



# **Combined Heat and Power: Air Quality Guidance for Local Authorities**

February 2012



## About Environmental Protection UK

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Environmental Protection UK's vision is of a cleaner, quieter, healthier world. We seek changes in policy and practice to minimise air, noise and land pollution, bringing together stakeholders to inform debate and influence decision making. We are a national membership based charity and have been playing a leading role in environmental protection in the UK since 1898.

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This guidance was commissioned by the London Borough of Camden, with funding provided by Defra under the Air Quality Grant programme.



## Credits

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Original material for this guidance document has been supplied by Ed Dearnley, Environmental Protection UK and Bureau Veritas.

This guidance incorporates material from documents published by the Carbon Trust and the Department of Energy and Climate Change. Parts of this guidance also draw from Environmental Protection UK's 2008 guidance 'Biomass and Air Quality Guidance for Local Authorities' which contains material supplied by AEA Technology.

An oversight group was set up to oversee development of this guidance. Environmental Protection UK would like to thank the members of this group for their assistance with the development of this guidance. Group members included representatives from:

- Combined Heat and Power Association
- Environment Agency
- London Borough of Camden
- Department for Environment, Food and Rural Affairs
- Air Quality Experts Group
- SLR Consulting
- Stuart Stearn

The discussion of commercially available products within this guidance, such as dispersion models, does not constitute endorsement of any kind. This document represents policy guidance from Environmental Protection UK, and does not necessarily reflect policy within the organisations of those who have contributed to, or were consulted on, its development. Information relating to time relevant items, such as limit values, objectives, draft or other guidance documents, was correct at the time of production.

Design: 7creative.co.uk

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#### **Other Resources (available online)**

- Template Air Quality Assessment Procedure for Gas-Fired Combined Heat and Power Plant
- Template Combined Heat and Power System Information Request Form
- CHP System Inventory Template

## Executive Summary

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In common with other combustion appliances, emissions from combined heat and power (CHP) systems should be managed to ensure potential air quality impacts are controlled. Management of combustion appliances can include product and fuel standards, emissions abatement equipment, regulatory controls and/ or planning controls to restrict where certain appliances can be installed. This guidance aims to help local authorities understand and manage emissions from CHP systems, with a focus on the most common types found in the small/ medium size range – natural gas fuelled internal combustion engines and gas turbines.

CHP can help reduce carbon dioxide emissions and cut fuel costs, as it is usually a more efficient way of providing heat and power than using boilers and electricity from the national grid. As such it is being encouraged by the Government in order to help the UK meet stretching targets under the Climate Change Act.

Unabated climate change presents a major environmental and health hazard to the whole world, and de-carbonising our energy supply is therefore a priority. At the same time the UK is currently failing to meet legally binding EU air quality standards in many parts of the country, and public health is suffering as a result. Management of CHP emissions should therefore seek to encourage CHP use, whilst limiting any negative effect on, or indeed improving, air quality.

The term CHP does not represent a single class of technology. CHP covers a wide variety of combustion (and non combustion) technologies which can each be used with a number of different fuels. All of these combinations will have differing emissions performance, which can complicate the task of air quality assessment.

Installing a CHP system replaces emissions from two locations (boilers and power stations) with a single source. In some situations installing a CHP system may cause overall emissions of air pollutants to fall but local emissions may actually rise. For the purposes of air quality assessment only local emissions should be taken into account, as power station emissions will have a negligible impact on local air quality.

As is the case with all combustion plant, air quality assessment of planning applications containing CHP systems should follow a risk based approach based upon factors such as:

- The location of the CHP system, i.e. is it in or close to an area of poor air quality;
- The type of CHP system proposed and the fuel it will use;
- The likely emission standard of the CHP system; and
- Whether the CHP system is substituting for a conventional boiler, and what the difference in emissions between the old boiler and new CHP system is likely to be.

The approach to assessment should therefore have a lighter touch where risk is low (for example in a rural or suburban area where air quality is good), and more rigorous where risk is high (for example in or adjacent to an Air Quality Management Area).

This guidance document contains information on the policy background to CHP, climate change and air quality, details of CHP technologies and their regulation, and finally advice on the management and mitigation of CHP emissions. Several tools have been developed alongside this guidance to help local authorities and their partners manage emissions. These are listed on the contents page, and are also available for download.

This guidance does not intend to be a complete guide to CHP, and suggested reading links have been placed in the text if more detailed information is needed about any of the policies, technologies and methodologies raised. This guidance is intended as a companion to the more general Environmental Protection UK planning guidance 'Development Control: Planning for Air Quality' which was last updated in 2010.

At the time of writing we were unable to confirm whether the Environmental Protection UK website would be available after January 2012. The Institute of Air Quality Management has agreed to host EPUK guidance on their website – if the links in this guidance to the EPUK website do not work please search for the documents you require at [www.iaqm.co.uk](http://www.iaqm.co.uk).



# 1

## Chapter 1: Background



## Key Points

Combined Heat and Power (CHP) is the co-production of electricity and heat. The term covers a wide range of technologies, size scales and fuels.

CHP usually delivers savings in fuel consumption when compared to the heat and electricity produced using on site heat generation (through boilers) and electricity from the national grid. CHP has a key role to play in meeting national and local targets for reducing emissions of the greenhouse gas carbon dioxide.

CHP is classed as a low carbon technology. Uptake of CHP is being driven by legislation requiring significant reductions in UK carbon dioxide (CO<sub>2</sub>) emissions. A number of schemes offer financial advantages to individuals and organisations that make use of CHP.

Air quality is poor in many areas of the UK, which has a direct impact on the health of people living and working in these areas. There are binding obligations on both national and local government to address poor air quality, with nitrogen dioxide (NO<sub>2</sub>) and particulate matter (PM<sub>10</sub>) being the key pollutants of concern.

In common with any combustion technology, CHP systems will have an impact on air quality. The exact impact will depend upon the emission performance of the CHP plant, dispersion of emissions from the plant and the emissions performance of any existing on-site plant that the CHP system replaces.

## What is Combined Heat and Power?

- 1.1 Combined Heat and Power (CHP) is the co-production of electricity and heat for a building (or an industrial process). CHP is generally a more energy efficient technology than the on-site boilers and electricity from the National Grid that is used to heat and power most buildings. This is due to the low efficiency of large scale electricity generation and supply. Typically only 40% of the energy used to generate electricity is supplied to the end user as useful energy, as heat is wasted in the generation process and energy is lost in transmission between the power station and the end user. By contrast CHP systems use low temperature 'waste' heat to provide heating, cooling and/ or hot water; transmission distances (and therefore losses) are also minimised. Fuel efficiency can exceed 80% in modern systems, meaning that fuel costs and CO<sub>2</sub> emissions can be significantly improved over the separate production of heat and power.
- 1.2 Like any other combustion technology, CHP will have an impact on air quality. The exact impact will depend upon the technology and fuel used, the size and design of the plant, the presence of any emission abatement equipment, the nature of emission dispersion from exhaust stacks and the air quality impacts of the plant (if any) that the CHP system is replacing.
- 1.3 The status of CHP as a low carbon technology means there is growing interest in using CHP to meet local and national targets for reducing greenhouse gas emissions. CHP is one of the most cost effective ways of reducing CO<sub>2</sub> emissions associated with generation of heat and power. CHP is not automatically a renewable technology but it can be if the plant runs on a renewable fuel, for example biomass. The use of renewable fuels in a CHP system can also lead to both lower costs and CO<sub>2</sub> emissions than if the same fuel is burnt in conventional boilers or power station due to the higher fuel efficiency of CHP systems.

## Types of CHP

- 1.4 The term CHP covers a wide variety of size ranges, technologies and fuels. The most common technologies are summarised in Table 1.1 below. More details on these technologies, and less common technologies, are provided in Chapter 2. Note that the size of a CHP system is normally quoted by its electrical output in kilowatt electric (kW<sub>e</sub>) or megawatt electric (MW<sub>e</sub>), but can also be quoted according to its thermal input (kW<sub>th</sub> or MW<sub>th</sub>).

**Table 1.1 – Common CHP Technologies**

Size Range	Typical Technologies	Typical Fuels
‘Micro’ (up to 5 kW <sub>e</sub> )	<ul style="list-style-type: none"> <li>• Stirling engines</li> <li>• Internal combustion engines</li> </ul>	<ul style="list-style-type: none"> <li>• Natural gas<sup>+</sup></li> </ul>
Small scale (below 2 MW <sub>e</sub> )	<ul style="list-style-type: none"> <li>• Internal combustion engines</li> <li>• Gas turbines</li> </ul>	<ul style="list-style-type: none"> <li>• Natural gas<sup>+</sup></li> <li>• Liquid fuels<sup>*</sup></li> </ul>
Large scale (above 2 MW <sub>e</sub> )	<ul style="list-style-type: none"> <li>• Large internal combustion engines</li> <li>• Large gas turbines</li> <li>• Steam turbines</li> <li>• Organic Rankin Cycle engines</li> </ul>	<ul style="list-style-type: none"> <li>• Natural gas</li> <li>• Liquid fuels<sup>*</sup></li> <li>• Solid fuels/ biomass</li> </ul>

<sup>+</sup> Biogas (e.g. from landfill sites or anaerobic digestion) or biomethane can also be used

<sup>\*</sup> Liquid fuels can include diesel and heavy fuel oil, as well as biofuels such as bioethanol and biodiesel

- 1.5 CHP is supplied as ‘packaged’ or ‘custom’ systems. Packaged CHP units are ‘off the peg’ systems, typically ranging from 60 kW<sub>e</sub> to 1.5 MW<sub>e</sub>. These are designed and supplied as complete units, selected to meet the requirements of the site and its energy demands. The package contains the engine, generator and heat recovery equipment, together with all the associated pipework, valves and controls. Packaged systems most commonly use internal combustion engines.
- 1.6 Custom-built CHP plant can range from 1 MW<sub>e</sub> up to hundreds of MW<sub>e</sub>. The plant generally consists of large and complex systems installed on-site, although systems can be built for smaller power requirements.
- 1.7 The heat output of a CHP plant can also be used to provide cooling (e.g. air conditioning) via equipment known as ‘absorption chillers’. These increasingly popular types of installations are known as Combined Cooling, Heat and Power (CCHP).

## Scope of this Guidance

- 1.8 This guidance covers CHP systems in the 50 kW<sub>th</sub> to 20 MW<sub>th</sub> size range, incorporating the common technologies and fuels used with this size of plant. The document is aimed at local authorities, and is intended to help officers and elected members with strategic planning and decisions on individual planning applications. The 50 kW<sub>th</sub> to 20 MW<sub>th</sub> size range covers the most common CHP systems that local authorities will need to assess as part of a planning application, but are too small to be regulated as a Part B process. Whilst this guidance relates to practice and the legislative position in England and Wales, the general approach will be of relevance to Scotland and Northern Ireland.
- 1.9 The air quality impacts of CHP systems smaller than 50 kW<sub>th</sub> should not be disregarded: in some cases they may be significant. However, smaller systems are less likely to fall into the planning system, as if they are installed in existing buildings they may not need planning permission to proceed.
- 1.10 The guidance focuses on assessing and managing the effects of CHP on air quality – specifically nitrogen dioxide (NO<sub>2</sub>). It does not cover particulates (PM<sub>10</sub> and PM<sub>2.5</sub>) or sulphur dioxide (SO<sub>2</sub>) in depth. Lifecycle CO<sub>2</sub> emissions from different CHP technologies and fuels are beyond the scope of this guidance. This guidance does not provide advice on what CHP technologies (if any) are suitable for a particular site and application. Nevertheless these considerations are extremely important to ensure CHP plant operate efficiently with low emissions. Guidance on this area can be found in the reading links section of this Chapter.
- 1.11 As with any energy technology, CHP does have other environmental and sustainability impacts surrounding its use, for example in the production and transportation of fuels. These are mentioned in this guidance, and links are given to sources of further information.
- 1.12 CHP systems fuelled by biomass are now available, typically using a biomass fuelled boiler to drive a steam turbine. Environmental Protection UK has produced ‘Biomass and Air Quality’ guidance which should be used with regard to such systems. The guidance can be downloaded from the EPUK or IAQM website.
- 1.13 The majority of installations of CHP plant will typically occur as part of a larger development, and will therefore need planning approval and in some cases pollution control regulatory approval. Both issues are looked at in Chapter 3 of this guidance. Wider air quality issues surrounding development control are considered in the guidance document ‘Development Control: Planning for Air Quality’ which is available

to download from the Environmental Protection UK or IAQM website. It should however be noted that not all CHP installations will need a planning application, particularly if they are installed in an existing building.

- 1.14 At the time of writing this document, technology and legislation surrounding the air quality effects of CHP were developing quickly. Readers are advised to check for new regulatory developments before applying this guidance. Environmental Protection UK will not be providing updates to this guidance.

## Introduction to the Air Quality Impacts of CHP

- 1.15 In common with other combustion plant, CHP can affect air quality in a variety of ways. As CHP covers a wide variety of technologies and fuels careful attention needs to be paid to the type of plant used and its potential impact on air quality. The exact impact of the CHP plant on air quality will depend upon:

- The emissions performance of the plant;
- The difference in emissions between the CHP plant and any plant it is replacing (whether CHP or conventional boilers); and
- The dispersion of emissions from the CHP flue.

All of these factors will need to be considered when making an assessment. These three factors are briefly described below, with more detail being available in Chapters 3 and 4.

- 1.16 The emissions performance of CHP plant will be dependent on:
- The type and design of the combustion plant;
  - The type of fuel used, and its chemical and physical qualities (fuel quality); and
  - The presence of any emissions abatement equipment fitted to the plant.
- 1.17 The difference in emissions between a new CHP plant and the plant it replaces (if any) will be a key factor in its air quality impact. If a new, gas fuelled CHP system replaces an old solid or oil fuelled boiler the overall air quality impact may be beneficial. If on the other hand it replaces a conventional gas fired boiler, or is an entirely new source of combustion on a site, the air quality impacts may be to some degree negative.
- 1.18 The dispersion of emissions from a CHP plant will be affected by the height and design of the chimney stack or flue, meteorology and the design of surrounding buildings (if any). Screening tools and computer models can be used to assess dispersion.

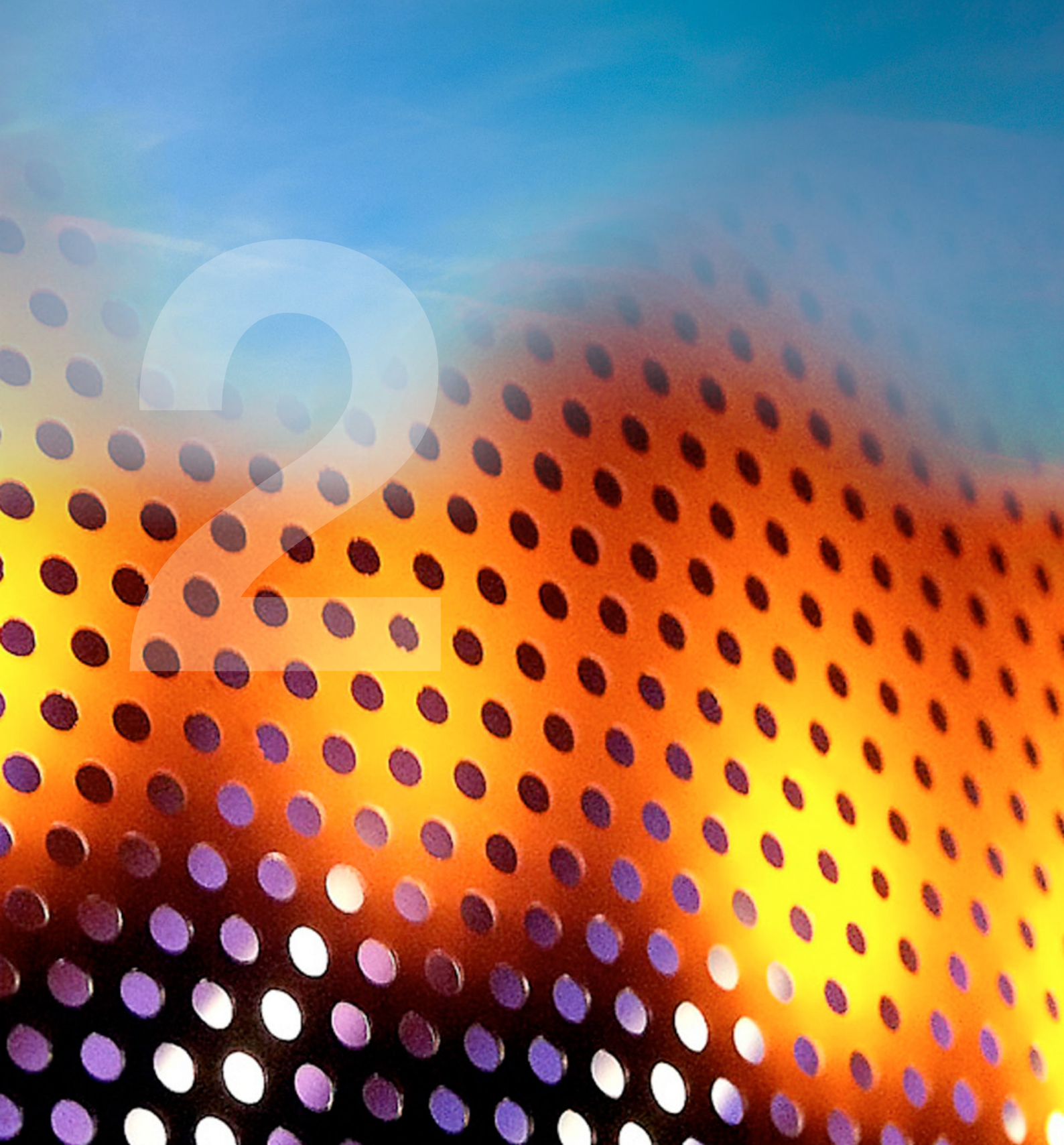


## Chapter 1 Reading Links

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- Department of Energy and Climate Change ‘CHP Focus’ website  
<http://chp.decc.gov.uk/cms/>
- The Carbon Trust’s ‘Introducing combined heat and power’  
<http://www.carbontrust.co.uk/publications/pages/publicationdetail.aspx?id=CTV044>
- Environmental Protection UK Planning Guidance  
<http://www.environmental-protection.org.uk/aqplanning/>
- Environmental Protection UK Biomass and Air Quality Guidance  
<http://www.environmental-protection.org.uk/biomass/>
- Information on the Code for Sustainable Homes  
<http://www.communities.gov.uk/documents/planningandbuilding/pdf/803784.pdf>
- UK-AIR (UK Government Air Quality portal)  
<http://uk-air.defra.gov.uk/>
- Air Quality Strategy Objectives  
<http://uk-air.defra.gov.uk/air-pollution/daqi#std>

If the links above to the EPUK website do not work please search for the documents you require at [www.iaqm.co.uk](http://www.iaqm.co.uk)



## Chapter 2: Technologies, Fuels, Standards and Certification

## Key Points

The term CHP covers a wide variety of different combustion (and some non combustion) technologies. Some technologies can be used with a number of different fuels creating a large number of potential technology/fuel combinations. All of these combinations will have differing emissions performance.

CHP systems consist of the 'prime mover' (which provides power for the system), the electrical generator and the heat recovery equipment. In terms of emissions the prime mover will be of most interest.

The most common type of prime movers in the size range covered by this guidance are internal combustion engines (although gas turbines are also sometimes used), and the most common fuel is natural gas.

There are no UK emission standards for smaller (<20 MW) CHP plant. Standards are, however, in place in several other European countries. These may be quoted by CHP suppliers, particularly if they sell equipment in Europe.

## CHP Technologies

- 2.1 The term CHP covers a wide variety of combustion and non-combustion technologies. Different technologies will be compatible with different fuels. The emissions performance of the CHP system will be related to the type of technology and the fuel it uses, with a significant variation in emissions of pollutants between the different technology/ fuel combinations.
- 2.2 The most common technology used in the CHP size range covered by this guidance is packaged ('off the peg') internal combustion engines fuelled by natural gas. Internal combustion engines fuelled by liquid biofuels are also becoming more popular due to Government policies on renewable energy.
- 2.3 The size of a CHP system is normally quoted by its electrical output in kilowatt electric ( $\text{kW}_e$ ) or megawatt electric ( $\text{MW}_e$ ). This may not, however, provide a good guide to emissions from the system, as there are two outputs to a CHP system (heat and power). The proportion of total system output delivered as heat or power can vary significantly between different technologies and applications. The thermal input of the system ( $\text{kW}_{th}$  or  $\text{MW}_{th}$ ) may therefore provide a better guide to size and emissions performance.
- 2.4 The basic elements of CHP plant are the engine or 'prime mover', which provides the mechanical motive power, the electrical generator and the heat recovery equipment. The heat recovery equipment may include absorption chillers if the CHP is to provide cooling (CCHP).
- 2.5 The prime mover provides the mechanical power in the system. The four most common types of CHP prime mover as shown in Table 2.1 below, whilst less common/ emerging technologies are shown in Table 2.2.

**Table 2.1 – Common CHP Prime Movers**

Technology	Description	Common applications	Fuels
Internal Combustion Engines	These use traditional spark-ignition or compression-ignition engines (as used in cars and small electricity generators) to provide the motive power; in CHP these are usually converted to operate on natural gas. Compression-ignition diesel engines can also be used with heavier, liquid fuels.	Typically used in the 70kW <sub>e</sub> - 1,500kW <sub>e</sub> in size (but are available up to about 5MW <sub>e</sub> and down to 5.5kW <sub>e</sub> ) and best suited to non-industrial smaller sites where most of the demand is for hot water.	Gaseous and liquid fuels.
Steam Turbines	These use a steady stream of high-pressure steam generated in a boiler to drive a turbine. 'Pass-out' turbines extract heat as medium-pressure steam between turbine stages, which produces more/ higher grade heat at the expense of a reduction in power generation. 'Back pressure' turbines extract heat as low-pressure steam (slightly above atmospheric pressure) exiting the final stage of the turbine.	Typically suited to large-scale applications or where the amount of heat required is much greater than the amount of power. They are particularly appropriate for CHP when steam is needed, or where the fuel available cannot be burned directly in the prime mover (e.g. solid fuels).	All fuel types.
Gas Turbines	These use a steady stream of burning fuel to drive a turbine to generate the motive power. The heat from the turbine's exhaust gases can be recovered and used for space or process heating. Gas turbines have a higher electrical efficiency than steam turbines, as they operate at higher temperatures, but require a cleaner fuel (typically natural gas).	Typically employed in large-scale custom-built schemes, larger than 1MW <sub>e</sub> , although there are small-scale 'mini turbines' of between 80kW <sub>e</sub> and 100kW <sub>e</sub> in some packaged CHP systems.	Gaseous fuels.
Combined Cycle Gas Turbines	These use the high temperature exhaust from a gas turbine to generate high-pressure steam which then passes through steam turbines to generate more power. This combination provides much higher electrical efficiency than standard gas turbines (i.e. more electrical output and less heat).	Typically used in large-scale power generation.	Gaseous fuels.



**Table 2.2 – Less Common and Emerging CHP Prime Movers**

Technology	Description	Common applications	Fuels
Organic Rankin Cycle (ORC) Engines	ORC engines operate in a similar fashion to steam turbines, but use an organic working fluid rather than water. This makes ORC engines more efficient when using low grade heat sources such as biomass. ORC engines may also have lower capital and running costs than equivalent steam turbine plant.	Biomass CHP.	Currently biomass CHP, but potential to run on other fuel types.
Stirling Engines	A stirling engine is a type of external combustion engine, where fuel is burnt outside of the engine (like a steam engine) rather than inside (like a car engine). They are characterised by their quiet and efficient operation, and are now finding an application at the smaller end of the CHP size scale.	Small 'Micro CHP' systems suitable for a single dwelling (up to 5 kW <sub>e</sub> ).	Currently gaseous fuels, but potential to run on all fuel types.
Fuel Cells	A fuel cell is an electrochemical cell that directly generates electricity and some heat by electrochemically oxidising fuel. This process is often accelerated by a catalyst such as a transition metal or an acid solution. Fuel cells operating at high temperatures (>600°C) do not require catalysts. These systems are more expensive than Stirling engines but offer higher electrical efficiencies of around 55%.	Potentially any application, as the technology is modular.	Liquid and gaseous fuels.
Anaerobic Digestion (AD)	AD is a process that can be used to produce CHP fuel. A digestion process is used to produce biogas and digestate (which can be used as a fertiliser) from organic waste or energy crops. Biogas can be burnt in internal combustion engines. It can also be upgraded to 'biomethane', which is chemically identical to natural gas and can be used in a similarly wide variety of CHP technologies.	Typically medium scale CHP.	Organic waste and energy crops.

2.6 The electrical generator converts the mechanical shaft power of the prime mover into electricity. Generators for CHP can be categorised as synchronous ('self-controlled')

or asynchronous ('grid-controlled'). Synchronous generators can operate completely independently of the grid in what is known as 'island mode'. This means they are suitable for stand-by electricity generation if the grid power fails. Asynchronous generators require a constant connection to the grid and will shut down in the event of a grid power failure; they are therefore not suitable for stand-by generation. Below 100 kW<sub>e</sub> size, synchronous generators are significantly more expensive than asynchronous generators because of the additional control equipment. So unless it's essential that a site has back-up, asynchronous generators are usually installed. Above 100 kW<sub>e</sub> the cost differences are very small and so synchronous generators are usually employed.

- 2.7 The heat recovery equipment captures the heat from the prime mover either for process use (generally steam) or heating and hot water. Generally, for internal combustion engines, the heat recovery equipment comprises plate heat exchangers, whereas for gas turbines the heat is recovered in a heat recovery steam generator (HRSG). In some cases, the HRSG itself has additional fuel burned in it (called supplementary firing), in which case it's referred to as a 'fired HRSG'. In systems with a steam turbine, the heat is usually used directly. However, in some cases, its pressure may need to be reduced before use.

## 'Peaking' Plant and Heat Stores

- 2.8 CHP plant is commonly sized to meet the base heat load of a building, as the overall efficiency of the plant tends to fall when it is modulating (varying output) or dumping heat. Conventional 'heat only' boilers are therefore often installed alongside CHP plant to meet peaks in the building's heat demand. These are usually fuelled by natural gas, if this fuel is available.
- 2.9 Some CHP systems also incorporate heat stores. As the name suggests, these store heat produced by the CHP system for later use. They can be used for two purposes. Firstly they can be used to meet peak heat demands, reducing or even eliminating the need for peak load boilers. Secondly they can be used to maximise electricity revenues for the CHP plant operator, running the plant during the day when electricity prices are high but leaving it idle at night when electricity prices are lower (with heat demand met from the store).

## CHP Fuels

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- 2.10 The choice of CHP fuels will be influenced by the type of CHP technology used, and the cost of the fuel. In general, the cost of a fuel is influenced by availability, flexibility of supply, storage and use. When renewable fuels are used the total cost will also be influenced by any payments received through Government incentive schemes (see Table A1). The fuel for custom-built and packaged units is usually natural gas, though some can operate on other gases, such as stored propane, butane, LPG or biogas from sewage/ landfill waste. Distillate fuels (e.g. diesel or petrol) can also be used, but this is less common.
- 2.11 CHP installations can be designed to accept more than one fuel, usually at an additional cost, which gives more flexibility and means fuel supply is more secure. However, where an environmental permit is required to operate fuel choice may be limited in practice by the emission requirements of the permit. Steam turbines can burn cheaper fuels such as coal, heavy oils and waste materials, but there may be additional costs for handling, burning and meeting environmental standards. Back-up fuels – natural gas or oil – may be needed if a CHP installation is burning a solid or waste product, either to bridge supply shortfalls or to initiate combustion.
- 2.12 The type of fuel used, and the quality of the fuel, will have a significant effect on the type and quantity of air quality emissions from the CHP system. Table 2.3 below shows the main pollutants associated with common CHP fuels. Note that the type of CHP technology used will also have a significant effect on emissions.

**Table 2.3 – Common CHP Fuels and Associated Pollutants**

Fuel	Associated pollutants
Natural gas/ biomethane/ butane/ propane	<ul style="list-style-type: none"> <li>• Nitrogen dioxide (NO<sub>2</sub>)</li> </ul>
Heavy fuel oil	<ul style="list-style-type: none"> <li>• Nitrogen dioxide (NO<sub>2</sub>)</li> <li>• Particulates (PM<sub>10</sub> and PM<sub>2.5</sub>)</li> <li>• Sulphur dioxide (SO<sub>2</sub>)</li> </ul>
Gas oil (diesel)	<ul style="list-style-type: none"> <li>• Nitrogen dioxide (NO<sub>2</sub>)</li> <li>• Particulates (PM<sub>10</sub> and PM<sub>2.5</sub>)</li> </ul>
Coal	<ul style="list-style-type: none"> <li>• Nitrogen dioxide (NO<sub>2</sub>)</li> <li>• Particulates (PM<sub>10</sub> and PM<sub>2.5</sub>)</li> <li>• Sulphur dioxide (SO<sub>2</sub>)</li> </ul>
Biomass	<ul style="list-style-type: none"> <li>• Nitrogen dioxide (NO<sub>2</sub>)</li> <li>• Particulates (PM<sub>10</sub> and PM<sub>2.5</sub>)</li> </ul>
Bioliuids	<ul style="list-style-type: none"> <li>• Nitrogen dioxide (NO<sub>2</sub>)</li> <li>• Particulates (PM<sub>10</sub> and PM<sub>2.5</sub>)</li> </ul>

## Emissions Performance of CHP Technologies

2.13 Different CHP prime mover technology and fuel combinations will have different performance in terms of air pollutant emissions for similar electrical and heat outputs. Ultimately the technology/ fuel combination used will depend upon the size and application of the CHP plant, and cost efficiency. However, if air quality is a significant issue in the area the CHP plant is being installed in then it may be a determining factor in the choice of technology and fuel used.

2.14 The overwhelming majority of CHP systems currently installed are internal

combustion engine or gas turbine prime movers fuelled by natural gas. The principal pollutant of concern with this fuel is NO<sub>x</sub>. Table 2.4 below shows typical NO<sub>x</sub> emissions for a range of prime mover technologies and more detailed consideration of NO<sub>x</sub> emissions from gas turbines and internal combustion engines follows in paragraphs 2.15 - 2.22.

**Table 2.4 – Typical NO<sub>x</sub> Emissions from Natural Gas Fuelled CHP systems**

Prime Mover	Additional technology	Typical NO <sub>x</sub> Emission (g/kWh)
Gas Turbine		1.1
Gas Turbine	Back pressure steam turbine	0.9
Small Scale Gas Turbine		0.2-0.5
Compression Ignition Engine		5-10
Spark Ignition Engine		5-20
Spark Ignition Engine	Lean burn	3
All CHP plant reviewed in consultation with manufacturers		0.2 - 22

## Gas Turbines (Gas Fuelled)

2.15 Gas turbines range in size from less than 1 MW<sub>e</sub> to over 200 MW<sub>e</sub>. The combustion process in a gas turbine occurs with high levels of excess air since the power output obtained is related to the mass flow rate achieved through the turbine. As a result of the high volume of air used in the combustion process, nitrogen oxides (NO<sub>x</sub>) emissions are generally considered to be low.

2.16 Typical NO<sub>x</sub> emissions from gas turbines (less than 50 MW thermal input) are 1.1 g NO<sub>x</sub>/kWh for natural gas (0.9 g NO<sub>x</sub>/kWh with a back-pressure steam driven turbine to generate electricity and thereby increase efficiency). The advantages of these low emissions are offset by the more complex maintenance requirements and lower efficiencies compared to other technologies. These maintenance requirements mean



that gas turbines are usually employed for larger CHP, typically above 1 MW<sub>e</sub>.

- 2.17 Smaller gas turbines in the range of 60 to 100 kW<sub>e</sub> are however becoming increasingly available. These produce very clean exhaust gases, with extremely low NO<sub>x</sub> and carbon monoxide (CO) emissions. NO<sub>x</sub> emissions from natural gas fired small-scale gas turbines can be as low as 0.2-0.5 g NO<sub>x</sub>/kWh.
- 2.18 Gas turbines for CHP can also use other gaseous fuels, such as methane-based fuel gases from landfill sites, sewage treatment works and mine ventilation systems. These can contain high levels of inert constituents such as nitrogen (N) and carbon dioxide (CO<sub>2</sub>). Using these fuels in lieu of natural gas reduces NOX emissions by more than 50% because of the lower combustion temperatures involved; however the constituents of such fuels can result in emissions of more hazardous compounds such as dioxins and furans which may need to be addressed using abatement equipment.

### Internal Combustion Engines (Gas Fuelled)

- 2.19 Internal combustion engines form the basis for a wide range of CHP systems as they are capable of running at full output for long periods over many years. For most internal combustion engines, NO<sub>x</sub> and CO emissions are influenced by how the engine is built and operated, and, for many engines, it is possible to make adjustments that will affect emissions levels. In particular, NO<sub>x</sub> levels can be increased or decreased by a factor of three or more by adjusting combustion parameters as detailed in 4.50. However, adjustments made to reduce the level of one pollutant often result in an increase in the level of another. For example, changing an engine set-up to reduce NO<sub>x</sub> emissions often results in increases in emissions of CO and unburned hydrocarbon and can lower engine efficiency, thereby increasing CO<sub>2</sub> emissions.
- 2.20 It is anticipated that the majority of new CHP systems in urban areas will be compression-ignition and spark-ignition engines, as these are typically 70 kW<sub>e</sub> to 1,500 kW<sub>e</sub>, which is likely to be the most common size range. Typical gas engine NO<sub>x</sub> emissions are 2-20 g NO<sub>x</sub>/kWh depending on the type of engine.
- 2.21 Compression-ignition engines (also known as diesel engines, as they require a liquid fuel to ignite) are internal combustion engines in which the fuel and oxygen mixture is compressed to the point of auto ignition. As compression-ignition engines are based on liquid fuel being injected into the compressed air combustion chamber, gas fuelled versions require a small quantity of pilot oil to ignite the gaseous fuel. Compression-

ignition engines generally operate with lower air-to-fuel ratios and higher combustion temperatures than gas turbines. This leads to relatively high NO<sub>x</sub> emissions levels per unit of power generated, although actual emissions vary widely between different designs as it is possible to reduce NO<sub>x</sub> emissions by operating at a lower engine efficiency. NO<sub>x</sub> emissions are typically 5-10 g NO<sub>x</sub>/kWh when firing on natural gas.

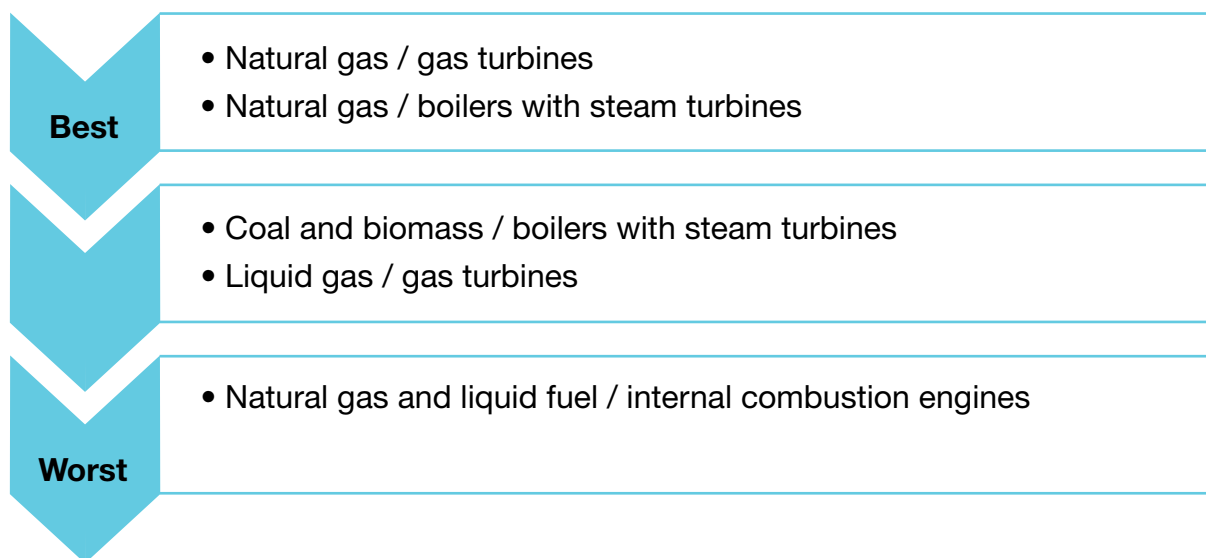
- 2.22 Spark-ignition engines are internal combustion engines in which the combustion process is initiated by a spark. These engines operate on natural gas and are based on lean-burn combustion technology to enable them to meet NO<sub>x</sub> emissions limits. Typical NO<sub>x</sub> emissions from natural gas spark-ignition gas engine CHP units are 5-20 g NO<sub>x</sub>/kWh but this can be reduced to something in the region of 3g NO<sub>x</sub>/kWh with lean burn and a heat recovery boiler.

### Other Prime Mover Technologies and Fuels

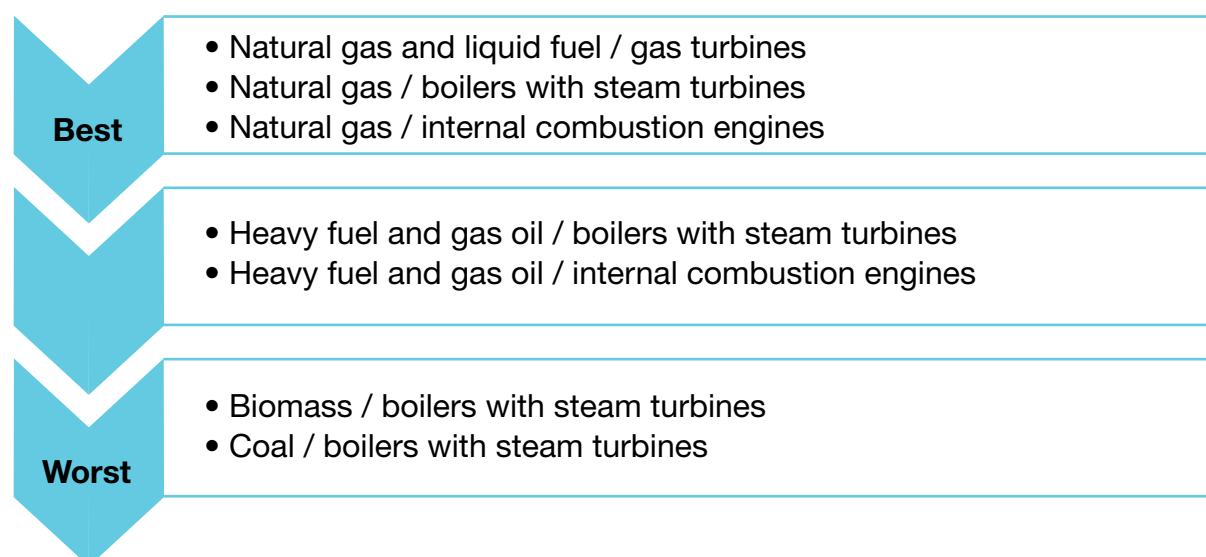
- 2.23 Graphs 2.1 and 2.2 below show the common spectrum of emissions performance for typical prime mover technologies and fuels. It is important to note that this is indicative only, and emissions performance may vary significantly between similar prime mover technologies from different manufacturers and also the same prime movers installed in different applications. Emissions performance is also affected by other factors including

- Fuel quality
- The use of emissions abatement techniques and equipment.

**Graph 2.1 – Indicative Relative NO<sub>x</sub> Emissions Performance of Common CHP Prime Mover Technology/ Fuel Combinations**



**Graph 2.2 – Indicative Relative PM Emissions Performance of Common CHP Prime Mover Technology/ Fuel Combinations**



## Emission Standards and Certifications

2.24 Emission standards for CHP systems apply to each prime mover technology, rather than CHP as a class of technology in its own right. Emission standards for smaller CHP plant, as focused upon by this guidance, form an incomplete patchwork and the smaller size range covered by this guidance operates outside of set emission standards. In these cases it may be useful to refer to overseas emission standards, such as the German TA-Luft standards, which may be referred to by CHP suppliers, particularly if they also sell their technology in Europe.

### UK Standards

2.25 In England and Wales medium sized CHP (20 - 50 MW<sub>th</sub>) plant is the subject of the Local Authority Pollution Prevention and Control (LA-PPC) regulatory regime, and PPC guidance notes (with emission limits) exist for:

- Boilers and furnaces
- Gas turbines
- Compression ignition engines.

PPC emission limits for gas turbines and compression ignition engines running on natural gas are shown in Table 2.5.

**Table 2.5 – PPC Emission Limits for CHP Prime Movers Fuelled by Natural Gas**

Technology	NO <sub>x</sub> Limits (mg/m <sup>3</sup> )	PM <sub>10</sub> Limits (mg/m <sup>3</sup> )
Turbines (operating for more than 100 hours per year, 30% efficiency)	125	n/a
Compression ignition engines (dual fuel, installed since 1998)	500	50 (for new installations)

2.26 PPC emission limits also exist for other fuels and pollutants. See PG 1/3 (95) - Boilers

and Furnaces, PG 1/4 (95) - Gas Turbines, PG1/05 (95) - Compression Ignition Engines. Whilst this guidance forms current PPC guidance it is worth noting its age (1995), as it is considered by some to be out of date.

- 2.27 For biomass fuelled CHP (as well as heat only biomass boilers) emission limits will be established in the Government's new Renewable Heat Incentive (RHI). These limits will be introduced for RHI biomass installations below 20MW<sub>th</sub> in the next set of RHI regulations in 2012, with the proposed limits being 30 g/GJ for particulate matter (PM<sub>10</sub>) and 150 g/GJ for NO<sub>x</sub>. Biomass CHP that does not meet these limits will not be eligible for payments under the RHI.

## European Standards

- 2.28 Several European countries have set emission standards for smaller CHP prime mover technologies. The most well know are the German TA-Luft standards and the Dutch BEMS standards.

### TA-Luft Standards

- 2.29 Germany has a well known air pollution control regulation entitled 'Technical Instructions on Air Quality Control' (Technische Anleitung zur Reinhaltung der Luft) and commonly referred to as the TA-Luft. The standards were last revised in 2002, and include provision for stationary internal combustion engines and smaller stationary gas turbines, as used in CHP installations. These are shown in Tables 2.6 and 2.7 below. Emissions limits are quoted in milligrams per meter cubed of exhaust gas (mg/m<sup>3</sup>) at 5% oxygen for internal combustion engines, and 15% oxygen for gas turbines.

**Table 2.6 – TA-LUFT PM Emission Limits for Internal Combustion Engines (mg/m<sup>3</sup>)**

Technology	PM
Compression ignition liquid fuelled	20
Compression ignition gas fuelled (dual fuel) or spark ignition	no limit



**Table 2.7 – TA-LUFT NO<sub>x</sub> Emission Limits for Internal Combustion Engines and Gas Turbines (mg/m<sup>3</sup>)**

Technology	NO <sub>x</sub>	
	≥ 3 MW	< 3 MW
Compression ignition liquid fuelled Compression ignition biogas (dual fuel)	500	1000
Spark ignition biogas or spark ignition lean-burn using other gas fuels Compression ignition (dual fuel) using other gas fuels	500	
Other 4-stroke Otto engines	250	
2-stroke engines	800	
Gas turbines – natural gas	75	
Gas turbines – other gas or liquid fuels	150	

## Dutch BEMS Standards

2.30 The Netherlands Ministry for Infrastructure and the Environment has set emission limit values (known as BEMS) for medium sized combustion plant, including limits for common CHP prime mover technologies. These standards came into force during April 2010. New plant are to comply with these regulations immediately, whilst existing plant are allowed a transitional period until 2017. These limits are shown in Table 2.8.

**Table 2.8 – Dutch BEMS Emission Limit Values for Common CHP Prime Movers (mg/m<sup>3</sup>)**

Technology	NO <sub>x</sub>	PM <sub>10</sub>
Boiler (liquid fuels) ≥1 MW	100	5
Boiler (Biomass) <5 MW <sub>th</sub>	200	20
Boiler (Biomass) ≥5 MW <sub>th</sub>	145	5
Boiler (gas) ≥1 MW	70	
Internal combustion engine (liquid fuel, compression ignition)	450	50
Internal combustion engine (gas >2.5 MW <sub>th</sub> )	100	
Internal combustion engine (biogas or <2.5 MW <sub>th</sub> )	340	
Gas turbine (gas and liquid fuels)	140	15 (liquid fuel only)

## Chapter 2 Reading Links

- Department of Energy and Climate Change ‘CHP Focus’ website  
<http://chp.decc.gov.uk/cms/>
- Good Practice Guide 234, Guide to community heating and CHP – Commercial, domestic and public applications (please note the age of this document)  
<http://www.cibse.org/pdfs/GPG234.pdf>
- Defra PPC Guidance Notes  
<http://www.defra.gov.uk/environment/quality/industrial/las-regulations/guidance/>

# 3

## Chapter 3: Approvals and Consents

## Key Points

CHP plant may require both planning approval (to be installed) and regulatory consent (to be operated). The regimes that will be applied to gain both planning approval and regulatory consent depend largely on the size of the CHP plant, and the fuel that it runs upon.

Very small CHP plant installed in existing buildings may be covered under permitted development rights, and not require planning approval. Larger CHP plant will require planning approval from the local authority.

Air quality is a 'material consideration' in the planning system, meaning local authorities can require mitigation measures or even refuse an application entirely if a development will have an unacceptable impact on air quality.

The regulatory regime that CHP plant falls into depends upon its size. For smaller CHP plant ( $<20 \text{ MW}_{\text{th}}$ ) the relevant regime is the Clean Air Act. This Act is old legislation, and provides very little regulatory control for CHP plant running on the most commonly used fuel (natural gas). The planning system is therefore a much more powerful and effective tool for controlling smaller CHP installations than regulation under the Clean Air Act.

## CHP in the Planning System

- 3.1 This chapter provides only a brief description of CHP in the planning system and should be read alongside the Environmental Protection UK document 'Development Control: Planning for Air Quality'. Another useful source of guidance is the Defra guidance 'Low Emission Strategies', part of the Local Air Quality Management policy guidance.
- 3.2 All but the smallest CHP installations will require planning consent. Planning approval may be required for a development as a whole in cases where the plant is part of a new building development, or for new buildings, stacks, etc where a CHP plant is installed in an existing development.
- 3.3 In November 2008 a new Planning Act was passed, which affects how planning consent is provided for larger CHP plant. This set the foundations for the establishment of an Infrastructure Planning Commission (IPC), which will decide on planning applications for infrastructure of 'national significance'. The IPC's decisions will be based on National Policy Statements; Policy Statements for energy infrastructure have now been formally designated (2011). In terms of energy projects, generation stations of more than 50MW<sub>th</sub> will in the future receive planning approval from the IPC rather than the local authority and/ or the Secretary of State. Planning applications will be handled under the 'new' regime once the relevant National Policy Statements are in place. Until this time planning applications will continue to be handled under the 'old' system, and once started applications will not be transferred into the new system.
- 3.4 The coalition Government has announced its intention to make further changes to this new system. The system of National Policy Statements will remain, however the Infrastructure Planning Commission will be abolished as an independent body and recreated as a Major Infrastructure Unit within the Planning Inspectorate. The new unit will advise Ministers at the relevant government department for each category of infrastructure, who will provide the final decision on planning consent (e.g. Ministers at the Department of Energy and Climate Change will decide upon energy infrastructure).
- 3.5 It is unlikely that planning applications for CHP installations in the size range covered by this guidance will require a formal Environmental Impact Assessment (EIA). The type of development and relevant size (or other) thresholds that require an EIA in England are set in the Town and Country Planning (Environmental Impact Assessment) Regulations 2011.

## General Permitted Development

- 3.6 Certain types of changes to properties can be made without the need to apply for planning permission. These are called ‘permitted development rights’ and derive from a general planning permission granted not by the local authority but by Parliament. In some areas of the country, known generally as ‘designated areas’, permitted development rights are more restricted. These areas may include conservation areas, National Parks, Areas of Outstanding Natural Beauty and the Norfolk and Suffolk Broads,
- 3.7 Local planning authorities can also remove permitted development rights by issuing an ‘Article 4’ direction. Article 4 directions are made when the character of an area of acknowledged importance would be threatened. They are most common in conservation areas. Planning departments can provide details of the status of permitted development in a local authority area.
- 3.8 Permitted development will only normally apply to smaller CHP plant installed in domestic property. When CHP plant is installed in an existing domestic property planning permission is not normally needed if all of the work is internal. If the installation requires a flue outside, however, it will normally be permitted development as long as it:
- does not exceed 1m above the roof height;
  - is not installed on the principal elevation and visible from a road; or
  - Scotland only – the flue is not situated within an Air Quality Management Area (when CHP is wood fuelled).

At the time of writing the Government were still deciding upon permitted development rights for CHP in non-domestic buildings.

- 3.9 If the project also requires an outside building to store fuel or related equipment the same rules apply to that building as for other extensions and garden outbuildings.
- 3.10 Further information about permitted development is available on the Planning Portal website (see Chapter 3 reading links).

## Section 106 Agreements

- 3.11 Section 106 agreements are commonly known as ‘planning gain’. They attach conditions to the grant of planning consent, for example for the developer to fund

new community facilities or road improvements. The legislative basis for planning obligations is Section 106 of the Town and Country Planning Act 1990.

- 3.12 Section 106 agreements can also be used to mitigate air quality impacts. PPS23 outlines the statutory basis for applying a combination of planning conditions and legal obligations to address the environmental impacts of proposed developments. In particular, it notes that ‘Section 106 Agreements can be used to improve air quality, make other environmental improvements ...or offset the subsequent environmental impact of a proposed development.’ The use of Section 106 agreements to mitigate transport impacts of development is extensively covered in the Defra Guidance ‘Low Emission Strategies’.

## Regulation of CHP Plant

- 3.13 In common with other combustion appliances, CHP systems are subject to a range of regulatory regimes. The regime that a system will fall into depends upon its size (based upon its rated thermal input), and sometimes the type of fuel it burns.
- 3.14 The regulatory regime applicable to different CHP plant is shown in Table 3.1. The regulatory thresholds apply to the cumulative total of the combustion plant on a site regulated under a single permit. Note that if a CHP plant is running on a fuel classified as waste (for example waste wood or oils) then special regulatory conditions may apply; see the Environmental Protection UK guidance ‘Biomass and Air Quality’ for more details.

**Table 3.1: Regulation of CHP Plant**

Plant size	Pollution regulation applicable	Regulator
<20 MW <sub>th</sub>	Clean Air Act	Local authority
20 - 50 MW <sub>th</sub>	LA-PPC (Part B PPC)	Local authority; SEPA/NIEA
> 50 MW <sub>th</sub>	EPR (Part A1); PPC Part A Sc & NI LCPD also applies	Environment Agency SEPA/NIEA
All plant rating is thermal (input) capacity.		



3.15 More information on the regulatory regimes shown in Table 3.1 is contained in Appendix B – Regulatory Regimes Applicable to CHP.

## Chapter 3 Reading Links

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- The Planning Portal - the UK Government's online planning and building regulations resource for England and Wales  
<http://www.planningportal.gov.uk/wps/portal/portalhome>
- Environmental Protection UK Air Quality and Planning Guidance  
<http://www.environmental-protection.org.uk/aqplanning/>
- Environmental Protection UK Biomass and Air Quality Guidance  
<http://www.environmental-protection.org.uk/biomass/>

If the links above to the EPUK website do not work please search for the documents you require at [www.iaqm.co.uk](http://www.iaqm.co.uk)



## Chapter 4 – Assessing and Mitigating Potential Impacts

## Key Points

There is no requirement on developers to provide detailed information on building services as part of planning applications. Air quality officers in local authorities may therefore wish to work with planning colleagues to develop suitable policies and flags for CHP systems within the planning application process.

Once planning applications containing a CHP system have been identified a quick risk based assessment can be used to ascertain if air quality impacts may be an issue. If this identifies a significant risk, assessment should proceed to a screening assessment and, if needed, detailed dispersion modelling.

If air quality impacts are judged to be significantly negative the applicant should be given the option to specify a cleaner CHP system or apply abatement measures. Abatement for NO<sub>x</sub> takes the form of primary measures (reducing direct NO<sub>x</sub> output from the system) or secondary measures (using abatement equipments to remove NO<sub>x</sub> from the flue gases).

Careful site design can also be used to reduce air quality impacts. Offset measures can also be used to reduce the overall air quality impact of developments containing CHP systems.

## Identifying CHP Systems with Potential Air Quality Impacts

- 4.1 Air quality professionals within local authorities may become aware of proposed developments containing CHP plant at a number of stages in the planning process, as they would with development containing any other combustion plant. There is no universal requirement on developers to provide detailed information on building services (which cover any CHP plant) at the planning stage, and the planning policies of individual local authorities will therefore determine the stage within the planning process where that local authority is notified of a proposed CHP system. If no policies are in place at all local authorities may not receive any notice of a proposed CHP system until the Building Control stage.
- 4.2 If air quality is a particular issue for a local authority, or there is a potential risk that emissions from CHP plant (or other combustion plant installed in buildings) could significantly impact on air quality, it is essential that air quality professionals raise the issue with their planning colleagues and any necessary planning policies are put in place.
- 4.3 Once a local authority receives notification that a CHP system is planned for a particular location a number of steps need to be followed to assess whether the potential air quality impacts are significant. The first, and probably most important step, is to collect basic information about the proposed CHP system to enable a quick risk based assessment to be made. This may be followed by the collection of more detailed information, a screening assessment, and proceeding to a more detailed assessment if screening suggests that there may be a significant impact. Factors to consider within an initial quick risk based assessment are shown in Table 4.1.
- 4.4 It is important to note that a CHP system replaces emissions from two sources (boilers and power stations) with emissions from a single CHP system. However, any reductions in emissions from power stations achieved by a new CHP installation will not be a factor in assessment of local air quality impacts, as these emissions reductions will not affect air quality in the area around the proposed CHP system. Assessments of CHP impacts on local air quality should therefore compare the difference in local emissions only between CHP and realistic alternatives (e.g. boilers).

**Table 4.1 – Factors to Consider in a Quick Risk Based Assessment**

<b>Geography</b>	The potential risk of a breach of air quality standards is increased if the CHP system is in or near (and could potentially affect) an Air Quality Management Area. If air quality in the area around the CHP system is marginal there is a risk that emissions from the CHP plant could trigger a new AQMA.
<b>Fuel substitution/alternatives</b>	If the CHP system is replacing a conventional boiler running on a 'clean' fuel such as gas then it could negatively affect air quality. Conversely if it is a natural gas system replacing old boilers running on 'dirtier' fuels such as coal, oil or biomass there may be little, or even a positive, effect on air quality. If the boiler is being installed on a site with no current combustion appliances some consideration of alternative fuels or technologies should be made – for example are 'clean' fuels and technologies such as natural gas boilers available, or are the realistic alternatives coal and oil?
<b>Technology and fuel</b>	Although a detailed assessment of the emissions performance of the CHP system is unlikely to be available at this stage some simple questions can be asked, e.g. what kind of fuel and prime mover technology is likely to be used, and how does this compare to the indicative performance in graphs 2.1 and 2.2.

- 4.5 Note that even if this quick assessment suggests that there is very little risk to air quality the proposed CHP system should still be checked to ensure it is compliant with any provisions of the Clean Air Act that may apply and/ or whether it needs a permit to operate (see Charts 4.1 and 4.2). Suitable conditions can then be added to planning to ensure regulatory conditions are met (e.g. that a permit is gained from the appropriate regulator).
- 4.6 If the quick assessment suggests that the CHP system may pose a risk to air quality then more detailed information about the CHP system will be required. Collecting this at the earliest stage possible is key to making a good assessment, but is a step that many local authorities have found to be difficult. There are several reasons for this:
- Decisions on building services (including heating and power systems) are often left

until after outline planning permission has been granted;

- The costs of the technical consultants and air quality assessments that may be needed to specify a CHP system can be high, and developers may want to secure planning permission before incurring such costs;
- Planners and developers are often unaware that CHP systems have air quality impacts, and also that different CHP technologies and fuels can vary significantly in their emission rates.

Flagging up air quality issues with planning colleagues and developers at the earliest stage possible is therefore extremely important.

- 4.7 A CHP information request form has been produced alongside this guidance, which local authorities can tailor and use to request information from developers. It is good practice to vary the depth of the information requested according to the risk to air quality suggested by the initial quick assessment. Where the developer is unable to supply information on their proposed appliance(s) generic figures may be available to use in screening assessments; however if this assessment suggests that air quality impacts may be significant developers should be allowed the opportunity to supply more detailed information on their proposed system to enable a more accurate assessment to be made.
- 4.8 Once basic information has been collected a screening tool can be used to make an initial assessment. If this shows that the impact may be significant the developer can then be asked to use more detailed dispersion modelling to make a more detailed assessment of emissions and stack heights. If the impact is still judged to be significant the developer can be asked to use abatement technology, choose a cleaner CHP system or, if none of these are suitable, use different technologies to reduce carbon emission. A simple flow diagram of the process is shown in Chart 4.1. The process for checking any provisions of the Clean Air Act that may apply is shown in Chart 4.2.
- 4.9 There is no specific Government guidance on determining the significance of air quality impacts within an air quality assessment, and the definition of what is a significant impact therefore ultimately lies with the judgement of the individual local authority. Chapter 6 (Assessing Significance) of the Environmental Protection UK document 'Development Control: Planning for Air Quality' provides a detailed background against which decisions on significance can be made.
- 4.10 To support local authorities' duties under LAQM a help desk has been established, which can be contacted on 0800 0327952. The helpdesk can provide assistance in

three areas:

- Answers to local authorities' questions on air quality monitoring, modelling and emissions inventories.
- Information and guidance to assist local authorities in carrying out the Local Air Quality Review and Assessment process required under Part IV of the Environment Act 1995.
- Information and guidance to assist local authorities in preparing and implementing Air Quality Action Plans for improvement of local air quality.

- 4.11 Smaller CHP systems installed in existing buildings may be fitted without notification to, or involvement of, the local authority. Localised increases of NO<sub>x</sub> or PM concentrations could potentially occur if a number of small CHP systems are installed in a particular geographical area.

## Energy Statements and Basic Information about a CHP System

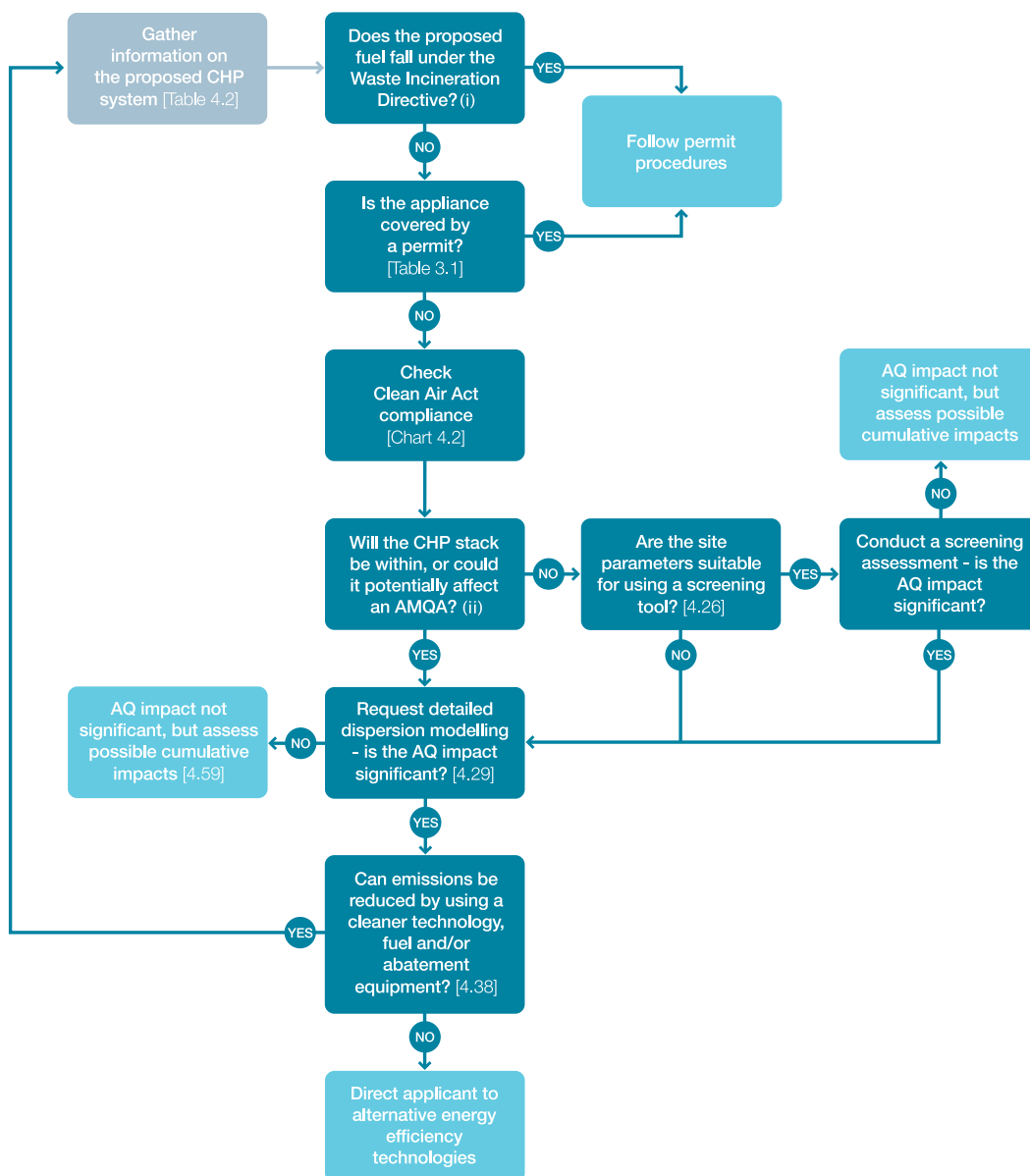
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- 4.12 If a local authority has introduced a carbon reduction or local renewable energy target, developers submitting affected planning applications should include an Energy Statement to detail how the target will be achieved. There is no Government guidance on what a local authority should ask developers to include in these statements; however a common series of steps within a statement would be:
- A description of measures taken to reduce carbon emissions through energy efficiency;
  - A calculation of the predicted energy demand and carbon emissions for the development, and the amount of renewable energy provision needed to meet the target;
  - A consideration of the technologies that could be used to generate any renewable energy requirement, and their advantages and disadvantages for the particular development in question;
  - A decision on the type of any renewable energy system(s) to be installed and a calculation of their size to comply with the energy demand.

CHP systems may be covered in an Energy Statement at a number of stages: fossil fuelled systems may form part of the proposed energy efficiency measures, whilst renewably fuelled systems may be mentioned in the renewable energy section.



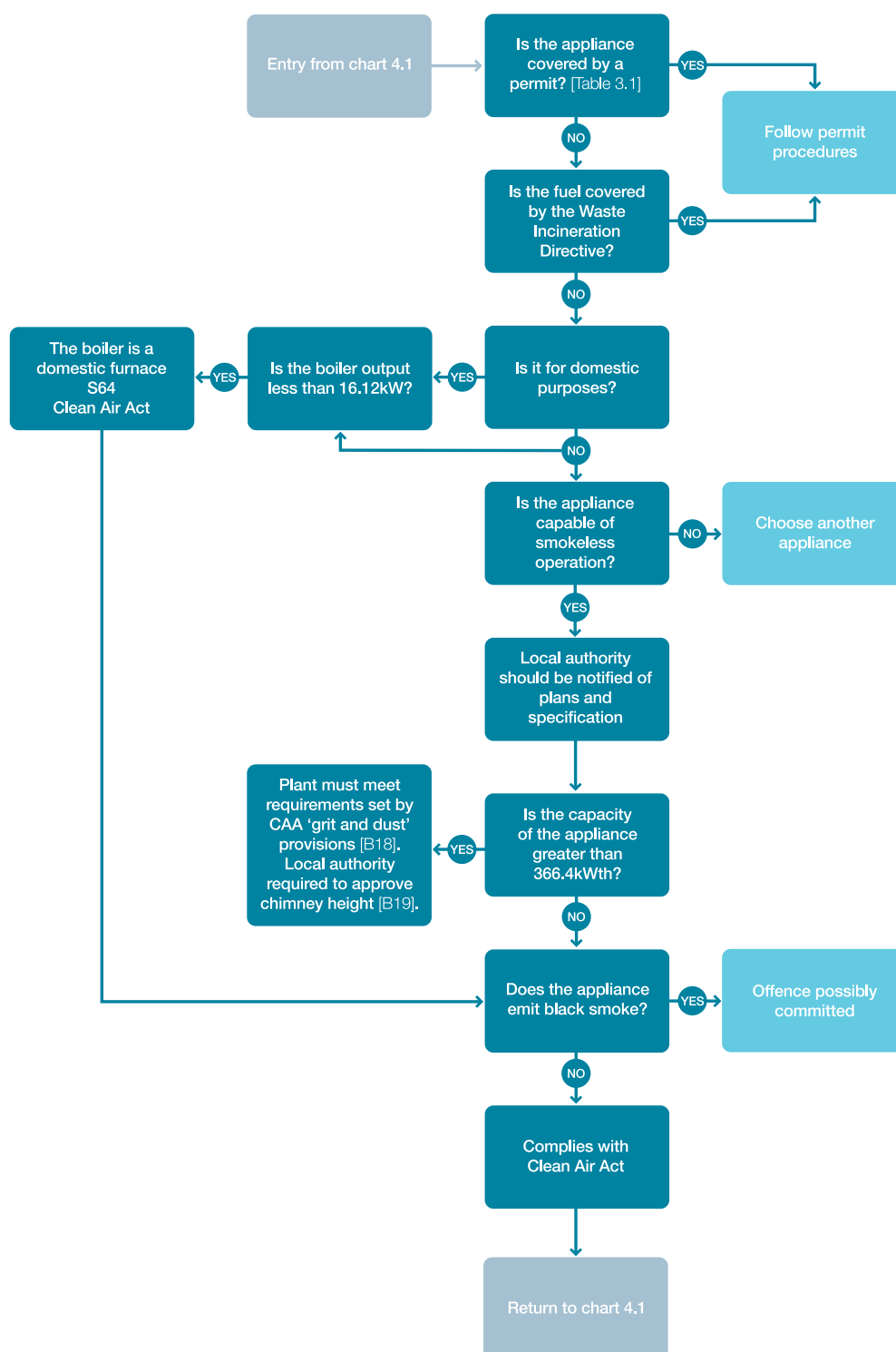
**Chart 4.1:– An Air Quality Assessment in the Planning Process for CHP Systems  
(numbers in brackets refer to relevant sections of this guidance)**



i) See paragraph 3.21 in EPUK's Biomass and Air Quality Guidance <http://www.environmental-protection.org.uk/biomass/>

ii) How a new development may affect an AQMA is discussed in more detail in EPUK's guidance 'Development Control: Planning for Air Quality'. See [www.environmental-protection.org.uk/aqplanning/](http://www.environmental-protection.org.uk/aqplanning/)

**Chart 4.2: The Application of the Clean Air Act to Gas or Liquid Fuelled CHP Systems**



- 4.13 If a CHP system is proposed in the Energy Statement basic information should be requested about the proposed system to enable an initial assessment to be made. As a minimum, this should include:
- The capacity of the proposed system either in thermal input or electrical output, and if possible its make and model;
  - The type of prime mover technology and the fuel to be used;
  - If the CHP system is solid fuelled confirmation that it will be an approved appliance under the Clean Air Act;
  - The precise location of the proposed stack(s).
- 4.14 To avoid time-consuming conversations for both sides, it is advisable that guidance on air quality issues and the type of basic information needed to make an assessment should be provided to developers early in the planning process. It is essential that developers are informed of, and understand, the need to supply this basic information at the earliest stage possible.
- 4.15 If an Energy Statement is required the local authority planning department should provide guidance to the applicant regarding the format of the statement and the information that they would like to see included. Information regarding CHP and air quality can be provided to developers alongside (or integrated into) this guidance.

## Making an Initial Assessment

- 4.16 Once sufficient information is available a basic assessment on the suitability of the CHP system can be made. Initially this can be a simple checklist:
- Does the CHP system require a permit to operate?
  - If the CHP system uses solid fuel will it be installed in a Smoke Control Area and is it an exempt appliance ?
  - Will the CHP system be installed in or close to an Air Quality Management Area?
  - Is air quality likely to be a material consideration in this planning application (i.e. is their potential to breach, or make a breach worse, of an air quality objective?
- 4.17 Any air quality consideration that relates to land use and its development is capable of being a 'material' planning consideration. However, the weight given to air quality in deciding the application will depend on such factors as:
- The severity of the impacts on air quality;

- The air quality in the area surrounding the proposed development;
- The likely use of the development, i.e. the length of time people are likely to be exposed at that location; and
- The positive benefits provided through other material considerations.

- 4.18 Ultimately the decision on whether air quality is a material consideration comes down to the significance of the effects of the development (and CHP system) on air quality. Whether the impact is 'significant' is a judgement made by the local authority, and assessing significance can be a difficult process in some cases. The issue of significance of the air quality impacts of a development, and the likely outcome in terms of planning decisions, is explored in detail in the Environmental Protection UK Guidance 'Development Control: Planning for Air Quality' (Chapter 6).
- 4.19 If air quality is judged to be a material consideration for the application, planning can be conditional on stricter conditions than minimum compliance with the applicable regulatory regime and in certain cases permission for a CHP system to be installed can even be refused. Before these decisions are taken, however, further information about the proposed system should be obtained, and a more detailed assessment made.

## Technical Information to Obtain on a CHP System

- 4.20 Table 4.2 shows the type of information that should be collected to enable a more detailed assessment to be made. A template information request form has been produced alongside this guidance document and is available to download. Note that this form is a template, and the amount of information requested should be considered against the likely risk the CHP system poses to air quality.

**Table 4.2 – Typical Information to Obtain on a CHP System**

Item	Details of the proposed boiler
Detail	This should include the type of prime mover technology and the fuel the system will use. More detailed information will also be required to make a full assessment – this should include the make, model and capacity of the CHP plant, its combustion system, emissions rates, whether it is fitted with a heat store or peaking plant, and details of any emissions abatement equipment fitted.
Reasoning	This information on the basic design of the system will help to assess the emissions performance. The emissions performance of a CHP system can vary with its loading, hence the need to ask about heat stores or peaking plant which can even out load (although there may be additional emissions associated with peaking plant).
Item	Procedures for system operation and maintenance
Detail	This will include the maintenance schedule associated with the CHP system, stack and abatement equipment (if fitted). Plans for identifying and rectifying system failures should also be requested.
Reasoning	System efficiency and emissions performance greatly depend upon regular maintenance.
Item	Stack details
Detail	This will include the height and diameter of the stack, and details of the methodology used to calculate this. The grid reference of the stack should also be requested to help monitor possible cumulative impacts.
Reasoning	The design of the stack greatly affects how pollutants produced in the CHP system disperse over the surrounding area. Where the area is heavily built up, or has existing air quality issues, dispersion becomes more complicated.

Item		Fuel details
Detail		This will include details of the type of fuel used and its compatibility with the proposed CHP system. If the fuel is not natural gas details of fuel standards, procedures in place to ensure consistent fuel quality and arrangements for fuel storage and delivery should also be requested.
Reasoning		Emissions from a CHP system depend greatly on the type and quality of the fuel used. If the fuel is not natural gas reasonable guarantees are needed that the fuel is compatible with the CHP system, is of a high quality and that quality will be assured for a reasonable period of time.
Item		Building details
Detail		This will include the height of the building the stack is attached to, and details of neighbouring buildings.
Reasoning		The height and distance of neighbouring buildings will determine their exposure to emissions from the CHP system, and therefore the height of the stack needed
Item		Plans
Detail		This will include a site plan of the development and the CHP infrastructure (the system itself and its stack, and fuel stores and delivery routes for systems not using natural gas).
Reasoning		These details will help with the air quality assessment. For non-natural gas systems these details can also be used to ensure that fuel storage, reception and delivery areas are adequate.

## Screening Assessment

4.21 A screening tool is designed to make a simple ‘worst case’ assessment of the air quality impacts of, in this case, a CHP system. The screening assessment uses basic information to produce a predicted worst case increase in the concentration of a pollutant(s) due to the CHP installation. If a screening assessment indicates that the



air quality impact of an installation is acceptable no further assessment is usually required – the application has been ‘screened out’.

- 4.22 As part of the development of this guidance a spreadsheet screening tool has been produced to help screen the air quality impacts of proposed CHP installations. This can be freely downloaded from the EPUK website. The spreadsheet tool is for gas fired CHP only, as these currently make up the overwhelming majority of installations. It screens for the pollutant nitrogen dioxide, as this is the pollutant most strongly associated with gas fired CHP.
- 4.23 Please note that the screening tool uses macros. These may be incorrectly reported as viruses by your computer. Your spreadsheet package may automatically disable macros, in which case the screening tool will not be fully functional. If this is the case please contact your IT support or use your spreadsheet’s help function to find out how to enable macros.
- 4.24 To use the screening tool a minimum level of information will be required, including:
- CHP technology type (internal combustion engines and gas turbines supported);
  - Fuel (natural gas and biogas supported);
  - Size of the CHP installation (in kW<sub>e</sub>);
  - Height of stack above ground;
  - Diameter of stack;
  - Height, and distance to, the nearest receptor to the stack (only needed if the stack height is less than 10m)
- 4.25 To use the tool please complete the yellow boxes using either the drop down menus or by entering the appropriate figures. If the ELV or NO<sub>x</sub> emission rates are available for the proposed CHP system these can be used, if they are not the tool uses worst case emission assumptions for the combination of CHP technology and fuel indicated.
- 4.26 Other screening assessment tools are also available, with a list available in Appendix C of EPUK’s ‘Biomass and Air Quality Guidance for Local Authorities’. It is important to read and note the limitations of a screening tool and check that the site parameters are suitable for the application of the tool. This information is contained in the ‘information’ sheet of the screening tool that accompanies this guidance.
- 4.27 Assessment using screening models is likely to be appropriate for CHP installations that are not regulated under the Environmental Permitting Regulations provided that the limitations of screening models are not exceeded. For example, most screening

models are not applicable in areas where there are steep hills (>1:10) close (<10 stack heights) to the stack.

- 4.28 Screening assessments are designed to be inherently conservative – they use worst-case scenarios to ensure that the worst-cases (in terms of emissions and dispersion) are captured by the tool. If the screening tool shows a significant impact then a more detailed assessment should be undertaken.

## Dispersion Modelling and Stack Height Assessment

- 4.29 Detailed assessment of air quality impacts from combustion plant is usually achieved by dispersion modelling of emissions from the boiler to ascertain if they are significant. Dispersion modelling is also used to calculate the stack height necessary to ensure adequate dispersal of pollutants (note however that stack heights may be restricted by other considerations within the planning regime).
- 4.30 Most local authorities will require the developer to commission and fund the dispersion modelling. The modelling itself is usually carried out by a private consultant, as the costs of software and training are high. Local industry knowledge is usually enough to select a competent consultant. A template air quality assessment procedure for gas-fired CHP plant has been developed alongside this guidance which consultants can be asked to follow.
- 4.31 There are a number of validated detailed dispersion models that can be used for air quality assessment. The most widely used in the UK for assessing the impact of stack emissions on local air quality are ADMS 4.2 and AERMOD.
- 4.32 ADMS 4.2 has been developed by Cambridge Environmental Research. It is a new generation air dispersion model, which means that the atmospheric boundary layer properties are described by two parameters – the boundary layer depth, and the Monin-Obukhov length – rather than in terms of the single parameter Pasquill Class. Dispersion under convective meteorological conditions uses a skewed Gaussian concentration distribution. The model takes account of the plume rise resulting from the thermal buoyancy and upwards momentum of the discharge. ADMS 4.2 has a number of model options including the ability to take account of hills and buildings. It includes an in-built meteorological pre-processor that allows the user to input a range of meteorological data.
- 4.33 AERMOD has been developed by the US Environmental Protection Agency. AERMOD is also a new generation dispersion model. The model operates with a

range of data pre-processors:

- AERMET, a meteorological data preprocessor;
- AERMAP, a terrain data pre-processor that incorporates complex;
- AERSURFACE, a surface characteristics pre-processor; and
- BPIPPRIME, a multi-building dimensions program.

4.34 Various companies have integrated the AERMOD models in proprietary modelling packages, including BEE-Line Software, BREEZE and Lakes Environmental.

4.35 Older models used a simpler representation of the atmospheric boundary layer. Examples of these models were ISC3 from the US EPA and various models based on the National Radiological Protection Board R91 model. These models are no longer widely used.

4.36 Table 4.3 summarises the input data typically required for detailed dispersion modelling.

**Table 4.3: Input Data Typically Required for Detailed Modelling**

Data class	Input required	Units	Notes
Emissions	Rate of emission of pollutant	g/s	
Discharge characteristics	Stack height above ground	m	
	Stack diameter	m	
	Discharge temperature	°C	
	Discharge velocity	m/s	
	OS grid coordinates	m	
Building characteristics	Height	m	
	Length	m	
	Width	m	
	Orientation	degrees	
	OS grid coordinates	m	
Terrain	Height above datum	m	Data usually required on a regular grid

Data class	Input required	Units	Notes
	Surface roughness	m	Constant value usually applied, but possible varying across grid
Meteorological data	Wind speed	m/s	Hourly sequential data, typically for at least 3 years.
Data is typically purchased from the Met. Office or other data suppliers			
	Wind direction	degrees	
	Cloud cover	oktas	
	Boundary layer height	m	
Receptor grid	OS grid coordinates	m	Receptors on a regular grid or at specific locations

4.37 Dispersion models do have limitations in some cases, for example where building designs and layout are very complicated or receptors are in close proximity to the source(s) – particularly where surrounding buildings are of a similar height (or are taller) than the stack. In such cases consideration should be given to computational fluid dynamics modelling which will allow more detailed consideration of impacts. An appropriately qualified air quality consultant will be able to provide advice in these cases.

## Mitigation of Emissions

4.38 If dispersion modelling suggests that air quality impacts would be significant and/or the stack height needed to adequately disperse emissions is unacceptable then mitigation options should be looked at.

## NO<sub>x</sub> Formation and Emission Reduction

4.39 NO<sub>x</sub> is the principal pollutant associated with natural gas fired CHP systems (the most commonly used fuel). To understand abatement options it is important to understand how NO<sub>x</sub> forms in combustion plant.

- 4.40 Natural gas consists of a high percentage of methane (generally above 85%), plus varying amounts of other hydrocarbons such as ethane, propane, butane and other gases such as nitrogen, carbon dioxide and helium. As with any combustion process in atmospheric air, when natural gas is burned, the high proportion of nitrogen means that oxides of nitrogen are created (typically 90% NO and less than 10% NO<sub>2</sub> at the point of emission).
- 4.41 There are three recognised NO<sub>x</sub> formation mechanisms in the combustion process:
- “Fuel NO<sub>x</sub>” by conversion of chemically bound nitrogen in the fuel;
  - “Thermal NO<sub>x</sub>” by fixation of nitrogen in the combustion air; and
  - “Prompt NO<sub>x</sub>” by a mechanism in which molecular nitrogen is converted to NO via intermediate products in the early phase of the flame front with hydrocarbons participating in the reactions.

The first two mechanisms are the only ones of major importance in most combustion plants. Fuel NO<sub>x</sub> is most important in coal-fired and biomass fired combustion systems, as these fuels have a higher fuel nitrogen content; fuel NO<sub>x</sub> is less important in natural gas combustion. Most NO<sub>x</sub> formation in natural gas combustion is through the thermal mechanism (at over 1000°C) which is influenced by oxygen concentration, peak temperature and time of exposure of the fuel to this peak temperature. As these three factors increase, NO<sub>x</sub> emission levels rise. NO<sub>x</sub> emissions can be reduced by designing and tuning systems in such a way that oxygen concentrations, peak temperatures and exposure times are reduced.

- 4.42 Control of NO<sub>x</sub> emissions can be achieved through primary measures, which generally minimise thermal NO<sub>x</sub> formation through oxygen reduction and the control of combustion temperature, or secondary measures where exhaust gases are treated to remove NO<sub>x</sub>.
- 4.43 Primary measures (summarised in Table 4.4) include low-NO<sub>x</sub> burners (LNB), staged air supply, flue gas recirculation and water/steam injection. These measures can be retrofitted to existing CHP systems to achieve varying degrees of NO<sub>x</sub> reduction, though use of new systems may be more cost-effective. There are trade-offs in controlling NO<sub>x</sub> emissions in this fashion, as systems such as low NO<sub>x</sub> burners, lean-burn engines and flue gas recirculation (FGR) may experience reduced combustion efficiency and thereby increase CO emission.

**Table 4.4 – Primary NO<sub>x</sub> Reduction Techniques**

CHP type		Applicable techniques	Paragraph
Gas Turbines		<ul style="list-style-type: none"> <li>• Steam injection</li> <li>• Low NO<sub>x</sub> burners</li> </ul>	4.37
Gas Engine	Compression Ignition Engines	<ul style="list-style-type: none"> <li>• Lean burn technology</li> <li>• Water addition</li> <li>• Tuning for NO<sub>x</sub></li> <li>• Fuel/air mixing improvements</li> <li>• Reduction of air manifold temperature</li> <li>• Exhaust Gas Recirculation</li> </ul>	4.43
	Spark Ignition Engines	<ul style="list-style-type: none"> <li>• Lean burn technology</li> <li>• Tuning for NO<sub>x</sub></li> <li>• Reduction of air manifold temperature</li> <li>• Exhaust Gas Recirculation</li> </ul>	4.43

**Table 4.5 – Secondary and Wider NO<sub>x</sub> Reduction Techniques**

CHP type	Applicable techniques	Paragraph
All (secondary measures)	<ul style="list-style-type: none"> <li>• Selective Non-Catalytic Reduction</li> <li>• Selective Catalytic Reduction</li> </ul>	4.46
All (wider measures)	<ul style="list-style-type: none"> <li>• Building and stack design optimisation</li> <li>• Offset measures (e.g. Low Emission Strategies)</li> </ul>	4.50

## Primary Measures – Gas Turbines

- 4.44 NO<sub>x</sub> emissions from unabated gas turbines are generally a function of engine load, combustion temperature and size. NO<sub>x</sub> emission reductions are generally achieved by reducing average combustion temperatures. The most common methods for achieving this are water or steam injection and low-NO<sub>x</sub> burners.
- 4.45 Water or steam can be injected into the turbine combustion chamber, typically at a rate of 50-100% fuel input rate. This will slightly reduce CHP system efficiency and increase CO emissions. Injection also tends to reduce the life of some of the turbine components and has operating cost implications for the turbine and its associated systems. The equipment needed to treat and inject water or steam into a gas turbine increases the capital cost of the scheme by around 2-3% and operating costs typically rise by 1-2%.
- 4.46 Low-NO<sub>x</sub> burners (sometimes known as dry low-NO<sub>x</sub>), have been developed which operate with a lower-temperature flame to reduce emissions. As such, it is anticipated that low NO<sub>x</sub> burners could be used widely in all new plant. Retrofitting low NO<sub>x</sub> burners is sometimes feasible, but the modifications required may make this impractical in some cases.

## Primary Measures – Internal Combustion Engines

- 4.47 NO<sub>x</sub> emissions from gas engines vary with engine size and speed. It is generally considered that larger, lower speed engines will produce more NO<sub>x</sub> than smaller high-speed engines.
- 4.48 The quantity of NO<sub>x</sub> in engine exhausts is influenced by the quantity of air mixed with the fuel in the engine. If the mixture contains exactly enough air to burn the fuel (in the case of natural gas, about 17 parts of air per unit of gas), combustion is stoichiometric and there is no oxygen in the resulting exhaust release. Under these conditions, it is possible to add a special catalytic converter to the exhaust system which converts NO<sub>x</sub> into nitrogen. An alternative is use of lean-burn technology.
- 4.49 Lean-burn technology is the principal technique for the reduction of NO<sub>x</sub> emissions. Lean-burn engines run with a high level of excess air (typically about 50%) to reduce the peak temperature, so that low levels of NO<sub>x</sub> are emitted. The drawbacks of this process are that the proportion of NO<sub>x</sub> formed as NO<sub>2</sub> is increased and emissions of unburned fuel are higher, which necessitates the use of an 'oxidation catalyst' to convert this unburned fuel into CO<sub>2</sub> and water. Lower temperatures do have the



advantage of giving longer component life and lower maintenance costs.

4.50 Reductions in  $\text{NO}_x$  emissions can also be achieved by combustion modification.

Depending on engine design, and cost-effectiveness over a long period, the use of the following techniques may be appropriate for emission reduction in CHP systems:

- Reduction of charge temperature by the addition of water (CI Engines). This is impractical in most circumstances;
- Tuning for  $\text{NO}_x$  (ignition timing). Incorrect spark-ignition timing can result in lost power, high emissions and unburned fuel;
- Fuel/ air mixing improvements (CI engines). This is generally only available on new engines, although in some cases systems can be retrofitted to existing engines;
- Reduction of air manifold temperature. Decreasing the temperature of air drawn into the engine can reduce combustion temperatures and reduce  $\text{NO}_x$  levels. This technique should be applicable to both existing and new engines;
- Exhaust Gas Recirculation (EGR). Recycling exhaust gas into the air inlet feeds more inert mixture into the engine lowering peak flame temperatures and thereby  $\text{NO}_x$  generation. This method of  $\text{NO}_x$  reduction is not recommended for lean-burn engines as peak temperatures are already reduced.

4.51 All the above techniques (except lean burn engines) have the drawback of reduced efficiency and increased emissions of  $\text{CO}$ ,  $\text{CO}_2$  and VOCs. As application of emission abatement technology becomes more cost-effective with larger systems these options should be considered at the design stage where possible.

4.52 The performance of any CHP package will only remain close to the initial level specified if it is monitored and maintained to the appropriate level. Failure to operate the CHP systems correctly, and to maintain it effectively, will not only result in a loss of the expected cost savings: it will also reduce the environmental benefits that can be achieved. Maintenance contracts can generally be agreed to guarantee an availability of operations for more than 90% of the time. Monitoring systems can track both performance and the condition of a CHP installation, thereby helping the early diagnosis of problems to minimise downtime and repair costs.

## Secondary Measures

4.53 The principal secondary treatment measures to remove  $\text{NO}_x$  from flue gases are Selective Non-Catalytic Reduction (SNCR) and Selective Catalytic Reduction (SCR). Generally,  $\text{NO}_x$  levels in the flue gas are reduced based on the selective reaction. As

these processes are large-scale plants in their own right with associated capital and operating costs, they are not expected to be used commonly with new CHP systems.

- 4.54 SNCR involves injection of ammonia or urea near the furnace to reduce  $\text{NO}_x$  to nitrogen and water. SNCR is operated without a catalyst at a temperature of 850 to 1100°C. Emission reduction with SNCR can be limited (typically up to 50%) and is lower than with SCR. SNCR also requires a sufficient retention time for the injected reagents to enable them to react with the  $\text{NO}_x$ , therefore reagent distribution must be optimised. This can be helped by the use of Computational Fluid Dynamics (CFD) modelling in the design process.
- 4.55 An SCR system is based on selective reactions with ammonia (and occasionally urea) in the presence of a catalyst at 300-400°C, so that nitrogen and water are produced. It is important that excess ammonia remaining in the exhaust after the conversion process is minimised to avoid potential pollution and odour issues. The  $\text{NO}_x$  reduction efficiency can be between 70 and 90% if the system is well maintained to ensure optimum temperatures. The use of SCR for gas turbines can achieve ultra-low  $\text{NO}_x$  emissions (<10 mg/m<sup>3</sup> at 15% O<sub>2</sub>).
- 4.56 The SCR process has been widely used in America and Japan, but has been applied to very few CHP or power generation plants in the UK, as it adds to the operating costs of a CHP plant and reduces efficiency by using additional energy. Due to the high associated costs, use of this technique is envisaged only in special circumstances for larger CHP systems in sensitive locations, e.g. in areas with high background  $\text{NO}_x$  levels.

## Mitigation through Wider Measures

- 4.57 In addition to measures addressing the CHP and flue systems, mitigation options can also include looking at the building and stack design to optimise dispersion of emissions. Measures can include optimisation of stack placement within the development site and, where multiple combustion appliances are in use, consideration of multiple or single flue systems. However, whether such measures are used or not the plant should still employ the best available techniques for emissions control, as even well dispersed emissions can still contribute to background pollutant concentrations.
- 4.58 If reducing emissions from the CHP system itself is impractical, wider mitigation measures can be attached to the development containing the CHP system to effectively offset emissions. Potential measures are considered in the Environmental

Protection UK guidance ‘Development Control: Planning for Air Quality’, whilst the Defra guidance ‘Low Emission Strategies’ examines transport measures in detail.

## Assessing Cumulative Impacts

- 4.59 Assessment of potential cumulative air quality impacts of multiple CHP installations will become increasingly important as a greater number of CHP systems are installed over coming years. At the present time it would be very difficult to set an overall ‘acceptable level’ of CHP deployment in terms of air quality, as technology and regulation is subject to change. It is, however, important to consider individual planning applications for developments containing CHP systems in the context of current and planned CHP deployment.
- 4.60 Whilst a single CHP system is unlikely to affect air quality outside of its immediate vicinity, the cumulative effect of a number CHP installations could potentially add to localised air quality exceedances, and raise background levels of air pollutants. Steps should therefore be taken to ensure that biomass deployment is monitored, and screening assessments are made to ensure that any significant issues are flagged up. Steps that local authorities should take include:
- Logging of information on CHP system installations;
  - Conducting screening assessments to flag up any potential impacts;
  - Establishing common systems with neighbouring local authorities where necessary to assess any transboundary cumulative impacts;

## Logging Information

- 4.61 When planning approval is given for developments containing CHP systems the information collected on the system should be logged in a systematic fashion. It is helpful to use a common template to do this, so that information can be collected and shared with neighbouring local authorities. A suitable template with essential and desirable information is available to download from Environmental Protection UK’s website (see Chapter 4 reading links).

## Transboundary Assessments

- 4.62 CHP installations in neighbouring local authorities may have an effect on air quality in your own area, and it is therefore useful for local authorities to share information on CHP installations close to local authority boundaries.
- 4.63 In order to make the sharing of information as easy as possible it is recommended that a common format is used to record information on CHP installations. A suitable template for recording information with essential and desirable information has been developed alongside this guidance and is available to download from Environmental Protection UK's website (see Chapter 4 reading links). Many local authorities take part in county or metropolitan area air quality/ environmental health groups, which are an excellent opportunity to flag up developments with potential transboundary effects and swap information. If you do not have contact details for air quality officers in neighbouring local authorities, organisations such as the Chartered Institute of Environmental Health can help you identify whom to contact.

## Chapter 4 Reading Links

- Environmental Protection UK's guidance 'Development Control: Planning for Air Quality' contains general information on air quality assessment and mitigation of emissions.  
<http://www.environmental-protection.org.uk/aqplanning/>
- A screening tool for CHP systems has been developed to sit alongside this guidance.  
<http://www.environmental-protection.org.uk/chp/>
- A template air quality assessment procedure for gas-fired CHP plant has also been developed for use alongside this guidance.  
<http://www.environmental-protection.org.uk/chp/>
- DECC's CHP Focus website contains a section on minimising emissions.  
<http://chp.decc.gov.uk/cms/minimising-emissions/>

If the links above to the EPUK website do not work please search for the documents you require at [www.iaqm.co.uk](http://www.iaqm.co.uk)



## Appendix A: The Policy Context



The policy context described below was correct to the best of Environmental Protection UK's knowledge at the time of writing. Policy will change with time and readers are advised to check for new policy developments before applying this guidance. Environmental Protection UK will not be providing updates to this guidance.

## The Policy Context (CHP)

- A1 Policies to encourage the use of CHP have primarily been driven by climate change and the need to reduce greenhouse gases. Other relevant drivers include sustainability and energy security. UK legislative drivers have developed within the framework of EU and other international policies, strategies and instruments such as the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC).
- A2 Carbon dioxide (CO<sub>2</sub>) in the atmosphere is understood to have a warming effect. Since pre-industrial times the level of atmospheric CO<sub>2</sub> has increased from about 280 parts per million to 390 parts per million, largely due to emissions from the combustion of fossil fuels and human induced land use changes. Observations have shown that the world is now warming as a result, and modelling predicts that if we continue to emit carbon dioxide and other greenhouse gases at present rates there will be a significant change in climate over coming decades. The consequences of unabated climate change would be widespread, with increased temperatures, sea level rises and a greater frequency of extreme weather events having serious effects on the natural environment, and human health and well-being.
- A3 The Climate Change Act 2008 – is now the UK's pre-eminent climate change framework legislation. The Act commits the Government to achieving an 80% cut in CO<sub>2</sub> emissions (from 1990 levels) by 2050. An interim target of a 45% cut by 2020 has also been set. Under the Act the Government will set a series of 5-year carbon 'budgets', with three successive budgets always in legislation. The first three budgets were set alongside the (financial) budget in 2009. The official Government advisory body for setting targets and budgets under the Act is the Committee on Climate Change.
- A4 In Scotland the Climate Change (Scotland) Act 2009 commits the Scottish Government to achieving an 80% cut in CO<sub>2</sub> emissions by 2050. The Act sets annual targets for emission reduction rather than 5 year 'budgets'. An interim target of at least 42% by 2020 has been set.
- A5 In 2008 a new framework for local authority performance indicators was introduced

in England and Wales, reducing the number of indicators to 198. Local authorities are required to monitor all of the indicators; however they are only required to set improvement targets for up to 35 indicators as part of multi agency Local Area Agreements. Relevant indicators for CHP are:

- NI 185 CO<sub>2</sub> reduction from local authority operations
- NI 186 Per capita CO<sub>2</sub> emissions in the LA area
- NI 194 Level of air quality – reduction in NO<sub>x</sub> and primary PM<sub>10</sub> emissions through local authority's estate and operations.

Note that at the time of writing local Government policy was changing significantly under the UK Government's 'Localism' agenda. Local policy drivers may therefore change significantly over coming months.

- A6 A framework of financial support has been established to encourage the use of CHP. As CHP spans a wide variety of scales and fuels, the number of potential support schemes is quite large and complex. In order to receive support CHP systems are usually required to be registered as 'Good Quality' under the CHP Quality Assurance Programme (CHPQA). As well as measuring electricity efficiency, this judges CHP schemes on something called a Quality Index (QI), which measures overall energy efficiency.
- A7 The main support packages are summarised in Table A1 below. Further details are provided in the Carbon Trust publication 'Introducing combined heat and power', available on their website.



**Table A1 – The Main Support Packages Available for CHP Schemes**

Scheme	Description	Scale Supported	Fuels Supported	Notes
<b>Business Exemptions</b>				
Climate Change Levy (CCL)	CCL is a levy placed on fossil fuels consumed by business. It is chargeable on gas, electricity, coal and LPG (liquid petroleum gas) consumed in business and industry. Businesses using CHP may be eligible for reductions or even a full exemption on CCL payments (on the input fuel).	All	All fossil fuels	If power is exported to the grid from CHP, Levy Exemption Certificates (LEC) can be obtained.  These can either be sold on with the exported electricity, or sold separately to a buyer who can then gain CCL exemption on the corresponding number of units of electricity.
Enhanced Capital Allowance (ECA)	The ECA scheme offers 100% first-year tax relief on any equipment featured on the Energy Technology List (ETL), which is managed by the Carbon Trust on behalf of Government. ECAs improve cash flow, and mean the whole cost of the equipment can be written off against taxable profits in the year a business buys the equipment.	All	All	
Business Rate Exemptions	Business Rates are calculated on the rentable value of a property, which includes assumptions on the plant providing heat and power. Exemptions may be provided for CHP plant, i.e. the service provided by the plant may be deducted from the rentable value of the building.	All	All	

Scheme	Description	Scale Supported	Fuels Supported	Notes
<b>Direct Support</b>				
Renewables Obligation (RO)	The RO is the main support scheme for larger renewable electricity projects in the UK. It places an obligation on UK electricity suppliers to source an increasing proportion of their electricity from renewable sources. Accredited generators are issued with Renewables Obligation Certificates (ROCs) for any eligible renewable electricity they generate and supply within the UK. ROCs have significant financial value, and can be sold by CHP users to electricity supply companies.	All CHP schemes exporting electricity to the national grid, except those covered by Feed in Tariffs (see below)	Renewable fuels only	CHP fuelled by solid biomass is now eligible for a 'ROC uplift' if useful heat is recovered from the plant. The size of the uplift depends upon the technology and fuel used. Government proposals suggest that this uplift will be removed in April 2015, however CHP operators will be allowed to claim both ROCs and RHI payments (see below).
Feed in Tariffs (FiTs)/ Clean Energy Cashbacks	The FiTs scheme provides support for small scale low carbon electricity generation, providing direct payments for all electricity generated and also electricity exported to the grid. At present the FiTs scheme has only limited application to CHP, and the RO remains the main support scheme at all size scales.	Small scale only, see fuels	Anaerobic digestion (AD) up to 5 MW <sub>e</sub> Fossil-fuelled micro-CHP up to 2 kW <sub>e</sub> eligible for FiTs	Micro CHP FiTs payments will form a pilot scheme supporting up to 30,000 installations, with a review when 12,000 installations are completed.
Renewable Heat Incentive (RHI)	A scheme to support the production of renewable heat. CHP users will be able to claim RHI payments where a renewable fuel is used (e.g. biomass, biogas, etc).	All	Renewable fuels only	Qualifying CHP schemes will also be able to claim support under the Renewables Obligation; however the current 'uplift' for CHP in the RO is likely to be removed from April 2015.

- A8 The Carbon Reduction Commitment Energy Efficiency Scheme (CRC) is a mandatory carbon emissions reporting and pricing scheme to cover all organisations (private and public) using more than 6,000 MWh per year of electricity (equivalent to an annual electricity bill of about £500,000). Under the CRC organisations are required to report on their carbon emissions, and purchase allowances to cover their emissions. Although it does not directly support CHP the scheme encourages organisations to reduce their carbon emissions, therefore indirectly supporting low carbon technologies such as CHP.
- A9 The Code for Sustainable Homes is a system for rating the sustainability of new homes, including energy and water use performance. It replaces the EcoHomes standard in England. The Code measures the sustainability of a new home against categories of sustainable design, rating the 'whole home' as a complete package, using a 1 to 6 star rating system to communicate the overall sustainability performance of a new home. The Code sets minimum standards for energy and water use at each level. Since April 2007 the developer of any new home in England has been able to choose to be assessed against the Code, and a mandatory rating against the Code was implemented for new homes from 1st May 2008. Together with the Code, the previous Government has announced its plans to tighten the Building Regulations so that from 2016, all new homes will have to be zero carbon and meet level 6 of the Code. Level 3 became compulsory in 2010 and level 4 will follow in 2013.

## The Policy Context (Air Quality)

- A10 Policies to reduce concentrations of pollutants in the air are a response to the negative effects of these pollutants on human health and ecosystems. Many parts of the UK, (particularly densely populated urban areas) are failing to meet legally binding air quality standards. For some pollutants there has been no significant trend of improvement over the past decade. Poor air quality represents a major hazard to human health in many areas of the country, causing premature death and chronic illness.
- A11 The most widespread air quality problems relate to concentrations of fine particles (PM), nitrogen dioxide (NO<sub>2</sub>) and ozone (O<sub>3</sub>), with NO<sub>2</sub> being the pollutant most strongly associated with combustion in gas fuelled CHP systems. Particles are normally referred to as PM<sub>10</sub> or PM<sub>2.5</sub> with the number denoting their maximum size in micrometers. The smaller particles (PM<sub>2.5</sub>) are understood to have the greatest

effect on human health. Particles and nitrogen dioxide are strongly associated with combustion processes. In towns and cities vehicles emissions are normally the most significant source of both pollutants; however background (pollutants transported by the winds into an area from outside) can also sometimes be high. Ozone is a product of polluted air reacting in strong sunlight; as a long lived pollutant it can often build up to significant concentrations well away from the urban areas where it is formed.

- A12 Developments in air pollution policy during the 1990s resulted in the UK Government introducing the first National Air Quality Strategy in 1997, as a requirement of the Environment Act 1995. A series of national air quality standards and objectives were also established. The Act also established Local Air Quality Management (LAQM) as a way to address localised ‘hot spots’ of poor air quality, which could not be resolved effectively through national policy measures.
- A13 Since the development of the first UK Air Quality Strategy legally binding standards for several air pollutants have been set at a European level, including standards for  $PM_{10}$ ,  $PM_{2.5}$  and  $NO_2$ . These EU standards have been incorporated into revisions of the UK Air Quality Standards and the Air Quality Strategy, the most recent revision having taken place in 2007 (although note that standards for  $PM_{2.5}$  are not as yet incorporated into the LAQM regime).
- A14 The 2007 revision introduced a target value and exposure reduction target for  $PM_{2.5}$ , the former to be achieved by 2020. The exposure reduction target calls for a 15% cut in urban background exposure between 2010 and 2020. Urban areas are defined as agglomerations with a population of over 100,000.
- A15 The Scottish Government has established tighter Scotland only  $PM_{10}$  and  $PM_{2.5}$  objectives. These targets are not enforceable by the European Commission, but are applicable to Local Air Quality Management in Scotland.
- A16 In 2008 a new European Air Quality Directive came into force. This tidied up existing legislation by merging several Directives into one, introduced limit and target values for  $PM_{2.5}$  and provided a means of addressing breaches in air quality standards by member states, by allowing them to apply for ‘compliance flexibilities’ (deadline extensions). The UK has successfully applied for an extension to meet the  $PM_{10}$  limit values and is in the process of doing so for  $NO_2$ . The applications will need to be accompanied by a robust plan for achieving the standards by the new deadlines.
- A17 The Local Air Quality Management (LAQM) regime requires individual local authorities to periodically assess air quality and identify locations within their locality where the national air quality objectives may be exceeded by their target dates. Where any such exceedances are predicted, and where there is relevant public exposure,

local authorities have a duty to declare Air Quality Management Areas following a process of consultation. Such designations are a statutory requirement, and local authorities in England, Scotland, Wales and Northern Ireland have a duty to work towards achieving the national air quality objectives based upon standards for seven key pollutants. The legislative basis for LAQM in England, Scotland and Wales is the Environment Act (1995) and in Northern Ireland the Environment (Northern Ireland) Order 2002.

- A18 Following the designation of AQMAs, local authorities are required to develop Air Quality Action Plans (AQAPs) to identify and implement actions to improve air quality locally. Such plans require effective collaboration between authority departments and external agencies and stakeholders (such as the Environment Agency, Highways Agency and industry). Land-use planning and transport planning underpin the development of effective air quality action plans.
- A19 Local authorities have taken different approaches to establishing AQMAs. Some have declared only the exact areas where exceedances are expected to take place; this often leads to the declaration of multiple AQMAs in, for example, a city centre. Others have chosen to declare the whole area around where exceedances are found to form a single AQMA, or even make a whole district/ borough declaration (these are especially common in London). It should therefore be noted that air quality standards might not be exceeded across an entire AQMA.
- A20 Local authorities have been provided with technical and policy guidance to assist them with their duties under LAQM. This guidance is provided by Defra (England) and the Welsh Assembly Government (Wales). The technical guidance applies UK wide and was last updated in 2009. The policy guidance is issued by Defra or the relevant devolved administration. In both England and Wales the policy guidance was last updated in 2009.
- A21 The Environment Act (1995) also forms the legislative basis linking the actions of the Environment Agency (the environmental regulator) and the Air Quality Strategy. The Act requires them to 'have regard to the Air Quality Strategy in discharging pollution control functions'. Broadly this means the regulators base permit conditions for applicable installations upon Best Available Techniques (BAT). This is covered in more depth in Chapter 3.

## The (London) Mayor's Air Quality Strategy

- A22 The (London) Mayor's latest Air Quality Strategy acknowledges that CHP installations

potentially introduce new sources of air pollution into the city that, due to their relatively small size, are not covered by effective regulatory regimes. The Mayor will therefore use his planning powers to ensure emission standards are set and maintained for new CHP installations. Specifically the Mayor will:

- Require an air quality assessment for new CHP installations;
- Set emission standards for CHP plant – applicants will have to demonstrate that the proposed CHP plant is capable of meeting and maintaining the standard;
- Require annual submission of evidence that a CHP plant is meeting the emission standard (e.g. an annual maintenance report).

A23 At the time of writing the Mayor's team was working with the CHP industry and the London Boroughs to set an appropriate emission limit. Other UK local authorities were yet to set any specific planning conditions regarding CHP; however it is likely that other local authorities experiencing a high volume of planning applications containing CHP plant will follow the Mayor's lead in time.

A24 Planning policies for London are set out in the London Plan. The latest Plan (July 2011) states that developments should 'be at least 'air quality neutral' and not lead to further deterioration of existing poor air quality (such as areas designated as Air Quality Management Areas (AQMAs)'. At the time of writing the Mayor was working with the London Boroughs to define how this commitment is implemented in practice.

## Appendix A Reading Links

- Defra LAQM Guidance  
<http://www.defra.gov.uk/publications/2011/03/25/pb13081-laqm-technical-guidance-tg09/>
- Welsh Assembly Government LAQM Guidance  
<http://wales.gov.uk/topics/environmentcountryside/epq/airqualitypollution/airquality/guidance/?lang=en>
- Scottish Government LAQM Technical and Policy Guidance  
<http://www.scotland.gov.uk/Topics/Environment/waste-and-pollution/Pollution-1/16215/6148>  
<http://www.scotland.gov.uk/Topics/Environment/waste-and-pollution/Pollution-1/16215/6151>
- The Mayor of London's Air Quality Strategy  
<http://www.london.gov.uk/publication/mayors-air-quality-strategy>
- The London Plan  
<http://www.london.gov.uk/priorities/planning/londonplan>





# B

## **Appendix B: Regulatory Regimes Applicable to CHP**



The regulatory systems described below were correct to the best of Environmental Protection UK's knowledge at the time of writing. Regulation will change with time and readers are advised to check for new regulatory developments before applying this guidance. Environmental Protection UK will not be providing updates to this guidance.

## **Environmental Permitting Regulations – Pollution Prevention and Control (PPC) and Local Authority Pollution Prevention and Control (LA-PPC)**

- B1 Procedures, permit limits and conditions for the regulation of industrial pollution are broadly the same across the UK; however the systems and regulatory bodies differ between England and Wales, Scotland, and Northern Ireland. Whilst we have noted the main features of the regulatory environment across the UK below, this guidance is not intended for use in Scotland and Northern Ireland.
- B2 In England and Wales new Environmental Permitting Regulations came into force on 6 April 2010 (replacing 2007 Regulations). Most installations (known as Part A1) are regulated by the Environment Agency, with a lesser number of smaller, or less complex, installations (known as Part A2) regulated by local authorities. Some smaller installations (Part B) are regulated by local authorities for emissions to air only.
- B3 Elsewhere in the UK the comparable regulatory system is referred to as Pollution Prevention and Control (PPC). In Scotland all installations are regulated by the Scottish Environment Protection Agency (SEPA), with no local authority involvement. In Northern Ireland all Part A installations are regulated for IPPC by the Northern Ireland Environment Agency (NIEA), who also regulate Part B installations for emissions to air; district councils in Northern Ireland regulate some smaller less complex installations (Part C) also for emissions to air only under the PPC regime.
- B4 In England and Wales changes to the environmental permitting regime came into force on 1 October 2011 through the Environmental Permitting (England and Wales) (Amendment) Regulations 2011. The main changes include:
- Administrative changes to how environmental permits are issued;
  - Changes to the regulation of radioactive material & radioactive waste (and exemptions);
  - Regulation of carbon capture and storage which will require an environmental permit.

## Best Available Techniques

- B5 Permit conditions are based on the use of Best Available Techniques (BAT), which balances the cost to the operators against benefits to the environment. The IPPC Directive requires competent authorities to ensure that “installations are operated in such a way that all the appropriate preventive measures are taken against pollution, in particular through the application of best available techniques”. In seeking through the application of BAT to balance costs to the operator against benefits to the environment, the Directive defines BAT as:
- “The most effective and advanced stage in the development of activities and their methods of operation which indicates the practical suitability of particular techniques for providing in principle the basis for emission limit values designed to prevent and, where that is not practicable, generally to reduce emissions and the impact on the environment as a whole;
  - “Available techniques” means those techniques which have been developed on a scale which allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the costs and advantages, whether or not the techniques are used or produced inside the Member State in question, as long as they are reasonably accessible to the operator;
  - “Best” means, in relation to techniques, the most effective in achieving a high general level of protection of the environment as a whole;
  - “Techniques” includes both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned.”
- B6 Where a breach of legally binding EU air quality limit values is caused by a particular industrial installation or sector the regulator must set emission limits or other conditions in the permit(s) to ensure the EU limit values are met, even if the permit conditions are beyond BAT.
- B7 Guidance notes are available to assist local authorities in England and Wales with the regulation of Part A2 and Part B plant under their Local Authority Pollution Prevention and Control duties.

## The Large Combustion Plant Directive (LCPD)

- B8 The LCPD applies to combustion plant with a rated thermal input equal to, or greater than 50 MW<sub>th</sub>, irrespective of the fuel used – solid, liquid or gaseous. The Directive defines three categories of plant – with a group of boilers discharging through a single

stack being counted as a single combustion plant:

- “New-new” plant which are subject to request for a licence on or after 27 November 2002; these must comply with the Directive and meet emission limit values (ELVs) from when they are brought into operation;
- “New” plant – licensed on or after 1 July 1987, but before 27 November 2002, or subject to a full licence request before 27 November 2002 and which came into operation before 27 November 2003; these must comply with the Directive and meet ELVs from 27 November 2002;
- “Existing” plant, licensed before 1 July 1987; for this category Member States may choose to meet required emissions reductions by 1 January 2008, either through ELVs or a National Emissions Reduction Plan (NERP).

- B9 The UK’s NERP set a 2008 emissions ‘bubble’ for total emissions of SO<sub>2</sub> of 133,445 tonnes per year, 107,720 tonnes of NO<sub>x</sub> per year and 9,659 tonnes per year of dust, and allows emissions trading between participating plants.
- B10 Individual operators of existing plant may alternatively choose not to be included in the ELV or national plan approach and instead undertake to close down after 20,000 operational hours beginning 1 January 2008 and ending 31 December 2015. Operators had to inform the competent authority (i.e. the Regulators) of their decision before 30 June 2004. Implementation of the LCPD is through IPPC permit conditions.

## The Industrial Emissions Directive

- B11 The Industrial Emissions Directive (2010/75/EU) is new EU legislation that will apply to larger combustion plan (> 50 MW<sub>th</sub>). It entered into force on 6th January 2011, and must be transposed into national legislation by 7th January 2013. At the time of writing it has not yet been transposed into UK law. The Directive revises several existing Directives on industrial emissions and combines them into a single piece of legislation. Existing Directives affected include:
- The IPPC Directive, which has been revised to take account of the results of the Commission’s review of its implementation
  - VOCs (1999)
  - Waste incineration (2000)
  - Various Directives regulating the titanium dioxide industry (1978 as amended)
  - The Large Combustion Plants Directive (2001)

These Directives (including the IPPC Directive) are all to be repealed on 7 January 2014, except for the Large Combustion Plant Directive which will be repealed on 1 January 2016.

## The Clean Air Act

- B12 The Clean Air Act 1993 (in NI: the Clean Air (Northern Ireland) Order 1981) is the primary regulatory legislation for smaller CHP plant that fall outside the Environmental Permitting/ PPC system. Local authorities are the regulating body for the conditions of the Act. The most commonly known parts of the Act are those that allow local authorities to set up Smoke Control Areas (section 18; NI: Article 17), where domestic premises are committing an offence if they emit smoke unless using an approved smokeless fuel, or an exempt (approved) appliance. The Act also contains other powers regarding the control of emissions from larger domestic and industrial combustion plant. Application of the Act to CHP plant is summed up in Chart 4.2, and described in more detail below.
- B13 It is important to note the limitations of the Act. The CAA was introduced to control air pollution arising from widespread use of coal and includes provision for creation of Smoke Control Areas, planning review of furnaces, general control on smoke emissions and emission limits (for grit and dust) for larger solid fuel combustion installations. Its application to CHP plant is limited, unless the CHP system is fuelled by solid fuel (typically coal or biomass). The Clean Air Act does not directly control emissions of nitrogen oxides ( $\text{NO}_x$ ) or the smaller particles ( $\text{PM}_{10}$  and  $\text{PM}_{2.5}$ ) that are the subject of modern air quality legislation. The cumulative impacts of a large number of CHP systems and/ or other combustion appliances freely permitted under the Act could therefore be significant. Assessing cumulative impacts is discussed in Chapter 4.
- B14 In terms of fuels for CHP systems the Clean Air Act applies as follows:
- Natural gas/ biogas – these are considered to be inherently smokeless fuels and can be freely used;
  - Liquid fuels – can be freely used as long as the appliance they are burnt within has been specifically designed (or modified) to burn liquid fuels;
  - Solid fuels – in a Smoke Control Area approved smokeless fuels must be used, unless the fuel is burnt in an appliance exempted specifically for the purpose of burning that fuel. Wood is not an approved smokeless fuel.

## Emissions from Commercial Premises

- B15 Clean Air Act provisions for commercial and industrial premises apply everywhere, i.e. not just in designated smoke control areas.
- B16 Under section 1 of the Act (Art.3 of NI Order) it is an offence to emit dark smoke from industrial/ commercial chimneys unless within the limited periods allowed by the dark smoke permitted periods regulations. Sources of dark smoke can include chimneys, bonfires, skip fires and waste disposal/ demolition fires. 'Dark smoke' is defined using a Ringlemann smoke chart; British Standard approved versions of these are available to purchase online.
- B17 Under section 4 of the Act (Art. 5 of NI Order) all new furnaces installed should be capable of operating without emitting smoke, and should be notified to the local authority. Domestic boilers are excluded from these conditions – these are furnaces of less than 16.12kW output (defined as domestic furnaces).
- B18 Larger furnaces fall under the so called 'grit and dust' provisions of the Act. Here the use of a furnace burning solid fuel at 45.4 kg/h or more or liquid and gas fuels at 366.4 kW or more (other than a domestic furnace) is prohibited unless it has grit and dust arrestment plant fitted which has been agreed by the local authority, or unless the local authority has been satisfied that the emissions will not be prejudicial to health or a nuisance (section 6; NI Art. 10). Emission limits on grit and dust from furnaces (other than domestic furnaces) are prescribed by the Secretary of State under section 6.

## Approval of Chimney (Stacks and Flues) Heights

- B19 Local authorities are required to approve the chimney heights of furnaces which burn pulverised fuel and solid fuel at 45.4 kg/h or more, or liquid and gas fuels at 366.4 kW or more (sections 14 & 15; NI Arts. 14 & 15). It is an offence to use the furnace if the chimney heights are not approved, unless the local authority did not respond within 4 weeks (or a longer time if mutually agreed) following the provision of relevant information by the applicant.

## Powers to Request Monitoring and Information

- B20 A local authority may request that monitoring of emissions from furnaces be carried

out. Where the furnace is burning pulverised fuel or solid fuel at 45.4 kg/h or more or, liquid and gas fuels at 366.4 kW or more, the local authority may direct that measurements of the dust emissions are made by the occupiers of the building (section 10; NI. Art. 11). However, if the furnace is burning solid matter at less than 1.02 te/h or liquid or gas at 8.21 MW or less then the local authority can be required to carry out the monitoring at its own expense. Section 36 of the Act adds to this by requiring occupiers of buildings other than private dwellings or caravans to return estimates (not necessarily monitored) of the emission of pollutants from the premises when requested by the local authority.

- B21 Section 12 of the Act (Art.11 of NI Order) gives local authorities the power to request information on the furnaces in a building, and the fuels or wastes burnt in them, to properly perform their functions under sections 5-11 of the Act. Notice must be served in writing and the occupier must reply within fourteen days (or such longer time as may be limited by the notice). Note that whilst this applies to both domestic and commercial premises, it is unlikely that any domestic premises will fall under sections 5-11. This power could be used where local authorities suspect breaches of regulations are taking place, for example where there is a suspicion that waste derived fuels are being burnt in an appliance designed for 'virgin' fuels.
- B22 Under section 4 of the Act, before installing a furnace (except a domestic furnace) in a building or fixed boiler, the local authority must be informed; any such furnace must be capable of being operated continuously without emitting smoke when burning fuel of a type for which the furnace was designed. There is no definition of "furnace", but a practical interpretation of this word whenever it appears in clean air legislation is usually taken as "any enclosed or partly enclosed space in which liquid, solid or gaseous matter is burned, or in which heat is produced". Domestic furnaces are defined as those with a maximum heating capacity of 16.12 kilowatts.

## Appendix B Reading Links

- Defra process guidance notes for Local Authority Pollution Prevention and Control  
<http://www.defra.gov.uk/environment/quality/industrial/las-regulations/guidance/>
- The Clean Air Act (1993)  
<http://www.legislation.gov.uk/ukpga/1993/11/contents>





## Appendix C: Further Reading



This appendix provides information on the main sources of further reading on Combined Heat and Power to complement the links given at the end of each chapter. Links are provided to useful webpages and documents.

## CHP Focus – Department of Energy and Climate Change

CHP Focus is a Government initiative to facilitate the increased use of CHP. The site provides background information on both packaged and custom CHP, finance help, and a number of useful tools including a CHP assessment tool. In addition to the website a helpline has been set up 0845 365 5153.

### Useful pages

- Home page - <http://chp.decc.gov.uk>
- Packaged CHP home - <http://chp.decc.gov.uk/cms/packaged-chp/>
- Packaged CHP technology - <http://chp.decc.gov.uk/cms/technology/>
- Packaged CHP emissions - <http://chp.decc.gov.uk/cms/chp-emissions/>
- CHP assessment tool - <http://chp.decc.gov.uk/CHPAssessment>

## The CHP Association (CHPA)

The CHPA is the trade body for the UK CHP industry. Their website includes a knowledge centre containing CHP information and a number of case studies.

### Useful pages

- Home page - [www.chpa.co.uk/](http://www.chpa.co.uk/)
- Knowledge centre - [www.chpa.co.uk/knowledge-centre\\_13.html](http://www.chpa.co.uk/knowledge-centre_13.html)
- Case studies - [www.chpa.co.uk/case-studies\\_19.html](http://www.chpa.co.uk/case-studies_19.html)



## Carbon Trust Publications

The Carbon Trust helps private and public sector organisations cut their carbon emissions and reduce fuel costs. They publish a number of useful documents on CHP ranging from basic introductions to in-depth examinations. Free registration is required to download Carbon Trust publications:

### Useful documents:

- Carbon Trust Publications Home - [www.carbontrust.co.uk/publications](http://www.carbontrust.co.uk/publications)
- Overview - Combined heat and power (CHP) technology fact sheet (CTL089)
- Overview - Introducing combined heat and power (CHP) - technology overview (CTV044)
- In depth - Combined heat and power for buildings (GPG388)

## Environmental Protection UK

The Environmental Protection UK website provides comprehensive information on air quality, climate change and the planning process.

### Useful pages:

- Home page - [www.environmental-protection.org.uk](http://www.environmental-protection.org.uk)
- Air quality information - [www.environmental-protection.org.uk/air-quality-and-climate/air-quality/](http://www.environmental-protection.org.uk/air-quality-and-climate/air-quality/)
- Air quality and climate change policy integration - [www.environmental-protection.org.uk/aqclimate](http://www.environmental-protection.org.uk/aqclimate)
- Air quality and planning guidance - [www.environmental-protection.org.uk/aqplanning](http://www.environmental-protection.org.uk/aqplanning)
- Air quality and biomass guidance - [www.environmental-protection.org.uk/biomass](http://www.environmental-protection.org.uk/biomass)

If these links do not work please search for the documents you require at [www.iaqm.co.uk](http://www.iaqm.co.uk)



## Appendix D: Glossary of Terms Used

**(EU) Air Quality Directive** – A European Directive that sets standards for the concentration of several pollutants in the air that all European member states must meet. This is the pre-eminent piece of legislation affecting how air quality is managed in the UK.

**Air Quality Management Area (AQMA)** – An area where levels of one or more air pollutants breach air quality standards, as designated by the relevant local authority. AQMAs are part of the system of Local Air Quality Management.

**(UK) Air Quality Standards** – UK objectives for maximum concentrations of several pollutants in the air; in the main these follow the standards imposed by the EU Air Quality Directive. The Scottish Government has also set tougher standards for several pollutants, which only apply in Scotland.

**(UK) Air Quality Strategy** – The Air Quality Strategy sets out the Government's policies for achieving the Air Quality Standards. Production of an Air Quality Strategy is a requirement of the Environment Act (1995).

**Biofuels** – Fuels derived from biological material such as plants or trees. They can be solid, liquid or gaseous fuels.

**Biomass** – Solid biofuels, such as wood. Biomass is typically burnt to provide heat or electricity.

**Biomethane** – Natural gas (methane) produced by the decomposition of organic material. Biomethane can be extracted from landfills, or produced using a process known as anaerobic digestion. 'Raw' gas from these processes is known as biogas; once the gas has had impurities removed it is known as biomethane.

**Carbon dioxide (CO<sub>2</sub>)** – CO<sub>2</sub> is exhaled by living organisms, as well as emitted from the combustion of fuels. CO<sub>2</sub> in the atmosphere exists in a 'carbon cycle' where CO<sub>2</sub> emitted into the atmosphere is balanced by processes that remove it, keeping concentrations in the atmosphere roughly steady. Emissions from human activities have upset this balance, and concentrations in the atmosphere are climbing. As CO<sub>2</sub> is a greenhouse gas, this is causing the Earth's climate to change.

**Clean Air Act** – The Clean Air Act dates back to the 1950s, where it was introduced to deal with the problem of coal smoke smogs. It regulates the use of solid fuels and emissions of smoke in commercial and domestic premises, and sets a number of responsibilities on local authorities to act as local regulators. The Act was last updated in 1993. Similar controls for Northern Ireland are contained in the Clean Air (Northern Ireland) Order 1981.

**Carbon Emissions Reduction Target (CERT)** – An obligation on domestic energy supply companies (gas and electricity) to reduce carbon emissions from domestic buildings. Typically CERT is discharged through subsidised home insulation, appliances and lighting schemes.

**Clean Energy Cashback** – The Government’s support package for small scale renewable electricity generation. Operators of technologies such as solar photovoltaic and micro wind turbines are able to claim payments from energy supply companies for the electricity they generate (whether they use it on site or export it into the electricity grid), and also claim extra payments for electricity exported into the grid.

**Climate Change Levy** – A levy charged on energy supplied to business users. The levy is not charged on energy supplied from renewable sources, or that supplied by good quality Combined Heat and Power systems.

**Combined Heat and Power (CHP)** – Systems that produce both heat (for space heating or hot water) and electricity. CHP tends to be more efficient than separate heating boilers and electricity from the grid, as much of the energy consumed by power stations is wasted as unused heat. Losses incurred during electricity generation are also reduced if electricity is generated near to where it is consumed.

**Custom CHP** – A CHP system designed specifically for a particular site and application.

**Department of Energy and Climate Change (DECC)** – The Government department with responsibility for climate change and energy policy.

**Department for Environment, Food and Rural Affairs (Defra)** – the Government department with responsibility for air quality, and also adaptation to climate change.

**Dispersion Model** – A computer package used to model the dispersion of pollutants from a source. They are often used to assess the impacts of a proposed development that may impact negatively on air quality.

**Enhanced Capital Allowances** – A scheme that lets businesses claim 100% first year tax relief on certain energy efficiency technologies.

**European Limit Values** – Limit Values are standards for the concentration of several pollutants in the air, as set in the EU Air Quality Directive. Limit Values are legally binding – if member states do not achieve them they can be subject to legal action in the European Courts, and ultimately receive fines ranging into hundreds of millions of pounds.

**Fuel Cell** – A device that generates electricity via the chemical reaction of two substances, for example hydrogen and oxygen. Fuel cells work rather like batteries, although they are re-fuelled (the tank of fuel can be filled up) rather than re-charged.

**Greenhouse Gas** – Any atmospheric gas that traps heat in the atmosphere. Like the panes of glass in a greenhouse, greenhouse gases allow radiation from the sun to pass through, but trap heat re-radiated from the Earth’s surface.

**kW<sub>e</sub> (kilowatt electric)** – The maximum electrical output of a CHP system.

**kW<sub>th</sub> (kilowatt thermal)** – The thermal input (fuel input) for a CHP system.



**Local Air Quality Management (LAQM)** – LAQM is the system under which local authorities review and assess air quality in their areas against agreed national standards. Where air quality is found to be in breach of the standards they must declare an Air Quality Management Area and produce an action plan to pursue attainment of the standards.

**Merton Rule** – Planning rules which state that a certain proportion of a new development's energy needs must be met by on-site renewable energy generation. Named after the London Borough of Merton which was the first to introduce such conditions.

**Nitrogen Dioxide (NO<sub>2</sub>)** – A common air pollutant emitted by combustion processes, including road vehicles, aircraft and domestic and industrial combustion. NO<sub>2</sub> is a respiratory irritant, and in strong sunlight is a precursor for ozone formation.

**Nitrogen Oxides (NO<sub>x</sub>)** – A catch all term for both nitrogen oxide (NO) and nitrogen dioxide (NO<sub>2</sub>). Combustion processes emit both types of nitrogen oxide in varying proportions. Once emitted into the atmosphere the relationship between the two is complex as NO may be oxidised to NO<sub>2</sub> by natural processes.

**Ozone (O<sub>3</sub>)** – Ground level (tropospheric) ozone is a common air pollutant, formed by other pollutant gases reacting in strong sunlight. Ozone is relatively long lived and is transported over long distances by the winds. This factor combined with chemical processes that destroy ozone in polluted urban environments means that ozone levels can actually be highest in rural areas. Ozone is associated with lung disease, exacerbation of conditions such as asthma, and damage to vegetation and crops.

**PM<sub>10</sub> and PM<sub>2.5</sub>** – Airborne particle pollution, with the number denoting the appropriate size of the particle in micro-meters. Fine particles are taken deep into the lung's membrane, and can even cross over into the bloodstream. Particle pollution is strongly associated with illness and premature death from heart and lung disease. Common sources of particles include diesel vehicles, solid fuel combustion and vehicle tyre and brake wear.

**Packed CHP** – An 'off the peg' CHP system.

**Prime Mover** – the system providing mechanical power for a CHP system, commonly an internal combustion engine or a gas turbine

**Renewable Heat Incentive (RHI)** – A scheme to provide payments to people producing heat from renewable sources (e.g. biomass, solar, heat pumps). Payments will be provided based on the amount of heat produced, rather than an upfront grant to cover the costs of installation. The RHI will be the heat equivalent of the Clean Energy Cashbacks available for renewable electricity generation.

**Sulphur Dioxide (SO<sub>2</sub>)** – A common air pollutant produced by coal and oil combustion. Sulphur dioxide is harmful to human health and is associated with the process of acid rain.

**TA-Luft** – Emission standards used in Germany, which include standards for CHP prime movers.