Department of the
Environment
www.doeni.gov.uk

Air Pollution
in Northern Ireland 2010

AEA

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Report Highlights

This brochure is the ninth in a series of annual reports on air quality in Northern Ireland. Produced by AEA, on behalf of the Department of the Environment, it aims to provide the citizens of Northern Ireland, and the wider air quality community, with user-friendly information on local air quality monitoring, and the results of that monitoring, throughout the region during 2010. Figure 1.1 shows the locations of all the automatic air quality monitoring sites in Northern Ireland that were in operation during part or all of 2010.

Section 2 of this report outlines the air quality legislation and policy applicable to Northern Ireland. This section includes information on the actions that district councils are taking to improve air quality at a local level. **Section 3** summarises the monitoring carried out in Northern Ireland, and presents an overview of the data from 2010, including exceedances of air quality objectives. This section highlights the winter pollution episodes that occurred as a result of the cold weather at the beginning and end of 2010.

As in previous reports, **Section 4** deals with trends in air pollution in Northern Ireland, and **Section 5** covers spatial patterns of pollution. **Section 6** is used to report on topics of special interest; this year it looks at links between climate change and air quality. Finally, **Section 7** provides information on how each one of us can help protect the quality of the air in our region, and where to find more information.

Air quality in Northern Ireland has improved substantially in recent decades. In particular, concentrations of sulphur dioxide, which is associated with coal and oil combustion, have declined significantly over the past twenty years (see Section 4). However some pollutants in some parts of Northern Ireland continue to exceed air quality objectives. Continued effort to reduce air pollution is therefore important, together with monitoring to assess progress and to provide sound, science-based input to policy development.

Figure 1.1

Locations of Air Quality Monitoring Sites in Northern Ireland, 2010.

2

Legislation and Policy

The management of air quality is based on legislation and policy originating from Europe, and cascading down to a local level through the UK and Northern Ireland governments. Together, these statutory instruments form the basis of a strong framework for managing air quality in Northern Ireland over the coming years.

2.1 The European Union

Much of Northern Ireland's air quality legislation has its roots within the Air Quality Directives which apply to all Member States of the European Union:

- Directive 2008/50/EC on Ambient Air Quality and Cleaner Air for Europe (the Air Quality Directive), which relates to sulphur dioxide, oxides of nitrogen, particulate matter, lead, carbon monoxide, benzene and ozone in ambient air.
- Directive 2004/107/EC (the Fourth Daughter Directive) relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons (PAH) in ambient air.

These are incorporated into Northern Ireland's national law by the Air Quality Standards Regulations (Northern Ireland), of which the most recent revision was in 2010.

2.2 The Air Quality Standards Regulations (Northern Ireland) 2010

These Regulations transpose the provisions of the above Directives into Northern Ireland's own legislation. As well as the EU limit values and non-mandatory target values for ambient concentrations of pollutants, the Regulations set out requirements for ambient air quality monitoring, including number of monitoring sites required, suitable locations and acceptable methodology. They also identify the duties of Northern Ireland's Departments in relation to achieving limit and target values, and the responsibility of Departments to inform the public about air quality in the region, particularly with regard to warning the public when information and alert thresholds are exceeded.

2.3 The Air Quality Strategy for England, Scotland, Wales and Northern Ireland

The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, first published in 1997 and updated in 2007, establishes a strong framework for tackling air pollution. It was established on the basis of strong scientific evidence and a science-based understanding of the effects of air pollutants on health and the environment.

The Strategy sets objectives for a series of pollutants to be met within the UK. The scientific basis, the objectives set and provisions contained within the Strategy are closely associated with the corresponding standards set within European Air Quality Directives, as described above. The Strategy's provisions for some pollutants differ from those in the Directives; these differences relate to scientific evidence and expert opinion that is specific to the UK situation. However, all the Air Quality Strategy objectives are at least as stringent as the corresponding limit values in the Air Quality Directive or 4th Daughter Directive.

The full Air Quality Strategy and its technical annexes are available online and can be downloaded from http://www.defra.gov.uk/environment/quality/air/air-quality/approach/.

Photo: Antrim Coast

2.4 Local Air Quality Management

Local Air Quality Management (LAQM) provides the framework under the Environment Order (NI) 2002 within which air quality is managed by district councils in Northern Ireland. LAQM requires district councils to review and assess a range of air pollutants against the objectives set out within the Air Quality Strategy, using a range of monitoring, modelling, observations and corresponding analyses. For locations where objectives are not expected to be met by the relevant target date, district councils are required to declare an Air Quality Management Area (AQMA), and to develop an Action Plan to address the problem. The requirements for Air Quality Action Planning, and the part that Action Plans should play in meeting objectives, are also set out in the Air Quality Standards Regulations (NI) 2010.

At the time of writing, ten of Northern Ireland's 26 district councils have Air Quality Management Areas in place. Of these, one has declared AQMAs for PM_{10} alone, seven have declared AQMAs for NO_2 only and two have declared AQMAs for both NO_2 and PM_{10}. Two AQMAs in Antrim and Ballymoney were revoked in 2010. Figure 2.1 shows the locations of these AQMAs, and which pollutants they address.

Figure 2.1

Air Quality Management Areas in Northern Ireland (source: DoENI)

3

2010 Results from Monitoring Networks

3.1 Monitoring in Northern Ireland

A wide range of air quality monitoring is carried out in Northern Ireland. Some monitoring sites are run as part of UK-wide monitoring networks; others are operated by district councils in order to meet local objectives. The following pollutants were monitored in Northern Ireland during 2010:

- Carbon Monoxide (CO)
- Oxides of Nitrogen (NO_x), comprising Nitric Oxide (NO) and Nitrogen Dioxide (NO_2)
- Sulphur Dioxide (SO_2)
- Particles (as PM_{10}, $PM_{2.5}$ and Black Carbon)
- Ozone
- Benzene
- Polycyclic Aromatic Hydrocarbons (PAH).

During 2010, there were 36 automatic air quality monitoring stations in Northern Ireland, each equipped with continuous monitoring equipment for some or all of the above pollutants. These sites (shown previously in Figure 1.1) provide high-resolution hourly information on a wide range of pollutants. Data from the continuous monitoring sites are communicated rapidly to the public, together with warnings when levels approach or reach the "high" pollution band. Five sites are part of the UK's national monitoring network, and are used to assess compliance with the Air Quality Directive.

Northern Ireland's automatic monitoring is supplemented by non-automatic monitoring techniques, for example for hydrocarbons. These include the pumped tube samplers used to measure benzene, and the high-volume samplers used to measure PAH.

In addition, NO_2 diffusion tubes are widely used by the district councils for the purpose of Local Air Quality Management (LAQM). These low-cost, single-use samplers absorb the pollutant directly from the air and need no power supply. They measure average concentrations over a specified sampling period (typically one month), and provide invaluable data for screening purposes, 'hot-spot' identification, local impact assessment and mapping overall levels of pollution across the country as a whole.

3.2 King's College London Volatile Correction Model

Many monitoring sites use the Tapered Element Oscillating Microbalance (TEOM) to measure PM_{10}. The relatively high operating temperature of this instrument (necessary to prevent condensation on the filter) can result in the loss of volatile components of the particulate matter sampled, causing under-estimation of the PM_{10} concentration. However, it is possible to correct for this, using the Volatile Correction Model (VCM) developed by King's College, London. The VCM uses data from Filter Dynamic Measurement Systems (FDMS) PM_{10} analysers in the region (which measure both the volatile and non-volatile fractions) to calculate an appropriate correction based on the location of the instrument and the period of the measurements. The resulting corrected measurements have been demonstrated as equivalent to the gravimetric reference method. In 2010 the TEOM air quality data submitted by the UK to the European Commission was corrected by the Volatile Correction Model. To access the model and for more information, visit www.volatile-correction-model.info.

3.3 Key Results for 2010

This section summarises key monitoring results from 2010, including compliance with EU limit values and the corresponding Air Quality Strategy objectives. Further information is provided on the Northern Ireland Air website at www.airqualityni.co.uk/.

Carbon monoxide was monitored using an automatic instrument at one site - Belfast Centre. The results were well within the limit value and AQS objective for this pollutant, as they have been for many years.

Nitrogen Dioxide was monitored using automatic analysers at 20 sites during 2010. Eight roadside sites exceeded the limit value and objective for annual mean NO_2 concentration (40 µg m^{-3}). These sites were: Belfast Newtownards Road, Belfast Stockman's Lane, Belfast Westlink Roden Street (although this site only had 71%

data capture), Castlereagh Dundonald, Derry Dale's Corner, Newry Canal Street, Newry Trevor Hill and Newtownabbey Antrim Road. (A ninth site, Limavady Dungiven, also exceeded this objective: however this site only began monitoring NO_2 in November 2010 and therefore had insufficient data for a valid annual mean).

Figure 3.1 shows the annual mean NO_2 concentrations at Northern Ireland's sites. (Limavady Dungiven is excluded, as is Downpatrick which also began operation towards the end of 2010.)

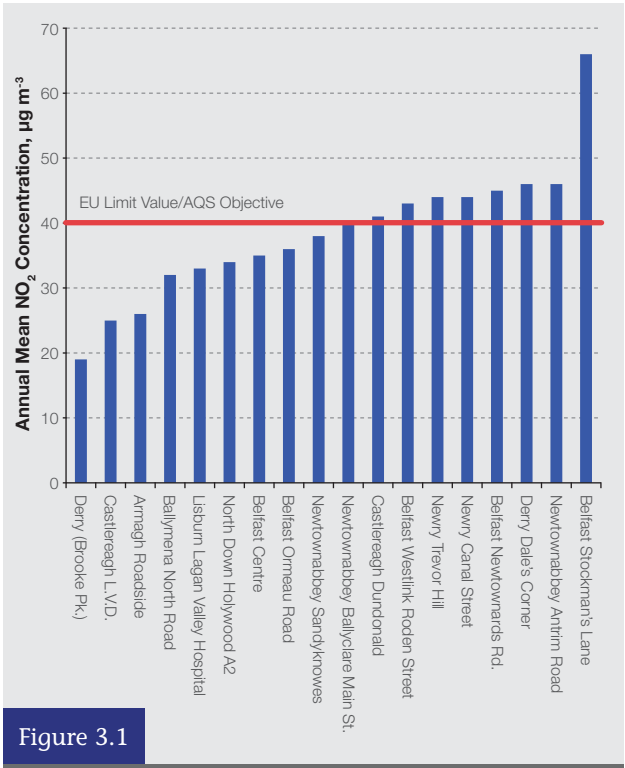

Figure 3.1

Annual Mean NO_2 Concentrations, 2010

Of the eight sites which exceeded the annual mean limit value, two also recorded more than the permitted 18 exceedances of the hourly mean limit value and AQS objective (200 µg m^{-3}). These were Newry Canal Street and Belfast Stockman's Lane. Also, Newtownabbey Sandyknowes exceeded the hourly mean limit value, despite meeting the annual mean limit value. This is unusual; the annual mean limit value is the more stringent of the two, so sites which exceed the hourly mean limit value usually also exceed the annual mean limit value. A large proportion of the hourly mean exceedances at Newtownabbey Sandyknowes occurred between 20th – 23rd December 2010, during a winter pollution episode. None of these sites are used for monitoring compliance with the Air Quality Directive.

Sulphur Dioxide was monitored at 11 automatic sites. All sites met the EU limit values for SO_2 (1-hour and 24-hour mean), and the AQS objective for the 15-minute mean. 2010 was the seventh consecutive year in which all the SO_2 limit values and objectives have been met – evidence of the progress made in reducing ambient levels of this pollutant in Northern Ireland.

Particulate matter – PM_{10} Particulate matter as PM_{10} was monitored at 25 locations in 2010. All sites met the limit value and objective of 40 µg m^{-3} for annual mean PM_{10}. However, two sites (Newry Trevor Hill and Newry Canal Street) exceeded the 24-hour mean limit value and objective of 50 µg m^{-3}, on more than the permitted 35 occasions during the year. Neither site is used for monitoring compliance with the Air Quality Directive. Newry Canal Street began operation in 2009: however, there has since been concern about its location (in a corner formed by two adjoining buildings). It is feared that wind vortices could form in the corner, blowing dust into the sampling inlet and leading to artificially high PM_{10} measurements. (Note: where TEOM analysers were used, as at Newry Canal Street, data have been converted to gravimetric equivalent by applying the King's College London's Volatile Correction Model to correct for loss of volatile components, see Section 3.2.)

Particulate matter – $PM_{2.5}$ Fine particulate matter as $PM_{2.5}$ was monitored at Belfast Centre, Belfast Clara Street, Derry and Lisburn Dunmurry throughout 2010. All four sites measured annual mean $PM_{2.5}$ concentrations well within the EU annual mean target value of 25 µg m^{-3} to be achieved by 2010.

Ozone was monitored at Belfast Centre, Derry and the rural Lough Navar site. No sites exceeded the EU target value for human health of 120 µg m^{-3} (for the maximum daily 8-hour mean) on more than the permitted 25 days, but Lough Navar did exceed the more stringent AQS objective of 100 µg m^{-3} on more than the permitted 10 days. Ozone (O_3) is a secondary pollutant that is formed by reactions involving other pollutant gases, in the presence of sunlight, and over several hours. Once formed, it may persist for several days and be transported over long distances. This means that district councils have little control over ozone levels in their area.

Unlike some other pollutants, levels of ozone in Northern Ireland do not appear to be decreasing, but remain variable from year to year, depending substantially on weather conditions. It is believed that hemispheric background O_3 concentrations are not decreasing: O_3 exceedances therefore remain possible in future. Figure 3.2 shows the

number of days per year when the maximum daily 8-hour running mean ozone concentration was greater than 100 µg m^{-3}, for the past five consecutive years: 2006-2010. This shows the exceedance of the AQS objective at Lough Navar in 2010, and the earlier exceedance at Derry in 2008.

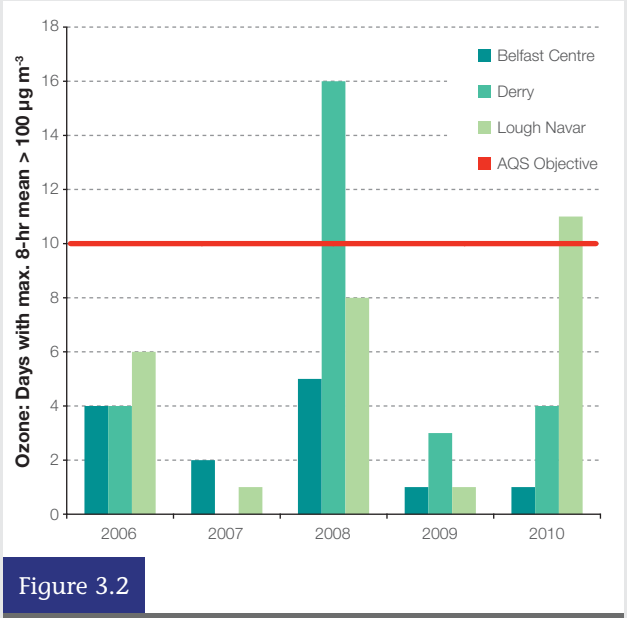

Figure 3.2

Days with Maximum Daily 8-hour Mean O_3 Concentration > 100 µg m^{-3}

Benzene was monitored at one site: Belfast Centre – which met the annual mean EU limit value and AQS objective in 2010.

Polycyclic aromatic hydrocarbons (PAH) were monitored at three sites: Ballymena Ballykeel, Derry Brandywell and Lisburn Dunmurry. All three sites exceeded the AQS annual mean objective of 0.25 ng m^{-3} for the PAH species benzo[a]pyrene (B[a]P), which was to have been achieved by 31st Dec 2010. All three sites also exceeded the less stringent EU target value of 1 ng m^{-3} for annual mean B[a]P concentration, to be met by 31st Dec 2012. B[a]P concentrations at these three sites were among the four highest in the UK: this is believed to reflect the high usage of solid fuels in the areas in which they are located.

3.4 Summary

EU limit values, and corresponding AQS Objectives, have been met by the due dates for the following pollutants –

- Carbon monoxide
- Benzene
- Sulphur dioxide

Earlier monitoring from previous years established that ambient concentrations of lead were also well within the limit and objective values.

However, a small number of sites close to busy roads in the Belfast conurbation, Derry and Newry do not meet the limit values and objectives for nitrogen dioxide. Northern Ireland is not alone in this respect: many parts of the UK (and other Member States of Europe) have reported similar exceedances. The UK has applied for a time extension for this pollutant.

Two sites in Newry did not meet the limit value and objective for 24-hour mean PM_{10}: since neither is used for monitoring compliance with the Directive limit value, they do not affect Northern Ireland's compliance status. However, the exceedances are relevant to LAQM.

In addition, benzo[a]pyrene concentrations at Northern Ireland's three sites exceeded the AQS objective for 2010 and EU target value for 2012. The Department is currently carrying out research into PAH concentrations across Northern Ireland and plans to publish a report in December 2011.

Ozone concentrations are affected by long-range rather than local factors, and occasional O_3 exceedances (like that which occurred at Lough Navar in 2010) also remain a possibility.

3.5 Winter Pollution Episodes

Cold, still winter weather can cause a specific type of pollution episode. Under these conditions, pollutants emitted by vehicles, domestic heating and other sources may become trapped close to the ground, building up rather than being dispersed. Winter pollution episodes are characterised by high concentrations of "primary" pollutants (that is, pollutants emitted directly from source rather than formed in the air by chemical reactions) including NO_x, PM_{10} and (in industrial or coal-burning areas), SO_2.

Northern Ireland used to experience frequent winter pollution episodes. They have become less common in recent years, as use of coal and solid fuels has decreased, and winters have been relatively mild. However, during 2010 there were several periods when cold, still weather gave rise to winter pollution episodes. These are described below.

3.5.1 January - March 2010 Northern Ireland experienced severe weather conditions between January and March 2010. 2010 had the coldest January since 1987, and the ninth coldest in the last 100 years. Snow fell frequently and sometimes heavily during the first fortnight, and

further periods of low temperature and snowfall occurred in February. Snow returned to Northern Ireland on the last two days of March. During this three-month period, several episodes of relatively high pollutant concentrations were recorded. These were attributed to the increased emissions from domestic heating and queuing traffic, during calm weather with low overnight temperatures.

Averaged daily mean PM_{10} concentrations for this period are presented in Figure 3.3. During the period 7th-10th January, ten sites recorded PM_{10} concentrations in the "Moderate" band. (Information about the bands used in the UK air quality index can be found at http://www.airqualityni.co.uk/airquality.php?n_action=standards&item=03.) Further periods of increased pollution occurred between 24th-27th January (when Newry Canal Street measured "Moderate" PM_{10}), and also around 10th February and 10th March.

Average NO_2 concentrations for this period are presented in Figure 3.4. Although some increase in NO_2 concentrations was seen, they remained in the "Low" band at all sites.

3.5.2 December 2010 Winter pollution episodes also affected Northern Ireland in December 2010, with elevated concentrations of particulate pollution. "Moderate" PM_{10} concentrations were reported across Northern Ireland from 2nd December onwards. By December 8th, "Very High" PM_{10} had been reported at Armagh Roadside and three sites in Newry. The increased levels continued with varying degrees of severity, until December 17th when milder temperatures resulted in a brief improvement in air quality. A further period of high pollution occurred from 19th to 27th December (with "Very High" PM_{10} at five sites) before milder weather improved the situation again from December 28th. "Moderate" NO_2 was measured once: at Belfast Stockman's Lane on 27th December. Daily mean concentrations of PM_{10} and NO_2 are shown in Figure 3.5 and Figure 3.6 respectively.

Ambient concentrations of black carbon are monitored at three sites in Northern Ireland: daily mean concentrations for December 2010 are shown in Figure 3.7. This shows clear peaks around 7th, 13th – 14th and 19th -25th December. Black carbon is associated with solid fuel and oil combustion, so this pattern reflects increased use of such fuels during the cold, still weather conditions.

Although PM_{10} went into the "Moderate", "High" and even the "Very High" bands on occasions during the winter pollution episodes in 2010, the same was not true of SO_2, which remained in the "Low" band (15-minute mean not exceeding 266 µg m^{-3}) throughout. This is an indication of the progress made in reducing ambient concentrations of this pollutant in Northern Ireland.

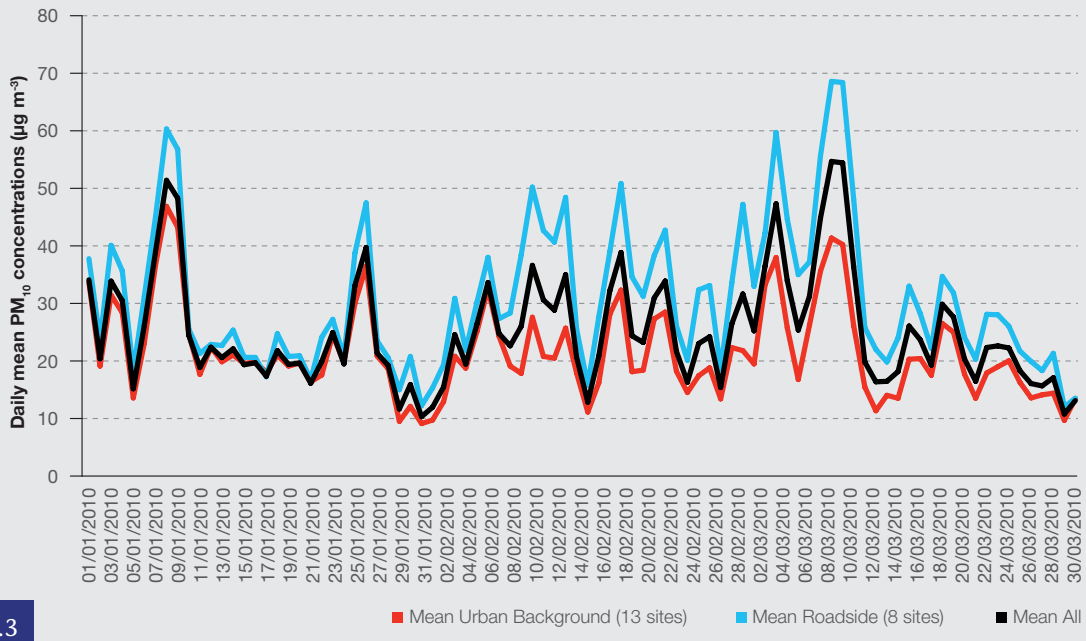

Figure 3.3

Daily Mean PM_{10} concentrations at sites in Northern Ireland, Jan - Mar 2010

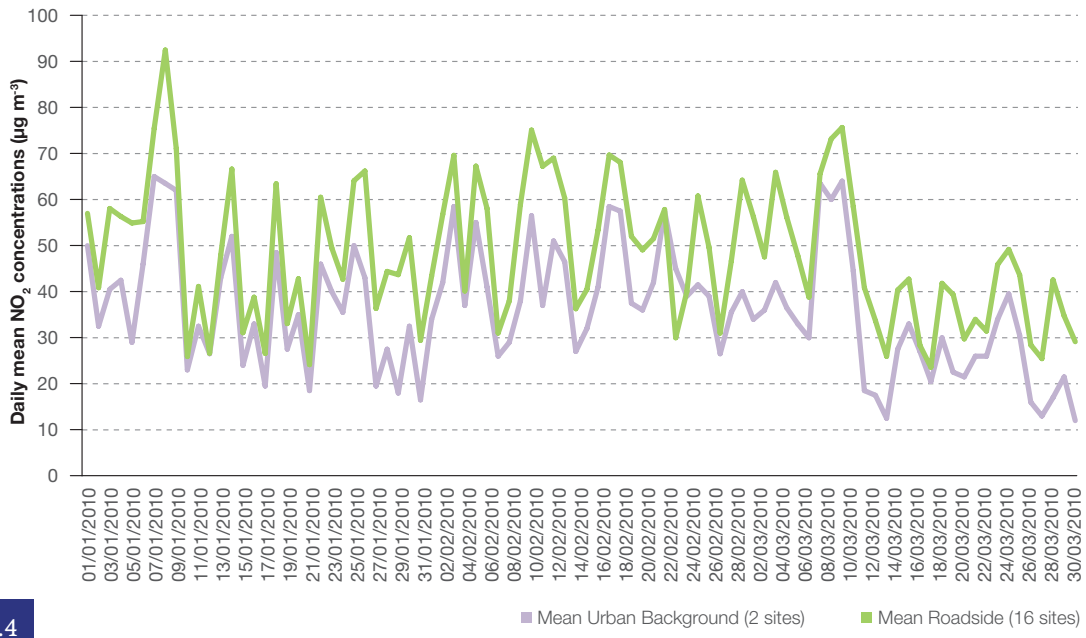

Figure 3.4

Daily mean NO_2 concentrations at sites in Northern Ireland, Jan - Mar 2010

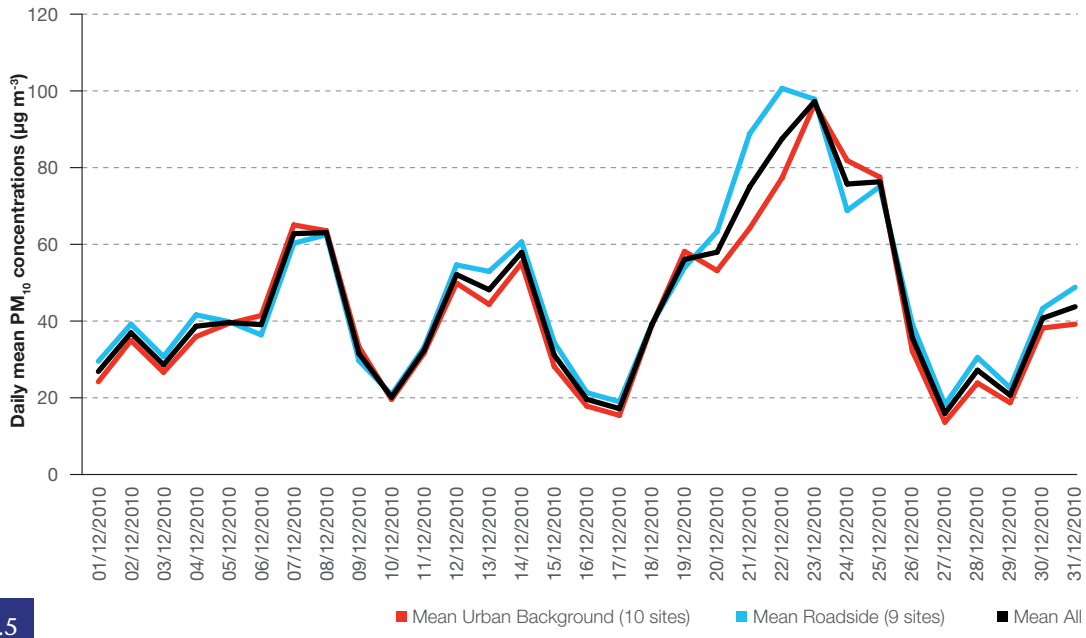

Figure 3.5

Daily Mean PM_{10} Concentrations in Northern Ireland, December 2010

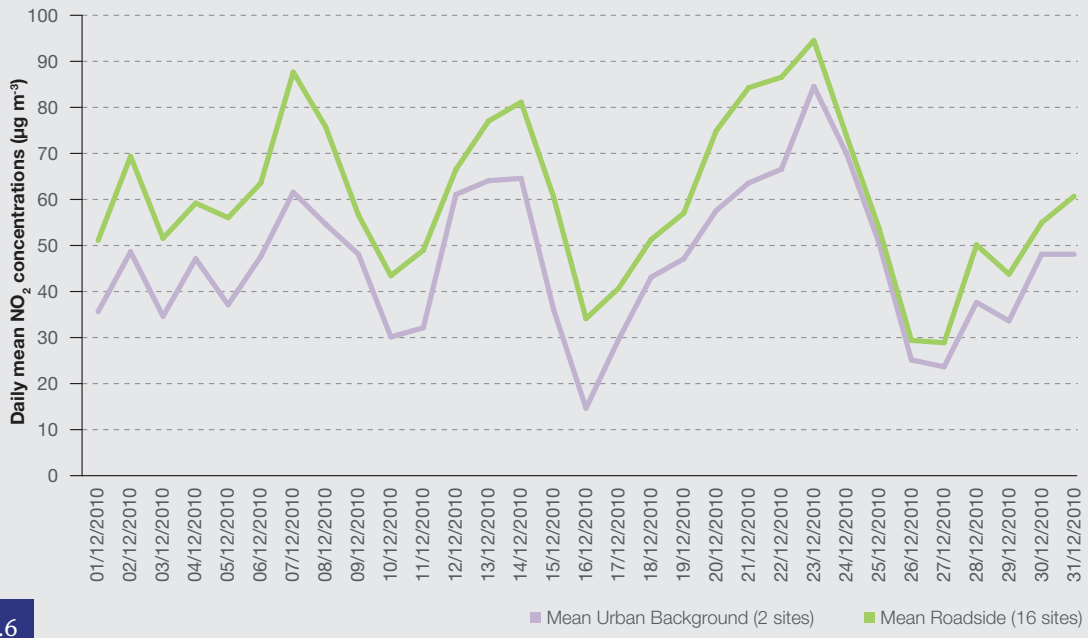

Figure 3.6

Daily Mean NO_2 Concentrations in Northern Ireland, December 2010

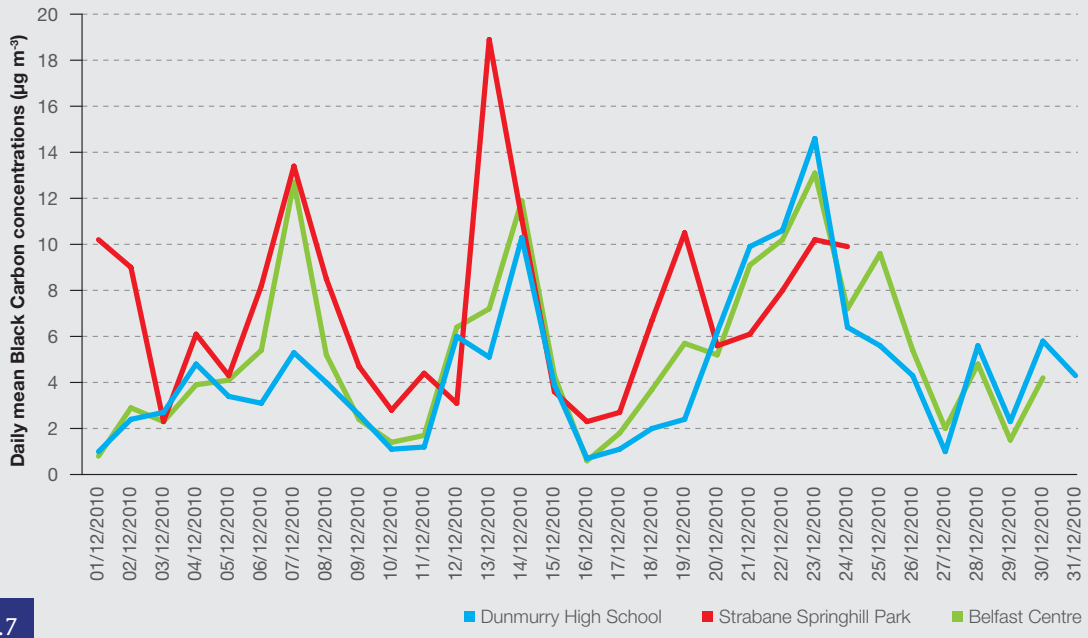

Figure 3.7

Daily Mean Black Carbon Concentrations in Northern Ireland, December 2010

4

Changes Over Time

Recent decades have seen a marked improvement in Northern Ireland's overall air quality. In particular, concentrations of pollutants such as SO_2, associated with coal and oil combustion, have declined significantly over the past decades. Here we examine how overall air pollution levels in Northern Ireland have changed over the last 20 years.

It is usually considered that at least five consecutive years' data are required from a monitoring site, in order to assess long-term trends. Also, recent research has also indicated that for robust annual mean trend analysis, at least four monitoring sites with good annual mean data capture should be available[1].

Recent years have seen a substantial increase in the number of automatic monitoring sites in Northern Ireland. This has improved our understanding of the region's pollution climate. However, it potentially complicates the investigation of trends in air quality: if such investigations are based on all available data, discontinuities may be introduced because of the changes in the number of sites (and their distribution). Therefore, this year, investigation of changes over time has been based on subsets of long-running sites (comprising at least four sites where possible). This should lead to a more robust assessment.

4.1 Sulphur Dioxide

Sulphur dioxide is formed when fuels containing small amounts of sulphur (such as coal and oil) are burned. In the past, such fuels have been widely used for domestic heating in Northern Ireland, leading to relatively high concentrations of sulphur dioxide. However, as natural gas has become more widely available, sulphur dioxide concentrations have declined significantly. This is illustrated by Figure 4.1, which shows a time series of annual mean SO_2 concentrations for two subsets of sites: firstly, Belfast East and Belfast Centre – the only two sites in operation since the early 1990s - and secondly, five urban sites all of which have been in operation since 2003.

4.2 Particulate Matter as PM_{10}

Figure 4.2 shows a time series of annual mean concentrations of PM_{10} over the past two decades. Roadside locations are represented by a subset of four

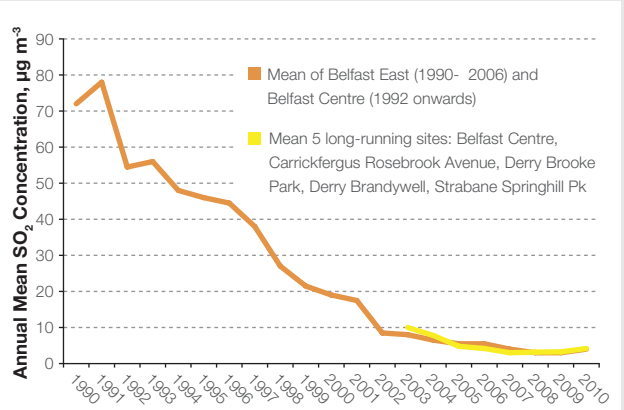

Figure 4.1

Time Series of Annual Mean Sulphur Dioxide Concentration at Long-Running Sites in Northern Ireland, 1990- 2010

long-running monitoring sites, (Castlereagh Lough View Drive, Lisburn Lagan Valley Hospital, Newry Trevor Hill and North Down Holywood A2) all of which have operated since 2004. Urban background locations are represented by a subset of eight long-running monitoring sites, all operational since 2004 or earlier (Belfast Centre, Derry Brandywell, Derry Brooke Park, Lisburn Dunmurry, Lisburn Island Civic Centre, Newry Monaghan Row, North Down Bangor and Strabane Springhill Park). Belfast Centre, which has monitored PM_{10} since 1992, is also shown.

PM_{10} concentrations at Belfast Centre have generally decreased since 1992. The urban background average from 2004 onwards shows a similar pattern. Similarly, the roadside average PM_{10} concentration has generally decreased from 2004 to 2009.

However, the downward trend at Belfast Centre has not continued: annual mean PM_{10} concentrations have increased in 2009 and 2010. Similarly, both the urban background average and the roadside average have increased in 2010 compared to 2009. It is possible that this increase is due to the periods of cold weather that occurred in 2010; these caused periods of elevated PM_{10} concentration, as discussed in Section 3 of this report.

[1] Draft report – University of Glasgow, School of Mathematics and Statistics.

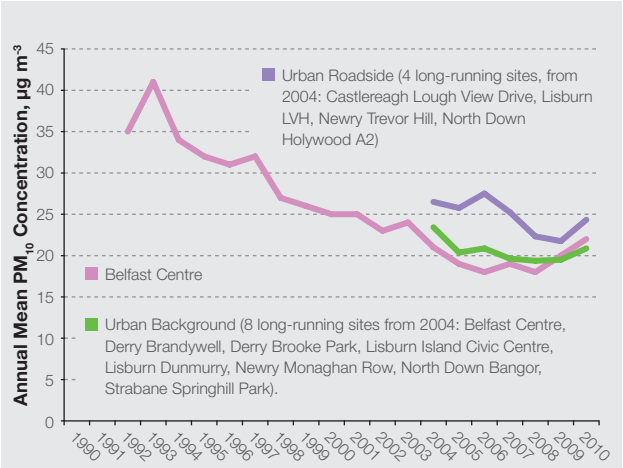

Figure 4.2

Time Series of Annual Mean PM_{10} at Long-Running Sites in Northern Ireland, 1990 - 2010.

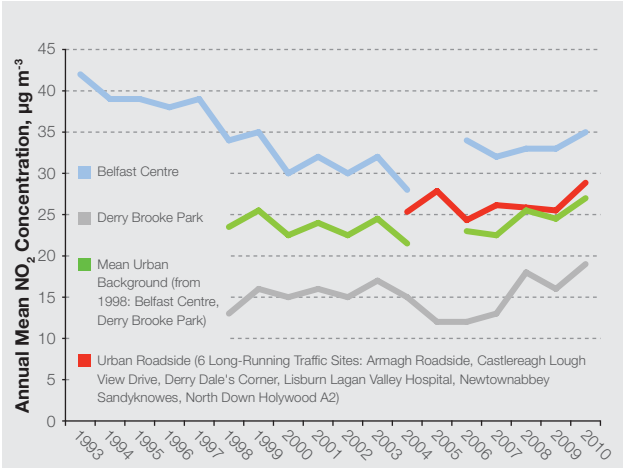

Figure 4.3

Time Series of Average Annual Mean NO_2 at Long-Running Sites in Northern Ireland, 1993-2010

4.3 Oxides of Nitrogen

Within Northern Ireland (and throughout the UK) the most widely exceeded AQS objective and EU limit value applies to annual mean nitrogen dioxide (NO_2). It is therefore important to understand how ambient concentrations of this pollutant are changing over time.

Figure 4.3 shows a time series graph of the average annual mean NO_2 concentration for two sub-sets of long-running monitoring sites. Urban background (i.e. non-roadside) sites are represented by Belfast Centre and Derry Brooke Park. The mean of both sites is also shown, as the green line on Fig 4.3. (Note: in 2005, data capture at Belfast Centre was only 50%, so the mean of both sites is omitted, to avoid a misleading discontinuity in the graph.)

Urban roadside sites (the red line on Fig 4.3) are represented from 2004 by a subset of six long-running sites (Armagh Roadside, Castlereagh Lough View Drive, Derry Dale's Corner, Lisburn Lagan Valley Hospital, Newtownabbey Sandyknowes and North Down Holywood A2). The minimum annual data capture for inclusion in this graph is 70%.

The annual mean NO_2 concentration at Belfast Centre (the longest-running site) decreased through the 1990s. However, this downward trend appears to have reversed, as annual mean NO_2 concentrations at the site during the last three years have been slightly (but consistently) higher than those measured in 2000-2004. The annual mean at Derry Brooke Park has also increased in the past three years. The mean of these two urban background sites (shown as a green line on Fig 4.3 from 1998 onwards) reflects these results.

The average annual mean NO_2 concentration for urban roadside sites (based on the six sites listed above, from 2004 onwards) shows no clear upward or downward slope, though the 2010 average is the highest year since the series began in 2004.

This is consistent with the findings of a 2007 report by the Air Quality Expert Group, which reported that roadside NO_2 concentrations in the UK (which had previously been falling) showed *"little indication of a downward trend after 1997"*[2]. AQEG attributed this to:

- An increase in the proportion of total NO_x emitted directly to the atmosphere as NO_2. This is due to the increased market penetration of diesel cars, and the retrofitting of pollution control devices, such as catalytically regenerative traps, to buses.
- Increasing hemispheric background concentrations of ozone, which promotes the oxidation of emitted NO to NO_2.

2010 appears to have been a relatively high year for NO_2 in Northern Ireland, possibly due to the cold winter weather experienced at the beginning and end of the year.

[2] Air Quality Expert Group (2007) "Trends in primary nitrogen dioxide in the UK". [online]. Available at http://archive.defra.gov.uk/environment/quality/air/airquality/publications/primaryno2-trends/documents/primary-no-trends.pdf [accessed 5th Oct 2011].

5

Maps of Air Quality

Measurements from air quality monitoring sites in Northern Ireland have been combined with pollutant emissions data from the UK's National Atmospheric Emissions Inventory (NAEI) to produce detailed modelled maps - at 1km resolution - of average or peak background pollutant concentrations across the country for 2010.

Figure 5.1 shows peak (99.9th percentile) 15-minute average concentrations of sulphur dioxide (SO_2). The main sources of this pollutant are industrial and domestic fuel burning - particularly coal and oil. While peak concentrations are very low over most of Northern Ireland, there are some small areas of higher peak SO_2 concentration in parts of the Belfast conurbation. There are also isolated spots of higher concentration elsewhere, such as the Craigavon area - possibly small pockets of high domestic coal or oil use in small towns.

Figure 5.2 shows corresponding annual mean PM_{10} concentrations. Highest concentrations occur in the Lagan Valley, in the area around Belfast and Dunmurry. However, annual mean background concentrations throughout the region are well below the AQS objective.

Figure 5.3 shows modelled annual mean background NO_2 concentrations. These are all well below the AQS objective even in central Belfast. Although this map shows background concentrations, the contribution of vehicle emissions can still be seen – the network of major roads connecting Northern Ireland's cities is clearly visible in Figure 5.3.

For traffic-related pollutants, roadside concentrations (4m from the kerb) are also modelled. Figure 5.4 shows modelled annual mean NO_2 concentrations alongside major roads in the Belfast area. Exceedances of the AQS objective are predicted along numerous road links, including some city centre streets (e.g. Victoria Street, Oxford Street), the A2, B505 towards Holywood, the A12 (Westlink) and A1 (Lisburn Road). This is consistent with the monitoring results, which identified exceedances at several urban roadside sites.

SO_2

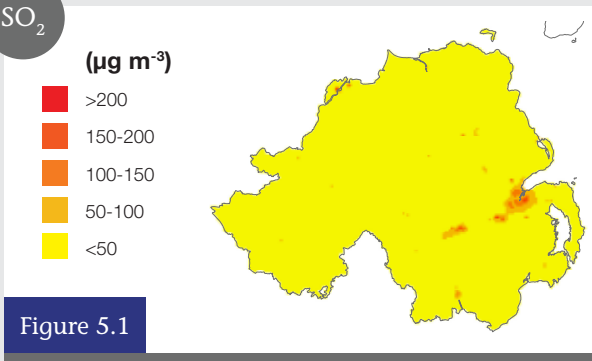

Figure 5.1

Estimated 99.9th percentile of 15-minute mean SO_2 µg m^{-3}

PM_{10}

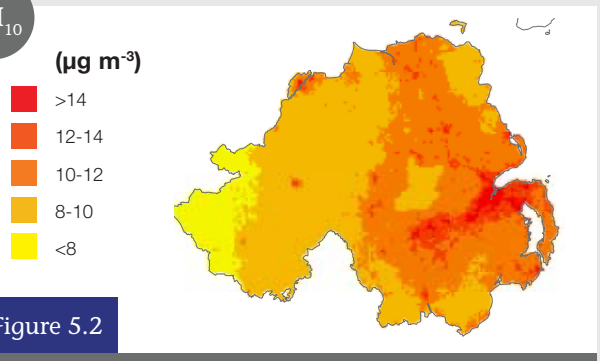

Figure 5.2

Estimated annual mean background PM_{10} µg m^{-3}

NO_2

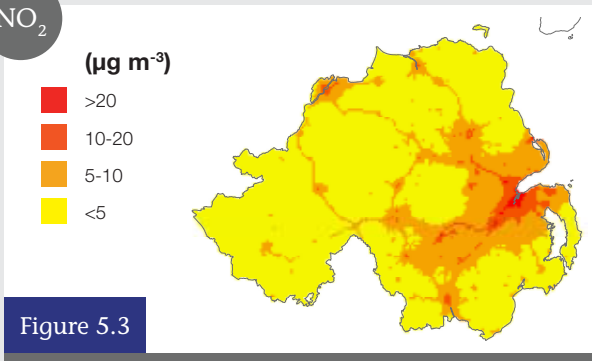

Figure 5.3

Estimated annual mean background NO_2 µg m^{-3}

NO_2

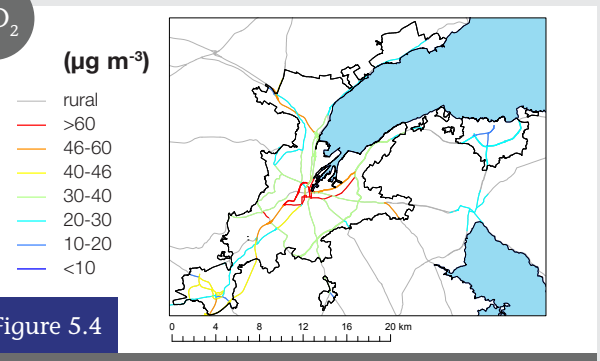

Figure 5.4

Estimated annual mean roadside NO_2 µg m^{-3} in the Belfast area

6

Links With Climate Change

The Intergovernmental Panel on Climate Change reports that our climate is changing, and increases in global average temperatures are "very likely" due to human activity[3]. Globally, climate change potentially threatens water supplies, food production, health, biodiversity, economic and political stability. In Northern Ireland, it is acknowledged that *"disruption to business, services and our daily lives will increase if adverse changes occur. An increased risk of flooding and coastal erosion with pressure on drainage, sewage, roads, water and habitat is very real. Increased temperature, increased pollution and poorer air quality may bring discomfort to the vulnerable and threaten species of animals and crops"*[4].

Climate change is predicted to impact on air quality: higher temperatures and other meteorological changes are expected encourage the build-up of ground-level ozone, so summer pollution episodes in Europe could become more frequent and severe[5]. There is also evidence that extreme high temperatures increase the health impacts of particulate pollution[6].

The main contributors to man-made climate change include –

- **Carbon dioxide (CO_2)**, produced when any carbon-containing fuel is burned. Although it occurs naturally in the atmosphere, there is evidence that fossil fuel burning has increased the concentration to the extent that our climate is affected. CO_2 is the most important compound associated with climate change.
- **Methane** (produced from some agricultural processes and from landfill). Methane is 21 times more effective as a "greenhouse gas" than CO_2.
- **Nitrous oxide (N_2O)**, primarily from agriculture. It is not harmful to health at ambient concentrations, but is believed to make a significant contribution to climate change.
- The so-called "**F-gases**" (fluorinated greenhouse gases), used in various industrial applications and as refrigerants. Their use is strictly regulated.
- **Black carbon** (soot from combustion processes) is also implicated in climate change.

Northern Ireland is committed to reducing its total emissions of "greenhouse gases" (the gases believed to contribute towards climate change) by 25% of 1990 levels by 2025. The Northern Ireland Greenhouse Gas Emissions Reduction Action Plan[4] sets out how this will be achieved by the various Government Departments. The document identifies the roles of the Departments in influencing emissions from a number of defined sectors:

- Power
- Workplaces & Jobs: Industrial Process
- Workplaces & Jobs: Heating Workplaces
- Agriculture, Land And Forestry Management
- Homes And Communities
- Transport
- Waste
- Public Sector

The air quality monitoring discussed in this report is primarily carried out because of the effects of the pollutants on human health and ecosystems. However, the combustion sources that are the main producers of CO_2 often release the air pollutants discussed in this report, such as NO_X, particulate matter, black carbon and sulphur dioxide. **So, reducing the amount of fuel we burn (especially fossil fuels like oil and coal) will help reduce both climate change and air pollution**. Black carbon is of particular relevance as it is believed to be a "short-lived climate forcer", being removed from the atmosphere by natural processes much more quickly than CO_2. As a result, it is thought that reducing ambient concentrations of black carbon will bring relatively quick benefits[7].

[3] Intergovernmental Panel on Climate Change (2007) "Climate Change 2007: Synthesis Report – Summary for Policymakers" [online]. Available at http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf. (Accessed 9th Nov 2011).

[4] Northern Ireland Greenhouse Gas Emissions Reduction Action Plan (Feb 2011). Available online at http://www.doeni.gov.uk/northern_ireland_action_plan_on_greenhouse_gas_emissions_reductions.pdf. (Accessed 4th Oct 2011).

[5] Defra (2010) "Air Pollution: Action in a Changing Climate" [online]. Available at http://www.defra.gov.uk/publications/files/pb13378-air-pollution.pdf. (Accessed 4th Oct 2011).

[6] Qian Z, He Q, Lin H-M, Kong L, Bentley CM, Liu W, et al. 2008. "High Temperatures Enhanced Acute Mortality Effects of Ambient Particle Pollution in the 'Oven' City of Wuhan, China." Environ Health Perspect 116:1172-1178. http://dx.doi.org/10.1289/ehp.10847

[7] P Landau "is black carbon the new pollution" Air Quality Management issue no. 181, Jul 2011

7

What Can I Do To Help?

It takes energy to produce food, treat our drinking water, manufacture the things we use, heat our homes and workplaces, and transport us to the places we need to go. Most of this energy comes from the burning of fuels – producing CO_2 (which contributes to climate change) and usually some air pollutants (such as NO_x and PM_{10}).

Therefore, the choices we make about how we travel, how we heat our homes, and the things we buy and use can all help to make a difference to air quality. If we can use less energy, and avoid wasting it, this will avoid releasing unnecessary pollution into the air. It will also save us money. Most importantly, it will help us tackle other important environmental problems such as climate change.

Here are some things we can do:

- Try to drive less. Walk or cycle if possible, or use public transport – especially for short journeys. Make use of car sharing[8] if you can.
- Make sure your home is well insulated and the boiler well-maintained: 80% of energy used in homes is for heating and hot water[9]. You may be eligible for financial support towards this.
- If you are a landlord, ensure that the homes you let are properly insulated, so that your tenants do not have to waste energy to keep warm.
- Stay warm but don't overheat your home: 21° C is comfortable for most people.
- Turn off unnecessary lights, and switch off electrical equipment (such as televisions and computers) when you have finished using them.
- Boil only as much water as you need (but be sure the kettle's heating element is submerged).
- Avoid wasting food – it takes energy to produce.
- Reduce the amount of animal products (especially red meat) in your diet. Livestock farming is a major source of greenhouse gas emissions.
- When washing clothes, wait until you have enough washing for a full machine load.
- Wash clothes at a lower temperature such as 30° C, unless they are very dirty.
- Dry clothes outdoors if possible rather than using a tumble drier.
- When buying electrical items, choose energy-efficient models.
- Avoid buying items with excessive amounts of packaging.
- Shop wisely and think before you buy.

Lots more energy saving advice can be found on the Energy Saving Trust's web pages for Northern Ireland, at http://www.energysavingtrust.org.uk/northernireland/Take-action/Money-saving-tips/Energy-saving-tips.

Where to find out more:

The Northern Ireland Air Quality Website at http://www.airqualityni.co.uk/ provides information covering all aspects of air pollution in Northern Ireland.

The DoENI website at www.doeni.gov.uk provides information on a range of environmental issues including air quality, waste and climate change.

National and local air quality forecasts are available from:

- The Air Pollution Information Service on freephone 0800 556677
- The Defra UK Air Information Resource (UK-AIR) at http://uk-air.defra.gov.uk/

For information on air quality issues in your local area, please contact the Environmental Health Department of your District Council.

[8] Directgov "Car sharing" [online]. Available at http://www.direct.gov.uk/en/Environmentandgreenerliving/Greenertravel/Greenercarsanddriving/DG_10036310. (Accessed 15th Aug 2011)

[9] Directgov "Insulation and heating" [online]. Available at http://www.direct.gov.uk/en/Environmentandgreenerliving/Energyandwatersaving/Energyandwaterefficiencyinyourhome/DG_064374. (Accessed 15th Aug 2011)

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