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CO Alarms - Cost Benefit Analysis - Final

Prepared by Adroit Economics

For and on behalf of

Welsh Government

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1. Introduction

- 1.1 This report sets out the results of a cost benefit analysis of the Welsh Government's (WG) proposals to amend the statutory guidance Approved Document J (ADJ) so that carbon monoxide alarms must be fitted alongside the installation of flued fixed combustion appliances of any fuel type.

2. Summary

Policy proposal considered.

2.1 The policy proposal considered and assessed relative to the counterfactual:

- Requirement to fit CO alarms with new or replacement boilers, fires, flued fixed cookers, and high-risk rooms;

Costs

2.2 Table 2.1 sets out the total costs (transition, capital, and installation costs) for the policy proposals:

- the analysis estimates £19.17m present value capital and installation costs for the mid scenario (ranging from £16.71m to £21.82m for the low and high scenarios);

Table 2.1: Total Costs	Total Costs (10 year) £m			Annual Costs (EAC) £m		
	Low scenario	Mid scenario	High scenario	Low scenario	Mid scenario	High scenario
CO alarms with new or replacement boilers, fires, flued fixed cookers, and high-risk rooms	£16.71	£19.17	£21.82	£1.94	£2.23	£2.53

Benefits

2.3 Table 2.2 shows the present value of the estimated health benefits of the policy. Research into hospital admissions has identified that some carbon monoxide poisonings are being wrongly diagnosed and therefore under-reported. The range in benefits reflect the uncertainty about the health impacts of CO poisoning associated with fixed flue combustion appliance.

Table 2.2: Benefits	Total Benefits (20 year) £m			Annual Benefits (EAB) £m		
	Low scenario	Mid scenario	High scenario	Low scenario	Mid scenario	High scenario
CO alarms with new or replacement boilers, fires, flued fixed cookers, and high-risk rooms	£20.70	£35.03	£51.20	£2.21	£3.74	£5.47

Net policy benefits

2.4 Table 2.3 sets out the present value of the net policy benefits:

- the analysis estimates present value net policy benefits of £15.86m for the mid scenario (ranging from net costs of -£1.12m to net benefits of £34.50m for the low and high scenarios);

Table 2.3 Net Benefits	Total Net Benefits (PV) £m			Annual Net Benefits (EANC) £m		
	Low cost/high benefit scenario	Mid cost/mid benefit scenario	High cost/Low benefit scenario	Low cost/high benefit scenario	Mid cost/mid benefit scenario	High cost/Low benefit scenario
CO alarms with new or replacement boilers, fires, flued fixed cookers, and high-risk rooms	£34.50	£15.86	-£1.12	£3.69	£1.69	-£0.12

3. Context and Policy Proposals

Current requirements

- 3.1 Currently, carbon monoxide alarms must be installed in all residential buildings when a fixed solid-fuel burning appliance, like a log burning stove, is installed. This requirement is set out in Building Regulations Approved Document J.
- 3.2 The current requirement in building regulations for alarms for solid-fuel heating was introduced prior to the devolution of the Building Regulations. This was undertaken based on cost-benefit analysis, undertaken by the UK Government, which showed the benefits to installing alarms for solid-fuel appliances to be greater than for gas and oil appliances.

Recent evidence

- 3.3 Since the requirement was introduced, the following evidence has been identified:
- The original cost-benefit analysis which supported the introduction of CO alarms for solid fuel stoves only, is now outdated, with carbon monoxide alarms being cheaper and more efficient than they had been previously;
 - The regulations, which separate the requirement for solid fuel from other combustion appliances have been considered unnecessarily complex by The All-Party Parliamentary Carbon Monoxide Group. While this is a UK forum, the same standards apply in all nations, meaning the criticism is equally placed on the current Welsh legislation;
 - Research into hospital admissions has identified some carbon monoxide poisonings are being wrongly diagnosed and therefore under-reported.

What other administrations are doing

- 3.4 England announced changes to regulations covering CO alarms on 23 November 2021. Part J of the building regulations now requires CO alarms to be fitted alongside the installation of fixed combustion appliances of any fuel type (excluding gas cookers). The announcement also covered legislative changes for landlords that are being considered separately in Wales.
- 3.5 In Scotland, from February 2022 where there is a carbon-fuelled appliance (such as boilers, fires, and heaters) or a flue, then a CO alarm is required. This requirement has been taken forward by housing standards legislation, rather than via building regulations as it applies to both new and existing dwellings. As the policy applies to all houses with no identified regulatory body, enforcement of the policy is only expected to be undertaken when a house is sold.

Policy proposals

3.6 Welsh Government proposes to amend the statutory guidance (Approved Document J) so that carbon monoxide alarms must be fitted alongside the installation of combustion appliances of any fuel type.

3.7 The option being considered:

Requirement to fit CO alarms with new or replacement boilers and fires

- The following will be covered: oil, gas (including LPG), solid fuel;
- All appliances that have a flue are covered. This also means that cookers that contain a flue (such as a combination oil cooker/boiler) will also be covered;
- Non-fixed appliances (such as non flued cookers) are not included as these are outside of the control of Building Regulations.
- a CO alarm is required in any space connected to the dwelling such as a garage space which is attached to the dwelling (i.e., not detached garages).
- a CO alarm is also required within any high-risk room (e.g., bedroom/living room) if the flue from an appliance runs through that room.
- The building regulations will not specify if the alarm type must be battery or hard wired.

Phase in proposals

3.8 Welsh Government proposes that the start of the policy will be 2023, with a short phase in period.

Appraisal period

3.9 This appraisal covers a ten-year policy period and an additional ten-year benefits period.

Taking account of Part L

3.10 Numbers of alarms take account of the proposals for Part L 2025 that will require new housing to use low carbon heating and the UK Government proposed phase out of gas boilers in 2035.

4. Approach and methodology

4.1 This section sets out the principal steps and key considerations used to estimate the impact of the policy proposals.

Number of dwellings affected

- Housing stock is split by tenure;
- The percentage with each type of combustion appliance is estimated;
 - = Solid fuel;
 - = Boilers;
 - = Gas fires;
 - = Gas cookers within new dwellings;
- The installation rate and replacement rate of combustion appliances is estimated;
- The counterfactual - % installed with CO alarms - is estimated.

Types of costs considered

- Installation costs (0.25hr per CO alarm);
- Supply costs (£12.76 per CO alarm¹).

Types of benefits considered

- The number of fatalities and non-fatal casualties related to CO poisoning for each appliance type under the counterfactual is estimated;
- The effectiveness of CO alarms at reducing incident rates is estimated;
- The value of avoided fatalities and non-fatal casualties is estimated (using DfT figures 2023 prices).

4.2 The appendices provide further details of the methodology, the sequence of calculations undertaken and the assumptions, metrics, and their sources.

Appraisal period

- 4.3 Costs and benefits are assessed over a 20-year period (2023-2042) as follows:
- A 10-year policy period (2023-32) during which additional CO alarms are installed;
 - The impact of which is assessed over the assumed lifespan of each CO alarm installed (7-10 years, following installation) as a result of the policy.

¹ the analysis assumes a carbon monoxide alarm compliant to British Standard Institute standards (British Standard BS EN 50291) and powered by a battery designed to operate for the working life of the alarm

Discount rates used

- 4.4 The results are presented in present value terms using the HM Treasury's standard discount rates:
- Non-Health impacts – 3.5% for the first 30 years and 3.0% for the subsequent years;
 - Health impacts – 1.5% for the first 30 years and 1.0% for the subsequent years.

5. Costs

Types of cost considered

5.1 The following types of cost have been considered in the analysis:

- Transition costs – time cost of firms' employees to familiarise themselves with the new policy;
- Purchase (capital) cost of a new alarm;
- Installation time costs.

5.2 Monitoring and enforcement costs have not been assessed (in this or the England IA) as there is no requirement in the building regulations to monitor or enforce.

Transition cost calculations

5.3 The analysis makes the following assumptions to estimate transition costs:

- 7,280 installers (Gas Safe and OFTEC) and 200 building inspectors will need to familiarise themselves with the changed regulations;
- 0.25hr per person is assumed to be required to familiarise with the requirements
- Monetised at an hourly rate of £65 for installers and £65 for building inspectors.

5.4 Table 5.1 sets out the estimated transition costs for the policy:

- The analysis estimates £0.12m present value transition costs for the policy.

Table 5.1: Transition Costs	Transition Costs (10 year) £m			Costs (EAC) £m		
	Low scenario	Mid scenario	High scenario	Low scenario	Mid scenario	High scenario
CO alarms with new or replacement boilers, fires, flued fixed cookers, and high-risk rooms	£0.12	£0.12	£0.12	£0.01	£0.01	£0.01

Purchase (capital) and installation costs calculations per alarm

5.5 Table 5.2 shows how the costs of installing each additional CO alarm were calculated.

Table 5.2: Installation costs – per alarm	
Hourly rate for installer (£ per hour)	£65
Time to installer alarm (hr)	0.25
Purchase (capital) cost of alarm	£12.76

Appliance installation assumptions

5.6 For each appliance type (solid fuel, boilers, gas fire and gas cookers within new dwellings), the analysis makes assumptions about the proportion of dwellings that have each appliance type and applies an assumption about the rate at which new appliances are installed and existing appliances are replaced.

Boilers

5.7 The proportion of dwellings with boilers is based on data from the housing conditions survey, showing that 96% of social and owner-occupied dwellings and 88% of private rented dwellings having central heating systems. These proportions are also applied to new build up until 2025. Beyond 2025, the analysis assumes that no gas boilers are installed in new dwellings after 2025 reflecting the proposals for Part L 2025 that will require new housing to use low carbon heating.

5.8 The analysis assumes that 5% of existing boilers are replaced per annum.

Fires

5.9 The Housing Condition Survey indicates that 38% of owner occupiers, 18% of private rented and 16% of social rented had gas fires.

5.10 The analysis assumes that 5% of these fires are replaced per annum

Cookers within new dwellings

5.11 Combustion fuel ovens and hobs are assumed to be installed in 33% of new dwellings based on industry data².

Number of additional alarms required for the policy proposals, over and above the counterfactual

5.12 Under the counterfactual, the analysis assumes that CO alarms are being installed alongside a proportion of combustion appliance installations:

- Boilers and Gas Fires: 50%³

² https://www.amdea.org.uk/industry-information/market-information/chart-1_market-information-140819_6/

³ assumption that half of households will take up recommendations from boiler installers (e.g. British Gas) based on Housing Conditions Survey data indicating that 43-51% of households have CO monitors installed

- Cookers within new dwellings: 10%⁴
- 5.13 The analysis also assumes that a proportion of CO alarms will be replaced at the end of their lifespan:
- Owner occupied – 50% of alarms replaced⁵;
- 5.14 Under the policy proposals, CO alarms will be required when fixed combustion appliances are installed or replaced. They will be required in the room (or space connected to the dwelling – e.g., connected garage space) in which the combustion appliance is installed and in any high-risk room (e.g., bedroom/living room) if the flue from an appliance runs through that room.
- 5.15 The analysis applies assumptions to estimate the number of high-risk rooms with a flue that runs through that room.
- The analysis assumes that modern dwellings are unlikely to have flues that run through high-risk rooms. Welsh Government house conditions data that indicates that 75% of dwellings in Wales were constructed pre 1981 has been used to estimate the proportion of older dwellings. The analysis applies an assumption that 10-30% of older dwellings have a flue that passes through a high-risk room.
 - Conversions will also create new high-risk rooms in existing dwellings which would be in scope of the policy, such as loft conversions. Planning applications data published in England indicates that approximately 0.75% of dwellings are granted permission for householder developments annually. Householder developments include loft conversions, extensions, and conservatories. The analysis assumes that this is evenly split between the 3 categories, which suggests that about 0.25% of dwellings having a loft conversion per annum (4000 p.a. in Wales).
- 5.16 Based on the above methodology, sources and assumptions, the analysis calculated the number of additional CO alarms required by the policy proposal, over and above the counterfactual are estimated as follows:
- Mid estimate of 77,000 pa. (low: 67,000 p.a. and high 87,000 p.a.);
- Total additional capital and installation costs, over and above the counterfactual**
- 5.17 Table 5.3 shows the estimated total capital and installation costs for the policy proposal:
- the analysis estimates £19.05m present value capital and installation costs for the mid scenario (ranging from £16.58m to £21.69m for the low and high scenarios;

⁴ Consultants assumption

⁵ FHH Regulations require carbon monoxide alarms to be installed and maintained in rooms with a combustion appliance. Therefore, replacement costs of CO monitors in rented accommodation are not attributed to the Building Regs policy

Table 5.2: Capital and Installation Costs	Capital and Installation Costs £m			Costs (EAC) £m		
	low	Mid	high	low	Mid	high
CO alarms with new or replacement boilers, fires, flued fixed cookers, and high-risk rooms	£16.58	£19.05	£21.69	£1.93	£2.21	£2.52

Total costs – transition, capital, and installation costs

5.18 Table 5.3 sets out the total costs (transition, capital, and installation costs) for the policy proposal.

- the analysis estimates £19.17m present value capital and installation costs for the mid scenario (ranging from £16.71m to £21.82m for the low and high scenarios;

Table 5.3: Total Costs	Total Costs (10 year) £m			Costs (EAC) £m		
	low	Mid	high	low	Mid	high
CO alarms with new or replacement boilers, fires, flued fixed cookers, and high-risk rooms	£16.71	£19.17	£21.82	£1.94	£2.23	£2.53

6. Benefits

Types of benefit considered.

6.1 Two types of benefit have been considered in the analysis:

- Reduced/avoided fatalities;
- Reduced/ avoided injuries – both major and minor injuries.

Numbers of fatalities and injuries

6.2 ONS data indicates that there are 14 fatalities as a result of CO poisonings that occur at home in England and Wales in 2021. Reports indicate that there are a further 200 serious injuries and at least 4,000 minor injuries.

6.3 The analysis applies the proportion of casualties related to each appliance type to the estimated number of fatalities and injuries:

- Central heating boiler: 43%;
- Gas fires: 14%;
- Cookers within new dwellings: 5%.

Avoided fatalities and injuries

6.4 The analysis assumes that CO alarms reduce the risk of CO poisoning by 75%⁶

6.5 Applying this assumption to the estimated number of additional CO alarms installed indicates that over the 20 year appraisal period, the policy could prevent:

- 2 fatalities.
- 28-31 serious injuries (mid estimate 29 serious injuries).
- 600-2,100 minor injuries (mid estimate 1,300 minor injuries).

6.6 Table 6.3 shows the mid estimate of avoided injuries and fatalities avoided under the different policy proposal.

Table 6.3: Estimated numbers of fatalities and injuries over the appraisal period (mid estimate)

	Counterfactual	Proposal
avoided fatalities due to alarms		
solid fuel	1	1
boilers	2	3.8
gas fires	1	1.1
cooker	0	0.1
	4	6
avoided injuries/fatalities due to alarms		

⁶ Assumption is based on research that indicates that monitors can reduce the risk of poisoning and the severity of illness. <https://pubmed.ncbi.nlm.nih.gov/32163299/>.

fatalities	4	6
serious injury	53	82
minor injury	2,360	3,637

Value of avoided fatalities and injuries

- 6.7 To monetise the benefits, the analysis applies the value of an avoided fatality and a serious and minor injury (shown in Annex E) to the above estimates of the number of a prevented fatalities and injury.
- 6.8 Table 6.4 shows the estimated present value of the estimated benefits of the policy proposals.

Table 6.4	Benefits (20 year) £m			Benefits (EAB) £m		
	low	Mid	high	low	Mid	high
CO alarms with new or replacement boilers, fires, flued fixed cookers, and high-risk rooms	£20.70	£35.03	£51.20	£2.21	£3.74	£5.47

7. Net Benefits

7.1 Table 7.1 sets out the present value of the net policy benefits of the policy proposals.

- the analysis estimates present value net policy benefits of £15.86m for the mid scenario (ranging from -£1.12m to £34.50m for the low and high scenarios);

Table 7.1 Net Benefits	Net Benefits £m			Net Benefits (EANC) £m		
	Low cost/high benefit	Mid cost/mid benefit	High cost/low benefit	Low cost/high benefit	Mid cost/mid benefit	High cost/low benefit
CO alarms with new or replacement boilers, fires, flued fixed cookers, and high-risk rooms	£34.50	£15.86	-£1.12	£3.69	£1.69	-£0.12

8. Appendix A: Housing Stock, Heating Types and Replacement Rates

8.1 Table 8.1 shows the housing stock estimates used in the analysis.

Table 8.1 Housing Stock						
	yr1	yr2	yr3	yr9	yr10
	2023	2024	2025		2031	2032
	yr1	yr2	yr3		yr9	yr10
new build (completions)	6,400	6,400	6,400		6,400	6,400
owner occupied	1,016,092	1,020,556	1,025,019		1,051,803	1,056,267
private rented	207,738	208,651	209,563		215,039	215,952
social sector	232,970	233,994	235,017		241,158	242,182
Total	1,456,800	1,463,200	1,469,600		1,508,000	1,514,400

8.2 Table 8.2 sets out the housing stock data sources and assumptions used in the analysis.

Table 8.2: Housing stock – data sources and assumptions			
	assumption	source	
net additional dwellings p.a.	6,400	Part L IA	
2020 housing stock - owner occupied	1,002,700	Welsh Government Statistical Bulletin	70%
2020 housing stock - private rented	205,000	Welsh Government Statistical Bulletin	14%
2020 housing stock - social sector	229,900	Welsh Government Statistical Bulletin	16%
2014/19 - social sector new dwellings as % of total	18%	Welsh Government Statistics	
2014/19 - private sector new dwellings - as % of total	82%	Welsh Government Statistics	
of which			
private rented	17%	as above	
private - owner occupied	83%	as above	

8.3 Table 8.3 shows the housing stock by type of heating

Table 8.3: Housing Stock by type of heating		
2017 % of households with central heating		
owner occupied	96%	Housing Conditions Survey
private rented	88%	Housing Conditions Survey
social sector	96%	Housing Conditions Survey
2016 % of households with solid fuel appliance		
owner occupied	10%	based on domestic wood fuel survey
private rented	10%	based on domestic wood fuel survey
social sector	10%	based on domestic wood fuel survey
2016 % of households with gas fire		
owner occupied	38%	2013 EHS Table 4.9
private rented	18%	2013 EHS Table 4.9
social sector	16%	2013 EHS Table 4.9

8.4 Table 8.4 shows the annual replacement rate of appliances assumptions

Table 8.4: annual replacement rate of appliances		
annual replacement of solid fuel appliances	5%	Adroit central assumption of average 20 year lifespan
annual replacement of boilers	5%	Adroit central assumption of average 20 year lifespan
annual replacement of gas fires	5%	Adroit central assumption of average 20 year lifespan

9. Appendix B: Counterfactual Assumptions

Baseline assumptions

9.1 Table 9.1 shows the proportions of households with a CO alarm/alarm.

Table 9.1: Proportions of households with CO Alarm		
owner occupied	45%	2017-18 Housing Conditions Survey - households with working CO alarm
private rented	43%	2017-18 Housing Conditions Survey - households with working CO alarm
social sector	51%	2017-18 Housing Conditions Survey - households with working CO alarm

9.2 Table 9.2 shows assumptions regarding proportion of new solid fuel installations provided with CO alarm.

Table 9.2: Proportion of new solid fuel installations provided with CO alarm		
		Source
owner occupied	80%	adroit assumption
private rented	95%	adroit assumption
social sector	95%	adroit assumption

10. Appendix C: Lifespan and Replacement of CO Alarms

10.1 Table 10.1 shows assumptions regarding the lifespan of CO alarms and Table 10.2 shows the proportion of households replacing CO alarms at end of life.

Table 10.1: Assumptions regarding the lifespan a CO alarm

	Low	Mid	High	Source
lifespan of CO alarms (years)	10	8.5	7	literature review

Table 10.2: Proportion of households replacing CO alarm at end of life

	Low	Mid	High	Source
owner occupied	50%	50%	50%	adroit assumption

11. Appendix D: Applying the assumptions

11.1 Tables 11.1 to 11.4 show the application of the assumptions to the model:

Modelling the counterfactual

Table 11.1	yr1	yr2	yr3	yr4	Yr5	Yr6	Yr7
	2023	2024	2025	2026	2027	2028	2029

Counterfactual**New Installations****Proportion of new solid fuel installations provided with CO alarm**

owner occupied	80%	80%	80%	80%	80%	80%	80%
private rented	95%	95%	95%	95%	95%	95%	95%
social sector	95%	95%	95%	95%	95%	95%	95%

Proportion of new boiler/gas fire installations with CO alarm

owner occupied	50%	50%	50%	50%	50%	50%	50%
private rented	50%	50%	50%	50%	50%	50%	50%
social sector	50%	50%	50%	50%	50%	50%	50%

Proportion of new gas cooker installations with CO alarm

owner occupied	10%	10%	10%	10%	10%	10%	10%
private rented	10%	10%	10%	10%	10%	10%	10%
social sector	10%	10%	10%	10%	10%	10%	10%

Modelling CO Alarms in all rooms with Combustible Fuel Appliances (excluding cookers within new dwellings)

Table 11.2: CO Alarms in all rooms with Combustible Fuel Appliances (excluding cookers within new dwellings)

	yr1	yr2	yr3	yr4	Yr5	Yr6	Yr7
	2023	2024	2025	2026	2027	2028	2029
New Installations							
Proportion of new solid fuel installations provided with CO alarm							
owner occupied	80%	80%	80%	80%	80%	80%	80%
private rented	95%	95%	95%	95%	95%	95%	95%
social sector	95%	95%	95%	95%	95%	95%	95%
Proportion of new boiler/gas fire installations with CO alarm							
owner occupied	100%	100%	100%	100%	100%	100%	100%
private rented	100%	100%	100%	100%	100%	100%	100%
social sector	100%	100%	100%	100%	100%	100%	100%
Proportion of new gas cooker installations with CO alarm							
owner occupied	10%	10%	10%	10%	10%	10%	10%
private rented	10%	10%	10%	10%	10%	10%	10%
social sector	10%	10%	10%	10%	10%	10%	10%

Modelling CO Alarms in all rooms with Combustible Fuel Appliances (including cookers within new dwellings)

Table 11.3: CO Alarms in all rooms with Combustible Fuel Appliances (including cookers within new dwellings)							
	yr1	yr2	yr3	yr4	Yr5	Yr6	Yr7
	2023	2024	2025	2026	2027	2028	2029
New Installations							
Proportion of new solid fuel installations provided with CO alarm							
owner occupied	80%	80%	80%	80%	80%	80%	80%
private rented	95%	95%	95%	95%	95%	95%	95%
social sector	95%	95%	95%	95%	95%	95%	95%
Proportion of new boiler/gas fire installations with CO alarm							
owner occupied	100%	100%	100%	100%	100%	100%	100%
private rented	100%	100%	100%	100%	100%	100%	100%
social sector	100%	100%	100%	100%	100%	100%	100%
Proportion of new gas cooker installations with CO alarm							
owner occupied	70%	70%	70%	70%	70%	70%	70%
private rented	70%	70%	70%	70%	70%	70%	70%
social sector	70%	70%	70%	70%	70%	70%	70%

13. Appendix E: Benefit Monetisation Metrics

- 13.1 Table 13.1 shows metrics used to monetise the benefits of avoided/reduced fatalities and injuries in the cost benefit analysis. These metrics, originally developed for the Department for Transport are customarily used when valuing fatalities and injuries, across all Government Departments⁷.

Table 13.1: Web Tag Metrics DfT	
Unit Value of Benefits	2023 prices; 2023 base year
Fatal injury	£2,473,479
Serious injury	£275,409
Slight injury	£21,165

⁷ <https://www.gov.uk/government/publications/tag-data-book>

14. Appendix F: Transition Cost Calculations

14.1 Tables 14.1 to 14.4 set out the transition cost assumptions, sources of metrics and calculations.

Table 14.1: number of people needing familiarisation

	number	source
gas safe installers	7,000	assume 5% of total number on gas safe register
OFTEC registered installers	280	assume 5% of total number on OFTEC
Building inspectors	200	assume 5% of England estimate

Table 14.2: hourly rates

gas safe installers	£65	blended rate for engineers
OFTEC registered installers	£65	blended rate for engineers
Building inspectors	£65	blended rate public/private surveyors

Table 14.3: Familiarisation time required

familiarisation time (hr)	proposal	Source	Assumptions
gas safe installers	0.25	adroit estimate	assume 0.25 hr to familiarise with regs
OFTEC registered installers	0.25	adroit estimate	assume 0.25 hr to familiarise with regs
Building inspectors	0.25	adroit estimate	assume 0.25 hr to familiarise with regs

Table 14.4: Transition Costs

	Proposal
gas safe installers	£ 114,000
OFTEC registered installers	£ 5,000
Building inspectors	£ 3,000
Total	£ 122,000

15. Annex G: Data on CO poisonings

CO poisoning by type of appliance⁸

15.1 Table 6.1 shows data on CO poisoning by appliance.

Table 6.1: Poisoning by appliance	Casualties
central heating boiler	27%
gas fire	9%
portable room heater	2%
wood burner	5%
BBQ	1%
camping appliance	1%
cooker	3%
engine	7%
generator	1%
machinery	2%
outdoor heater	1%
other	1%
unknown	36%

⁸ <https://www.coresearchtrust.org/assets/uploads/documents/CO-cases-reported-to-NPIS-Gentile-et-al-2021.pdf>

16. Annex H: Health Benefit Assumptions

16.1 Table 6.2: shows the number of fatalities pa, fatality risk per million appliances (without alarm), effectiveness of CO alarms, level of casualties from CO poisoning, without alarm.

Table 6.2: Number of fatalities pa, fatality risk per million appliances (without alarm), effectiveness of CO alarms, level of casualties from CO poisoning, without alarm				
	Low	Mid	High	Source
number of fatalities per annum				
solid fuel	0.1	0.1	0.1	apportioning fatalities to appliances using long run averages from research ⁹
boilers	0.3	0.3	0.3	apportioning fatalities to appliances using long run averages from research
gas fires	0.1	0.1	0.1	apportioning fatalities to appliances using long run averages from research
cooker	0.0	0.0	0.0	
fatality risk per million appliances (without alarm)				
solid fuel	0.6	0.6	0.6	ratio calculated using estimated current number of appliances, assuming those with alarms are 75% effective at avoiding fatality
boilers	0.3	0.3	0.3	ratio calculated using estimated current number of appliances, assuming those with alarms are 75% effective at avoiding fatality
gas fires	0.3	0.3	0.3	ratio calculated using estimated current number of appliances, assuming those with alarms are 75% effective at avoiding fatality
cooker	0.1	0.1	0.1	ratio calculated using estimated current number of appliances, assuming those with alarms are 75% effective at avoiding fatality
effectiveness of CO alarms				
effectiveness of alarms in preventing fatalities	75%	75%	75%	
effectiveness of alarms in	75%	75%	75%	

⁹ <https://www.coresearchtrust.org/assets/uploads/documents/CO-cases-reported-to-NPIS-Gentile-et-al-2021.pdf>

preventing serious injury				
effectiveness of alarms in preventing minor injury	75%	75%	75%	
level of casualties from accidental CO poisoning in domestic properties - assuming no alarm				
Fatal	0.7	0.7	0.7	latest ONS figure for England and Wales adjusted to Wales using population weighting (5%) ¹⁰
Serious	10	10	10	CO reports
Slight	688	444	200	low - NHS figure, high = assume 25% of annual calls to gas helpline (55,000) are related to an incident that causes a slight injury
cost per incident ¹¹				
Fatal	see webtag values sheet			value of fatalities injuries avoided increases annually due to GDP deflator
Serious				
Slight				

¹⁰

<https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/adhocs/12420numberofdeathsfromaccidentalpoisoningbycarbonmonoxideenglandandwalesdeathsregisteredin2019>

¹¹ <https://www.gov.uk/government/publications/tag-data-book>