Masterton and Carterton domestic fire emissions inventory 2013

Greater Wellington
Te Pane Matua Taiao

Masterton & Carterton
Domestic Fire Emissions Inventory 2013

Report for

Greater Wellington Regional Council

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1.0 Introduction

Solid fuel domestic fires are the primary contributor to air pollution in some parts of the Wellington region, particularly Wairarapa, Upper Hutt and Wainuiomata. Smoke from domestic fires generates high levels of particulate matter smaller than 10 micrometres in size (PM_{10}). These particulates can worsen health conditions such as asthma, and are associated with a range of adverse health effects such as respiratory diseases, heart diseases or even premature death.

The Wairarapa airshed is currently designated as polluted under the national environmental standards for air quality. This is due to PM_{10} emissions from solid fuel domestic fires from urban areas within the Wairarapa airshed (GWRC, 2013). Both Masterton and Carterton form only a small part of the Wairarapa airshed.

The **Greater Wellington Regional Council** commissioned **Emission Impossible Limited (EIL)** to develop an inventory of PM_{10} domestic fire emissions from Masterton and Carterton. The inventory was designed to provide input data to airshed modelling by **Greater Wellington Regional Council** for the purposes of redefining the Wairarapa airshed boundary. The data from this inventory can also be used to undertake scenario analysis of policy options for managing domestic emissions in Masterton and Carterton to meet the national environmental standards for PM_{10}.

1.1 Background

Masterton has had two home heating surveys undertaken previously in 2005 and 2008 as summarised in Table 1. The 2005 survey was performed as part of the Ministry for the Environment's survey of domestic heating methods and fuels used in 29 urban areas of New Zealand (MfE, 2005). The 2005 survey found that 74 per cent of households use wood for heating (margin of error eight per cent).

In 2006 a census was undertaken. This found that 69 per cent of people in Masterton used wood for heating.

In 2008, Greater Wellington Regional Council conducted a home heating survey in Masterton (Wilton & Baynes, 2008). The 2008 inventory found 75 per cent of households using wood for heating (margin of error five per cent).

Table 1.   **Previous home heating surveys in Masterton**

Date:	2005 (MfE)	2006 Census	2008 (GWRC)
Area:	Masterton	Masterton	Masterton
Type of burner	Open fire, wood burners, coal burner, multi-fuel burner, pellet burners	All	Open fire, wood burners, coal burner, multi-fuel burner, pellet burners
Age of burners	< 5 yrs, 5-10 yrs, > 10 yrs (don't know)	Not identified	< 5 yrs, 5-10 yrs, > 10 yrs (don't know)
Fuel use	How many logs per day Which months Days per week in each month	Not identified	How many logs per day Which months Days per week in each month
Sample size	n = 149	n = 7,212	n = 355
Sample error	8%	<1%	5%

1.2   Home heating surveys

EIL reviewed the 2005 and 2008 home heating surveys to see if an update was needed or if any trends could be detected to make reasonable assumptions for future scenario analysis. Unfortunately, the first two surveys occurred within a relatively short time and there appeared to be little discernible trend. For example, the overall percentage of wood use in each inventory is (just) within the margin of error;

- 86 +/- 8% total wood use (= 79%) in 2005

- 75 +/- 5% total wood use (= 79%) in 2008

EIL therefore recommended Greater Wellington Regional Council undertake another home heating survey for future scenario analysis.

However, the questions in the previous surveys were considered appropriate and no significant changes were recommended. It was also helpful having identical survey questions to enable direct comparisons for trend analysis.

To economise, questions about fuel use were not repeated. This is because whilst the number of burners may have changed, actual heating requirements will not, which means that fuel use will similarly be unlikely to have changed.

Sample size

The sample size was calculated to achieve a five per cent margin of error on the question of age of wood burner.

The calculated margin of error for a survey statistic reflects the level of confidence that is required. A 95 per cent confidence level (as used in the 2008 inventory) translates into two standard deviations (1.96). When the sample size is small, compared to the population (as with a home heating survey), the calculated margin of error is:

$$1.96 \; x \sqrt{\frac{(p)(1-p)}{n}} = margin \; of \; error$$

Where:

p = *the percentage of respondents answering a particular question. Eg. if 50% of respondents answer "yes" to a particulate question, then p=0.5 and 1 − p = 0.5.*

n = *sample size*

1.96 *represents the 95% confidence level (two standard deviations)*

To determine the sample size the above equation is rearranged as:

$$n = \frac{(p)(1-p)}{\left(\frac{margin \; of \; error}{1.96}\right)^2}$$

If an assumption is made (conservatively) that 50 per cent of people in Masterton and Carterton have a wood burner, then for a 95 per cent confidence interval with a five per cent margin of error, this requires a sample size as follows. [1]

$$n = \frac{(0.5)(1 - 0.5)}{\left(\frac{0.05}{1.96}\right)^2}$$

Sample size $(n) = 384$

However, the age of wood burner is a critical question that informs policy for domestic emissions management. Assuming a similar split to 2008, then the 27 per cent (of the 50 per cent of households with a wood burner) with wood burners aged less than five years old has a margin of error of six per cent.

In order to achieve a margin of error five per cent on this question ("How old is your wood burner?") then the overall sample size needs to be increased to around 550. [2]

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[1] ie. a 16% drop from 2008 once open fires and multi-fuel burners are excluded.
[2] Margin of error = 5.2%

1.3   Outline of report

This report is structured as follows:

Section 2 describes the methodology and assumptions used to estimate hourly, daily, monthly and annual PM_{10} emissions. This draws upon the results of the 2013 home heating survey.

Section 3 presents the results of the 2013 inventory.

Section 4 presents the results of the back casted emissions for 2005 and 2008.

Section 5 summarises the findings and conclusions.

2.0 Method

This section details the methods used to estimate emissions. Emissions have been calculated as follows:

- Hourly emissions (typical and worst case)

- Daily emissions (typical and worst case)

- Monthly emissions (typical), and

- Annual emissions (typical).

For all scenarios, emission factors are specified for each burner type (kilograms PM_{10} emitted per kilogram of fuel burned). Burners are classified as follows:

- Open fires

- Multi-fuel burners

- Wood burner – NES compliant (since 2005 – ie. wood burners are less than eight years old) [3]

- Wood burner (old)

  o 1998-2005 wood burners (ie. burners 8-15 years old)

  o Pre 1998 wood burners (ie. burners 15 years or older)

- Pellet fires

Prior to development of this inventory, **EIL** carried out a review of whether or not it would be worthwhile stratifying emissions by census area unit. It was decided this was not worthwhile for the reasons outlined in Appendix 1.

Note – people living in Carterton were not included in the 2013 home heating survey. It is assumed that the trends in home heating in Carterton are similar to Masterton, so all assumptions made for Masterton have also been applied to households burning wood in Carterton.

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[3] Wood burners compliant under the national environmental standards for air quality which came into effect from 2005.

2.1   2013 home heating survey results

A home heating survey was undertaken by UMR in June 2013. This surveyed 551 people in the Masterton area. The questionnaire used for the survey is provided in Appendix 2 and UMR's summary of results report is provided in Appendix 3.

The 2013 survey found that approximately 69 per cent of respondents surveyed used some form of solid fuel heating appliance to heat their home over winter.   Figure 1 compares the overall proportion of houses using wood as a fuel in the 2013 home heating survey with previous surveys and the 2006 census. Figure 1 shows little change in the fraction of households burning wood over the last eight years, with an average of 67 per cent over that period.

Figure 1.   Proportion of households in Masterton using wood as a fuel

Figure 2 presents the age of wood burners in Masterton, as surveyed in each of the 2005, 2008 and 2013 surveys. The age presented is the age of the burner *at the time of the survey* in order to make a direct comparison with all three surveys. Thus, a wood burner aged eight years old in 2005, will shift into the 8 - 15 year category when surveyed again in 2008, and then into the > 15 years category when surveyed again in 2013.
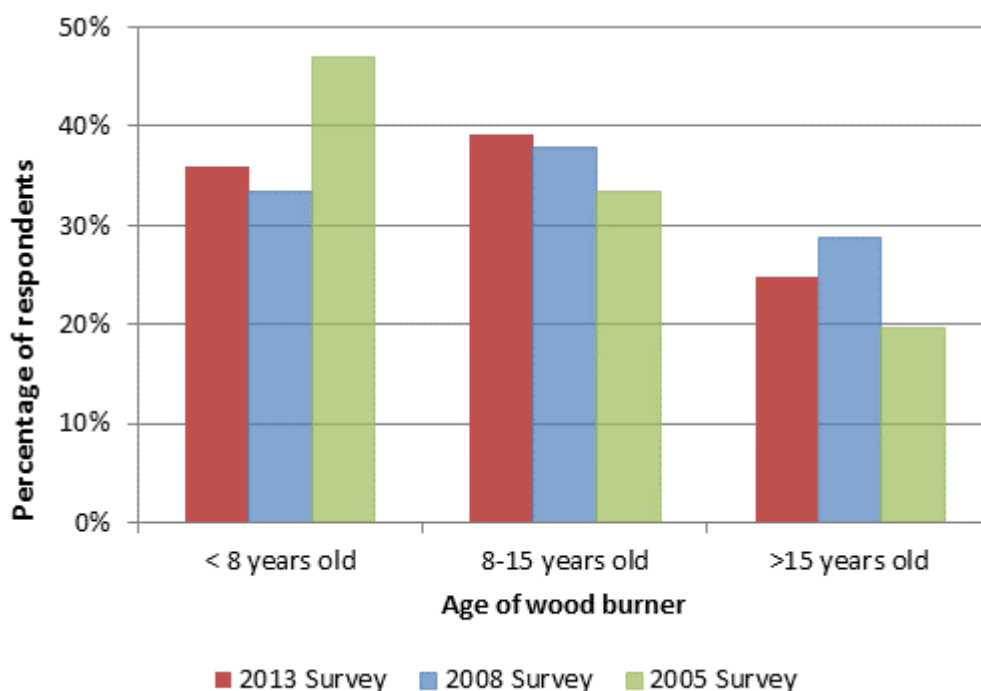
Figure 2. **Age of wood burner at the time of each of the 2005, 2008 and 2013 surveys**

At the time of the 2005 survey, there were more burners aged less than eight years old in Masterton, and fewer proportions of older burners (as shown in Figure 2). However, at the time of the 2008 survey, there were more wood burners aged eight to 15 years old, and this is also seen in the age distribution of wood burners at the time of the 2013 survey.

Figure 3 shows the types of wood burner identified in the 2013 survey, with margin of error calculations. The results indicate that there are a higher proportion of NES burners and 1998-2005 wood burners in Masterton, compared with the older pre-1998 burners. The NES wood burners are cleaner and more efficient to operate, so this higher proportion of burner usage should also reflect in a reduction of PM_{10} emissions in Masterton compared to previous inventories.

Notes:

1. *Less than one per cent of the survey respondents indicated that they used a coal burner for home heating but no-one reported using coal to heat the **main** living area of their home). It was assumed that coal burner use in Masterton was negligible and therefore set to zero.*

2. *Pellet burners were included because, whilst less than one per cent of respondents indicated they had one, it was reported as being used to heat the main living area of their home in at least one household.*

3. *A number of people reported using their burner 25 hours a day and/or eight days a week. These were set to 24 hours a day and/or seven days a week respectively.*

4. *People reporting zero hours of operation were removed from calculations of operating hours.*

**Age of wood burners in Masterton
(Home heating survey, 2013)**

Figure 3. **Graph showing percentages by wood burner type and margin of error from the 2013 survey**

2.2 Fuel use

The 2013 survey did not repeat questions around fuel use as this was considered unlikely to change. The average daily winter fuel use from the 2008 survey (20 kg/day, Wilton & Baynes, 2008) was used in the 2013 inventory as the typical daily fuel use.

A typical hourly fuel use was calculated by dividing the typical daily fuel use by the <u>winter daily average</u> number of hours burners are used (from the 2013 survey). The average number of hours per typical winter's day that burners are used is 12 hours. This is a weighted average of week days and weekends.

This typical hourly fuel use was then multiplied by 24 hours to give a **worst case daily** fuel use (because worst case assumes that every burner in town is on for every hour of the day).

That is:

$$Daily\ FC_{WC} = (FC_T/Winter\ Daily\ Hrs_{Average}) * 24$$

Where:

Daily FC$_{WC}$ *is the calculated worst case daily fuel consumption (kg/day)*

FC$_T$ *is the typical daily fuel consumption (20 kg/day)*

Winter Daily Hrs$_{Average}$ is the average number of hours that burners are used on a winter's day (12 hours), and

24   *is the total number of hours in a day (hours).*

Daily and hourly fuel consumption for typical and worst case scenarios are displayed in Table 2 by burner type. The hourly fuel use was derived for the purpose of calculating the hourly emissions profile.

Table 2.   **Typical and worst case fuel use by burner type (per day and per hour).**

Winter daily fuel use	Wood burners			Open fire	Multi-fuel	Pellet
	NES burners	98-05 burners	Pre 98 burners			
Typical (kg/day)*	20	20	20	20	20	5
Worst case (kg/day)	40	40	40	40	40	10
Typical (kg/hr)	1.7	1.7	1.7	1.7	1.7	0.4
Worst case (kg/hr)	1.7	1.7	1.7	1.7	1.7	0.4

* From the 2008 inventory (Wilton & Baynes, 2008)

Note: The hourly fuel use is the same for both typical and worst case scenarios. This is because the two differences between typical and worst case scenarios are the number of burners in operation, and how many hours they are operating. The actual burners still burn at the same rate (with the same emissions).

As a cross check, the typical daily fuel use of 20 kg/day for wood (1.7 kg/hour used for an average 12 hours per winter's day, UMR, 2013) can be compared against Auckland's fuel use of approximately 14 kg/day (1.4 kg/hour used for an average 6 hours per winter's day, ARC, 2010a). This is a reasonable comparison - Auckland fuel use is expected to be lower as Auckland generally experiences warmer winter conditions than the Wairarapa.

2.3   Burner numbers

The 2013 survey results found that 69 per cent of respondents used a solid fuel heating appliance during winter to heat the main living area of their home. This (69 per cent) was applied to the total number of households in each census area unit, to determine the total number of solid fuel appliances in each census area unit. The type and age of appliance was then determined using the percentage split from the 2013 home heating survey.

A small proportion of respondents (approximately three per cent) either did not know what type of appliance they had in their home, or had none of the appliance types listed by the survey company. These non-responses were removed from the calculations. Of the remaining valid responses, 97 per cent of respondents used wood burners while the other three per cent used open fires, multi-fuel burners or pellet burners. Table 3 below shows the survey responses with and without those who responded with "Other/Don't know".

Table 3.   **Type of solid fuel burning appliance (from 2013 survey)**

Appliance	Survey #s	%	% (excl. Other/Don't Know)
Wood burner	358	94	97
Open fires	8	2	2
Multi-fuel burner	3	1	1
Pellet burners	1	0	0.3
Other	9	2	
Don't know	1	0	
TOTAL	**380**	**100**	**100**

The 2013 survey also asked people about the age of their appliance. These data were used to calculate the number of NES burners, 1998-2005 and pre 1998 wood burner numbers. This is important because PM_{10} emissions from domestic solid-fuel appliances vary by age of burner.

2.4   Emission factors

Emission factors from the Auckland Council's *Domestic Fire Emissions Prediction Model* (ARC, 2010a) have been used for all appliances and are shown in Table 4 below. The emission factors are still considered current as they are based on the real-life emission testing for wood burners carried out in New Zealand (ARC, 2010b) and the latest reviews of international emission factors for all other appliances.

Table 4. **PM$_{10}$ emission factors used in this inventory**

	Wood burners			Open fires	Multi-fuel	Pellet
	NES burners	98-05 burners	Pre 98 burners			
Emission factor (g/kg)	3.7	7.2	10.7	12	19	1.4

2.5 Hourly emissions

This section outlines our approach to estimating domestic PM$_{10}$ emissions on an hourly basis.

Hourly PM$_{10}$ emissions were calculated as follows.

$$Hourly\ PM_{10}\ =\ EF\ x\ FC_H\ x\ \%BurnersUsed_H\ x\ CAU\ Burner\ \#s.$$

Where:

Hourly PM$_{10}$ is the hourly typical or worst case PM$_{10}$ emissions for a week day or week end day (in g/hour)

EF   is the emission factor by appliance type (g/kg) (Table 5)

FC$_H$ is the hourly typical or worst case fuel use (kg/hour) (Table 3)

%BurnersUsed$_H$ is the proportion of burners used for a given hour, and

CAU Burner #s is the number of burners in a census area unit by appliance type (Section 2.3).

The 2013 survey found that, **on average**, people used their burners for around 12 hours a day, for 6.2 days a week during winter. This means that 88 per cent of burners are used on a typical winter's day.

Separating the week day from the weekend, the 2013 survey further showed that:

Week days

- Typically, 22 per cent of people run their burner continuously (i.e. 24-hours a day) on week days;

- The remaining 78 per cent use their burners for an average seven hours on a typical winter week day**.** Light up times on week days are typically 7am in the morning and 5pm in the afternoon/evening.

Weekend days

- Typically around 31 per cent of people run their burners continuously on weekend days.

- The remaining 69 per cent use their burners for an average of 10 hours. Light up times on weekends are typically 8am in the morning and 4pm in the afternoon/evening.

This is summarised in Table 5.

Table 5.   **Hours of operation**

	Typical	Worst case
Winter week day		
Morning time of lighting burner	7 am for 3 hours	
Evening time of lighting burner	5 pm for 4 hours	
Total hours used in a day	7	24
Fraction of all burners running continuously	22%	100%
Winter week end day		
Morning time of lighting burner	8 am for 4 hours	
Evening time of lighting burner	4 pm for 6 hours	
Total hours used in a day	10	24
Fraction of all burners running continuously	31%	100%
Winter daily (overall for the week)		
No. of days used	6.2	-
Hours used in a day	12	24

The dispersion modelling considers both typical and worst-case emissions. Separate hourly profiles to both scenarios were developed as detailed below.

Typical hourly emissions profile

To develop a 24-hour profile, bi-modal daily profiles for week days and weekend days were developed as follows:

Typical week day hourly profile

88 per cent of all burners are running every week day

    22% (of the 88%) run 24 hours
    78% (of the 88%) run 7 hours

This equates to:

    19% of all burners running 24 hours
    69% of all burners running 7 hours

Typical weekend hourly profile

88 per cent of all burners are running every weekend day

      31% (of the 88%) run 24 hours

      69% (of the 88%) run 10 hours

This equates to:

      28% of all burners running 24 hours

      60% of all burners running 10 hours

These overall burner percentages were used to calculate the number of burners in each census area unit that are 'on' for each hour of the day.

An hourly profile is shown in Figure 4. Figure 4 shows that the hourly profile accounts for burners that are running continuously, as well as those that are used only for a portion of the day.

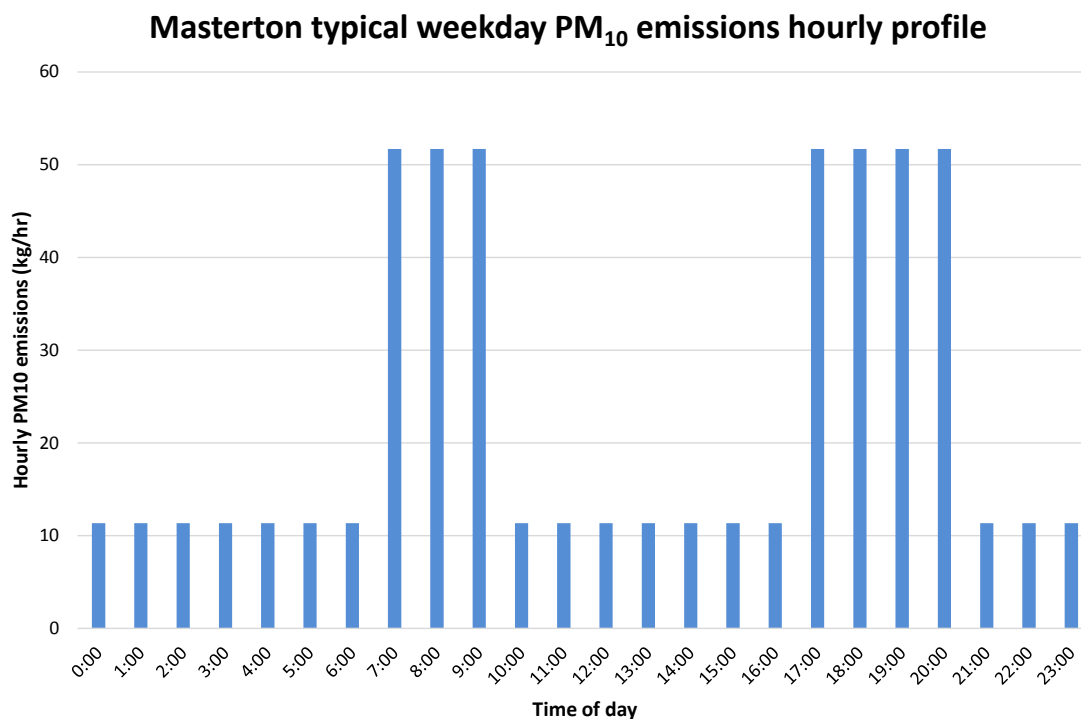## Masterton typical weekday PM$_{10}$ emissions hourly profile

Figure 4. **Typical week day hourly emissions profile showing bi-modal distribution**

Worst-case hourly emissions profile

The worst case hourly emissions profile is very straightforward as it simply assumes that every available burning is on for every hour of the day.

Example hourly emission calculations

For example, calculating typical hourly PM_{10} emissions from NES burners for the Masterton Central census area unit for a week day at 7am are:

$Hr_7 \, PM_{10} \, NES = EF \, (3.7g/kg) \, x \, FC_H \, (1.7kg/hr) \, x \, \%BurnersUsed_H \, (88\%) \, x \, CAU \, Burner \, \#s \, (66)$

$= 365 \, g/hr$

And at 3pm:

$Hr_{15} \, PM_{10} \, NES = EF \, (3.7g/kg) \, x \, FC_H \, (1.7kg/hr) \, x \, \%BurnersUsed_H \, (19\%) \, x \, CAU \, Burner \, \#s \, (66)$

$= 79 \, g/hr$

For example, calculating worst case hourly PM_{10} emissions from NES burners for the Masterton Central census area unit for any hour of the week day is:

$Hr_{24} \, PM_{10} \, NES = EF \, (3.7g/kg) \, x \, FC_H \, (1.7kg/hr) \, x \, \%BurnersUsed_H \, (100\%) \, x \, CAU \, Burner \, \#s \, (66)$

$= 415 \, g/hr$

Note: The example calculations here will not match the output in the spreadsheets. This is because the spreadsheets calculate to eight decimal places whereas the text examples only use two significant figures.

2.6 Daily emissions

The 2013 survey found that people used their burners for 6.2 days a week during winter (on average). This means that 88 per cent of burners are being used on a typical winter's day.

Daily PM_{10} emissions were calculated as follows.

$Daily \, PM_{10} \; = \; EF \; x \; FC_H \; x \; \%BurnersUsed_H \; x \; CAU \, Burner \, \#s.$

Where:

Daily PM_{10} is the PM_{10} emissions for a typical or worst case day (in kg/day)*

EF   is the emission factor by appliance type (g/kg) (Table 5)

FC_H is the typical or worst case fuel use (kg/day) (Table 3)

%BurnersUsed$_H$ is the proportion of burners used for a given hour, and

CAU Burner #s are the number of burners in a census area unit by appliance type (Section 2.3).

Note: Daily emissions are not split by week day/weekend.

For example, calculating typical daily PM_{10} emissions from NES burners for the Masterton Central census area unit are:

PM_{10} NES = EF (3.7g/kg) x FC_H (20kg/day) x %BurnersUsed$_H$ (88%) x CAU Burner #s (66)

= 4.3 kg/day

As a check, hourly emissions can be summed to total daily emission rate for a comparison with the above daily calculation.

Because typical hourly profiles are separated by week day and weekend, a weighted average must be calculated for direct comparison with the typical daily emission rate. This compares within two per cent (due to rounding).

Worst case hourly emissions sum accurately to those calculated daily.

2.7 Monthly emissions

Typical monthly PM_{10} emissions were calculated for Masterton and Carterton using a monthly distribution of burner usage from the 2008 survey shown in Table 6 below.

PM_{10} emissions for each month are calculated as follows:

$$Monthly\ PM_{10}\ =\ \frac{EF\ x\ FC\ x\ \%BurnersUsed_M\ x\ Days\ x\ Burner\ \#s.}{1,000}$$

Where:

Monthly PM_{10} is the monthly typical PM_{10} emissions (in kg/month)

EF   is the emission factor by appliance type (g/kg) (Table 5)

FC   is the daily winter typical fuel consumption (kg/day) (Table 3)

%BurnersUsed$_M$ is the proportion of burners used in a month (Table 6)

Days   is the days per month

Burner #s   are the number of burners in Masterton or Carterton by appliance type (Section 2.3)

The monthly typical calculation assumes that:

- Only a proportion of burners are used each month (with the highest usage over June, July and August) based on a monthly distribution from the 2008 survey (as shown in Table 6).

- The monthly distribution was assumed to be the same for all appliances.

For example, calculating monthly PM$_{10}$ emissions for March from NES burners for the Masterton:

Monthly PM$_{10}$ NES =

$$\frac{EF\ (3.7g/kg)\ x\ FC\ (20kg/day)\ x\ \%BurnersUsed_M\ (3\%)\ x\ Days\ (31)\ x\ CAU\ Burner\#s\ (1,729)}{1,000}$$

= 119 kg/month

Table 6.   Typical use by month (Wilton & Baynes, 2008)

Month	% Use	Month	% Use
January	1%	July	95%
February	1%	August	85%
March	3%	September	44%
April	23%	October	16%
May	73%	November	6%
June	98%	December	2%

2.8   Annual emissions

The annual PM$_{10}$ emissions are simply a sum of all the monthly PM$_{10}$ emission estimates in the year (ie. January to December).

3.0   2013 inventory results

3.1   Daily, monthly and annual emissions

The 2013 Masterton and Carterton domestic emissions inventory found that:

- Approximately 620 kg of PM_{10} is emitted on a typical winter day from all burners in Masterton and approximately 150 kg of PM_{10} from Carterton.

- 39 per cent of the daily winter PM_{10} emissions are emitted from the 1998-2005 wood burners, and 37 per cent of PM_{10} emissions are from the pre 1998 wood burners. This adds up to 76 per cent of overall emissions.

- 18 per cent of daily winter PM_{10} emissions were from NES wood burners, while only four per cent and two per cent of emissions were from open fires and multi-fuel burners using wood respectively.

- In Masterton, approximately 1,400 kg of PM_{10} is emitted on a winter day under the worst case scenario, which assumes that all burners are being used all day.

- For a typical year, around 100 tonnes of PM_{10} is emitted annually from all burners in the Masterton and 25 tonnes of PM_{10} from Carterton.

Table 7 and 8 shows the PM_{10} emissions by burner type for each census area unit for a typical and worst case winter's day for Masterton and Carterton respectively. The worst case scenario assumes that every single burner in each census area unit is being used on a winter's day for 24 hours a day (which is possible during a very cold winter). This is the absolute worst case scenario for Masterton and Carterton. Figure 5 shows the distribution of daily total PM_{10} emissions by burner type for Masterton only for both typical and worst case scenarios. The worst case daily PM_{10} emissions are estimated at being almost more than double the typical daily PM_{10} emission estimate.

Table 9a and 9b shows the typical monthly PM_{10} distribution of emissions for all of Masterton and Carterton respectively, with annual totals. The majority of annual PM_{10} emissions from domestic fires occur during the months of June and July, and to a lesser extent, August. This reflects the 2008 home heating survey monthly profile which showed that 98 per cent of burners are used during June, 95 per cent in July and 85 per cent during August.
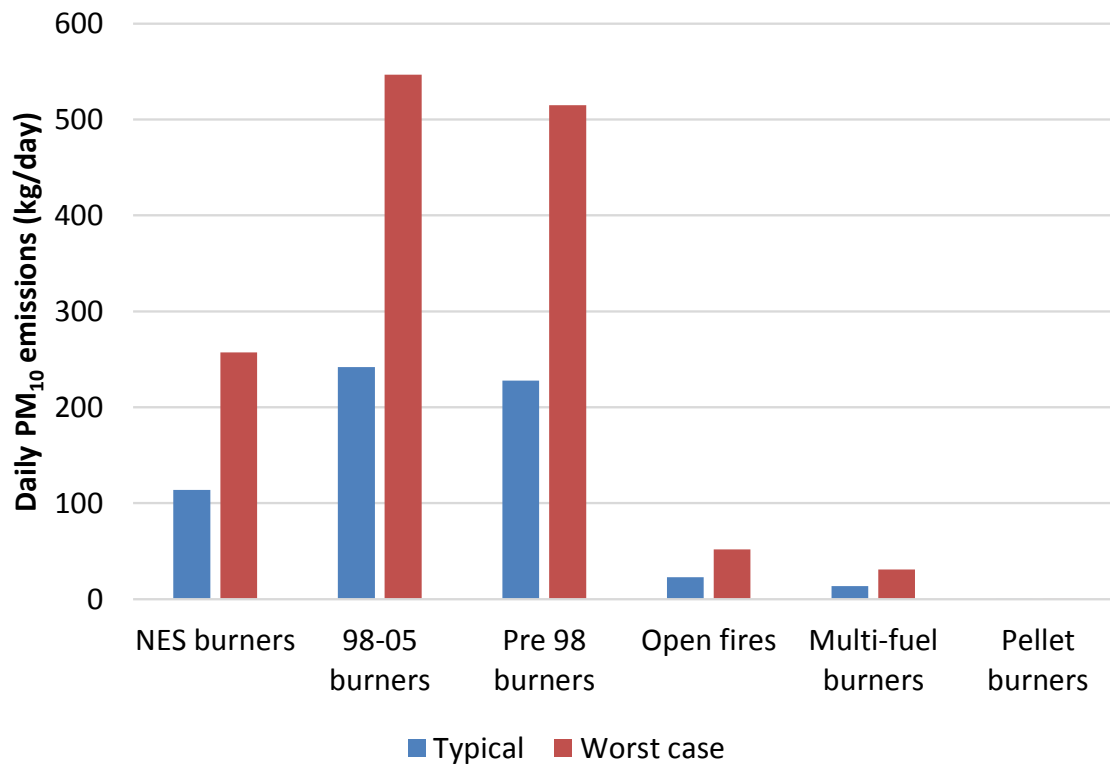
Figure 5. **Distribution of daily PM$_{10}$ emissions for typical and worst case scenarios by burner type for 2013***

*Pellet burners produce less than 1kg/day of PM$_{10}$ emissions and therefore do not show on the graph.

Table 7. **Masterton PM$_{10}$ emissions by burner type for typical and worst case winter days.**

	Wood burners			Open Fires	Multi-Fuel	Pellet	Total
	NES burners	98-05 burners	Pre 98 burners				
Typical PM$_{10}$ daily emissions (kg/day) – average 12 hours a day, 20 kg fuel used per day							
Masterton Central	4	9	9	1	1	0	24
Masterton West	18	38	36	4	2	0	98
Masterton East	21	45	42	4	3	0	115
Solway North	15	31	29	3	2	0	80
Solway South	18	39	36	4	2	0	99
Ngaumutawa	9	20	19	2	1	0	51
Masterton Railway	2	4	4	0	0	0	10
Lansdowne	25	53	50	5	3	0	136
Waingawa	1	3	3	0	0	0	8
Typical daily total (kg/day)	**114**	**242**	**228**	**23**	**14**	**0**	**620**
Worst case PM$_{10}$ daily emissions (kg/day) – 24 hours a day, 40 kg fuel used per day							
Masterton Central	10	21	20	2	1	0	54
Masterton West	41	87	82	8	5	0	222
Masterton East	48	101	95	10	6	0	259
Solway North	33	71	67	7	4	0	181
Solway South	41	87	82	8	5	0	224
Ngaumutawa	21	45	42	4	3	0	115
Masterton Railway	4	8	8	1	0	0	22
Lansdowne	56	120	113	11	7	0	307
Waingawa	3	7	7	1	0	0	18
Worst case daily total (kg/day)	**257**	**547**	**515**	**52**	**31**	**0**	**1,402**

Table 8. **Carterton PM$_{10}$ emissions by burner type for typical and worst case winter days.**

	Wood burners			Open Fires	Multi-Fuel	Pellet	Total
	NES burners	98-05 burners	Pre 98 burners				
Typical PM$_{10}$ daily emissions (kg/day) – average 12 hours a day, 20 kg fuel used per day							
Typical daily total (kg/day)	27	57	54	5	3	0	146
Worst case PM$_{10}$ daily emissions (kg/day) – 24 hours a day, 40 kg fuel used per day							
Worst case daily total (kg/day)	60	128	121	12	7	0	329

Table 9a. **Typical Masterton PM$_{10}$ emissions by month and burner type.**

PM$_{10}$ Monthly (kg/month)	Wood burners			Open fires	Multi-fuel	Pellet	Total
	NES burners	98-05 burners	Pre 98 burners				
January	52	110	103	10	6	0	**281**
February	47	99	93	9	6	0	**254**
March	103	219	206	21	12	0	**562**
April	881	1,872	1,763	178	106	1	**4,801**
May	2,939	6,243	5,878	593	352	2	**16,006**
June	3,792	8,055	7,585	765	454	3	**20,654**
July	3,815	8,105	7,631	770	457	3	**20,780**
August	3,420	7,265	6,841	690	410	2	**18,627**
September	1,696	3,604	3,393	342	203	1	**9,240**
October	636	1,351	1,272	128	76	0	**3,463**
November	216	459	432	44	26	0	**1,178**
December	86	183	172	17	10	0	**468**

Table 9b. **Typical Carterton PM$_{10}$ emissions by month and burner type.**

PM$_{10}$ Monthly (kg/month)	Wood burners			Open fires	Multi-fuel	Pellet	Total
	NES burners	98-05 burners	Pre 98 burners				
January	12	26	24	2	1	0	**66**
February	11	23	22	2	1	0	**60**
March	24	51	48	5	3	0	**132**
April	207	440	414	42	25	0	**1,128**
May	691	1,467	1,381	139	83	1	**3,762**
June	891	1,893	1,783	180	107	1	**4,854**
July	897	1,905	1,794	181	107	1	**4,884**
August	804	1,707	1,608	162	96	1	**4,378**
September	399	847	797	80	48	0	**2,172**
October	149	317	299	30	18	0	**814**
November	51	108	102	10	6	0	**277**
December	20	43	40	4	2	0	**110**

Table 10. **Typical annual PM$_{10}$ emissions by burner type for Masterton and Carterton.**

PM$_{10}$ Annual (t/year)	Wood burners			Open fires	Multi-fuel	Pellet	Total
	NES burners	98-05 burners	Pre 98 burners				
Masterton PM$_{10}$ emissions	18	38	35	4	2	0	**96**
Carterton PM$_{10}$ emissions	4	9	8	1	0	0	**23**

3.2   Hourly emissions

Hourly PM_{10} emissions were calculated for a typical and worst case winter week day and week end day. The emissions were calculated by burner type, for each census area unit in Masterton and Carterton for input to dispersion modelling.

The detailed emissions profiles are provided separately as spreadsheets and not presented here. The daily total for typical and worst case scenarios are discussed below.

The 2013 home heating survey revealed that 22 per cent of burners in Masterton were operating 24 hours a day during a winter week day, while 31 per cent of burners in Masterton were operating 24 hours a day on a winter weekend day. This translates to hourly profiles as follows:

Typical winter week day

- Approximately 10 kg per hour of PM_{10} is emitted on a typical winter week day in Masterton from continuous burners. This increases to around 50 kg per hour during peak operation when 88 per cent of the burners are on.

- Approximately 3 kg per hour of PM_{10} is emitted on a typical winter week day in Carterton from continuous burners. This increases to around 12 kg per hour during peak operation when 88 per cent of the burners are on.

Typical winter weekend

- Approximately 15 kg per hour of PM_{10} is emitted on a typical winter weekend day in Masterton from continuous burners. This increases to around 50 kg per hour during peak operation when 88 per cent of the burners are on.

- Approximately 4 kg per hour of PM_{10} is emitted on a typical winter weekend day in Carterton from continuous burners. This increases to around 12 kg per hour during peak operation when 88 per cent of the burners are on.

Worst case daily

- The worst case scenario for Masterton (i.e. every burner operating) would be PM_{10} emissions of around 60 kg per hour.

- The worst case scenario for Carterton (i.e. every burner operating) would be PM_{10} emissions of around 15 kg per hour.

As expected, daily weekend emissions are higher than daily week day PM_{10} emissions. This is because more people use their burners, for longer on the weekend.

4.0   2005 and 2008 inventory (back cast)

Emissions estimates for 2005 and 2008 were back cast using the same burner numbers and fuel use data from the 2005 and 2008 inventories, but with the updated emission factors that have been used to calculate the 2013 PM_{10} domestic fire emissions here. This permits a direct comparison between estimates for 2013, 2005 and 2008.

Back cast calculations for a typical winter's day compare as follows:

- Back cast 2005, approximately 1,640 kg of PM_{10} was emitted from all burners in Masterton.

- Back cast 2008, approximately 900 kg of PM_{10} was emitted from all burners in Masterton.

- This inventory 2013, 620 kg of PM_{10} is discharged from all burners in Masterton.

Table 11 displays the results of the back cast 2005 and 2008 inventories, and the data used for the calculations. The table also includes the 2013 inventory typical winter's day PM_{10} emission estimate for comparison.

Note - The 2005 and 2008 surveys did not include Carterton so the Carterton CAU has been reported separately throughout this report.

The 2013 inventory estimates approximately 620 kg of PM_{10} is emitted on a typical winter's day for Masterton only (not including Carterton). Figure 6 displays a reduction in PM_{10} emissions for a typical winter's day from 2005. Because the proportion of households using wood as a fuel for heating has remained constant, the emissions reductions are all due to improved emissions from newer burners.
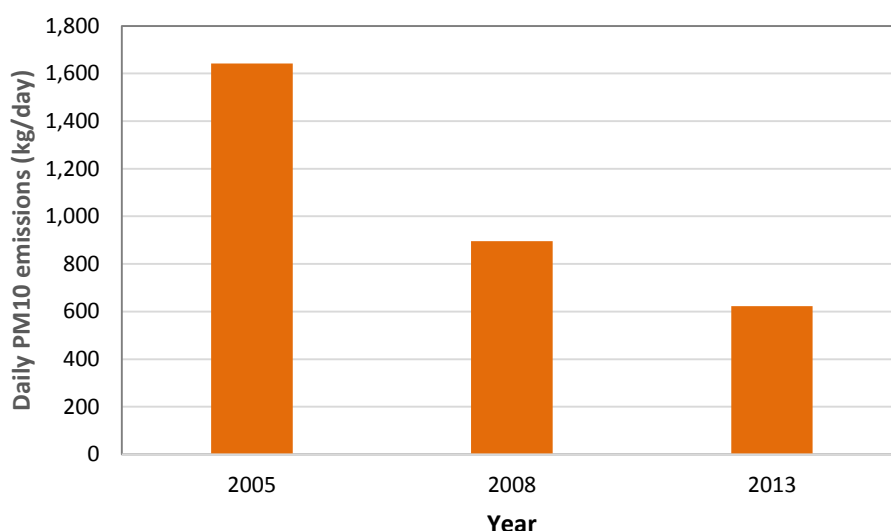

Figure 6.   Typical daily PM_{10} emissions for 2005, 2008 and 2013 for Masterton

Table 11.   Back cast typical daily PM$_{10}$ emissions for 2005 and 2008 for Masterton.

	Wood burners			Open Fires		Multi-fuel		Pellet	Total
	NES burners	98-05 burners	Pre 98 burners	Wood	Coal	Wood	Coal		
PM$_{10}$ Emission factors (g/kg)[1]	3.7	7.2	11	12	21	19	11	1.4	
Back cast 2008									
Average daily fuel use (kg/day)[2]	20	20	20	20	10	20	10	5	
Burner numbers[2]	1,565	1,761	1,345	281	40	361	160	60	5,573
2008 PM$_{10}$ emissions (kg/day)	**117**	**256**	**291**	**68**	**8**	**138**	**17**	**0**	**896**
Back cast 2005									
Average daily fuel use (kg/day)[3]	N/A	26	26	29	9	22	9	N/A	
Burner numbers[3]		2,181	2,468	511	93	790	232		
2005 PM$_{10}$ emissions (kg/day)		**408**	**687**	**178**	**18**	**330**	**22**	**0**	**1,643**
2013 PM$_{10}$ emissions (kg/day)	**114**	**243**	**229**	**23**	**0**	**14**	**0**	**0**	**623**

[1] ARC (2010a)

[2] Wilton, E & Baynes, M (2008)

[3] MfE (2005)

5.0 Conclusions

The **Greater Wellington Regional Council** commissioned **Emission Impossible Limited (EIL)** to develop an inventory of PM_{10} emissions from domestic fires in Masterton and Carterton. The inventory was designed to provide input data to airshed modelling by **Greater Wellington Regional Council** for the purposes of redefining the Wairarapa airshed boundary.

The PM_{10} domestic fire emissions inventory was based:

- the 2013 domestic home heating survey conducted by UMR in June 2013 in Masterton

- census data from the 2006 census; and

- fuel use data collected from the 2008 domestic survey (Wilton & Baynes, 2008).

Emissions have been calculated as follows:

- Hourly emissions (typical and worst case)

- Daily emissions (typical and worst case)

- Monthly emissions (typical), and

- Annual emissions (typical).

For all scenarios emission are stratified for each burner type. The results of the inventory show that:

- Approximately 620 kg of PM_{10} is emitted on a typical winter day from all burners in Masterton. Carterton emits around 150 kg of PM_{10} on a typical winter day.

- 39 per cent of the daily winter PM_{10} emissions are emitted from wood burners installed between 1998 and 2005, and 37 per cent of PM_{10} emissions are from wood burners installed before 1998.

- 18 per cent of daily winter PM_{10} emissions were from wood burners installed after 2005, while only four per cent and two per cent of emissions were from open fires and multi-fuel burners using wood respectively.

- On a typical winter week day, hourly emissions from burners running continuously are around 10 kg per hour in Masterton. On a typical winter weekend day, hourly emissions from burners running continuously are around 15 kg per hour in Masterton. Both weekend and week day typical emissions peak at around 50 kg per hour in Masterton when 88 per cent of burners are operating.

- The worst case scenario for Masterton, i.e. assuming 100 per cent of burners are on, equates to around 60 kg of PM_{10} per hour.

Emission estimates were also back cast to 2005 and 2008 for comparison with this (2013) inventory. The trends indicate that PM_{10} emissions from domestic fires have reduced since 2005, mainly as burners are gradually replaced with more modern, cleaner burners. There appears to be little overall reduction in burner numbers.

6.0 References

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MfE, 2005. *Warm Homes Technical Report: Home Heating Methods and Fuels in New Zealand*. Prepared by Environet Ltd for Ministry for the Environment, November 2005

UMR, 2013. *Masterton Domestic Fire Survey*. Conducted by UMR in June 2013 for Greater Wellington Regional Council.

Wilton, E. & Baynes, M., 2008. *Air Emissions Inventory – Masterton, July 2008.* Prepared by Environet Ltd for Greater Wellington Regional Council, July 2008

Appendix 1   Review of stratification by census area unit

Table A-1 (overleaf) provides an examination of key indicator data for Masterton by census area unit. Census data is the 'platinum standard' because every single house was included in the survey. In reviewing this data, however, we can discount two areas from a comparison by census area unit:

- Masterton central, because it is the central business district and not primarily residential; and

- Masterton railway, because it is land associated with the railway line and not primarily residential. (It is further too small in numbers to be statistically relevant).

A comparison of the remaining areas shows surprisingly little difference.

For example, compared with Masterton overall, Masterton East is the youngest area with the lowest median personal income and Lansdowne is the oldest with the highest median personal income. However, these areas have the same per cent (i.e. within 2 per cent) of people burning wood as the Masterton average as shown in Table A-2.

Similarly, the remaining areas all have less than 10 per cent difference in the per cent of people burning wood. In summary, the 2006 Census (which surveyed every single house) shows little difference in age, personal income and per cent households using wood between different Masterton census area units.

Table A-2.   **Masterton census area unit comparison**

2006 Census	Masterton	Masterton East	Lansdowne
Median age	39	35	43
Difference		-9%	11%
Median personal income	$20,013	$18,400	$21,600
Difference		-8%	8%
Per cent using wood	**69%**	**68%**	**69%**
Difference		**-2%**	**0%**

Table A-1.   2006 Census data for Masterton

2006 Census	Masterton	Masterton Central	Masterton West	Masterton East	Solway North	Solway South	Ngaumu-tawa	Masterton Railway	Lansdowne
Number of people	17,664	585	3,000	3,390	2,220	2,907	1,380	297	3,885
Median age	39	45	41	35	41	37	38	29	43
Median personal income	$20,013	$18,100	$21,500	$18,400	$20,600	$19,700	$21,300	$18,900	$21,600
Number of dwellings	7,119	276	1,143	1,332	933	1,152	591	111	1,581
Number using wood	4,911	126	834	900	651	846	369	90	1,095
Per cent using wood	69%	46%	73%	68%	70%	73%	62%	81%	69%
Difference from Masterton average	-	-34%	6%	-2%	1%	6%	-9%	18%	0%
Survey sample size [1]	[n =550*]	21	88	103	72	89	46	9	122
Margin of error [2]		21%	10%	10%	12%	10%	15%	33%	9%

[1]   Distributed by per cent population in each census area unit

[2]   Based on above sample size for question "Do you have a wood burner?"

* To achieve 5% error on question on <u>age</u> of wood burner (refer memo from EIL to Greater Wellington dated 7 March 2013)

We then queried the following assumptions:

1. Whether the 2006 Census results are still relevant (i.e. relative wood burning incidence between census area units still hold).

2. Whether there are any major differences in the age strata of wood burners between census area units.

We could investigate any changes since the 2006 Census by stratifying our sample by each census area unit (for wood burning incidence, age of burner, etc.).   However, **Table A-1** shows that the margin of error (based on a sample of 550 distributed by per cent population in each census area unit) from the limited sample size in each census area unit, is larger than the differences provided by the 2006 Census (which surveyed <u>every</u> house). In other words, the margin of error on our stratified data would be too large to show any statistically significant differences between each census area unit.

To improve certainty, we could increase the sample size. But the sample size is determined by the percentage of respondents answering a particular question. So if the question determining margin of error is the question about age of wood burner, and this is stratified by census area unit, then we need to increase the sample size to 550 in every census area unit. Clearly this is not reasonable.

We further note that one of the most interesting findings of the final household energy end-use project (BRANZ, 2010) was:

> *There was no statistically significant correlation found between equivalised income and mean living room winter temperatures.*

At this time this was simplified to both rich and poor alike suffering from the 'put another jumper on' mentality. It does, however, support our key assumption that there will be little difference in wood burner incidence **and** age of burner between different census area units.

We conclude:

> Given the small differences between census area units in the 2006 Census and the unreasonably large sample size that would be required to show statistically significant differences between each census area unit, it is not a worthwhile undertaking to stratify data by census area unit.

However, an important area for clarification in the survey, is owner versus rental properties. A recent national inspection (BRANZ, 2012) found that:

> *Rental households were more likely to use portable heating, such as electric plug-in and portable LPG, than fixed heating, such as solid fuel, heat pumps or fixed gas*

heaters. A quarter of renting households had unflued gas heaters compared with 17% of owner occupied households.[4]

The same study found that rental properties comprise 33% of all properties nationally. This will not affect emissions by census area unit (for all the reasons given above), but it will be important for developing well-informed and socially responsible policy.

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[4] We note that this was a national survey of 491 houses in which 50% of the houses were located in major urban areas (Auckland, Hamilton, Wellington, Christchurch and Dunedin). It may not therefore, be representative of Masterton.

Appendix 2   Home Heating Survey

Q1   Does your home have...

[READ LIST]

a) Insulation above the ceiling
b) Under floor insulation
c) Insulation in the walls
d) An HRV or DVS (*if necessary*: air made to circulate through roof space)
e) Hot Water Cylinder wrap(s)
f) Double glazing in the main living or bedroom areas
1   Anything else: specify

1   Yes
2   No
3   Don't Know
4   Refused

Q2   Do you rent the home you live in, or own it with or without a mortgage?

SINGLECODE

- Rent
- Own with or without a mortgage
- Don't know [DO NOT READ]
- Other: specify

Q3   What types of heating are you using to heat your home this winter? Are you using….

MULTICODE   [READ LIST]

1   Heat pump(s) [GO TO Q14]
2   Solar heating [GO TO Q14]
3   Electric heaters (including bar heaters, oil filled or fan) [GO TO Q14]
4   Bottled gas heater(s) [GO TO Q14]
5   Mains gas heater(s) [GO TO Q14]
6   Wood burner
7   Coal burner
8   Other solid fuel burner e.g. pellets
9   Oil burner [GO TO Q14]
10 Some other type of heating [GO TO Q14]
11 No form of heating ever used [GO TO Q14]

[Use 'wood burner' 'coal burner' or 'other solid burner']

[IF Q3 = 6,7,8] ASK

Q4   What type of solid fuel burning appliance do you use in your MAIN living area?

Interviewer: if more than one, **ask for most frequently used**

SINGLECODE   [READ LIST TO PROMPT]

1   Wood burner (This is a fully enclosed burner **but does not** include multi fuel burner like those that burn coal, or a pellet fire)
2   Open fire (this is enclosed on three sides but open on the front. Includes a visor fireplace)
3   Multi-fuel burner (an enclosed burner which burns wood as well as coal, this includes incinerators, pot belly stoves, McKay space heaters etc, but does not include open fires)
4   Pellet fire (using processed wood pellets) [GO TO Q14]
5   None of these   [GO TO Q14]
6   Don't know   [GO TO Q14]

[IF Q4 = 1,2,3] ASK

Q5   What are the main reasons why you are you using wood or coal fired heating?

MULTICODE   [DO NOT READ] – [PROBE]

- There is no other heating in the house / living area
- Wood supply is cheap
- Wood supply free
- Coal supply is cheap
- More efficient / warmer than other methods
- Heats the whole house
- Enjoyment / ambience
- When visitors come over
- Already here when we moved in
- Use also for water heating (wetback)
- Environmentally friendly
- Saves on electricity
- Dry heat/ less condensation
- Self-sufficiency
- Security of supply (eg, power cuts)
- Don't know
- Other (Specify)

Q6   How old is your burner or open fire place? Is it…..

SINGLECODE   [READ LIST]

- Less than 8 years (that is, since 2006)
- Between 8 and 15 years (that is, from 1998)
- More than 15 years (before 1998)
- Don't know/here when we moved in. [DO NOT READ]

Q7   Over the winter months, on average, how many days per week would you use your burner?

- Record number of days (RANGE 1 - 7)
- Don't know

These next few questions are about how you use your burner on a week day.

Q8   Over the winter months, how many hours a day would you typically use your burner, on a week day?

- Record number of hours (RANGE 1 - 24)
- Do not use fire on weekdays (0)
- Don't know

[IF Q8 = DO NOT USE FIRE ON WEEKDAYS SKIP TO Q10]

Q9b   When do you usually first light your fire? Is it in the morning, before 12 noon, in the afternoon, between 1pm and 5pm, or in the evening after 6pm, (on a week day)?

MULTICODE

- Morning (1AM – 12 noon) [ASK Q9bi]
- Afternoon (1PM – 5PM) [ASK Q9bii]
- Evening (6PM – 12AM) [ASK Q9biii]
- Don't Know [GO TO Q10]

[IF Q9b = Morning]

Q9bi   Typically, what time of the morning do you light your fire (on a week day)?

[INTERVIEWER NOTE: Record to the nearest hour]

- AM range (01:00 to 12:00) [SPECIFY TIME] (RANGE 1 -12)
- Don't light it in the morning [SHOW SCREEN: INTERVIEWER RECODE Q9b] -[GO BACK TO Q9b]
- Don't Know

[IF 9b = Afternoon]

Q9bii   (And) typically, what time of the afternoon do you light your fire (on a week day)?

[INTERVIEWER NOTE: Record to the nearest hour]

- Afternoon PM range (01:00 to 5:00) [SPECIFY TIME] (RANGE 1 -5)
- Don't light it in the afternoon [SHOW SCREEN: INTERVIEWER RECODE Q9b] -[GO BACK TO Q9b]
- Don't Know

[IF Q9b = Evening]

Q9biii   (And) typically, what time of the evening do you light your fire on (a week day)?

[INTERVIEWER NOTE: Record to the nearest hour]

- Evening PM range (6:00 to 12:00) [SPECIFY TIME] (RANGE 6 -12)
- Don't light it in the evening [SHOW SCREEN: INTERVIEWER RECODE Q9b] -[GO BACK TO Q9b]
- Don't Know

These next few questions are about how you use your burner on a weekend day.

Q10   Over the winter months, how many hours a day would you typically use your burner, on a weekend day?

- Record number of hours (RANGE 1 - 24)
- Do not use fire on weekend (0)
- Don't know

[IF Q10 = DO NOT USE FIRE ON WEEKDAYS SKIP TO Q12]

Q11b   When do you usually first light your fire? Is it in the morning, before 12 noon, in the afternoon, between 1pm and 5pm, or in the evening after 6pm, (on a weekend day)?

MULTICODE

- Morning (1AM – 12 noon) [ASK Q11bi]
- Afternoon (1PM – 5PM) [ASK Q11bii]
- Evening (6PM – 12AM) [ASK Q11biii]
- Don't Know [GO TO Q12]

[IF Q11b = Morning]

Q11bi   Typically, what time of the morning do you light your fire (on a weekend day)?

[INTERVIEWER NOTE: Record to the nearest hour]

- AM range (01:00 to 12:00) [SPECIFY TIME] (RANGE 1 -12)
- Don't light it in the morning [SHOW SCREEN: INTERVIEWER RECODE Q11b] -[GO BACK TO Q11b]
- Don't Know

[IF Q11b = Afternoon]

Q11bii (And) typically, what time of the afternoon do you light your fire (on a weekend day)?

[INTERVIEWER NOTE: Record to the nearest hour]

- Afternoon PM range (01:00 to 5:00) [SPECIFY TIME] (RANGE 1 -5)
- Don't light it in the afternoon [SHOW SCREEN: INTERVIEWER RECODE Q11b] -[GO BACK TO Q11b]
- Don't Know

[IF Q11b = Evening]

Q11biii (And) typically, what time of the evening do you light your fire (on a weekend day)?

[INTERVIEWER NOTE: Record to the nearest hour]

- Evening PM range (6:00 to 12:00) [SPECIFY TIME] (RANGE 6 -12)
- Don't light it in the evening [SHOW SCREEN: INTERVIEWER RECODE Q11b] -[GO BACK TO Q11b]
- Don't Know

Q12   Over the winter months, when you use your fire, do you keep it burning over night by dampening it down?

SINGLECODE

- Yes
- No [GO TO Q13]
- Don't know [GO TO Q13]

[Q12 = YES] ASK Q12a
Q12a   Typically how many days per week do you do this (dampen your fire down)?

1   [SPECIFY] (RANGE = 0 TO 7)
2   Don't know

[IF Q4 = 1,2,3]

Q13   Apart from fire wood, how often do you burn the following?

[READ LIST]

1. Waste paper – eg cardboard or magazines
2. Timber offcuts from building work, eg fence posts or decking
3. Manufactured wood products such as plywood, chipboard or MDF (custom wood)
4. Wooden pallets [not to be confused with processed wood pellets]
5. Household rubbish
6. Anything else?

1. Always
2. Often
3. Sometimes
4. Rarely
5. Never
6. [DO NOT READ] Don't know

Q13a   Do you buy wood for your wood burner, or do you get if for free?

SINGLECODE

1. Buy it
2. Get it free
3. Both buy it and get it free
4. Don't know

ASK ALL

Q14   Thinking about changing to another type of home heating, but not using wood or coal;   under what circumstances would you consider changing to another type of home heating?

MULTICODE [DO NOT READ] – [PROBE]

- With financial help / subsidy
- If alternative types of heating were cheaper
- If alternative types of heating were more environmentally friendly
- Thinking about changing anyway
- Landlord/ other person's responsibility
- Only if I have to (because of rules/regulations etc)
- Would not consider changing
- Don't know/ no answer
- Other (specify)

Q15   How concerned are you about residential chimney smoke in your local area and its effect on you and your family? Are you...

SINGLECODE   [READ LIST]

- Very concerned [GO TO 15a]
- Somewhat concerned [GO TO 15a]
- Not so concerned [GO TO 16]
- Not concerned at all [GO TO 16]
- Don't know [DO NOT READ] [GO TO 16]

Q15a   Why is chimney smoke a concern to you?

[DO NOT READ]   [RECORD FIRST MENTION; SECOND MENTION; OTHER]

- Affects my health; family's health
- Visual; unsightly
- Smell is not nice
- Quality of life
- Affects the environment; air pollution
- Affects buildings (e.g. grime)
- Affects washing on line; makes them smelly, grimy
- Other specified
- Don't know [DO NOT READ]

Q16   Which of the following statements best describes how you feel about the air quality in <u>winter,</u> where you live? Is it...

SINGLECODE   [READ LIST]

- Almost always good
- Good most of the time, poor on occasion
- Good about half of the time, poor the other half
- Poor most of the time, good on occasion
- Almost always poor
- Don't know [DO NOT READ]

Appendix 3   2013 Survey Summary Data (UMR report)

Fieldwork conducted: 22nd – 23rd of June 2013

Asked of All (n=551)

q1x@1 Does your home have...Insulation above the ceiling

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00 Yes	507	92.0	92.0	92.0
	2.00 No	31	5.6	5.6	97.6
	3.00 Don't know	13	2.4	2.4	100.0
	Total	551	100.0	100.0	

q1x@2 Does your home have...Under floor insulation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00 Yes	246	44.6	44.6	44.6
	2.00 No	275	49.9	49.9	94.6
	3.00 Don't know	30	5.4	5.4	100.0
	Total	551	100.0	100.0	

q1x@3 Does your home have...Insulation in the walls

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00 Yes	265	48.1	48.1	48.1
	2.00 No	220	39.9	39.9	88.0
	3.00 Don't know	65	11.8	11.8	99.8
	5.00 Other	1	.2	.2	100.0
	Total	551	100.0	100.0	

q1x@4 Does your home have...An HRV or DVS (if necessary: air made to circulate through roof space)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00 Yes	126	22.9	22.9	22.9
	2.00 No	412	74.8	74.8	97.6
	3.00 Don't know	13	2.4	2.4	100.0
	Total	551	100.0	100.0	

q1x@5 Does your home have...Hot Water Cylinder wrap(s)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00 Yes	232	42.1	42.1	42.1
	2.00 No	308	55.9	55.9	98.0
	3.00 Don't know	10	1.8	1.8	99.8
	5.00 Other	1	.2	.2	100.0
	Total	551	100.0	100.0	

q1x@6 Does your home have...Double glazing in the main living or bedroom areas

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00 Yes	76	13.8	13.8	13.8
	2.00 No	469	85.1	85.1	98.9
	3.00 Don't know	6	1.1	1.1	100.0
	Total	551	100.0	100.0	

q1x@7 Does your home have...Anything else? [IF

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2.00 No	520	94.4	94.4	94.4
	3.00 Don't know	5	.9	.9	95.3
	6.00 Yes_No bare floors/ Floor coverings throughout house	2	.4	.4	95.6
	7.00 Yes_Carpet has underlay	2	.4	.4	96.0
	8.00 Yes_Windows have foam seals/ Doors have draft stoppers	5	.9	.9	96.9
	9.00 Yes_Curtains/ Double curtains/ Full length curtains/ Thermal backed etc..	15	2.7	2.7	99.6
	10.00 Yes_Ground has polyurothane so moist doesn"t rise	2	.4	.4	100.0
	Total	551	100.0	100.0	

q2 Do you rent the home you live in, or own it with or without a mortgage?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00 Rent	50	9.1	9.1	9.1
	2.00 Own with or without a mortgage	501	90.9	90.9	100.0
	Total	551	100.0	100.0	

This variable (q3@t) counts the number of mentions:
261 respondents gave 1 response
232 respondents gave 2 responses
49 respondents gave 3 responses
7 respondents gave 4 responses
2 respondents gave 5 responses

q3@t TOTAL NUMBER OF MENTIONS: What types of heating are you using to heat your home this winter? Are you using..

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	261	47.4	47.4	47.4
	2.00	232	42.1	42.1	89.5
	3.00	49	8.9	8.9	98.4
	4.00	7	1.3	1.3	99.6
	5.00	2	.4	.4	100.0
	Total	551	100.0	100.0	

This $q3MR shows the multiple response output. N is the number of mentions (not the number of respondents):

$q3MR Frequencies

		Responses		Percent of Cases
		N	Percent	
$q3MR What types of heating are you using .... [a]	1.00 Heat pump(s)	222	24.4%	40.3%
	2.00 Solar heating	7	.8%	1.3%
	3.00 Electric heaters (including bar heaters, oil filled or fan)	162	17.8%	29.4%
	4.00 Bottled gas heater	83	9.1%	15.1%
	5.00 Mains gas heater	10	1.1%	1.8%
	6.00 Wood burner	376	41.3%	68.2%
	7.00 Coal burner	4	.4%	.7%
	8.00 Other solid fuel burner e.g. pellets	4	.4%	.7%
	9.00 Oil burner	14	1.5%	2.5%
	10.00 Some other type of heating	26	2.9%	4.7%
	11.00 No form of heating ever used	2	.2%	.4%
Total		910	100.0%	165.2%

a. Group

Asked of those who have a Wood burner/ Coal burner OR Other solid fuel burner (n=380)

q4 What type of solid fuel burning appliance do you use in your MAIN living area?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00 Wood burner (This is a fully enclosed burner but does not include multi fuel burner like those that burn coal, or a pell	358	65.0	94.2	94.2
	2.00 Open fire (this is enclosed on three sides but open on the front. Includes a visor fireplace)	8	1.5	2.1	96.3
	3.00 Multi-fuel burner (an enclosed burner which burns wood as well as coal, this includes incinerators, pot belly stoves, Mc	3	.5	.8	97.1
	4.00 Pellet fire (using processed wood pellets)	1	.2	.3	97.4
	5.00 None of these	9	1.6	2.4	99.7
	6.00 Don't know	1	.2	.3	100.0
	Total	380	69.0	100.0	
Missing	-99.99	171	31.0		
Total		551	100.0		

Asked of those who have a Wood burner/ Open fire or Multi burner in their MAIN living area (n=369)

This variable (q5@t) counts the number of mentions:
243 respondents gave 1 response
95 respondents gave 2 responses
25 respondents gave 3 responses
5 respondents gave 4 responses
1 respondents gave 5 responses

q5@t TOTAL NUMBER OF MENTIONS - What are the main reasons why you are you using wood or coal fired heating?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	243	44.1	65.9	65.9
	2.00	95	17.2	25.7	91.6
	3.00	25	4.5	6.8	98.4
	4.00	5	.9	1.4	99.7
	5.00	1	.2	.3	100.0
	Total	369	67.0	100.0	
Missing	-99.99	182	33.0		
Total		551	100.0		

This $q5MR shows the multiple response output. N is the number of mentions (not the number of respondents):

$q5MR Frequencies

		Responses		Percent of Cases
		N	Percent	
$q5MR What are the main reasons why you ...[a]	1.00 There is no other heating in the house / living area	20	3.8%	5.4%
	2.00 Wood supply is cheap	100	18.8%	27.1%
	3.00 Wood supply free	56	10.5%	15.2%
	5.00 More efficient / warmer than other methods	74	13.9%	20.1%
	6.00 Heats the whole house	50	9.4%	13.6%
	7.00 Enjoyment / ambience	65	12.2%	17.6%
	9.00 Already here when we moved in	84	15.8%	22.8%
	10.00 Use also for water heating (wetback)	27	5.1%	7.3%
	11.00 Environmentally friendly	6	1.1%	1.6%
	12.00 Saves on electricity	29	5.4%	7.9%
	13.00 Dry heat/ less condensation	2	.4%	.5%
	14.00 Self-sufficiency	9	1.7%	2.4%
	15.00 Security of supply (eg, power cuts)	4	.8%	1.1%
	16.00 Don't know	4	.8%	1.1%
	18.00 Easy to manage	2	.4%	.5%
	19.00 Can cook on it/ Like cooking on it/ Use it for cooking	1	.2%	.3%
Total		533	100.0%	144.4%

a. Group

Asked of those who have a Wood burner/ Open fire or Multi burner in their MAIN living area (n=369)

q6 How old is your burner or open fire place? Is it..:

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00 Less than 8 years (that is, since 2006)	120	21.8	32.5	32.5
	2.00 Between 8 and 15 years (that is, from 1998)	131	23.8	35.5	68.0
	3.00 More than 15 years (before 1998)	83	15.1	22.5	90.5
	4.00 Don't know / here when we moved in.	35	6.4	9.5	100.0
	Total	369	67.0	100.0	
Missing	-99.99	182	33.0		
Total		551	100.0		

Asked of those who have a Wood burner/ Open fire or Multi burner in their MAIN living area (n=369)

q7 Over the winter months, on average, how many days per week would you use your burner?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	3	.5	.8	.8
	2.00	8	1.5	2.2	3.0
	3.00	20	3.6	5.4	8.4
	4.00	27	4.9	7.3	15.7
	5.00	31	5.6	8.4	24.1
	6.00	18	3.3	4.9	29.0
	7.00	254	46.1	68.8	97.8
	Don't know	8	1.5	2.2	100.0
	Total	369	67.0	100.0	
Missing	-99.99	182	33.0		
Total		551	100.0		

Asked of those who have a Wood burner/ Open fire or Multi burner in their MAIN living area (n=369)

q8 Over the winter months, how many hours a day would you typically use your burner, on a week day?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	8	1.5	2.2	2.2
	1.00	2	.4	.5	2.7
	2.00	2	.4	.5	3.3
	3.00	11	2.0	3.0	6.2
	4.00	34	6.2	9.2	15.4
	5.00	55	10.0	14.9	30.4
	6.00	52	9.4	14.1	44.4
	7.00	18	3.3	4.9	49.3
	8.00	26	4.7	7.0	56.4
	9.00	3	.5	.8	57.2
	10.00	16	2.9	4.3	61.5
	11.00	1	.2	.3	61.8
	12.00	28	5.1	7.6	69.4
	13.00	1	.2	.3	69.6
	14.00	6	1.1	1.6	71.3
	15.00	8	1.5	2.2	73.4
	16.00	6	1.1	1.6	75.1
	18.00	4	.7	1.1	76.2
	19.00	1	.2	.3	76.4
	20.00	6	1.1	1.6	78.0
	24.00	74	13.4	20.1	98.1
	Don't know	7	1.3	1.9	100.0
	Total	369	67.0	100.0	
Missing	-99.99	182	33.0		
Total		551	100.0		

Asked of those who have a Wood burner/ Open fire or Multi burner in their MAIN living area (n=369)

q9a Over the winter months, how many times per day do you light your fire on a week day?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00 Once a day	337	61.2	91.3	91.3
	2.00 More than once a day	11	2.0	3.0	94.3
	3.00 Don't know	21	3.8	5.7	100.0
	Total	369	67.0	100.0	
Missing	-99.99	182	33.0		
Total		551	100.0		

Asked of those who have a Wood burner/ Open fire or Multi burner in their MAIN living area AND <u>did not</u> respond 'zero' in q8 (n=361)

This variable (q9b@t) counts the number of mentions:
350 respondents gave 1 response
4 respondents gave 2 responses
7 respondents gave 3 responses

q9b@t TOTAL NUMBER OF MENTIONS: When do you usually first light your fire on a week day? Is it in the morning, before 12 noon, in the afternoon, between 1pm and 5pm, or in the evening after 6pm?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	350	63.5	97.0	97.0
	2.00	4	.7	1.1	98.1
	3.00	7	1.3	1.9	100.0
	Total	361	65.5	100.0	
Missing	-99.99	190	34.5		
Total		551	100.0		

This $q9bMR shows the multiple response output. N is the number of mentions (not the number of respondents):

$q9bMR Frequencies

		Responses		Percent of Cases
		N	Percent	
$q9bMR When do you usually first light your ...a	1.00 Morning (1AM - 12 noon)	124	32.7%	34.3%
	2.00 Afternoon (1PM - 5PM)	171	45.1%	47.4%
	3.00 Evening (6PM - 12AM)	71	18.7%	19.7%
	4.00 Don't know	13	3.4%	3.6%
Total		379	100.0%	105.0%

a. Group

Asked of those who 'light' in the morning on a weekday in q9bMR (n=124)

q9bi Typically, what time of the morning do you light your fire (on a week day)?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	4	.7	3.2	3.2
	2.00	1	.2	.8	4.0
	3.00	1	.2	.8	4.8
	4.00	2	.4	1.6	6.5
	5.00	9	1.6	7.3	13.7
	6.00	25	4.5	20.2	33.9
	7.00	36	6.5	29.0	62.9
	8.00	19	3.4	15.3	78.2
	9.00	11	2.0	8.9	87.1
	10.00	4	.7	3.2	90.3
	11.00	7	1.3	5.6	96.0
	12.00	3	.5	2.4	98.4
	Don't know	2	.4	1.6	100.0
	Total	124	22.5	100.0	
Missing	-99.99	427	77.5		
Total		551	100.0		

Asked of those who 'light' in the afternoon on a weekday in q9bMR (n=171)

q9bii (And) typically, what time of the afternoon do you light your fire (on a week day)?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	15	2.7	8.8	8.8
	2.00	13	2.4	7.6	16.4
	3.00	23	4.2	13.5	29.8
	4.00	62	11.3	36.3	66.1
	5.00	55	10.0	32.2	98.2
	Don't know	3	.5	1.8	100.0
	Total	171	31.0	100.0	
Missing	-99.99	380	69.0		
Total		551	100.0		

Asked of those who 'light' in the evening on a weekday in q9bMR (n=71)

q9biii (And) typically, what time of the evening do you light your fire on (a week day)?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	6.00	67	12.2	94.4	94.4
	7.00	1	.2	1.4	95.8
	9.00	1	.2	1.4	97.2
	Don't know	2	.4	2.8	100.0
	Total	71	12.9	100.0	
Missing	-99.99	480	87.1		
Total		551	100.0		

Asked of those who have a Wood burner/ Open fire or Multi burner in their MAIN living area (n=369)

q10 Over the winter months, how many hours a day would you
typically use your burner, on a weekend day?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	3	.5	.8	.8
	1.00	2	.4	.5	1.4
	2.00	1	.2	.3	1.6
	3.00	5	.9	1.4	3.0
	4.00	7	1.3	1.9	4.9
	5.00	18	3.3	4.9	9.8
	6.00	24	4.4	6.5	16.3
	7.00	11	2.0	3.0	19.2
	8.00	36	6.5	9.8	29.0
	9.00	11	2.0	3.0	32.0
	10.00	26	4.7	7.0	39.0
	11.00	4	.7	1.1	40.1
	12.00	53	9.6	14.4	54.5
	13.00	4	.7	1.1	55.6
	14.00	14	2.5	3.8	59.3
	15.00	13	2.4	3.5	62.9
	16.00	7	1.3	1.9	64.8
	18.00	7	1.3	1.9	66.7
	19.00	1	.2	.3	66.9
	20.00	5	.9	1.4	68.3
	21.00	1	.2	.3	68.6
	24.00	109	19.8	29.5	98.1
	Don't know	7	1.3	1.9	100.0
	Total	369	67.0	100.0	
Missing	-99.99	182	33.0		
Total		551	100.0		

Asked of those who have a Wood burner/ Open fire or Multi burner in their MAIN living area (n=369)

q11a Over the winter months, how many times per day do you light your fire
on a weekend day?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00 Once a day	333	60.4	90.2	90.2
	2.00 More than once a day	14	2.5	3.8	94.0
	3.00 Don't know	22	4.0	6.0	100.0
	Total	369	67.0	100.0	
Missing	-99.99	182	33.0		
Total		551	100.0		

Asked of those who have a Wood burner/ Open fire or Multi burner in their MAIN living area AND <u>did not</u> respond 'zero' in q10 (n=366)

This variable (q11b@t) counts the number of mentions:
352 respondents gave 1 response
3 respondents gave 2 responses
11 respondents gave 3 responses

q11b@t TOTAL NUMBER OF MENTIONS: When do you usually first light your fire on a weekend day? Is it in the morning, before 12 noon, in the afternoon, between 1pm and 5pm, or in the evening after 6pm?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	352	63.9	96.2	96.2
	2.00	3	.5	.8	97.0
	3.00	11	2.0	3.0	100.0
	Total	366	66.4	100.0	
Missing	-99.99	185	33.6		
Total		551	100.0		

This $q11bMR shows the multiple response output. N is the number of mentions (not the number of respondents):

$q11bMR Frequencies

		Responses		Percent of Cases
		N	Percent	
$q11bMR When you you usually a light your fire...	1.00 Morning (1AM - 12 noon)	227	58.1%	62.0%
	2.00 Afternoon (1PM - 5PM)	120	30.7%	32.8%
	3.00 Evening (6PM - 12AM)	25	6.4%	6.8%
	4.00 Don't know	19	4.9%	5.2%
Total		391	100.0%	106.8%

a. Group

Asked of those who 'light' in the morning on a weekend day in q9bMR (n=227)

q11bi Typically, what time of the morning do you light your fire (on a weekend day)?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	7	1.3	3.1	3.1
	4.00	2	.4	.9	4.0
	5.00	4	.7	1.8	5.7
	6.00	26	4.7	11.5	17.2
	7.00	45	8.2	19.8	37.0
	8.00	45	8.2	19.8	56.8
	9.00	37	6.7	16.3	73.1
	10.00	43	7.8	18.9	92.1
	11.00	9	1.6	4.0	96.0
	12.00	7	1.3	3.1	99.1
	Don't know	2	.4	.9	100.0
	Total	227	41.2	100.0	
Missing	-99.99	324	58.8		
Total		551	100.0		

Asked of those who 'light' in the afternoon on a weekend day in q9bMR (n=120)

q11bii (And) typically, what time of the afternoon do you light your fire (on a weekend day)?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	27	4.9	22.5	22.5
	2.00	15	2.7	12.5	35.0
	3.00	26	4.7	21.7	56.7
	4.00	30	5.4	25.0	81.7
	5.00	20	3.6	16.7	98.3
	Don't know	2	.4	1.7	100.0
	Total	120	21.8	100.0	
Missing	-99.99	431	78.2		
Total		551	100.0		

Asked of those who 'light' in the evening on a weekend day in q9bMR (n=25)

q11biii (And) typically, what time of the evening do you light your fire on (a weekend day)?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	6.00	21	3.8	84.0	84.0
	7.00	1	.2	4.0	88.0
	8.00	1	.2	4.0	92.0
	Don't know	2	.4	8.0	100.0
	Total	25	4.5	100.0	
Missing	-99.99	526	95.5		
Total		551	100.0		

Asked of those who have a Wood burner/ Open fire or Multi burner in their MAIN living area (n=369)

q12 Over the winter months, when you use your fire, do you keep it burning over night by dampening it down?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00 Yes	162	29.4	43.9	43.9
	2.00 No	207	37.6	56.1	100.0
	Total	369	67.0	100.0	
Missing	-99.99	182	33.0		
Total		551	100.0		

Asked of those who dampen down fire in q12 (n=162)

q12a Typically how many days per week do you do this (dampen your fire down)?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	1	.2	.6	.6
	1.00	3	.5	1.9	2.5
	2.00	11	2.0	6.8	9.3
	3.00	15	2.7	9.3	18.5
	4.00	12	2.2	7.4	25.9
	5.00	7	1.3	4.3	30.2
	6.00	3	.5	1.9	32.1
	7.00	106	19.2	65.4	97.5
	Don't know	4	.7	2.5	100.0
	Total	162	29.4	100.0	
Missing	-99.99	389	70.6		
Total		551	100.0		

Asked of those who have a Wood burner/ Open fire or Multi burner in their MAIN living area (n=369)

q13@1 How often do you burn the following? Waste paper - eg cardboard or magazines

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00 Always	40	7.3	10.8	10.8
	2.00 Often	30	5.4	8.1	19.0
	3.00 Sometimes	60	10.9	16.3	35.2
	4.00 Rarely	82	14.9	22.2	57.5
	5.00 Never	156	28.3	42.3	99.7
	6.00 Don't know	1	.2	.3	100.0
	Total	369	67.0	100.0	
Missing	-99.99	182	33.0		
Total		551	100.0		

q13@2 How often do you burn the following? Timber offcuts from building work, eg fence posts or decking

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00 Always	18	3.3	4.9	4.9
	2.00 Often	9	1.6	2.4	7.3
	3.00 Sometimes	32	5.8	8.7	16.0
	4.00 Rarely	49	8.9	13.3	29.3
	5.00 Never	260	47.2	70.5	99.7
	6.00 Don't know	1	.2	.3	100.0
	Total	369	67.0	100.0	
Missing	-99.99	182	33.0		
Total		551	100.0		

q13@3 How often do you burn the following? Manufactured wood products such as plywood, chipboard or MDF (custom wood)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00 Always	2	.4	.5	.5
	2.00 Often	1	.2	.3	.8
	3.00 Sometimes	7	1.3	1.9	2.7
	4.00 Rarely	26	4.7	7.0	9.8
	5.00 Never	333	60.4	90.2	100.0
	Total	369	67.0	100.0	
Missing	-99.99	182	33.0		
Total		551	100.0		

q13@4 How often do you burn the following? Wooden pallets [not to be confused with processed wood pellets]

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00 Always	2	.4	.5	.5
	2.00 Often	3	.5	.8	1.4
	3.00 Sometimes	9	1.6	2.4	3.8
	4.00 Rarely	16	2.9	4.3	8.1
	5.00 Never	339	61.5	91.9	100.0
	Total	369	67.0	100.0	
Missing	-99.99	182	33.0		
Total		551	100.0		

q13@5 How often do you burn the following? Household rubbish

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00 Always	5	.9	1.4	1.4
	2.00 Often	8	1.5	2.2	3.5
	3.00 Sometimes	41	7.4	11.1	14.6
	4.00 Rarely	40	7.3	10.8	25.5
	5.00 Never	274	49.7	74.3	99.7
	6.00 Don't know	1	.2	.3	100.0
	Total	369	67.0	100.0	
Missing	-99.99	182	33.0		
Total		551	100.0		

q13a Do you buy wood for your wood burner, or do you get if for free?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00 Buy it	197	35.8	53.4	53.4
	2.00 Get it free	101	18.3	27.4	80.8
	3.00 Both buy it and get it free	70	12.7	19.0	99.7
	4.00 Don't know	1	.2	.3	100.0
	Total	369	67.0	100.0	
Missing	-99.99	182	33.0		
Total		551	100.0		

Asked of All (n=551)

This variable (q14@t) counts the number of mentions:
527 respondents gave 1 response
20 respondents gave 2 responses
4 respondents gave 3 responses

q14@t TOTAL NUMBER OF MENTIONS: Thinking about changing to another type of home heating, but not using wood or coal under what circumstances would you consider changing to another type of home heating?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	527	95.6	95.6	95.6
	2.00	20	3.6	3.6	99.3
	3.00	4	.7	.7	100.0
	Total	551	100.0	100.0	

This $q14MR shows the multiple response output. N is the number of mentions (not the number of respondents):

$q14MR Frequencies

		Responses		Percent of Cases
		N	Percent	
$q14MR Thinking about changing to another...ᵃ	1.00 With financial help / subsidy	47	8.1%	8.5%
	2.00 If alternative types of heating were cheaper	83	14.3%	15.1%
	3.00 If alternative types of heating were more environmentally friendly	10	1.7%	1.8%
	4.00 Thinking about changing anyway	14	2.4%	2.5%
	5.00 Landlord/ other person"s responsibility	12	2.1%	2.2%
	6.00 Only if I have to (because of rules/regulations etc)	37	6.4%	6.7%
	7.00 Would not consider changing	304	52.5%	55.2%
	8.00 Don't know/ no answer	34	5.9%	6.2%
	10.00 If I could no longer get firewood	9	1.6%	1.6%
	11.00 If I am physically unable to deal with firewood (lifting etc.)	21	3.6%	3.8%
	12.00 If our burner needed replacing	4	.7%	.7%
	13.00 If access to gas	1	.2%	.2%
	15.00 If house better designed/ better layout/ renovating	3	.5%	.5%
Total		579	100.0%	105.1%

a. Group

q15 How concerned are you about residential chimney smoke in your local area and its effect on you and your family? Are you..:

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00 Very concerned	47	8.5	8.5	8.5
	2.00 Somewhat concerned	150	27.2	27.2	35.8
	3.00 Not so concerned	141	25.6	25.6	61.3
	4.00 Not concerned at all	209	37.9	37.9	99.3
	5.00 Don't know	4	.7	.7	100.0
	Total	551	100.0	100.0	

Asked of those who are concerned in q15 (n=197)

This $q15aMR shows the multiple response output. N is the number of mentions (not the number of respondents):

$q15aMR Frequencies

		Responses		Percent of Cases
		N	Percent	
$q15aMR Why is chimney smoke a concern to you?[a]	1.00 Affects my health/ family's health	80	31.5%	40.6%
	2.00 Visual/ unsightly	17	6.7%	8.6%
	3.00 Smell is not nice	30	11.8%	15.2%
	4.00 Quality of life	2	.8%	1.0%
	5.00 Affects the environment/ air pollution	110	43.3%	55.8%
	6.00 Affects buildings (e.g. grime)	3	1.2%	1.5%
	7.00 Affects washing on line/ makes them smelly, grimy	7	2.8%	3.6%
	8.00 Don't know	5	2.0%	2.5%
Total		254	100.0%	128.9%

a. Group

The following tables show the actual order of 'mentions' for q15:

nq15a@1 First Mention: Why is chimney smoke a concern to you?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00 Affects my health/ family's health	70	12.7	35.5	35.5
	2.00 Visual/ unsightly	14	2.5	7.1	42.6
	3.00 Smell is not nice	20	3.6	10.2	52.8
	5.00 Affects the environment/ air pollution	86	15.6	43.7	96.4
	6.00 Affects buildings (e.g. grime)	1	.2	.5	97.0
	7.00 Affects washing on line/ makes them smelly, grimy	1	.2	.5	97.5
	8.00 Don't know	5	.9	2.5	100.0
	Total	197	35.8	100.0	
Missing	-99.99	354	64.2		
Total		551	100.0		

nq15a@2 Second Mention: Why is chimney smoke a concern to you?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00 Affects my health/ family's health	9	1.6	19.6	19.6
	2.00 Visual/ unsightly	3	.5	6.5	26.1
	3.00 Smell is not nice	9	1.6	19.6	45.7
	4.00 Quality of life	1	.2	2.2	47.8
	5.00 Affects the environment/ air pollution	21	3.8	45.7	93.5
	7.00 Affects washing on line/ makes them smelly, grimy	3	.5	6.5	100.0
	Total	46	8.3	100.0	
Missing	-99.99	505	91.7		
Total		551	100.0		

nq15a@3 Third Mention: Why is chimney smoke a concern to you?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00 Affects my health/ family's health	1	.2	11.1	11.1
	3.00 Smell is not nice	1	.2	11.1	22.2
	5.00 Affects the environment/ air pollution	3	.5	33.3	55.6
	6.00 Affects buildings (e.g. grime)	1	.2	11.1	66.7
	7.00 Affects washing on line/ makes them smelly, grimy	3	.5	33.3	100.0
	Total	9	1.6	100.0	
Missing	-99.99	542	98.4		
Total		551	100.0		

nq15a@4 Fourth Mention: Why is chimney smoke a concern to you?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	4.00 Quality of life	1	.2	50.0	50.0
	6.00 Affects buildings (e.g. grime)	1	.2	50.0	100.0
	Total	2	.4	100.0	
Missing	-99.99	549	99.6		
Total		551	100.0		

Asked of All (n=551)

q16 Which of the following statements best describes how you feel about the air quality in winter, where you live? Is it…:

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00 Almost always good	255	46.3	46.3	46.3
	2.00 Good most of the time, poor on occasion	228	41.4	41.4	87.7
	3.00 Good about half of the time, poor the other half	45	8.2	8.2	95.8
	4.00 Poor most of the time, good on occasion	12	2.2	2.2	98.0
	5.00 Almost always poor	3	.5	.5	98.5
	6.00 Don't know	8	1.5	1.5	100.0
	Total	551	100.0	100.0	

q17a Do you have any people aged 17 or under living in your household?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00 Yes	141	25.6	25.6	25.6
	2.00 No / Unsure	410	74.4	74.4	100.0
	Total	551	100.0	100.0	

Asked of those who said 'yes' to having people aged 17 and under (n=141)

q17b@1 How many are aged…under 5 years

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	94	17.1	66.7	66.7
	1.00	29	5.3	20.6	87.2
	2.00	16	2.9	11.3	98.6
	3.00	1	.2	.7	99.3
	4.00	1	.2	.7	100.0
	Total	141	25.6	100.0	
Missing	-99.99	410	74.4		
Total		551	100.0		

q17b@2 How many are aged…5 to 15 years

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	45	8.2	31.9	31.9
	1.00	42	7.6	29.8	61.7
	2.00	41	7.4	29.1	90.8
	3.00	11	2.0	7.8	98.6
	4.00	1	.2	.7	99.3
	6.00	1	.2	.7	100.0
	Total	141	25.6	100.0	
Missing	-99.99	410	74.4		
Total		551	100.0		

q17b@3 How many are aged...16 to 17 years

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	104	18.9	73.8	73.8
	1.00	34	6.2	24.1	97.9
	2.00	3	.5	2.1	100.0
	Total	141	25.6	100.0	
Missing	-99.99	410	74.4		
Total		551	100.0		

Asked of All (n=551)

q17c@1 How many people in your household, including yourself, are aged...18 to 19 years

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	513	93.1	93.1	93.1
	1.00	31	5.6	5.6	98.7
	2.00	5	.9	.9	99.6
	3.00	1	.2	.2	99.8
	4.00	1	.2	.2	100.0
	Total	551	100.0	100.0	

q17c@2 How many people in your household, including yourself, are aged...20 to 39 years

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	425	77.1	77.1	77.1
	1.00	67	12.2	12.2	89.3
	2.00	53	9.6	9.6	98.9
	3.00	5	.9	.9	99.8
	7.00 Refused	1	.2	.2	100.0
	Total	551	100.0	100.0	

q17c@3 How many people in your household, including yourself, are aged...40 to 64 years

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	273	49.5	49.5	49.5
	1.00	108	19.6	19.6	69.1
	2.00	168	30.5	30.5	99.6
	3.00	1	.2	.2	99.8
	7.00 Refused	1	.2	.2	100.0
	Total	551	100.0	100.0	

q17c@4 How many people in your household, including yourself, are aged...65 years or over

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	304	55.2	55.2	55.2
	1.00	135	24.5	24.5	79.7
	2.00	111	20.1	20.1	99.8
	7.00 Refused	1	.2	.2	100.0
	Total	551	100.0	100.0	

Asked of All (n=551)

This variable (q18@t) counts the number of mentions:
520 respondents gave 1 response
30 respondents gave 2 responses
1 respondent gave 3 responses

q18@t TOTAL NUMBER OF MENTIONS: Which ethnic group or groups do you belong to? One or several groups may apply to you. Are you....

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	520	94.4	94.4	94.4
	2.00	30	5.4	5.4	99.8
	3.00	1	.2	.2	100.0
	Total	551	100.0	100.0	

This \$q18MR shows the multiple response output. N is the number of mentions (not the number of respondents):

\$q18MR Frequencies

		Responses		Percent of Cases
		N	Percent	
\$q18MR Which ethnic group or groups do you ...[a]	1.00 New Zealand European	502	86.1%	91.1%
	2.00 Maori	36	6.2%	6.5%
	3.00 Samoan	3	.5%	.5%
	4.00 Cook Island Maori	1	.2%	.2%
	5.00 Tongan	1	.2%	.2%
	7.00 Chinese	1	.2%	.2%
	9.00 New Zealander	20	3.4%	3.6%
	10.00 Refused	2	.3%	.4%
	12.00 Other European	5	.9%	.9%
	13.00 Other Pacific Islander	1	.2%	.2%
	14.00 Other Asian	3	.5%	.5%
	15.00 Irish/ Scottish/ British/ Welsh	8	1.4%	1.5%
Total		583	100.0%	105.8%

a. Group

q19 What is the total income in your household before tax? Just stop me when I get to the right point. Is it...:

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00 $15,000 or less	21	3.8	3.8	3.8
	2.00 $15,001 to 25,000	82	14.9	14.9	18.7
	3.00 $25,001-50,000	138	25.0	25.0	43.7
	4.00 $50,001-70,000	102	18.5	18.5	62.3
	5.00 $70,001-100,000	56	10.2	10.2	72.4
	6.00 $100,001-150,000	43	7.8	7.8	80.2
	7.00 Over $150,000	17	3.1	3.1	83.3
	8.00 Unsure	28	5.1	5.1	88.4
	9.00 Income was nil/or made a loss	11	2.0	2.0	90.4
	10.00 Refused	53	9.6	9.6	100.0
	Total	551	100.0	100.0	

q20 Which Masterton suburb do you live in?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00 Masterton West	111	20.1	20.1	20.1
	2.00 Masterton East	78	14.2	14.2	34.3
	3.00 Masterton Central	33	6.0	6.0	40.3
	4.00 Landsdowne	161	29.2	29.2	69.5
	5.00 Masterton Railway	11	2.0	2.0	71.5
	6.00 Ngaumutawa	12	2.2	2.2	73.7
	7.00 Solway North	73	13.2	13.2	86.9
	8.00 Solway South	56	10.2	10.2	97.1
	10.00 Kuripuni	16	2.9	2.9	100.0
	Total	551	100.0	100.0	