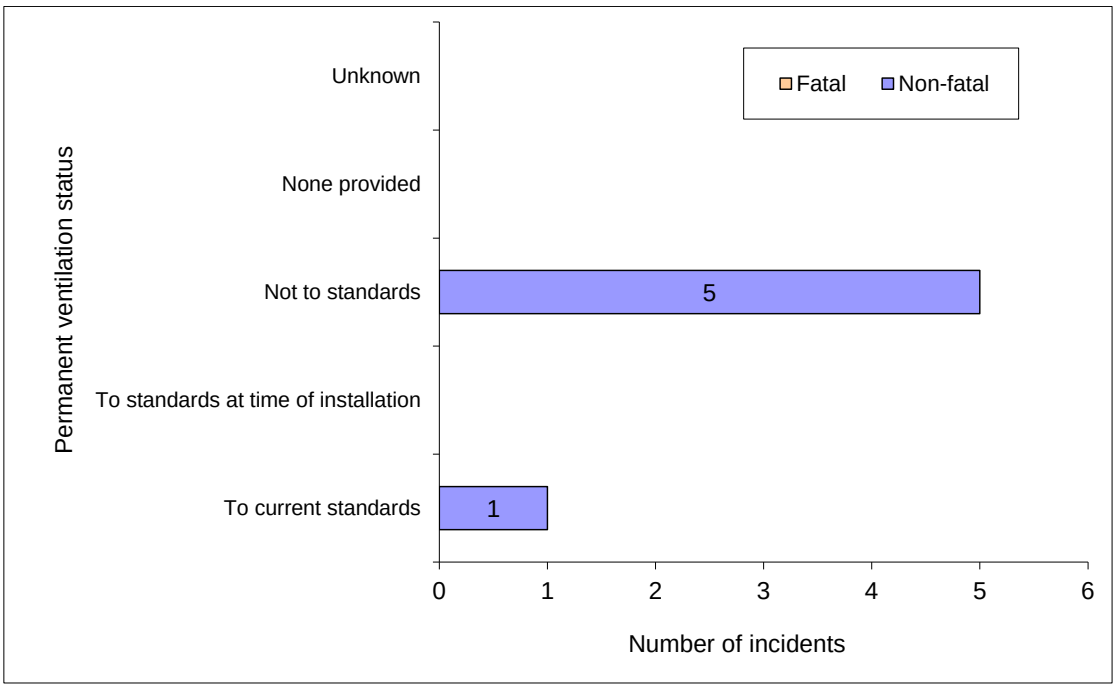

Figure 24 Incidents by reported ventilation condition

Where ventilation provision was reported, there were two incident sites at which this was found to be either fully or partially obstructed. One was intentionally obstructed and the other unintentionally obstructed.

2.11 Safety devices

The categories of safety device specified on DIDR forms are CO detectors (chemical spot or battery/mains powered alarm type), downdraught sensors and anti-vitiation devices. The only safety devices reported this year were CO electrical alarms. They were installed at nine of the incident sites. Seven were reported to have sounded during the incident.

Figure 25 shows the percentage of incidents where a CO detector was reported to have been installed for the years since 1996. Prior to 2004/5, the average proportion of incidents where CO detectors were installed was around 5% and this had risen to over 20% by 2010/11. The graph shows a three-year moving average centred on the middle year. The moving average for 2013/14 is the average of 2012/13 and 2013/14.

CO alarms were found by investigators at 31% of incident sites this year which is the second highest on record.

Investigators at seven of the nine sites with CO alarms reported that activation occurred during the incident. At the other two incidents, one alarm did not sound due to incorrectly fitted batteries and it was not stated whether or not the other alarm activated.

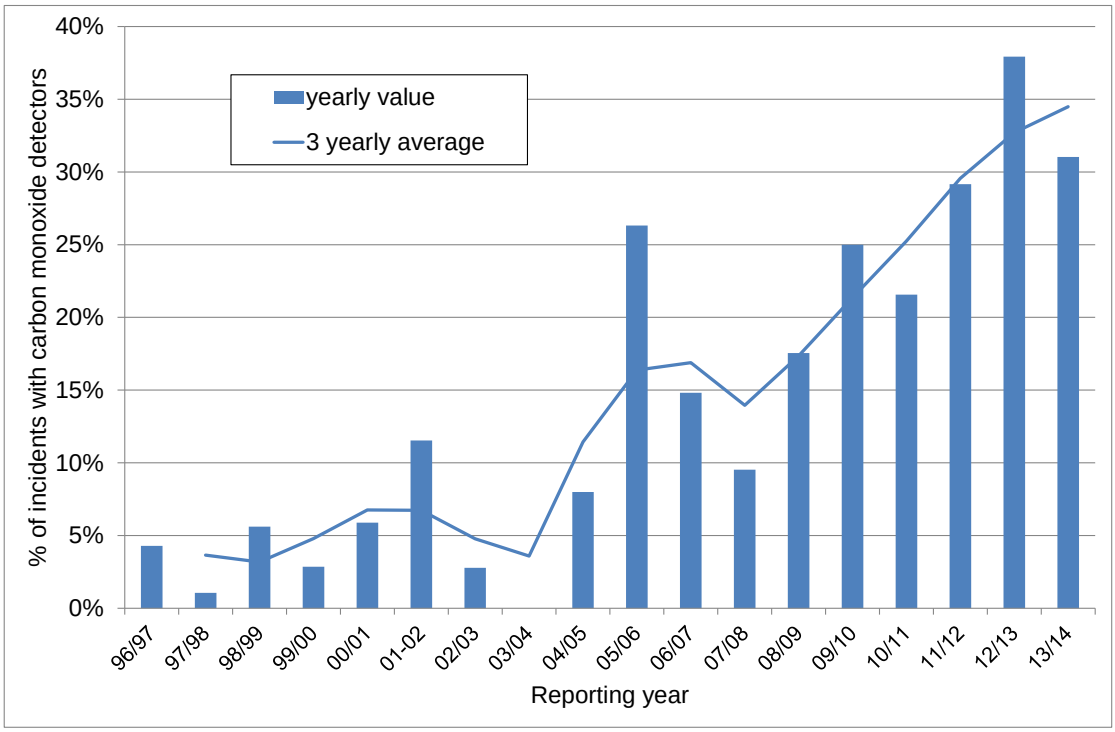

Figure 25 CO detectors incident data

2.11.1 Discussion

The rise in the proportion of incidents where CO alarms had been installed (see Figure 25) is probably a reflection of a rise in the general availability. An estimated 16%[33] of homes had CO alarms nationwide in 2010. In 2013/14 31% of reported incidents involved homes with CO alarms.

If sited and fitted properly, alarms are intended to sound before CO in the property reaches levels that would be dangerous to health. The activation level is intended to prevent the blood carboxyhaemoglobin (COHb) level reaching more than 2.5% v/v saturation.

Of the seven incidents where the alarm sounded, four had at least one person hospitalised and three had no one hospitalised. All were confirmed to have involved CO leakage within or into the property. Insufficient information was available to confirm whether the victims were only hospitalised so that precautionary tests could be carried out although it is known that at least one person staying longer than 24 hours to recover from the effects of CO poisoning.

From the outset of the work to collate and report on CO incidents involving mains natural gas and piped LPG using DIDR in 1996, incidents only qualified if someone required treatment (even if treatment was refused). These may not all have been RIDDOR reportable incidents in the strictest sense (i.e death or a major injury up until 1 Oct 2013) but as an investigation has to be conducted in order to identify a source of CO, it would be unwise to ignore the information obtained given it can contribute to a body of knowledge for use in the future.

When COHb levels are recorded, this can give an indication of the level of exposure in the victim but at lower COHb levels this can sometimes be misleading due to an individual's smoking habits and also the time delay between exposure and COHb measurement.

There is concern that the activation of a CO alarm may be leading to an increase in the number of RIDDOR incidents reported because the effect of the alarm sounding may lead the "injured party" to seek medical advice even though their exposure to CO may have been minimal.

Investigators confirmed that CO had been released during all of the incidents reported this year where alarms were installed, (i.e. no alarm activation proved to be a false or nuisance alarm). The number of incidents where CO alarms had been installed was not disproportionately higher in the private rented sector as reported last year.

There is other evidence that CO alarms may be helping to reduce the number of incidents reportable under RIDDOR. Two instances were identified by British Gas during 2013/14 in which the alarm sounded and alerted the occupants before they were harmed. Subsequent investigations confirmed the installations involved were discharging excessive amounts of CO into the properties. Between 2009/10 and 2012/13, 18 similar situations were brought to our attention by British Gas from their incident records.

It should be emphasised that only the details of the incidents confirmed to have been caused by CO are entered onto the national CO incident database.

In principle, it could be argued that alarms which have triggered might motivate those who may have been exposed and are feeling unwell to seek medical attention and this could lead to a reportable incident when none should have been recorded.

[33] CO alarms, page 6, Ref 5.

As alarms are becoming more prevalent, and this might be leading to more reportable incidents which do not involve fatal injury, loss of consciousness or a condition requiring someone being taken to hospital, then consideration may need to be given towards creating a sub-category of incident 'triggered by CO alarm' in order to help identify trends in those specific incidents where death and/or serious injury do occur.

2.12 On-site checks

The on-site investigation of an incident involves the investigator making a number of fundamental observations and carrying out specific checks and measurements so that faults are identified. The results this year are broken down by category in Figure 26 and Table 21. A wide range of faults were identified but it should be remembered that these did not necessarily contribute to the incident.

The specific faults which were considered to have contributed to each incident are discussed in Section 2.14.

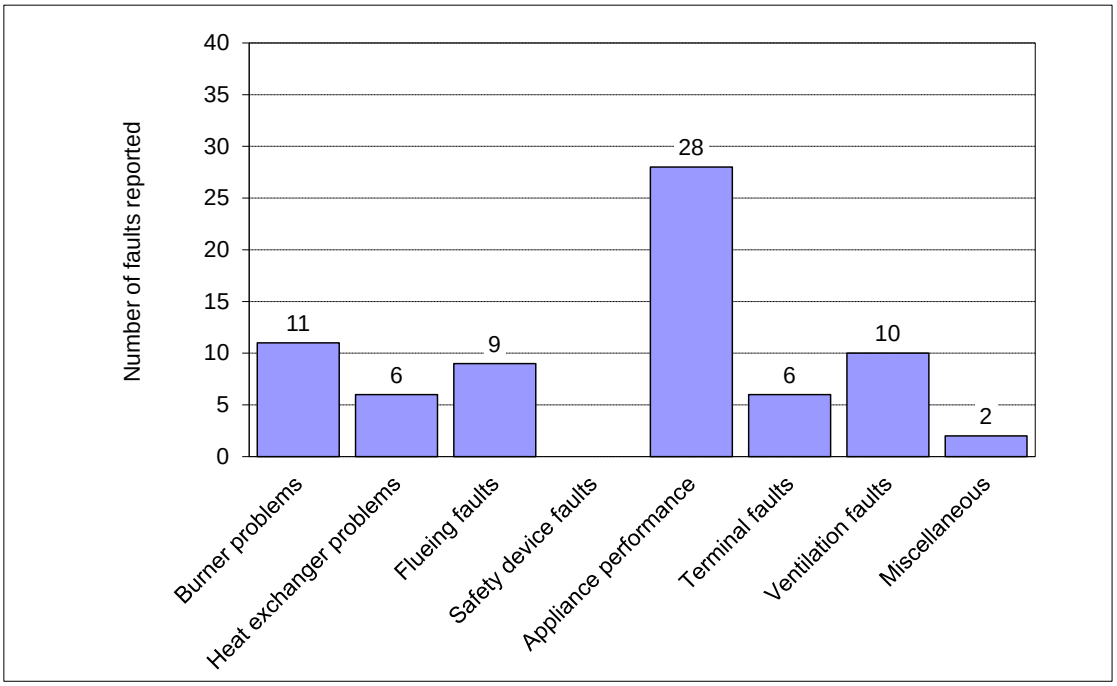

Figure 26 Reported faults by type

Table 21 Incident appliance/installation faults

Fault group	Number of faults		Fault group	Number of faults
Burner			**Appliance performance**	
Corrosion	0		High CO/CO_2 ratio	5
Defective flame picture	5		Failed spillage test	5
Linting	2		Overrated	2
Over-pressure	1		Underrated	2
Under-pressure	1		Signs of spillage	7
Other	2		**Terminal**	
Flue			Down draught	0
Blockage	6		Bad siting	3
Corrosion	1		Unapproved design	0
Flue not to any standard	0		Other	3
Installation fault	2		**Ventilation**	
Other	0		Air vent/vents ineffective	2
Heat exchanger			Air vents obstructed - intentionally	1
Blockage - shale	2		Air vents obstructed - unintentionally	1
Blockage - soot	4		Compartment not to any standards	1
Cracked	0		No permanent ventilation provided	0
Other	0		Ventilation was not to any standard	5
Safety device			**Miscellaneous**	
CO inoperable alarm	0		Local topography	0
Failed down draught	0		Weather	2
Failed vitiation device	0			

Note to Table 21
The number of faults and in almost all incidents there is more than one fault per appliance.

The greatest numbers of faults reported were related to appliance performance. From Table 21 it can be seen that there were five instances of a high CO/CO_2 combustion ratio and seven instances where signs of spillage were observed by investigators. Defective flame pictures were also reported at five sites.

Although not necessarily contributing to the incident concerned, a high proportion of flue installation faults (31%) were reported this year compared to 8% in 2010/11, 16% in 2011/12 and 28% in 2012/13.

2.13 Incident appliance service history

The "incident appliance history" section of the DIDR form was completed, at least in part, for 19 of the 29 incidents reported. The section contains information on service regularity, reason for last working visit, status of operative who carried out the working visit and last service, if any.

Regularity of service information was reported for 12 incidents and details are given in Table 22.

Table 22 Regularity of services

Service history status	*Number of incidents*	*Number of fatalities*	*Number of Non-fatal casualties*
On a regular service contract	3	0	5
Not on a regular service contract	9	0	19

The registration status of the gas operative who attended the installation prior to an incident is given in Table 23. A working visit may include the original installation if this was the last visit made prior to the incident.

Table 23 Status of operative attending at last working visit

	Number reported	*Number of fatalities*	*Number of non-fatal casualties*
Non-registered operative	0	0	0
Registered operative	13	0	28

Table 24 details when the last working visit occurred. Thirteen incidents had the last working visit during the 12 months prior to the incident.

Table 24 Interval between the last working visit and the incident

Time between the last working visit and the incident	**Number of reported visits**	**Number of reported fatalities**	**Number of reported non-fatal casualties**
Less than 6 months	6	0	13
6 months to 1 year	7	0	16
1 year to 2 years	0	0	0
More than 2 years	0	0	0
Unknown	16	3	29
Total of all incidents	29	3	58

Of the 13 working visits that were within 12 months of the incident, four had been for a service, three had been to attend to a breakdown or report of fumes, three had been for a Landlord's Safety Check, one to install the appliance, two for a Landlord's Safety Check and a service, and one for a reason unknown.

A new appliance installation by a registered operative was involved in an incident within 12 months, although there is no indication that the installation was at fault. The cause of the incident is unknown.

The two visits following a report of fumes or a breakdown and the two service visits were attended by registered operatives. The faults/causes of the incidents reported by investigators following different types of operative visit are detailed below.

Service visits:

- The metal flue collector on rear of heat exchanger of floor standing boiler in a compartment had corroded and holed.

- The burner of a warm air unit showed signs linting and defective flame picture. The flue terminal had become disconnected from the flue pipe.

- A boiler had a short flue termination and fly screens on the inside of an external ventilator. Poor ventilation provision and bad siting of the flue terminal were sighted as problems.

- The heat exchanger and burner of a warm air unit had linting and blockage/soot problems. The room ventilation was stated as not to any appropriate standard and the occupant had fitted a shelf which had partial restricted the return air grill. A flue installation fault was also noted.

Service and Landlord's Safety Inspection visit:

- The heat exchanger of a warm air unit had blockage/shale and flue blockage problems. Substandard servicing is sighted as the contributory cause of the incident.

Breakdown visit:

- The flue of a range cooker/boiler was blocked with twigs cause by the chimney being topped with a terracotta pot and not a terminal. Also inadequate air ventilation provision was noted.

- Gas burner pressure of boiler of 16.37 mbar was too high; manufacturer's maximum badged capacity is 11mb. Manufacturer's factory installed overheat device had been disconnected and rendered ineffective. Flue fitted too close to ventilated soffit, allowing CO to travel into property. Sub-standard servicing also sighted as contributory cause.

- Flue of wall mounted boiler fitted too close to painted eaves/soffits without appropriate heat shield. The replacement of horizontal flue/chimney system was fitted incorrectly by Registered Operative resulting in the disconnection of the flue duct causing poor combustion.

Landlord's Gas Safety Inspection:

- Tested hob and found the ambient CO reading was going over 30ppm, the appliance was turned off at 56ppm as it was still climbing. An AR warning notice had been left during a previous LGSC in Oct 2013 but this was not evident during the investigation.

- A wall mounted boiler had signs blockage by shale and soot on the heat exchanger, a defective flame picture and loose terminal fitting. The contributory cause was a sub-standard compartment.

- A cooker had no stability bracket or a bayonet/isolation valve on hose connection. It was also too close to combustible materials. The contributory was sighted as lack of servicing and an appliance fault.

Warning notices classify a situation as immediately dangerous (ID), at risk (AR) and not to current standards (NCS)[34]. No notices were evident during the investigations.

2.13.1 Discussion

The number of operatives visiting to carry out gas work in the period up to 12 months prior to an incident (13) was slightly higher than the numbers in 2012/13 (10), 2010/11 (7) and in 2011/12 (8).

Before leaving an appliance in operation, the operative must always carry out the safety checks required by Regulation 26(9) of the GSIURs which are intended to ensure that an appliance is safe for continued use.

However, as there is no requirement to carry out a combustion check on leaving an appliance following a breakdown or Landlord's Safety Check, it is by no means certain that combustion will remain satisfactory for the next 12 months.

During a service visit, either the appliance should be fully stripped and cleaned or serviced in accordance with BS 7967. Following this, the combustion is expected to remain satisfactory for the subsequent 12 months.

Five incidents in 2013/14 had a service visit up to 12 months prior to the incident and sub-standard servicing was reported as a contributory cause, in two of the cases evident by signs of linting, a defective flame picture, flue blockages and shale build-up.

2.14 Incident causes

Details of the causes of reported incidents are summarised in Figure 27 and Figure 28. It should be noted that these causes are different from the general faults discussed in Section 2.12.

Figure 27 shows the distribution by the number of causes reported per incident. For example, a single cause was recorded for 15 incidents whilst a further six had two causes specified. Only two incidents had 3 or more established causes. "zero causes" means no cause was identified.

Experience has tended to suggest that incidents occur when a number of events occur simultaneously resulting in the production of CO and leading to its discharge into the property. This year, like last year, a sizeable number of incidents were reported as having a single cause (15 out of 29 compared to 16 out of 24 in 2012/13).

[34] The Gas Industry Unsafe Situations Procedure, Ref 15.

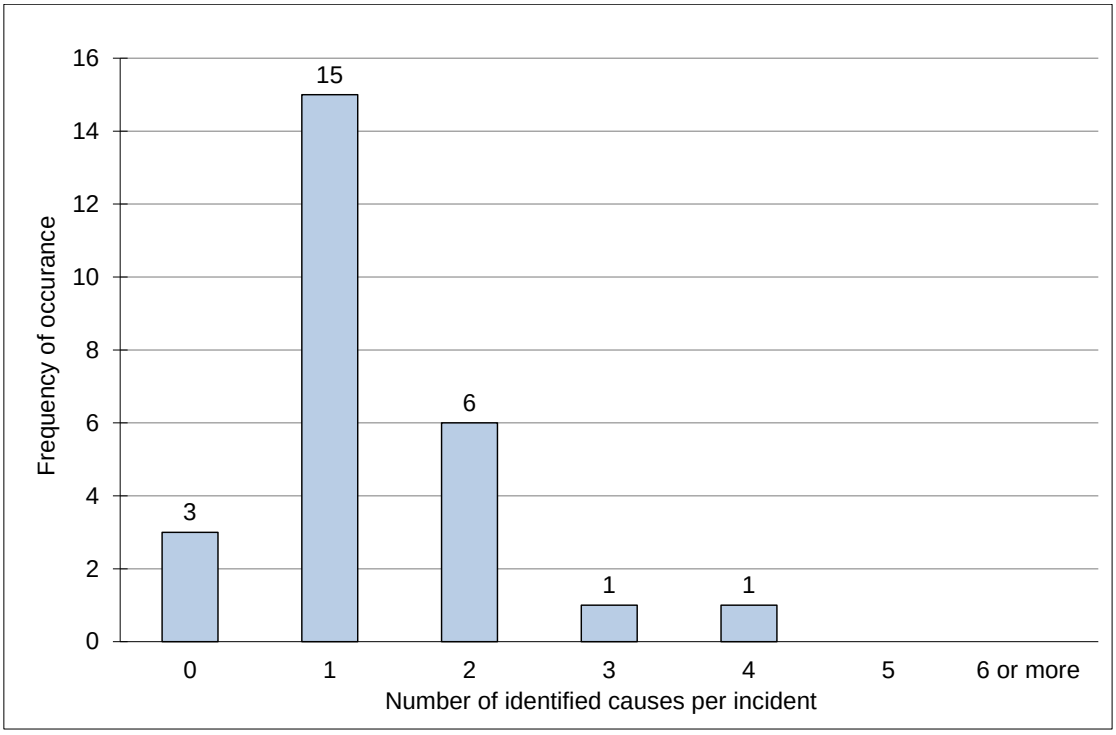

Figure 27 Distribution of the number of stated causes

In Figure 28 the counts (the number of times a specific fault was reported) have been standardised by dividing these by the number of established causes per incident and are expressed as a percentage of the total count (29). For example, if there were three causes reported for one incident, each of the three causes would represent a third of a count.

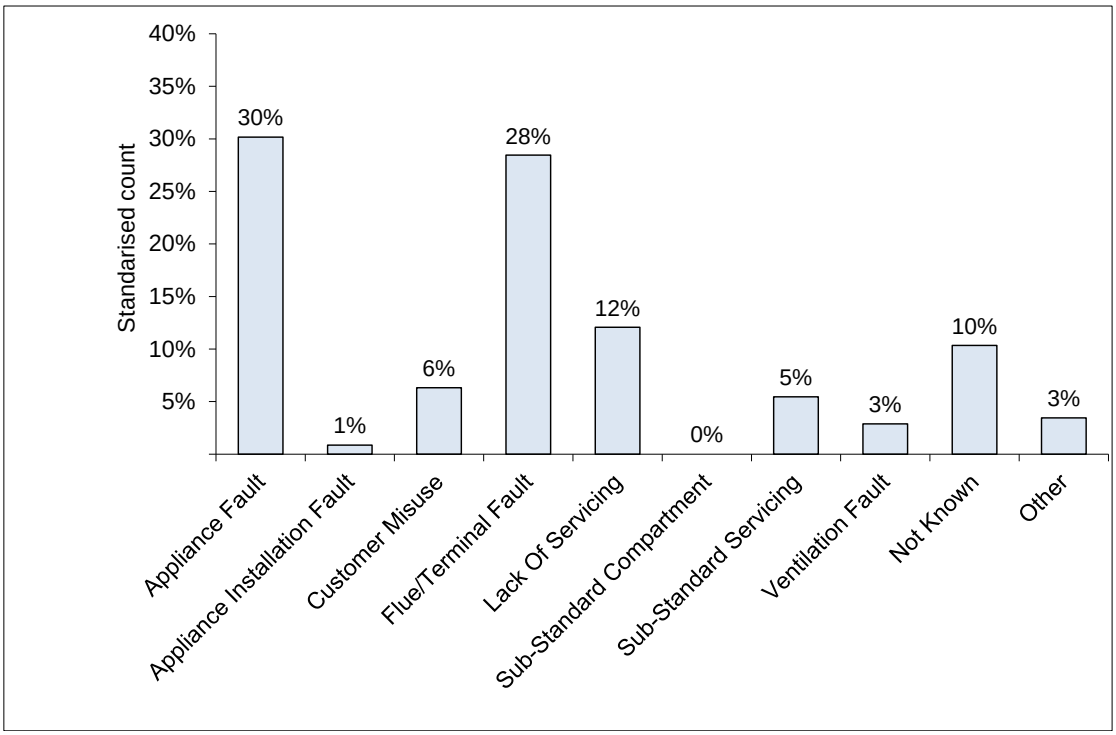

Figure 28 Reported causes[35]

[35] Figures may not add up to 100% due to rounding errors.

As there were 10 reported causes if all the causes were equally likely, the contribution score for each of the causes detailed in Figure 27 would be 10%, so groups with a contribution score above 10% constitute a higher contribution than average.

Lack of servicing in 12% of incidents is lower than in recent years (36% in both 2012/13 and 2011/12).

Flue/terminal problems and appliance faults are by far the main contributory factors.

Reports of customer misuse of an appliance (6%) as a contributory cause of an incident related to two cookers and one warm air unit and were similar to 2012/13 (6%), 2011/12 (8%), 2010/11 (9%) and 2009/10 (7%). Customer misuse in 2013/14 was misaligned burner rings, placing unsuitable objects on the burners and installing a shelf that restricted the return air flow grill to a warm air unit.

3 Incidents involving solid fuel and oil fired installations

Details of domestic CO incidents involving solid fuel and oil fired installations have been gathered via HETAS, the solid fuel advisory service and competence assessor for operatives that install, commission, service and maintain appliances, and OFTEC, the trade association that works on behalf of the oil heating and cooking industry in the UK and Republic of Ireland, representing the interests of manufacturers, suppliers and training providers. This information is presented in Appendix D.

The data is compared with that obtained from investigators of mains natural gas and piped LPG incidents and the reported figures are tabulated below.

	GB households at risk, in 1000s	GB population at risk, millions	Fatalities	Non-fatal casualties	Incidents
Oil	946	2.24	0	0	0
Mains natural gas	21885	51.87	3	58	29
Piped LPG	150[36]	0.36	0	1	1
Solid fuel	180	0.43	3	1	3

Table 25 Oil, mains natural gas, piped LPG and solid fuel incident data for 2013/14

Fuel	Risk of a CO incident per million people at risk per year		
	Fatalities	Non-fatal casualties	Incidents
Oil	< 0.45	< 0.45	< 0.45
Mains natural gas	0.06	1.12	0.56
Piped LPG	< 2.81	2.81	2.81
Solid fuel	7.03	2.34	7.03

Table 26 Risk of an injury from a CO incident in GB

The common factor quoted by investigators of solid fuel incidents has been the lack of servicing of an incident installation.

[36] Piped LPG population 150,000 households (UKLPG).

4 Conclusions and recommendations

1. This year the third lowest number of fatalities was recorded since detailed records began in 1996 within the mains natural gas and piped LPG sectors and maintains a continuing trend of fewer fatalities compared with those experienced in the early 2000s. There is no doubt that the industry has to remain vigilant in order that such a trend continues and factors such as operative competence, CO alarm effectiveness and open flue installation maintenance are important in this respect.

2. The number of incidents reported involving boilers with open flues has again been disproportionate to the number of installations nationwide and their investigation has highlighted the importance of regular servicing for this particular appliance type. Boilers with open flues posed a risk of 7.3 times that of room sealed boilers.

3. An evaluation of those CO incidents involving room sealed installations has revealed that flue related issues tend to be the predominant cause of failure. This indicates that, even for appliance types considered to be of relative safe design, regular flue maintenance is important.

4. The double fatality involving the use of a gas cooker is the latest in a series of incidents that have resulted in personal injury over a number of years.

5. This year, a significant number of incidents involving space heaters (gas fires) were caused by debris which had resulted in blockage of the flue. This demonstrates the importance of regularly maintaining such installations to reduce the associated safety risk.

6. This year, unlike incident information gathered in the solid fuel sector since 2011, a lack of regular servicing has been reported by investigators as the primary cause of a CO incident. This is the first year this has been noted.

7. There are a sizable number of incidents that are not fully investigated and this is for a variety of reasons. One case of concern serves to illustrate the need to investigate fully even if part of the evidence has been disturbed. The potential cause of the exposure could have been any of four possible appliances present (a gas boiler, a gas water heater, a gas cooker or solid fuel fire). Before the investigator could arrange a visit to investigate, the occupant had the boiler replaced and no further action was taken as the evidence was disturbed. This would only have been acceptable were the boiler to have been confirmed as the only cause.

5 References

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APPENDIX A: DIDR PORTABLE LPG INCIDENT INFORMATION

One LPG incident involving bottled gas was reported to Downstream Gas during the 2013/14 reporting period.

The incident occurred in Kent in April 2014. A 61 year-old woman in a detached bungalow died.

The investigator found the incident was caused by a natural gas flueless water heater which was connected to LPG (in a bathroom) without a satisfactory conversion of the appliance having taken place.

APPENDIX B: DIDR NON-DOMESTIC INFORMATION

No non-domestic incidents were reported.

APPENDIX C: PAST INCIDENTS PREVIOUSLY UNREPORTED

No records were received in 2013/14 of previously unreported incidents.

APPENDIX D: CARBON MONOXIDE INCIDENTS RELATED TO THE USE OF SOLID FUEL AND OIL IN THE HOME

Since 1996, the focus for gathering CO incident information from those who investigate has been on the gas industry in GB. Mains natural gas and piped LPG represent the domestic energy supply for between 20 and 21 million homes in GB and legislation has ensured the responsibility for investigating such an incident resides with the gas supplier.

Whilst the gas industry has made significant inroads towards improving the situation for domestic gas users, and recognises there is still work to do, moves have been made since 1st July 2010 towards agreeing a similar reporting system for the oil and solid fuel industries which represent the other major domestic energy sectors in GB.

The Gas Safety (Management) Regulations confer a responsibility upon the gas supplier to investigate a gas related CO incident. The RIDDOR regulations define what constitutes an incident in terms of the severity of a victim's injuries and appropriate treatment. These together mean the gas industry has significant regulation which essentially stems from the potential for gas to cause both fire and explosion damage.

Oil and solid fuel reporting system

Regulation in the oil and solid fuel sectors is not as great as in the gas industry even though it is recognised that CO incidents associated with using these fuels in the home have occurred regularly for many years.

It was therefore agreed by the Gas Safety Trust and Downstream Gas that a reporting system be proposed for the oil and solid fuel energy sectors.

This was done for the solid fuel sector with the specific agreement and assistance of HETAS, the solid fuel advisory service and competence assessor for operatives that install, commission, service and maintain appliances.

The counterpart of HETAS for the domestic oil energy sector is OFTEC, whose help was volunteered in identifying and co-ordinating a reporting system for CO incidents involving oil.

Both HETAS and OFTEC have specialist investigators who were initially consulted on the way the format of the DIDR form used for reporting gas related CO incidents should be modified for their energy sectors.

Implementation

Meetings were held between Downstream Gas and investigators at both OFTEC and HETAS in order to ensure the detailed assessments of CO incidents were undertaken in such a way as to optimise data quality.

It was recognised from the outset when the reporting year 1st July 2010 to 30th June 2011 began that it would be challenging to expect the extent of information obtained from oil and solid fuel related incidents to be as wide as that gathered from gas related incidents. This would be a consequence both of the way investigators became acclimatised to completing their reporting forms but also, and more importantly, it would be a result of there being relatively minimal legislative drivers compelling proper investigations to be carried out and for them to be the responsibility of a particular individual or organisation.

As the year went on, this latter factor became crucially important and HETAS were sometimes in the situation where no-one would pay for an investigation to be carried out. In order for there to be sufficient data to be obtained from such investigations one of the following needs to happen:

Either

A fund is set up that investigators can draw upon as and when a 'reportable' incident occurs which can be assessed at the year end to determine whether its magnitude is affordable by one or more stakeholders

Or

Regulations are introduced that confer responsibility upon the solid fuel and oil sectors to investigate 'reportable' CO incidents in the way the Gas Safety (Management) Regulations do for the gas industry.

Nothing is understood to have taken place since last year which would be expected to resolve this issue.

Northern Ireland reporting structure

Downstream Gas and the Gas Safety Trust are presently working with representatives of HSENI (the health and safety regulator in NI) with a view to establishing a reporting process for CO incidents for the three major domestic energy sectors. HSENI has advised Downstream Gas that it intends to gather incident data in-house on CO related incidents using the forms currently being used by investigators in GB. The domestic customer split in NI is approximately 70% oil, 10% solid fuel and 20% gas.

Reporting forms completed by HETAS

Details of three fatal CO incidents were received from HETAS investigators.

a) An 86 year old female died in November 2013. She lived in an owner-occupied semi-detached property with double glazing and a solid floor construction in the Oxfordshire area. The appliance was a Trianco TRG 80 independent batch fed boiler using a mineral natural smokeless fuel, and it was found to have a blocked heat exchanger. The investigator reported lack of servicing as the cause.
b) An incident in August 2013 involved the death of a 25 year old female. The property was semi-detached and had double glazing and a solid floor construction in the Cardiff area. The incident involved a room heater and back boiler unit using mineral natural smokeless fuel. The investigator reported the Trianco TRH 45 installation had a blocked throat plate at the point of entry to the chimney and a lack of servicing contributed towards this (clinker and ash were found in the flue way).
c) In February 2014 a 79 year old male died in an owner-occupied semi-detached house with double glazing and a solid floor construction. A female was also hospitalised for more than 24 hours. The incident involved mineral natural smokeless fuel used by a Trianco TRG 45 independent automatic boiler. The reported cause was a blocked heat exchanger and a lack of servicing.

Reporting forms completed by OFTEC

OFTEC has an office in NI and no report of any incident in GB or NI was received during 2013/14.

Reported data

The CO incident data forms completed by HETAS and OFTEC investigators have provided the details presented below in Table D1, together with data for gas and LPG for comparative purposes. The figures for oil and solid fuel should be viewed as minimum numbers given the lack of regulation that exists to drive the reporting and full investigation of such incidents.

	GB households at risk, in 1000s	GB population at risk, millions	Fatalities,	Non-fatal casualties,	Incidents,
Oil	946	2.24	0	0	0
Gas	21885	51.87	3	58	29
Piped LPG	150[37]	0.36	0	1	1
Solid fuel	180	0.43	3	1	3

Table D1 Oil, mains natural gas, piped LPG and solid fuel incident data for 2013/14

	Risk of a CO incident per million people per year		
	Fatalities	Non-fatal casualties	Incidents
Oil	< 0.45	< 0.45	< 0.45
Gas	0.06	1.12	0.56
Piped LPG	< 2.81	2.81	2.81
Solid fuel	7.03	2.34	7.03

Table D2 Risk of an injury from a CO incident in GB

The risk of a fatality as a result of a CO incident occurring in GB associated with operating a domestic solid fuel installation is above the societally accepted risk of 1 per million persons per year. The risk of being involved in a non-fatal incident associated with piped LPG is 2.81 per million persons per year. However, this is the first time in at least ten years that an incident involving piped LPG has occurred. So over ten years the risk has been 0.28 per million persons per year.

Dedicated databases for detailed CO incident information gathered since 1st July 2010 by incident investigators and submitted to Downstream Gas on the reporting forms developed with HETAS and OFTEC continue to be maintained.

[37] Piped LPG population 150,000 households (UKLPG).

APPENDIX E: 2013/14 INCIDENT DATA COMPARED TO DATA FROM PREVIOUS YEARS

The information presented in this section allows a pictorial comparison to be made between this year and recent years (2010/11, 2011/12, 2012/13).

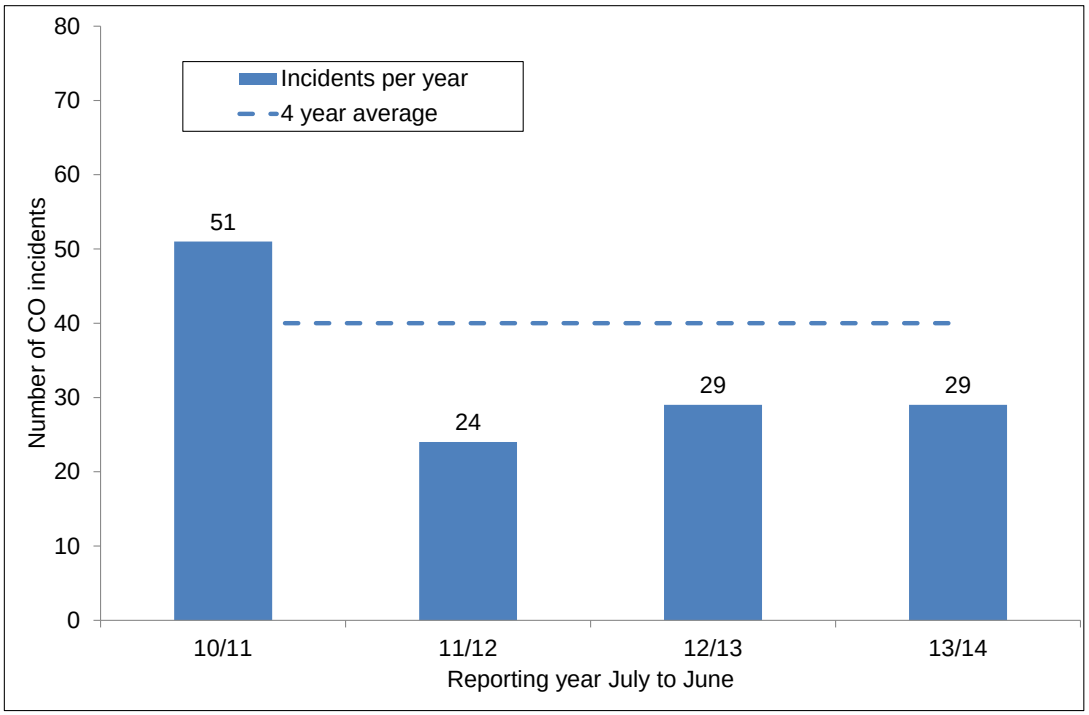

Figure E1 Incidents reported in 2013/14 compared with those reported since 2010/11

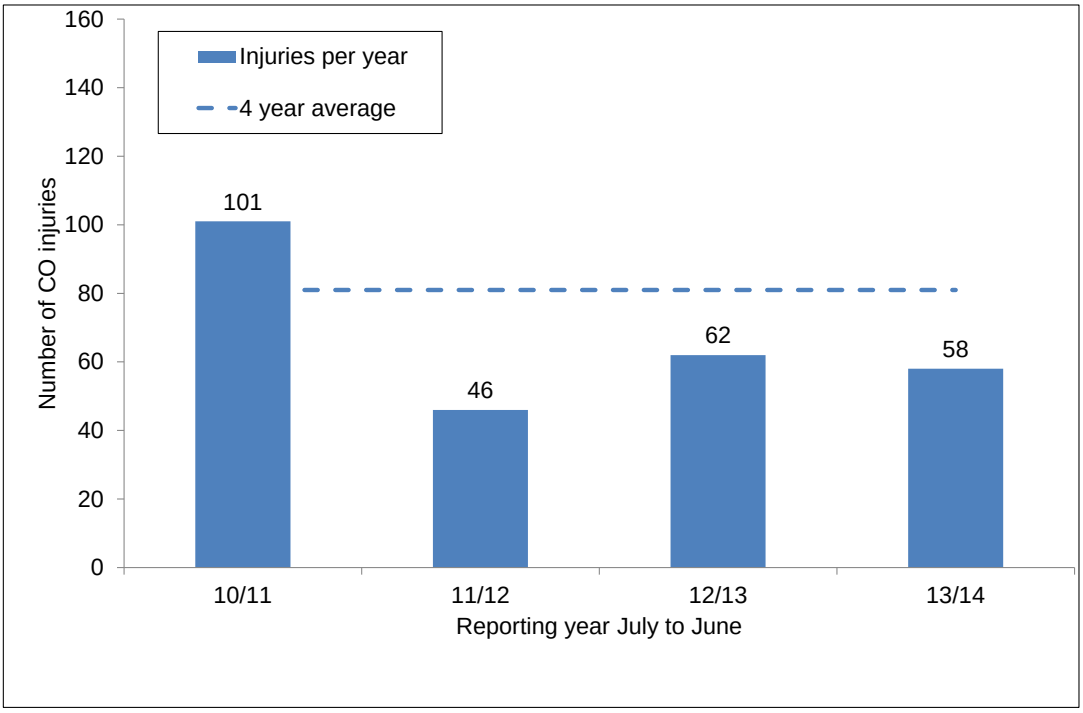

Figure E2 Injuries reported in 2013/14 compared with those reported since 2010/11

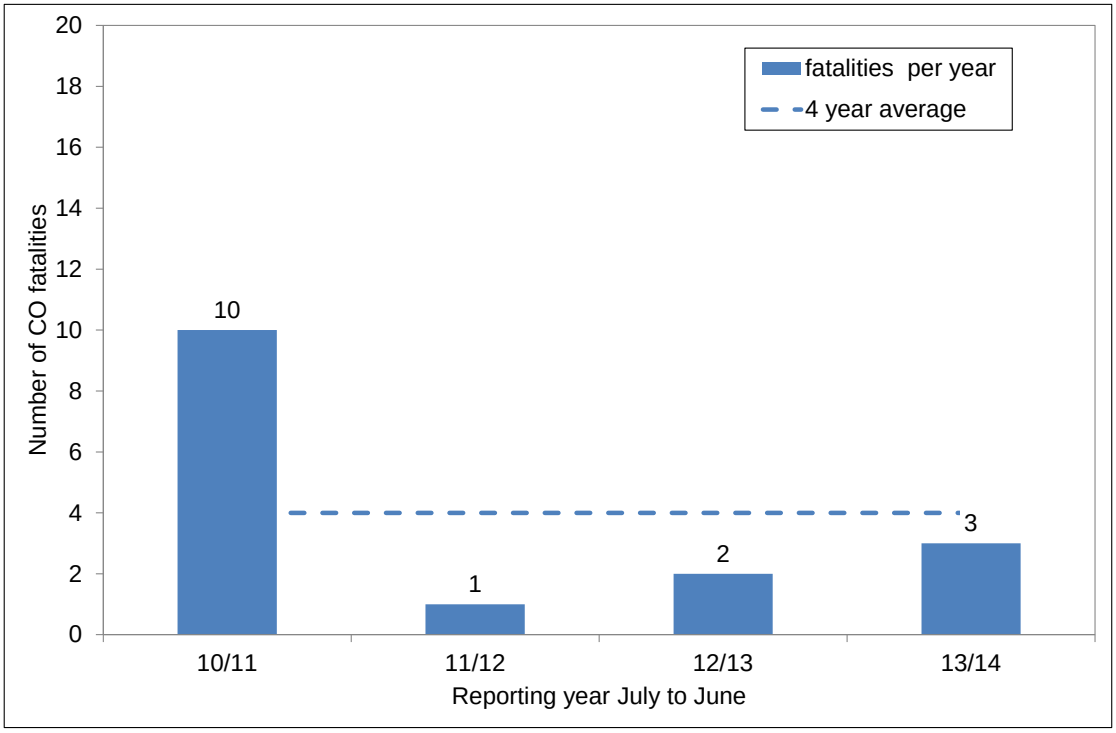

Figure E3 Fatalities reported in 2013/14 compared with those reported since 2010/11

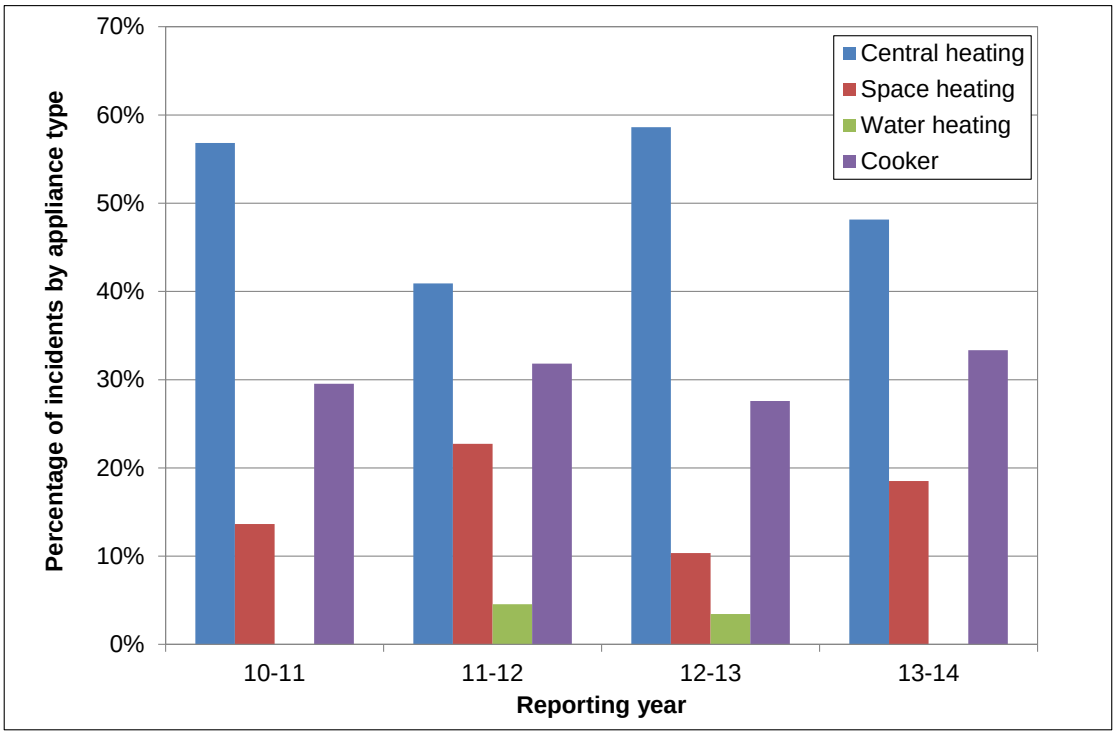

Figure E4 Incidents by appliance type for 2013/14 compared with those reported since 2010/11

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