Department of the
Environment
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Air Pollution
in Northern Ireland 2012

RICARDO-AEA

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Report Highlights

This is the eleventh in a series of annual reports on air quality in Northern Ireland. It is produced by Ricardo-AEA, on behalf of the Department of the Environment. This report aims to provide the citizens of Northern Ireland, and the wider air quality community, with user-friendly information on local air quality monitoring. The report presents the key results of that monitoring from throughout the region during 2012. 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 2012.

Section 2 of this report outlines the air quality legislation and policy applicable to Northern Ireland, including the Local Air Quality Management process by which district councils manage air quality at a local level. **Section 3** summarises the monitoring carried out in Northern Ireland, and presents an overview of the data from 2012, including exceedances of air quality objectives.

As in previous reports, **Section 4** deals with how air pollution in Northern Ireland has changed over time, and **Section 5** covers spatial patterns in pollution. **Section 6** is used to report on topics of special interest; this year (as Northern Ireland prepares to host the 2014 Giro d'Italia) it looks at the benefits of cycling in relation to air quality.

Finally, **Section 7** provides information on how each one of us can help protect and improve 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, a pollutant associated with coal and oil combustion, have declined significantly over the past twenty years. However some pollutants in some parts of Northern Ireland continue to exceed air quality objectives. A 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.

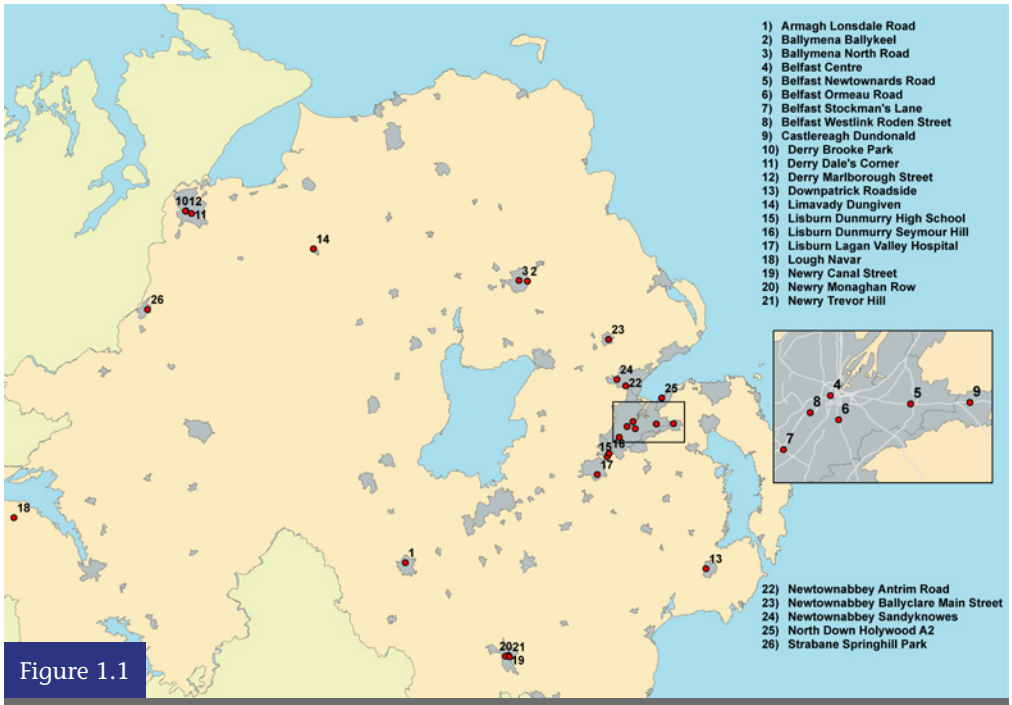

Figure 1.1

Locations of Air Quality Monitoring Sites in Northern Ireland, 2012.

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Legislation and Policy

The management of air quality in Northern Ireland is based on the requirements of European Union (EU) Air Quality Directives, and on the UK Air Quality Strategy. These requirements are incorporated (or "transposed") into Northern Ireland's own legislation by statutory measures, forming the basis of a strong framework for managing air quality.

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 the number of monitoring sites required, siting criteria and acceptable methodology. They also identify the duties of Northern Ireland's Government Departments in relation to achieving limit and target values. It is the responsibility of Department of the Environment 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, provides a comprehensive 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 www.gov.uk/search?q=air+quality+strategy&tab=government-results.

Photo: The Big Fish, Donegall Quay, Belfast

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 by 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.

At the time of writing, there are a total of 28 AQMA's in Northern Ireland which have been declared by twelve of Northern Ireland's 26 district councils (Table 2.1). Of these, eleven have declared AQMAs for NO_2 (either on its own or with together with PM_{10}), four have AQMAs for PM_{10} (on its own or with another pollutant), and one has declared an AQMA for SO_2 (together with PM_{10}). Table 2.1 and Figure 2.1 show the locations of these AQMAs, and which pollutants they address.

Table 2.1 Air Quality Management Areas in Northern Ireland (as of Sep 2013)

District Council	No. of AQMAs	Pollutants	Sources
Armagh	2	NO_2 (2)	Road traffic
Ballymena	2	PM_{10} and SO_2 (1), NO_2 (1)	Domestic emissions (PM_{10} & SO_2), road traffic (NO_2)
Belfast City	4	NO_2 (3), NO_2 and PM_{10} (1)	Road traffic
Castlereagh	1	NO_2	Road traffic
Craigavon	2	NO_2 (2)	Road traffic
Derry City	5	NO_2 (5)	Road traffic
Dungannon	4	NO_2 (4)	Road traffic
Limavady	1	NO_2	Road traffic
Magherafelt	1	NO_2	Road traffic
Newry & Mourne	2	NO_2 (1), PM_{10} (1)	Road traffic, domestic emissions
Newtownabbey	1	NO_2	Road traffic
Strabane	3	PM_{10} (3)	Domestic emissions

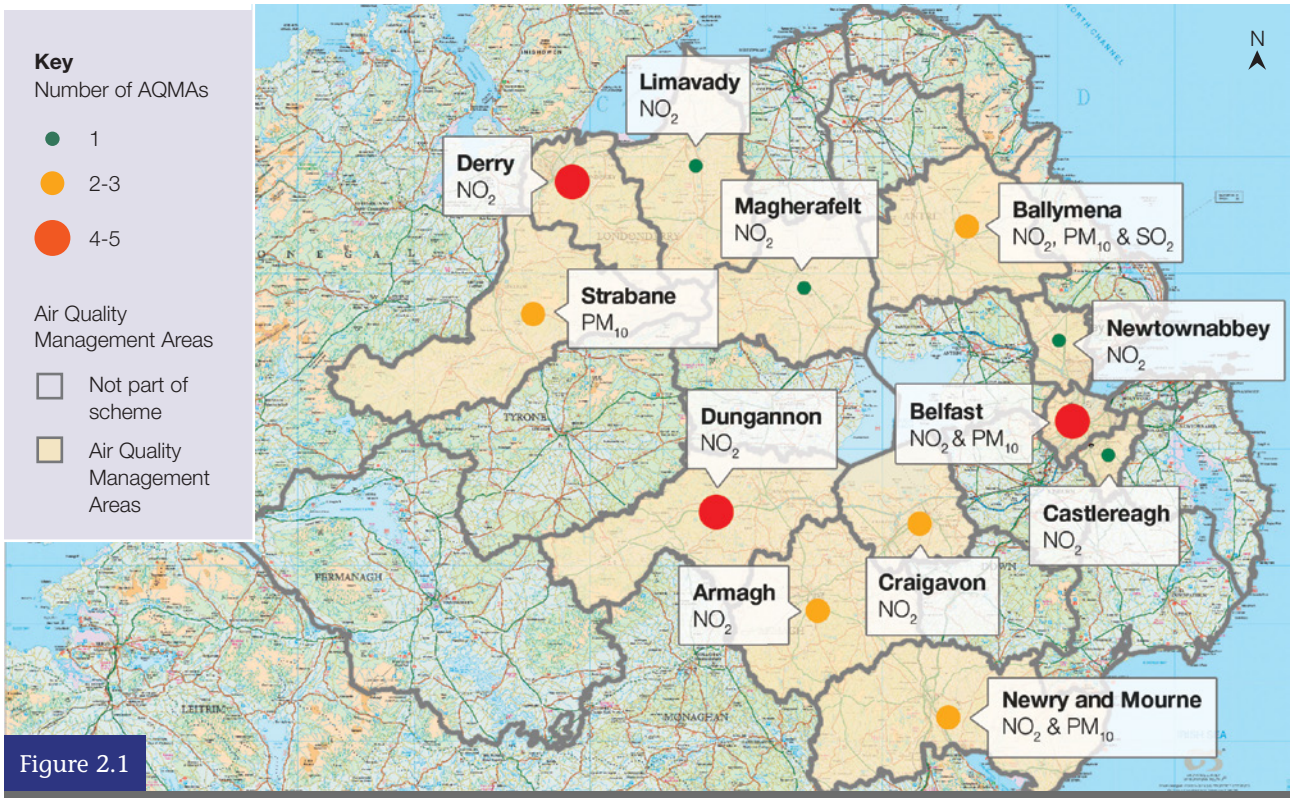


Figure 2.1

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

3

Monitoring Results for 2012

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 Air Quality Directive requires Member States to be divided into 'zones' for reporting purposes. Northern Ireland comprises two reporting zones – the 'Belfast Metropolitan Urban Area' agglomeration (the conurbation of Belfast), and the 'Northern Ireland' zone (the rest of the region). The Directive then specifies how many monitoring sites (or 'stations') are needed in each zone (based on its size and population). Only sites which meet the stringent siting criteria of the Directive may be used for reporting to the European Commission. The Directive siting criteria are different from those used for LAQM: for example, sites located close to major road junctions are used in LAQM, but must not be used for Directive compliance monitoring purposes. There are also different criteria regarding relevant public exposure.

The following pollutants were monitored in Northern Ireland during 2012:

- Carbon monoxide (CO)
- Oxides of nitrogen (NOx), comprising nitric oxide (NO) and nitrogen dioxide (NO_2)
- Sulphur dioxide (SO_2)
- Particles (as PM_{10}, $PM_{2.5}$, and black carbon)
- Ozone (O_3)
- Benzene
- Metallic pollutants
- Polycyclic Aromatic Hydrocarbons (PAH).

During 2012, there were 26 automatic air quality monitoring stations in Northern Ireland, each equipped with continuous monitoring equipment for one or more of the pollutants for which automatic methods are used: CO, NOx, SO_2, PM_{10}, $PM_{2.5}$ and O_3. 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 via the website www.airqualityni.co.uk. Public warnings are issued when levels approach or reach the 'high' pollution band.

Five of the automatic monitoring sites (Belfast Centre, Derry Brooke Park, Armagh Lonsdale Road, Ballymena Ballykeel and Lough Navar) are part of the UK's national monitoring network, and are used to assess compliance with the Air Quality Directive.

Non-automatic monitoring techniques are used for benzene, metallic pollutants, black carbon, and PAH: some of these measurements are used to assess compliance with the Air Quality Directive and Fourth Daughter Directive.

In addition, many district councils use diffusion tubes for indicative monitoring of nitrogen dioxide. 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 a useful and economical supplement to automatic monitoring.

3.2 King's College London Volatile Correction Model

Three of Northern Ireland's 15 PM_{10} monitoring sites use the Tapered Element Oscillating Microbalance (TEOM) to measure PM_{10}. The relatively high operating temperature of the TEOM (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 equivalent. To access the model and for more information, visit www.volatile-correction-model.info. The TEOM PM_{10} data presented in this report have been corrected to gravimetric equivalent using the VCM. (This issue only arises for PM_{10}: there is at present no requirement to correct TEOM measurements of $PM_{2.5}$, and in any case, all four of Northern Ireland's $PM_{2.5}$ monitoring sites use the FDMS analyser.)

3.3 Key Results for 2012

This section summarises key monitoring results from 2012, including compliance with EU limit values and the corresponding Air Quality Strategy (AQS) 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 EU limit value and AQS objective for this pollutant, and have been for many years.

Benzene was monitored at one site: Belfast Centre – which met the annual mean EU limit value and AQS objective (for the running annual mean) in 2012, as it has for many years.

Metallic pollutants - including lead, arsenic, cadmium and nickel - were monitored using non-automatic techniques at Belfast Centre, as part of the Urban Metals Network. The results for 2012 were within the annual mean EU limit value and AQS objective for lead, and within the EU annual mean target values for arsenic, cadmium and nickel.

Sulphur dioxide was monitored at seven 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. 2012 was the ninth consecutive year in which all the SO_2 limit values and objectives have been met – this provides 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 15 locations in 2012. Three of these sites (Castlereagh Dundonald, Newry Canal Street and North Down Holywood A2) used the TEOM instrument: data from these sites have been corrected to gravimetric equivalent using the King's College Volatile Correction Model as explained in Section 3.2. All sites met the limit value and objective of 40 µg m^{-3} for annual mean PM_{10}. All sites also met the compliance criteria for the daily mean limit value and objective of 50 µg m^{-3}, as (after VCM correction where applicable) none exceeded this value on more than the maximum permitted 35 occasions during the year.

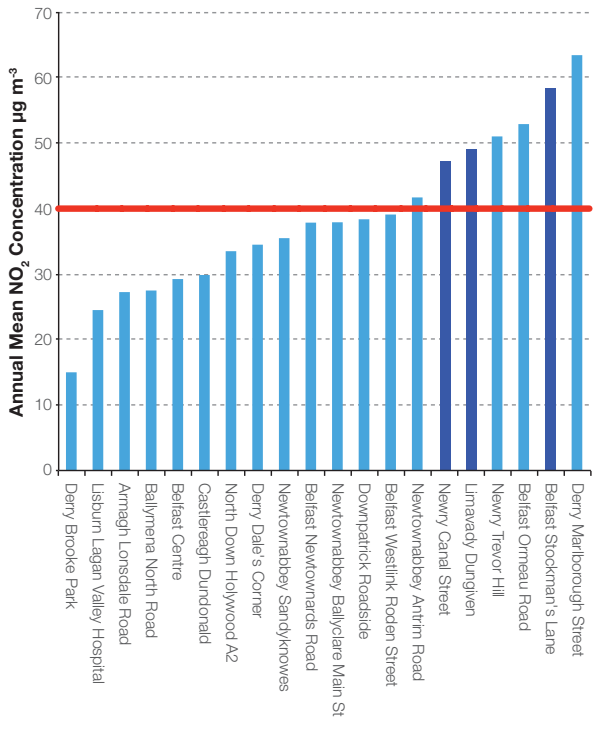
Particulate matter – $PM_{2.5}$ Fine particulate matter as $PM_{2.5}$ was monitored (using the FDMS analyser) at Belfast Centre, Derry Brooke Park, Lisburn Dunmurry High School and Lisburn Dunmurry Seymour Hill during 2012. (Lisburn Dunmurry Seymour Hill replaced Lisburn Dunmurry High School part way through the year, so neither of these two sites achieved 90% data capture for $PM_{2.5}$.) All four sites measured annual mean $PM_{2.5}$ concentrations well within the EU target value for 2010 of 25 µg m^{-3}. They therefore have already achieved the Stage 1 limit value, which is also 25 µg m^{-3} , and must be met by 1st Jan 2015. All sites were also within the Stage 2 limit value (20 µg m^{-3} to be achieved by 1st Jan 2020).

Nitrogen dioxide was monitored using automatic analysers at 20 sites during 2012. Seven roadside sites exceeded the AQS objective for annual mean NO_2 concentration (40 µg m^{-3}). These sites were: Newtownabbey Antrim Road, Newry Canal Street, Limavady Dungiven, Newry Trevor Hill, Belfast Ormeau Road, Belfast Stockman's Lane and Derry Marlborough Street (Figure 3.1). None of these sites are used for monitoring compliance with the Air Quality Directive. However, the UK's compliance assessment is based not only on monitoring but also on modelling. This modelling indicated that there were locations within the Belfast Metropolitan Urban Area reporting zone,


Photo: Dunluce Castle

which did not achieve compliance with the Directive limit value for NO_2 during 2012. Member States with zones not meeting NO_2 limit values by the specified date were allowed to apply for a time extension (to 2015 at the latest). Applications for time extensions had to be accompanied by Action Plans showing how the limit values would be achieved. The application and Action Plan for the Belfast zone were rejected. The zone comprising the remainder of Northern Ireland (outside of Belfast) was modelled and is expected to achieve full compliance by 2014; the European Commission granted an extension to the NO_2 compliance deadline for this zone to reflect this.

Of the seven sites showing exceedances of the annual mean AQS objective in 2012, three also recorded more than the permitted 18 exceedances of the hourly mean AQS objective (200 µg m^{-3}), or, where data capture was less than 90%, the 99.8th percentile of hourly means exceeded 200 µg m^{-3}. These three sites were Newry Canal Street, Limavady Dungiven and Belfast Stockman's Lane.



Sites which also exceeded AQS objective for hourly mean NO_2 on >18 occasions, or for which 99.8th %ile was > 200 µg m^{-3}, are shaded dark blue.

Figure 3.1

Annual Mean NO_2 Concentrations 2012

Ozone was monitored at Belfast Centre, Derry Brooke Park 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, or the more stringent AQS objective of 100 µg m^{-3} on more than the permitted 10 days in 2012 (Figure 3.2).

Unlike some other pollutants, levels of ozone (O_3) in Northern Ireland do not appear to be decreasing, but remain variable from year to year. Ozone exceedances happen in some years but not others. The reasons for this relate to how ozone is formed: it is a "secondary" pollutant – that is, it is formed by reactions involving other pollutant gases, in the presence of sunlight, and over several hours. This means that the number of ozone exceedances in any given year depend substantially on weather conditions. It is also believed that the "hemispheric background" concentration of (largely natural) O_3 is not decreasing: O_3 exceedances therefore remain possible in future.

Ozone is also a "transboundary" pollutant: 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.

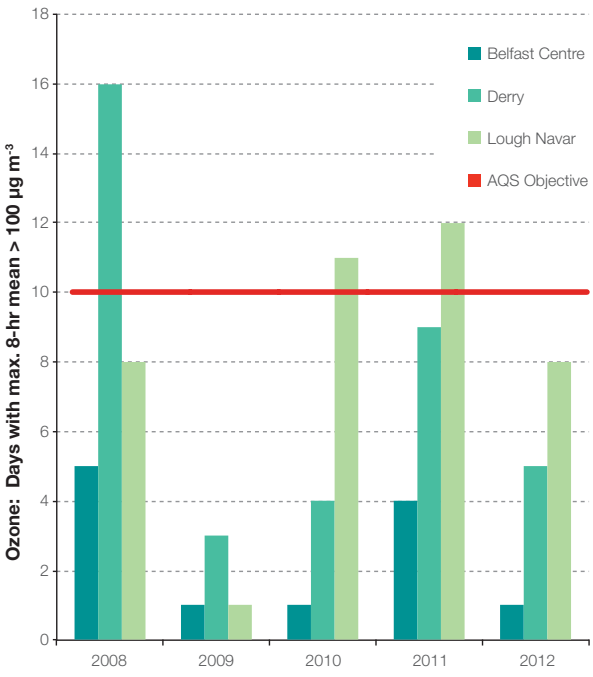


Figure 3.2

Ozone: Days with Maximum 8-hour mean > 100 µg m^{-3}, for Five Years 2008-2012

Polycyclic aromatic hydrocarbons (PAH) were monitored at four sites in 2012, which were all part of the PAH Network (Fig 3.3). The network measures a range of PAH compounds, but one species in particular, benzo[a] pyrene (B[a]P), is used as a "marker" for PAH compounds and is the subject of an AQS objective and EU target value. All four sites exceeded the AQS annual mean objective of 0.25 ng m^{-3} for this PAH species, which was to have been achieved by 31st Dec 2010. (Please note, Kilmakee Leisure Centre replaced Lisburn Dunmurry High School part way through the year, so both these sites have limited data capture for 2012.) One site (Ballymena Ballykeel) also exceeded the EU target value of 1 ng m^{-3} for annual mean B[a]P concentration, to be met by 31st Dec 2012. (Unlike EU limit values, EU target values are non-mandatory; Member States must show that they are taking all necessary and reasonable measures towards achieving target values).

A report on PAH in Northern Ireland was released in Feb 2012 by NPL[1] (the organisation responsible for operating the UK PAH Network). This report explores the reasons for the high PAH concentrations measured in Northern Ireland: these are believed to reflect the high usage of solid fuels (particularly bituminous or 'smoky' coal) in certain areas, particularly those with limited availability of natural gas. NPL's report also makes recommendations for policy in Northern Ireland, aimed at helping to reduce concentrations of these pollutants. (For more information on these, please refer to NPL's report: they are also summarised in "Air Pollution in Northern Ireland 2011".)

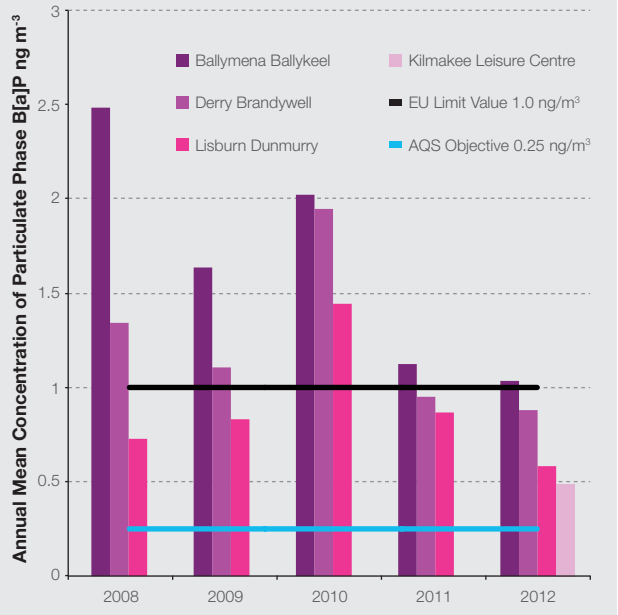


Figure 3.3

Annual mean concentrations of benzo[a]pyrene, for Five Years 2008 - 2012

3.4 Summary

EU limit values, target values and corresponding AQS objectives, have been met by the due dates for the following pollutants in Northern Ireland –

- Particulate matter as PM_{10} and $PM_{2.5}$
- Carbon monoxide
- Benzene
- Sulphur dioxide
- Metallic pollutants: lead, arsenic, cadmium and nickel.

However, a small number of sites close to busy roads in urban areas did not meet the limit values and objectives for nitrogen dioxide in 2012. Although none of these sites are used for assessment of compliance with the Air Quality Directive, modelling carried out for compliance assessment purposes indicated that there were locations within the Belfast Urban Area which did not achieve compliance with the EU limit value for annual mean NO_2, and would not do so even by 2015 (the year up to which Member States could comply for a compliance extension). Belfast Urban Area is not alone in this respect: many parts of the UK (and other Member States of Europe) have reported similar exceedances.

Benzo[a]pyrene concentrations at one of Northern Ireland's four sites exceeded the EU target value for 2012, and all four exceeded the AQS objective for 2010. The reasons for the high PAH concentrations in some parts of the country have been explored in a 2012 report by NPL; they are believed to arise primarily from household combustion of solid fuel, in particular "smoky" coal.

Ozone concentrations are affected by both long-range and local factors. Although no sites exceeded the AQS objective in 2012, O_3 exceedances (like those which occurred in 2008, 2010 and in 2011) remain a possibility in future.

[1] DM Butterfield, RJC Brown 2012 "Polycyclic Aromatic Hydrocarbons in Northern Ireland". NPL Report Number AS66. Available online at http://uk-air.defra.gov.uk/reports/cat05/1203080854_pah_in_ni_report_final_published_version_v2.pdf

4

Changes Over Time

This section looks at how air quality in Northern Ireland has changed over the years since routine automatic monitoring began in the region.

Recent years have seen a substantial increase in the number of 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 this investigation is based on all available data from all sites, the apparent changes in the dataset may not reflect real changes in the region's air quality, but rather, may be due to the changes in the number of sites (and their distribution). Also, it is usually considered that at least five consecutive years' data are required from a monitoring site, in order to assess long-term trends. Therefore, in these pages, investigation of trends has been based on sub-sets of long-running sites, all with at least five years of continuous operation. This should lead to a more robust assessment.

For the first time, trend analysis has been carried out using Openair: a free, open-source software package of tools for analysis of air pollution data. Openair was developed by the University of Leeds with King's College London: for more information on this package please see www.openair-project.org/Default.aspx. Here, the Openair "TheilSen" tool (based on the Theil-Sen statistical method) has been used to determine trends in pollutant concentrations over several years. The trend analysis is based on monthly mean pollutant concentrations, calculated here from daily mean data. Openair includes an option to "de-seasonalise" the data (i.e. statistically modify the plotted data to remove the influence of seasonal cycles, thus providing a clearer indication of the overall trend over the relevant time). The "de-seasonalise" option has been used here, where appropriate. When the "de-seasonalise" option is used, Openair also fills any gaps in the dataset by a linear interpolation method.

Trend plots have been prepared for SO_2, PM, O_3 and NOx. These are presented and discussed on the "Trend" pages of the Northern Ireland Air website, at www.airqualityni.co.uk/reports.php?n_action=trend.

This report considers the trends in concentrations of NO_2, a pollutant of particular concern as it still frequently exceeds AQS objectives.

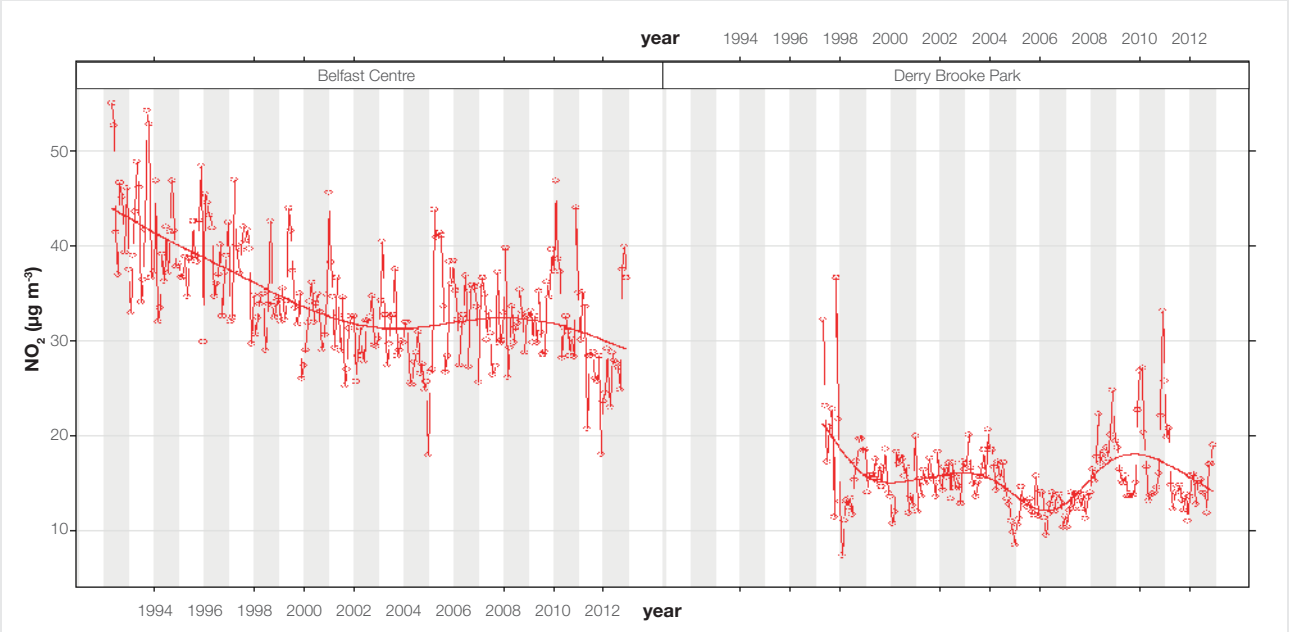


Figure 4.1

Smoothed Trend Plot for NO_2 at Belfast Centre and Derry Brooke Park, 1992 - 2012

4.1 NO_2 at Urban Background Sites

The two longest-running urban background NO_2 sites in Northern Ireland are Belfast Centre (which has been in operation since 1992) and Derry Brooke Park (in operation since 1997). Figure 4.1 shows a smoothed trend plot for these two sites over their complete periods of operation. (Both plots are based upon monthly averages of daily mean values.) Belfast Centre shows a consistent downward trend until the middle years of the last decade: concentrations then rose slightly before the downward trend resumed. At Derry Brooke Park, NO_2 concentrations have always been substantially lower, reflecting its location. However, at this site there appears to be no clear trend in NO_2 concentration.

In Figure 4.2, the Openair Theil-Sen function has been used to quantify trends in NO_2 concentration for these two sites. The trend line is shown by a solid red line, with 95% confidence intervals shown by dotted red lines. The trend is given at the top of the plot in green, with confidence intervals shown in square brackets. The trend is given as units (i.e. µg m^{-3}) per year, over the period shown. This may be followed by a symbol, with + indicating that the trend is statistically significant at the 0.1 level,* indicating significance at the 0.05 level, ** indicating significance at the 0.01 level and *** indicating significance at the 0.001 level.

The trend plots in Figure 4.2 confirm that for Belfast Centre, the downward trend is highly significant (at the 0.001 level). However, there is no statistically significant trend in the case of Derry Brooke Park.

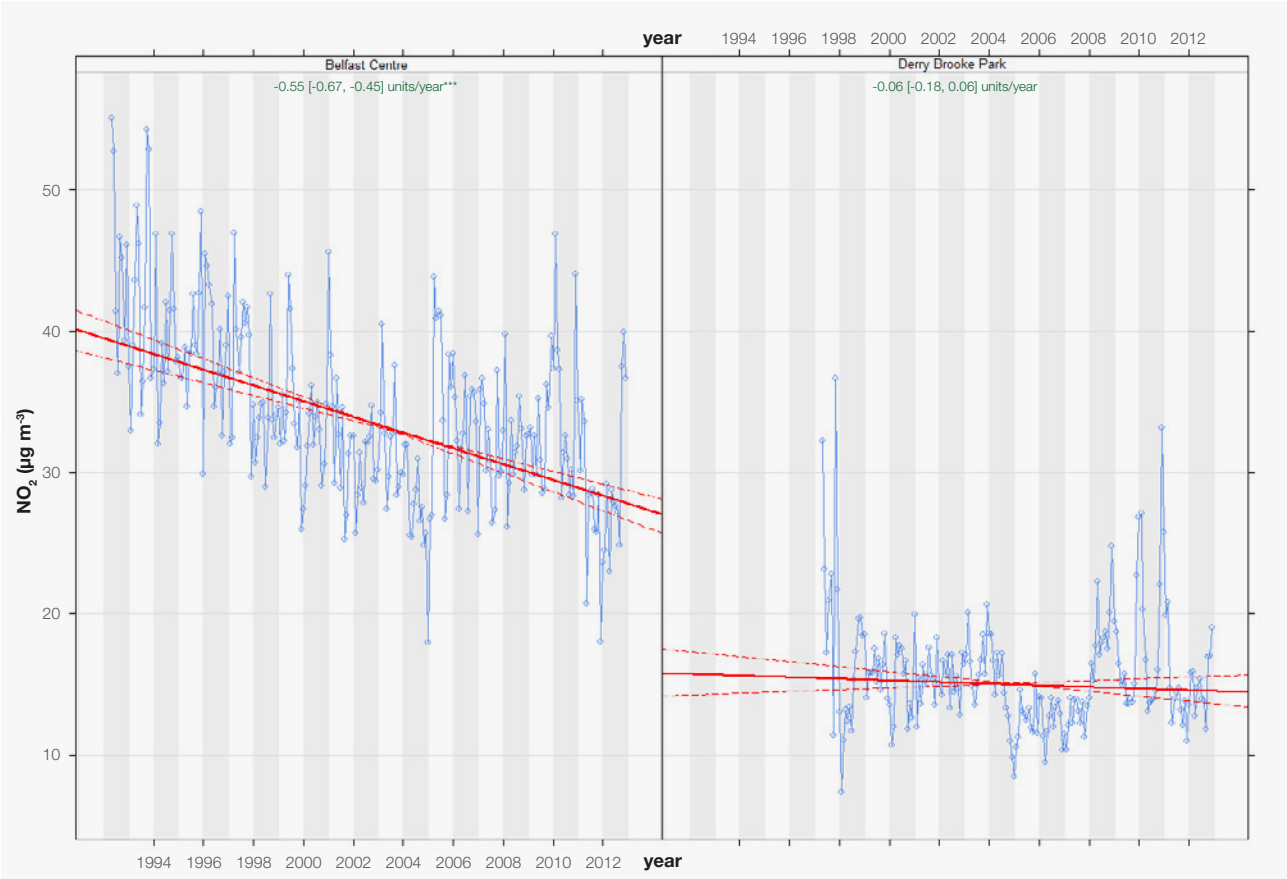


Figure 4.2

De-seasonalised Trend Plots for NO_2 at Belfast Centre and Derry Brooke Park, 1992 - 2012.

4.2 NO_2 at Urban Traffic Sites

Four traffic-related sites in Northern Ireland have monitored NO_2 for ten or more years. These are; Belfast Newtownards Road (2000 to date), Lisburn Lagan Valley Hospital (2003-2012), Newry Trevor Hill (2001 to date) and North Down Holywood A2 (2003 to date). Using the Openair Theil-Sen function, the trends in monthly mean NO_2 concentration at these four sites (since 2003) have been quantified in Figure 4.3.

One of these sites (Belfast Newtownards Road) shows a statistically significant downward trend, one (Lisburn Lagan Valley Hospital) shows no trend at all, and the remaining two sites (Newry Trevor Hill and North Down Holywood A2) show slight upward trends (statistically significant in the case of North Down Holywood A2). Trends at urban traffic sites appear to be site-dependent: it is possible that they may reflect changes in traffic emissions on the nearby roads.

The observation that many sites (roadside sites in particular) do not show a clear downward trend is consistent with the findings of a 2007 report by the Air Quality Expert Group (AQEG). This 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 NOx 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.

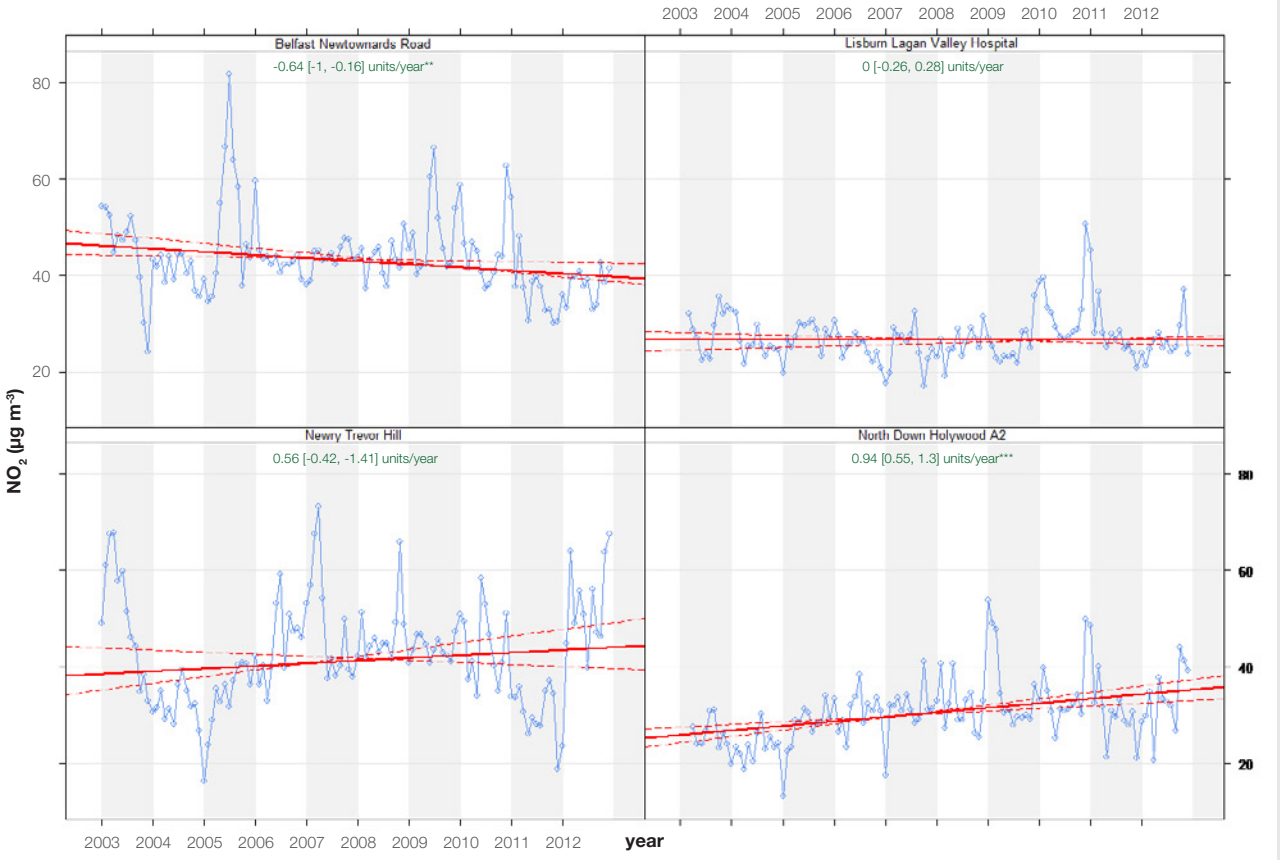


Figure 4.3

De-seasonalised Trend Plots for NO_2 at Four Urban Traffic Sites, 2003 - 2012

[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 18th Nov 2013].

5

Maps of Air Quality

Measurements from air quality monitoring sites in Northern Ireland have been combined with pollutant emissions estimates 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 Northern Ireland for 2012.

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 modelled peak concentrations are below 50 µg m^{-3} over most of Northern Ireland, there are some small areas of higher peak SO_2 concentration (over 150 µg m^{-3}) in parts of the Belfast conurbation, as well as the Craigavon area and Newry - possibly areas of high domestic coal or oil use in these 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 NO_2 concentrations at background locations (i.e. at least 10m away from major roads). 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. The roads are visible because the presence of a major road in a grid square raises the average NO_2 concentration in that grid square.

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, the A12 (Westlink), part of the A55, parts of the A20 and stretches of the A2 towards Holywood. This is generally consistent with the monitoring results, which identified exceedances at several urban roadside sites: however, there is no modelled exceedance along Newtownabbey's Antrim Road, where a monitoring exceedance was measured in 2012.

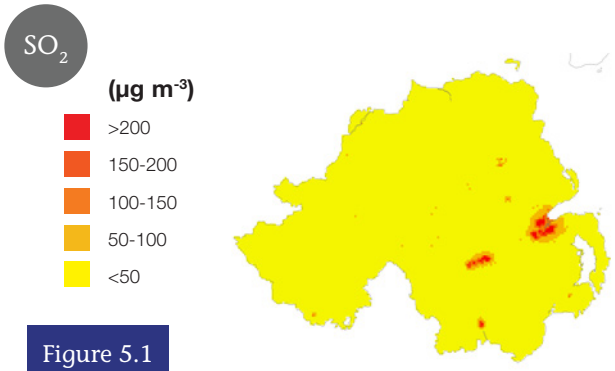


Figure 5.1

Estimated 99.9th percentile of 15-minute mean

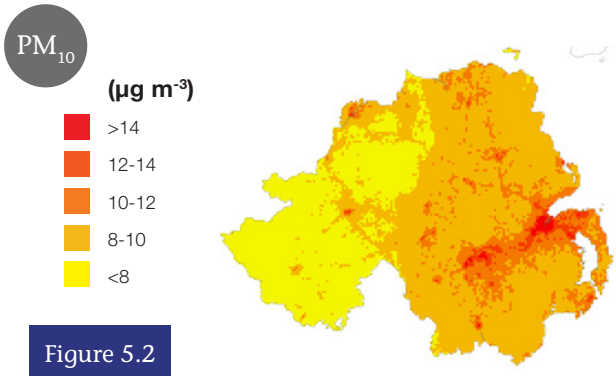


Figure 5.2

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

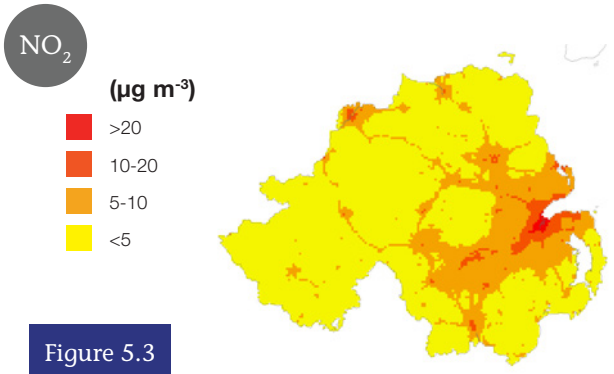


Figure 5.3

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

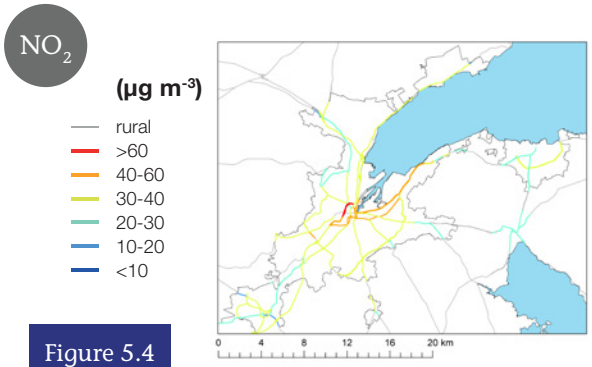


Figure 5.4

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

6

Benefits of Cycling and Walking

In January 2013 the Department for Regional Development published its active travel strategy, "Building an Active Travel Future for Northern Ireland".[3] This set out a vision to substantially increase distances travelled by foot and by bicycle in Northern Ireland, which have historically been amongst the lowest anywhere in Europe.

In launching the strategy, the Department for Regional Development highlighted that 7% of car journeys made by adults who have access to a car are estimated to be less than one mile long, and that if each person made seven or more short trips per year on foot or by bike instead, it would reduce car travel by over ten million miles.[4]

The active travel strategy was reinforced by the launch in August 2013 of the Action Plan for Active Travel (2012-2015)[5], which detailed progress to date and set out initiatives to be delivered in four key areas:

- Promotion and information
- Developing infrastructure
- Working with the education sector and young people
- Local initiatives.

While the biggest health benefits from the promotion of walking and cycling are through the benefits of increased physical activity[6], they can also contribute to reducing air pollution problems. Short car journeys are typically the most polluting, as the engine and emissions control system may not fully warm up. In Northern Ireland almost a quarter of all car journeys are under two miles, and more than half are under five miles.[7] Many of these journeys would be suitable for walking or cycling.

The Department for Regional Development has also announced the formation of a dedicated cycle unit in September 2013. The unit will work with all NI Departments and key stakeholders to develop cycle infrastructure plans, making sure cycling promotion is effective and co-ordinated. Currently there is an ongoing feasibility study for a dedicated Lagan Cycle Bridge in Belfast. As part of the Active School Travel Programme, a range of cycle and walking skills training is to be provided in 60 schools across Northern Ireland over the next three years.

Analysis of the reasons why people (with access to a bicycle) do not cycle in Northern Ireland revealed that perceived barriers are that there is "too much traffic" or that it is "too dangerous".[8] As a result, cycling accounts for just 1% of all journeys. By contrast in Germany, Denmark and particularly the Netherlands, cycling accounts for 10-27% of all trips.[9] In fact Groningen in the Netherlands is generally accepted to have the highest cycling mode share in the world: 59% of trips within the city.[10]

[3] Department for Regional Development, "Building an active travel future for Northern Ireland" (2013)
www.drdni.gov.uk/index/publications/publications-details.htm?docid=7723

[4] NIE, "Kennedy issues challenge for more active travel" (2013)
www.northernireland.gov.uk/index/media-centre/news-departments/news-drd/news-releases-drd-january-2013/news-drd-230113-kennedy-issues-challenge.htm

[5] Department for Regional Development, Action Plan for Active Travel 2012-2015, (2013)
www.drdni.gov.uk/index/publications/publications-details.htm?docid=9014

[6] See for example "Essential Evidence on a page: No 76 Benefits of shift from car to active travel"
www.bristol.gov.uk/sites/default/files/documents/transport_and_streets/policies_and_advice/benefits_of_walking_and_cycling/Essential%20Evidence%20No%2076%20Benefits%20of%20shift%20from%20car%20to%20act%E2%80%A6.pdf

[7] Analysis of table 3.3, Department for Regional Development "Travel Survey for Northern Ireland In-depth Report 2009-2011"
www.drdni.gov.uk/tsni_indepth_report_2009-2011.pdf

[8] DRD, "Public Awareness of Travelwise Initiatives" April 2012.
www.drdni.gov.uk/public_awareness_of_travelwise_ni_initiatives.pdf

[9] Table 2, NIA, "The wider contribution of cycling and its potential to replace car journeys", Oct 2011,
www.niassembly.gov.uk/Documents/RalSe/Publications/2011/Regional-Development/15411.pdf

[10] World Transport Policy & Practice, Volume 13, Number 3, "At the frontiers of cycling: Policy innovations in the Netherlands, Denmark and Germany", 2007
www.eco-logica.co.uk/pdf/wtpp13.3.pdf

Groningen also ranks second highest out of 75 cities for perceived air quality in the European *Survey on perception of quality of life*.[11] The leader for air quality in this survey was Rostock. This German town with over 200,000 inhabitants saw cycle mode share more than double to over 20% in the period 1998-2008, with car commuting falling by 5%. The town implemented an active bicycle policy, emphasising allowing bicycles on public transport and contra-flow cycling on one-way streets amongst other measures.[12]

Cycling is a low cost, quick and convenient way to make short journeys, saving money on fuel and avoiding parking problems. Men and women in Northern Ireland have the lowest physical activity levels in the UK, with less than a third of people achieving the recommended minimum levels.[13] Cycling is an ideal way to build physical activity into your regular daily routine and improve your health. The benefits far outweigh any risks, even on today's busier roads.

If you would like to take up cycling, or to make more of your everyday journeys by bike, it is important that your bike is the right size for you, and in a safe and roadworthy condition. The better quality it is, the more likely you are to enjoy riding it. If you will be riding at night, you'll need working lights and reflective clothing, to ensure you can see, and be seen by, other road users. Mudguards and wet-weather clothing will help keep you dry when riding in the rain. If you need to carry heavy or bulky items, then a carrier rack or pannier bags can be safer and more comfortable than a large backpack. It is also a good idea to invest in a sturdy lock and to carry a puncture repair kit, a pump and a small emergency toolkit.

Children and many adults can benefit from cycle training. This can really help build confidence by teaching you how to stay safe on busy roads. Many schools run cycling proficiency schemes and adults can find cycle training through: www.cycleni.com.

More information on all aspects of cycling can be found through the Northern Ireland Travelwise website's cycling pages: www.nidirect.gov.uk/index/information-and-services/travel-transport-and-roads/travelwiseni/travelwise-cycling.htm.

Photo: Cycling past Dunluce Castle

[11] Flash Eurobarometer, "Survey on perception of quality of life in 75 European cities, March 2010 http://ec.europa.eu/regional_policy/sources/docgener/studies/pdf/urban/survey2009_en.pdf

[12] Fietsberaad, Rostock: bicycle use more than doubled, 2010 www.fietsberaad.nl/index.cfm?lang=nl&repository=Rostock:+bicycle+use+more+than+doubled

[13] British Heart Foundation. Physical Activity Statistics 2012. July 2012. www.bhf.org.uk/publications/view-publication.aspx?ps=1001983

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 NOx 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.

Here are some things we can do:

- Make sure your home is well insulated and the boiler well-maintained: in most UK homes, the central heating system accounts for the highest percentage of energy used.[14] Under the Warm Homes Scheme you may be able to receive energy advice and help to make sure your home is well insulated. Check out the Warm Homes website at www.warm-homes.com to see if you qualify.
- Stay warm but don't overheat your home: 21 °C is comfortable for most people.
- 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.
- Avoid wasting food – it takes energy to produce. There is plenty of useful advice on the Love Food Hate Waste website, at http://ni.lovefoodhatewaste.com.
- Try to drive less. Walk or cycle if possible, or use public transport – especially for short journeys. The NIDirect Travelwise Northern Ireland website provides advice and information on more sustainable transport options, including walking, cycling, car sharing and public transport, for commuters, schools and employers. Travelwise Northern Ireland will help you to understand the health and environmental benefits and cost savings of cycling. For example, by visiting the website at www.nidirect.gov.uk/index/information-and-services/travel-transport-and-roads/travelwiseni.htm, you can:
  - Compare the costs of cycling with those of using a car
  - Estimate the calories you can burn
  - Learn about important safety skills for cyclists
  - Plan your bike journey using interactive route maps
  - Find out about the Cycle to Work scheme, a financial initiative that allows employees to take out a tax exempt loan to purchase a bicycle.

Lots more energy saving advice can be found on the NI Direct "Environment and Greener Living" webpages at www.nidirect.gov.uk/index/information-and-services/environment-and-greener-living.htm.

Where to Find Out More on Air Quality:

The Northern Ireland Air Quality Website at 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.

[14] nidirect "Central Heating" [online]. Available at www.nidirect.gov.uk/index/information-and-services/environment-and-greener-living/energy-wise/central-heating.htm. (Accessed 2 Oct 2013)

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