A DETAILED REVIEW OF CARBON MONOXIDE INCIDENT INFORMATION, FOR 2011/12, 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

Carbon Monoxide Incident Report

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A detailed review of carbon monoxide incident information, for 2011/12, 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

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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 carbon monoxide incidents related to appliance and system design, the home environment, installation, servicing and maintenance. The conclusions reached are intended to help further improve safety, to target investment on carbon monoxide incident prevention and to identify additional research work.

This is the 16th report in a series that began with the publication of a first annual report in 1996 and covers the 12 months between 1st July 2011 and 30th June 2012. During this period details of 24 domestic 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 this report and believes the information and data contained within to be crucial to the further reduction in fatalities and serious injuries from accidental carbon monoxide exposure.

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Executive Summary

This report has been prepared by Downstream Gas and is the sixteenth annual report that has analysed 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.

This annual report covers the period from 1st July 2011 to 30th June 2012 inclusive.

24 incidents were reported by investigators this year all of which involved the use of domestic mains natural gas and these resulted in 46 casualties (non-fatal) and one fatality. This is less than half the number of incidents and casualties recorded in recent years (2010/11, 2009/10 and 2008/9) and represents a welcome downward trend. The single fatality was the lowest number reported since detailed records of incidents began in 1996. This is a significant reduction from the 21-24 fatalities and 70 to 104 incidents reported annually during the period 1996 to 2000.

For the first time since the CO incident database for GB has existed, the data was less than the accepted threshold of risk (referred to as that considered acceptable in society) in terms of each of the major categories, namely:

- a fatally injured victim
- a non-fatal casualty *and*
- involved in a RIDDOR reportable incident.

The single fatality reported in 2011/12 involved a gas fire where the open flue had become blocked.

The details in this year's report nevertheless focus attention upon specific key areas to which it is recommended the gas industry remains alert.

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

- Those renting from private landlords have been shown to be more at risk than those in other occupancy types. There are a number of ways this issue could be addressed, e.g. requiring regular appliance servicing as the means of maintaining the appliance in a safe condition and considering mandatory installation of CO alarms in such tenanted properties ensuring there is an appropriate replacement schedule for these detectors (e.g. noting an alarm exists and any requirement for replacement on the Landlord's Safety Check form).
- Anyone in control of an investigation should ensure the time taken between incident notification (as required under RIDDOR regulations) and investigation is kept to a minimum to reduce the chances of an incident appliance being replaced or repaired before the investigation can be conducted.
- This year, information continues to be submitted by investigators working on behalf of the oil and solid fuel sectors. However, this is not considered to be as extensive as it could be, particularly in respect of the solid fuel sector. If the current absence of regulations driving incident investigation to be carried out is addressed, and in particular the responsibility assigned for funding this in these sectors, far more information would be forthcoming upon which to base measures aimed at improving safety.
- The downward trend in the numbers of fatalities during 2011/12 based upon authoritative and authenticated information confirms the progress made by the gas industry in improving the safety of domestic gas users. It is recommended that the key issues (i.e. number of fatalities, non-fatal casualties and incidents) are communicated nationwide in context and there is no attempt to suggest the gas industry is disproportionately unsafe when compared with other areas including disposable barbecues, fires, the solid fuel and oil-fired energy sectors and fuel gas which is not piped or mains supplied.
- Figures for CO incidents are constantly being quoted which do not put into context the facts relating to which fuel sector they refer. If care was taken to ensure the figures for the relevant fuels only were used, this would help to focus regulatory attention on those sectors where risk to personal injury was greatest.
- Incidents involving open flued boilers again figured disproportionately and this year represented at least 3.4 times the risk of being involved in a RIDDOR reportable incident than one with a room-sealed boiler. Bearing in mind that such a trend has persisted since the collation of detailed CO incident data began in 1996 and the only fatality this year involved an open flued gas fire this serves to emphasise the importance for the regular servicing (as per manufacturer's instructions) of all open flued appliances.

1 Introduction

1.1 Context

Downstream Incident Data Report (DIDR) forms are completed by investigators following the investigation of accidental carbon monoxide poisonings in GB from 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 2010/11. 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 sixteenth report in the series and is the fifth 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 2011 and 30th June 2012.

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 Regulations referred to above are known as RIDDOR.

Regulation 6(1) states that:

> *Whenever a conveyor of flammable gas through a fixed pipe distribution system, or a filler, importer or supplier (other than by means of retail trade) of a refillable container containing liquefied petroleum gas receives notification of any death or major injury which has arisen out of or in connection with the gas distributed, filled, imported or supplied, as the case may be, by that person, he shall forthwith notify the Executive of the incident, and shall within 14 days send a report of it to the Executive on a form approved for the purposes of this regulation.*

The Executive is the Health and Safety Executive.

The Guidance to Regulation 6(1) states that:

> *The trigger for a report to the HSE under regulation 6(1) is the receipt by the person on whom the reporting duty is placed of 'notification' of a flammable gas incident causing a death or a major injury other than one reportable under regulation 3(1).*

Regulation 3(1) relates to a fatality or major injury as a result of an accident arising out of or in connection with work whether or not the person was at work. It also covers hotel or care home residents, pupils or students and customers in shops.

For this report it may be interpreted that Regulation 6(1) covers domestic premises.

As specified in GSMR, a CO incident has to fulfil specific criteria in order to be formally reported. Such an incident is notifiable under regulation 6(1) of the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995 and for this reason is frequently known as a RIDDOR reportable incident.

Primarily, following the inhalation of a substance (in this case CO) the incident has to result in:

- an acute illness requiring medical treatment or
- a loss of consciousness

An acute illness means:

- one that progresses rapidly to a crisis after the onset of symptoms and
- has severe symptoms

Medical treatment covers:

- hospital treatment
- treatment by a general medical practitioner or
- treatment by a firm's medical and nursing staff

Treatment by a paramedic is also included here.

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 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 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.

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. Occasionally DIDR forms are completed for incidents occurring in non-domestic premises so, for completeness, any received are included in a separate Appendix and these details will not feature in the statistical analysis of data covered in the main body of the report.

The reporting of LPG incidents via the DIDR forms is limited to those associated with refillable LPG tanks or cylinders. Incidents related to portable LPG are not RIDDOR reportable but occasionally completed forms are received by Downstream Gas.

An incident investigation and systematic reporting scheme for heating oil, kerosene and solid fuel based around the gas forms started in July 2010. It is a cross industry initiative co-ordinated by Downstream Gas between the Gas Safety Trust, OFTEC and HETAS.

The statistics in the main body of the report:

- Include data on DIDR forms that relate to the use of mains natural gas in the home.
- Exclude any DIDR forms that relate to CO incidents involving mains natural gas or piped LPG in non-domestic situations. However, for completeness, any such information received on DIDR forms is presented in Appendix A in this report.

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.

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 either to 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 analyzing 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.

For the period 1st July 2011 to 30th June 2012, 24 incidents were reported involving mains natural gas and none involving piped LPG. Details of one incident involving a portable LPG appliance were received on a DIDR form and for completeness these details are reported separately in Appendix A.

In a fully detailed DIDR report submitted following an investigation, the investigator completes all sections 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, full details were submitted for 18 of the 24 incidents reported.

Short reports only feature brief details and tend to only include the incident date, geographical location, casualty details and the suspected cause together with the type of appliance involved. This year six such reports were submitted by incident investigators.

The reasons given for being unable to provide fully detailed reports were:

- The appliance had been replaced or repaired before a full investigation could take place (three)
- The visit reportedly identified a cause although a full investigation was not conducted* (one)
- Unknown (two)

**Information made available did not explain the reason why a full investigation was not carried out. The cause of the incident was apparently established to be a cooker hob producing high levels of CO. The cooker was left disconnected.*

Full reports formed 75% of the total submitted in 2011/12 and this was a higher proportion than last year (64%) although lower than the previous year (80%)[1].

The main reason given for not providing a full report was that the installation involved had been repaired or changed before a full investigation could take place. In two cases this was because the initial visit established the likely cause and so arrangements were made to rectify the situation quickly. The third case involved a conflict of interest between the gas supplier and investigation service at the property. This left it to the HSE to organise the investigation and by the time it had been arranged, the incident appliance had been replaced.

It should be stressed that once reported as a RIDDOR reportable incident, the organisation controlling the investigation has a legal duty to investigate fully. A way to ensure a full investigation is carried out as per the GSMR, may therefore be to speed up the response time the investigation service takes to attend. However, it is appreciated that it can occasionally be difficult to contact the occupier in order to do this or that the occupier might be uncooperative.

There may be occasions when an investigation report is delayed, for example whilst waiting on the result of an inquest or a trial. One such double fatality involving natural gas was only recently confirmed by inquest as an accidental CO poisoning despite it occurring in November 2010. Historical data in the 2011/12 report has therefore been updated accordingly and the incident details are included in Appendix C.

A further fatality reported in March 2011 to the Walsall Police was identified during discussions with the HSE but it was not natural gas related. Details of this incident remain sketchy although it is understood to have involved LPG. The incident has been treated as bottled LPG related and therefore no changes to historical data are warranted. Further details will appear in a future report should more information be received. After reconciling the number of fatal incidents reported by British Gas, CORGI Technical Services and the Gas Safe Register with those recorded by the HSE, the data provided to Downstream Gas in DIDR forms has been analysed and is presented in this report. Tables and charts are included relating to the numbers of reported fatalities, non-fatalities and incidents.

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 by investigators 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.

1 Ref 1.

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 property tenancy occupancy type, 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 population statistics, where available. Section 3 then draws conclusions and where appropriate lists recommendations.

- **Appendix A** is devoted to domestic LPG incidents reported to Downstream Gas on the DIDR form. One incident was reported fully this year following investigation by CORGI Services.
- **Appendix B** is devoted to non-domestic incidents should they be reported to Downstream Gas on the DIDR form. Three such incidents were reported fully this year.
- **Appendix C** is devoted to details of incidents that occurred in previous years for which information was made available this year. One such incident was received this year.
- **Appendix D** is devoted to 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 respectively.
- **Appendix E** features charts which present summarised information for 2011/12 that 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 very tragic and can be avoided so we should never ever become complacent in the pursuit of a zero target.

Quite often we see statistics and figures reported in the media that quote around 50 CO fatalities per year. It should be noted that this high figure relates to 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 appliances e.g. boilers, fires, garage compressors, barbecues and stoves.

The information contained within this report originates from the data captured within the RIDDOR process which is thoroughly investigated, reviewed and critiqued before being published. The RIDDOR statistics relate to CO fatalities and injuries linked to mains natural gas and piped LPG within GB and the number of fatalities confirmed from carbon monoxide last year and this year were eight and one respectively. This is from a population of homes with gas numbering approximately 20 million nationwide.

The current situation regarding CO incidents clearly shows how the numerous gas safety initiatives implemented over the last 25 years have made a real difference. The following initiatives are all considered to be contributing to this downward trend in CO fatalities and injuries 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 benefits of CO alarms and
- The focus of CO Charities, Industry and Government.
- UK legislation that restricts 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).

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 safe practice in other fuel sectors, most if not all of which are far less regulated.

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 both extremely keen to work 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.

2 Analysis of DIDR Forms

2.1 Preliminary overview

There were 24 domestic mains natural gas incidents reported on DIDR forms that met the criteria for inclusion during the 12 month reporting period (1st July 2011 to June 30th 2012). There were no reports concerned with piped LPG. The criteria that have to be met have been specified in Section 1.2. Confirmation that the victim or victims were exposed to excessive levels of CO is typically obtained via blood tests or following examination of an installation shown to be producing dangerous levels of CO when investigated in the 'as found' condition. Deliberate acts such as suicides are excluded.

A further incident involved the use of a portable LPG appliance. This is excluded from the main analysis as it falls outside the scope of the analysis but included in Appendix A.

All domestic CO incidents referred to in this report were a result of natural gas usage unless otherwise stated.

CO incidents are usually notified directly to the gas supplier and the HSE. British Gas and CORGI Technical Services provide an incident investigation service for gas suppliers. On occasions the HSE engages Gas Safe Register to investigate incidents. There have been rare occasions when HSE has requested the support of the Health and Safety Laboratory with incident investigation. During this year, 15 confirmed CO related incidents were investigated by British Gas, seven by CORGI Technical Services, and two by Gas Safe Register.

Of the 24 natural gas domestic incidents reported, 18 were fully reported. Information on the remainder was supplied on short (i.e. less detailed) reports. Thus, whilst for 24 cases the analysis covers incident date, casualty information and main appliance data (see sub-sections 2.1, 2.2 and 2.6), for 18 of these the analysis was more comprehensive and covered, for example, incident appliances, flues, ventilation provision, appliance operation and servicing (Sections 2.3-2.13 inclusive).

Each DIDR form completed and submitted by an investigator is dedicated to a separate CO incident. The incident rates and yearly trend data have been combined with the casualty information and are described below in Section 2.2 Incident Details.

Each of the following sections includes an assessment of the information retrieved from the CO incident database for 2011/12 and, where appropriate, a discussion of the data. This discussion may relate 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 2011 and 30th June 2012 inclusive, are plotted in Figure 1. Figure 2 shows how these monthly figures break down in terms of the fatalities and non-fatal injuries. The so-called heating season, the period during which the majority of CO incidents tend to occur, typically runs between September/October and April/May.

Figure 1 Monthly incident numbers

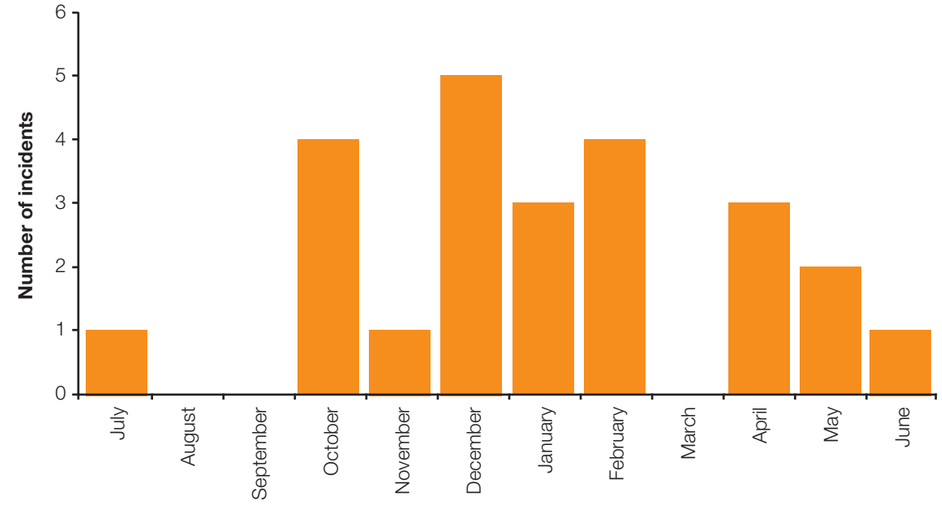
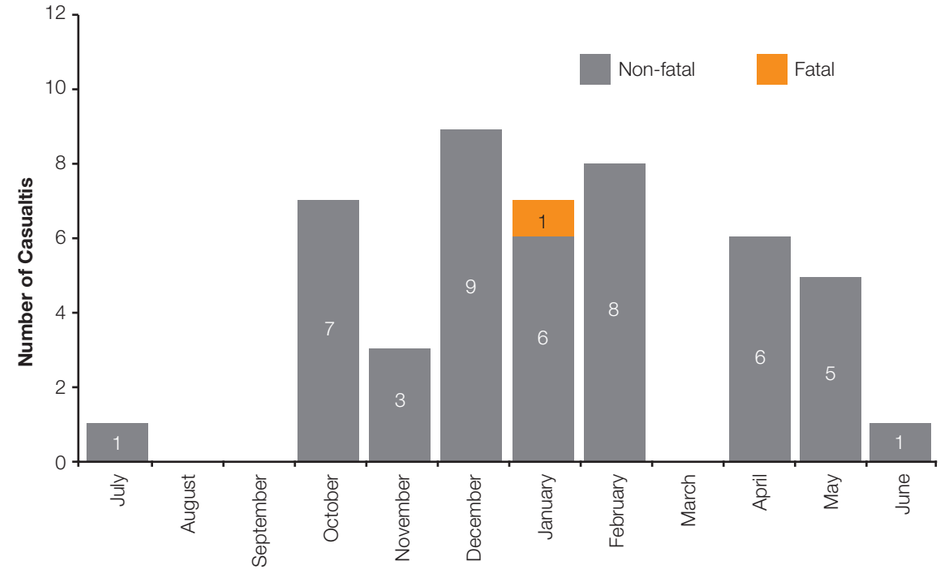


Figure 2 Monthly casualty numbers



For the period 1st July 2011 to 30th June 2012 there were 24 separate carbon monoxide incidents reported related to natural gas. These affected 47 people, of whom one died. The number of fatalities has been reconciled with figures recorded by the HSE.

2.2.1 Geographic coverage

Of the 119 postal areas in GB, 96 were incident free, 22 had a single incident and one (Doncaster postal area) had two incidents.

Based upon 24 incidents per year, the likelihood of only one incident occurring per postal area is very low and would be expected to occur by chance alone once a century. As it is very unlikely that there would be only one incident per postal area rather than two or more, it is likely that there will be two incidents in any one postal area. The two incidents reported this year as happening in the Doncaster postal area should therefore not be considered unusual.

2.3 Casualty details

2.3.1 Fatalities, casualties and incident numbers

A breakdown of those persons (46) reported as having been injured, although not fatally, by CO poisoning during the reporting period 2011/12 is presented in Table 1 and in Figure 3, with the severity of the casualties classified into four groups.

Table 1 Classification of non-fatalities

Classification	N1	N2	N3	N4	Not stated	Total
Number of casualties	0	37	0	1	8	46

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 38 casualties whose severity classification had been reported, only one (or 2.5%) was classified as not requiring hospitalisation. This contrasts to recent years of 2008/9, 2009/10 and 2010/11 when the proportion had been close to 20% (see Figure 4).

The reported number of incidents in 2011/12 (fatal and not fatal) was 24 and the number of non-fatal casualties was 46. These are about half the totals reported in 2008/9, 2009/10 and 2010/11. They are lower, and in particular lower in the statistically significant sense, than the average number reported over the past 4 years which was 51 incidents and 95 non-fatalities. The normal spread expected in 19 out of 20 years is between 38 and 65 incidents and 77 and 115 casualties.

This indicates, therefore, that both the number of non-fatalities reported and the number of incidents recorded in 2011/12 is significantly lower.

Figure 3 Reported incident and casualty numbers

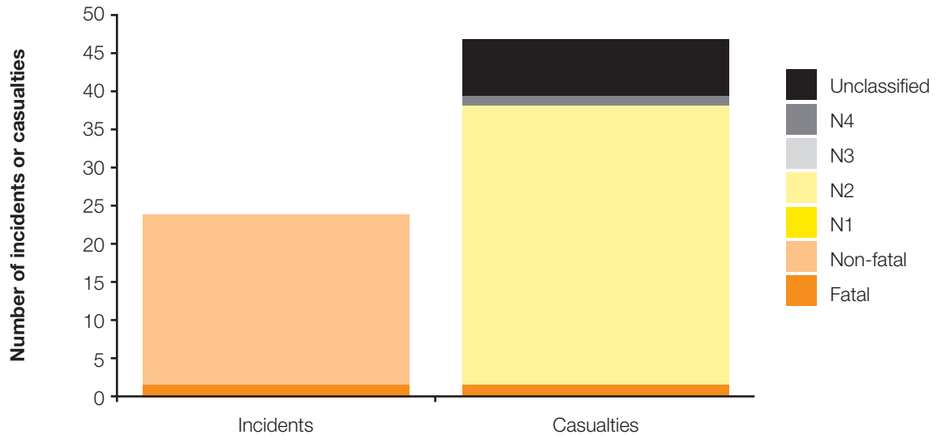
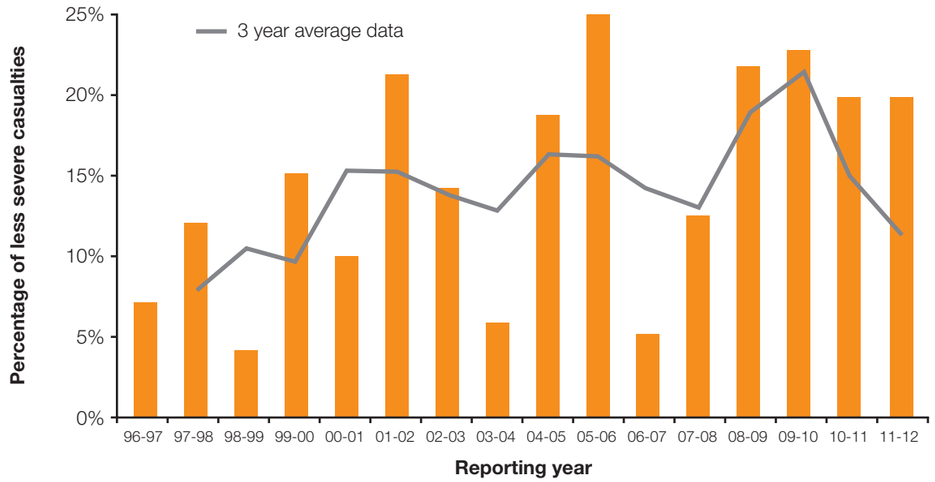


Figure 4 Percentage of casualties not requiring hospital treatment



2.3.2 Overall risk and trends

Table 2, shows the likelihood of someone being involved in a CO incident during 2011/12. The risk rates were calculated by dividing the number of incidents, casualties or fatalities by the number of people at risk. 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 households using mains natural gas of 22.3 million (85%[2] of 26.258[3]) in 2011.

Table 2 Carbon monoxide incident numbers and risks for 2011/12

Total Incidents	Numbers of people affected		Incidents, fatalities or casualties per million people at risk per year		
	Fatal	Non-fatal	Incident	Fatality	Non-fatal
24	1	46	0.46	0.02	0.88

The risk rates calculated for previous years are given in Table 3. Yearly trends recorded for fatality and incident rates are also shown in Figures 5 and 6 respectively. The trend is defined as a moving average over 3 years centred on the middle year. It should be noted that for the 2011/12 year the trend is represented as the average of 2010/11 and 2011/12 only.

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	0.41	0.24	0.43
06/07	27	8	40	0.57	0.17	0.85
07/08	42	12	67	0.84	0.24	1.35
08/09	57	17	97	1.11	0.33	1.89
09/10	56	4	115	1.09	0.08	2.25
10/11	51	10	101	0.98	0.19	1.94
11/12	24	1	46	0.46	0.02	0.88

2 Percentage of homes in England using gas as the main heating fuel, Annex Table 6.17, ref 2.
3 Table 102: Dwelling stock: by tenure, GB (historical series), ONS, ref 3.

Figure 5 Fatality data

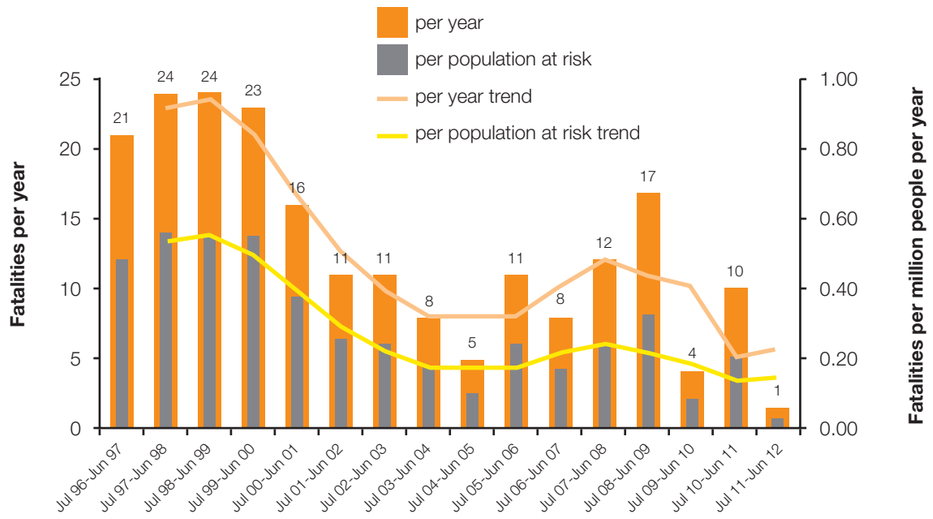
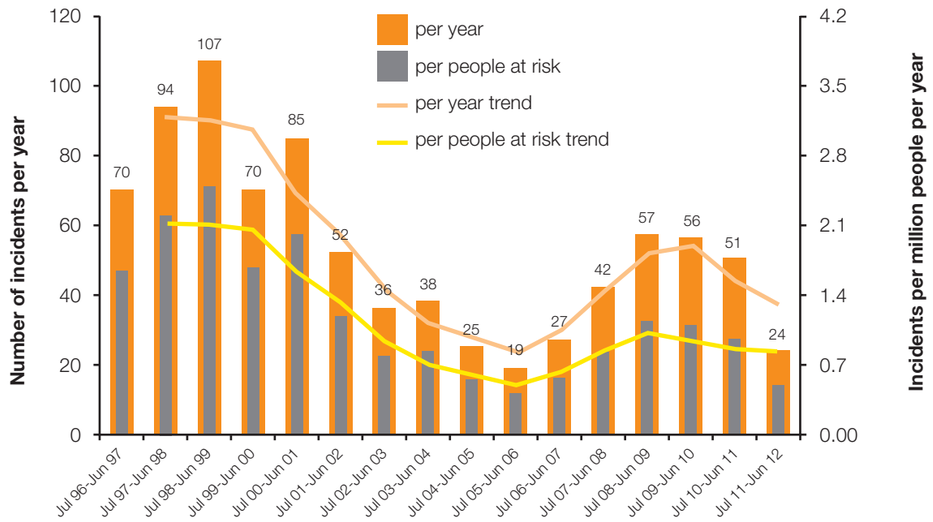


Figure 6 Incident data



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 1990s of 24 to an average of 10 per year over the past 4 years (2007/8 to 2010/11). This year's reported data means the average for the last 4 years (2008/9 to 2011/12) has reduced further to eight. Statistically, if the average was eight fatalities per year in GB, the chance of one or zero fatalities in a year would be only 1% and this falls within the level of statistical significance of 5%.

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 an average of 51 per year over the 4 year period 2007/8 to 2010/11. This year's reported number of incidents (24) means the average for the 4 years (2008/9 to 2011/12) has reduced further to 47 incidents per year. Statistically, if the average was 47 incidents per year in GB, the chance of 24 or fewer incidents in a year is less than 1% and well within the level of statistical significance.

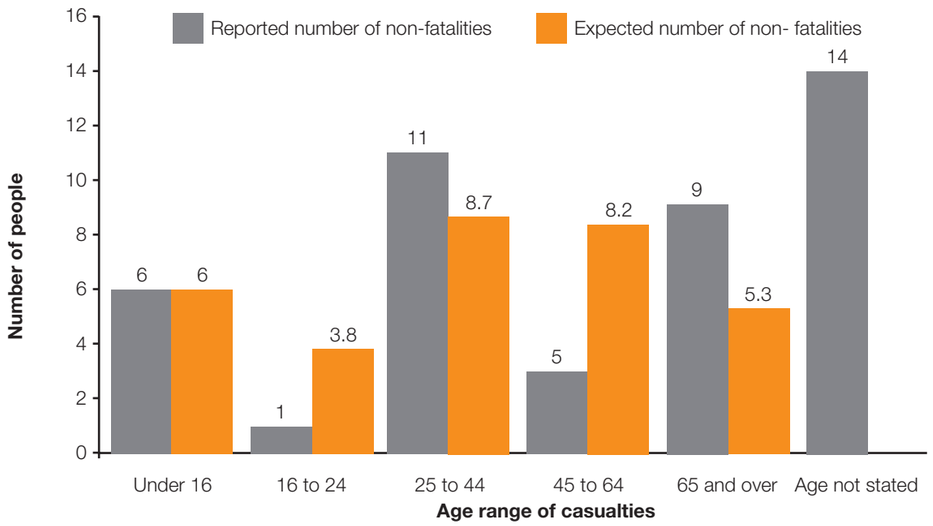
2.3.3 Casualty ages

There was one fatality reported, a 95 year old man.

The age ranges of people non-fatally injured are presented in Figure 7. The percentage of people in each age group in GB is 18.6% for those under 16, 12% 16 to 24, 27.3% 25 to 44, 25.6% 45 to 64 and 16.6% 65 or over[4].

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 is also shown in Figure 7. The expected number is the percentage of those within each age range resident in GB in mid-2011 (the latest published figures) 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



4 England and Wales ref 4 and Scotland ref 5.

2.3.3.1 Discussion

From Figure 7 it is evident that there are only minor differences between the age profiles of non-fatalities. Indeed, a statistical Chi-squared test shows that the reported distribution is not significantly different to that which would be expected by chance alone from the age distribution of the general population assuming all are equally at risk. However this conclusion must be viewed with caution as nearly a third of the casualties did not have their age reported.

2.4 Incident location details

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

2.4.1 Occupancy type

A breakdown of English homes using gas as a heating fuel by occupancy type is shown in Table 4. This is considered to be a reasonable measure of the breakdown of gas homes in Great Britain in 2011/12 because a) England accounts for 85% of the homes in Great Britain, b) the percentage of homes with a gas supply in Wales and Scotland is similar to England and c) the number of new homes built since 2010 is around 2% of the existing stock.

Table 4 Percentage of gas homes by occupancy type in England in 2010[5]

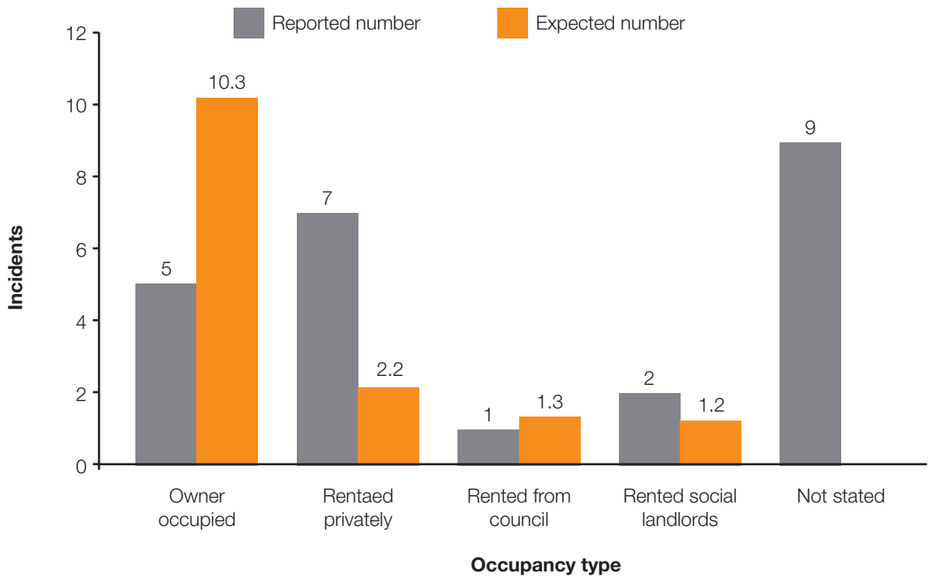
Occupancy type	% of homes with a gas supply
Owner occupied	68.6%
Rented privately	14.9%
Rented from council	8.4%
Registered Social Landlords (RSL)	7.8%
ALL	100%

It should be noted that any changes in the figures quoted in Table 4 since the 2010/11 report are due predominantly to changes in the housing stock number that have taken place since 2009.

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

5 Annex Table 6.17, Ref 2.

Figure 8 Incidents by occupancy type



Additionally, five of the seven incidents reported in properties with private landlords had lack of servicing specified as a contributory cause. Furthermore, nine incidents were reported where lack of servicing was reported to be a contributory cause, making the risk associated with these dwellings more than three times greater than would be expected given the prevalence of such properties nationwide (see Table 9).

2.4.1.1 Discussion

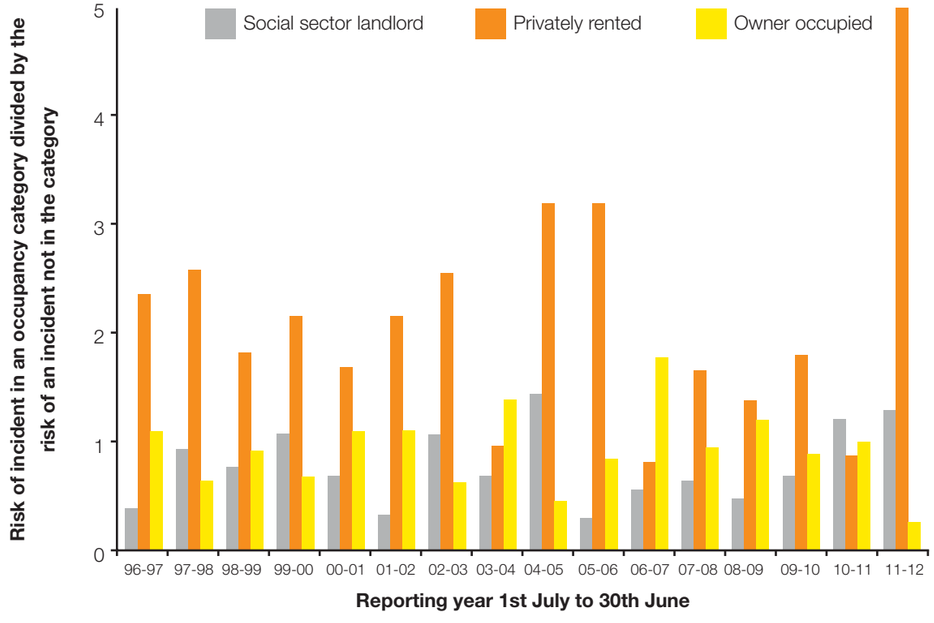
Incidents in privately rented properties occurred more frequently than would be expected in other occupancy types. The increased frequency was confirmed to be statistically significant using a binomial test comparing the number of incidents in privately rented properties with those in all other occupancy types. Those renting from private landlords have five times[6] the risk of a CO incident than other occupancy types.

As the data was unavailable in six short reports and was missing from three full reports, the significance of this was taken into account and it can be concluded that private rented properties present an increased risk which is at least 4.4 times that of other occupancy types.

In 2011/12 the evidence of an elevated risk associated with private rented properties has returned following insufficient evidence in 2010/11. Prior to 2010/11, annual reports of incidents have recorded a greater risk associated with privately rented properties than any other occupancy type every year except 2003/4 and 2006/7.

6 The relative risk is (A x D) / (C x B) where A and B are the reported and expected number of incidents in privately rented properties respectively and C and D are the reported and expected number in other occupancy types respectively.

Figure 9 Incident risk by occupancy type



Whilst there is a specific requirement in the GSIUR (Regulation 36) for a landlord to ensure gas fittings and flues are maintained in safe condition, by no means all organise regular servicing as would be recommended by appliance manufacturers. Furthermore, the risk figures presented in Figure 9 tend to suggest that landlords in the social sector manage to keep appliances in safer condition than private landlords. For this reason, mandatory servicing of appliances/installations in properties with private landlords is worthy of consideration and offers the first line of defence against carbon monoxide.

In addition, domestic carbon monoxide alarms are now required in GB when a new or replacement appliance burning solid fuel is installed and in Northern Ireland, this extends to all newly installed appliances irrespective of the fossil fuel.

A move, therefore, which required private landlords to have carbon monoxide detection in their properties as the second line of defence against carbon monoxide could further afford protection to gas users and in particular would not restrict appliances or installations involved to those that were new or replacement. Incident data collated since 1996 shows that it is older systems which tend to figure most often. Issues such as the best location for an alarm in a property and the concern currently being expressed about how long the sensors in these devices remain reliable in order that gas users are protected would need to be properly examined.

2.4.2 Dwelling type

Column A of Table 5 shows the percentage of properties in England by dwelling type. Column B shows that in England 84.3% of detached homes, for example, had gas as the main heating fuel. The final column shows the percentage of gas properties in England by dwelling type.

Figure 10 provides a breakdown of incidents by dwelling type reported in 2011/12 and compares this with the number that would be expected. The expected number is based on the national profile of dwelling types and assumes a CO incident to have been equally likely in all types.

The reported numbers of incidents by dwelling type were similar to the proportion of properties supplied with gas by dwelling type for terraced houses, flats and bungalows but not for semi-detached houses, where more were reported than would have been expected.

Table 5 Dwelling types in England 2010

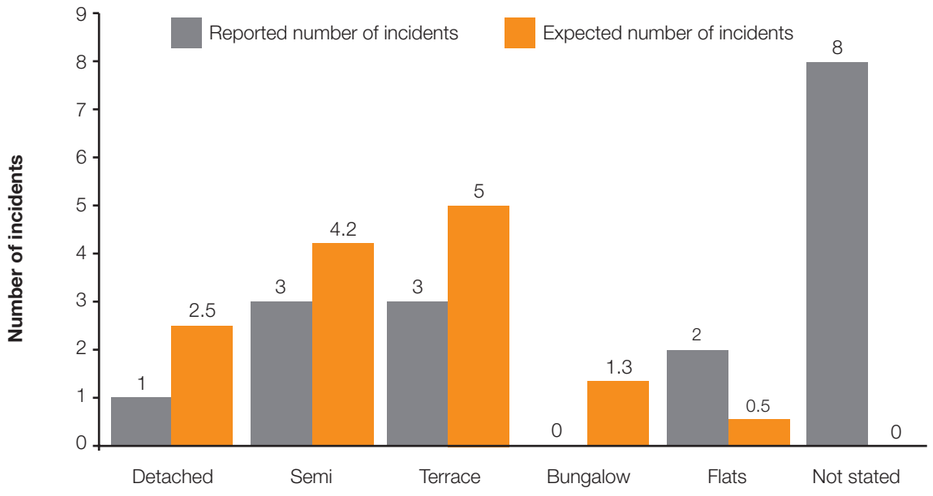
	% of gas and non-gas properties by type in England[7]	% of properties in a given type that have gas as the main heating fuel in England[8]	% of gas properties by type in England
	Column A	Column B	A x B ÷ Total (A x B)
Detached house	17.0%	84.3%	16.9%
Semi detached house	26.2%	90.7%	28.0%
Terraced house	28.4%	91.7%	30.8%
Bungalow	8.9%	80.9%	8.5%
Flats purpose built	15.3%	67.5%	12.2%
Flats converted	4.2%	71.6%	3.6%
Total	100%		100%

Table Notes:

Total (A x B) = [A(det) x B(det)] + [A(semi) x B(semi)]+ ...+ [A(conv. flat) x B(conv. flat)]

Any changes in figures quoted in Table 5 since the 2010/11 report are predominately due to the change in numbers of housing stock.

Figure 10 Incidents by dwelling type



7 Annex Table 6.5, ref 3.
8 Table SST6.1, Ref 6

2.4.2.1 Discussion

Figure 10 shows the expected number of incidents assuming all property types pose an equal risk. The number of incidents in purpose built flats was proportionally higher than expected and suggests that purpose built flats pose a risk of five times that of other property types[9]. As this is the first year this raised risk has been observed it would be prudent to wait until next year before any firm conclusions about a possible new trend are reached. Data reported in previous years has not drawn the distinction between purpose built and converted flats.

Six of the incidents with unknown property type were recorded in short reports which were assumed not to correlate with any particular property type. The remaining two did not conflict with the above trend.

In 2010/11 it was reported that semi-detached houses posed an increased risk. This was the first year it had happened and this has not been repeated in 2011/12. Therefore it is concluded that it was a statistical anomaly.

2.4.3 Property construction period

Table 6 gives the national breakdown of properties in each of five periods for property types as listed on the DIDR form. Figure 11 shows the reported number and expected number (assuming all ranges pose equal risk) of incidents by property age based on the estimated national profile of the five age ranges specified on the DIDR form.

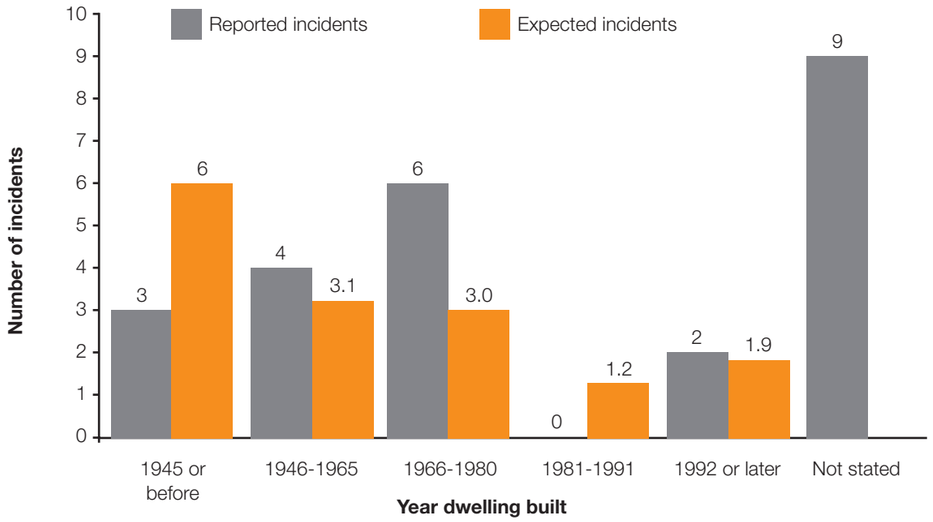
Table 6 National breakdown by property construction period[10]

	% of gas properties by built era in England
Built period	
Pre 1945	20.7%
1945 to 1965	18.4%
1966 to 1980	20.7%
1981 to 1990	20.3%
Post 1991	7.7%
Total	100%

Note the population source document used in 2011/12 provides a direct breakdown of gas properties by built period. In previous years the source document did not provide a direct breakdown and it had to be calculated using the breakdown for all properties (gas and non-gas properties). This calculation was presented in previous reports by two additional columns in Table 6.

9 The relative risk is (A x D) / (C x B) where A and B are the reported and expected number of incidents in purpose built flats and C and D are the reported and expected number in other dwelling respectively..
10 Annex Table 6.15, Ref2.

Figure 11 Incidents by property construction 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. More incidents than expected occurred in properties built after 1945 but before 1981.

Based on a single year's data there are too few incidents to carry out a statistical test. However, combining the data available for 2010/11 and 2011/12 a chi-squared test reveals that there is evidence to support the suggestion that a build-up of CO is less likely in older properties than would be expected based on their national breakdown alone.

A third of the incidents reported during 2010/11 and 2011/12 were in properties of unknown built period (see Table 7). As the details for most of these incidents (23) were submitted in short reports and for reasons unrelated to the dwelling type (e.g. appliance replaced before investigation could take place) it was considered they were unlikely to be biased towards older or newer properties. This missing information was therefore unlikely to obscure the trend noted above.

Table 7 Numbers of Incidents in properties of different construction periods compared to those expected (2010/11 to 2011/12)

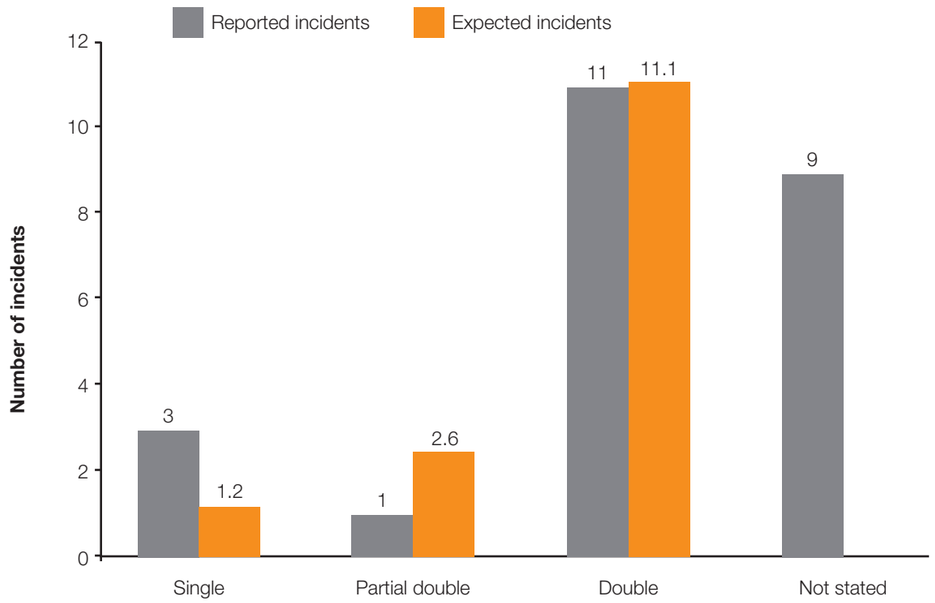
Built period	Reported number of incidents	Expected number of incidents
1945 or before	11	19
1946 - 1965	14	10
1966 - 1980	17	10
1981 - 1991	6	10
Unknown	26	-
Total	74	-

2.4.4 Glazing type

The percentage breakdown of homes by glazing type in the latest English Housing Survey was 8.2% single glazed, 17.6% partial single-glazed and double-glazed and 74.2% double-glazed in 2010[11].

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 2011/12, 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 5 years and is contrary to the suggestion that double glazed properties are more at risk because they tend to have lower background ventilation rates.

11 Annex Table 6.9. Section 4 Ref 2.

2.4.5 Floor construction

Table 8 shows a breakdown of carbon monoxide incidents reported by ground floor construction.

Table 8 Incidents by floor construction

Ground floor construction	Reported number of incidents
Solid	11
Suspended	3
Partial solid	2
Not stated	8
Total	24

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 70% have solid floor construction[12]. A similar estimate made assuming all properties with cavity walls have solid floors also produces the same result of 69.3% with solid floors[13]. If this were the case 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 four and for solid floor would be 10. In fact, there were three and 11 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 (e.g. room or compartment) of 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	2
First	2
Ground	10
Below ground	1
Not stated	9

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

12 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.
13 Annex Table 6.6, Ref 2.

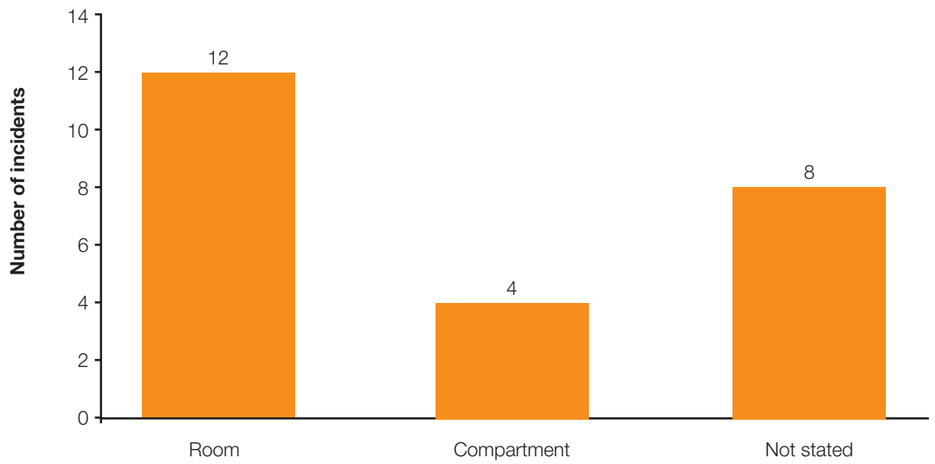
Table 10 Appliance and casualty locations

	Number of appliances at each location	Number of casualties at each location	Number affected where the occupants were in the same room as the appliance	
			Fatal	Non-fatal
Hall/landing	3	4	0	0
Kitchen	8	1	0	0
Living rooms	4	7	0	2
Bathroom	0	1	0	0
Utility	0	0	0	0
Bedroom	0	9	0	0
Other	3	1	0	0
Not stated	6	23	1	23

The most common location for casualties was the bedroom, living rooms and landings/hallways.

A further analysis was carried out on the number of incident appliances fitted in compartments. There were four incidents reported that involved appliances in compartments, out of a total 16 where the relevant details were recorded. This is presented in Figure 13 and shows a similar proportion of incident appliances were fitted in a room compared to a compartment as reported in 2010/11.

Figure 13 Incident appliances installed in compartments



Of the 17 reports that provided a response to the question *"was the casualty located in the same or an adjacent property?"* all specified that they were located within the same property as the incident appliance. There were no reports of casualties being located in adjacent properties.

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). The one fatal incident involved the victim dying in chair in the living room from CO discharged by a fire caused by a blocked flue.

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. Over the last 3 years a similar proportion of the detailed incident reports involved appliances installed in compartments. 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.

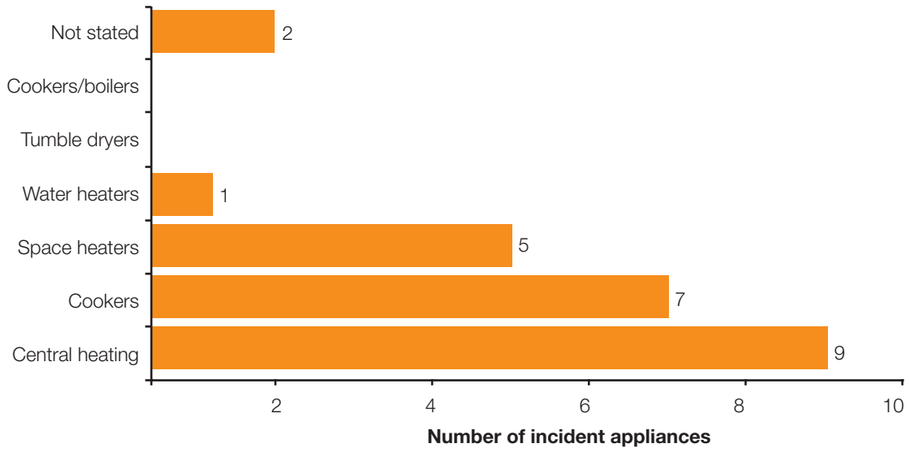
2.6 Incident appliance details

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

2.6.1 Appliance type

Details of incidents classified by the appliance type are given in Figure 14.

Figure 14 Incidents by appliance type



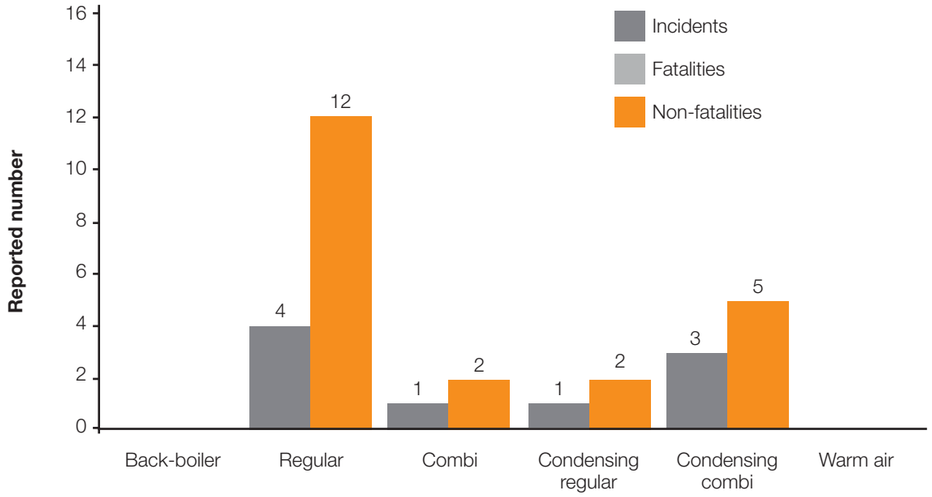
Most incidents where the appliance type was specified (22 out of 24) involved central heating appliances (nine), none of which were from warm air heaters (there were four and two in 2010/11 and 2009/10 respectively). This is as expected given the prevalence of central heating installations, their larger heat input and the fact that they tend to be in operation for significant periods.

There were seven incidents involving cookers and five space heaters. There was one incident involving a water heating (circulator) for the first time in many years.

2.6.2 Central heating and boiler type

The incident numbers involving central heating appliances are further broken down in Figure 15. No fatalities involved central heating appliances.

Figure 15 Incidents by central heating type



In order to establish the relative risk presented by each boiler type, the boiler population by boiler type is required. The latest English Housing Survey is typically 18 months behind the required reporting period. The boiler population was projected forward 18 months using a best fit quadratic equation to the years 2006 to 2010.

Table 11 shows the resultant percentage breakdown for England which has been assumed to apply to GB as a whole. Figure 16 illustrates the projected figures.

Table 11 Boiler populations by boiler type for England

Boiler type	Mid-year boiler population (%)[14]				Projection for
	2007	2008	2009	2010	end of 2011
Regular	39.6	36.3	32.7	29.2	23.8
Back-boiler	8.8	7.6	6.6	5.7	4.8
Combi-boiler	28.3	27.3	24.6	21.6	14.6
Condensing regular boiler	3.1	4.3	6.0	7.9	11.8
Condensing combi-boiler	8.3	12.5	18.2	23.7	33.9
No boiler	11.9	12.0	11.9	11.8	11.2

14 Source of 2007 t0 2010 data. Annex Table 6.13, ref 2.

Figure 16 Boiler population and projected figures

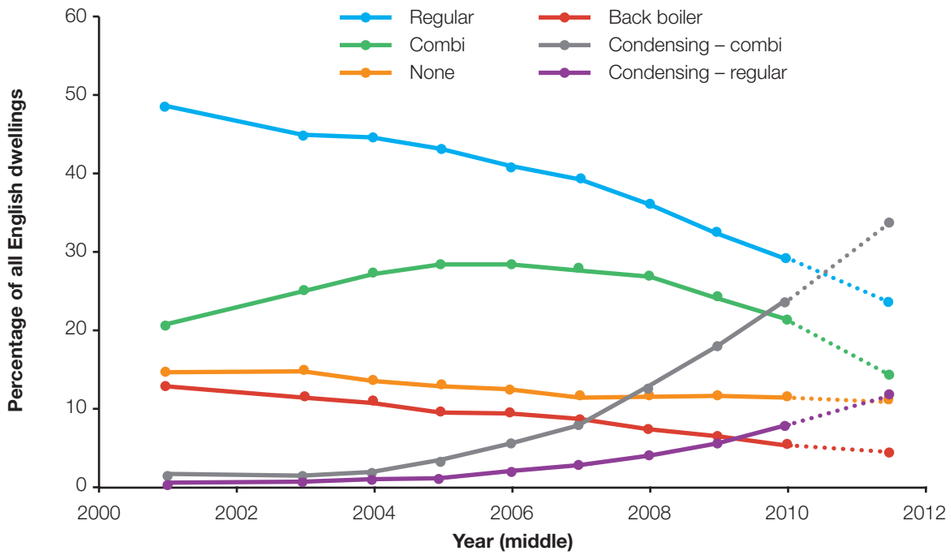


Figure 17 Reported and expected incident numbers by boiler type

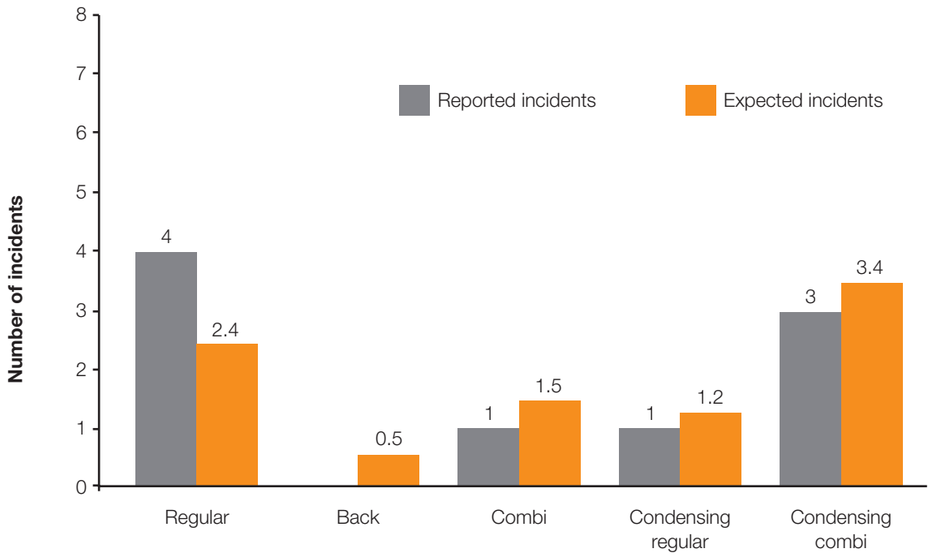


Figure 17 compares the nine CO incidents reported with a known boiler type with those expected given the prevalence of each boiler type in the general population and assuming each poses an equal risk[15]. There is insufficient data to make firm conclusions but there appears to be only a little difference between expected and reported incidents across all boiler types.

15 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.

2.6.2.1 Discussion

Unlike in 2010/11, when there was evidence suggesting that back-boilers pose a greater risk, in 2011/12 there is no evidence to support the greater risk.

Figure 17 also suggests there is no evidence that condensing boiler installations are less or more of a risk than non-condensing boilers.

It is estimated that at the end of 2011, nearly 50% of installed boilers nationwide will be condensing and of the nine incidents reported this year relating to boilers, four (44%) involved condensing boilers. The expected number would be four or five given their prevalence and assuming condensing and non-condensing boilers pose similar risk. Therefore there is no evidence to suggest that condensing boiler installations represent a greater risk of being involved in an incident than non-condensing boilers. This has been the finding for several years and strongly suggests the risk associated with boilers is not usually the boiler itself but installation, servicing and maintenance practices.

2.6.3 Appliance age

Table 12 lists the numbers of incidents reported this year by appliance type and age.

Unlike other parameters, the boilers of unknown age are not likely to have the same age distribution as the boilers of known age because these boilers are likely to be biased towards older boilers. 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.

There are more appliances with unknown ages than those with known ages making any detailed risk analysis by appliance age unreliable. Therefore no reliable conclusions about appliance age and associated risk can be deduced.

Table 12 Incident numbers by appliance age

	Appliance age (years)			
	Under 3	3 – 12	Over 12	Unknown
Cooker	1	0	3	5
Other	0	0	0	0
Space Heater	1	0	0	4
Central Heating	0	3	3	3
Water Heater	0	0	0	1
Total	2	3	6	13

2.6.4 Trends in incident appliance rates

Figure 18 and Table 13 shows the yearly fatality numbers associated with appliance type since July 1996. The single fatal incident this year was associated with a space heater and represents a much lower figure than the 10 year average up to 2010/11 of 10 fatalities per year.

Figure 18 Fatalities by appliance type since 1996

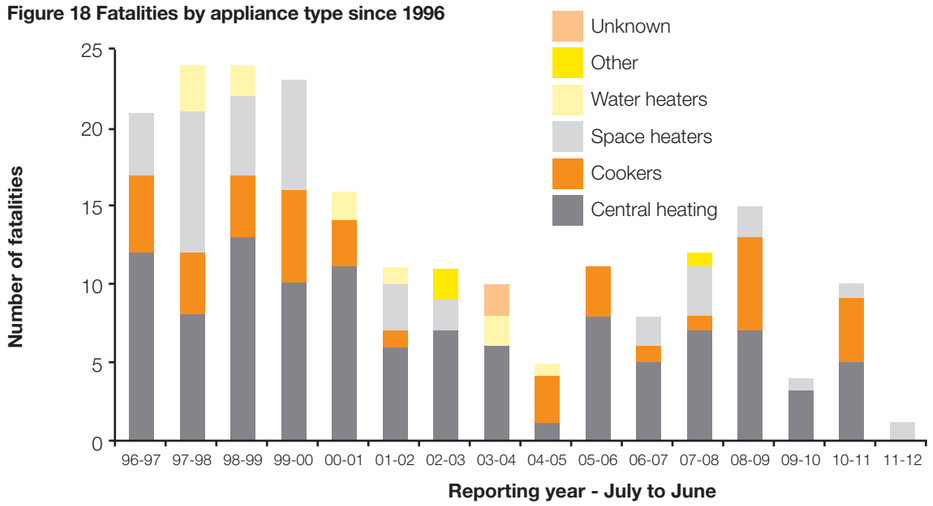


Table 13 Fatalities per year by appliance type since 1996

Year (July to June)	Unknown	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
Average First five years		3.8	1.4	5.6	10.8		21.6
Average Last ten years		1.7	0.5	1.4	5.7		9.7

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 heaters and cookers and therefore absolute risks have only been calculated for these categories of appliance. Risks for warm air heaters were not calculated as there were no reported incidents involving warm air heaters.

2.6.6 Absolute risk of a CO incident involving boilers

For 2011/12, the estimated number of people living in properties with gas central heating boilers in GB was 51.7 million[16] (22 million households). Using 51.7 million as the number of people at risk from gas boilers an estimate of the range of the absolute incident rate related to gas boilers has been derived (see Table 14). The higher estimate of risk assumes all unknown (unreported) appliances were gas boilers and the lower estimate assumes none of these were gas boilers.

Table 14 Incident data for gas boilers

	July 1st 2011 to June 30th 2012		
	Incidents	Fatalities	Non-fatalities
CO incidents - excluding unknowns	9	0	21
CO incidents - including 2 incidents with unknown appliances which had no fatalities and 23 non-fatalities	11	0	24
	Incident rate	Fatality rate	Non-fatality rate
Per million people per year (assuming unknowns are not central heating related)	0.17	<0.019	0.41
Per million people per year (assuming unknowns are central heating related)	0.21	<0.019	0.46

The risk of a fatality associated with central heating appliances in GB over the reporting year 2011/12 is considerably less than the commonly accepted health and safety criterion of one fatality per million people at risk per year. More particularly it is less than 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 0.5 per million people at risk per year (or five per 10 million people per year).

16 Great Britain population mid 2011, 60.4 million (ref 4 and ref 5) of which 84.1% (table 6.12 and 6.14, ref 2) are gas boiler households.

2.6.7 Absolute risk of a CO incident involving cookers

The estimated gas hob and gas oven populations for GB are shown in Table 15.

Table 15 UK cooking appliance population estimates

	Source data DUKES[17]			Inferred populations		
	Electric ovens millions	Electric hobs millions	Households millions	Gas hob & oven millions	Electric hob & oven millions	Gas hob & electric oven millions
UK households	16.6	12	26.6	10.0	12.0	4.6
GB households			26.3	9.9	11.8	4.5
GB population			61.7[18]	23.2	27.8	10.7

Table 15 assumes:

1) Homes without an electric oven have a gas hob and gas oven (i.e 26.6 – 16.6 = 10.0 million).
2) 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.
3) 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 16. A range of risk is shown because of the differing assumptions made about the incident data concerning unknown appliances.

Table 16 Incident data for cooking appliances

	July 1st 2011 to June 30th 2012		
	Incidents	Fatalities	Non-fatalities
Gas cooker or separate hob			
CO related incidents excluding unknown	7	0	13
CC related incidents including 2 incidents with unknown appliances which had no fatalities and 3 non-fatalities	9	0	16
	Incident rate	Fatality rate	Non-fatality rate
Gas cooker or separate hob population base			
Per million people per year (assuming unknowns are not cooking related)	0.21	<0.03	0.38
Per million people per year (assuming unknowns are cooking related)	0.27	<0.03	0.47
Gas cooker population base			
Per million people per year (assuming unknowns are not cooking related)	0.30	<0.04	0.56
Per million people per year (assuming unknowns are cooking related)	0.39	<0.04	0.69

The risk of a fatality associated with cooking appliances in GB over the reporting year 2011/12 is considerably less than the commonly accepted health and safety criterion of one fatality per million people at risk per year. More particularly, it is even less than 0.03 fatalities per million people at risk per year (or three per 100 million people per year).

17 Table 3.11, ref 8.
18 Number of GB households (ref 3) x 2.35 people per household (table 5, ref 7).

2.6.8 Discussion

The total number of fatalities due to accidental CO poisoning associated with natural gas use has declined from an average of 22 to 10 per year over the last 15 years, the turning point being around the start of the millennium. The average number of fatalities associated with central heating appliances has declined by four, space heaters by four and cookers by two (see Table 12) over the last 10 years ending 2010/11. The 2011/12 figures by appliance type are significantly less because only a single fatal incident occurred and this involved a space heater.

Absolute fatality rates and incident rates in 2010/11 associated with cookers have been slightly lower than those associated with central heating appliances. The reverse is true in 2011/12. Risk rates for fatalities involving each appliance type in 2011/12 are well below one tenth of the generally accepted risk criteria of one fatality per million-people years.

There is insufficient data to drawn any conclusion concerning risks associated with boiler age.

There were no incidents reported with back-boilers and so there is no evidence to suggest back-boilers pose a greater risk, unlike last year.

For the 5th year running, there are some reported incidents involving condensing boilers (all room-sealed); four out of nine in 2011/2. This is considered to be a reflection of the rapid increase in the condensing boiler market (now over 99% of GB sales and just over 50% of the installed boiler population in 2012) due to energy efficiency legislation introduced in April 2005.

There is no statistical evidence to suggest that condensing boilers pose less or more of a risk than non-condensing boilers, despite the former being predominantly room sealed appliances. This has been a theme for a couple of years and illustrates that the risk associated with boilers is not the actual boiler design but more related to installation, maintenance and service practice.

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 included 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

No fatal incidents concerning central heating appliances were reported.

2.7.1.2 Space heaters

The single fatality involved a Berry Magicoal, Queensbury, gas fire and was caused by a blocked natural draught flue and lack of servicing.

2.7.1.3 Cooking appliances

No fatal incidents concerning cooking appliances were reported.

2.7.1.4 Water heating appliances

No fatal incidents concerning water heating appliances were reported.

2.7.2 Non-fatal incidents

The following sub-sections describe those appliances involved in non fatal incidents that were fully investigated.

2.7.2.1 Central heating appliances

These were involved in nine incidents.

- **Back boiler units (BBU)**
  None
- **Condensing regular boilers**
  Stokvis - Econoflame R30X
- **Condensing combi-boilers**
  Glow-worm - 24 CXI
  Potterton Powermax HE
  Potterton Promax HE Store
- **Combi-boilers (non-condensing)**
  Worcester 240OF
- **Regular boilers (non-condensing)**
  Ideal - Mexico Super 2 CF50
  Ideal - Mexico Super 2 CF50
  Ideal - Vulcan Continental 45/60
  Thorn - Apollo
- **Warm air heaters**
  None

2.7.2.2 Space heaters

Four non-fatal incidents involved space heaters. Only two of the DIDR forms submitted specified the manufacturer or brand name.

Cannon - Aluma
Valor - Majestic

2.7.2.3 Cooker/boiler

None

2.7.2.4 Cooking appliances

Six incidents involved free standing cookers and one incident involved a built-in hob. Details were supplied for five free standing cookers.

Leisure - no model name specified
Cannon - Oxford
Logik - LPSTG50W
Beko - SCG 1811B
Beko - Double Oven DVG 953

2.7.2.5 Water heating appliances

One incident involved a Johnson and Starley, Hi Jan, Water Circulator.

2.8 Appliance installation details

Table 17 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 17 Appliance installation details

	To current standards	To standards current at time of installation	Not to any appropriate standards	Unsure/ don't know	Total
Registered	0	2	2	0	4
Non-registered	0	0	0	0	0
DIY	0	0	0	0	0
Unknown	6	2	2	10	20
Total	6	4	4	10	24

The vast majority of appliances had unknown installers (20 out 24) so an analysis of those carrying out the appliance installation is inappropriate.

Two registered operatives carried out an installation that was not to standard. The first installed after 2004 was a boiler installation with the twin pipe flue system not supported in a void and without a means of inspection. The second was a free standing cooker installed in 2012. The reasons for it not being installed to standard were not reported although ventilation provision was stated as to standard. The reason for the incident is not yet known.

2.9 Flue details

A breakdown of the 20 incidents where flue type details were reported is shown in Figure 19.

Most of these incidents involved open flues with four incidents associated with room-sealed flues, nine with open flues and seven with flueless appliances (which were all either cookers or hobs). The fatal incident involved an open flued appliance.

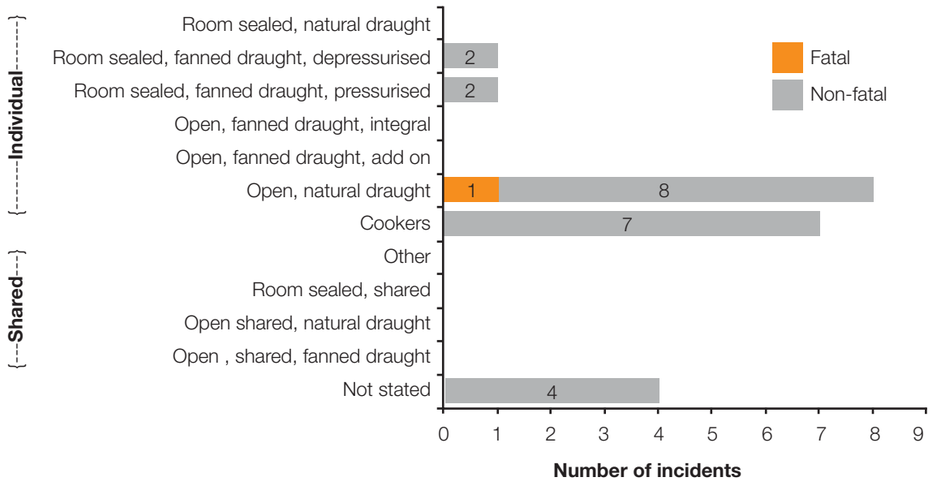
An analysis of the nine incidents with a known flue installation status is shown in Figure 20 and indicates that 44% had not been installed to standard (either current or that existing at the time of installation), which is a sizeable proportion. This compares with a corresponding proportion of 50% and 40% not installed to standard in 2009/10 and 2011/12.

The single fatality reported this year involved an open flue system (of unknown installation standard) with the cause reported to have been a blocked flue due to lack of servicing.

2.9.1 Discussion

The proportion of incidents involving appliances with open flues has increased from 55% in 2009/10 to 63% in 2010/11 and 69% in 2011/12. The proportion of open flues existing and operational nationwide will have decreased over the same period of time.

Figure 19 Incidents by flue type



In previous annual reports, population data on open-flued and room-sealed boilers has referred to a survey published in 2005. In May 2005[19] 19% of boilers had open flues. Since then the number of boilers with open flues has gradually declined as they have been replaced by newer room-sealed appliances. The figures published in 2005 therefore represent an upper estimate of the population of room-sealed boilers during 2011/12 and hence this represents a lower estimate for the relative risk associated with open-flued boilers compared to room-sealed boilers.

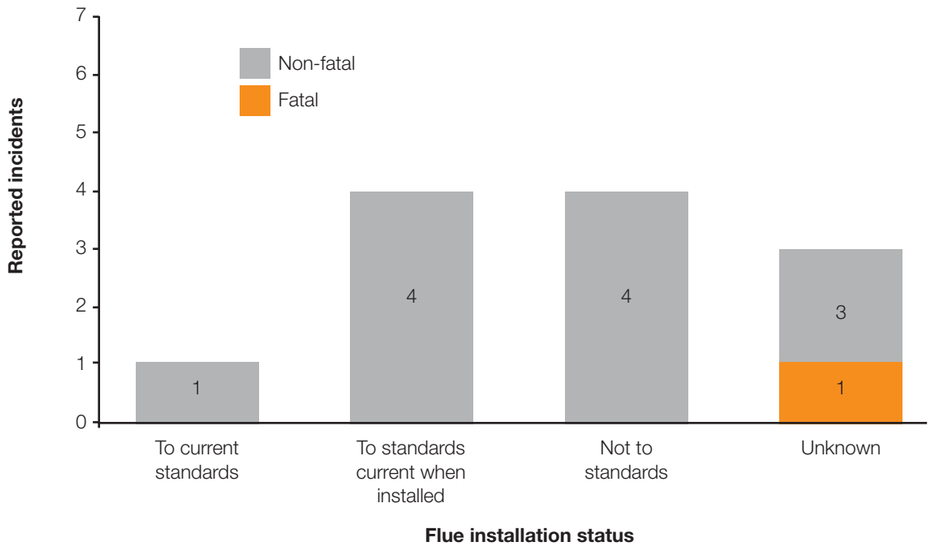
Table 18 shows the numbers of boiler incidents reported this year where the flue status was specified (nine) and the expected number based upon the estimated boiler population in May 2005 and based on equal risk by flue type.

Table 18 Reported and expected incident numbers for boilers by flue type

Boiler flue	Reported number	Expected number
Open flue	4	2
Room-sealed	5	7

Assuming open-flued and room-sealed boilers are equally likely to be involved in an incident, the probability of nine or more incidents occurring by chance is very small (less than 0.5%). It is therefore concluded that boilers with open flues expose occupants to a higher risk of a CO incident, either fatal or non-fatal, and this is at least 3.4 times that associated with room-sealed appliances. This is lower than the corresponding figure reported in 2010/11 which was at least six times.

Figure 20 Incidents by flue standards

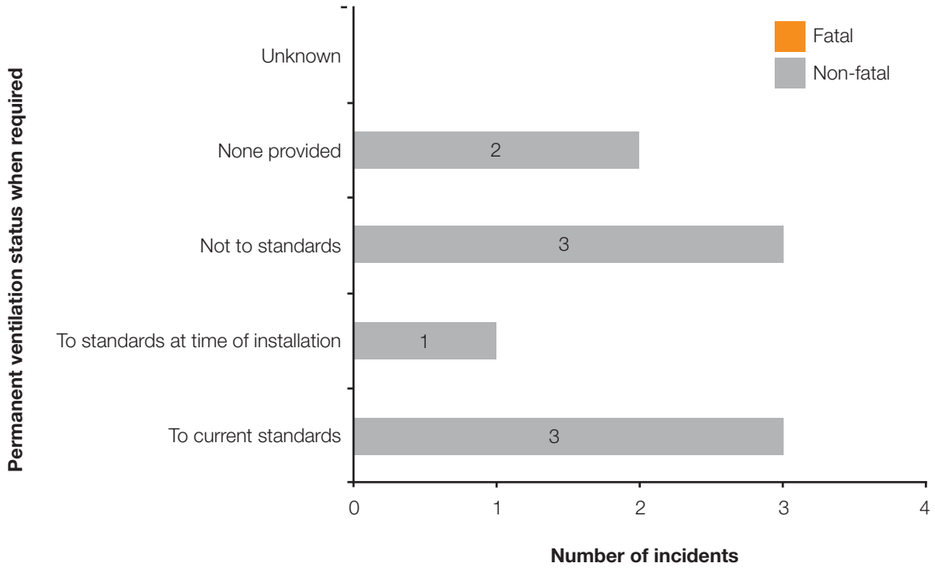


19 Ref 9.

2.10 Permanent ventilation

Nine DIDR forms specified permanent room ventilation was required. The breakdown of reported ventilation provision is summarised in Figure 21. Five out of nine reports stated ventilation was not to standard either at the time of inspection or appliance installation (or was not specified at all).

Figure 21 Incidents by reported ventilation condition



Where ventilation was provided, there were five incident sites at which this was found to be obstructed. A breakdown of those incident sites where partially or totally obstructed vents were reported is given in Table 19.

Table 19 Incidents reported with obstructed ventilation

Number of incidents with:	
Vents intentionally obstructed	1
Vents unintentionally obstructed	2

2.11 Safety devices

The categories of safety device specified on the DIDR forms are CO detectors (chemical spot or battery/mains powered alarm type), downdraught sensors and anti-vitiation devices. Safety devices were reported at 13 sites.

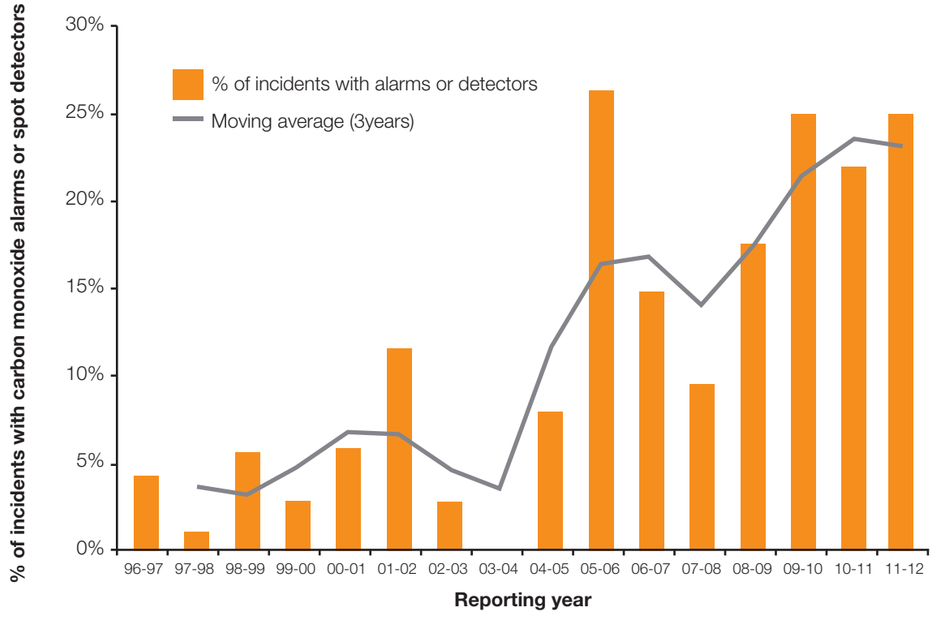
CO electrical alarms were installed at six of the incident sites with five reported to have sounded during the incident. The investigator of the single fatality found the mains alarm unplugged and could not ascertain whether it sounded during the incident.

One anti-vitiation device was identified and reported as not faulty. No downdraught sensors were reported.

Figure 22 shows the percentage of incidents where a CO alarm or chemical spot detector was reported to have been installed for the years since 1996. Prior to 2004/5 the average proportion of incidents where alarms or detectors were installed was around 5% and this had risen to over 20% by 2010/11. The graph shows a 3-year moving average centred on the middle year. The moving average for 2011/12 is the average of 2010/11 and 2011/12.

CO detectors were found by investigators at 25% of incident sites this year. This was a similar proportion to those found in 2009/10 and 2010/11 (25% and 22% respectively). Five of the Six CO alarms found this year were reported to have sounded during the incident.

Figure 22 Percentage of incidents with CO alarms or detectors



2.11.1 Discussion

This year, there has been further evidence that CO alarms may be helping to reduce the number of incidents reportable under RIDDOR. Seven instances were identified during which the alarm sounded and alerted the occupants before they were harmed. Subsequent investigations confirmed the appliances/installations involved were causing excessive amounts of CO to be discharged into the properties. In 2009/10 and 2010/11, five and three similar situations respectively were brought to the attention of British Gas.

The 2011/12 information has therefore been positive in terms of CO alarms providing occupants with a forewarning of CO building up. This year, however, one incident appears to have been escalated to RIDDOR reportable status by the Emergency Response operative advising the occupants to go to hospital. This obviously precautionary measure nevertheless raises the potential for a CO alarm to generate a RIDDOR reportable incident.

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

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. The results are broken down by category in Figure 23 and Table 20. There was a wide range of faults but it should be remembered that these have not necessarily caused the incident.

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

Figure 23 Reported faults by type

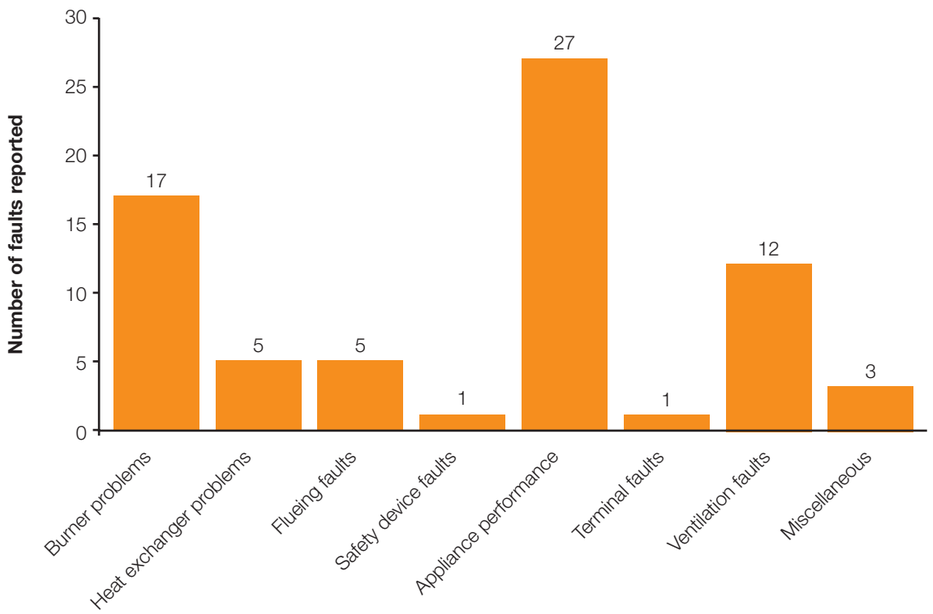


Table 20 Incident appliance/installation faults

Fault group	Number of faults	Fault group	Number of faults
Burner		Appliance performance	
Corrosion	2	High CO/CO_2 ratio	10
Defective flame picture	8	Failed spillage test	4
Linting	5	Overrated	2
Over-pressure	1	Underrated	0
Under-pressure	0	Signs of spillage – inside or outside	11
Other	1	Terminal	
Flue		Down draught	0
Blockage	1	Bad siting	1
Corrosion	0	Unapproved design	0
Flue not to any standard	0	Other	0
Installation fault	4	Ventilation	
Other	0	Air vent/vents ineffective	3
Heat exchanger		Air vents obstructed - intentionally	1
Blockage - shale	3	Air vents obstructed - unintentionally	2
Blockage - soot	2	Compartment not to any standards	1
Cracked	0	No permanent ventilation provided	2
Other	0	Ventilation was not to any standard	3
Safety device		Miscellaneous	
CO inoperable alarm†	1	Local topography	1
Failed down draught detector	0	Weather	2
Failed vitiation device	0		

Note to Table 20:
The number of faults (not incidents with a fault) and it is evident that there is likely to be more than 1 fault existing per appliance.
† CO alarm was deemed as inoperable as it was found unplugged.

The greatest numbers of faults reported were related to appliance performance. From Table 20 it can be seen that there were 10 instances of a high CO/CO_2 combustion ratio and 11 instances where signs of spillage were present were observed by investigators and were reported to have been associated with the appliances from eight incidents.

2.13 Incident appliance history

Service history details were reported for 18 incidents and details are given in Table 21.

Table 21 Details of service history

Service history status	Number of incidents	Number of fatalities	Number of non-fatalities
On a regular service contract	3	0	6
Not on a regular service contract	6	0	13
Unknown if on a regular service contract	9	0	17
Total where the service history was known (sum of three rows above)	18	0	36
Total reported incidents	24	1	46

The registration status of the gas operative who attended the installation prior to the incident is given in Table 22. A working visit is a visit other than the original installation.

Nearly half of the incidents with a prior working visited reported (eight) had a working visit at most 12 months prior to the incident. Of these eight working visits two were for a service, two for a breakdown and four for a Landlord's Safety Check. Seven of these eight visits were by registered operatives.

Table 22 Status of operator at last working visit

	Number reported	Number of fatalities	Number of non-fatalities
Non-registered operative	0	0	0
Registered operative	8	0	15
Other	1	0	4
Unknown	9	0	17
Total for all incidents	24	1	46

Warning notices classify a situation as immediately dangerous (ID), at risk (AR) and not to current standards (NCS)[20]. No warning notices had been left prior to the incidents.

Nearly half of the incident sites (eight) that were reported as having had a prior working visit had received such a visit within 12 months of the incident (Table 23). Two of the visits were for a service, two were for a breakdown and four involved a Landlord's Safety Check. Seven of these visits were by registered operatives.

20 The Gas Industry Unsafe Situations Procedure. Ref 11.

Table 23 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-fatalities
Less than 6 months	5	0	11
6 months to 1 year	3	0	6
1 year to 2 years	0	0	0
More than 2 years	3	0	9
Unknown	4	0	6
Not applicable	3	0	4
Total with appliance history	18	0	32
Total of all incidents	24	1	46

2.13.1 Discussion

It would be expected that operatives visiting a property in the 12 months prior to an incident (at least 24 noted in 2009/10 and at least seven in 2010/11) would be leaving the appliance working safely and operating satisfactorily. If all due care was taken, appliance failure in the period soon afterwards would typically be a result of misuse or particularly extreme adverse weather conditions.

It would be reasonable to expect that an appliance which had been *serviced* would be safe for a year after a working visit by an operative. However, for a non-service related visit or a service visit that was not conducted in compliance with the appliance manufacturer's instructions, the time for which the installation would be expected to work safely and operate satisfactorily cannot be guaranteed.

It would be anticipated that a service visit where the combustion performance measurement was made would generally mean a boiler would remain operating with satisfactory combustion until the next service was due. It would not necessarily be anticipated that such satisfactory combustion would follow a Landlord's Safety Check or an on demand visit that did not involve carrying out a service. See also Section 2.4.1.1 for commentary on further discussion relating to the potential virtues of regular appliance servicing and also CO alarm protection.

The issue of non-registered gas operatives attending properties remains a concern. One such attendance occurred in 2010/11 and was reported to have been by an occupant's relative. It is unclear whether the relative was registered or not. There have been only 3 years since 1996 where non-registered operatives attending a property prior to an incident have failed to feature in the annual CO incident statistics.

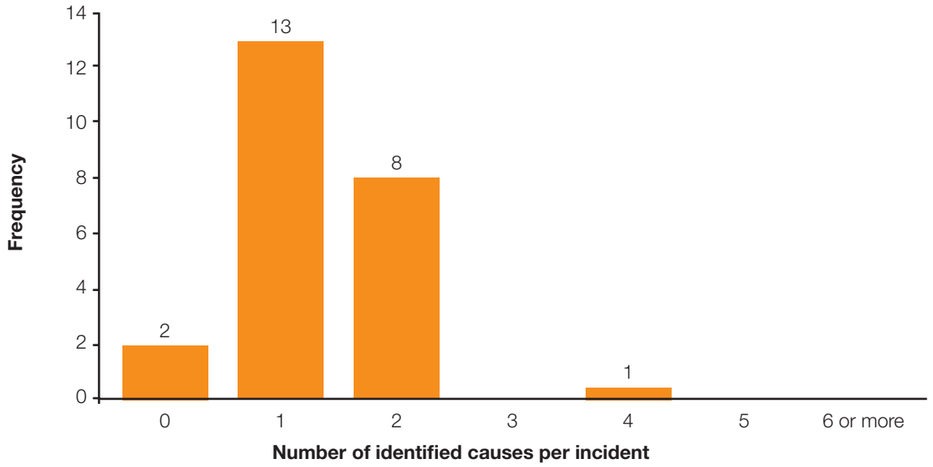
2.14 Incident cause or causes

Details of the causes of reported incidents are summarised in Figures 24 and 25. It should be noted that these causes are different from the general faults discussed in Section 2.12.

Figure 24 shows the distribution by the number of causes reported per incident. For example, a single cause was recorded for 23 incidents whilst a further eight had two causes specified. "Zero causes" means there had been no cause specified.

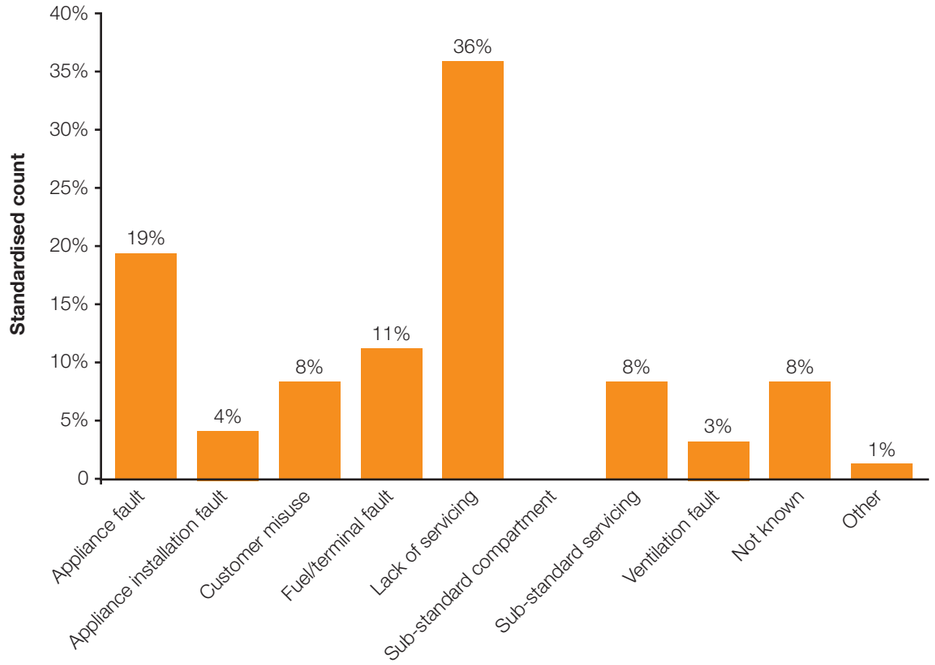
Experience has tended to suggest that incidents occur when a number of events occur simultaneously resulting in the production of CO and leading to its discharge into a property. This year, like last year, a sizeable number of incidents were reported as having a single cause (13 out of 24). Lack of servicing was the most frequently reported fault, although when only one fault was identified this was most frequently reported to be due to flue or terminal issues.

Figure 24 Distribution of the number of stated causes



In Figure 25 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 (24). For example, if there were three causes reported for one incident, each of the three causes would represent a third of a count.

Figure 25 Reported causes



If all causes were equally likely, the contribution score for each of the causes detailed in Figure 25 would be 10%, so groups with a contribution score above 10% constitute a higher contribution than average.

Lack of servicing was the most common cause specified by investigators with a standardised count of over a third of incidents (36%), followed by appliance fault (19%) and flue terminal fault (11%). The other remaining causes were less frequently specified. One cause reported was a disconnected concentric room-sealed flue system which had separated in the void above the ceiling.

These are the same top three as 2010/11 but the order has changed with lack of servicing by far the biggest contributor, implicated in a third of all incidents.

Reports of customer misuse of an appliance (8%) as the cause of an incident, all related to cookers, were similar to 2010/11 (9%) and 2009/10 (7%) but were less compared to 2008/9 (13%). Customer misuse in 2011/12 was using the cooker for a prolonged period as a heater and two cases of uncleaned hobs where the dirt was adversely affecting the burner combustion.

Sub-standard compartments reportedly causing an incident had the contributory score of 1% for 2009/10 and 2010/11. It was zero in 2011/12. Although the gas industry has known for some time that sub-standard installations in compartments can cause a more rapid generation and spread of CO around a property compared to those not installed in a compartment, this has rarely been specified by investigators as the cause of an incident for at least the last 4 years.

3 Conclusions and recommendations

i) Those renting from private landlords have been shown to be more at risk than those in other occupancy types. There are a number of ways this issue could be addressed, e.g. requiring regular appliance servicing as the means of maintaining the appliance in a safe condition and considering mandatory installation of CO alarms in such tenanted properties ensuring there is an appropriate replacement schedule for these detectors (e.g. noting an alarm exists and any requirement for replacement on the Landlord's Safety Check form).

ii) Anyone in control of an investigation should ensure the time taken between incident notification (as required under RIDDOR regulations) and investigation is kept to a minimum to reduce the chances of an incident appliance being replaced or repaired before the investigation can be conducted.

iii) This year, information continues to be submitted by investigators working on behalf of the oil and solid fuel sectors. However, this is not considered to be as extensive as it could be, particularly in respect of the solid fuel sector. If the current absence of regulations driving incident investigation to be carried out is addressed, and in particular the responsibility assigned for funding this in these sectors, far more information would be forthcoming upon which to base measures aimed at improving safety.

iv) The downward trend in the numbers of fatalities during 2011/12 based upon authoritative and authenticated information confirms the progress made by the gas industry in improving the safety of domestic gas users. It is recommended that the key issues (i.e. number of fatalities, non-fatal casualties and incidents) are communicated nationwide in context and there is no attempt to suggest the gas industry is disproportionately unsafe when compared with other areas including disposable barbecues, fires, the solid fuel and oil-fired energy sectors and fuel gas which is not piped or mains supplied.

v) Figures for CO incidents are constantly being quoted which do not put into context the facts relating to which fuel sector they refer. If care was taken to ensure the figures for the relevant fuels only were used, this would help to focus regulatory attention on those sectors where risk to personal injury was greatest.

vi) Incidents involving open flued boilers again figured disproportionately and this year represented at least 3.4 times the risk of being involved in a RIDDOR reportable incident than one with a room-sealed boiler. Bearing in mind that such a trend has persisted since the collation of detailed CO incident data began in 1996 and the only fatality this year involved and open flued gas fire this serves to emphasise the importance for the regular servicing (as per manufacturer's instructions) of all open flued appliances.

4 References

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Appendix A: LPG incident information received via DIDR forms

One LPG incident was reported to Downstream Gas during the 2011/12 reporting period.

The incident occurred in the Cleethorpes, Lincolnshire (DN35) on the 1st February 2012. A 52 year old woman was fatally poisoned by carbon monoxide produced by a flueless room heater in a privately rented converted flat with partial double glazing which was built between 1946 and 1965. The appliance was fuelled by bottled LPG. The reported cause was an appliance fault (defective flame picture) and lack of servicing.

A man and woman in a neighbouring property were non-fatally injured; the extent of the injury is not known and therefore likely to be minor.

Appendix B: DIDR non-domestic incidents

Three non-domestic incidents that were reported in detail were received and all three involved natural gas.

The first incident occurred on the 11th November 2011 in the EN3 postal area of Enfield, Middlesex, affected eight males (none fatally) on the factory floor caused by a second hand closed pizza bread oven that had been used prior to commissioning. It was installed in 2011 by a Gas Safe Registered operative. An airborne concentration of 442ppm of CO was detected in an upstairs office. The causes were reported to be a faulty flue/terminal and customer misuse.

The second incident occurred on 18th October 2011 in the Dartford area during a bell ringing practice in a church. It resulted in two females and five males in the bell ringing chamber requiring immediate hospitalisation for less than 24 hours. No fatalities occurred. The CO was produced by a 146kW Crane floor standing boiler manufactured in 1984 and located in the basement. The reported cause was a flue installation fault as the flue/chimney was not safely connected.

The third incident occurred on the 13th February 2012 in a community sports centre in the Harlow area of Essex. It resulted in three females requiring non-hospital treatment. The Broag Remeha wall mounted condensing regular boiler was producing high levels of CO. It had been installed by a registered operative in 2005 but not in accordance with the manufacturer's instructions or appropriate standards. It was reported that five flue terminals were positioned too close together on the roof. Although the ventilation was adequate the boiler produced 456ppm CO in the studio due to a disconnected flue.

Appendix C: Past incidents previously unreported

The death on 29th December 2010 was caused by CO poisoning of a 22 year old woman in Bath. The CO was produced due to a poorly installed gas fired condensing boiler. The registered installer was prosecuted and found guilty in 2012. The boiler was installed in the bathroom of a flat. The fatality was included in the overall statistics in the previous annual report. It is only since the completion of the trial that the above details have been released.

A double fatality (32 and 34 year old males) occurred in the Plymouth area on 13th November 2010. Press reports of the inquest confirmed the incident was accidental and the result of a cooker being used with the grill door shut. The make of cooker had been involved in previous incidents when used in this manner and had been the subject of a recall. These fatalities were not included in last year's overall statistics and so the historical data in this report has been updated accordingly.

A single fatality reported to the Walsall Police, involving LPG, occurred on 28th March 2011. The exact fuel has not been specified although it is likely to have been bottled LPG.

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 more than 20 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.

Regulation

The Gas Safety (Management) Regulations place 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.

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.

Reporting forms completed by HETAS

One CO report was received from a HETAS investigator. The details from this non-fatal incident are:

One male and one female from the Exeter area required hospital treatment on 18th May 2012. The incident occurred in an owner-occupied house with double glazing and solid floor construction built between 1946 and 1965. The appliance involved was an AGA range cooker (double oven) using natural smokeless mineral fuel. The 100mm diameter flue pipe was too small and should have been 125mm diameter. It had been installed in the previous 6 months by a member of the HETAS Competent Persons Scheme. A CO alarm sounded during the incident.

Reporting forms completed by OFTEC

Three CO reports were received from OFTEC investigators. All were non-fatal incidents and no-one require hospital treatment. One of the incidents was on the Isle of Man, one in the Truro area and one in Northern Ireland (NI). The incident details are:

i) One adult and two young children were involved in the incident which occurred on 18th March 2012. The property was a privately rented detached house with double glazing and a solid floor, built between 1946 and 1965. The appliance involved was reported to be in a poor condition despite recent visits by a non-OFTEC engineer. It had been poorly installed, the flue system was unsatisfactory and there was inadequate ventilation.

ii) This incident which involved one male aged 23 and a 60 year old female occurred in the Truro area on 23rd February 2012. The property was a detached bungalow built in 1987 with double glazing and a solid floor. The appliance was a floor standing boiler and the vertical flue section in the loft was not adequately supported and was not continuous. The break had not been identified when the boiler was serviced.

iii) This incident involving a 50 year old male occurred in NI on the 10th October 2011. The property was an owner occupied detached house built around 1900 with single glazing and solid floor. The appliance involved was a cooker with a conventional natural draught open flue. Ventilation was not to the required standard. A CO alarm sounded during the incident. The investigator reported the cause to have been a faulty flue.

Details of two further incidents involving domestic oil-fired installations were received although neither involved burnt fuel.

It should be remembered that the GSMR do not apply in NI and hence no gas related incidents in the Province form part of this report. However, OFTEC does have offices in NI and therefore for the purposes of this report any oil related CO incidents that have been reported there have been included.

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. To date 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.

The CO incident data forms completed by HETAS and OFTEC investigators have provided the details presented below in Table D1. These figures should be viewed as minimum numbers given the lack of regulation that exists to drive the reporting and full investigation of such incidents.

Table D1 Incident numbers reported by HETAS and OFTEC

	GB households at risk, in 1000s	GB population at risk, in millions	Fatalities, per year	Non-fatal injuries, per year	Incidents, per year
Oil	946	2.3	0	5	2
Gas	22,300	52.2	1	46	24
Solid fuel	1800	4.32	0	2	1

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

	Risk of a carbon monoxide incident per million people per year		
	Fatalities	Non-fatalities	Incidents
Oil (GB)	<0.44[21]	2.20	0.88
Oil (NI)	<1.98[21]	1.98	1.98
Gas (GB)	0.019	0.86	0.45
Solid fuel (GB)	<0.232[21]	0.463	0.231

The risk of a non-fatal casualty as a result of a CO incident occurring in GB associated with operating a domestic installation using solid fuel is therefore at least 0.54 times greater than one which uses natural gas. The risk of an incident occurring in a domestic installation using solid fuel is at least 0.51 times greater than one using natural gas.

Similarly, the risk of a non-fatal casualty as a result of a CO incident occurring in GB associated with operating a domestic oil-fired installation is at least 2.5 times greater than one which uses natural gas. The risk of an incident occurring in a domestic property using a domestic oil-fired installation is at least 1.9 times greater than one using natural gas.

The risk values specified above for both oil-fired and solid fuel domestic installations rely upon all incident information having been made available. As the legal requirements for these two energy sectors are not covered by RIDDOR and GSMR, the actual risk values are likely to be greater than those quoted.

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.

21 When no fatalities occurred all that can be deduced is that the calculated risk is less than the value based on one fatality per year.

Appendix E: Carbon monoxide incident data for mains natural gas from 2011/12 compared with information from previous years

The information presented in this section allows a pictorial comparison to be made between this year and recent years (2008/9, 2009/10, 2010/11).

Figure E1 Incidents reported in 2011/12 compared with those reported since 2008/9

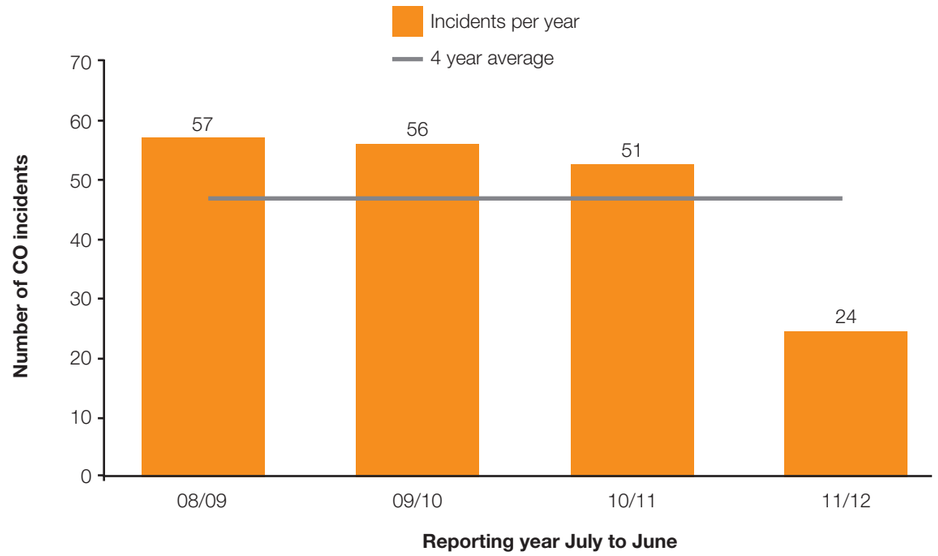


Figure E2 Injuries reported in 2011/12 compared with those reported since 2008/9

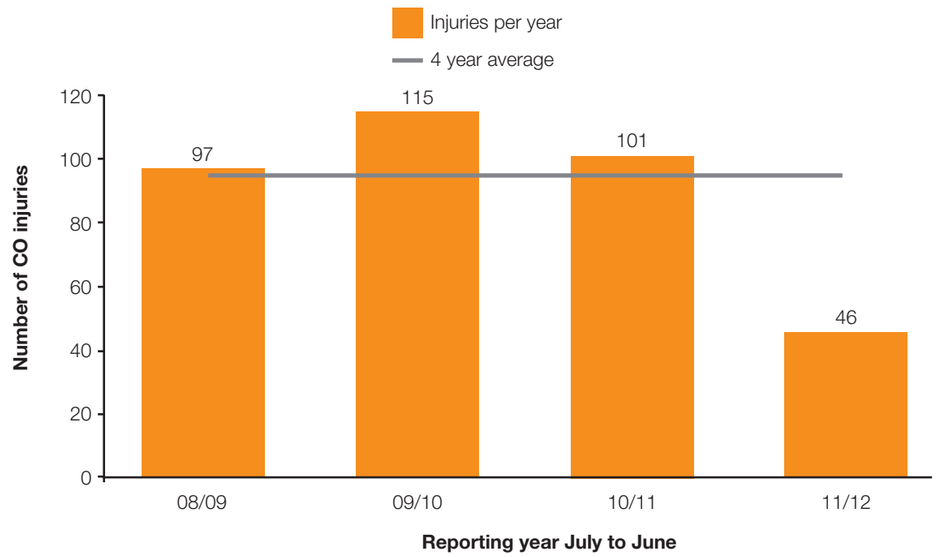


Figure E3 Fatalities reported in 2011/12 compared with those reported since 2008/9

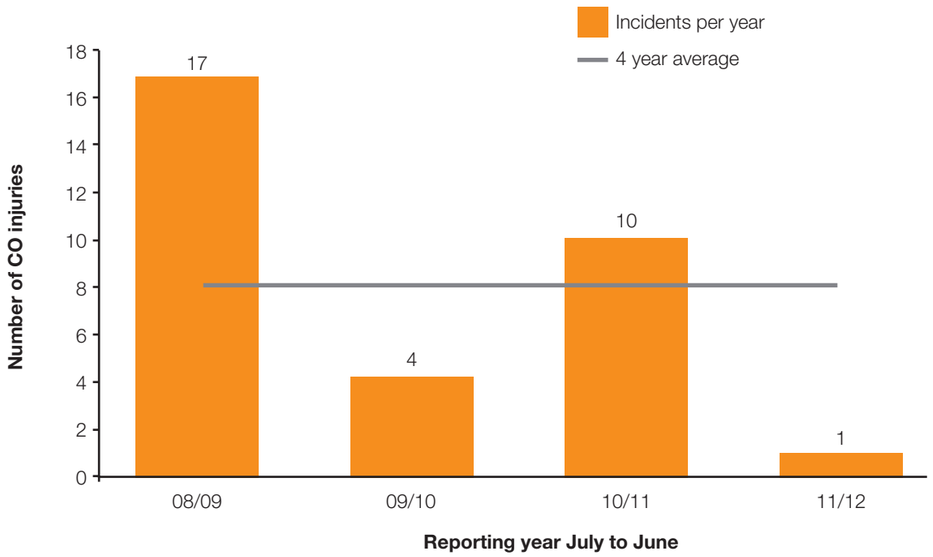
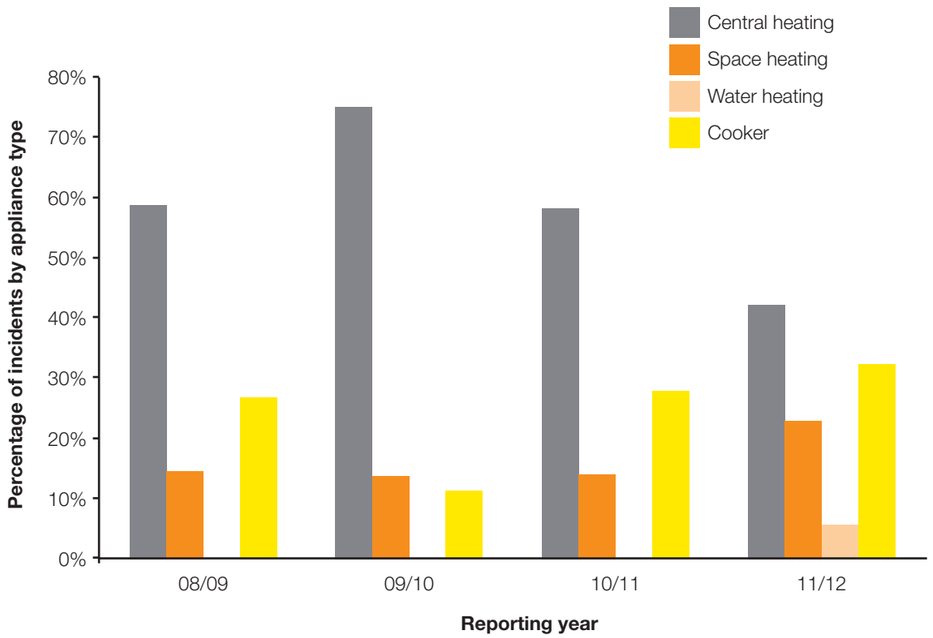


Figure E4 Incidents by appliance type for 2011/12 compared with those reported since 2008/9



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