EMISSION FACTORS FOR DOMESTIC SOLID FUELS

Work Package 3 Report

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0 EXECUTIVE SUMMARY

0.1 BACKGROUND

The measurement programme provided:

- continuously monitored emission concentration data throughout the different phases of the burning cycle for some gaseous measurements (CO, CO_2, O_2, NOx, SO_2, TOC),
- an integrated concentration measurement for (PCDD/F, PAH and heavy metals) over the whole burn cycle,
- integrated PM-related concentrations measurements for alternate phases of the burning cycle (ignition, 2nd operation/refuel and burnout phases).

The calculation of emission factors for each appliance and fuel combination from the emission concentration data reported by the test houses required several calculation stages, discussed in Chapter 6.

Emission factors have been developed for use in the NAEI for wood logs at different moisture contents, wood briquettes, coffee logs, coal, anthracite and manufactured solid (mineral) fuels for the appliance categories detailed in Table 0-2 for PM, $PM_{2.5}$, PM_{10}, NOx, SO_2, CO, NMVOC, PAH, PCDD/F and, for mineral fuels, heavy metals. These emission factors have been approved by the Air Quality Inventory Steering Group (AQISG), will be implemented in the next annual cycle of the NAEI.

Condensable PM emission factors have also been determined for all appliance types and fuels (these are not currently applied in the NAEI as total filterable and condensable emissions are reported).

Black Carbon emission factors have also been developed in the measurement programme, with three repeat measurements made for each appliance-fuel combination in each phase of the burn cycle. These data will be combined with WP1 and WP2 measurements, which are for a more limited dataset to produce a black carbon emission factor for each category of appliance.

Heavy metal emission factor measurements indicated some anomalous data for certain metals, anomalous tests were removed from the data. Note, many of the measurements for certain metals were at or below the limit of detection.

In general, although substantial changes can be seen for emission estimates in the residential combustion sector, the combined impact from mineral and biomass fuels on UK national emissions is generally small. However, the new emission factors for PAH including Benzo(a)pyrene, PCDD/F and $PM_{2.5}$ would result in a significant reduction in national emissions.

The country-specific emission factors developed in this project are considered to be an improvement on current emission factors used by the NAEI because they:

- Better represent UK operating practise with respect to burn duration, number of refuels, fuel load, draught and the types of solid mineral fuels used in the UK.
- Are based on three replicate test cycles.
- Better represents appliances used in the UK.
- Are based on tests for the same appliance and the same test cycles for measured pollutants.
- Provide data measured by accredited test houses using test approaches that are consistent with EN and CEN/TS approaches for emission measurement.

In general, WP3 confirmed emission factors determined in WP1 for wood logs and WP2 for solid mineral fuels.

- In WP1 and WP3 tests on appliances burning wood logs, emission factors for CO, PM (TPM, PM_{10}, $PM_{2.5}$) and VOC were highest for wet fuels. PAH emission factors were generally highest for wet fuels on the open fireplace. Dioxins emissions were more variable and showed little association with moisture. On the modern stoves, emission factors for CO, PM, VOC and PAH were higher for dry wood than for seasoned wood.

- $PM_{2.5}$ emissions are broadly highest for the wet wood but for the modern stoves (including the Blue Angel stove), emission factors for dry wood are higher than for seasoned wood.
- The BaP emission factors for dry wood for all the stoves are generally higher than for seasoned wood. For most stoves emission factors for dry wood are also higher than for wet wood. For the open appliance, BaP emission factors for wet wood are higher than for seasoned wood which are higher than for dry wood.
- For the modern Ecodesign appliance using mineral fuels there are higher emission factors for CO, PM and TOC/OGC (which have emission limits in the Ecodesign Regulation) and PAH compared to the older appliances. Smaller differences in emission factors will be mitigated by higher energy efficiency for the modern appliance but elevated emission factors are often higher than could be offset by improved energy efficiency. This indicates that implementation of Ecodesign Regulation has had little beneficial impact on $PM_{2.5}$ emissions from stoves for solid mineral fuels.
- The BaP emission factors for the approved MSF (Low_Sulphur_MSF) for the modern stoves are generally higher than for older stoves and open fires.
- The PM_1 fraction in PM emissions from wood-burning is variable but is typically more than about 65% of the total PM emission. The PM_1 fraction for mineral fuels is less variable than for wood fuels and generally forms more than about 65% of the total PM emission.

0.2 INTRODUCTION

This is the Work Package 3 Report for the project “Emission Factors for Domestic Solid Fuels”. The project was undertaken by Ricardo Energy and Environment (Ricardo), Kiwa Gastec (Kiwa), Environmental Compliance Ltd (ECL), University of Manchester and University of Leeds for the United Kingdom Department for Environment, Food and Rural Affairs (Defra).

Work Package 3 focused on the development of emission factors for the combustion of wood logs with varying moisture contents, coal, anthracite, Manufactured Solid Fuels (MSFs), coffee logs, and wood briquettes. These fuels were tested predominantly on stoves commonly used in UK residences, with additional tests conducted on a low emission wood log stove (Blue Angel ecolabel) and a pellet stove. This report summarises combined results from across all three Work Packages carried out under the work programme.

This report contains background information about the project team, scope of work and methodology. It includes detailed information about the fuels and appliances, and results of the test programme which have been used to develop the emission factors. Within the report the authors outline the challenges and uncertainties associated with the final emission factors.

The emission factors developed through this project will be used directly in the UK National Atmospheric Emissions Inventory, which fulfils reporting requirements under the National Emissions Ceiling Directive (NECD), transposed into UK law as the National Emissions Ceiling Regulations (NECR); the United Nations Economic Commission for Europe (UNECE)’s Convention on Long Range Transboundary Air Pollution (CLRTAP).

In addition to fulfilling the national and international reporting requirements, the NAEI provides emissions data for a wide range of other uses including providing policy makers, researchers, air quality professionals and the public with an understanding of the key polluting sources, how these sources have varied over time and how they are likely to contribute to pollution in the future.

This report should be read in conjunction with the project Inception Report, Test Protocol, Work Package 1 report[1] and Work Package 2 report[2], which provide full detail on the methodologies employed and results to date.

0.3 GOVERNANCE

A Steering Group was set up by Defra to provide expert advice around domestic solid combustion, emissions measurements, and emissions factors calculations; to review progress and outcomes from the emissions factors project. The Steering Group reviewed and approved results, reports, model(s), calculations, other project outputs and challenged assumptions. The Steering Group convened several times during this study and gave approval to proceed at key stages of the project:

1. Approval of the Test Protocol
2. Approval to proceed to the main test programme following review of results from an interlaboratory comparison to assess the approach (the round-robin testing)[1]
3. Approval of the outputs of the WP1 test programme and emission factors
4. Approval of the outputs of the WP2 test programme and emission factors
5. Approval of the outputs of the WP3 test programme and emission factors

Selected outputs of WP3 have been presented to the UK's Air Quality Inventory Steering Group (AQISG), a separate group with remit to govern the scientific development of the NAEI. The AQISG has provided approval for use in the NAEI 2023 (to be submitted spring 2025).

0.4 FUEL

Work Package 1 tested wood logs, and for Work Package 2 a range of mineral and manufactured solid fuels (MSF) were selected. In Work Package 3 all the fuels from across WP1 and WP2 were tested on a range of different stoves as well as wood briquettes and wood pellets. These were:

1. Wood logs : Dry (0-10% moisture), Seasoned (10-20% moisture), Wet (20-30% moisture)
2. House coal trebles. Supply of this fuel is now prohibited in England and is not authorised for use in smoke control areas.
3. Anthracite small nuts, approved for use in smoke control areas under the generic authorisation for smokeless fuels.
4. An MSF Authorised for use in Smoke Control Areas designated under the Clean Air Act and under the Air Quality Domestic Solid Fuel Standards (England) Regulations. The fuel "Heat"" was used, this is a HETAS-approved smokeless and low sulphur fuel
5. A non-Authorised MSF; "Superheat" was used in WP2 but is no longer available and was replaced by "Briteflame" in WP3. Although there are Authorised versions of these fuels available, these were non-approved versions for markets outside England as supply of these fuels for domestic burning is now prohibited in England. This is a non-approved, higher sulphur petcoke based fuel.
6. Biobean coffee logs for wood burners and multifuel stoves.
7. Wood briquettes
8. Wood pellets

Fuel samples were independently analysed, and results are presented in the appendices.

0.5 TEST CYCLE/BURN CYCLE

The project test cycle considered emissions during ignition, steady operation including refuels, and shutdown. A full description is given in the test protocol and is summarised below. Note that the pellet

[1] Further details are provided in the Work Package 1 report available here : https://uk-air.defra.gov.uk/assets/documents/reports/cat09/2401050850_Ricardo_EFDSF_WP1_Report_v1.5.pdf

[2] Work Package 2 report available here : https://uk-air.defra.gov.uk/assets/documents/reports/cat07/2410240831_Ricardo_EFDSF_Report_WP2_final_v2.pdf

stove and Blue Angel-ecolabelled stove required altered test protocols, these are detailed in section 4.1.1.

Ignition

For wood and biomass fuels:

- The typical batch mass of the wood for refuels was 1.2 kg split between two logs. Coffee logs and wood briquettes were tested as two logs per the ignition phase and two per burn.
- Wood logs were typically 35-38cm in length with a diameter of 5-10cm. Bark was not removed; logs were placed with the bark face pressed into the fire bed.
- For ignition the total mass of kindling material was limited at 50% of the total batch mass (0.6 kg kindling for wood logs).
- The total mass of starting aids (firelighter) was limited at 3% of the total batch mass. Firelighters were placed in the centre of the kindling. A kerosene-based firelighter was used for all ignition batches.

For mineral and MSF fuels:

The typical batch mass of fuel varies depending on the stove and fuel under test as mineral and MSF require primary air (through the grate) and different grate sizes require different loads.

- Fuel is weighed out for the test and screened to ensure that the fuel size is uniform removing large or broken pieces.
- For ignition the total mass of kindling material was limited at 1/3 of the total batch mass.
- The total mass of starting aids (firelighter) was limited at 3% of the total batch mass. Firelighters were placed in the centre of the kindling. A kerosene-based firelighter was used for all ignition batches.

Steady operation

The operation step is the phase where the appliance is hot and will most closely align with standard test methods for domestic solid fuel heating appliances. In this step the appliance was allowed to run and burn down fuel in the fuel bed. The fuel bed was generally refuelled once for mineral and MSF fuels and twice for wood logs and coffee logs, refuelling when the flames have gone out. A standardised refuel procedure is described in the test protocol.

Shutdown

The shutdown step in the test cycle is the period where the final batch is allowed to burn out completely. The start of shutdown was defined as when the flames go out.

Typical durations for each phase are:

Wood and biomass fuels:

- Start-up ¾ to 1 hour.
- Normal operation 3x~45minutes = 2½ to 3 hours.
- Shutdown 1 to 1½ hours.

For mineral and MSF fuels:

- Start-up 1 hour 30 minutes.
- Normal operation 1 hour 30 minutes.
- Shutdown 1 hour.

0.6 MEASUREMENTS

Measurements for the main test programme were taken by Kiwa and ECL at the Kiwa laboratory. A custom-made test rig was used to house the appliances, sampling equipment and analysers.

Emission measurements were undertaken at two locations:

1. The appliance outlet – in a short section of flue at the exit of the stove/fireplace
2. A dilution tunnel – in a section of flue located above the appliance outlet and which was designed to collect all the flue gases from the appliance outlet and ambient air

The test programme is based on measurements on **three** test cycles for each fuel and appliance combination. Repeat testing allowed the uncertainty in the measurements to be reported and the interval and confidence level to be expressed. The pollutants measured are detailed in Table 0-1. Some measurements were taken over all phases of a test cycle and others were collected separately during start-up, shutdown and a single operating step. A blend of continuous measurements and periodic measurements were undertaken as described in Table 0-1.

The following pollutants were measured:

Table 0-1 Pollutants measured in Work Package 3

Measurement	Measurement location	Comments
CO CO_2 TOC/HC NOx	Appliance outlet	Continuous measurement, unweighted CO and O_2 used to standardise integrated samples. Weighted data used to standardise continuous measurements. NOx data used in preference to dilution tunnel data.
NOx CO CO_2 SO_2 TOC/HC	Dilution tunnel	Continuous measurements, unweighted CO data used to establish dilution ratio for integrated samples. Weighted CO data used to establish dilution ratio for continuous measurements. NOx and SO_2 not used (close to LoD and/or variable).
PM	Appliance outlet	Heated filter measurement, integrated samples for alternate phases of burn cycle.
PM	Dilution tunnel	Heated filter measurement, integrated samples for alternate phases of burn cycle.
Dioxins & Furans PAH	Dilution tunnel	Integrated sample collected over entire burn cycle (combined sample).
Heavy Metals	Dilution tunnel	Integrated sample collected over entire burn cycle (combined sample).
PM PM_{10}, $PM_{2.5}$, PM_1	Dilution tunnel	Impactor measurement, integrated samples for alternate phases of burn cycle.
Black carbon	Dilution tunnel	Integrated samples collected over short periods in alternate phases of burn cycle. Analysed for EC and OC. Single sample for each fuel, appliance and test phase.

Measurement	Measurement location	Comments
Condensable PM	By calculation	Difference between heated filter (or particle size) measurements at dilution tunnel and appliance outlet.

0.7 APPLIANCES

The three stoves and an open fire tested during Work Package 1 and 2 were chosen to represent the installed base in the UK and to capture the significant developments in stove performance over the years. WP3 expanded on these, testing a range of additional appliances that are representative of these UK stove categories as well as a pellet stove and Blue Angel-ecolabelled stove. The appliances from WP1 and WP2 were tested again in WP3 burning wood briquettes.

Table 0-2 Summary of stoves and fuels tested

Appliance category	Appliance	Fuels
Open fire	Parkray Paragon inset open fire	Coal Low sulphur MSF High sulphur MSF Wet wood Seasoned wood Dry wood Wood briquettes (WP3) Coffee logs
	16 inch Cromwell fire basket (WP3)	Coal Low sulphur MSF High sulphur MSF Wet wood Seasoned wood Dry wood Wood briquettes Coffee logs
Pre 2000 closed stove	Hunter Oakwood	Anthracite Coal Low sulphur MSF High sulphur MSF Wet wood Seasoned wood Dry wood Wood briquettes (WP3) Coffee logs
	Coalbrookdale (Aga) Little Wenlock (WP3)	Anthracite Coal Low sulphur MSF High sulphur MSF Wet wood Seasoned wood

Appliance category	Appliance	Fuels
		Dry wood Wood briquettes Coffee logs
2000-2009 closed stove	Stovax / Dovre Model Dovre 500MRF	Anthracite Coal Low sulphur MSF High sulphur MSF Wet wood Seasoned wood Dry wood Wood briquettes (WP3) Coffee logs
	Redfyre (Gazco) Kensal 20 RF-KEN20M (WP3)	Anthracite Coal Low sulphur MSF High sulphur MSF Wet wood Seasoned wood Dry wood Wood briquettes Coffee logs
Very efficient modern stove (clearSkies level 2 or above)	Charnwood Model: C4. *Woodburner in WP1, multifuel version used for WP2.*	Anthracite Coal Low sulphur MSF High sulphur MSF Wet wood Seasoned wood Dry wood Wood briquettes (WP3) Coffee logs
	Hunter Aspect 5 (WP3)	Anthracite Coal Low sulphur MSF High sulphur MSF Wet wood Seasoned wood Dry wood Wood briquettes Coffee logs
	Hunter Aspect 8 (Large stove) (WP3). *Included part load tests.*	Anthracite Coal Low sulphur MSF High sulphur MSF Wet wood Seasoned wood Dry wood

Appliance category	Appliance	Fuels
		Wood briquettes Coffee logs
	Stovax Stockton 5 Eco (WP3)	Wet wood Seasoned wood Dry wood Wood briquettes Coffee logs
Blue Angel-ecolabelled	Hase Sila IQ+ (WP3)	Wet wood Seasoned wood Dry wood Wood briquettes Coffee logs
Pellet stove	Island stoves, Ramsey (WP3)	Wood pellets

It was not possible to test anthracite on the open fire appliances due to difficulties keeping the fuel alight.

0.8 QUALITY AND UNCERTAINTY

An independent audit was carried out during Work Packages 1 and 2 to assess compliance with the agreed test protocol and measurement methods. These provided assurance that the test protocol and measurement methods have been followed and identified improvements which were implemented prior to WP3.

The uncertainty in the final emission factors comprises a range of contributing elements including:

- Representativeness of the appliances
- Variation in fuels
- Variation in operation
- Measurement – include measurement method, sampling protocol, analysis LoD (Limit of Detection), calibration/reference materials
- Data handling – data acquisition, storage and handling – the processes to work up the measured data into the final emission factors.

These are discussed in Chapter 5.

0.9 RECOMMENDATIONS

The following recommendations are made:

1. To include the emissions factors for PM, $PM_{2.5}$, PM_{10}, NOx, SO_2, CO, NMVOC, PAH, PCDD/F and metals in the next submission of the NAEI (2025).
2. To consider similar testing programmes to represent a wider range of appliances including new appliance types and any emerging fuels.
3. To consider further testing on modern Ecodesign appliances to understand why emissions of certain pollutants appear to be elevated compared to older technologies.
4. To consider further testing on wood pellets intended for residential use to establish typical sulphur content and sulphur oxides emission factors.
5. To consider sensitivity testing of emission parameters to (for example) different lighting practises, inclusion of fine materials in fuel mix (or influence of fuel size), fuel mixtures, appliance misuse.

6. To consider alternatives to emission monitoring for determination of heavy metals (fuel and ash analysis).

We would like to dedicate this report to our dear friend and colleague, Prof Alan Williams, who passed away suddenly on 6th September 2023.

Alan was a lively and valued member of the research team on this project with nearly 70 years' experience in fuels, combustion and emissions. We will remember him as someone who was always sharp, always insightful, always prompting lively debate, and someone with a genuine thirst for enquiry in research. He is fondly remembered and sadly missed.

GLOSSARY

AQEG	Defra Air Quality Expert Group
AQISG	Air Quality Inventory Steering Group
BC	Black Carbon
BS	British Standard
CAS	Centre for Atmospheric Sciences (University of Manchester)
CEMS	Continuous Emission Monitoring Systems
CEN	European Standards organisation
CEN/TS	CEN Technical Specification
CLRTAP	Convention on Long-Range Transboundary Air Pollution
CO	Carbon Monoxide
Defra	Department for Environment, Food and Rural Affairs
DP	Differential Pressure
EC	Elemental Carbon (Black Carbon)
ECL	Environmental Compliance Limited
EEA	European Environment Agency
EF	Emission Factor
EFDSF	Emission Factors for Domestic Solid Fuels (this project)
EIG	Emission Inventory Guidebook
EMEP	European Monitoring and Evaluation Programme (of the UN Convention on long-range Transboundary Air Pollution)
EN	European Standard
EPA	Environmental Protection Agency (US)
FID	Flame Ionisation Detector
FTIR	Fourier Transform Infrared Spectroscopy
GC-MS	Gas Chromatography-Mass Spectrometry
GJ	Gigajoules
HEPA	High-Efficiency Particulate Air
HETAS	Heating Equipment Testing and Approval Scheme
ISO	International Organization for Standardization
I-TEQ	International Toxic Equivalent
IVOC	Intermediate Volatile Organic Compounds
LOD	Limit of Detection
MCERTS	Monitoring Certification Scheme
MCS	Microgeneration Certification Scheme
MJ	Megajoules
MSF	Manufactured Solid Fuels

MST	Manual Sampling Train
NAEI	National Atmospheric Emissions Inventory
NMVOC	Non-Methane Volatile Organic Compounds
NO	Nitrogen Oxide
NO_X	Nitrogen Oxides
NPL	National Physical Laboratory
OC	Organic Carbon
PAH	Polycyclic Aromatic Hydrocarbon
PCDD/F	Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans (also referred to simply as 'Dioxins')
PM	Particulate Matter
PTFE	Polytetrafluoroethylene
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/ Quality Control
SCAPE	School of Chemical and Process Engineering (University of Leeds)
SG	Steering group
SO_X	Sulfur Oxides
STP	Standard Temperature and Pressure
SVOC	Semi-volatile Organic Compounds
TB	Test Batch
TC	Total Carbon
TGA	Thermogravimetric Analysis
TOC	Total Organic Carbon
TPM	Total Particulate Matter
UKCA	UK Conformity Assessment
VOC	Volatile Organic Carbon
WP	Work Package

1 INTRODUCTION

1.1 BACKGROUND

This is the Work Package 3 Report for the project "Emission Factors for Domestic Solid Fuels". The project was undertaken by Ricardo Energy and Environment, Kiwa Gastec, Environmental Compliance Ltd, University of Manchester and University of Leeds for the United Kingdom Department for Environment, Food and Rural Affairs (Defra).

The project has provided emission factor data for the National Atmospheric Emissions Inventory (NAEI) which is a business-critical model used by Defra for policy development which fulfils reporting requirements under the National Emissions Ceiling Directive (NECD), transposed into UK law as the National Emissions Ceiling Regulations (NECR); the United Nations Economic Commission for Europe (UNECE)'s Convention on Long Range Transboundary Air Pollution (CLRTAP). The NAEI estimates emissions across a range of sectors and sources including domestic (residential) fuel use for heating, cooking and leisure.

An **emission factor** is a representative value that relates the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant. These factors are usually expressed as the weight of pollutant divided by a unit weight, volume, distance, or duration of the activity emitting the pollutant[3]. In this context, the activity we are concerned with is the amount of fuel burnt and emission factors are expressed as mass of pollutant per gigajoule of fuel burnt (on a net heat input basis).

The overall aim of the project is to reduce the uncertainty in the NAEI emission estimates for domestic combustion through the development of UK-specific pollutant emission factors for solid fuels (wood, mineral fuels and manufactured briquettes). Residential burning is a 'key category' in the UK emission inventory for many pollutants, which means that it is a source which makes an important contribution to the emissions totals and trends. Key categories are those which, when summed up in descending order of magnitude, cumulatively add up to 80 % of total emissions for a given pollutant. The main contributions are from solid fuel use – for some pollutants solid fuel is the largest source.

The aim of the project is to develop more accurate (and UK specific) emission factors for a range of pollutants emitted from burning the following solid fuels in selected domestic appliances:

- Wood logs (for a range of moisture contents)
- house coal
- anthracite
- manufactured solid fuels (MSFs)
- coffee logs
- wood briquettes
- wood pellets

This report summarises the results from across all three Work Packages of this project, developing emissions factors for the combustion of wood, mineral fuels and manufactured briquettes in a range of appliances that can be commonly found in domestic residences in the UK, at the time of writing. Additionally, this report contains background information about the project team, scope of work and methodology. It includes detailed information about the fuels and appliances, and results of the test programme which have been used to develop the emission factors. Within the report the authors outline the challenges and uncertainties associated with the final emission factors.

1.2 AIMS AND OBJECTIVES

This project included three technical work packages (WP1, WP2 and WP3) and a project management work package (WP4). WP1 is the "Measurement of emission factors for wood fuels" and ran from

[3] Basic Information of Air Emissions Factors and Quantification | US EPA

September 2021 to May 2022. The report of the WP1 work package has been published[4]. WP2 is the "Measurement of emissions factors for other domestic solid fuels - house coal, anthracite, Manufactured Solid Fuels (MSFs) and coffee logs", carried out between May 2022 and October 2022[5]. WP3 is an extension of WP1 and WP2, measuring emissions of the fuels in additional appliances, and was completed in October 2024.

Work Package 3 involved measurement of emissions factors for domestic solid fuels (wood logs, house coal, anthracite, MSFs, coffee logs, wood briquettes and wood pellets) on several appliance types, included the following tasks and draws together the deliverables outlined below:

- Measurement of specified pollutants emissions (Deliverable 3.3)
- Provide compositional and proximate analysis of the fuels tested (Deliverable 3.2)
- Emitted pollutants speciation and categorisation (Deliverable 3.4, 3.5). The full suite of species measured is given below, and the measurement results have been used to develop aggregated emission factors for each category of pollutant. This is commensurate with the aggregated emission factors used in the NAEI.
- Develop emission factors for all project fuels and appliances (Deliverable 3.6)

- ✓ Particulates
  - Total filterable particulate matter (including condensable fraction)
  - Particulate fractions PM_{10} / $PM_{2.5}$ / PM_1 (including condensable fraction)
  - Condensable PM fraction.

- ✓ Polynuclear aromatic hydrocarbons (PAHs)
  - Anthanthrene
  - Benzo(a)anthracene
  - Benzo(a)pyrene
  - Benzo(b)fluoranthene
  - Benzo(b)napth(2,1-d)thiophene
  - Benzo(c)phenanthrene
  - Benzo(ghi)perylene
  - Benzo(k)fluoranthene
  - Cholanthrene
  - Chrysene
  - Cyclopenta (c,d)pyrene
  - Dibenzo(a,i)pyrene
  - Dibenzo(ah)anthracene
  - Fluoranthene
  - Indeno(1,2,3-cd)pyrene
  - Naphthalene

  Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene and Indeno(1,2,3-cd)pyrene are used for international reporting.

- ✓ Polychlorinated dibenzo-p-dioxins (PCDDs) and dibenzofurans (PCDFs)
  We monitored the following tetra, penta, hexa and hepta chlorinated dibenzo dioxin and furan congeners which have toxic equivalence factors.
  - 2378-TCDD
  - 12378-PCDD
  - 123478-HxCDD
  - 123678-HxCDD
  - 123789-HxCDD
  - 1234678-HpCDD

[4] Emission Factors for Domestic Solid Fuels Project - Work Package 1 Report available here: https://naei.beis.gov.uk/reports/reports?report_id=1133

[5] Emission Factors for Domestic Solid Fuels Project - Work Package 2 Report available here: Emission Factors for Domestic Solid Fuels Project - Work Package 2 Report | National Atmospheric Emissions Inventory

- 2378-TCDF
- 12378-PCDF
- 23478-PCDF
- 123478-HxCDF
- 123678-HxCDF
- 234678-HxCDF
- 123789-HxCDF
- 1234678-HpCDF
- 1234789-HpCD

*Note the **total** (expressed as a toxic equivalence) is required for international reporting.*

✓ Heavy Metals:
- Arsenic (As)
- cadmium (Cd)
- cobalt (Co)
- chromium (Cr)
- copper (Cu)
- manganese (Mn)
- nickel (Ni)
- lead (Pb)
- antimony (Sb)
- selenium (Se)
- thallium (Tl)
- vanadium (V)
- mercury (Hg)
- zinc (Zn)

Lead, cadmium and mercury are 'priority' metals for international reporting.

✓ Black carbon refers to only condensed phase species and will include the IVOC and SVOC that is condensable on the filter media taken from the cooled dilution tunnel sampling point.

✓ Sulphur oxides (SOx)**,** Oxides of nitrogen (NOx), Carbon monoxide (CO), and Total Organic Carbon (TOC)/Total hydrocarbons.

- Emissions Factors development (Deliverable 3.4)

The scope of work is summarised in Table 1-1, below.

Table 1-1 : Summary of Technical Work Package 3 specification

WP	Item	Requirement		
3	***Measurement of emissions factors for other domestic solid fuels - wood logs, wood briquettes pellets, house coal, anthracite, MSFs and coffee logs on a range of additional appliances.***			
3.1	Measurements	Fuel	Appliance	Pollutant
		Dry wood (0-10% moisture); Seasoned wood 11-20% moisture) Wet wood (21-30% moisture) House coal Anthracite	Modern ecodesign appliance (3) Middling age stove (1) Old stove (1) Open appliance (firebasket) (1)	$PM_{2.5}$ filterable and condensable Polycyclic aromatic hydrocarbons (PAHs)/ Benzo[a]pyrene (B[a]P) Polychlorinated dibenzo-p-dioxins (PCDDs) and dibenzofurans (PCDFs) NOx SOx Black Carbon

		MSF1 (high smoke/sulphur) – note WP3 fuel is different from WP2 fuel MSF2 (low smoke/sulphur) Coffee logs Wood briquettes Wood pellets	Modern Blue Angel-certified stove (1) Pellet stove (1)	Heavy metals: As, Se, Hg, Pb
3.2	Fuel analysis	Compositional and proximate analysis of fuels tested		
3.3	Emission speciation	Speciation and categorisation of emitted pollutants		
3.4	Develop Emission factors	For pollutants of interest		
Other	-	Rationale for wood briquettes chosen		

A full description of the scope of work and approach is given in the Inception Plan[6], which was presented to the Steering Group and Defra at the project outset. Details of fuels and appliances are provided at Section 2 and Section 3 respectively.

1.3 TEAM

The project team included the current National Atmospheric Emissions Inventory (NAEI) Agency (Ricardo), and the project team fully understand the existing model and the needs of the Inventory Agency for incorporating new information. Several members of the Ricardo team are also part of the NAEI project team and have detailed understanding of the NAEI, residential combustion models and international best practise for emission inventories.

Ricardo is an energy and environmental consultancy, providing overall management and technical leadership of the programme of work.

Kiwa Gastec have led the procurement, set up and testing of emissions from the range of appliances covered by this work. Kiwa holds accreditations for laboratory testing of solid fuels and appliances and measurement of smoke emissions, for product certification under the MCS scheme of biomass appliances and for UKCA Approved Body activities under the Construction Product Regulation for solid fuel heating appliances.

Environmental Compliance Limited (ECL) is an accredited emissions monitoring test house which has carried out testing of PCDDs/PCDFs/PAHs, Heavy metals, Acid Gases, Volatile Organic Compounds and combustion gases in Work Package 3.

The **University of Leeds** School of Chemical and Process Engineering (SCAPE) has provided expert advice to the project team through the project Steering Group and verification of the test protocol through participation in round-robin testing during the initial stages of the project. It has world-class facilities for the characterisation of solid fuels, including a fully instrumented biomass heating stove test facility (gas analysis, temperature measurements, burning rates, flow rates, total particulate, particle size, VOC all in situ; PAH ex situ).

The Centre for Atmospheric Sciences (CAS) at the **University of Manchester** has also provided expert advice and test protocol verification through participation in round-robin testing. Their state-of-the-art laboratories have been used to provide further detailed analysis of the black carbon and condensable fractions of the emitted pollutants.

[6] Emission Factors for Domestic Solid Fuels: Deliverable 5.1 - Inception Plan, Ref: ED 14880, Issue 1, 25/8/21

1.4 STEERING GROUP

1.4.1 Role and membership

A Steering Group was set up by Defra to provide expert advice around domestic solid combustion, emissions measurements, and emissions factors calculations; to review progress and outcomes from the emissions factors project. The Steering Group were required to review and approve results, reports, model(s), calculations and other project outputs and challenge assumptions. The project Steering Group advised the NAEI Air Quality Inventory Steering Group (AQISG) on approval of the new emission factors into the NAEI, which have now been approved.

Defra's Emission Factors for Domestic Solid Fuels Steering Group included representatives from the following organisations:

- Defra Air Quality and Industrial Emissions team
- Department for Energy Security and Net Zero (DESNZ)
- Defra Air Quality Expert Group (AQEG)
- Team representatives from the Supplier (Ricardo)
- Supplier's sub-contractors (University of Manchester, University of Leeds, Kiwa Gastec, Environmental Compliance Limited)
- Experts in domestic combustion, appliance testing and air quality science, including HETAS, National Physical Laboratory and Aarhus University.

1.4.2 Terms of Reference

The Emissions Factors for Domestic Solid Fuels Steering Group (EFDSF SG) was established to:

- Provide expert advice around domestic solid combustion, emission measurements and emission factors calculations.
- Review progress and outcomes from the emission factors for domestic solid fuels project.
- Fulfil a role in steering and/or advising on the delivery of the project relevant to members' expertise - review and approve results, reports, model(s), calculations and other project outputs and challenge assumptions.
- Recommend the incorporation of these factors into the NAEI by working with the Air Quality Inventory Steering Group (AQISG) (run separately to this project). The AQISG has now given final approval to adopt the proposed factors into the NAEI.

1.4.3 Steering Group Meetings

The steering group met a number of times starting with the project inception in September 2021 and concluding with the discussion of final results meeting in September 2024. The final meeting combined the Steering Group and AQISG to discuss final results from across the three Work Packages and seek approval for implementation of the emission factors in 2025 submission of the NAEI. No significant issues were raised, and the emission factors have been approved for use.

Other notable meetings include:

- Steering Group meeting and Technical Workshop was held on the 2nd September 2021 to present the project Inception Plan, Gantt chart and technical approach.
- Steering Group meeting was held on 27 July 2023 to discuss the outcome of PM measurement comparisons and proposals for dealing with (WP1) PM measurement issues. This meeting also discussed the proposed Blue Angel stove for WP3.

This report is provided as evidence, and contains further detail and explanation of methods, analysis of data and a review of the newly developed emission factors from the EFDSF project.

1.5 RELATED REPORTS

This report should be considered alongside the project Inception Plan[7], which outlines the scope of work and general approach, and the project Test Protocol[8], which is a detailed document stating the methodologies which have been used in the Work Package 3 test programme. The reader may also refer to the WP1 and WP2 reports[9], which describe the round-robin testing, some modifications to the test methodologies after the initial development of the test protocol, and the results from WP1 and WP2. A report of potential future residential solid fuels was also prepared as part of WP3[10].

[7] Emission Factors for Domestic Solid Fuels: Deliverable 5.1 - Inception Plan, Ref: ED 14880, Issue 1, 25/8/21

[8] Emission Factors for Domestic Solid Fuels: Deliverable 1.1 – Test Protocol, Ref: ED 14880, Issue 1, 11/2/22

[9] Emission Factors for Domestic Solid Fuels, WP1 report https://naei.energysecurity.gov.uk/reports/emission-factors-domestic-solid-fuels-project-work-package-1-report
Emission Factors for Domestic Solid Fuels, WP2 report https://naei.energysecurity.gov.uk/reports/emission-factors-domestic-solid-fuels-project-work-package-2-report

[10] Future Fuels Report, University of Leeds, Issue 1, 10/2022 https://naei.energysecurity.gov.uk/reports/future-fuels-report

2 FUEL

Mineral fuels and manufactured fuels tend to have low variability in composition, moisture content and dimensions compared to wood fuels. They do however present more variability than refined liquid and gaseous fuels. However, for wood logs moisture content can vary and change more quickly than for mineral fuels and additional measures were required to manage moisture levels (see Section 2.1). All fuels were stored in a secure storage bin within the testing laboratory, with consistent humidity and temperature. Most of the manufactured fuels were supplied in sealed plastic bags, which prevent moisture ingress during transport and storage. Table 2-1 and Table 2-2 show the average fuel analysis for each fuel from across all three work packages. Further analysis data are provided in Appendices including fuel analysis for WP3 fuels specifically.

Table 2-1 Fuel analysis results summary (as received basis) – wood and biomass fuels

Component	Units	Wet Wood	Seasoned Wood	Dry Wood	Wood Briquettes	Coffee Logs	Wood Pellets
CV, net	MJ/kg	13.041	14.865	17.245	17.791	17.572	16.935
Moisture range	% m/m	21.2 - 28.3 %	13.4 - 17.3 %	1.4 - 7.6 %	5.2-6.0%	-	-
Moisture	% m/m	24.68%	15.35%	3.90%	5.60%	7.20%	7.60%
Ash	% m/m	0.56%	0.64%	0.51%	0.40%	0.70%	0.00%
C	% m/m	36.22%	40.86%	46.36%	46.75%	47.20%	45.40%
H	% m/m	4.54%	5.08%	5.70%	5.68%	5.7%	5.74%
N	% m/m	0.21%	0.20%	0.25%	0.10%	1.13%	0.13%
S	% m/m	0.01%	0.03%	0.01%	0.01%	0.04%	0.01%
O (by diff)	% m/m	33.41%	37.35%	43.09%	41.55%	34.9%	40.70%

Table 2-2 Fuel analysis results summary (as received basis) – mineral fuels

Component	Units	Approved MSF - Heat Approved	Non-approved MSF - Superheat (WP2)	Non-approved MSF - BriteFlame	Coal	Anthracite
CV, net	MJ/kg	24.27	28.007	27.919	28.166	32.49
Moisture	% m/m	20.4	7	14.9%	3.9	2.1
Ash	% m/m	5	4.6	3.1%	1.8	3.9
C	% m/m	65.20	73.40	72.90%	73.40	87.10
H	% m/m	2.97	3.93	3.49%	5.04	3.72
N	% m/m	1.16	1.16	1.14%	1.52	1.22
S	% m/m	1.33	2.35	3.58%	0.22	0.81
O (by diff)	% m/m	3.94	0.89	0.90%	14.12	1.15

Calculated dry flue gas volume, 0% O_2	m^3/GJ (0°C, 101.3 kPa, net heat input)	263	259	263	257	263

The following sections (2.1 - 2.7) outline the fuels, along with their storage and preparation, used within the work programme.

2.1 WOOD LOGS

For testing log wood fired appliances to the relevant standard (BS EN 13240 or BS EN 16510-1) the test fuel specification prescribes the species to be beech, birch or hornbeam. Information from wood suppliers suggests that beech or ash are the main species of log fuels used in the UK. This does vary geographically as suppliers will source material close to where they are established.

To represent the real world, we can examine the UK supply of wood fuel. The 2020 Forest Resource Assessment[11] shows the composition of the UK Growing Stock (using the metric: million m^3 over bark) to be Oak 11% (not a fuel wood), Spruces 35% (not a fuel wood), Scots Pine 9% (not a fuel wood), Ash 7%, beech 5% and Birches 5%.

Using the growing stock and laboratory appliance test fuel information, beech was chosen for the test programme as it is used widely across the UK and its use in this test programme could also be linked to existing data on appliance testing allowing comparisons to be made.

The wood was supplied in 25cm tall wedges of varying size and weight. This was then divided into seasoned, wet and dry wood and stored or seasoned accordingly. This can be seen in Figure 2-2. To keep the fuel mass constant between tests, each wood piece was cut down to size using a hand axe

Figure 2-1 - Wood logs cut to size

[11] Forest Research, Forest Resources Assessment 2020, available here : https://www.forestresearch.gov.uk/tools-and-resources/statistics/statistics-by-topic/international-returns/forest-resources-assessment/

and weighed. Each log was cut into rough pentagon shapes with some bark left on the log, representative of the fuels burned in a domestic setting. This size was able to fit into all appliances tested. Prepared logs can be seen in Figure 2-1.

The wood used for the test programme was sourced from a local supplier, Mark Hannis Firewood. They delivered firewood which is locally sourced from within 5 miles of the sawmill. This wood is partially seasoned to around 20% - 25% moisture content prior to delivery. For laboratory use, this wood is then stored and processed as appropriate for the tests. Further detail of how the moisture content was managed can be found in the sections below on Wet, Seasoned and Dry wood.

The moisture content of wood is from ‘inherent’ moisture contained within the cells of the plant and ‘free’ moisture on exposed surfaces (both external and internal surfaces of the porous structure) i.e., not bound within the wood structure. When wood is harvested, changes in moisture content start to occur to align with prevailing humidity levels. Three moisture content levels were selected to represent the various conditions of the wood commonly burnt in domestic settings. This included dry wood, seasoned wood, and wet wood.

The approach to determination of moisture using current standards involves:

- Sampling from supply: BS EN ISO 18135:2017 Solid Biofuels – Sampling
- Preparing the sample: BS EN ISO 14780:2017 Solid biofuels — Sample preparation
- Determination of moisture content: BS EN ISO 18134-1:2015 Solid biofuels - Oven dry method Parts 1-3

The uncertainties relating to the measurement of moisture contents in wood logs are expected to be significant. The key question for this project relates to how characteristics can be determined for material ‘as used’ and, how these relate to any measurements made in an analytical laboratory. For this project a range of measurement approaches were used.

- Accredited laboratory testing as part of the fuel analysis (on delivery)
- Oven drying based measurements of a representative samples (weekly).
- Moisture probe measurements at point of use (daily)

The management of the three moisture levels for the test fuels differed slightly and is detailed below:

Dry wood (moisture content 0% - 10%) – 6% target moisture selected

Dry wood is commonly available as ‘kiln dried’ wood and typically supplied in the UK in sealed plastic bags to maintain moisture levels. Kiwa used its own kilns to dry wood to the targeted 6% moisture levels. By preparing wood logs at 15% moisture to 666g and placing in a kiln over for 48 hours dried the wood to the required levels. This resulted in wood logs of 600g with a moisture content of 5%. These logs were then stored in sealed plastic bags until the test date to prevent exchange of moisture with the atmosphere with a sealed sample sent away for accredited laboratory testing. The storage and testing protocol were designed to limit the period of potential exposure to environmental/atmospheric moisture.

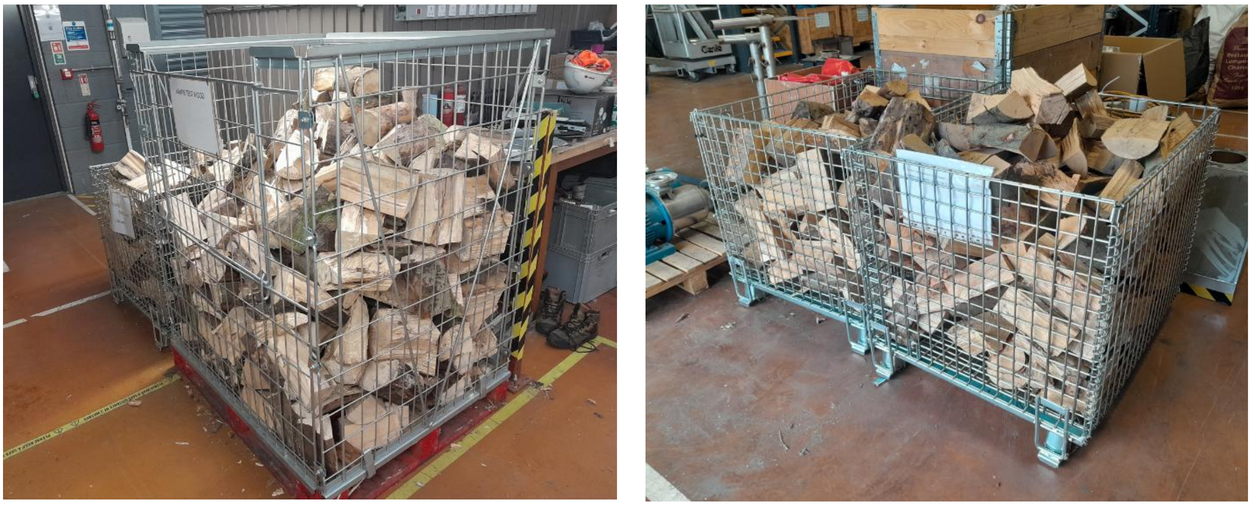
Seasoned wood (moisture content 11% - 20%) – 15% target moisture selected

This wood was stored inside of the building in controlled conditions until the desired moisture content is achieved. Kiwa has developed methods and expertise in ensuring 15% moisture contents in its current procedures for its solid fuel testing laboratory. There is a constant cycle of deliveries and drying of wood to ensure that there is always wood fuel available for testing. Any fuel that is out of spec i.e. below 15% moisture is returned to the supplier. The experience and expertise at Kiwa resulted in wood moisture content being close to that specified in the standard (BS EN 16510-1:2018 Table B.1 — Test fuel specifications) i.e. (15±3)%. This is controlled through weekly tests on fuel moisture using Kiwa’s in house procedures. This procedure can be found in Figure 2-2. Hand-held moisture probes provide a final check before the logs were subjected to the test procedure.

Wet wood (moisture content 21% - 30%) - 25% target moisture selected

This represents unseasoned wood or wood stored in outdoor/wet conditions. Achieving consistent levels of moisture significantly above the equilibrium levels for seasoned wood is a challenge. To manage the fuel for the test programme logs were sourced in a wet state with moisture levels of around 30%. These were then stored in humid conditions to maintain the elevated moisture level. Once the 25% level required for testing has been achieved the wood logs were sealed in bags until the test date. This was managed so that testing was completed within a few weeks of storage to ensure that the wood fuel did not deteriorate in the wet bagged condition.

Figure 2-2 Storage of wood fuels



Samples of the three types of wood (dry, seasoned and wet) were analysed by Alfred H Knight Energy Services Ltd which is accredited for solid fuel analysis. The full data sets from this analysis can be found in Appendix A1. Table 2-3 shows the ranges of moisture content set out to differentiate the wood types in this test programme as well as the average moisture content reported in the wood analysis for WP1 and WP3.

Table 2-3 Measured Moisture Content of Wood

Wood Type	Moisture Content Range	Actual Moisture Content
Dry Wood	0 - 10 %	3.9 %
Seasoned Wood	11 - 20 %	15.3 %*
Wet Wood	21 - 30 %	24.7%

*Seasoned in house, moisture content measured in house at time of use.

2.2 HOUSE COAL

Figure 2-3 House coal trebles

The House Coal used was the CPL Premium House coal trebles, supplied in 25 kg plastic bags. This fuel is not authorised for use in smoke control areas. This fuel was supplied directly by CPL.

This type of fuel was, until recently, widely available at retail points such as DIY stores, petrol stations and garden centres. However, its sale in England for domestic uses has been prohibited since May 2023 under the Air Quality (Domestic Solid Fuels Standards) (England) Regulations 2020.

Coal lump sizes have big variations. Pieces weighing 60 – 80 g were selected from each bag. This results in 1/3 of the bagged fuel remaining unused.

The sulphur content of coal is very low at 0.2%, making it the mineral fuel with the lowest sulphur content among those tested in this programme. The calorific value is similar to that for the MSF fuels but lower than anthracite (on an as received basis).

2.3 ANTHRACITE

Figure 2-4 Anthracite small nuts

Anthracite sourced was the GLO-PAK Anthracite Small Nuts supplied in bags. This is advertised as a naturally smokeless fuel and is approved for use in smoke control areas under the generic authorisation for smokeless fuels.

The net calorific value is the highest of all the fuels (on an as received basis).

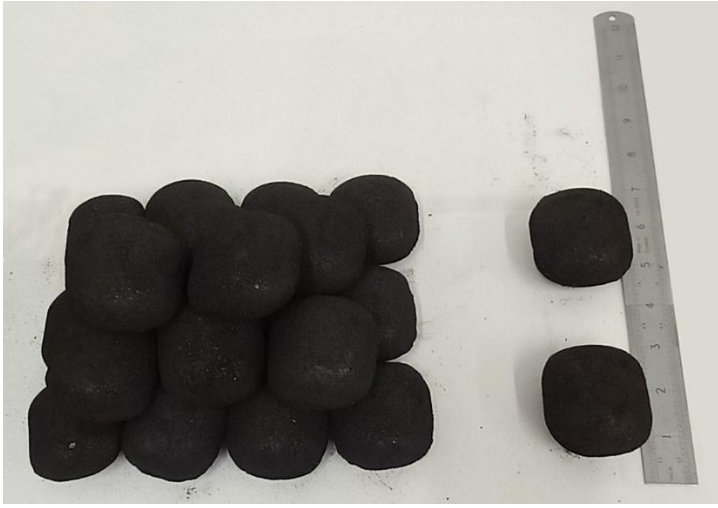
Anthracite proved difficult to light compared to other fuels. Significantly more heat had to be supplied by kindling and firelighters during the ignition phase. The amount of fuel itself was also increased to cover the entire fuel grate. Once ignited, this fuel burned slowly, releasing heat over a long time. Some firelighters had to be added on refuel to maintain the flame.

There is a large variation in the anthracite nut size. Pieces weighing 40-60g were selected from each bag of anthracite. This results in 1/4 of the bagged fuel remaining unused.

2.4 MANUFACTURED SOLID FUELS

Heat Authorised fuel (MSF2)

Figure 2-5 Heat Approved ovoids



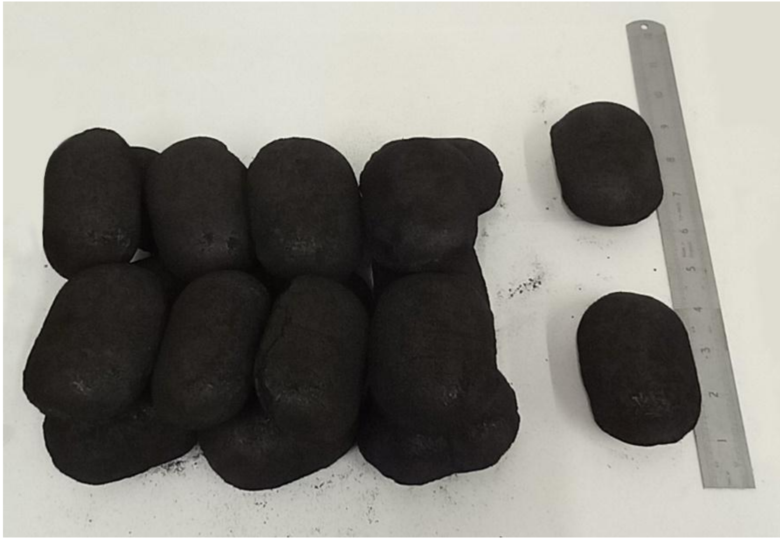
This is an Authorised fuel smokeless (<5g/hr) and low sulphur (<2%) fuel and is a HETAS approved fuel. Heat was supplied by CPL directly in sealed 25kg plastic bags.

The small ovoid/pillow shapes are very uniform at approx. 1.5” x 1.5” with a thickness of 1”.

Total moisture of this sample was measured at 20.4%, which is very high compared to other mineral fuels tested.

Briteflame non-Authorised fuel (MSF1)

Figure 2-6 Briteflame ovoids



This fuel is a petcoke based ovoid made with a resin binder. There is an Authorised fuel with this name but this is a non-approved fuel. Following introduction of The Air Quality (Domestic Solid Fuels Standards) (England) Regulations 2020[12] this fuel is not available for residential use in England and is currently only sold in Scotland. Briteflame fuel was supplied by CPL directly in sealed plastic bags, 25kg each. This fuel was different to the fuel used in WP2 (Superheat) due to the WP2 fuel no longer being available. The Briteflame fuel was provided by CPL as it is a similar fuel to the Superheat.

As a manufactured solid fuel, the shape and size of each ovoid is very uniform, measuring around 3" in length by 2" wide and around 1" thick.

2.5 COFFEE LOGS

Figure 2-7 Coffee logs

[12] Available here : https://www.legislation.gov.uk/uksi/2020/1095/contents/made

Coffee logs were sourced from an online retailer and most main national DIY stores (B&Q, Wickes etc.) sold this product, but the manufacturer has since gone into administration.

They were advertised as ‘bio-bean Coffee Logs - Eco-Friendly Fire Logs for Wood Burners and Multi-Fuel Stoves’, and sold in paper bags of 16 logs each.

It is difficult to find other manufacturers’ products on the market. The retail price is similar to the other manufactured wood-based heat logs.

Coffee logs used for testing showed a moisture level of around 8%, which is typically somewhere in between seasoned and kiln dried firewood. Sulphur content in WP3 was significantly below other manufactured fuels at 0.04%. Net and gross calorific values were approximately a third lower than the other manufactured fuels tested.

Compared to wood logs, coffee logs are a smaller size. Some coffee logs can crumble in transport and while burning.

When burning, coffee logs produce more smoke than seasoned or kiln dried wood. They also burn relatively hot and fast; modern stoves with good air supply controls allow for the burn rate to be slowed down.

The manufacturer states coffee logs are suitable for burning in wood burning stoves and multi fuel stoves.

2.6 WOOD BRIQUETTES

Wood Briquettes were sourced from an online retailer but most main national DIY stores (B&Q, Wickes etc.) sold this product. They were advertised as ‘Homefire Heat Logs (shimada) A high-energy, next generation fuel, these ultra-dry heat logs provide an attractive flame and sustained heat output”

There are a number of competitor products on the market which have varying shape and size due to the type of manufacturing process. These products comprise of compressed wood material (sawdust) usually in the form of small particles as the source material is usually sourced from saw mills or wood manufacturing processes.

Because the source material is from processed wood this material is usually very dry (6% in the heat log product used) and is equivalent to kiln dried wood. As this is a manufactured fuel the shape of each log is identical with similar composition which makes these fuels more uniform than a wood log. They do burn differently to a wood log however as the material is made up of small particles and does not have the same structure as a wood log.

The Shimada type log refers to the manufacturing process which torrefies the outside and inside of the log using high temperature and pressure during production. This torrefaction process reduces the need for binder to keep the structure of the compressed material together. In the case of the heat log used in WP3 the manufacturing process has formed a hollow structure inside the logs used which may impact the combustion properties.

Compared to wood logs, Heat logs are a similar size. When burning, burn relatively hot and fast; modern stoves with good air supply controls allow for the burn rate to be slowed down.

The manufacturer states heat logs are suitable for burning in wood burning stoves, multi fuel stoves and open fires.

2.7 WOOD PELLETS

Figure 2-8 Wood Pellets

Wood pellets were sourced from an online retailer but can also be found in main national DIY stores (B&Q, Wickes etc.).

They were advertised as 'Blazers Premium Wood pellets, Blazers Premium wood fuels are all ENplus®, BSL, Woodsure and HETAS certified so you can burn with confidence." These pellets have been produced from 100% virgin British wood residue from sawmill activity.

The UK requirements for pellets mean that although there are a number of competitor products on the market all have the same size and composition as they follow the ENplus A1 specification. This specification is in Table 2-4:

Table 2-4: Summary of ENplus A1 Pellet Requirements (excluding metals data)

Quality class	EN*plus*® A1	Unit
Diameter (as received)	6 ± 1, 8 ± 1	mm
Length (as received)	3,15 ≤ L ≤ 40 (a)	mm
Share of pellets with a length < 10 mm (as received) Category L < 20%, 20%≤ M ≤ 30%, S > 30%	value & category to be stated	w-%
Moisture (as received)	≤ 10,0	w-%
Ash (dry basis)	≤ 0,70	w-%
Mechanical durability (as received) (c)	≥ 98,0	w-%
Bulk density (as received)	600 ≤ BD ≤ 750	kg/m³
Particle density (as received)	value to be stated	g/cm3
Coarse fines (3,15 mm ≤ FP < 5,6 mm) (as received)	value to be stated	w-%
Fines (< 3,15 mm) (bulk) (as received)	≤ 1,0	w-%
Fines (< 3,15 mm) (bags) (as received)	≤ 0,5	w-%

Quality class	EN*plus*® A1	Unit
Net calorific value (as received)	≥ 4,6 (h)	kWh/kg

Similar to wood briquettes these products comprise of compressed wood material (sawdust) usually in the form of small particles as the source material is usually sourced from sawmills or wood manufacturing processes.

Because the source material is from processed wood this material is usually very dry (less than 6% specified) and is equivalent to kiln dried wood. However, as this is a manufactured pellet fuel the shape is very small compared to a log and each pellet has similar dimensions with similar composition which makes these fuels uniform. They do burn differently to other fuels used in WP3 and require a specific appliance type to enable their use.

3 APPLIANCES

The procurement of stoves and open fires was a key part of the project to conform with the requirement that stoves used represent the installed base in the UK and to capture significant developments in stove performance at breakpoints in the years 2000, 2010 and present stove technology (Ecodesign and better – clearSkies Mark 2 or above). Note that in addition to the clearSkies ecolabel, the HETAS Cleaner Choice ecolabel provides third party certification of stoves in the UK and a range of ecolabels are available in other countries.

3.1 DRIVERS FOR SOLID FUEL APPLIANCE DEVELOPMENT

The drivers for stove development over time which has driven improved performance have been:

Introduction of the Construction Products Directive[13]: For stoves, demonstration of conformity involves demonstration of key performance requirements through a harmonised EN Standard (EN13240:2001) including use of Notified Bodies to certify products, 'System 3' attestation and CE marking. However, the Standard did not consider PM emission requirements. The harmonised Standard was amended in 2004 and the threshold for efficiency was added of equal to or exceeding 50% net. The Directive has since evolved into the Construction Products Regulations and, post Brexit, CE marking has been replaced by UK Conformity Assessment.

Publication of the 2010: Domestic Building Services Compliance Guide[14] (DBSCG): This sets a minimum efficiency threshold for 'Solid fuel dry room heater - 65% gross' and for 'Simple open fire 37% gross'. The project teams' experience is that there were appliances in the market which significantly exceeded this minimum level of performance prior to this guidance being published.

Ecodesign regulation for solid fuel space heaters[15] which came into force 2022: This sets the minimum threshold for seasonal space heating energy efficiency to not be less than 65 % net, and sets emission limits for NOx, OGC, particulate, and CO. In the regulation seasonal efficiency is efficiency measured at rated output -10% for appliances without controls or electrical supplementary heating. So, a measured efficiency of not less than 75 % net must be achieved in standard type tests. The Ecodesign benchmark is seasonal efficiency of 86% net. Note that Ecodesign regulations use market surveillance to assess product performance which is markedly different from the type approval controls on Construction Products.

clearSkies[16] - Since early 2020 the clearSkies Mark certification scheme has been operating and shows that a significant number of products are available in the market that exceed the requirements of the Ecodesign regulation. Prior to the clearSkies mark an 'Ecodesign-ready' listing was available and numerous stoves were included in this for two or more years prior to clearSkies. Note that in addition to the clearSkies ecolabel, the HETAS **Cleaner Choice**[17] ecolabel provides third party certification of stoves in the UK.

These developments have impacted the performance of stoves and therefore impacted the installed base of appliances. As the appliance inventory has been built up over decades, it is not possible for a single appliance to give statistically robust representation of the products installed over timeframes of 10 or more years. Therefore, selection of appliances solely on the basis of age in order to fit with the NAEI stove classification system will not necessarily result in appropriate representation of the performance of these segments of the installed population. This is highlighted by the publication of the

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[13] Construction Products Directive (Council Directive 89/106/EEC) (CPD) is a now repealed European Union Directive which aimed to remove technical barriers to trade in construction products between Member States in the European Union. The directive is now replaced by Regulation (EU) No 305/2011

[14] https://www.gov.uk/government/publications/amended-approved-document-l1b-and-domestic-building-services-compliance-guide

[15] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2015.193.01.0001.01.ENG

[16] www.clearskiesmark.org

[17] HETAS Cleaner Choice - New Scheme Raising Industry Standards

2010: DBSCG which set minimum efficiency thresholds which many appliances were already meeting. Because of this, appliance choice should not be based just on age but also its relative performance to the installed inventory.

3.2 APPLIANCE CATEGORIES AND STOVE SELECTION

Appliances were selected for WP3 which built on the work completed in WP1 and WP2. This meant selecting additional stoves from existing categories and choosing new appliances from new categories to develop the emissions factors produced.

WP1 / WP2 Criteria

i. open fires
ii. pre 2000 closed stoves
iii. 2000-2009 closed stove
iv. modern stove (Ecodesign-compliant, clearSkies level 2 or above)

Expanded WP3 Criteria

v. Larger appliance
vi. Modern Blue Angel appliance
vii. Pellet Stove
viii. Modern stove (Ecodesign-compliant, clearSkies level 1 or below

The stoves selected for testing and fuels tested in WP3 are detailed in Table 3-1. Further information for each stove can be found in Appendix A.2. Note that appliances tested in WP1 and WP2 were tested for one additional fuel in WP3 (wood briquettes) with note that the pre-2000 stoves proved difficult to source. Several options were found but their size and/or condition was not appropriate for use in the test program.

Installation data was available from Hetas for years after 2006 and helped to identify common appliances in categories iii and iv. However it was notable that there are a large range of stove models available and no individual stove dominated the installations.

Table 3-1 Summary of appliances tested in WP3

Appliance category	Appliance	Fuel type	Fuels tested in WP3	Commentary
Open fire	Parkray Paragon inset open fire, 400mm nominal width	Multifuel	Wood briquettes	These appliances are seen as representative of the open fires in use in UK.
	16 inch Cromwell fire basket (WP3)	Multifuel	Coal Low sulphur MSF High sulphur MSF Wet wood Seasoned wood Dry wood Wood briquettes Coffee logs	
Pre 2000 closed stove	Hunter Oakwood	Multifuel	Wood briquettes	There is little detail on this appliance as the manufacturer no longer have records of their discontinued models. The 'turbo baffle' system which was part of the air system has been blocked for the test program according to manufacturer's recommendation.
	Coalbrookdale (Aga) Little Wenlock (WP3)	Multifuel	Coal Low sulphur MSF High sulphur MSF Wet wood Seasoned wood Dry wood Wood briquettes	The Coalbrookdale (Aga) Little Wenlock is a cast iron stove suited to smaller rooms. The stove incorporates airwash to keep the glass clear and has a reported 79% efficiency rating. The woodburning version is approved for burning wood in smoke control areas. It has a nominal heat output of 4.5kW[18]..

[18] Whatstoves – Little Wenlock Stove review https://www.whatstove.co.uk/little-wenlock-stove-reviews

Appliance category	Appliance	Fuel type	Fuels tested in WP3	Commentary
			Coffee logs	
2000-2009 closed stove	Stovax / Dovre Model Dovre 500MRF	Multifuel	Wood briquettes	This traditional multi fuel cast iron stove has reported efficiency of 79% and a heat output of 8kW and an airwash system to keep the door glass clean. The wood burning stove incorporates a Cleanburn system and is suitable for use in Smoke Control Areas[19]. Hetas installation data for years after 2006 indicate that it made up 2.9% of installations in the period.
	Redfyre (Gazco) Kensal 20 RF-KEN20M (WP3)	Multifuel	Coal Low sulphur MSF High sulphur MSF Wet wood Seasoned wood Dry wood Wood briquettes Coffee logs	An iron and steel construction stove. The heavy gauge steel firebox features airtight cast iron doors and cast iron fittings. It has a rotating grate that can be riddled from outside the stove to improve combustion[20]. Hetas installation data for years after 2006 indicate that this was a popular appliance in period.
Modern Ecodesign stove	Charnwood Model: C4. *Woodburner in WP1, multifuel version used for WP2.*	Wood-burner (WP1) Multifuel (WP2)	Wood briquettes	The smallest model in the C-Series, delivering a heat output to the room of between 2 to 5.5kW with a rated output of 4.9kW. The stove meets Clean Air Act requirements for smoke control exemption; allowing wood to be burnt in smoke control areas”[21]. Hetas installation data indicate the stove represented about 1% of installations in period July 2020-june 2021. Note that a multifuel variant was used in WP2.
	Hunter Aspect 5 (WP3)	Multifuel	Coal Low sulphur MSF High sulphur MSF	The Aspect 5 stove delivers a nominal heat output of 5 kW The stove adheres to Ecodesign and Defra regulations, and is suitable for

[19] Country Wood Burning Centre – Dovre 500 Stove http://www.countywoodburningcentre.co.uk/stoves/dovre-500-stove.html
[20] Stovedirectory Redfyre Kensal 20 https://www.stovedirectory.co.uk/stoves/redfyre-kensall-20/
[21] Charnwood Stoves C-Four https://www.charnwood.com/all-stoves/room-heating-stoves/c-series/c-four/

Appliance category	Appliance	Fuel type	Fuels tested in WP3	Commentary
			Wet wood Seasoned wood Dry wood Wood briquettes Coffee logs	installation in smoke-controlled areas[22]. Hetas installation data indicate the stove was a common choice for recent installations.
	Hunter Aspect 8 (Large stove) (WP3). *Included part load tests.*	Multifuel	Coal Low sulphur MSF High sulphur MSF Wet wood Seasoned wood Dry wood Wood briquettes Coffee logs	The Aspect-8 stove has a manufacturers' quoted efficiency of 76% and a nominal heat output of 8kW[23]. Hetas installation data indicate the stove was a common choice of larger stove for recent installations.
	Stovax Stockton 5 Eco wood FT (WP3)	Wood-burner	Wet wood Seasoned wood Dry wood Wood briquettes Coffee logs	An Ecodesign compliant wood-burning stove which was obtained from the manufacturer from stock. Hetas installation data for the period January 2021 to June 2023 indicated a popular stove with about 0.6% of installations
Very modern stove (Blue Angel-ecolabel stove)	Hase Sila IQ+ (WP3)	Wood-burner	Wet wood Seasoned wood Dry wood Wood briquettes Coffee logs	A Blue Angel ecolabel wood-burning stove was chosen to represent a very modern appliance. Blue Angel includes an expanded test process and requirements are stricter than defined in Ecodesign Regulations. For example, stoves appliances holding the Blue Angel must comply with a particle mass concentration limit of 15 mg/m^3. [24] The appliance selection was limited by the small number of appliances which have gone through the ecolabel's certification process. A further

[22] Hunter Stoves Apsect-5 https://www.hunterstoves.co.uk/product/aspect-5-eco/
[23] Hunter Stoves Aspect-8 https://www.hunterstoves.co.uk/product/aspect-8-eco/
[24] Blue Angel The German Ecolabel https://www.blauer-engel.de/en/productworld/stoves-for-wood

Appliance category	Appliance	Fuel type	Fuels tested in WP3	Commentary
				limiting factor is the technology. Most manufacturers have selected an electrostatic precipitator (ESP) technology to enable them to meet the particulate emission requirements of the Blue Angel certification. However, the ESP technology was a constraint for installation in the test rig as the appliances are tall and the high voltages were a concern for manoeuvring sampling equipment. The Hase SILA iQ+ stove incorporates a catalyst for emission control and has technology continuously monitoring the combustion chamber to regulate the air flows and temperature. The stove has a heat output 5.5 - 7.5kW[25].
Pellet stove	Island stoves, Ramsey (WP3)	Pellets	Wood pellets	The Ramsey is a slimline pellet stove with a 12kg pellet hopper capacity. It is Ecodesign compliant and has a reported efficiency of 82%. The appliance is Defra Approved for use in Smoke Controlled Areas[26].

[25] Hase Stoves SILA PLUS IQ+ https://www.hase-stoves.com/iq-technology
[26] Island Pellet Stoves https://www.islandpelletstoves.co.uk/shop/pellet-stoves/ramsey-4-supply-install-with-balanced-flue/

4 WP3 POLLUTANT MEASUREMENTS

4.1 TEST PROTOCOL

Initial testing and discussions with the Steering Group informed the development of a Test Protocol, which defined how the measurement programme should be undertaken to develop the emissions factors for all the specified fuels and appliances. The Test Protocol was largely developed before the round-robin tests began and was subsequently updated based on the challenges and findings from the round-robin tests. The Test Protocol was presented to the Steering Group on 25th November 2021 and was approved for use. A final version[27] was used in the WP3 test programme. A modified test protocol was applied for the Blue Angel stove and for the pellet stove (see Section 4.1.1).

The test protocol addresses several considerations including:

- How to measure 'real-world' emission performance
- Consistent appliance operation
- Pollutant Measurements
- Methodology development for black carbon measurements and characterisation of condensables
- Performance characterisation - assessments of uncertainty, variability, and accuracy of measurements through repeatability testing
- Uncertainty and accuracy of results
- Method for the creation of final emissions factors and co-operation with NAEI agency

The Test Protocol describes the equipment set up, methodology, appliance operation and operating parameters in detail and this is not duplicated in this report.

The following data were recorded by the project:

Figure 4-1 Components measured in WP3

Measurement	Measurement location	Comments
CO CO_2 TOC/HC NO_X	Appliance outlet	Continuous measurement, unweighted CO and O_2 used to standardise integrated samples. Weighted data used to standardise continuous measurements. NO_X data used in preference to dilution tunnel data.
NO_X CO CO_2 SO_2 HC	Dilution tunnel	Continuous measurements, unweighted CO data used to establish dilution ratio for integrated samples. Weighted CO data used to establish dilution ratio for continuous measurements. NO_X not used (close to limit of detection and/or too variable).
PM	Appliance outlet	Heated filter measurement, integrated samples for alternate phases of burn cycle.
PM	Dilution tunnel	Heated filter measurement, integrated samples for alternate phases of burn cycle.
Dioxins & Furans PAH Heavy metals	Dilution tunnel	Integrated samples collected over entire burn cycle (a combined sample system for PCDD/F and PAH analysis and a separate sample system for heavy metals).

[27] Emission Factors for Domestic Solid Fuels: Deliverable 1.1 – Test Protocol, Ref: ED 14880, Issue 1, 11/2/22

Measurement	Measurement location	Comments
PM PM_{10}, $PM_{2.5}$, PM_1	Dilution tunnel	Impactor measurement, integrated samples for alternate phases of burn cycle. PM data compared with PM at appliance outlet to assess condensable PM component (by difference).
Black carbon	Dilution tunnel	Integrated samples collected over short periods in alternate phases of burn cycle. Analysed for EC and OC. Note that a single sample was collected for each fuel and following the WP1 work, additional testing is planned in WP3.
Condensable PM	By calculation	Difference between impactor and heated filter measurements at dilution tunnel and appliance outlet respectively.

In addition, oxygen concentrations, flue gas temperatures, mass burnt, burn rate, appliance draught and ambient temperature were all monitored. PCDD/F, PAH, heavy metals and, in some instances, SOx have been determined using integrated samples collected over the entire burn cycle. PM species were measured during each type of phase (ignition, refuel and burnout). Samples for Black Carbon were collected for short periods during selected ignition, refuel and burnout phases with timings informed by preliminary tests at the University of Manchester. NOx, SO_2, CO, TOC, O_2 and CO_2 were monitored continuously over entire burn cycle. Some measurements were undertaken at the appliance outlet, but most emissions were measured using a dilution tunnel.

Three measurements were undertaken on each appliance + fuel combination. The test protocol included ignition, one or two refuels and a burnout phase. Note that the number of refuels depended on how quickly a fuel load was consumed for each appliance and fuel combination. Wood and biomass fuels required more refuels than mineral fuels to provide sufficient burn duration to replicate real world operation of 4 hours. Wood and biomass fuels typically required at least two refuels to achieve burn time whereas mineral fuels only required one refuel due to the longer burn period of the fuels.

The amount of fuel used per refuel depended on the appliance and fuel type under test. This is because the primary air supply through the grate is the main source of combustion air for mineral fuels and MSF. This is a key difference compared to wood fuels for which the main combustion air is from secondary air (air wash). The covering of the grate is therefore very important for effective and consistent combustion for mineral solid fuels. If part of the grate is left uncovered, then combustion air will bypass the fuel bed and the fuel will only burn partially. As the grate sizes vary between stoves the mass of fuel needed to cover the grates changes therefore the mass of fuel used varies between appliance + fuel combination.

Two of the stoves, the Blue-Angel certified and the pellet stove, had some level of automatic control and required amendments to the test protocol, these are described in section 4.1.1.

All measurements in WP3 were conducted on the test rig constructed at Kiwa, Cheltenham, with Kiwa and ECL undertaking measurements.

4.1.1 Changes to the Test Protocol

4.1.1.1 Procedure adaptations for the Hase Blue Angel Stove

The main updates to the protocol and procedures relate to the inclusion of the catalytic technology in the stove body. This catalytic technology has a cleaning procedure which was completed before each test with the stove. This cleaning involves brushing the surface to ensure that the entrance to the structure is not blocked prior to testing. This cleaning is suggested by the manufacturer periodically to ensure good operation. While the stove would not be cleaned as frequently during real operation, cleaning this surface between tests ensures that each test is comparable.

Additional repeat measurements were taken outside the main test program with seasoned wood to check for degradation of the catalyst between the testing with different fuels.

For the operation of the stove, the manufacturer's operating instructions were followed. The main difference for this stove compared to the other wood log stoves tested is that the stove includes a fan to force air through the fuel bed and the flue gasses through the catalytic structure. This air rate is controlled using temperature sensors in the stove. To enable testing there have been some minor changes to procedures:

1. The stove door was closed after ignition (for other stoves the stove door was kept open for a period after ignition).
2. The procedures have also been adjusted to ensure that the stove's automatic refuel detection was not triggered by opening the door of the stove prematurely before a refuel. This can occur during testing, for example to reposition fuel. However, this cannot be completed on the HASE stove due to its automatic controls.

The stove itself also prompts the user to refuel, this function was not used as part of the tests. This has been done for consistency with the test protocol and procedures used on other stoves where the flame out point has been used as a trigger for refueling.

4.1.2 Procedure adaptations for the Pellet Stove

Pellet stoves operate in different modes to traditional solid fuel appliances. As they are automatically controlled, they have different outputs during an operating period and they are often designed to maintain an internal temperature rather than being manually controlled by the user. So, they need their own operating procedure. To complete this one of the most appropriate pieces of research used was the beReal test method[28]which was also used to inform the development of the wood log stove test procedure. We have adapted the principles of the beReal method's pellet stove test cycle for the UK operating period to provide a test cycle which includes ignition, reduced output and standby operation. The following table shows the test cycle adopted for the pellet stove:

Table 4-1 – Test Protocol for Pellet Stove

Operation	Time (minutes)	Power setting
Cold start (high load)	30	5
Low output (low load)	45	1
Shutdown	30	-
Warm start (high load)	45	5
Shutdown	30	-
Warm start (medium load)	45	3
Shutdown	30	-
Total	*255 minutes - 4.25 hours*	

The stove has 5 power settings which allowed modulation of the output between 100% (5.7 kW setting 5) and 50% (2.8 kW setting 1). Note that the duration of shutdown periods was determined by the stove's operating software which prevented a restart within 30 minutes of a shutdown.

Extractive particulate sample measurements were taken continuously for the total particulate. Gravimetric analysis and EC/OC split were taken during the cold start (high load), during steady operation (15 mins after warm start) and during final shutdown.

28 https://www.researchgate.net/publication/321292705_Development_of_a_Test_Procedure_to_Reflect_the_Real_Life_Operation_of_Pellet_Stoves

4.1.3 Measurement Issues

Although some of the burn cycles proved difficult to control (particularly on the older appliances), the continuous monitoring data indicate that emission trends and burn rates during consecutive burn cycles were consistent. Maintaining a high level of dilution proved difficult on some appliances including the open fireplace.

4.1.3.1 Measurement Issues - Stockton 5

As part of WP3 a Stockton 5 ECO WOOD FT stove model was selected for testing. This is a popular wood-only stove that is a representative example of a *modern* Ecodesign stove used in the UK. The Stockton 5 ECO WOOD FT was obtained from the manufacturer from stock.

Please note that the Stockton 5 is one of only three wood-only Ecodesign stoves tested – the WP1 stove was for wood only (a variant was tested for other fuels in WP2) and the second wood-only stove in WP3 is the Blue Angel stove, which is fitted with a catalyst and not representative of typical UK appliances. The other *modern* stoves tested in WP1 and WP3 are all multifuel devices.

The issue - during testing issues emerged in the performance of the Stockton 5 appliance. Tests were completed measuring a range of pollutant emissions under real world conditions with five fuels appropriate for a wood-burning appliance:

- Three wood log fuels at different moisture contents
  - Seasoned wood
  - Wet wood
  - Dry wood
- Coffee log fuel
- Wood briquette fuel

During these tests, testing staff noticed some irregularities with the appliance performance that would not be expected of a modern Ecodesign stove. These variations in expected performance were most noticeable when testing with seasoned wood as this is the material the stove is designed to burn and is the fuel used when undertaking performance testing for certification to EN Standards.

Initially the stove was inspected by the Solid Fuel team at Kiwa Energy for defects in its manufacture and for any operation during testing that was different from the recommended operation as described in the stoves operating manual. No defects were found in the inspection of the appliance by the testing staff.

The stove was then tested on the performance testing equipment at Kiwa Energy which is used for certifying the performance of solid fuel appliances. These tests found that the efficiency of the stove was lower than expected with the appliance not meeting Ecodesign efficiency requirements and well below net efficiency reported in the stove's declaration of performance.

At this time the stove manufacturer was contacted for assistance in investigating the stove's low performance. The manufacturer sent images and details to check on the appliance. These checks identified that during manufacture the flue collar had been installed incorrectly. This was something that could be corrected by reinstalling the part in the correct orientation.

The appliance manufacturer also attended the Kiwa testing facility to assist the investigations. The stove was retested on the performance testing rig with the manufacturer present on the 25th January. The results showed that the stove performance was improved by changes made to the stove on the day.

- Test 1 - Flue collar adjustment and tightening of fixings on the stove;
- Test 2 - Taping up of the slider gap for the tertiary air control;
- Test 3 - Final run with adjustments made.

However, the stove was still unable to meet the Ecodesign requirements even with these improvements. This suggests that there were defects which remained in the stove after these changes were made, so the manufacturer removed the stove for further investigation at their own facility.

A second Stockton 5 stove was supplied by the manufacturer and tested without the manufacturer present on the 26th January. This second stove had been thoroughly checked and results were consistent with what was expected of an Ecodesign stove and very close to the stated performance of the appliance. Although the exact stated performance was not met, the testing team believe that it is very likely that further optimization would have resulted in the stated performance being matched.

The resolution - additional tests were completed on the replacement appliance to measure the differences between the replacement and original appliance when tested with dry and seasoned wood. This enabled the team to create correction factors which when applied to the previously completed tests allowed for adjustments to be made to the emission factors. This enabled all the results from the original stove tests to be utilised and not just the repeat tests.

4.1.3.2 Measurement issue - Kensal Redfyre

The issue - Emission factors for the Kensal Redfyre were inconsistent with other appliances for several pollutants when burning dry and seasoned wood. Analysis of the data indicated a high dilution ratio for the test rig during emission testing (low CO concentrations determined at the dilution tunnel). However, a high dilution ratio was considered unlikely as no changes to the test rig had occurred. A high dilution ratio was also recorded for one test (of three) for wood briquettes.

The resolution – for the wood briquette test, the dilution ratios for ignition, refuel and burnout periods were aggregated for the two other tests and applied to the third test. For the dry and seasoned wood, appliance outlet oxygen content and dilution ratio for the ignition, refuel and burnout phases for other stoves when burning dry and seasoned wood were compared. The appliance outlet oxygen content measured for the Kensal Redfyre was used to estimate the likely dilution ratio for the tests.

4.2 TEST SCHEDULE

The test schedule is summarised in Table 4-2.

Table 4-2 Emission test programme

		WP1			WP2					WP3	Optional
	Stove Category	**Wet Wood**	**Dry Wood**	**Seasoned Wood**	**High Sulphur MSF**	**Low Sulphur MSF**	**Coal Trebles**	**Coffee Logs**	**Anthracite**	**Wood Briquettes**	**Wood Pellets**
WP1/WP2 Stove	Open fire	Tested	Tested	Tested	Tested	Tested	Tested	Tested	Tested	Tested	Not tested
	Pre-2000 closed stove	Tested	Tested	Tested	Tested	Tested	Tested	Tested	Tested	Tested	Not tested
	Old stove	Tested	Tested	Tested	Tested	Tested	Tested	Tested	Tested	Tested	Not tested
	Very efficient modern stove	Tested	Tested	Tested	Tested	Tested	Tested	Tested	Tested	Tested	Not tested
WP3 Stove Category	Defra exempt stove	Tested	Tested	Tested	Tested	Tested	Tested	Tested	Tested	Tested	Not tested
	Large stove (low output)	Tested	Tested	Tested	Tested	Tested	Tested	Tested	Tested	Tested	Not tested
	Large stove (high output)	Tested	Tested	Tested	Tested	Tested	Tested	Tested	Tested	Tested	Not tested
	Post-2000 older stove	Tested	Tested	Tested	Tested	Tested	Tested	Tested	Tested	Tested	Not tested
	Eco-design compliant stove	Tested	Tested	Tested	Not tested	Not tested	Not tested	Tested	Not tested	Tested	Not tested
	Open fire	Tested	Tested	Tested	Tested	Tested	Tested	Tested	Not tested	Tested	Not tested
	Very good modern stove	Tested	Tested	Tested	Not tested	Not tested	Not tested	Tested	Not tested	Tested	Not tested
	Pre-2000 closed stove	Tested	Tested	Tested	Tested	Tested	Tested	Tested	Tested	Tested	Not tested
	Pellet stove (current, new)	Not tested	Not tested	Not tested	Not tested	Not tested	Not tested	Not tested	Not tested	Not tested	Tested

Tested	Not tested

4.3 QUALITY ASSURANCE AND QUALITY CONTROL

4.3.1 Importance of QA/QC

The emission factors developed through this project will be used directly in the UK National Atmospheric Emissions Inventory (NAEI), which fulfils reporting requirements under the National Emissions Ceiling Directive (NECD), transposed into UK law as the National Emissions Ceiling Regulations (NECR), and the United Nations Economic Commission for Europe (UNECE)'s Convention on Long Range Transboundary Air Pollution (CLRTAP).

In addition to fulfilling the national and international reporting requirements, the NAEI provides emissions data for a wide range of other uses including providing policy makers and the public with an understanding of the key polluting sources, how these sources have varied over time and how they are likely to contribute to pollution in the future. NAEI data are publicly available via https://naei.energysecurity.gov.uk/ and their uses include:

- Annual reporting of Accredited Official Statistics.
- Input into models used for academic research and policy making (including Pollution Climate Mapping and UK Integrated Assessment Model) and analysis by expert groups on air quality.
- Input into ambient air quality mapping for compliance assessments against the requirements of the Fourth Daughter Directive (2004/107/EC) and the Ambient Air Quality Directive (2008/50/EC) and assessment against Air Quality Strategy Objectives.
- Development and assessing progress of national air quality plans.
- Local and regional reporting including production of inventories for England, Scotland, Wales and Northern Ireland, Local Air Quality Management and Clean Air Zones.
- Responding to Freedom of Information Act and Environmental Information Regulation requests, Parliamentary Questions and general queries from the public.

It is therefore critical that the measurements and derived emission factors are of high quality, and subject to checks that give the users confidence in the reported data – particularly around uncertainty in the emission factors data and applicability to UK domestic burning. It is a key responsibility of the Steering Group to guide the project team in this respect and communication with the Steering Group has been frequent and valuable.

4.3.2 QA/QC of measurements and outputs

The initial phase of the project included test protocol development, which was subsequently used to determine repeatability and reproducibility of the protocol, through round-robin testing within the laboratories at Kiwa, Leeds and Manchester. Analysis of the round-robin data has provided an understanding of the uncertainties associated with the test protocol.

The main body of the work of testing of appliances and fuels has been undertaken in the Kiwa laboratory. Testing of solid fuel appliances undertaken under Kiwa's laboratory accreditation supported by the systems required by the testing laboratory standard (ISO 17025) and the relevant appliance standards (BS EN 16510-1, BS EN 13240 and BS EN 13229). For this work the appliance operation protocol has sometimes been different to those defined in appliance testing standards, as described and explained in the Test Protocol, but the support systems of sensor calibration, data collection and checking for accredited work have been applied throughout WP3. Where changes to methods were required, these have been documented in this report and/or in the Test Protocol and have been validated during the development and round-robin activities. In addition, measurement refinements for PM, heavy metals and Black Carbon identified in WP1 and WP2 have been implemented in WP3.

Regular checks have been carried out to ensure equipment is calibrated and working within specification. For measurements of components at the dilution tunnel (gaseous pollutants, PCDD/PCDF, PAH & Heavy Metals) sampling has been undertaken in accordance with the ECL Procedures based on EN Standards but with some deviations to combine sampling (for example mercury and other metals and, PAH and PCDD/F). Where possible, testing has been undertaken in accordance with ECL's organizational MCERTS accreditation, by MCERTS qualified personnel and with MCERTS approved monitoring equipment to ensure that the highest quality of data is obtained.

Analytical methodologies have been applied as described in the Test Protocol. Compositional analyses of fuel samples have been undertaken at accredited test laboratories. The accuracy and uncertainty of results from accredited laboratories is reported with the results of the measurements.

Automatic logging of data has been used where possible, with additional manual quality checks to check completeness and accuracy. Other data and metadata have been recorded manually in a dated and signed laboratory book, or electronically with associated files. All documents, datasets and other relevant files will be provided to Defra, with a backup held by Ricardo.

4.4 UNCERTAINTY ASSESSMENT

The uncertainty in the final emission factors comprises a range of contributing elements including:

- Representativeness of the appliances
- Variation in fuels
- Variation in operation
- Measurement – include measurement method, sampling protocol, analysis Limits of Detection (LoD), calibration/reference materials
- Data handling – data acquisition, storage and handling – the processes to work up the measured data into the final emission factors.

4.4.1 Appliance representativeness

The work programme has tested across thirteen appliances in total which have been selected as representing different types of solid fuel room heater technology used in UK. The choice of type of appliance was based on the broad types of appliance categories (open/stove) and aligned the stove age classification used in the NAEI to a technology type (basic control/secondary air/secondary and tertiary air) as set out to the EFDSF steering group earlier in the project. The EFDSF steering group helped identify the most popular installed stoves in recent years and also provided information on the older appliances. The choice of appliances has been endorsed by the EFDSF steering group – recognising that it is a small subset of the diverse range of appliances in use in UK.

4.4.2 Fuel type and quality

The procurement of the fuel has been undertaken to ensure as much as possible the consistency of the fuel to reduce uncertainty in the testing. All the five fuel types detailed in section 2 have been procured as a single batch from either the manufacturer or as with the coffee logs and anthracite a third-party supplier. This was done to ensure that the fuel is consistent as possible and from the same source / batch with each of the fuels stored together in stable conditions throughout the test programme to ensure fuel properties such as moisture remain constant between tests.

There are two main characteristics which are different between the fuels which impact the uncertainty of the results: material consistency and shape. Three of the fuel types are manufactured fuels which are formed into a product of consistent material and shape. This helps to reduce the uncertainty of the testing as the consistent material ensures tests are burning the same material and the consistent shape ensures the fuels distribution within the stove is consistent. The remaining fuels, House Coal trebles and Anthracite small nuts are formed naturally in rock strata which are mined and screened to provide a fuel of similar sized pieces. The uniformity of these naturally formed fuels is therefore less consistent than the MSF products with the size and shape of the fuels also making the distribution in the fuel bed less consistent.

The increased number of fuel pieces used during tests with the two MSFs, coal and anthracite will help to reduce overall uncertainty between tests. This is because the variation in the average distribution of fuel within the stove is reduced when there are more pieces of fuel and the burn rate and air distribution is easier to maintain between tests. This removes some of the randomness of fuel distribution caused by large pieces of fuel which can impact testing. Coffee logs are large pieces of fuel and the way they break down inside the stove during combustion changes the distribution of the fuel inside the stove, and therefore burn rates and air distribution, thus increasing the uncertainty in the results. Every care has been taken to ensure that the stoves are refuelled identically for each load to minimise this vector of uncertainty.

4.4.3 Operation

The appliance test cycle for the measurement programme is based on the typical UK hours of use and, comprises an ignition phase, normal operation with refuels and a burnout phase (based on the Defra burning survey and an indoor air quality survey). The number of refuels depends on the duration of the burn and is aimed at replicating typical UK hours of use. For mineral fuels the number of refuels was 1, for wood fuels and coffee logs the number of refuels ranged from 2 to 7. Aggregate emission factors have been constructed for this test cycle based on combining each of these phases for each test. Note that it is possible, for some pollutants, to calculate other aggregations for example as a sensitivity check or to reflect different durations of operation.

4.4.4 Measurement

The appliance test protocol includes test methods which draw on EN Standards and/or EN Technical Specifications for emission and appliance testing but with compromises to reflect the challenges of sampling emissions from a small, batch-fired combustion appliance and a bespoke test protocol. Where no EN Standard exists, literature and research were used to guide the test methodology. The main measurements have been undertaken by IEC/ISO 17025 accredited test houses – recognising that many of the measurements are outside the scope of accreditation (because of changes from the accredited test methods to accommodate the test protocol and constraints of the test facility). For example, measurement during ignition (appliance testing) and combined PAH and PCDD/F sampling (emission testing). However, the test protocol reflects the objectives of the project and incorporated suggestions from the steering group to align operation closer with real-world operating conditions (for example around the appliance draught and, for wood logs, retaining bark).

Measurement uncertainties provided by the test houses for the reported concentrations do not reflect uncertainties in the choice of appliance, test protocol or fuel but selected uncertainties are shown in Table 4-3.

Some measurements have more uncertainty than others due to a range of factors including analytical uncertainty. The analysis of the individual PCDD/F congeners indicated that although some congeners in the tests were reported as below the field blank[29] there were relatively few tests where the tetra and penta-chlorinated PCDD congeners and penta-chlorinated PCDF congeners with the highest toxic equivalent factors were below the LoD. In the PAH samples, the four compounds used for international reporting were rarely found below the LoD (2/211 tests in WP3). Chloranthene, was below the LoD for 104 of the 211 tests in WP3, in these cases the field blank value is used however contribution to totals (assuming present at field blank concentration) was <<1%. For the metals testing there were 8 occurrences out of 966 measurements when the metals were below the field blank value in WP3, although there were significantly more occurrences in WP2[30]. In these cases the field blank concentration was used instead, most of these occurred for coal trebles for a variety of the metal pollutants.

4.4.5 Data handling

For some pollutants integrated samples were collected over the entire test cycle (PCDD/F, PAH, metals), some were measured continuously over the entire test cycle and data have also been gathered for each phase of operation (CO, NOx, SO_2, TOC). For some pollutants, integrated samples were collected in selected phases of operation – ignition, 2nd refuel and burn out (PM, PM size). These latter samples were taken from one refuel phase (of up to three) so are likely to have higher uncertainty than measurement which sampled all phases of operation.

[29] The measurement procedure requires a blank sample to be prepared and recovered at the measurement site for each group of tests (one field blank for each set of three tests) – the field bank is prepared and recovered in the same way as a measurement sample except no flue gases are sampled.

[30] 57/784 occurrences of metals below the field blank in WP2.

In addition to the measurement uncertainties all pollutants required the following calculations to reach an emission factor based on the concentration data:

1. Application of a dilution ratio based on CO concentrations measured at appliance outlet and dilution tunnel
2. Standardisation of undiluted concentration to a reference oxygen content
3. Application of a conversion factor to calculate an emission factor
4. Aggregation of short-term emission factors to cover the entire burn cycle.

These operations contribute additional uncertainty to the measurement uncertainty.

Three sets of measurements were undertaken for each fuel and appliance combination, and this has allowed calculation of standard deviation and other indicators of repeatability. The EMEP/EEA Guidebook confidence intervals for emission factors are generally (much) larger but are typically based on expert judgment to assign an indicative uncertainty range. This reflects the challenges in understanding the uncertainty from combining emission factors reported by a range of studies (or calculated from reported data) with differing objectives, different appliances and often different measurement approaches.

Table 4-3 Selected measurement uncertainties

Measurement	Lab	Maximum Allowed Uncertainty of Method (MCERTS), %	Range of recorded uncertainty
Concentrations			
PCDD/F	ECL	30%	15 – 25%
PAH	ECL	30%	15 – 25%
SO_X	ECL	20%	10 – 20%
TOC	ECL	15%*	15 – 25%
CO	ECL	6%*	5 – 15%
			Method uncertainty
CO	Kiwa		6%
NO_X	Kiwa		±1.2 ppm
CO_2	Kiwa		2%
O_2	Kiwa		2%
PM	Kiwa		0.29g/h
Other			
Appliance/Fuel weight	Kiwa		±20g
Fuel load	Kiwa		±5g
Flue gas Draught	Kiwa		±2Pa
Flue gas temp	Kiwa		±5°C

- MCERTS maximum allowed uncertainties are for application on industrial activities (specifically ‘Part A’ activities regulated under Schedule 1 of the Environmental Permitting Regulations (England & Wales) 2016 and equivalent in Scotland and Northern Ireland).

- MCERTS TOC and CO uncertainties are defined in terms of Emission Limit Values (ELVs) for TOC and CO but ELVs for stoves are not applicable for measurement on diluted exhaust gases.
- PM uncertainty is for DIN+ PM test method (at appliance outlet).

5 EMISSION FACTORS

The emission factors presented here are expressed as mass of pollutant (usually grams but different mass units apply for PCDD/F, PAHs and heavy metals) per gigajoule of fuel burnt (on a net heat input basis), as described in section 1.1. The emission factors units are aligned to those used in the NAEI and in the EMEP/EEA Emission Inventory Guidebook[31]. Emission factors can also be expressed on a mass basis (for example per tonne of fuel burned)[32].

5.1 METHODOLOGY

The measurement programme provided:

- continuously monitored emission concentration data throughout the different phases of the burning cycle for some gaseous measurements (CO, CO_2, O_2, NOx, SO_2, TOC),
- an integrated concentration measurement for (PCDD/F, PAH and metals) over the whole burn cycle,
- integrated PM-related concentrations measurements for alternate phases of the burning cycle (ignition, an operation phase and burnout phases).

Measurements were generally undertaken at the dilution tunnel with selected measurements also undertaken at the appliance outlet.

Emission measurements were generally provided as concentrations (a volume or mass in a known volume of sampled gas). Continuously monitored data has a weighting to adjust for different burn rate at each 1-minute average data point (not applied to integrated samples). Black carbon and particle size data were reported as weights or similar metric and were developed into concentrations based on sample duration and reported sampling rate.

The calculation of emission factors for each appliance and fuel combination from the emission concentration data reported by the test houses required several calculation stages:

- Initial data check to confirm concentration provided at STP (0°C, 101.3kPa) and dry gas for period sampled, identification of odd data for review.
- Conversion to a mass concentration at STP for a dry gas (where required).
- Correction to undiluted concentration applying ratio of CO determined at appliance outlet and dilution tunnel (where required).
- Standardising to a reference oxygen concentration (13% O_2).
- Converting to a g/GJ net heat input emission factor by applying a stoichiometric dry flue gas volume (adjusted to 13% O_2) for each fuel (see Table 2-2).
- Aggregating emission factors for each phase for full burn cycle (weighted for fuel burned in each phase).
- Averaging for each appliance/fuel combination (3 tests to single value).

The procedure used the same methodology and calculation template as used in the previous two work packages but modified for the number of appliances, fuel characteristics and number of refuels.

Some components were determined from an integrated sample collected across the entire burn cycle, others from integrated samples from selected phases of the burn cycle and, some using continuous monitoring data. Where possible, average concentrations have been calculated for each phase (ignition, refuel and burnout phases) and then developed into emission factors. An aggregate emission

[31] Emission factors for residential combustion are provided in sectoral guidance Chapter 1A4 for small combustion available here: https://www.eea.europa.eu/publications/emep-eea-guidebook-2023/part-b-sectoral-guidance-chapters/1-energy/1-a-combustion/1-a-4-small-combustion-2023/view

[32] Conversion between energy input and mass basis requires knowledge of the calorific value of the fuel.

factor for the entire burn cycle was then constructed using the weight of fuel burned in each phase to develop a weighted average.

For continuously-monitored pollutants, data were recorded as one-minute averages and an additional weighting was undertaken to reflect variation of fuel burn rate during each phase – that is, the weighted average in each phase reflects the combination of emission concentration and burn rate at the minute average data.

5.2 SUMMARY OF EMISSION FACTORS

The figures below provide a summary of selected emission factor data to illustrate emissions from fuels and appliances from WP1, WP2 and WP3. Appliance-specific emission factors for WP3 only are provided at Appendix A3-A7.

The coloured bars represent emission factors for each fuel and appliance group with the **black dots** representing the associated existing NAEI emission factor from the most recent inventory submission (NAEI22) for the fuel and technology or EMEP/EEA Guidebook 2019 emission factors. Note that most emission factors for solid fuels used in the NAEI are derived from EMEP/EEA Guidebook 2019 emission factors with some country-specific emission factors. However, non-PM EFDSF emission factors from WP1 were included in the 2024 NAEI submission (for years to 2022 - NAEI22).

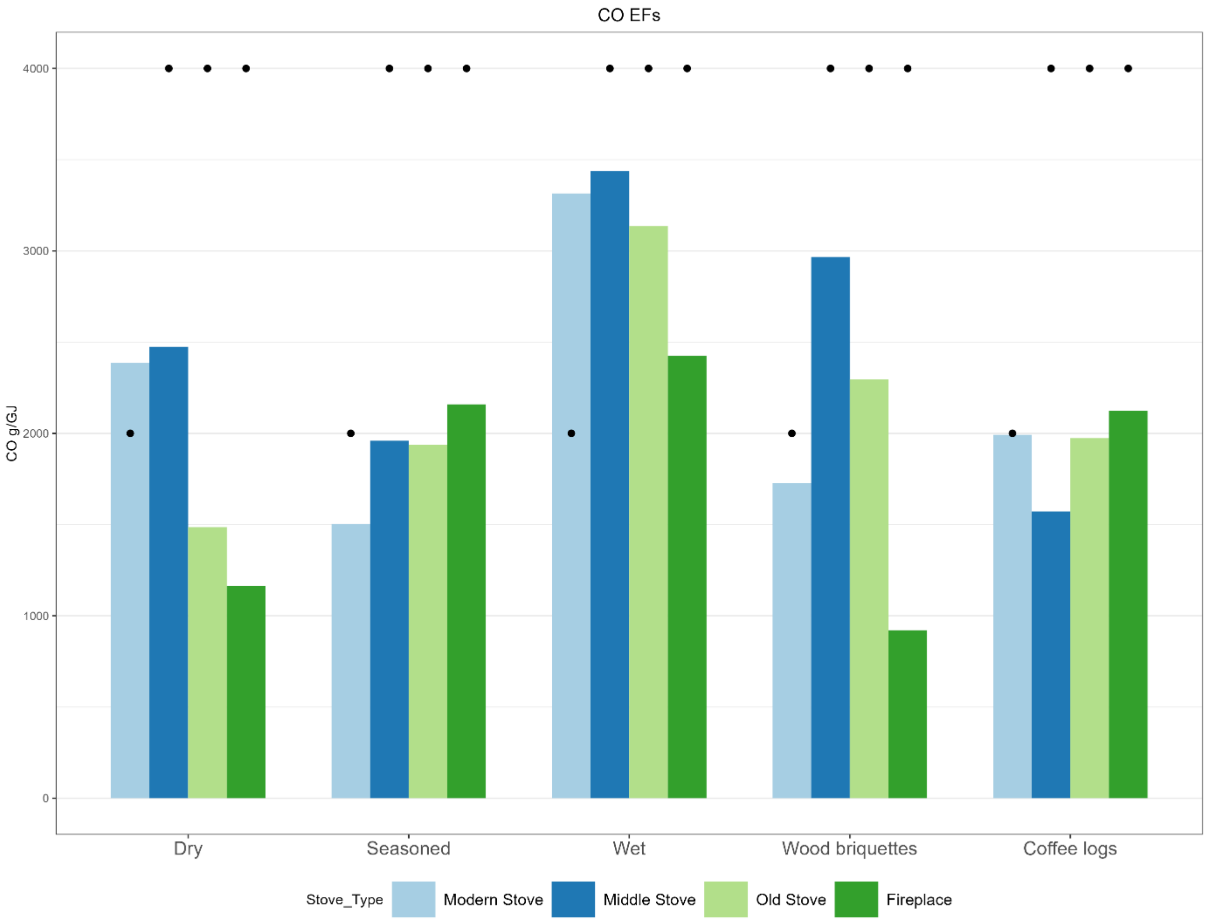
For wood/biomass emission factors, comparisons are with EMEP/EEA Guidebook 2019 emission factors.

Emission estimates from use of coffee logs, wood briquettes and pellets will be included in the NAEI for the first time in the 2025 submission. The emission factors from this project for wood logs, coal, anthracite and manufactured solid fuels from WP1, WP2 and WP3 will be included in the 2025 NAEI inventory submission.

5.2.1 Wood and biomass fuels

5.2.1.1 Carbon monoxide (CO)

Figure 5-1 Carbon monoxide emission factors for wood and biomass fuels



Emission factors generally increase as moisture increases on the open fireplace and older stoves. This is consistent with higher fuel moisture decreasing combustion efficiency. On the modern appliances, CO emissions are higher for both dry and wet fuels. The CO emissions (Figure 5-1) when using dry wood logs in the modern stove are unexpectedly high in comparison with the older technologies which would be expected to have poorer energy and combustion efficiency.

The emissions observed for the modern appliance may indicate that the appliance design has been optimised for seasoned wood. Drier wood log fuels may increase emissions in the modern stoves (compared to the seasoned moisture level) because drier fuels will have a higher burnrate and the air supply may be limited compared to the older devices. The coffee log emission factors show little variability across the appliance categories compared to wood briquettes.

5.2.1.2 Particulate matter

Total particulate matter, $PM_{2.5}$ and condensable PM emission factors determined at the dilution tunnel are presented in Figure 5-3 , Figure 5-2 and Figure 5-4 respectively. The highest emission factors for each appliance were for wet wood logs. Emission factors for seasoned wood are all lower than used in the current NAEI. The modern stove emission factors determined when burning wet and dry wood are higher than the current NAEI emission factor (from EMEP/EEA Guidebook 2019).

Particle size distribution based on the aggregated emission factors are consistent with the NAEI for PM_{10} and $PM_{2.5}$ but the PM_1 fraction is higher than applied currently in the NAEI. For wood logs the PM_1 fraction is variable but is typically more than about 65% of the total PM emission (Table 5-1). The

PM_1 fraction for mineral fuels is less variable than for wood fuels and generally forms more than about 65% of the total PM emission (Table 5-2). The proportion appears slightly higher for the manufactured solid fuels (generally greater than 75%).The collected PM is predominantly PM_1 for all wood/biomass fuels but others have reported that material larger than PM_1 is negligible for wood-burning stoves[33]. Note that emission data reported for this study include sample probe washings (assigned to the >PM_{10} size fraction) and the sampling system included a sample inlet aligned to the gas flow with near isokinetic sampling (it was not designed to exclude larger particle sizes).

Table 5-1 - Particle size distributions for wood/biomass fuels, shown as % of total PM

Stove Type	Pollutant	Dry wood	Seasoned wood	Wet wood	Wood briquettes	Coffee logs
Modern stove	PM10	88%	79%	93%	90%	86%
	PM2.5	86%	77%	92%	88%	84%
	PM1	77%	69%	80%	80%	70%
Middle stove	PM10	91%	85%	94%	88%	81%
	PM2.5	76%	84%	93%	85%	78%
	PM1	66%	79%	86%	76%	70%
Old stove	PM10	91%	78%	89%	92%	82%
	PM2.5	89%	75%	88%	89%	81%
	PM1	81%	69%	79%	81%	75%
Open fireplace	PM10	87%	86%	95%	92%	86%
	PM2.5	85%	85%	93%	90%	84%
	PM1	74%	73%	74%	86%	67%

Table 5-2 - Particle size distributions for mineral fuels, shown as % of total PM

Stove Type	Pollutant	High Sulphur MSF	Low Sulphur MSF	Coal Trebles	Anthracite
Modern stove	PM10	97%	92%	91%	70%
	PM2.5	95%	89%	88%	65%
	PM1	78%	79%	68%	54%
Middle stove	PM10	96%	94%	92%	74%
	PM2.5	95%	92%	88%	69%
	PM1	86%	90%	77%	64%
Old stove	PM10	94%	90%	92%	83%
	PM2.5	92%	89%	89%	79%
	PM1	67%	79%	76%	71%

[33] Fachinger, F. et al How the user can influence particulate emissions from residential wood and pellet stoves: Emission factors for different fuels and burning conditions. Atmospheric Environment, Volume 158, June 2017, Pages 216-226.

Open fireplace	**PM10**	92%	90%	91%	-
	PM2.5	91%	89%	89%	-
	PM1	88%	86%	81%	-

In the PM datasets (and others including CO) the emission factors determined for the stoves might be expected to increase with the age of stove across each of the fuel types. However, this is not always evident in the measured data. In part this is likely due to how each appliance has been operated, variability between manufacturers, efficiency of the combustion chambers, and the condition of each individual appliance (particularly relevant for the older pre-owned stoves). Features of the test protocol, including retention of bark on the wood logs (more representative of real-life use of the stoves), result in more heterogenicity between fuel loadings which means that it is harder to assess trends. There are many variables to consider to fully characterise emissions and operation and these have not been tested in isolation within the test programme.

Figure 5-3 TPM emission factors for wood and biomass fuels

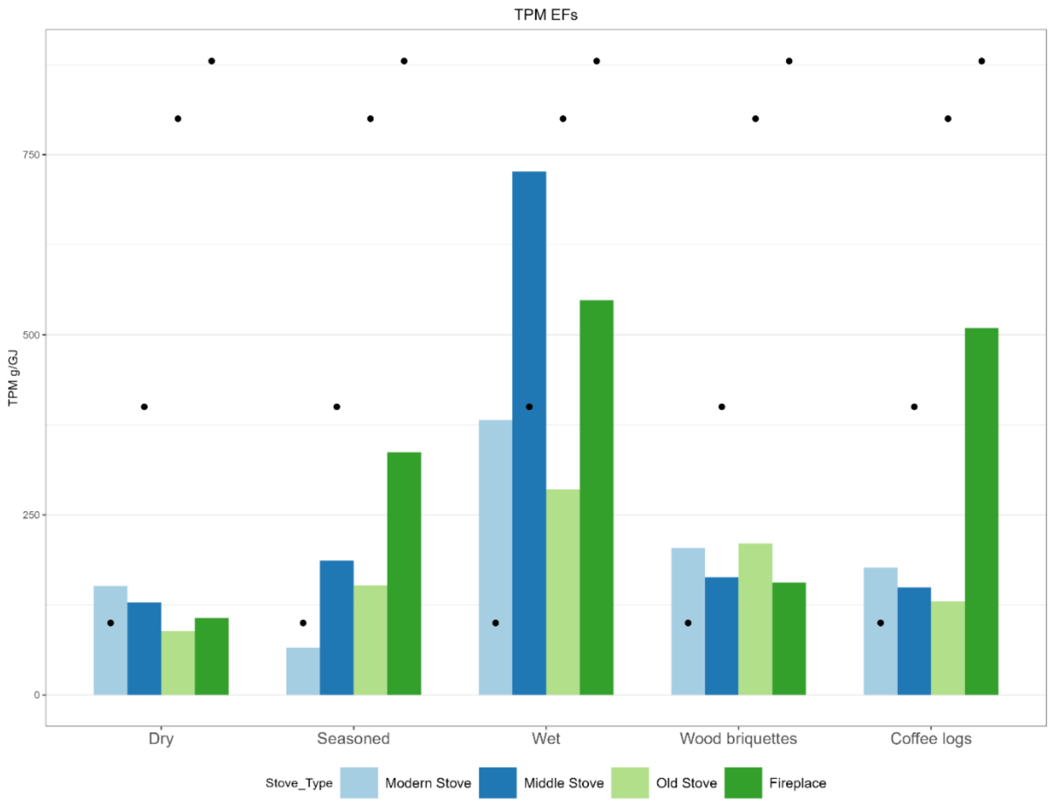


Figure 5-2 PM2.5 emission factors for wood and biomass fuels

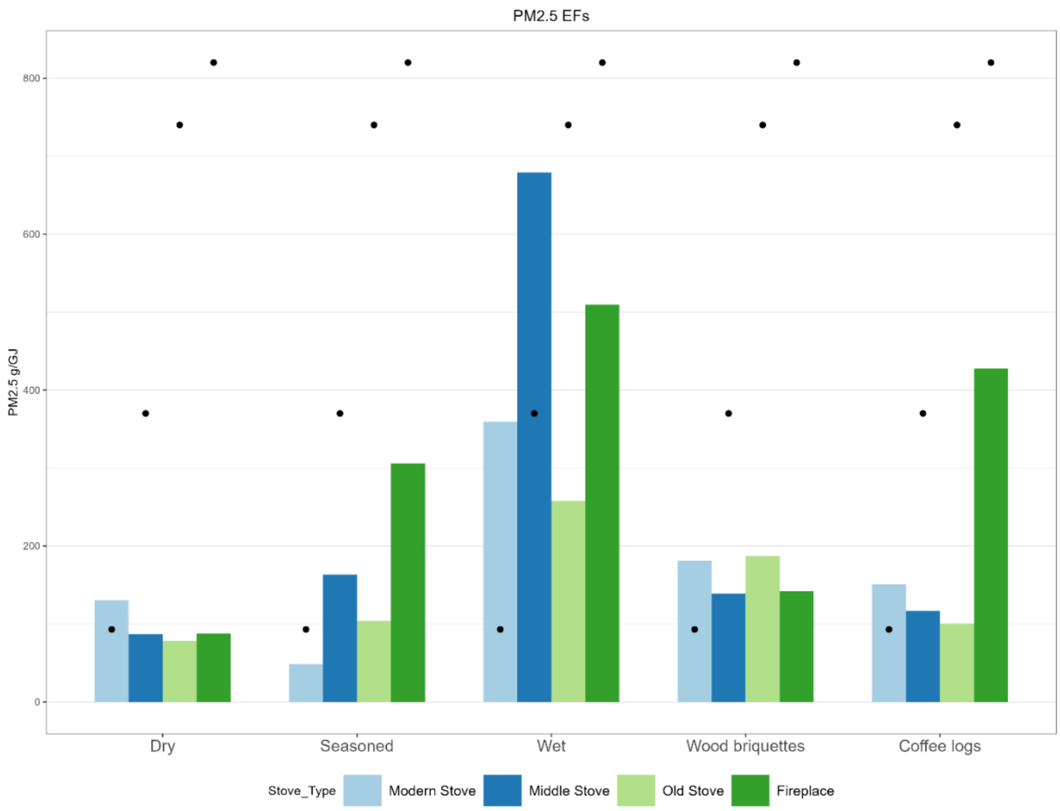
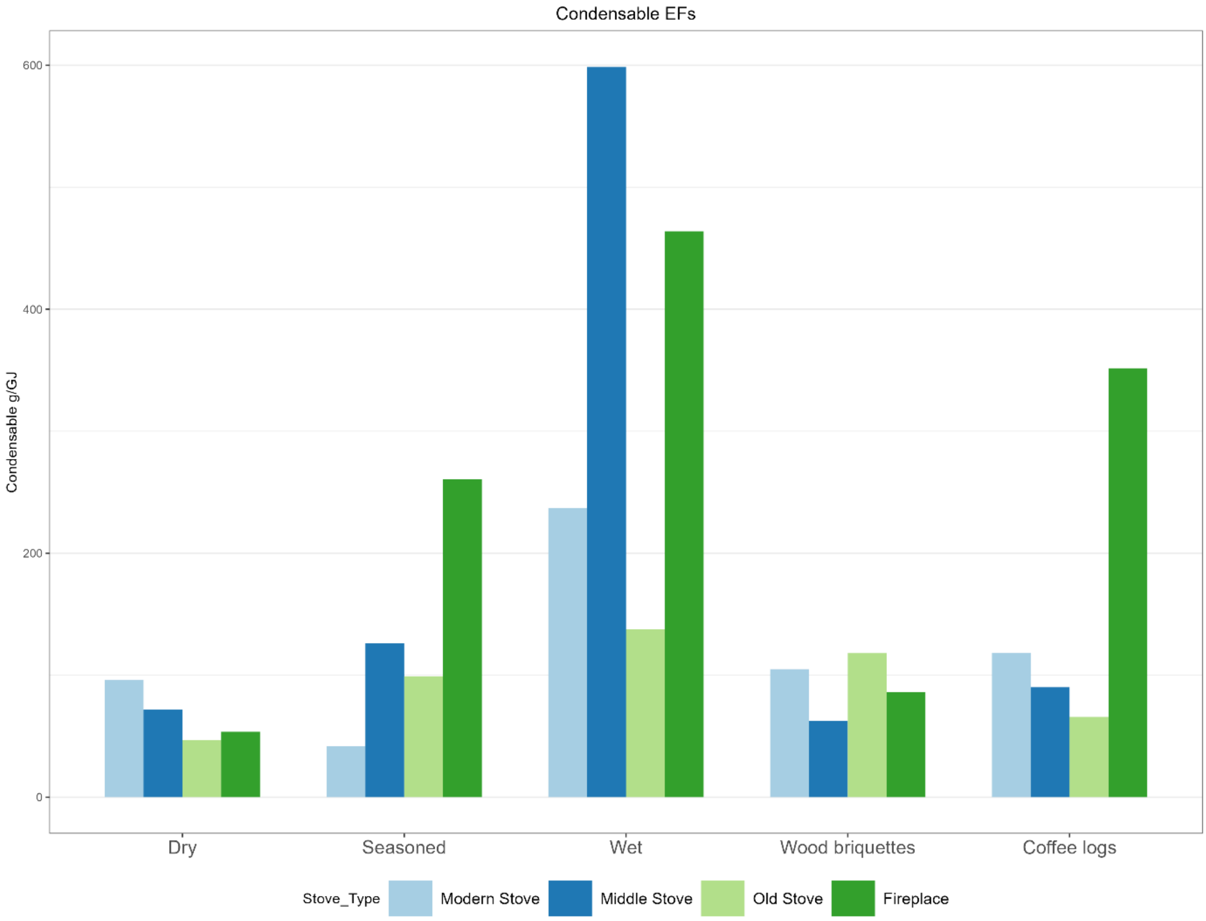


Figure 5-4 Condensable PM emission factors for wood and biomass fuels



5.2.1.3 *Total organic compounds (HC/OGC/TOC)*

Higher fuel moisture increases TOC emissions (also referred to as HC and OGC) which is consistent with higher fuel moisture decreasing combustion efficiency. However, the middle and modern stove also had higher TOC emissions when burning drier wood (Figure 6-5Figure 5-6). Note that measurements include methane and that emission factors used for international reporting are for non-methane volatile organic compounds (NMVOC). TOC emission factors have been modified for use in the NAEI by applying the NMVOC/methane ratio in the current NAEI (45%-67% depending on appliance type). Derived NMVOC emission factors are shown in Figure 5-6.

Figure 5-5 Total Organic Compounds emission factors for wood and biomass fuels

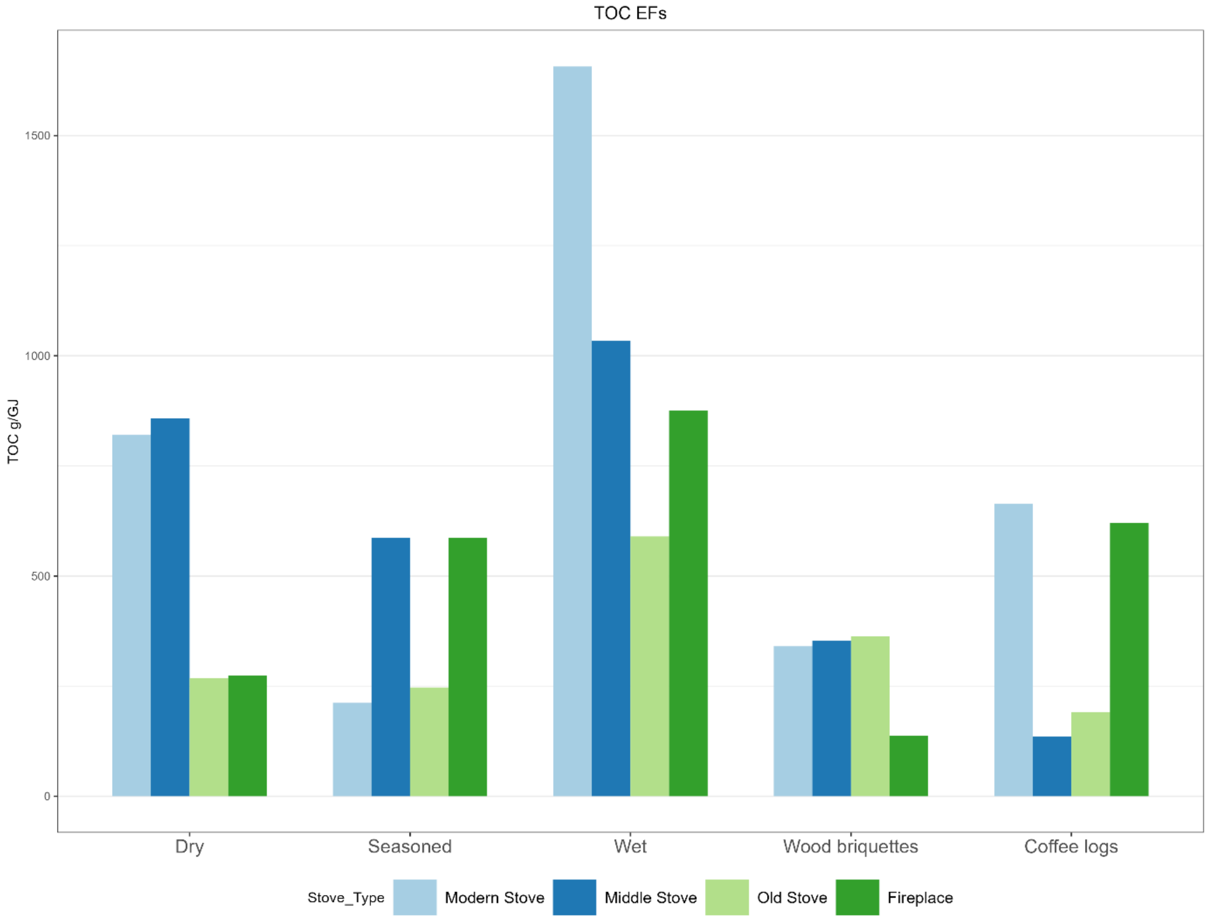
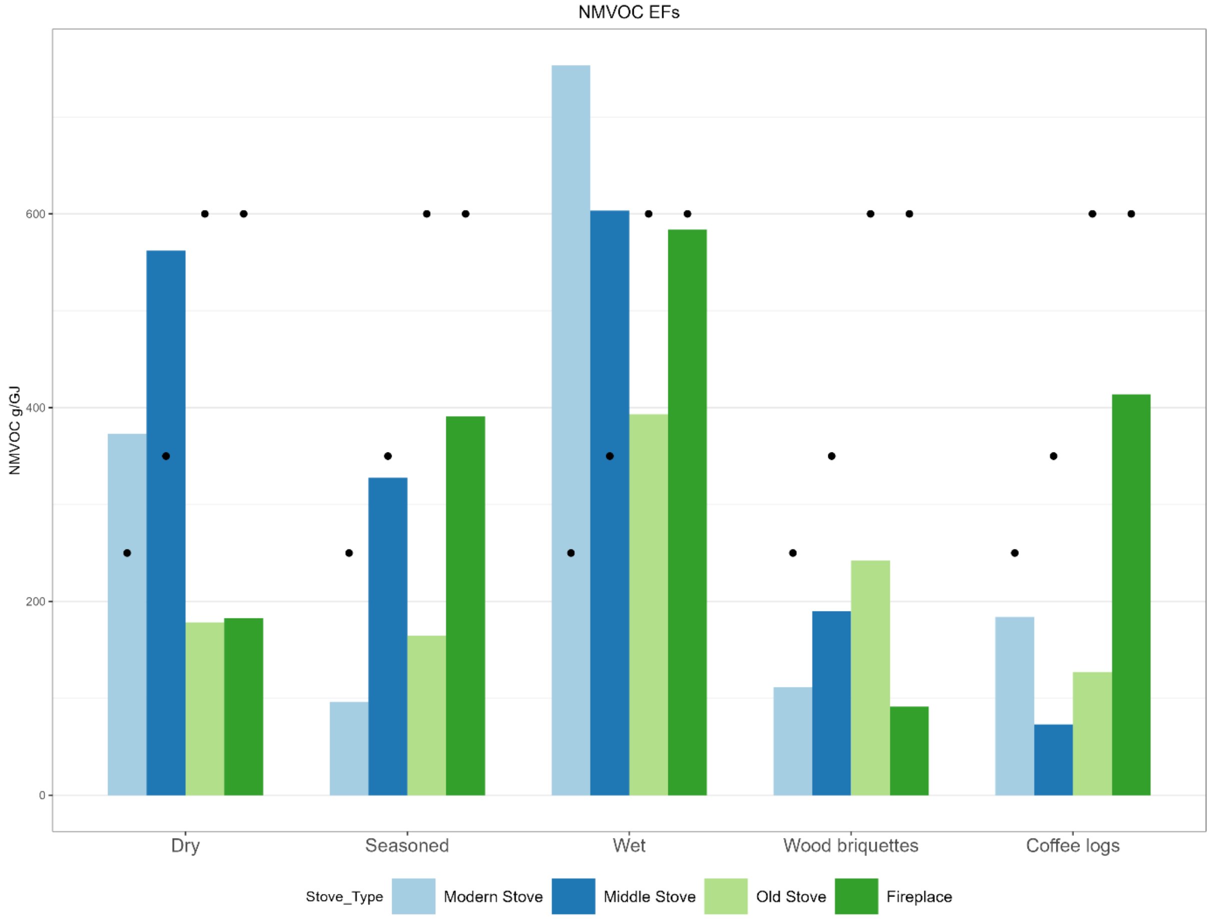


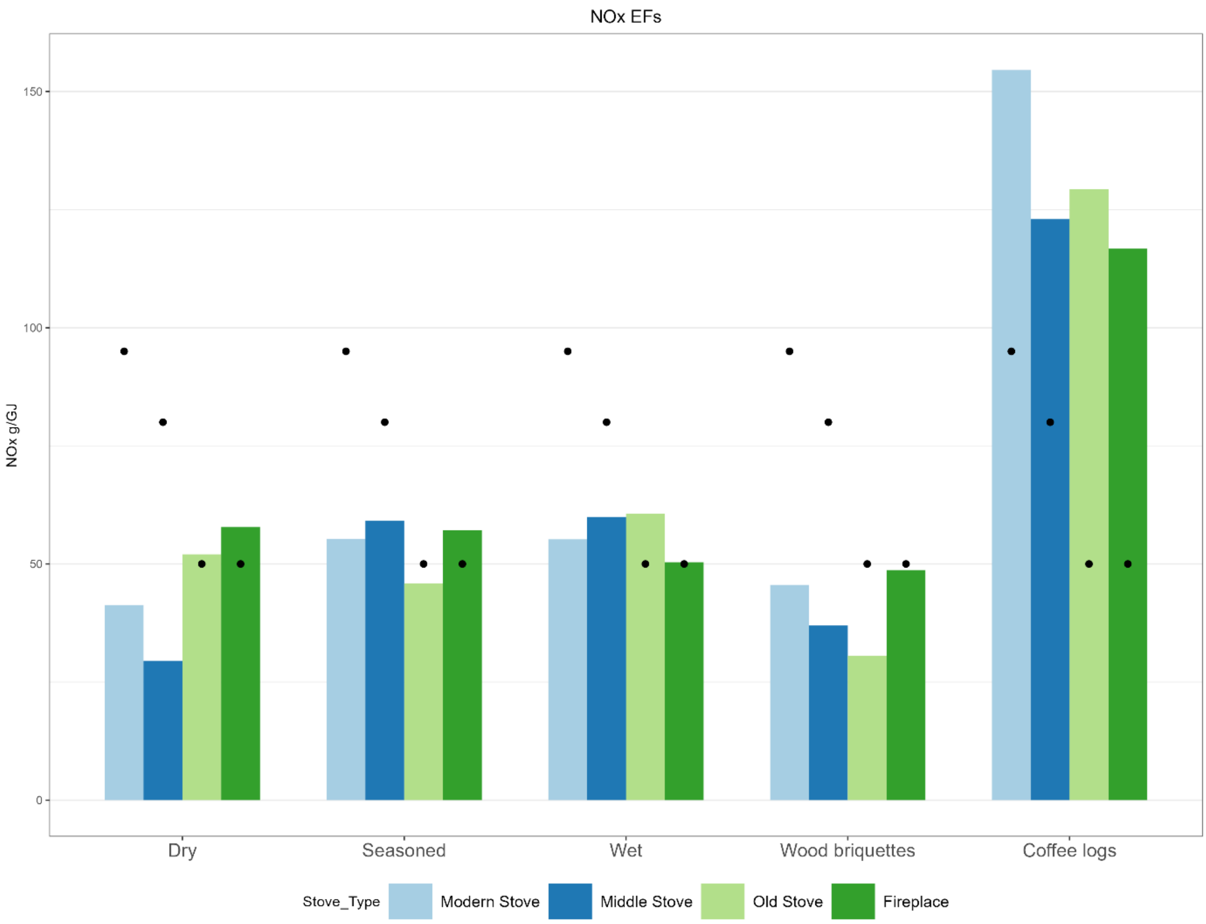
Figure 5-6 NMVOC emissions for wood and biomass fuels



5.2.1.4 Nitrogen oxides (NOx)

Emission factors for NO_X do not generally reflect fuel moisture content or technology. Notably the coffee logs show significantly higher NOx emissions factors than the wood fuels but this reflects a higher nitrogen content in coffee logs compared to wood.

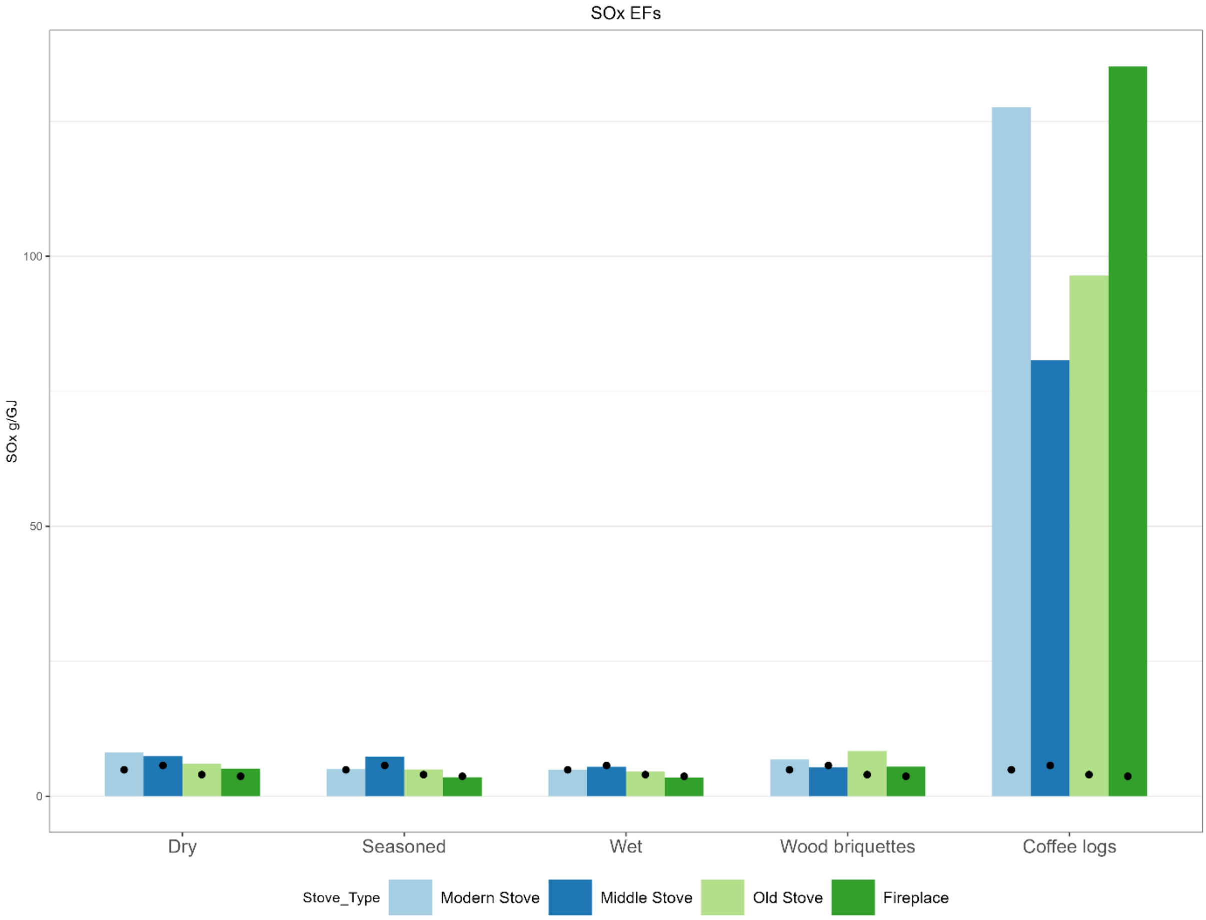
Figure 5-7 NOx emission factors for wood and biomass fuels



5.2.1.5 *Sulphur oxides (SOx)*

A periodic, integrated sampling methodology was applied as the anticipated concentrations after dilution were expected to result in concentrations close to the limit of detection for continuous measurement techniques. The measured emission factors are low for wood fuels but consistent with EMEP/EEA Guidebook 2019 emission factors. The measured emission factors for SOx are significantly higher from coffee logs Figure 5-8, which reflects a higher sulphur content in this fuel.

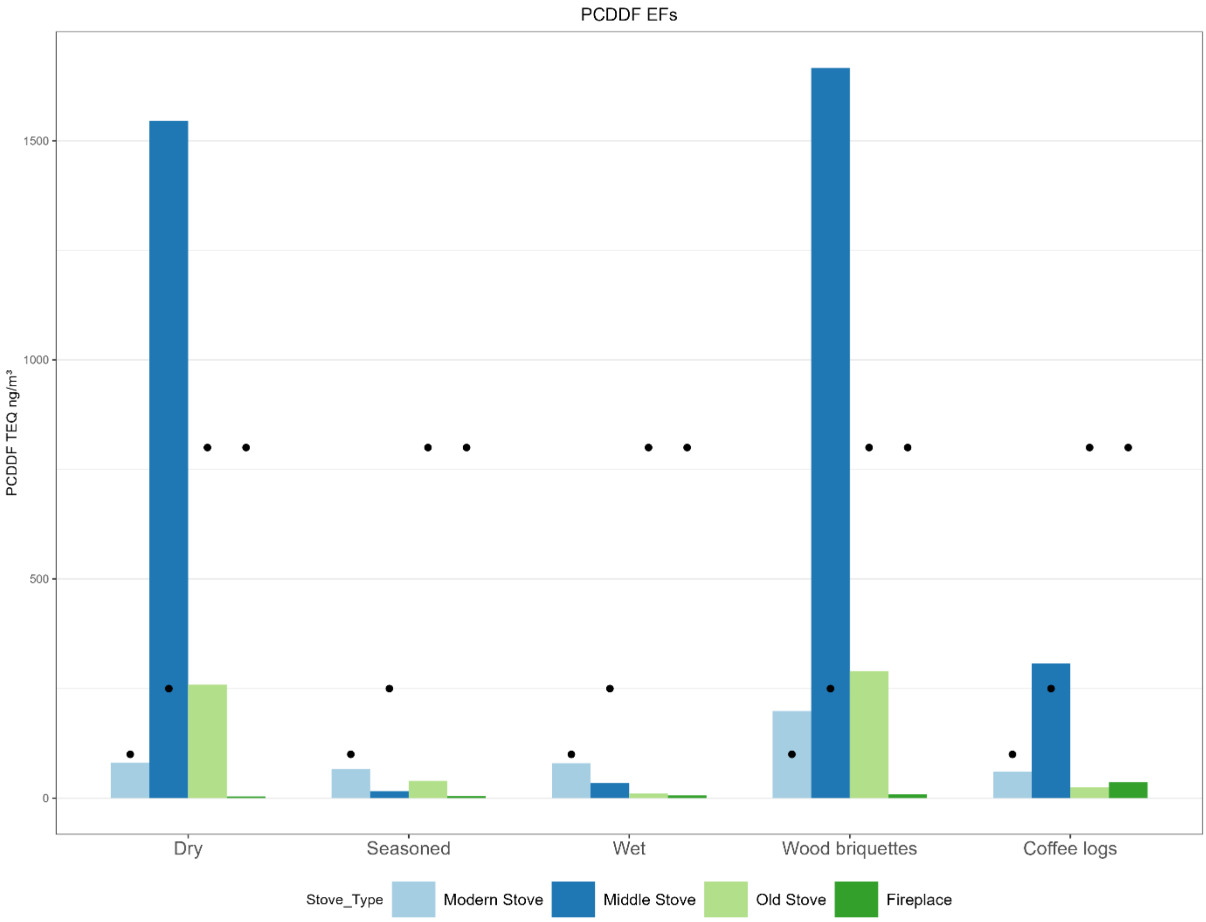
Figure 5-8 Sulphur dioxide emission factors for wood and biomass fuels



5.2.1.6 *Dioxin and furans (PCDD/F)*

The PCDD/F emission factors were lower than the EMEP/EEA Guidebook 2019 default emission factors Figure 5-9. The highest emission factors were observed with the middle stove when burning wood briquettes fuel. Some of the higher PCDD/F emission factors in literature may be due to inclusion of wastes and non-wood fuels in the briquette feedstock.

Figure 5-9 PCDD/F emission factors for wood and biomass fuels



5.2.1.7 Polynuclear Aromatic Hydrocarbons (PAH)

PAH emission factors were generally lower than current EMEP/EEA Guidebook 2019 emission factors for seasoned and wet wood logs but emission factors determined for wood briquettes are generally higher than the EMEP/EEA Guidebook wood log emission factors (except on the open fireplace).

Notably, PAH emission factors determined for the modern appliances were higher than the EMEP/EEA Guidebook 2019 emission factors for all fuels.

Figure 5-10 PAH emission factors for wood and biomass fuels

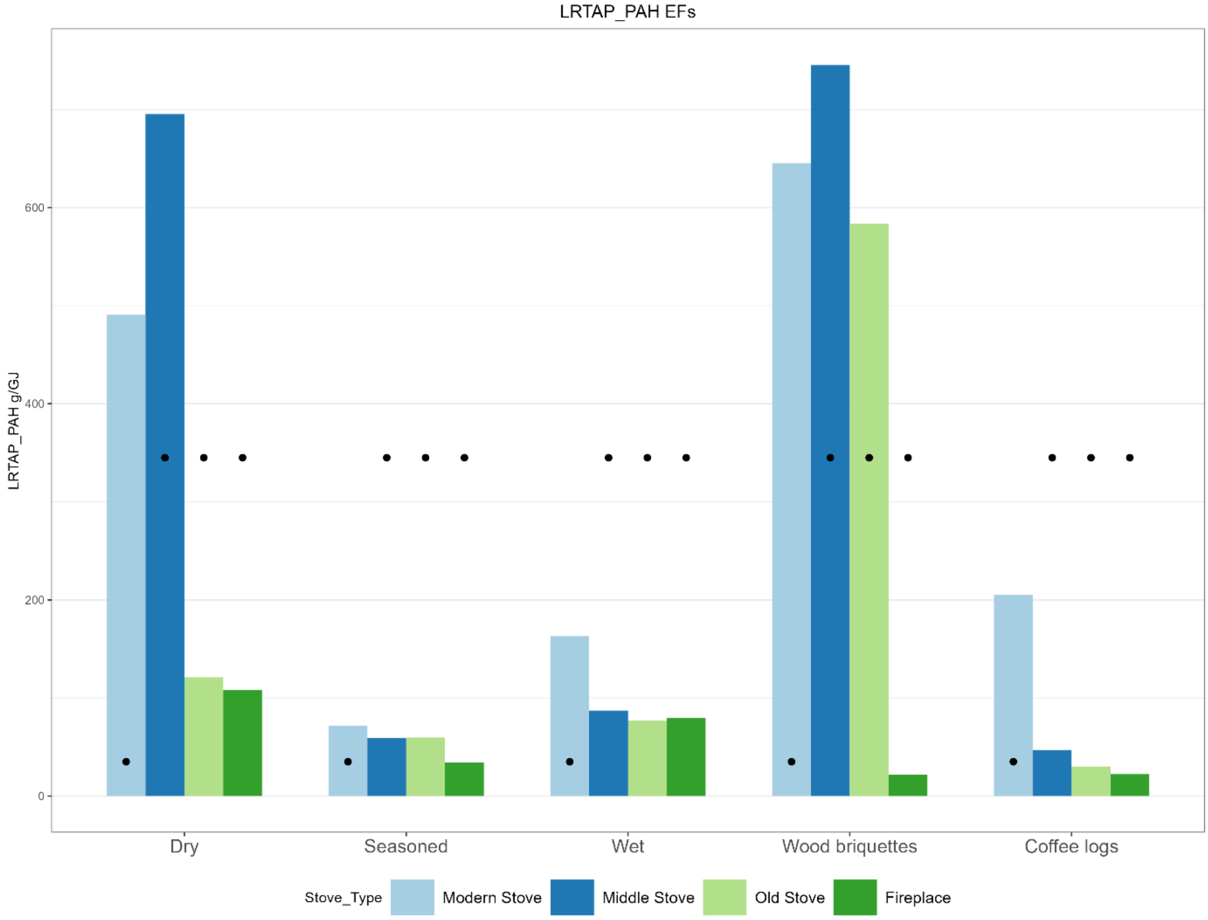
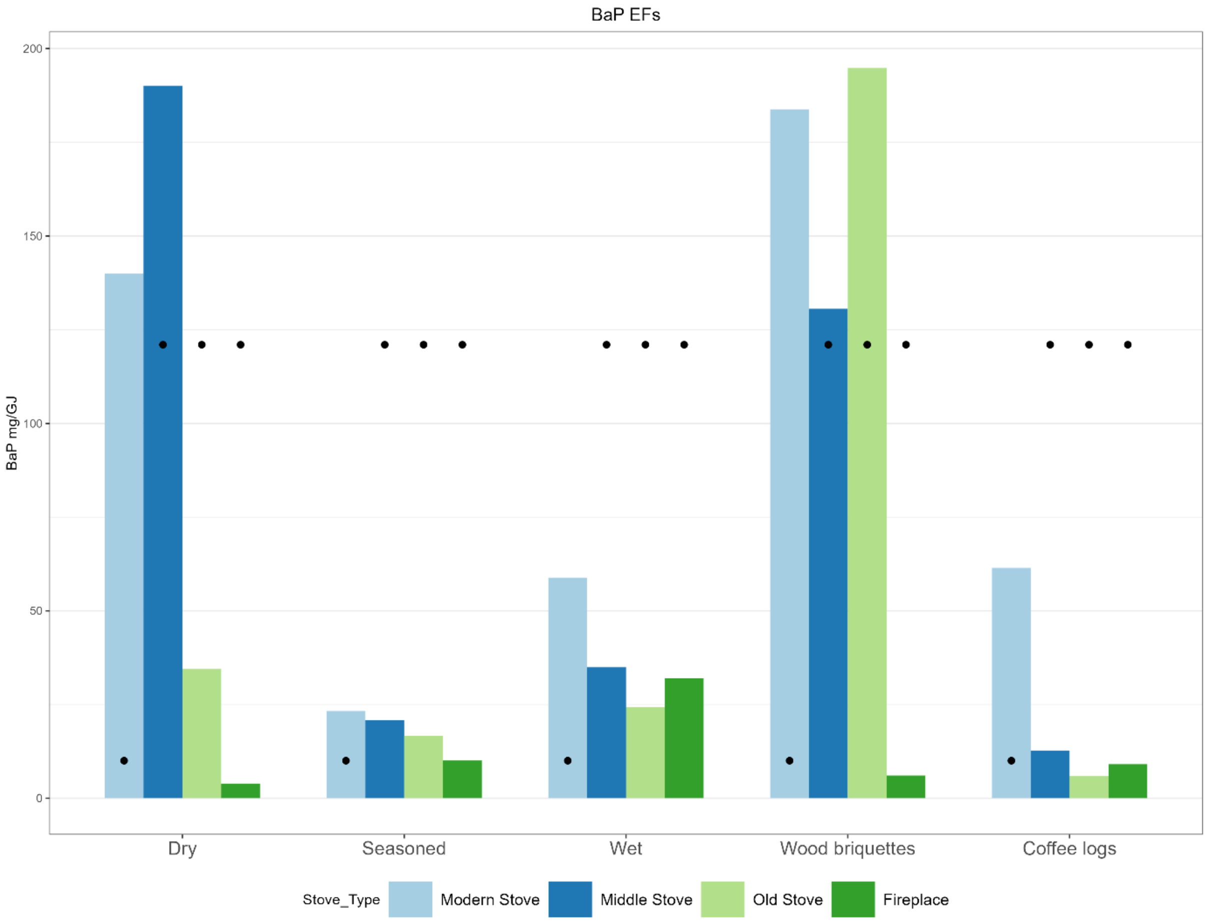


Figure 5-11 BaP emission factors for wood and biomass fuels

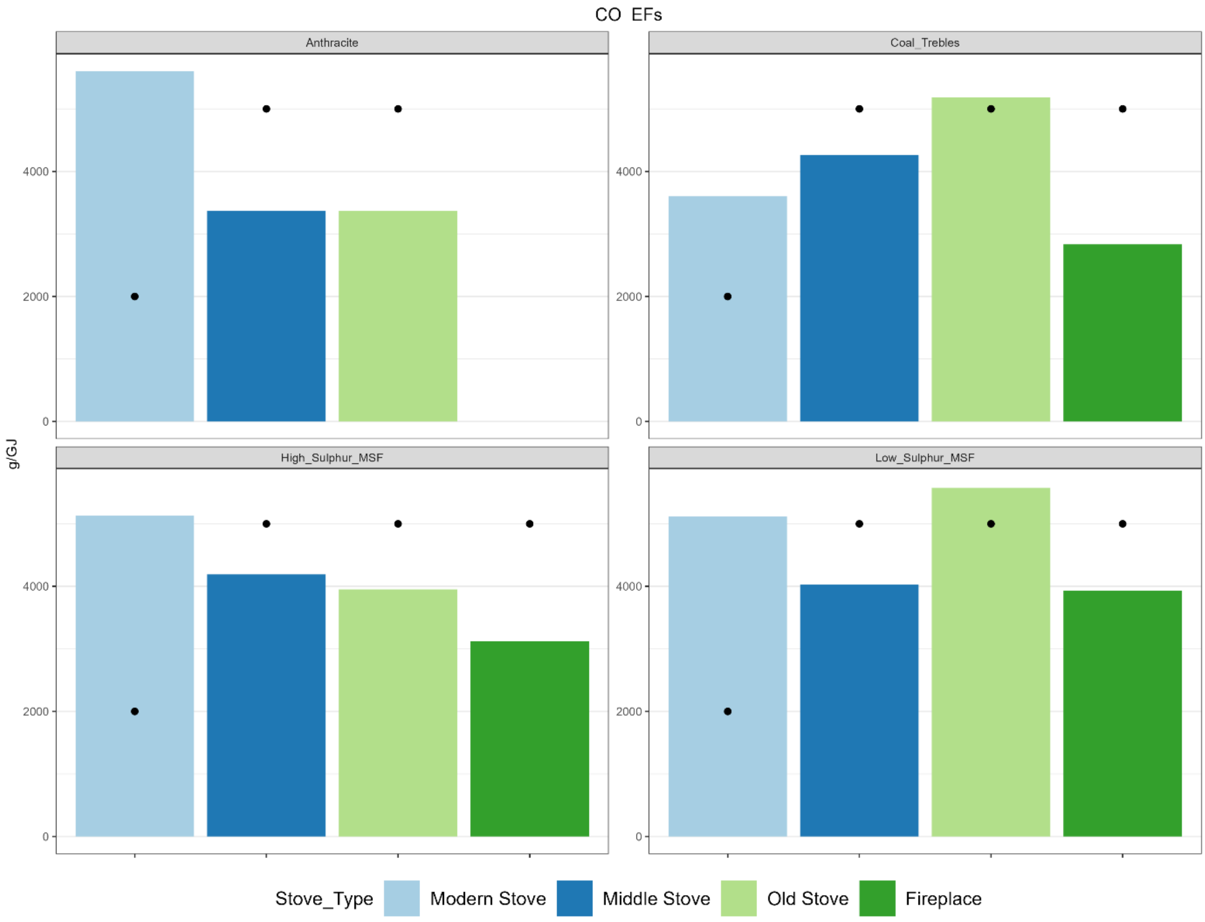


5.2.2 Mineral fuels

It is notable that for the modern Ecodesign appliance using anthracite and MSF mineral fuels that there are frequently higher emission factors for CO, PM and TOC/OGC (which have emission limits in the Ecodesign Regulation) and PAH compared to the older appliances. Smaller differences in emission factors will be mitigated by higher energy efficiency for the modern appliance but the emission factors for the modern appliances are often higher than could be offset by improved energy efficiency.

5.2.2.1 *Carbon monoxide (CO)*

Figure 5-12 Carbon monoxide emission factors for mineral fuels



Carbon monoxide emission factors were notably high for the modern appliance for anthracite and both the approved and non-approved MSF, having the highest EF of all the stoves for anthracite and the non-approved MSF. The lowest CO emission factors were found for the open fireplace for all fuels except for anthracite which was not tested on this appliance type. In general emission factors were lower than the comparable emission factor used in the NAEI (EMEP/EEA Guidebook 2019) but notably the emission factors for the modern appliance were higher (and often higher than emission factors determined for older stoves and the open fireplace).

5.2.2.2 Particulate matter

Figure 5-13 Total Particulate matter emission factors for mineral fuels

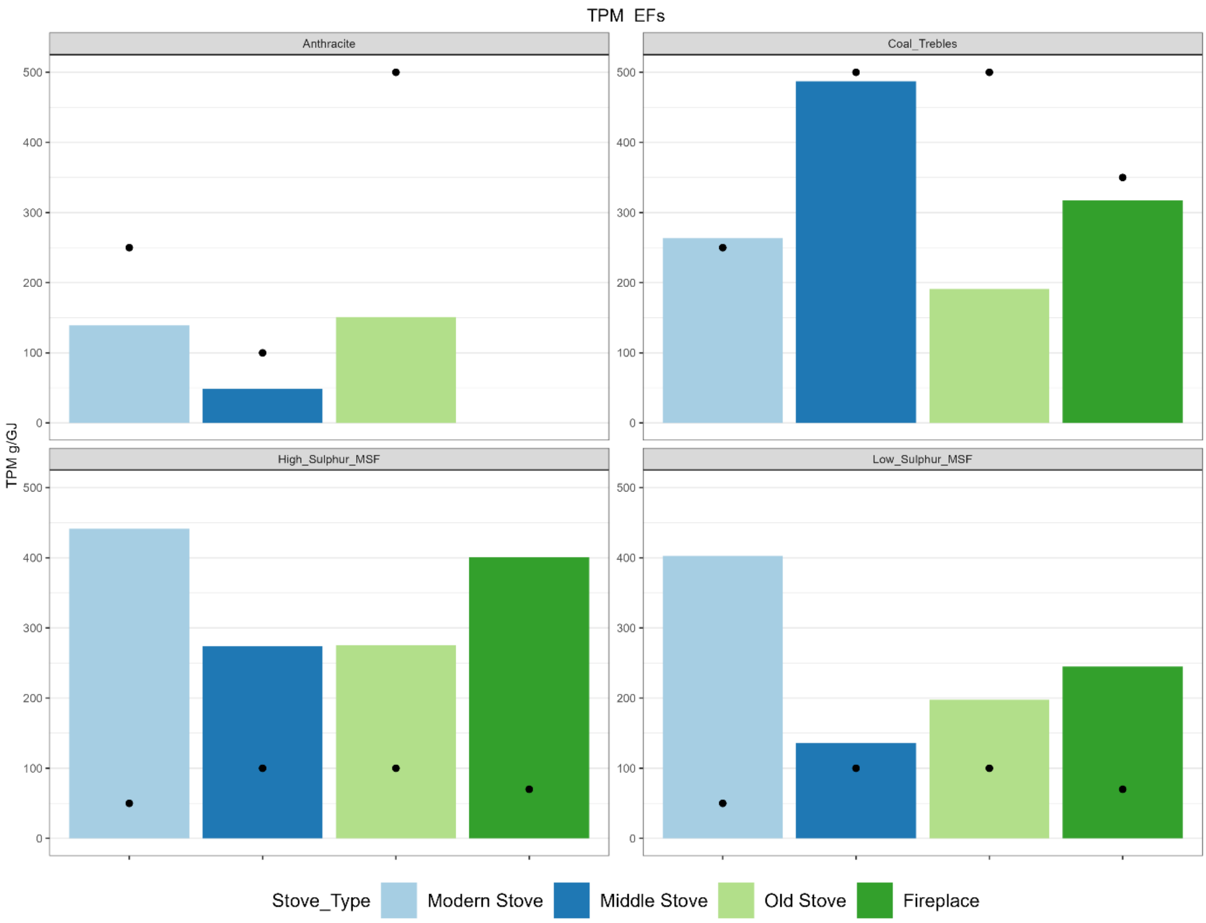
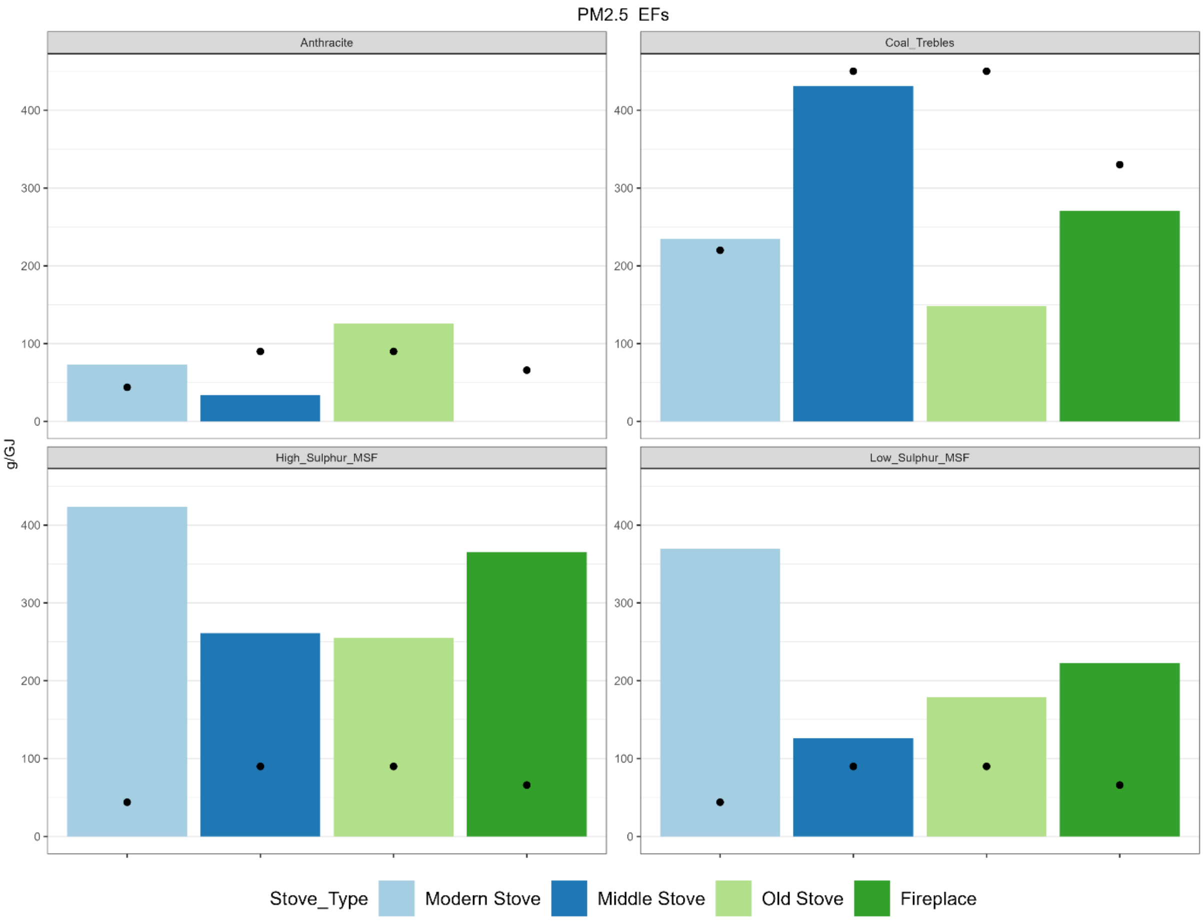


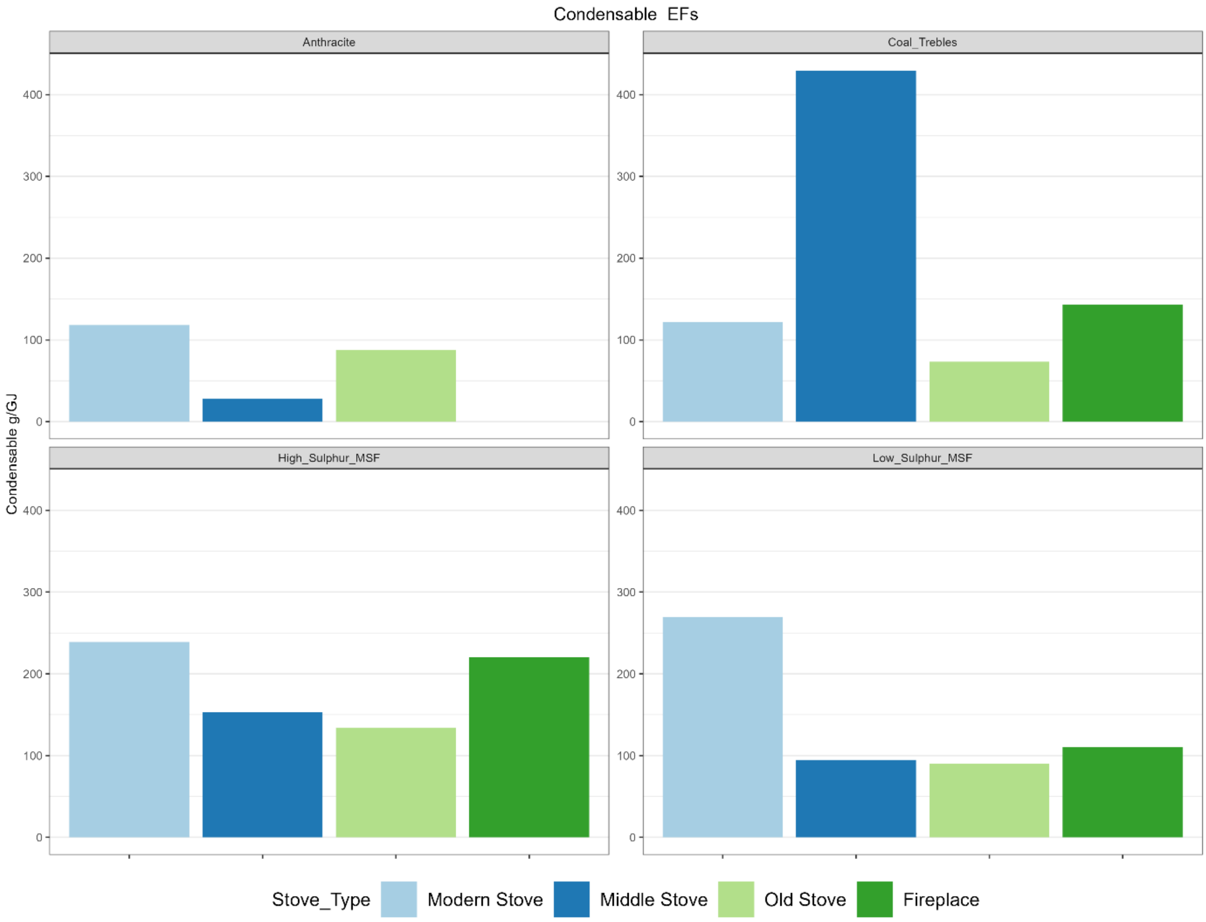
Figure 5-14 $PM_{2.5}$ emission factors for mineral fuels



For TPM and $PM_{2.5}$, the emission factors determined for approved and non-approved MSF are higher than the emission factors used by the NAEI, but for coal the emission factors are generally lower than current NAEI emission factors. The emission factors for the modern stove are higher than the older stove for the MSFs and higher than the emission factors in the NAEI for all mineral fuels.

For condensable PM (Figure 5-15), which is not currently reported in the NAEI, the relatively high contribution from condensable PM for anthracite and MSFs (on the modern stove) is a little surprising as these fuels have a low volatile matter content or are sold as smokeless products. The condensable PM emission factors appear lower on the older closed appliances.

Figure 5-15 Condensable PM emission factors for mineral fuels



5.2.2.3 Total organic compounds (HC/OGC/TOC)

The NAEI reports methane and non-methane volatile organic compounds (NMVOC) separately. In the test programme, the measurements are of total organic compounds (TOC but sometimes known as OGC or total hydrocarbons). Figure 5-16 shows TOC emission factors. Figure 5-17 shows NMVOC emission factors derived from TOC measurements and methane emission factors. The NMVOC emission factors derived in WP3 are generally similar to the NAEI emission factors, however, the modern stove had higher emission factors when burning anthracite and the manufactured solid mineral fuels than applied in the NAEI.

Figure 5-16 Total Organic Compounds emission factors for mineral fuels

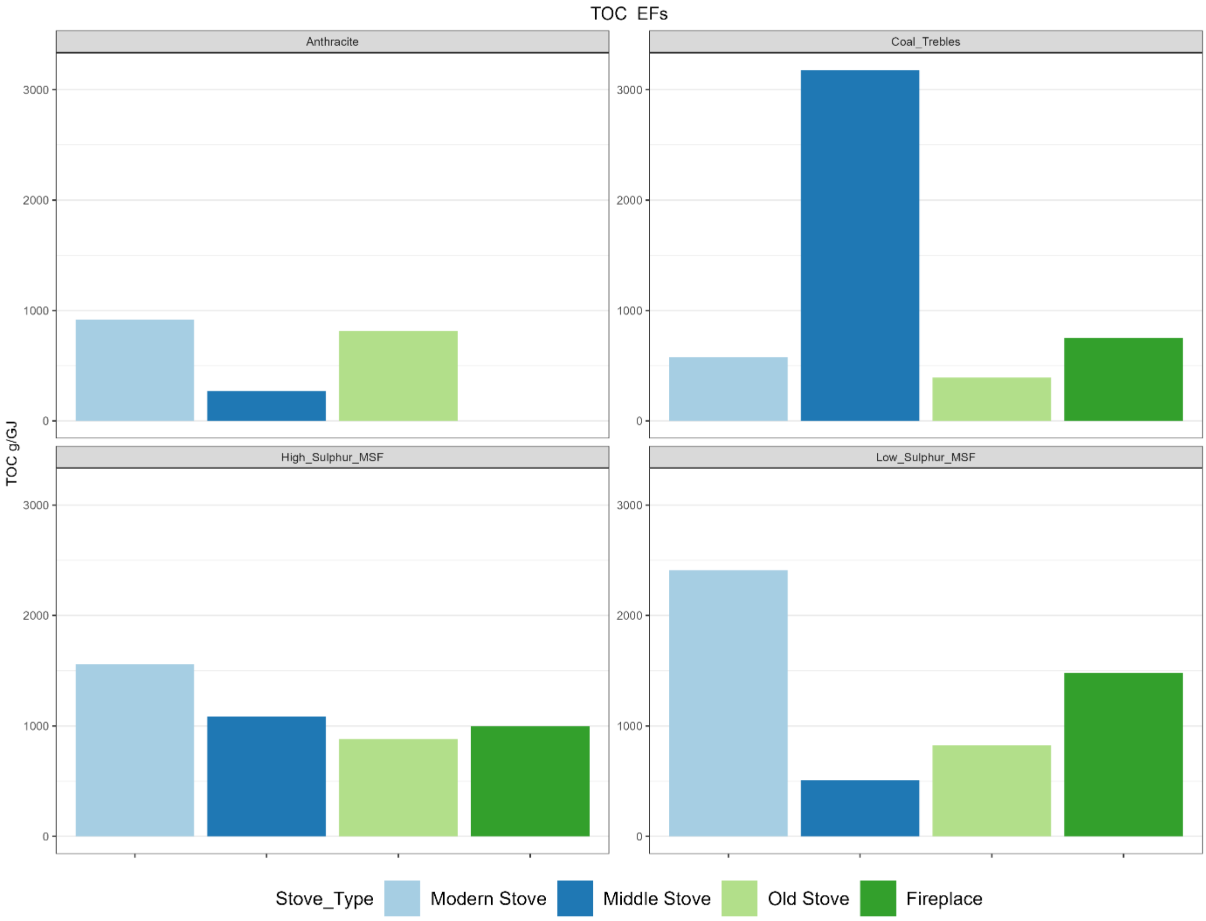
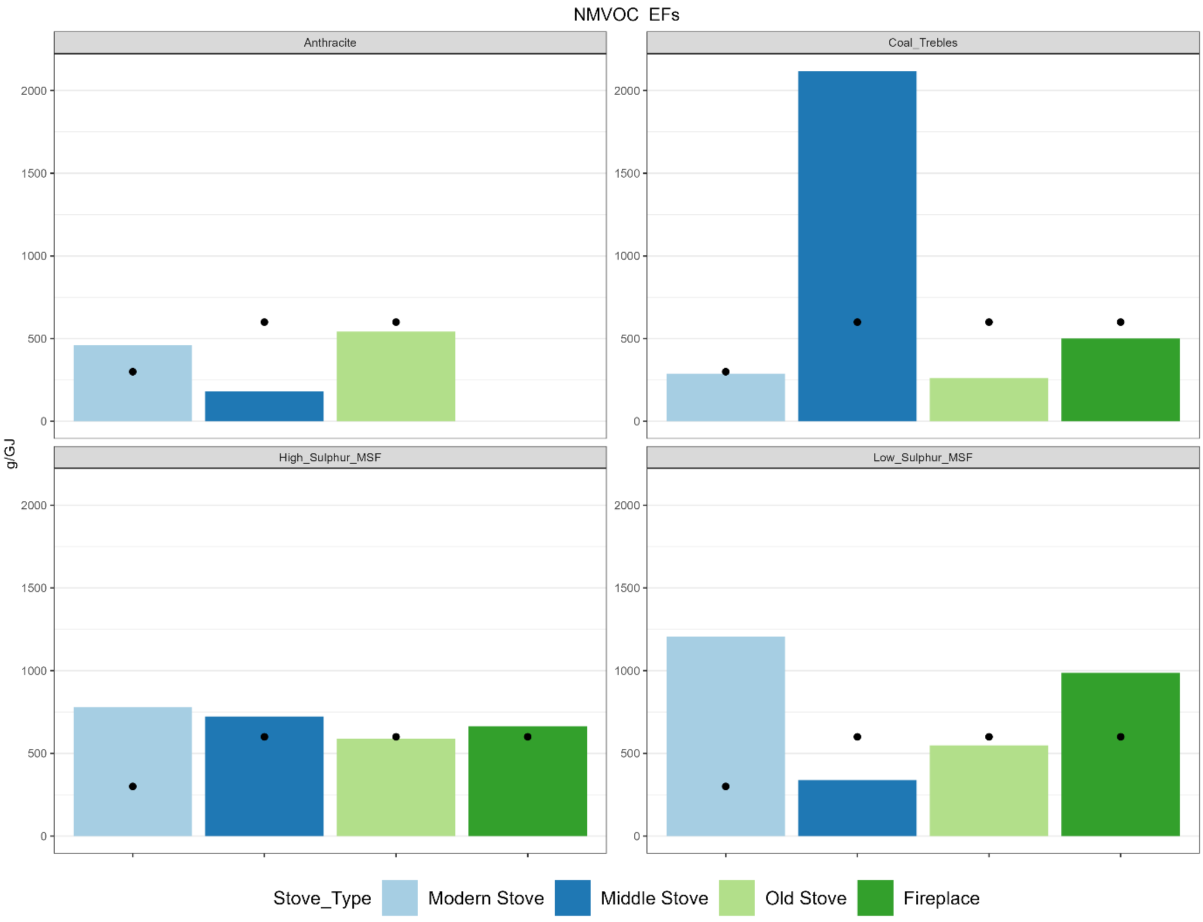


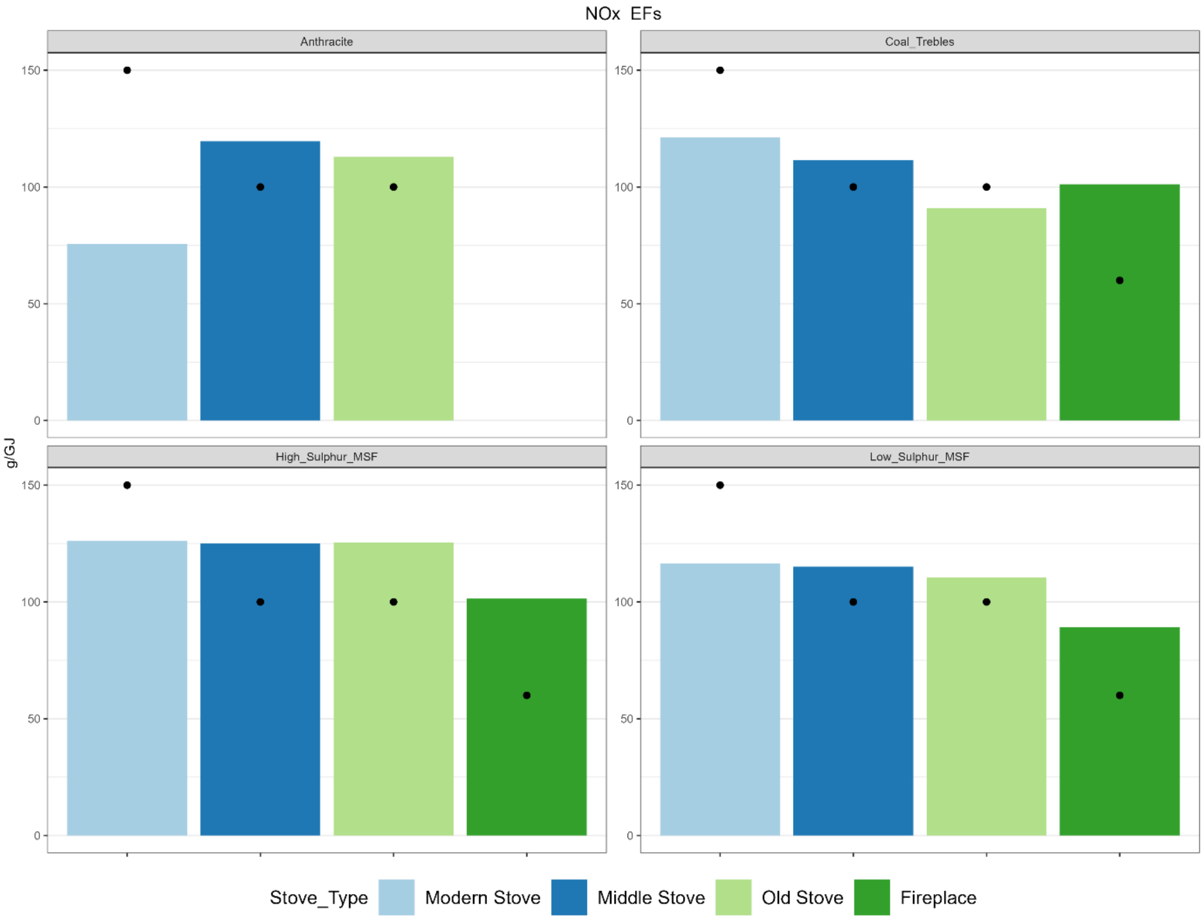
Figure 5-17 NMVOC emission factors for mineral fuels



5.2.2.4 Nitrogen oxides (NO_X)

Emission factors for NO_X are broadly similar for the stoves although the open fireplace is lower for the MSFs (see Figure 5-18). The emission factors for the modern stove were lower for all fuels than the value used in NAEI.

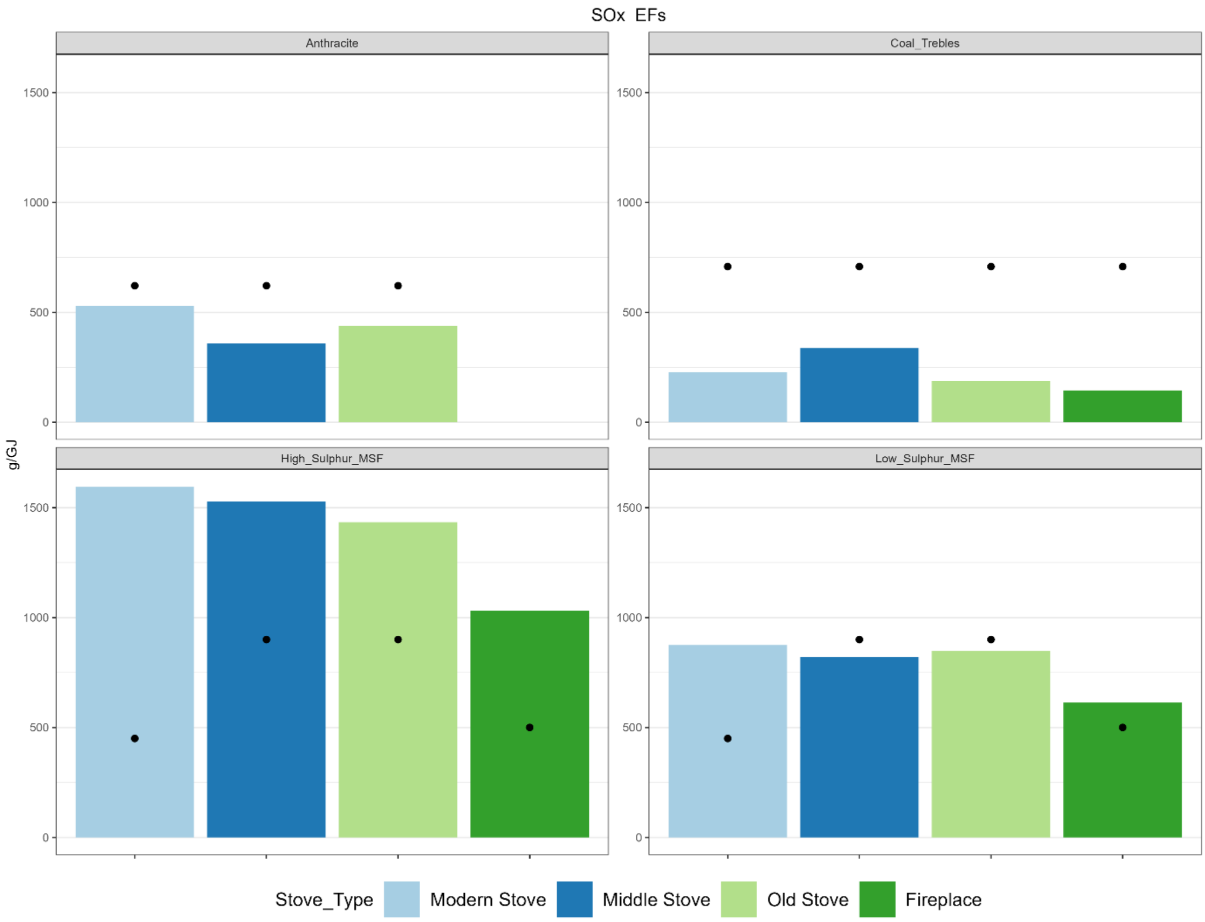
Figure 5-18 NO_X emission factors for mineral fuels



5.2.2.5 *Sulphur oxides (SOx)*

Note that emission factors represent sulphur dioxide (SO_2) as they are derived from an SO_2 continuous measurement system. Emission factors vary between fuels more so than between appliance type. The highest emissions are seen for the manufactured solid fuels. Compared to the current NAEI emission factors the MSFs are generally higher whereas anthracite and coal both have lower sulphur dioxide emission factors in this test programme than estimated in the current NAEI. Note that the NAEI emission factors are derived from sulphur analysis provided by fuel suppliers, but the number of mines and suppliers of coal has decreased over recent years and this has increased the uncertainty of the NAEI estimates of sulphur oxides emissions for domestic combustion.

Figure 5-19 Sulphur dioxide emission factors for mineral fuels



5.2.2.6 *Dioxin and furans (PCDD/F)*

Figure 5-20 PCDD/F emission factors for mineral fuels

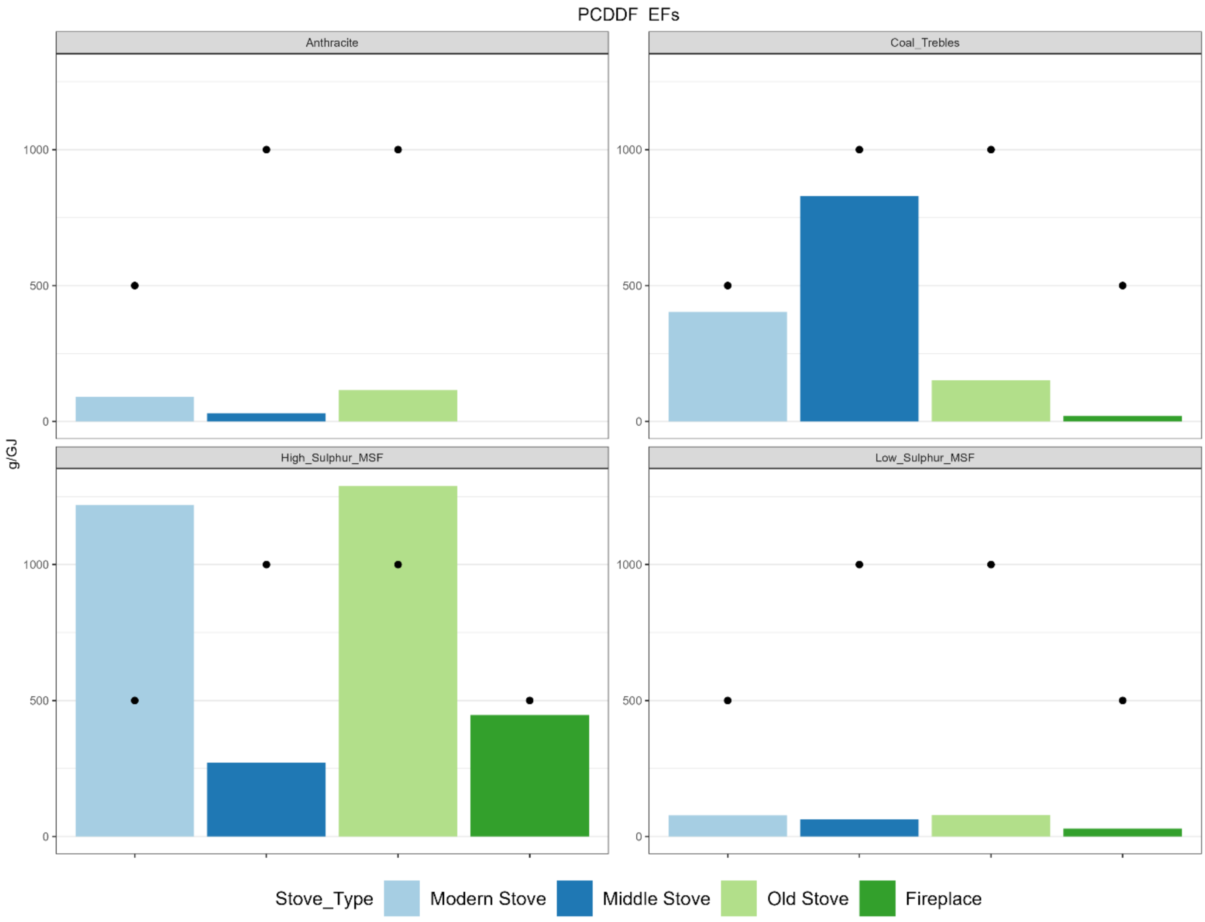


Figure 5-20 shows the PCDD/F emission factors determined for mineral fuels. Emission factors were lower than the NAEI default emission factors all fuels except for the non-approved MSF which had higher emissions factors for the modern and old stove. The PCDD/F emission factors for the approved MSF were considerably lower than for the non-approved fuel.

5.2.2.7 *Polynuclear Aromatic Hydrocarbons (PAH)*

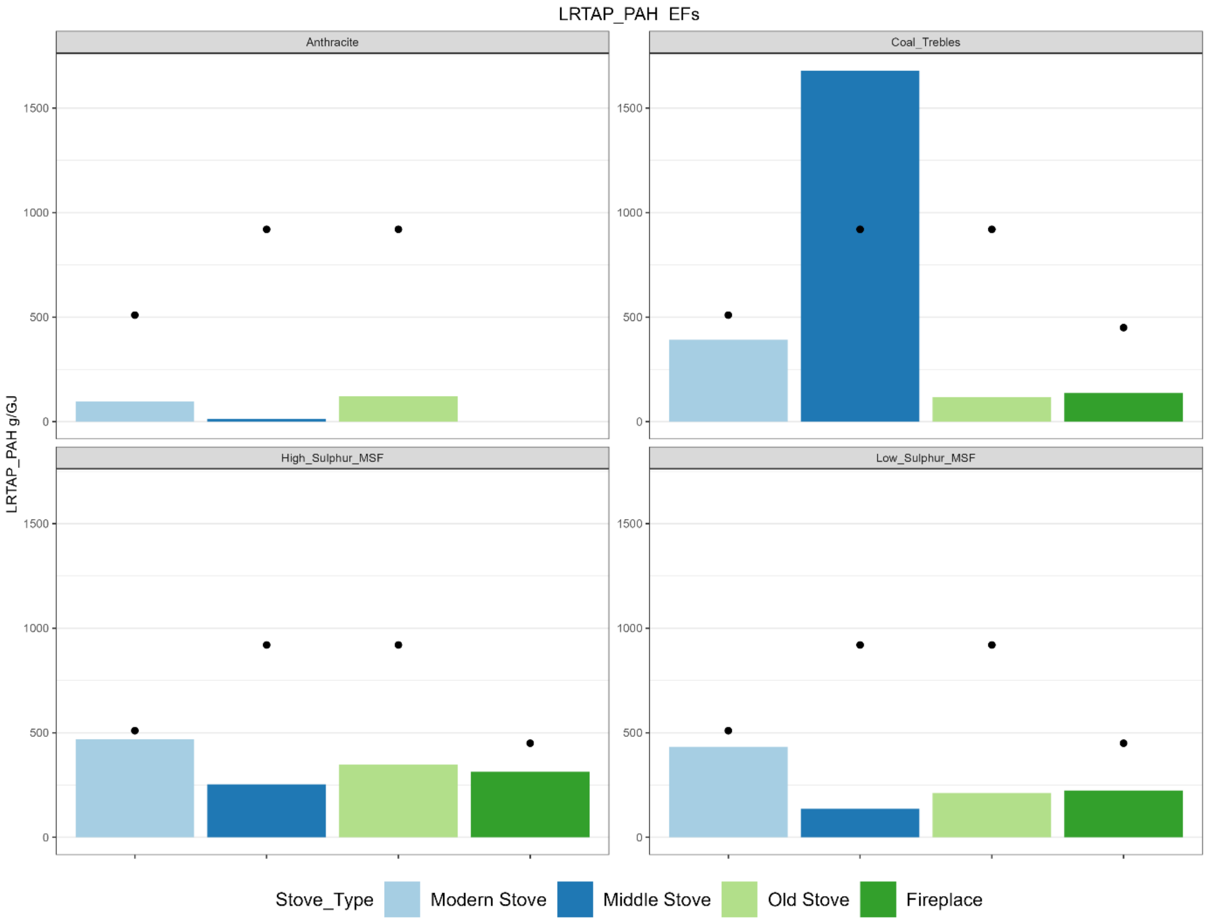
A suite of 16 PAH were determined:

- Anthanthrene
- Benzo(a)anthracene
- **Benzo(a)pyrene**
- **Benzo(b)fluoranthene**
- Benzo(b)naptho(2,1-d)thiophene
- Benzo(c)phenanthrene
- Benzo(ghi)Perylene
- **Benzo(k)fluoranthene**
- Cholanthrene
- Chrysene
- Cyclopenta(cd)pyrene

- Dibenzo (ai)pyrene
- Dibenzo(ah)anthracene
- Fluoranthene
- **Indeno(123-cd)pyrene**
- Naphthalene

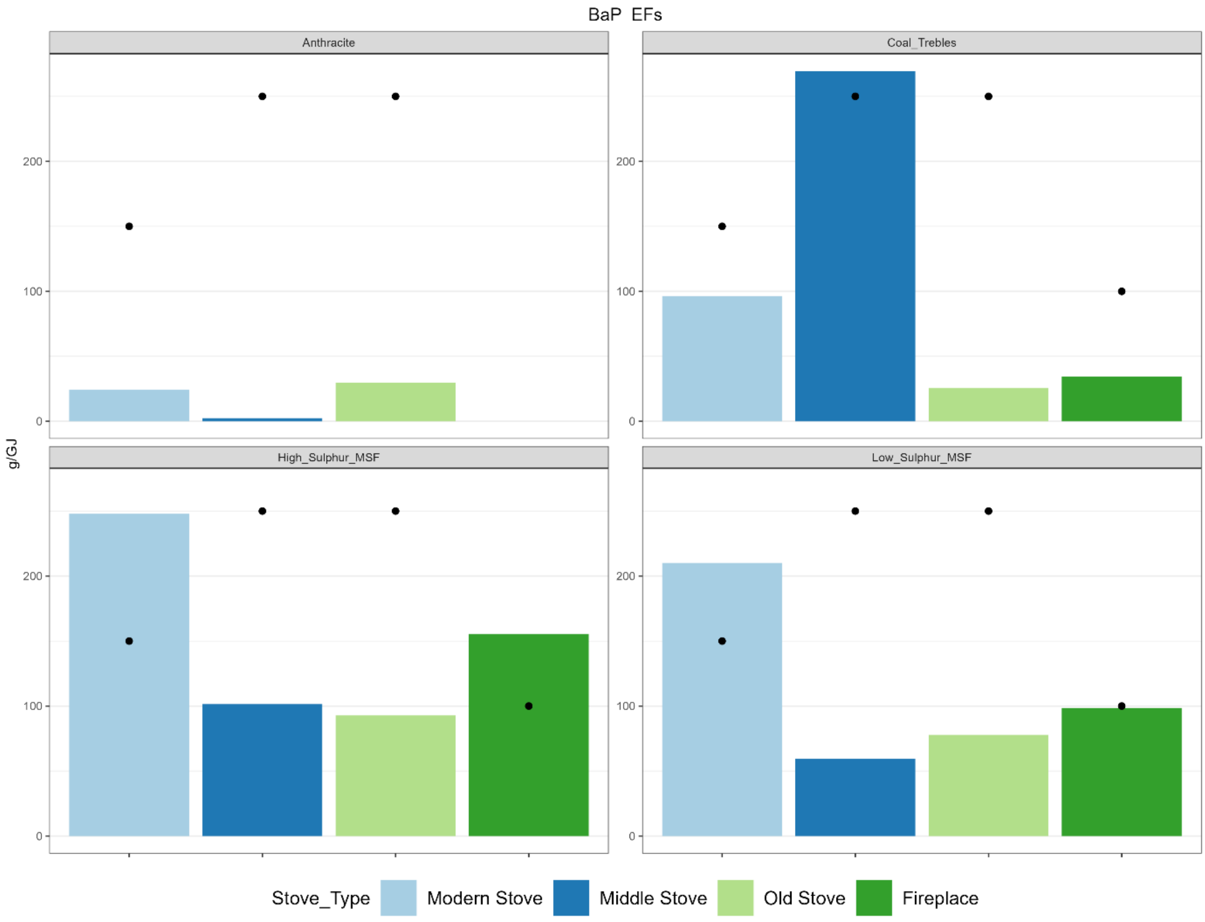
The PAH highlighted in **bold** are used for international emission inventory reporting.

Figure 5-21 PAH emission factors for mineral fuels



Sixteen PAH compounds were determined, however only four are used for international reporting for emission inventories. Figure 5-21 compares the sum of the four PAH used in international reporting from the measurement programme with emission factors used in the NAEI. Benzo(a)pyrene emission factors are shown in Figure 5-22. The PAH emission factors determined for solid mineral fuels were all lower than the NAEI default factors. The emission factors determined on the modern stove were highest for the both the MSFs. Findings for B(a)P emission factors are broadly similar as for PAH although notably the modern stove emission factors are higher than the NAEI factors for the MSFs.

Figure 5-22 Benzo(a)pyrene emission factors



5.2.2.8 Heavy Metals

For mineral fuels a suite of fourteen metals were also sampled:

- Antimony (Sb)
- **Arsenic (As)**
- **Cadmium (Cd)**
- **Chromium (Cr)**
- Cobalt (Co)
- **Copper (Cu)**
- **Lead (Pb)**
- Manganese (Mn)
- **Mercury (Hg)**
- **Nickel (Ni)**
- **Selenium (Se)**
- Thallium (Th)
- Vanadium (V)
- **Zinc (Zn)**

The metals highlighted in **bold** are reported in the NAEI and emission results are illustrated in the following figures. Metals were sampled to collect both solid and vapour phases. Three sets of samples (and a field blank) were collected for each appliance and fuel combination across the WPs.

Samples were recovered in several fractions:

- Probe rinse (particulate fraction)
- Filter (particulate fraction)
- Absorber group 1, Impinger 1 &2 (vapour phase fraction)
- Absorber group 1, Impinger 3 (vapour phase fraction)
- Absorber Group 2, Impinger 1 (vapour phase Hg fraction)
- Absorber Group 2, Impinger 2 (vapour phase Hg fraction)

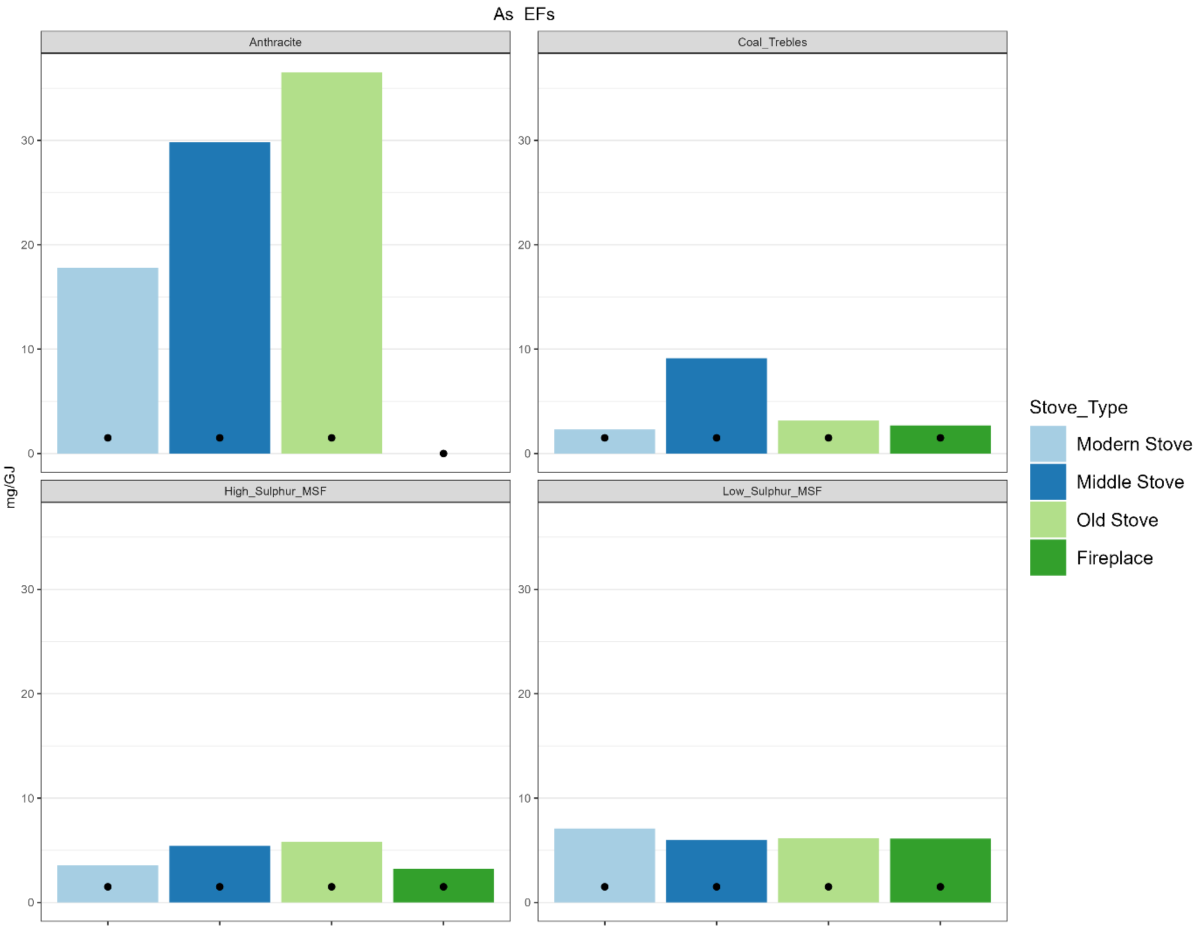
The particulate fractions (filter and probe rinse) were digested prior to analysis. Absorbent solutions and washings were analysed without digestion.

In WP2, several tests were affected by large particulate and/or gaseous contributions to selected metals for one or more of the three tests undertaken for each fuel and appliance combination. In some instances, the calculated emission factors were higher than indicated by fuel analysis and higher than EMEP/EEA Guidebook 2019 emission factors. Following a review of data and measurement procedures, sample recovery and preparation measures were modified to minimise the risk of such incidents.

Following discussion with the project steering group, criteria were applied to data to exclude potentially anomalous results and this approach was continued in WP3.

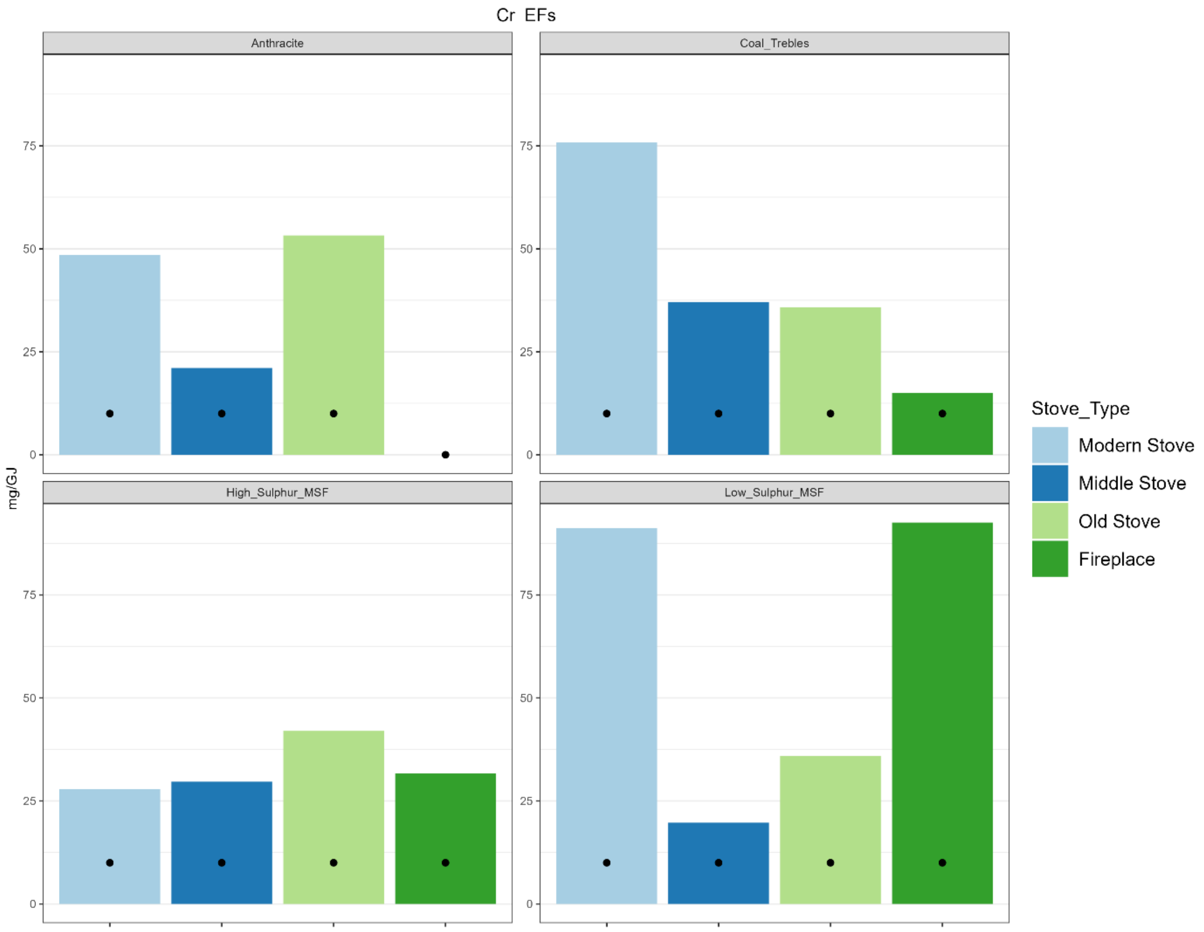
Although emission monitoring provides a well-established and standardised approach to determination of emissions of heavy metals, the EFDSF measurements indicate that concentrations of most metals concentrations are at, or close to, the Limit of detection. Adoption of other approaches such as fuel and ash sampling and analysis may potentially provide data with less uncertainty.

Figure 5-23 Arsenic emission factors



Arsenic - The Arsenic emission factors calculated are generally consistent with the NAEI for each fuel type. Also, the emission factor does not vary with the appliance types very much. The exception to this is the emission factors from Anthracite, these are much higher than the current NAEI factors. The data for the Dovre (Middle) and Hunter Aspect 5 (Modern) stoves for Coal Trebles each had the vapour phase removed for 2 of the 3 tests due to high vapour phases recorded which were much higher than the particle phase.

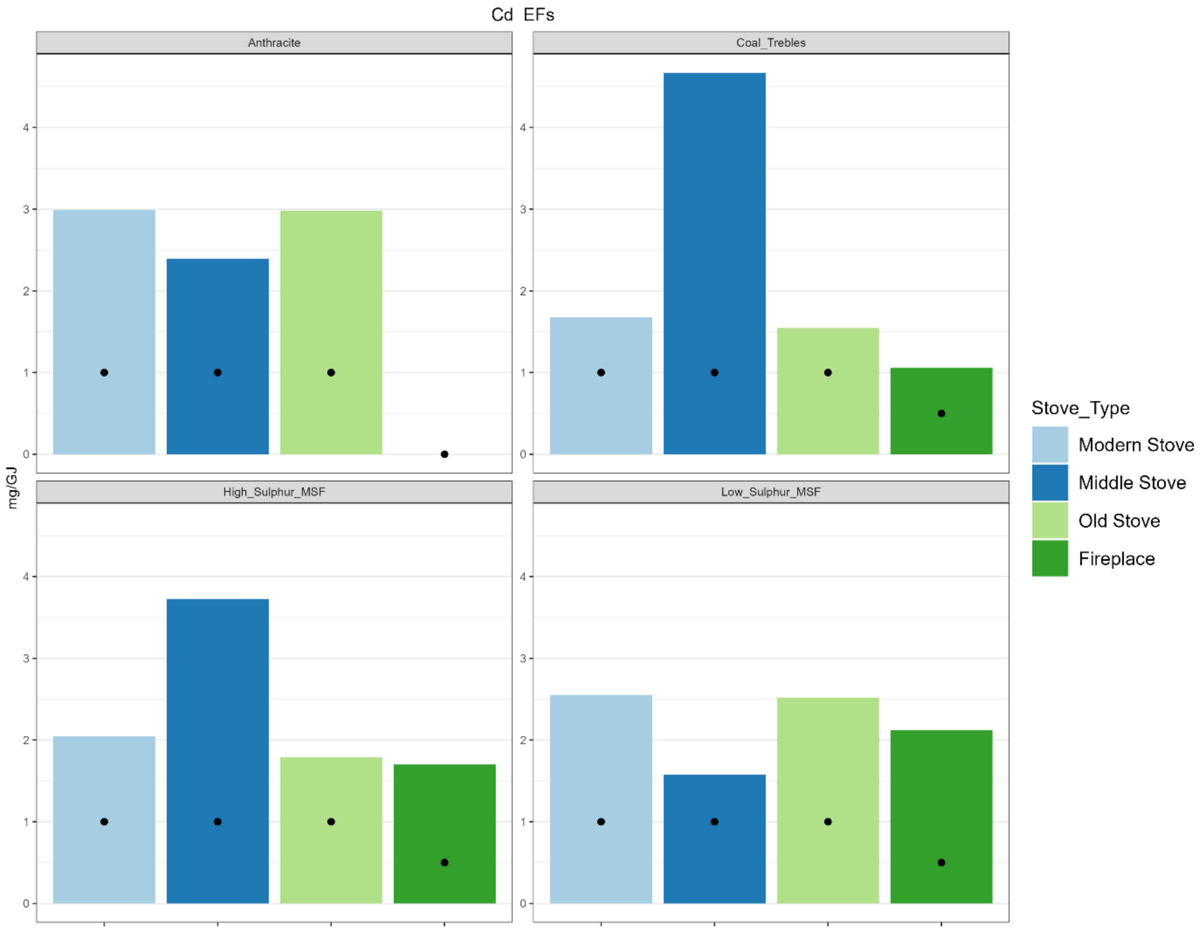
Figure 5-24 Chromium emission factors



Chromium

Chromium emission factors are variable between fuels and stoves. High vapour phase emissions were found for some tests and may be due to migration of potassium dichromate solution in the sampling train (used to collect mercury vapour). The vapour phase for chromium should be a very small fraction of the sample with most metal expected to be present in the particle phase. Where the vapour phase was the issue, the vapour phase data has been removed for all three tests and the remaining particle phase data has been used to develop an emission factor. The calculated mission factors for chromium are higher than the factors currently used in the NAEI.

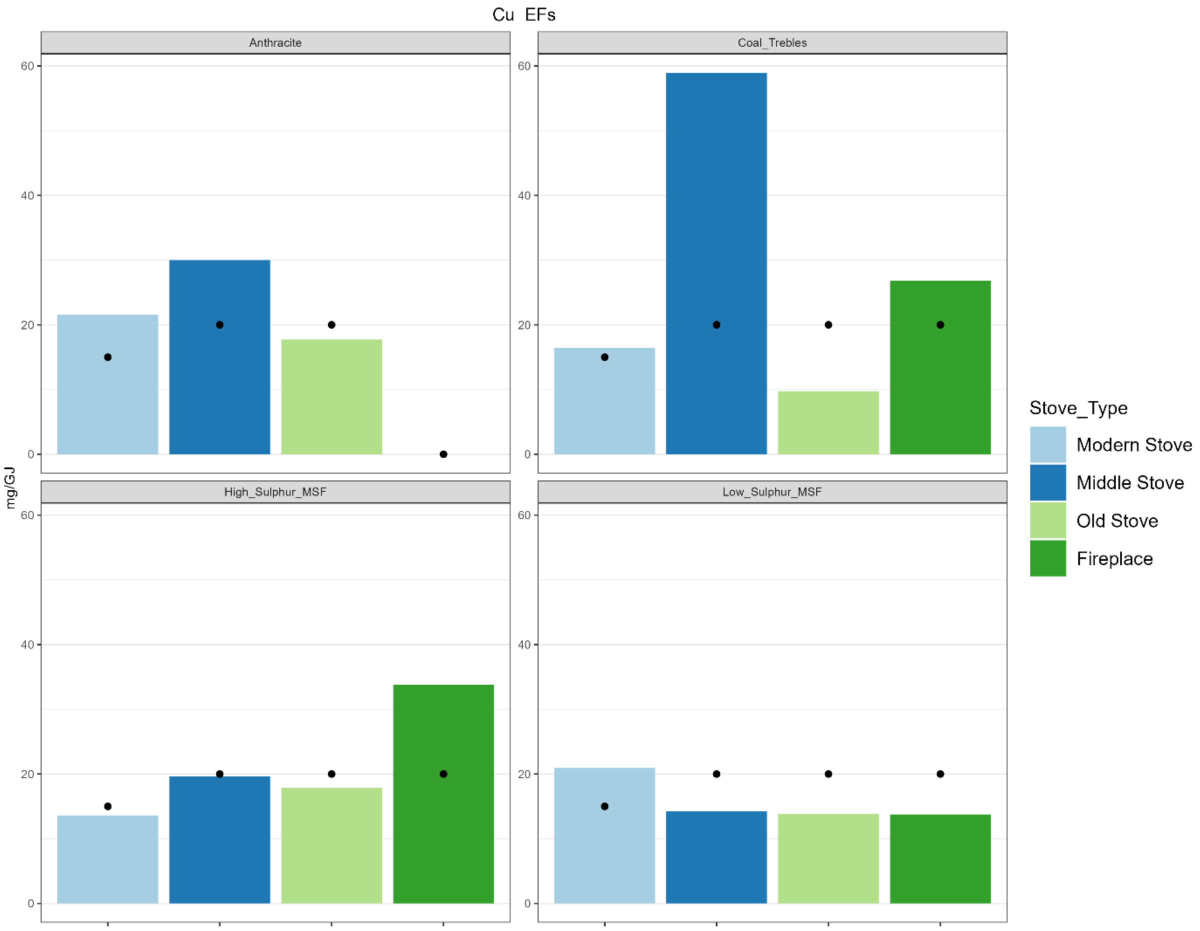
Figure 5-25 Cadmium emission factors



Cadmium

Emission factors calculated are generally in line with, if not slightly higher than, the NAEI factors for each fuel type and do not vary much between fuels. Also, the emission factor does not vary much between appliance types although the emission factors for the coal trebles and non-approved MSF are higher for the Middle Stove.

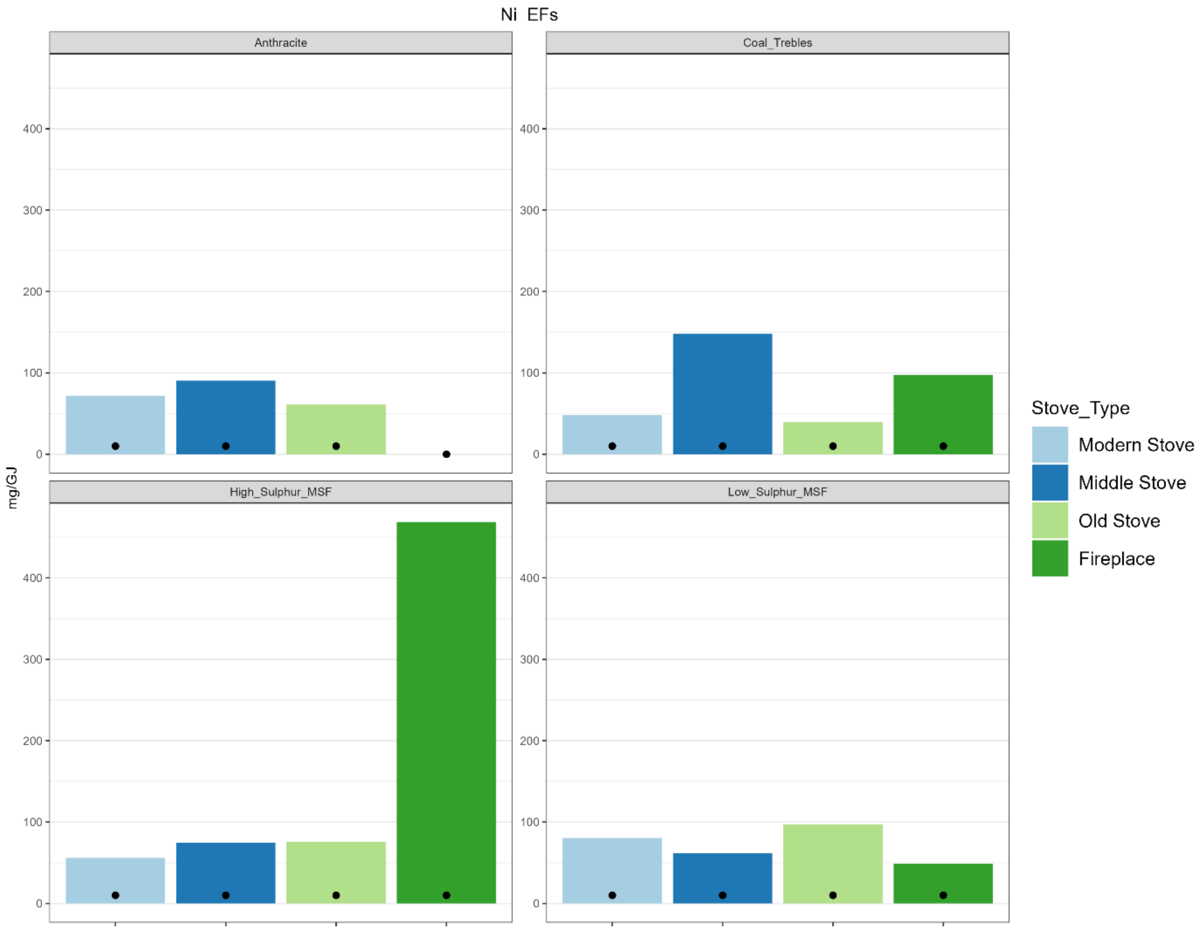
Figure 5-26 Copper emission factors



Copper

Copper emissions are quite variable between fuel and stove type. The emission factors for Anthracite and the manufactured solid fuels are quite similar to the NAEI factors. Whereas the Coal Trebles emission factor was significantly higher for the Middle Stove. For some of the tests one repeat has been excluded as they were a clear outlier.

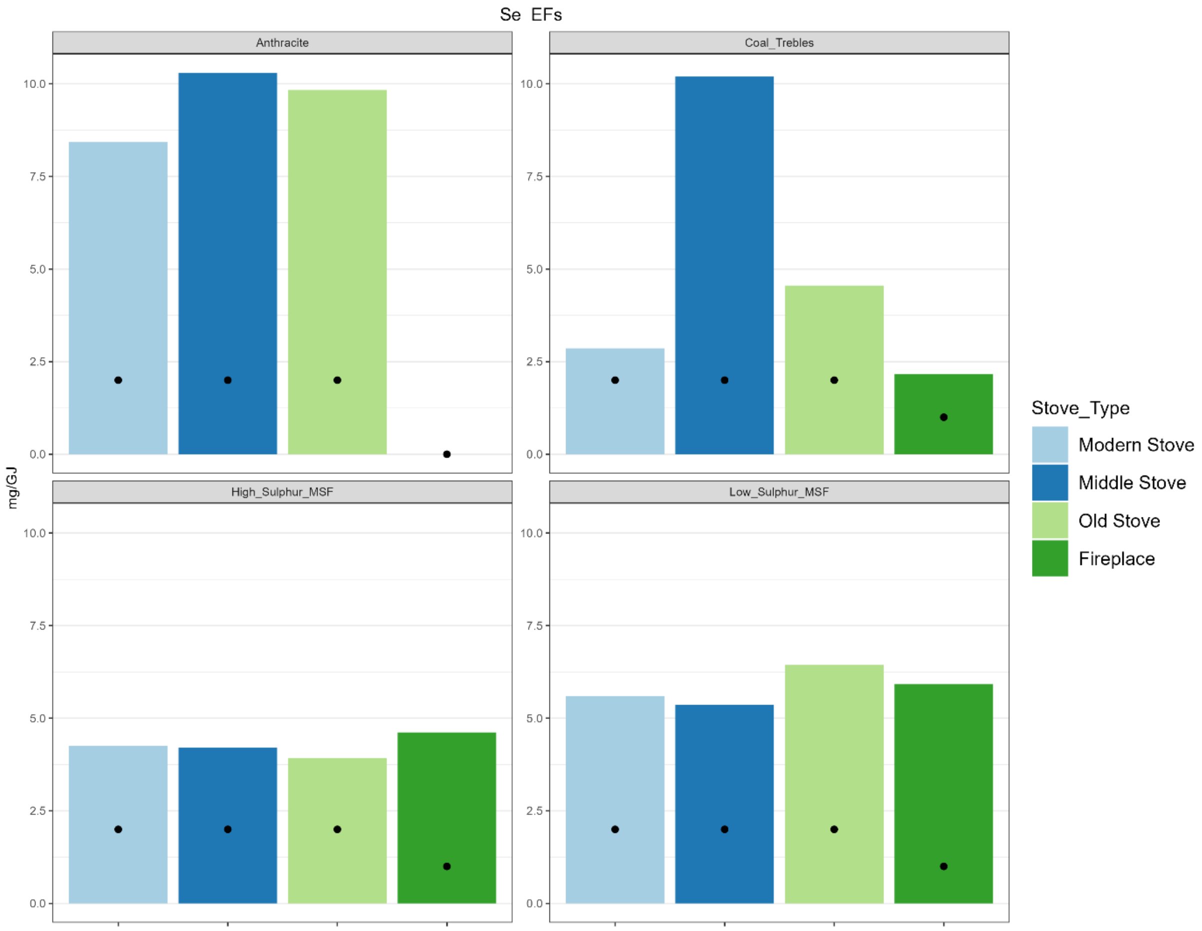
Figure 5-27 Nickel emission factors



Nickel

The nickel emission factors are all observed to be higher than the current NAEI emission factors. The highest emission factor was found for non-approved MSF in the open fireplace. For some of the tests one repeat has been excluded as they were a clear outlier.

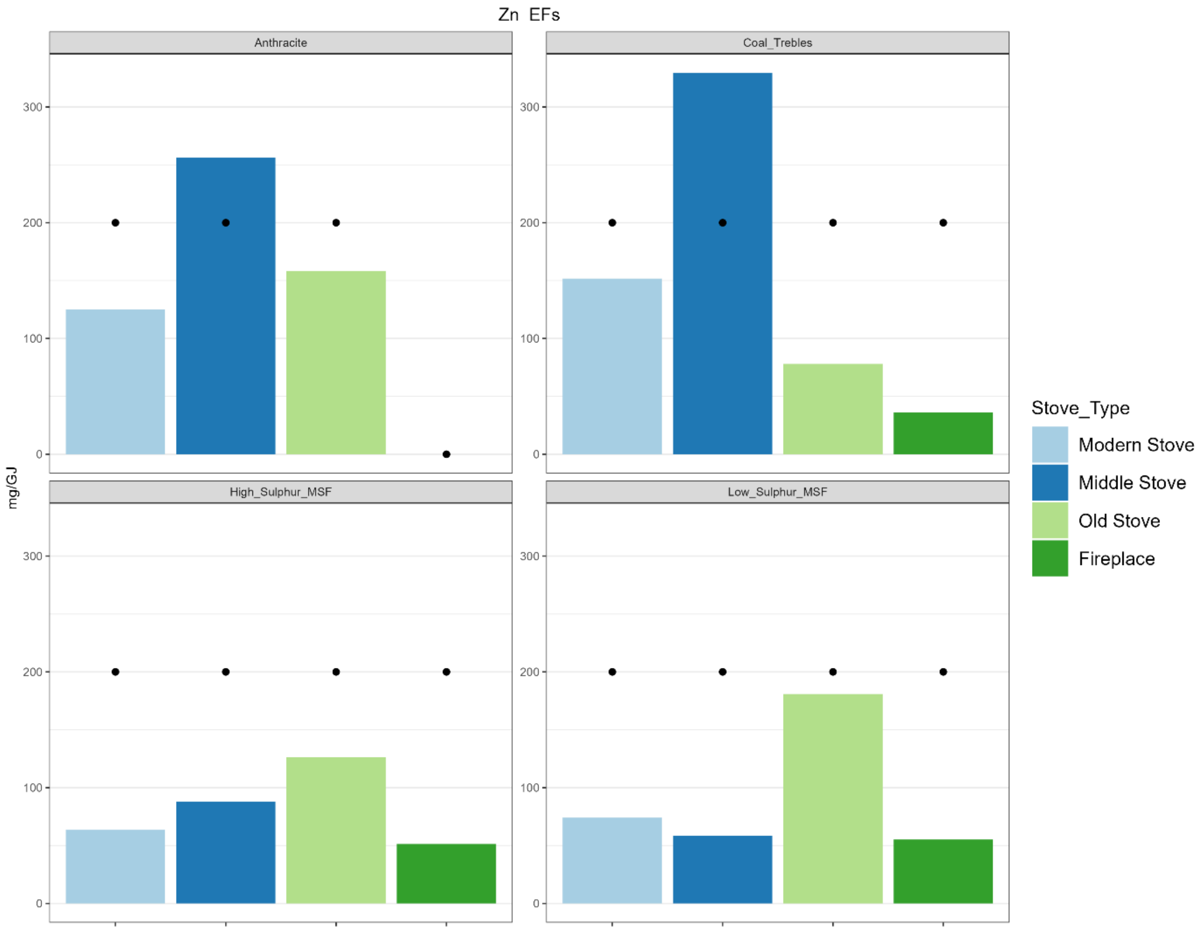
Figure 5-28 Selenium emission factors



Selenium

All emission factors are higher than the current NAEI emission factors. The emission factors for Anthracite are the largest across the stove types and are larger than the NAEI factors. There is not much variation across the stove types except for the coal trebles where the middle stove emission factor is highest.

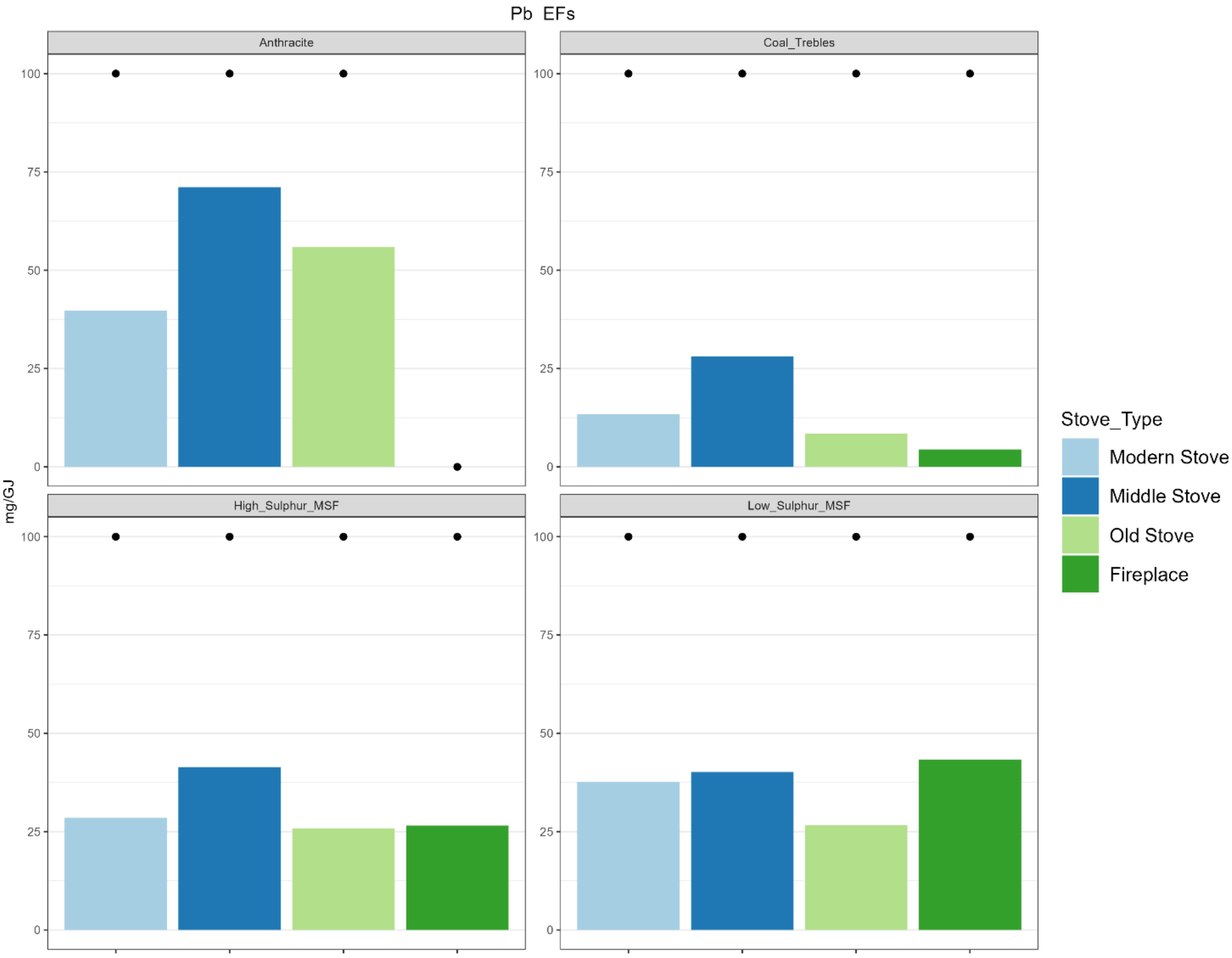
Figure 5-29 Zinc emission factors



Zinc

Zinc emission factors are generally much lower than the current NAEI factors, with the exception of the middle stove for anthracite and coal trebles. For some of the tests one repeat has been excluded as they were a clear outlier.

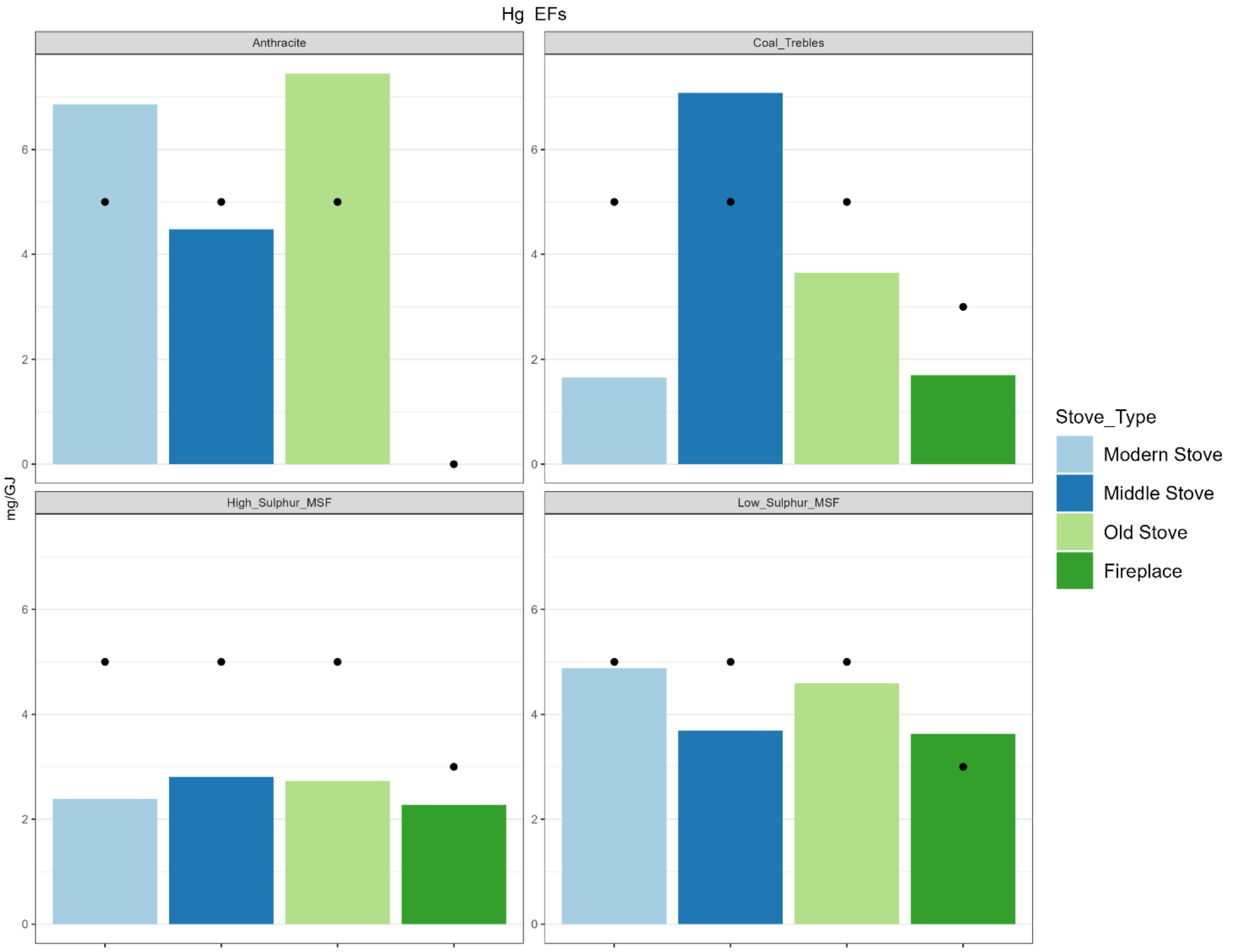
Figure 5-30 Lead emission factors



Lead

Lead emission factors are lower than the current NAEI emission factors for all fuels with the highest emission factors coming from anthracite.

Figure 5-31 Mercury emission factors



Mercury

The Anthracite and approved MSF emission factors are similar to those used in the NAEI. Whilst the emission factors from the non-approved MSF are significantly lower than those used in the NAEI. This is also true for coal trebles except for the middle stove which exceeds the NAEI value. There is some variation between the appliances.

5.2.3 Black Carbon

These represent measurement of Elemental Carbon and the data provided is derived only from tests conducted in WP3 as the methodology was amended from the previous work packages to provide a greater number of samples. In the previous work packages one sample was collected in each type of operating phase (ignition, operation and burnout) from one of three tests for each fuel and appliance combination. In WP3 additional measurements provided at least three sets of samples for each fuel and technology combination.

The BC results are expressed as percentages of the $PM_{2.5}$ emission factor. Note that a small number of samples for individual operating phases indicated BC quantities higher than the $PM_{2.5}$ for the same phase. The BC samples are collected over a shorter sampling period than the $PM_{2.5}$ samples so it is possible that sampling coincided with a period of relatively high emission. In such cases, the BC value has been moderated to match the $PM_{2.5}$ value.

Black carbon emission factors for wood and biomass fuels are general highest from wet wood (Table 5-3). For the modern stove emission factors from dry wood are higher compared to burning seasoned wood.

Table 5-3 Black carbon emission factors (%$PM_{2.5}$) for wood and biomass fuels

Stove Type	Dry Wood	Seasoned Wood	Wet Wood	Wood Briquettes	Coffee Logs
Modern Stove	44%	36%	63%	33%	36%
Middle Stove	65%	39%	97%	58%	20%
Old Stove	49%	5%	14%	18%	41%
Open fireplace	53%	94%	100%	20%	90%

Among the four appliance types, modern stoves have the highest black carbon emission factors for mineral fuels, except for the approved (low sulphur) MSF (Table 5-4). The open fireplace has the lowest black carbon emission factors for mineral fuels.

Table 5-4 Black carbon emission factors (%PM2.5) for mineral fuels

Stove Type	High Sulphur MSF	Low Sulphur MSF	Coal Trebles	Anthracite
Modern Stove	61%	47%	74%	72%
Middle Stove	76%	56%	72%	36%
Old Stove	12%	2%	14%	38%
Open fireplace	1%	1%	14%	Not tested

5.2.4 Additional Stove Comparisons

5.2.4.1 Blue Angel and pellet stove emission factors

The emission factors for the Blue Angel and pellet stove are compared with the modern stoves in Table 5-5. The Blue Angel stove which incorporates automatic management of the combustion process and a catalyst for emission control has lower emission factors for all fuels compared to the modern conventional stoves and indicates that a higher level of emission performance is possible for wood log appliances. The Blue Angel stove appears more able to cope with high moisture content wood logs.

Similarly, the emission factors for the pellet stove indicate improved emission performance compared to modern conventional wood log stoves. Surprisingly, a higher SOx emission factor was found for the pellet stove indicating high sulphur levels in wood pellets compared to wood logs. A high PCDD/F emission factor was also found.

5.2.4.2 Larger appliance reduced output tests

Emission tests on an 8kW output appliance were undertaken at rated output and part load on selected fuels to assess impact of load on emissions. For seasoned wood, pollutant emission factors increased at part load however for other fuels the changes are less consistent (Table 5-6, Table 5-7).

Table 5-5 Comparison of Modern Stove, Blue Angel Stove and Pellet Stove emission factors

	Modern Stove					Blue Angel Stove					Pellet Stove
Emission factor	**Wet Wood**	**Seasoned Wood**	**Dry Wood**	**Wood Briquettes**	**Coffee Logs**	**Wet Wood**	**Seasoned Wood**	**Dry Wood**	**Wood Briquettes**	**Coffee Logs**	**Pellets**
CO (g/GJ)	3315	1503	2386	1728	1992	463	427	1261	1260	519	502
TPM (g/GJ)	382	65	151	204	177	39	31	52	122	85	54
PM_{10} (g/GJ)	360	49	135	185	153	24	22	46	116	78	21
$PM_{2.5}$ (g/GJ)	359	48	131	181	151	23	19	43	113	77	17
Condensable PM (g/GJ)	237	42	96	105	118	20	18	22	54	32	36
TOC (g/GJ)	1657	212	821	341	664	71	48	186	165	53	6
NMVOC (g/GJ)	753	96	373	112	184	32	22	85	75	24	3
NOx (g/GJ)	55	55	41	46	155	64	57	47	28	108	66
SOx (g/GJ)	5	5	8	7	128	4	3	6	8	71	90
PCDD/F (gITEq)	80	66	81	199	61	42	48	66	103	27	1467
B[a]P (mg/GJ)	59	23	140	184	61	4	4	81	1	6	4
B[b]F (mg/GJ)	33	17	121	158	49	4	6	78	1	12	5
B[k]F (mg/GJ)	19	11	76	104	28	2	3	49	0	6	2
I(123-cd)P (mg/GJ)	52	20	154	200	67	3	7	86	0	9	3
Black Carbon (g/GJ)	161	16	47	16	18	2	2	24	61	55	4

Table 5-6 Comparison of Hunter Aspect 8 emission factors at rated and low output for wood and biomass fuels

	Hunter Aspect 8 – Rated Output					Hunter Aspect 8 – Low Output				
Emission factor	**Wet Wood**	**Seasoned Wood**	**Dry Wood**	**Wood Briquettes**	**Coffee Logs**	**Wet Wood**	**Seasoned Wood**	**Dry Wood**	**Wood Briquettes**	**Coffee Logs**
CO (g/GJ)	3649	1688	2734	1436	1882	4161	2031	1819	1390	1941
TPM (g/GJ)	463	73	209	317	116	684	141	106	179	260
PM10 (g/GJ)	440	54	191	281	100	646	126	93	157	245
PM2.5 (g/GJ)	438	54	185	277	99	623	125	90	152	242
Condensable PM (g/GJ)	317	43	157	206	90	352	96	60	65	216
TOC (g/GJ)	999	168	1457	173	192	957	288	105	107	411
NMVOC (g/GJ)	454	76	662	78	87	435	131	48	49	187
NOx (g/GJ)	56	53	37	55	196	111	60	54	37	235
SOx (g/GJ)	5	4	10	6	117	5	11	8	8	166
PCDD/F (gITEq)	6	10	88	76	38	12	33	23	181	65
B[a]P (mg/GJ)	22	9	212	120	12	51	14	29	80	8
B[b]F (mg/GJ)	15	8	233	116	16	39	12	23	97	10
B[k]F (mg/GJ)	9	5	149	69	9	21	7	13	61	5
I(123-cd)P (mg/GJ)	13	12	281	119	15	31	10	22	87	8
Black Carbon (g/GJ)	64	22	48	8	13	491	132	10	21	1

Table 5-7 Comparison of Hunter Aspect 8 emission factors at rated and low output for mineral fuels

	Hunter Aspect 8 – Rated Output				Hunter Aspect 8 – Low Output			
Emission factor	**Approved MSF**	**Non-approved MSF**	**Coal Trebles**	**Anthracite**	**Approved MSF**	**Non-approved MSF**	**Coal Trebles**	**Anthracite**
CO (g/GJ)	3475	4183	3249	5890	3919	5862	4302	5130
TPM (g/GJ)	408	358	362	72	456	351	473	147
PM10 (g/GJ)	395	339	334	61	442	333	442	136
PM2.5 (g/GJ)	393	335	322	59	440	331	424	134
Condensable PM (g/GJ)	141	233	186	48	261	203	283	120
TOC (g/GJ)	1654	5241	831	850	893	1149	716	744
NMVOC (g/GJ)	827	2621	416	425	446	575	358	372
NOx (g/GJ)	122	143	94	86	148	116	115	65
SOx (g/GJ)	1644	971	197	623	1838	777	263	441
PCDD/F (gITEq)	3	10	17	9	15	23	4	57
B[a]P (mg/GJ)	167	125	77	5	224	16	137	74
B[b]F (mg/GJ)	121	104	138	12	101	94	280	79
B[k]F (mg/GJ)	25	32	84	4	51	62	152	45
I(123-cd)P (mg/GJ)	39	28	79	7	39	-	194	26
Black Carbon (g/GJ)	155	207	177	53	53	127	37	19

5.3 COMPARISON WITH CURRENT NAEI EMISSION ESTIMATES

The results from this study have been presented to the NAEI Air Quality Inventory Steering Group, which is a separate body of UK experts with responsibility for overseeing and approving major changes to the UK NAEI and have been approved for inclusion in the 2025 submission.

The likely changes to the NAEI emissions as a result of implementing the EFDSF emission factors are shown in the following figures. A series of comparative charts are provided and show the impact of proposed emission factors on emissions from the most recent submission of the NAEI (NAEI22) from wood and biomass fuel use, mineral fuel use, the residential sector (NFR 1A4bi) and National Totals.

Note that NAEI22 included non-PM EFDSF WP1 emission factors for wood logs.

5.3.1 Carbon monoxide

Figure 5-32 Historic impact of new EFs on CO emissions in domestic combustion (solid fuels) sector

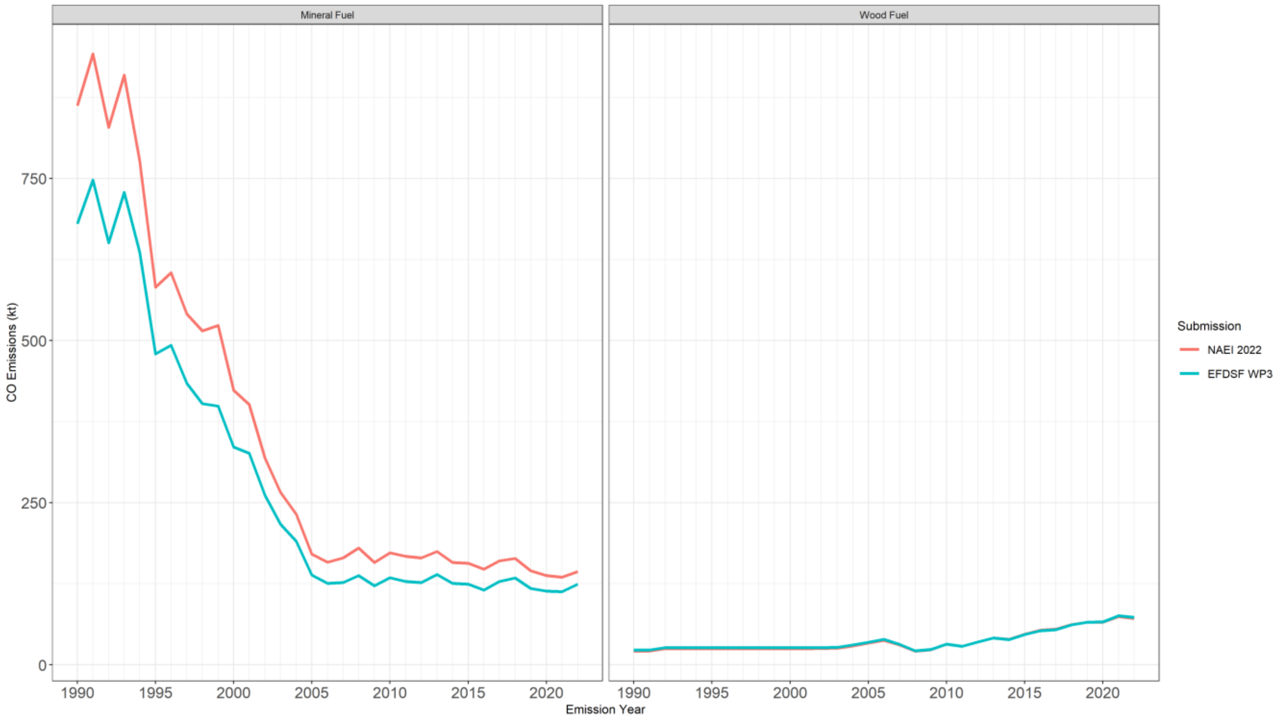
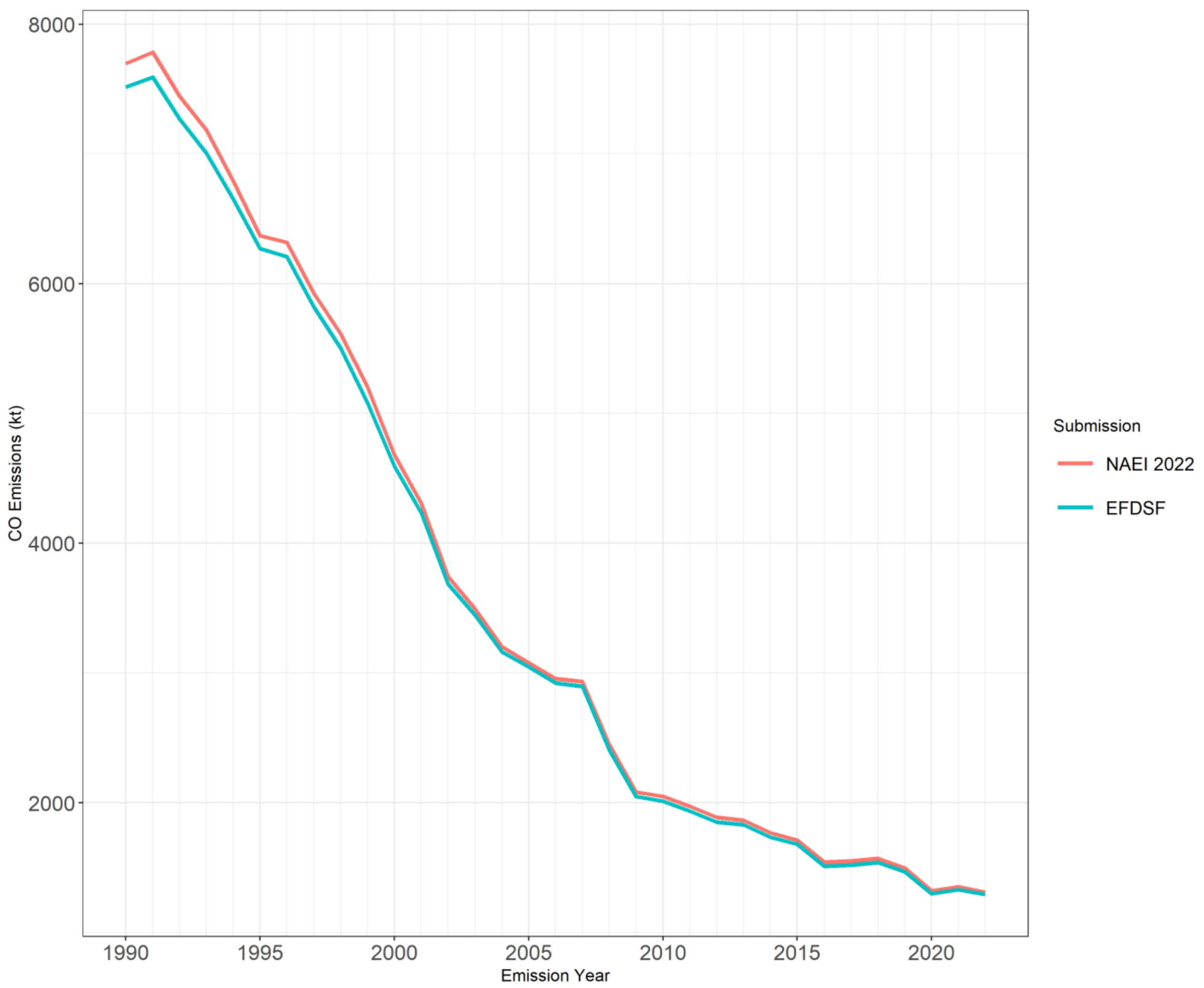


Figure 5-33 Historic impact of new EFs on CO emissions in domestic combustion sector

Figure 5-34 Historic impact of new EFs on CO emissions in all sectors



Although residential combustion (NFR 1A4bi) is a key source in the NAEI and revision of solid fuel emission factors has a major impact on emissions attributed to mineral fuels and residential combustion, the impact on the national totals is small. The limited impact on emissions for solid wood/biomass combustion in residential combustion indicates that the additional testing in WP3 has confirmed the WP1 emission factors.

5.3.2 Particulate matter

Figure 5-35 Historic impact of new EFs on $PM_{2.5}$ emissions in domestic combustion (solid fuels) sector

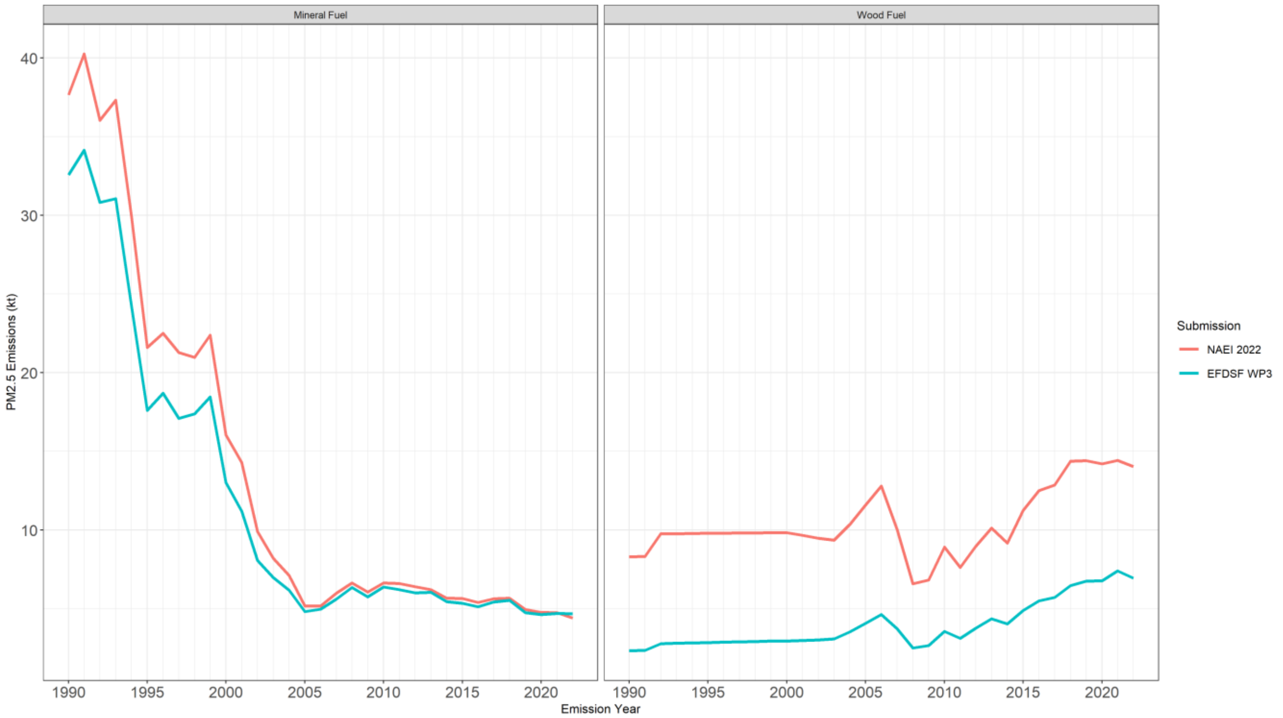


Figure 5-36 Historic impact of new EFs on $PM_{2.5}$ emissions in domestic combustion sector

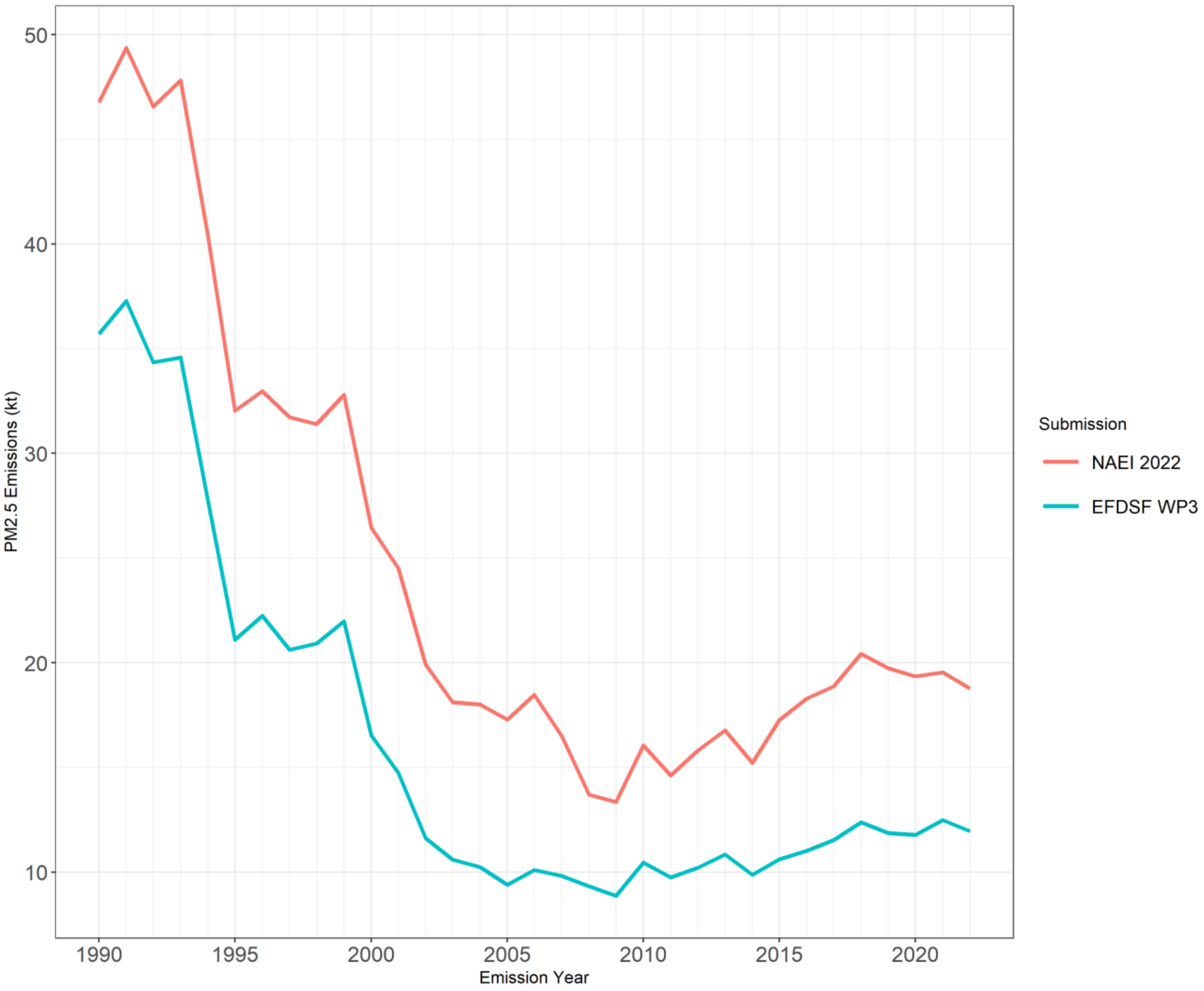


Figure 5-37 Historic impact of new EFs on $PM_{2.5}$ emissions in all sectors

The revision of solid fuel $PM_{2.5}$ emission factors has a major impact on emissions attributed to wood fuel and to a lesser degree emissions from mineral fuels (in recent years). The combined impact is a significant decrease in emissions from residential combustion across the whole timeseries, which is still significant when considering the national total.

5.3.3 Non-Methane Volatile Organic Compounds

Figure 5-38 Historic impact of new EFs on NMVOC emissions in domestic combustion (solid fuels) sector

Figure 5-39 Historic impact of new EFs on NMVOC emissions in domestic combustion sector

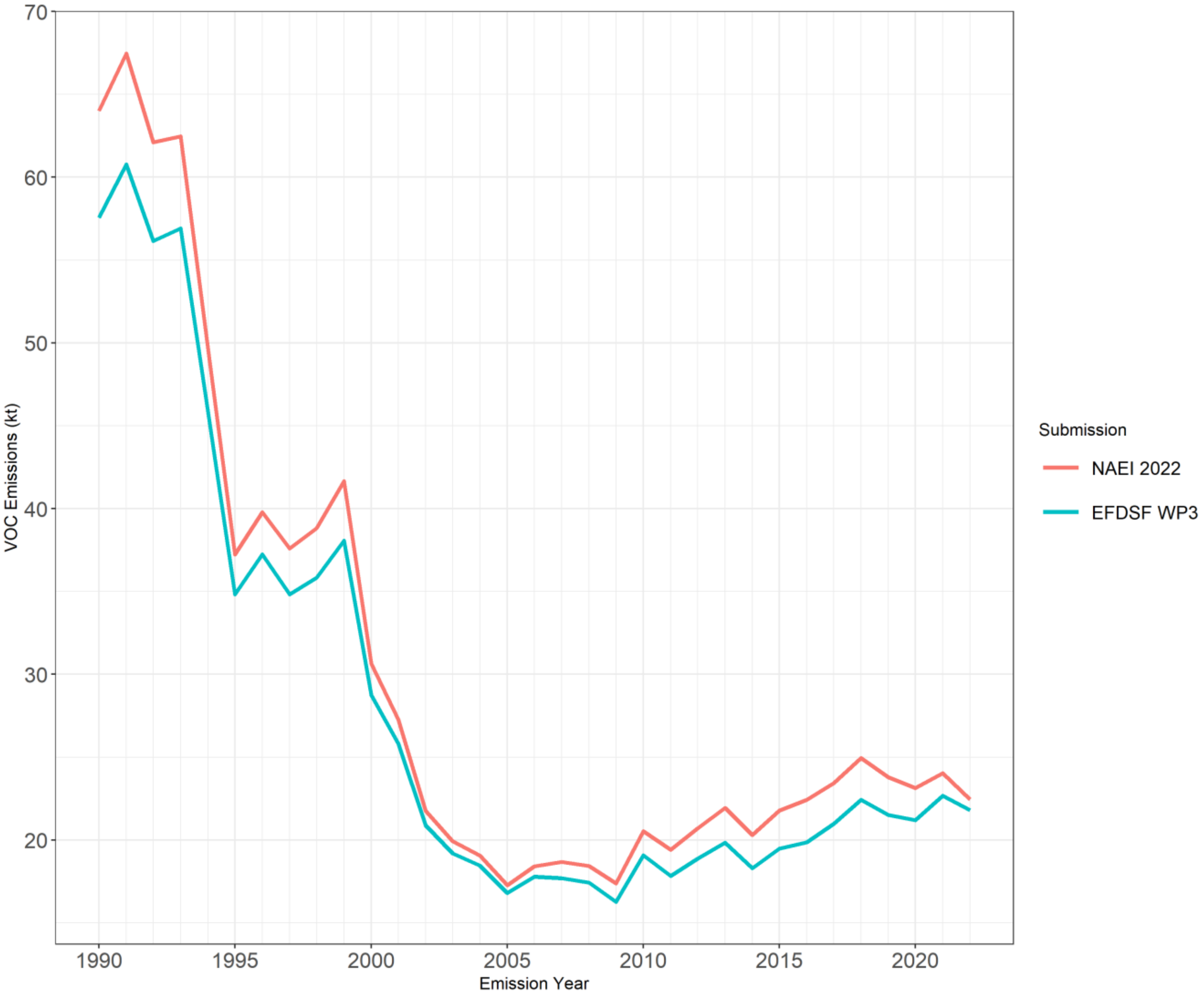
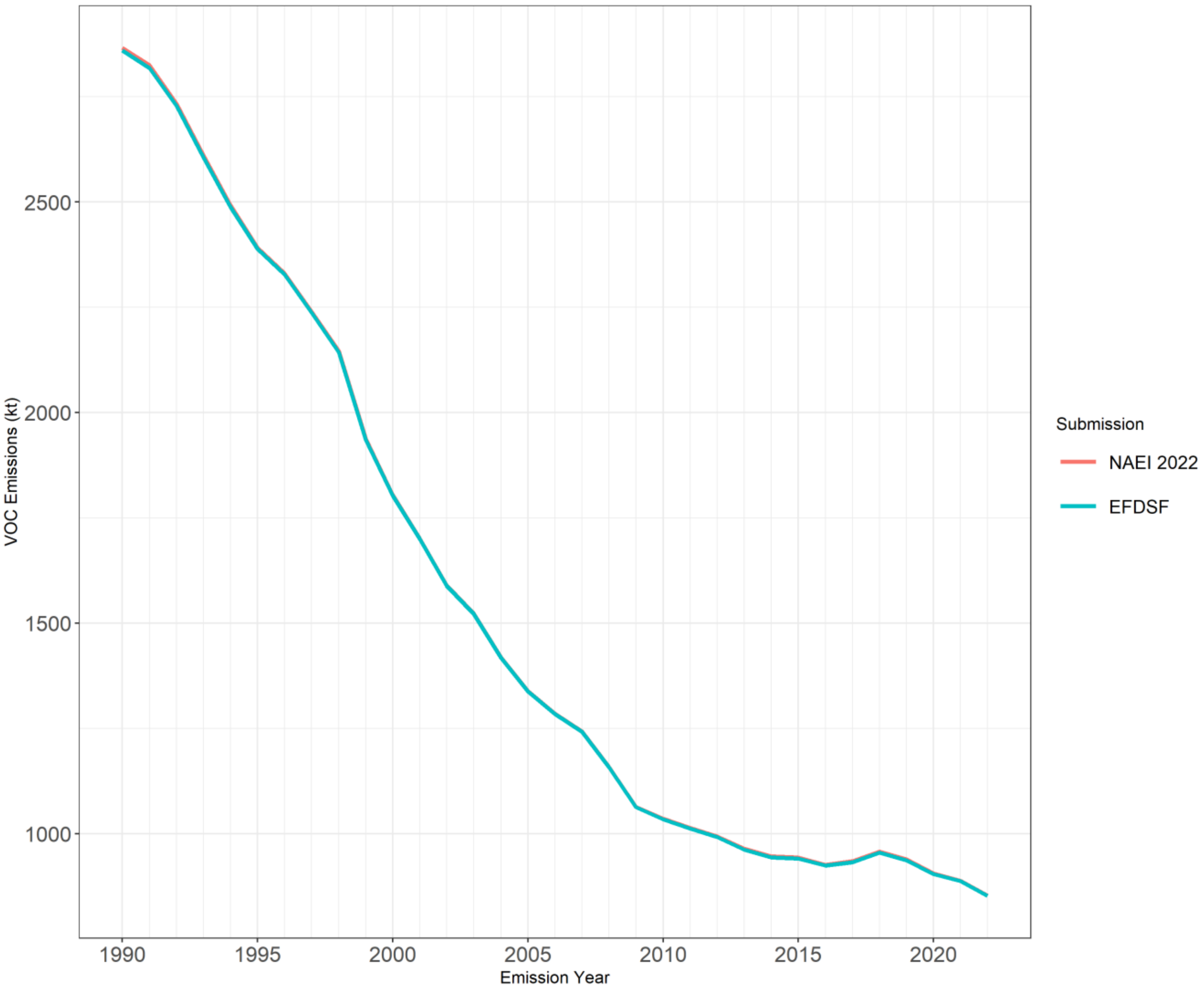


Figure 5-40 Historic impact of new EFs on NMVOC emissions in all sectors



The revision of solid fuel emission factors for VOC has a major impact on emissions attributed to solid mineral fuel but the impact on wood fuels is minor. The limited impact on emissions for solid wood/biomass combustion in residential combustion (Figure 5-38) indicates that the additional testing in WP3 has confirmed the WP1 emission factors (which were adopted in NAEI 2022) but with some moderation (lower emission factors) for newer stoves. Although the combined effect on emissions from residential combustion is significant, the impact on the national totals is small because UK NMVOC emissions are dominated by other sources including industrial sources and use of products containing solvents.

5.3.4 Oxides of nitrogen

Figure 5-41 Historic impact of new EFs on NO_x emissions in domestic combustion (solid fuels) sector

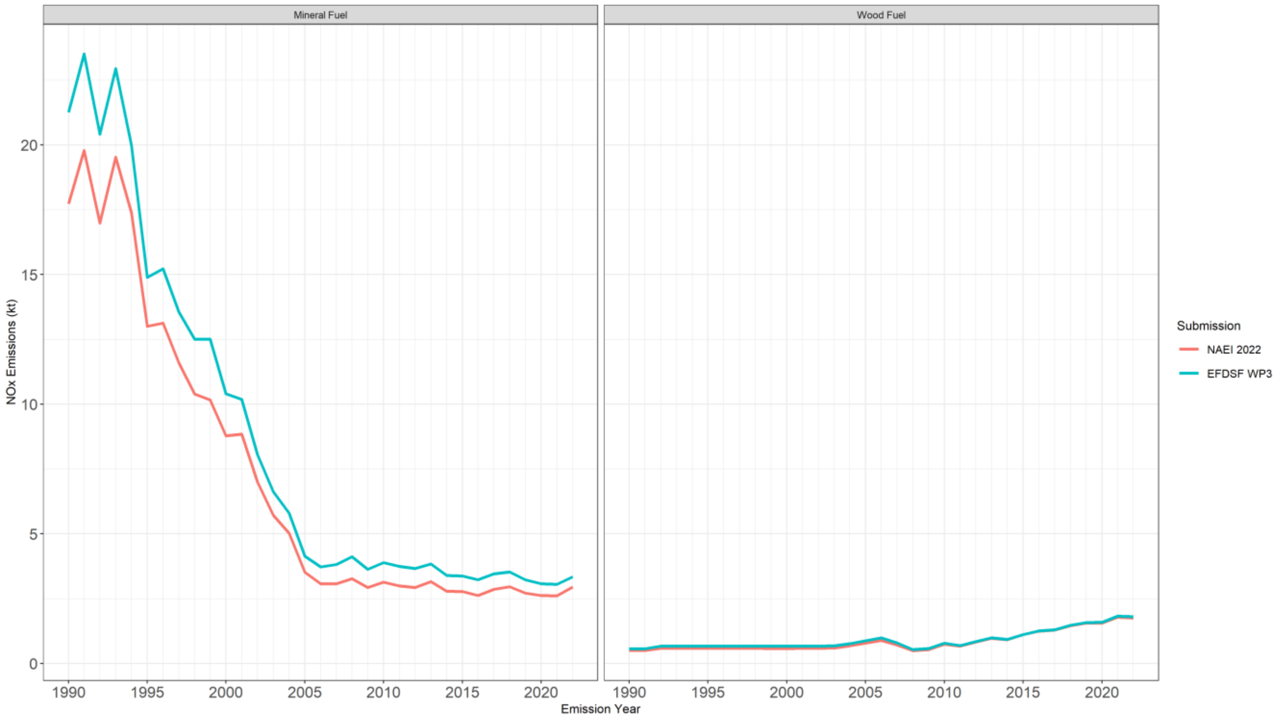


Figure 5-42 Historic impact of new EFs on NO_x emissions in domestic combustion sector

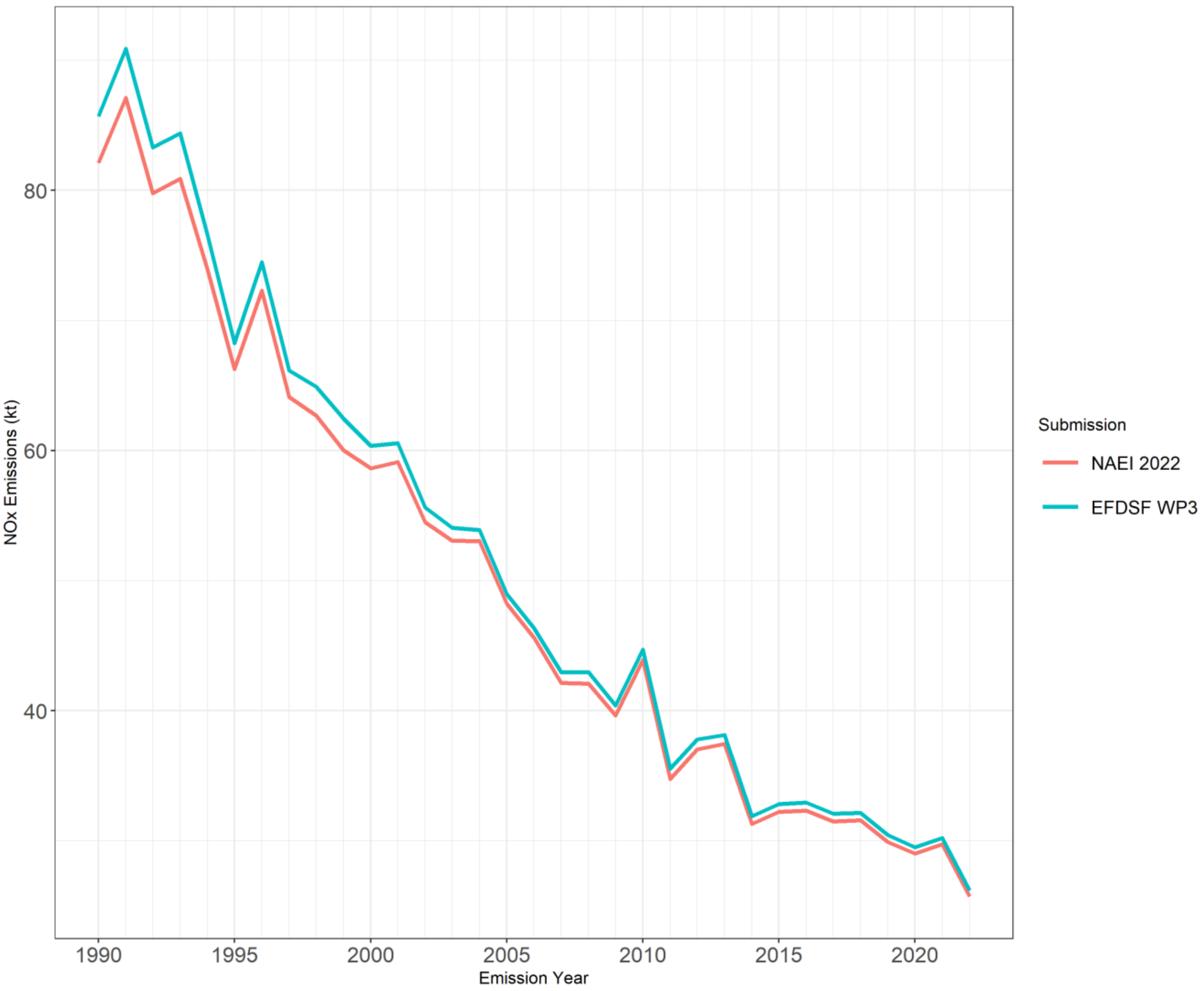
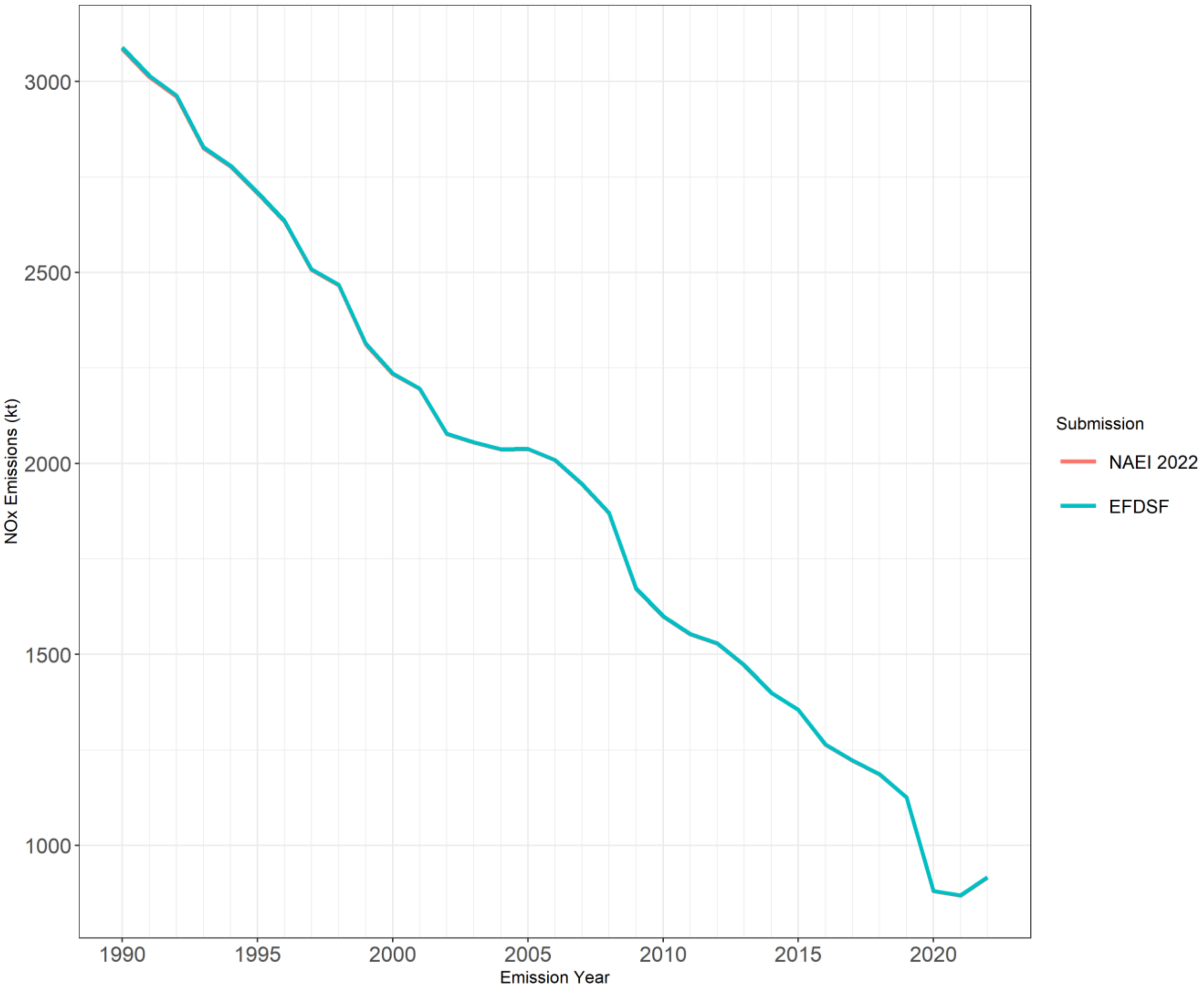


Figure 5-43 Historic impact of new EFs on NO_x emissions in all sectors



The limited impact on emissions for solid wood/biomass combustion in residential combustion indicates that the additional testing in WP3 has confirmed the WP1 emission factors. Although revision of solid fuel emission factors has a significant impact on NOx emissions attributed to solid mineral fuel, emissions in the residential sector in recent years are dominated by emissions from use of other fuels (in particular natural gas use) and the impact of solid fuel emission factor changes on the national emission total is small – this is shown in Figure 5-43 as an apparent complete overlap between NAEI 2022 and EFDSF which are indistinguishable at this scale.

5.3.5 Sulphur dioxide

Figure 5-44 Historic impact of new EFs on SO_2 emissions in domestic combustion (solid mineral fuels) sector

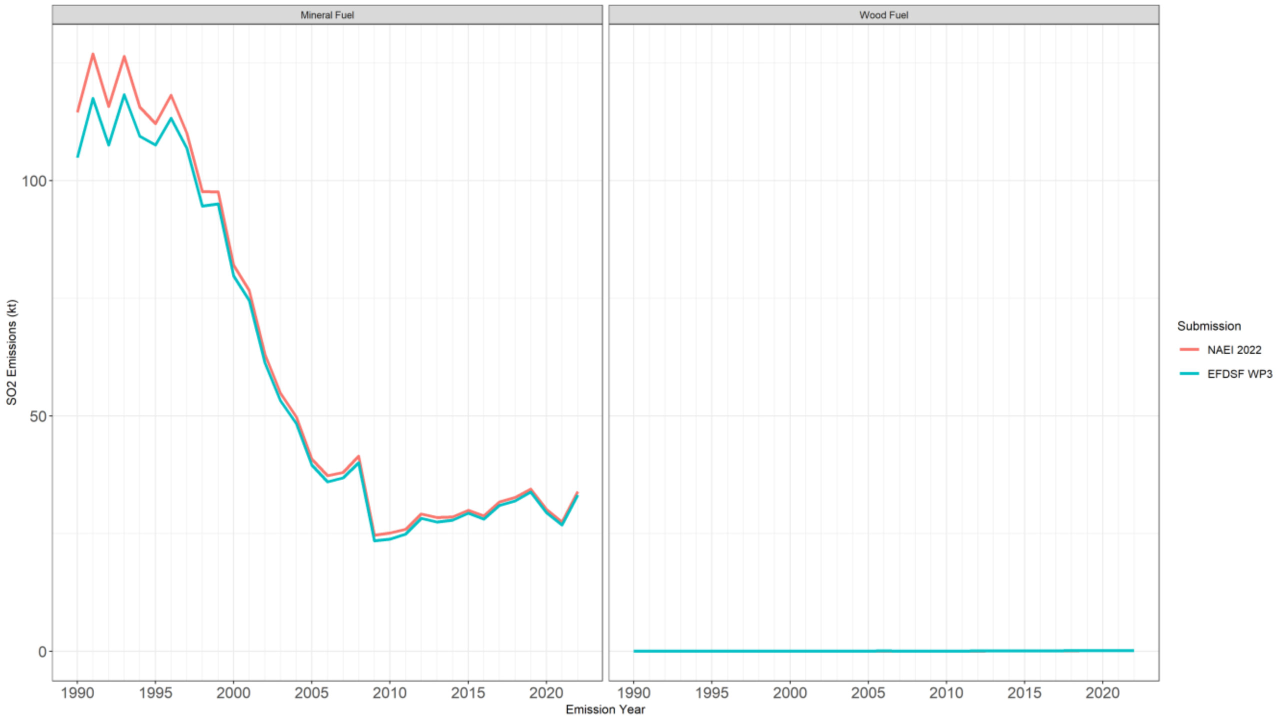
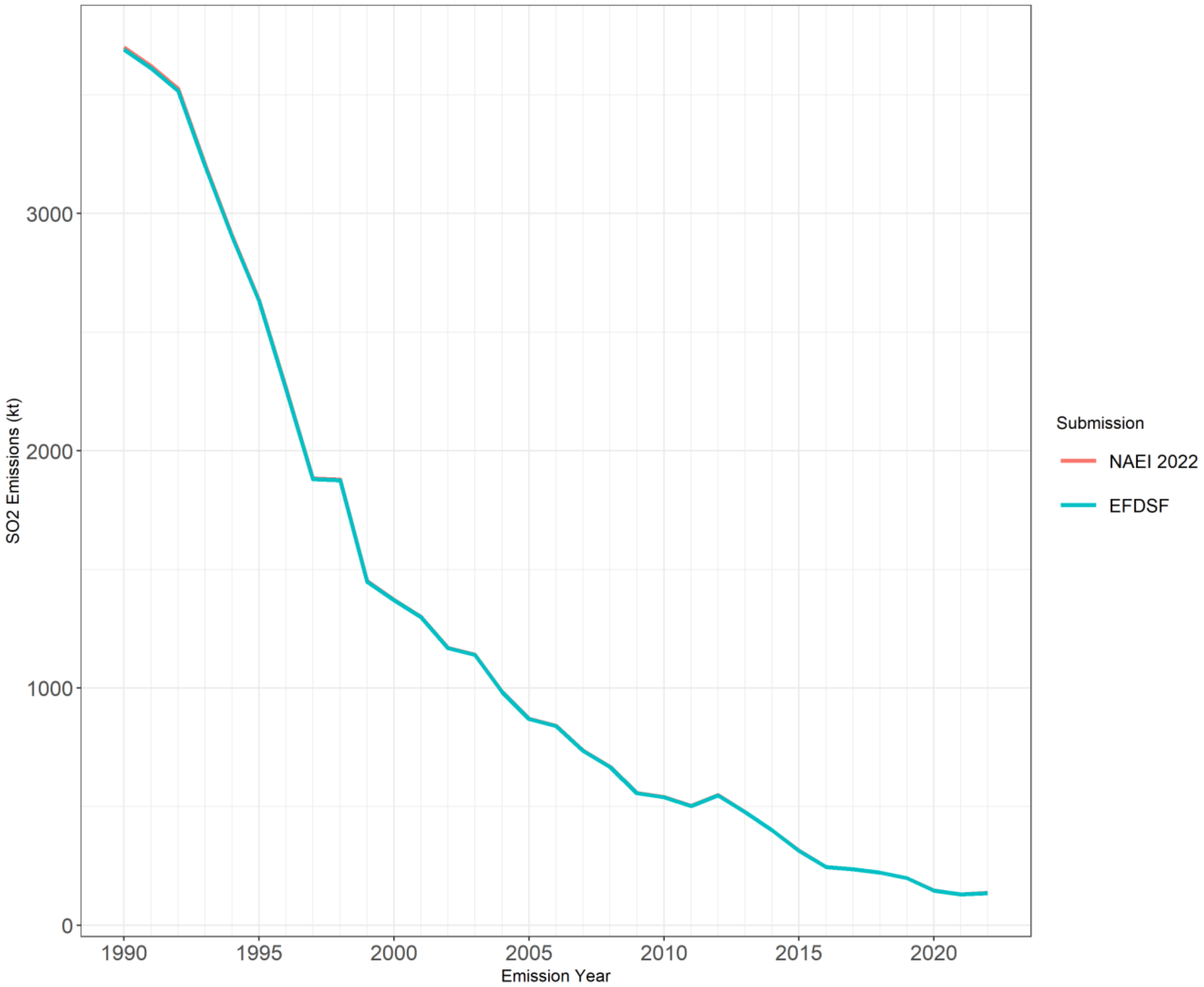


Figure 5-45 Historic impact of new EFs on SO_2 emissions in domestic combustion sector

Figure 5-46 Historic impact of new EFs on SO_2 emissions in all sectors



Revision of solid mineral emission factors for SO_2 has a significant impact on emissions attributed to solid mineral fuel whereas the impact on emissions from wood fuels is minor. The limited impact on emissions for solid wood/biomass combustion in residential combustion indicates that the additional testing in WP3 has confirmed the WP1 emission factors. The combined impact on emissions from the residential sector is more pronounced earlier in the timeseries but becomes less significant in recent years. Emissions of SO_2 have declined significantly over the timeseries due to increased emission abatement and latterly decarbonisation of the energy sector which has increased the significance of residential combustion in recent years. The impact of emission factor changes on the national totals in recent years is small despite residential combustion being a key source for this pollutant. Other sources include non-residential small combustion sources, industry, oil refining and construction.

5.3.6 Dioxins and furans (PCDD/F)

Figure 5-47 Historic impact of new EFs on PCDD/F emissions in domestic combustion (solid mineral fuels) sector

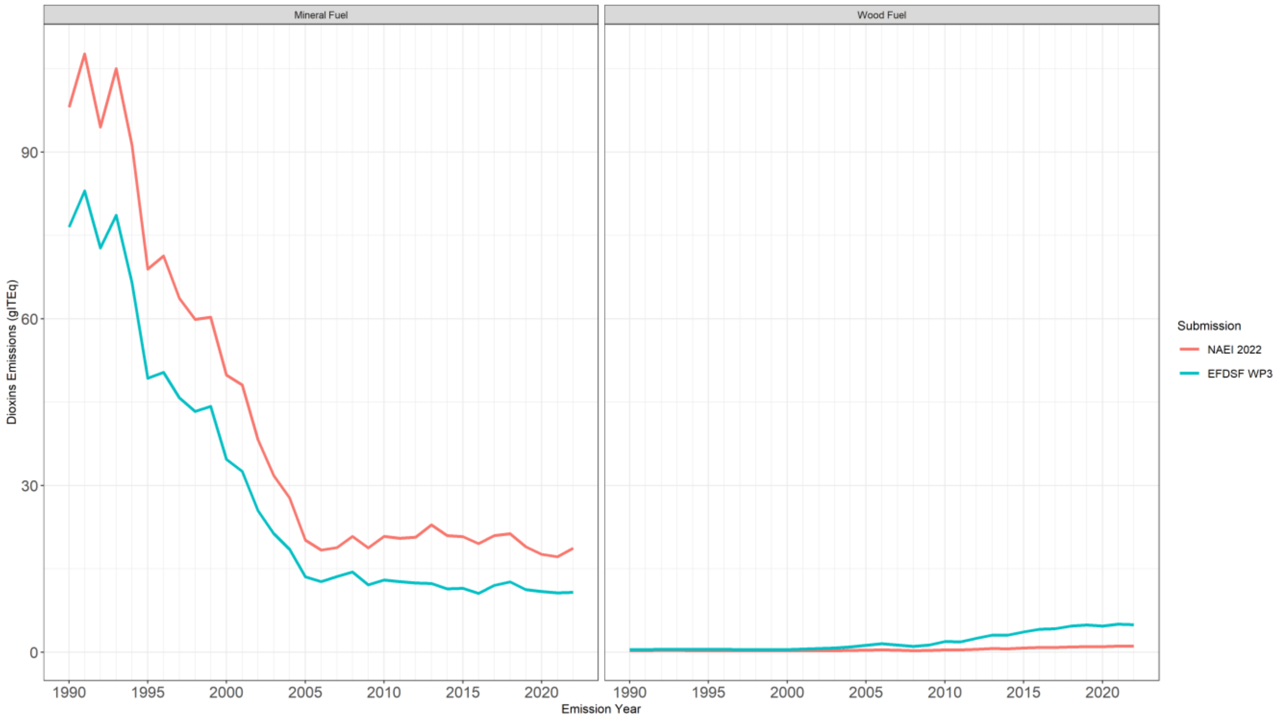
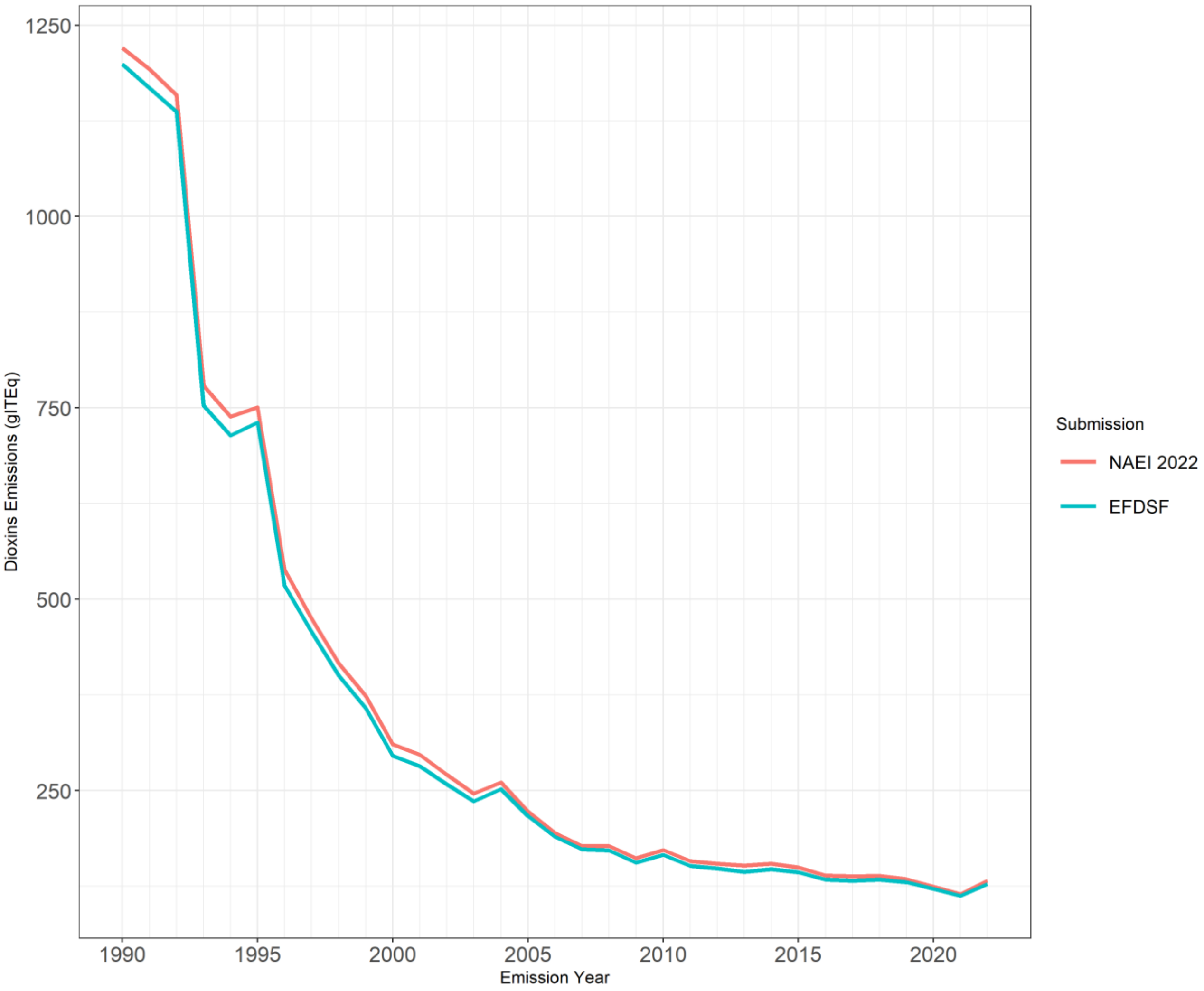


Figure 5-48 Historic impact of new EFs on PCDD/F emissions in domestic combustion sector

Figure 5-49 Historic impact of new EFs on PCDD/F emissions in all sectors



Revision of solid fuel PCDD/F emission factors has a major impact on emissions attributed to solid mineral fuel which are lower across the time series. For wood fuels the impact is less significant but implementation of the emissions factors shows an increase in emissions in recent years. The limited impact on emissions for solid wood/biomass combustion in residential combustion in early years indicates that the additional testing in WP3 has confirmed the WP1 emission factors for open fireplaces and older appliances but moderated the emission factor for newer appliances.

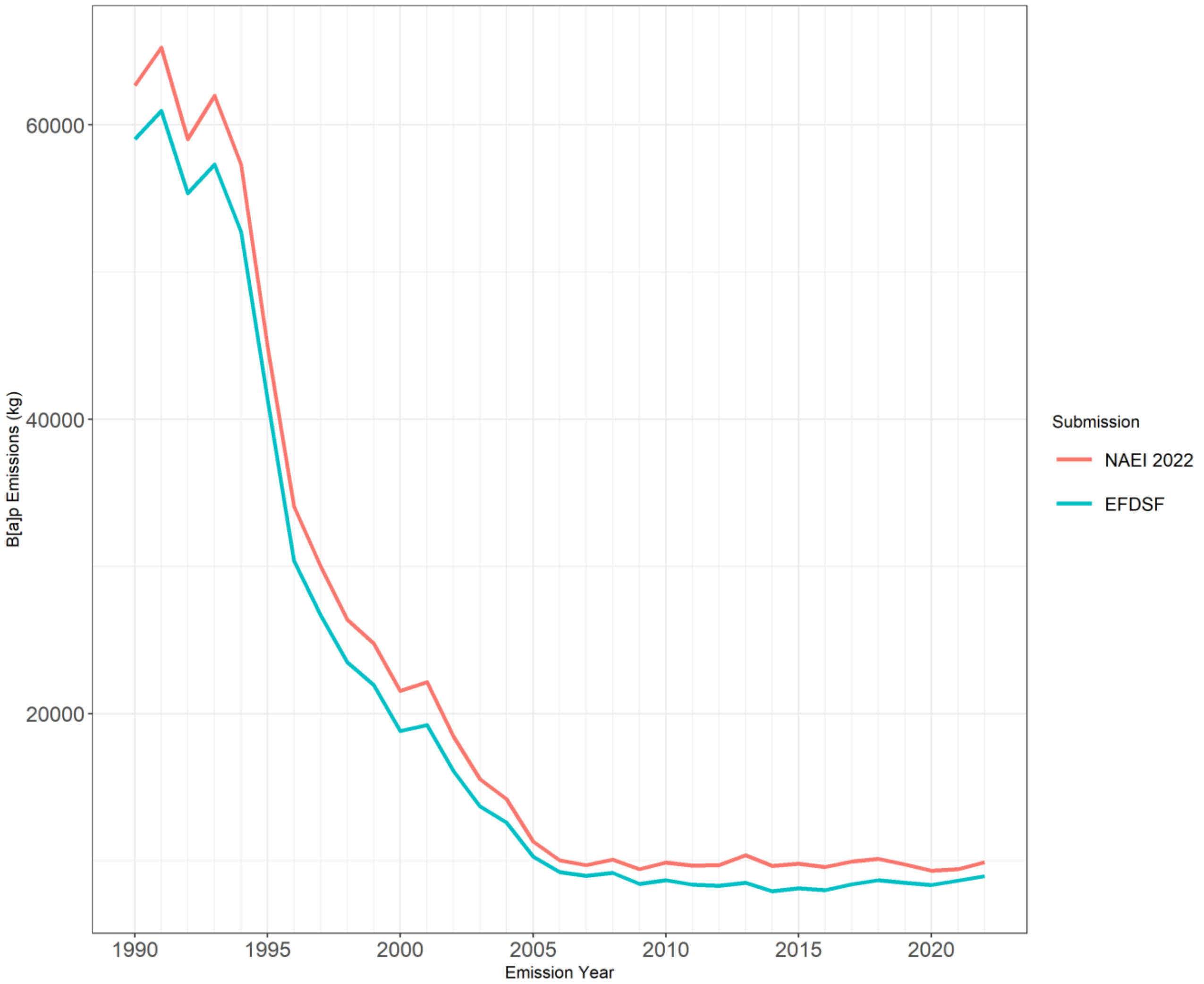
The combined impact on emissions from the residential combustion sector is a significant decrease across the time series. Residential combustion is a key source for PCDD/F in the NAEI. The contribution of PCDD/F emissions from residential combustion to the national total was 16% in 2022 (other key sources in 2022 include waste activities, iron and steel production and industrial combustion activity) and the impact of revisions to PCDD/F emission factors for residential combustion on the national totals is significant across the timeseries.

5.3.7 PAH (Benzo[a]pyrene)

Figure 5-50 Historic impact of new EFs on total PAH emissions in domestic combustion (solid mineral fuels) sector

Figure 5-51 Historic impact of new EFs on total PAH emissions in domestic combustion sector

Figure 5-52 Historic impact of new EFs on total PAH emissions in all sectors



Revision of solid fuel PAH emission factors has a major impact on emissions attributed to solid mineral fuel and residential combustion across the time series. The limited impact on emissions for solid wood/biomass combustion in residential combustion indicates that the additional testing in WP3 has confirmed the WP1 emission factors. Residential combustion is the main source for PAH in the NAEI in 2022 - the contribution of residential combustion to the national total for PAH was 88% in 2022. Consequently, the impact of revisions to PAH emission factors for residential combustion on the national totals is significant.

5.4 INCLUSION OF EFDSF PROJECT EMISSION FACTORS IN THE UK NAEI

5.4.1 Overview

The NAEI uses emission estimation methodologies which are consistent with international guidance on emission inventories and in particular the EMEP/EEA Emission Inventory Guidebook (EIG). The EIG sets out methodologies for activities required for international reporting. Different methodology levels ('Tiers') are applied with higher tier methods providing improved uncertainty but requiring more detailed understanding of the activity. Inventory compilers can improve uncertainty by application of country-specific emission factors and/or higher tier methods, for example more detailed modelling of an activity.

For residential combustion of solid fuels, the NAEI uses estimates of fuels burned at UK-level from UK energy statistics, EIG 'Tier 2' default emission factors and selected country-specific emission factors (including EFDSF project WP1 emission factors for wood) which cover several residential heating burning technologies:

- Open fireplace
- Stoves (three sub-types)
- Boilers

The recent Defra Domestic Burning Survey has led to revision of residential energy data for wood-burning and, for all fuels and provided improved understanding of the types of appliances used. The improved understanding of the solid fuel technologies is key to disaggregating national residential energy use into different technologies as this allows use of Tier 2 and country-specific emission factors.

A second Domestic Burning Survey has been undertaken and is expected to report in 2024. The Defra Emission Factors for Domestic Solid Fuel (EFDSF) project has been developed to provide country-specific emission factors to replace EIG default factors.

The EIG emission factors for residential biomass use are drawn from peer-reviewed scientific literature and include several relatively recent publications. However, emission factors predate Ecodesign regulations on solid fuel roomheaters and boilers which have set minimum emission requirements for these products. The evolution of voluntary and mandatory Ecolabels, National and EU Ecodesign controls on solid fuel heating appliances, means that there are appliances in the market which have different emission characteristics to the range of appliance types provided in the EIG.

In addition, emissions from residential biomass use has been a very active research area in recent years and there is additional information that could be incorporated into the EIG.

The EIG emission factors for residential solid mineral fuels are predominantly referenced to an earlier (2006) version of the EIG and the original references are unclear. There are also very few recent papers for mineral fuels for appliances or fuels used in European countries.

A review of EIG emission factors was included in the WP1 and WP2 reports. the following commentary summarises evidence that the proposed EFs are better than current NAEI default EFs which are drawn from the EIG and other research.

Information on uncertainty has been provided in Section 4.4 and the EFDSF project team is investigating ways to extend the measurement uncertainty to account for the data manipulation/handling operations (including dilution correction, normalisation of concentrations and the conversion of concentrations to emission factor) as well as other approaches to assessing a confidence interval. However, there are a range of wider uncertainty factors where quantification is not straightforward and not within the scope of the EFDSF project.

5.4.2 Comparison of EFDSF and EMEP/EEA Guidebook Tier 2 default emission factor references

5.4.2.1 Wood, biomass fuels

The EFDSF project test protocol has been designed to reflect the use of appliances in the UK including evidence from the Defra Burning Survey on residential wood-burning practise in the UK. The EIG references have applied a variety of test protocols and whilst there are similarities there are also significant differences which arise from the aims and scope of the individual studies. The key points are outlined below:

Table 5-8 : Comparison of EFDSF and EIG

Parameter	EFDSF	EIG
Test period	Based on UK evidence.	Generally shorter than UK evidence.
Test cycle	Ignitions, Refuels (3), Burnout – developed to suit test period.	Main difference is fewer refuel cycles. There is a lack of clarity whether all measurements include ignition and burnout phases.
Repeat tests	Three.	Often not clearly stated in references. Where information has been provided there are typically

Parameter	EFDSF	EIG
		fewer than the three measurements and in two studies referenced by EIG no repeat tests were undertaken on several appliances.
Fuel wood	Beech based on analysis of available fuels and discussion with suppliers.	Some references used wood types and wood-based fuels which are not typical of the UK. Several reference papers include mixed fuels including waste and waste woods.
Fuel quantity	1.2 kg per refuel – consistent with size of appliances and heat output.	Different quantities of fuel with, generally, higher weights in refuel batches suggesting larger appliances/higher output.
Fuel moisture	Dry (about 5%) Seasoned (15%) Wet (25%)	Does not provide separate EFs for different wood moisture contents. Several EIG reference studies consider moisture effects and there are moisture data provided for most fuels but limited information.
Pollutant measurements	Measurements undertaken in parallel on same burn cycle.	Multiple references for pollutants – measurements on different appliances and fuels. Few measurements on same burn cycle.
Appliance types (i)	Fireplace Old stove Recent stove Ecodesign stove	No Ecodesign-compliant appliances are included in the EIG reference studies; many appliances tested predate the EN Standards. The EIG Tier 2 reference studies include several types of biomass appliance that are not common technologies in the UK.
Appliance type (ii)	Multifuel and wood-burning appliances typical for UK. UK appliances are commonly multifuel devices (capable of burning wood and/or mineral fuels) with a different grate and air management provision.	Most EIG reference studies assessed wood-burning stoves.
Appliance draught	16 Pa based on UK measurements from steering group.	Very limited data in EIG reference studies to confirm the draught applied.
House /Laboratory measurement	Laboratory.	Mainly laboratory with some monitoring on houses.
Measurement techniques	Based on EN and CEN/TS by accredited testhouses.	A range of measurement approaches have been applied in EIG references including novel approaches, short-term measurement and semi-continuous monitoring. Often limited information on measurement approaches or appliance operation.

5.4.2.2 Solid mineral fuels

The absence of references in the EIG makes comparison difficult. It is likely that the features of literature data identified for wood-burning in WP1 also apply to mineral fuels with the addition that EIG emission factors for solid mineral fuels are essentially for older appliances only (mainly before 2006). In addition, the EIG emission factors do not distinguish different solid (mineral) fuels whereas the EFDSF provides emission factors for coal, anthracite and MSF types.

5.4.3 Comparison of EFDSF and current NAEI country-specific emission factors

The NAEI currently uses some country-specific emission factors for certain pollutants from solid mineral fuels including:

- PM emission factors – based on EIG Tier 2 emission factors for coal but with anthracite and solid smokeless fuel (SSF) set at one-fifth of the EIG factor based on dated UK country-specific research on emission limits for Authorised fuels approved for use in Smoke Control Areas under the Clean Air Act 1969.

- SOx – country-specific data for sulphur content but with the reduction in coal use and fewer mines in operation the data are increasingly uncertain.
- NMVOC – EIG Tier 2 emission factors applied to coal but with dated UK country-specific research for manufactured solid mineral fuels.

The EFDSF emission factors cover a range of fuels and appliance types (including more appliances and fuels) using a test cycle consistent with UK burning practises and applied testing based on EN and CEN/TS methods undertaken by accredited testhouses.

5.4.4 Conclusion

The EFDSF project team considers that the proposed country-specific emission factors from EFDSF are an improvement on current NAEI emission factors because they :

1. Better represent UK operating practise with respect to burn duration, number of refuels, fuel load, draught and fuel types.
2. Are largely based on three replicate test cycles – the number of replicate tests is unknown for many of the EIG emission factors.
3. Better represent the range of appliances used in UK
4. Are based on tests for the same appliance and same test cycles for all measured pollutants.
5. Provide data measured by accredited test houses using test approaches which are consistent with EN and CEN/TS approaches for emission measurement.
6. Allow application of emission factors for a wider range of fuels (wood logs at different moisture levels, anthracite and manufactured solid fuels).

6 RECOMMENDATIONS AND CONCLUSIONS

6.1 CONCLUSIONS

Emission factors have been developed for use in the NAEI for wood logs, wood briquettes, coal, anthracite, manufactured solid (mineral) fuels and coffee logs for four appliance types for PM, $PM_{2.5}$, PM_{10}, NOx, SO_2, CO, NMVOC, PAH, PCDD/F and Black Carbon. In addition, heavy metal emission factors have been determined for selected solid mineral fuels, condensable PM emission factors have been determined (these are not currently applied in the NAEI as total filterable+condensable emissions are reported) and emission factors for a wood pellet stove and a Blue Angel ecolabel stove have been determined for selected wood fuels.

Although substantial changes can be seen for emission estimates from residential solid fuel use, the impact of changes on UK national emissions is generally small. However, the new emission factors for $PM_{2.5}$, PAH including Benzo(a)pyrene and PCDD/F would result in a significant reduction in national emissions.

The proposed country-specific emission factors are an improvement on current emission factors used by the NAEI because they:

- Better represent UK operating practise with respect to burn duration, number of refuels, fuel load, draught and the types of solid mineral fuels used in the UK.
- Are based on three replicate test cycles.
- Better represent appliances used in the UK.
- Are based on tests for the same appliance and the same test cycles for measured pollutants.
- Provide data measured by accredited test houses using test approaches that are consistent with EN and CEN/TS approaches for emission measurement.

In general, WP3 confirmed emission factors determined in WP1 for wood logs and WP2 for solid mineral fuels.

- In WP1 and WP3 tests on appliances burning wood logs, emission factors for CO, PM (TPM, PM_{10}, $PM_{2.5}$) and VOC were highest for wet fuels. PAH emission factors were generally highest for wet fuels on the open fireplace. Dioxins emissions were more variable and showed little association with moisture. On the modern stoves, emission factors for CO, PM, VOC and PAH were higher for dry wood than for seasoned wood.
- $PM_{2.5}$ emissions are broadly highest for the wet wood but for the modern stoves (including the Blue Angel stove), emission factors for dry wood are higher than for seasoned wood.
- The BaP emission factors for dry wood for all the stoves are generally higher than for seasoned wood. For most stoves emission factors for dry wood are also higher than for wet wood. For the open appliance, BaP emission factors for wet wood are higher than for seasoned wood which are higher than for dry wood.
- For the modern Ecodesign appliance using mineral fuels there are higher emission factors for CO, PM and TOC/OGC (which have emission limits in the Ecodesign Regulation) and PAH compared to the older appliances. Smaller differences in emission factors will be mitigated by higher energy efficiency for the modern appliance but elevated emission factors are often higher than could be offset by improved energy efficiency. This indicates that implementation of Ecodesign Regulation has had little beneficial impact on $PM_{2.5}$ emissions from stoves for solid mineral fuels.
- The BaP emission factors for the approved MSF (Low_Sulphur_MSF) for the modern stoves are generally higher than for older stoves and open fires.
- The PM_1 fraction in PM emissions from wood-burning is variable but is typically more than about 65% of the total PM emission. The PM_1 fraction for mineral fuels is less variable than for wood fuels and generally forms more than about 65% of the total PM emission.

6.2 RECOMMENDATIONS

The following recommendations are made:

1. To include the emissions factors for PM, $PM_{2.5}$, PM_{10}, NOx, SO_2, CO, NMVOC, PAH, PCDD/F and metals in the next submission of the NAEI (2025).

2. To consider similar testing programmes to represent a wider range of appliances including new appliance types and any emerging fuels.
3. To consider further testing on modern Ecodesign appliances to understand why emissions of certain pollutants appear to be elevated compared to older technologies.
4. To consider further testing on wood pellets intended for residential use to establish typical sulphur content and sulphur oxides emission factors.
5. To consider sensitivity testing of emission parameters to (for example) different ignition practises, inclusion of fine material in fuel mix (or influence of fuel size), fuel mixtures, appliance misuse.
6. To consider alternatives to emission monitoring for determination of heavy metals (fuel and ash analysis).

A APPENDICES

A.1 FUEL ANALYSIS

Table A- 1 - Summary of Fuel Analysis by an Independent Testing House – mineral fuel

Component	Units	Heat Approved	Bright Flame	Coal	Anthracite
CV, net	MJ/kg	24.270	27.919	27.293	32.490
Moisture	% m/m	20.4%	14.9%	7.2%	2.10%
Ash	% m/m	5.0%	3.1%	4.6%	3.90%
C	% m/m	65.20%	72.90%	72.58%	87.10%
H	% m/m	2.97%	3.49%	4.61%	3.72%
N	% m/m	1.16%	1.14%	2.12%	1.22%
S	% m/m	1.33%	3.58%	0.28%	0.81%
O (by diff)	% m/m	3.90%	0.90%	8.95%	1.10%

Table A- 2 - Summary of WP3 Fuel Analysis by an Independent Testing House – wood and biomass fuels

Component	Units	Wet Wood	Seasoned Wood	Dry Wood	Wood Briquettes	Coffee Logs	Wood Pellets
CV, net	MJ/kg	13.081	14.849	17.209	17.791	17.572	16.935
Moisture	% m/m	24.4%	15.4%	4.0%	5.6%	10.1%	7.6%
Ash	% m/m	0.5%	0.6%	0.5%	0.4%	1.0%	0.0%
C	% m/m	36.35%	40.81%	46.21%	46.75%	47.20%	45.40%
H	% m/m	4.55%	5.09%	5.73%	5.68%	5.70%	5.74%
N	% m/m	0.23%	0.21%	0.27%	0.10%	1.13%	0.13%
S	% m/m	0.02%	0.03%	0.01%	0.01%	0.04%	0.01%
O (by diff)	% m/m	33.53%	37.28%	43.05%	41.55%	34.90%	40.70%

Fuel was analysed by Alfred H Knight Energy Services Limited
All analysis data is on as received basis (see analysis sheets for other reporting)

Figure A- 1 - Certificate of Analysis for Wood logs 1

CERTIFICATE OF ANALYSIS

ALFRED H KNIGHT

UKAS TESTING 1765

JASON POWIS
KIWA UK
KIWA HOUSE
MALVERN VIEW BUSINESS PARK
STELLA WAY
BISHOPS CLEEVE
CHELTENHAM
GL52 7DQ

Test Date(s): **03-Jul-2023 to 10-Jul-2023**

Date Received: 03-Jul-2023

Date of Report: **11-Jul-2023**

AHK Ref: DB/400214

Material Described As: WOOD LOGS

Client Ref: LAB SUPPORT WOOD LOGS (MAY 2023)

Samples were received by Alfred H Knight Energy Services Ltd and analysis results relate only to the items tested.

Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
Wood Logs (May 2023)						
	Removed Ash Contributors *		%	0.00		
	Free Moisture *		%	13.3		
	Total Moisture *	SM030	%	17.8		
	Total Ash Content *	SM033	%	0.7	0.9	
	Volatile Matter *	SM032	%	69.5	84.6	85.4
	Fixed Carbon *	SM022	%	11.9	14.5	14.6
	Total Sulphur *	SM034	%	0.02	0.02	0.02
	Chlorine *	SM045	%	< 0.01	< 0.01	< 0.01
	Carbon *	SM035	%	40.3	49.0	49.4
	Hydrogen *	SM035	%	4.95	6.02	6.07
	Nitrogen *	SM035	%	0.19	0.23	0.23
	Oxygen By Difference		%	36.0	43.8	44.2
	Gross Calorific Value *	SM036	MJ/Kg	15.993	19.456	19.633
	Net Calorific Value *	SM037	MJ/Kg	14.482		

** - Accredited Test*

Gibson Kabaso
Technical Manager
For and on behalf of Alfred H Knight Energy Services Ltd

Doc Id: DB/400214/2

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Figure A- 2 - Certificate of Analysis for Wood logs 2

CERTIFICATE OF ANALYSIS

ALFRED H KNIGHT

UKAS TESTING 1765

JASON POWIS
KIWA UK
KIWA HOUSE
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STELLA WAY
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Test Date(s): **25-Sep-2023 to 02-Oct-2023** Date Received: 25-Sep-2023
Date of Report: **02-Oct-2023**

AHK Ref: DB/403071 Material Described As: WOOD LOGS
Client Ref: 1836 1 - 2

Samples were received by Alfred H Knight Energy Services Ltd and analysis results relate only to the items tested.

Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
1836-1						
	Removed Ash Contributors *		%	0.00		
	Free Moisture *		%	13.4		
	Total Moisture *	SM031	%	16.6		
	Total Ash Content *	SM033	%	0.3	0.3	
	Total Sulphur *	SM034	%	< 0.01	< 0.01	< 0.01
	Carbon *	SM035	%	40.9	49.1	49.2
	Hydrogen *	SM035	%	5.11	6.13	6.15
	Nitrogen *	SM035	%	0.16	0.19	0.19
	Oxygen By Difference		%	36.9	44.3	44.4
	Gross Calorific Value *	SM036	MJ/Kg	16.201	19.426	19.484
	Net Calorific Value *	SM037	MJ/Kg	14.682		

** - Accredited Test*

Ken Hepburn
Biomass Manager
For and on behalf of Alfred H Knight Energy Services Ltd

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Figure A- 3 - Certificate of Analysis for Wood logs 3

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Test Date(s): **25-Sep-2023 to 02-Oct-2023** Date Received: 25-Sep-2023
Date of Report: **02-Oct-2023**

AHK Ref: DB/403071 Material Described As: WOOD LOGS
Client Ref: 1836 1 - 2

Samples were received by Alfred H Knight Energy Services Ltd and analysis results relate only to the items tested.

Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
1836-2						
	Removed Ash Contributors *		%	0.00		
	Free Moisture *		%	11.6		
	Total Moisture *	SM031	%	15.3		
	Total Ash Content *	SM033	%	0.3	0.3	
	Total Sulphur *	SM034	%	0.08	0.09	0.09
	Carbon *	SM035	%	41.3	48.8	48.9
	Hydrogen *	SM035	%	5.19	6.13	6.15
	Nitrogen *	SM035	%	0.17	0.20	0.20
	Oxygen By Difference		%	37.7	44.5	44.6
	Gross Calorific Value *	SM036	MJ/Kg	16.364	19.320	19.378
	Net Calorific Value *	SM037	MJ/Kg	14.859		

** - Accredited Test*

Ken Hepburn
Biomass Manager
For and on behalf of Alfred H Knight Energy Services Ltd

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Figure A- 4 - Certificate of Analysis for Wood logs 4

CERTIFICATE OF ANALYSIS

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Test Date(s): **20-Feb-2024 to 28-Feb-2024**
Date of Report: **28-Feb-2024**

Date Received: 20-Feb-2024

AHK Ref: **DB/408253**
Client Ref: **REF 1850 WOOD LOGS JANUARY 2024**

Material Described As: WOOD LOGS

Samples were received by Alfred H Knight Energy Services Ltd and analysis results relate only to the items tested.

Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
1850						
	Removed Ash Contributors *		%	0.00		
	Total Moisture *	SM031	%	21.2		
	Total Ash Content *	SM033	%	0.6	0.7	
	Total Sulphur *	SM034	%	< 0.01	< 0.01	< 0.01
	Carbon *	SM035	%	38.8	49.3	49.6
	Hydrogen *	SM035	%	4.81	6.10	6.14
	Nitrogen *	SM035	%	0.27	0.34	0.34
	Oxygen By Difference		%	34.3	43.5	43.8
	Gross Calorific Value *	SM036	MJ/Kg	15.569	19.757	19.896
	Net Calorific Value *	SM037	MJ/Kg	14.004		

** - Accredited Test*

Gibson Kabaso
Technical Manager
For and on behalf of Alfred H Knight Energy Services Ltd

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Figure A- 5 - Certificate of Analysis for Wood logs 5

CERTIFICATE OF ANALYSIS

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CHELTENHAM
GL52 7DQ

Test Date(s): 02-Feb-2023 to 21-Feb-2023
Date of Report: 21-Feb-2023
Date Received: 02-Feb-2023

AHK Ref: DB/395550
Material Described As: WOOD LOGS
Client Ref: PROJECT NUMBER :- LAB SUPPORT WOOD LOGS

Samples were received by Alfred H Knight Energy Services Ltd and analysis results relate only to the items tested.

Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
Logs January 2023						
	Free Moisture		%	23.2		
	Total Moisture *	SM031	%	27.1		
	Ash Content *	SM033	%	0.6	0.8	
	Total Sulphur *	SM034	%	< 0.01	< 0.01	< 0.01
	Carbon *	SM035	%	35.7	49.0	49.4
	Hydrogen *	SM035	%	4.37	6.00	6.05
	Nitrogen *	SM035	%	0.21	0.29	0.29
	Oxygen By Difference		%	32.0	43.9	44.3
	Gross Calorific Value *	SM036	MJ/Kg	14.370	19.712	19.871
	Net Calorific Value *	SM037	MJ/Kg	12.755		

** - Accredited Test*

Gibson Kabaso
Biomass Technical Manager
For and on behalf of Alfred H Knight Energy Services Ltd

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Figure A- 6 - Certificate of Analysis for Wood logs 6

CERTIFICATE OF ANALYSIS

ALFRED H KNIGHT

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KIWA HOUSE
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CHELTENHAM
GL52 7DQ

Test Date(s): 02-Feb-2023 to 21-Feb-2023

Date of Report: 21-Feb-2023

Date Received: 02-Feb-2023

AHK Ref: DB/395550

Material Described As: WOOD LOGS

Client Ref: PROJECT NUMBER :- LAB SUPPORT WOOD LOGS

Samples were received by Alfred H Knight Energy Services Ltd and analysis results relate only to the items tested.

Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
Logs December 2022						
	Free Moisture		%	17.3		
	Total Moisture *	SM031	%	21.8		
	Ash Content *	SM033	%	0.6	0.8	
	Total Sulphur *	SM034	%	< 0.01	< 0.01	< 0.01
	Carbon *	SM035	%	37.5	48.0	48.4
	Hydrogen *	SM035	%	4.66	5.96	6.01
	Nitrogen *	SM035	%	0.22	0.28	0.28
	Oxygen By Difference		%	35.1	44.9	45.3
	Gross Calorific Value *	SM036	MJ/Kg	15.282	19.542	19.700
	Net Calorific Value *	SM037	MJ/Kg	13.733		

** - Accredited Test*

Gibson Kabaso
Biomass Technical Manager
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Figure A- 7 - Certificate of Analysis for Wood logs 7

CERTIFICATE OF ANALYSIS

ALFRED H KNIGHT

UKAS TESTING 1765

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KIWA UK
KIWA HOUSE
MALVERN VIEW BUSINESS PARK
STELLA WAY
BISHOPS CLEEVE
CHELTENHAM
GL52 7DQ

Test Date(s): **03-Jul-2023 to 10-Jul-2023**
Date Received: 03-Jul-2023
Date of Report: **11-Jul-2023**

AHK Ref: DB/400214
Material Described As: WOOD LOGS
Client Ref: LAB SUPPORT WOOD LOGS (MAY 2023)

Samples were received by Alfred H Knight Energy Services Ltd and analysis results relate only to the items tested.

Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
Wood Logs (May 2023)						
	Removed Ash Contributors *		%	0.00		
	Free Moisture *		%	13.3		
	Total Moisture *	SM030	%	17.8		
	Total Ash Content *	SM033	%	0.7	0.9	
	Volatile Matter *	SM032	%	69.5	84.6	85.4
	Fixed Carbon *	SM022	%	11.9	14.5	14.6
	Total Sulphur *	SM034	%	0.02	0.02	0.02
	Chlorine *	SM045	%	< 0.01	< 0.01	< 0.01
	Carbon *	SM035	%	40.3	49.0	49.4
	Hydrogen *	SM035	%	4.95	6.02	6.07
	Nitrogen *	SM035	%	0.19	0.23	0.23
	Oxygen By Difference		%	36.0	43.8	44.2
	Gross Calorific Value *	SM036	MJ/Kg	15.993	19.456	19.633
	Net Calorific Value *	SM037	MJ/Kg	14.482		

** - Accredited Test*

Gibson Kabaso
Technical Manager
For and on behalf of Alfred H Knight Energy Services Ltd

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Figure A- 8 - Certificate of Analysis for Wood logs 8

CERTIFICATE OF ANALYSIS

ALFRED H KNIGHT

UKAS TESTING 1765

JACK BEVAN
KIWA UK
KIWA HOUSE
MALVERN VIEW BUSINESS PARK
STELLA WAY
BISHOPS CLEEVE
CHELTENHAM
GL52 7DQ

Test Date(s): **10-Oct-2023 to 17-Oct-2023**
Date of Report: **17-Oct-2023**

Date Received: 10-Oct-2023

AHK Ref: DB/403674
Client Ref: 1837 1 - 2

Material Described As: VIRGIN WOOD LOGS

Samples were received by Alfred H Knight Energy Services Ltd and analysis results relate only to the items tested.

Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
1837-1						
	Removed Ash Contributors *		%	0.00		
	Free Moisture *		%	2.4		
	Total Moisture *	SM031	%	4.3		
	Total Ash Content *	SM033	%	1.0	1.0	
	Volatile Matter *	SM032	%	80.8	84.4	85.3
	Total Sulphur *	SM034	%	< 0.01	< 0.01	< 0.01
	Carbon *	SM035	%	45.8	47.9	48.4
	Hydrogen *	SM035	%	5.78	6.04	6.10
	Nitrogen *	SM035	%	0.20	0.21	0.21
	Oxygen By Difference		%	42.9	44.8	45.3
	Gross Calorific Value *	SM036	MJ/Kg	18.568	19.402	19.598
	Net Calorific Value *	SM037	MJ/Kg	17.203		

** - Accredited Test*

Scott Foster
Technical Manager
For and on behalf of Alfred H Knight Energy Services Ltd

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Figure A- 9 - Certificate of Analysis for Wood logs 9

CERTIFICATE OF ANALYSIS

ALFRED H KNIGHT

UKAS TESTING 1765

JACK BEVAN
KIWA UK
KIWA HOUSE
MALVERN VIEW BUSINESS PARK
STELLA WAY
BISHOPS CLEEVE
CHELTENHAM
GL52 7DQ

Test Date(s): **10-Oct-2023 to 17-Oct-2023**

Date of Report: **17-Oct-2023**

Date Received: 10-Oct-2023

AHK Ref: DB/403674

Client Ref: 1837 1 - 2

Material Described As: VIRGIN WOOD LOGS

Samples were received by Alfred H Knight Energy Services Ltd and analysis results relate only to the items tested.

Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
1837-2						
	Removed Ash Contributors *		%	0.00		
	Free Moisture *		%	18.9		
	Total Moisture *	SM031	%	21.2		
	Total Ash Content *	SM033	%	0.6	0.7	
	Volatile Matter *	SM032	%	67.5	85.7	86.3
	Total Sulphur *	SM034	%	0.04	0.05	0.05
	Carbon *	SM035	%	38.5	48.9	49.2
	Hydrogen *	SM035	%	4.76	6.04	6.08
	Nitrogen *	SM035	%	0.16	0.20	0.20
	Oxygen By Difference		%	34.8	44.1	44.4
	Gross Calorific Value *	SM036	MJ/Kg	15.342	19.470	19.607
	Net Calorific Value *	SM037	MJ/Kg	13.787		

** - Accredited Test*

Scott Foster
Technical Manager
For and on behalf of Alfred H Knight Energy Services Ltd

Doc Id: DB/403674/1

Alfred H Knight Energy Services Ltd
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Figure A- 10 - Certificate of Analysis for Wood logs 10

CERTIFICATE OF ANALYSIS

ALFRED H KNIGHT

UKAS TESTING 1765

JACK BEVAN
KIWA UK
KIWA HOUSE
MALVERN VIEW BUSINESS PARK
STELLA WAY
BISHOPS CLEEVE
CHELTENHAM
GL52 7DQ

Date Received: 11-Jun-2024

Test Date(s): **11-Jun-2024 to 20-Jun-2024**
Date of Report: **20-Jun-2024**

AHK Ref: **DB/412320**
Client Ref: **REF 1858-1**

Material Described As: WOOD LOGS

Samples were received by Alfred H Knight Energy Services Ltd and analysis results relate only to the items tested.

Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
1858-1 Hannis April 2024						
	Removed Ash Contributors *		%	0.00		
	Free Moisture *		%	8.5		
	Total Moisture *	SM031	%	14.4		
	Total Ash Content *	SM033	%	1.0	1.2	
	Volatile Matter *	SM032	%	72.8	85.0	86.0
	Total Sulphur *	SM034	%	0.01	0.01	0.01
	Carbon *	SM035	%	41.2	48.1	48.7
	Hydrogen *	SM035	%	5.10	5.96	6.03
	Nitrogen *	SM035	%	0.15	0.18	0.18
	Oxygen By Difference		%	38.1	44.5	45.0
	Gross Calorific Value *	SM036	MJ/Kg	16.494	19.269	19.503
	Net Calorific Value *	SM037	MJ/Kg	15.030		

** - Accredited Test*

Gibson Kabaso
Technical Manager
For and on behalf of Alfred H Knight Energy Services Ltd

Doc Id: DB/412320/2

Alfred H Knight Energy Services Ltd
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Figure A- 11 - Certificate of Analysis for Wood logs 11

CERTIFICATE OF ANALYSIS

ALFRED H KNIGHT

UKAS TESTING 1765

JACK BEVAN
KIWA UK
KIWA HOUSE
MALVERN VIEW BUSINESS PARK
STELLA WAY
BISHOPS CLEEVE
CHELTENHAM
GL52 7DQ

Date Received: 07-Jul-2023

Test Date(s): **07-Jul-2023 to 18-Jul-2023**
Date of Report: **18-Jul-2023**

AHK Ref: DB/400461
Client Ref: PROJECT NUMBER 31153 1823-1 - 4

Material Described As: WOOD LOGS

Samples were received by Alfred H Knight Energy Services Ltd and analysis results relate only to the items tested.

Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
1823-1						
	Removed Ash Contributors *		%	0.00		
	Free Moisture *		%	5.5		
	Total Moisture *	SM031	%	7.6		
	Total Ash Content *	SM033	%	0.3	0.3	
	Volatile Matter *	SM032	%	78.8	85.3	85.6
	Total Sulphur *	SM034	%	< 0.01	< 0.01	< 0.01
	Carbon *	SM035	%	43.2	46.8	46.9
	Hydrogen *	SM035	%	5.59	6.05	6.07
	Nitrogen *	SM035	%	0.18	0.19	0.19
	Oxygen By Difference		%	43.2	46.7	46.8
	Gross Calorific Value *	SM036	MJ/Kg	18.069	19.555	19.614
	Net Calorific Value *	SM037	MJ/Kg	16.663		

** - Accredited Test*

Gibson Kabaso
Technical Manager
For and on behalf of Alfred H Knight Energy Services Ltd

Doc Id: DB/400461/2 | **Alfred H Knight Energy Services Ltd** | Page 1 of 4

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Figure A- 12 - Certificate of Analysis for Wood logs 12

CERTIFICATE OF ANALYSIS

ALFRED H KNIGHT

UKAS TESTING 1765

JACK BEVAN
KIWA UK
KIWA HOUSE
MALVERN VIEW BUSINESS PARK
STELLA WAY
BISHOPS CLEEVE
CHELTENHAM
GL52 7DQ

Date Received: 07-Jul-2023

Test Date(s): **07-Jul-2023 to 18-Jul-2023**
Date of Report: **18-Jul-2023**

AHK Ref: **DB/400461**
Client Ref: **PROJECT NUMBER 31153 1823-1 - 4**

Material Described As: WOOD LOGS

Samples were received by Alfred H Knight Energy Services Ltd and analysis results relate only to the items tested.

Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
1823-2						
	Removed Ash Contributors *		%	0.00		
	Free Moisture *		%	11.4		
	Total Moisture *	SM031	%	13.4		
	Total Ash Content *	SM033	%	0.4	0.5	
	Volatile Matter *	SM032	%	74.0	85.5	85.9
	Total Sulphur *	SM034	%	0.02	0.02	0.02
	Carbon *	SM035	%	40.4	46.6	46.8
	Hydrogen *	SM035	%	5.25	6.06	6.09
	Nitrogen *	SM035	%	0.20	0.23	0.23
	Oxygen By Difference		%	40.4	46.6	46.8
	Gross Calorific Value *	SM036	MJ/Kg	16.919	19.537	19.635
	Net Calorific Value *	SM037	MJ/Kg	15.447		

** - Accredited Test*

Gibson Kabaso
Technical Manager
For and on behalf of Alfred H Knight Energy Services Ltd

Doc Id: DB/400461/2 **Alfred H Knight Energy Services Ltd** Page 2 of 4
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Figure A- 13 - Certificate of Analysis for Wood logs 13

CERTIFICATE OF ANALYSIS

ALFRED H KNIGHT

UKAS TESTING
1765

JACK BEVAN
KIWA UK
KIWA HOUSE
MALVERN VIEW BUSINESS PARK
STELLA WAY
BISHOPS CLEEVE
CHELTENHAM
GL52 7DQ

Date Received: 07-Jul-2023

Test Date(s): **07-Jul-2023 to 18-Jul-2023**
Date of Report: **18-Jul-2023**

AHK Ref: DB/400461
Material Described As: WOOD LOGS
Client Ref: PROJECT NUMBER 31153 1823-1 - 4

Samples were received by Alfred H Knight Energy Services Ltd and analysis results relate only to the items tested.

Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
1823-3						
	Removed Ash Contributors *		%	0.00		
	Free Moisture *		%	26.8		
	Total Moisture *	SM031	%	28.6		
	Total Ash Content *	SM033	%	0.2	0.3	
	Volatile Matter *	SM032	%	61.5	86.1	86.4
	Total Sulphur *	SM034	%	< 0.01	< 0.01	< 0.01
	Carbon *	SM035	%	33.3	46.6	46.7
	Hydrogen *	SM035	%	4.33	6.06	6.08
	Nitrogen *	SM035	%	0.11	0.15	0.15
	Oxygen By Difference		%	33.5	46.9	47.0
	Gross Calorific Value *	SM036	MJ/Kg	13.879	19.439	19.498
	Net Calorific Value *	SM037	MJ/Kg	12.237		

** - Accredited Test*

Gibson Kabaso
Technical Manager
For and on behalf of Alfred H Knight Energy Services Ltd

Doc Id: DB/400461/2 **Alfred H Knight Energy Services Ltd** Page 3 of 4
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Figure A- 14 - Certificate of Analysis for Wood logs 14

CERTIFICATE OF ANALYSIS

ALFRED H KNIGHT

UKAS TESTING 1765

JACK BEVAN
KIWA UK
KIWA HOUSE
MALVERN VIEW BUSINESS PARK
STELLA WAY
BISHOPS CLEEVE
CHELTENHAM
GL52 7DQ

Test Date(s): **07-Jul-2023 to 18-Jul-2023**
Date of Report: **18-Jul-2023**
Date Received: 07-Jul-2023

AHK Ref: DB/400461
Client Ref: PROJECT NUMBER 31153 1823-1 - 4
Material Described As: WOOD LOGS

Samples were received by Alfred H Knight Energy Services Ltd and analysis results relate only to the items tested.

Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
1823-4						
	Removed Ash Contributors *		%	0.00		
	Free Moisture *		%	3.8		
	Total Moisture *	SM031	%	6.0		
	Total Ash Content *	SM033	%	0.4	0.4	
	Volatile Matter *	SM032	%	78.7	83.7	84.0
	Total Sulphur *	SM034	%	< 0.01	< 0.01	< 0.01
	Carbon *	SM035	%	45.2	48.1	48.3
	Hydrogen *	SM035	%	5.75	6.12	6.14
	Nitrogen *	SM035	%	0.11	0.12	0.12
	Oxygen By Difference		%	42.6	45.3	45.5
	Gross Calorific Value *	SM036	MJ/Kg	19.105	20.324	20.406
	Net Calorific Value *	SM037	MJ/Kg	17.704		

** - Accredited Test*

Gibson Kabaso
Technical Manager
For and on behalf of Alfred H Knight Energy Services Ltd

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Figure A- 15 - Certificate of Analysis for Wood logs 15

CERTIFICATE OF ANALYSIS

ALFRED H KNIGHT

UKAS TESTING 1765

JACK BEVAN
KIWA UK
KIWA HOUSE
MALVERN VIEW BUSINESS PARK
STELLA WAY
BISHOPS CLEEVE
CHELTENHAM
GL52 7DQ

Date Received: 01-Mar-2023

Test Date(s): **01-Mar-2023 to 07-Mar-2023**
Date of Report: **07-Mar-2023**

AHK Ref: **DB/396460**
Material Described As: WOOD
Client Ref: **PROJECT NUMBER :- 31153 1809-1 - 4**

Samples were received by Alfred H Knight Energy Services Ltd and analysis results relate only to the items tested.

Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
1809-1						
	Free Moisture		%	0.2		
	Total Moisture *	SM031	%	2.4		
	Ash Content *	SM033	%	0.3	0.3	
	Volatile Matter *	SM032	%	83.6	85.7	86.0
	Total Sulphur *	SM034	%	< 0.01	< 0.01	< 0.01
	Carbon *	SM035	%	48.0	49.2	49.3
	Hydrogen *	SM035	%	5.80	5.94	5.96
	Nitrogen *	SM035	%	0.36	0.37	0.37
	Oxygen By Difference		%	43.1	44.2	44.3
	Gross Calorific Value *	SM036	MJ/Kg	19.174	19.646	19.705
	Net Calorific Value *	SM037	MJ/Kg	17.852		

** - Accredited Test*

Scott Foster
Technical Manager
For and on behalf of Alfred H Knight Energy Services Ltd

Doc Id: DB/396460/3

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Figure A-16 - Certificate of Analysis for Wood logs 16

CERTIFICATE OF ANALYSIS

ALFRED H KNIGHT

UKAS TESTING 1765

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KIWA UK
KIWA HOUSE
MALVERN VIEW BUSINESS PARK
STELLA WAY
BISHOPS CLEEVE
CHELTENHAM
GL52 7DQ

Test Date(s): **01-Mar-2023 to 07-Mar-2023** Date Received: 01-Mar-2023
Date of Report: **07-Mar-2023**

AHK Ref: **DB/396460** Material Described As: WOOD
Client Ref: **PROJECT NUMBER :- 31153 1809-1 - 4**

Samples were received by Alfred H Knight Energy Services Ltd and analysis results relate only to the items tested.

Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
1809-2						
	Free Moisture		%	1.0		
	Total Moisture *	SM031	%	3.5		
	Ash Content *	SM033	%	0.6	0.6	
	Volatile Matter *	SM032	%	82.7	85.7	86.2
	Total Sulphur *	SM034	%	< 0.01	< 0.01	< 0.01
	Carbon *	SM035	%	47.0	48.7	49.0
	Hydrogen *	SM035	%	5.71	5.92	5.96
	Nitrogen *	SM035	%	0.36	0.37	0.37
	Oxygen By Difference		%	42.8	44.4	44.7
	Gross Calorific Value *	SM036	MJ/Kg	18.651	19.327	19.444
	Net Calorific Value *	SM037	MJ/Kg	17.319		

** - Accredited Test*

Scott Foster
Technical Manager
For and on behalf of Alfred H Knight Energy Services Ltd

Doc Id: DB/396460/3 **Alfred H Knight Energy Services Ltd** Page 2 of 4
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A-17 - Certificate of Analysis for Wood logs 17

CERTIFICATE OF ANALYSIS

ALFRED H KNIGHT

UKAS TESTING 1765

JACK BEVAN
KIWA UK
KIWA HOUSE
MALVERN VIEW BUSINESS PARK
STELLA WAY
BISHOPS CLEEVE
CHELTENHAM
GL52 7DQ

Test Date(s): **01-Mar-2023 to 07-Mar-2023**
Date Received: 01-Mar-2023
Date of Report: **07-Mar-2023**

AHK Ref: DB/396460
Material Described As: WOOD
Client Ref: PROJECT NUMBER :- 31153 1809-1 - 4

Samples were received by Alfred H Knight Energy Services Ltd and analysis results relate only to the items tested.

Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
1809-3						
	Free Moisture		%	0.9		
	Total Moisture *	SM031	%	3.5		
	Ash Content *	SM033	%	0.2	0.2	
	Volatile Matter *	SM032	%	82.2	85.2	85.4
	Total Sulphur *	SM034	%	0.04	0.04	0.04
	Carbon *	SM035	%	48.2	49.9	50.0
	Hydrogen *	SM035	%	5.77	5.98	5.99
	Nitrogen *	SM035	%	0.38	0.39	0.39
	Oxygen By Difference		%	42.0	43.5	43.6
	Gross Calorific Value *	SM036	MJ/Kg	18.765	19.446	19.485
	Net Calorific Value *	SM037	MJ/Kg	17.423		

** - Accredited Test*

Scott Foster
Technical Manager
For and on behalf of Alfred H Knight Energy Services Ltd

Doc Id: DB/396460/3 Page 3 of 4

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A-18 - Certificate of Analysis for Wood logs 18

CERTIFICATE OF ANALYSIS

ALFRED H KNIGHT

UKAS TESTING 1765

JACK BEVAN
KIWA UK
KIWA HOUSE
MALVERN VIEW BUSINESS PARK
STELLA WAY
BISHOPS CLEEVE
CHELTENHAM
GL52 7DQ

Test Date(s): **01-Mar-2023 to 07-Mar-2023**
Date of Report: **07-Mar-2023**

Date Received: 01-Mar-2023

AHK Ref: **DB/396460**
Client Ref: **PROJECT NUMBER :- 31153 1809-1 - 4**

Material Described As: WOOD

Samples were received by Alfred H Knight Energy Services Ltd and analysis results relate only to the items tested.

Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
1809-4						
	Free Moisture		%	24.7		
	Total Moisture *	SM031	%	28.3		
	Ash Content *	SM033	%	0.6	0.9	
	Volatile Matter *	SM032	%	61.2	85.3	86.1
	Total Sulphur *	SM034	%	0.04	0.05	0.05
	Carbon *	SM035	%	34.8	48.6	49.0
	Hydrogen *	SM035	%	4.29	5.98	6.03
	Nitrogen *	SM035	%	0.37	0.51	0.51
	Oxygen By Difference		%	31.5	44.0	44.4
	Gross Calorific Value *	SM036	MJ/Kg	13.921	19.416	19.592
	Net Calorific Value *	SM037	MJ/Kg	12.295		

** - Accredited Test*

Scott Foster
Technical Manager
For and on behalf of Alfred H Knight Energy Services Ltd

Doc Id: DB/396460/3

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Page 4 of 4

A-19 - Certificate of Analysis for Wood Pellets

CERTIFICATE OF ANALYSIS

ALFRED H KNIGHT

UKAS TESTING 1765

JACK BEVAN
KIWA UK
KIWA HOUSE
MALVERN VIEW BUSINESS PARK
STELLA WAY
BISHOPS CLEEVE
CHELTENHAM
GL52 7DQ

Test Date(s): **11-Jun-2024 to 19-Jun-2024**
Date Received: 11-Jun-2024
Date of Report: **19-Jun-2024**

AHK Ref: **DB/412321**
Material Described As: WOOD PELLETS
Client Ref: **REF 1858-2**

Samples were received by Alfred H Knight Energy Services Ltd and analysis results relate only to the items tested.

Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
1858-2 Wood Pellets 31153						
	Removed Ash Contributors *		%	0.00		
	Free Moisture *		%	5.6		
	Total Moisture *	SM031	%	7.6		
	Total Ash Content *	SM033	%	0.5	0.5	
	Volatile Matter *	SM032	%	76.9	83.2	83.6
	Total Sulphur *	SM034	%	< 0.01	< 0.01	< 0.01
	Carbon *	SM035	%	45.4	49.1	49.3
	Hydrogen *	SM035	%	5.74	6.21	6.24
	Nitrogen *	SM035	%	0.13	0.14	0.14
	Oxygen By Difference		%	40.7	44.0	44.2
	Gross Calorific Value *	SM036	MJ/Kg	18.370	19.881	19.981
	Net Calorific Value *	SM037	MJ/Kg	16.935		

** - Accredited Test*

Gibson Kabaso
Technical Manager
For and on behalf of Alfred H Knight Energy Services Ltd

Doc Id: DB/412321/1
Alfred H Knight Energy Services Ltd
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A-20 - Certificate of Analysis for Mineral Fuels (1)

CERTIFICATE OF ANALYSIS

ALFRED H KNIGHT

UKAS TESTING 1765

JACK BEVAN
KIWA UK
KIWA HOUSE
MALVERN VIEW BUSINESS PARK
STELLA WAY
BISHOPS CLEEVE
CHELTENHAM
GL52 7DQ

Test Date(s): **10-Jul-2023 to 17-Jul-2023**
Date Received: 10-Jul-2023
Date of Report: **17-Jul-2023**

AHK Ref: **DC/400490**
Material Described As: COAL & COAL ASH
Client Ref: **PROJECT NUMBER 31153**

Samples were received by Alfred H Knight Energy Services Ltd and analysis results relate only to the items tested.

Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
1826-1						
	Total Moisture *	SM031	%	9.6		
	Total Ash Content *	SM033	%	5.5	6.1	
	Volatile Matter *	SM032	%	35.3	39.1	41.6
	Total Sulphur *	SM034	%	0.36	0.40	0.43
	Carbon *	SM035	%	79.6	88.0	93.7
	Hydrogen *	SM035	%	3.58	3.96	4.22
	Nitrogen *	SM035	%	2.46	2.72	2.90
	Oxygen By Difference		%	< 0.1	< 0.1	< 0.1
	Gross Calorific Value *	SM036	MJ/Kg	27.699	30.640	32.630
	Net Calorific Value *	SM037	MJ/Kg	26.704		
	TRACE METAL ANALYSIS					
	Cadmium *	SM044	mg/Kg		0.12	
	Zinc *	SM044	mg/Kg		22.44	
	Vanadium *	SM044	mg/Kg		15.02	
	Lead *	SM044	mg/Kg		4.87	
	Copper *	SM044	mg/Kg		7.90	
	Chromium *	SM044	mg/Kg		51.30	
	Nickel *	SM044	mg/Kg		22.00	
	Antimony *	SM044	mg/Kg		0.30	
	Cobalt *	SM044	mg/Kg		4.73	
	Manganese *	SM044	mg/Kg		131.42	

** - Accredited Test*

Stephanie Stakim
Client Services Manager
For and on behalf of Alfred H Knight Energy Services Ltd

Doc Id: DC/400490/2
Alfred H Knight Energy Services Ltd
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A-21 - Certificate of Analysis for Mineral Fuels (1/2)

CERTIFICATE OF ANALYSIS

ALFRED H KNIGHT

UKAS TESTING 1765

JACK BEVAN
KIWA UK
KIWA HOUSE
MALVERN VIEW BUSINESS PARK
STELLA WAY
BISHOPS CLEEVE
CHELTENHAM
GL52 7DQ

Test Date(s): **10-Jul-2023 to 17-Jul-2023**
Date of Report: **17-Jul-2023**

Date Received: 10-Jul-2023

AHK Ref: DC/400490
Client Ref: PROJECT NUMBER 31153

Material Described As: COAL & COAL ASH

Samples were received by Alfred H Knight Energy Services Ltd and analysis results relate only to the items tested.

Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
1826-1						
	TRACE METAL ANALYSIS					
	Arsenic *	SM044	mg/Kg		2.40	
	Mercury *	SM044	mg/Kg		0.03	
	Selenium *	SM044	mg/Kg		< 0.01	
	Titanium *	SM044	mg/Kg		1468.62	
1826-2						
	Total Moisture *	SM030	%	1.4		
	Total Ash Content *	SM033	%	21.3	21.6	
	Volatile Matter *	SM032	%	5.5	5.6	7.1
	Total Sulphur *	SM034	%	0.32	0.32	0.41
	Carbon *	SM035	%	69.9	70.9	90.4
	Hydrogen *	SM035	%	0.66	0.67	0.85
	Nitrogen *	SM035	%	2.37	2.40	3.06
	Oxygen By Difference		%	4.0	4.1	5.2
	Gross Calorific Value *	SM036	MJ/Kg	25.272	25.631	32.693
	Net Calorific Value *	SM037	MJ/Kg	25.092		

** - Accredited Test*

Stephanie Stakim
Client Services Manager
For and on behalf of Alfred H Knight Energy Services Ltd

Doc Id: DC/400490/2 **Alfred H Knight Energy Services Ltd** Page 2 of 9

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A-22 - Certificate of Analysis for Mineral Fuels (2)

CERTIFICATE OF ANALYSIS

ALFRED H KNIGHT

UKAS TESTING 1765

JACK BEVAN
KIWA UK
KIWA HOUSE
MALVERN VIEW BUSINESS PARK
STELLA WAY
BISHOPS CLEEVE
CHELTENHAM
GL52 7DQ

Date Received: 10-Jul-2023

Test Date(s): **10-Jul-2023 to 17-Jul-2023**
Date of Report: **17-Jul-2023**

AHK Ref: **DC/400490**
Client Ref: **PROJECT NUMBER 31153**

Material Described As: COAL & COAL ASH

Samples were received by Alfred H Knight Energy Services Ltd and analysis results relate only to the items tested.

Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
1826-2						
	TRACE METAL ANALYSIS					
	Cadmium *	SM044	mg/Kg		0.13	
	Zinc *	SM044	mg/Kg		76.95	
	Vanadium *	SM044	mg/Kg		25.01	
	Lead *	SM044	mg/Kg		12.66	
	Copper *	SM044	mg/Kg		18.49	
	Chromium *	SM044	mg/Kg		101.60	
	Nickel *	SM044	mg/Kg		90.07	
	Antimony *	SM044	mg/Kg		0.60	
	Cobalt *	SM044	mg/Kg		13.89	
	Manganese *	SM044	mg/Kg		677.46	
	Arsenic *	SM044	mg/Kg		5.26	
	Mercury *	SM044	mg/Kg		0.05	
	Selenium *	SM044	mg/Kg		< 0.01	
	Titanium *	SM044	mg/Kg		1075.47	

* - *Accredited Test*

Stephanie Stakim
Client Services Manager
For and on behalf of Alfred H Knight Energy Services Ltd

Doc Id: DC/400490/2

Alfred H Knight Energy Services Ltd
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A-23 - Certificate of Analysis for Mineral Fuels (3)

CERTIFICATE OF ANALYSIS

ALFRED H KNIGHT

UKAS TESTING 1765

JACK BEVAN
KIWA UK
KIWA HOUSE
MALVERN VIEW BUSINESS PARK
STELLA WAY
BISHOPS CLEEVE
CHELTENHAM
GL52 7DQ

Test Date(s): **10-Jul-2023 to 17-Jul-2023**
Date of Report: **17-Jul-2023**

Date Received: 10-Jul-2023

AHK Ref: DC/400490
Client Ref: PROJECT NUMBER 31153

Material Described As: COAL & COAL ASH

Samples were received by Alfred H Knight Energy Services Ltd and analysis results relate only to the items tested.

Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
1826-3						
	Total Moisture *	SM031	%	7.6		
	Total Ash Content *	SM033	%	4.7	5.1	
	Volatile Matter *	SM032	%	37.0	40.0	42.1
	Total Sulphur *	SM034	%	0.30	0.32	0.34
	Carbon *	SM035	%	69.0	74.7	78.7
	Hydrogen *	SM035	%	5.01	5.42	5.71
	Nitrogen *	SM035	%	2.29	2.48	2.61
	Oxygen By Difference		%	11.1	12.0	12.6
	Gross Calorific Value *	SM036	MJ/Kg	28.796	31.164	32.839
	Net Calorific Value *	SM037	MJ/Kg	27.537		
	TRACE METAL ANALYSIS					
	Cadmium *	SM044	mg/Kg		0.05	
	Zinc *	SM044	mg/Kg		9.02	
	Vanadium *	SM044	mg/Kg		4.50	
	Lead *	SM044	mg/Kg		3.17	
	Copper *	SM044	mg/Kg		3.92	
	Chromium *	SM044	mg/Kg		8.22	
	Nickel *	SM044	mg/Kg		8.76	
	Antimony *	SM044	mg/Kg		0.09	
	Cobalt *	SM044	mg/Kg		1.69	
	Manganese *	SM044	mg/Kg		29.23	

* - *Accredited Test*

Stephanie Stakim
Client Services Manager
For and on behalf of Alfred H Knight Energy Services Ltd

Doc Id: DC/400490/2 **Alfred H Knight Energy Services Ltd** Page 4 of 9

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A-24 - Certificate of Analysis for Mineral Fuels (3/4)

CERTIFICATE OF ANALYSIS

ALFRED H KNIGHT

UKAS TESTING 1765

JACK BEVAN
KIWA UK
KIWA HOUSE
MALVERN VIEW BUSINESS PARK
STELLA WAY
BISHOPS CLEEVE
CHELTENHAM
GL52 7DQ

Test Date(s): **10-Jul-2023 to 17-Jul-2023**
Date of Report: **17-Jul-2023**

Date Received: 10-Jul-2023

AHK Ref: DC/400490
Client Ref: PROJECT NUMBER 31153

Material Described As: COAL & COAL ASH

Samples were received by Alfred H Knight Energy Services Ltd and analysis results relate only to the items tested.

Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
1826-3						
	TRACE METAL ANALYSIS					
	Arsenic *	SM044	mg/Kg		1.97	
	Mercury *	SM044	mg/Kg		0.02	
	Selenium *	SM044	mg/Kg		< 0.01	
	Titanium *	SM044	mg/Kg		365.64	
1826-4						
	Total Moisture *	SM030	%	1.1		
	Total Ash Content *	SM033	%	24.5	24.8	
	Volatile Matter *	SM032	%	6.1	6.2	8.2
	Total Sulphur *	SM034	%	0.30	0.30	0.40
	Carbon *	SM035	%	68.4	69.2	92.0
	Hydrogen *	SM035	%	0.91	0.92	1.22
	Nitrogen *	SM035	%	2.47	2.50	3.32
	Oxygen By Difference		%	2.3	2.3	3.1
	Gross Calorific Value *	SM036	MJ/Kg	24.034	24.301	32.315
	Net Calorific Value *	SM037	MJ/Kg	23.810		

** - Accredited Test*

Stephanie Stakim
Client Services Manager
For and on behalf of Alfred H Knight Energy Services Ltd

Doc Id: DC/400490/2 Page 5 of 9

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A-25 - Certificate of Analysis for Mineral Fuels (4)

CERTIFICATE OF ANALYSIS

ALFRED H KNIGHT

UKAS TESTING 1765

JACK BEVAN
KIWA UK
KIWA HOUSE
MALVERN VIEW BUSINESS PARK
STELLA WAY
BISHOPS CLEEVE
CHELTENHAM
GL52 7DQ

Date Received: 10-Jul-2023

Test Date(s): **10-Jul-2023 to 17-Jul-2023**
Date of Report: **17-Jul-2023**

AHK Ref: **DC/400490**
Client Ref: **PROJECT NUMBER 31153**

Material Described As: COAL & COAL ASH

Samples were received by Alfred H Knight Energy Services Ltd and analysis results relate only to the items tested.

Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
1826-4						
	TRACE METAL ANALYSIS					
	Cadmium *	SM044	mg/Kg		0.15	
	Zinc *	SM044	mg/Kg		77.19	
	Vanadium *	SM044	mg/Kg		30.48	
	Lead *	SM044	mg/Kg		14.37	
	Copper *	SM044	mg/Kg		17.76	
	Chromium *	SM044	mg/Kg		133.69	
	Nickel *	SM044	mg/Kg		103.06	
	Antimony *	SM044	mg/Kg		0.28	
	Cobalt *	SM044	mg/Kg		11.94	
	Manganese *	SM044	mg/Kg		324.20	
	Arsenic *	SM044	mg/Kg		9.48	
	Mercury *	SM044	mg/Kg		0.05	
	Selenium *	SM044	mg/Kg		< 0.01	
	Titanium *	SM044	mg/Kg		2415.50	

** - Accredited Test*

Stephanie Stakim
Client Services Manager
For and on behalf of Alfred H Knight Energy Services Ltd

Doc Id: DC/400490/2

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A-26 - Certificate of Analysis for Mineral Fuels (5)

CERTIFICATE OF ANALYSIS

ALFRED H KNIGHT

UKAS TESTING 1765

JACK BEVAN
KIWA UK
KIWA HOUSE
MALVERN VIEW BUSINESS PARK
STELLA WAY
BISHOPS CLEEVE
CHELTENHAM
GL52 7DQ

Date Received: 10-Jul-2023

Test Date(s): **10-Jul-2023 to 17-Jul-2023**
Date of Report: **17-Jul-2023**

AHK Ref: **DC/400490**
Client Ref: **PROJECT NUMBER 31153**

Material Described As: COAL & COAL ASH

Samples were received by Alfred H Knight Energy Services Ltd and analysis results relate only to the items tested.

Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
1826-5						
	Total Moisture *	SM031	%	7.5		
	Total Ash Content *	SM033	%	6.5	7.0	
	Volatile Matter *	SM032	%	35.1	37.9	40.8
	Total Sulphur *	SM034	%	0.22	0.24	0.26
	Carbon *	SM035	%	68.3	73.8	79.4
	Hydrogen *	SM035	%	4.82	5.21	5.60
	Nitrogen *	SM035	%	2.22	2.40	2.58
	Oxygen By Difference		%	10.5	11.4	12.3
	Gross Calorific Value *	SM036	MJ/Kg	27.979	30.248	32.525
	Net Calorific Value *	SM037	MJ/Kg	26.764		
	TRACE METAL ANALYSIS					
	Cadmium *	SM044	mg/Kg		0.08	
	Zinc *	SM044	mg/Kg		9.83	
	Vanadium *	SM044	mg/Kg		8.19	
	Lead *	SM044	mg/Kg		5.92	
	Copper *	SM044	mg/Kg		6.86	
	Chromium *	SM044	mg/Kg		12.37	
	Nickel *	SM044	mg/Kg		10.97	
	Antimony *	SM044	mg/Kg		0.10	
	Cobalt *	SM044	mg/Kg		3.90	
	Manganese *	SM044	mg/Kg		18.23	

** - Accredited Test*

Stephanie Stakim
Client Services Manager
For and on behalf of Alfred H Knight Energy Services Ltd

Doc Id: DC/400490/2

Alfred H Knight Energy Services Ltd
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A-27 - Certificate of Analysis for Mineral Fuels (5/6)

CERTIFICATE OF ANALYSIS

ALFRED H KNIGHT

UKAS TESTING 1765

JACK BEVAN
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STELLA WAY
BISHOPS CLEEVE
CHELTENHAM
GL52 7DQ

Test Date(s): **10-Jul-2023 to 17-Jul-2023**
Date Received: 10-Jul-2023
Date of Report: **17-Jul-2023**

AHK Ref: **DC/400490**
Material Described As: COAL & COAL ASH
Client Ref: **PROJECT NUMBER 31153**

Samples were received by Alfred H Knight Energy Services Ltd and analysis results relate only to the items tested.

Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
1826-5						
	TRACE METAL ANALYSIS					
	Arsenic *	SM044	mg/Kg		2.39	
	Mercury *	SM044	mg/Kg		0.02	
	Selenium *	SM044	mg/Kg		< 0.01	
	Titanium *	SM044	mg/Kg		782.05	
1826-6						
	Total Moisture *	SM030	%	2.2		
	Total Ash Content *	SM033	%	17.9	18.3	
	Volatile Matter *	SM032	%	4.8	4.9	6.0
	Total Sulphur *	SM034	%	0.33	0.34	0.42
	Carbon *	SM035	%	73.1	74.7	91.4
	Hydrogen *	SM035	%	0.66	0.67	0.82
	Nitrogen *	SM035	%	2.51	2.57	3.15
	Oxygen By Difference		%	3.3	3.4	4.2
	Gross Calorific Value *	SM036	MJ/Kg	25.784	26.364	32.269
	Net Calorific Value *	SM037	MJ/Kg	25.587		

** - Accredited Test*

Stephanie Stakim
Client Services Manager
For and on behalf of Alfred H Knight Energy Services Ltd

Doc Id: DC/400490/2

Alfred H Knight Energy Services Ltd
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A-28 - Certificate of Analysis for Mineral Fuels (6)

CERTIFICATE OF ANALYSIS

ALFRED H KNIGHT

UKAS TESTING 1765

JACK BEVAN
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STELLA WAY
BISHOPS CLEEVE
CHELTENHAM
GL52 7DQ

Test Date(s): **10-Jul-2023 to 17-Jul-2023**
Date of Report: **17-Jul-2023**

Date Received: 10-Jul-2023

AHK Ref: DC/400490
Client Ref: PROJECT NUMBER 31153

Material Described As: COAL & COAL ASH

Samples were received by Alfred H Knight Energy Services Ltd and analysis results relate only to the items tested.

Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
1826-6						
	TRACE METAL ANALYSIS					
	Cadmium *	SM044	mg/Kg		0.11	
	Zinc *	SM044	mg/Kg		53.84	
	Vanadium *	SM044	mg/Kg		19.31	
	Lead *	SM044	mg/Kg		10.45	
	Copper *	SM044	mg/Kg		20.29	
	Chromium *	SM044	mg/Kg		117.60	
	Nickel *	SM044	mg/Kg		114.15	
	Antimony *	SM044	mg/Kg		0.49	
	Cobalt *	SM044	mg/Kg		23.91	
	Manganese *	SM044	mg/Kg		119.27	
	Arsenic *	SM044	mg/Kg		7.99	
	Mercury *	SM044	mg/Kg		0.05	
	Selenium *	SM044	mg/Kg		< 0.01	
	Titanium *	SM044	mg/Kg		1153.20	

* - *Accredited Test*

Stephanie Stakim
Client Services Manager
For and on behalf of Alfred H Knight Energy Services Ltd

Doc Id: DC/400490/2 **Alfred H Knight Energy Services Ltd** Page 9 of 9
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A-29 - Certificate of Analysis for Mineral Fuels (7)

CERTIFICATE OF ANALYSIS

ALFRED H KNIGHT

UKAS TESTING 1765

JACK BEVAN
KIWA UK
KIWA HOUSE
MALVERN VIEW BUSINESS PARK
STELLA WAY
BISHOPS CLEEVE
CHELTENHAM
GL52 7DQ

Test Date(s): **01-Mar-2023 to 09-Mar-2023**
Date of Report: **09-Mar-2023**

Date Received: 01-Mar-2023

AHK Ref: DB/396461
Client Ref: PROJECT NUMBER :- 31153 1808-1 - 6

Material Described As: VARIOUS

Samples were received by Alfred H Knight Energy Services Ltd and analysis results relate only to the items tested.

Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
1808-1						
	Free Moisture		%	19.2		
	Total Moisture *	SM031	%	20.4		
	Ash Content *	SM033	%	5.0	6.3	
	Volatile Matter *	SM032	%	13.4	16.8	17.9
	Total Sulphur *	SM034	%	1.33	1.67	1.78
	Carbon *	SM035	%	65.2	81.9	87.4
	Hydrogen *	SM035	%	2.97	3.73	3.98
	Nitrogen *	SM035	%	1.16	1.46	1.56
	Oxygen By Difference		%	3.9	4.9	5.2
	Gross Calorific Value *	SM036	MJ/Kg	25.402	31.912	34.058
	Net Calorific Value *	SM037	MJ/Kg	24.270		

** - Accredited Test*

Gibson Kabaso
Technical Manager
For and on behalf of Alfred H Knight Energy Services Ltd

Doc Id: DB/396461/1 | **Alfred H Knight Energy Services Ltd** | Page 1 of 12

Unit 1 Palmermount Industrial Estate, Bypass Road, Dundonald Kilmarnock, Ayrshire, KA2 9BL
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A-30 - Certificate of Analysis for Mineral Fuels (7)

CERTIFICATE OF ANALYSIS

ALFRED H KNIGHT

UKAS TESTING 1765

JACK BEVAN
KIWA UK
KIWA HOUSE
MALVERN VIEW BUSINESS PARK
STELLA WAY
BISHOPS CLEEVE
CHELTENHAM
GL52 7DQ

Test Date(s): **01-Mar-2023 to 09-Mar-2023** Date Received: 01-Mar-2023
Date of Report: **09-Mar-2023**

AHK Ref: **DB/396461** Material Described As: VARIOUS
Client Ref: **PROJECT NUMBER :- 31153 1808-1 - 6**

Samples were received by Alfred H Knight Energy Services Ltd and analysis results relate only to the items tested.

Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
1808-1						
	TRACE METAL ANALYSIS					
	Cadmium *	SM044	mg/Kg		0.10	
	Zinc *	SM044	mg/Kg		23.53	
	Vanadium *	SM044	mg/Kg		205.60	
	Lead *	SM044	mg/Kg		4.31	
	Copper *	SM044	mg/Kg		7.96	
	Chromium *	SM044	mg/Kg		34.77	
	Nickel *	SM044	mg/Kg		118.24	
	Antimony *	SM044	mg/Kg		0.67	
	Cobalt *	SM044	mg/Kg		5.33	
	Manganese *	SM044	mg/Kg		59.31	
	Arsenic *	SM044	mg/Kg		3.05	
	Mercury *	SM044	mg/Kg		0.07	
	Selenium *	SM044	mg/Kg		0.25	
	Titanium *	SM044	mg/Kg		386.84	

** - Accredited Test*

Gibson Kabaso
Technical Manager
For and on behalf of Alfred H Knight Energy Services Ltd

Doc Id: DB/396461/1 **Alfred H Knight Energy Services Ltd** Page 2 of 12
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A-31 - Certificate of Analysis for Mineral Fuels (8)

CERTIFICATE OF ANALYSIS

ALFRED H KNIGHT

UKAS TESTING 1765

JACK BEVAN
KIWA UK
KIWA HOUSE
MALVERN VIEW BUSINESS PARK
STELLA WAY
BISHOPS CLEEVE
CHELTENHAM
GL52 7DQ

Test Date(s): **01-Mar-2023 to 09-Mar-2023** Date Received: 01-Mar-2023
Date of Report: **09-Mar-2023**

AHK Ref: DB/396461 Material Described As: VARIOUS
Client Ref: PROJECT NUMBER :- 31153 1808-1 - 6

Samples were received by Alfred H Knight Energy Services Ltd and analysis results relate only to the items tested.

Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
1808-2						
	Free Moisture		%	6.2		
	Total Moisture *	SM030	%	10.1		
	Ash Content *	SM033	%	1.0	1.1	
	Volatile Matter *	SM032	%	73.4	81.7	82.6
	Total Sulphur *	SM034	%	0.04	0.05	0.05
	Carbon *	SM035	%	47.2	52.5	53.1
	Hydrogen *	SM035	%	5.70	6.34	6.41
	Nitrogen *	SM035	%	1.13	1.26	1.27
	Oxygen By Difference		%	34.9	38.8	39.2
	Gross Calorific Value *	SM036	MJ/Kg	19.056	21.197	21.433
	Net Calorific Value *	SM037	MJ/Kg	17.572		

** - Accredited Test*

Gibson Kabaso
Technical Manager
For and on behalf of Alfred H Knight Energy Services Ltd

Doc Id: DB/396461/1 **Alfred H Knight Energy Services Ltd** Page 3 of 12

Unit 1 Palmermount Industrial Estate, Bypass Road, Dundonald Kilmarnock, Ayrshire, KA2 9BL
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A-32 - Certificate of Analysis for Mineral Fuels (8)

CERTIFICATE OF ANALYSIS

ALFRED H KNIGHT

UKAS TESTING 1765

JACK BEVAN
KIWA UK
KIWA HOUSE
MALVERN VIEW BUSINESS PARK
STELLA WAY
BISHOPS CLEEVE
CHELTENHAM
GL52 7DQ

Date Received: 01-Mar-2023

Test Date(s): **01-Mar-2023 to 09-Mar-2023**
Date of Report: **09-Mar-2023**

AHK Ref: DB/396461
Client Ref: PROJECT NUMBER :- 31153 1808-1 - 6

Material Described As: VARIOUS

Samples were received by Alfred H Knight Energy Services Ltd and analysis results relate only to the items tested.

Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
1808-2						
	TRACE METAL ANALYSIS					
	Cadmium *	SM044	mg/Kg		0.05	
	Zinc *	SM044	mg/Kg		14.05	
	Vanadium *	SM044	mg/Kg		0.76	
	Lead *	SM044	mg/Kg		1.73	
	Copper *	SM044	mg/Kg		16.18	
	Chromium *	SM044	mg/Kg		1.60	
	Nickel *	SM044	mg/Kg		2.61	
	Antimony *	SM044	mg/Kg		< 0.10	
	Cobalt *	SM044	mg/Kg		0.18	
	Manganese *	SM044	mg/Kg		48.87	
	Arsenic *	SM044	mg/Kg		< 0.10	
	Mercury *	SM044	mg/Kg		< 0.01	
	Selenium *	SM044	mg/Kg		0.15	
	Titanium *	SM044	mg/Kg		16.19	

** - Accredited Test*

Gibson Kabaso
Technical Manager
For and on behalf of Alfred H Knight Energy Services Ltd

Doc Id: DB/396461/1 | **Alfred H Knight Energy Services Ltd** | Page 4 of 12

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A-33 - Certificate of Analysis for Mineral Fuels (9)

CERTIFICATE OF ANALYSIS

ALFRED H KNIGHT

UKAS TESTING 1765

JACK BEVAN
KIWA UK
KIWA HOUSE
MALVERN VIEW BUSINESS PARK
STELLA WAY
BISHOPS CLEEVE
CHELTENHAM
GL52 7DQ

Date Received: 01-Mar-2023

Test Date(s): **01-Mar-2023 to 09-Mar-2023**
Date of Report: **09-Mar-2023**

AHK Ref: **DB/396461**
Material Described As: VARIOUS
Client Ref: **PROJECT NUMBER :- 31153 1808-1 - 6**

Samples were received by Alfred H Knight Energy Services Ltd and analysis results relate only to the items tested.

Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
1808-3						
	Free Moisture		%	1.4		
	Total Moisture *	SM031	%	2.1		
	Ash Content *	SM033	%	3.9	4.0	
	Volatile Matter *	SM032	%	7.1	7.3	7.6
	Total Sulphur *	SM034	%	0.81	0.83	0.86
	Carbon *	SM035	%	87.1	89.0	92.7
	Hydrogen *	SM035	%	3.72	3.80	3.96
	Nitrogen *	SM035	%	1.22	1.25	1.30
	Oxygen By Difference		%	1.1	1.1	1.1
	Gross Calorific Value *	SM036	MJ/Kg	33.332	34.047	35.466
	Net Calorific Value *	SM037	MJ/Kg	32.490		

** - Accredited Test*

Gibson Kabaso
Technical Manager
For and on behalf of Alfred H Knight Energy Services Ltd

Doc Id: DB/396461/1

Alfred H Knight Energy Services Ltd
Unit 1 Palmermount Industrial Estate, Bypass Road, Dundonald Kilmarnock, Ayrshire, KA2 9BL
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A-34 - Certificate of Analysis for Mineral Fuels (9)

CERTIFICATE OF ANALYSIS

ALFRED H KNIGHT

UKAS TESTING 1765

JACK BEVAN
KIWA UK
KIWA HOUSE
MALVERN VIEW BUSINESS PARK
STELLA WAY
BISHOPS CLEEVE
CHELTENHAM
GL52 7DQ

Test Date(s): **01-Mar-2023 to 09-Mar-2023**   Date Received: 01-Mar-2023
Date of Report: **09-Mar-2023**

AHK Ref: DB/396461   Material Described As: VARIOUS
Client Ref: PROJECT NUMBER :- 31153 1808-1 - 6

Samples were received by Alfred H Knight Energy Services Ltd and analysis results relate only to the items tested.

Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
1808-3						
	TRACE METAL ANALYSIS					
	Cadmium *	SM044	mg/Kg		0.05	
	Zinc *	SM044	mg/Kg		13.52	
	Vanadium *	SM044	mg/Kg		23.92	
	Lead *	SM044	mg/Kg		7.53	
	Copper *	SM044	mg/Kg		21.19	
	Chromium *	SM044	mg/Kg		10.94	
	Nickel *	SM044	mg/Kg		33.32	
	Antimony *	SM044	mg/Kg		0.36	
	Cobalt *	SM044	mg/Kg		17.11	
	Manganese *	SM044	mg/Kg		25.58	
	Arsenic *	SM044	mg/Kg		4.19	
	Mercury *	SM044	mg/Kg		0.04	
	Selenium *	SM044	mg/Kg		0.64	
	Titanium *	SM044	mg/Kg		153.76	

** - Accredited Test*

Gibson Kabaso
Technical Manager
For and on behalf of Alfred H Knight Energy Services Ltd

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AHK Ref: **DB/396461**
Material Described As: VARIOUS
Client Ref: **PROJECT NUMBER :- 31153 1808-1 - 6**

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Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
1808-4						
	Free Moisture		%	14.3		
	Total Moisture *	SM031	%	14.9		
	Ash Content *	SM033	%	3.1	3.6	
	Volatile Matter *	SM032	%	13.2	15.5	16.1
	Total Sulphur *	SM034	%	3.58	4.21	4.37
	Carbon *	SM035	%	72.9	85.7	88.9
	Hydrogen *	SM035	%	3.49	4.10	4.25
	Nitrogen *	SM035	%	1.14	1.34	1.39
	Oxygen By Difference		%	0.9	1.1	1.1
	Gross Calorific Value *	SM036	MJ/Kg	29.024	34.106	35.380
	Net Calorific Value *	SM037	MJ/Kg	27.919		

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Material Described As: VARIOUS
Client Ref: PROJECT NUMBER :- 31153 1808-1 - 6

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Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
1808-4						
	TRACE METAL ANALYSIS					
	Cadmium *	SM044	mg/Kg		0.06	
	Zinc *	SM044	mg/Kg		21.07	
	Vanadium *	SM044	mg/Kg		408.60	
	Lead *	SM044	mg/Kg		3.20	
	Copper *	SM044	mg/Kg		28.31	
	Chromium *	SM044	mg/Kg		22.19	
	Nickel *	SM044	mg/Kg		154.73	
	Antimony *	SM044	mg/Kg		1.08	
	Cobalt *	SM044	mg/Kg		3.38	
	Manganese *	SM044	mg/Kg		53.97	
	Arsenic *	SM044	mg/Kg		1.40	
	Mercury *	SM044	mg/Kg		0.04	
	Selenium *	SM044	mg/Kg		0.27	
	Titanium *	SM044	mg/Kg		152.45	

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AHK Ref: **DB/396461** Material Described As: VARIOUS
Client Ref: **PROJECT NUMBER :- 31153 1808-1 - 6**

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Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
1808-5						
	Free Moisture		%	0.0		
	Total Moisture *	SM031	%	3.9		
	Ash Content *	SM033	%	1.8	1.9	
	Volatile Matter *	SM032	%	41.6	43.3	44.1
	Total Sulphur *	SM034	%	0.22	0.23	0.23
	Carbon *	SM035	%	73.4	76.4	77.9
	Hydrogen *	SM035	%	5.04	5.24	5.34
	Nitrogen *	SM035	%	1.52	1.58	1.61
	Oxygen By Difference		%	14.1	14.7	15.0
	Gross Calorific Value *	SM036	MJ/Kg	29.341	30.532	31.123
	Net Calorific Value *	SM037	MJ/Kg	28.166		

** - Accredited Test*

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AHK Ref: **DB/396461**
Material Described As: VARIOUS
Client Ref: **PROJECT NUMBER :- 31153 1808-1 - 6**

Samples were received by Alfred H Knight Energy Services Ltd and analysis results relate only to the items tested.

Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
1808-5						
	TRACE METAL ANALYSIS					
	Cadmium *	SM044	mg/Kg		< 0.01	
	Zinc *	SM044	mg/Kg		7.18	
	Vanadium *	SM044	mg/Kg		7.30	
	Lead *	SM044	mg/Kg		1.00	
	Copper *	SM044	mg/Kg		7.75	
	Chromium *	SM044	mg/Kg		2.89	
	Nickel *	SM044	mg/Kg		8.64	
	Antimony *	SM044	mg/Kg		< 0.10	
	Cobalt *	SM044	mg/Kg		0.99	
	Manganese *	SM044	mg/Kg		38.41	
	Arsenic *	SM044	mg/Kg		0.87	
	Mercury *	SM044	mg/Kg		< 0.01	
	Selenium *	SM044	mg/Kg		< 0.10	
	Titanium *	SM044	mg/Kg		97.62	

* - *Accredited Test*

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Technical Manager
For and on behalf of Alfred H Knight Energy Services Ltd

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Client Ref: PROJECT NUMBER :- 31153 1808-1 - 6

Material Described As: VARIOUS

Samples were received by Alfred H Knight Energy Services Ltd and analysis results relate only to the items tested.

Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
1808-6						
	Free Moisture		%	2.8		
	Total Moisture *	SM031	%	5.2		
	Ash Content *	SM033	%	0.4	0.4	
	Volatile Matter *	SM032	%	80.0	84.4	84.7
	Total Sulphur *	SM034	%	< 0.01	< 0.01	< 0.01
	Carbon *	SM035	%	48.3	50.9	51.1
	Hydrogen *	SM035	%	5.60	5.91	5.93
	Nitrogen *	SM035	%	0.08	0.08	0.08
	Oxygen By Difference		%	40.5	42.7	42.9
	Gross Calorific Value *	SM036	MJ/Kg	19.225	20.280	20.361
	Net Calorific Value *	SM037	MJ/Kg	17.878		

** - Accredited Test*

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AHK Ref: DB/396461
Client Ref: PROJECT NUMBER :- 31153 1808-1 - 6

Material Described As: VARIOUS

Samples were received by Alfred H Knight Energy Services Ltd and analysis results relate only to the items tested.

Client Ref.	Test	Method	Unit	As Received	Dry Basis	Dry Ash-Free
1808-6						
	TRACE METAL ANALYSIS					
	Cadmium *	SM044	mg/Kg		0.07	
	Zinc *	SM044	mg/Kg		6.92	
	Vanadium *	SM044	mg/Kg		0.79	
	Lead *	SM044	mg/Kg		0.24	
	Copper *	SM044	mg/Kg		1.22	
	Chromium *	SM044	mg/Kg		2.75	
	Nickel *	SM044	mg/Kg		0.92	
	Antimony *	SM044	mg/Kg		< 0.10	
	Cobalt *	SM044	mg/Kg		0.17	
	Manganese *	SM044	mg/Kg		58.34	
	Arsenic *	SM044	mg/Kg		< 0.10	
	Mercury *	SM044	mg/Kg		< 0.01	
	Selenium *	SM044	mg/Kg		0.14	
	Titanium *	SM044	mg/Kg		5.74	

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A.2 STOVE SPECIFICATIONS

Charnwood C-4 blu – Modern Stove

A-2-1 - Charnwood C-4 blu stove specification

charnwood

C-FOUR *blu*

Featuring a large picture window the C-Four is the smallest model in the C-Series delivering a heat output to the room of between 2 to 5.5kW. The stove is steel plate lined and can take a log length of up to 282mm (11"). With a rated output of 4.9kW the C-Four, in certain situations, can be installed without the need for external air. This model is SIA Ecodesign ready (blu).

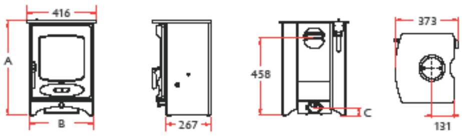
RATED OUTPUT
4.9kW to room (range 2-5.5kW)

NET EFFICIENCY
82%

FLUE OUTLET
Top or Rear 125mm (5") dia

MAX LOG LENGTH
282mm (11")

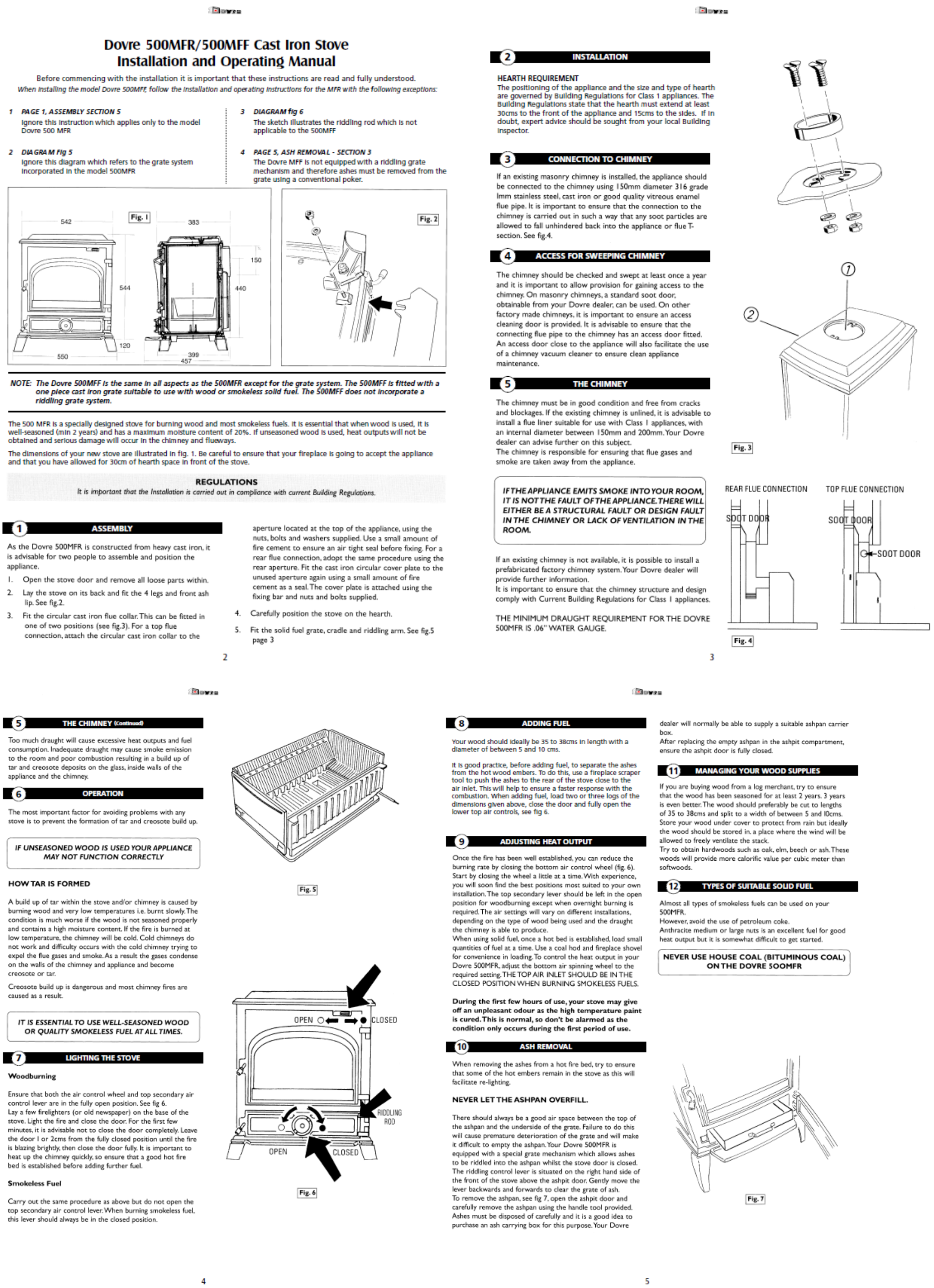
MIN DISTANCE TO COMBUSTIBLES
Side: 500mm Rear: 370mm With heatshield - Rear: 175mm



		A	B	C	WEIGHT
LOW LEGS		500	386	45	83KG
STORE STAND		710	386	195	89KG
HIGH LEGS		765	400	248	85.5KG

Dovre 500MRF Cast Iron Stove

Figure A-2- 1 - Dovre 500MRF Cast Iron Stove specification



Dovre 500MFR/500MFF Cast Iron Stove
Installation and Operating Manual

Before commencing with the installation it is important that these instructions are read and fully understood.

When installing the model Dovre 500MFF, follow the installation and operating instructions for the MFR with the following exceptions:

1 ***PAGE 1, ASSEMBLY SECTION 5***
Ignore this instruction which applies only to the model Dovre 500 MFR

2 ***DIAGRAM Fig 5***
Ignore this diagram which refers to the grate system incorporated in the model 500MFR

3 ***DIAGRAM fig 6***
The sketch illustrates the riddling rod which is not applicable to the 500MFF

4 ***PAGE 5, ASH REMOVAL - SECTION 3***
The Dovre MFF is not equipped with a riddling grate mechanism and therefore ashes must be removed from the grate using a conventional poker.

Fig. 1

Fig. 2

NOTE: The Dovre 500MFF is the same in all aspects as the 500MFR except for the grate system. The 500MFF is fitted with a one piece cast iron grate suitable to use with wood or smokeless solid fuel. The 500MFF does not incorporate a riddling grate system.

The 500 MFR is a specially designed stove for burning wood and most smokeless fuels. It is essential that when wood is used, it is well-seasoned (min 2 years) and has a maximum moisture content of 20%. If unseasoned wood is used, heat outputs will not be obtained and serious damage will occur in the chimney and flueways.

The dimensions of your new stove are illustrated in fig. 1. Be careful to ensure that your fireplace is going to accept the appliance and that you have allowed for 30cm of hearth space in front of the stove.

REGULATIONS

It is important that the installation is carried out in compliance with current Building Regulations.

1 ASSEMBLY

As the Dovre 500MFR is constructed from heavy cast iron, it is advisable for two people to assemble and position the appliance.

1. Open the stove door and remove all loose parts within.
2. Lay the stove on its back and fit the 4 legs and front ash lip. See fig.2.
3. Fit the circular cast iron flue collar. This can be fitted in one of two positions (see fig.3). For a top flue connection, attach the circular cast iron collar to the aperture located at the top of the appliance, using the nuts, bolts and washers supplied. Use a small amount of fire cement to ensure an air tight seal before fixing. For a rear flue connection, adopt the same procedure using the rear aperture. Fit the cast iron circular cover plate to the unused aperture again using a small amount of fire cement as a seal. The cover plate is attached using the fixing bar and nuts and bolts supplied.
4. Carefully position the stove on the hearth.
5. Fit the solid fuel grate, cradle and riddling arm. See fig.5 page 3

2

2 INSTALLATION

HEARTH REQUIREMENT

The positioning of the appliance and the size and type of hearth are governed by Building Regulations for Class 1 appliances. The Building Regulations state that the hearth must extend at least 30cms to the front of the appliance and 15cms to the sides. If in doubt, expert advice should be sought from your local Building Inspector.

3 CONNECTION TO CHIMNEY

If an existing masonry chimney is installed, the appliance should be connected to the chimney using 150mm diameter 316 grade 1mm stainless steel, cast iron or good quality vitreous enamel flue pipe. It is important to ensure that the connection to the chimney is carried out in such a way that any soot particles are allowed to fall unhindered back into the appliance or flue T-section. See fig.4.

4 ACCESS FOR SWEEPING CHIMNEY

The chimney should be checked and swept at least once a year and it is important to allow provision for gaining access to the chimney. On masonry chimneys, a standard soot door, obtainable from your Dovre dealer, can be used. On other factory made chimneys, it is important to ensure an access cleaning door is provided. It is advisable to ensure that the connecting flue pipe to the chimney has an access door fitted. An access door close to the appliance will also facilitate the use of a chimney vacuum cleaner to ensure clean appliance maintenance.

5 THE CHIMNEY

The chimney must be in good condition and free from cracks and blockages. If the existing chimney is unlined, it is advisable to install a flue liner suitable for use with Class 1 appliances, with an internal diameter between 150mm and 200mm. Your Dovre dealer can advise further on this subject.
The chimney is responsible for ensuring that flue gases and smoke are taken away from the appliance.

IF THE APPLIANCE EMITS SMOKE INTO YOUR ROOM, IT IS NOT THE FAULT OF THE APPLIANCE. THERE WILL EITHER BE A STRUCTURAL FAULT OR DESIGN FAULT IN THE CHIMNEY OR LACK OF VENTILATION IN THE ROOM.

If an existing chimney is not available, it is possible to install a prefabricated factory chimney system. Your Dovre dealer will provide further information.
It is important to ensure that the chimney structure and design comply with Current Building Regulations for Class 1 appliances.

THE MINIMUM DRAUGHT REQUIREMENT FOR THE DOVRE 500MFR IS .06" WATER GAUGE.

Fig. 3

Fig. 4

3

5 THE CHIMNEY (Continued)

Too much draught will cause excessive heat outputs and fuel consumption. Inadequate draught may cause smoke emission to the room and poor combustion resulting in a build up of tar and creosote deposits on the glass, inside walls of the appliance and the chimney.

6 OPERATION

The most important factor for avoiding problems with any stove is to prevent the formation of tar and creosote build up.

IF UNSEASONED WOOD IS USED YOUR APPLIANCE MAY NOT FUNCTION CORRECTLY

HOW TAR IS FORMED

A build up of tar within the stove and/or chimney is caused by burning wood and very low temperatures i.e. burnt slowly. The condition is much worse if the wood is not seasoned properly and contains a high moisture content. If the fire is burned at low temperature, the chimney will be cold. Cold chimneys do not work and difficulty occurs with the cold chimney trying to expel the flue gases and smoke. As a result the gases condense on the walls of the chimney and appliance and become creosote or tar.

Creosote build up is dangerous and most chimney fires are caused as a result.

IT IS ESSENTIAL TO USE WELL-SEASONED WOOD OR QUALITY SMOKELESS FUEL AT ALL TIMES.

7 LIGHTING THE STOVE

Woodburning

Ensure that both the air control wheel and top secondary air control lever are in the fully open position. See fig 6.
Lay a few firelighters (or old newspaper) on the base of the stove. Light the fire and close the door. For the first few minutes, it is advisable not to close the door completely. Leave the door 1 or 2cms from the fully closed position until the fire is blazing brightly, then close the door fully. It is important to heat up the chimney quickly, so ensure that a good hot fire bed is established before adding further fuel.

Smokeless Fuel

Carry out the same procedure as above but do not open the top secondary air control lever. When burning smokeless fuel, this lever should always be in the closed position.

Fig. 5

Fig. 6

4

8 ADDING FUEL

Your wood should ideally be 35 to 38cms in length with a diameter of between 5 and 10 cms.

It is good practice, before adding fuel, to separate the ashes from the hot wood embers. To do this, use a fireplace scraper tool to push the ashes to the rear of the stove close to the air inlet. This will help to ensure a faster response with the combustion. When adding fuel, load two or three logs of the dimensions given above, close the door and fully open the lower top air controls, see fig 6.

9 ADJUSTING HEAT OUTPUT

Once the fire has been well established, you can reduce the burning rate by closing the bottom air control wheel (fig. 6). Start by closing the wheel a little at a time. With experience, you will soon find the best positions most suited to your own installation. The top secondary lever should be left in the open position for woodburning except when overnight burning is required. The air settings will vary on different installations, depending on the type of wood being used and the draught the chimney is able to produce.
When using solid fuel, once a hot bed is established, load small quantities of fuel at a time. Use a coal hod and fireplace shovel for convenience in loading. To control the heat output in your Dovre 500MFR, adjust the bottom air spinning wheel to the required setting. THE TOP AIR INLET SHOULD BE IN THE CLOSED POSITION WHEN BURNING SMOKELESS FUELS.

During the first few hours of use, your stove may give off an unpleasant odour as the high temperature paint is cured. This is normal, so don't be alarmed as the condition only occurs during the first period of use.

10 ASH REMOVAL

When removing the ashes from a hot fire bed, try to ensure that some of the hot embers remain in the stove as this will facilitate re-lighting.

NEVER LET THE ASHPAN OVERFILL.

There should always be a good air space between the top of the ashpan and the underside of the grate. Failure to do this will cause premature deterioration of the grate and will make it difficult to empty the ashpan. Your Dovre 500MFR is equipped with a special grate mechanism which allows ashes to be riddled into the ashpan whilst the stove door is closed. The riddling control lever is situated on the right hand side of the front of the stove above the ashpit door. Gently move the lever backwards and forwards to clear the grate of ash.
To remove the ashpan, see fig 7, open the ashpit door and carefully remove the ashpan using the handle tool provided. Ashes must be disposed of carefully and it is a good idea to purchase an ash carrying box for this purpose. Your Dovre dealer will normally be able to supply a suitable ashpan carrier box.
After replacing the empty ashpan in the ashpit compartment, ensure the ashpit door is fully closed.

11 MANAGING YOUR WOOD SUPPLIES

If you are buying wood from a log merchant, try to ensure that the wood has been seasoned for at least 2 years. 3 years is even better. The wood should preferably be cut to lengths of 35 to 38cms and split to a width of between 5 and 10cms. Store your wood under cover to protect from rain but ideally the wood should be stored in. a place where the wind will be allowed to freely ventilate the stack.
Try to obtain hardwoods such as oak, elm, beech or ash. These woods will provide more calorific value per cubic meter than softwoods.

12 TYPES OF SUITABLE SOLID FUEL

Almost all types of smokeless fuels can be used on your 500MFR.
However, avoid the use of petroleum coke.
Anthracite medium or large nuts is an excellent fuel for good heat output but it is somewhat difficult to get started.

NEVER USE HOUSE COAL (BITUMINOUS COAL) ON THE DOVRE 5OOMFR

Fig. 7

5

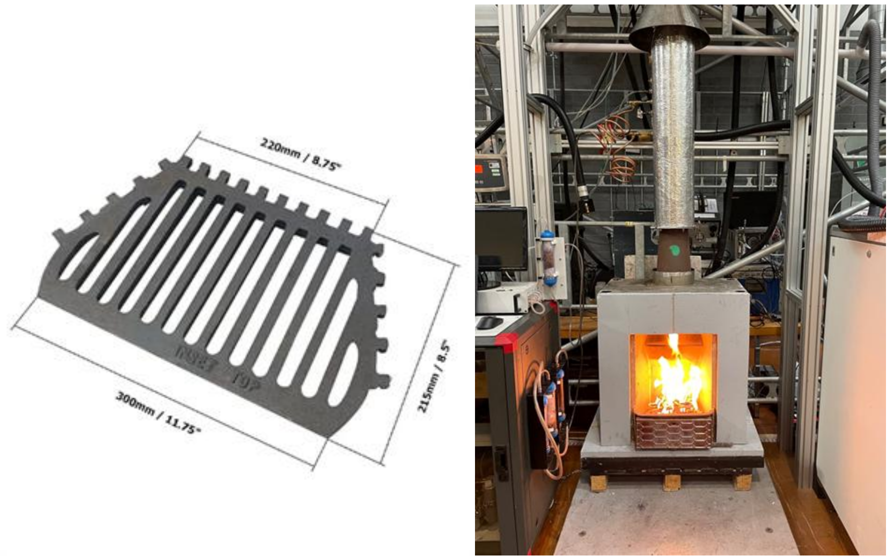
Hunter Oakwood Stove

Specification for the Hunter Oakwood stove (Figure A-2- 2) is not available, we believe it is a 1997 model and as per manufacturer's instructions the turbo baffle system was blocked for the test programme.

Figure A-2- 2 - Images of the Hunter Oakwood Stove used in the test programme

Parkray Paragon

Figure A-2- 3- Images of the Parkray Paragon 16 inch Fire Grate (Open Fire) used in the test programme



Cromwell Fire Basket

Figure A-2- 4 - Images of the Cromwell Fire basket (Open Fire) used in the test programme

Coalbrookdale Little Wenlock

Figure A-2- 5 - Images of the Coalbrookedale Little Wenlock used in the test programme

Redfyre (Gazco) Kensal 20 RF-KEN20M

Figure A-2- 6 - Images of the Redfyre (Gazco) Kensal 20 RF-KEN20M used in the test programme

Hunter Aspect 5

Figure A-2- 7 - Images of the Hunter Aspect 5 in wood only configuration (left) and multifuel configuration (right)

Figure A-2- 8 - Dimensions of the Hunter Aspect 5

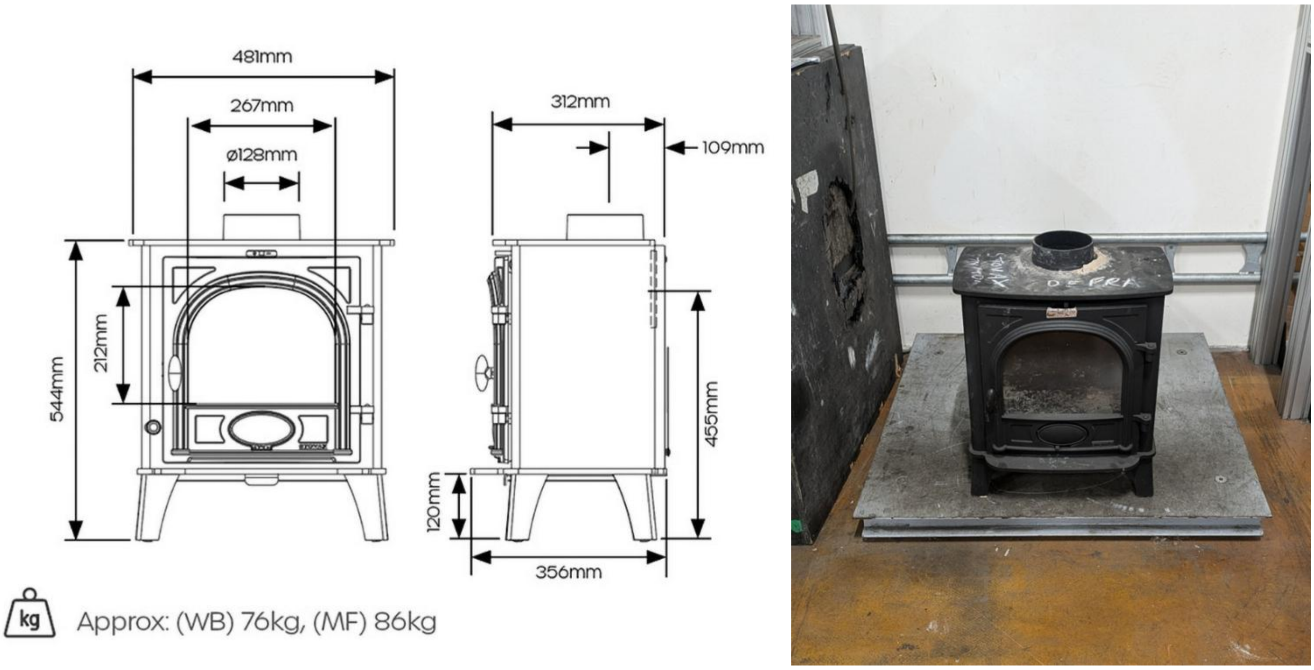
Hunter Aspect 8

Figure A-2- 9 - Images of the Hunter Aspect 8 in wood only configuration (left) and multifuel configuration (right)

Figure A-2- 10 – Dimensions of the Hunter Aspect 8

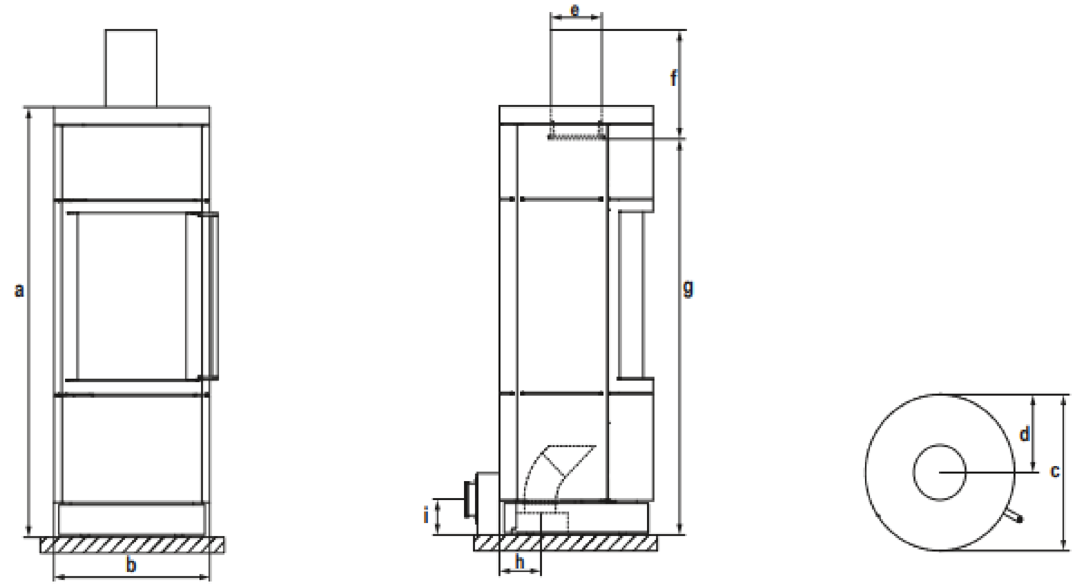
Stovax Stockton 5 Eco

Figure A-2-11 – Image of Stovax Stockton 5 Eco and specifications



Hase Sila IQ+

Figure A-2- 12 - Specifications of Hase Sila IQ+ used in work programme



Maße & Gewichte · Dimensions & poids · Dimensions & weights · Dimensioni & pesi · Afmetingen & gewichten

Maße in mm, Gewichte in kg · Dimensions en cm, poids en kg · Dimensions in cm, weights in kg · Dimensioni in cm, pesi in kg · Afmetingen in cm, Gewichten in kg

a	**Höhe** · Hauteur · Height · Altezza · Hoogte	126
b	**Breite** · Largeur · Width · Larghezza · Breedte	47
c	**Tiefe** · Profondeur · Depth · Profondità · Diepte	47
d	**Distanz Ofenrückwand - Rauchrohrmitte** · Distances de l´arrière du poêle - centre tuyau · Distance from rear stove wall - flue pipe centre · Distanza schienale stufa - centro del tubo · Afstand achterkant kachel - midden rookkanaal	23,5
e	**Rauchrohr-Durchmesser** · Diamètre du tuyau de fumée · Flue pipe diameter · Diametro tubo di uscita fumi · Diameter van het rookkanaal	15
f	**Vertikale Rauchrohrlänge** · Raccord vertical du conduit de fumée · Vertical flue pipe length · Raccordo verticale della canna fumaria · Verbindingsstuk verticaal rookkanaal	33
g	**Rauchrohranschlusshöhe** · Hauteur de raccordement · Flue pipe connection height · Altezza allaccio tubi · Rookkanaal aansluithoogte	118
h	**Externe Luftzufuhr, Anschlussbereich unten** / Ø* · Arrivée d'air externe par le bas · External air supply connector connection area below · Aria di combustione esterna, zona di allaccio inferiore · Externe luchttoevoer aansluithoogte Aansluitbereik beneden	13,5/10
i	**Externe Luftzufuhr, Anschlusshöhe hinten** / Ø* · Arrivée d'air externe arrière · External air supply connector height on the back · Aria di combustione esterna, altezza attacco posteriore · Externe luchttoevoer aansluithoogte achteraan	10/10
	Feuerraum (HxBxT) · Foyer (HxLxP) · Fire box (HxWxD) · Interno stufa (AxLxP) · Brandkamer (HxBxD)	40x31x28
	Gewicht (Stahl/Keramik/Speckstein) · Poids (acier/céramique/pierre ollaire) · Weight (steel/ceramic/soapstone) · Peso (acciaio/maiolica/pietra ollare) · Gewicht (staal/tegels/speksteen)	146/180/200

* Rohrdurchmesser HASE Luftsystem · Diamètre du tuyau du système d'air HASE · Diametro presa d'aria esterna HASE · Pipe diameter of HASE ventilation system · Buisdiameter van het HASE-ventilatiesysteem

Island Stoves, Ramsey Pellet Appliance

Figure A-2- 13 - Specification of Island Stoves Ramsey Pellet Appliance

A.3 POLLUTANT MEASUREMENTS DATASET (WP3 STOVES)

Table A-3-1 : Charnwood C-4 blu – Modern Stove test results – Wood Briquettes

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	1,250	1,075	1,560	1,295
CO2 (Dry, weighted) g/GJ	Appliance outlet	77,673	79,742	85,323	80,913
HC (Dry, weighted) g/GJ	Appliance outlet	176	54	78	103
NOx (Dry, weighted) g/GJ	Appliance outlet	44	40	36	40
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	30	30	45	35
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	1,250	1,075	1,560	1,295
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	62,549	65,041	87,335	71,642
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	82	84	81	82
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	116	76	88	93
PM (AO) g/GJ	Appliance outlet	82	69	74	75
PM (DT) g/GJ	Dilution tunnel	136	113	114	121
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	121	94	130	121
PAH's mg/GJ	Dilution tunnel	2,415	1,653	5,498	2,415
SO2 g/GJ	Dilution tunnel	6	7	8	6
Condensable PM g/GJ	Dilution tunnel	54	44	41	54
Total PM, g/GJ	Dilution tunnel	87	80	96	87
PM10, g/GJ	Dilution tunnel	115	95	103	115
PM2.5, g/GJ	Dilution tunnel	110	90	101	110
PM1, g/GJ	Dilution tunnel	104	83	95	104
B[a]P mg/GJ	Dilution tunnel	29	25	132	29
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	39	33	146	39
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	20	16	75	20
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	30	24	147	30
LRTAP PAH total mg/GJ	Dilution tunnel	117	98	500	117

Table A-3-2 : Dovre 500MRF – Middle Stove test results – Wood Briquettes

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	1,313	1,118	1,093	1,175
CO2 (Dry, weighted) g/GJ	Appliance outlet	72,314	68,835	69,800	70,316
HC (Dry, weighted) g/GJ	Appliance outlet	121	78	77	92
NOx (Dry, weighted) g/GJ	Appliance outlet	49	41	57	49
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	44	46	49	46
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	1,313	1,118	1,093	1,175
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	74,297	70,085	76,340	73,574
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	59	52	49	53
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	101	83	66	83
PM (AO) g/GJ	Appliance outlet	99	72	96	89
PM (DT) g/GJ	Dilution tunnel	167	121	99	129
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	382	211	145	246
PAH's mg/GJ	Dilution tunnel	1,054	1,064	684	934
SO2 g/GJ	Dilution tunnel	3	6	5	5
Condensable PM g/GJ	Dilution tunnel	69	48	3	40
Total PM, g/GJ	Dilution tunnel	141	132	101	125
PM10, g/GJ	Dilution tunnel	149	108	90	116
PM2.5, g/GJ	Dilution tunnel	144	106	87	113
PM1, g/GJ	Dilution tunnel	135	99	82	105
B[a]P mg/GJ	Dilution tunnel	21	20	13	18
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	32	30	17	26
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	16	14	9	13
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	22	23	13	19
LRTAP PAH total mg/GJ	Dilution tunnel	91	88	51	77

A-3-3 - Hunter Oakwood - Old Stove test results – Wood Briquettes

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	1,192	1,110	1,162	1,155
CO2 (Dry, weighted) g/GJ	Appliance outlet	77,003	71,610	72,014	73,542
HC (Dry, weighted) g/GJ	Appliance outlet	33	32	32	32
NOx (Dry, weighted) g/GJ	Appliance outlet	39	39	27	35
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	49	45	41	45
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	1,192	1,110	1,162	1,155
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	83,016	74,250	72,208	76,491
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	55	46	49	50
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	38	34	59	43
PM (AO) g/GJ	Appliance outlet	75	112	81	89
PM (DT) g/GJ	Dilution tunnel	165	137	118	140
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	145	109	81	112
PAH's mg/GJ	Dilution tunnel	632	571	1,087	763
SO2 g/GJ	Dilution tunnel	6	6	5	6
Condensable PM g/GJ	Dilution tunnel	90	25	37	51
Total PM, g/GJ	Dilution tunnel	145	137	118	133
PM10, g/GJ	Dilution tunnel	153	132	103	129
PM2.5, g/GJ	Dilution tunnel	149	129	100	126
PM1, g/GJ	Dilution tunnel	143	122	94	120
B[a]P mg/GJ	Dilution tunnel	15	11	15	13
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	24	22	27	24
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	11	10	13	12
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	16	15	19	17
LRTAP PAH total mg/GJ	Dilution tunnel	66	59	74	66

A-3-4 - Parkwood Paragon - Open fire test results – Wood Briquettes

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	904	958	970	944
CO2 (Dry, weighted) g/GJ	Appliance outlet	66,839	67,445	66,092	66,792
HC (Dry, weighted) g/GJ	Appliance outlet	81	109	97	96
NOx (Dry, weighted) g/GJ	Appliance outlet	47	39	37	41
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	57	51	51	53
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	904	958	970	944
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	77,719	73,314	76,338	75,790
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	59	60	64	61
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	108	140	165	138
PM (AO) g/GJ	Appliance outlet	71	87	84	81
PM (DT) g/GJ	Dilution tunnel	167	212	214	198
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	15	6	6	9
PAH's mg/GJ	Dilution tunnel	658	723	696	693
SO2 g/GJ	Dilution tunnel	8	7	6	7
Condensable PM g/GJ	Dilution tunnel	95	126	130	117
Total PM, g/GJ	Dilution tunnel	214	225	264	234
PM10, g/GJ	Dilution tunnel	156	203	201	187
PM2.5, g/GJ	Dilution tunnel	152	200	198	184
PM1, g/GJ	Dilution tunnel	145	191	189	175
B[a]P mg/GJ	Dilution tunnel	7	8	10	8
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	8	8	12	9
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	5	5	8	6
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	7	7	10	8
LRTAP PAH total mg/GJ	Dilution tunnel	27	28	40	32

Table A-3-5: Moden Hunter – Modern Stove test results – High Sulphur MSF (Bright Flame)

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	4,108	5,096	4,400	4,534
CO2 (Dry, weighted) g/GJ	Appliance outlet	76,903	75,352	79,291	77,182
HC (Dry, weighted) g/GJ	Appliance outlet	824	1,083	902	936
NOx (Dry, weighted) g/GJ	Appliance outlet	161	-	3	54
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	197	188	176	187
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	4,108	5,096	4,400	4,534
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	120,108	112,019	103,787	111,971
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	1,331	1,557	1,397	1,428
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	998	1,561	1,012	1,190
PM (AO) g/GJ	Appliance outlet	241	320	276	279
PM (DT) g/GJ	Dilution tunnel	639	697	622	653
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	81	17	17	38
PAH's mg/GJ	Dilution tunnel	7,585	7,589	5,451	6,875
SO2 g/GJ	Dilution tunnel	1,930	2,081	1,961	1,991
Condensable PM g/GJ	Dilution tunnel	443	377	346	389
Total PM, g/GJ	Dilution tunnel	566	529	527	541
PM10, g/GJ	Dilution tunnel	626	679	610	638
PM2.5, g/GJ	Dilution tunnel	620	679	608	636
PM1, g/GJ	Dilution tunnel	500	519	528	515
B[a]P mg/GJ	Dilution tunnel	272	546	239	353
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	106	87	86	93
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	63	116	52	77
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	128	56	67	83
LRTAP PAH total mg/GJ	Dilution tunnel	569	804	443	605

Table A-3-6: Hunter Aspect 5 – Modern Stove test results – Low Sulphur MSF

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry) g/GJ	Appliance outlet	5,504	6,085	5,508	5,699
CO2 (Dry) g/GJ	Appliance outlet	73,038	73,320	73,367	73,242
HC (Dry) g/GJ	Appliance outlet	921	1,061	1,085	1,022
NOx (Dry) g/GJ	Appliance outlet	108	140	130	126
NOx (ECL Dry) g/GJ	Dilution tunnel	114	155	152	140
CO (ECL Dry) g/GJ	Dilution tunnel	5,504	6,085	5,508	5,699
CO2 (ECL Dry) g/GJ	Dilution tunnel	77,394	105,164	96,093	92,884
SO2 (ECL Dry) g/GJ	Dilution tunnel	875	663	669	736
HC (ECL Dry) g/GJ	Dilution tunnel	1,250	462	529	747
CO (Dry, weighted) g/GJ	Appliance outlet	5,041	5,913	5,526	5,493
CO2 (Dry, weighted) g/GJ	Appliance outlet	78,786	72,302	74,474	75,187
HC (Dry, weighted) g/GJ	Appliance outlet	1,007	1,169	1,234	1,136
NOx (Dry, weighted) g/GJ	Appliance outlet	100	141	123	121
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	104	155	134	131
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	5,041	5,913	5,526	5,493
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	87,585	107,747	102,448	99,260
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	601	571	600	591
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	976	500	661	712
PM (AO) g/GJ	Appliance outlet	193	243	173	203
PM (DT) g/GJ	Dilution tunnel	499	531	583	538
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	120	65	166	117
PAH's mg/GJ	Dilution tunnel	5,793	7,949	9,950	7,897
SO2 g/GJ	Dilution tunnel	872	739	790	800
Condensable PM g/GJ	Dilution tunnel	306	288	410	335
Total PM, g/GJ	Dilution tunnel	318	256	437	337
PM10, g/GJ	Dilution tunnel	484	500	559	514
PM2.5, g/GJ	Dilution tunnel	479	493	549	507
PM1, g/GJ	Dilution tunnel	434	413	448	432

Condensable PM II g/GJ	Not Applicable	124	13	264	134
B[a]P mg/GJ	Dilution tunnel	266	397	423	362
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	102	153	164	140
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	69	106	141	105
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	53	77	101	77
LRTAP PAH total mg/GJ	Dilution tunnel	490	733	829	684

Table A-3-2: Hunter Aspect 5 – Modern Stove test results – Coal Trebles

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	4,165	4,108	3,785	4,019
CO2 (Dry, weighted) g/GJ	Appliance outlet	74,966	74,003	76,187	75,052
HC (Dry, weighted) g/GJ	Appliance outlet	644	324	210	393
NOx (Dry, weighted) g/GJ	Appliance outlet	199	177	108	161
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	118	135	134	129
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	4,165	4,108	3,785	4,019
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	72,190	74,515	80,312	75,672
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	200	187	192	193
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	480	365	393	413
PM (AO) g/GJ	Appliance outlet	312	136	146	198
PM (DT) g/GJ	Dilution tunnel	347	337	339	341
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	10	47	6	21
PAH's mg/GJ	Dilution tunnel	5,430	4,307	7,762	5,833
SO2 g/GJ	Dilution tunnel	220	233	223	226
Condensable PM g/GJ	Dilution tunnel	35	201	192	143
Total PM, g/GJ	Dilution tunnel	293	302	279	291
PM10, g/GJ	Dilution tunnel	316	311	299	309
PM2.5, g/GJ	Dilution tunnel	305	302	290	299
PM1, g/GJ	Dilution tunnel	208	253	259	240
B[a]P mg/GJ	Dilution tunnel	140	112	192	148
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	204	134	281	206
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	127	78	193	133

Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	141	98	186	142
LRTAP PAH total mg/GJ	Dilution tunnel	611	423	853	629

Table A-3-3: Hunter Aspect 5 – Modern Stove test results – Coffee Logs

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	2,091	1,274	2,196	1,854
CO2 (Dry, weighted) g/GJ	Appliance outlet	77,179	78,130	76,285	77,198
HC (Dry, weighted) g/GJ	Appliance outlet	138	69	93	100
NOx (Dry, weighted) g/GJ	Appliance outlet	145	141	154	147
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	135	144	197	159
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	2,091	1,274	2,196	1,854
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	83,122	84,965	98,454	88,847
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	120	22	29	57
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	329	118	134	194
PM (AO) g/GJ	Appliance outlet	62	52	45	53
PM (DT) g/GJ	Dilution tunnel	163	160	141	155
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	42	31	54	42
PAH's mg/GJ	Dilution tunnel	7,438	2,474	3,009	4,307
SO2 g/GJ	Dilution tunnel	123	35	42	67
Condensable PM g/GJ	Dilution tunnel	101	108	95	101
Total PM, g/GJ	Dilution tunnel	117	119	108	115
PM10, g/GJ	Dilution tunnel	148	143	121	137
PM2.5, g/GJ	Dilution tunnel	147	135	120	134
PM1, g/GJ	Dilution tunnel	131	129	106	122
B[a]P mg/GJ	Dilution tunnel	138	35	33	69
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	123	35	34	64
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	76	19	19	38
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	122	33	30	62
LRTAP PAH total mg/GJ	Dilution tunnel	458	122	117	232

Table A-3-4: Hunter Aspect 5 – Modern Stove test results – Anthracite

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	4,423	4,439	4,241	4,368
CO2 (Dry, weighted) g/GJ	Appliance outlet	74,725	76,824	77,876	76,475
HC (Dry, weighted) g/GJ	Appliance outlet	175	105	135	138
NOx (Dry, weighted) g/GJ	Appliance outlet	95	60	55	70
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	85	101	115	100
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	4,423	4,439	4,241	4,368
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	85,852	92,456	96,288	91,532
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	415	438	467	440
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	562	391	775	576
PM (AO) g/GJ	Appliance outlet	16	13	10	13
PM (DT) g/GJ	Dilution tunnel	70	64	99	78
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	3	20	10	11
PAH's mg/GJ	Dilution tunnel	1,702	957	1,534	1,398
SO2 g/GJ	Dilution tunnel	500	497	539	512
Condensable PM g/GJ	Dilution tunnel	54	51	90	65
Total PM, g/GJ	Dilution tunnel	53	39	45	46
PM10, g/GJ	Dilution tunnel	55	56	74	61
PM2.5, g/GJ	Dilution tunnel	53	51	71	58
PM1, g/GJ	Dilution tunnel	45	44	62	51
B[a]P mg/GJ	Dilution tunnel	10	6	5	7
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	11	17	8	12
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	5	6	3	5
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	10	6	6	7
LRTAP PAH total mg/GJ	Dilution tunnel	36	34	23	31

Table A-3-10: Hunter Aspect 5 – Modern Stove test results – Wood Briquettes

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	2,855	2,542	2,812	2,736

CO2 (Dry, weighted) g/GJ	Appliance outlet	77,122	74,281	79,311	76,905
HC (Dry, weighted) g/GJ	Appliance outlet	121	351	155	209
NOx (Dry, weighted) g/GJ	Appliance outlet	30	94	20	48
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	39	48	54	47
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	2,855	2,542	2,812	2,736
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	79,154	88,034	103,780	90,323
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	102	133	130	122
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	475	603	468	515
PM (AO) g/GJ	Appliance outlet	116	148	98	121
PM (DT) g/GJ	Dilution tunnel	217	150	287	218
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	315	188	85	196
PAH's mg/GJ	Dilution tunnel	2,643	21,785	27,490	17,306
SO2 g/GJ	Dilution tunnel	16	7	6	9
Condensable PM g/GJ	Dilution tunnel	101	2	189	97
Total PM, g/GJ	Dilution tunnel	117	128	269	171
PM10, g/GJ	Dilution tunnel	211	141	278	210
PM2.5, g/GJ	Dilution tunnel	204	138	271	204
PM1, g/GJ	Dilution tunnel	188	119	240	182
B[a]P mg/GJ	Dilution tunnel	122	491	406	340
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	127	386	422	311
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	73	297	379	250
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	89	603	603	432
LRTAP PAH total mg/GJ	Dilution tunnel	411	1,776	1,810	1,332

Table A-3-11: Hunter Aspect 5 – Modern Stove test results – Wood Logs (Wet)

Pollutant + Method	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
CO (Dry, weighted) g/GJ	Appliance outlet	3337	4214	4205	3919
CO2 (Dry, weighted) g/GJ	Appliance outlet	71476	69729	68772	69993
HC (Dry, weighted) g/GJ	Appliance outlet	788	1531	1062	1127
NOx (Dry, weighted) g/GJ	Appliance outlet	37	64	41	47
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	54	54	56	55
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	3337	4214	4205	3919

CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	84934	99615	99200	94583
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	120	194	157	157
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	762	1249	1174	1062
PM (AO) g/GJ	Appliance outlet	88	283	140	170
PM (DT) g/GJ	Dilution tunnel	358	407	601	455
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	11	3	3	6
PAH's mg/GJ	Dilution tunnel	4120	3459	3368	3649
SO2 g/GJ	Dilution tunnel	5	4	3	4
Condensable PM g/GJ	Dilution tunnel	270	124	461	285
Total PM, g/GJ	Dilution tunnel	338	514	477	443
PM10, g/GJ	Dilution tunnel	342	385	571	432
PM2.5, g/GJ	Dilution tunnel	340	381	570	430
PM1, g/GJ	Dilution tunnel	284	317	539	380
B[a]P mg/GJ	Dilution tunnel	18	17	15	17
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	21	18	18	19
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	14	13	13	13
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	22	13	18	17
LRTAP PAH total mg/GJ	Dilution tunnel	74	61	64	66

Table A-3-12: Hunter Aspect 5 – Modern Stove test results – Wood Logs (Seasoned)

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	2176	2310	1299	1928
CO2 (Dry, weighted) g/GJ	Appliance outlet	72723	73667	79415	75268
HC (Dry, weighted) g/GJ	Appliance outlet	58	74	151	94
NOx (Dry, weighted) g/GJ	Appliance outlet	58	40	60	53
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	81	48	66	65
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	2176	2310	1299	1928
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	122951	87389	92834	101058
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	151	114	74	113
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	337	179	94	203
PM (AO) g/GJ	Appliance outlet	29	26	28	28
PM (DT) g/GJ	Dilution tunnel	165	87	64	105

Dioxins & Furans nqTEQ/GJ	Dilution tunnel	35	3	6	15
PAH's mg/GJ	Dilution tunnel	4916	1640	2564	3040
SO2 g/GJ	Dilution tunnel	9	3	5	6
Condensable PM g/GJ	Dilution tunnel	135	60	37	77
Total PM, g/GJ	Dilution tunnel	74	74	58	68
PM10, g/GJ	Dilution tunnel	103	62	46	70
PM2.5, g/GJ	Dilution tunnel	103	62	43	69
PM1, g/GJ	Dilution tunnel	97	57	38	64
B[a]P mg/GJ	Dilution tunnel	86	8	39	86
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	49	5	29	49
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	32	3	18	32
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	75	11	28	75
LRTAP PAH total mg/GJ	Dilution tunnel	242	26	114	242

Table A-3-13: Hunter Aspect 5 – Modern Stove test results – Wood Logs (Dry)

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	2217	2861	2967	2682
CO2 (Dry, weighted) g/GJ	Appliance outlet	81805	82255	79576	81212
HC (Dry, weighted) g/GJ	Appliance outlet	19	71	48	46
NOx (Dry, weighted) g/GJ	Appliance outlet	12	44	41	32
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	50	68	52	56
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	2217	2861	2967	2682
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	90151	112375	100670	101065
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	29	80	96	68
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	169	551	495	405
PM (AO) g/GJ	Appliance outlet	54	75	65	65
PM (DT) g/GJ	Dilution tunnel	158	241	204	201
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	88	56	7	50
PAH's mg/GJ	Dilution tunnel	6283	10936	12687	9968
SO2 g/GJ	Dilution tunnel	12	10	9	11
Condensable PM g/GJ	Dilution tunnel	104	167	139	136
Total PM, g/GJ	Dilution tunnel	104	175	151	143

PM10, g/GJ	Dilution tunnel	131	228	173	177
PM2.5, g/GJ	Dilution tunnel	124	223	170	172
PM1, g/GJ	Dilution tunnel	112	198	154	155
B[a]P mg/GJ	Dilution tunnel	102	306	272	227
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	84	191	182	152
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	47	127	116	96
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	96	261	279	212
LRTAP PAH total mg/GJ	Dilution tunnel	329	884	848	687

Table A-3-14: Hunter Aspect 8 (nominal output) – Modern Stove test results – High Sulphur MSF

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	3,942	3,460	3,022	3,475
CO2 (Dry, weighted) g/GJ	Appliance outlet	72,307	75,601	72,540	73,483
HC (Dry, weighted) g/GJ	Appliance outlet	925	1,239	1,053	1,072
NOx (Dry, weighted) g/GJ	Appliance outlet	124	122	121	122
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	129	104	106	113
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	3,942	3,460	3,022	3,475
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	70,721	58,676	58,270	62,556
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	1,626	1,101	1,217	1,315
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	2,021	1,510	1,431	1,654
PM (AO) g/GJ	Appliance outlet	342	349	322	338
PM (DT) g/GJ	Dilution tunnel	606	338	281	408
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	5	3	3	3
PAH's mg/GJ	Dilution tunnel	5,720	3,147	4,152	4,340
SO2 g/GJ	Dilution tunnel	1,928	1,474	1,530	1,644
Condensable PM g/GJ	Dilution tunnel	477	-12	-41	141
Total PM, g/GJ	Dilution tunnel	448	230	219	299
PM10, g/GJ	Dilution tunnel	586	328	270	395
PM2.5, g/GJ	Dilution tunnel	583	327	268	393
PM1, g/GJ	Dilution tunnel	412	244	192	283
B[a]P mg/GJ	Dilution tunnel	217	123	162	167
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	145	94	123	121

Benzo(k)fluoranthene mg/GJ	Dilution tunnel	2	31	41	25
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	46	30	40	39
LRTAP PAH total mg/GJ	Dilution tunnel	409	278	367	351

Table A-3-15: Hunter Aspect 8 (nominal output) – Modern Stove test results – Low Sulphur MSF

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	2,865	5,112	4,573	4,183
CO2 (Dry, weighted) g/GJ	Appliance outlet	76,446	71,479	73,977	73,967
HC (Dry, weighted) g/GJ	Appliance outlet	740	1,135	768	881
NOx (Dry, weighted) g/GJ	Appliance outlet	127	184	119	143
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	34	139	121	98
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	2,865	5,112	4,573	4,183
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	58,839	79,990	72,845	70,558
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	1,081	855	788	908
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	12,207	1,925	1,591	5,241
PM (AO) g/GJ	Appliance outlet	126	222	119	156
PM (DT) g/GJ	Dilution tunnel	466	336	272	358
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	20	4	6	10
PAH's mg/GJ	Dilution tunnel	5,221	6,581	5,604	5,802
SO2 g/GJ	Dilution tunnel	1,062	977	873	971
Condensable PM g/GJ	Dilution tunnel	431	114	153	233
Total PM, g/GJ	Dilution tunnel	456	271	251	326
PM10, g/GJ	Dilution tunnel	438	321	260	339
PM2.5, g/GJ	Dilution tunnel	432	316	258	335
PM1, g/GJ	Dilution tunnel	390	252	221	287
B[a]P mg/GJ	Dilution tunnel	140	123	112	125
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	120	94	98	104
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	33	32	32	32
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	17	37	31	28
LRTAP PAH total mg/GJ	Dilution tunnel	311	287	272	290

Table A-3-16: Hunter Aspect 8 (nominal output) – Modern Stove test results – Coal Trebles

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	3,136	3,362	3,250	3,249
CO2 (Dry, weighted) g/GJ	Appliance outlet	73,451	72,050	75,285	73,595
HC (Dry, weighted) g/GJ	Appliance outlet	324	417	537	426
NOx (Dry, weighted) g/GJ	Appliance outlet	90	90	104	94
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	88	95	83	89
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	3,136	3,362	3,250	3,249
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	54,507	53,050	50,485	52,680
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	156	209	230	198
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	649	738	1,107	831
PM (AO) g/GJ	Appliance outlet	156	161	213	176
PM (DT) g/GJ	Dilution tunnel	319	350	419	362
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	18	16	17	17
PAH's mg/GJ	Dilution tunnel	2,038	8,671	8,350	6,353
SO2 g/GJ	Dilution tunnel	152	216	223	197
Condensable PM g/GJ	Dilution tunnel	163	189	206	186
Total PM, g/GJ	Dilution tunnel	170	230	304	235
PM10, g/GJ	Dilution tunnel	288	318	395	334
PM2.5, g/GJ	Dilution tunnel	272	306	386	322
PM1, g/GJ	Dilution tunnel	209	249	259	239
B[a]P mg/GJ	Dilution tunnel	67	77	87	77
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	137	131	146	138
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	85	77	89	84
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	80	78	80	79
LRTAP PAH total mg/GJ	Dilution tunnel	369	363	402	378

Table A-3-17: Hunter Aspect 8 (nominal output) – Modern Stove test results – Coffee Logs

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average

CO (Dry, weighted) g/GJ	Appliance outlet	1,802	2,164	1,680	1,882
CO2 (Dry, weighted) g/GJ	Appliance outlet	74,319	76,294	76,859	75,824
HC (Dry, weighted) g/GJ	Appliance outlet	133	283	61	159
NOx (Dry, weighted) g/GJ	Appliance outlet	199	178	210	196
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	175	178	193	182
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	1,802	2,164	1,680	1,882
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	85,373	83,342	88,939	85,885
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	93	100	85	93
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	188	302	86	192
PM (AO) g/GJ	Appliance outlet	27	22	27	26
PM (DT) g/GJ	Dilution tunnel	123	112	113	116
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	43	47	25	38
PAH’s mg/GJ	Dilution tunnel	1,372	2,582	341	1,431
SO2 g/GJ	Dilution tunnel	118	127	107	117
Condensable PM g/GJ	Dilution tunnel	96	89	86	90
Total PM, g/GJ	Dilution tunnel	88	61	84	78
PM10, g/GJ	Dilution tunnel	105	91	106	100
PM2.5, g/GJ	Dilution tunnel	104	89	103	99
PM1, g/GJ	Dilution tunnel	69	57	83	70
B[a]P mg/GJ	Dilution tunnel	10	24	2	12
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	17	28	3	16
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	10	17	2	9
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	16	28	2	15
LRTAP PAH total mg/GJ	Dilution tunnel	53	97	8	53

Table A-3-18 : Hunter Aspect 8 (nominal output) – Modern Stove test results – Anthracite

Pollutant + Method	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
CO (Dry, weighted) g/GJ	Appliance outlet	6,372	6,679	4,619	5,890
CO2 (Dry, weighted) g/GJ	Appliance outlet	72,584	65,079	78,113	71,925
HC (Dry, weighted) g/GJ	Appliance outlet	402	621	293	439
NOx (Dry, weighted) g/GJ	Appliance outlet	93	80	84	86

NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	95	85	123	101
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	6,372	6,679	4,619	5,890
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	70,849	71,398	83,887	75,378
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	429	482	515	475
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	440	753	1,357	850
PM (AO) g/GJ	Appliance outlet	29	25	17	24
PM (DT) g/GJ	Dilution tunnel	53	92	70	72
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	7	6	13	9
PAH's mg/GJ	Dilution tunnel	812	1,122	1,739	1,224
SO2 g/GJ	Dilution tunnel	532	516	822	623
Condensable PM g/GJ	Dilution tunnel	24	67	53	48
Total PM, g/GJ	Dilution tunnel	57	108	85	83
PM10, g/GJ	Dilution tunnel	45	82	58	61
PM2.5, g/GJ	Dilution tunnel	43	79	54	59
PM1, g/GJ	Dilution tunnel	35	67	48	50
B[a]P mg/GJ	Dilution tunnel	3	7	6	5
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	7	9	20	12
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	3	4	6	4
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	4	6	11	7
LRTAP PAH total mg/GJ	Dilution tunnel	16	26	43	29

Table A-3-19: Hunter Aspect 8 (nominal output)– Modern Stove test results – Wood Briquettes

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	1,043	1,849	1,416	1,436
CO2 (Dry, weighted) g/GJ	Appliance outlet	79,015	76,643	77,899	77,853
HC (Dry, weighted) g/GJ	Appliance outlet	63	243	91	132
NOx (Dry, weighted) g/GJ	Appliance outlet	29	84	52	55
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	55	38	42	45
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	1,043	1,849	1,416	1,436
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	85,243	75,537	84,889	81,890
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	94	28	70	64

HC (ECL Dry, weighted) g/GJ	Dilution tunnel	96	300	122	173
PM (AO) g/GJ	Appliance outlet	80	147	105	111
PM (DT) g/GJ	Dilution tunnel	290	239	422	317
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	91	75	62	76
PAH's mg/GJ	Dilution tunnel	4,688	7,419	6,308	6,138
SO2 g/GJ	Dilution tunnel	4	6	6	6
Condensable PM g/GJ	Dilution tunnel	210	92	316	206
Total PM, g/GJ	Dilution tunnel	141	223	197	187
PM10, g/GJ	Dilution tunnel	233	218	391	281
PM2.5, g/GJ	Dilution tunnel	232	216	382	277
PM1, g/GJ	Dilution tunnel	207	201	316	241
B[a]P mg/GJ	Dilution tunnel	73	145	141	120
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	58	152	138	116
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	32	92	81	69
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	61	153	142	119
LRTAP PAH total mg/GJ	Dilution tunnel	224	542	503	423

Table A-3-20: Hunter Aspect 8 (nominal output)– Modern Stove test results – Wood Logs (Wet)

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	3337	4214	4205	3919
CO2 (Dry, weighted) g/GJ	Appliance outlet	71476	69729	68772	69993
HC (Dry, weighted) g/GJ	Appliance outlet	788	1531	1062	1127
NOx (Dry, weighted) g/GJ	Appliance outlet	37	64	41	47
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	54	54	56	55
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	3337	4214	4205	3919
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	84934	99615	99200	94583
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	120	194	157	157
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	762	1249	1174	1062
PM (AO) g/GJ	Appliance outlet	88	283	140	170
PM (DT) g/GJ	Dilution tunnel	358	407	601	455
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	11	3	3	6
PAH's mg/GJ	Dilution tunnel	4120	3459	3368	3649

SO2 g/GJ	Dilution tunnel	5	4	3	4
Condensable PM g/GJ	Dilution tunnel	270	124	461	285
Total PM, g/GJ	Dilution tunnel	338	514	477	443
PM10, g/GJ	Dilution tunnel	342	385	571	432
PM2.5, g/GJ	Dilution tunnel	340	381	570	430
PM1, g/GJ	Dilution tunnel	284	317	539	380
B[a]P mg/GJ	Dilution tunnel	18	17	15	17
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	21	18	18	19
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	14	13	13	13
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	22	13	18	17
LRTAP PAH total mg/GJ	Dilution tunnel	74	61	64	66

Table A-3-21: Hunter Aspect 8 (nominal output)– Modern Stove test results – Wood Logs (Seasoned)

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	105159	86217	91547	94307
CO2 (Dry, weighted) g/GJ	Appliance outlet	147	154	75	125
HC (Dry, weighted) g/GJ	Appliance outlet	273	183	89	182
NOx (Dry, weighted) g/GJ	Appliance outlet	2176	2310	1299	1928
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	72723	73667	79415	75268
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	58	74	151	94
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	58	40	60	53
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	81	48	66	65
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	2176	2310	1299	1928
PM (AO) g/GJ	Appliance outlet	122951	87389	92834	101058
PM (DT) g/GJ	Dilution tunnel	151	114	74	113
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	337	179	94	203
PAH's mg/GJ	Dilution tunnel	29	26	28	28
SO2 g/GJ	Dilution tunnel	165	87	64	105
Condensable PM g/GJ	Dilution tunnel	35	3	6	15
Total PM, g/GJ	Dilution tunnel	4916	1640	2564	3040
PM10, g/GJ	Dilution tunnel	9	3	5	6
PM2.5, g/GJ	Dilution tunnel	135	60	37	77

PM1, g/GJ	Dilution tunnel	74	74	58	68
B[a]P mg/GJ	Dilution tunnel	86	8	39	44
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	49	5	29	28
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	32	3	18	18
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	75	11	28	38
LRTAP PAH total mg/GJ	Dilution tunnel	242	26	114	127

Table A-3-22: Hunter Aspect 8 (nominal output)– Modern Stove test results – Wood Logs (Dry)

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	2217	2861	2967	2682
CO2 (Dry, weighted) g/GJ	Appliance outlet	81805	82255	79576	81212
HC (Dry, weighted) g/GJ	Appliance outlet	19	71	48	46
NOx (Dry, weighted) g/GJ	Appliance outlet	12	44	41	32
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	50	68	52	56
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	2217	2861	2967	2682
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	90151	112375	100670	101065
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	29	80	96	68
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	169	551	495	405
PM (AO) g/GJ	Appliance outlet	54	75	65	65
PM (DT) g/GJ	Dilution tunnel	158	241	204	201
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	88	56	7	50
PAH's mg/GJ	Dilution tunnel	6283	10936	12687	9968
SO2 g/GJ	Dilution tunnel	12	10	9	11
Condensable PM g/GJ	Dilution tunnel	104	167	139	136
Total PM, g/GJ	Dilution tunnel	104	175	151	143
PM10, g/GJ	Dilution tunnel	131	228	173	177
PM2.5, g/GJ	Dilution tunnel	124	223	170	172
PM1, g/GJ	Dilution tunnel	112	198	154	155
B[a]P mg/GJ	Dilution tunnel	102	306	272	227
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	84	191	182	152
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	47	127	116	96

Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	96	261	279	212
LRTAP PAH total mg/GJ	Dilution tunnel	329	884	848	687

Table A-3-23: Hunter Aspect 8 (Low Output) – Modern Stove test results – High Sulphur MSF

Pollutant + Method	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
CO (Dry, weighted) g/GJ	Appliance outlet	4,020	3,661	4,075	3,919
CO2 (Dry, weighted) g/GJ	Appliance outlet	76,048	77,622	77,994	77,221
HC (Dry, weighted) g/GJ	Appliance outlet	719	617	724	687
NOx (Dry, weighted) g/GJ	Appliance outlet	151	146	148	148
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	157	149	158	154
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	4,020	3,661	4,075	3,919
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	94,689	96,253	90,740	93,894
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	1,422	1,184	1,208	1,271
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	944	895	839	893
PM (AO) g/GJ	Appliance outlet	125	199	228	184
PM (DT) g/GJ	Dilution tunnel	306	551	511	456
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	13	10	21	15
PAH’s mg/GJ	Dilution tunnel	6,249	5,457	6,077	5,928
SO2 g/GJ	Dilution tunnel	1,929	1,814	1,771	1,838
Condensable PM g/GJ	Dilution tunnel	149	352	283	261
Total PM, g/GJ	Dilution tunnel	303	420	324	349
PM10, g/GJ	Dilution tunnel	294	534	497	442
PM2.5, g/GJ	Dilution tunnel	292	531	497	440
PM1, g/GJ	Dilution tunnel	241	461	391	365
B[a]P mg/GJ	Dilution tunnel	172	308	191	224
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	65	160	79	101
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	37	74	43	51
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	47	56	14	39
LRTAP PAH total mg/GJ	Dilution tunnel	320	598	327	415

Table A-3-24: Hunter Aspect 8 (Low Output) – Modern Stove test results – Low Sulphur MSF

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	6,338	5,983	5,266	5,862
CO2 (Dry, weighted) g/GJ	Appliance outlet	72,383	80,635	79,885	77,635
HC (Dry, weighted) g/GJ	Appliance outlet	699	1,046	1,029	925
NOx (Dry, weighted) g/GJ	Appliance outlet	97	115	135	116
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	108	128	139	125
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	6,338	5,983	5,266	5,862
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	96,325	104,573	101,878	100,925
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	735	631	611	659
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	1,023	1,326	1,099	1,149
PM (AO) g/GJ	Appliance outlet	150	145	147	147
PM (DT) g/GJ	Dilution tunnel	290	424	339	351
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	26	35	7	23
PAH's mg/GJ	Dilution tunnel	2,518	3,257	2,730	2,835
SO2 g/GJ	Dilution tunnel	770	779	784	777
Condensable PM g/GJ	Dilution tunnel	140	279	191	203
Total PM, g/GJ	Dilution tunnel	288	344	388	340
PM10, g/GJ	Dilution tunnel	272	405	322	333
PM2.5, g/GJ	Dilution tunnel	269	403	320	331
PM1, g/GJ	Dilution tunnel	256	354	297	302
B[a]P mg/GJ	Dilution tunnel	15	17	16	16
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	101	103	79	94
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	28	98	59	62
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	-	-	-	-
LRTAP PAH total mg/GJ	Dilution tunnel	143	218	154	172

Table A-3-25: Hunter Aspect 8 (Low Output) – Modern Stove test results – Coal Trebles

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	4,552	3,825	4,529	4,302

CO2 (Dry, weighted) g/GJ	Appliance outlet	74,506	73,373	74,956	74,278
HC (Dry, weighted) g/GJ	Appliance outlet	397	350	430	393
NOx (Dry, weighted) g/GJ	Appliance outlet	119	121	106	115
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	114	124	109	116
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	4,552	3,825	4,529	4,302
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	86,922	90,722	77,710	85,118
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	238	253	223	238
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	665	646	838	716
PM (AO) g/GJ	Appliance outlet	196	189	185	190
PM (DT) g/GJ	Dilution tunnel	453	450	515	473
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	3	5	3	4
PAH's mg/GJ	Dilution tunnel	7,284	8,715	10,240	8,746
SO2 g/GJ	Dilution tunnel	269	260	259	263
Condensable PM g/GJ	Dilution tunnel	257	261	330	283
Total PM, g/GJ	Dilution tunnel	285	323	316	308
PM10, g/GJ	Dilution tunnel	437	418	471	442
PM2.5, g/GJ	Dilution tunnel	419	400	454	424
PM1, g/GJ	Dilution tunnel	344	337	364	349
B[a]P mg/GJ	Dilution tunnel	120	139	152	137
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	273	290	276	280
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	138	165	151	152
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	212	193	178	194
LRTAP PAH total mg/GJ	Dilution tunnel	743	787	759	763

Table A-3-26: Hunter Aspect 8 (Low Output) – Modern Stove test results – Coffee Logs

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	1,888	1,921	2,014	1,941
CO2 (Dry, weighted) g/GJ	Appliance outlet	72,950	68,455	67,049	69,485
HC (Dry, weighted) g/GJ	Appliance outlet	382	362	513	419
NOx (Dry, weighted) g/GJ	Appliance outlet	207	242	257	235
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	156	142	160	153
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	1,888	1,921	2,014	1,941

CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	61,883	64,707	58,802	61,797
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	155	136	143	145
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	427	344	462	411
PM (AO) g/GJ	Appliance outlet	28	46	58	44
PM (DT) g/GJ	Dilution tunnel	178	284	319	260
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	133	31	32	65
PAH's mg/GJ	Dilution tunnel	1,077	1,077	1,247	1,134
SO2 g/GJ	Dilution tunnel	183	158	158	166
Condensable PM g/GJ	Dilution tunnel	150	238	261	216
Total PM, g/GJ	Dilution tunnel	123	609	194	309
PM10, g/GJ	Dilution tunnel	159	277	299	245
PM2.5, g/GJ	Dilution tunnel	155	276	293	242
PM1, g/GJ	Dilution tunnel	137	267	237	214
B[a]P mg/GJ	Dilution tunnel	6	8	10	8
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	8	8	15	10
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	4	4	7	5
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	6	8	9	8
LRTAP PAH total mg/GJ	Dilution tunnel	24	28	41	31

Table A-3-27: Hunter Aspect 8 (Low Output) – Modern Stove test results – Anthracite

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	5,113	4,787	5,490	5,130
CO2 (Dry, weighted) g/GJ	Appliance outlet	79,699	79,719	73,862	77,760
HC (Dry, weighted) g/GJ	Appliance outlet	234	317	310	287
NOx (Dry, weighted) g/GJ	Appliance outlet	57	93	44	65
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	107	114	100	107
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	5,113	4,787	5,490	5,130
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	94,058	83,585	88,113	88,585
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	351	309	441	367
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	414	748	1,070	744
PM (AO) g/GJ	Appliance outlet	23	13	47	28
PM (DT) g/GJ	Dilution tunnel	73	69	300	147

Dioxins & Furans nqTEQ/GJ	Dilution tunnel	6	157	7	57
PAH's mg/GJ	Dilution tunnel	966	21,239	2,802	8,336
SO2 g/GJ	Dilution tunnel	429	409	486	441
Condensable PM g/GJ	Dilution tunnel	50	55	253	120
Total PM, g/GJ	Dilution tunnel	72	240	343	218
PM10, g/GJ	Dilution tunnel	57	68	282	136
PM2.5, g/GJ	Dilution tunnel	57	68	278	134
PM1, g/GJ	Dilution tunnel	53	58	240	117
Condensable PM II g/GJ	Not Applicable	50	227	295	191
B[a]P mg/GJ	Dilution tunnel	8	177	37	74
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	15	183	38	79
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	5	114	15	45
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	7	45	26	26
LRTAP PAH total mg/GJ	Dilution tunnel	34	519	116	223

Table A-3-28: Hunter Aspect 8 (Low Output) – Modern Stove test results – Wood Briquettes

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	1,308	1,464	1,397	1,390
CO2 (Dry, weighted) g/GJ	Appliance outlet	77,823	77,024	77,642	77,496
HC (Dry, weighted) g/GJ	Appliance outlet	75	101	83	86
NOx (Dry, weighted) g/GJ	Appliance outlet	39	36	38	37
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	40	49	41	43
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	1,308	1,464	1,397	1,390
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	72,872	90,037	80,343	81,084
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	67	73	66	69
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	84	131	107	107
PM (AO) g/GJ	Appliance outlet	117	104	121	114
PM (DT) g/GJ	Dilution tunnel	188	177	172	179
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	380	101	61	181
PAH's mg/GJ	Dilution tunnel	3,972	5,418	4,394	4,595
SO2 g/GJ	Dilution tunnel	8	9	7	8

Condensable PM g/GJ	Dilution tunnel	71	73	52	65
Total PM, g/GJ	Dilution tunnel	147	169	186	167
PM10, g/GJ	Dilution tunnel	159	155	157	157
PM2.5, g/GJ	Dilution tunnel	156	149	150	152
PM1, g/GJ	Dilution tunnel	140	139	140	140
B[a]P mg/GJ	Dilution tunnel	83	73	85	80
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	73	107	111	97
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	51	67	66	61
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	61	102	98	87
LRTAP PAH total mg/GJ	Dilution tunnel	268	349	360	326

Table A-3-29: Hunter Aspect 8 (Low Output) – Modern Stove test results – Wood Logs (Wet)

Pollutant + Method	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
CO (Dry, weighted) g/GJ	Appliance outlet	3847	5016	3621	4161
CO2 (Dry, weighted) g/GJ	Appliance outlet	71261	64643	62411	66105
HC (Dry, weighted) g/GJ	Appliance outlet	1054	2571	964	1530
NOx (Dry, weighted) g/GJ	Appliance outlet	56	238	39	111
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	52	111	56	73
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	3847	5016	3621	4161
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	86051	127696	85862	99870
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	251	333	237	273
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	953	1116	802	957
PM (AO) g/GJ	Appliance outlet	228	535	233	332
PM (DT) g/GJ	Dilution tunnel	587	816	649	684
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	16	11	8	12
PAH’s mg/GJ	Dilution tunnel	3539	4295	3861	3898
SO2 g/GJ	Dilution tunnel	5	5	4	5
Condensable PM g/GJ	Dilution tunnel	360	281	416	352
Total PM, g/GJ	Dilution tunnel	601	744	709	685
PM10, g/GJ	Dilution tunnel	551	775	613	646
PM2.5, g/GJ	Dilution tunnel	547	767	555	623
PM1, g/GJ	Dilution tunnel	524	699	475	566

B[a]P mg/GJ	Dilution tunnel	37	71	46	51
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	30	50	37	39
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	16	26	20	21
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	23	40	31	31
LRTAP PAH total mg/GJ	Dilution tunnel	106	187	133	142

Table A-3-30: Hunter Aspect 8 (Low Output) – Modern Stove test results – Wood Logs (Seasoned)

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	2110	2520	1464	2031
CO2 (Dry, weighted) g/GJ	Appliance outlet	71816	75853	78047	75239
HC (Dry, weighted) g/GJ	Appliance outlet	353	427	51	277
NOx (Dry, weighted) g/GJ	Appliance outlet	62	70	49	60
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	66	59	53	59
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	2110	2520	1464	2031
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	68181	67755	68959	68298
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	119	129	69	105
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	306	446	110	288
PM (AO) g/GJ	Appliance outlet	57	53	26	45
PM (DT) g/GJ	Dilution tunnel	165	223	35	141
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	25	25	50	33
PAH's mg/GJ	Dilution tunnel	1326	1590	1728	1548
SO2 g/GJ	Dilution tunnel	5	5	24	11
Condensable PM g/GJ	Dilution tunnel	108	170	9	96
Total PM, g/GJ	Dilution tunnel	174	168	61	134
PM10, g/GJ	Dilution tunnel	153	205	20	126
PM2.5, g/GJ	Dilution tunnel	152	204	20	125
PM1, g/GJ	Dilution tunnel	145	186	19	117
B[a]P mg/GJ	Dilution tunnel	8	13	20	14
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	7	10	20	12
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	4	6	12	7
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	6	8	16	10

LRTAP PAH total mg/GJ	Dilution tunnel	24	37	67	43

Table A-3-31: Hunter Aspect 8 (Low Output) – Modern Stove test results – Wood Logs (Dry)

Pollutant + Method	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
CO (Dry, weighted) g/GJ	Appliance outlet	1754	1815	1888	1819
CO2 (Dry, weighted) g/GJ	Appliance outlet	78593	80040	80925	79853
HC (Dry, weighted) g/GJ	Appliance outlet	52	87	66	68
NOx (Dry, weighted) g/GJ	Appliance outlet	52	52	58	54
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	49	38	56	48
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	1754	1815	1888	1819
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	64689	59085	66591	63455
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	75	70	78	74
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	67	126	123	105
PM (AO) g/GJ	Appliance outlet	45	56	37	46
PM (DT) g/GJ	Dilution tunnel	113	108	97	106
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	27	26	15	23
PAH's mg/GJ	Dilution tunnel	898	3034	1772	1901
SO2 g/GJ	Dilution tunnel	9	7	8	8
Condensable PM g/GJ	Dilution tunnel	68	52	60	60
Total PM, g/GJ	Dilution tunnel	96	91	90	92
PM10, g/GJ	Dilution tunnel	97	99	82	93
PM2.5, g/GJ	Dilution tunnel	95	95	80	90
PM1, g/GJ	Dilution tunnel	88	88	75	84
B[a]P mg/GJ	Dilution tunnel	9	59	18	29
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	11	41	16	23
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	5	24	8	13
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	7	45	14	22
LRTAP PAH total mg/GJ	Dilution tunnel	32	169	56	86

Table A-3-32: Kensal Redfyre – Middle Stove test results – Bright Flame High Sulphur MSF

Pollutant + Method	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**

CO (Dry, weighted) g/GJ	Appliance outlet	4,267	3,600	4,029	3,965
CO2 (Dry, weighted) g/GJ	Appliance outlet	74,867	76,010	75,745	75,541
HC (Dry, weighted) g/GJ	Appliance outlet	555	554	673	594
NOx (Dry, weighted) g/GJ	Appliance outlet	125	136	123	128
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	217	169	169	185
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	4,267	3,600	4,029	3,965
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	113,562	84,086	83,005	93,551
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	1,385	1,405	1,130	1,307
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	1,397	865	1,387	1,216
PM (AO) g/GJ	Appliance outlet	262	166	195	208
PM (DT) g/GJ	Dilution tunnel	468	344	351	388
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	154	83	47	94
PAH's mg/GJ	Dilution tunnel	4,646	4,373	5,049	4,689
SO2 g/GJ	Dilution tunnel	2,159	1,947	1,789	1,965
Condensable PM g/GJ	Dilution tunnel	206	178	155	180
Total PM, g/GJ	Dilution tunnel	325	287	276	296
PM10, g/GJ	Dilution tunnel	449	327	340	372
PM2.5, g/GJ	Dilution tunnel	447	321	339	369
PM1, g/GJ	Dilution tunnel	412	282	291	328
B[a]P mg/GJ	Dilution tunnel	157	135	194	162
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	103	138	138	126
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	31	39	43	38
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	54	48	53	52
LRTAP PAH total mg/GJ	Dilution tunnel	346	361	428	378

Table A-3-33: Kensal Redfyre – Middle Stove test results – Low Sulphur MSF

Pollutant + Method	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
CO (Dry, weighted) g/GJ	Appliance outlet	4,179	4,051	4,543	4,257
CO2 (Dry, weighted) g/GJ	Appliance outlet	77,513	75,585	77,882	76,993
HC (Dry, weighted) g/GJ	Appliance outlet	294	335	334	321
NOx (Dry, weighted) g/GJ	Appliance outlet	130	125	142	132

NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	201	159	160	174
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	4,179	4,051	4,543	4,257
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	101,792	101,392	89,024	97,403
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	683	569	686	646
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	393	592	567	518
PM (AO) g/GJ	Appliance outlet	42	51	57	50
PM (DT) g/GJ	Dilution tunnel	126	146	105	126
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	52	66	68	62
PAH's mg/GJ	Dilution tunnel	3,551	830	1,998	2,126
SO2 g/GJ	Dilution tunnel	896	876	1,039	937
Condensable PM g/GJ	Dilution tunnel	84	95	48	76
Total PM, g/GJ	Dilution tunnel	99	109	96	102
PM10, g/GJ	Dilution tunnel	111	133	94	113
PM2.5, g/GJ	Dilution tunnel	108	133	89	110
PM1, g/GJ	Dilution tunnel	103	126	89	106
B[a]P mg/GJ	Dilution tunnel	65	10	40	38
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	63	12	38	38
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	14	21	19	18
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	23	5	14	14
LRTAP PAH total mg/GJ	Dilution tunnel	165	49	110	108

Table A-3-34: Kensal Redfyre – Middle Stove test results – Coal trebles

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	5,385	5,586	4,119	5,030
CO2 (Dry, weighted) g/GJ	Appliance outlet	75,112	72,372	75,755	74,413
HC (Dry, weighted) g/GJ	Appliance outlet	126	228	278	211
NOx (Dry, weighted) g/GJ	Appliance outlet	105	97	137	113
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	235	185	144	188
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	5,385	5,586	4,119	5,030
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	90,521	148,850	113,457	117,609
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	592	553	373	506

HC (ECL Dry, weighted) g/GJ	Dilution tunnel	4,696	9,398	3,347	5,814
PM (AO) g/GJ	Appliance outlet	70	79	63	71
PM (DT) g/GJ	Dilution tunnel	759	1,135	506	800
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	2,300	738	686	1,241
PAH's mg/GJ	Dilution tunnel	63,475	80,031	8,564	50,690
SO2 g/GJ	Dilution tunnel	568	487	358	471
Condensable PM g/GJ	Dilution tunnel	690	1,056	443	730
Total PM, g/GJ	Dilution tunnel	571	765	333	556
PM10, g/GJ	Dilution tunnel	715	1,036	462	737
PM2.5, g/GJ	Dilution tunnel	678	963	456	699
PM1, g/GJ	Dilution tunnel	602	838	395	611
B[a]P mg/GJ	Dilution tunnel	676	744	88	503
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	1,389	1,921	153	1,154
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	907	1,175	69	717
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	1,074	1,459	71	868
LRTAP PAH total mg/GJ	Dilution tunnel	4,046	5,299	380	3,242

Table A-3-35: Kensal Redfyre – Middle Stove test results – Coffee Logs

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	1,747	2,280	1,491	1,839
CO2 (Dry, weighted) g/GJ	Appliance outlet	77,189	74,903	78,387	76,826
HC (Dry, weighted) g/GJ	Appliance outlet	24	55	19	33
NOx (Dry, weighted) g/GJ	Appliance outlet	181	112	106	133
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	156	163	165	161
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	1,747	2,280	1,491	1,839
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	72,671	89,314	79,350	80,445
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	56	84	71	70
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	34	87	51	57
PM (AO) g/GJ	Appliance outlet	82	44	39	55
PM (DT) g/GJ	Dilution tunnel	197	114	88	133
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	785	441	140	455
PAH's mg/GJ	Dilution tunnel	412	1,867	576	951

SO2 g/GJ	Dilution tunnel	74	89	80	81
Condensable PM g/GJ	Dilution tunnel	115	70	49	78
Total PM, g/GJ	Dilution tunnel	128	105	66	100
PM10, g/GJ	Dilution tunnel	182	101	72	118
PM2.5, g/GJ	Dilution tunnel	180	99	70	117
PM1, g/GJ	Dilution tunnel	169	94	68	110
B[a]P mg/GJ	Dilution tunnel	6	26	4	12
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	8	35	6	16
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	4	14	3	7
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	4	26	5	12
LRTAP PAH total mg/GJ	Dilution tunnel	23	101	18	47

Table A-3-36: Kensal Redfyre – Middle Stove test results – Anthracite

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	4,453	3,869	3,766	4,029
CO2 (Dry, weighted) g/GJ	Appliance outlet	77,981	81,225	81,099	80,102
HC (Dry, weighted) g/GJ	Appliance outlet	212	143	82	146
NOx (Dry, weighted) g/GJ	Appliance outlet	121	130	119	123
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	92	85	144	107
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	4,453	3,869	3,766	4,029
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	75,607	54,723	89,185	73,172
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	217	279	305	267
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	444	634	132	403
PM (AO) g/GJ	Appliance outlet	11	14	7	11
PM (DT) g/GJ	Dilution tunnel	59	38	27	41
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	37	44	19	34
PAH’s mg/GJ	Dilution tunnel	2,372	978	415	1,255
SO2 g/GJ	Dilution tunnel	266	327	376	323
Condensable PM g/GJ	Dilution tunnel	47	24	20	30
Total PM, g/GJ	Dilution tunnel	48	31	22	34
PM10, g/GJ	Dilution tunnel	48	27	20	32
PM2.5, g/GJ	Dilution tunnel	43	27	18	29

PM1, g/GJ	Dilution tunnel	43	27	17	29
Condensable PM II g/GJ	Not Applicable	37	17	15	23
B[a]P mg/GJ	Dilution tunnel	6	1	1	3
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	7	4	2	4
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	3	2	1	2
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	9	4	2	5
LRTAP PAH total mg/GJ	Dilution tunnel	25	11	6	14

Table A-3-37: Kensal Redfyre – Middle Stove test results – Wood Briquettes

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	4,774	6,200	3,301	4,758
CO2 (Dry, weighted) g/GJ	Appliance outlet	75,711	76,557	79,173	77,147
HC (Dry, weighted) g/GJ	Appliance outlet	592	599	182	458
NOx (Dry, weighted) g/GJ	Appliance outlet	30	20	25	25
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	64	37	39	47
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	4,774	6,200	3,301	4,758
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	142,776	91,362	84,985	106,374
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	249	177	98	175
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	979	643	245	622
PM (AO) g/GJ	Appliance outlet	194	78	65	112
PM (DT) g/GJ	Dilution tunnel	289	182	120	197
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	1,295	1,777	6,185	3,086
PAH’s mg/GJ	Dilution tunnel	20,178	20,119	6,234	15,511
SO2 g/GJ	Dilution tunnel	7	7	4	6
Condensable PM g/GJ	Dilution tunnel	95	104	56	85
Total PM, g/GJ	Dilution tunnel	183	138	97	139
PM10, g/GJ	Dilution tunnel	255	160	100	172
PM2.5, g/GJ	Dilution tunnel	245	154	96	165
PM1, g/GJ	Dilution tunnel	205	118	89	138
B[a]P mg/GJ	Dilution tunnel	347	245	138	243
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	595	340	170	368

Benzo(k)fluoranthene mg/GJ	Dilution tunnel	510	386	118	338
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	605	603	185	464
LRTAP PAH total mg/GJ	Dilution tunnel	2,056	1,574	612	1,414

Table A-3-5: Kensal Redfyre – Middle Stove test results – Wood Logs (Wet)

Pollutant + Method	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
CO (Dry, weighted) g/GJ	Appliance outlet	4002	3325	3486	3604
CO2 (Dry, weighted) g/GJ	Appliance outlet	72787	68621	71845	71084
HC (Dry, weighted) g/GJ	Appliance outlet	873	753	776	801
NOx (Dry, weighted) g/GJ	Appliance outlet	62	63	70	65
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	78	70	83	77
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	4002	3325	3486	3604
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	89254	80002	82868	84041
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	212	171	173	185
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	907	621	655	728
PM (AO) g/GJ	Appliance outlet	164	174	94	144
PM (DT) g/GJ	Dilution tunnel	514	865	422	600
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	88	74	26	63
PAH's mg/GJ	Dilution tunnel	1797	1911	2193	1967
SO2 g/GJ	Dilution tunnel	7	4	5	5
Condensable PM g/GJ	Dilution tunnel	349	691	328	456
Total PM, g/GJ	Dilution tunnel	762	493	417	558
PM10, g/GJ	Dilution tunnel	487	792	380	553
PM2.5, g/GJ	Dilution tunnel	485	786	378	550
PM1, g/GJ	Dilution tunnel	479	780	376	545
B[a]P mg/GJ	Dilution tunnel	20	18	23	20
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	16	16	17	16
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	8	8	8	8
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	11	11	13	11
LRTAP PAH total mg/GJ	Dilution tunnel	55	53	62	56

Table A-3-39: Kensal Redfyre – Middle Stove test results – Wood Logs (Seasoned)

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	1580	1602	1426	1536
CO2 (Dry, weighted) g/GJ	Appliance outlet	77787	78024	76547	77453
HC (Dry, weighted) g/GJ	Appliance outlet	82	64	52	66
NOx (Dry, weighted) g/GJ	Appliance outlet	61	40	60	53
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	91	68	67	75
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	1580	1602	1426	1536
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	98670	83152	90811	90878
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	104	90	99	97
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	157	225	158	180
PM (AO) g/GJ	Appliance outlet	20	25	27	24
PM (DT) g/GJ	Dilution tunnel	55	61	89	68
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	3	15	6	8
PAH's mg/GJ	Dilution tunnel	886	686	964	845
SO2 g/GJ	Dilution tunnel	8	8	11	9
Condensable PM g/GJ	Dilution tunnel	34	36	62	44
Total PM, g/GJ	Dilution tunnel	53	65	68	62
PM10, g/GJ	Dilution tunnel	42	48	69	53
PM2.5, g/GJ	Dilution tunnel	42	48	66	52
PM1, g/GJ	Dilution tunnel	36	46	61	47
B[a]P mg/GJ	Dilution tunnel	5	4	3	4
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	6	12	5	8
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	3	4	2	3
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	5	4	4	4
LRTAP PAH total mg/GJ	Dilution tunnel	19	24	14	19

Table A-3-40: Kensal Redfyre – Middle Stove test results – Wood Logs (Dry)

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	3280	4393	3069	3581
CO2 (Dry, weighted) g/GJ	Appliance outlet	72770	76361	75376	74836

HC (Dry, weighted) g/GJ	Appliance outlet	58	61	45	55
NOx (Dry, weighted) g/GJ	Appliance outlet	30	18	14	21
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	71	121	116	103
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	3280	4393	3069	3581
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	180645	268736	218002	222461
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	276	447	291	338
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	1230	1954	1497	1560
PM (AO) g/GJ	Appliance outlet	59	62	39	53
PM (DT) g/GJ	Dilution tunnel	113	83	111	102
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	1362	3020	4364	2916
PAH's mg/GJ	Dilution tunnel	9328	11317	13568	11404
SO2 g/GJ	Dilution tunnel	8	9	11	9
Condensable PM g/GJ	Dilution tunnel	54	22	72	49
Total PM, g/GJ	Dilution tunnel	619	67	105	264
PM10, g/GJ	Dilution tunnel	111	73	96	93
PM2.5, g/GJ	Dilution tunnel	21	73	94	63
PM1, g/GJ	Dilution tunnel	15	68	77	53
B[a]P mg/GJ	Dilution tunnel	292	262	479	344
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	209	316	586	370
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	126	179	379	228
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	188	299	488	325
LRTAP PAH total mg/GJ	Dilution tunnel	815	1057	1932	1268

Table A-3-6: Stovax Stockton 5 – Modern Stove test results – Coffee Logs

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	1,567	1,614	1,677	2,242
CO2 (Dry, weighted) g/GJ	Appliance outlet	70,778	73,025	76,745	76,231
HC (Dry, weighted) g/GJ	Appliance outlet	216	213	175	111
NOx (Dry, weighted) g/GJ	Appliance outlet	217	232	234	198
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	202	233	214	286
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	1,567	1,614	1,677	2,242
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	65,378	67,597	67,133	102,360

SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	110	137	121	90
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	278	294	204	1,991
PM (AO) g/GJ	Appliance outlet	56	22	41	76
PM (DT) g/GJ	Dilution tunnel	245	95	169	259
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	145	163	128	143
PAH's mg/GJ	Dilution tunnel	962	827	795	5,201
SO2 g/GJ	Dilution tunnel	116	158	130	168
Condensable PM g/GJ	Dilution tunnel	189	73	127	163
Total PM, g/GJ	Dilution tunnel	144	107	127	189
PM10, g/GJ	Dilution tunnel	221	87	162	236
PM2.5, g/GJ	Dilution tunnel	218	85	160	238
PM1, g/GJ	Dilution tunnel	176	79	122	191
B[a]P mg/GJ	Dilution tunnel	4	4	4	79
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	6	3	3	50
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	3	2	1	24
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	3	2	3	87
LRTAP PAH total mg/GJ	Dilution tunnel	17	11	11	226

Table A-3-7: Stovax Stockton 5 – Modern Stove test results – Wood Briquettes

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	819	1,194	1,113	1,443
CO2 (Dry, weighted) g/GJ	Appliance outlet	75,315	75,725	75,163	78,186
HC (Dry, weighted) g/GJ	Appliance outlet	50	69	85	38
NOx (Dry, weighted) g/GJ	Appliance outlet	48	39	48	39
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	46	43	43	58
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	819	1,194	1,113	1,443
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	61,795	62,847	59,254	94,067
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	70	73	68	52
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	54	81	91	581
PM (AO) g/GJ	Appliance outlet	36	59	52	93
PM (DT) g/GJ	Dilution tunnel	97	106	111	160
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	501	365	374	408

PAH's mg/GJ	Dilution tunnel	453	1,197	668	4,665
SO2 g/GJ	Dilution tunnel	5	4	4	5
Condensable PM g/GJ	Dilution tunnel	61	47	58	70
Total PM, g/GJ	Dilution tunnel	87	94	95	138
PM10, g/GJ	Dilution tunnel	87	97	101	144
PM2.5, g/GJ	Dilution tunnel	85	95	98	143
PM1, g/GJ	Dilution tunnel	77	88	92	131
B[a]P mg/GJ	Dilution tunnel	5	20	7	214
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	4	21	8	131
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	2	9	3	62
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	2	12	4	181
LRTAP PAH total mg/GJ	Dilution tunnel	13	63	22	570

Table A-3-43: Stovax Stockton 5 – Modern Stove test results – Wood Logs (Wet)

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	2322	3299	2677	2597
CO2 (Dry, weighted) g/GJ	Appliance outlet	73545	62800	68729	73982
HC (Dry, weighted) g/GJ	Appliance outlet	604	973	678	258
NOx (Dry, weighted) g/GJ	Appliance outlet	58	53	61	55
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	63	53	74	81
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	2322	3299	2677	2597
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	64831	60784	65961	98358
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	146	243	207	103
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	731	1316	859	3836
PM (AO) g/GJ	Appliance outlet	87	162	158	141
PM (DT) g/GJ	Dilution tunnel	334	512	445	360
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	146	10	13	283
PAH's mg/GJ	Dilution tunnel	1723	2059	2282	7342
SO2 g/GJ	Dilution tunnel	5	3	4	6
Condensable PM g/GJ	Dilution tunnel	247	351	288	206
Total PM, g/GJ	Dilution tunnel	271	344	346	257
PM10, g/GJ	Dilution tunnel	320	488	428	337

PM2.5, g/GJ	Dilution tunnel	317	487	423	341
PM1, g/GJ	Dilution tunnel	291	468	402	320
B[a]P mg/GJ	Dilution tunnel	13	13	22	180
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	10	10	17	88
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	5	5	8	46
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	10	7	12	166
LRTAP PAH total mg/GJ	Dilution tunnel	38	35	59	446

Table A-3-44: Stovax Stockton 5 – Modern Stove test results – Wood Logs (Seasoned)

Pollutant + Method	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
CO (Dry, weighted) g/GJ	Appliance outlet	1226	1573	1387	1396
CO2 (Dry, weighted) g/GJ	Appliance outlet	77035	78928	74722	76895
HC (Dry, weighted) g/GJ	Appliance outlet	88	92	111	97
NOx (Dry, weighted) g/GJ	Appliance outlet	71	58	57	62
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	75	68	59	67
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	1226	1573	1387	1396
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	83677	74614	76218	78170
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	67	57	61	62
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	150	142	150	147
PM (AO) g/GJ	Appliance outlet	868	1686	1195	1250
PM (DT) g/GJ	Dilution tunnel	79980	77369	75793	77714
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	75	128	111	105
PAH's mg/GJ	Dilution tunnel	77	62	60	66
SO2 g/GJ	Dilution tunnel	78	68	62	70
Condensable PM g/GJ	Dilution tunnel	868	1686	1195	1250
Total PM, g/GJ	Dilution tunnel	80744	76330	76523	77866
PM10, g/GJ	Dilution tunnel	54	59	50	54
PM2.5, g/GJ	Dilution tunnel	151	204	176	177
PM1, g/GJ	Dilution tunnel	24	19	18	20
B[a]P mg/GJ	Dilution tunnel	15	48	16	26
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	14	42	14	24
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	9	27	8	15

Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	12	40	13	21
LRTAP PAH total mg/GJ	Dilution tunnel	49	156	52	86

Table A-3-45: Stovax Stockton 5 – Modern Stove test results – Wood Logs (Dry)

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	1397	1817	1242	1485
CO2 (Dry, weighted) g/GJ	Appliance outlet	81079	80018	80416	80504
HC (Dry, weighted) g/GJ	Appliance outlet	70	73	62	68
NOx (Dry, weighted) g/GJ	Appliance outlet	73	57	66	65
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	77	82	80	80
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	1397	1817	1242	1485
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	94429	90896	93988	93104
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	71	88	22	60
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	885	1345	729	986
PM (AO) g/GJ	Appliance outlet	37	50	42	43
PM (DT) g/GJ	Dilution tunnel	75	99	75	83
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	129	153	215	166
PAH's mg/GJ	Dilution tunnel	3632	5681	2675	3996
SO2 g/GJ	Dilution tunnel	7	6	7	7
Condensable PM g/GJ	Dilution tunnel	38	50	33	40
Total PM, g/GJ	Dilution tunnel	43	93	64	67
PM10, g/GJ	Dilution tunnel	62	88	59	70
PM2.5, g/GJ	Dilution tunnel	62	86	57	68
PM1, g/GJ	Dilution tunnel	57	81	55	64
B[a]P mg/GJ	Dilution tunnel	29	46	20	32
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	23	42	20	28
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	12	23	10	15
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	33	56	19	36
LRTAP PAH total mg/GJ	Dilution tunnel	97	167	69	111

Table A-3-46: Hase Sila IQ – Blue Angel test results - Coffee Logs

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	359	559	638	519
CO2 (Dry, weighted) g/GJ	Appliance outlet	77,893	78,521	77,490	77,968
HC (Dry, weighted) g/GJ	Appliance outlet	23	35	37	32
NOx (Dry, weighted) g/GJ	Appliance outlet	116	101	108	108
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	149	161	165	158
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	359	559	638	519
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	69,594	72,449	74,774	72,272
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	69	63	66	66
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	24	56	79	53
PM (AO) g/GJ	Appliance outlet	47	58	54	53
PM (DT) g/GJ	Dilution tunnel	75	93	87	85
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	28	28	25	27
PAH's mg/GJ	Dilution tunnel	609	975	1,602	1,062
SO2 g/GJ	Dilution tunnel	76	70	68	71
Condensable PM g/GJ	Dilution tunnel	28	35	34	32
Total PM, g/GJ	Dilution tunnel	55	76	73	68
PM10, g/GJ	Dilution tunnel	68	88	79	78
PM2.5, g/GJ	Dilution tunnel	67	86	79	77
PM1, g/GJ	Dilution tunnel	65	77	76	73
B[a]P mg/GJ	Dilution tunnel	2	8	9	6
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	5	15	16	12
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	2	7	8	6
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	2	9	15	9
LRTAP PAH total mg/GJ	Dilution tunnel	11	40	48	33

Table A-3-47: Hase Sila IQ – Blue Angel test results – Wood Briquettes

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	842	1,641	1,297	1,260
CO2 (Dry, weighted) g/GJ	Appliance outlet	81,575	81,883	82,260	81,906

HC (Dry, weighted) g/GJ	Appliance outlet	76	147	106	110
NOx (Dry, weighted) g/GJ	Appliance outlet	32	26	26	28
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	37	30	29	32
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	842	1,641	1,297	1,260
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	80,124	80,368	81,102	80,531
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	60	67	67	65
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	131	189	176	165
PM (AO) g/GJ	Appliance outlet	51	79	72	67
PM (DT) g/GJ	Dilution tunnel	96	152	116	122
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	120	95	95	103
PAH's mg/GJ	Dilution tunnel	5	16	10	11
SO2 g/GJ	Dilution tunnel	9	6	7	8
Condensable PM g/GJ	Dilution tunnel	45	73	44	54
Total PM, g/GJ	Dilution tunnel	85	131	111	109
PM10, g/GJ	Dilution tunnel	93	143	111	116
PM2.5, g/GJ	Dilution tunnel	90	141	109	113
PM1, g/GJ	Dilution tunnel	85	134	102	107
B[a]P mg/GJ	Dilution tunnel	0	1	1	1
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	0	1	1	1
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	0	0	0	0
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	0	1	0	0
LRTAP PAH total mg/GJ	Dilution tunnel	2	3	2	2

Table A-3-48: Hase Sila IQ – Blue Angel test results – Wood Logs (Wet)

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	337	539	513	463
CO2 (Dry, weighted) g/GJ	Appliance outlet	77059	78431	78172	77887
HC (Dry, weighted) g/GJ	Appliance outlet	34	62	62	52
NOx (Dry, weighted) g/GJ	Appliance outlet	64	60	68	64
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	60	61	73	65
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	337	539	513	463
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	74451	79183	85643	79759

SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	60	68	83	70
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	53	67	92	71
PM (AO) g/GJ	Appliance outlet	15	21	21	19
PM (DT) g/GJ	Dilution tunnel	42	41	33	39
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	51	52	23	42
PAH's mg/GJ	Dilution tunnel	447	21	693	387
SO2 g/GJ	Dilution tunnel	3	5	4	4
Condensable PM g/GJ	Dilution tunnel	26	20	13	20
Total PM, g/GJ	Dilution tunnel	32	30	26	29
PM10, g/GJ	Dilution tunnel	20	27	24	24
PM2.5, g/GJ	Dilution tunnel	20	26	23	23
PM1, g/GJ	Dilution tunnel	18	24	19	20
B[a]P mg/GJ	Dilution tunnel	7	0	5	4
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	7	0	6	4
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	4	0	3	2
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	4	0	4	3
LRTAP PAH total mg/GJ	Dilution tunnel	21	1	18	13

Table A-3-49: Hase Sila IQ – Blue Angel test results – Wood Logs (Seasoned)

Pollutant + Method	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
CO (Dry, weighted) g/GJ	Appliance outlet	359	387	536	427
CO2 (Dry, weighted) g/GJ	Appliance outlet	78906	81027	76770	78901
HC (Dry, weighted) g/GJ	Appliance outlet	27	23	35	28
NOx (Dry, weighted) g/GJ	Appliance outlet	61	55	56	57
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	62	55	60	59
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	359	387	536	427
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	82748	79988	79640	80792
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	38	32	24	32
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	43	43	59	48
PM (AO) g/GJ	Appliance outlet	15	11	15	14
PM (DT) g/GJ	Dilution tunnel	36	22	36	31
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	78	31	34	48

PAH's mg/GJ	Dilution tunnel	535	490	1567	864
SO2 g/GJ	Dilution tunnel	2	2	6	3
Condensable PM g/GJ	Dilution tunnel	21	11	21	18
Total PM, g/GJ	Dilution tunnel	23	22	29	24
PM10, g/GJ	Dilution tunnel	25	14	26	22
PM2.5, g/GJ	Dilution tunnel	25	12	19	19
PM1, g/GJ	Dilution tunnel	23	11	17	17
B[a]P mg/GJ	Dilution tunnel	3	2	9	4
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	5	3	11	6
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	2	1	6	3
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	4	2	14	7
LRTAP PAH total mg/GJ	Dilution tunnel	14	8	39	20

Table A-3-50: Hase Sila IQ – Blue Angel test results – Wood Logs (Dry)

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	331	1022	2430	1261
CO2 (Dry, weighted) g/GJ	Appliance outlet	83121	83475	83183	83260
HC (Dry, weighted) g/GJ	Appliance outlet	33	92	158	94
NOx (Dry, weighted) g/GJ	Appliance outlet	56	47	38	47
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	56	47	42	48
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	331	1022	2430	1261
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	78410	81228	81995	80544
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	54	58	90	67
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	40	127	392	186
PM (AO) g/GJ	Appliance outlet	29	30	30	30
PM (DT) g/GJ	Dilution tunnel	50	44	62	52
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	51	96	50	66
PAH's mg/GJ	Dilution tunnel	1031	1675	12811	5172
SO2 g/GJ	Dilution tunnel	7	6	5	6
Condensable PM g/GJ	Dilution tunnel	21	14	32	22
Total PM, g/GJ	Dilution tunnel	32	36	50	39
PM10, g/GJ	Dilution tunnel	39	41	59	46

PM2.5, g/GJ	Dilution tunnel	34	39	55	43
PM1, g/GJ	Dilution tunnel	31	38	52	40
B[a]P mg/GJ	Dilution tunnel	9	32	202	81
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	11	28	196	78
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	6	15	124	49
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	9	24	225	86
LRTAP PAH total mg/GJ	Dilution tunnel	35	99	747	294

Table A-3-8: Aga (Coalbrookdale) Little Wenlock– Old Stove test results – High Sulphur MSF

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	3,848	4,072	3,775	3,898
CO2 (Dry, weighted) g/GJ	Appliance outlet	75,159	73,218	70,006	72,794
HC (Dry, weighted) g/GJ	Appliance outlet	656	717	698	690
NOx (Dry, weighted) g/GJ	Appliance outlet	126	139	150	138
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	153	168	160	160
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	3,848	4,072	3,775	3,898
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	93,153	82,518	75,515	83,729
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	1,238	1,349	1,388	1,325
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	1,172	1,237	1,038	1,149
PM (AO) g/GJ	Appliance outlet	287	387	259	311
PM (DT) g/GJ	Dilution tunnel	416	531	368	438
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	25	6	4	12
PAH's mg/GJ	Dilution tunnel	4,267	8,386	3,458	5,371
SO2 g/GJ	Dilution tunnel	1,756	1,893	1,793	1,814
Condensable PM g/GJ	Dilution tunnel	263	144	109	172
Total PM, g/GJ	Dilution tunnel	251	267	227	248
PM10, g/GJ	Dilution tunnel	395	495	346	412
PM2.5, g/GJ	Dilution tunnel	390	488	333	403
PM1, g/GJ	Dilution tunnel	286	336	254	292
B[a]P mg/GJ	Dilution tunnel	168	12	128	103
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	119	479	101	233
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	36	148	32	72

Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	39	242	39	107
LRTAP PAH total mg/GJ	Dilution tunnel	362	882	301	515

Table A-3-9: Aga (Coalbrookdale) Little Wenlock – Old Stove test results – Low Sulphur MSF

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	6,115	5,660	6,553	6,109
CO2 (Dry, weighted) g/GJ	Appliance outlet	74,241	75,302	77,137	75,560
HC (Dry, weighted) g/GJ	Appliance outlet	960	716	1,013	896
NOx (Dry, weighted) g/GJ	Appliance outlet	121	110	104	111
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	125	123	120	123
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	6,115	5,660	6,553	6,109
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	83,095	91,102	91,327	88,508
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	727	719	700	716
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	1,099	798	1,845	1,247
PM (AO) g/GJ	Appliance outlet	120	101	161	127
PM (DT) g/GJ	Dilution tunnel	184	173	323	227
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	15	28	29	24
PAH's mg/GJ	Dilution tunnel	3,784	3,251	5,772	4,269
SO2 g/GJ	Dilution tunnel	848	853	913	871
Condensable PM g/GJ	Dilution tunnel	64	72	163	99
Total PM, g/GJ	Dilution tunnel	194	170	260	208
PM10, g/GJ	Dilution tunnel	175	163	312	217
PM2.5, g/GJ	Dilution tunnel	172	163	312	216
PM1, g/GJ	Dilution tunnel	148	156	276	193
B[a]P mg/GJ	Dilution tunnel	71	71	105	83
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	71	91	119	94
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	19	24	33	25
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	26	30	36	31
LRTAP PAH total mg/GJ	Dilution tunnel	187	217	292	232

Table A-3-53: Aga (Coalbrookdale) Little Wenlock – Old Stove test results – Coal Trebles

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	6,449	5,654	6,484	6,196
CO2 (Dry, weighted) g/GJ	Appliance outlet	73,467	71,283	70,177	71,642
HC (Dry, weighted) g/GJ	Appliance outlet	307	437	482	409
NOx (Dry, weighted) g/GJ	Appliance outlet	107	103	106	106
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	106	133	133	124
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	6,449	5,654	6,484	6,196
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	77,800	85,836	75,699	79,778
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	160	164	249	191
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	413	611	531	519
PM (AO) g/GJ	Appliance outlet	84	126	191	134
PM (DT) g/GJ	Dilution tunnel	181	214	202	199
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	26	9	17	17
PAH's mg/GJ	Dilution tunnel	3,187	4,639	3,617	3,814
SO2 g/GJ	Dilution tunnel	204	194	248	215
Condensable PM g/GJ	Dilution tunnel	97	88	11	65
Total PM, g/GJ	Dilution tunnel	158	179	201	179
PM10, g/GJ	Dilution tunnel	160	198	190	183
PM2.5, g/GJ	Dilution tunnel	153	196	184	178
PM1, g/GJ	Dilution tunnel	132	161	161	151
B[a]P mg/GJ	Dilution tunnel	28	33	33	31
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	66	94	94	85
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	33	40	41	38
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	10	27	7	15
LRTAP PAH total mg/GJ	Dilution tunnel	137	194	175	169

Table A-3-54: Aga (Coalbrookdale) Little Wenlock – Old Stove test results – Coffee Logs

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	1,876	2,204	2,268	2,116
CO2 (Dry, weighted) g/GJ	Appliance outlet	72,166	74,373	73,701	73,413

HC (Dry, weighted) g/GJ	Appliance outlet	155	138	273	189
NOx (Dry, weighted) g/GJ	Appliance outlet	144	135	197	159
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	130	130	137	133
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	1,876	2,204	2,268	2,116
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	81,868	81,058	83,330	82,085
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	80	78	83	80
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	155	159	158	158
PM (AO) g/GJ	Appliance outlet	53	50	106	70
PM (DT) g/GJ	Dilution tunnel	83	81	96	87
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	18	19	13	17
PAH's mg/GJ	Dilution tunnel	2,159	2,372	2,570	2,367
SO2 g/GJ	Dilution tunnel	82	87	84	84
Condensable PM g/GJ	Dilution tunnel	30	30	-9	17
Total PM, g/GJ	Dilution tunnel	78	70	76	75
PM10, g/GJ	Dilution tunnel	77	74	89	80
PM2.5, g/GJ	Dilution tunnel	76	71	88	78
PM1, g/GJ	Dilution tunnel	72	67	82	74
B[a]P mg/GJ	Dilution tunnel	8	9	11	9
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	19	19	24	21
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	8	8	11	9
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	11	10	15	12
LRTAP PAH total mg/GJ	Dilution tunnel	46	47	61	51

Table A-3-10: Aga (Coalbrookdale) Little Wenlock – Old Stove test results – Anthracite

Pollutant + Method	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
CO (Dry, weighted) g/GJ	Appliance outlet	2,046	4,410	4,422	3,626
CO2 (Dry, weighted) g/GJ	Appliance outlet	75,068	69,591	78,996	74,552
HC (Dry, weighted) g/GJ	Appliance outlet	465	439	282	395
NOx (Dry, weighted) g/GJ	Appliance outlet	157	102	84	114
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	198	317	207	241
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	2,046	4,410	4,422	3,626

CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	105,755	274,652	172,649	184,352
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	317	823	725	622
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	415	2,895	1,064	1,458
PM (AO) g/GJ	Appliance outlet	208	54	19	94
PM (DT) g/GJ	Dilution tunnel	474	120	63	219
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	361	102	40	168
PAH's mg/GJ	Dilution tunnel	9,333	11,944	4,771	8,683
SO2 g/GJ	Dilution tunnel	459	397	582	479
Condensable PM g/GJ	Dilution tunnel	266	66	45	125
Total PM, g/GJ	Dilution tunnel	582	125	63	256
PM10, g/GJ	Dilution tunnel	437	111	58	202
PM2.5, g/GJ	Dilution tunnel	419	108	56	194
PM1, g/GJ	Dilution tunnel	376	95	53	175
B[a]P mg/GJ	Dilution tunnel	61	86	20	55
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	90	97	32	73
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	39	47	14	33
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	86	77	37	67
LRTAP PAH total mg/GJ	Dilution tunnel	277	306	102	228

Table A-3-11: Aga (Coalbrookdale) Little Wenlock – Old Stove test results – Wood Briquettes

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	3,744	2,941	3,625	3,437
CO2 (Dry, weighted) g/GJ	Appliance outlet	77,665	78,833	77,292	77,930
HC (Dry, weighted) g/GJ	Appliance outlet	175	95	123	131
NOx (Dry, weighted) g/GJ	Appliance outlet	24	30	25	26
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	39	44	40	41
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	3,744	2,941	3,625	3,437
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	91,754	95,269	89,810	92,278
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	99	60	92	83
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	738	432	880	683
PM (AO) g/GJ	Appliance outlet	95	96	94	95

PM (DT) g/GJ	Dilution tunnel	304	269	269	280
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	496	417	492	468
PAH's mg/GJ	Dilution tunnel	50,890	47,597	45,768	48,085
SO2 g/GJ	Dilution tunnel	11	12	10	11
Condensable PM g/GJ	Dilution tunnel	209	173	174	185
Total PM, g/GJ	Dilution tunnel	200	170	194	188
PM10, g/GJ	Dilution tunnel	271	250	252	258
PM2.5, g/GJ	Dilution tunnel	260	242	241	247
PM1, g/GJ	Dilution tunnel	226	218	201	215
B[a]P mg/GJ	Dilution tunnel	377	412	340	376
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	337	350	310	332
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	236	235	209	227
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	172	195	130	166
LRTAP PAH total mg/GJ	Dilution tunnel	1,122	1,192	989	1,101

Table A-3-57: Aga (Coalbrookdale) Little Wenlock – Old Stove test results – Wood Logs (Wet)

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	2351	3573	2934	2953
CO2 (Dry, weighted) g/GJ	Appliance outlet	72047	73852	71546	72481
HC (Dry, weighted) g/GJ	Appliance outlet	225	448	302	325
NOx (Dry, weighted) g/GJ	Appliance outlet	67	60	61	63
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	66	58	52	59
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	2351	3573	2934	2953
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	83962	85861	84470	84764
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	103	144	124	124
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	422	736	608	588
PM (AO) g/GJ	Appliance outlet	61	57	38	52
PM (DT) g/GJ	Dilution tunnel	103	208	205	172
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	13	16	11	13
PAH's mg/GJ	Dilution tunnel	2116	4345	3455	3305
SO2 g/GJ	Dilution tunnel	6	5	5	5
Condensable PM g/GJ	Dilution tunnel	42	152	167	120

Total PM, g/GJ	Dilution tunnel	71	166	81	106
PM10, g/GJ	Dilution tunnel	80	186	179	148
PM2.5, g/GJ	Dilution tunnel	78	180	171	143
PM1, g/GJ	Dilution tunnel	74	162	146	128
B[a]P mg/GJ	Dilution tunnel	16	52	34	34
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	23	44	39	35
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	12	25	21	19
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	13	35	31	26
LRTAP PAH total mg/GJ	Dilution tunnel	64	156	125	115

Table A-3-58: Aga (Coalbrookdale) Little Wenlock – Old Stove test results – Wood Logs (Seasoned)

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	2630	2216	1867	2238
CO2 (Dry, weighted) g/GJ	Appliance outlet	75627	76865	77215	76569
HC (Dry, weighted) g/GJ	Appliance outlet	53	56	148	86
NOx (Dry, weighted) g/GJ	Appliance outlet	52	41	46	46
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	94	74	71	80
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	2630	2216	1867	2238
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	105651	92931	94639	97740
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	128	95	115	113
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	332	303	362	332
PM (AO) g/GJ	Appliance outlet	135	48	48	77
PM (DT) g/GJ	Dilution tunnel	388	148	106	214
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	64	15	17	32
PAH's mg/GJ	Dilution tunnel	6090	3473	997	3520
SO2 g/GJ	Dilution tunnel	13	3	2	6
Condensable PM g/GJ	Dilution tunnel	253	100	58	137
Total PM, g/GJ	Dilution tunnel	108	113	101	107
PM10, g/GJ	Dilution tunnel	227	110	89	142
PM2.5, g/GJ	Dilution tunnel	214	105	88	136
PM1, g/GJ	Dilution tunnel	179	89	85	118
B[a]P mg/GJ	Dilution tunnel	45	22	13	27

Benzo(b)fluoranthene mg/GJ	Dilution tunnel	54	27	17	33
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	28	14	8	17
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	49	2	16	22
LRTAP PAH total mg/GJ	Dilution tunnel	176	65	54	98

Table A-3-59: Aga (Coalbrookdale) Little Wenlock – Old Stove test results – Wood Logs (Dry)

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	1887	1451	1231	1523
CO2 (Dry, weighted) g/GJ	Appliance outlet	81034	79931	77498	79488
HC (Dry, weighted) g/GJ	Appliance outlet	36	27	24	29
NOx (Dry, weighted) g/GJ	Appliance outlet	56	43	66	55
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	86	101	87	91
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	1887	1451	1231	1523
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	102726	119130	101800	107885
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	54	64	35	51
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	211	246	63	174
PM (AO) g/GJ	Appliance outlet	47	35	33	38
PM (DT) g/GJ	Dilution tunnel	100	111	85	99
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	727	459	201	463
PAH’s mg/GJ	Dilution tunnel	3451	5398	1505	3451
SO2 g/GJ	Dilution tunnel	8	8	8	8
Condensable PM g/GJ	Dilution tunnel	52	76	52	60
Total PM, g/GJ	Dilution tunnel	71	86	62	73
PM10, g/GJ	Dilution tunnel	77	102	79	86
PM2.5, g/GJ	Dilution tunnel	75	98	77	83
PM1, g/GJ	Dilution tunnel	72	84	71	76
B[a]P mg/GJ	Dilution tunnel	40	69	24	44
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	56	78	25	53
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	31	50	12	31
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	26	62	15	34
LRTAP PAH total mg/GJ	Dilution tunnel	153	258	75	162

Table A-3-60 : Basket Grate – Open Fire test results – High Sulphur MSF

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	2,449	2,405	2,516	2,457
CO2 (Dry, weighted) g/GJ	Appliance outlet	51,389	48,429	49,361	49,727
HC (Dry, weighted) g/GJ	Appliance outlet	582	653	854	696
NOx (Dry, weighted) g/GJ	Appliance outlet	180	176	177	178
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	110	104	108	107
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	2,449	2,405	2,516	2,457
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	50,585	51,467	50,939	50,997
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	1,015	1,008	1,015	1,013
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	805	834	1,005	881
PM (AO) g/GJ	Appliance outlet	312	239	219	257
PM (DT) g/GJ	Dilution tunnel	485	424	405	438
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	8	9	8	8
PAH’s mg/GJ	Dilution tunnel	1,888	1,808	2,665	2,120
SO2 g/GJ	Dilution tunnel	1,227	1,187	1,240	1,218
Condensable PM g/GJ	Dilution tunnel	375	185	186	249
Total PM, g/GJ	Dilution tunnel	208	166	367	247
PM10, g/GJ	Dilution tunnel	466	415	303	395
PM2.5, g/GJ	Dilution tunnel	463	415	300	392
PM1, g/GJ	Dilution tunnel	448	389	284	373
B[a]P mg/GJ	Dilution tunnel	137	117	133	129
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	91	74	88	84
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	28	21	26	25
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	34	28	29	30
LRTAP PAH total mg/GJ	Dilution tunnel	290	240	276	269

Table A-3-61 : Basket Grate – Open Fire test results – Low Sulphur MSF

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	4,054	4,918	4,609	4,527

CO2 (Dry, weighted) g/GJ	Appliance outlet	41,820	46,294	46,135	44,749
HC (Dry, weighted) g/GJ	Appliance outlet	1,083	1,434	845	1,121
NOx (Dry, weighted) g/GJ	Appliance outlet	137	134	142	137
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	91	94	101	95
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	4,054	4,918	4,609	4,527
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	47,057	53,712	52,917	51,229
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	472	625	596	564
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	1,862	2,643	2,070	2,192
PM (AO) g/GJ	Appliance outlet	109	125	110	115
PM (DT) g/GJ	Dilution tunnel	371	473	145	330
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	25	66	27	40
PAH's mg/GJ	Dilution tunnel	3,809	6,291	4,429	4,843
SO2 g/GJ	Dilution tunnel	535	681	667	628
Condensable PM g/GJ	Dilution tunnel	262	348	35	215
Total PM, g/GJ	Dilution tunnel	239	355	290	294
PM10, g/GJ	Dilution tunnel	360	450	138	316
PM2.5, g/GJ	Dilution tunnel	355	446	137	312
PM1, g/GJ	Dilution tunnel	350	435	135	307
B[a]P mg/GJ	Dilution tunnel	94	132	141	122
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	75	97	106	92
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	23	31	30	28
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	18	16	35	23
LRTAP PAH total mg/GJ	Dilution tunnel	209	276	312	266

Table A-3-62 : Basket Grate – Open Fire test results – Coal Trebles

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	3,227	3,431	3,502	3,387
CO2 (Dry, weighted) g/GJ	Appliance outlet	52,460	48,942	59,810	53,737
HC (Dry, weighted) g/GJ	Appliance outlet	404	161	464	343
NOx (Dry, weighted) g/GJ	Appliance outlet	208	126	236	190
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	173	215	219	202
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	3,227	3,431	3,502	3,387

CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	56,693	64,134	62,482	61,103
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	160	174	147	160
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	877	939	877	898
PM (AO) g/GJ	Appliance outlet	172	175	223	190
PM (DT) g/GJ	Dilution tunnel	339	436	360	378
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	25	37	15	26
PAH's mg/GJ	Dilution tunnel	3,583	2,951	3,329	3,288
SO2 g/GJ	Dilution tunnel	133	139	142	138
Condensable PM g/GJ	Dilution tunnel	166	261	138	188
Total PM, g/GJ	Dilution tunnel	224	249	258	244
PM10, g/GJ	Dilution tunnel	314	394	328	345
PM2.5, g/GJ	Dilution tunnel	308	375	320	334
PM1, g/GJ	Dilution tunnel	290	338	283	304
B[a]P mg/GJ	Dilution tunnel	33	31	28	31
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	54	57	52	55
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	33	36	29	33
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	30	46	38	38
LRTAP PAH total mg/GJ	Dilution tunnel	150	171	147	156

Table A-3-63: Basket Grate – Open Fire test results – Coffee Logs

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Appliance outlet	2,155	2,074	1,755	1,995
CO2 (Dry, weighted) g/GJ	Appliance outlet	63,683	63,806	59,879	62,456
HC (Dry, weighted) g/GJ	Appliance outlet	612	604	480	565
NOx (Dry, weighted) g/GJ	Appliance outlet	213	229	238	227
NOx (ECL Dry, weighted) g/GJ	Dilution tunnel	202	229	221	217
CO (ECL Dry, weighted) g/GJ	Dilution tunnel	2,155	2,074	1,755	1,995
CO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	68,099	68,608	66,489	67,732
SO2 (ECL Dry, weighted) g/GJ	Dilution tunnel	114	113	87	105
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	688	738	525	650
PM (AO) g/GJ	Appliance outlet	95	143	82	107
PM (DT) g/GJ	Dilution tunnel	437	689	400	509

Dioxins & Furans nqTEQ/GJ	Dilution tunnel	15	20	9	15
PAH's mg/GJ	Dilution tunnel	862	993	556	804
SO2 g/GJ	Dilution tunnel	143	126	100	123
Condensable PM g/GJ	Dilution tunnel	342	546	318	402
Total PM, g/GJ	Dilution tunnel	268	349	251	289
PM10, g/GJ	Dilution tunnel	384	601	340	441
PM2.5, g/GJ	Dilution tunnel	382	585	334	433
PM1, g/GJ	Dilution tunnel	293	407	272	324
B[a]P mg/GJ	Dilution tunnel	9	7	3	6
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	6	4	1	4
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	3	2	1	2
Indeno(123-cd)Pyrene mg/GJ	Dilution tunnel	1	4	2	2
LRTAP PAH total mg/GJ	Dilution tunnel	18	16	7	14

Table A-3-64: Basket Grate – Open Fire test results – Wood Briquettes

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Dilution tunnel	904	908	880	897
CO2 (Dry, weighted) g/GJ	Dilution tunnel	68,091	63,804	71,934	67,943
HC (Dry, weighted) g/GJ	Dilution tunnel	113	118	82	104
NOx (Dry, weighted) g/GJ	Dilution tunnel	57	56	56	57
NOx (ECL Dry, weighted) g/GJ	Appliance outlet	52	45	51	50
CO (ECL Dry, weighted) g/GJ	Appliance outlet	904	908	880	897
CO2 (ECL Dry, weighted) g/GJ	Appliance outlet	75,648	61,595	68,533	68,592
SO2 (ECL Dry, weighted) g/GJ	Appliance outlet	62	65	61	63
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	153	127	130	137
PM (AO) g/GJ	Dilution tunnel	57	60	61	59
PM (DT) g/GJ	Dilution tunnel	119	102	123	115
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	9	5	9	7
PAH's mg/GJ	Dilution tunnel	473	331	492	432
SO2 g/GJ	Appliance outlet	4	3	4	4
Condensable PM g/GJ	Dilution tunnel	62	42	62	55
Total PM, g/GJ	Dilution tunnel	99	90	97	95

PM10, g/GJ	Dilution tunnel	109	86	112	102
PM2.5, g/GJ	Dilution tunnel	108	84	112	101
PM1, g/GJ	Dilution tunnel	105	81	105	97
B[a]P mg/GJ	Dilution tunnel	4	3	5	4
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	4	2	4	3
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	2	1	2	2
Indeno(123-cd)Pyrene mg/GJ	Not Applicable	3	2	3	3
LRTAP PAH total mg/GJ	Dilution tunnel	14	8	14	12

Table A-3-65: Basket Grate – Open Fire test results – Wood Logs (Wet)

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Dilution tunnel	1778	2191	1911	1960
CO2 (Dry, weighted) g/GJ	Dilution tunnel	50535	49657	53365	51186
HC (Dry, weighted) g/GJ	Dilution tunnel	581	684	614	626
NOx (Dry, weighted) g/GJ	Dilution tunnel	71	50	63	62
NOx (ECL Dry, weighted) g/GJ	Appliance outlet	66	58	64	63
CO (ECL Dry, weighted) g/GJ	Appliance outlet	1778	2191	1911	1960
CO2 (ECL Dry, weighted) g/GJ	Appliance outlet	52314	51419	53958	52564
SO2 (ECL Dry, weighted) g/GJ	Appliance outlet	97	135	110	114
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	485	889	818	731
PM (AO) g/GJ	Dilution tunnel	85	103	90	92
PM (DT) g/GJ	Dilution tunnel	423	552	503	492
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	4	6	3	5
PAH's mg/GJ	Dilution tunnel	966	1735	1347	1349
SO2 g/GJ	Appliance outlet	4	3	3	3
Condensable PM g/GJ	Dilution tunnel	338	449	413	400
Total PM, g/GJ	Dilution tunnel	320	440	344	368
PM10, g/GJ	Dilution tunnel	395	521	465	460
PM2.5, g/GJ	Dilution tunnel	374	495	451	440
PM1, g/GJ	Dilution tunnel	305	342	360	336
B[a]P mg/GJ	Dilution tunnel	11	19	18	16
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	9	15	14	13

Benzo(k)fluoranthene mg/GJ	Dilution tunnel	6	10	9	8
Indeno(123-cd)Pyrene mg/GJ	Not Applicable	8	14	14	12
LRTAP PAH total mg/GJ	Dilution tunnel	34	59	55	49

Table A-3-12: Basket Grate – Open Fire test results – Wood Logs (Seasoned)

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Dilution tunnel	2954	2449	2417	2607
CO2 (Dry, weighted) g/GJ	Dilution tunnel	62971	57865	53292	58043
HC (Dry, weighted) g/GJ	Dilution tunnel	868	761	790	806
NOx (Dry, weighted) g/GJ	Dilution tunnel	77	65	67	70
NOx (ECL Dry, weighted) g/GJ	Appliance outlet	67	62	64	65
CO (ECL Dry, weighted) g/GJ	Appliance outlet	2954	2449	2417	2607
CO2 (ECL Dry, weighted) g/GJ	Appliance outlet	68461	58226	48553	58413
SO2 (ECL Dry, weighted) g/GJ	Appliance outlet	141	122	129	131
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	820	638	825	761
PM (AO) g/GJ	Dilution tunnel	85	121	156	120
PM (DT) g/GJ	Dilution tunnel	496	594	500	530
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	8	5	3	5
PAH's mg/GJ	Dilution tunnel	2193	1941	1749	1961
SO2 g/GJ	Appliance outlet	4	3	3	3
Condensable PM g/GJ	Dilution tunnel	411	474	345	410
Total PM, g/GJ	Dilution tunnel	462	550	415	476
PM10, g/GJ	Dilution tunnel	460	559	459	493
PM2.5, g/GJ	Dilution tunnel	452	548	448	482
PM1, g/GJ	Dilution tunnel	402	416	379	399
B[a]P mg/GJ	Dilution tunnel	18	13	16	16
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	16	11	13	13
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	10	7	8	8
Indeno(123-cd)Pyrene mg/GJ	Not Applicable	16	12	12	13
LRTAP PAH total mg/GJ	Dilution tunnel	59	42	49	50

Table A-3-67: Basket Grate – Open Fire test results – Wood Logs (Dry)

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Dilution tunnel	1768	1446	1700	1638
CO2 (Dry, weighted) g/GJ	Dilution tunnel	79980	68887	68696	72521
HC (Dry, weighted) g/GJ	Dilution tunnel	89	73	93	85
NOx (Dry, weighted) g/GJ	Dilution tunnel	290	208	678	392
NOx (ECL Dry, weighted) g/GJ	Appliance outlet	1294	1133	1484	1304
CO (ECL Dry, weighted) g/GJ	Appliance outlet	70735	64666	63184	66195
CO2 (ECL Dry, weighted) g/GJ	Appliance outlet	212	165	264	214
SO2 (ECL Dry, weighted) g/GJ	Appliance outlet	79	70	66	72
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	88	67	66	73
PM (AO) g/GJ	Dilution tunnel	1294	1133	1484	1304
PM (DT) g/GJ	Dilution tunnel	80189	66931	67223	71448
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	72	59	82	71
PAH's mg/GJ	Dilution tunnel	252	189	661	368
SO2 g/GJ	Appliance outlet	49	53	61	55
Condensable PM g/GJ	Dilution tunnel	173	152	160	162
Total PM, g/GJ	Dilution tunnel	3	2	2	2
PM10, g/GJ	Dilution tunnel	632	504	730	622
PM2.5, g/GJ	Dilution tunnel	6	8	6	7
PM1, g/GJ	Dilution tunnel	124	99	98	107
B[a]P mg/GJ	Dilution tunnel	3	3	4	3
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	3	3	4	3
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	1	2	2	2
Indeno(123-cd)Pyrene mg/GJ	Not Applicable	581	2	4	196
LRTAP PAH total mg/GJ	Dilution tunnel	588	10	14	204

Table A-3-68: Island Ramsey – Pellet Stove test results – Wood Pellets

Pollutant + Method	Measurement location	Run 1	Run 2	Run 3	Average
CO (Dry, weighted) g/GJ	Dilution tunnel	432	702	373	502
CO2 (Dry, weighted) g/GJ	Dilution tunnel	77173	74780	72872	74942

HC (Dry, weighted) g/GJ	Dilution tunnel	6	2	2	4
NOx (Dry, weighted) g/GJ	Dilution tunnel	78	60	61	66
NOx (ECL Dry, weighted) g/GJ	Appliance outlet	38	44	48	43
CO (ECL Dry, weighted) g/GJ	Appliance outlet	432	702	373	502
CO2 (ECL Dry, weighted) g/GJ	Appliance outlet	36840	43464	47770	42691
SO2 (ECL Dry, weighted) g/GJ	Appliance outlet	82	129	85	99
HC (ECL Dry, weighted) g/GJ	Dilution tunnel	15	2	2	6
PM (AO) g/GJ	Dilution tunnel	25	20	11	19
PM (DT) g/GJ	Dilution tunnel	55	68	39	54
Dioxins & Furans nqTEQ/GJ	Dilution tunnel	1332	1654	1416	1467
PAH's mg/GJ	Dilution tunnel	159	127	114	133
SO2 g/GJ	Appliance outlet	84	97	88	90
Condensable PM g/GJ	Dilution tunnel	30	48	29	36
Total PM, g/GJ	Dilution tunnel	22	39	13	25
PM10, g/GJ	Dilution tunnel	38	12	14	21
PM2.5, g/GJ	Dilution tunnel	27	11	14	17
PM1, g/GJ	Dilution tunnel	21	10	13	14
B[a]P mg/GJ	Dilution tunnel	12	1	0	4
Benzo(b)fluoranthene mg/GJ	Dilution tunnel	12	1	1	5
Benzo(k)fluoranthene mg/GJ	Dilution tunnel	5	1	0	2
Indeno(123-cd)Pyrene mg/GJ	Not Applicable	6	1	1	3
LRTAP PAH total mg/GJ	Dilution tunnel	35	4	2	14

A.4 POLLUTION MEASUREMENTS DATASET – DIOXINS AND FURANS

Table A-4-1: Charnwood C-4 blu – Modern Stove test results – Wood Briquettes

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	9.29	10.34	24.97	14.87
1,2,3,7,8 - PeCDD	Dilution tunnel	5.59	3.16	9.38	6.04
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.25	0.39	0.30	0.32
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.26	0.33	0.37	0.32
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.25	0.32	0.31	0.30
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.02	0.02	0.10	0.04
OCDD	Dilution tunnel	0.02	0.02	0.02	0.02
2,3,7,8 - TCDF	Dilution tunnel	35.39	25.70	33.65	31.58
1,2,3,7,8 - PeCDF	Dilution tunnel	0.94	1.39	2.67	1.67
2,3,4,7,8 - PeCDF	Dilution tunnel	67.71	49.42	52.34	56.49
1,2,3,4,7,8 - HxCDF	Dilution tunnel	0.39	0.44	1.77	0.87
1,2,3,6,7,8 - HxCDF	Dilution tunnel	0.30	0.36	2.23	0.96
2,3,4,6,7,8 - HxCDF	Dilution tunnel	0.20	2.04	1.86	1.37
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.17	0.21	0.14	0.17
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.01	0.01	0.20	0.07
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.01	0.02	0.02	0.02
OCDF	Dilution tunnel	0.01	0.01	0.00	0.01
Total	Dilution tunnel	120.81	94.19	130.33	115.11

Table A-4-2: Dovre 500MRF Cast Iron Stove test results – Wood Briquettes

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	57.93	37.84	30.69	42.15
1,2,3,7,8 - PeCDD	Dilution tunnel	29.08	10.29	7.40	15.59

1,2,3,4,7,8 - HxCDD	Dilution tunnel	2.18	1.18	0.18	1.18
1,2,3,6,7,8 - HxCDD	Dilution tunnel	4.56	1.90	0.18	2.21
1,2,3,7,8,9 - HxCDD	Dilution tunnel	2.58	1.74	0.17	1.49
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	1.23	0.51	0.01	0.58
OCDD	Dilution tunnel	0.09	0.04	0.01	0.05
2,3,7,8 - TCDF	Dilution tunnel	59.70	41.49	33.10	44.77
1,2,3,7,8 - PeCDF	Dilution tunnel	10.82	5.16	4.13	6.70
2,3,4,7,8 - PeCDF	Dilution tunnel	169.06	92.39	59.19	106.88
1,2,3,4,7,8 - HxCDF	Dilution tunnel	13.00	6.26	4.03	7.77
1,2,3,6,7,8 - HxCDF	Dilution tunnel	13.95	5.84	3.27	7.69
2,3,4,6,7,8 - HxCDF	Dilution tunnel	13.95	5.44	2.33	7.24
1,2,3,7,8,9 - HxCDF	Dilution tunnel	1.26	0.36	0.23	0.62
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	2.20	0.91	0.25	1.12
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.19	0.05	0.01	0.08
OCDF	Dilution tunnel	0.04	0.01	0.00	0.02
Total	Dilution tunnel	381.82	211.43	145.18	246.14

Table A-4-3: Hunter Aspect 5 - Modern Stove test results – Low Sulphur MSF

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	17.39	19.37	14.37	17.04
1,2,3,7,8 - PeCDD	Dilution tunnel	13.50	18.63	4.96	12.36
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.59	0.31	0.20	0.37
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.94	0.71	0.22	0.62
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.90	1.07	0.60	0.86
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.46	0.03	0.02	0.17
OCDD	Dilution tunnel	0.08	0.11	0.11	0.10
2,3,7,8 - TCDF	Dilution tunnel	12.43	7.89	16.14	12.16
1,2,3,7,8 - PeCDF	Dilution tunnel	3.59	2.89	10.62	5.70
2,3,4,7,8 - PeCDF	Dilution tunnel	57.09	2.89	96.88	52.29

1,2,3,4,7,8 - HxCDF	Dilution tunnel	3.87	4.02	7.90	5.26
1,2,3,6,7,8 - HxCDF	Dilution tunnel	3.74	3.18	7.77	4.90
2,3,4,6,7,8 - HxCDF	Dilution tunnel	4.07	3.43	2.14	3.21
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.33	0.31	1.94	0.86
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.67	0.34	1.48	0.83
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.11	0.03	0.12	0.09
OCDF	Dilution tunnel	0.01	3.29E-03	0.02	0.01
Total	Dilution tunnel	119.77	65.19	165.50	116.82

Table A-4-4: Hunter Aspect 5 - Modern Stove test results – High Sulphur MSF

Pollutant + Method (ngTEQ/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
2,3,7,8 - TCDD	Dilution tunnel	5.74	1.63	1.81	3.06
1,2,3,7,8 - PeCDD	Dilution tunnel	5.34	1.20	2.96	3.17
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.79	0.10	0.31	0.40
1,2,3,6,7,8 - HxCDD	Dilution tunnel	2.51	0.77	0.84	1.37
1,2,3,7,8,9 - HxCDD	Dilution tunnel	2.37	0.69	0.59	1.21
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	1.52	0.46	0.46	0.81
OCDD	Dilution tunnel	0.17	0.08	0.09	0.11
2,3,7,8 - TCDF	Dilution tunnel	33.05	1.72	1.57	12.11
1,2,3,7,8 - PeCDF	Dilution tunnel	1.14	0.35	0.38	0.62
2,3,4,7,8 - PeCDF	Dilution tunnel	21.87	7.33	5.84	11.68
1,2,3,4,7,8 - HxCDF	Dilution tunnel	1.92	0.55	0.66	1.05
1,2,3,6,7,8 - HxCDF	Dilution tunnel	1.89	0.91	0.75	1.18
2,3,4,6,7,8 - HxCDF	Dilution tunnel	2.36	0.75	0.89	1.33
1,2,3,7,8,9 - HxDF	Dilution tunnel	0.13	0.09	0.10	0.11
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.36	0.12	0.16	0.21
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.05	0.01	0.01	0.02
OCDF	Dilution tunnel	0.01	2.61E-03	0.01	0.01
Total	Dilution tunnel	81.24	16.75	17.43	38.47

Table A-4-5: Hunter Aspect 5 - Modern Stove test results – Coal Trebles

Pollutant + Method (ngTEQ/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
2,3,7,8 - TCDD	Dilution tunnel	1.27	15.17	1.40	5.95
1,2,3,7,8 - PeCDD	Dilution tunnel	0.72	0.86	0.57	0.72
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.12	1.74	0.11	0.66
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.12	1.96	0.11	0.73
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.11	2.45	0.11	0.89
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.01	0.35	0.01	0.12
OCDD	Dilution tunnel	0.08	0.10	0.04	0.07
2,3,7,8 - TCDF	Dilution tunnel	1.45	2.35	0.54	1.45
1,2,3,7,8 - PeCDF	Dilution tunnel	0.44	1.22	0.07	0.57
2,3,4,7,8 - PeCDF	Dilution tunnel	4.89	10.01	2.23	5.71
1,2,3,4,7,8 - HxCDF	Dilution tunnel	0.14	2.59	0.08	0.94
1,2,3,6,7,8 - HxCDF	Dilution tunnel	0.14	3.05	0.08	1.09
2,3,4,6,7,8 - HxCDF	Dilution tunnel	0.52	3.02	0.50	1.35
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.12	1.17	0.07	0.45
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.12	0.27	0.08	0.16
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.05	0.20	0.05	0.10
OCDF	Dilution tunnel	0.01	0.04	0.01	0.02
Total	Dilution tunnel	10.30	46.54	6.08	20.97

Table A-4-6: Hunter Aspect 5 - Modern Stove test results – Coffee Logs

Pollutant + Method (ngTEQ/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
2,3,7,8 - TCDD	Dilution tunnel	2.23	2.22	2.67	2.37
1,2,3,7,8 - PeCDD	Dilution tunnel	1.70	1.66	1.32	1.56
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.22	0.16	0.15	0.18
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.91	0.18	0.16	0.42

1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.55	0.17	0.15	0.29
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.52	0.29	0.01	0.27
OCDD	Dilution tunnel	0.13	0.12	0.07	0.11
2,3,7,8 - TCDF	Dilution tunnel	7.98	5.24	13.93	9.05
1,2,3,7,8 - PeCDF	Dilution tunnel	0.93	0.13	1.90	0.99
2,3,4,7,8 - PeCDF	Dilution tunnel	21.20	20.33	32.37	24.63
1,2,3,4,7,8 - HxCDF	Dilution tunnel	1.59	0.15	0.15	0.63
1,2,3,6,7,8 - HxCDF	Dilution tunnel	1.78	0.14	0.14	0.69
2,3,4,6,7,8 - HxCDF	Dilution tunnel	2.05	0.15	0.14	0.78
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.20	0.14	0.14	0.16
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.37	0.18	0.19	0.25
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.10	0.01	0.01	0.04
OCDF	Dilution tunnel	0.02	0.02	4.22E-03	0.01
Total	Dilution tunnel	42.47	31.30	53.51	42.42

Table A-4-7: Hunter Aspect 5 - Modern Stove test results – Anthracite

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	0.59	2.10	2.70	1.80
1,2,3,7,8 - PeCDD	Dilution tunnel	0.57	1.12	1.26	0.98
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.09	0.55	0.20	0.28
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.10	0.21	0.20	0.17
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.09	0.24	0.19	0.17
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.01	0.16	0.02	0.07
OCDD	Dilution tunnel	2.37E-03	0.15	0.01	0.05
2,3,7,8 - TCDF	Dilution tunnel	0.77	4.64	2.04	2.48
1,2,3,7,8 - PeCDF	Dilution tunnel	0.06	0.16	0.22	0.15
2,3,4,7,8 - PeCDF	Dilution tunnel	0.59	6.52	2.28	3.13
1,2,3,4,7,8 - HxCDF	Dilution tunnel	0.06	1.79	0.15	0.67
1,2,3,6,7,8 - HxCDF	Dilution tunnel	0.06	1.30	0.14	0.50
2,3,4,6,7,8 - HxCDF	Dilution tunnel	0.06	0.82	0.16	0.35

1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.06	0.18	0.16	0.13
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.06	0.28	0.01	0.12
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	4.51E-03	0.01	0.01	0.01
OCDF	Dilution tunnel	5.86E-04	0.01	2.40E-03	0.01
Total	Dilution tunnel	3.18	20.24	9.77	11.06

Table A-4-8: Hunter Aspect 5 - Modern Stove test results – Wet Wood

Pollutant + Method (ngTEQ/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
2,3,7,8 - TCDD	Dilution tunnel	0.91	0.71	0.50	0.71
1,2,3,7,8 - PeCDD	Dilution tunnel	0.69	0.56	0.75	0.67
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.10	0.09	0.07	0.08
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.10	0.09	0.07	0.09
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.09	0.08	0.07	0.08
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.01	0.01	0.01	0.01
OCDD	Dilution tunnel	0.06	0.01	0.05	0.04
2,3,7,8 - TCDF	Dilution tunnel	1.79	0.47	0.56	0.94
1,2,3,7,8 - PeCDF	Dilution tunnel	0.57	0.08	0.06	0.23
2,3,4,7,8 - PeCDF	Dilution tunnel	5.42	0.78	0.55	2.25
1,2,3,4,7,8 - HxCDF	Dilution tunnel	0.75	0.07	0.06	0.29
1,2,3,6,7,8 - HxCDF	Dilution tunnel	0.08	0.07	0.05	0.07
2,3,4,6,7,8 - HxCDF	Dilution tunnel	0.08	0.07	0.05	0.07
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.08	0.07	0.05	0.06
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.13	0.01	0.04	0.06
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.03	0.01	0.02	0.02
OCDF	Dilution tunnel	0.01	3.61E-03	0.01	0.01
Total	Dilution tunnel	10.89	3.18	2.95	5.67

Table A-4-9: Hunter Aspect 5 - Modern Stove test results – Seasoned Wood

Pollutant + Method (ngTEQ/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
2,3,7,8 - TCDD	Dilution tunnel	1.51	0.45	0.52	0.82
1,2,3,7,8 - PeCDD	Dilution tunnel	1.84	0.89	0.65	1.13
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.25	0.05	0.07	0.12
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.25	0.07	0.08	0.13
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.23	0.06	0.07	0.12
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.77	0.01	0.09	0.29
OCDD	Dilution tunnel	0.20	0.02	0.04	0.09
2,3,7,8 - TCDF	Dilution tunnel	6.56	0.43	3.81	3.60
1,2,3,7,8 - PeCDF	Dilution tunnel	1.33	0.04	0.07	0.48
2,3,4,7,8 - PeCDF	Dilution tunnel	13.47	0.38	0.61	4.82
1,2,3,4,7,8 - HxCDF	Dilution tunnel	2.78	0.05	0.05	0.96
1,2,3,6,7,8 - HxCDF	Dilution tunnel	2.16	0.05	0.06	0.75
2,3,4,6,7,8 - HxCDF	Dilution tunnel	2.58	0.05	0.05	0.89
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.21	0.04	0.05	0.10
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.65	0.01	0.08	0.25
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.07	0.01	4.31E-03	0.03
OCDF	Dilution tunnel	0.04	0.01	0.01	0.02
Total	Dilution tunnel	34.90	2.63	6.32	14.62

Table A-4-10: Hunter Aspect 5 - Modern Stove test results – Dry Wood

Pollutant + Method (ngTEQ/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
2,3,7,8 - TCDD	Dilution tunnel	4.10	1.24	1.42	2.25
1,2,3,7,8 - PeCDD	Dilution tunnel	2.37	2.79	1.47	2.21
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.50	0.32	0.17	0.33
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.76	0.54	0.17	0.49

1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.49	0.59	0.17	0.42
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.35	0.02	0.01	0.13
OCDD	Dilution tunnel	0.07	0.04	0.01	0.04
2,3,7,8 - TCDF	Dilution tunnel	10.08	6.34	0.67	5.70
1,2,3,7,8 - PeCDF	Dilution tunnel	2.35	1.92	0.18	1.48
2,3,4,7,8 - PeCDF	Dilution tunnel	47.85	28.57	1.80	26.07
1,2,3,4,7,8 - HxCDF	Dilution tunnel	5.61	3.82	0.21	3.21
1,2,3,6,7,8 - HxCDF	Dilution tunnel	4.66	3.93	0.21	2.94
2,3,4,6,7,8 - HxCDF	Dilution tunnel	5.69	3.99	0.20	3.29
1,2,3,7,8,9 - HxCDF	Dilution tunnel	1.29	0.39	0.20	0.63
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	1.25	1.02	0.02	0.76
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.14	0.14	0.02	0.10
OCDF	Dilution tunnel	0.03	0.02	2.38E-03	0.02
Total	Dilution tunnel	87.57	55.69	6.92	50.06

Table A-4-11: Hunter Aspect 5 - Modern Stove test results – Wood Briquettes

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	23.12	2.08	26.46	17.22
1,2,3,7,8 - PeCDD	Dilution tunnel	13.14	2.94	25.44	13.84
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.70	0.22	3.12	1.34
1,2,3,6,7,8 - HxCDD	Dilution tunnel	1.02	0.24	3.20	1.48
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.48	0.23	2.53	1.08
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.35	0.02	0.90	0.42
OCDD	Dilution tunnel	0.06	0.04	0.08	0.06
2,3,7,8 - TCDF	Dilution tunnel	26.28	14.51	16.60	19.13
1,2,3,7,8 - PeCDF	Dilution tunnel	5.36	3.68	9.02	6.02
2,3,4,7,8 - PeCDF	Dilution tunnel	94.60	48.68	161.18	101.48
1,2,3,4,7,8 - HxCDF	Dilution tunnel	6.50	4.33	17.56	9.46
1,2,3,6,7,8 - HxCDF	Dilution tunnel	6.43	3.04	17.44	8.97
2,3,4,6,7,8 - HxCDF	Dilution tunnel	6.71	3.59	21.89	10.73

1,2,3,7,8,9 - HxCDF	Dilution tunnel	1.99	0.38	1.26	1.21
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	1.00	0.54	4.11	1.88
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.21	0.16	4.57	1.65
OCDF	Dilution tunnel	0.04	0.03	0.06	0.04
Total	Dilution tunnel	187.98	84.69	315.42	196.03

Table A-4-12: Hunter Aspect-8 - Modern Stove test results – Low Sulphur MSF

Pollutant + Method (ngTEQ/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
2,3,7,8 - TCDD	Dilution tunnel	1.63	0.73	0.60	0.99
1,2,3,7,8 - PeCDD	Dilution tunnel	0.96	0.39	0.44	0.59
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.12	0.06	0.05	0.08
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.53	0.07	0.06	0.22
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.44	0.07	0.06	0.19
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.14	0.05	0.02	0.07
OCDD	Dilution tunnel	0.05	0.02	0.02	0.03
2,3,7,8 - TCDF	Dilution tunnel	2.89	0.69	1.11	1.56
1,2,3,7,8 - PeCDF	Dilution tunnel	1.03	0.23	0.05	0.44
2,3,4,7,8 - PeCDF	Dilution tunnel	7.43	0.66	3.28	3.79
1,2,3,4,7,8 - HxCDF	Dilution tunnel	1.37	0.25	0.04	0.55
1,2,3,6,7,8 - HxCDF	Dilution tunnel	1.39	0.70	0.04	0.71
2,3,4,6,7,8 - HxCDF	Dilution tunnel	1.66	0.32	0.04	0.68
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.17	0.06	0.04	0.09
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.31	0.01	0.06	0.13
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.02	0.01	0.01	0.02
OCDF	Dilution tunnel	0.01	4.86E-03	4.44E-03	0.01
Total	Dilution tunnel	20.15	4.31	5.95	10.14

Table A-4-13: Hunter Aspect-8 - Modern Stove test results – High Sulphur MSF

Pollutant + Method (ngTEQ/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**

2,3,7,8 - TCDD	Dilution tunnel	0.76	0.60	0.60	0.65
1,2,3,7,8 - PeCDD	Dilution tunnel	0.49	0.45	0.44	0.46
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.17	0.05	0.06	0.10
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.09	0.05	0.07	0.07
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.12	0.05	0.07	0.08
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.10	0.17	0.01	0.09
OCDD	Dilution tunnel	0.03	0.02	0.00	0.02
2,3,7,8 - TCDF	Dilution tunnel	1.47	0.79	0.99	1.08
1,2,3,7,8 - PeCDF	Dilution tunnel	0.18	0.03	0.04	0.08
2,3,4,7,8 - PeCDF	Dilution tunnel	0.44	0.30	0.35	0.36
1,2,3,4,7,8 - HxCDF	Dilution tunnel	0.28	0.04	0.04	0.12
1,2,3,6,7,8 - HxCDF	Dilution tunnel	0.15	0.04	0.05	0.08
2,3,4,6,7,8 - HxCDF	Dilution tunnel	0.27	0.05	0.05	0.13
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.06	0.05	0.05	0.05
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.06	0.01	0.01	0.03
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.02	0.01	0.01	0.01
OCDF	Dilution tunnel	1.91E-03	1.89E-03	1.00E-03	1.60E-03
Total	Dilution tunnel	4.69	2.73	2.86	3.43

Table A-4-14 : Hunter Aspect-8 - Modern Stove test results – Coal Trebles

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	3.30	2.15	0.87	2.11
1,2,3,7,8 - PeCDD	Dilution tunnel	0.94	1.18	0.75	0.96
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.15	0.20	0.08	0.14
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.16	0.23	0.08	0.15
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.14	0.21	0.08	0.14
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.12	0.06	0.07	0.08
OCDD	Dilution tunnel	0.07	0.01	0.01	0.03

2,3,7,8 - TCDF	Dilution tunnel	2.79	2.70	4.11	3.20
1,2,3,7,8 - PeCDF	Dilution tunnel	0.54	0.12	0.53	0.40
2,3,4,7,8 - PeCDF	Dilution tunnel	6.64	6.74	8.02	7.13
1,2,3,4,7,8 - HxCDF	Dilution tunnel	0.99	0.17	0.80	0.65
1,2,3,6,7,8 - HxCDF	Dilution tunnel	1.27	0.90	0.50	0.89
2,3,4,6,7,8 - HxCDF	Dilution tunnel	0.61	0.86	0.42	0.63
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.16	0.17	0.10	0.14
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.09	0.01	0.11	0.07
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.04	0.01	0.02	0.02
OCDF	Dilution tunnel	0.02	0.01	2.27E-03	0.01
Total	Dilution tunnel	18.03	15.71	16.54	16.76

Table A-4-15: Hunter Aspect-8 - Modern Stove test results – Coffee Logs

Pollutant + Method (ngTEQ/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
2,3,7,8 - TCDD	Dilution tunnel	1.48	10.69	1.55	4.57
1,2,3,7,8 - PeCDD	Dilution tunnel	2.31	7.57	6.72	5.54
1,2,3,4,7,8 - HxCDD	Dilution tunnel	1.64	3.96	0.28	1.96
1,2,3,6,7,8 - HxCDD	Dilution tunnel	5.88	3.67	3.37	4.31
1,2,3,7,8,9 - HxCDD	Dilution tunnel	2.42	2.28	1.80	2.17
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	3.42	2.19	1.99	2.54
OCDD	Dilution tunnel	0.56	0.46	0.52	0.51
2,3,7,8 - TCDF	Dilution tunnel	1.82	3.15	2.24	2.40
1,2,3,7,8 - PeCDF	Dilution tunnel	0.57	0.73	0.12	0.47
2,3,4,7,8 - PeCDF	Dilution tunnel	15.71	11.05	6.07	10.95
1,2,3,4,7,8 - HxCDF	Dilution tunnel	0.17	0.17	0.12	0.16
1,2,3,6,7,8 - HxCDF	Dilution tunnel	2.42	0.16	0.11	0.90
2,3,4,6,7,8 - HxCDF	Dilution tunnel	4.05	0.15	0.11	1.44
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.16	0.15	0.11	0.14
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.56	0.27	0.18	0.33
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.05	0.01	0.01	0.02
OCDF	Dilution tunnel	0.01	0.02	3.06E-03	0.01

Total	Dilution tunnel	43.23	46.69	25.32	38.41

Table A-4-16: Hunter Aspect-8 - Modern Stove test results – Anthracite

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	0.82	0.90	2.30	1.34
1,2,3,7,8 - PeCDD	Dilution tunnel	0.56	0.55	1.62	0.91
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.11	0.11	0.32	0.18
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.12	0.12	0.36	0.20
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.12	0.11	0.34	0.19
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.01	0.01	0.04	0.02
OCDD	Dilution tunnel	0.02	0.00	0.06	0.03
2,3,7,8 - TCDF	Dilution tunnel	1.98	2.34	5.60	3.31
1,2,3,7,8 - PeCDF	Dilution tunnel	0.03	0.04	0.13	0.07
2,3,4,7,8 - PeCDF	Dilution tunnel	2.58	1.86	1.24	1.89
1,2,3,4,7,8 - HxCDF	Dilution tunnel	0.07	0.07	0.19	0.11
1,2,3,6,7,8 - HxCDF	Dilution tunnel	0.06	0.06	0.17	0.10
2,3,4,6,7,8 - HxCDF	Dilution tunnel	0.06	0.06	0.18	0.10
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.06	0.06	0.17	0.09
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	3.89E-03	0.01	0.01	0.01
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	4.50E-03	0.01	0.01	0.01
OCDF	Dilution tunnel	1.27E-03	1.24E-03	3.66E-03	2.06E-03
Total	Dilution tunnel	6.62	6.32	12.75	8.57

Table A-4-17: Hunter Aspect-8 - Modern Stove test results – Wet Wood

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	0.53	0.64	0.37	0.52
1,2,3,7,8 - PeCDD	Dilution tunnel	1.07	0.58	0.31	0.65
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.11	0.08	0.07	0.09
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.84	0.08	0.19	0.37

1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.11	0.08	0.14	0.11
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.39	0.01	0.12	0.17
OCDD	Dilution tunnel	0.15	0.02	0.04	0.07
2,3,7,8 - TCDF	Dilution tunnel	1.17	0.44	0.84	0.82
1,2,3,7,8 - PeCDF	Dilution tunnel	0.13	0.05	0.15	0.11
2,3,4,7,8 - PeCDF	Dilution tunnel	4.71	0.39	1.56	2.22
1,2,3,4,7,8 - HxCDF	Dilution tunnel	0.48	0.05	0.39	0.31
1,2,3,6,7,8 - HxCDF	Dilution tunnel	0.06	0.05	0.36	0.15
2,3,4,6,7,8 - HxCDF	Dilution tunnel	0.07	0.04	0.28	0.13
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.07	0.04	0.03	0.04
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.07	0.04	0.07	0.06
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.01	0.00	0.01	0.01
OCDF	Dilution tunnel	0.01	3.40E-03	4.88E-03	0.01
Total	Dilution tunnel	9.96	2.62	4.92	5.83

Table A-4-18 : Hunter Aspect-8 - Modern Stove test results – Seasoned Wood

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	0.76	3.72	0.75	1.74
1,2,3,7,8 - PeCDD	Dilution tunnel	0.62	1.53	0.54	0.89
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.09	0.05	0.06	0.07
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.40	0.05	0.06	0.17
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.10	0.12	0.06	0.09
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.13	0.11	0.06	0.10
OCDD	Dilution tunnel	0.04	0.03	0.03	0.03
2,3,7,8 - TCDF	Dilution tunnel	2.29	3.22	0.62	2.04
1,2,3,7,8 - PeCDF	Dilution tunnel	0.47	0.26	0.18	0.30
2,3,4,7,8 - PeCDF	Dilution tunnel	5.41	3.47	3.33	4.07
1,2,3,4,7,8 - HxCDF	Dilution tunnel	0.07	0.03	0.03	0.05
1,2,3,6,7,8 - HxCDF	Dilution tunnel	0.07	0.03	0.04	0.04
2,3,4,6,7,8 - HxCDF	Dilution tunnel	0.68	0.35	0.03	0.36

1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.07	0.03	0.03	0.04
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.15	0.12	0.07	0.11
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.02	0.01	0.01	0.01
OCDF	Dilution tunnel	0.01	4.39E-03	2.88E-03	0.01
Total	Dilution tunnel	11.39	13.14	5.90	10.14

Table A-4-19: Hunter Aspect-8 - Modern Stove test results – Dry Wood

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	6.60	7.36	6.28	6.75
1,2,3,7,8 - PeCDD	Dilution tunnel	3.35	5.52	6.62	5.17
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.65	0.84	1.68	1.06
1,2,3,6,7,8 - HxCDD	Dilution tunnel	1.30	1.22	2.40	1.64
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.82	0.89	2.00	1.24
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.57	0.73	1.34	0.88
OCDD	Dilution tunnel	0.08	0.11	0.17	0.12
2,3,7,8 - TCDF	Dilution tunnel	4.41	5.45	6.67	5.51
1,2,3,7,8 - PeCDF	Dilution tunnel	1.41	2.43	3.63	2.49
2,3,4,7,8 - PeCDF	Dilution tunnel	22.06	39.63	59.60	40.43
1,2,3,4,7,8 - HxCDF	Dilution tunnel	2.46	4.80	10.00	5.75
1,2,3,6,7,8 - HxCDF	Dilution tunnel	2.93	5.55	9.09	5.86
2,3,4,6,7,8 - HxCDF	Dilution tunnel	2.86	4.78	12.88	6.84
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.77	1.20	5.03	2.33
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.66	1.19	3.03	1.63
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.22	0.38	0.84	0.48
OCDF	Dilution tunnel	0.04	0.08	0.22	0.12
Total	Dilution tunnel	51.20	82.17	131.47	88.28

Table A-4-20: Hunter Aspect-8 - Modern Stove test results – Wood Briquettes

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average

2,3,7,8 - TCDD	Dilution tunnel	9.97	14.05	6.37	10.13
1,2,3,7,8 - PeCDD	Dilution tunnel	5.34	6.75	2.28	4.79
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.82	0.24	0.25	0.44
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.33	0.21	0.22	0.25
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.32	0.21	0.21	0.25
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.50	0.13	0.39	0.34
OCDD	Dilution tunnel	0.08	0.04	0.06	0.06
2,3,7,8 - TCDF	Dilution tunnel	16.34	11.31	11.86	13.17
1,2,3,7,8 - PeCDF	Dilution tunnel	2.14	2.34	2.55	2.34
2,3,4,7,8 - PeCDF	Dilution tunnel	38.94	31.20	27.27	32.47
1,2,3,4,7,8 - HxCDF	Dilution tunnel	4.42	2.44	3.38	3.42
1,2,3,6,7,8 - HxCDF	Dilution tunnel	5.63	2.52	3.27	3.81
2,3,4,6,7,8 - HxCDF	Dilution tunnel	3.94	2.42	3.04	3.13
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.98	0.28	0.40	0.55
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.70	0.40	0.58	0.56
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.30	0.10	0.12	0.17
OCDF	Dilution tunnel	0.06	0.02	0.02	0.04
Total	Dilution tunnel	90.81	74.66	62.25	75.91

Table A-4-21 : Hunter Aspect-8 – Low output test results – Heat Approved

Pollutant + Method (ngTEQ/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
2,3,7,8 - TCDD	Dilution tunnel	1.73	2.53	1.27	1.84
1,2,3,7,8 - PeCDD	Dilution tunnel	1.31	1.16	0.75	1.07
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.14	0.05	0.11	0.10
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.16	0.05	0.13	0.11
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.14	0.05	0.12	0.11
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.01	0.09	0.01	0.04
OCDD	Dilution tunnel	0.06	0.05	0.06	0.05
2,3,7,8 - TCDF	Dilution tunnel	5.64	6.34	2.94	4.97

1,2,3,7,8 - PeCDF	Dilution tunnel	0.63	1.02	0.12	0.59
2,3,4,7,8 - PeCDF	Dilution tunnel	14.22	19.04	1.07	11.45
1,2,3,4,7,8 - HxCDF	Dilution tunnel	0.78	1.20	0.14	0.71
1,2,3,6,7,8 - HxCDF	Dilution tunnel	0.63	1.72	0.15	0.83
2,3,4,6,7,8 - HxCDF	Dilution tunnel	0.71	1.05	0.16	0.64
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.14	0.19	0.16	0.16
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.19	0.19	0.27	0.22
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.01	0.01	0.01	0.01
OCDF	Dilution tunnel	1.12E-03	3.32E-03	2.03E-03	2.16E-03
Total	Dilution tunnel	26.50	34.74	7.48	22.91

Table A-4-22 : Hunter Aspect-8 – Low output test results – Bright Flame

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	0.80	1.27	1.46	1.18
1,2,3,7,8 - PeCDD	Dilution tunnel	0.80	0.82	0.89	0.84
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.08	0.08	0.09	0.08
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.08	0.08	0.11	0.09
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.08	0.08	0.50	0.22
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.01	0.01	0.02	0.01
OCDD	Dilution tunnel	0.04	0.05	0.06	0.05
2,3,7,8 - TCDF	Dilution tunnel	2.70	3.69	0.61	2.33
1,2,3,7,8 - PeCDF	Dilution tunnel	0.14	0.24	0.18	0.19
2,3,4,7,8 - PeCDF	Dilution tunnel	7.52	2.51	16.21	8.75
1,2,3,4,7,8 - HxCDF	Dilution tunnel	0.10	0.15	0.24	0.16
1,2,3,6,7,8 - HxCDF	Dilution tunnel	0.08	0.15	0.22	0.15
2,3,4,6,7,8 - HxCDF	Dilution tunnel	0.08	0.14	0.22	0.15
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.09	0.15	0.24	0.16
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.19	0.19	0.14	0.17
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.01	0.02	0.01	0.01
OCDF	Dilution tunnel	2.58E-03	0.01	0.01	0.01
Total	Dilution tunnel	12.78	9.65	21.21	14.55

Table A-4-23 : Hunter Aspect-8 – Low output test results – Coal Trebles

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	0.61	0.91	0.76	0.76
1,2,3,7,8 - PeCDD	Dilution tunnel	0.57	1.29	0.68	0.84
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.08	0.19	0.14	0.14
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.10	0.21	0.16	0.15
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.09	0.20	0.15	0.15
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.19	0.02	0.02	0.08
OCDD	Dilution tunnel	0.05	0.07	0.08	0.07
2,3,7,8 - TCDF	Dilution tunnel	0.11	0.30	0.15	0.18
1,2,3,7,8 - PeCDF	Dilution tunnel	0.07	0.12	0.09	0.09
2,3,4,7,8 - PeCDF	Dilution tunnel	0.72	1.01	0.92	0.88
1,2,3,4,7,8 - HxCDF	Dilution tunnel	0.12	0.14	0.08	0.11
1,2,3,6,7,8 - HxCDF	Dilution tunnel	0.10	0.13	0.08	0.10
2,3,4,6,7,8 - HxCDF	Dilution tunnel	0.12	0.15	0.09	0.12
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.12	0.18	0.09	0.13
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.20	0.01	0.01	0.07
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.01	0.01	0.01	0.01
OCDF	Dilution tunnel	0.02	3.85E-03	1.38E-03	0.01
Total	Dilution tunnel	3.28	4.92	3.49	3.90

Table A-4-24: Hunter Aspect-8 – Low output test results – Anthracite

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	1.09	13.24	1.64	5.32
1,2,3,7,8 - PeCDD	Dilution tunnel	0.76	4.35	1.02	2.04
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.26	0.30	0.20	0.25
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.15	0.38	0.19	0.24

1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.12	0.34	0.18	0.21
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.01	0.17	0.01	0.06
OCDD	Dilution tunnel	0.07	0.03	0.04	0.04
2,3,7,8 - TCDF	Dilution tunnel	1.57	91.66	0.64	31.29
1,2,3,7,8 - PeCDF	Dilution tunnel	0.56	2.49	0.57	1.21
2,3,4,7,8 - PeCDF	Dilution tunnel	1.05	33.85	1.39	12.10
1,2,3,4,7,8 - HxCDF	Dilution tunnel	0.10	5.21	0.20	1.84
1,2,3,6,7,8 - HxCDF	Dilution tunnel	0.09	2.03	0.20	0.77
2,3,4,6,7,8 - HxCDF	Dilution tunnel	0.12	2.19	0.20	0.84
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.12	0.30	0.19	0.21
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.10	0.62	0.27	0.33
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.01	0.05	0.01	0.02
OCDF	Dilution tunnel	0.01	0.02	1.34E-03	0.01
Total	Dilution tunnel	6.19	157.23	6.96	56.79

Table A-4-25: Hunter Aspect-8 – Low output test results – Wet wood

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	1.00	1.11	1.06	1.05
1,2,3,7,8 - PeCDD	Dilution tunnel	1.02	1.46	0.85	1.11
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.10	0.11	0.12	0.11
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.10	0.11	0.13	0.11
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.10	0.11	0.12	0.11
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.26	0.01	0.24	0.17
OCDD	Dilution tunnel	0.12	0.07	0.08	0.09
2,3,7,8 - TCDF	Dilution tunnel	1.62	1.65	0.60	1.29
1,2,3,7,8 - PeCDF	Dilution tunnel	0.52	0.19	0.21	0.31
2,3,4,7,8 - PeCDF	Dilution tunnel	4.76	5.74	2.60	4.37
1,2,3,4,7,8 - HxCDF	Dilution tunnel	1.77	0.14	0.43	0.78
1,2,3,6,7,8 - HxCDF	Dilution tunnel	1.85	0.13	0.61	0.86
2,3,4,6,7,8 - HxCDF	Dilution tunnel	2.16	0.13	0.67	0.99

1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.17	0.13	0.09	0.13
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.66	0.27	0.20	0.38
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.01	0.04	0.01	0.02
OCDF	Dilution tunnel	0.02	0.02	0.01	0.02
Total	Dilution tunnel	16.24	11.42	8.02	11.89

Table A-4-26: Hunter Aspect-8 – Low output test results – Seasoned wood

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	7.22	6.52	4.74	6.16
1,2,3,7,8 - PeCDD	Dilution tunnel	6.67	5.99	2.07	4.91
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.59	0.58	0.19	0.46
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.46	0.56	0.25	0.42
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.45	0.55	0.22	0.41
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.19	0.22	0.12	0.18
OCDD	Dilution tunnel	0.02	0.18	0.01	0.07
2,3,7,8 - TCDF	Dilution tunnel	1.52	0.68	20.47	7.56
1,2,3,7,8 - PeCDF	Dilution tunnel	0.42	0.43	1.12	0.66
2,3,4,7,8 - PeCDF	Dilution tunnel	4.86	5.55	14.07	8.16
1,2,3,4,7,8 - HxCDF	Dilution tunnel	0.82	0.93	3.21	1.65
1,2,3,6,7,8 - HxCDF	Dilution tunnel	0.97	1.11	1.22	1.10
2,3,4,6,7,8 - HxCDF	Dilution tunnel	0.65	0.74	1.47	0.95
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.45	0.63	0.19	0.42
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.15	0.17	0.27	0.19
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.01	0.02	0.02	0.02
OCDF	Dilution tunnel	4.18E-03	0.01	0.01	0.01
Total	Dilution tunnel	25.45	24.86	49.65	33.32

Table A-4-27: Hunter Aspect-8 – Low output test results – Dry wood

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average

2,3,7,8 - TCDD	Dilution tunnel	6.94	2.34	0.70	3.33
1,2,3,7,8 - PeCDD	Dilution tunnel	0.62	0.27	0.36	0.42
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.35	0.10	0.05	0.17
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.49	0.14	0.04	0.22
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.51	0.07	0.09	0.22
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.32	0.07	0.00	0.13
OCDD	Dilution tunnel	0.08	0.02	0.02	0.04
2,3,7,8 - TCDF	Dilution tunnel	4.80	1.71	1.63	2.71
1,2,3,7,8 - PeCDF	Dilution tunnel	0.75	0.30	0.27	0.44
2,3,4,7,8 - PeCDF	Dilution tunnel	9.51	5.83	3.76	6.37
1,2,3,4,7,8 - HxCDF	Dilution tunnel	1.08	0.69	0.04	0.60
1,2,3,6,7,8 - HxCDF	Dilution tunnel	1.19	0.58	0.05	0.61
2,3,4,6,7,8 - HxCDF	Dilution tunnel	1.11	0.66	0.43	0.74
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.11	0.05	0.06	0.07
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.22	0.13	0.08	0.14
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.03	0.01	2.71E-03	0.02
OCDF	Dilution tunnel	0.01	0.00	1.47E-03	0.01
Total	Dilution tunnel	28.13	12.97	7.57	16.22

Table A-4-28: Hunter Aspect-8 – Low output test results – Wood Briquettes

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	60.50	23.33	11.92	31.91
1,2,3,7,8 - PeCDD	Dilution tunnel	27.55	8.28	5.02	13.62
1,2,3,4,7,8 - HxCDD	Dilution tunnel	1.58	0.39	0.24	0.74
1,2,3,6,7,8 - HxCDD	Dilution tunnel	2.17	0.59	0.34	1.04
1,2,3,7,8,9 - HxCDD	Dilution tunnel	1.87	0.65	0.39	0.97
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.71	0.39	0.29	0.47
OCDD	Dilution tunnel	0.08	0.06	0.05	0.07
2,3,7,8 - TCDF	Dilution tunnel	53.26	19.01	14.05	28.77

1,2,3,7,8 - PeCDF	Dilution tunnel	10.62	2.98	1.55	5.05
2,3,4,7,8 - PeCDF	Dilution tunnel	174.87	35.78	22.02	77.56
1,2,3,4,7,8 - HxCDF	Dilution tunnel	14.97	2.79	1.47	6.41
1,2,3,6,7,8 - HxCDF	Dilution tunnel	13.99	2.79	1.51	6.10
2,3,4,6,7,8 - HxCDF	Dilution tunnel	13.99	2.88	1.27	6.05
1,2,3,7,8,9 - HxCDF	Dilution tunnel	1.57	0.26	0.15	0.66
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	2.23	0.57	0.24	1.02
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.29	0.08	0.03	0.13
OCDF	Dilution tunnel	0.03	0.01	0.01	0.02
Total	Dilution tunnel	380.30	100.83	60.56	180.56

Table A-4-28: Kensal Redfyre – Middle stove test results – Low Sulphur MSF

Pollutant + Method (ngTEQ/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
2,3,7,8 - TCDD	Dilution tunnel	3.13	6.24	6.73	5.37
1,2,3,7,8 - PeCDD	Dilution tunnel	1.87	3.66	8.52	4.68
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.36	0.65	1.92	0.98
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.35	1.99	1.86	1.40
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.34	1.84	1.28	1.15
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.02	0.67	0.73	0.47
OCDD	Dilution tunnel	0.03	0.03	0.59	0.22
2,3,7,8 - TCDF	Dilution tunnel	7.17	6.26	5.73	6.39
1,2,3,7,8 - PeCDF	Dilution tunnel	1.00	2.10	1.38	1.49
2,3,4,7,8 - PeCDF	Dilution tunnel	30.03	31.62	29.22	30.29
1,2,3,4,7,8 - HxCDF	Dilution tunnel	2.01	2.78	2.58	2.46
1,2,3,6,7,8 - HxCDF	Dilution tunnel	2.40	3.63	3.21	3.08
2,3,4,6,7,8 - HxCDF	Dilution tunnel	2.55	3.87	3.16	3.19
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.27	0.40	0.37	0.35
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.33	0.49	0.51	0.44
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.01	0.10	0.03	0.05
OCDF	Dilution tunnel	1.03E-03	1.33E-03	0.01	3.97E-03
Total	Dilution tunnel	51.88	66.34	67.82	62.01

Table A-4-29 : Kensal Redfyre – Middle stove test results – Low Sulphur MSF

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	3.98	8.80	2.89	5.22
1,2,3,7,8 - PeCDD	Dilution tunnel	11.91	4.42	4.51	6.94
1,2,3,4,7,8 - HxCDD	Dilution tunnel	1.39	0.56	0.38	0.77
1,2,3,6,7,8 - HxCDD	Dilution tunnel	6.43	2.62	1.41	3.49
1,2,3,7,8,9 - HxCDD	Dilution tunnel	3.98	1.57	0.35	1.97
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	30.22	0.33	0.26	10.27
OCDD	Dilution tunnel	13.37	0.05	0.03	4.49
2,3,7,8 - TCDF	Dilution tunnel	10.98	7.92	5.27	8.06
1,2,3,7,8 - PeCDF	Dilution tunnel	4.21	2.62	1.06	2.63
2,3,4,7,8 - PeCDF	Dilution tunnel	49.18	40.23	25.72	38.38
1,2,3,4,7,8 - HxCDF	Dilution tunnel	5.36	4.78	1.62	3.92
1,2,3,6,7,8 - HxCDF	Dilution tunnel	6.06	4.21	2.22	4.16
2,3,4,6,7,8 - HxCDF	Dilution tunnel	4.35	3.68	0.50	2.84
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.86	0.52	0.23	0.54
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.98	0.55	0.23	0.59
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.07	0.03	0.01	0.04
OCDF	Dilution tunnel	0.19	1.51E-03	1.80E-03	0.06
Total	Dilution tunnel	153.51	82.90	46.70	94.37

Table A-4-30: Kensal Redfyre – Middle stove test results – Coal Trebles

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	135.85	20.84	17.52	58.07
1,2,3,7,8 - PeCDD	Dilution tunnel	109.17	24.90	56.39	63.48
1,2,3,4,7,8 - HxCDD	Dilution tunnel	5.09	1.09	5.74	3.97
1,2,3,6,7,8 - HxCDD	Dilution tunnel	12.98	1.29	6.53	6.93

1,2,3,7,8,9 - HxCDD	Dilution tunnel	12.74	1.27	3.28	5.76
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	2.60	0.92	2.16	1.90
OCDD	Dilution tunnel	0.19	0.11	0.17	0.16
2,3,7,8 - TCDF	Dilution tunnel	283.83	81.87	98.58	154.76
1,2,3,7,8 - PeCDF	Dilution tunnel	81.27	20.90	18.02	40.07
2,3,4,7,8 - PeCDF	Dilution tunnel	1328.19	469.89	370.05	722.71
1,2,3,4,7,8 - HxCDF	Dilution tunnel	99.58	30.70	37.46	55.91
1,2,3,6,7,8 - HxCDF	Dilution tunnel	108.20	41.06	32.32	60.53
2,3,4,6,7,8 - HxCDF	Dilution tunnel	99.34	32.70	29.30	53.78
1,2,3,7,8,9 - HxCDF	Dilution tunnel	5.99	3.48	2.13	3.87
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	14.43	6.04	5.63	8.70
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.51	0.50	0.33	0.45
OCDF	Dilution tunnel	0.20	0.11	0.04	0.12
Total	Dilution tunnel	2300.15	737.68	685.67	1241.17

Table A-4-31: Kensal Redfyre – Middle stove test results – Coffee Logs

Pollutant + Method (ngTEQ/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
2,3,7,8 - TCDD	Dilution tunnel	33.90	42.58	15.59	30.69
1,2,3,7,8 - PeCDD	Dilution tunnel	44.11	22.85	5.87	24.28
1,2,3,4,7,8 - HxCDD	Dilution tunnel	7.88	3.04	0.59	3.84
1,2,3,6,7,8 - HxCDD	Dilution tunnel	10.74	3.93	1.17	5.28
1,2,3,7,8,9 - HxCDD	Dilution tunnel	6.81	2.56	0.61	3.33
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	4.97	1.63	0.46	2.35
OCDD	Dilution tunnel	0.63	0.25	0.07	0.31
2,3,7,8 - TCDF	Dilution tunnel	36.38	50.08	22.75	36.40
1,2,3,7,8 - PeCDF	Dilution tunnel	16.15	10.68	4.28	10.37
2,3,4,7,8 - PeCDF	Dilution tunnel	395.34	212.19	67.10	224.88
1,2,3,4,7,8 - HxCDF	Dilution tunnel	62.24	23.48	5.74	30.49
1,2,3,6,7,8 - HxCDF	Dilution tunnel	55.81	23.91	6.13	28.62

2,3,4,6,7,8 - HxCDF	Dilution tunnel	78.95	30.56	6.94	38.81
1,2,3,7,8,9 - HxCDF	Dilution tunnel	3.87	2.18	0.34	2.13
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	25.49	9.80	2.24	12.51
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	1.40	0.61	0.09	0.70
OCDF	Dilution tunnel	0.48	0.19	0.04	0.24
Total	Dilution tunnel	785.15	440.52	140.00	455.22

Table A-4-32: Kensal Redfyre – Middle stove test results – Anthracite

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	3.24	2.53	1.39	2.39
1,2,3,7,8 - PeCDD	Dilution tunnel	1.43	1.43	0.60	1.16
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.23	0.15	0.11	0.16
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.25	0.14	0.12	0.17
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.25	0.15	0.12	0.17
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.42	0.18	0.09	0.23
OCDD	Dilution tunnel	0.06	0.04	0.02	0.04
2,3,7,8 - TCDF	Dilution tunnel	8.16	9.09	4.12	7.12
1,2,3,7,8 - PeCDF	Dilution tunnel	0.90	0.82	0.48	0.73
2,3,4,7,8 - PeCDF	Dilution tunnel	14.46	23.17	8.86	15.50
1,2,3,4,7,8 - HxCDF	Dilution tunnel	1.59	1.38	0.85	1.28
1,2,3,6,7,8 - HxCDF	Dilution tunnel	1.79	1.71	1.05	1.52
2,3,4,6,7,8 - HxCDF	Dilution tunnel	3.69	2.48	1.21	2.46
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.25	0.36	0.12	0.24
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.44	0.44	0.16	0.35
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.02	0.13	0.01	0.05
OCDF	Dilution tunnel	0.02	0.02	8.36E-04	0.01
Total	Dilution tunnel	37.22	44.22	19.33	33.59

Table A-4-33: Kensal Redfyre – Middle stove test results – Wet Wood

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	2.57	3.17	1.64	2.46
1,2,3,7,8 - PeCDD	Dilution tunnel	2.36	8.16	1.76	4.09
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.55	0.26	0.16	0.32
1,2,3,6,7,8 - HxCDD	Dilution tunnel	1.18	0.26	0.17	0.54
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.62	0.26	0.17	0.35
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.68	0.12	0.14	0.31
OCDD	Dilution tunnel	0.25	0.06	0.08	0.13
2,3,7,8 - TCDF	Dilution tunnel	9.56	5.97	2.56	6.03
1,2,3,7,8 - PeCDF	Dilution tunnel	2.69	0.67	0.80	1.39
2,3,4,7,8 - PeCDF	Dilution tunnel	50.61	44.05	15.60	36.76
1,2,3,4,7,8 - HxCDF	Dilution tunnel	4.52	3.41	1.54	3.16
1,2,3,6,7,8 - HxCDF	Dilution tunnel	4.95	3.08	0.20	2.74
2,3,4,6,7,8 - HxCDF	Dilution tunnel	5.70	3.63	0.19	3.18
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.33	0.35	0.17	0.29
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	1.19	0.89	0.36	0.81
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.06	0.05	0.04	0.05
OCDF	Dilution tunnel	0.01	0.01	0.01	0.01
Total	Dilution tunnel	87.83	74.43	25.61	62.62

Table A-4-34: Kensal Redfyre – Middle stove test results – Seasoned Wood

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	0.85	1.54	1.67	1.35
1,2,3,7,8 - PeCDD	Dilution tunnel	0.83	0.82	0.78	0.81
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.13	0.40	0.13	0.22
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.14	0.16	0.12	0.14
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.14	0.17	0.12	0.14
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.02	0.12	0.01	0.05
OCDD	Dilution tunnel	0.00	0.11	0.00	0.04
2,3,7,8 - TCDF	Dilution tunnel	1.11	3.40	1.26	1.92
1,2,3,7,8 - PeCDF	Dilution tunnel	0.08	0.12	0.14	0.11
2,3,4,7,8 - PeCDF	Dilution tunnel	0.85	4.77	1.41	2.34
1,2,3,4,7,8 - HxCDF	Dilution tunnel	0.09	1.31	0.09	0.50
1,2,3,6,7,8 - HxCDF	Dilution tunnel	0.09	0.95	0.09	0.38
2,3,4,6,7,8 - HxCDF	Dilution tunnel	0.09	0.60	0.10	0.26
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.08	0.13	0.10	0.10
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.09	0.20	0.01	0.10
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.01	0.01	0.01	0.01
OCDF	Dilution tunnel	8.47E-04	0.01	1.48E-03	4.40E-03
Total	Dilution tunnel	4.59	14.82	6.04	8.49

Table A-4-35: Kensal Redfyre – Middle stove test results – Dry Wood

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	55.77	135.91	187.64	126.44
1,2,3,7,8 - PeCDD	Dilution tunnel	114.31	273.99	458.54	282.28
1,2,3,4,7,8 - HxCDD	Dilution tunnel	17.93	53.56	67.57	46.35
1,2,3,6,7,8 - HxCDD	Dilution tunnel	23.32	64.70	91.41	59.81

1,2,3,7,8,9 - HxCDD	Dilution tunnel	18.79	45.51	63.35	42.55
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	10.08	26.59	32.58	23.09
OCDD	Dilution tunnel	0.89	2.02	2.26	1.73
2,3,7,8 - TCDF	Dilution tunnel	56.39	138.70	203.93	133.00
1,2,3,7,8 - PeCDF	Dilution tunnel	55.93	116.10	174.97	115.66
2,3,4,7,8 - PeCDF	Dilution tunnel	995.98	2523.15	3559.70	2359.61
1,2,3,4,7,8 - HxCDF	Dilution tunnel	200.42	458.19	591.27	416.63
1,2,3,6,7,8 - HxCDF	Dilution tunnel	209.61	476.77	567.14	417.84
2,3,4,6,7,8 - HxCDF	Dilution tunnel	197.36	538.69	645.57	460.54
1,2,3,7,8,9 - HxCDF	Dilution tunnel	19.55	24.92	30.02	24.83
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	60.07	159.44	181.00	133.50
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	6.56	13.93	16.02	12.17
OCDF	Dilution tunnel	1.04	2.50	2.51	2.02
Total	Dilution tunnel	2043.99	5054.67	6875.47	4658.04

Table A-4-36: Kensal Redfyre – Middle stove test results – Wood Briquettes

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	119.85	164.74	1271.81	518.80
1,2,3,7,8 - PeCDD	Dilution tunnel	802.72	517.07	485.85	601.88
1,2,3,4,7,8 - HxCDD	Dilution tunnel	7.56	6.36	21.20	11.71
1,2,3,6,7,8 - HxCDD	Dilution tunnel	7.90	9.42	23.99	13.77
1,2,3,7,8,9 - HxCDD	Dilution tunnel	7.88	8.25	21.31	12.48
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.99	2.31	4.09	2.46
OCDD	Dilution tunnel	0.21	0.15	0.19	0.18
2,3,7,8 - TCDF	Dilution tunnel	58.43	149.11	999.60	402.38
1,2,3,7,8 - PeCDF	Dilution tunnel	12.88	39.80	218.10	90.26
2,3,4,7,8 - PeCDF	Dilution tunnel	203.48	679.41	2660.76	1181.22
1,2,3,4,7,8 - HxCDF	Dilution tunnel	24.27	60.73	156.19	80.39
1,2,3,6,7,8 - HxCDF	Dilution tunnel	20.91	65.54	170.69	85.71
2,3,4,6,7,8 - HxCDF	Dilution tunnel	19.41	54.95	129.41	67.93

1,2,3,7,8,9 - HxCDF	Dilution tunnel	3.92	7.66	2.34	4.64
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	3.81	10.23	17.07	10.37
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.83	1.55	1.99	1.46
OCDF	Dilution tunnel	0.11	0.16	0.21	0.16
Total	Dilution tunnel	1295.14	1777.43	6184.80	3085.79

Table A-4-37: Stovax Stockton 5 –re-test results – Coffee Logs

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average*
2,3,7,8 - TCDD	Dilution tunnel	33.71	44.44	35.38	84.08
1,2,3,7,8 - PeCDD	Dilution tunnel	14.67	12.28	7.89	15.24
1,2,3,4,7,8 - HxCDD	Dilution tunnel	1.07	0.53	0.36	1.57
1,2,3,6,7,8 - HxCDD	Dilution tunnel	1.36	1.81	0.10	5.06
1,2,3,7,8,9 - HxCDD	Dilution tunnel	2.04	0.57	0.48	3.80
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	1.26	1.07	0.59	5.32
OCDD	Dilution tunnel	0.31	0.27	0.15	0.64
2,3,7,8 - TCDF	Dilution tunnel	23.60	33.75	26.40	57.56
1,2,3,7,8 - PeCDF	Dilution tunnel	4.24	0.30	3.63	3.64
2,3,4,7,8 - PeCDF	Dilution tunnel	56.71	60.89	47.53	109.25
1,2,3,4,7,8 - HxCDF	Dilution tunnel	1.97	2.35	1.52	8.24
1,2,3,6,7,8 - HxCDF	Dilution tunnel	2.60	2.31	1.67	10.40
2,3,4,6,7,8 - HxCDF	Dilution tunnel	1.20	2.12	1.67	11.45
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.16	0.15	0.13	0.62
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.16	0.15	0.18	3.14
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.03	0.03	0.02	0.24
OCDF	Dilution tunnel	0.01	0.01	2.24E-03	0.03
Total	Dilution tunnel	145.10	163.02	127.68	320.31

*extrapolated values

Table A-4-38: Stovax Stockton 5 –re-test results – Wet Wood

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average*

2,3,7,8 - TCDD	Dilution tunnel	11.62	5.15	5.44	39.90
1,2,3,7,8 - PeCDD	Dilution tunnel	19.17	0.71	0.77	23.36
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.41	0.17	0.14	0.35
1,2,3,6,7,8 - HxCDD	Dilution tunnel	1.66	0.62	0.65	2.54
1,2,3,7,8,9 - HxCDD	Dilution tunnel	1.67	0.19	0.34	2.00
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.29	0.06	0.06	0.46
OCDD	Dilution tunnel	0.04	0.04	0.01	0.06
2,3,7,8 - TCDF	Dilution tunnel	38.63	0.56	0.29	47.95
1,2,3,7,8 - PeCDF	Dilution tunnel	4.70	0.56	0.04	5.10
2,3,4,7,8 - PeCDF	Dilution tunnel	53.46	1.02	4.80	72.84
1,2,3,4,7,8 - HxCDF	Dilution tunnel	4.31	0.09	0.10	5.89
1,2,3,6,7,8 - HxCDF	Dilution tunnel	4.79	0.48	0.22	7.25
2,3,4,6,7,8 - HxCDF	Dilution tunnel	3.75	0.09	0.13	6.79
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.52	0.09	0.13	0.73
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.81	0.04	0.04	3.53
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.02	0.01	0.01	0.07
OCDF	Dilution tunnel	2.13E-03	1.74E-03	1.84E-03	4.17E-03
Total	Dilution tunnel	145.83	9.86	13.18	56.29

*extrapolated values

Table A-4-39: Stovax Stockton 5 – Modern stove test results – Seasoned Wood

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	13.78	19.46	59.90	31.05
1,2,3,7,8 - PeCDD	Dilution tunnel	4.13	3.91	13.07	7.04
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.17	0.15	0.25	0.19
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.29	0.14	0.23	0.22
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.10	0.82	1.43	0.78
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.05	0.19	0.15	0.13
OCDD	Dilution tunnel	0.02	0.04	0.05	0.03
2,3,7,8 - TCDF	Dilution tunnel	9.26	33.03	44.63	28.97

1,2,3,7,8 - PeCDF	Dilution tunnel	1.31	2.03	6.44	3.26
2,3,4,7,8 - PeCDF	Dilution tunnel	17.55	31.75	93.68	47.66
1,2,3,4,7,8 - HxCDF	Dilution tunnel	0.78	2.26	3.86	2.30
1,2,3,6,7,8 - HxCDF	Dilution tunnel	0.97	2.02	4.06	2.35
2,3,4,6,7,8 - HxCDF	Dilution tunnel	0.98	2.99	4.16	2.71
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.08	0.25	0.41	0.25
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.15	0.87	0.42	0.48
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.02	0.05	0.05	0.04
OCDF	Dilution tunnel	0.01	0.01	6.83E-04	0.01
Total	Dilution tunnel	49.65	99.98	232.78	127.47

Table A-3-40: Stovax Stockton 5 – Modern stove test results – Dry Wood

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	96.65	111.74	4.38	70.92
1,2,3,7,8 - PeCDD	Dilution tunnel	23.35	25.22	1.72	16.77
1,2,3,4,7,8 - HxCDD	Dilution tunnel	2.65	1.85	0.18	1.56
1,2,3,6,7,8 - HxCDD	Dilution tunnel	2.81	2.78	0.15	1.91
1,2,3,7,8,9 - HxCDD	Dilution tunnel	3.60	2.87	0.07	2.18
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.95	1.07	0.10	0.70
OCDD	Dilution tunnel	0.14	0.11	0.01	0.09
2,3,7,8 - TCDF	Dilution tunnel	80.42	118.32	5.89	68.21
1,2,3,7,8 - PeCDF	Dilution tunnel	9.35	13.15	0.76	7.75
2,3,4,7,8 - PeCDF	Dilution tunnel	168.60	246.50	9.51	141.54
1,2,3,4,7,8 - HxCDF	Dilution tunnel	19.61	27.53	0.66	15.93
1,2,3,6,7,8 - HxCDF	Dilution tunnel	21.59	32.62	0.62	18.28
2,3,4,6,7,8 - HxCDF	Dilution tunnel	23.56	34.92	0.65	19.71
1,2,3,7,8,9 - HxCDF	Dilution tunnel	1.58	1.28	0.06	0.97
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	5.88	10.52	0.15	5.52
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.58	0.45	3.23E-03	0.35
OCDF	Dilution tunnel	0.12	0.13	4.58E-03	0.09
Total	Dilution tunnel	461.45	631.04	24.93	372.47

Table A-4-41: Stovax Stockton 5 –re-test results – Wood Briquettes

Pollutant + Method (ngTEQ/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average***
2,3,7,8 - TCDD	Dilution tunnel	154.05	113.26	109.08	278.76
1,2,3,7,8 - PeCDD	Dilution tunnel	32.68	28.40	25.71	37.96
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.63	0.60	0.73	1.59
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.86	0.85	0.56	3.51
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.56	0.99	0.77	2.85
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.13	0.11	0.09	0.61
OCDD	Dilution tunnel	0.02	0.02	0.01	0.05
2,3,7,8 - TCDF	Dilution tunnel	97.67	72.00	64.39	160.87
1,2,3,7,8 - PeCDF	Dilution tunnel	15.29	11.03	11.69	16.94
2,3,4,7,8 - PeCDF	Dilution tunnel	185.40	124.45	148.16	303.05
1,2,3,4,7,8 - HxCDF	Dilution tunnel	5.29	4.88	4.15	20.19
1,2,3,6,7,8 - HxCDF	Dilution tunnel	4.66	4.79	4.73	22.45
2,3,4,6,7,8 - HxCDF	Dilution tunnel	3.50	3.51	2.95	22.89
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.19	0.24	0.25	0.97
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.25	0.32	0.23	5.03
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.05	0.04	0.04	0.40
OCDF	Dilution tunnel	0.01	0.01	4.26E-03	0.03
Total	Dilution tunnel	501.26	365.49	373.52	878.14

*extrapolated values

Table A-4-42 : Parkray Paragon 16 inch Fire Grate – Open Fire test results – Wood Briquettes

Pollutant + Method (ngTEQ/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
2,3,7,8 - TCDD	Dilution tunnel	2.22	0.53	1.31	1.36
1,2,3,7,8 - PeCDD	Dilution tunnel	1.58	0.21	0.26	0.69
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.15	0.03	0.03	0.07
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.27	0.04	0.03	0.11

1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.24	0.04	0.03	0.10
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.20	0.11	0.14	0.15
OCDD	Dilution tunnel	0.06	0.04	0.04	0.05
2,3,7,8 - TCDF	Dilution tunnel	2.12	1.31	1.03	1.49
1,2,3,7,8 - PeCDF	Dilution tunnel	0.44	0.24	0.18	0.28
2,3,4,7,8 - PeCDF	Dilution tunnel	6.38	3.00	2.18	3.86
1,2,3,4,7,8 - HxCDF	Dilution tunnel	0.53	0.28	0.16	0.32
1,2,3,6,7,8 - HxCDF	Dilution tunnel	0.46	0.19	0.19	0.28
2,3,4,6,7,8 - HxCDF	Dilution tunnel	0.55	0.23	0.20	0.32
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.04	0.02	0.02	0.03
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.09	0.04	0.03	0.05
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.01	2.32E-03	1.63E-03	0.01
OCDF	Dilution tunnel	3.85E-03	2.11E-03	2.27E-03	2.74E-03
Total	Dilution tunnel	15.35	6.32	5.86	9.17

Table A-4-43: Basket Grate – Open Fire test results – High Sulphur MSF

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	1.28	1.64	1.45	1.46
1,2,3,7,8 - PeCDD	Dilution tunnel	0.97	8.49	1.09	3.52
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.41	1.15	0.47	0.68
1,2,3,6,7,8 - HxCDD	Dilution tunnel	1.07	2.87	1.21	1.72
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.53	1.40	0.60	0.84
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.23	0.58	0.26	0.36
OCDD	Dilution tunnel	0.05	0.06	0.05	0.05
2,3,7,8 - TCDF	Dilution tunnel	3.13	3.52	2.98	3.21
1,2,3,7,8 - PeCDF	Dilution tunnel	0.49	1.54	0.55	0.86
2,3,4,7,8 - PeCDF	Dilution tunnel	13.08	35.16	14.74	21.00
1,2,3,4,7,8 - HxCDF	Dilution tunnel	0.93	2.67	1.05	1.55
1,2,3,6,7,8 - HxCDF	Dilution tunnel	1.10	3.23	1.23	1.85
2,3,4,6,7,8 - HxCDF	Dilution tunnel	1.30	3.40	1.46	2.05

1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.10	0.24	0.11	0.15
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.14	0.33	0.16	0.21
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.02	0.08	0.03	0.04
OCDF	Dilution tunnel	0.01	0.01	0.01	0.01
Total	Dilution tunnel	24.85	66.37	27.44	39.55

Table A-4-44: Basket Grate – Open Fire test results – Low Sulphur MSF

Pollutant + Method (ngTEQ/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
2,3,7,8 - TCDD	Dilution tunnel	0.57	0.32	0.63	0.51
1,2,3,7,8 - PeCDD	Dilution tunnel	0.64	0.83	0.53	0.67
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.18	0.12	0.06	0.12
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.07	0.38	0.19	0.22
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.38	0.27	0.28	0.31
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.15	0.08	0.11	0.11
OCDD	Dilution tunnel	0.04	0.03	0.03	0.03
2,3,7,8 - TCDF	Dilution tunnel	2.90	2.40	2.84	2.71
1,2,3,7,8 - PeCDF	Dilution tunnel	0.13	0.21	0.22	0.18
2,3,4,7,8 - PeCDF	Dilution tunnel	2.32	3.19	2.28	2.60
1,2,3,4,7,8 - HxCDF	Dilution tunnel	0.22	0.31	0.18	0.24
1,2,3,6,7,8 - HxCDF	Dilution tunnel	0.09	0.30	0.22	0.20
2,3,4,6,7,8 - HxCDF	Dilution tunnel	0.06	0.32	0.19	0.19
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.06	0.08	0.07	0.07
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.05	0.04	0.06	0.05
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.01	0.01	0.01	0.01
OCDF	Dilution tunnel	0.01	0.01	0.01	0.01
Total	Dilution tunnel	7.88	8.89	7.92	8.23

Table A-4-45: Basket Grate – Open Fire test results – Coal Trebles

Pollutant + Method (ngTEQ/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**

2,3,7,8 - TCDD	Dilution tunnel	2.07	2.63	1.46	2.06
1,2,3,7,8 - PeCDD	Dilution tunnel	1.31	6.89	1.11	3.10
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.42	0.23	0.17	0.27
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.95	1.48	0.99	1.14
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.81	0.27	0.19	0.42
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.31	0.35	0.15	0.27
OCDD	Dilution tunnel	0.07	0.04	0.02	0.04
2,3,7,8 - TCDF	Dilution tunnel	4.06	3.69	3.34	3.70
1,2,3,7,8 - PeCDF	Dilution tunnel	0.37	0.94	0.39	0.57
2,3,4,7,8 - PeCDF	Dilution tunnel	10.68	15.86	5.68	10.74
1,2,3,4,7,8 - HxCDF	Dilution tunnel	1.02	1.36	0.48	0.96
1,2,3,6,7,8 - HxCDF	Dilution tunnel	0.86	1.36	0.62	0.95
2,3,4,6,7,8 - HxCDF	Dilution tunnel	1.37	1.40	0.65	1.14
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.16	0.14	0.08	0.13
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.20	0.15	0.10	0.15
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.05	0.04	0.02	0.04
OCDF	Dilution tunnel	0.01	0.01	0.01	0.01
Total	Dilution tunnel	24.73	36.83	15.46	25.67

Table A-4-46: Basket Grate – Open Fire test results – Coffee Logs

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	2.81	2.14	1.49	2.15
1,2,3,7,8 - PeCDD	Dilution tunnel	1.34	2.11	1.25	1.57
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.56	1.14	0.29	0.66
1,2,3,6,7,8 - HxCDD	Dilution tunnel	3.21	3.72	2.45	3.13
1,2,3,7,8,9 - HxCDD	Dilution tunnel	2.81	4.27	0.35	2.48
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	3.23	4.42	2.28	3.31
OCDD	Dilution tunnel	0.51	0.83	0.45	0.60
2,3,7,8 - TCDF	Dilution tunnel	0.17	0.18	0.10	0.15

1,2,3,7,8 - PeCDF	Dilution tunnel	0.02	0.04	0.02	0.02
2,3,4,7,8 - PeCDF	Dilution tunnel	0.18	0.40	0.18	0.25
1,2,3,4,7,8 - HxCDF	Dilution tunnel	0.06	0.06	0.06	0.06
1,2,3,6,7,8 - HxCDF	Dilution tunnel	0.06	0.06	0.07	0.06
2,3,4,6,7,8 - HxCDF	Dilution tunnel	0.07	0.07	0.07	0.07
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.06	0.06	0.05	0.06
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.01	0.00	0.07	0.03
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.01	0.01	0.01	0.01
OCDF	Dilution tunnel	4.23E-04	6.93E-04	4.20E-04	5.12E-04
Total	Dilution tunnel	15.09	19.51	9.17	14.59

Table A-4-46: Basket Grate – Open Fire test results – Wet Wood

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	1.21	1.15	0.90	1.09
1,2,3,7,8 - PeCDD	Dilution tunnel	0.72	0.82	0.64	0.73
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.13	0.11	0.09	0.11
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.14	0.13	0.27	0.18
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.14	0.13	0.11	0.13
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.21	0.15	0.03	0.13
OCDD	Dilution tunnel	0.05	0.02	0.02	0.03
2,3,7,8 - TCDF	Dilution tunnel	0.26	0.25	0.23	0.24
1,2,3,7,8 - PeCDF	Dilution tunnel	0.04	0.07	0.04	0.05
2,3,4,7,8 - PeCDF	Dilution tunnel	0.43	2.73	0.37	1.18
1,2,3,4,7,8 - HxCDF	Dilution tunnel	0.17	0.22	0.15	0.18
1,2,3,6,7,8 - HxCDF	Dilution tunnel	0.30	0.27	0.18	0.25
2,3,4,6,7,8 - HxCDF	Dilution tunnel	0.32	0.22	0.09	0.21
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.05	0.07	0.04	0.05
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.07	0.06	0.06	0.06
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.01	0.01	4.05E-03	0.01
OCDF	Dilution tunnel	3.25E-03	2.98E-03	2.88E-03	3.04E-03
Total	Dilution tunnel	4.25	6.40	3.23	4.63

Table A-4-47: Basket Grate – Open Fire test results – Seasoned Wood

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	0.51	0.64	0.34	0.50
1,2,3,7,8 - PeCDD	Dilution tunnel	1.26	0.65	0.44	0.78
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.09	0.06	0.02	0.06
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.10	0.08	0.03	0.07
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.15	0.08	0.03	0.09
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.21	0.05	0.03	0.10
OCDD	Dilution tunnel	0.06	0.02	0.01	0.03
2,3,7,8 - TCDF	Dilution tunnel	2.13	2.08	1.18	1.80
1,2,3,7,8 - PeCDF	Dilution tunnel	0.25	0.07	0.04	0.12
2,3,4,7,8 - PeCDF	Dilution tunnel	1.67	0.36	0.41	0.81
1,2,3,4,7,8 - HxCDF	Dilution tunnel	0.56	0.23	0.20	0.33
1,2,3,6,7,8 - HxCDF	Dilution tunnel	0.46	0.17	0.24	0.29
2,3,4,6,7,8 - HxCDF	Dilution tunnel	0.25	0.41	0.18	0.28
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.05	0.14	0.03	0.07
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.15	0.08	0.05	0.09
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.01	0.02	4.43E-03	0.01
OCDF	Dilution tunnel	0.01	0.01	3.70E-03	0.01
Total	Dilution tunnel	7.91	5.15	3.24	5.43

Table A-4-47: Basket Grate – Open Fire test results – Dry Wood

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	0.29	0.27	0.45	0.34
1,2,3,7,8 - PeCDD	Dilution tunnel	0.15	0.13	0.18	0.15
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.02	0.03	0.05	0.03
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.09	0.03	0.06	0.06

1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.02	0.03	0.07	0.04
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.03	0.01	0.05	0.03
OCDD	Dilution tunnel	0.01	0.01	0.01	0.01
2,3,7,8 - TCDF	Dilution tunnel	0.61	0.45	0.53	0.53
1,2,3,7,8 - PeCDF	Dilution tunnel	0.07	0.05	0.02	0.04
2,3,4,7,8 - PeCDF	Dilution tunnel	0.66	0.76	0.19	0.54
1,2,3,4,7,8 - HxCDF	Dilution tunnel	0.15	0.02	0.02	0.06
1,2,3,6,7,8 - HxCDF	Dilution tunnel	0.19	0.05	0.05	0.10
2,3,4,6,7,8 - HxCDF	Dilution tunnel	0.15	0.04	0.04	0.07
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.02	0.01	0.02	0.02
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.06	0.03	0.03	0.04
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	2.35E-03	2.32E-03	2.15E-03	2.27E-03
OCDF	Dilution tunnel	4.95E-03	3.49E-03	2.68E-03	3.71E-03
Total	Dilution tunnel	2.54	1.91	1.79	2.08

Table A-4-48: Basket Grate – Open Fire test results – Wood Briquettes

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	0.36	0.49	0.46	0.43
1,2,3,7,8 - PeCDD	Dilution tunnel	0.68	0.30	0.99	0.65
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.04	0.03	0.06	0.04
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.09	0.06	0.06	0.07
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.07	0.10	0.16	0.11
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.13	0.06	0.11	0.10
OCDD	Dilution tunnel	0.03	0.01	0.03	0.02
2,3,7,8 - TCDF	Dilution tunnel	1.18	1.20	1.28	1.22
1,2,3,7,8 - PeCDF	Dilution tunnel	0.05	0.02	0.21	0.09
2,3,4,7,8 - PeCDF	Dilution tunnel	4.70	2.06	3.56	3.44
1,2,3,4,7,8 - HxCDF	Dilution tunnel	0.38	0.10	0.50	0.33
1,2,3,6,7,8 - HxCDF	Dilution tunnel	0.47	0.11	0.42	0.33
2,3,4,6,7,8 - HxCDF	Dilution tunnel	0.48	0.10	0.51	0.36

1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.07	0.03	0.06	0.05
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.08	0.07	0.14	0.10
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	4.79E-03	0.02	0.01	0.01
OCDF	Dilution tunnel	2.32E-03	2.23E-04	4.34E-03	2.29E-03
Total	Dilution tunnel	8.80	4.76	8.55	7.37

Table A-4-49: Aga Coalbrookdale – Old stove test results – High Sulphur MSF

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	0.58	3.51	2.69	2.26
1,2,3,7,8 - PeCDD	Dilution tunnel	0.51	0.70	2.17	1.12
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.17	0.07	0.17	0.14
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.33	0.24	0.35	0.31
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.28	0.24	0.30	0.27
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.11	0.14	0.21	0.15
OCDD	Dilution tunnel	0.03	0.03	0.03	0.03
2,3,7,8 - TCDF	Dilution tunnel	5.39	6.34	8.66	6.80
1,2,3,7,8 - PeCDF	Dilution tunnel	0.44	0.78	1.15	0.79
2,3,4,7,8 - PeCDF	Dilution tunnel	6.36	13.05	10.65	10.02
1,2,3,4,7,8 - HxCDF	Dilution tunnel	0.35	0.73	1.05	0.71
1,2,3,6,7,8 - HxCDF	Dilution tunnel	0.22	0.71	0.89	0.61
2,3,4,6,7,8 - HxCDF	Dilution tunnel	0.39	0.72	0.87	0.66
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.05	0.08	0.08	0.07
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.07	0.14	0.18	0.13
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	4.34E-03	0.03	0.02	0.02
OCDF	Dilution tunnel	0.01	0.01	0.01	0.01
Total	Dilution tunnel	15.28	27.52	29.48	24.09

Table A-4-50: Aga Coalbrookdale – Old stove test results – Low Sulphur MSF

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average

2,3,7,8 - TCDD	Dilution tunnel	1.27	0.61	0.46	0.78
1,2,3,7,8 - PeCDD	Dilution tunnel	0.91	0.49	0.37	0.59
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.45	0.06	0.04	0.18
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.45	0.06	0.04	0.18
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.10	0.06	0.13	0.10
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.17	0.08	0.06	0.10
OCDD	Dilution tunnel	0.02	0.02	0.02	0.02
2,3,7,8 - TCDF	Dilution tunnel	2.67	0.97	1.20	1.61
1,2,3,7,8 - PeCDF	Dilution tunnel	0.56	0.03	0.03	0.21
2,3,4,7,8 - PeCDF	Dilution tunnel	14.56	2.58	1.28	6.14
1,2,3,4,7,8 - HxCDF	Dilution tunnel	1.37	0.17	0.28	0.61
1,2,3,6,7,8 - HxCDF	Dilution tunnel	1.27	0.20	0.13	0.53
2,3,4,6,7,8 - HxCDF	Dilution tunnel	1.17	0.23	0.18	0.53
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.10	0.04	0.03	0.05
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.21	0.10	0.08	0.13
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.01	0.01	0.01	0.01
OCDF	Dilution tunnel	2.94E-03	0.01	4.87E-03	4.57E-03
Total	Dilution tunnel	25.29	5.72	4.32	11.78

Table A-4-51: Aga Coalbrookdale – Old stove test results – Coal Trebles

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	1.13	0.56	13.24	4.97
1,2,3,7,8 - PeCDD	Dilution tunnel	0.90	0.93	4.35	2.06
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.07	0.06	0.30	0.14
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.19	0.06	0.38	0.21
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.07	0.05	0.34	0.16
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.11	0.09	0.17	0.12
OCDD	Dilution tunnel	0.03	0.02	0.03	0.02
2,3,7,8 - TCDF	Dilution tunnel	6.27	2.60	91.66	33.51

1,2,3,7,8 - PeCDF	Dilution tunnel	0.55	0.05	2.49	1.03
2,3,4,7,8 - PeCDF	Dilution tunnel	13.70	3.37	33.85	16.97
1,2,3,4,7,8 - HxCDF	Dilution tunnel	1.32	0.46	5.21	2.33
1,2,3,6,7,8 - HxCDF	Dilution tunnel	0.74	0.32	2.03	1.03
2,3,4,6,7,8 - HxCDF	Dilution tunnel	0.60	0.36	2.19	1.05
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.09	0.05	0.30	0.15
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.12	0.07	0.62	0.27
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.01	0.01	0.05	0.02
OCDF	Dilution tunnel	0.02	0.01	0.02	0.02
Total	Dilution tunnel	25.91	9.06	157.23	64.07

Table A-4-52: Aga Coalbrookdale – Old stove test results – Coffee Logs

Pollutant + Method (ngTEQ/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
2,3,7,8 - TCDD	Dilution tunnel	2.87	2.75	0.61	2.08
1,2,3,7,8 - PeCDD	Dilution tunnel	1.13	1.40	1.13	1.22
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.11	0.14	0.11	0.12
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.28	0.34	0.21	0.28
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.19	0.26	0.06	0.17
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.23	0.33	0.30	0.29
OCDD	Dilution tunnel	0.05	0.08	0.06	0.07
2,3,7,8 - TCDF	Dilution tunnel	3.25	4.63	4.95	4.28
1,2,3,7,8 - PeCDF	Dilution tunnel	0.28	0.50	0.36	0.38
2,3,4,7,8 - PeCDF	Dilution tunnel	8.06	5.66	4.92	6.22
1,2,3,4,7,8 - HxCDF	Dilution tunnel	0.62	0.44	0.04	0.36
1,2,3,6,7,8 - HxCDF	Dilution tunnel	0.50	0.55	0.34	0.46
2,3,4,6,7,8 - HxCDF	Dilution tunnel	0.88	0.53	0.04	0.48
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.07	0.05	0.04	0.06
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.16	0.11	0.04	0.10
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.02	0.01	3.97E-03	0.01
OCDF	Dilution tunnel	0.01	0.01	0.01	0.01
Total	Dilution tunnel	18.72	17.78	13.22	16.58

Table A-4-53: Aga Coalbrookdale – Old stove test results – Anthracite

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	16.25	3.38	1.29	16.25
1,2,3,7,8 - PeCDD	Dilution tunnel	44.25	2.32	1.02	44.25
1,2,3,4,7,8 - HxCDD	Dilution tunnel	7.57	0.40	0.33	7.57
1,2,3,6,7,8 - HxCDD	Dilution tunnel	15.49	3.15	2.24	15.49
1,2,3,7,8,9 - HxCDD	Dilution tunnel	11.62	1.78	1.59	11.62
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	6.67	0.91	0.66	6.67
OCDD	Dilution tunnel	0.41	0.09	0.05	0.41
2,3,7,8 - TCDF	Dilution tunnel	16.62	10.68	3.59	16.62
1,2,3,7,8 - PeCDF	Dilution tunnel	8.12	2.67	0.92	8.12
2,3,4,7,8 - PeCDF	Dilution tunnel	163.88	52.65	18.71	163.88
1,2,3,4,7,8 - HxCDF	Dilution tunnel	16.81	7.10	2.33	16.81
1,2,3,6,7,8 - HxCDF	Dilution tunnel	19.08	6.40	2.63	19.08
2,3,4,6,7,8 - HxCDF	Dilution tunnel	27.96	8.16	3.86	27.96
1,2,3,7,8,9 - HxCDF	Dilution tunnel	2.27	0.45	0.33	2.27
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	3.74	1.33	0.62	3.74
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.33	0.30	0.08	0.33
OCDF	Dilution tunnel	0.09	0.07	0.02	0.09
Total	Dilution tunnel	361.17	101.85	40.26	361.17

Table A-4-54: Aga Coalbrookdale – Old stove test results – Wet Wood

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	2.57	1.31	1.37	1.75
1,2,3,7,8 - PeCDD	Dilution tunnel	1.25	0.96	1.00	1.07
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.24	0.25	0.26	0.25
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.24	0.34	0.26	0.28

1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.25	0.26	0.27	0.26
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.18	0.19	0.20	0.19
OCDD	Dilution tunnel	0.03	0.02	0.03	0.03
2,3,7,8 - TCDF	Dilution tunnel	3.39	3.72	3.89	3.66
1,2,3,7,8 - PeCDF	Dilution tunnel	0.40	0.42	0.44	0.42
2,3,4,7,8 - PeCDF	Dilution tunnel	3.76	6.64	2.53	4.31
1,2,3,4,7,8 - HxCDF	Dilution tunnel	0.18	0.51	0.15	0.28
1,2,3,6,7,8 - HxCDF	Dilution tunnel	0.18	0.38	0.15	0.23
2,3,4,6,7,8 - HxCDF	Dilution tunnel	0.20	0.49	0.16	0.28
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.23	0.17	0.18	0.19
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.20	0.16	0.17	0.18
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.02	0.03	0.02	0.03
OCDF	Dilution tunnel	0.01	0.01	0.01	0.01
Total	Dilution tunnel	13.33	15.85	11.08	13.42

Table A-4-55: Aga Coalbrookdale – Old stove test results – Seasoned Wood

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	1.94	1.41	2.68	2.01
1,2,3,7,8 - PeCDD	Dilution tunnel	0.83	0.38	0.43	0.55
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.13	0.21	0.30	0.21
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.14	0.51	0.53	0.39
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.14	0.30	0.33	0.26
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.02	0.30	0.26	0.19
OCDD	Dilution tunnel	3.42E-03	0.02	0.02	0.02
2,3,7,8 - TCDF	Dilution tunnel	1.11	3.62	3.63	2.78
1,2,3,7,8 - PeCDF	Dilution tunnel	0.08	0.35	0.41	0.28
2,3,4,7,8 - PeCDF	Dilution tunnel	0.85	4.93	5.43	3.74
1,2,3,4,7,8 - HxCDF	Dilution tunnel	0.09	0.65	0.72	0.48
1,2,3,6,7,8 - HxCDF	Dilution tunnel	0.09	0.90	1.05	0.68
2,3,4,6,7,8 - HxCDF	Dilution tunnel	0.09	0.61	0.81	0.50

1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.08	0.14	0.13	0.12
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.09	0.21	0.26	0.19
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.01	0.03	0.02	0.02
OCDF	Dilution tunnel	0.00	0.01	0.01	0.01
Total	Dilution tunnel	5.69	14.57	17.03	12.43

Table A-4-56: Aga Coalbrookdale – Old stove test results – Dry Wood

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	13.24	12.52	11.15	12.30
1,2,3,7,8 - PeCDD	Dilution tunnel	27.54	11.89	4.99	14.80
1,2,3,4,7,8 - HxCDD	Dilution tunnel	4.18	3.22	0.45	2.62
1,2,3,6,7,8 - HxCDD	Dilution tunnel	5.99	4.19	0.58	3.59
1,2,3,7,8,9 - HxCDD	Dilution tunnel	3.81	2.82	0.43	2.35
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	2.53	2.14	0.13	1.60
OCDD	Dilution tunnel	0.27	0.27	0.01	0.18
2,3,7,8 - TCDF	Dilution tunnel	23.92	14.06	10.34	16.11
1,2,3,7,8 - PeCDF	Dilution tunnel	11.79	6.54	3.66	7.33
2,3,4,7,8 - PeCDF	Dilution tunnel	412.77	250.28	48.97	237.34
1,2,3,4,7,8 - HxCDF	Dilution tunnel	58.08	38.36	3.93	33.46
1,2,3,6,7,8 - HxCDF	Dilution tunnel	56.52	34.82	4.28	31.87
2,3,4,6,7,8 - HxCDF	Dilution tunnel	76.88	53.73	4.40	45.00
1,2,3,7,8,9 - HxCDF	Dilution tunnel	4.51	2.35	0.64	2.50
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	24.25	20.63	0.61	15.16
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.78	0.71	0.15	0.54
OCDF	Dilution tunnel	0.25	0.28	0.01	0.18
Total	Dilution tunnel	727.28	458.81	94.74	426.95

Table A-4-57: Aga Coalbrookdale – Old stove test results – Wood Briquettes

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	41.90	35.05	26.46	34.47
1,2,3,7,8 - PeCDD	Dilution tunnel	39.33	31.64	25.44	32.14
1,2,3,4,7,8 - HxCDD	Dilution tunnel	4.25	2.62	3.12	3.33
1,2,3,6,7,8 - HxCDD	Dilution tunnel	3.82	3.19	3.20	3.40
1,2,3,7,8,9 - HxCDD	Dilution tunnel	3.66	2.27	2.53	2.82
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.91	0.69	0.90	0.83
OCDD	Dilution tunnel	0.06	0.03	0.08	0.06
2,3,7,8 - TCDF	Dilution tunnel	39.08	35.63	16.60	30.43
1,2,3,7,8 - PeCDF	Dilution tunnel	14.86	13.47	9.02	12.45
2,3,4,7,8 - PeCDF	Dilution tunnel	246.64	210.71	161.18	206.18
1,2,3,4,7,8 - HxCDF	Dilution tunnel	31.39	24.62	17.56	24.52
1,2,3,6,7,8 - HxCDF	Dilution tunnel	30.75	27.08	17.44	25.09
2,3,4,6,7,8 - HxCDF	Dilution tunnel	30.75	22.59	21.89	25.08
1,2,3,7,8,9 - HxCDF	Dilution tunnel	1.79	2.84	1.26	1.97
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	6.07	4.14	4.11	4.78
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.32	0.49	4.57	1.79
OCDF	Dilution tunnel	0.06	0.04	0.06	0.05
Total	Dilution tunnel	495.65	417.10	315.42	409.39

Table A-4-58: Hase Sila IQ – Modern stove test results – Coffee Logs

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	3.69	4.34	4.38	4.14
1,2,3,7,8 - PeCDD	Dilution tunnel	2.23	1.56	1.72	1.84
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.06	0.04	0.18	0.09
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.06	0.04	0.15	0.08
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.06	0.04	0.07	0.06

1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.07	0.10	0.10	0.09
OCDD	Dilution tunnel	0.01	0.02	0.01	0.02
2,3,7,8 - TCDF	Dilution tunnel	5.61	7.99	5.89	6.50
1,2,3,7,8 - PeCDF	Dilution tunnel	0.88	0.59	0.76	0.74
2,3,4,7,8 - PeCDF	Dilution tunnel	12.30	10.94	9.51	10.92
1,2,3,4,7,8 - HxCDF	Dilution tunnel	0.83	0.97	0.66	0.82
1,2,3,6,7,8 - HxCDF	Dilution tunnel	0.79	0.58	0.62	0.66
2,3,4,6,7,8 - HxCDF	Dilution tunnel	0.79	0.79	0.65	0.74
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.09	0.07	0.06	0.07
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.14	0.27	0.15	0.19
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.05	0.01	3.23E-03	0.02
OCDF	Dilution tunnel	0.01	0.01	4.58E-03	0.01
Total	Dilution tunnel	27.68	28.36	24.93	26.99

Table A-4-59: Hase Sila IQ – Modern stove test results – Wet Wood

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	8.46	8.63	3.31	6.80
1,2,3,7,8 - PeCDD	Dilution tunnel	2.01	4.79	0.48	2.43
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.20	0.37	0.17	0.25
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.12	0.30	0.27	0.23
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.19	0.28	0.12	0.20
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.06	0.20	0.09	0.12
OCDD	Dilution tunnel	0.01	0.02	0.02	0.02
2,3,7,8 - TCDF	Dilution tunnel	11.39	10.41	5.08	8.96
1,2,3,7,8 - PeCDF	Dilution tunnel	1.19	1.64	0.74	1.19
2,3,4,7,8 - PeCDF	Dilution tunnel	22.23	20.65	10.66	17.85
1,2,3,4,7,8 - HxCDF	Dilution tunnel	1.25	1.32	0.63	1.07
1,2,3,6,7,8 - HxCDF	Dilution tunnel	1.57	1.25	0.68	1.17
2,3,4,6,7,8 - HxCDF	Dilution tunnel	2.25	1.36	0.57	1.39
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.17	0.16	0.06	0.13

1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.27	0.20	0.14	0.20
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.04	0.03	3.62E-03	0.03
OCDF	Dilution tunnel	0.01	0.01	0.01	0.01
Total	Dilution tunnel	51.42	51.62	23.03	42.02

Table A-4-60: Hase Sila IQ – Modern stove test results – Seasoned Wood

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	13.64	4.70	0.83	6.39
1,2,3,7,8 - PeCDD	Dilution tunnel	5.17	1.79	2.40	3.12
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.06	0.04	0.07	0.06
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.07	0.05	0.08	0.06
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.07	0.05	0.08	0.06
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.14	0.12	0.13	0.13
OCDD	Dilution tunnel	0.02	0.02	0.02	0.02
2,3,7,8 - TCDF	Dilution tunnel	13.88	8.02	7.99	9.96
1,2,3,7,8 - PeCDF	Dilution tunnel	1.98	0.94	1.14	1.35
2,3,4,7,8 - PeCDF	Dilution tunnel	35.99	11.98	17.54	21.84
1,2,3,4,7,8 - HxCDF	Dilution tunnel	1.91	0.89	0.82	1.21
1,2,3,6,7,8 - HxCDF	Dilution tunnel	2.55	1.00	1.15	1.57
2,3,4,6,7,8 - HxCDF	Dilution tunnel	2.12	1.11	1.34	1.52
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.30	0.12	0.17	0.20
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.41	0.17	0.25	0.28
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.01	3.58E-03	0.01	4.93E-03
OCDF	Dilution tunnel	7.59E-04	0.01	9.23E-04	2.81E-03
Total	Dilution tunnel	78.30	31.01	34.02	47.78

Table A-4-61: Hase Sila IQ – Modern stove test results – Dry Wood

Pollutant + Method (ngTEQ/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
2,3,7,8 - TCDD	Dilution tunnel	7.67	13.94	7.22	9.61

1,2,3,7,8 - PeCDD	Dilution tunnel	1.94	5.43	2.26	3.21
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.25	0.25	0.04	0.18
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.08	0.66	0.05	0.26
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.37	0.31	0.05	0.24
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.17	0.20	0.10	0.15
OCDD	Dilution tunnel	0.02	0.04	0.01	0.02
2,3,7,8 - TCDF	Dilution tunnel	9.97	16.71	7.71	11.46
1,2,3,7,8 - PeCDF	Dilution tunnel	1.27	3.53	1.46	2.09
2,3,4,7,8 - PeCDF	Dilution tunnel	22.72	44.90	23.28	30.30
1,2,3,4,7,8 - HxCDF	Dilution tunnel	1.75	3.01	2.05	2.27
1,2,3,6,7,8 - HxCDF	Dilution tunnel	1.79	3.26	2.42	2.49
2,3,4,6,7,8 - HxCDF	Dilution tunnel	1.96	2.96	3.06	2.66
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.17	0.46	0.25	0.29
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.42	0.78	0.39	0.53
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.01	0.01	0.06	0.03
OCDF	Dilution tunnel	0.01	0.02	0.01	0.01
Total	Dilution tunnel	50.56	96.46	50.44	65.82

Table A-4-62: Hase Sila IQ – Modern stove test results – Wood Briquettes

Pollutant + Method (ngTEQ/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
2,3,7,8 - TCDD	Dilution tunnel	15.82	14.61	11.15	13.86
1,2,3,7,8 - PeCDD	Dilution tunnel	8.17	3.50	4.99	5.55
1,2,3,4,7,8 - HxCDD	Dilution tunnel	0.52	0.34	0.45	0.44
1,2,3,6,7,8 - HxCDD	Dilution tunnel	0.67	0.46	0.58	0.57
1,2,3,7,8,9 - HxCDD	Dilution tunnel	0.65	0.47	0.43	0.52
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	0.23	0.16	0.13	0.17
OCDD	Dilution tunnel	0.02	0.01	0.01	0.02
2,3,7,8 - TCDF	Dilution tunnel	17.51	15.63	10.34	14.49
1,2,3,7,8 - PeCDF	Dilution tunnel	3.59	3.46	3.66	3.57

2,3,4,7,8 - PeCDF	Dilution tunnel	58.01	43.09	48.97	50.02
1,2,3,4,7,8 - HxCDF	Dilution tunnel	3.86	3.94	3.93	3.91
1,2,3,6,7,8 - HxCDF	Dilution tunnel	4.42	3.84	4.28	4.18
2,3,4,6,7,8 - HxCDF	Dilution tunnel	4.78	3.21	4.40	4.13
1,2,3,7,8,9 - HxCDF	Dilution tunnel	0.49	1.00	0.64	0.71
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	0.80	0.62	0.61	0.68
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.11	0.15	0.15	0.14
OCDF	Dilution tunnel	0.02	0.02	0.01	0.02
Total	Dilution tunnel	119.65	94.52	94.74	102.97

Table A-4-63: Island Ramsey – Pellet stove test results – Wood Pellets

Pollutant + Method (ngTEQ/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
2,3,7,8 - TCDD	Dilution tunnel	280.35	388.58	378.80	349.24
1,2,3,7,8 - PeCDD	Dilution tunnel	199.09	217.08	196.05	204.07
1,2,3,4,7,8 - HxCDD	Dilution tunnel	9.63	10.91	7.29	9.28
1,2,3,6,7,8 - HxCDD	Dilution tunnel	8.35	9.38	7.78	8.50
1,2,3,7,8,9 - HxCDD	Dilution tunnel	9.79	10.51	7.60	9.30
1,2,3,4,6,7,8 - HpCDD	Dilution tunnel	1.58	1.50	1.24	1.44
OCDD	Dilution tunnel	0.10	0.10	0.08	0.09
2,3,7,8 - TCDF	Dilution tunnel	132.05	205.08	200.70	179.28
1,2,3,7,8 - PeCDF	Dilution tunnel	33.42	52.05	37.99	41.15
2,3,4,7,8 - PeCDF	Dilution tunnel	520.07	622.45	470.73	537.75
1,2,3,4,7,8 - HxCDF	Dilution tunnel	34.33	43.42	31.23	36.33
1,2,3,6,7,8 - HxCDF	Dilution tunnel	39.61	43.66	37.66	40.31
2,3,4,6,7,8 - HxCDF	Dilution tunnel	44.90	41.26	32.79	39.65
1,2,3,7,8,9 - HxCDF	Dilution tunnel	12.98	3.65	1.90	6.18
1,2,3,4,6,7,8 - HpCDF	Dilution tunnel	4.55	4.08	3.28	3.97
1,2,3,4,7,8,9 - HpCDF	Dilution tunnel	0.73	0.47	0.41	0.54
OCDF	Dilution tunnel	0.14	0.08	0.07	0.10
Total	Dilution tunnel	1331.66	1654.23	1415.58	1467.16

A.5 POLLUTANT MEASUREMENTS DATASET – PAH

Table A-5-1: Charnwood C-4 blu – Modern Stove test results – Wood Briquettes

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	4.49	4.53	23.25	10.76
Benzo(a)Anthracene	Dilution tunnel	37.75	30.61	146.47	71.61
Benzo(a)pyrene	Dilution tunnel	28.70	25.23	131.67	61.87
Benzo(b)fluoranthene	Dilution tunnel	38.52	33.09	145.72	72.44
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.22	0.12	0.25	0.20
Benzo(c)phenanthrene	Dilution tunnel	16.03	11.97	49.68	25.89
Benzo(ghi)Perylene	Dilution tunnel	30.24	25.44	138.77	64.82
Benzo(k)fluoranthene	Dilution tunnel	20.03	15.59	75.20	36.94
Cholanthrene	Dilution tunnel	0.02	0.02	0.02	0.02
Chrysene	Dilution tunnel	36.40	32.06	131.83	66.76
Cyclopenta(cd)pyrene	Dilution tunnel	19.11	14.46	72.78	35.45
Dibenzo (ai) pyrene	Dilution tunnel	1.09	0.72	3.16	1.65
Dibenzo(ah)Anthracene	Dilution tunnel	2.58	1.83	8.92	4.44
Fluoranthene	Dilution tunnel	225.36	180.34	756.53	387.41
Indeno(123-cd)Pyrene	Dilution tunnel	29.86	23.78	147.08	66.90
Naphthalene	Dilution tunnel	1924.20	1253.25	3666.35	2281.27
Total (Excluding Non-Detects)	Dilution tunnel	2414.57	1653.00	5497.67	3188.41
Total (Including Non-Detects)	Dilution tunnel	2414.59	1653.03	5497.68	3188.43
LRTAP PAH total	Dilution tunnel	117.11	97.70	499.67	238.16

Table A-5-2: Dovre 500MRF Cast Iron Stove test results – Wood briquettes

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	1.38	1.55	1.11	1.34

Benzo(a)Anthracene	Dilution tunnel	36.50	31.24	17.96	28.57
Benzo(a)pyrene	Dilution tunnel	20.84	20.20	12.60	17.88
Benzo(b)fluoranthene	Dilution tunnel	32.14	30.14	17.20	26.49
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.46	0.21	0.10	0.26
Benzo(c)phenanthrene	Dilution tunnel	13.66	12.58	7.51	11.25
Benzo(ghi)Perylene	Dilution tunnel	21.43	21.41	13.04	18.63
Benzo(k)fluoranthene	Dilution tunnel	16.13	14.13	8.68	12.98
Cholanthrene	Dilution tunnel	0.01	0.01	0.01	0.01
Chrysene	Dilution tunnel	37.56	31.57	16.98	28.70
Cyclopenta(cd)pyrene	Dilution tunnel	11.89	10.37	5.83	9.36
Dibenzo (ai) pyrene	Dilution tunnel	0.67	0.84	0.53	0.68
Dibenzo(ah)Anthracene	Dilution tunnel	2.25	1.95	1.18	1.80
Fluoranthene	Dilution tunnel	156.60	160.06	109.54	142.07
Indeno(123-cd)Pyrene	Dilution tunnel	22.25	23.07	12.93	19.42
Naphthalene	Dilution tunnel	680.54	704.27	458.98	614.60
Total (Excluding Non-Detects)	Dilution tunnel	1054.30	1063.59	684.16	934.01
Total (Including Non-Detects)	Dilution tunnel	1054.31	1063.60	684.17	934.03
LRTAP PAH total	Dilution tunnel	91.37	87.54	51.40	76.77

Table A-5-3 Hunter Oakwood Stove test results – Wood briquettes

Pollutant + Method (mg/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
Anthanthrene	Dilution tunnel	27.59	22.53	16.68	22.27
Benzo(a)Anthracene	Dilution tunnel	10.87	7.20	5.13	7.74
Benzo(a)pyrene	Dilution tunnel	0.48	0.25	0.26	0.33
Benzo(b)fluoranthene	Dilution tunnel	0.57	0.81	0.57	0.65
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.37	0.37	0.38	0.37
Benzo(c)phenanthrene	Dilution tunnel	0.15	0.21	0.23	0.20
Benzo(ghi)Perylene	Dilution tunnel	0.02	0.02	0.03	0.02

Benzo(k)fluoranthene	Dilution tunnel	24.99	19.48	18.79	21.09
Cholanthrene	Dilution tunnel	4.15	2.93	2.47	3.18
Chrysene	Dilution tunnel	64.38	44.80	29.44	46.20
Cyclopenta(cd)pyrene	Dilution tunnel	3.94	2.93	2.24	3.04
Dibenzo (ai) pyrene	Dilution tunnel	3.30	3.04	1.97	2.77
Dibenzo(ah)Anthracene	Dilution tunnel	3.62	3.17	1.91	2.90
Fluoranthene	Dilution tunnel	0.23	0.14	0.14	0.17
Indeno(123-cd)Pyrene	Dilution tunnel	0.60	0.56	0.52	0.56
Naphthalene	Dilution tunnel	0.03	0.05	0.05	0.04
Total (Excluding Non-Detects)	Dilution tunnel	0.01	0.01	0.01	0.01
Total (Including Non-Detects)	Dilution tunnel	145.30	108.50	80.83	111.55
LRTAP PAH total	Dilution tunnel	27.59	22.53	16.68	22.27

Table A-5-4: Parkray Paragon 16 inch Fire Grate – Open Fire test results – Wood briquettes

Pollutant + Method (mg/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
Anthanthrene	Dilution tunnel	1.07	1.40	1.47	1.31
Benzo(a)Anthracene	Dilution tunnel	11.07	11.02	16.72	12.94
Benzo(a)pyrene	Dilution tunnel	6.66	7.71	10.16	8.18
Benzo(b)fluoranthene	Dilution tunnel	8.35	8.17	11.74	9.42
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.48	0.11	0.07	0.22
Benzo(c)phenanthrene	Dilution tunnel	4.04	4.40	6.23	4.89
Benzo(ghi)Perylene	Dilution tunnel	6.61	7.24	9.40	7.75
Benzo(k)fluoranthene	Dilution tunnel	5.04	5.09	7.80	5.98
Cholanthrene	Dilution tunnel	0.01	0.01	0.02	0.02
Chrysene	Dilution tunnel	11.62	11.11	16.36	13.03
Cyclopenta(cd)pyrene	Dilution tunnel	8.10	11.06	14.21	11.12
Dibenzo (ai) pyrene	Dilution tunnel	0.26	0.32	0.34	0.31
Dibenzo(ah)Anthracene	Dilution tunnel	0.66	0.76	0.93	0.78
Fluoranthene	Dilution tunnel	62.24	63.92	90.03	72.06

Indeno(123-cd)Pyrene	Dilution tunnel	7.02	7.45	10.40	8.29
Naphthalene	Dilution tunnel	524.92	583.52	500.29	536.24
Total (Excluding Non-Detects)	Dilution tunnel	658.15	723.27	696.16	692.53
Total (Including Non-Detects)	Dilution tunnel	658.16	723.28	696.16	692.53
LRTAP PAH total	Dilution tunnel	27.07	28.42	40.09	31.86

Table A-5-5: Hunter Aspect 5 – Modern Stove test results – Dry Wood

Pollutant + Method (mg/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
Anthanthrene	Dilution tunnel	14.78	64.31	65.72	48.27
Benzo(a)Anthracene	Dilution tunnel	114.62	288.97	322.25	241.95
Benzo(a)pyrene	Dilution tunnel	102.21	305.97	271.50	226.56
Benzo(b)fluoranthene	Dilution tunnel	84.14	190.66	181.93	152.25
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.16	0.32	0.32	0.26
Benzo(c)phenanthrene	Dilution tunnel	36.14	80.18	96.42	70.91
Benzo(ghi)Perylene	Dilution tunnel	79.29	275.94	201.98	185.73
Benzo(k)fluoranthene	Dilution tunnel	46.66	126.92	115.71	96.43
Cholanthrene	Dilution tunnel	0.04	0.11	0.11	0.09
Chrysene	Dilution tunnel	120.01	288.97	329.86	246.28
Cyclopenta(cd)pyrene	Dilution tunnel	168.02	679.93	723.16	523.70
Dibenzo (ai) pyrene	Dilution tunnel	1.52	5.07	4.85	3.81
Dibenzo(ah)Anthracene	Dilution tunnel	7.04	55.24	63.43	41.91
Fluoranthene	Dilution tunnel	517.80	1187.05	1266.16	990.34
Indeno(123-cd)Pyrene	Dilution tunnel	95.74	260.92	279.11	211.93
Naphthalene	Dilution tunnel	4894.85	7125.12	8764.16	6928.04
Total (Excluding Non-Detects)	Dilution tunnel	6283.00	10935.70	12686.66	9968.45
Total (Including Non-Detects)	Dilution tunnel	6283.00	10935.70	12686.66	9968.45
LRTAP PAH total	Dilution tunnel	328.75	884.48	848.25	687.16

Table A-5-6: Hunter Aspect 5 – Modern Stove test results – Seasoned Wood

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	16.61	2.97	3.83	7.80
Benzo(a)Anthracene	Dilution tunnel	65.68	5.42	40.23	37.11
Benzo(a)pyrene	Dilution tunnel	86.35	7.84	38.52	44.23
Benzo(b)fluoranthene	Dilution tunnel	49.45	4.68	29.10	27.74
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.11	0.02	0.07	0.07
Benzo(c)phenanthrene	Dilution tunnel	18.23	1.71	12.05	10.66
Benzo(ghi)Perylene	Dilution tunnel	78.23	12.00	26.96	39.06
Benzo(k)fluoranthene	Dilution tunnel	31.62	3.07	18.08	17.59
Cholanthrene	Dilution tunnel	0.04	0.02	0.02	0.03
Chrysene	Dilution tunnel	64.94	5.24	41.51	37.23
Cyclopenta(cd)pyrene	Dilution tunnel	148.34	9.20	60.98	72.84
Dibenzo (ai) pyrene	Dilution tunnel	2.39	0.40	0.67	1.15
Dibenzo(ah)Anthracene	Dilution tunnel	6.49	0.97	2.52	3.33
Fluoranthene	Dilution tunnel	383.76	44.53	220.39	216.23
Indeno(123-cd)Pyrene	Dilution tunnel	74.54	10.66	28.03	37.74
Naphthalene	Dilution tunnel	3889.26	1531.30	2041.31	2487.29
Total (Excluding Non-Detects)	Dilution tunnel	4916.03	1639.98	2564.25	3040.09
Total (Including Non-Detects)	Dilution tunnel	4916.03	1640.03	2564.27	3040.11
LRTAP PAH total	Dilution tunnel	241.95	26.25	113.73	127.31

Table A-5-7: Hunter Aspect 5 – Modern Stove test results – Wet Wood

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	4.98	3.81	4.95	4.58
Benzo(a)Anthracene	Dilution tunnel	31.95	35.64	34.84	34.14
Benzo(a)pyrene	Dilution tunnel	17.88	16.63	15.34	16.62

Benzo(b)fluoranthene	Dilution tunnel	20.63	18.41	18.28	19.11
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.16	0.09	0.09	0.11
Benzo(c)phenanthrene	Dilution tunnel	12.13	12.89	13.58	12.87
Benzo(ghi)Perylene	Dilution tunnel	16.73	8.87	12.72	12.78
Benzo(k)fluoranthene	Dilution tunnel	14.21	12.54	12.56	13.11
Cholanthrene	Dilution tunnel	0.05	0.12	0.13	0.10
Chrysene	Dilution tunnel	31.95	39.83	35.80	35.86
Cyclopenta(cd)pyrene	Dilution tunnel	35.76	49.26	46.99	44.00
Dibenzo (ai) pyrene	Dilution tunnel	0.58	0.51	0.51	0.53
Dibenzo(ah)Anthracene	Dilution tunnel	1.75	1.10	1.46	1.44
Fluoranthene	Dilution tunnel	225.38	196.36	119.54	180.43
Indeno(123-cd)Pyrene	Dilution tunnel	21.66	13.00	17.80	17.49
Naphthalene	Dilution tunnel	3683.97	3050.20	3033.26	3255.81
Total (Excluding Non-Detects)	Dilution tunnel	4119.78	3459.28	3367.86	3648.97
Total (Including Non-Detects)	Dilution tunnel	4119.78	3459.28	3367.86	3648.97
LRTAP PAH total	Dilution tunnel	74.38	60.58	63.99	66.32

Table A-5-8: Hunter Aspect 5 – Modern Stove test results – Wood briquettes

Pollutant + Method (mg/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
Anthanthrene	Dilution tunnel	160.78	139.31	12.45	104.18
Benzo(a)Anthracene	Dilution tunnel	651.99	948.90	170.40	590.43
Benzo(a)pyrene	Dilution tunnel	490.75	406.03	122.06	339.61
Benzo(b)fluoranthene	Dilution tunnel	385.59	421.73	126.90	311.41
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.47	0.60	0.60	0.56
Benzo(c)phenanthrene	Dilution tunnel	173.16	251.25	66.11	163.51
Benzo(ghi)Perylene	Dilution tunnel	390.26	390.33	75.05	285.21
Benzo(k)fluoranthene	Dilution tunnel	296.79	379.11	73.24	249.71
Cholanthrene	Dilution tunnel	1.82	1.45	0.01	1.09

Chrysene	Dilution tunnel	572.54	771.68	119.28	487.83
Cyclopenta(cd)pyrene	Dilution tunnel	1423.17	1668.99	154.69	1082.28
Dibenzo (ai) pyrene	Dilution tunnel	17.62	16.67	4.59	12.96
Dibenzo(ah)Anthracene	Dilution tunnel	43.47	54.06	13.90	37.14
Fluoranthene	Dilution tunnel	2579.93	3239.28	1024.84	2281.35
Indeno(123-cd)Pyrene	Dilution tunnel	602.92	603.44	88.71	431.69
Naphthalene	Dilution tunnel	13993.32	18197.38	589.76	10926.82
Total (Excluding Non-Detects)	Dilution tunnel	21784.56	27490.21	2642.58	17305.78
Total (Including Non-Detects)	Dilution tunnel	21784.56	27490.21	2642.59	17305.79
LRTAP PAH total	Dilution tunnel	1776.04	1810.32	410.90	1332.42

Table A-5-9: Hunter Aspect 5 – Modern Stove test results – Coffee Logs

Pollutant + Method (mg/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
Anthanthrene	Dilution tunnel	17.61	1.72	1.73	7.02
Benzo(a)Anthracene	Dilution tunnel	194.55	38.63	45.44	92.87
Benzo(a)pyrene	Dilution tunnel	138.03	34.60	33.05	68.56
Benzo(b)fluoranthene	Dilution tunnel	122.73	34.93	34.44	64.03
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.67	0.25	0.26	0.39
Benzo(c)phenanthrene	Dilution tunnel	57.77	13.03	15.05	28.62
Benzo(ghi)Perylene	Dilution tunnel	93.68	28.15	25.29	49.04
Benzo(k)fluoranthene	Dilution tunnel	75.88	18.84	19.46	38.06
Cholanthrene	Dilution tunnel	0.07	0.03	0.03	0.05
Chrysene	Dilution tunnel	194.24	49.37	55.84	99.82
Cyclopenta(cd)pyrene	Dilution tunnel	294.17	24.89	39.89	119.65
Dibenzo (ai) pyrene	Dilution tunnel	2.35	0.44	0.44	1.08
Dibenzo(ah)Anthracene	Dilution tunnel	19.49	2.73	2.88	8.36
Fluoranthene	Dilution tunnel	808.81	234.78	256.32	433.30
Indeno(123-cd)Pyrene	Dilution tunnel	121.79	33.45	30.21	61.82
Naphthalene	Dilution tunnel	5296.32	1958.19	2448.75	3234.42

Total (Excluding Non-Detects)	Dilution tunnel	7438.17	2474.00	3009.04	4307.07
Total (Including Non-Detects)	Dilution tunnel	7438.17	2474.03	3009.08	4307.09
LRTAP PAH total	Dilution tunnel	458.43	121.82	117.17	232.47

Table A-5-10: Hunter Aspect 5 – Modern Stove test results – High Sulphur MSF

Pollutant + Method (mg/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
Anthanthrene	Dilution tunnel	17.61	1.72	1.73	7.02
Benzo(a)Anthracene	Dilution tunnel	194.55	38.63	45.44	92.87
Benzo(a)pyrene	Dilution tunnel	138.03	34.60	33.05	68.56
Benzo(b)fluoranthene	Dilution tunnel	122.73	34.93	34.44	64.03
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.67	0.25	0.26	0.39
Benzo(c)phenanthrene	Dilution tunnel	57.77	13.03	15.05	28.62
Benzo(ghi)Perylene	Dilution tunnel	93.68	28.15	25.29	49.04
Benzo(k)fluoranthene	Dilution tunnel	75.88	18.84	19.46	38.06
Cholanthrene	Dilution tunnel	0.07	0.03	0.03	0.05
Chrysene	Dilution tunnel	194.24	49.37	55.84	99.82
Cyclopenta(cd)pyrene	Dilution tunnel	294.17	24.89	39.89	119.65
Dibenzo (ai) pyrene	Dilution tunnel	2.35	0.44	0.44	1.08
Dibenzo(ah)Anthracene	Dilution tunnel	19.49	2.73	2.88	8.36
Fluoranthene	Dilution tunnel	808.81	234.78	256.32	433.30
Indeno(123-cd)Pyrene	Dilution tunnel	121.79	33.45	30.21	61.82
Naphthalene	Dilution tunnel	5296.32	1958.19	2448.75	3234.42
Total (Excluding Non-Detects)	Dilution tunnel	7438.17	2474.00	3009.04	4307.07
Total (Including Non-Detects)	Dilution tunnel	7438.17	2474.03	3009.08	4307.09
LRTAP PAH total	Dilution tunnel	458.43	121.82	117.17	232.47

Table A-5-11: Hunter Aspect 5 – Modern Stove test results – Low Sulphur MSF

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	14.54	27.30	33.61	25.15
Benzo(a)Anthracene	Dilution tunnel	324.92	462.19	462.80	416.64
Benzo(a)pyrene	Dilution tunnel	266.29	397.14	423.44	362.29
Benzo(b)fluoranthene	Dilution tunnel	101.54	153.21	163.93	139.56
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	207.66	267.90	230.97	235.51
Benzo(c)phenanthrene	Dilution tunnel	51.75	77.03	103.81	77.53
Benzo(ghi)Perylene	Dilution tunnel	154.27	192.58	179.50	175.45
Benzo(k)fluoranthene	Dilution tunnel	69.11	105.70	141.00	105.27
Cholanthrene	Dilution tunnel	0.38	0.87	0.68	0.65
Chrysene	Dilution tunnel	448.73	603.41	596.88	549.68
Cyclopenta(cd)pyrene	Dilution tunnel	196.85	422.39	510.38	376.54
Dibenzo (ai) pyrene	Dilution tunnel	4.49	8.13	4.58	5.73
Dibenzo(ah)Anthracene	Dilution tunnel	50.44	48.36	46.71	48.50
Fluoranthene	Dilution tunnel	419.25	616.25	873.70	636.40
Indeno(123-cd)Pyrene	Dilution tunnel	53.06	77.03	100.78	76.96
Naphthalene	Dilution tunnel	3429.35	4489.23	6076.95	4665.18
Total (Excluding Non-Detects)	Dilution tunnel	5792.64	7948.74	9949.70	7897.03
Total (Including Non-Detects)	Dilution tunnel	5792.64	7948.74	9949.70	7897.03
LRTAP PAH total	Dilution tunnel	490.00	733.08	829.15	684.08

Table A-5-12: Hunter Aspect 5 – Modern Stove test results – Coal Trebles

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	21.70	17.12	35.80	24.87
Benzo(a)Anthracene	Dilution tunnel	249.25	194.45	476.24	306.65
Benzo(a)pyrene	Dilution tunnel	112.61	111.96	192.41	138.99

Benzo(b)fluoranthene	Dilution tunnel	163.81	134.22	280.95	192.99
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	6.22	4.42	19.47	10.03
Benzo(c)phenanthrene	Dilution tunnel	71.59	55.00	149.58	92.06
Benzo(ghi)Perylene	Dilution tunnel	55.13	56.63	74.79	62.18
Benzo(k)fluoranthene	Dilution tunnel	101.89	78.24	193.37	124.50
Cholanthrene	Dilution tunnel	0.34	0.30	0.54	0.40
Chrysene	Dilution tunnel	213.71	171.54	412.31	265.86
Cyclopenta(cd)pyrene	Dilution tunnel	91.70	106.72	735.13	311.19
Dibenzo (ai) pyrene	Dilution tunnel	3.81	3.50	5.18	4.17
Dibenzo(ah)Anthracene	Dilution tunnel	19.41	14.57	17.26	17.08
Fluoranthene	Dilution tunnel	802.08	687.46	1540.58	1010.04
Indeno(123-cd)Pyrene	Dilution tunnel	113.13	98.21	186.02	132.45
Naphthalene	Dilution tunnel	2346.16	2573.05	3442.34	2787.18
Total (Excluding Non-Detects)	Dilution tunnel	4368.30	4307.39	7761.97	5479.22
Total (Including Non-Detects)	Dilution tunnel	4368.30	4307.39	7761.97	5479.22
LRTAP PAH total	Dilution tunnel	491.44	422.62	852.75	588.94

Table A-5-13: Hunter Aspect 5 – Modern Stove test results – Anthracite

Pollutant + Method (mg/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
Anthanthrene	Dilution tunnel	2.08	0.40	0.87	1.12
Benzo(a)Anthracene	Dilution tunnel	15.43	19.00	0.30	11.58
Benzo(a)pyrene	Dilution tunnel	9.62	5.56	5.01	6.73
Benzo(b)fluoranthene	Dilution tunnel	11.50	16.77	8.31	12.19
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	5.38	9.37	2.68	5.81
Benzo(c)phenanthrene	Dilution tunnel	4.50	5.65	3.46	4.54
Benzo(ghi)Perylene	Dilution tunnel	17.31	8.10	8.07	11.16
Benzo(k)fluoranthene	Dilution tunnel	4.94	5.82	3.39	4.72
Cholanthrene	Dilution tunnel	0.04	0.04	0.06	0.05

Chrysene	Dilution tunnel	15.78	21.76	8.61	15.39
Cyclopenta(cd)pyrene	Dilution tunnel	9.27	1.32	2.08	4.22
Dibenzo (ai) pyrene	Dilution tunnel	0.05	0.20	0.34	0.20
Dibenzo(ah)Anthracene	Dilution tunnel	2.98	1.68	1.12	1.93
Fluoranthene	Dilution tunnel	72.56	62.62	60.41	65.20
Indeno(123-cd)Pyrene	Dilution tunnel	9.92	5.82	5.89	7.21
Naphthalene	Dilution tunnel	1521.11	792.60	1423.49	1245.73
Total (Excluding Non-Detects)	Dilution tunnel	1702.42	956.69	1534.04	1397.71
Total (Including Non-Detects)	Dilution tunnel	1702.46	956.73	1534.10	1397.76
LRTAP PAH total	Dilution tunnel	35.97	33.98	22.60	30.85

Table A-5-14: Hunter Aspect 8 – Modern Stove test results – Dry Wood

Pollutant + Method (mg/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
Anthanthrene	Dilution tunnel	12.53	58.95	58.04	43.17
Benzo(a)Anthracene	Dilution tunnel	189.45	432.06	309.28	310.26
Benzo(a)pyrene	Dilution tunnel	107.54	272.88	256.32	212.25
Benzo(b)fluoranthene	Dilution tunnel	136.29	299.12	264.80	233.40
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.19	0.34	0.24	0.26
Benzo(c)phenanthrene	Dilution tunnel	62.01	128.04	93.84	94.63
Benzo(ghi)Perylene	Dilution tunnel	105.76	225.65	252.09	194.50
Benzo(k)fluoranthene	Dilution tunnel	85.32	199.41	160.79	148.51
Cholanthrene	Dilution tunnel	0.04	0.14	0.14	0.11
Chrysene	Dilution tunnel	169.00	384.83	288.10	280.65
Cyclopenta(cd)pyrene	Dilution tunnel	179.91	813.39	639.75	544.35
Dibenzo (ai) pyrene	Dilution tunnel	2.52	8.43	9.96	6.97
Dibenzo(ah)Anthracene	Dilution tunnel	13.63	26.94	28.60	23.06
Fluoranthene	Dilution tunnel	963.60	1915.41	1436.27	1438.42
Indeno(123-cd)Pyrene	Dilution tunnel	136.29	351.60	353.77	280.55
Naphthalene	Dilution tunnel	5308.65	7525.19	7545.69	6793.18

Total (Excluding Non-Detects)	Dilution tunnel	7472.73	12642.39	11697.67	10604.26
Total (Including Non-Detects)	Dilution tunnel	7472.73	12642.39	11697.67	10604.26
LRTAP PAH total	Dilution tunnel	465.44	1123.01	1035.68	874.71

Table A-5-15: Hunter Aspect 8 – Modern Stove test results – Seasoned Wood

Pollutant + Method (mg/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
Anthanthrene	Dilution tunnel	1.75	1.04	0.99	1.26
Benzo(a)Anthracene	Dilution tunnel	17.16	9.34	8.86	11.79
Benzo(a)pyrene	Dilution tunnel	15.78	6.39	5.85	9.34
Benzo(b)fluoranthene	Dilution tunnel	11.93	6.27	5.87	8.02
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.06	0.05	0.04	0.05
Benzo(c)phenanthrene	Dilution tunnel	5.83	3.41	3.67	4.30
Benzo(ghi)Perylene	Dilution tunnel	10.06	5.19	4.65	6.63
Benzo(k)fluoranthene	Dilution tunnel	7.51	3.82	3.70	5.01
Cholanthrene	Dilution tunnel	0.05	0.06	0.05	0.05
Chrysene	Dilution tunnel	17.66	9.57	8.81	12.02
Cyclopenta(cd)pyrene	Dilution tunnel	12.89	10.00	6.75	9.88
Dibenzo (ai) pyrene	Dilution tunnel	0.44	0.23	0.19	0.28
Dibenzo(ah)Anthracene	Dilution tunnel	0.75	0.49	0.42	0.55
Fluoranthene	Dilution tunnel	93.45	55.15	49.74	66.12
Indeno(123-cd)Pyrene	Dilution tunnel	17.49	9.37	8.76	11.87
Naphthalene	Dilution tunnel	1284.38	854.72	810.33	983.14
Total (Excluding Non-Detects)	Dilution tunnel	1497.18	975.09	918.70	1130.32
Total (Including Non-Detects)	Dilution tunnel	1497.18	975.09	918.70	1130.32
LRTAP PAH total	Dilution tunnel	52.71	25.85	24.19	34.25

Table A-5-16: Hunter Aspect 8 – Modern Stove test results – Wet Wood

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	3.25	3.53	2.39	3.06
Benzo(a)Anthracene	Dilution tunnel	24.77	12.35	24.48	20.54
Benzo(a)pyrene	Dilution tunnel	28.41	16.14	20.05	21.53
Benzo(b)fluoranthene	Dilution tunnel	19.23	9.01	15.76	14.67
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.07	0.03	0.07	0.06
Benzo(c)phenanthrene	Dilution tunnel	10.52	5.56	10.93	9.00
Benzo(ghi)Perylene	Dilution tunnel	12.58	9.88	10.74	11.07
Benzo(k)fluoranthene	Dilution tunnel	12.56	5.70	9.52	9.26
Cholanthrene	Dilution tunnel	0.11	0.03	0.07	0.07
Chrysene	Dilution tunnel	24.24	12.30	29.44	21.99
Cyclopenta(cd)pyrene	Dilution tunnel	30.84	15.33	21.48	22.55
Dibenzo (ai) pyrene	Dilution tunnel	0.30	0.27	0.22	0.27
Dibenzo(ah)Anthracene	Dilution tunnel	1.44	1.21	1.52	1.39
Fluoranthene	Dilution tunnel	131.63	72.05	142.43	115.37
Indeno(123-cd)Pyrene	Dilution tunnel	14.69	11.27	12.70	12.89
Naphthalene	Dilution tunnel	2273.18	2356.32	2543.64	2391.04
Total (Excluding Non-Detects)	Dilution tunnel	2587.83	2530.95	2845.46	2654.74
Total (Including Non-Detects)	Dilution tunnel	2587.83	2530.98	2845.46	2654.75
LRTAP PAH total	Dilution tunnel	74.90	42.12	58.03	58.35

Table A-5-17: Hunter Aspect 8 – Modern Stove test results – Wood Briquettes

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	4.25	15.33	8.61	9.39
Benzo(a)Anthracene	Dilution tunnel	58.01	204.57	172.77	145.11
Benzo(a)pyrene	Dilution tunnel	72.88	145.09	141.22	119.73

Benzo(b)fluoranthene	Dilution tunnel	57.79	152.33	137.90	116.00
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.08	0.14	0.11	0.11
Benzo(c)phenanthrene	Dilution tunnel	21.16	62.63	55.63	46.48
Benzo(ghi)Perylene	Dilution tunnel	60.56	144.77	119.19	108.17
Benzo(k)fluoranthene	Dilution tunnel	32.08	92.21	81.31	68.54
Cholanthrene	Dilution tunnel	0.02	0.04	0.02	0.03
Chrysene	Dilution tunnel	65.87	196.70	169.60	144.05
Cyclopenta(cd)pyrene	Dilution tunnel	28.05	265.94	72.91	122.30
Dibenzo (ai) pyrene	Dilution tunnel	1.50	3.40	2.19	2.36
Dibenzo(ah)Anthracene	Dilution tunnel	5.23	11.39	11.35	9.32
Fluoranthene	Dilution tunnel	414.33	963.05	903.45	760.28
Indeno(123-cd)Pyrene	Dilution tunnel	60.98	152.64	142.49	118.70
Naphthalene	Dilution tunnel	3805.42	5008.82	4289.03	4367.76
Total (Excluding Non-Detects)	Dilution tunnel	4688.17	7419.05	6307.76	6138.33
Total (Including Non-Detects)	Dilution tunnel	4688.19	7419.05	6307.77	6138.34
LRTAP PAH total	Dilution tunnel	223.74	542.27	502.92	422.98

Table A-5-18: Hunter Aspect 8 – Modern Stove test results – Coffee Logs

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	0.19	1.21	0.06	0.49
Benzo(a)Anthracene	Dilution tunnel	19.06	36.35	3.60	19.67
Benzo(a)pyrene	Dilution tunnel	10.46	24.44	1.50	12.13
Benzo(b)fluoranthene	Dilution tunnel	16.93	28.45	3.14	16.17
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.20	0.39	0.09	0.22
Benzo(c)phenanthrene	Dilution tunnel	7.56	14.62	1.41	7.86
Benzo(ghi)Perylene	Dilution tunnel	14.47	25.87	1.83	14.06
Benzo(k)fluoranthene	Dilution tunnel	9.71	16.94	1.58	9.41
Cholanthrene	Dilution tunnel	0.02	0.03	0.03	0.03

Chrysene	Dilution tunnel	20.74	43.20	5.89	23.27
Cyclopenta(cd)pyrene	Dilution tunnel	6.91	9.72	0.29	5.64
Dibenzo (ai) pyrene	Dilution tunnel	0.17	0.69	0.03	0.30
Dibenzo(ah)Anthracene	Dilution tunnel	1.46	2.69	0.21	1.45
Fluoranthene	Dilution tunnel	117.46	239.95	18.07	125.16
Indeno(123-cd)Pyrene	Dilution tunnel	16.31	27.66	2.14	15.37
Naphthalene	Dilution tunnel	1129.99	2109.77	300.72	1180.16
Total (Excluding Non-Detects)	Dilution tunnel	1371.61	2581.96	340.53	1431.37
Total (Including Non-Detects)	Dilution tunnel	1371.64	2581.96	340.58	1431.39
LRTAP PAH total	Dilution tunnel	53.40	97.48	8.35	53.08

Table A-5-19: Hunter Aspect 8 – Modern Stove test results – High Sulphur MSF (Bright Flame)

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	7.43	7.11	9.38	7.98
Benzo(a)Anthracene	Dilution tunnel	170.32	144.76	190.97	168.68
Benzo(a)pyrene	Dilution tunnel	216.58	122.84	162.05	167.16
Benzo(b)fluoranthene	Dilution tunnel	144.68	93.61	123.49	120.59
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	1264.83	153.03	201.88	539.91
Benzo(c)phenanthrene	Dilution tunnel	149.53	15.99	21.10	62.21
Benzo(ghi)Perylene	Dilution tunnel	114.18	94.30	124.40	110.96
Benzo(k)fluoranthene	Dilution tunnel	1.73	31.02	40.92	24.56
Cholanthrene	Dilution tunnel	1.73	1.38	1.82	1.64
Chrysene	Dilution tunnel	249.50	153.03	201.88	201.47
Cyclopenta(cd)pyrene	Dilution tunnel	144.68	6.15	8.11	52.98
Dibenzo (ai) pyrene	Dilution tunnel	1.73	1.38	1.82	1.64
Dibenzo(ah)Anthracene	Dilution tunnel	51.98	39.84	52.56	48.13
Fluoranthene	Dilution tunnel	159.40	90.72	119.68	123.26
Indeno(123-cd)Pyrene	Dilution tunnel	45.57	30.47	40.19	38.74
Naphthalene	Dilution tunnel	2995.73	2161.75	2851.84	2669.77

Total (Excluding Non-Detects)	Dilution tunnel	5714.40	3144.63	4148.48	4335.84
Total (Including Non-Detects)	Dilution tunnel	5719.60	3147.39	4152.12	4339.70
LRTAP PAH total	Dilution tunnel	408.56	277.94	366.66	351.05

Table A-5-20: Hunter Aspect 8 – Modern Stove test results – Low Sulphur MSF

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	3.06	8.23	5.00	5.43
Benzo(a)Anthracene	Dilution tunnel	109.54	89.79	187.32	128.88
Benzo(a)pyrene	Dilution tunnel	140.43	123.04	111.51	124.99
Benzo(b)fluoranthene	Dilution tunnel	120.15	94.38	98.43	104.32
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	94.24	78.71	205.00	125.98
Benzo(c)phenanthrene	Dilution tunnel	17.76	15.32	31.28	21.45
Benzo(ghi)Perylene	Dilution tunnel	103.61	83.30	73.34	86.75
Benzo(k)fluoranthene	Dilution tunnel	32.77	32.48	31.81	32.35
Cholanthrene	Dilution tunnel	3.12	1.91	1.77	2.27
Chrysene	Dilution tunnel	149.48	100.88	175.48	141.95
Cyclopenta(cd)pyrene	Dilution tunnel	6.99	12.28	3.45	7.57
Dibenzo (ai) pyrene	Dilution tunnel	3.12	3.10	2.01	2.74
Dibenzo(ah)Anthracene	Dilution tunnel	25.21	34.01	29.16	29.46
Fluoranthene	Dilution tunnel	153.22	166.79	289.82	203.28
Indeno(123-cd)Pyrene	Dilution tunnel	17.32	37.26	30.57	28.38
Naphthalene	Dilution tunnel	4240.98	5699.10	4327.90	4755.99
Total (Excluding Non-Detects)	Dilution tunnel	5214.75	6578.67	5602.09	5798.50
Total (Including Non-Detects)	Dilution tunnel	5221.00	6580.58	5603.86	5801.81
LRTAP PAH total	Dilution tunnel	310.66	287.15	272.33	290.05

Table A-5-21: Hunter Aspect 8 – Modern Stove test results – Coal Trebles

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	16.95	16.19	18.74	17.30
Benzo(a)Anthracene	Dilution tunnel	231.09	164.20	175.84	190.37
Benzo(a)pyrene	Dilution tunnel	66.50	76.55	86.55	76.53
Benzo(b)fluoranthene	Dilution tunnel	137.24	131.36	146.36	138.32
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	3.59	3.31	3.49	3.46
Benzo(c)phenanthrene	Dilution tunnel	71.45	50.16	51.59	57.73
Benzo(ghi)Perylene	Dilution tunnel	29.67	36.24	29.17	31.69
Benzo(k)fluoranthene	Dilution tunnel	85.17	77.12	88.55	83.61
Cholanthrene	Dilution tunnel	0.10	0.13	0.25	0.16
Chrysene	Dilution tunnel	223.01	143.81	210.59	192.47
Cyclopenta(cd)pyrene	Dilution tunnel	229.07	163.06	104.24	165.46
Dibenzo (ai) pyrene	Dilution tunnel	3.28	4.16	4.69	4.04
Dibenzo(ah)Anthracene	Dilution tunnel	9.78	15.74	7.47	10.99
Fluoranthene	Dilution tunnel	665.00	588.84	550.68	601.51
Indeno(123-cd)Pyrene	Dilution tunnel	79.82	77.68	80.23	79.25
Naphthalene	Dilution tunnel	186.69	7122.70	6791.43	4700.27
Total (Excluding Non-Detects)	Dilution tunnel	2038.31	8671.25	8349.86	6353.14
Total (Including Non-Detects)	Dilution tunnel	2038.41	8671.25	8349.86	6353.17
LRTAP PAH total	Dilution tunnel	368.73	362.70	401.69	377.71

Table A-5-22: Hunter Aspect 8 – Modern Stove test results – Anthracite

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	0.02	1.81	0.06	0.63
Benzo(a)Anthracene	Dilution tunnel	13.11	12.85	18.77	14.91
Benzo(a)pyrene	Dilution tunnel	2.90	6.60	6.16	5.22

Benzo(b)fluoranthene	Dilution tunnel	7.09	8.72	19.78	11.86
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	14.95	6.40	15.16	12.17
Benzo(c)phenanthrene	Dilution tunnel	3.23	3.83	5.84	4.30
Benzo(ghi)Perylene	Dilution tunnel	3.80	5.98	11.96	7.25
Benzo(k)fluoranthene	Dilution tunnel	2.53	3.99	6.34	4.28
Cholanthrene	Dilution tunnel	0.02	0.02	0.06	0.03
Chrysene	Dilution tunnel	14.32	11.76	23.92	16.67
Cyclopenta(cd)pyrene	Dilution tunnel	0.99	5.80	5.31	4.03
Dibenzo (ai) pyrene	Dilution tunnel	0.02	0.02	0.06	0.03
Dibenzo(ah)Anthracene	Dilution tunnel	0.72	0.76	1.60	1.03
Fluoranthene	Dilution tunnel	35.54	52.15	96.52	61.40
Indeno(123-cd)Pyrene	Dilution tunnel	3.76	6.46	11.19	7.14
Naphthalene	Dilution tunnel	708.71	994.71	1515.89	1073.10
Total (Excluding Non-Detects)	Dilution tunnel	811.63	1121.81	1738.44	1223.96
Total (Including Non-Detects)	Dilution tunnel	811.69	1121.85	1738.62	1224.05
LRTAP PAH total	Dilution tunnel	16.27	25.77	43.46	28.50

Table A-5-23: Hunter Aspect 8 (Low Output) – Modern Stove test results – Dry Wood

Pollutant + Method (mg/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
Anthanthrene	Dilution tunnel	2.54	4.17	3.66	3.46
Benzo(a)Anthracene	Dilution tunnel	36.39	28.51	41.22	35.37
Benzo(a)pyrene	Dilution tunnel	32.07	30.44	40.65	34.39
Benzo(b)fluoranthene	Dilution tunnel	40.53	20.98	35.74	32.41
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.24	0.04	0.13	0.14
Benzo(c)phenanthrene	Dilution tunnel	14.39	9.52	19.81	14.57
Benzo(ghi)Perylene	Dilution tunnel	28.52	25.76	35.99	30.09
Benzo(k)fluoranthene	Dilution tunnel	18.79	12.42	19.03	16.75
Cholanthrene	Dilution tunnel	0.08	0.01	0.05	0.05

Chrysene	Dilution tunnel	46.46	26.88	47.06	40.13
Cyclopenta(cd)pyrene	Dilution tunnel	5.44	33.40	18.00	18.94
Dibenzo (ai) pyrene	Dilution tunnel	0.73	0.97	0.73	0.81
Dibenzo(ah)Anthracene	Dilution tunnel	2.84	2.60	3.41	2.95
Fluoranthene	Dilution tunnel	250.48	174.12	324.25	249.62
Indeno(123-cd)Pyrene	Dilution tunnel	26.23	23.01	31.75	27.00
Naphthalene	Dilution tunnel	2784.05	1167.90	3371.83	2441.26
Total (Excluding Non-Detects)	Dilution tunnel	3289.68	1560.71	3993.25	2947.88
Total (Including Non-Detects)	Dilution tunnel	3289.76	1560.72	3993.30	2947.93
LRTAP PAH total	Dilution tunnel	117.62	86.85	127.17	110.55

Table A-5-24: Hunter Aspect 8 (Low Output) – Modern Stove test results – Seasoned Wood

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	1.03	2.23	5.61	2.96
Benzo(a)Anthracene	Dilution tunnel	10.68	16.30	25.36	17.45
Benzo(a)pyrene	Dilution tunnel	8.00	12.96	19.96	13.64
Benzo(b)fluoranthene	Dilution tunnel	7.13	10.23	19.57	12.31
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.06	0.10	0.30	0.15
Benzo(c)phenanthrene	Dilution tunnel	4.81	6.94	9.13	6.96
Benzo(ghi)Perylene	Dilution tunnel	5.51	8.38	16.88	10.26
Benzo(k)fluoranthene	Dilution tunnel	3.52	5.91	11.62	7.02
Cholanthrene	Dilution tunnel	0.02	0.04	0.06	0.04
Chrysene	Dilution tunnel	10.84	17.15	24.74	17.58
Cyclopenta(cd)pyrene	Dilution tunnel	6.41	12.56	31.91	16.96
Dibenzo (ai) pyrene	Dilution tunnel	0.13	0.17	0.65	0.32
Dibenzo(ah)Anthracene	Dilution tunnel	0.74	1.14	1.87	1.25
Fluoranthene	Dilution tunnel	67.35	88.80	127.36	94.50
Indeno(123-cd)Pyrene	Dilution tunnel	5.51	8.00	15.79	9.77
Naphthalene	Dilution tunnel	1194.38	1399.53	1419.14	1337.68

Total (Excluding Non-Detects)	Dilution tunnel	1326.10	1590.44	1727.90	1548.15
Total (Including Non-Detects)	Dilution tunnel	1326.13	1590.44	1727.90	1548.16
LRTAP PAH total	Dilution tunnel	24.17	37.11	66.93	42.73

Table A-5-25: Hunter Aspect 8 (Low Output) – Modern Stove test results – Wet Wood

Pollutant + Method (mg/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
Anthanthrene	Dilution tunnel	7.75	13.78	10.69	10.74
Benzo(a)Anthracene	Dilution tunnel	45.92	72.78	52.27	56.99
Benzo(a)pyrene	Dilution tunnel	36.80	71.16	45.52	51.16
Benzo(b)fluoranthene	Dilution tunnel	29.62	49.61	37.43	38.89
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.47	0.67	0.43	0.52
Benzo(c)phenanthrene	Dilution tunnel	16.72	25.21	18.41	20.11
Benzo(ghi)Perylene	Dilution tunnel	23.10	38.95	31.39	31.15
Benzo(k)fluoranthene	Dilution tunnel	15.74	26.27	19.73	20.58
Cholanthrene	Dilution tunnel	0.20	0.34	0.27	0.27
Chrysene	Dilution tunnel	41.36	63.03	45.86	50.08
Cyclopenta(cd)pyrene	Dilution tunnel	55.73	86.20	72.16	71.37
Dibenzo (ai) pyrene	Dilution tunnel	0.04	0.04	0.03	0.04
Dibenzo(ah)Anthracene	Dilution tunnel	2.89	4.68	3.74	3.77
Fluoranthene	Dilution tunnel	246.05	375.31	292.02	304.46
Indeno(123-cd)Pyrene	Dilution tunnel	23.48	39.65	30.62	31.25
Naphthalene	Dilution tunnel	2993.29	3427.79	3200.13	3207.07
Total (Excluding Non-Detects)	Dilution tunnel	3539.12	4295.42	3860.69	3898.41
Total (Including Non-Detects)	Dilution tunnel	3539.15	4295.46	3860.72	3898.44
LRTAP PAH total	Dilution tunnel	105.64	186.68	133.30	141.87

Table A-5-26: Hunter Aspect 8 (Low Output) – Modern Stove test results – Wood Briquettes

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	5.11	6.00	0.01	3.71
Benzo(a)Anthracene	Dilution tunnel	105.67	132.10	135.40	124.39
Benzo(a)pyrene	Dilution tunnel	83.08	72.93	85.24	80.42
Benzo(b)fluoranthene	Dilution tunnel	73.45	106.56	110.51	96.84
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.41	0.33	0.26	0.33
Benzo(c)phenanthrene	Dilution tunnel	38.89	56.76	52.10	49.25
Benzo(ghi)Perylene	Dilution tunnel	68.89	105.28	112.19	95.45
Benzo(k)fluoranthene	Dilution tunnel	50.61	66.83	65.89	61.11
Cholanthrene	Dilution tunnel	0.02	0.01	0.01	0.02
Chrysene	Dilution tunnel	105.43	140.75	114.77	120.32
Cyclopenta(cd)pyrene	Dilution tunnel	81.85	99.18	59.45	80.16
Dibenzo (ai) pyrene	Dilution tunnel	1.52	0.01	0.01	0.52
Dibenzo(ah)Anthracene	Dilution tunnel	5.89	8.50	8.43	7.61
Fluoranthene	Dilution tunnel	471.58	742.07	652.49	622.05
Indeno(123-cd)Pyrene	Dilution tunnel	60.98	102.30	98.26	87.18
Naphthalene	Dilution tunnel	2818.38	3778.47	2898.83	3165.23
Total (Excluding Non-Detects)	Dilution tunnel	3971.77	5418.05	4393.81	4594.54
Total (Including Non-Detects)	Dilution tunnel	3971.77	5418.08	4393.85	4594.56
LRTAP PAH total	Dilution tunnel	268.14	348.62	359.90	325.55

Table A-5-27: Hunter Aspect 8 (Low Output) – Modern Stove test results – Coffee Logs

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	0.18	0.18	0.03	0.13
Benzo(a)Anthracene	Dilution tunnel	10.47	7.16	16.28	11.30
Benzo(a)pyrene	Dilution tunnel	6.40	7.78	9.51	7.90

Benzo(b)fluoranthene	Dilution tunnel	8.23	8.04	14.83	10.37
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.11	0.10	0.17	0.13
Benzo(c)phenanthrene	Dilution tunnel	3.40	1.99	5.02	3.47
Benzo(ghi)Perylene	Dilution tunnel	6.23	8.69	10.73	8.55
Benzo(k)fluoranthene	Dilution tunnel	3.72	3.63	6.78	4.71
Cholanthrene	Dilution tunnel	0.02	0.02	0.02	0.02
Chrysene	Dilution tunnel	13.15	17.34	20.79	17.10
Cyclopenta(cd)pyrene	Dilution tunnel	5.58	2.44	5.65	4.56
Dibenzo (ai) pyrene	Dilution tunnel	0.19	0.19	0.22	0.20
Dibenzo(ah)Anthracene	Dilution tunnel	0.55	0.72	0.85	0.70
Fluoranthene	Dilution tunnel	60.10	37.41	82.33	59.94
Indeno(123-cd)Pyrene	Dilution tunnel	5.67	8.17	9.43	7.76
Naphthalene	Dilution tunnel	953.32	973.05	1064.80	997.06
Total (Excluding Non-Detects)	Dilution tunnel	1077.30	1076.90	1247.42	1133.87
Total (Including Non-Detects)	Dilution tunnel	1077.33	1076.92	1247.44	1133.90
LRTAP PAH total	Dilution tunnel	24.01	27.63	40.55	30.73

Table A-5-28: Hunter Aspect 8 (Low Output) – Modern Stove test results – High Sulphur MSF (Bright Flame)

Pollutant + Method (mg/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
Anthanthrene	Dilution tunnel	7.65	7.01	4.77	6.47
Benzo(a)Anthracene	Dilution tunnel	508.89	585.95	589.00	561.28
Benzo(a)pyrene	Dilution tunnel	172.10	308.08	191.11	223.76
Benzo(b)fluoranthene	Dilution tunnel	64.95	160.38	78.78	101.37
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	626.52	715.82	738.11	693.48
Benzo(c)phenanthrene	Dilution tunnel	70.58	81.25	89.96	80.60
Benzo(ghi)Perylene	Dilution tunnel	80.30	102.99	84.50	89.26
Benzo(k)fluoranthene	Dilution tunnel	36.82	73.70	42.99	51.17
Cholanthrene	Dilution tunnel	0.20	0.17	0.11	0.16

Chrysene	Dilution tunnel	600.95	646.36	566.63	604.64
Cyclopenta(cd)pyrene	Dilution tunnel	49.61	19.21	25.60	31.47
Dibenzo (ai) pyrene	Dilution tunnel	3.99	4.11	2.31	3.47
Dibenzo(ah)Anthracene	Dilution tunnel	49.35	46.51	41.01	45.62
Fluoranthene	Dilution tunnel	432.17	413.79	407.57	417.85
Indeno(123-cd)Pyrene	Dilution tunnel	46.54	56.18	13.94	38.89
Naphthalene	Dilution tunnel	3498.30	2235.06	3200.95	2978.11
Total (Excluding Non-Detects)	Dilution tunnel	6248.94	5456.56	6077.34	5927.61
Total (Including Non-Detects)	Dilution tunnel	6248.94	5456.56	6077.34	5927.61
LRTAP PAH total	Dilution tunnel	320.42	598.33	326.83	415.19

Table A-5-29: Hunter Aspect 8 (Low Output) – Modern Stove test results – Low Sulphur MSF (Heat Approved)

Pollutant + Method (mg/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
Anthanthrene	Dilution tunnel	-	-	-	-
Benzo(a)Anthracene	Dilution tunnel	251.16	330.65	250.41	277.41
Benzo(a)pyrene	Dilution tunnel	14.80	16.87	15.81	15.83
Benzo(b)fluoranthene	Dilution tunnel	100.52	102.90	79.03	94.15
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	218.62	284.91	215.00	239.51
Benzo(c)phenanthrene	Dilution tunnel	38.31	47.59	34.56	40.15
Benzo(ghi)Perylene	Dilution tunnel	-	-	-	-
Benzo(k)fluoranthene	Dilution tunnel	28.11	98.27	58.92	61.77
Cholanthrene	Dilution tunnel	0.19	0.15	0.22	0.19
Chrysene	Dilution tunnel	339.88	451.17	291.77	360.94
Cyclopenta(cd)pyrene	Dilution tunnel	14.26	11.25	27.25	17.59
Dibenzo (ai) pyrene	Dilution tunnel	-	-	-	-
Dibenzo(ah)Anthracene	Dilution tunnel	-	-	-	-
Fluoranthene	Dilution tunnel	230.14	318.29	241.63	263.35
Indeno(123-cd)Pyrene	Dilution tunnel	-	-	-	-
Naphthalene	Dilution tunnel	1281.74	1594.53	1515.51	1463.93

Total (Excluding Non-Detects)	Dilution tunnel	2517.73	3256.58	2730.11	2834.81
Total (Including Non-Detects)	Dilution tunnel	2517.73	3256.58	2730.11	2834.81
LRTAP PAH total	Dilution tunnel	143.44	218.04	153.76	171.75

Table A-5-30: Hunter Aspect 8 (Low Output) – Modern Stove test results – Coal Trebles

Pollutant + Method (mg/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
Anthanthrene	Dilution tunnel	30.60	30.02	31.32	30.65
Benzo(a)Anthracene	Dilution tunnel	410.20	694.65	539.62	548.16
Benzo(a)pyrene	Dilution tunnel	120.40	138.68	152.41	137.16
Benzo(b)fluoranthene	Dilution tunnel	272.73	290.27	276.39	279.80
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	14.52	15.31	13.45	14.43
Benzo(c)phenanthrene	Dilution tunnel	122.17	221.05	184.00	175.74
Benzo(ghi)Perylene	Dilution tunnel	59.20	44.66	53.17	52.34
Benzo(k)fluoranthene	Dilution tunnel	138.36	165.23	151.36	151.65
Cholanthrene	Dilution tunnel	0.43	0.71	0.76	0.64
Chrysene	Dilution tunnel	330.38	550.76	402.74	427.96
Cyclopenta(cd)pyrene	Dilution tunnel	383.59	570.61	534.36	496.19
Dibenzo (ai) pyrene	Dilution tunnel	4.35	5.26	4.37	4.66
Dibenzo(ah)Anthracene	Dilution tunnel	12.04	15.16	15.53	14.24
Fluoranthene	Dilution tunnel	1341.47	2351.89	1908.42	1867.26
Indeno(123-cd)Pyrene	Dilution tunnel	211.53	192.52	178.47	194.17
Naphthalene	Dilution tunnel	3831.51	3428.60	5793.69	4351.27
Total (Excluding Non-Detects)	Dilution tunnel	7283.50	8715.36	10240.07	8746.31
Total (Including Non-Detects)	Dilution tunnel	7283.50	8715.36	10240.07	8746.31
LRTAP PAH total	Dilution tunnel	743.02	786.69	758.63	762.78

Table A-5-31: Hunter Aspect 8 (Low Output) – Modern Stove test results – Anthracite

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	0.69	3.50	7.51	3.90
Benzo(a)Anthracene	Dilution tunnel	19.81	297.08	45.19	120.69
Benzo(a)pyrene	Dilution tunnel	7.71	176.64	36.55	73.63
Benzo(b)fluoranthene	Dilution tunnel	14.74	183.09	38.21	78.68
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	16.48	0.97	7.91	8.45
Benzo(c)phenanthrene	Dilution tunnel	5.01	109.16	14.55	42.91
Benzo(ghi)Perylene	Dilution tunnel	9.62	42.14	27.25	26.34
Benzo(k)fluoranthene	Dilution tunnel	5.05	113.77	15.42	44.74
Cholanthrene	Dilution tunnel	0.04	0.11	0.19	0.11
Chrysene	Dilution tunnel	23.20	280.96	41.87	115.34
Cyclopenta(cd)pyrene	Dilution tunnel	2.30	389.20	28.71	140.07
Dibenzo (ai) pyrene	Dilution tunnel	0.30	1.05	1.21	0.85
Dibenzo(ah)Anthracene	Dilution tunnel	1.93	4.81	4.02	3.59
Fluoranthene	Dilution tunnel	74.76	1536.08	201.36	604.07
Indeno(123-cd)Pyrene	Dilution tunnel	6.85	45.14	25.65	25.88
Naphthalene	Dilution tunnel	777.72	18055.24	2306.05	7046.34
Total (Excluding Non-Detects)	Dilution tunnel	966.21	21238.94	2801.65	8335.60
Total (Including Non-Detects)	Dilution tunnel	966.21	21238.94	2801.65	8335.60
LRTAP PAH total	Dilution tunnel	35.97	518.63	115.83	223.48

Table A-5-32: Kensal Redfyre – Middle Stove test results – Dry Wood

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	66.21	135.08	278.46	159.91
Benzo(a)Anthracene	Dilution tunnel	426.46	593.48	1086.08	702.01
Benzo(a)pyrene	Dilution tunnel	438.39	438.93	754.22	543.85

Benzo(b)fluoranthene	Dilution tunnel	313.14	528.57	923.17	588.29
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	1.67	2.37	8.09	4.04
Benzo(c)phenanthrene	Dilution tunnel	153.88	229.66	359.01	247.52
Benzo(ghi)Perylene	Dilution tunnel	257.97	364.74	300.18	307.63
Benzo(k)fluoranthene	Dilution tunnel	188.78	300.14	597.34	362.09
Cholanthrene	Dilution tunnel	0.38	0.93	1.68	1.00
Chrysene	Dilution tunnel	480.14	652.21	1131.33	754.56
Cyclopenta(cd)pyrene	Dilution tunnel	429.45	534.75	2371.27	1111.82
Dibenzo (ai) pyrene	Dilution tunnel	33.40	55.02	135.16	74.53
Dibenzo(ah)Anthracene	Dilution tunnel	23.14	20.34	63.05	35.51
Fluoranthene	Dilution tunnel	2579.66	4305.80	6709.55	4531.67
Indeno(123-cd)Pyrene	Dilution tunnel	282.42	500.75	769.30	517.49
Naphthalene	Dilution tunnel	8320.51	10277.66	5885.94	8161.37
Total (Excluding Non-Detects)	Dilution tunnel	13995.60	18940.42	21373.81	18103.28
Total (Including Non-Detects)	Dilution tunnel	13995.60	18940.42	21373.81	18103.28
LRTAP PAH total	Dilution tunnel	32.12	168.83	1035.68	412.21

Table A-5-33: Kensal Redfyre – Middle Stove test results – Seasoned Wood

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	1.56	0.29	0.55	0.80
Benzo(a)Anthracene	Dilution tunnel	11.59	13.63	0.19	8.47
Benzo(a)pyrene	Dilution tunnel	7.22	3.99	3.15	4.79
Benzo(b)fluoranthene	Dilution tunnel	8.63	12.03	5.22	8.63
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	4.04	6.72	1.69	4.15
Benzo(c)phenanthrene	Dilution tunnel	3.38	4.05	2.17	3.20
Benzo(ghi)Perylene	Dilution tunnel	13.00	5.81	5.07	7.96
Benzo(k)fluoranthene	Dilution tunnel	3.71	4.18	2.13	3.34
Cholanthrene	Dilution tunnel	0.03	0.03	0.04	0.03

Chrysene	Dilution tunnel	11.85	15.61	5.41	10.96
Cyclopenta(cd)pyrene	Dilution tunnel	6.96	0.95	1.31	3.07
Dibenzo (ai) pyrene	Dilution tunnel	0.37	0.15	0.21	0.24
Dibenzo(ah)Anthracene	Dilution tunnel	2.24	1.21	0.70	1.38
Fluoranthene	Dilution tunnel	54.50	44.91	37.96	45.79
Indeno(123-cd)Pyrene	Dilution tunnel	7.45	4.18	3.70	5.11
Naphthalene	Dilution tunnel	1142.48	568.50	894.40	868.46
Total (Excluding Non-Detects)	Dilution tunnel	1278.98	686.20	963.86	976.35
Total (Including Non-Detects)	Dilution tunnel	1279.01	686.23	963.90	976.38
LRTAP PAH total	Dilution tunnel	27.02	24.37	14.20	21.86

Table A-5-34: Kensal Redfyre – Middle Stove test results – Wet Wood

Pollutant + Method (mg/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
Anthanthrene	Dilution tunnel	3.31	3.29	4.66	3.75
Benzo(a)Anthracene	Dilution tunnel	21.23	24.41	26.93	24.19
Benzo(a)pyrene	Dilution tunnel	20.46	17.84	22.90	20.40
Benzo(b)fluoranthene	Dilution tunnel	15.54	16.27	17.47	16.43
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.19	0.22	0.20	0.20
Benzo(c)phenanthrene	Dilution tunnel	7.54	8.25	9.46	8.41
Benzo(ghi)Perylene	Dilution tunnel	12.27	12.79	14.69	13.25
Benzo(k)fluoranthene	Dilution tunnel	8.00	7.81	8.42	8.08
Cholanthrene	Dilution tunnel	0.07	0.07	0.07	0.07
Chrysene	Dilution tunnel	21.36	24.27	24.51	23.38
Cyclopenta(cd)pyrene	Dilution tunnel	27.67	23.21	37.89	29.59
Dibenzo (ai) pyrene	Dilution tunnel	0.03	0.68	0.22	0.31
Dibenzo(ah)Anthracene	Dilution tunnel	1.37	1.19	1.68	1.41
Fluoranthene	Dilution tunnel	122.66	110.96	143.18	125.60
Indeno(123-cd)Pyrene	Dilution tunnel	10.91	10.60	12.84	11.45
Naphthalene	Dilution tunnel	1524.13	1649.36	1867.75	1680.41

Total (Excluding Non-Detects)	Dilution tunnel	1796.72	1911.22	2192.89	1966.94
Total (Including Non-Detects)	Dilution tunnel	1796.72	1911.22	2192.89	1966.94
LRTAP PAH total	Dilution tunnel	54.91	52.52	61.63	56.36

Table A-5-35: Kensal Redfyre – Middle Stove test results – Wood Briquettes

Pollutant + Method (mg/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
Anthanthrene	Dilution tunnel	197.74	151.68	52.81	134.08
Benzo(a)Anthracene	Dilution tunnel	911.48	731.69	212.80	618.66
Benzo(a)pyrene	Dilution tunnel	346.51	245.11	138.15	243.26
Benzo(b)fluoranthene	Dilution tunnel	595.10	339.76	170.46	368.44
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	1.15	0.85	0.26	0.75
Benzo(c)phenanthrene	Dilution tunnel	295.67	260.88	67.18	207.91
Benzo(ghi)Perylene	Dilution tunnel	291.90	197.79	111.19	200.29
Benzo(k)fluoranthene	Dilution tunnel	510.35	385.87	118.10	338.11
Cholanthrene	Dilution tunnel	1.72	0.75	0.19	0.89
Chrysene	Dilution tunnel	851.21	794.79	173.81	606.60
Cyclopenta(cd)pyrene	Dilution tunnel	1574.37	815.41	350.95	913.58
Dibenzo (ai) pyrene	Dilution tunnel	14.46	0.01	0.01	4.83
Dibenzo(ah)Anthracene	Dilution tunnel	12.37	13.47	7.64	11.16
Fluoranthene	Dilution tunnel	4525.37	3943.60	1028.35	3165.77
Indeno(123-cd)Pyrene	Dilution tunnel	604.51	603.07	184.95	464.18
Naphthalene	Dilution tunnel	9444.34	11634.22	3617.61	8232.06
Total (Excluding Non-Detects)	Dilution tunnel	20178.26	20118.92	6234.47	15510.55
Total (Including Non-Detects)	Dilution tunnel	20178.26	20118.93	6234.48	15510.56
LRTAP PAH total	Dilution tunnel	2056.47	1573.80	611.66	1413.98

Table A-5-36: Kensal Redfyre – Middle Stove test results – Coffee Logs

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	0.25	1.48	0.25	0.66
Benzo(a)Anthracene	Dilution tunnel	8.78	25.42	6.00	13.40
Benzo(a)pyrene	Dilution tunnel	6.44	25.99	4.28	12.24
Benzo(b)fluoranthene	Dilution tunnel	8.08	34.89	6.27	16.41
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.17	0.43	0.16	0.26
Benzo(c)phenanthrene	Dilution tunnel	2.38	12.12	2.50	5.67
Benzo(ghi)Perylene	Dilution tunnel	4.46	34.61	4.74	14.60
Benzo(k)fluoranthene	Dilution tunnel	4.06	14.12	2.88	7.02
Cholanthrene	Dilution tunnel	0.03	0.05	0.02	0.03
Chrysene	Dilution tunnel	9.06	32.77	6.32	16.05
Cyclopenta(cd)pyrene	Dilution tunnel	4.67	8.32	1.48	4.82
Dibenzo (ai) pyrene	Dilution tunnel	0.07	0.56	0.05	0.23
Dibenzo(ah)Anthracene	Dilution tunnel	0.41	2.73	0.45	1.20
Fluoranthene	Dilution tunnel	41.51	221.76	46.59	103.29
Indeno(123-cd)Pyrene	Dilution tunnel	4.03	26.27	4.50	11.60
Naphthalene	Dilution tunnel	317.49	1425.19	489.33	744.00
Total (Excluding Non-Detects)	Dilution tunnel	411.89	1866.72	575.83	951.48
Total (Including Non-Detects)	Dilution tunnel	411.89	1866.72	575.83	951.48
LRTAP PAH total	Dilution tunnel	22.61	101.27	17.93	47.27

Table A-5-37: Kensal Redfyre – Middle Stove test results – High Sulphur MSF (Bright Flame)

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	11.07	3.48	8.10	7.55
Benzo(a)Anthracene	Dilution tunnel	116.75	256.08	129.24	167.36
Benzo(a)pyrene	Dilution tunnel	157.00	135.48	194.31	162.27

Benzo(b)fluoranthene	Dilution tunnel	103.33	138.01	137.64	126.33
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	115.07	405.17	138.84	219.69
Benzo(c)phenanthrene	Dilution tunnel	23.15	3.17	13.49	13.27
Benzo(ghi)Perylene	Dilution tunnel	145.60	121.55	137.64	134.93
Benzo(k)fluoranthene	Dilution tunnel	30.86	39.25	42.88	37.67
Cholanthrene	Dilution tunnel	3.35	3.17	3.00	3.17
Chrysene	Dilution tunnel	115.74	322.87	155.63	198.08
Cyclopenta(cd)pyrene	Dilution tunnel	10.06	11.71	6.90	9.56
Dibenzo (ai) pyrene	Dilution tunnel	7.72	6.81	4.80	6.44
Dibenzo(ah)Anthracene	Dilution tunnel	51.66	24.06	55.48	43.73
Fluoranthene	Dilution tunnel	1197.66	262.09	117.55	525.77
Indeno(123-cd)Pyrene	Dilution tunnel	54.35	48.11	53.08	51.85
Naphthalene	Dilution tunnel	2502.67	2592.45	3849.99	2981.70
Total (Excluding Non-Detects)	Dilution tunnel	4642.69	4367.12	5045.56	4685.13
Total (Including Non-Detects)	Dilution tunnel	4646.05	4373.45	5048.56	4689.35
LRTAP PAH total	Dilution tunnel	345.54	360.85	427.91	378.10

Table A-5-38: Kensal Redfyre – Middle Stove test results – Low Sulphur MSF (Heat Approved)

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	3.15	3.29	3.63	3.35
Benzo(a)Anthracene	Dilution tunnel	26.66	9.01	21.49	19.05
Benzo(a)pyrene	Dilution tunnel	64.90	10.33	39.90	38.38
Benzo(b)fluoranthene	Dilution tunnel	63.35	12.38	37.67	37.80
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	42.77	57.79	20.65	40.40
Benzo(c)phenanthrene	Dilution tunnel	6.14	7.77	5.61	6.51
Benzo(ghi)Perylene	Dilution tunnel	85.22	14.11	30.69	43.34
Benzo(k)fluoranthene	Dilution tunnel	13.70	20.86	18.61	17.72
Cholanthrene	Dilution tunnel	3.22	2.93	2.79	2.98

Chrysene	Dilution tunnel	56.92	11.82	27.07	31.94
Cyclopenta(cd)pyrene	Dilution tunnel	1.60	1.00	3.82	2.14
Dibenzo (ai) pyrene	Dilution tunnel	2.49	2.70	2.79	2.66
Dibenzo(ah)Anthracene	Dilution tunnel	20.36	18.63	10.88	16.62
Fluoranthene	Dilution tunnel	91.65	18.72	52.46	54.28
Indeno(123-cd)Pyrene	Dilution tunnel	23.19	5.22	13.67	14.03
Naphthalene	Dilution tunnel	3045.49	633.66	1706.08	1795.08
Total (Excluding Non-Detects)	Dilution tunnel	3550.81	830.22	1992.24	2124.42
Total (Including Non-Detects)	Dilution tunnel	3550.81	830.22	1997.82	2126.28
LRTAP PAH total	Dilution tunnel	165.14	48.79	109.86	107.93

Table A-5-39: Kensal Redfyre – Middle Stove test results – Coal Trebles

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	248.63	342.88	9.57	200.36
Benzo(a)Anthracene	Dilution tunnel	1304.10	1884.63	214.91	1134.55
Benzo(a)pyrene	Dilution tunnel	676.42	744.12	87.55	502.70
Benzo(b)fluoranthene	Dilution tunnel	1389.41	1921.10	152.52	1154.34
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	45.70	45.47	7.38	32.85
Benzo(c)phenanthrene	Dilution tunnel	349.79	520.40	64.47	311.55
Benzo(ghi)Perylene	Dilution tunnel	650.83	725.88	55.66	477.46
Benzo(k)fluoranthene	Dilution tunnel	906.77	1174.55	68.63	716.65
Cholanthrene	Dilution tunnel	0.86	1.23	0.39	0.83
Chrysene	Dilution tunnel	1200.50	1580.65	206.00	995.72
Cyclopenta(cd)pyrene	Dilution tunnel	1681.92	2918.13	67.05	1555.70
Dibenzo (ai) pyrene	Dilution tunnel	14.75	0.12	9.03	7.97
Dibenzo(ah)Anthracene	Dilution tunnel	110.54	119.04	11.19	80.26
Fluoranthene	Dilution tunnel	4290.12	7526.34	843.80	4220.09
Indeno(123-cd)Pyrene	Dilution tunnel	1073.75	1459.07	70.91	867.91
Naphthalene	Dilution tunnel	49531.36	59067.82	6694.94	38431.37

Total (Excluding Non-Detects)	Dilution tunnel	63475.47	80031.31	8564.01	50690.26
Total (Including Non-Detects)	Dilution tunnel	63475.47	80031.43	8564.01	50690.30
LRTAP PAH total	Dilution tunnel	4046.36	5298.84	379.61	3241.60

Table A-5-40: Kensal Redfyre – Middle Stove test results – Anthracite

Pollutant + Method (mg/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
Anthanthrene	Dilution tunnel	0.81	0.25	0.03	0.36
Benzo(a)Anthracene	Dilution tunnel	6.87	2.97	1.30	3.71
Benzo(a)pyrene	Dilution tunnel	5.77	1.39	0.78	2.65
Benzo(b)fluoranthene	Dilution tunnel	7.10	4.27	1.96	4.44
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	2.02	0.94	0.33	1.09
Benzo(c)phenanthrene	Dilution tunnel	2.58	1.61	0.70	1.63
Benzo(ghi)Perylene	Dilution tunnel	11.48	4.51	2.88	6.29
Benzo(k)fluoranthene	Dilution tunnel	3.13	1.68	0.77	1.86
Cholanthrene	Dilution tunnel	0.03	0.03	0.03	0.03
Chrysene	Dilution tunnel	8.32	5.31	2.26	5.30
Cyclopenta(cd)pyrene	Dilution tunnel	2.54	0.39	0.10	1.01
Dibenzo (ai) pyrene	Dilution tunnel	0.38	0.04	0.03	0.15
Dibenzo(ah)Anthracene	Dilution tunnel	1.30	0.52	0.28	0.70
Fluoranthene	Dilution tunnel	58.70	32.65	19.41	36.92
Indeno(123-cd)Pyrene	Dilution tunnel	9.05	4.15	2.25	5.15
Naphthalene	Dilution tunnel	2252.01	917.03	382.33	1183.79
Total (Excluding Non-Detects)	Dilution tunnel	2372.06	977.70	415.34	1255.04
Total (Including Non-Detects)	Dilution tunnel	2372.09	977.73	415.43	1255.08
LRTAP PAH total	Dilution tunnel	25.05	11.49	5.76	14.10

Table A-5-41: Stovax Stockton 5 – Modern Stove test results – Dry Wood

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	21.26	52.28	1.20	24.92
Benzo(a)Anthracene	Dilution tunnel	60.86	169.39	12.61	80.95
Benzo(a)pyrene	Dilution tunnel	104.22	191.38	8.89	101.50
Benzo(b)fluoranthene	Dilution tunnel	83.37	171.02	15.70	90.03
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.25	0.47	0.11	0.28
Benzo(c)phenanthrene	Dilution tunnel	23.07	67.10	5.36	31.84
Benzo(ghi)Perylene	Dilution tunnel	118.11	231.28	17.08	122.16
Benzo(k)fluoranthene	Dilution tunnel	43.42	92.84	8.09	48.12
Cholanthrene	Dilution tunnel	0.21	0.08	0.01	0.10
Chrysene	Dilution tunnel	53.98	129.48	11.11	64.86
Cyclopenta(cd)pyrene	Dilution tunnel	41.76	163.69	12.26	72.57
Dibenzo (ai) pyrene	Dilution tunnel	4.34	14.58	0.56	6.49
Dibenzo(ah)Anthracene	Dilution tunnel	12.44	20.85	1.27	11.52
Fluoranthene	Dilution tunnel	464.11	1229.69	106.70	600.17
Indeno(123-cd)Pyrene	Dilution tunnel	116.72	232.09	15.47	121.43
Naphthalene	Dilution tunnel	11873.84	20636.07	1385.59	11298.50
Total (Excluding Non-Detects)	Dilution tunnel	13021.98	23402.21	1602.00	12675.40
Total (Including Non-Detects)	Dilution tunnel	13021.98	23402.29	1602.01	12675.43
LRTAP PAH total	Dilution tunnel	347.74	687.33	48.16	361.07

Table A-5-42: Stovax Stockton 5 – Modern Stove test results – Seasoned Wood

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	3.58	8.61	3.40	5.20
Benzo(a)Anthracene	Dilution tunnel	25.36	60.83	19.30	35.16

Benzo(a)pyrene	Dilution tunnel	19.96	48.12	16.24	28.11
Benzo(b)fluoranthene	Dilution tunnel	19.57	42.25	14.31	25.38
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.30	0.16	0.14	0.20
Benzo(c)phenanthrene	Dilution tunnel	9.13	20.73	7.58	12.48
Benzo(ghi)Perylene	Dilution tunnel	16.88	42.25	12.97	24.03
Benzo(k)fluoranthene	Dilution tunnel	11.62	26.60	8.36	15.53
Cholanthrene	Dilution tunnel	0.06	0.05	0.04	0.05
Chrysene	Dilution tunnel	24.74	53.01	18.55	32.10
Cyclopenta(cd)pyrene	Dilution tunnel	31.91	81.18	26.74	46.61
Dibenzo (ai) pyrene	Dilution tunnel	0.65	1.59	0.43	0.89
Dibenzo(ah)Anthracene	Dilution tunnel	1.87	4.62	1.43	2.64
Fluoranthene	Dilution tunnel	127.36	262.12	92.87	160.78
Indeno(123-cd)Pyrene	Dilution tunnel	15.79	39.51	12.73	22.67
Naphthalene	Dilution tunnel	1419.14	1723.31	999.10	1380.52
Total (Excluding Non-Detects)	Dilution tunnel	1727.90	2414.95	1234.19	1792.35
Total (Including Non-Detects)	Dilution tunnel	1727.90	2414.95	1234.19	1792.35
LRTAP PAH total	Dilution tunnel	66.93	156.49	51.64	91.69

Table A-5-43: Stovax Stockton 5 – Modern Stove test results – Wet Wood*

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	264.67	298.44	417.04	326.72
Benzo(a)Anthracene	Dilution tunnel	179.46	166.99	275.10	207.19
Benzo(a)pyrene	Dilution tunnel	429.09	423.82	740.92	531.28
Benzo(b)fluoranthene	Dilution tunnel	207.78	205.04	335.67	249.50
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.29	0.08	0.35	0.24
Benzo©phenanthrene	Dilution tunnel	61.51	56.62	95.21	71.11
Benzo(ghi)Perylene	Dilution tunnel	314.98	306.53	437.68	353.06
Benzo(k)fluoranthene	Dilution tunnel	105.65	110.56	177.05	131.08

Cholanthrene	Dilution tunnel	0.37	0.12	0.47	0.32
Chrysene	Dilution tunnel	128.37	129.77	188.49	148.88
Cyclopenta(cd)pyrene	Dilution tunnel	383.55	470.22	755.05	536.27
Dibenzo (ai) pyrene	Dilution tunnel	161.98	100.55	229.27	163.94
Dibenzo(ah)Anthracene	Dilution tunnel	54.84	53.95	60.05	56.28
Fluoranthene	Dilution tunnel	1055.15	940.48	1423.56	1139.73
Indeno(123-cd)Pyrene	Dilution tunnel	526.33	380.92	626.24	511.16
Naphthalene	Dilution tunnel	15007.06	18360.80	19595.77	17654.54
Total (Excluding Non-Detects)	Dilution tunnel	17673.95	21121.19	23406.26	20733.80
Total (Including Non-Detects)	Dilution tunnel	17656.25	21100.51	23382.82	20713.19
LRTAP PAH total	Dilution tunnel	1135.13	1051.80	1760.41	1315.78

*extrapolated values based on retest data

Table A-5-44: Stovax Stockton 5 – Modern Stove test results – Wood Briquettes*

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	99.63	378.05	154.19	210.62
Benzo(a)Anthracene	Dilution tunnel	98.52	405.13	159.17	220.94
Benzo(a)pyrene	Dilution tunnel	301.64	1279.79	469.51	683.65
Benzo(b)fluoranthene	Dilution tunnel	163.71	803.79	284.61	417.37
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.25	0.28	0.39	0.31
Benzo(c)phenanthrene	Dilution tunnel	35.61	162.13	68.71	88.82
Benzo(ghi)Perylene	Dilution tunnel	160.42	848.70	294.25	434.45
Benzo(k)fluoranthene	Dilution tunnel	79.30	384.79	135.04	199.71
Cholanthrene	Dilution tunnel	0.25	0.12	0.11	0.16
Chrysene	Dilution tunnel	89.31	337.08	153.13	193.17
Cyclopenta(cd)pyrene	Dilution tunnel	97.64	276.00	204.49	192.71
Dibenzo (ai) pyrene	Dilution tunnel	140.69	502.46	382.71	341.95
Dibenzo(ah)Anthracene	Dilution tunnel	31.73	123.10	22.01	58.95
Fluoranthene	Dilution tunnel	692.64	2517.11	1226.35	1478.70
Indeno(123-cd)Pyrene	Dilution tunnel	213.85	1214.60	406.92	611.79

Naphthalene	Dilution tunnel	7210.77	17601.43	10329.31	11713.83
Total (Excluding Non-Detects)	Dilution tunnel	8686.10	22949.92	12803.09	14813.04
Total (Including Non-Detects)	Dilution tunnel	8676.80	22925.69	12789.70	14797.40
LRTAP PAH total	Dilution tunnel	745.75	3566.93	1263.03	1858.57

*extrapolated values based on retest data

Table A-5-45: Stovax Stockton 5 – Modern Stove test results – Coffee Logs*

Pollutant + Method (mg/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
Anthanthrene	Dilution tunnel	52.22	41.76	67.48	53.82
Benzo(a)Anthracene	Dilution tunnel	203.89	102.08	87.91	131.29
Benzo(a)pyrene	Dilution tunnel	286.85	237.17	231.48	251.84
Benzo(b)fluoranthene	Dilution tunnel	230.92	125.83	120.48	159.08
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.75	0.37	0.22	0.45
Benzo(c)phenanthrene	Dilution tunnel	76.60	35.95	33.66	48.74
Benzo(ghi)Perylene	Dilution tunnel	250.40	177.05	219.60	215.68
Benzo(k)fluoranthene	Dilution tunnel	111.69	62.31	58.91	77.64
Cholanthrene	Dilution tunnel	0.14	0.15	0.13	0.14
Chrysene	Dilution tunnel	197.93	104.87	86.47	129.76
Cyclopenta(cd)pyrene	Dilution tunnel	232.86	162.28	155.11	183.42
Dibenzo (ai) pyrene	Dilution tunnel	172.58	27.07	90.45	96.70
Dibenzo(ah)Anthracene	Dilution tunnel	46.84	33.85	32.45	37.71
Fluoranthene	Dilution tunnel	1413.89	792.16	690.76	965.60
Indeno(123-cd)Pyrene	Dilution tunnel	345.63	243.43	295.31	294.79
Naphthalene	Dilution tunnel	15599.89	13973.83	13464.88	14346.20
Total (Excluding Non-Detects)	Dilution tunnel	18452.37	15862.61	15233.55	16516.18
Total (Including Non-Detects)	Dilution tunnel	18433.01	15846.04	15217.59	16498.88
LRTAP PAH total	Dilution tunnel	952.36	623.80	634.72	736.96

*extrapolated values based on retest data

Table A-5-46: Cromwell Fire Basket – Open Fire test results – Dry Wood

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	0.01	0.01	1.41	0.48
Benzo(a)Anthracene	Dilution tunnel	4.64	4.92	6.83	5.46
Benzo(a)pyrene	Dilution tunnel	2.98	3.08	4.28	3.45
Benzo(b)fluoranthene	Dilution tunnel	2.60	2.72	3.60	2.97
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.06	0.05	0.07	0.06
Benzo(c)phenanthrene	Dilution tunnel	1.67	1.58	2.41	1.88
Benzo(ghi)Perylene	Dilution tunnel	1.80	2.06	3.16	2.34
Benzo(k)fluoranthene	Dilution tunnel	1.44	1.57	2.21	1.74
Cholanthrene	Dilution tunnel	0.02	0.03	0.05	0.04
Chrysene	Dilution tunnel	4.34	3.80	5.62	4.58
Cyclopenta(cd)pyrene	Dilution tunnel	5.31	5.65	9.17	6.71
Dibenzo (ai) pyrene	Dilution tunnel	0.14	0.12	0.31	0.19
Dibenzo(ah)Anthracene	Dilution tunnel	23.76	0.28	0.46	8.17
Fluoranthene	Dilution tunnel	2.05	21.99	31.61	18.55
Indeno(123-cd)Pyrene	Dilution tunnel	581.03	2.13	3.53	195.57
Naphthalene	Dilution tunnel	-	453.99	655.65	554.82
Total (Excluding Non-Detects)	Dilution tunnel	631.85	503.98	730.36	622.07
Total (Including Non-Detects)	Dilution tunnel	631.86	503.99	730.36	622.07
LRTAP PAH total	Dilution tunnel	588.06	9.50	13.62	203.73

Table A-5-47: Cromwell Fire Basket – Open Fire test results – Seasoned Wood

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	5.89	5.28	4.38	5.18
Benzo(a)Anthracene	Dilution tunnel	35.12	20.39	27.84	27.79
Benzo(a)pyrene	Dilution tunnel	17.89	13.29	15.99	15.72

Benzo(b)fluoranthene	Dilution tunnel	16.34	10.54	13.32	13.40
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.21	0.23	0.10	0.18
Benzo(c)phenanthrene	Dilution tunnel	13.22	6.78	10.37	10.12
Benzo(ghi)Perylene	Dilution tunnel	12.32	10.29	10.04	10.88
Benzo(k)fluoranthene	Dilution tunnel	9.52	6.78	8.25	8.19
Cholanthrene	Dilution tunnel	0.22	0.15	0.01	0.13
Chrysene	Dilution tunnel	21.72	14.66	18.99	18.46
Cyclopenta(cd)pyrene	Dilution tunnel	39.79	35.22	38.98	38.00
Dibenzo (ai) pyrene	Dilution tunnel	1.04	1.22	0.72	0.99
Dibenzo(ah)Anthracene	Dilution tunnel	1.68	1.59	1.49	1.59
Fluoranthene	Dilution tunnel	156.52	91.45	119.80	122.59
Indeno(123-cd)Pyrene	Dilution tunnel	15.71	11.86	11.77	13.11
Naphthalene	Dilution tunnel	1845.36	1711.67	1466.48	1674.50
Total (Excluding Non-Detects)	Dilution tunnel	2192.56	1941.41	1748.52	1960.83
Total (Including Non-Detects)	Dilution tunnel	2192.56	1941.41	1748.53	1960.84
LRTAP PAH total	Dilution tunnel	59.46	42.47	49.33	50.42

Table A-5-48: Cromwell Fire Basket – Open Fire test results – Wet Wood

Pollutant + Method (mg/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
Anthanthrene	Dilution tunnel	2.38	5.85	6.28	4.84
Benzo(a)Anthracene	Dilution tunnel	16.04	29.50	23.60	23.05
Benzo(a)pyrene	Dilution tunnel	10.85	19.02	17.50	15.79
Benzo(b)fluoranthene	Dilution tunnel	9.18	15.18	13.96	12.77
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.13	0.09	0.07	0.10
Benzo(c)phenanthrene	Dilution tunnel	5.97	11.06	8.77	8.60
Benzo(ghi)Perylene	Dilution tunnel	8.12	12.25	12.00	10.79
Benzo(k)fluoranthene	Dilution tunnel	5.81	10.40	9.21	8.47
Cholanthrene	Dilution tunnel	0.02	0.18	0.16	0.12

Chrysene	Dilution tunnel	18.02	24.50	18.13	20.22
Cyclopenta(cd)pyrene	Dilution tunnel	27.64	49.80	39.23	38.89
Dibenzo (ai) pyrene	Dilution tunnel	0.02	0.02	0.02	0.02
Dibenzo(ah)Anthracene	Dilution tunnel	0.93	1.15	1.41	1.16
Fluoranthene	Dilution tunnel	77.67	126.69	105.81	103.39
Indeno(123-cd)Pyrene	Dilution tunnel	8.06	14.36	13.86	12.10
Naphthalene	Dilution tunnel	774.98	1415.14	1076.84	1088.99
Total (Excluding Non-Detects)	Dilution tunnel	965.78	1735.16	1346.84	1349.26
Total (Including Non-Detects)	Dilution tunnel	965.81	1735.18	1346.85	1349.28
LRTAP PAH total	Dilution tunnel	33.90	58.96	54.53	49.13

Table A-5-49: Cromwell Fire Basket – Open Fire test results – Wood Briquettes

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	0.56	0.30	0.54	0.47
Benzo(a)Anthracene	Dilution tunnel	7.17	3.56	7.06	5.93
Benzo(a)pyrene	Dilution tunnel	4.37	2.55	4.80	3.91
Benzo(b)fluoranthene	Dilution tunnel	4.22	2.15	3.93	3.43
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.19	0.05	0.11	0.11
Benzo(c)phenanthrene	Dilution tunnel	2.26	1.12	2.25	1.88
Benzo(ghi)Perylene	Dilution tunnel	3.04	1.47	3.12	2.54
Benzo(k)fluoranthene	Dilution tunnel	2.46	1.27	2.39	2.04
Cholanthrene	Dilution tunnel	0.01	0.01	0.01	0.01
Chrysene	Dilution tunnel	7.55	3.73	7.12	6.14
Cyclopenta(cd)pyrene	Dilution tunnel	6.06	2.87	7.67	5.53
Dibenzo (ai) pyrene	Dilution tunnel	0.17	0.09	0.12	0.13
Dibenzo(ah)Anthracene	Dilution tunnel	0.44	0.23	0.38	0.35
Fluoranthene	Dilution tunnel	32.89	18.24	34.58	28.57
Indeno(123-cd)Pyrene	Dilution tunnel	3.22	1.67	3.11	2.67
Naphthalene	Dilution tunnel	398.05	291.58	414.78	368.14

Total (Excluding Non-Detects)	Dilution tunnel	472.66	330.87	491.98	431.84
Total (Including Non-Detects)	Dilution tunnel	472.67	330.88	491.99	431.85
LRTAP PAH total	Dilution tunnel	14.26	7.64	14.23	12.04

Table A-5-50: Cromwell Fire Basket – Open Fire test results – Coffee Logs

Pollutant + Method (mg/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
Anthanthrene	Dilution tunnel	1.13	0.02	0.01	0.39
Benzo(a)Anthracene	Dilution tunnel	13.33	8.84	2.70	8.29
Benzo(a)pyrene	Dilution tunnel	8.59	6.60	2.70	5.96
Benzo(b)fluoranthene	Dilution tunnel	5.77	4.11	1.44	3.77
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.13	0.10	0.03	0.09
Benzo(c)phenanthrene	Dilution tunnel	3.65	2.58	0.74	2.32
Benzo(ghi)Perylene	Dilution tunnel	3.86	3.33	1.80	2.99
Benzo(k)fluoranthene	Dilution tunnel	3.03	2.16	0.76	1.98
Cholanthrene	Dilution tunnel	0.12	0.08	0.01	0.07
Chrysene	Dilution tunnel	11.74	10.47	2.73	8.31
Cyclopenta(cd)pyrene	Dilution tunnel	9.28	6.45	1.41	5.71
Dibenzo (ai) pyrene	Dilution tunnel	0.02	0.02	0.01	0.02
Dibenzo(ah)Anthracene	Dilution tunnel	0.69	0.56	0.27	0.50
Fluoranthene	Dilution tunnel	56.54	40.02	12.33	36.30
Indeno(123-cd)Pyrene	Dilution tunnel	0.63	3.57	1.83	2.01
Naphthalene	Dilution tunnel	743.46	904.43	526.76	724.88
Total (Excluding Non-Detects)	Dilution tunnel	861.96	993.30	555.51	803.59
Total (Including Non-Detects)	Dilution tunnel	861.97	993.33	555.55	803.62
LRTAP PAH total	Dilution tunnel	18.03	16.44	6.72	13.73

Table A-5-51: Cromwell Fire Basket – Open Fire test results – High Sulphur MSF (Bright Flame)

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	5.98	5.70	5.88	5.85
Benzo(a)Anthracene	Dilution tunnel	124.56	100.00	157.55	127.37
Benzo(a)pyrene	Dilution tunnel	136.51	116.50	133.37	128.79
Benzo(b)fluoranthene	Dilution tunnel	90.77	74.07	87.93	84.26
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	142.94	108.25	184.91	145.37
Benzo(c)phenanthrene	Dilution tunnel	14.48	10.81	20.80	15.36
Benzo(ghi)Perylene	Dilution tunnel	97.67	75.05	84.99	85.90
Benzo(k)fluoranthene	Dilution tunnel	28.27	21.02	26.00	25.09
Cholanthrene	Dilution tunnel	2.30	1.96	2.26	2.17
Chrysene	Dilution tunnel	139.49	117.29	184.68	147.15
Cyclopenta(cd)pyrene	Dilution tunnel	1.84	2.55	3.39	2.59
Dibenzo (ai) pyrene	Dilution tunnel	3.22	2.55	2.26	2.68
Dibenzo(ah)Anthracene	Dilution tunnel	37.23	29.67	35.49	34.13
Fluoranthene	Dilution tunnel	109.62	75.05	141.28	108.65
Indeno(123-cd)Pyrene	Dilution tunnel	34.01	28.29	29.16	30.49
Naphthalene	Dilution tunnel	919.23	1039.30	1564.91	1174.48
Total (Excluding Non-Detects)	Dilution tunnel	1888.10	1808.07	2664.85	2120.34
Total (Including Non-Detects)	Dilution tunnel	1888.10	1808.07	2664.85	2120.34
LRTAP PAH total	Dilution tunnel	289.56	239.88	276.45	268.63

Table A-5-52: Cromwell Fire Basket – Open Fire test results – Low Sulphur MSF (Heat Approved)

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	10.07	17.74	12.90	13.57
Benzo(a)Anthracene	Dilution tunnel	81.71	120.96	145.61	116.09
Benzo(a)pyrene	Dilution tunnel	94.21	132.00	141.07	122.43

Benzo(b)fluoranthene	Dilution tunnel	74.50	96.53	105.54	92.19
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	55.52	74.72	99.66	76.63
Benzo(c)phenanthrene	Dilution tunnel	17.59	22.97	24.05	21.54
Benzo(ghi)Perylene	Dilution tunnel	71.62	85.77	89.77	82.39
Benzo(k)fluoranthene	Dilution tunnel	22.83	31.40	30.19	28.14
Cholanthrene	Dilution tunnel	2.40	0.30	0.19	0.96
Chrysene	Dilution tunnel	94.21	150.32	204.13	149.55
Cyclopenta(cd)pyrene	Dilution tunnel	20.19	39.25	42.48	33.97
Dibenzo (ai) pyrene	Dilution tunnel	3.82	5.52	5.45	4.93
Dibenzo(ah)Anthracene	Dilution tunnel	23.31	25.01	29.12	25.81
Fluoranthene	Dilution tunnel	153.09	305.30	265.58	241.32
Indeno(123-cd)Pyrene	Dilution tunnel	17.57	16.02	35.27	22.95
Naphthalene	Dilution tunnel	3066.64	5166.77	3198.18	3810.53
Total (Excluding Non-Detects)	Dilution tunnel	3809.29	6290.59	4429.20	4843.03
Total (Including Non-Detects)	Dilution tunnel	3809.29	6290.59	4429.20	4843.03
LRTAP PAH total	Dilution tunnel	209.11	275.96	312.07	265.71

Table A-5-53: Cromwell Fire Basket – Open Fire test results – Coal Trebles

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	9.53	4.04	10.94	8.17
Benzo(a)Anthracene	Dilution tunnel	100.80	106.31	96.72	101.28
Benzo(a)pyrene	Dilution tunnel	32.75	30.77	28.16	30.56
Benzo(b)fluoranthene	Dilution tunnel	54.10	57.49	52.40	54.66
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	3.13	3.24	2.53	2.97
Benzo(c)phenanthrene	Dilution tunnel	29.16	32.06	26.20	29.14
Benzo(ghi)Perylene	Dilution tunnel	19.14	21.74	26.64	22.51
Benzo(k)fluoranthene	Dilution tunnel	33.39	35.93	28.82	32.71
Cholanthrene	Dilution tunnel	0.80	0.68	1.23	0.90

Chrysene	Dilution tunnel	69.10	81.44	63.97	71.50
Cyclopenta(cd)pyrene	Dilution tunnel	105.45	108.71	84.71	99.62
Dibenzo (ai) pyrene	Dilution tunnel	1.93	2.54	2.05	2.17
Dibenzo(ah)Anthracene	Dilution tunnel	7.06	6.03	6.79	6.62
Fluoranthene	Dilution tunnel	316.97	309.54	259.81	295.44
Indeno(123-cd)Pyrene	Dilution tunnel	29.58	46.43	37.77	37.93
Naphthalene	Dilution tunnel	2770.32	2104.15	2600.32	2491.60
Total (Excluding Non-Detects)	Dilution tunnel	3583.19	2951.09	3329.07	3287.78
Total (Including Non-Detects)	Dilution tunnel	3583.19	2951.09	3329.07	3287.78
LRTAP PAH total	Dilution tunnel	149.82	170.62	147.16	155.86

Table A-5-54: Coalbrookdale (Arga) Little Wenlock – Old Stove test results – Dry Wood

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	3.09	19.15	0.08	7.44
Benzo(a)Anthracene	Dilution tunnel	72.29	101.71	0.71	58.24
Benzo(a)pyrene	Dilution tunnel	39.72	69.09	0.71	36.51
Benzo(b)fluoranthene	Dilution tunnel	55.79	77.54	0.61	44.65
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.51	0.30	0.01	0.27
Benzo(c)phenanthrene	Dilution tunnel	26.27	34.48	0.23	20.33
Benzo(ghi)Perylene	Dilution tunnel	32.13	73.18	0.48	35.26
Benzo(k)fluoranthene	Dilution tunnel	31.15	49.54	0.35	27.01
Cholanthrene	Dilution tunnel	0.03	0.04	0.01	0.02
Chrysene	Dilution tunnel	52.53	80.45	0.57	44.52
Cyclopenta(cd)pyrene	Dilution tunnel	48.41	183.62	0.25	77.42
Dibenzo (ai) pyrene	Dilution tunnel	0.65	4.61	0.03	1.76
Dibenzo(ah)Anthracene	Dilution tunnel	2.50	7.03	0.07	3.20
Fluoranthene	Dilution tunnel	326.70	441.20	3.42	257.11
Indeno(123-cd)Pyrene	Dilution tunnel	26.37	61.69	0.49	29.52
Naphthalene	Dilution tunnel	2732.97	4194.09	1.83	2309.63

Total (Excluding Non-Detects)	Dilution tunnel	3451.10	5397.72	9.84	2952.88
Total (Including Non-Detects)	Dilution tunnel	3451.10	5397.72	9.85	2952.89
LRTAP PAH total	Dilution tunnel	153.04	257.85	2.16	137.69

Table A-5-55: Coalbrookdale (Arga) Little Wenlock – Old Stove test results – Seasoned Wood

Pollutant + Method (mg/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
Anthanthrene	Dilution tunnel	8.07	0.02	3.66	3.92
Benzo(a)Anthracene	Dilution tunnel	54.18	23.77	13.24	30.40
Benzo(a)pyrene	Dilution tunnel	44.79	21.94	12.95	26.56
Benzo(b)fluoranthene	Dilution tunnel	53.94	27.24	16.67	32.62
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	1.45	6.78	1.18	3.14
Benzo(c)phenanthrene	Dilution tunnel	21.99	59.06	4.84	28.63
Benzo(ghi)Perylene	Dilution tunnel	58.04	1.83	23.14	27.67
Benzo(k)fluoranthene	Dilution tunnel	28.42	13.64	7.64	16.57
Cholanthrene	Dilution tunnel	0.02	0.02	0.02	0.02
Chrysene	Dilution tunnel	43.83	50.83	12.04	35.57
Cyclopenta(cd)pyrene	Dilution tunnel	46.00	22.49	13.22	27.23
Dibenzo (ai) pyrene	Dilution tunnel	0.02	0.02	0.02	0.02
Dibenzo(ah)Anthracene	Dilution tunnel	4.91	1.83	1.44	2.73
Fluoranthene	Dilution tunnel	344.37	265.11	73.10	227.53
Indeno(123-cd)Pyrene	Dilution tunnel	48.64	1.83	16.39	22.29
Naphthalene	Dilution tunnel	5331.68	2976.58	797.61	3035.29
Total (Excluding Non-Detects)	Dilution tunnel	6090.30	3472.93	997.13	3520.12
Total (Including Non-Detects)	Dilution tunnel	6090.35	3472.98	997.17	3520.17
LRTAP PAH total	Dilution tunnel	175.80	64.65	53.66	98.04

Table A-5-56: Coalbrookdale (Arga) Little Wenlock – Old Stove test results – Wet Wood

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	1.52	8.16	5.18	4.95
Benzo(a)Anthracene	Dilution tunnel	31.55	52.22	41.93	41.90
Benzo(a)pyrene	Dilution tunnel	15.96	52.22	34.10	34.09
Benzo(b)fluoranthene	Dilution tunnel	23.09	43.93	39.41	35.48
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.65	0.63	0.60	0.63
Benzo(c)phenanthrene	Dilution tunnel	13.37	19.38	16.80	16.52
Benzo(ghi)Perylene	Dilution tunnel	16.19	40.42	35.36	30.66
Benzo(k)fluoranthene	Dilution tunnel	12.08	25.08	20.89	19.35
Cholanthrene	Dilution tunnel	0.02	0.05	0.03	0.03
Chrysene	Dilution tunnel	28.51	55.98	45.47	43.32
Cyclopenta(cd)pyrene	Dilution tunnel	3.67	30.13	22.73	18.84
Dibenzo (ai) pyrene	Dilution tunnel	0.52	1.65	1.43	1.20
Dibenzo(ah)Anthracene	Dilution tunnel	1.35	3.62	2.96	2.64
Fluoranthene	Dilution tunnel	211.26	281.18	267.76	253.40
Indeno(123-cd)Pyrene	Dilution tunnel	13.37	34.64	30.82	26.28
Naphthalene	Dilution tunnel	1743.36	3695.45	2889.74	2776.18
Total (Excluding Non-Detects)	Dilution tunnel	2116.44	4344.74	3455.17	3305.45
Total (Including Non-Detects)	Dilution tunnel	2116.47	4344.74	3455.19	3305.47
LRTAP PAH total	Dilution tunnel	64.50	155.88	125.21	115.20

Table A-5-57: Coalbrookdale (Arga) Little Wenlock – Old Stove test results – Wood Briquettes

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	37.71	44.52	12.45	31.56
Benzo(a)Anthracene	Dilution tunnel	782.54	456.73	170.40	469.89
Benzo(a)pyrene	Dilution tunnel	377.11	412.06	122.06	303.75

Benzo(b)fluoranthene	Dilution tunnel	337.21	350.11	126.90	271.41
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	3.48	1.44	0.60	1.84
Benzo(c)phenanthrene	Dilution tunnel	292.17	157.05	66.11	171.77
Benzo(ghi)Perylene	Dilution tunnel	122.53	143.65	75.05	113.74
Benzo(k)fluoranthene	Dilution tunnel	235.53	234.85	73.24	181.21
Cholanthrene	Dilution tunnel	1.29	1.44	0.01	0.91
Chrysene	Dilution tunnel	572.75	342.91	119.28	344.98
Cyclopenta(cd)pyrene	Dilution tunnel	722.05	299.68	154.69	392.14
Dibenzo (ai) pyrene	Dilution tunnel	7.21	8.07	4.59	6.62
Dibenzo(ah)Anthracene	Dilution tunnel	28.06	33.86	13.90	25.27
Fluoranthene	Dilution tunnel	3623.11	2094.90	1024.84	2247.62
Indeno(123-cd)Pyrene	Dilution tunnel	172.47	194.51	88.71	151.89
Naphthalene	Dilution tunnel	43575.11	42821.57	589.76	28995.48
Total (Excluding Non-Detects)	Dilution tunnel	50890.32	47597.34	2642.58	33710.08
Total (Including Non-Detects)	Dilution tunnel	50890.32	47597.34	2642.59	33710.08
LRTAP PAH total	Dilution tunnel	1122.33	1191.53	410.90	908.25

Table A-5-58: Coalbrookdale (Arga) Little Wenlock – Old Stove test results – Coffee Logs

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	0.23	0.17	0.45	0.28
Benzo(a)Anthracene	Dilution tunnel	20.81	16.59	20.93	19.44
Benzo(a)pyrene	Dilution tunnel	9.23	7.92	11.32	9.49
Benzo(b)fluoranthene	Dilution tunnel	19.11	19.40	24.20	20.90
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	1.39	0.95	0.84	1.06
Benzo(c)phenanthrene	Dilution tunnel	10.20	8.24	10.15	9.53
Benzo(ghi)Perylene	Dilution tunnel	11.69	13.92	16.80	14.14
Benzo(k)fluoranthene	Dilution tunnel	8.24	8.14	10.51	8.96
Cholanthrene	Dilution tunnel	0.01	0.01	0.02	0.01

Chrysene	Dilution tunnel	24.49	20.21	23.92	22.87
Cyclopenta(cd)pyrene	Dilution tunnel	3.33	2.73	4.61	3.56
Dibenzo (ai) pyrene	Dilution tunnel	0.14	0.20	0.19	0.18
Dibenzo(ah)Anthracene	Dilution tunnel	1.43	1.26	1.72	1.47
Fluoranthene	Dilution tunnel	169.84	139.16	165.14	158.05
Indeno(123-cd)Pyrene	Dilution tunnel	9.96	10.96	14.66	11.86
Naphthalene	Dilution tunnel	2081.99	1909.49	2264.97	2085.48
Total (Excluding Non-Detects)	Dilution tunnel	2372.07	2159.33	2570.44	2367.28
Total (Including Non-Detects)	Dilution tunnel	2372.08	2159.35	2570.44	2367.29
LRTAP PAH total	Dilution tunnel	46.54	46.42	60.69	51.21

Table A-5-59: Coalbrookdale (Arga) Little Wenlock – Old Stove test results – High Sulphur MSF (Bright Flame)

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	8.77	51.14	9.38	23.10
Benzo(a)Anthracene	Dilution tunnel	161.86	458.46	104.84	241.72
Benzo(a)pyrene	Dilution tunnel	167.70	12.09	128.14	102.64
Benzo(b)fluoranthene	Dilution tunnel	119.11	479.29	100.86	233.09
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	182.32	486.59	115.92	261.61
Benzo(c)phenanthrene	Dilution tunnel	16.81	44.93	12.22	24.65
Benzo(ghi)Perylene	Dilution tunnel	95.36	661.21	88.08	281.55
Benzo(k)fluoranthene	Dilution tunnel	35.81	148.32	32.39	72.17
Cholanthrene	Dilution tunnel	3.65	3.65	2.84	3.38
Chrysene	Dilution tunnel	196.57	556.73	118.20	290.50
Cyclopenta(cd)pyrene	Dilution tunnel	12.42	31.78	6.82	17.01
Dibenzo (ai) pyrene	Dilution tunnel	4.75	51.14	3.41	19.77
Dibenzo(ah)Anthracene	Dilution tunnel	42.02	191.06	33.81	88.96
Fluoranthene	Dilution tunnel	142.13	401.48	116.21	219.94
Indeno(123-cd)Pyrene	Dilution tunnel	39.46	242.20	39.21	106.96
Naphthalene	Dilution tunnel	3038.40	4566.38	2545.74	3383.51

Total (Excluding Non-Detects)	Dilution tunnel	4267.13	8386.47	3458.06	5370.55
Total (Including Non-Detects)	Dilution tunnel	4267.13	8386.47	3458.06	5370.55
LRTAP PAH total	Dilution tunnel	362.08	881.90	300.60	514.86

Table A-5-60: Coalbrookdale (Arga) Little Wenlock – Old Stove test results – Low Sulphur MSF (Heat Approved)

Pollutant + Method (mg/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
Anthanthrene	Dilution tunnel	4.35	3.91	4.77	4.34
Benzo(a)Anthracene	Dilution tunnel	54.42	121.52	162.87	112.94
Benzo(a)pyrene	Dilution tunnel	71.48	71.11	104.91	82.50
Benzo(b)fluoranthene	Dilution tunnel	70.75	91.04	119.22	93.67
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	41.72	110.19	142.70	98.20
Benzo(c)phenanthrene	Dilution tunnel	7.98	18.76	23.84	16.86
Benzo(ghi)Perylene	Dilution tunnel	62.04	52.75	75.57	63.45
Benzo(k)fluoranthene	Dilution tunnel	18.50	24.23	32.65	25.13
Cholanthrene	Dilution tunnel	3.63	3.91	3.67	3.73
Chrysene	Dilution tunnel	75.83	192.24	221.57	163.21
Cyclopenta(cd)pyrene	Dilution tunnel	5.44	1.95	7.34	4.91
Dibenzo (ai) pyrene	Dilution tunnel	1.81	2.34	3.67	2.61
Dibenzo(ah)Anthracene	Dilution tunnel	17.42	17.97	23.48	19.62
Fluoranthene	Dilution tunnel	100.14	218.42	287.60	202.05
Indeno(123-cd)Pyrene	Dilution tunnel	26.12	30.48	35.55	30.72
Naphthalene	Dilution tunnel	3222.60	2289.70	4523.05	3345.12
Total (Excluding Non-Detects)	Dilution tunnel	3784.25	3250.52	5772.44	4269.07
Total (Including Non-Detects)	Dilution tunnel	3784.25	3250.52	5772.44	4269.07
LRTAP PAH total	Dilution tunnel	186.85	216.86	292.33	232.01

Table A-5-61: Coalbrookdale (Arga) Little Wenlock – Old Stove test results – Coal Trebles

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	1.63	7.74	3.50	4.29
Benzo(a)Anthracene	Dilution tunnel	84.52	116.53	297.08	166.05
Benzo(a)pyrene	Dilution tunnel	27.75	33.49	176.64	79.29
Benzo(b)fluoranthene	Dilution tunnel	65.94	94.03	183.09	114.35
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	3.00	3.00	0.97	2.32
Benzo(c)phenanthrene	Dilution tunnel	27.75	32.42	109.16	56.44
Benzo(ghi)Perylene	Dilution tunnel	11.25	20.90	42.14	24.76
Benzo(k)fluoranthene	Dilution tunnel	33.35	40.45	113.77	62.52
Cholanthrene	Dilution tunnel	0.03	0.03	0.11	0.05
Chrysene	Dilution tunnel	75.86	75.81	280.96	144.21
Cyclopenta(cd)pyrene	Dilution tunnel	13.26	66.97	389.20	156.48
Dibenzo (ai) pyrene	Dilution tunnel	0.03	0.03	1.05	0.37
Dibenzo(ah)Anthracene	Dilution tunnel	1.97	13.88	4.81	6.89
Fluoranthene	Dilution tunnel	366.59	442.03	1536.08	781.57
Indeno(123-cd)Pyrene	Dilution tunnel	10.08	26.52	45.14	27.25
Naphthalene	Dilution tunnel	2464.33	3664.81	18055.24	8061.46
Total (Excluding Non-Detects)	Dilution tunnel	3187.29	4638.59	21238.94	9688.27
Total (Including Non-Detects)	Dilution tunnel	3187.34	4638.64	21238.94	9688.31
LRTAP PAH total	Dilution tunnel	137.12	194.49	518.63	283.41

Table A-5-62: Coalbrookdale (Arga) Little Wenlock – Old Stove test results – Anthracite

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	13.72	11.65	2.97	9.45
Benzo(a)Anthracene	Dilution tunnel	38.52	70.91	19.71	43.05
Benzo(a)pyrene	Dilution tunnel	61.07	85.60	19.59	55.42

Benzo(b)fluoranthene	Dilution tunnel	90.01	96.74	31.69	72.81
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	16.35	5.06	2.92	8.11
Benzo(c)phenanthrene	Dilution tunnel	16.44	28.36	8.48	17.76
Benzo(ghi)Perylene	Dilution tunnel	89.26	62.30	41.05	64.20
Benzo(k)fluoranthene	Dilution tunnel	39.18	46.60	14.00	33.26
Cholanthrene	Dilution tunnel	0.09	5.06	0.03	1.73
Chrysene	Dilution tunnel	57.22	69.90	24.81	50.64
Cyclopenta(cd)pyrene	Dilution tunnel	4.60	17.22	3.95	8.59
Dibenzo (ai) pyrene	Dilution tunnel	4.23	5.77	1.18	3.73
Dibenzo(ah)Anthracene	Dilution tunnel	17.66	11.24	3.95	10.95
Fluoranthene	Dilution tunnel	304.42	643.24	168.41	372.03
Indeno(123-cd)Pyrene	Dilution tunnel	86.44	76.99	36.82	66.75
Naphthalene	Dilution tunnel	8493.71	10707.17	4391.44	7864.11
Total (Excluding Non-Detects)	Dilution tunnel	9332.84	11943.82	4771.01	8682.56
Total (Including Non-Detects)	Dilution tunnel	9332.94	11943.82	4771.01	8682.59
LRTAP PAH total	Dilution tunnel	276.70	305.92	102.10	228.24

Table A-5-63: Hase Sila IQ+ –Blue Angel Stove test results – Dry Wood

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	1.38	4.47	66.89	24.25
Benzo(a)Anthracene	Dilution tunnel	10.84	26.05	302.18	113.02
Benzo(a)pyrene	Dilution tunnel	8.65	32.16	202.08	80.96
Benzo(b)fluoranthene	Dilution tunnel	11.18	27.87	195.53	78.19
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.18	0.22	0.91	0.44
Benzo(c)phenanthrene	Dilution tunnel	4.39	9.73	101.97	38.70
Benzo(ghi)Perylene	Dilution tunnel	9.58	26.15	205.82	80.52
Benzo(k)fluoranthene	Dilution tunnel	5.74	15.44	124.43	48.54
Cholanthrene	Dilution tunnel	0.01	0.01	0.04	0.02

Chrysene	Dilution tunnel	10.49	26.58	241.37	92.81
Cyclopenta(cd)pyrene	Dilution tunnel	5.79	29.05	851.35	295.39
Dibenzo (ai) pyrene	Dilution tunnel	0.35	0.91	7.74	3.00
Dibenzo(ah)Anthracene	Dilution tunnel	0.84	2.17	14.50	5.84
Fluoranthene	Dilution tunnel	85.21	164.00	1135.75	461.65
Indeno(123-cd)Pyrene	Dilution tunnel	9.33	23.69	224.53	85.85
Naphthalene	Dilution tunnel	866.79	1286.29	9135.59	3762.89
Total (Excluding Non-Detects)	Dilution tunnel	1030.75	1674.78	12810.68	5172.07
Total (Including Non-Detects)	Dilution tunnel	1030.77	1674.79	12810.68	5172.08
LRTAP PAH total	Dilution tunnel	34.91	99.15	746.56	293.54

Table A-5-64: Hase Sila IQ+ –Blue Angel Stove test results – Seasoned Wood

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	0.17	0.25	0.96	0.46
Benzo(a)Anthracene	Dilution tunnel	4.33	2.68	9.59	5.53
Benzo(a)pyrene	Dilution tunnel	2.97	1.76	8.54	4.42
Benzo(b)fluoranthene	Dilution tunnel	4.98	2.61	11.14	6.25
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.14	0.09	0.13	0.12
Benzo(c)phenanthrene	Dilution tunnel	2.17	0.02	4.00	2.06
Benzo(ghi)Perylene	Dilution tunnel	3.69	2.55	14.18	6.81
Benzo(k)fluoranthene	Dilution tunnel	2.43	1.34	5.62	3.13
Cholanthrene	Dilution tunnel	0.02	0.02	0.02	0.02
Chrysene	Dilution tunnel	4.98	3.28	7.92	5.40
Cyclopenta(cd)pyrene	Dilution tunnel	1.76	1.52	10.87	4.72
Dibenzo (ai) pyrene	Dilution tunnel	0.21	0.10	0.61	0.31
Dibenzo(ah)Anthracene	Dilution tunnel	0.39	0.21	1.41	0.67
Fluoranthene	Dilution tunnel	41.08	24.12	105.72	56.98
Indeno(123-cd)Pyrene	Dilution tunnel	3.62	2.28	13.86	6.59
Naphthalene	Dilution tunnel	461.85	446.75	1372.35	760.32

Total (Excluding Non-Detects)	Dilution tunnel	534.78	489.56	1566.90	863.75
Total (Including Non-Detects)	Dilution tunnel	534.81	489.60	1566.92	863.78
LRTAP PAH total	Dilution tunnel	14.00	7.99	39.16	20.38

Table A-5-65: Hase Sila IQ+ –Blue Angel Stove test results – Wet Wood

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	0.40	0.02	0.49	0.30
Benzo(a)Anthracene	Dilution tunnel	5.51	0.21	5.80	3.84
Benzo(a)pyrene	Dilution tunnel	6.80	0.16	5.17	4.04
Benzo(b)fluoranthene	Dilution tunnel	6.75	0.21	5.55	4.17
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.08	0.02	0.08	0.06
Benzo(c)phenanthrene	Dilution tunnel	1.66	0.08	2.47	1.41
Benzo(ghi)Perylene	Dilution tunnel	3.92	0.12	4.04	2.69
Benzo(k)fluoranthene	Dilution tunnel	3.87	0.11	3.04	2.34
Cholanthrene	Dilution tunnel	0.02	0.02	0.02	0.02
Chrysene	Dilution tunnel	4.99	0.21	4.67	3.29
Cyclopenta(cd)pyrene	Dilution tunnel	5.40	0.17	5.23	3.60
Dibenzo (ai) pyrene	Dilution tunnel	0.12	0.02	0.13	0.09
Dibenzo(ah)Anthracene	Dilution tunnel	0.47	0.02	0.47	0.32
Fluoranthene	Dilution tunnel	26.01	1.71	39.63	22.45
Indeno(123-cd)Pyrene	Dilution tunnel	3.92	0.13	3.81	2.62
Naphthalene	Dilution tunnel	376.92	18.00	612.71	335.88
Total (Excluding Non-Detects)	Dilution tunnel	446.79	21.11	693.32	387.07
Total (Including Non-Detects)	Dilution tunnel	446.81	21.18	693.34	387.11
LRTAP PAH total	Dilution tunnel	21.33	0.61	17.58	13.17

Table A-5-66: Hase Sila IQ+ –Blue Angel Stove test results – Wood Briquettes

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	0.06	0.17	0.08	0.10
Benzo(a)Anthracene	Dilution tunnel	0.45	0.91	0.71	0.69
Benzo(a)pyrene	Dilution tunnel	0.46	0.97	0.71	0.71
Benzo(b)fluoranthene	Dilution tunnel	0.45	0.78	0.61	0.61
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.01	0.01	0.01	0.01
Benzo(c)phenanthrene	Dilution tunnel	0.14	0.28	0.23	0.22
Benzo(ghi)Perylene	Dilution tunnel	0.37	0.61	0.48	0.49
Benzo(k)fluoranthene	Dilution tunnel	0.24	0.48	0.35	0.36
Cholanthrene	Dilution tunnel	0.01	0.01	0.01	0.01
Chrysene	Dilution tunnel	0.37	0.66	0.57	0.53
Cyclopenta(cd)pyrene	Dilution tunnel	0.08	0.41	0.25	0.25
Dibenzo (ai) pyrene	Dilution tunnel	0.02	0.04	0.03	0.03
Dibenzo(ah)Anthracene	Dilution tunnel	0.04	0.08	0.07	0.06
Fluoranthene	Dilution tunnel	2.05	4.39	3.42	3.29
Indeno(123-cd)Pyrene	Dilution tunnel	0.36	0.60	0.49	0.49
Naphthalene	Dilution tunnel	0.39	6.01	1.83	2.74
Total (Excluding Non-Detects)	Dilution tunnel	5.47	16.39	9.84	10.57
Total (Including Non-Detects)	Dilution tunnel	5.50	16.41	9.85	10.59
LRTAP PAH total	Dilution tunnel	1.52	2.82	2.16	2.17

Table A-5-67: Hase Sila IQ+ –Blue Angel Stove test results – Coffee Logs

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Anthanthrene	Dilution tunnel	0.04	0.57	1.20	0.60
Benzo(a)Anthracene	Dilution tunnel	7.70	19.23	12.61	13.18
Benzo(a)pyrene	Dilution tunnel	1.78	8.49	8.89	6.39

Benzo(b)fluoranthene	Dilution tunnel	4.87	14.73	15.70	11.77
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.13	0.27	0.11	0.17
Benzo(c)phenanthrene	Dilution tunnel	3.93	8.05	5.36	5.78
Benzo(ghi)Perylene	Dilution tunnel	1.85	11.69	17.08	10.21
Benzo(k)fluoranthene	Dilution tunnel	2.32	7.29	8.09	5.90
Cholanthrene	Dilution tunnel	0.01	0.01	0.01	0.01
Chrysene	Dilution tunnel	6.38	15.63	11.11	11.04
Cyclopenta(cd)pyrene	Dilution tunnel	3.09	16.30	12.26	10.55
Dibenzo (ai) pyrene	Dilution tunnel	0.01	0.43	0.56	0.33
Dibenzo(ah)Anthracene	Dilution tunnel	0.15	0.69	1.27	0.71
Fluoranthene	Dilution tunnel	47.55	125.92	106.70	93.39
Indeno(123-cd)Pyrene	Dilution tunnel	1.61	9.15	15.47	8.74
Naphthalene	Dilution tunnel	527.29	736.40	1385.59	883.09
Total (Excluding Non-Detects)	Dilution tunnel	608.67	974.83	1602.00	1061.84
Total (Including Non-Detects)	Dilution tunnel	608.69	974.85	1602.01	1061.85
LRTAP PAH total	Dilution tunnel	10.58	39.65	48.16	32.80

Table A-5-68: Ramsey Pellet Appliance – Pellet Stove test results – Wood Pellets

Pollutant + Method (mg/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
Anthanthrene	Dilution tunnel	0.44	0.14	0.09	0.22
Benzo(a)Anthracene	Dilution tunnel	2.47	1.29	0.87	1.54
Benzo(a)pyrene	Dilution tunnel	11.63	1.16	0.50	4.43
Benzo(b)fluoranthene	Dilution tunnel	11.75	1.43	0.92	4.70
Benzo(b)naptho(2,1-d)thiophene	Dilution tunnel	0.08	0.06	0.06	0.07
Benzo(c)phenanthrene	Dilution tunnel	0.62	0.48	0.36	0.49
Benzo(ghi)Perylene	Dilution tunnel	5.78	1.25	0.69	2.57
Benzo(k)fluoranthene	Dilution tunnel	5.23	0.67	0.40	2.10
Cholanthrene	Dilution tunnel	0.02	0.02	0.02	0.02

Chrysene	Dilution tunnel	3.13	1.42	0.98	1.84
Cyclopenta(cd)pyrene	Dilution tunnel	1.55	0.51	0.35	0.80
Dibenzo (ai) pyrene	Dilution tunnel	0.02	0.02	0.02	0.02
Dibenzo(ah)Anthracene	Dilution tunnel	0.62	0.12	0.07	0.27
Fluoranthene	Dilution tunnel	11.43	10.03	8.65	10.04
Indeno(123-cd)Pyrene	Dilution tunnel	6.12	1.16	0.58	2.62
Naphthalene	Dilution tunnel	98.47	106.77	99.84	101.70
Total (Excluding Non-Detects)	Dilution tunnel	159.32	126.50	114.36	133.39
Total (Including Non-Detects)	Dilution tunnel	159.36	126.55	114.40	133.44
LRTAP PAH total	Dilution tunnel	34.74	4.42	2.40	13.85

A.6 POLLUTANT MEASUREMENTS DATASET – HEAVY METALS

A-6- 1 – Hunter Aspect 5 – Modern Stove test results – High Sulphur MSF (Bright Flame)

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Antimony	Dilution tunnel	3.99	2.71	2.58	3.10
Arsenic	Dilution tunnel	3.52	4.32	4.36	4.07
Cadmium	Dilution tunnel	3.21	2.34	2.23	2.59
Chromium	Dilution tunnel	28.46	19.64	106.10	51.40
Cobalt	Dilution tunnel	2.43	2.71	2.23	2.46
Copper	Dilution tunnel	14.87	6.82	17.06	12.91
Lead	Dilution tunnel	20.39	15.04	15.87	17.10
Manganese	Dilution tunnel	29.93	20.56	28.84	26.44
Mercury	Dilution tunnel	2.61	2.51	2.63	2.59
Nickel	Dilution tunnel	47.35	32.41	47.30	42.36
Selenium	Dilution tunnel	5.32	5.53	5.62	5.49
Thallium	Dilution tunnel	2.04	1.97	1.87	1.96
Vanadium	Dilution tunnel	27.19	20.03	36.10	27.77
Zinc	Dilution tunnel	76.45	42.96	118.35	79.25

A-6- 2 - Hunter Aspect 5 – Modern Stove test results – Low Sulphur MSF (Heat Approved)

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Antimony	Dilution tunnel	2.37	3.16	3.20	2.91
Arsenic	Dilution tunnel	5.43	6.31	5.95	5.90
Cadmium	Dilution tunnel	3.04	3.60	2.97	3.20
Chromium	Dilution tunnel	120.82	256.87	285.36	221.01
Cobalt	Dilution tunnel	2.03	2.72	2.76	2.50
Copper	Dilution tunnel	12.52	27.60	14.68	18.27
Lead	Dilution tunnel	20.79	30.37	22.90	24.69
Manganese	Dilution tunnel	8.20	10.08	10.69	9.66
Mercury	Dilution tunnel	3.92	4.67	4.23	4.28
Nickel	Dilution tunnel	33.24	92.86	46.46	57.52
Selenium	Dilution tunnel	4.08	5.97	5.65	5.23
Thallium	Dilution tunnel	2.03	2.72	2.76	2.50
Vanadium	Dilution tunnel	8.23	20.42	15.18	14.61
Zinc	Dilution tunnel	68.02	97.68	83.00	82.90

A-6- 3 - Hunter Aspect 5 – Modern Stove test results – Coal Trebles

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Antimony	Dilution tunnel	2.42	2.22	2.24	2.29
Arsenic	Dilution tunnel	2.94	2.39	3.36	2.90
Cadmium	Dilution tunnel	2.42	1.91	2.24	2.19
Chromium	Dilution tunnel	2001.72*	678.41*	129.80	129.80
Cobalt	Dilution tunnel	2.76	2.22	2.84	2.61
Copper	Dilution tunnel	16.24	10.07	10.01	12.11
Lead	Dilution tunnel	14.38	6.27	7.38	9.34
Manganese	Dilution tunnel	13.45	6.71	10.25	10.14
Mercury	Dilution tunnel	2.12	1.73	2.00	1.95
Nickel	Dilution tunnel	45.33	41.71	30.62	39.22
Selenium	Dilution tunnel	4.50	3.85	4.02	4.12
Thallium	Dilution tunnel	1.73	1.59	1.64	1.66
Vanadium	Dilution tunnel	1.90	2.36	2.93	2.40
Zinc	Dilution tunnel	108.83	517.75	75.68	234.09

*removed from average

A-6- 4 - Hunter Aspect 5 – Modern Stove test results – Anthracite

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Antimony	Dilution tunnel	3.10	4.00	4.96	4.02
Arsenic	Dilution tunnel	13.56	23.39	19.45	18.80
Cadmium	Dilution tunnel	3.10	2.70	4.35	3.39
Chromium	Dilution tunnel	30.81	54.59	113.14	66.18
Cobalt	Dilution tunnel	2.68	2.70	3.75	3.04
Copper	Dilution tunnel	14.90	39.94	21.52	25.45
Lead	Dilution tunnel	50.70	42.67	63.04	52.14
Manganese	Dilution tunnel	10.94	13.65	20.08	14.89
Mercury	Dilution tunnel	7.49	7.57	10.51	8.52
Nickel	Dilution tunnel	59.65	89.85	77.11	75.54
Selenium	Dilution tunnel	9.95	14.96	13.84	12.92
Thallium	Dilution tunnel	2.26	2.27	3.14	2.55
Vanadium	Dilution tunnel	7.92	19.37	10.04	12.44
Zinc	Dilution tunnel	58.95	536.65	92.50	229.37

A-6- 5 - Hunter Aspect 8 (Rated Output) – Modern Stove test results – High Sulphur MSF (Bright Flame)

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Antimony	Dilution tunnel	1.24	1.02	1.01	1.09
Arsenic	Dilution tunnel	4.01	2.82	3.21	3.35
Cadmium	Dilution tunnel	1.59	1.02	1.10	1.24
Chromium	Dilution tunnel	7.96	9.41	9.20	8.86
Cobalt	Dilution tunnel	1.07	0.88	0.83	0.92
Copper	Dilution tunnel	13.48	13.53	3.69	10.23
Lead	Dilution tunnel	27.33	19.80	18.15	21.76
Manganese	Dilution tunnel	3.87	4.59	4.08	4.18
Mercury	Dilution tunnel	3.09	2.06	1.93	2.36
Nickel	Dilution tunnel	42.41	44.82	26.08	37.77
Selenium	Dilution tunnel	4.48	2.77	2.62	3.29
Thallium	Dilution tunnel	1.24	0.88	0.83	0.98
Vanadium	Dilution tunnel	22.66	16.66	15.64	18.32
Zinc	Dilution tunnel	51.77	34.16	19.16	35.03

A-6- 6 - Hunter Aspect 8 (Rated Output) – Modern Stove test results – Low Sulphur MSF (Heat Approved)

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Antimony	Dilution tunnel	2.67	1.43	1.30	1.80
Arsenic	Dilution tunnel	12.11	6.80	6.98	8.63
Cadmium	Dilution tunnel	3.65	1.43	1.30	2.13
Chromium	Dilution tunnel	32.95	11.55	9.77	18.09
Cobalt	Dilution tunnel	2.01	1.23	1.12	1.46
Copper	Dilution tunnel	60.01	12.23	9.76	27.33
Lead	Dilution tunnel	77.19	42.29	41.07	53.52
Manganese	Dilution tunnel	12.09	6.07	5.39	7.85
Mercury	Dilution tunnel	8.27	5.93	6.17	6.79
Nickel	Dilution tunnel	108.44	37.69	37.36	61.16
Selenium	Dilution tunnel	8.01	5.26	5.32	6.19
Thallium	Dilution tunnel	3.65	2.43	2.21	2.77
Vanadium	Dilution tunnel	13.29	6.11	5.57	8.32
Zinc	Dilution tunnel	129.11	91.73	21.40	80.75

A-6- 7 - Hunter Aspect 8 (Rated Output) – Modern Stove test results – Coal Trebles

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Antimony	Dilution tunnel	0.86	0.86	0.86	0.86
Arsenic	Dilution tunnel	1.06	1.36	1.32	1.25
Cadmium	Dilution tunnel	0.62	0.70	0.93	0.75
Chromium	Dilution tunnel	3.93	3.98	9.41	5.77
Cobalt	Dilution tunnel	0.62	0.70	0.81	0.71
Copper	Dilution tunnel	6.87	9.74	11.19	9.27
Lead	Dilution tunnel	1.29	1.74	4.04	2.36
Manganese	Dilution tunnel	2.11	2.88	4.27	3.09
Mercury	Dilution tunnel	1.00	1.28	1.13	1.14
Nickel	Dilution tunnel	18.88	24.38	33.22	25.50
Selenium	Dilution tunnel	1.04	1.20	1.87	1.37
Thallium	Dilution tunnel	0.51	0.59	0.58	0.56
Vanadium	Dilution tunnel	0.46	0.52	0.52	0.50
Zinc	Dilution tunnel	11.50	9.80	57.17	26.16

A-6- 8 - Hunter Aspect 8 (Rated Output) – Modern Stove test results – Anthracite

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Antimony	Dilution tunnel	1.68	1.44	4.21	2.44
Arsenic	Dilution tunnel	6.58	5.88	36.79	16.42
Cadmium	Dilution tunnel	1.89	4.88	4.21	3.66
Chromium	Dilution tunnel	9.64	8.11	27.19	14.98
Cobalt	Dilution tunnel	1.27	1.24	3.62	2.04
Copper	Dilution tunnel	28.52	12.36	46.92	29.26
Lead	Dilution tunnel	10.59	10.14	38.53	19.75
Manganese	Dilution tunnel	5.62	15.17	11.90	10.90
Mercury	Dilution tunnel	4.57	4.40	12.68	7.22
Nickel	Dilution tunnel	69.12	20.57	123.48	71.05
Selenium	Dilution tunnel	3.32	3.97	12.83	6.71
Thallium	Dilution tunnel	1.06	1.04	3.02	1.71
Vanadium	Dilution tunnel	7.99	5.17	11.57	8.24
Zinc	Dilution tunnel	43.08	22486.78*	132.14	87.61

*removed from average

A-6- 9 - Hunter Aspect 8 (Low Output) – Modern Stove test results – High Sulphur MSF (Bright Flame)

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Antimony	Dilution tunnel	1.90	2.34	1.96	2.07
Arsenic	Dilution tunnel	4.65	4.83	4.88	4.79
Cadmium	Dilution tunnel	2.16	2.97	2.23	2.46
Chromium	Dilution tunnel	32.48	25.21	35.49	31.06
Cobalt	Dilution tunnel	1.64	2.02	1.69	1.78
Copper	Dilution tunnel	28.17	23.34	52.47	34.66
Lead	Dilution tunnel	20.86	18.82	20.28	19.98
Manganese	Dilution tunnel	10.28	9.63	8.97	9.62
Mercury	Dilution tunnel	3.66	4.93	4.20	4.26
Nickel	Dilution tunnel	81.49	70.06	112.82	88.12
Selenium	Dilution tunnel	4.65	6.07	5.08	5.27
Thallium	Dilution tunnel	1.64	2.02	1.69	1.78
Vanadium	Dilution tunnel	29.48	31.60	38.95	33.34
Zinc	Dilution tunnel	96.65	43.41	30.68	56.91

A-6- 10 - Hunter Aspect 8 (Low Output) – Modern Stove test results – Low Sulphur MSF (Heat Approved)

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Antimony	Dilution tunnel	2.08	2.29	2.26	2.21
Arsenic	Dilution tunnel	4.33	7.04	6.68	6.01
Cadmium	Dilution tunnel	1.92	3.17	3.18	2.75
Chromium	Dilution tunnel	20.93	21.30	43.98	28.74
Cobalt	Dilution tunnel	1.79	1.98	1.95	1.91
Copper	Dilution tunnel	17.54	14.64	1168.11*	16.09
Lead	Dilution tunnel	11.08	24.42	23.22	19.58
Manganese	Dilution tunnel	6.67	7.92	34.72	16.44
Mercury	Dilution tunnel	5.27	6.73	6.61	6.20
Nickel	Dilution tunnel	51.61	52.00	2171.69*	51.80
Selenium	Dilution tunnel	4.09	5.77	4.77	4.88
Thallium	Dilution tunnel	1.62	2.29	2.26	2.06
Vanadium	Dilution tunnel	12.46	15.53	23.49	17.16
Zinc	Dilution tunnel	51.88	45.60	354.32	150.60

*removed from average

A-6- 11 - Hunter Aspect 8 (Low Output) – Modern Stove test results – Coal Trebles

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Antimony	Dilution tunnel	1.87	1.81	1.80	1.82
Arsenic	Dilution tunnel	2.11	2.27	2.29	2.22
Cadmium	Dilution tunnel	1.44	1.56	1.55	1.52
Chromium	Dilution tunnel	16.56	15.49	11.85	14.63
Cobalt	Dilution tunnel	1.44	1.56	1.55	1.52
Copper	Dilution tunnel	5.64	7.54	6.65	6.61
Lead	Dilution tunnel	5.69	7.32	7.19	6.73
Manganese	Dilution tunnel	3.12	4.57	3.02	3.57
Mercury	Dilution tunnel	2.57	2.62	2.98	2.72
Nickel	Dilution tunnel	26.94	26.12	19.23	24.10
Selenium	Dilution tunnel	2.47	2.92	2.69	2.70
Thallium	Dilution tunnel	1.21	1.31	1.31	1.27
Vanadium	Dilution tunnel	6.14	4.91	2.12	4.39
Zinc	Dilution tunnel	28.52	35.64	32.19	32.12

A-6- 12 - Hunter Aspect 8 (Low Output) – Modern Stove test results – Anthracite

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Antimony	Dilution tunnel	1.56	1.62	2.48	1.89
Arsenic	Dilution tunnel	8.73	8.66	22.24	13.21
Cadmium	Dilution tunnel	1.56	1.39	3.15	2.03
Chromium	Dilution tunnel	19.53	22.69	29.88	24.03
Cobalt	Dilution tunnel	1.35	1.39	2.14	1.63
Copper	Dilution tunnel	8.57	23.76	242.44	91.59
Lead	Dilution tunnel	22.64	16.70	36.54	25.30
Manganese	Dilution tunnel	5.82	10.65	13.38	9.95
Mercury	Dilution tunnel	3.97	5.26	6.38	5.20
Nickel	Dilution tunnel	28.96	21.10	479.75	176.60
Selenium	Dilution tunnel	5.18	8.44	8.06	7.23
Thallium	Dilution tunnel	1.13	1.16	1.80	1.37
Vanadium	Dilution tunnel	7.60	7.66	5.94	7.06
Zinc	Dilution tunnel	37.10	72.83	137.82	82.58

A-6- 13 – Kensal Redfyre – Middle Stove test results – High Sulphur MSF (Bright Flame)

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Antimony	Dilution tunnel	2.54	2.33	2.28	2.38
Arsenic	Dilution tunnel	6.99	7.75	7.83	7.52
Cadmium	Dilution tunnel	2.19	12.22	1.97	5.46
Chromium	Dilution tunnel	39.69	7.40	37.88	28.32
Cobalt	Dilution tunnel	2.19	2.01	1.97	2.06
Copper	Dilution tunnel	10.37	10.24	60.43	27.01
Lead	Dilution tunnel	52.54	47.56	46.11	48.74
Manganese	Dilution tunnel	53.14	48.11	46.65	49.30
Mercury	Dilution tunnel	4.03	3.86	3.70	3.86
Nickel	Dilution tunnel	36.93	41.45	173.22	83.87
Selenium	Dilution tunnel	4.45	4.44	4.05	4.31
Thallium	Dilution tunnel	1.84	1.69	1.66	1.73
Vanadium	Dilution tunnel	28.40	38.17	38.87	35.15
Zinc	Dilution tunnel	81.14	122.14	131.06	111.45

A-6- 14 - Kensal Redfyre – Middle Stove test results – Low Sulphur MSF (Heat Approved)

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Antimony	Dilution tunnel	2.40	2.16	2.67	2.41
Arsenic	Dilution tunnel	5.52	6.43	7.35	6.43
Cadmium	Dilution tunnel	2.07	1.86	1.81	1.91
Chromium	Dilution tunnel	23.35	35.38	23.99	27.58
Cobalt	Dilution tunnel	2.07	1.86	1.81	1.91
Copper	Dilution tunnel	12.94	23.83	10.24	15.67
Lead	Dilution tunnel	31.85	44.20	42.96	39.67
Manganese	Dilution tunnel	9.61	9.43	43.45	20.83
Mercury	Dilution tunnel	5.68	5.23	5.04	5.32
Nickel	Dilution tunnel	56.70	82.88	34.27	57.95
Selenium	Dilution tunnel	5.83	6.30	6.53	6.22
Thallium	Dilution tunnel	2.40	2.46	2.39	2.42
Vanadium	Dilution tunnel	4.23	12.28	11.13	9.21
Zinc	Dilution tunnel	75.46	78.07	67.33	73.62

A-6- 15 - Kensal Redfyre – Middle Stove test results – Coal Trebles

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Antimony	Dilution tunnel	10.01	9.06	7.34	8.81
Arsenic	Dilution tunnel	22.48	17.74	10.41	16.88
Cadmium	Dilution tunnel	10.01	7.79	6.31	8.04
Chromium	Dilution tunnel	45.24	36.02	60.08	47.11
Cobalt	Dilution tunnel	10.01	9.06	6.31	8.46
Copper	Dilution tunnel	175.28	37.31	115.65	109.41
Lead	Dilution tunnel	85.80	32.06	23.27	47.05
Manganese	Dilution tunnel	28.60	18.74	30.08	25.81
Mercury	Dilution tunnel	12.69	12.49	10.19	11.79
Nickel	Dilution tunnel	306.89	143.07	194.01	214.65
Selenium	Dilution tunnel	22.83	15.75	13.76	17.45
Thallium	Dilution tunnel	6.30	6.52	5.28	6.03
Vanadium	Dilution tunnel	20.50	12.15	14.01	15.55
Zinc	Dilution tunnel	1189.15	397.64	213.63	600.14

A-6- 16 - Kensal Redfyre – Middle Stove test results – Anthracite

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Antimony	Dilution tunnel	3.13	2.19	2.03	2.45
Arsenic	Dilution tunnel	9.24	9.31	13.19	10.58
Cadmium	Dilution tunnel	2.44	1.89	2.32	2.21
Chromium	Dilution tunnel	25.73	21.80	30.60	26.04
Cobalt	Dilution tunnel	2.09	2.19	1.75	2.01
Copper	Dilution tunnel	77.57	26.11	8.35	37.35
Lead	Dilution tunnel	71.25	43.94	49.85	55.02
Manganese	Dilution tunnel	13.43	11.83	11.00	12.09
Mercury	Dilution tunnel	4.80	3.75	4.09	4.21
Nickel	Dilution tunnel	203.98	73.56	43.46	107.00
Selenium	Dilution tunnel	7.31	7.55	8.68	7.84
Thallium	Dilution tunnel	1.75	1.58	1.47	1.60
Vanadium	Dilution tunnel	4.33	12.06	9.80	8.73
Zinc	Dilution tunnel	208.88	143.55	116.51	156.31

A-6- 17 - Cromwell Fire Basket – Open Fire test results – High Sulphur MSF (Bright Flame)

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Antimony	Dilution tunnel	1.67	1.43	1.63	1.58
Arsenic	Dilution tunnel	3.67	3.10	3.13	3.30
Cadmium	Dilution tunnel	1.67	1.43	1.40	1.50
Chromium	Dilution tunnel	21.46	14.50	15.11	17.03
Cobalt	Dilution tunnel	1.43	1.24	1.40	1.36
Copper	Dilution tunnel	9.50	986.99*	100.54	55.02
Lead	Dilution tunnel	22.26	18.70	17.80	19.59
Manganese	Dilution tunnel	6.80	45.70	7.55	20.02
Mercury	Dilution tunnel	2.68	2.21	2.50	2.46
Nickel	Dilution tunnel	45.67	2333.44	185.13	854.75
Selenium	Dilution tunnel	5.24	4.50	4.43	4.72
Thallium	Dilution tunnel	1.43	1.24	1.17	1.28
Vanadium	Dilution tunnel	39.81	49.94	35.67	41.81
Zinc	Dilution tunnel	69.57	44.04	37.72	50.44

*removed from average

A-6- 18 - Cromwell Fire Basket – Open Fire test results – Low Sulphur MSF (Heat Approved)

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Antimony	Dilution tunnel	1.74	2.30	1.94	1.99
Arsenic	Dilution tunnel	4.89	5.57	5.74	5.40
Cadmium	Dilution tunnel	2.70	3.25	3.01	2.99
Chromium	Dilution tunnel	26.90	24.36	20.47	23.91
Cobalt	Dilution tunnel	1.49	1.98	1.68	1.72
Copper	Dilution tunnel	3.80	8.54	16.57	9.63
Lead	Dilution tunnel	28.31	28.98	29.43	28.91
Manganese	Dilution tunnel	5.83	8.33	8.08	7.41
Mercury	Dilution tunnel	3.65	6.34	4.28	4.76
Nickel	Dilution tunnel	19.68	39.97	53.62	37.76
Selenium	Dilution tunnel	4.24	4.99	5.03	4.75
Thallium	Dilution tunnel	1.74	2.30	2.21	2.08
Vanadium	Dilution tunnel	15.54	24.02	19.39	19.65
Zinc	Dilution tunnel	74.89	74.03	57.35	68.76

A-6- 19 - Cromwell Fire Basket – Open Fire test results – Coal Trebles

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Antimony	Dilution tunnel	1.47	1.38	1.05	1.30
Arsenic	Dilution tunnel	1.91	1.51	9.18	4.20
Cadmium	Dilution tunnel	1.27	1.19	1.05	1.17
Chromium	Dilution tunnel	11.73	25.30	6.79	14.61
Cobalt	Dilution tunnel	1.27	1.19	0.90	1.12
Copper	Dilution tunnel	7.46	12.16	11.71	10.44
Lead	Dilution tunnel	3.68	3.39	9.62	5.56
Manganese	Dilution tunnel	5.98	6.54	2.97	5.16
Mercury	Dilution tunnel	2.21	2.04	3.16	2.47
Nickel	Dilution tunnel	28.46	35.95	30.82	31.74
Selenium	Dilution tunnel	2.82	2.07	3.20	2.70
Thallium	Dilution tunnel	1.07	1.00	0.75	0.94
Vanadium	Dilution tunnel	2.54	1.44	2.89	2.29
Zinc	Dilution tunnel	46.54	50.68	32.98	43.40

A-6- 20 - Coalbrookdale (Arga) Little Wenlock – Old Stove test results – High Sulphur MSF (Bright Flame)

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Antimony	Dilution tunnel	2.64	2.65	2.08	2.46
Arsenic	Dilution tunnel	4.99	5.28	4.45	4.91
Cadmium	Dilution tunnel	2.28	2.28	1.79	2.12
Chromium	Dilution tunnel	45.62	43.53	82.19	57.11
Cobalt	Dilution tunnel	2.28	2.28	1.79	2.12
Copper	Dilution tunnel	15.40	14.83	10.98	13.74
Lead	Dilution tunnel	20.42	19.88	19.09	19.80
Manganese	Dilution tunnel	8.48	8.51	6.12	7.70
Mercury	Dilution tunnel	4.27	4.27	3.47	4.00
Nickel	Dilution tunnel	38.64	39.19	31.23	36.35
Selenium	Dilution tunnel	4.64	4.65	4.52	4.60
Thallium	Dilution tunnel	1.91	1.92	1.51	1.78
Vanadium	Dilution tunnel	27.95	28.07	34.14	30.05
Zinc	Dilution tunnel	183.79	199.65	212.42	198.62

A-6- 21 - Coalbrookdale (Arga) Little Wenlock – Old Stove test results – Low Sulphur MSF (Heat Approved)

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Antimony	Dilution tunnel	2.63	2.79	2.76	2.73
Arsenic	Dilution tunnel	5.28	5.54	5.46	5.42
Cadmium	Dilution tunnel	2.27	2.79	2.38	2.48
Chromium	Dilution tunnel	37.87	42.35	55.57	45.26
Cobalt	Dilution tunnel	2.27	2.40	2.38	2.35
Copper	Dilution tunnel	25.41	20.83	12.89	19.71
Lead	Dilution tunnel	17.32	18.09	11.22	15.54
Manganese	Dilution tunnel	12.30	19.53	10.83	14.22
Mercury	Dilution tunnel	5.69	6.21	5.92	5.94
Nickel	Dilution tunnel	80.94	81.05	55.23	72.41
Selenium	Dilution tunnel	4.61	4.86	13.82	7.76
Thallium	Dilution tunnel	1.90	2.01	1.99	1.97
Vanadium	Dilution tunnel	20.68	23.20	24.45	22.77
Zinc	Dilution tunnel	529.83	183.78	124.58	279.40

A-6- 22 - Coalbrookdale (Arga) Little Wenlock – Old Stove test results – Coal Trebles

Pollutant + Method (mg/GJ net)	Measurement location	Run 1	Run 2	Run 3	Average
Antimony	Dilution tunnel	1.88	1.99	1.62	1.83
Arsenic	Dilution tunnel	2.42	2.43	8.66	4.50
Cadmium	Dilution tunnel	1.62	1.71	1.39	1.58
Chromium	Dilution tunnel	43.17	33.14	22.69	33.00
Cobalt	Dilution tunnel	4.24	1.71	1.39	2.45
Copper	Dilution tunnel	7.09	4.37	23.76	11.74
Lead	Dilution tunnel	5.73	4.20	16.70	8.88
Manganese	Dilution tunnel	9.86	11.64	10.65	10.72
Mercury	Dilution tunnel	3.26	2.95	5.26	3.83
Nickel	Dilution tunnel	35.79	22.30	21.10	26.40
Selenium	Dilution tunnel	5.91	4.04	8.44	6.13
Thallium	Dilution tunnel	1.36	1.44	1.16	1.32
Vanadium	Dilution tunnel	7.76	4.30	7.66	6.57
Zinc	Dilution tunnel	213.05	61.91	72.83	115.93

A-6- 23 - Coalbrookdale (Arga) Little Wenlock – Old Stove test results – Anthracite

Pollutant + Method (mg/GJ net)	**Measurement location**	**Run 1**	**Run 2**	**Run 3**	**Average**
Antimony	Dilution tunnel	6.91	3.71	2.19	4.27
Arsenic	Dilution tunnel	13.39	30.98	35.02	26.47
Cadmium	Dilution tunnel	5.96	3.20	2.19	3.78
Chromium	Dilution tunnel	166.09	62.43	50.06	92.86
Cobalt	Dilution tunnel	5.96	3.20	1.89	3.68
Copper	Dilution tunnel	22.43	22.56	11.90	18.96
Lead	Dilution tunnel	9.18	19.55	42.44	23.72
Manganese	Dilution tunnel	22.62	13.05	7.33	14.33
Mercury	Dilution tunnel	13.62	9.71	8.58	10.63
Nickel	Dilution tunnel	71.75	73.54	30.22	58.50
Selenium	Dilution tunnel	11.20	8.29	9.71	9.73
Thallium	Dilution tunnel	5.00	2.69	1.58	3.09
Vanadium	Dilution tunnel	40.64	22.81	12.60	25.35
Zinc	Dilution tunnel	233.61	96.70	69.42	133.24

A.7 FINAL EMISSION FACTORS SUMMARY

A-7- 1 – Wood/Biomass Emission Factors

Stove Type	Fuel	CO (g/GJ)	TPM (g/GJ)	PCDD/F (ngTEQ/GJ)	NOx (g/GJ)	VOC (g/GJ)	PM2.5 (g/GJ)	B(a)p (mg/GJ)	B(b)f (mg/GJ)	B(k)f (mg/GJ)	I(123-cd)P (mg/GJ)	SO2 (g/GJ)	PM1 (g/GJ)	PM10 (g/GJ)
Modern Stove	Dry Wood	2386	151	81	41	373	131	140	121	76	154	8	116	135
	Seasoned Wood	1503	65	66	55	96	48	23	17	11	20	5	43	49
	Wet Wood	3315	382	80	55	753	359	59	33	19	52	5	317	360
	Wood Briquettes	1728	204	199	46	112	181	184	158	104	200	7	162	185
	Coffee Logs	1992	177	61	155	184	151	61	49	28	67	128	125	153
Middle Stove	Dry Wood	2474	101	1546	29	562	75	190	201	124	180	7	65	92
	Seasoned Wood	1959	183	16	59	328	161	21	16	10	13	7	156	162
	Wet Wood	3438	726	34	60	603	679	35	21	13	19	5	620	686
	Wood Briquettes	4265	487	829	112	2117	431	269	592	368	449	338	373	452
	Coffee Logs	1572	149	308	123	73	117	13	14	7	13	81	103	120
Old Stove	Dry Wood	1486	89	259	52	179	79	34	37	22	28	6	71	81
	Seasoned Wood	1938	152	39	46	165	104	17	19	10	14	5	93	109

Stove Type	Fuel	CO (g/GJ)	TPM (g/GJ)	PCDD/F (ngTEQ/GJ)	NOx (g/GJ)	VOC (g/GJ)	PM2.5 (g/GJ)	B(a)p (mg/GJ)	B(b)f (mg/GJ)	B(k)f (mg/GJ)	I(123-cd)P (mg/GJ)	SO2 (g/GJ)	PM1 (g/GJ)	PM10 (g/GJ)
	Wet Wood	3135	285	11	61	393	258	24	23	13	17	5	231	262
	Wood Briquettes	1974	130	25	129	127	100	6	12	5	7	96	93	103
	Coffee Logs	2296	210	290	31	242	187	195	178	119	91	8	167	194
Fireplace	Dry Wood	1164	107	4	58	183	88	4	3	2	99	5	76	90
	Seasoned Wood	2159	337	5	57	391	306	10	9	6	9	4	256	311
	Wet Wood	2426	548	6	50	584	510	32	17	13	18	3	406	524
	Wood Briquettes	2123	510	36	117	414	428	9	5	3	5	135	340	439
	Coffee Logs	921	156	8	49	91	142	6	6	4	5	5	136	144
Pellet Appliance	Pellets	502	54	1467	66	3	17	4	5	2	3	90	14	21

A-7- 2 - Mineral Emission Factors (not including metals)

Stove Type	Fuel	CO (g/GJ)	TPM (g/GJ)	PCDD/F (ngTEQ/GJ)	NOx (g/GJ)	VOC (g/GJ)	PM2.5 (g/GJ)	B(a)p (mg/GJ)	B(b)f (mg/GJ)	B(k)f (mg/GJ)	I(123-cd)P (mg/GJ)	SO2 (g/GJ)	PM1 (g/GJ)	PM10 (g/GJ)
Modern Stove	High Sulphur MSF	5129	441	1219	126	780	424	248	110	48	63	1594	342	429
	Low Sulphur MSF	5117	403	78	117	1205	370	210	116	57	50	875	314	380
	Coal Trebles	3603	263	403	121	288	234	96	128	80	86	228	184	242
	Anthracite	5603	139	91	76	459	73	24	27	16	28	530	59	80
Middle Stove	High Sulphur MSF	4192	274	272	125	723	261	101	80	29	43	1527	233	263
	Low Sulphur MSF	4027	136	63	115	339	126	59	41	16	21	821	122	128
	Coal Trebles	4265	487	829	112	2117	431	269	592	368	449	338	373	452
	Anthracite	3371	49	31	120	181	34	2	4	2	5	359	31	36
Old Stove	High Sulphur MSF	3952	275	1288	125	588	255	93	146	44	66	1434	194	260
	Low Sulphur MSF	5573	198	78	110	549	179	78	80	22	32	848	158	180

Stove Type	Fuel	CO (g/GJ)	TPM (g/GJ)	PCDD/F (ngTEQ/GJ)	NOx (g/GJ)	VOC (g/GJ)	PM2.5 (g/GJ)	B(a)p (mg/GJ)	B(b)f (mg/GJ)	B(k)f (mg/GJ)	I(123-cd)P (mg/GJ)	SO2 (g/GJ)	PM1 (g/GJ)	PM10 (g/GJ)
	Coal Trebles	5184	191	151	91	262	148	26	52	25	16	188	128	154
	Anthracite	3368	151	115	113	543	126	30	39	18	36	439	113	131
Fireplace	High Sulphur MSF	3126	401	447	101	665	365	155	86	28	44	1031	353	368
	Low Sulphur MSF	3932	245	29	89	987	223	99	73	22	30	613	217	226
	Coal Trebles	2834	318	21	101	501	271	34	41	27	34	145	249	277

A-7- 3 - Mineral Emission Factors - Metals

Stove Type	Fuel	Pb (mg/GJ)	Cd (mg/GJ)	Hg (mg/GJ)	As (mg/GJ)	Cr (mg/GJ)	Cu(mg/GJ)	Ni (mg/GJ)	Se (mg/GJ)	Zn (mg/GJ)
Modern Stove	High Sulphur MSF	28	2	2	4	28	14	56	4	63
	Low Sulphur MSF	38	3	5	7	91	21	80	6	74
	Coal Trebles	13	2	2	2	76	16	48	3	152
	Anthracite	40	3	7	18	48	22	72	8	125
Middle Stove	High Sulphur MSF	41	4	3	5	30	20	75	4	88
	Low Sulphur MSF	40	2	4	6	20	14	62	5	58
	Coal Trebles	28	5	7	9	37	59	148	10	329
	Anthracite	71	2	4	30	21	30	91	10	256
Old Stove	High Sulphur MSF	26	2	3	6	42	18	76	4	126
	Low Sulphur MSF	27	3	5	6	36	14	97	6	181
	Coal Trebles	8	2	4	3	36	10	40	5	78
	Anthracite	56	3	7	37	53	18	61	10	158
Fireplace	High Sulphur MSF	27	2	2	3	32	34	469	5	51
	Low Sulphur MSF	43	2	4	6	93	14	49	6	55
	Coal Trebles	4	1	2	3	15	27	97	2	36

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