

# A Simple Guide To Air Pollution





The people of the United Kingdom are becoming increasingly concerned with the quality of the air they breathe. While this greater awareness has brought about a rapid increase in the quality and quantity of information available to the public, the message it tries to deliver is not always clear.

This chapter is intended as a straightforward guide to the intricacies of air pollution.

## WHAT IS AIR POLLUTION?

### **Key Points:**

- ✓ ***There are seven main pollutants of concern – carbon monoxide (CO), nitrogen dioxide (NO<sub>2</sub>), ground level ozone (O<sub>3</sub>), particulate matter, sulphur dioxide (SO<sub>2</sub>), hydrocarbons and lead.***
- ✓ ***Each pollutant has different sources, effects and behaviour.***
- ✓ ***Concentrations of carbon monoxide, nitrogen dioxide and particulate matter will generally be highest close to busy roads.***
- ✓ ***Due to complex atmospheric chemistry, ozone levels will generally be highest in rural areas during the summer months.***
- ✓ ***Sulphur dioxide concentrations are highest in the vicinity of large industrial combustion processes.***
- ✓ ***Hydrocarbons are a group of chemicals, which contribute to the formation of ground level ozone. Benzene and 1,3 butadiene are part of this group and known carcinogens.***
- ✓ ***Concentrations of these hydrocarbons are generally highest close to busy roads and in the vicinity of petrol filling stations.***

Air pollution is made up of a mixture of gases and particles that have been released into the atmosphere by man-made processes. Such emissions are typically from the combustion of fossil fuels such as coal, oil, petrol or diesel. The sources, health effects and chemical behaviour of each separate pollutant are different, making the task of understanding and controlling air pollution as a whole very complex.

While it is us who produce the pollution, it is primarily the weather that dictates what will happen once it is released into the air. During wet or windy conditions pollution levels remain low, either blown away and

dispersed to harmless levels, or removed from the air by rain. During certain conditions pollution levels are able to build up to harmful levels leading to pollution 'episodes'.

The following paragraphs explain each of the major pollutants, their sources, health effects and upward or downward trends.

### **Carbon Monoxide (CO)**

Carbon Monoxide ('CO') is a colourless, odourless poisonous gas produced by incomplete, or inefficient, combustion of fuel



including 'cold' or badly tuned engines. It is estimated that road transport is responsible for almost 90% of all carbon monoxide emissions in the UK. Badly ventilated domestic fuel appliances (gas, oil or solid fuel) can cause high levels indoors, as can smoking.

The gas affects the transport of oxygen around the body by the blood. At very high levels, this can lead to a significant reduction in the supply of oxygen to the heart, particularly in people suffering from heart disease.

As traffic is a major source of carbon monoxide, ambient concentrations will generally be highest close to busy roads. Monitoring data suggests that annual average CO levels have been decreasing over the last few years. This is probably due to improved vehicle engine efficiency and the introduction of catalytic converters. The effect of technological improvements has been cancelled out to some degree by an increase in traffic levels.

### **Carbon Dioxide (CO<sub>2</sub>)**

As opposed to carbon monoxide, carbon dioxide ('CO<sub>2</sub>') is produced by 'complete' fossil fuel combustion. While ambient levels do not have any direct health effects, it is an important 'greenhouse gas' which contributes to global warming. Its major anthropogenic (i.e., man-made) sources are road transport, power stations and other industrial combustion processes and domestic heating.

As carbon dioxide emissions lead to global environmental problems, efforts to reduce levels have to be co-ordinated across the world. The UK Government, along with many other countries, has agreed a commitment to progressively reduce emissions in future years.

### **Nitrogen Dioxide (NO<sub>2</sub>)**

Nitrogen dioxide ('NO<sub>2</sub>') is one of a group of gases called nitrogen oxides ('NO<sub>x</sub>') formed in the combustion of fossil fuels. The majority of nitrogen oxides emitted from a vehicle exhaust are in the form of nitric oxide ('NO'), which is not considered harmful to health. However, this gas can react with other gases present both in the exhaust and the atmosphere, to form nitrogen dioxide. Nitrogen dioxide is harmful to health and is also an important component in the formation of ozone.

Road transport is estimated to be responsible for about 50% of total emissions of nitrogen oxides (NO<sub>x</sub>), power stations contributing another 25%. The calculation of how much of this NO<sub>x</sub> is converted to NO<sub>2</sub> is an important, but extremely difficult factor in the reduction of pollution levels.

Because of the domination of traffic sources, mean nitrogen dioxide levels are highest close to busy roads and in large urban areas.

At very high levels, nitrogen dioxide gas irritates and inflames the airways of the lungs. This irritation causes a worsening of symptoms of those with lung or respiratory diseases.

A shift from coal to gas-turbine power stations and the increased use of catalytic converters during the 1990s should have lead to a decrease in nitrogen dioxide levels over recent years. It is possible that increases in traffic volume have cancelled out these improvements. The situation is further complicated by complex reactions with other pollutants. A long-term trend is not clearly identifiable from monitoring data.

## Ground Level Ozone (O<sub>3</sub>)

While naturally occurring ozone in the upper atmosphere, 'the ozone layer', protects the Earth, ground level ozone ('O<sub>3</sub>') is harmful to health. Ozone is not directly emitted, but is formed by a complex set of reactions involving nitrogen oxides and hydrocarbons (described below) in the presence of sunlight. In natural, unpolluted conditions, a cyclic balance is reached where sunlight breaks down nitrogen dioxide to form ozone, which then reacts with nitric oxide to reform nitrogen dioxide. At night, when there is no sunlight to drive the first part of the cycle, ozone is destroyed but not replaced.

In polluted conditions where the air contains hydrocarbons from fuel combustion, the balance is upset. The hydrocarbons also react to form nitrogen dioxide, which then breaks down into more ozone. As a result, both nitrogen dioxide and ozone levels increase leading, in severe cases, to summertime 'smog'.

As mentioned above, the majority of nitrogen oxides emitted from a vehicle exhaust are in the form of nitric oxide. As it is nitric oxide that destroys ozone, ozone concentrations are actually lower next to busy roads. For the same reason, ozone annual means are higher in rural locations than in cities.

Like nitrogen dioxide, high levels of ozone can irritate and inflame the lungs. It can also cause eye irritation, migraine and coughing. It is also a strong oxidising agent. This means that it can attack materials such as rubber and pigments and damage vegetation. The international costs of ozone pollution through damage to health, crops and materials are huge.

Once formed, ozone can remain in the atmosphere for many days and is often transported over long distances. It is for this reason that a reduction in ozone lev-

els can only be achieved through European-wide action. Studies have shown that European ozone levels have increased rapidly since 1940. Monitoring data from rural sites in the UK suggest that there was a small annual increase during the 1990s.

## Particulate Matter

Particulate matter in the atmosphere can be from a whole range of sources, both natural, such as sand or sea spray, and man made, such as construction dust or soot. The amount of particulate matter (measured as 'black smoke') in the air in urban areas has decreased rapidly over the last 30 years. This is due to a decrease in coal burning, heavy industry and improved industrial pollution control measures; we no longer experience the infamous London Smogs of the 1950s.

Attention is now focused on finer particles known as PM<sub>10</sub>. These fine particles can be breathed more deeply into the lungs and are more likely to have a toxic effect than larger particles.

Measurements of PM<sub>10</sub> have only been carried out in this country for the last few years – too short a period to be able to identify any significant trends. Again, it is likely that improvements brought about by a decrease in coal burning and improved technology are at least partly offset by increased numbers of vehicles on the road. The increased market share of diesel vehicles, which typically emit more PM<sub>10</sub> particles than petrol vehicles, exaggerates this.

The smaller a particle, the longer it can remain suspended in the atmosphere. Very fine particles, made up of carbon from combustion and chemical compounds (sulphates and nitrates) can remain in the atmosphere for weeks. These particles can drift for many miles causing pollution problems across many countries. Episodes

caused by this long-range transport of particulate pollution are explained below.

As particulate matter is composed of such a large range of chemicals and materials from a variety of sources, the control of pollution levels is very difficult. As with ozone, local improvements will have only limited effect without international action.

The mass of sizes, shapes and chemical properties of particulate matter makes it very difficult to assess its health effects. Expert opinion is that there is no threshold concentration below which particulates have no effect on health. The aim must therefore be to reduce concentrations to a level at which minimal effects on health can be identified.

### **Sulphur Dioxide (SO<sub>2</sub>)**

Sulphur dioxide (SO<sub>2</sub>) is produced when a material, or fuel, containing sulphur is burned. Globally, much of the sulphur dioxide in the atmosphere comes from natural sources, but in the UK the major contributors are power stations (65% of the total emissions). Sulphur dioxide levels in this country have dropped considerably over recent years due to cleaner power stations and a decreased use of coal.

The highest levels of sulphur dioxide are recorded in areas where coal is used extensively. There is little domestic use of coal in Hertfordshire or Bedfordshire and no coal-fired power stations. Consequently, sulphur dioxide pollution episodes in these counties are extremely infrequent. The weather conditions that lead to an SO<sub>2</sub> episode are explained later in this chapter.

Short-term exposure to high levels of sulphur dioxide may cause coughing, tightening of the chest and irritation of the lungs.

### **Hydrocarbons (Including Benzene)**

The term 'hydrocarbons' is often used when discussing traffic pollution. This refers to a group of chemicals of which volatile organic compounds (VOCs) are a subgroup.

Volatile Organic Compounds (VOCs) comprise of a range of chemical compounds all of which contribute, to varying degrees, to the formation of ground level ozone. In addition, certain VOCs are known to cause cancer. Current attention is focused on 1,3 butadiene, primarily from vehicle exhausts, and benzene. Benzene in the atmosphere either comes from the combustion or evaporation of petrol. Levels are therefore highest close to busy roads or in the vicinity of petrol filling stations.

Long-term exposure to high levels of benzene and 1,3 butadiene has been linked to leukaemia and cancer. Health experts have concluded that the health risks from these pollutants become progressively smaller as cumulative exposure is reduced. Health standards are therefore set based on annual mean levels.

As only very small concentrations of hydrocarbons are typically found in the atmosphere, the monitoring process is very complicated and expensive. As monitoring has only been carried out for the last few years, it is impossible to identify any upward or downward trend in levels. Annual results suggest the annual mean levels are well below European health standards.

### **Lead**

The main source of lead in the atmosphere has historically been from combustion of petrol. Since the phasing out of leaded petrol across Europe, lead levels have fallen sharply and lead monitoring is no longer considered necessary in Herts and Beds.

## WHO IS MOST AT RISK FROM AIR POLLUTION?

### Key points:

- ✓ ***Pollution levels in the UK are unlikely to cause any serious health effects in most people.***
- ✓ ***Young children, the elderly and those who suffer from respiratory problems such as lung disease, asthma or bronchitis may be more sensitive to air pollution.***
- ✓ ***The Government's Air Quality Bands describe the health impact of varying levels of pollution on these sensitive individuals.***
- ✓ ***Health advice is available from the DETR's Air Pollution Information Service.***

For most people, pollution levels in the UK are unlikely to cause any serious health effect; during particularly severe pollution episodes, eye irritation or coughing may be triggered. Certain sensitive individuals who are more susceptible to respiratory pollution may feel the effects more acutely, or at lower levels. These individuals include those who suffer from heart and lung disease, including asthma and bronchitis, especially young children and the elderly.

Pollution bulletins produced by the Herts and Beds Air Pollution Monitoring Network are based on the Government's Air Pollution Banding system. These bands have been set using the latest research on the medical effects of air pollution on health and are intended to make air quality information more meaningful. Table 6.1 shows the four bands and their impact on the health of people who are sensitive to air pollution.

**Table 5.1 The Health Impact of Air Pollution Bands**

<b>Pollution Band</b>	<b>Health Impact</b>
<b>Low</b>	Effects are unlikely to be noticed, even by people who know they are sensitive to air pollutants
<b>Moderate</b>	Mild effects are unlikely to require action, but may be noticed by sensitive people
<b>High</b>	Sensitive people may notice significant effects, and may have to take action to reduce or avoid them (for example, by reducing time spent outdoors). Asthmatics will find that their 'reliever' inhaler is likely to reverse the effects of pollution on their lungs
<b>Very High</b>	The effects on sensitive people, described for 'high' levels of pollution, may worsen

Actual effects will, of course, vary from person to person, and individuals will learn from experience how they are affected by pollution.

The Government has issued the following guidelines to sensitive individuals. These guidelines are taken from the Department of Environment, Transport and the Regions Air Pollution Information Service:

## **HEALTH ADVICE FOR PEOPLE WITH LUNG DISORDERS AND OTHERS SENSITIVE TO AIR POLLUTION**

If you have asthma or another lung disease, your symptoms are unlikely to change when air pollution levels are 'low' or 'moderate'. This applies whatever the time of year.

However, your symptoms may get worse when air pollution reaches the 'high' or 'very high' bands, especially if you are elderly. If this happens and you suffer from asthma, you may need to change your treatment in the usual way. If this doesn't help, consult your doctor.

### *Asthma*

There is little evidence that air pollution itself causes asthma. However, if you already have asthma, you may find that air pollution triggers an attack, although infections and allergens are more likely to do so.

### *Smoking*

Smoking is likely to have a much more serious effect on your health than air pollution. Giving up smoking will cut down your risk of lung and heart disease considerably. It will also make you less vulnerable to the short-term effects of air pollution.

### *In winter*

If traffic fumes make breathing harder, avoid busy streets as much as you can. If you are elderly, stay indoors as much as possible and keep warm

### *In summer*

If you find it harder to breathe on hot sunny days, avoid energetic outdoor activities, especially in the afternoons when pollution levels tend to be higher.

If your child has asthma, they should be able to take part in games as normal, but they may need to use their reliever inhaler more before they start. They do not need to stay away from school.

**source: DETR Information Service**

## HOW BAD/GOOD IS AIR QUALITY IN HERTS AND BEDS?

### **Key Points:**

- ✓ ***Benchmarks have been set for each of the major pollutants, against which pollution levels can be compared.***
- ✓ ***'Air Quality Standards' have been agreed by a panel of health experts for each of the major pollutants. Levels of pollution below these standards are considered acceptable in the light of what is known about each pollutant's effects on health and the environment.***
- ✓ ***'Air Quality Bands' classify pollution levels into bands. These are intended as a tool to help the public assess the possible health impacts of pollution above certain thresholds.***
- ✓ ***'Air Quality Objectives' represent the Government's targets for improving air quality in the medium term (approximately the next five years).***
- ✓ ***Local authorities must assess pollution levels in their district and draw up action plans if these objectives are unlikely to be met.***
- ✓ ***Results of monitoring from throughout Hertfordshire and Bedfordshire show that pollution levels during 2000 were largely classified as 'low' according to the Air Quality Banding system. No periods of 'high' or 'very high' air pollution were recorded.***
- ✓ ***There were a total of eight days during which 'moderate' particulate pollution levels were recorded across the network, plus thirty eight days during which 'moderate' particulate pollution levels were recorded.***
- ✓ ***Winter episodes occur during periods of cold calm weather when pollution emissions are trapped close to their sources and cannot disperse.***
- ✓ ***Summer episodes are characterised by high ozone levels and occur during warm sunny weather in the summer months. This type of episode was responsible for most of the exceedence days recorded in 2000.***
- ✓ ***Particulate pollution episodes occur when easterly winds bring high levels of particulate matter from industrial areas of central Europe.***

Before we can assess how bad air pollution is, we have to have some benchmarks against which levels can be compared. The Government set up a panel of health experts to decide on these benchmarks, or standards.

### **Air Quality Standards**

Air Quality Standards have been decided for each of the eight major pollutants. Each one is set at a concentration, measured over a given time period, below which pol-



lution levels are considered acceptable in the light of what is known about its effects on health and the environment.

An 'exceedence' of a standard is a period of time where the concentration is higher than that set down. Any day when such an exceedence occurs, is described as an 'exceedence day'. An example is given below:

*The Standard for nitrogen dioxide is 150ppb measured as a one hour mean. An analyser records hourly mean concentrations above 150ppb between 10:00pm on the 1<sup>st</sup> December and 04:00am on the 2<sup>nd</sup> December. Therefore, the Air Quality Standard for nitrogen dioxide was exceeded six times on two exceedence days.*

### Air Quality Bands

As mentioned above, air pollution levels have been classified into bands. These bands help the public to assess the possible health impacts of pollution above cer-

tain thresholds (Table 5.1).

The first of these thresholds, the 'Standard Threshold' is based on the Air Quality Standard for each pollutant. Further thresholds are the 'Information' and 'Alert' levels that are in line with EC Directives on Air Quality. The bands and thresholds which separate them, are shown in Table 6.2.

Any concentration below the Standard threshold is described as 'Low air pollution'. A level between the Standard and Information thresholds would be described as 'Moderate', between the Information and Alert thresholds is 'High', and above the Alert threshold is 'Very High'.

The time taken for exposure to a pollutant to cause adverse health effects varies from pollutant to pollutant. The times over which concentrations are averaged varies to reflect this.

**Table 5.2 The Air Quality Bands**

Description...	Low	S	Moderate	I	High	A	Very High
<b>Sulphur Dioxide</b> (ppb, 15 minute averages)	< 100		100 - 199		200 - 399		>= 400
<b>Ozone</b> (ppb)	< 50 (8hr running average)		50 - 89 (hourly average)		90 - 179 (hourly average)		>= 180 (hourly average)
<b>Carbon Monoxide</b> (ppm, 8 hour running average)	< 10		10 - 14		15 - 19		>= 20
<b>Nitrogen Dioxide</b> (ppb, hourly average)	< 150		150 - 299		300 - 399		>= 400
<b>PM10 Particles</b> (ugm <sup>-3</sup> , 24 hour running average)	< 50		50 - 74		75 - 99		>= 100
<b>S = Standard Threshold, I = Information Threshold, A = Alert Threshold</b>							

## Air Quality Objectives

Air quality regulations in this country are grouped together in the Government's Air Quality Strategy. This Strategy describes the Government's plans to improve and protect ambient air quality in the UK in the medium term. Its proposals aim to protect people's health and environment without imposing unacceptable economic or social costs.

Air Quality Objectives have been established by the Strategy for eight main pollutants. Emphasis has been placed on local authorities to assess pollution levels in their districts, and then work towards achieving these objectives by the specified dates.

The Government expects these objectives to be met by a combination of national measures, regulation of industrial processes and action at local level.

**Table 5.3 The Air Quality Objectives**

**Benzene** - 5ppb measured as running annual mean (31/12/2003)

**1,3-Butadiene** - 1ppb measured as running annual mean (31/12/2003)

**\*Nitrogen Dioxide (i)** - 105ppb not to be exceeded more than 18 times a year measured as 1 hour mean (31/12/2005)

**\*Nitrogen Dioxide (ii)** - 21ppb measured as annual mean (31/12/2005)

**PM10 Particles (i)** - 50  $\mu\text{m}^{-3}$  not to be exceeded more than 35 times a year measured as 24 hour mean (31/12/2004)

**PM10 Particles (ii)** - 40  $\mu\text{m}^{-3}$  measured as annual mean (31/12/2004)

**Sulphur Dioxide (i)** - 132ppb not to be exceeded more than 24 times a year measured as 1 hour mean (31/12/2004)

**Sulphur Dioxide (ii)** - 47ppb not to be exceeded more than 3 times A year measured as 24 hour mean (31/12/2004)

**Sulphur Dioxide (iii)** - 100ppb not to be exceeded more than 35 times a year measured as 15 minute mean (31/12/2005)

**Carbon Monoxide** - 10ppm measured as running 8 hour mean (31/12/2003)

**\*\*Ozone** - 50ppb not to be exceeded more than 10 times a year measured as the daily max of running 8 hour mean (31/12/2005)

*\* Objectives are provisional.*

*\*\*Objective is outside of Local Air Quality Management regulation.*

Projections based on current data and modelling studies suggest that some of the objectives can be achieved through measures that are already in place, such as tighter control of vehicle emissions and regulation of industry. Other objectives will be more challenging and will require local authorities to take local action to reduce pollution in specific areas.

The objective for ozone is provisional, and not included in regulations. This is because pollutants produced outside of the UK heavily influence ozone levels. Reduction in ozone pollution will require combined international action.

The Air Quality Objectives and their target dates are shown in Table 6.3. These objectives are similar to the Air Quality Standards. The differences arise partly because the UK must comply with European Directives on air quality. Requirements placed on the UK by European Law must be integrated into UK Law. In some cases, UK-based standards have been replaced by European standards. In setting these Objectives the Government has considered cost and practicability. Where it would be 'impractical' or excessively costly to reduce levels to below the Standard at all times, a number of 'allowed' exceedences are given. For example, the 100ppb sulphur dioxide Standard may be exceeded up to 35 times per year.

The Air Quality Objectives were reviewed in 1999 and will continue to be reviewed at regular intervals in the future.

### **Air Quality in 2000**

We now have a range of benchmarks against which we can assess air pollution in Hertfordshire and Bedfordshire.

The tables in Appendix 1 compare results from each of the continuous monitoring sites in the network to the Air Quality

Bands and Objectives.

The tables show that air pollution levels across the two counties during 2000 were within the Air Quality Standards, i.e., classified 'low air pollution', for the majority of the year. The main problems obviously lie with ozone and particulate pollution.

These statistics are analysed in more detail in Chapter 2.

There were a total of eight days of 'moderate' PM10 particulate pollution and thirty eight days of 'moderate' ozone pollution across the network. In 1999 there were ten days of 'moderate' particulate pollution, seventy six days of 'moderate' ozone pollution and a further six days of 'high' ozone pollution.

Periods of poor air quality are called 'episodes' and are caused by specific weather conditions. Many pollution episodes can be loosely classified into winter, summer, particulate and plume grounding episodes. Plume grounding episodes occur when winds blow emissions from industrial chimneys down to ground level. With an absence of heavy industry, plume grounding is very rare in Hertfordshire and Bedfordshire, this class will not be described in detail.

### **Winter Episodes**

During cold calm periods of weather in the winter months, pollution emissions are trapped close to their sources and cannot disperse. This leads to a build up of pollution, often over several days. Weather such as this led to the 'pea-souper' fogs of the 1950's and 1960's, when sulphurous smoke from domestic coal burning was trapped over London.

Road traffic has replaced domestic fires as the biggest source of air pollution in most UK cities, and high concentrations of ni-

trogen dioxide, particulates and hydrocarbons are observed during winter episodes.

One such episode occurred in Hertfordshire and Bedfordshire during 1999. On the 20<sup>th</sup> December, cold still weather caused a build up of pollution, which peaked with the evening rush hour, around 6:00pm. This led to elevated nitrogen dioxide and 'moderate' particulate pollution being recorded at Luton Background site. Winds picked up in the early hours of the morning and dispersed the pollution.

### **Summer Episodes**

During the summer, an entirely different type of episode occurs during hot and sunny weather, characterised by high levels of ozone pollution. This type of episode is common between May and September and is responsible for almost all of the exceedence days recorded in an average year.

As previously explained, ozone is produced in a reaction involving nitrous oxides, hydrocarbons and sunlight. This pollution can be transported long distances, reacting in the atmosphere as it travels.

The most severe episodes occur when pollution combines with that transported from industrial areas of Europe by easterly winds.

### **Long Range Transport of PM10 Particulates**

Many of the PM10 exceedence days recorded in an average year can be linked to easterly winds transporting fine particulate pollution across the UK from industrial areas of Europe. This imported pollution causes elevated background levels which, when augmented by local pollution, can cause episodes throughout the network.

In addition to these kinds of episode, exceedences can be caused by local sources of pollution such as bonfires, traffic idling directly under a monitoring inlet for extended periods, road or building works producing large amounts of dust, or even the harvesting of crops. The cause of these isolated episodes can often be tracked down and suitable action taken.

In 2000, most of the particulate episodes recorded could be linked to bonfire night celebrations and Saharan dust blown up the Atlantic and dumped onto the UK.

## WHY MONITOR AIR POLLUTION?

### **Key Points:**

- ✓ ***Air pollution monitoring can help us understand how pollutants behave and their relationship with the weather.***
- ✓ ***Monitoring data can be used to validate pollution modelling, used to test 'what if' scenarios.***
- ✓ ***National and European law requires the monitoring of pollution levels. Results can be used to make informed policy decisions.***
- ✓ ***Members of the public benefit from easily available, accurate and up to date information on the quality of the air they breathe.***

The purchase and operation of accurate and comprehensive air quality monitoring equipment is costly, so why spend this money on monitoring rather than improving air quality?

Once emitted from exhausts or chimneys, the behaviour of air pollution is dictated by the weather. As the weather in this country is extremely variable, the behaviour of pollution is extremely variable. The situation is complicated further by atmospheric chemistry; pollutants react with other gases in the atmosphere and deposit onto surfaces such as roads and buildings. At present, our scientific understanding of air pollution is not sufficient to be able to accurately predict air quality at all times throughout the country. This is where monitoring can be used to fill the gap in understanding.

Monitoring provides raw measurements of air pollutant concentrations, which can then be analysed and interpreted. This information can then be applied in many ways.

Analysis of monitoring data allows us to assess how bad air pollution is from day to day, which areas are worse than others and whether levels are rising or falling. We can see how pollutants interact with each

other and how they relate to traffic levels or industrial activity. By analysing the relationship between meteorology and air quality, we can predict which weather conditions will give rise to pollution episodes.

Another important use is in the validation of computer models. Models are used to test 'what if' scenarios. For example, 'how much will air quality improve if traffic numbers reduce by 20%?' or 'what effect will building a power station near a certain town have?'. The accuracy of these models can only be tested by comparison with actual monitoring data.

All of this information can then be used by the Government to make informed policy decisions. Environmental policy is constantly being updated in the light of scientific research.

Increased awareness in air quality issues has led to the demand for more thorough and accessible information. Members of the public worried about pollution or with health problems worsened by pollution can benefit from such information. Up-to-date information taken from monitoring sites across the country can be broadcast to the public via television, teletext, dedicated help lines, or the Internet.

Many laws now require government and local authorities to ensure that air pollution does not exceed certain legal limits. EC law sets standards (known as Directives) for some pollutants and requires national governments to monitor air quality to show that the standards are not exceeded. The Government's National Air Quality Strategy makes it the responsibility of local authorities to use monitoring information to assess air quality in order to show that Air Quality Standards will not be exceeded in their area by certain deadlines.

## HOW IS AIR POLLUTION MONITORED?

### **Key Points:**

- ✓ ***There are two distinct types of air pollution monitoring in use in the two counties - automatic and non-automatic.***
- ✓ ***Non-automatic monitoring methods are generally cheaper and easier to operate but do not give as much accuracy or resolution as automatic methods.***
- ✓ ***The most common type of monitoring is by diffusion tube (non-automatic). There are over 200 diffusion tube sites in operation across Hertfordshire and Bedfordshire.***
- ✓ ***Diffusion tubes typically provide a fortnightly or monthly mean concentration of nitrogen dioxide or benzene.***
- ✓ ***Continuous (automatic) analysers produce high-resolution measurements for each of the major pollutants.***
- ✓ ***Analysers are maintained to strict QA/QC procedures to ensure reliable results, but purchase and operation is expensive.***
- ✓ ***There are currently 34 continuous analysers in use in the two counties.***
- ✓ ***Data is stored within the analyser and may be download by modem and disseminated to the public in many different ways.***

There are two distinct types of air pollution monitoring in use in the two counties - automatic and non-automatic. Non-automatic methods are generally cheaper and easier to install and maintain but do not give as much accuracy or resolution as automatic methods.

### **Passive Sampling (non-automatic)**

The most commonly used passive sampler is the diffusion tube. These provide a simple and inexpensive method of screening air quality in an area, to give a general indication of average pollution concentrations over a period of weeks or months. The sampler consists of a small plastic tube open at one end and an absorbent packed

at the other. The absorbent used depends on the pollutant gas to be monitored; nitrogen dioxide being the most common, then benzene, sulphur dioxide and ozone. Tubes are usually exposed for two to four weeks then sent to a laboratory for analysis.

The low cost per tube permits sampling at a number of points in the area of interest; this is useful in highlighting "hotspots" of high concentrations where more detailed studies may be needed. Recent comparisons of nitrogen dioxide diffusion tube measurements with simultaneous measurements from a co-located automatic nitrogen dioxide analyser found that the diffusion tubes tended to overestimate ambient nitrogen dioxide by approximately

10%. Other comparative studies have cited analysis laboratory, tube location, tube quality and meteorology as variables each affecting the accuracy of this method. The Network's comparative study described in Chapter 5 suggests that many of the laboratories in use in Hertfordshire and Bedfordshire underestimate ambient levels to some degree. Results from some of the laboratories were more consistent than others.

There is an extensive network of over 200 nitrogen dioxide diffusion tubes distributed throughout Hertfordshire and Bedfordshire. These are positioned by each district at locations they feel pollution levels require further investigation. In recent years some districts have also used sulphur dioxide and benzene diffusion tubes. Results are presented in Chapter 3.

### **Active Samplers (non- or semi-automatic)**

Active sampler methods collect pollutant samples either by physical or chemical means for subsequent analysis in a laboratory. Typically, a known volume of air is pumped through a collector such as a filter or chemical solution for a known period of time, which is then removed for analysis. Samples can be taken each day, thereby providing measurements for shorter periods of time, but at a relatively low capital cost compared with automatic monitoring methods. They do, however, require high labour costs. Sulphur dioxide/smoke bubblers have been used across the county for many years.

### **Continuous Analysers (automatic)**

These produce high-resolution measurements for pollutants such as ozone, oxides of nitrogen, sulphur dioxide, carbon monoxide and PM10 particulates. Hydro-

carbons can also be automatically measured, but the costs are extremely high and no monitoring exists in Hertfordshire or Bedfordshire.

This is the most expensive method of air quality monitoring routinely employed. In order to ensure that the data produced are accurate and reliable, strict maintenance, operational and quality assurance/control procedures are often required. These are usually followed to an agreed protocol to allow comparability between monitoring sites.

The sample is analysed on-line and in real-time. Data is stored within the analyser, or a separate logger and may be downloaded remotely by modem. It is the high resolution of such methods that allows pollution episodes to be analysed in detail and related to traffic flows, meteorology and other variables. By downloading data from automatic analysers each hour information can be relayed to the public while it is still relevant. Data from automatic analysers forms the hourly, daily, weekly and monthly reports provided to local authorities and on the Internet.

The number of continuous analysers in use in Hertfordshire and Bedfordshire has grown rapidly in recent years and currently stands at 34. More are expected to come on line in the coming years.

Chapter 1 describes the continuous monitoring network in more detail.

## AIR POLLUTION – WHAT'S BEING DONE AND WHAT CAN I DO?

### **Key Points:**

- ✓ ***The wide range of emission sources means that action to combat air pollution must be at a local, national and international level.***
- ✓ ***A number of measures are in place, or planned, as a result of National and International law. These are expected to have significant effect on pollution levels.***
- ✓ ***Local Authorities are now required to review and assess air quality in their area. This may lead to the declaration air quality management areas.***
- ✓ ***Local authorities have been given a wide range of powers to execute air quality management plans and achieve improvements in air quality.***
- ✓ ***Individuals can have a direct impact on air pollution. A range of measures at home, at work and travelling can not only reduce emissions but also save money.***

There is no single source of air pollution and action to reduce emissions has to be taken at international, national and local levels. Choices made by each of us in our everyday life can, and do, affect emissions and there is scope for us all to make a contribution to improvement schemes.

### **National and International Action**

It is clear that no single source of pollution can be identified. Different sources will be more important in different locations and pollutants have the capacity to travel over large distances between towns and even between countries. Actions to reduce emissions must reflect this. European and National Objectives have been set to combat the problem of air pollution.

The measures proposed, or currently in place include constraints on factory emissions, new car specifications and fuel quality and many other measures.

Nationally, controls are affected on industry by both local authorities and the Environment Agency under the Environmental Protection Act 1990. This enacts the principle of Integrated Pollution Control (IPC) where all pollutants from an industrial source are considered together and the requirement to control emissions using the best available technology not entailing excessive cost (BATNEEC). This process is currently under review.

Local Authorities are now required to review and assess air quality in their area. If national and international measures are not thought to be sufficient to meet the Government's Air Quality Strategy Objective, the local authority must declare an air quality management area and devise an air quality action plan following local consultation. Local authorities have been given a wide range of powers to execute this plan and achieve improvements in air quality. Further details of can be found in the Government's Air Quality Strategy.

## Individual Action

It is clear from consideration of the sources of pollution that decisions that we take about the way we use energy and other products have direct impact on air pollution. Since energy costs money reducing pollution can save you money.

There is considerable opportunity for all of us to take simple measures to reduce air pollution. A number of measures are discussed below:

### *Transport*

- ◆ Avoid using your car for short journeys. Around a fifth of trips made by car in London are less than 1 km. This will be true of many urban areas. These trips may be easily and sometimes more quickly undertaken by other means, such as walking or cycling.
- ◆ On short journeys both engines and catalysts do not reach optimum operating temperatures. If you have to make short journeys by car try to combine them.
- ◆ Ensure that your car is properly tuned and maintained and that tyres are correctly inflated.
- ◆ Remember that vehicle idling produces pollution. If safe to do so, switch off your engine if you expect to be stationary for around a minute or longer. Avoid idling to warm your engine more than you have to and minimise use of the choke.
- ◆ Think about the way that you drive. Rapid acceleration and deceleration are bad for fuel consumption and therefore for pollution. Avoid driving too fast; fuel consumption rapidly increases above 55mph.

- ◆ Filling your car with petrol or diesel causes emissions of hydrocarbons. Try to avoid this during summertime pollution incidents and avoid parking your vehicle in the sun.
- ◆ Think about public transport alternatives. When comparing the cost of transport consider the full cost of motoring rather than just the marginal cost of fuel. The AA and RAC calculate the cost of motoring to be around 35p per mile.

### *At Home*

- ◆ Try to use energy efficiently. Consider turning down your heating thermostat, investing in home insulation and buying low energy light bulbs. These measures can save money in the long term. Even closing curtains at night can help.
- ◆ Avoid having bonfires particularly when pollution levels are high and do not burn domestic waste such as rubber and plastics.
- ◆ Think about the use of petrol driven lawn mowers and other garden appliances. These are often badly maintained and very polluting.
- ◆ When decorating try to use water based or low solvent paints glues and varnishes. Put off decorating during high levels of air pollution.

### *At Work*

- ◆ As an employee think about energy use as you would do at home.
- ◆ As an employer consider investing in energy efficiency. Free advice is available to allow you to benefit from others best practice contact the Energy Efficiency Enquires Bureau on (01235) 436747.

- ◆ Consider car sharing. Opportunity to set up car sharing schemes formally or informally exists, particularly for work journeys.
- ◆ Try to make business trips by public transport. It is often possible to spend the time travelling productively.
- ◆ As an employer consider encouraging Green Commuting Schemes such as season ticket loans, provision for the safe storage of cycles and shower facilities.