Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhshaoil

Air Quality in Ireland 2013

Key Indicators of Ambient Air Quality

ENVIRONMENTAL PROTECTION AGENCY

The Environmental Protection Agency (EPA) is responsible for protecting and improving the environment as a valuable asset for the people of Ireland. We are committed to protecting people and the environment from the harmful effects of radiation and pollution.

The work of the EPA can be divided into three main areas:

Regulation: *We implement effective regulation and environmental compliance systems to deliver good environmental outcomes and target those who don't comply.*

Knowledge: *We provide high quality, targeted and timely environmental data, information and assessment to inform decision making at all levels.*

Advocacy: *We work with others to advocate for a clean, productive and well protected environment and for sustainable environmental behaviour.*

Our Responsibilities

Licensing

We regulate the following activities so that they do not endanger human health or harm the environment:

- waste facilities *(e.g. landfills, incinerators, waste transfer stations)*;
- large scale industrial activities *(e.g. pharmaceutical, cement manufacturing, power plants)*;
- intensive agriculture *(e.g. pigs, poultry)*;
- the contained use and controlled release of Genetically Modified Organisms *(GMOs)*;
- sources of ionising radiation *(e.g. x-ray and radiotherapy equipment, industrial sources)*;
- large petrol storage facilities;
- waste water discharges;
- dumping at sea activities.

National Environmental Enforcement

- Conducting an annual programme of audits and inspections of EPA licensed facilities.
- Overseeing local authorities' environmental protection responsibilities.
- Supervising the supply of drinking water by public water suppliers.
- Working with local authorities and other agencies to tackle environmental crime by co-ordinating a national enforcement network, targeting offenders and overseeing remediation.
- Enforcing Regulations such as Waste Electrical and Electronic Equipment (WEEE), Restriction of Hazardous Substances (RoHS) and substances that deplete the ozone layer.
- Prosecuting those who flout environmental law and damage the environment.

Water Management

- Monitoring and reporting on the quality of rivers, lakes, transitional and coastal waters of Ireland and groundwaters; measuring water levels and river flows.
- National coordination and oversight of the Water Framework Directive.
- Monitoring and reporting on Bathing Water Quality.

Monitoring, Analysing and Reporting on the Environment

- Monitoring air quality and implementing the EU Clean Air for Europe (CAFÉ) Directive.
- Independent reporting to inform decision making by national and local government *(e.g. periodic reporting on the State of Ireland's Environment and Indicator Reports)*.

Regulating Ireland's Greenhouse Gas Emissions

- Preparing Ireland's greenhouse gas inventories and projections.
- Implementing the Emissions Trading Directive, for over 100 of the largest producers of carbon dioxide in Ireland.

Environmental Research and Development

- Funding environmental research to identify pressures, inform policy and provide solutions in the areas of climate, water and sustainability.

Strategic Environmental Assessment

- Assessing the impact of proposed plans and programmes on the Irish environment *(e.g. major development plans)*.

Radiological Protection

- Monitoring radiation levels, assessing exposure of people in Ireland to ionising radiation.
- Assisting in developing national plans for emergencies arising from nuclear accidents.
- Monitoring developments abroad relating to nuclear installations and radiological safety.
- Providing, or overseeing the provision of, specialist radiation protection services.

Guidance, Accessible Information and Education

- Providing advice and guidance to industry and the public on environmental and radiological protection topics.
- Providing timely and easily accessible environmental information to encourage public participation in environmental decision-making *(e.g. My Local Environment, Radon Maps)*.
- Advising Government on matters relating to radiological safety and emergency response.
- Developing a National Hazardous Waste Management Plan to prevent and manage hazardous waste.

Awareness Raising and Behavioural Change

- Generating greater environmental awareness and influencing positive behavioural change by supporting businesses, communities and householders to become more resource efficient.
- Promoting radon testing in homes and workplaces and encouraging remediation where necessary.

Management and structure of the EPA

The EPA is managed by a full time Board, consisting of a Director General and five Directors. The work is carried out across five Offices:

- Office of Climate, Licensing and Resource Use
- Office of Environmental Enforcement
- Office of Environmental Assessment
- Office of Radiological Protection
- Office of Communications and Corporate Services

The EPA is assisted by an Advisory Committee of twelve members who meet regularly to discuss issues of concern and provide advice to the Board.

Environmental Protection Agency

The Environmental Protection Agency (EPA) is a statutory body responsible for protecting the environment in Ireland. We regulate and police activities that might otherwise cause pollution. We ensure there is solid information on environmental trends so that necessary actions are taken. Our priorities are protecting the Irish environment and ensuring that development is sustainable.
The EPA is an independent public body established in July 1993 under the Environmental Protection Agency Act, 1992. Its sponsor in Government is the Department of the Environment, Community and Local Government.

OUR RESPONSIBILITIES

LICENSING

We license the following to ensure that their emissions do not endanger human health or harm the environment:

• waste facilities (e.g., landfills, incinerators, waste transfer stations);

• large scale industrial activities (e.g., pharmaceutical manufacturing, cement manufacturing, power plants);

• intensive agriculture;

• the contained use and controlled release of Genetically Modified Organisms (GMOs);

• large petrol storage facilities.

• waste water discharges

NATIONAL ENVIRONMENTAL ENFORCEMENT

• Conducting over 2,000 audits and inspections of EPA licensed facilities every year.

• Overseeing local authorities' environmental protection responsibilities in the areas of - air, noise, waste, waste-water and water quality.

• Working with local authorities and the Gardaí to stamp out illegal waste activity by co-ordinating a national enforcement network, targeting offenders, conducting investigations and overseeing remediation.

• Prosecuting those who flout environmental law and damage the environment as a result of their actions.

MONITORING, ANALYSING AND REPORTING ON THE ENVIRONMENT

• Monitoring air quality and the quality of rivers, lakes, tidal waters and ground waters; measuring water levels and river flows.

• Independent reporting to inform decision making by national and local government.

REGULATING IRELAND'S GREENHOUSE GAS EMISSIONS

• Quantifying Ireland's emissions of greenhouse gases in the context of our Kyoto commitments.

• Implementing the Emissions Trading Directive, involving over 100 companies who are major generators of carbon dioxide in Ireland.

ENVIRONMENTAL RESEARCH AND DEVELOPMENT

• Co-ordinating research on environmental issues (including air and water quality, climate change, biodiversity, environmental technologies).

STRATEGIC ENVIRONMENTAL ASSESSMENT

• Assessing the impact of plans and programmes on the Irish environment (such as waste management and development plans).

ENVIRONMENTAL PLANNING, EDUCATION AND GUIDANCE

• Providing guidance to the public and to industry on various environmental topics (including licence applications, waste prevention and environmental regulations).

• Generating greater environmental awareness (through environmental television programmes and primary and secondary schools' resource packs).

PROACTIVE WASTE MANAGEMENT

• Promoting waste prevention and minimisation projects through the co-ordination of the National Waste Prevention Programme, including input into the implementation of Producer Responsibility Initiatives.

• Enforcing Regulations such as Waste Electrical and Electronic Equipment (WEEE) and Restriction of Hazardous Substances (RoHS) and substances that deplete the ozone layer.

• Developing a National Hazardous Waste Management Plan to prevent and manage hazardous waste.

MANAGEMENT AND STRUCTURE OF THE EPA

The organisation is managed by a full time Board, consisting of a Director General and four Directors.

The work of the EPA is carried out across four offices:

• Office of Climate, Licensing and Resource Use

• Office of Environmental Enforcement

• Office of Environmental Assessment

• Office of Communications and Corporate Services

The EPA is assisted by an Advisory Committee of twelve members who meet several times a year to discuss issues of concern and offer advice to the Board.

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Key Indicators of Ambient Air Quality

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National Ambient Air Quality Programme

Office of Environment Assessment

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Glossary

>	*Greater than*

AOT40 *Sum of the difference between hourly concentrations greater than 80 µg/m^3 (40 ppb) and 80 µg/m^3 over a given period using only the one-hour values measured between 8:00 and 20:00 Central European Time each day*

As	*Arsenic*
AEI	*Average exposure indicator*
Assessment Threshold	*Concentration at which varying levels of monitoring must be implemented*
Cd	*Cadmium*
CAFE	*Clean Air for Europe Directive (2008/50/EC)*
CEC	*Council of the European Communities*
C_6H_6	*Benzene*
CLRTAP	*Convention on Long-Range Transboundary Air Pollution*
CO	*Carbon monoxide*
DECLG	*Department of Environment, Community and Local Government*
EC	*European Commission*
EC/OC	*Elemental carbon/organic carbon*
EMEP	*European Monitoring and Evaluation Programme*
EPA	*Environmental Protection Agency*
EU	*European Union*
Hg	*Mercury*
LAT	*Lower assessment threshold*
Limit value	*Level to be attained and not exceeded*
mg/m^3	*Milligrammes per cubic metre*
na	*Not applicable*
ng/m^3	*Nanogrammes per cubic metre*
NH_3	*Ammonia*
Ni	*Nickel*
NO	*Nitric oxide*
NO_2	*Nitrogen dioxide*

NO_x	*Oxides of nitrogen*
O_3	*Ozone*
PAH	*Polycyclic aromatic hydrocarbon*
Pb	*Lead*
PM_{10}	*Particulate matter with diameter < 10 µm*
$PM_{2.5}$	*Particulate matter with diameter < 2.5 µm*
ppb	*Parts per billion*
SO_2	*Sulphur dioxide*
Target value	*Level to be attained where possible over a given period*
Troposphere	*Region of the atmosphere from ground level to ~10-15 kilometres*
VOCs	*Volatile organic compounds*
yr	*year*
UAT	*Upper assessment threshold*
µm	*Micron*
$\mu g/m^3$	*Microgrammes per cubic metre*
$\mu g/m^3.h$	*Microgrammes per cubic metre hours*
$\mu g/m^2/day$	*Microgrammes per square metre per day*
Zone A	*Dublin*
Zone B	*Cork*
Zone C	*Galway, Limerick, Waterford, Clonmel, Kilkenny, Sligo, Drogheda, Wexford, Athlone, Bray, Carlow, Dundalk, Ennis, Naas, Tralee, Balbriggan, Celbridge, Letterkenny, Mullingar, Navan, Newbridge, Portlaoise, Greystones and Leixlip.*
Zone D	*Remainder of State (excluding Zones A, B and C)*

Executive Summary

This report provides an overview of air quality in Ireland for 2013, based on data obtained from the 29 monitoring stations that form the National Ambient Air Quality Network, including data from a number of mobile air quality monitoring units. Monitoring stations are located across the country, with new stations added in 2013 at Davitt Road, Dublin, St. Anne's Park in Dublin and Finglas in Dublin. Also a previous monitoring station at Ballyfermot, Dublin reopened after refurbishment of the site. The monitoring site at Old Station Road in Cork also moved to a new location at the South Link Road, Cork.

The results of the monitoring are compared to limit values set out in EU and Irish legislation on ambient air quality. Overall, air quality in Ireland compares favourably with other EU Member States. Measured values of sulphur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), Ozone (O_3), particulate matter (PM_{10} and $PM_{2.5}$), heavy metals, benzene and polycyclic aromatic hydrocarbons (PAH) were all below limit and target values set out in the CAFE Directive and 4th Daughter Directive. However, when some of these parameters are compared to the tighter WHO Air Quality Guideline values, it highlights some potential issues. Ireland is above these guideline values with respect to PM_{10}, $PM_{2.5}$, ozone and PAH. This may have important implications for Ireland in the future, if these WHO guideline values are adopted as limit values by the EU, which may occur following the European Commission's review on the air quality Directives. This move would be supported by calls made recently in the 7th Environmental Action Programme.

This report for the first time has incorporated the EPA dioxins study as a chapter. The study found in 2013 that dioxin levels recorded in the survey compare favourably with those from previous surveys and from other EU countries. This report also introduces some aspects of research undertaken on behalf of the EPA, with relevance to air quality – including projects on air quality modelling, developing an emissions inventory for Ireland, particulate matter composition and an evaluation of the effect of home heating on air quality in Ireland.

The EPA Licensing and Enforcement aspects of Air Quality are introduced in this report, including a summary of the emissions monitoring undertaken in 2013. The National Ambient Air Quality Network also contributed data to the assessment of the impact on air quality of the fire which occurred over the period Saturday January 25th to Wednesday January 29th at the Oxigen facility in Ballymount, Dublin. Overall the results of the air quality monitoring undertaken indicated that the air quality impact of the fire was localised and transient, and there was no significant potential for any long-term health or environmental impacts as a result of this incident.

Informing the Public

The EPA is committed to making up to date information about air quality as easily accessible to members of the public as possible. In 2013, the EPA in conjunction with the Health Service Executive, Met Éireann and Department of the Environment Community and Local

Government, launched the Air Quality Index for Health (AQIH). This web-based index shows what the current air quality is across Ireland and is based on a coloured scale divided into 4 bands: Good; Fair; Poor and Very poor, with health advice provided for each band. The AQIH is calculated hourly and is represented on a colour coded map of Ireland, from which the public can easily assess current air quality in their area. The Air Quality Index for Health can be viewed at www.epa.ie/air/quality, with our Twitter handle being @EPAAirquality.

Future Challenges

A key future challenge for Ireland is in decreasing our PAH, PM_{10} and $PM_{2.5}$ concentrations to below that of the WHO air quality guideline values, particularly if the European Commission's review on air quality legislation leads it to adopt the more stringent limits recommended by the WHO. Particulate matter and polycyclic aromatic hydrocarbons (PAH) arise from domestic solid fuel burning, which particularly impacts air quality in areas where the sale of smoky coal is permitted. As a result, levels of particulate matter in smaller towns are similar or higher than those in cities, where bituminous coal is banned.

Also the complex relationship between a reduction in our carbon footprint and decreasing $PM_{2.5}$ concentrations needs to be tackled in the plans to implement the EU Clean Air for Europe Directive's National Emissions Reduction Target (NERT) for 2020. This NERT requires Ireland to decrease annual average $PM_{2.5}$ concentrations by 10%, a reduction which will require commitment and cooperation across all sectors of Irish government, industry and society.

To help protect our good air quality the Irish consumer must become more aware of their choice in home heating fuel and the potential impact that choice can have on our air quality. Also to reduce the impact of NO_2 in cities, Ireland must develop and implement policies to reduce travel demand, emphasising sustainable transport modes such as cycling, walking and public transport and improving the efficiency of motorised transport.

1. Introduction

1.1 Air quality in Ireland today

Ireland has seen a significant improvement in its ambient air quality since the introduction of a number of legislative measures, beginning in the early 1990s. These measures were driven by the European Union in an attempt to combat air quality issues that existed Europe-wide at the time, such as acid rain and smog. Despite the improvements in air quality since that time, Ireland faces new challenges with regard to its air quality. Many of these challenges are arising from assessment of previously un-monitored pollutants and increasing understanding of the impacts of historically important air pollutants.

In order to protect our health, vegetation and ecosystems, EU Directives set down air quality standards for a wide variety of pollutants. The current standards are contained in the Clean Air for Europe (CAFE) Directive (EP & CEU, 2008) and the Fourth Daughter Directive (EP & CEU, 2004). These Directives also include rules on how Member States should monitor, assess and manage ambient air quality.

The EPA, as the National Reference Laboratory, is tasked with coordinating and managing this monitoring programme. A nationwide network of 29 monitoring stations measures levels of air pollutants in each zone and delivers this information in real-time to the public at www.airquality.epa.ie.

1.2 Report objectives and coverage

This report provides an overview of ambient air quality trends in Ireland in 2013 based on monitoring data from 29 stations in operation during the year. Time series air quality concentrations are presented as a set of indicators, which compare measured concentrations with air quality standards for a suite of air pollutants. The air quality analysis presented here is based on concentration measurements of the following pollutants:

- sulphur dioxide;
- nitrogen dioxide and oxides of nitrogen;
- carbon monoxide;
- ozone;
- particulate matter - PM_{10} and $PM_{2.5;}$
- benzene and volatile organic compounds (VOCs);
- heavy metals - lead, arsenic, cadmium, nickel and mercury;
- polycyclic aromatic hydrocarbons (PAH);
- elemental carbon/organic carbon (EC/OC) as part of $PM_{2.5}$ speciation; and
- anions and cations as part of $PM_{2.5}$ speciation.

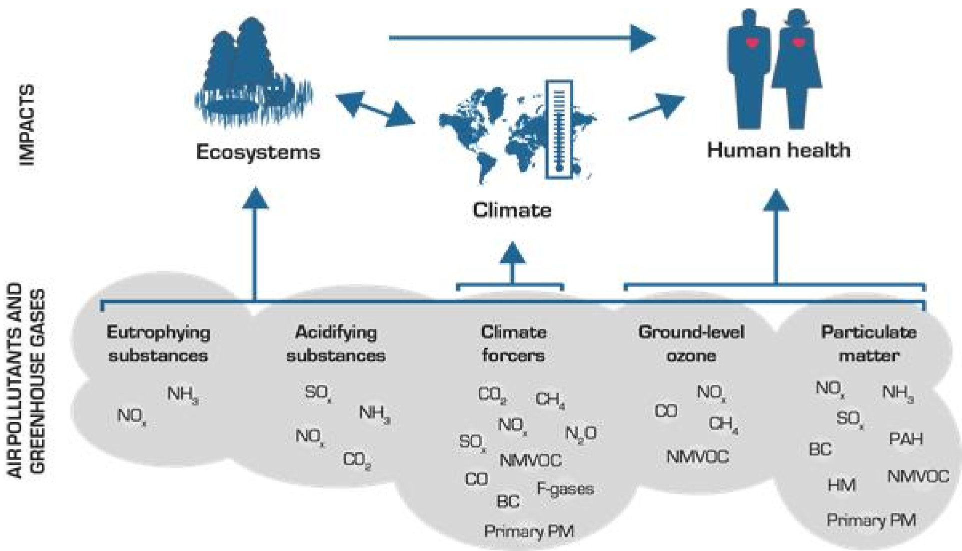
The pollutants of most concern are particulate matter, nitrogen dioxide, PAH and, to a lesser extent, ozone. The sources and impact of these air pollutants, current levels in Ireland and trends over time for each pollutant are outlined in this report. A chapter on dioxins in the Irish Environment is also included. Dioxins are not included in the Air Quality network but are measured separately.

1.3 Effects of air pollution

Air pollution in Ireland can be of a local, regional and/or transboundary nature caused by the emission of specific pollutants which either directly, or through chemical reactions and transformations, lead to negative impacts. These negative effects can have an impact on the human population, ecosystems and climate.

Figure 1.1 gives an overview of impacts of air pollution

Figure 1.1 Impacts of air pollution (source: EEA 2014)



Human health impacts

Air pollution is a major environmental health risk; poor air quality reduces human life expectancy by more than eight months on average and by more than two years in the most polluted cities and regions (EC, 2010). The World Health Organisation (WHO) also states that ambient air pollution is estimated to cause 3.7 million deaths worldwide per year (WHO, 2014).

These latest figures supplied by the WHO indicate that air pollution can negatively impact on health at much lower concentrations than those previously believed. This supports the scientific conclusions of the WHO air quality guidelines that were last updated in 2005, in which they stated that air pollution could lead to health effects at concentrations even lower than those which were used to establish the air quality guidelines (WHO, 2005).

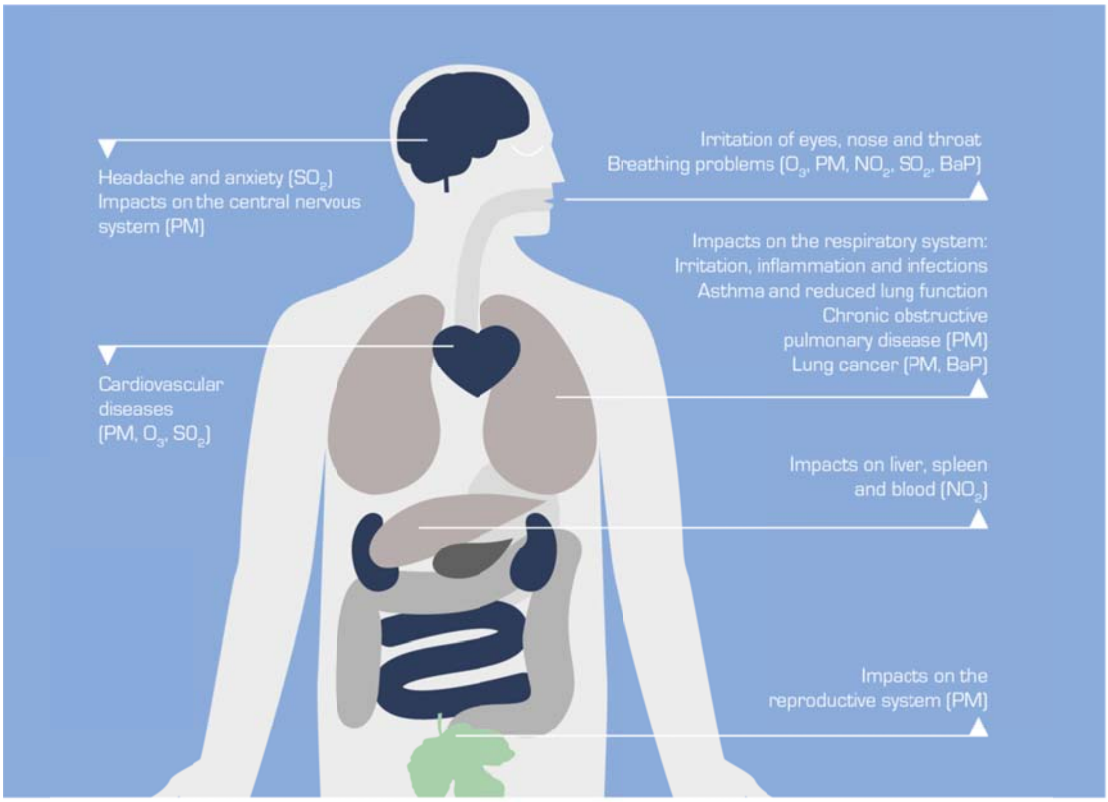
Most of the health impact studies reviewed by the WHO are focused on respiratory and cardiovascular effects of exposure to air pollution; however there is a growing body of evidence for a range of other effects, such as the exposure of pregnant women to air pollution leading to reduced foetal growth, pre-term birth and spontaneous abortions (WHO, 2005).

Health impacts of air pollution can be quantified and expressed as mortality and morbidity. Mortality reflects reduction in life expectancy by shortened life linked to premature death due to air pollution exposure, while morbidity relates to illness occurrence, ranging from minor effects such as coughing to serious conditions that may require hospitalization.

Figure 1.2 shows a graphical representation on the health impacts to humans of air pollution.

Of particular concern in Europe are particulate matter (PM), ground-level ozone (O_3), benzo(a)pyrene (BaP) and nitrogen dioxide (NO_2).

Figure 1.2 Health impacts of air pollution (source: EEA)



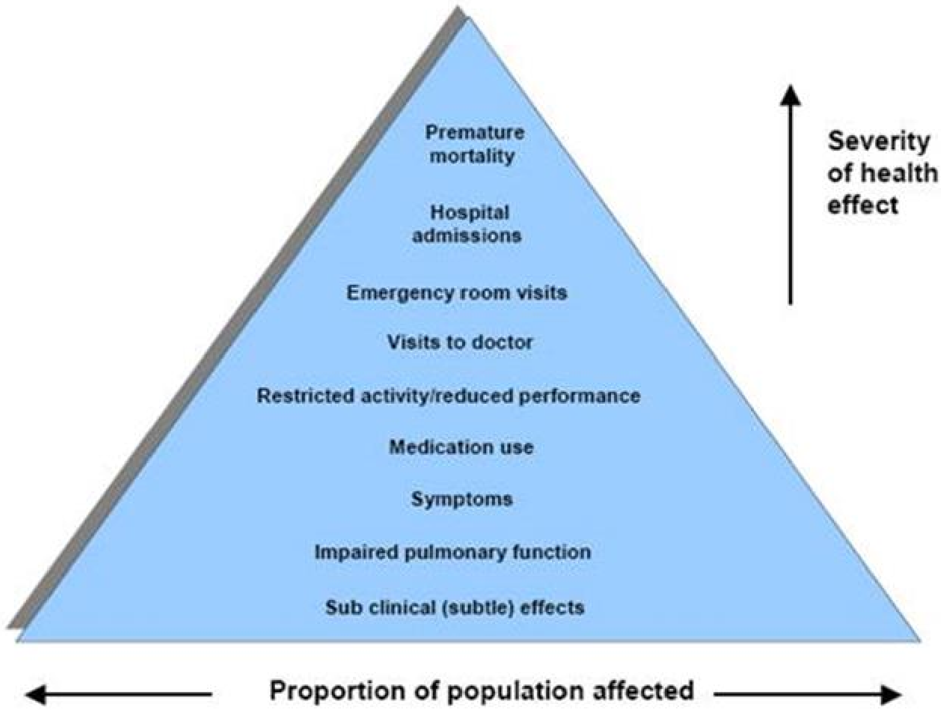
It has long been known that ground level ozone has had a deleterious effect on human health; however recent epidemiological studies indicate considerably larger mortality effects than previously thought (WHO, 2013). High concentrations of ozone cause breathing problems, reduce lung function and lead to diseases like asthma (WHO, 2008).

A similar situation exists with NO_2 in that several recent studies, reviewed by the WHO (2013) have shown increased mortality and morbidity associated with both short-term and long-term exposure to NO_2. Both short- and long-term studies have found these associations with health effects at concentrations that were at or below the current EU limit values (WHO, 2013).

Particulate matter (PM) has recently been classified as carcinogenic (IARC press release, 2013). Some polycyclic aromatic hydrocarbons (PAH) are potent carcinogens, and they are often constituents of particulate matter, as are dioxins. The WHO (2013) continues to recommend BaP as an indicator for carcinogenic PAH, even if it may only explain about half of the PAH overall carcinogenic potency. In addition, WHO (2013) has found new evidence linking PAH exposure to cardiovascular morbidity and mortality, although at present the effects of PAH exposure cannot be easily separated from those of particulates.

Figure 1.3 shows the health effects pyramid which indicates the wide ranging impact of air pollution on health, especially for at risk individuals.

Figure 1.3 Health effects pyramid (source: US EPA)



Ecosystem impacts

Air pollution can greatly impact on ecosystems, particularly through acidification and eutrophication of water bodies such as lakes and rivers. This form of pollution also impacts on soils, while ozone directly affects crops and vegetation. A recent report by the EEA has found that as SO_2 emissions have decreased, the relative contribution made by ammonia (NH3) emitted from agricultural activities and nitrogen oxides (NOX) emitted from combustion processes to surface water and soil acidification has increased or even become predominant in some regions in Europe (EEA 2014)

Climate impacts

Air pollution can also play an important role in changing the climate of the planet by acting as greenhouse gases or by scattering sunlight back into space (such as certain particulates).

Table 1.1 outlines some of the impacts that important pollutants can have on human health and the ecosystem (EEA, 2013).

Table 1.1 Effects of air pollution on health and the environment (EEA, 2013)

Pollutant	Health effects	Environmental effects
Nitrogen oxides (NO_x) Nitrogen dioxide (NO_2)	Short-term exposure to NO_2 is linked to adverse respiratory effects including airway inflammation in healthy people and increased respiratory symptoms in asthmatics. Long-term exposure is associated with increased risk of respiratory infection in children. NO_X is a major precursor in the formation of ground level ozone. It is also a major precursor in the formation of photochemical 'smog'. NO_X, along with SO_2, also contributes to acidic deposition.	Contributes to the acidification and eutrophication of soil and water. NO_x is an ozone precursor and it is also a source of particulate matter, through its reactions with other pollutants.
Sulphur dioxide (SO_2)	Impacts of high concentrations of SO_2 include temporary breathing difficulties for those who suffer from respiratory conditions such as asthma. Longer-term exposure to high SO_2 concentrations can aggravate existing cardiovascular disease and respiratory illness.	Contributes to the acidification and eutrophication of soil and water.
Carbon monoxide (CO)	CO enters the bloodstream through the lungs where it impairs oxygen delivery to the body's organs and tissue. The health impact of CO concentrations that may be found in ambient air is most serious for those who suffer from cardiovascular diseases such as angina. It may induce fatigue in healthy people. At higher concentrations not normally found in ambient air, CO is poisonous causing impaired vision and coordination, headaches, dizziness, confusion and nausea and death.	May affect animals in the same way it affects humans.
Ozone (O_3)	Irritates eyes, nose, throat and lungs. Can destroy throat and lung tissue leading to decrease in lung function and respiratory symptoms such as coughing, shortness of breath, aggravated asthma and other lung diseases. Can lead to premature mortality.	Damages crops, leaves and vegetation.

Table 1.1 Effects of air pollution on health and the environment (EEA, 2011) (cont.)

Particulate matter (PM)	The health impacts of particulate matter relate to its ability to penetrate deep into the respiratory tract. This inhalation can increase the risk, frequency and severity of cardiopulmonary and respiratory disorders. It is particularly harmful for those who have a pre-existing respiratory illness. It also has a strong association with circulatory disease and mortality.	Can affect animals in the same way it affects humans. Causes damage and soiling of buildings. Can reduce visibility.
Arsenic (As), Cadmium (Cd) and Nickel (Ni)	Short-term exposure to these heavy metals can cause irritation of the respiratory system, which can lead to laryngitis, bronchitis or rhinitis. Long-term exposure can cause irritation to the respiratory tract and cardiovascular and neurological effects, asthma, chronic bronchitis, emphysema, reduced vital capacity, and lung and nasal cancers.	Highly toxic to aquatic life, birds and land animals. Where soil has high heavy metal content, plant growth and crop yields may be reduced. Organic compounds containing heavy metals are very persistent in the environment and are subject to bioaccumulation.
Lead (Pb)	Lead interferes with a variety of biological processes and is toxic to many organs and tissues. It is particularly damaging to the brain and causes neurological impairments such as seizures, mental retardation and behavioural disorders. Even at relatively low doses lead is associated with damage to the nervous system of foetuses and may be a factor in high blood pressure and subsequent heart disease.	Bioaccumulates and adversely impacts both terrestrial and aquatic systems. Effects on animal life include reproductive problems and changes in appearance or behaviour.
Mercury (Hg)	Mercury exposure at high levels can harm the brain, heart, kidneys, lungs and immune system of people of all ages. It is harmful to the developing nervous system of unborn babies and young children.	Bioaccumulates and adversely impacts both terrestrial and aquatic systems. Can affect animals in the same way as humans. Very toxic to aquatic life.

Table 1.1 Effects of air pollution on health and the environment (EEA, 2011) (cont.)

Benzene (C_6H_6)	Acute (short-term) inhalation exposure of humans to benzene may cause drowsiness, dizziness, headaches, as well as eye, skin, and respiratory tract irritation and, at high levels, unconsciousness. Chronic (long-term) inhalation exposure has caused various disorders in the blood, including reduced numbers of red blood cells and aplastic anaemia, in occupational settings. Increased incidences of leukaemia (cancer of the tissues that form white blood cells) have been observed in humans occupationally exposed to benzene, although this level of exposure is unlikely in ambient air.	Has an acute toxic effect on aquatic life. It bioaccumulates, especially in invertebrates. Leads to reproductive problems and changes in appearance or behaviour. It can damage leaves of agricultural crops and cause death in plants.
Polycyclic aromatic hydrocarbons (PAH)	Short-term exposure to high levels of PAH may cause eye irritation, nausea, diarrhoea, vomiting and confusion, although high concentrations are unlikely to be found in ambient air. The chronic or long-term effects of exposure to low levels of PAH may include cataracts, kidney and liver damage and jaundice. Many PAH have also been identified as carcinogenic with airborne PAH most likely to cause lung cancer.	Is toxic to aquatic life and birds. Bioaccumulates, especially in invertebrates.

1.4 Relevant policy instruments and legislation

The EPA is the designated competent authority for the implementation of all Irish and EU ambient air quality legislation. It is assisted in its role by the local authorities, and it carries out ambient air quality monitoring, which contributes to what is known as the 'National Ambient Air Quality Monitoring Network'. The EPA manages this monitoring network and is responsible for all reporting to stakeholders – which include the public and the EU. The EPA is also the National Reference Laboratory (NRL) for air quality for Ireland.

The results of air quality monitoring in 2013 presented in this report are compared to the limit and target values in the latest EU legislation, the Clean Air for Europe (CAFE) Directive (EP and CEU, 2008) and the Fourth Daughter Directive (EP and CEU, 2004). The CAFE Directive is an amalgamation of the Air Quality Framework Directive and its subsequent First, Second and Third Daughter Directives. The EU intends to incorporate the Fourth Daughter Directive into the CAFE Directive in the future. The CAFE Directive introduced no changes to existing limit values for SO_2, NO_2, NO_X, CO, ozone, benzene and lead, however, the upper and lower assessment thresholds for PM_{10} were increased. The Stage II limit value for PM_{10} set out in the First Daughter Directive (CEC, 1999) is not included in the CAFE

Directive and no longer applies. The CAFE Directive introduced a limit value for $PM_{2.5}$. It also requires Member States to measure an average exposure indicator (AEI) for $PM_{2.5}$, which is an annual concentration, averaged over three years. Based on this value there will be a mandatory percentage reduction for each Member State to be achieved by 2020. This reduction target for Ireland is known as the $PM_{2.5}$ national exposure reduction target ($PM_{2.5}$ NERT). In addition, Member States will be required to undertake $PM_{2.5}$ speciation studies to determine the sources of background $PM_{2.5}$ levels.

The CAFE Directive was transposed into Irish legislation by the Air Quality Standards Regulations 2011 (S.I. No. 180 of 2011). It replaces the Air Quality Standards Regulations 2002 (S.I. No. 271 of 2002), the Ozone in Ambient Air Regulations 2004 (S.I. No. 53 of 2004) and S.I. No. 33 of 1999. The 4th Daughter Directive was transposed by the Arsenic, Cadmium, Mercury, Nickel and Polycyclic Aromatic Hydrocarbons in Ambient Air Regulations 2009 (S.I. No. 58 of 2009).

Specific requirements are set out in relation to providing the public with information on ambient air quality. Up-to-date information on air quality must be made available on a widespread basis through appropriate media including newspapers and the Internet, with more sensitive population groups provided with more specific information. Further details on air quality legislation can be found at http://www.epa.ie/air/quality/standards/.

1.4.1 Future air quality policy and legislation

Since 2012 the EC has been carrying out a review on air quality policy and legislation. This review is due for release before the end of 2014. The 7th Environmental Action Plan has outlined the pressing need for the update of the air quality Directives, setting out clear goals for the EU by 2020.

This view is also reflected in the EC 2013 document on impact assessment, which emphasizes the dual goals of tackling air pollution in the short and long term.

1.4.2 'Smoky' coal ban

The ban on the marketing, sale and distribution of bituminous fuel (or 'smoky coal ban') was first introduced in Dublin in 1990 in response to severe episodes of winter smog that resulted from the widespread use of smoky coal for residential heating. The ban proved effective in reducing smoke and sulphur dioxide levels and was subsequently extended to other areas. The ban now applies in 27 cities and towns, and now also includes a ban on the burning as well as the sale of bituminous coal. Air quality monitoring by the EPA has shown levels of particulate matter (PM_{10}) are lower in these areas than in towns where the ban does not apply.

Following the improvement of air quality observed in Dublin in the early to mid-nineties, the ban was rolled out to other cities and large towns as follows:

- Cork City since 1995
- Arklow, Drogheda, Dundalk, Limerick City and Wexford Town since 1998
- Celbridge, Galway City, Leixlip, Naas and Waterford City since 2000
- Bray, Kilkenny, Sligo and Tralee since 2003

- Athlone, Carlow, Clonmel and Ennis since 2011

In 2002, a Voluntary Agreement was established between the Minister for the Environment, Community and Local Government and the Solid Fuel Trade Group (SFTG), representing the majority of coal importers. The SFTG agreed that bituminous coal imported by its members would have a sulphur content of ≤ 0.7%. This Agreement has resulted in reduced SO_2 emissions to air from the household burning of bituminous coal.

Although these further changes to the regulations resulted in overall improved air quality, the EPA presented air quality data in previous annual reports showing that air quality was worse in smaller towns, than in large urban areas that had a 'smoky' coal ban. In June 2011, the Minister for the Environment, Community and Local Government introduced the Air Pollution Act, 1987 (Marketing, Sale and Distribution of Fuels) (Amendment) Regulations 2011 (S.I. No. 270 of 2011) to consolidate the environmental and related human health benefits achieved by the Voluntary Agreement. These Regulations require that all bituminous coal placed on the market in Ireland for residential use must have a sulphur content of no more than 0.7%. This placed the former Voluntary Agreement on a statutory footing and will ensure the continued dominance of low sulphur coal in the residential market. The Regulations also added four towns to the list of bituminous coal ban areas - Athlone, Carlow, Clonmel and Ennis. A further part of these regulations requires that certain coal baggers and coal suppliers be registered. The EPA has responsibility for this registration process, while relevant local authorities fulfil an enforcement role.

In 2012, the Minister announced a public consultation and review of the 'smoky coal ban' regulations. The purpose of the review was to ensure that the regulations remain fit for purpose in safeguarding air quality by limiting harmful emissions of air pollutants arising from the use of residential fuels. This can be viewed here Delivering Cleaner Air - smoky coal ban public consultation and review.

Following the review several changes were made to the regulations, which have the aim of consolidating the impact of the 'smoky' coal ban to date, and also to further improve air quality across the country. These changes include:

- Boundary modifications and extensions to most existing smoky coal ban specified areas, in line with Census 2011 data;
- The extension of the ban to all of Dublin County,
- The ban has been applied in six new provincial towns (with effect from 01 May 2013) because they have populations over 15,000 people - Greystones, Letterkenny, Mullingar, Navan, Newbridge and Portlaoise. Wicklow Town is also to be included following requests from members of the public, Wicklow County Council and local representatives;
- A prohibition on the burning of bituminous or smoky coal is also being introduced to complement the existing ban on its marketing, sale and distribution.

This process is an example of the interaction of research, environmental assessment and effective legislation and the impact it can have on the health and well-being of the public.

The regulations as they exist currently can be viewed on the DECLG website: 'smoky' coal regulations.

In May 2013, the Minister announced a joint North-South study on all-island air quality to examine air pollution from residential solid fuel, in particular 'smoky' coal, to consider the potential policy options to reduce such emissions with consequential environmental and human health benefits. This study has since commenced.

1.5 World Health Organisation air quality guidelines

This report makes reference to the World Health Organisation (WHO) air quality guidelines for particulate matter (PM_{10}), ozone, nitrogen dioxide and sulphur dioxide (WHO, 2005); and also the WHO air quality guidelines update, which includes $PM_{2.5}$ (Air Qual Atmos Health, 2008). These guidelines were developed by the WHO, to inform policy makers and provide appropriate air quality targets worldwide, based on the latest health information available. The results obtained in our monitoring program during 2013 are compared to these guideline values.

Table 1.2 Percentage of the urban population in the EU exposed to air pollutant concentrations above the EU and WHO reference levels (2009-2011)

Pollutant	EU reference level	Exposure estimate (%)	WHO AQG	Exposure estimate (%)
$PM_{2.5}$	Year (20)	20-31	Year (10)	91-96
PM_{10}	Day (50)	22-33	Day (20)	85-88
O_3	8-hour (120)	14-18	8-hour (100)	97-98
NO_2	Year (40)	5-13	Year (40)	5-13
BaP	Year (1)	22-31	Year (0.12)	76-94
SO_2	Day (125)	< 1	Day (20)	46-54
CO	8-hour (10)	< 2	8-hour (10)	< 2
Pb	Year (0.5)	< 1	Year (0.5)	< 1
Benzene	Year (5)	< 1	Year (1.7)	12-13

Colour coding:	< 5%	5-50%	50-75%	> 75%

1.6 Air Quality and Climate Change

Air pollution can impact on the climate of the planet by acting as greenhouse gases or by scattering sunlight back into space (such as certain particulates), thus affecting what is known as the planets albedo. However the more sensitive relationship between air quality

and climate change, is in the policies that may be adopted by countries to reduce their climate change impact.

Reduction in fossil fuel usage for a country is clearly a worthy goal; however the choice of fuel or energy source to replace those fossil fuels can impact on air quality. For example the adoption of renewable biomass energy as a strategy can lead to a balancing of the carbon equation, however biomass burning has a significant impact on air quality in the form of increased PM_{10} and $PM_{2.5}$ in particular for inefficient wood burning.

This complex relationship between particulate matter and climate change policy has implications for Ireland and other EU Member States, looking to reduce $PM_{2.5}$ concentrations for the NERT and at the same time reduce their carbon footprints.

1.7 Air quality zones 2013

EU legislation on air quality requires that Member States divide their territory into zones for the assessment and management of air quality. The zones in place in Ireland in 2013 are shown in Figure 1.4. Zone A is the Dublin conurbation, Zone B is the Cork conurbation with Zone C comprising 23 large towns in Ireland with a population >15,000. Zone D is the remaining area of Ireland. The zones changed on 1 January 2013 to reflect the results of the 2011 census.

The air quality in each zone is assessed and classified with respect to upper and lower assessment thresholds based on measurements over the previous five years. As recommended in the *Review of the Environmental Protection Agency* (EPARG, 2011), map-based assessments are presented. Upper and lower assessment thresholds are prescribed in the legislation for each pollutant. The number of monitoring locations required is dependent on population size and whether ambient air quality concentrations exceed the upper assessment threshold, are between the upper and lower assessment thresholds, or are below the lower assessment threshold.

The greatest monitoring effort applies where concentrations are above the upper assessment threshold, i.e. where they approach or exceed the limit value. Where concentrations are between the two thresholds, less intensive measurement combined with other assessment methods, such as air quality modelling, will suffice.

The 29 monitoring stations that were employed in 2013 and whose data was used in comprising this annual report are shown in Figure 1.5.

Figure 1.4 Air quality zones in Ireland in 2013

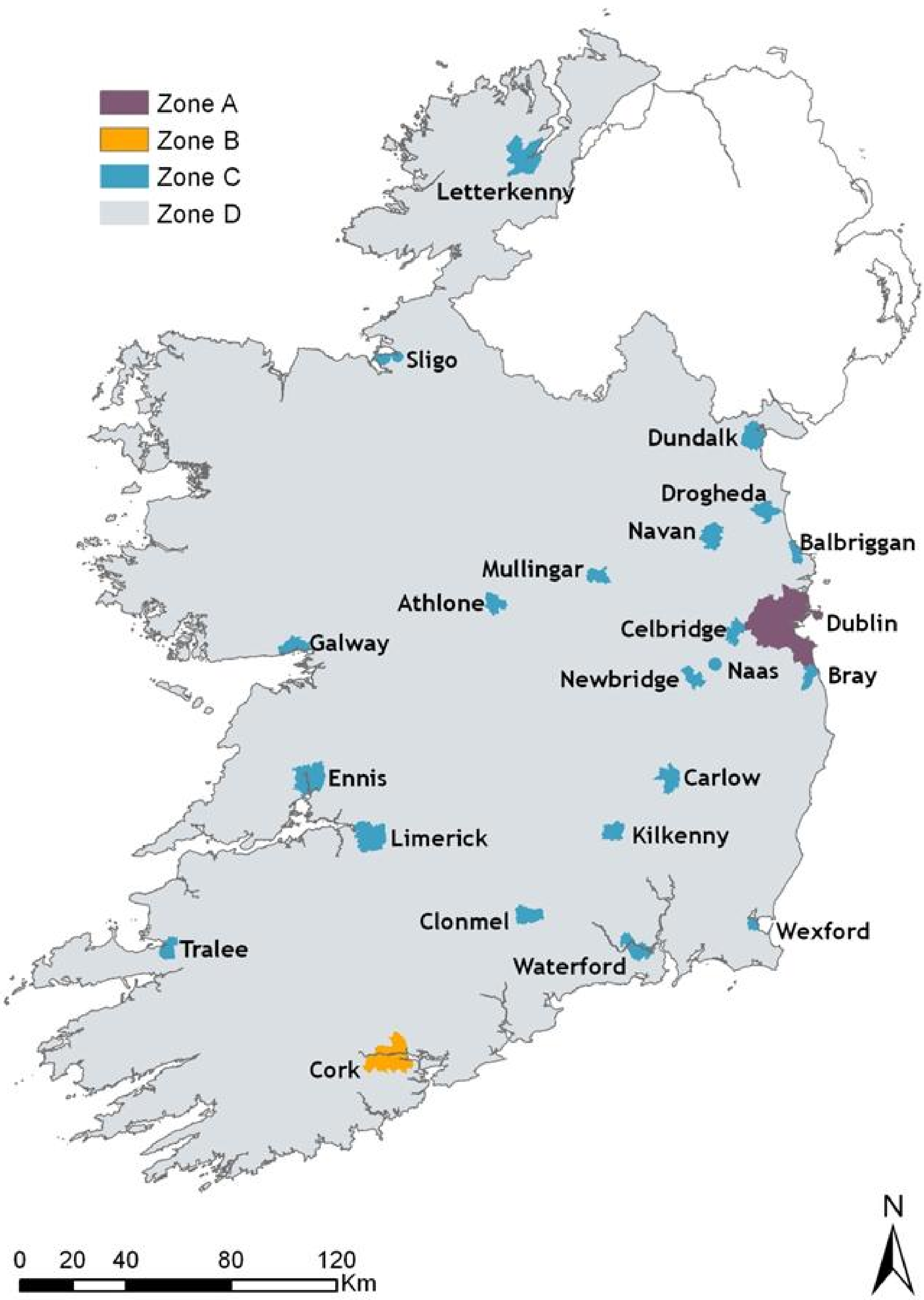
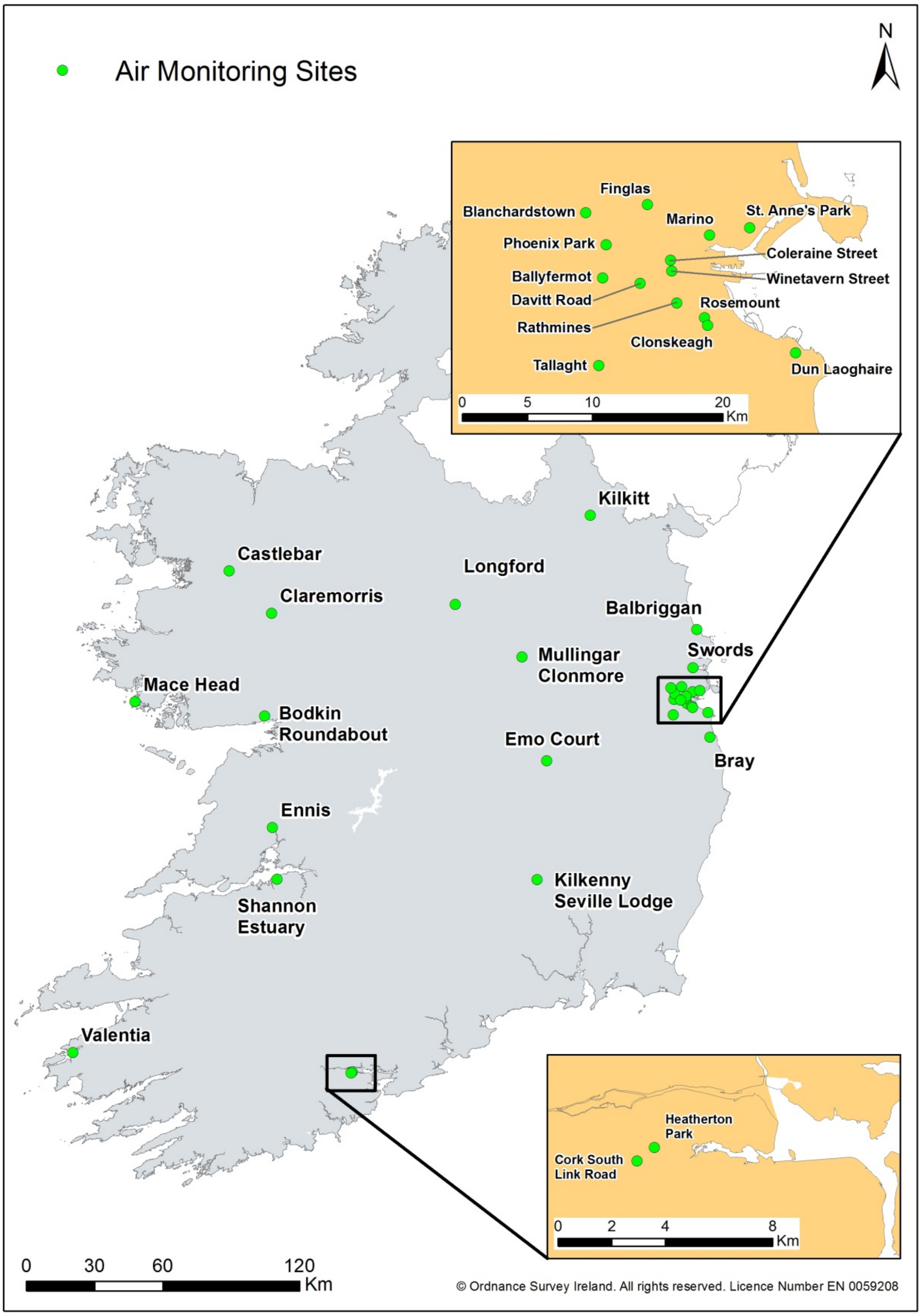


Figure 1.5 Air quality monitoring sites in Ireland in 2013



1.8 Air quality index for health

In April 2013, the EPA launched Ireland's new Air Quality Index for Health (AQIH). This web-based index, developed in conjunction with the Health Service Executive, Met Éireann and the DECLG, shows what the current air quality is across Ireland. The Air Quality Index for Health is a coloured scale of 1 - 10. As shown in Figure 1.6, the scale is divided into four bands:

- good
- fair
- poor
- very poor

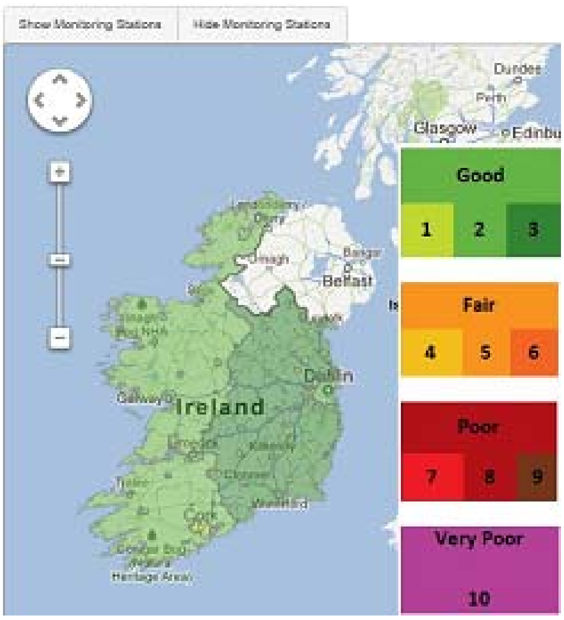
with health advice provided for each band.

The AQIH is calculated hourly and is represented on a colour coded map of Ireland, from which the public can easily assess current air quality in their area. The Air Quality Index for Health can be viewed at [www.airquality.epa.ie.](http://www.airquality.epa.ie)

The Air Quality Index for Health includes health advice for both the general population and those who are more sensitive to air pollution, for example, people with heart or lung problems. The accompanying information explains how to determine if you or your child is likely to be at risk from air pollution.

To coincide with the launch of the Air Quality Index for Health, the EPA also launched a Twitter channel @EPAAirQuality. The public can sign up to this Twitter channel and receive tweets on the status of air quality in their region every day.

Figure 1.6 Air Quality Index for Health



2. Nitrogen oxides (NO_X)

2.1 Origins of NO_x in air

NO_X refers to the two pollutants: nitric oxide (NO) and nitrogen dioxide (NO_2). They are produced during combustion at high temperatures with the main sources in Ireland coming from vehicles and power stations. The industrial sector is also a significant contributor to NO_X levels in Ireland, particularly the cement production industry. The majority of NO_x emissions are comprised of NO, with typically 5 - 10% being directly emitted NO_2. Diesel engines tend to emit a higher percentage of NO_2.

2.2 Air quality standards for NO_2 and NO_x

Air quality standards for NO_2 and NO_x are shown in Table 2.1. For NO_2 two limit values and an alert threshold are set out for the protection of human health. The limit values are specified for short-term (one-hour) and long-term (annual) exposure. The 1-hour value can be exceeded up to 18 times per year before the limit value is breached. For the protection of vegetation a critical level is set for the annual mean of nitrogen oxides (NO_X), defined as the sum of NO and NO_2 expressed in units of mass concentration of NO_2.

The legislation also defines an alert threshold value of 400 µg/m^3. When exceeded over three consecutive hours at locations representative of air quality over at least 100 km^2 or an entire air quality management zone or agglomeration, local authorities have to implement short-term action plans. Those action plans may include measures in relation to motor-vehicle traffic, construction works, ships at berth, and the use of industrial plants or products and residential heating. Specific actions aiming at the protection of sensitive population groups, including children, may also be considered in the framework of those plans.

Table 2.2 shows the WHO guideline for NO_2, which in this case is the same as the EU legislation.

Table 2.1 Limit and threshold values for NO_2 and NO_X as set out in the 2008 CAFE Directive and S.I. No. 180 of 2011

Objective	Averaging period	Limit or threshold value	Number of allowed exceedances
Human health	One hour	200 $\mu g/m^3$	18 hours per year
Human health	Calendar year	40 $\mu g/m^3$	
Alert[1]	One hour	400 $\mu g/m^3$	
Vegetation	Calendar year	30 $\mu g/m^3$	
Upper assessment threshold for human health	Calendar year	32 $\mu g/m^3$	
Lower assessment threshold for human health	Calendar year	26 $\mu g/m^3$	

Table 2.2 WHO air quality guideline for NO_2

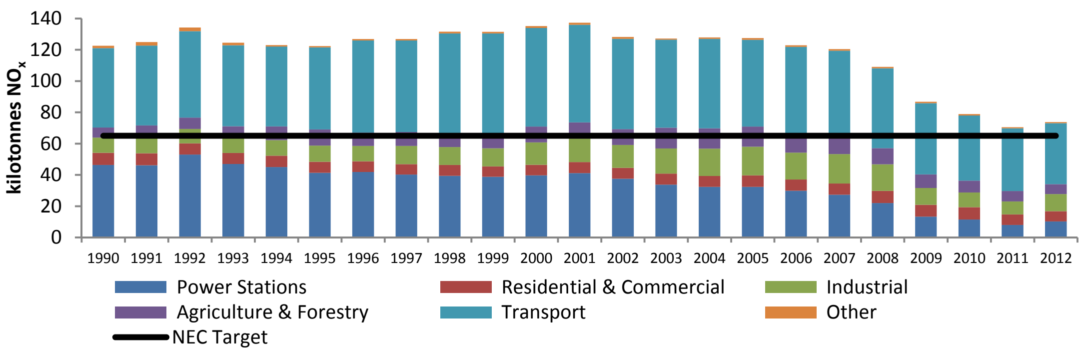
$\mu g/m^3$	1-hour mean	Annual Mean
NO_2	200	40

[1] To be measured over three consecutive hours at locations representative of air quality over at least 100 km^2 or an entire zone or agglomeration, whichever is smaller.

2.3 Emissions to air of NO_2 and NO_X in Ireland

Figure 2.1 shows the sources and trends of NO_X emissions to air from 1990 to 2012[2] compared with the National Emissions Ceiling Directive (NEC) target. The NEC for certain pollutants sets upper limits for each Member State of the EU, for the total emissions of the four pollutants responsible for acidification, eutrophication and ground-level ozone pollution (sulphur dioxide, nitrogen oxides, volatile organic compounds and ammonia). The main sources of NO_X emissions in Ireland are the transport, power generation and cement sectors. However, sustained NO_X emissions from road transport mean that Ireland failed to achieve the emissions ceiling target of 65 kt by 2010. The failure to achieve this 65 kt ceiling could be attributed to the underperformance of emission abatement technology in vehicles (which was estimated at 7.5 kt in 2012) combined with the ongoing revision and improvement which has been made to the national inventory, which has acted to increase absolute NOx emission estimates in overall terms.

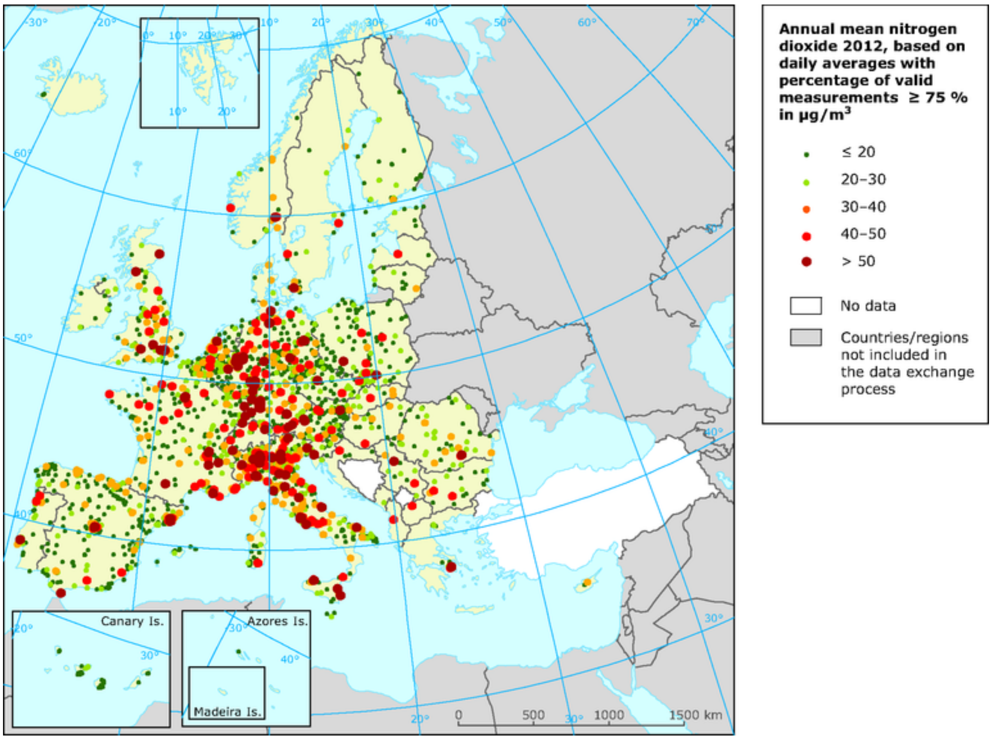
Figure 2.1 Sources and trends of NO_X emissions to air from 1990 to 2012 compared with the NEC target



[2] Emissions data for 2012 is the latest available data due to the way in which emission inventories are compiled.

Figure 2.2 shows the concentrations of NO_2 in Ireland put in the European context. Ireland compares favourably to other Member States in relation to NO_2, however it should be noted that some European countries are struggling with compliance in this area.

Figure 2.2 Concentration of NO_2 in Ireland in 2012 with relation to other EU Member States (source: EEA)



2.4 Monitoring of NO_2 and NO_x in Ireland in 2013

NO_2 concentrations were monitored at 15 locations across Ireland in 2013. The results are shown in Figure 2.3 and summary statistics for both NO_2 and NO_X are contained in Table A1 and Table A2 in Appendix A. NO_2 values for all monitoring sites in Ireland were below the annual limit value in 2013. Figure 2.4 shows the concentrations observed with respect to the WHO air quality guideline value for NO_2. Figure 2.5 shows the classification of zones for NO_2 in Ireland. Zones A and B are above the upper assessment threshold and lower assessment threshold respectively, due to the nature of the calculation of the classification, which takes into account concentrations over the last five year period. NO_2 concentrations in Ireland in 2013 were below the limit values set out in the CAFE Directive and WHO guidelines.

Figure 2.3 Annual mean NO_2 concentrations at individual stations across Ireland in 2013[3]

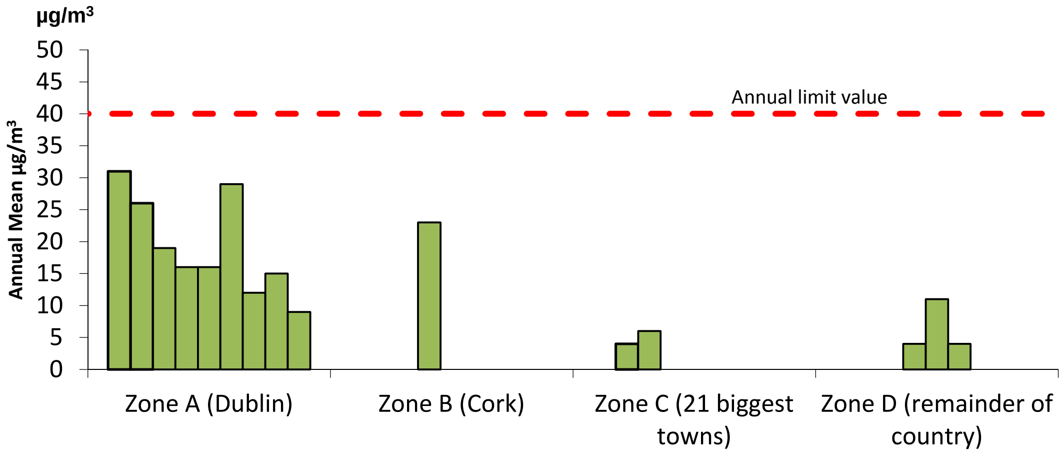
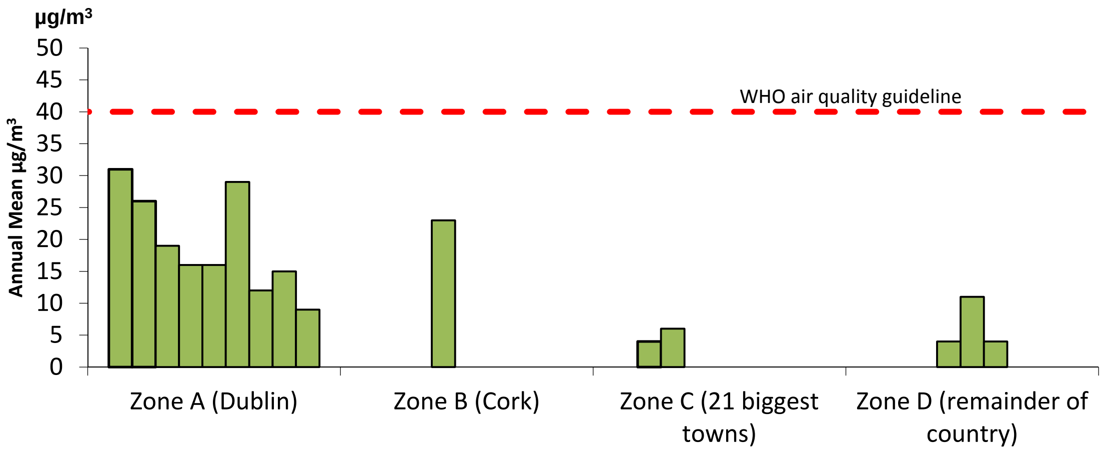
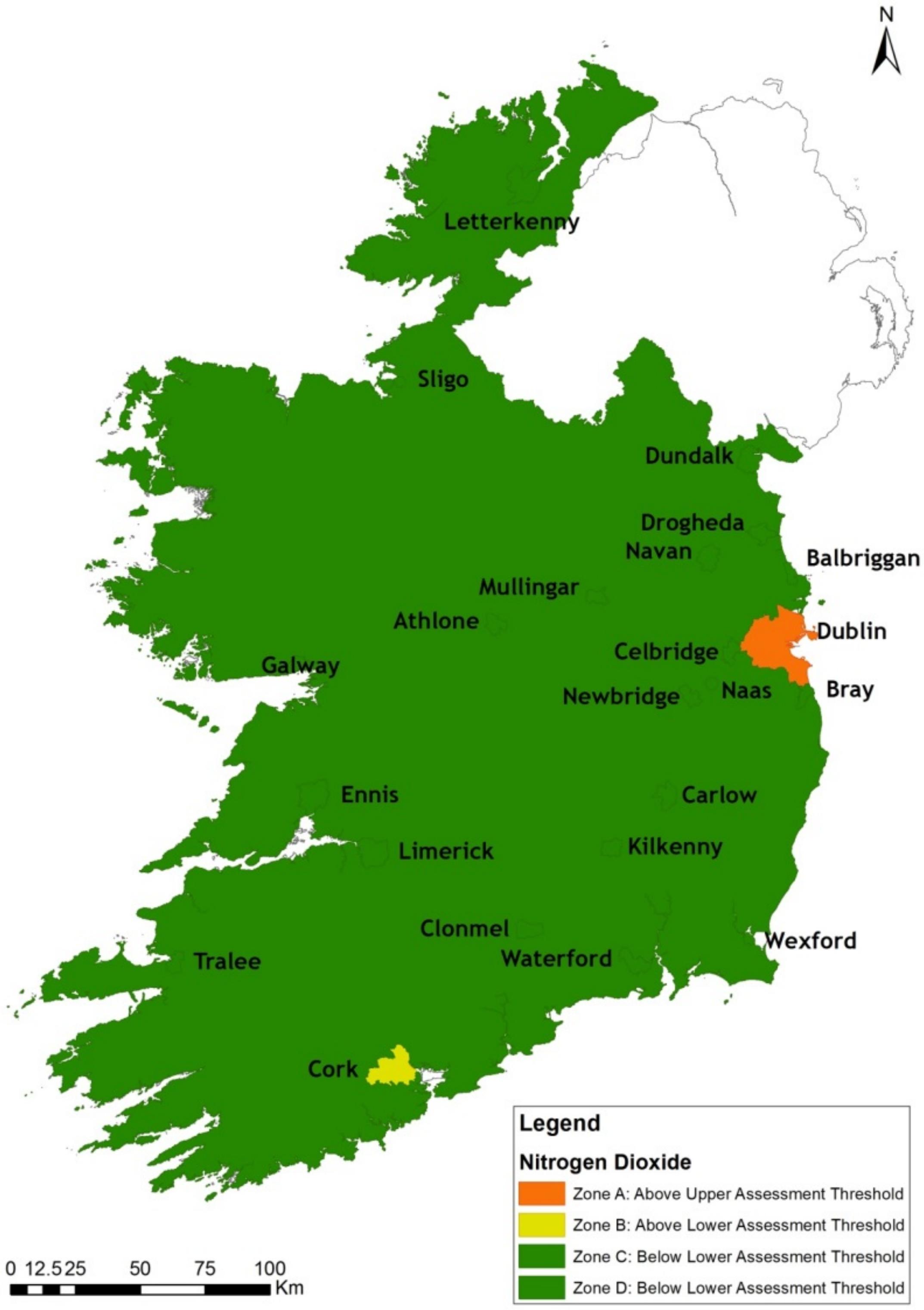


Figure 2.4 Annual mean NO_2 concentrations for Ireland in 2013 with reference to WHO air quality guideline value



[3] It must be noted that not all stations in Zone A monitor every air quality parameter. For details on what individual stations measure and related concentrations, please see Appendix A.

Figure 2.5 Classification of zones for NO_2 in Ireland[4]



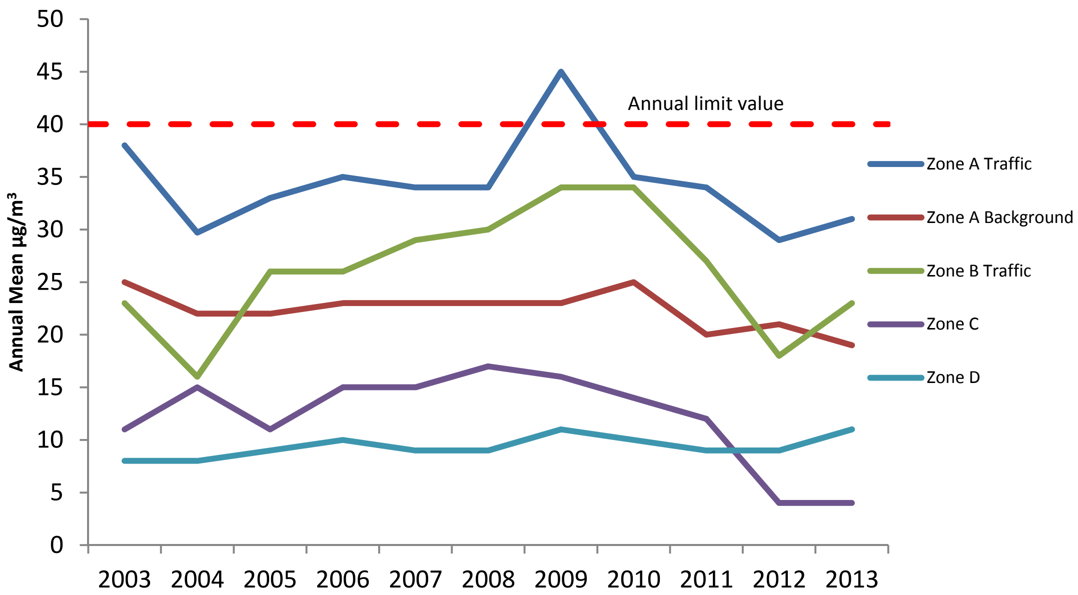
[4] Classification is based on monitoring results for the last five years.

2.5 Trend in NO_X concentrations

NO_2 levels across all zones of Ireland have remained relatively static since 2003, with signs of a slight increasing trend in the years 2008 - 2010. During this period NO_2 levels have been close to the limit value at Dublin City and Cork City centre monitoring sites, see Figure 2.6, with the limit value exceeded in Dublin in 2009. However, NO_2 levels decreased in 2010, 2011 and 2012. This downward trend may have stabilised in 2013.

The reason for the decrease in NO_2 concentrations in 2010, 2011 and 2012 could partly be due to meteorological conditions. Cold and dry or warm and dry periods of weather with stable airflows lead to a build-up of pollutants such as NO_2.

Figure 2.6 Trend in NO_2 concentrations for zones in Ireland 2003 - 2013



2.6 Outlook for NO_X levels in Ireland

High NO_X emissions within urban centres may lead to an exceedance of the limit value in the future due to our continued reliance on motorised vehicles. Although technological advances in the future may lead to lower NO_X emissions from individual cars, this technology will take time to make an impact on the levels as they stand. The actions set out in the Smarter Travel Policy for Sustainable Transport (DOT, 2009) should be implemented to ensure that we can control levels of NO_X in Ireland in the future. These include actions to reduce travel demand, increase alternatives to the private car, reduce the NO_X emissions of motorised transport and by also considering our choice of motor vehicle fuel.

3. Sulphur dioxide (SO_2)

3.1 Origins of SO_2 in air

SO_2 is a gas which is formed when sulphur containing fuels (mainly coal and oil) are burned in power stations, domestically, and elsewhere. Volcanic eruptions are the predominant natural source of sulphur dioxide.

3.2 Air quality standards for SO_2

Table 3.1 presents the European air quality limit values for SO_2 defined in the 2008 CAFE Directive and S.I. No. 180 of 2011 in Irish legislation. Values are given for human health protection and vegetation protection. Health protection limit values are specified for short-term exposure, for 1-hour and 24-hour averages and countries were obliged to meet them by 2005. There is also an alert threshold value of 500 µg/m^3. When exceeded over three consecutive hours, local authorities have to implement an action plan to deal with the pollution episode.

Table 3.1 Limit and threshold values for SO_2 as set out in the 2008 CAFE Directive and S.I. No. 180 of 2011

Objective	Averaging period	Limit or threshold value	Number of allowed exceedances
Human health	One hour	350 µg/m^3	24 hours per year
Human health	One day	125 µg/m^3	3 days per year
Alert[5]	One hour	500 µg/m^3	
Vegetation	Calendar year	20 µg/m^3	
Upper assessment threshold for human health	One day	75 µg/m^3	3 days per year
Lower assessment threshold for human health	One day	50 µg/m^3	3 days per year

Table 3.2 shows the WHO air quality guideline values for SO_2.

Table 3.2 WHO air quality guidelines for SO_2

µg/m^3	10-minute mean	24-hour mean
SO_2	500	20

[5] To be measured over three consecutive hours at locations representative of air quality over at least 100 km^2 or an entire zone or agglomeration, whichever is smaller.

3.3 Emissions to air of SO_2 in Ireland

Figure 3.1 shows the sources and trends of SO_2 emissions to air from 1990 to 2012 compared with the NEC target. Ireland achieved the emission ceiling of 42 kt in 2009 due to large decreases in SO_2 emissions across a range of sectors. Fuel switching, from solid and liquid fuels to natural gas, in the power generation and industry sectors was a significant contributor to the decreased emissions. The application of flue gas desulphurisation at the Moneypoint coal-fired power station also led to a substantial reduction in SO_2 from this key point source.

Figure 3.1 Sources and trends of SO_2 emissions to air from 1990 to 2012 compared with the NEC target

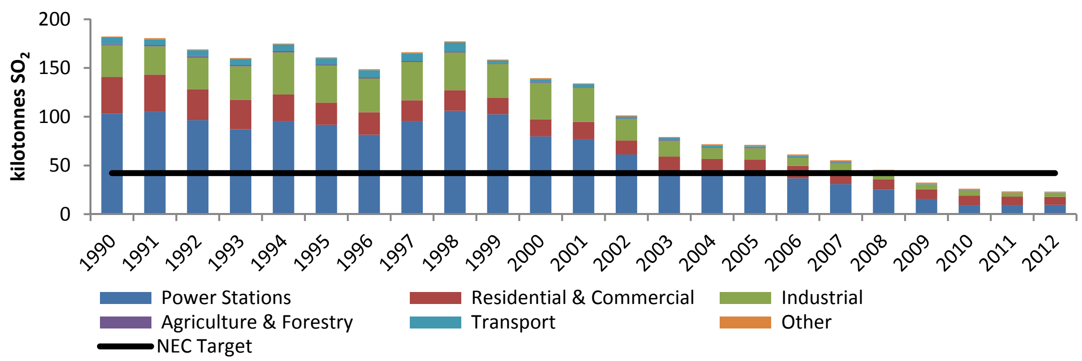
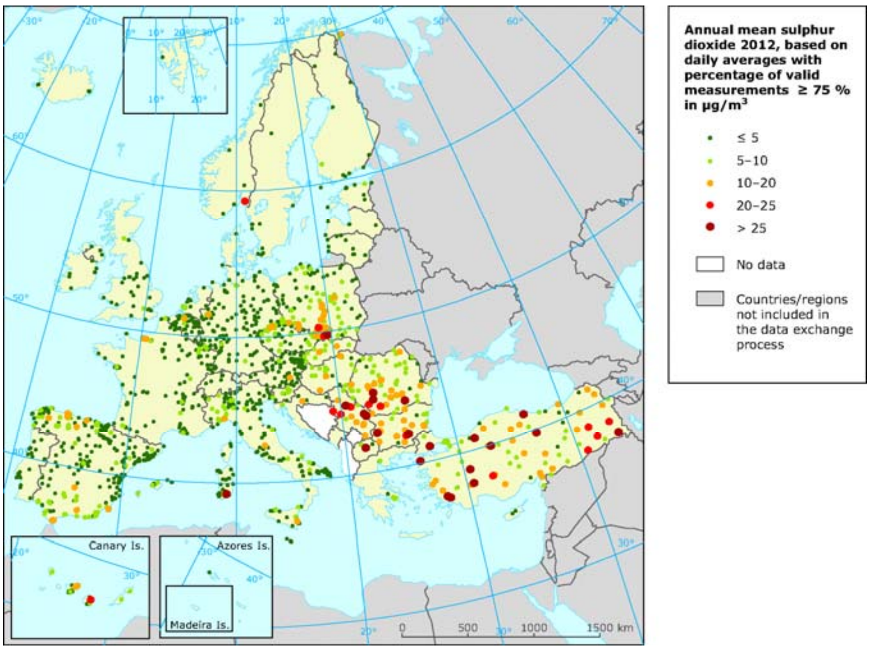


Figure 3.2 shows the concentrations of SO_2 in Ireland put in the European context. Levels of SO_2 are low across much of the European Union, where industrial abatement technology has being successful in tackling this pollutant.

Figure 3.2 Concentration of SO_2 in Ireland in 2012 with relation to other EU Member States



3.4 Monitoring of SO_2 in Ireland in 2013

SO_2 was measured at 10 stations in 2013. The results are shown in Figure 3.3 and indicate that 2013 concentrations were below the daily limit of 125 µg/m^3, as set out in the CAFE Directive. No exceedances of the daily limit were recorded in 2013. Table A3 in Appendix A contains summary SO_2 statistics from all stations in 2013. It is difficult to directly compare the current EU limit values with the WHO recommended values; however, the WHO values are considerably lower than the current EU limits but are not expected to be a significant challenge for Ireland, as concentrations of SO_2 in Ireland are low.

Figure 3.3 Daily maximum concentrations for SO_2 at individual stations across Ireland in 2013

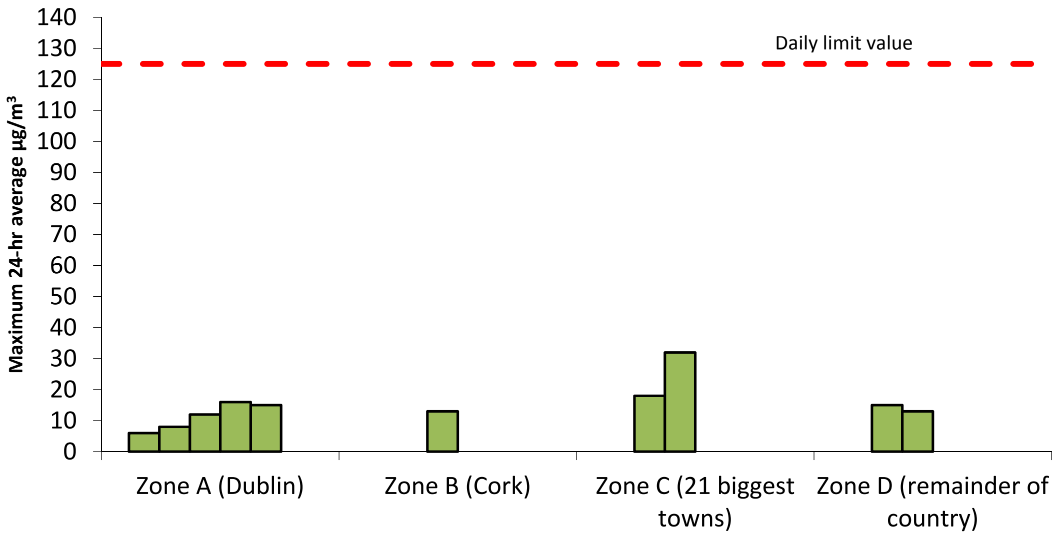


Figure 3.4 shows the classification of zones for SO_2 in Ireland. This classification is based on the last five years of monitoring.

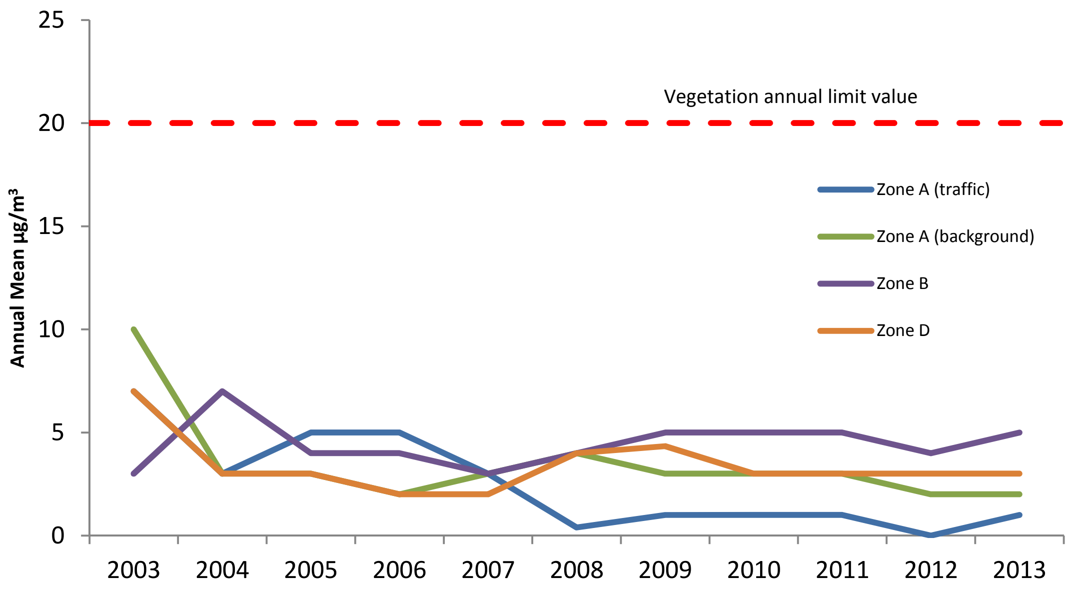
Figure 3.4 Classification of zones for SO_2 in Ireland[6]

[6] Classification is based on monitoring results for the last five years.

3.5 Trend in SO_2 concentrations

Figure 3.5 shows the trend in annual mean SO_2 concentrations across Ireland since 2003. Levels have been consistently low in Ireland in that period with a slight downward trend. This trend is reflective in the shift in fuel choice across Ireland in both the residential heating sector and the energy production sector. This shift has been from sulphur containing bituminous coal to those fuels which are low in SO_2 production such as natural gas.

Figure 3.5 Annual mean SO_2 concentrations 2003 - 2013



3.6 Outlook for SO_2 concentrations in Ireland

It is expected that SO_2 concentrations across Ireland will remain low for the foreseeable future.

4. Carbon monoxide (CO)

4.1 Origins of CO in air

Carbon monoxide is a colourless gas, formed from incomplete oxidation during combustion of fuel. Sources of CO in Ireland are mainly from automobiles, although tobacco smoke and poorly adjusted and maintained combustion devices, such as boilers, contribute also. CO concentrations tend to be higher in areas with heavy traffic congestion.

4.2 Air quality standards for CO

Table 4.1 sets out the European air quality limit value. Table 4.2 shows the WHO air quality guideline for CO. The European limit value for health protection is the maximum allowable 8-hour average, to be met by 2005.

Table 4.1 Air quality limit values set by the CAFE Directive and S.I. No. 180 of 2011 for CO

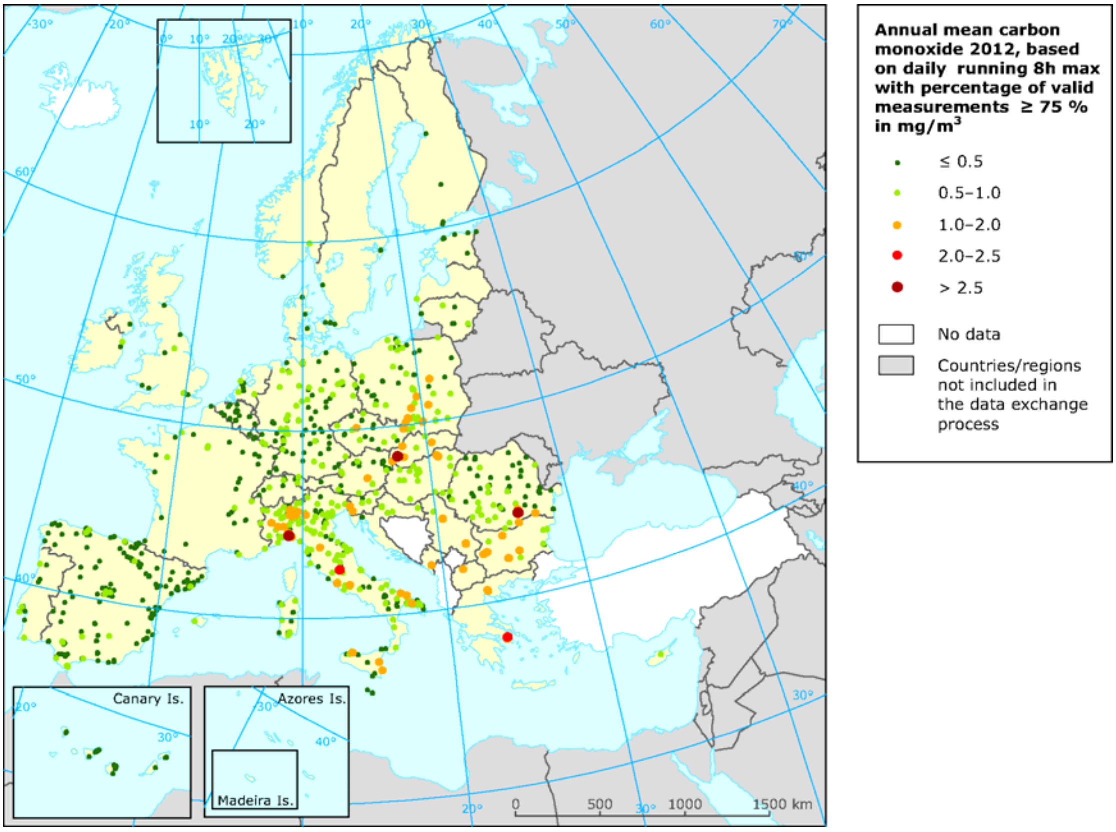
Limit value	Hourly	8-hour average
Human health		10 mg/m^3
Annual limit value upper assessment threshold		7 mg/m^3
Annual limit value lower assessment threshold		5 mg/m^3

Table 4.2 WHO air quality guideline values for CO

CO mg/m^3	Hourly	8-hour average
WHO	30	10

Figure 4.1 shows the concentrations of CO in Ireland put in the European context.

Figure 4.1 Concentration of CO in Ireland in 2012 in relation to other EU Member States



4.3 Monitoring of CO in Ireland in 2013

CO was measured at five locations in 2013; the results are shown in Figure 4.2. Levels in 2013 are very similar to concentrations observed in 2011 and 2012 and are below the limit value. Measured concentrations were also below the WHO air quality guideline as shown in Figure 4.3. Summary statistics of CO concentrations are presented in Table A4 of Appendix A. The zone classification for CO in Ireland is shown in Figure 4.4.

Figure 4.2 Max 8-hour mean CO Concentrations at individual stations in 2013

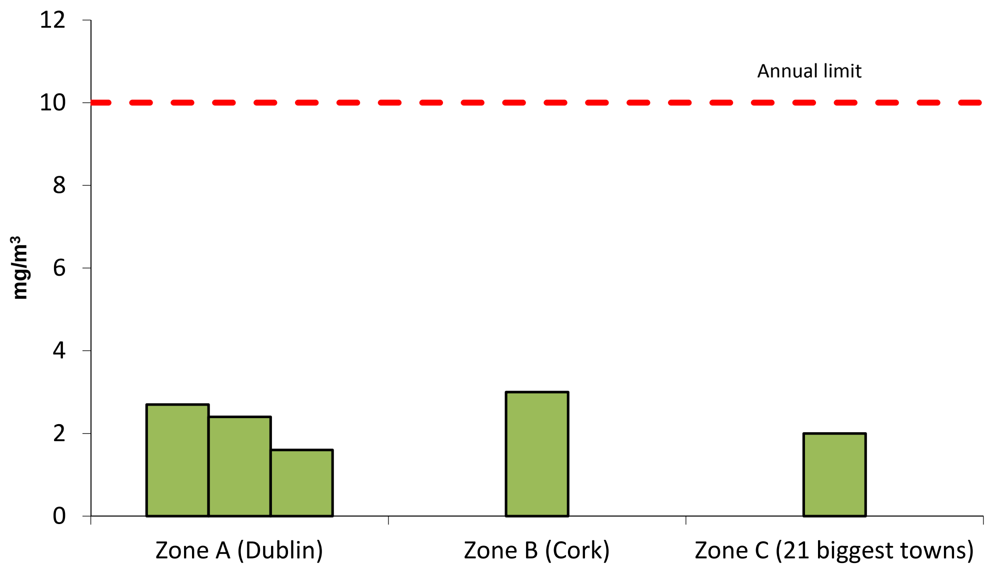


Figure 4.3 Max 8-hour mean CO Concentrations with reference to WHO air quality guideline value

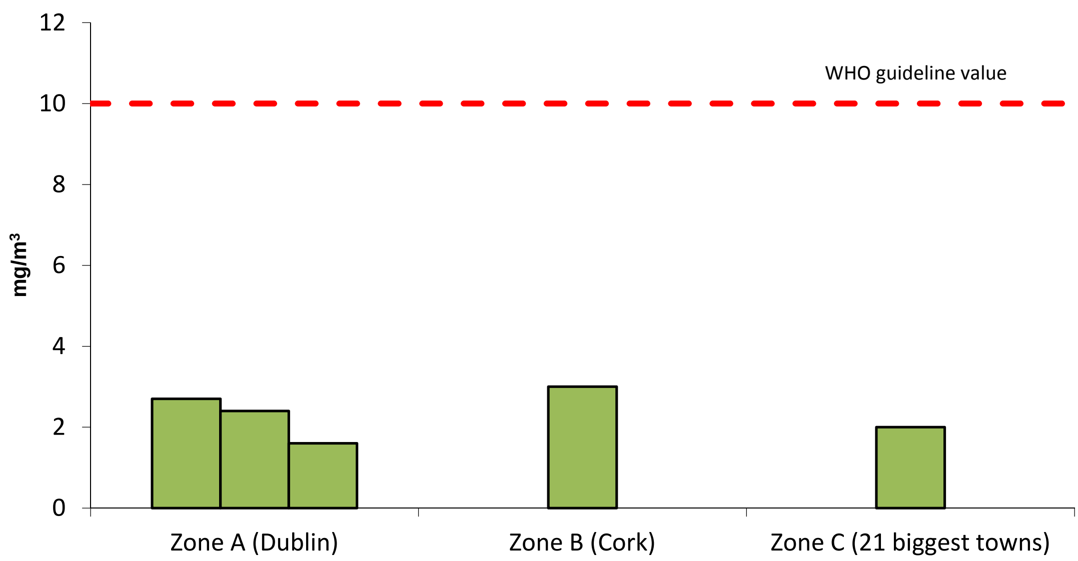
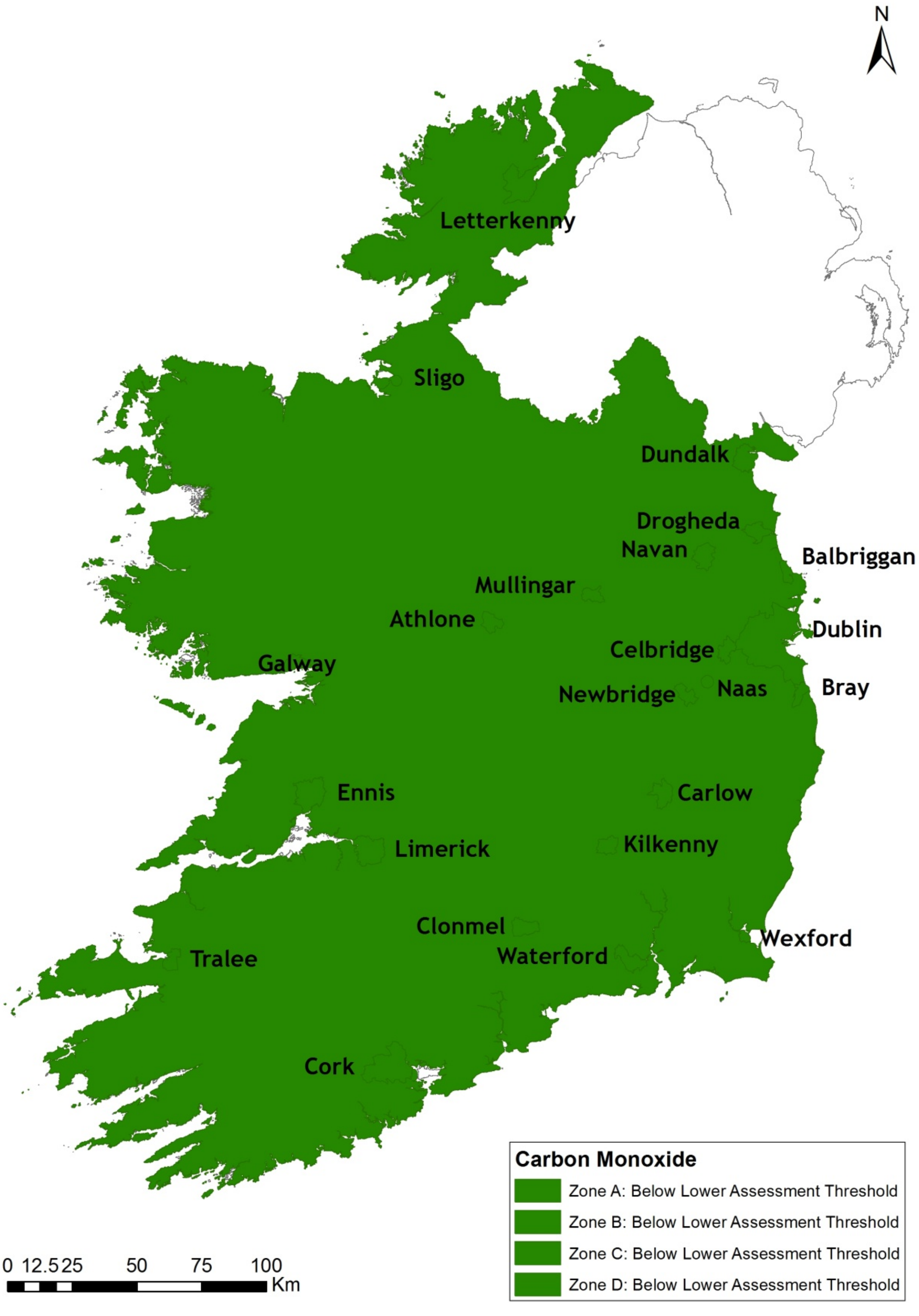


Figure 4.4 Classification of zones for CO in Ireland[7]

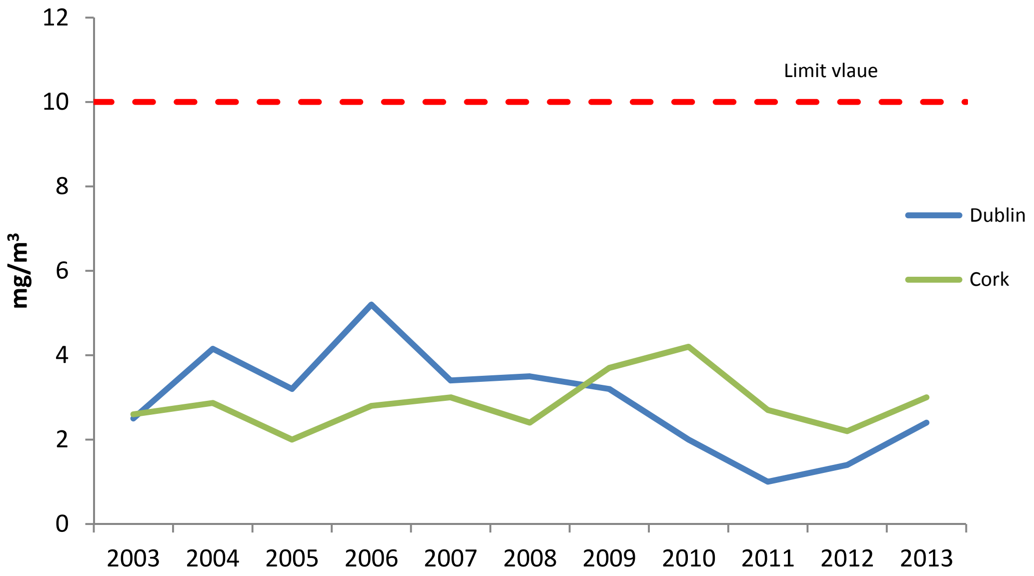


[7] Classification is based on the last five years of air quality monitoring.

4.4 Trends in CO concentrations

Trends in CO concentrations in Dublin and Cork since 2003 are shown in Figure 4.5. It can be seen that levels have remained low over the period with no discernible trend in changes. All levels recorded in this time period have remained below the limit value set out in the CAFE Directive and WHO guideline.

Figure 4.5 8-hour maximum CO concentrations in Cork and Dublin, 2003 - 2013



4.5 Outlook for CO concentrations

Carbon monoxide concentrations in Ireland are expected to stay low for the foreseeable future.

5. Ozone (O_3)

5.1 Origins of ozone in air

Ozone is formed as a secondary pollutant in the troposphere from the chemical reaction of NO_X, CO and volatile organic compounds (VOCs) in the presence of sunlight. Ozone can also be present in the troposphere due to downward flux from the ozone-rich stratosphere, where it occurs naturally and has an important role in absorbing harmful UV radiation. Ozone is readily transported from Atlantic and European regions due to the natural movement of air masses. Ground-level ozone is depleted through reactions with traffic-emitted pollutants, therefore levels of ozone are higher in rural areas than in urban areas.

5.2 Air quality standards for ozone

Air quality objectives for ozone are shown in Table 5.1. The CAFE Directive and S.I. No. 180 of 2011 set out values for the protection of human health and for the protection of vegetation.

For health protection a daily maximum 8-hour average threshold is specified (120 $\mu g/m^3$). The target value, to be applied by Member States from 1 January 2010, is that the threshold should not be exceeded at a monitoring station on more than 25 days per year, determined as a three-year average. The long-term objective (LTO) is that the threshold level should not be exceeded at all. For health protection, there are also public information and alert thresholds. When the alert threshold is exceeded, the country affected is requested to draw up a short-term action plan according to specific provisions defined in the 2008 Air Quality Directive. Table 5.2 shows the WHO air quality guideline value for ozone.

The vegetation protection value is specified as 'accumulated exposure over threshold', AOT40 (see Glossary) and is calculated as the sum of all hourly ozone values over 80 $\mu g/m^3$ (40 ppb) during the most intense growing season, which is May to July.

Table 5.1 Air quality limit values for ozone as set out in the 2008 CAFE Directive and S.I. No. 180 of 2011

Objective	Averaging period	Limit or threshold value	Comments
Human health	Daily maximum 8-hour mean	120 $\mu g/m^3$ [8]	25 days per year averaged over three years
Vegetation	AOT40 accumulated over May-July	18,000 $(\mu g/m^3)$.h averaged over five years	
LTO health	Daily maximum 8-hour mean	120 $\mu g/m^3$	
LTO vegetation	AOT40 accumulated over May-July	6,000 $(\mu g/m^3)$.h	
Information	One hour	180 $\mu g/m^3$	
Alert[9]	One hour	240 $\mu g/m^3$	

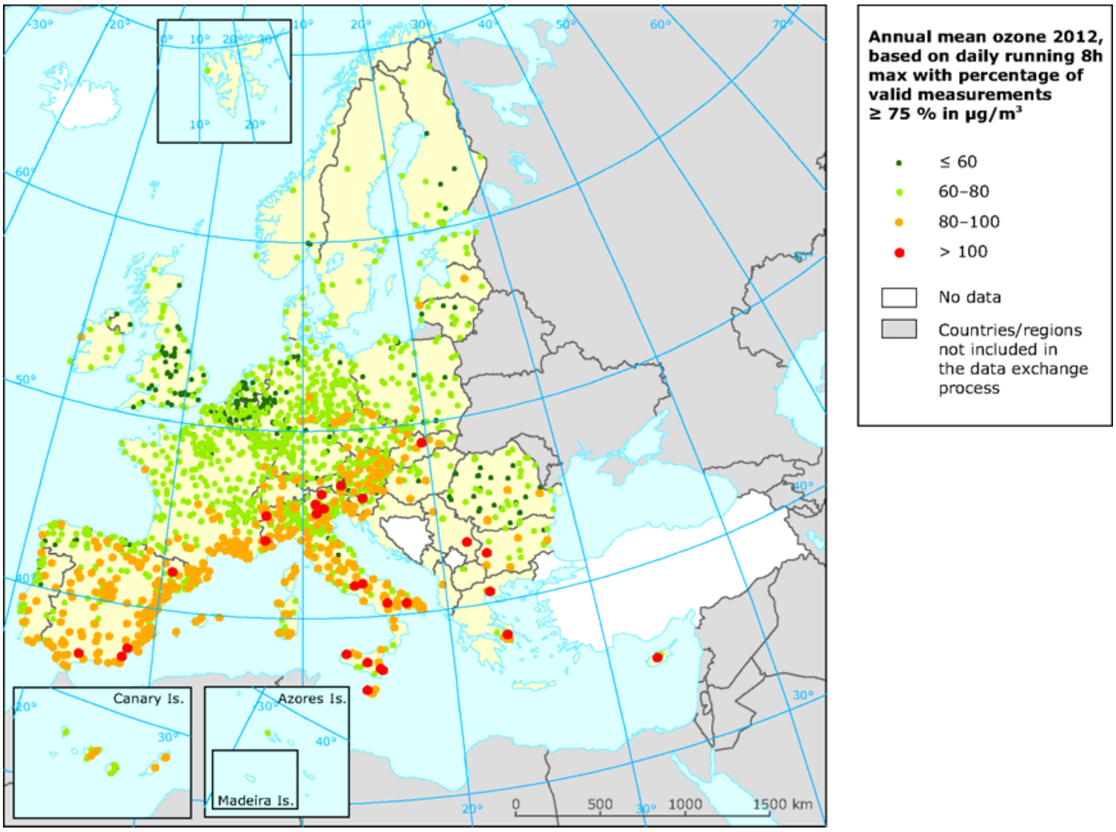
Table 5.2 WHO air quality guideline value for ozone

Averaging period	Limit or threshold value
Daily maximum 8-hour mean	100 $\mu g/m^3$

[8] Target value to be met by 1 January 2010, determined from a three-year average.
[9] To be measured over three consecutive hours.

Figure 5.1 shows the concentrations of ozone in Ireland put in the European context. The impacts of ground level ozone can be seen in central and southern Europe, particularly by those countries with larger cities and high sunshine levels. However the influence of background levels of ozone can be seen along the western seaboard, with Ireland experiencing this phenomenon.

Figure 5.1 Concentration of O_3 in Ireland in 2012 in relation to other EU Member States



5.3 Monitoring of ozone in Ireland in 2013

Ozone concentrations recorded in 2013 were below the EU limit value for human health; these results are shown in Figure 5.2. However ozone concentrations measured, exceeded the LTO for health at ten monitoring stations and were also above the WHO guideline value at eleven monitoring stations; these results are shown in Figure 5.3. The classification of zones for ozone in Ireland is shown in Figure 5.4.

Figure 5.2 Number of days with maximum 8-hour O_3 concentrations > 120 µg/m^3 at individual stations in 2013

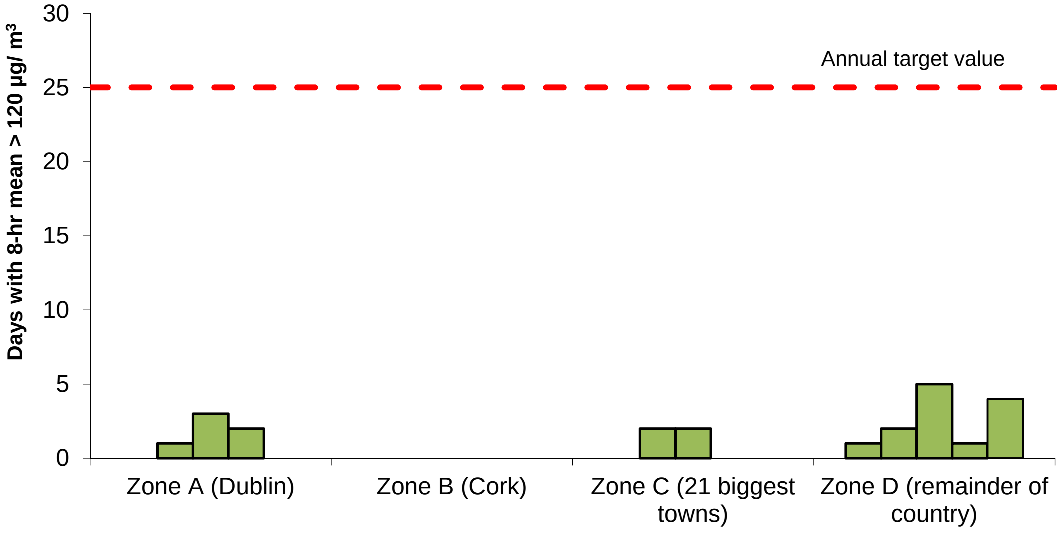


Figure 5.3 8-hour daily maximum concentrations at individual stations compared to the WHO guideline value for ozone

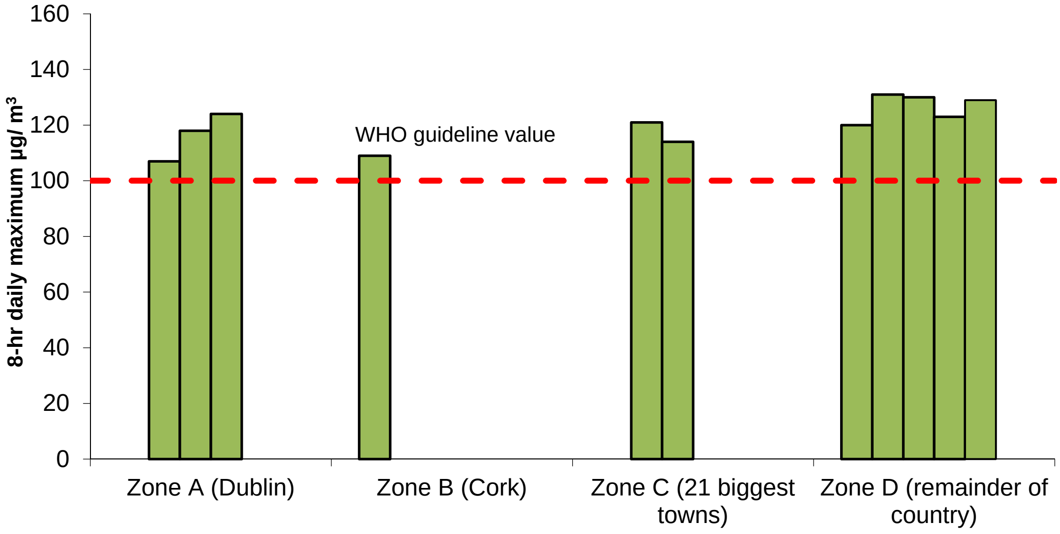
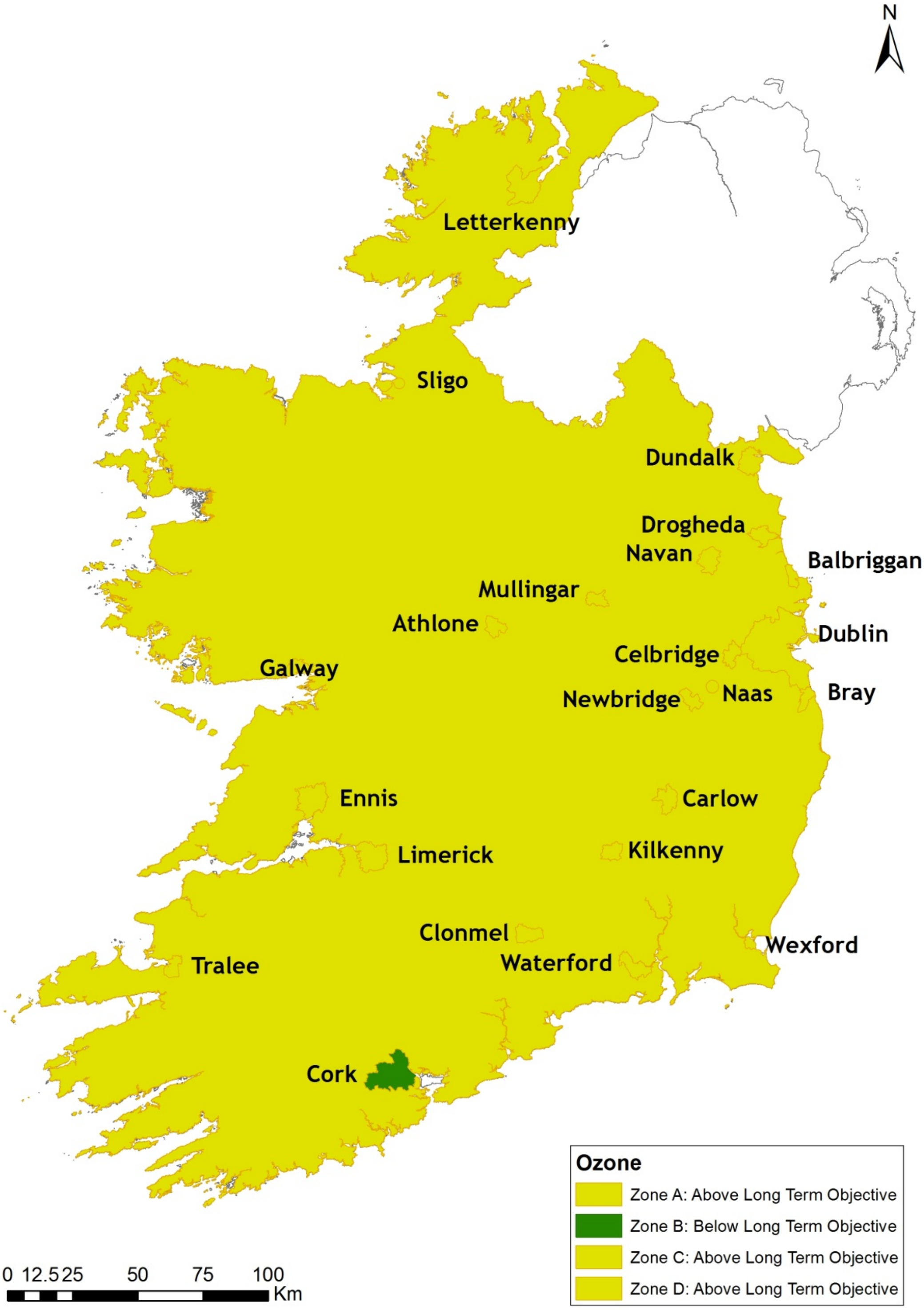


Figure 5.4 Classification of zones for ozone in Ireland[10]



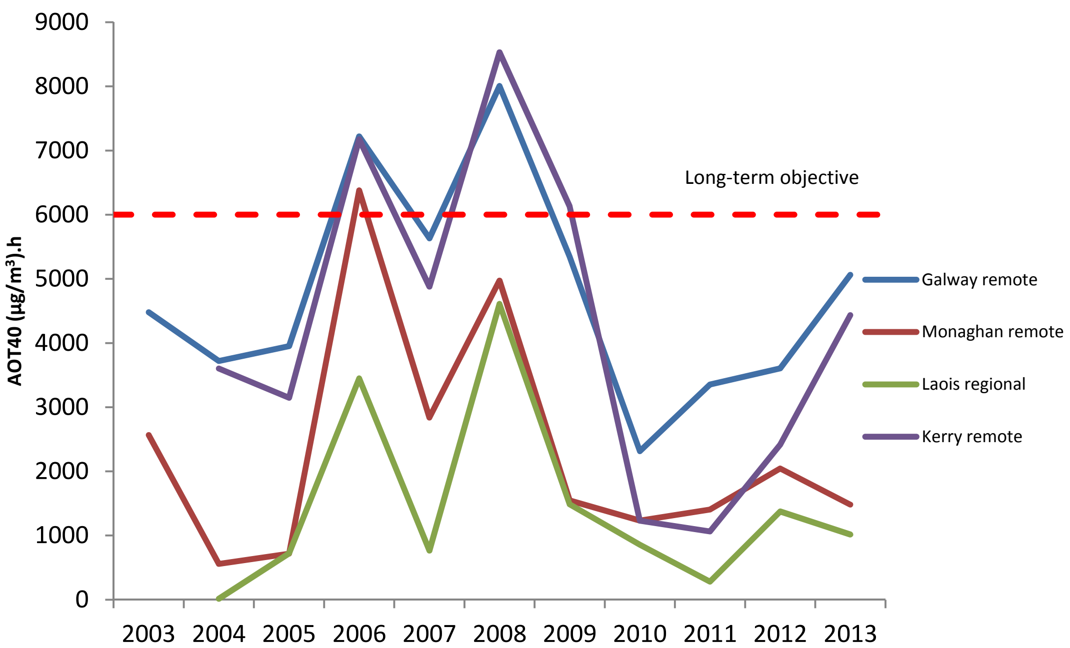
[10] Classification is based on the last five years of air quality monitoring.

5.4 Trend in ozone concentrations

Figure 5.5 shows the AOT40 for five rural background stations for the years 2003-2013. The AOT40 is an indicator of exposure of vegetation to ozone during the growing season, when vegetation is more susceptible to damage from pollutants. Rural background stations are classified as remote, regional or near-city depending on their proximity to urban areas. Ozone levels are higher in remote regions and tend to be highest along the western seaboard (indicated by the Galway and Kerry sites) and lower in the east of the country (indicated by the Monaghan site).

Ozone concentrations are strongly influenced by meteorological conditions; stable anticyclones over Ireland with warm sunny weather are more likely to produce higher levels of ozone. This can arise from local emissions; particularly the interaction of oxides of nitrogen, VOCs and sunlight or it can be due to transboundary sources from the rest of Europe. The lack of high pressure stable air masses during recent summers is reflected in the relatively low levels of ozone observed during these years.

Figure 5.5 AOT40 at rural background stations, 2003 - 2013



5.5 Outlook for ozone concentrations in Ireland

Short acute ozone pollution episodes are infrequent in Ireland; however they have happened in the past and will happen in the future. They are most likely to occur in summer months when there is a stable anti-cyclone over Ireland bringing settled, warm weather. Movement of polluted air masses from Europe are more likely to occur during these periods, with the air masses likely to contain high levels of ozone.

Because ozone levels in Ireland are highly influenced by transboundary sources, attainment of the LTO and compliance with the WHO guideline value will only occur should hemispheric ozone levels reduce. This will require a European, and possibly global, effort to reduce emissions of ozone precursors.

6. Particulate matter (PM_{10})

6.1 Origins of PM_{10} in air

PM_{10} are particles with diameters of 10 µm or less. These particles can consist of direct emissions such as dust, emissions from combustion engines, emissions from the burning of solid fuels or natural sources such as windblown salt, plant spores and pollens. These direct emissions are known as primary PM_{10}. PM_{10} can also be produced indirectly by formation of aerosols as a result of reactions of other pollutants such as NO_X and SO_2; these are known as secondary PM_{10}. In Ireland the main sources are solid fuel burning and vehicular traffic.

6.2 Air quality standards for PM_{10}

The PM_{10} limit and target values for health protection are shown in Table 6.1. The deadline for Member States to meet the PM_{10} limit values was 1 January 2005. For PM_{10} there are limit values for short-term (24-hour) and long-term (annual) exposure. In Europe the short-term limit value for PM_{10} (i.e. not more than 35 days per year with a daily average concentration exceeding 50µg/m^3) is the limit value most often exceeded in European cities and urban areas. Table 6.2 shows the WHO air quality guideline values for PM_{10}.

Table 6.1 Air quality limit and target values for PM_{10} as set out by the CAFE Directive and S.I. No. 180 of 2011

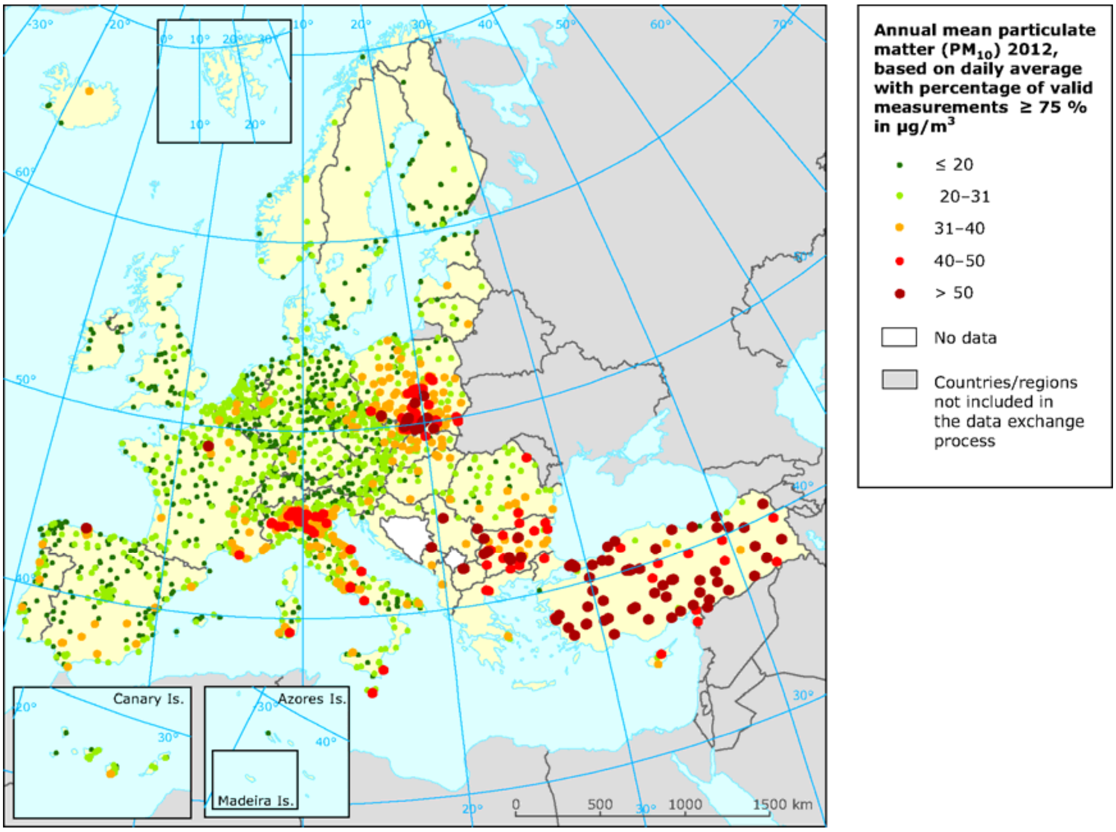
Objective	Averaging period	Limit or threshold value	Number of allowed exceedances
PM_{10} limit value	One day	50 µg/m^3	Not to be exceeded on more than 35 days per year
PM_{10} limit value	Calendar year	40 µg/m^3	
Upper assessment threshold	One day	35 µg/m^3	Not to be exceeded on more than 35 days per year
Lower assessment threshold	One day	25 µg/m^3	Not to be exceeded on more than 35 days per year
Upper assessment threshold	Calendar year	28 µg/m^3	
Lower assessment threshold	Calendar year	20 µg/m^3	

Table 6.2 WHO air quality guideline values for PM_{10}

µg/m^3	24-hour mean	Annual Mean
PM_{10}	50	20

Figure 6.1 shows the concentrations of PM_{10} in Ireland put in the European context. Ireland compares favourably to other Member States in relation to PM_{10}, however, as for other parameters, it should be noted that some other European countries are struggling with compliance with this pollutant.

Figure 6.1 Concentration of PM_{10} in Ireland in 2012 in relation to other EU Member States



6.3 Monitoring of PM_{10} in Ireland in 2013

PM_{10} was monitored at 20 stations across Ireland in 2013; the results are shown in Figure 6.2. Mean concentrations are below the annual limit value of 40 µg/m^3. Summary statistics for PM_{10} concentrations for all sites are available in Table A7 of Appendix A. Figure 6.3 shows the annual mean concentrations at these monitoring stations with respect to the WHO air quality guideline value with 2 of the 20 stations exceeding the value. However, when measuring against the WHO 24-hour mean guideline value (50 µg/m^3), 18 monitoring stations had daily mean values > 50 µg/m^3, see Table A7 of Appendix A. The zone classification for PM_{10} for Ireland is shown in Figure 6.4.

Figure 6.2 Annual mean PM_{10} concentrations at individual stations in 2013

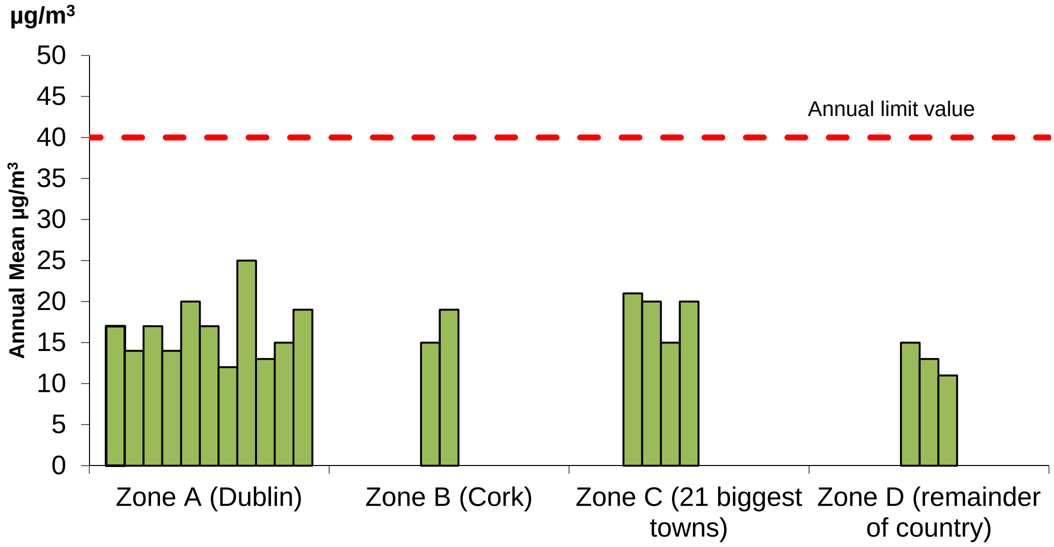
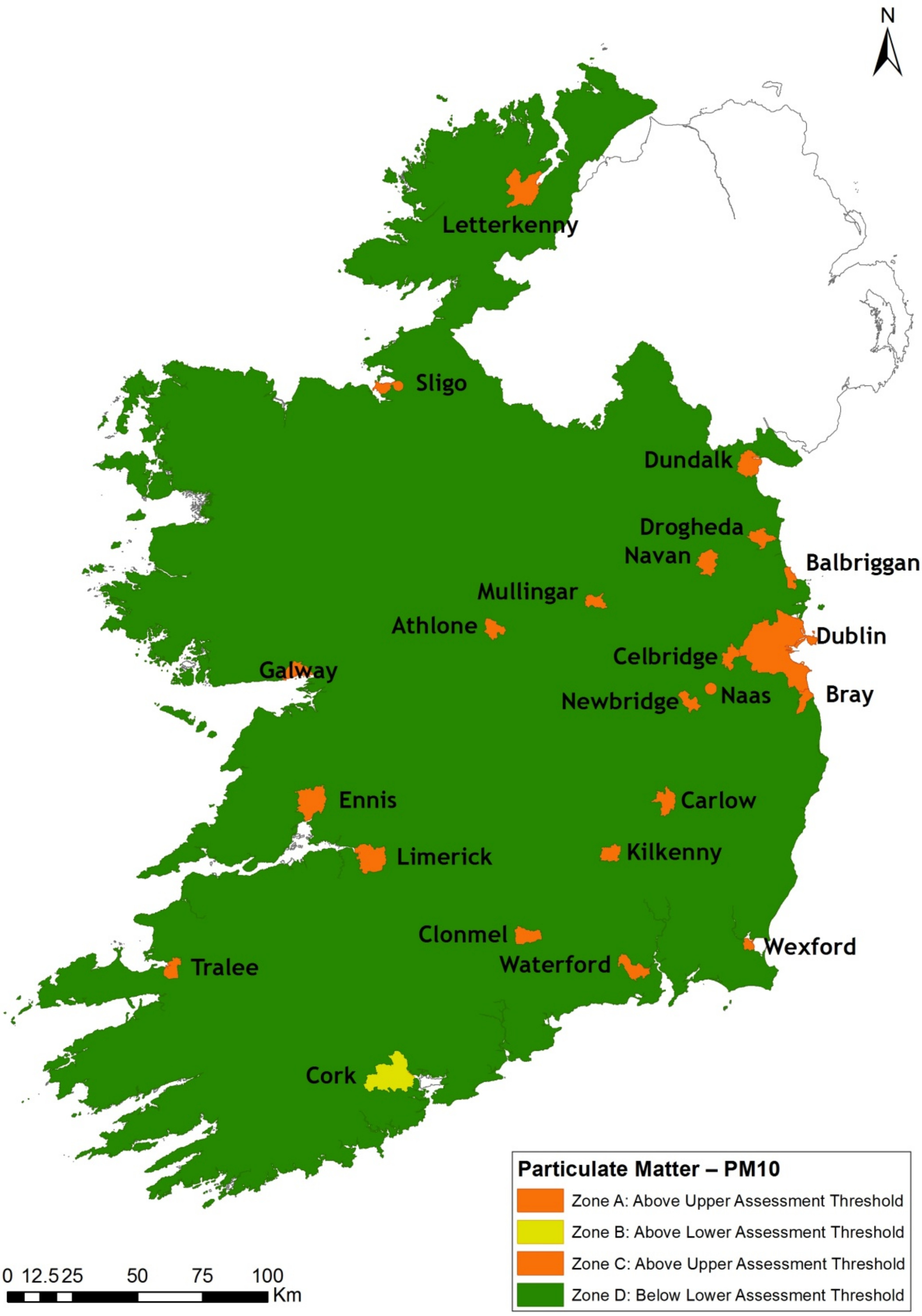


Figure 6.3 Annual mean PM_{10} concentrations at individual stations in 2013 with reference to WHO air quality guideline value for PM_{10}

Figure 6.4 Classification of zones for PM_{10} in Ireland[11]

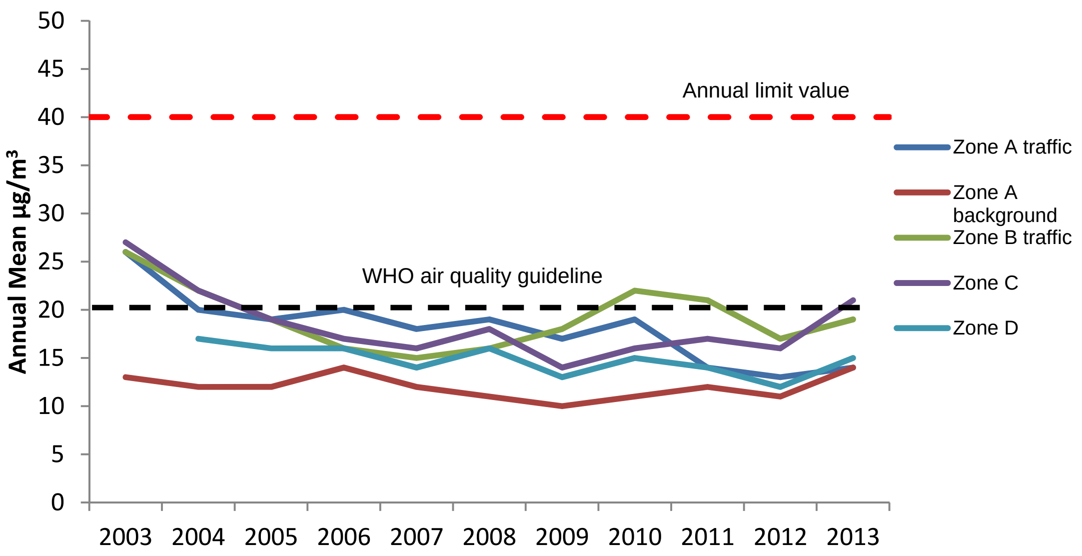


[11] Classification is based on the last five years of air quality monitoring.

6.4 Trends in PM_{10} concentrations

The trend in PM_{10} annual mean concentration from 2003 to 2013 is shown in Figure 6.5. In cities, traffic emissions are the main source of PM_{10}, while in smaller towns or those areas not connected to the natural gas grid, emissions from residential solid fuel combustion dominate. The air quality in cities benefits from the ban on smoky coal, as well as the increased use of gas, with the result that levels of PM_{10} are similar across all zones. Despite large differences in population number Zone D has similar PM concentrations compard to Zones A and B. This is most likely due to residential solid fuel emissions in Zone D which are more significant than traffic emissions.

Figure 6.5 Annual mean PM_{10} concentrations 2003-2013



6.5 Outlook for PM_{10} concentrations

Episodes of elevated PM_{10} levels can occur in Ireland if meteorological conditions which are favourable to poor dispersion of local emissions persist for a number of days or weeks. These conditions, brought about by the presence of a stable anti-cyclone over Ireland, are associated with warm weather in the summer and cold weather in the winter. Such conditions are also favourable to transportation of air masses with high concentrations of PM_{10} from other European countries to Ireland. The potential impact of any policy decisions such as promotion of increased use of biomass for commercial, residential and industrial combustion, could also have a great impact on PM_{10} concentrations in the future.

7. Particulate matter ($PM_{2.5}$)

7.1 Origins of $PM_{2.5}$ in air

$PM_{2.5}$ or 'fine' particulate matter is particle pollution made of a mixture of solids and liquids of size 2.5 µm or less. It is composed of a number of varying components depending on its source. These can include acids such as nitrates and sulphates, VOCs, metals, and soil or dust particles. This $PM_{2.5}$ can be emitted directly into the atmosphere or can be formed secondarily. For example, sulphate particles are formed by the chemical reaction of SO_2 in the atmosphere after its release from power plants or industrial facilities. $PM_{2.5}$ is considered a better indicator of man-made particulate matter than $PM_{10.}$

7.2 Air quality standards for $PM_{2.5}$

The deadline for meeting the target value for $PM_{2.5}$ (25 µg/m^3) was 1 January 2010, while the deadlines for meeting the other limit and 'obligation' values for $PM_{2.5}$ (20 µg/m^3) are 2015 or 2020. The PM_{10} limit and target values for health protection are shown in Table 7.1. The WHO air quality guidelines for $PM_{2.5}$ are shown in Table 7.2.

Table 7.1 Air quality limits and target values for $PM_{2.5}$ as set out by the CAFE Directive and S.I. No. 180 of 2011

Objective	Averaging period	Limit or threshold value[12]	Comments
$PM_{2.5}$, target value	Calendar year	25 µg/m^3	To be met by 1 January 2010
$PM_{2.5}$, limit value	Calendar year	25 µg/m^3	To be met by 1 January 2015
$PM_{2.5}$, limit value[13]	Calendar year	20 µg/m^3	To be met by 1 January 2020
Upper assessment threshold	Calendar year	17 µg/m^3	
Lower assessment threshold	Calendar year	12 µg/m^3	
$PM_{2.5}$ exposure concentration obligation[14]		20 µg/m^3	To be met by 1 January 2015
$PM_{2.5}$ exposure reduction target[14]	0 - 20 % reduction in exposure (depending on the average exposure indicator in the reference year) to be met by 2020		

Table 7.2 WHO air quality guidelines for $PM_{2.5}$

µg/m^3	24-hour mean	Annual Mean
$PM_{2.5}$	25	10

7.3 Monitoring of $PM_{2.5}$ in Ireland in 2013

The CAFE Directive introduced mandatory monitoring of $PM_{2.5}$. Levels in Ireland are below both the stage one and stage two limit values of 25 and 20 µg/m^3. $PM_{2.5}$ results for individual stations are shown in Figure 7.1. These results compared to the WHO air quality guideline value are presented in Figure 7.2, which show that Ireland exceeds the WHO guideline value for $PM_{2.5}$ at 5 of the 7 stations monitored Summary statistics for $PM_{2.5}$ concentrations in 2013 are presented in Table A8 of Appendix A.

[12] The upper assessment threshold and the lower assessment threshold for $PM_{2.5}$ do not apply to the measurements to assess compliance with the $PM_{2.5}$ exposure reduction target for the protection of human health.
[13] Indicative limit value (Stage 2) to be reviewed by the Commission in 2013 in the light of further information on health and environmental effects, technical feasibility and experience of the target value in Member States.
[14] Based on a three-year average.

Figure 7.1 Annual mean values for $PM_{2.5}$ at individual stations in Ireland in 2013

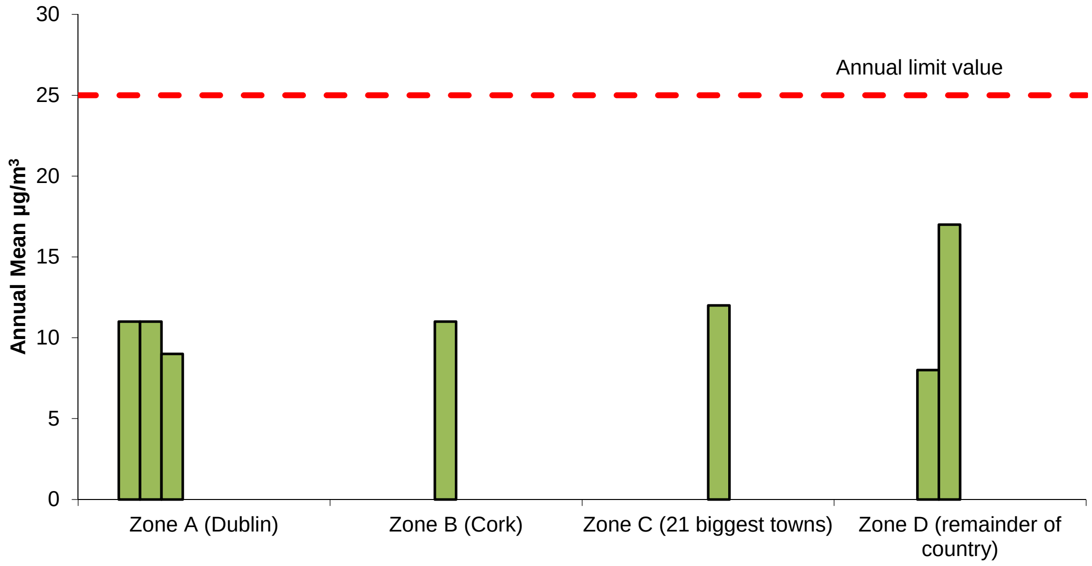
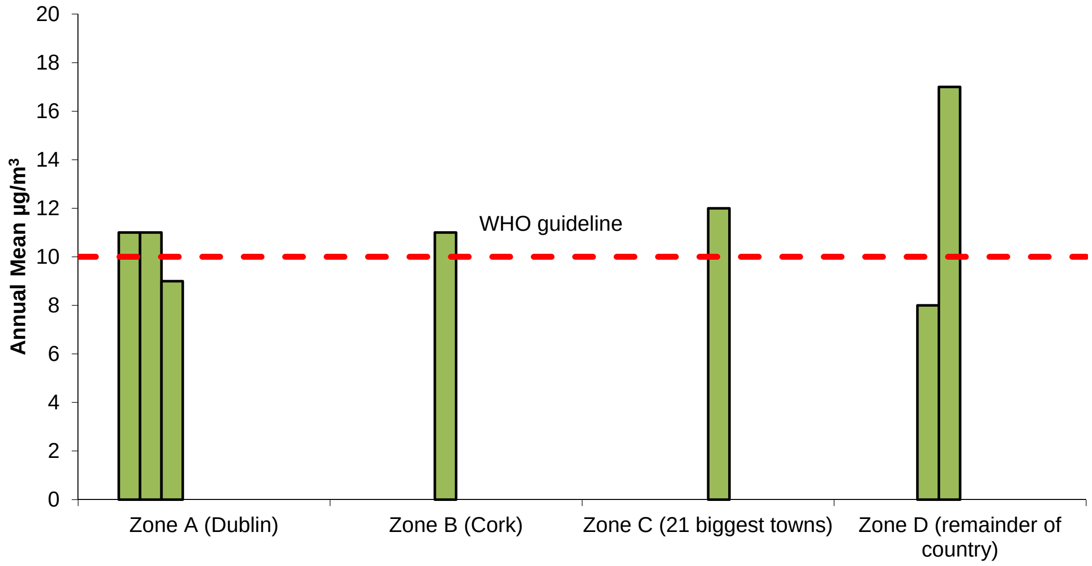
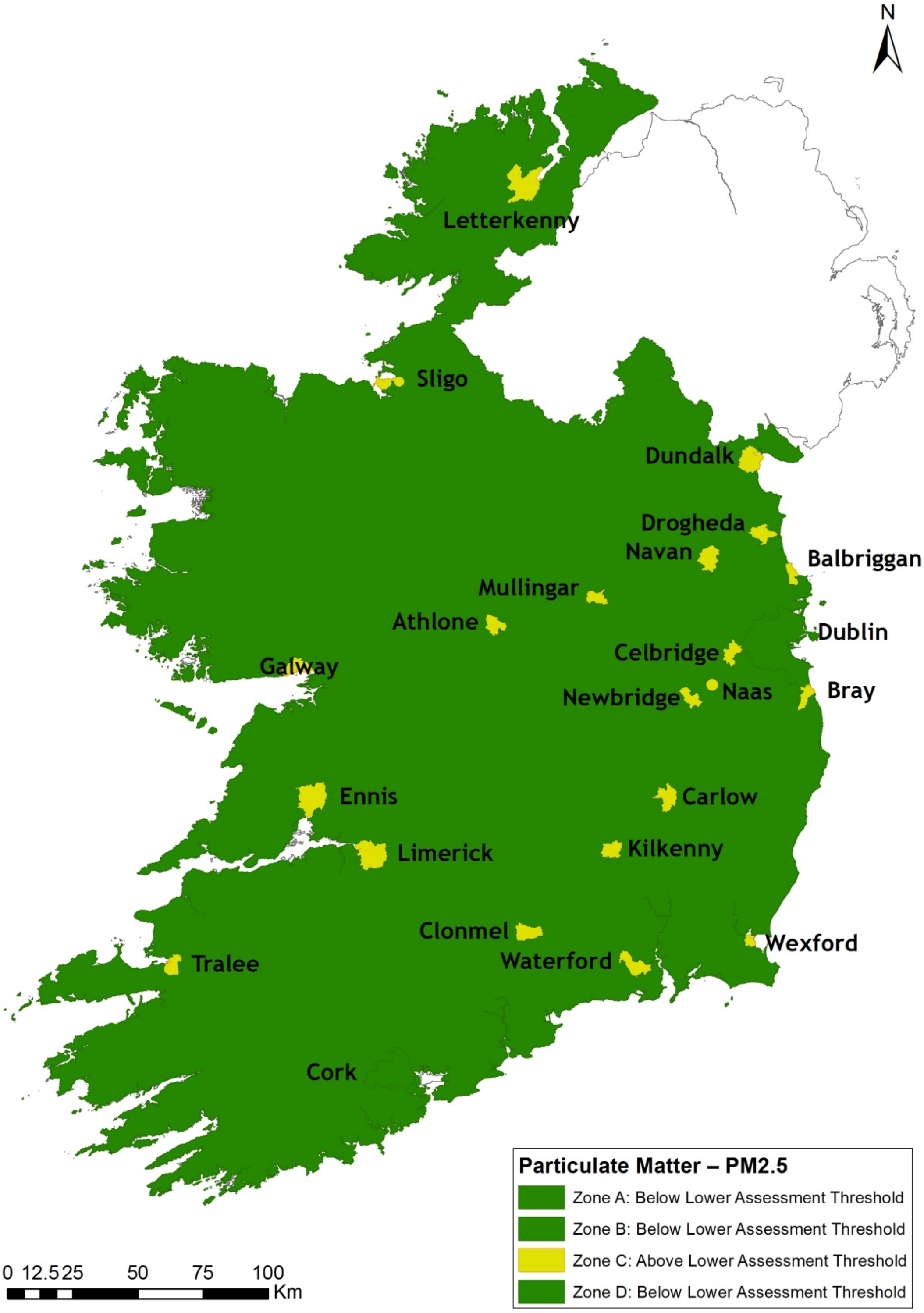


Figure 7.2 Annual mean values for $PM_{2.5}$ at individual stations in Ireland in 2013 with reference to WHO air quality guideline value for $PM_{2.5}$



Results for $PM_{2.5}$ speciation: elemental carbon/organic carbon (EC/OC), anions and cations; is presented in Table A9. Figure 7.3 shows the classification of zones for $PM_{2.5}$ in Ireland.

Figure 7.3 Classification of zones for $PM_{2.5}$ in Ireland[15]

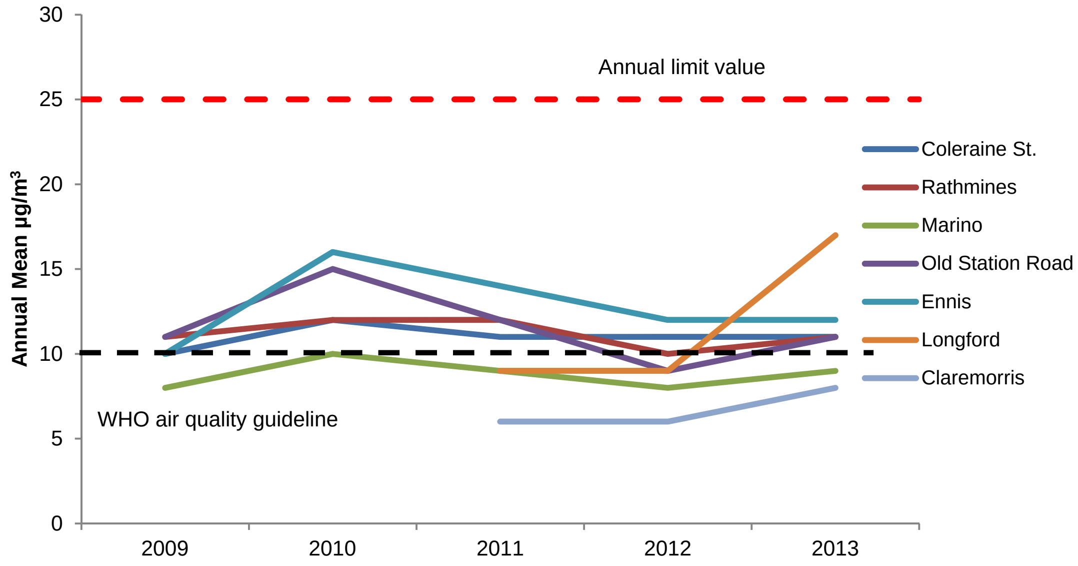


[15] Classification is based on the last five years of air quality monitoring.

7.4 Trends in $PM_{2.5}$ concentrations in Ireland

Figure 7.4 shows the trend in annual mean $PM_{2.5}$ concentrations from 2009 to 2013.

Figure 7.4 Annual mean $PM_{2.5}$ concentrations 2009-2013



It is noted that $PM_{2.5}$ levels were higher at the monitoring station in Longford in 2013; however, the level recorded was below the limit value. It is only the third year of monitoring at this location and future results will continue to be evaluated for any unusual trends.

7.5 Outlook for $PM_{2.5}$ concentrations

$PM_{2.5}$ levels in Ireland are below the EU limit value, however, due to the calculation of the average exposure indicator (AEI) and the national exposure reduction target (NERT) Ireland is obliged to decrease its average $PM_{2.5}$ concentrations by 10% by 2020. Implementing this challenging target will require an integrated approach across a number of source sectors including transport, residential, energy and industrial. The first step in this process has been taken with the establishment of the NERT working group, which is a body of stakeholders, headed by the EPA, who will work to implement this NERT in the coming years.

One aspect of particulate matter pollution which may be important in the future is 'black carbon'. Black carbon is the fraction of $PM_{2.5}$ which strongly absorbs light, and it may be included into the National Emissions Ceiling Directive in the future.

Black carbon is also a key concern for the recently formed Climate and Clean Air Coalition of which Ireland is a member. The synergy of air quality and climate change issues, in particular short lived climate pollutants such as methane, black carbon and ozone, is a key concern for this coalition.

8. Benzene and volatile organic compounds (VOCs)

8.1 Origins of benzene in air

Urban areas can have measurable quantities of benzene in air. The major source of benzene and VOCs in Ireland is from automobile exhaust emissions as regular unleaded petrol may contain up to 1% benzene. Benzene and VOCs can also be released to the air from petroleum refining, fuel storage/filling stations, industrial emissions, chemical usage and tobacco smoke.

8.2 Air quality standards for benzene

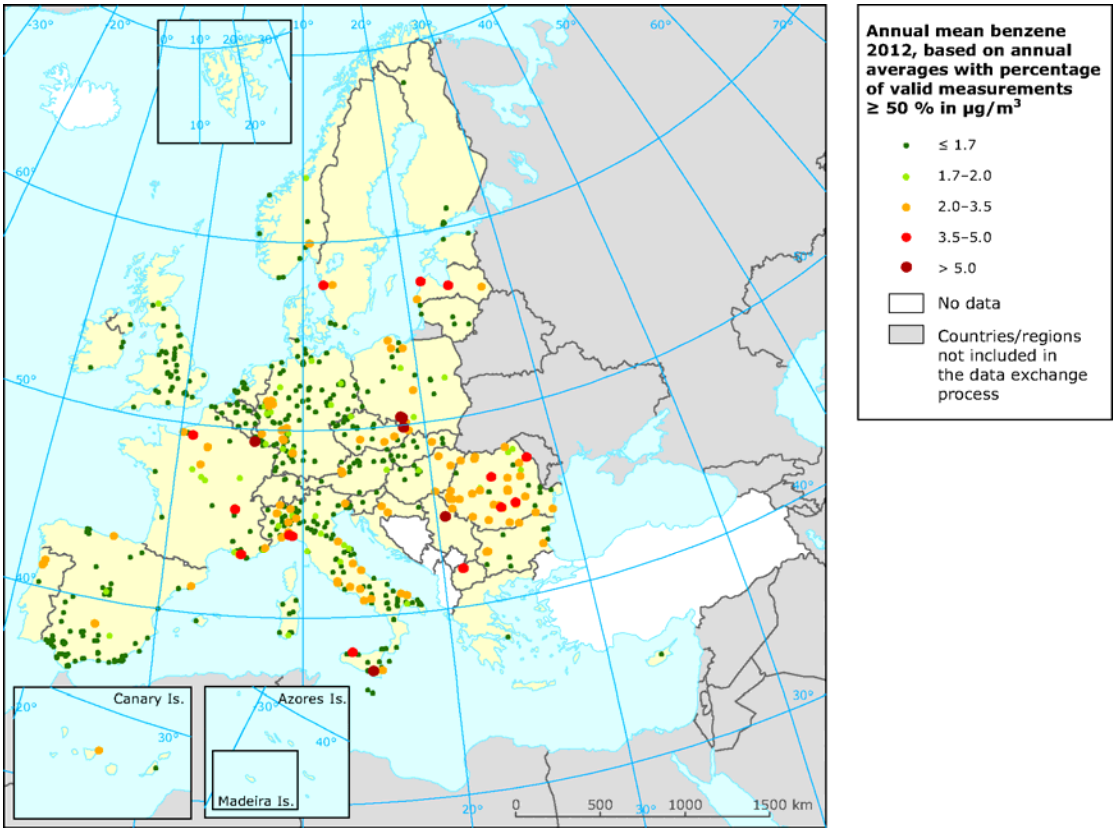
The relevant Irish and European legislation limit values for benzene are set out in Table 8.1.

Table 8.1 Limit value for benzene as set out in the CAFE Directive and S.I. No. 180 of 2011

Objective	Averaging period	Limit or threshold value	Comments
Limit value for the protection of human health	Calendar year	5 µg/m^3	To be met by 1 January 2010
Upper assessment threshold	Calendar year	3.5 µg/m^3	
Lower assessment threshold	Calendar year	2 µg/m^3	

Figure 8.1 shows the concentrations of benzene in Ireland put in the European context

Figure 8.1 Concentration of benzene in Ireland in 2012 with relation to other EU Member States (source: EEA)



8.3 Monitoring of benzene in Ireland in 2013

Benzene was measured at four stations in 2013; results are shown in Figure 8.2. The annual limit of 5 µg/m^3, which came into force in 2010, was not exceeded at any station. Table A10 in Appendix A contains summary benzene statistics for all stations. In addition, toluene, ethyl benzene, o-xylene, m-xylene and p-xylene were measured at Rathmines, an urban background station in Dublin. Summary results for these compounds are contained in Table A11 of Appendix A. There is no limit value for these ozone precursor VOCs. The zone classification for benzene is shown in Figure 8.3 Classification of zones for benzene in Ireland.

Figure 8.2 Benzene concentrations at individual stations across Ireland in 2013

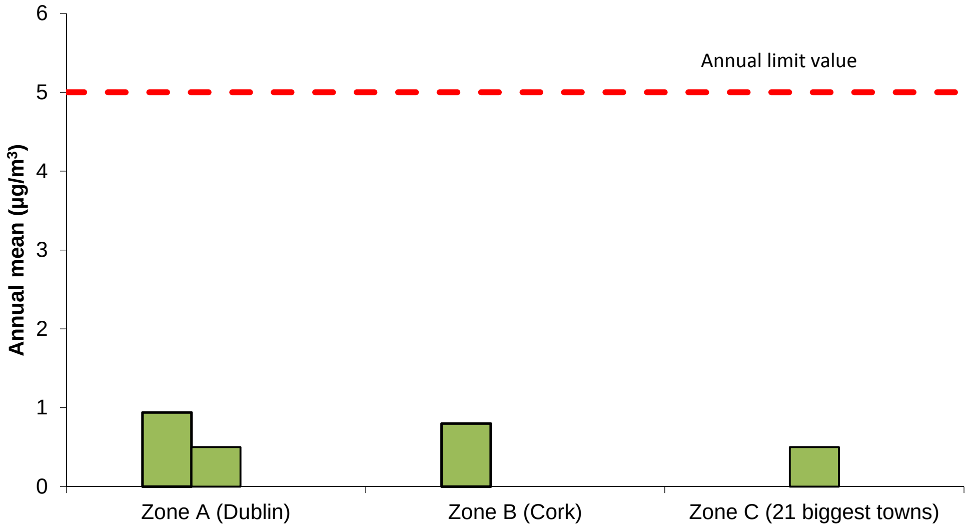


Figure 8.3 Classification of zones for benzene in Ireland[16]

[16] Classification is based on the last five years of air quality monitoring.

8.4 Trend in benzene concentrations

Figure 8.4 shows the trend in annual mean concentrations of benzene in Dublin and Cork from 2003 to 2013. It shows that the concentration of benzene in both cities since the early 2000s has been relatively stable and below the limit value. Figure 8.5 shows annual mean concentrations of benzene and four other ozone precursor VOCs at Rathmines from 2005 to 2013.

Figure 8.4 Annual mean concentrations of benzene in Cork and Dublin, 2002 - 2013

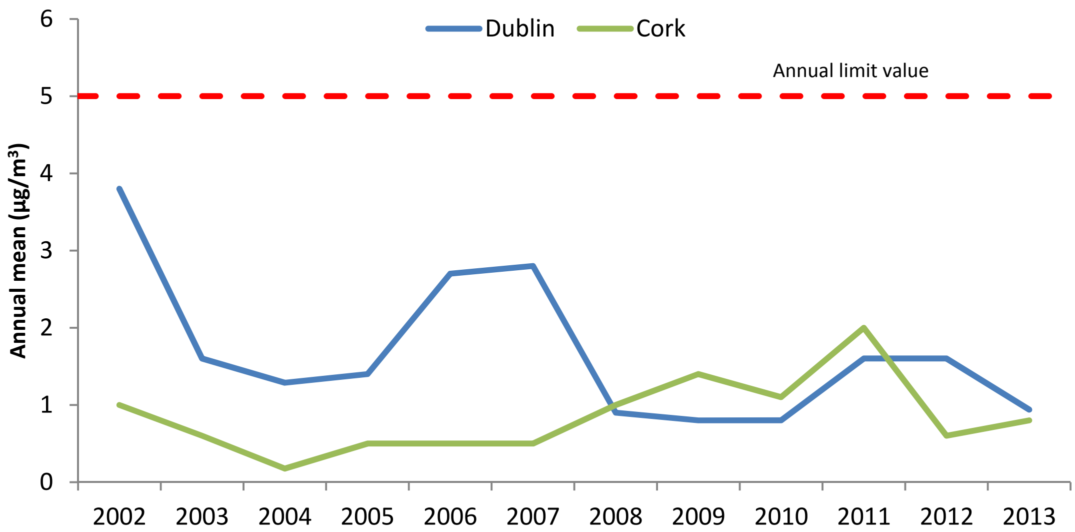
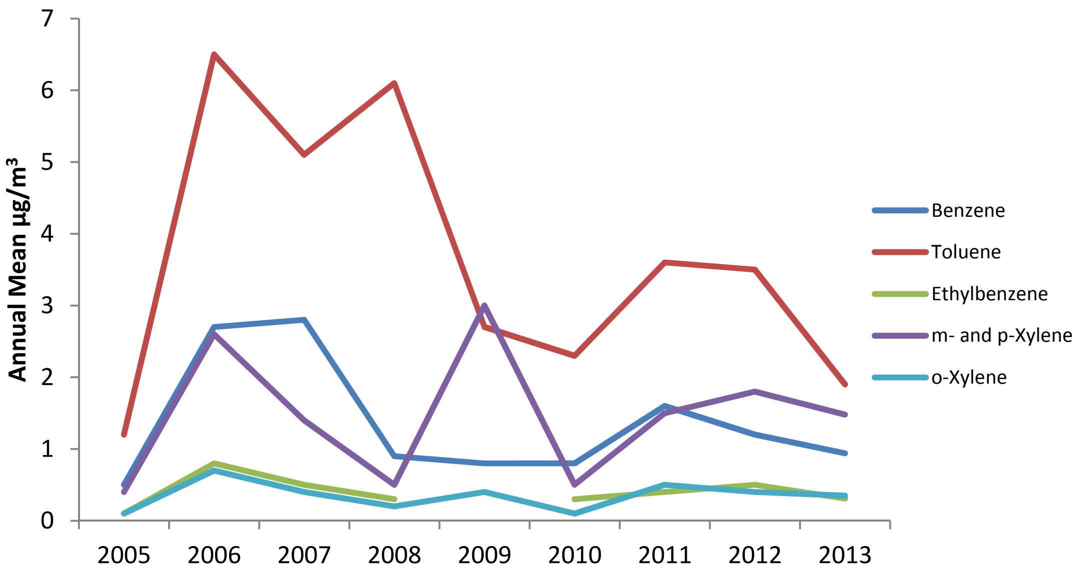


Figure 8.5 Annual mean concentrations for VOC ozone precursors at Rathmines, Dublin 2005-2013



8.5 Outlook for benzene concentrations

On 1 January 2000 the EU limit for benzene in petrol reduced from 5% to 1% and the average content of benzene in petrol in the EU is 0.7%. This has significantly reduced the levels of benzene Europe-wide. Benzene concentrations have been relatively low and stable for the last number of years and are anticipated to stay low in the medium term. The recently introduced Stage II Petrol Vapour Regulations will, over the next few years, require petrol stations to install equipment to collect vapour displaced from car fuel tanks during refuelling, so this may further reduce ambient levels.

9. Heavy metals

9.1 Origins of heavy metals in air

Lead, arsenic, cadmium, nickel and mercury are toxic heavy metals, which can be found in the air. They impact on health through inhalation of particulate matter containing the metals or, in the case of mercury, direct inhalation of vapour. Heavy metals can enter the food chain through deposition to the ground. Their sources are primarily fossil fuel combustion, industrial processes such as metal-plating, mining, smelting, the production of batteries, plastics and pigments and other sources. Lead was used in many products such as paint in the past. The most common source of lead was emissions from motor vehicles; however, this has dramatically reduced since the introduction of lead-free petrol in the 1980s.

Mercury is also a toxic heavy metal which can be found in the atmosphere. The majority of mercury emissions to the atmosphere are from natural sources such as volcanoes. Anthropogenic sources of atmospheric mercury include: unabated coal combustion; gold production and metal smelting.

Heavy metal deposition from air pollution can also have a significant impact on water quality. This is especially true with respect to mercury.

9.2 Air quality standards for heavy metals

Table 9.1 shows the air quality target values for the heavy metals arsenic, cadmium and nickel and the limit value for lead. The values specified are maximum annual averages, which countries are obliged to meet by 2013, except for the limit value for lead, which was to be met by 2005.

Table 9.1 Air quality limit and target values for As, Cd, Ni and Pb as set out in the Fourth Daughter Directive and S.I. No. 58 of 2009

Pollutant	EU limit or target value[17] (ng/m^3)	Upper assessment threshold value (ng/m^3)	Lower assessment threshold value (ng/m^3)
Arsenic	6[18]	3.6	2.4
Cadmium	5[18]	3	2
Nickel	20[18]	14	10
Lead	500[19]	350	250

[17] Annual mean, measured in PM_{10}.
[18] Target value, entered into force on 31 December 2012.
[19] Limit value to be met by 1 January 2005. The limit value to be met only by 1 January 2010 in the immediate vicinity of specific industrial sources situated on sites contaminated by decades of industrial activities. In such cases, the limit value until 1 January 2010 is 1.0 µg/m^3.

9.3 Monitoring of heavy metals in Ireland in 2013

Lead, arsenic, cadmium and nickel in PM_{10} were measured at five stations in 2013. The annual mean concentrations measured at all stations were all below the respective target or limit values. Levels of lead were more than 100 times less than the limit value as shown in Figure 9.1. Table A12 in Appendix A contains summary statistics for the four heavy metals in PM_{10} from all monitoring stations in 2013. Figure 9.2 shows the annual mean concentrations measured for arsenic in Ireland in 2013. These levels are compared with the target value, which is to be achieved by 2013. Figure 9.3 and Figure 9.4 show the equivalent levels for cadmium and nickel, respectively.

Mercury was measured at one site in 2013 and deposition of lead, arsenic, cadmium and nickel were measured at three stations in 2013. There is no target value for mercury or metal deposition specified in Directive 2004/107/EC. Table A13 in Appendix A contains summary statistics for mercury measurement in 2012. Table A14 contains summary statistics for deposition of lead, arsenic, cadmium and nickel from all monitoring stations in 2013.

Figure 9.1 Annual mean concentrations of lead at individual stations in 2013

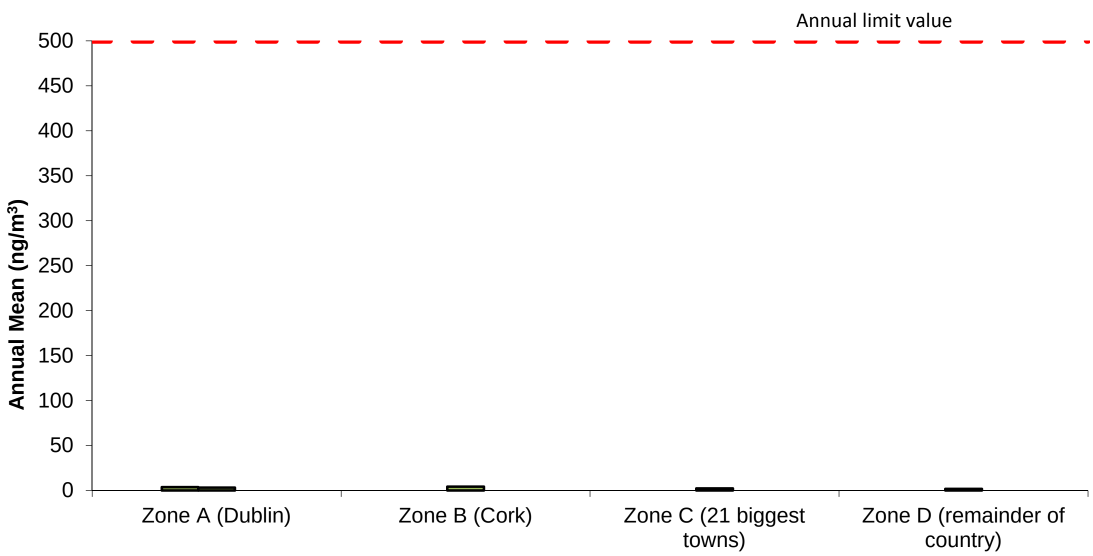


Figure 9.5 shows the classification of zones for arsenic, lead, cadmium and nickel in Ireland.

Figure 9.2 Annual mean concentrations of arsenic at individual stations in 2013[20]

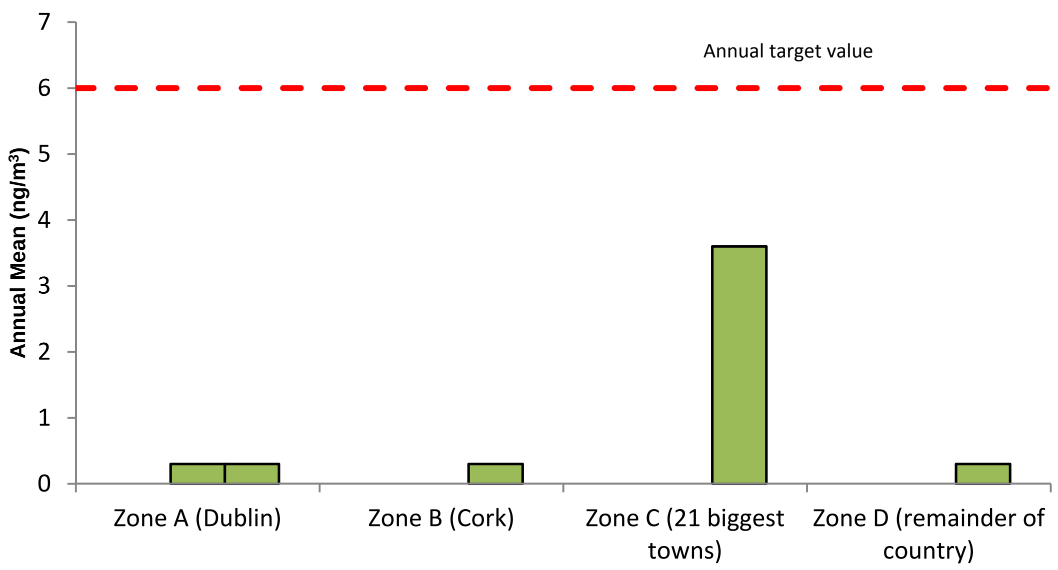
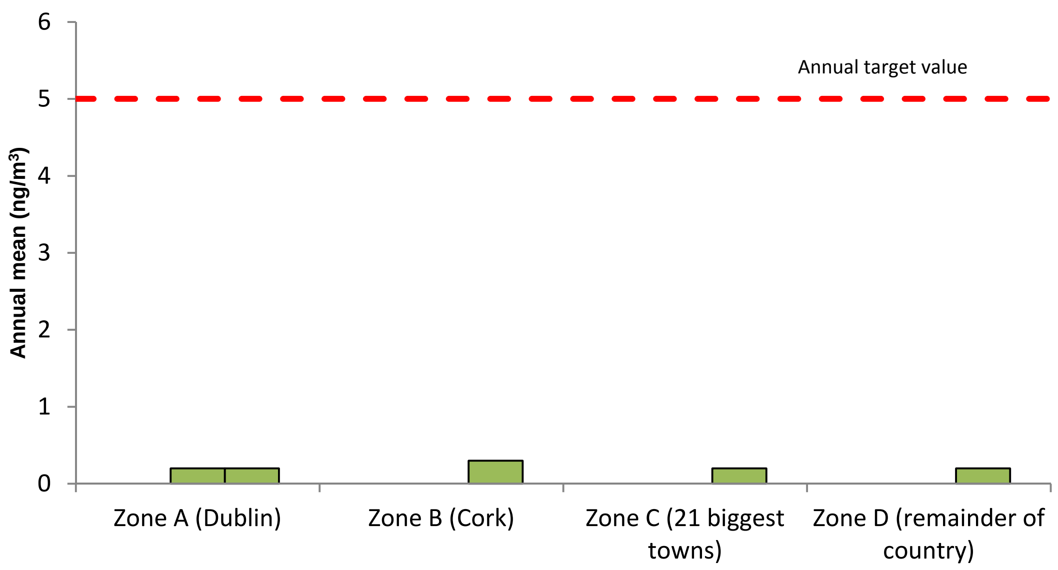
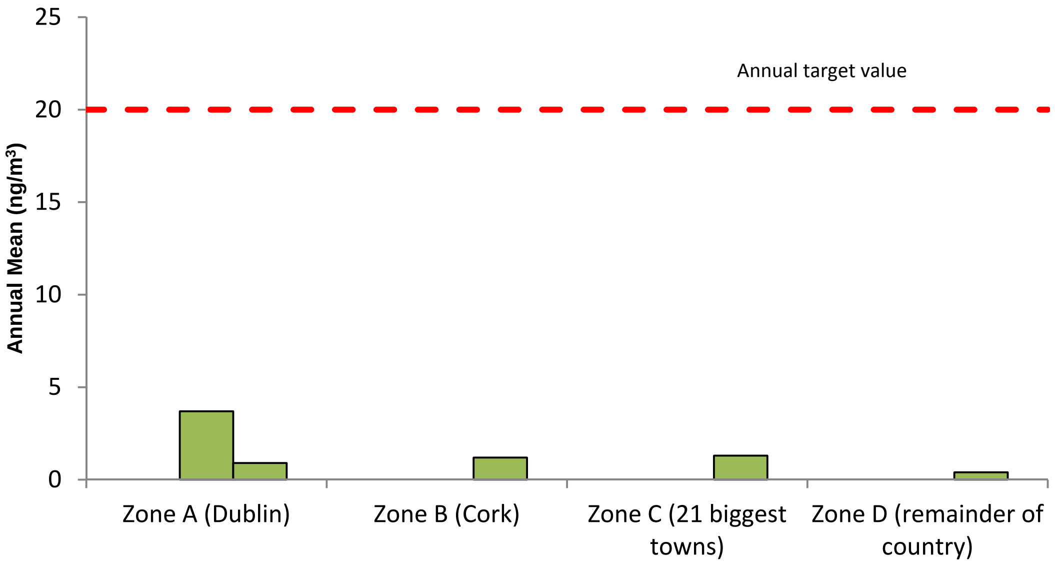


Figure 9.3 Annual mean concentrations of cadmium at individual stations in 2013[21]



[20] Target value to be achieved by 2013.
[21] Target value to be achieved by 2013.

Figure 9.4 Annual mean concentrations of nickel at individual stations in 2013[22]



[22] Target value to be achieved by 2013.

Figure 9.5 Classification of zones for Arsenic, lead, cadmium and nickel in Ireland[23]

[23] Classification is based on the last five years of air quality monitoring.

9.4 Trends in heavy metal concentrations in Ireland

Figure 9.6 shows the annual mean lead concentrations in Ireland from 2009 to 2013. Figure 9.7 shows the annual mean arsenic concentrations in Ireland from 2009 – 2013. Figure 9.8 shows the annual mean cadmium concentrations in Ireland from 2009 – 2013 and Figure 9.9 shows the annual mean nickel concentrations in Ireland from 2009 – 2013. All these trend graphs indicated that these heavy metals have concentrations below their limit or target values. The slightly elevated concentrations of arsenic observed in Zone C are most likely a result of home heating fuel choice; however the concentrations are still below the target value. Results will continue to be monitored in the future.

Figure 9.6 Annual mean lead concentrations in Ireland, 2009 - 2013

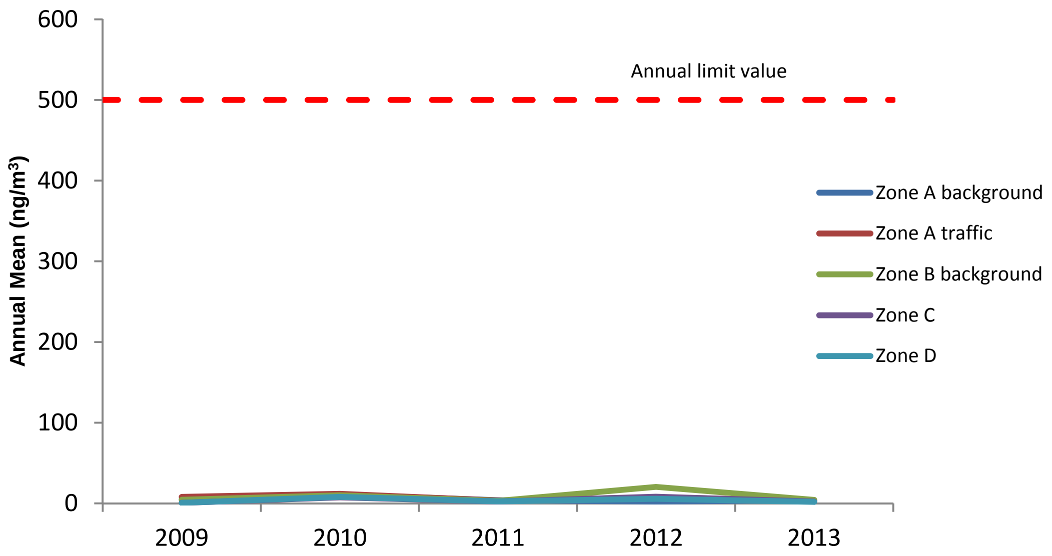


Figure 9.7 Annual mean arsenic concentrations in Ireland, 2009 - 2013

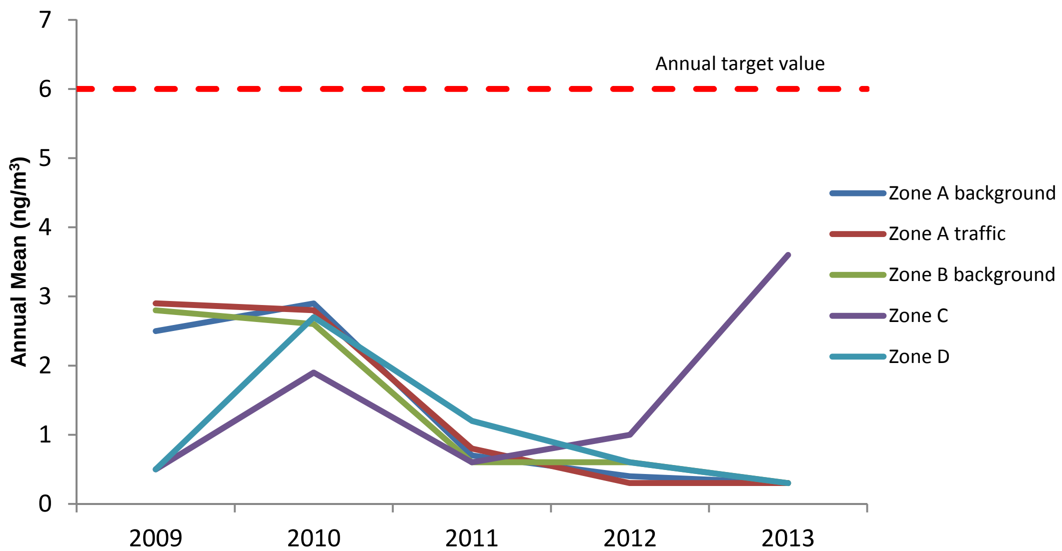


Figure 9.8 Annual mean cadmium concentrations in Ireland, 2009 – 2013

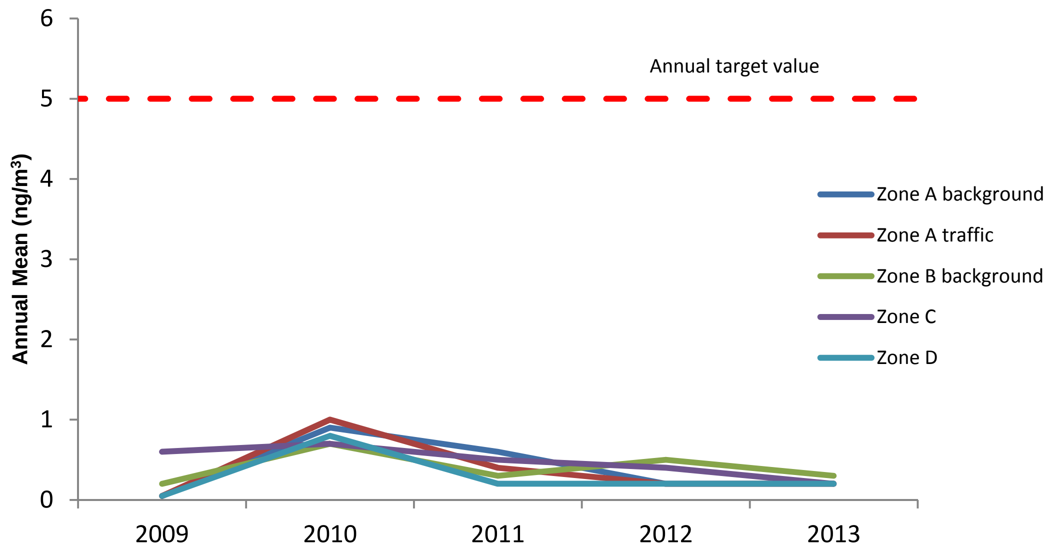
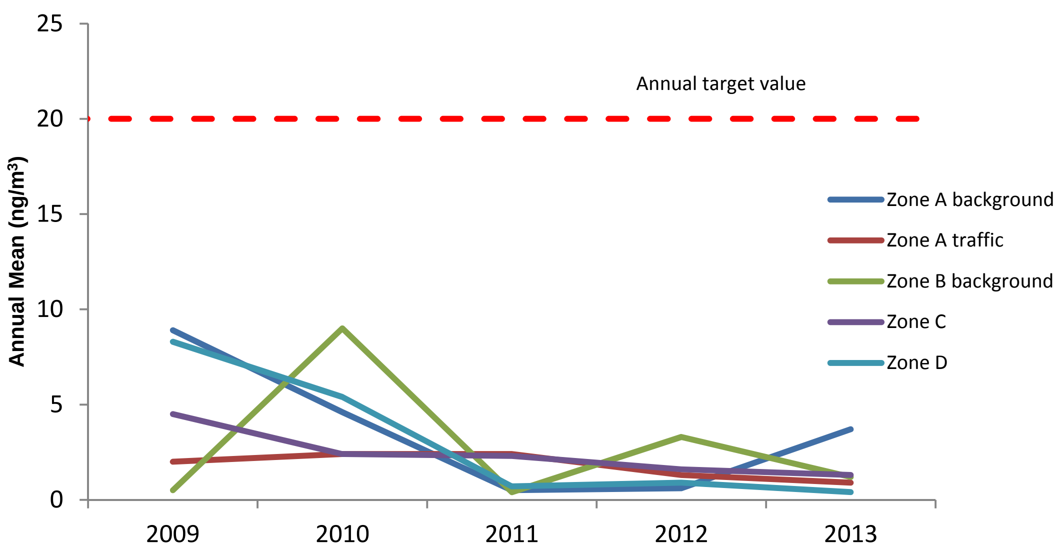


Figure 9.9 Annual mean nickel concentrations in Ireland, 2009 – 2013



9.5 Outlook for heavy metal concentrations

High levels of heavy metals such as arsenic, cadmium and nickel are usually observed in areas with a lot of heavy industry, such as smelting and mining. Ireland is a country which has few heavy industries such as these and as a consequence, the concentration of heavy metals is likely to remain low in the future.

10. Polycyclic aromatic hydrocarbons (PAH)

10.1 Origins of PAH in air

PAH are chemical compounds which consist of two or more fused aromatic rings made entirely from carbon and hydrogen. PAH are emitted domestically from the combustion of solid fuels, such as peat, wood and coal, and they can be emitted from incomplete combustion of fuel in automobiles. Waste burning or 'backyard burning' and bonfires are a source of PAH as is cigarette smoke.

PAH deposition from air pollution can also have a significant impact on the quality of water. It is considered that rainfall deposition arising from airborne PAH emissions may be a significant source of PAH concentrations in many surface waters, particularly in rural areas

10.2 Air quality standards for PAH

PAH are monitored based on the premise that one particular compound can be used as a marker for all PAH. This compound is benzo(a)pyrene (B(a)P) and the target value and assessment thresholds for B(a)P are shown in Table 10.1.

Table 10.1 Air quality target value and assessment thresholds for PAH (B(a)P) as set out in the Fourth Daughter Directive and S.I. No. 58 of 2009.

Objective	Averaging period	Limit or threshold value	Comments
Target value	Calendar year	1 ng/m^3	Target value to be met by 2013.
Upper assessment threshold	Calendar year	0.6 ng/m^3	
Lower assessment threshold	Calendar year	10.4 ng/m^3	

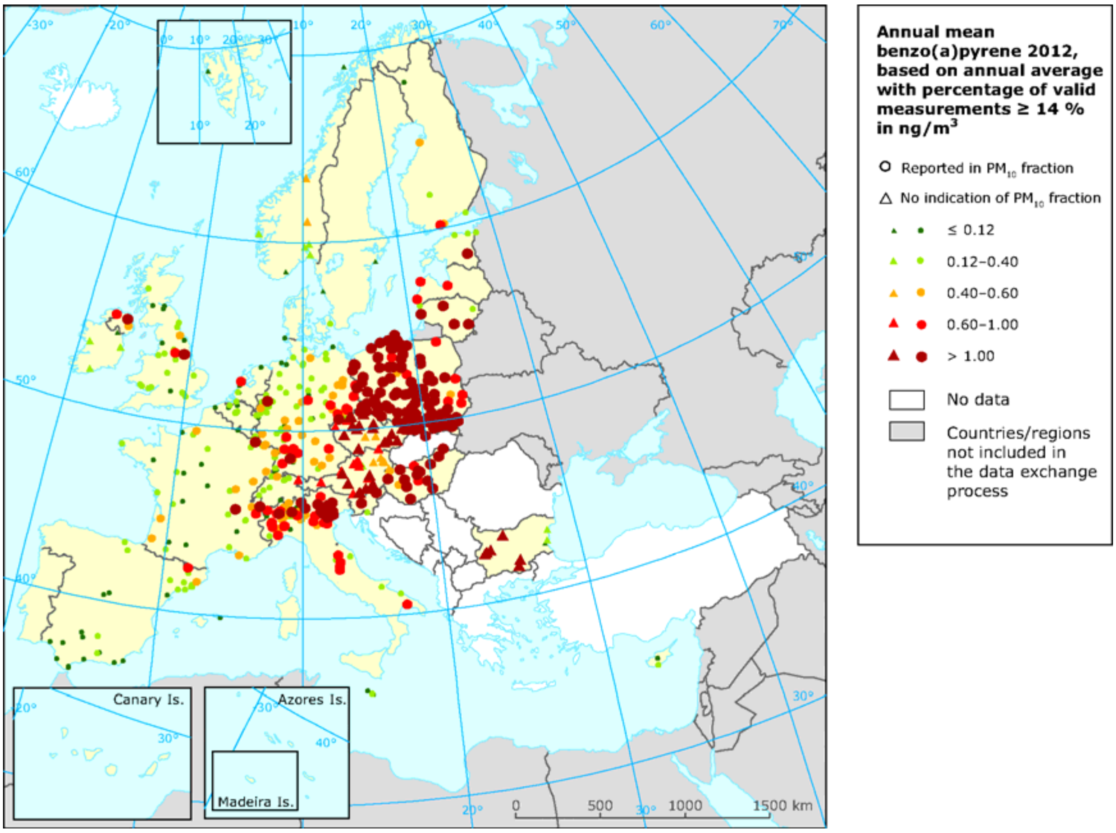
Table 10.2 WHO air quality guideline for BaP[24]

Averaging period	Limit or threshold value
Annual mean	0.12 ng/m^3

[24] As the WHO has not set AQG for BaP, the WHO reference level in the table was estimated assuming an additional lifetime risk of $1x10^{-5}$

Figure 10.1 shows the concentrations of benzo(a)pyrene in Ireland put in the European context

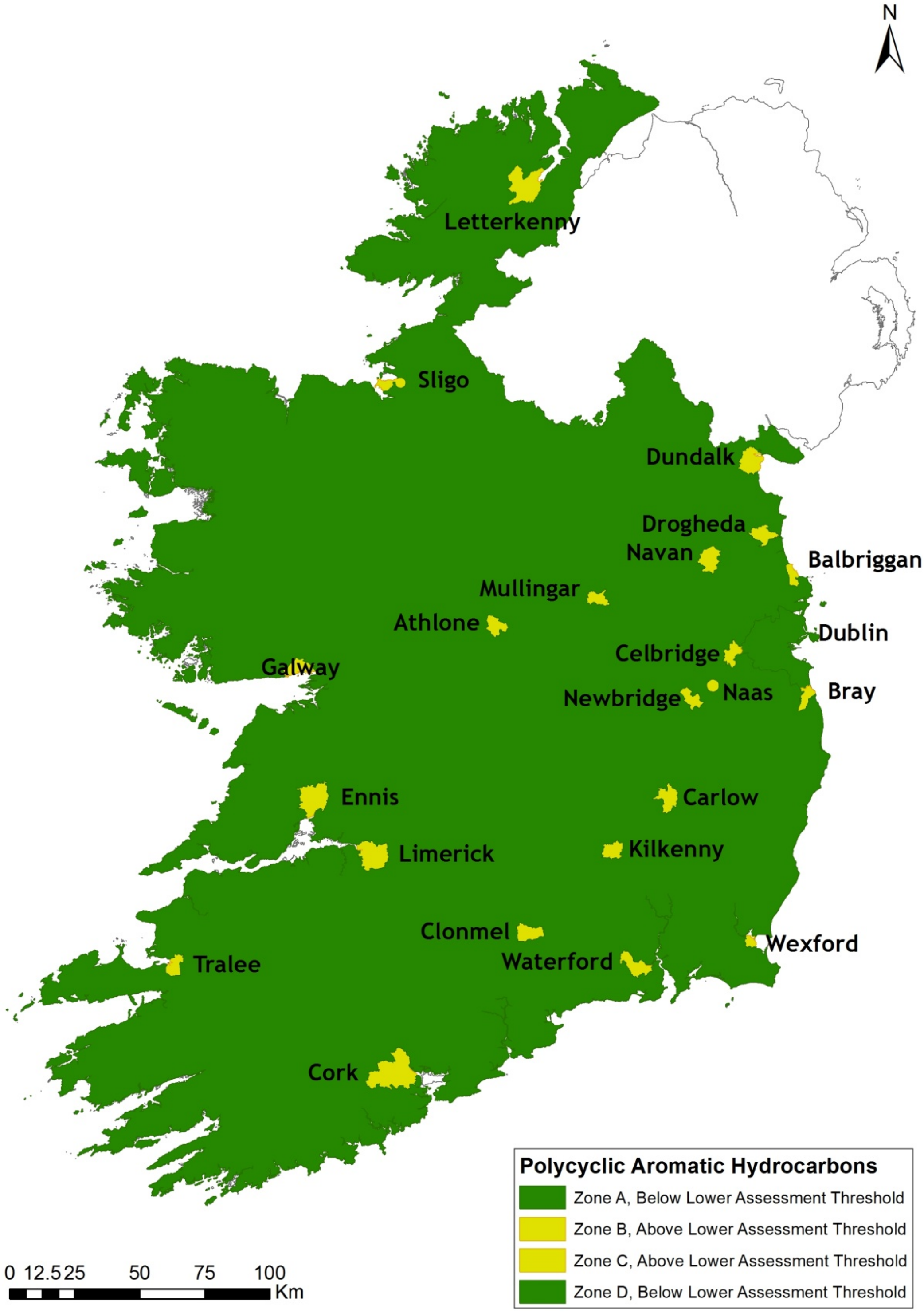
Figure 10.1 Concentration of B(a)P in Ireland in 2012 with relation to other EU Member States (source: EEA)



10.3 Monitoring of PAH in Ireland in 2013

Figure 10.2 shows the classification of zones for PAH in Ireland. B(a)P was monitored at five stations across Ireland in 2013. Levels at all five of the sites were below the target value of 1 ng/m^3. These results are shown in Figure 10.3. Figure 10.4 shows the annual mean concentrations of BaP at these monitoring stations with respect to the WHO air quality guideline value. It can be seen that BaP concentrations are above the WHO air quality guideline value at four of the five monitoring stations. Summary statistics for PAH concentrations in 2013 are available in Table A15.

Figure 10.2 Classification of zones for PAH in Ireland[25]



[25] Classification is based on the last five years of air quality monitoring.

Figure 10.3 Annual mean values for PAH (B(a)P) at individual stations across Ireland in 2013

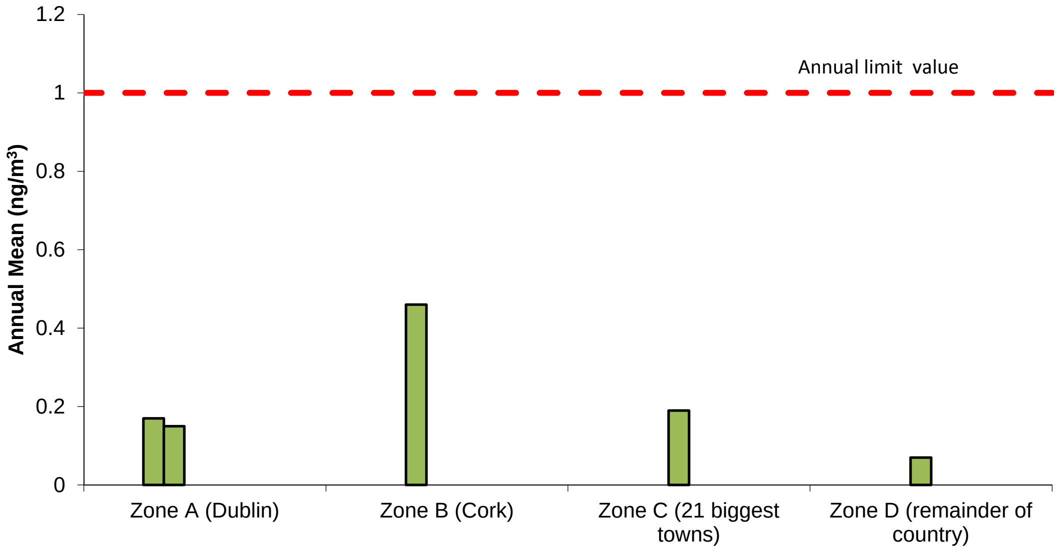
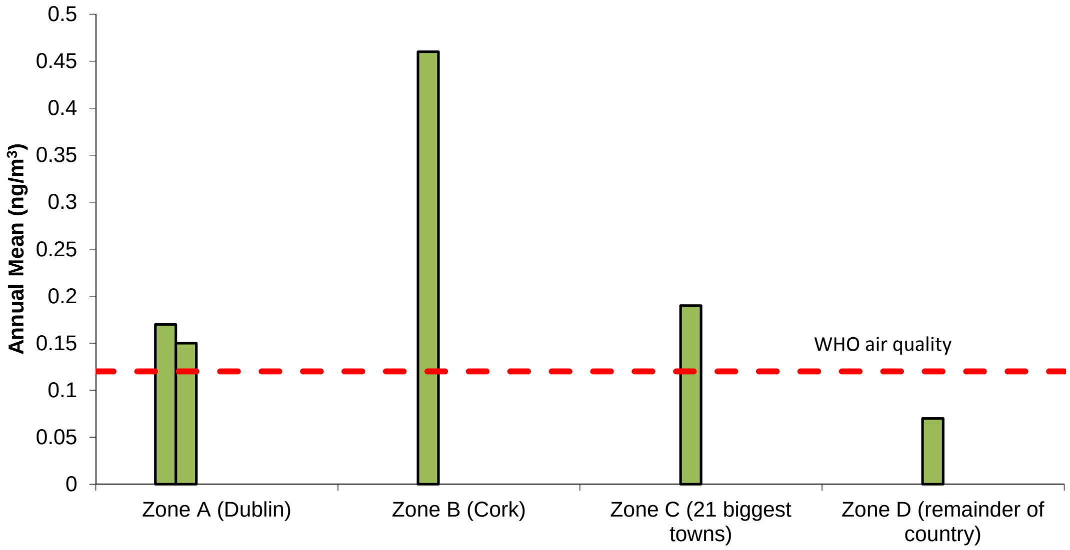


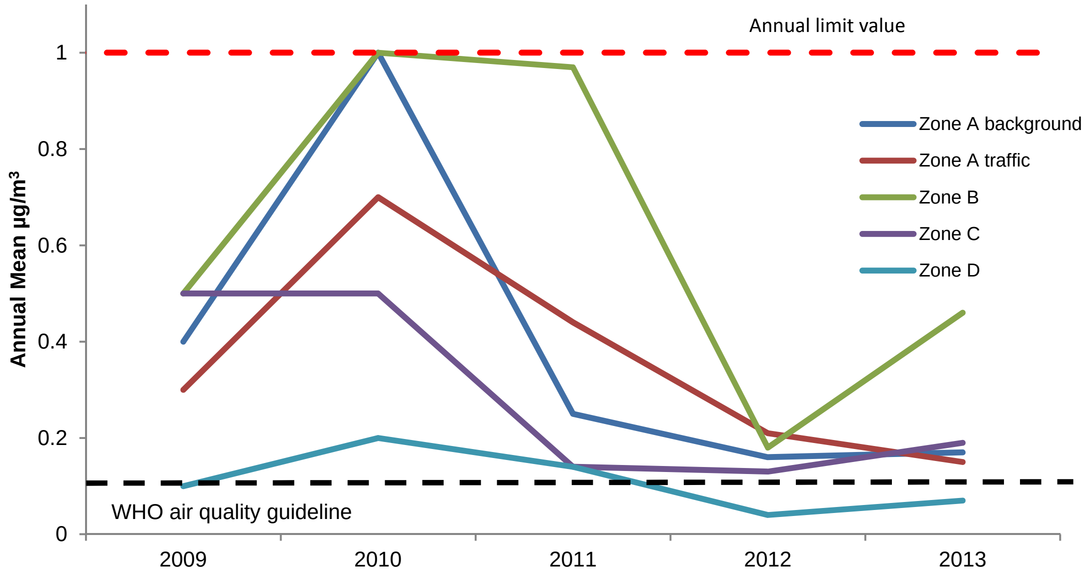
Figure 10.4 Annual mean values for PAH (BaP) at individual stations in Ireland in 2013 with reference to WHO air quality guideline value for BaP



10.4 Trend in PAH concentrations

Figure 10.5 shows the annual mean PAH concentration at the five monitoring sites from 2009 to 2013. It is difficult to ascertain any long-term trend with such inter-annual variation.

Figure 10.5 Annual mean PAH (B(a)P) concentration 2009-2013



10.5 Outlook for PAH concentrations in Ireland

Future PAH concentrations in Ireland will likely depend on the choices of fuel for home heating that is used by the public in Ireland in the forthcoming years. Peat, wood and biomass are high in PAH, especially when burnt inefficiently. Coal is also a large source of PAH, while gas is a relatively clean alternative. The increased use of solid fuel as a home heating source presents a problem for the compliance with PAH limit values.

11. Air Quality – Licensing and Enforcement

The EPA is responsible for the licensing and enforcement of a range of industrial and waste management activities in Ireland, including the regulation of air emissions at these sites. This responsibility lies with the Office of Environmental Enforcement within the EPA. This section provides summary information on compliance with air emissions licence requirements within the EPA licensed industrial and waste sectors for the year 2013. The EPA currently licences approximately 805 sites under the Industrial Emissions Licensing (IEL), Integrated Pollution Control (IPC) and Waste licensing regimes.

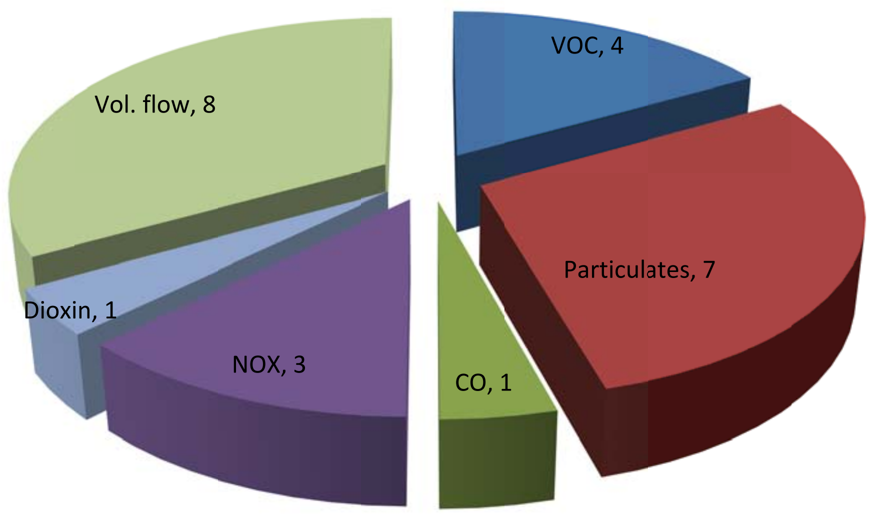
11.1 EPA Emissions Monitoring Summary 2013

Independent monitoring of emissions from licensed sites is carried out as part of the enforcement activities of the EPA. A total of 684 tests during 114 site visits were carried out by third party contractors in 2013 on behalf of the EPA. 25 of these tests indicated an emission above the emission limit value (ELV) specified in the licence. The main parameters exceeded include:

- Volumetric flow (i.e. the total amount of gas discharged);
- Particulates (dust);
- Volatile organic compounds (VOCs), e.g. from use of solvent based coatings/paints in coating activities;
- Pollutants from fuel combustion such as nitrogen dioxide and carbon monoxide;

ELV breaches are assessed by the relevant EPA inspectors, with enforcement action being taken as required to ensure that appropriate corrective and preventative actions are put in place by the licensee. For further details please see Air Sector Emission Report 2013 (EPA 2013)

Figure 11.1 ELV breaches by pollutant in 2013 (source: OEE)



11.2 Licensee Reported Air Enforcement Data for 2013

Licensees are required to report all environmental incidents to the EPA under the terms of their licence. Iincidents where there is a potential for impact on air quality are divided into 4 categories:

- Breach of ELV: This is where the licensees own monitoring indicates that emissions from an emission point are above the limit value specified in their licence;
- Monitoring Equipment Offline: This relates only to sites which have a requirement to monitor emissions continuously.
- Other/uncontrolled release: Uncontrolled releases typically relate to situations where a treatment system is not functioning adequately and cannot fully control emissions.
- Odour: Odour incidents typically occur at sites such as landfill, waste transfer stations, and food and drink processing activities.

A total of 188 ‘air’ incidents were reported in 2013, which was 11.3 % of all reported incidents to the EPA.

Every incident report is reviewed and assessed by an EPA inspector, and as part of the incident report the licensee is required to specify both corrective and preventative action which has been/will be undertaken. As part of incident reports, the licensee is required to select the ‘likely cause’ of the incident. In a large percentage of cases in relation to air emissions the likely cause relates to failure of air emissions treatment equipment, failure of monitoring equipment or abnormal operations with the industrial process. For incidents involving a breach of an emission limit value, licensees are required to detail the pollutant which caused the ELV breach and the amount of pollutant released

Odour impact is by far the most significant source of complaints. The majority of individual complaints are in relation to waste activities and also food and drink production activities. The 1,088 complaints reported above for air/noise/odour account for 91 % of all complaints recorded in 2013.

For further details please see the Air Sector Emission Report 2013 (EPA 2013).

11.3 Compliance Investigations

Where an issue is not resolved to the satisfaction of the EPA, enforcement activities are escalated and a formal investigation (known as a compliance investigation (CI)) is initiated. 464 of these CIs were created in 2013 in relation to all licensed sites, with 64 (14 %) related to air/odour/smells with the breakdown of 36 relating to air and 28 to odour/smells.

11.4 Special Investigation - Ballymount Fire Incident

The Ambient Air Quality Monitoring Network, contributed data to the assessment of the impact on air quality of the fire which occurred over the period Saturday January 25th to Wednesday January 29th 2014 at the Oxigen facility in Ballymount.

Figure 11.2 Map of ambient air quality monitoring stations in Dublin and surrounding areas

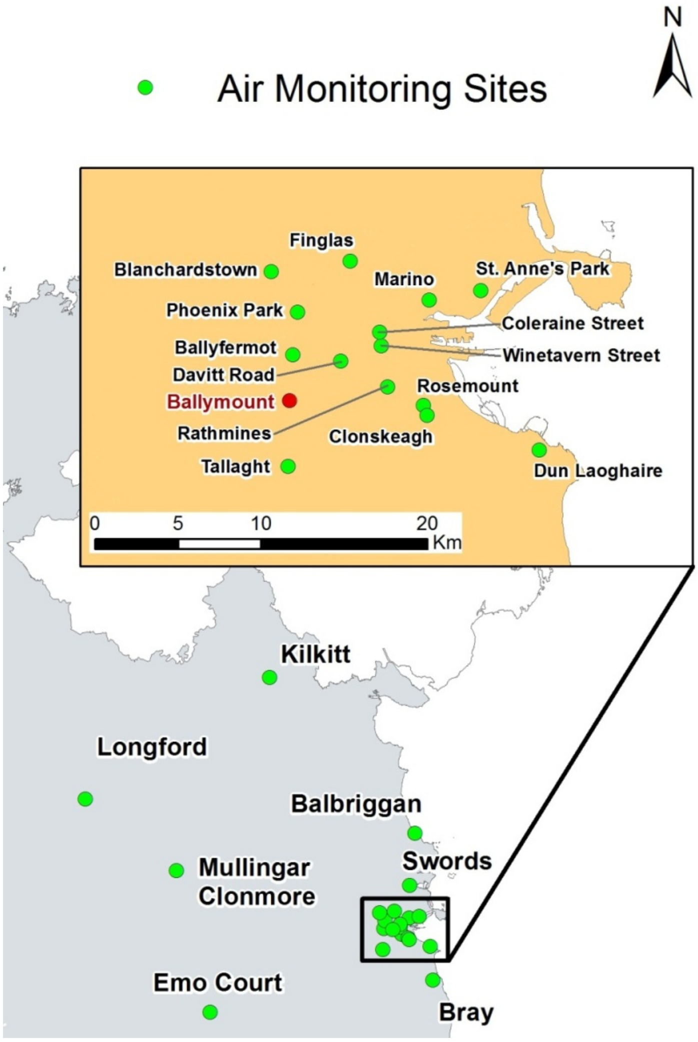
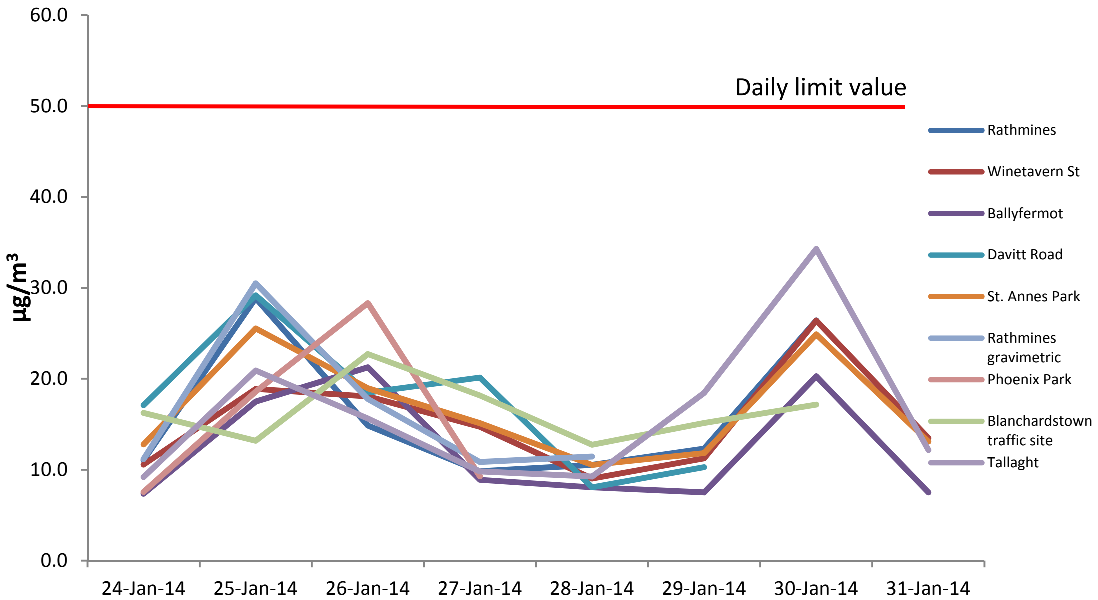
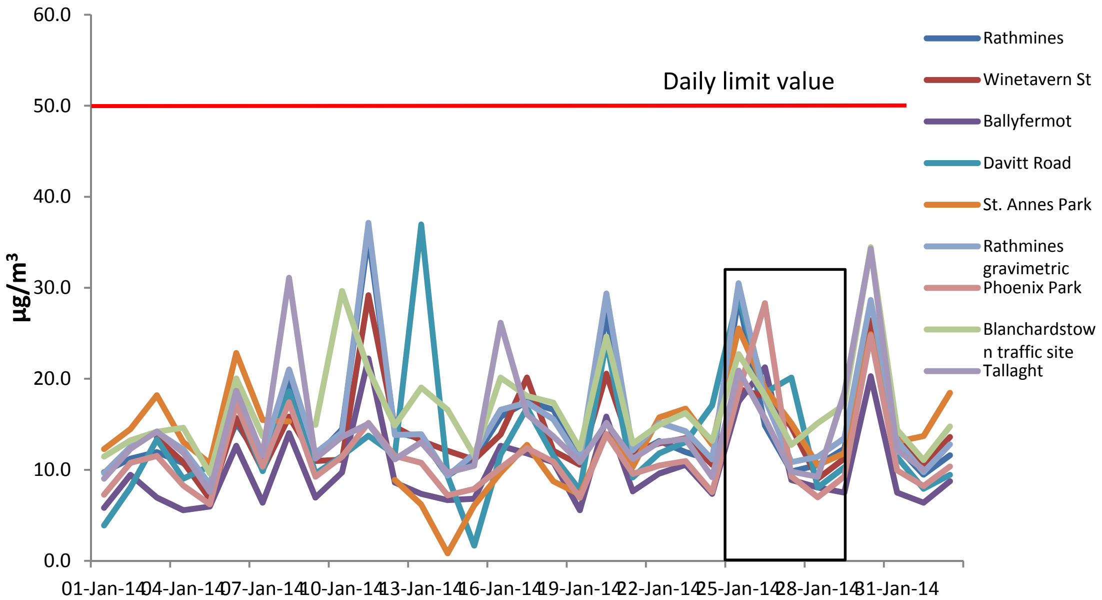


Figure 11.3 Daily averaged PM_{10} at all Dublin monitoring stations 24/01/14 - 31/01/14



shows daily averaged PM_{10} concentrations for all Dublin monitoring stations for the period of the 24th January to 31st January. All concentrations of PM_{10} were below the limit value and show minimal impact on ambient air across the wider city from the Ballymount fire incident. Figure 11.4 shows daily averaged PM_{10} concentrations for all Dublin monitoring stations for the period of the 1st January to 2nd February. This examination of concentrations of PM_{10} over the longer timeframe shows that levels over the period of the fire (highlighted) were within normal variations. Concentrations of NO_2, SO_2, benzene, toluene and polycyclic aromatic hydrocarbons in ambient air across Dublin for the period were also examined. These parameters were also below air quality limit values. For more details the full report on the incident can be downloaded from the EPA website at www.epa.ie/pubs/reports/other/corporate/oee/.

Figure 11.4 Daily averaged PM10 at all Dublin monitoring stations 01/01/14 - 02/02/14



The ambient air quality monitoring data indicated that the fire had no significant impact on air quality across the greater Dublin area with all measured results being below the relevant air quality standards.

As expected, the levels of pollutants in the smoke plume in close proximity to the fire were elevated in a number of cases; however this exposure would not be typical of exposed residents downwind of the fire. The results indicated the potential for short-term effects (e.g. discomfort) for exposed individuals. However those following the health advice to shelter and avoid physical exertion are unlikely to have experienced these levels for any significant period of time.

Overall the results of the air quality monitoring indicate that the air quality impact of the fire was localised and transient, and there was no significant potential for any long-term health or environmental impacts as a result of this incident.

12. EMEP

12.1 History of EMEP Network in Ireland

Ireland is a party to the Convention on Long Range Transboundary Air Pollution (CLRTAP). The history of the Convention can be traced back to the 1970s, when scientists demonstrated the interrelationship between sulphur emissions in continental Europe and the acidification of Scandinavian lakes. It is a multi-pollutant convention and the first international legally binding instrument to deal with problems of air pollution on a broad regional basis. The European Monitoring and Evaluation Programme (EMEP) is a body under CLRTAP and parties are obliged to undertake background monitoring in their jurisdictions. The main objective of EMEP is to provide governments with information of the deposition and concentration of air pollutants, as well as the quantity and significance of the long-range transmission of air pollutants and their fluxes across boundaries (UNECE, 2004)

EMEP monitoring sites in Ireland are shown in Figure 12.1 below. The longest running station for EMEP air quality monitoring is the Met Éireann Valentia Observatory, Caherciveen. Air and precipitation sampling has been ongoing on a daily basis at this site since 1980. In Mace Head, ozone has been measured since 1988. Three other Irish sites – Turloch Hill, The Burren, Ridge of Capard – were established in 1991 (Turloch Hill) and 1997 (The Burren and Ridge of Capard), run by the Electricity Supply Board (ESB). These were discontinued by 2003.

In 2004, the EPA set up new EMEP transboundary air quality monitoring sites to replace the old ESB sites through the EPA's ERTDI research programme. The new sites included Malin Head, Donegal, Glenveagh Park, Donegal, Oak Park, Carlow, Johnstown Castle, Wexford and Carnsore Point, Wexford. The sites are run in co-operation with Met Éireann and Teagasc. Chemical analysis of filter samples and precipitation samples is carried out in the Met Éireann laboratory for all sites. The Glenveagh site (Wet only Rainfall sampler) was removed from the Irish Network in November 2012. For further information on this network please see www.epa.ie/pubs/reports/research/air/ercreport10.

Figure 12.1 Location of active EMEP Monitoring Sites (2013) (Active and Inactive EMEP monitoring sites are available to view on the EPA Map viewer at http://gis.epa.ie/Envision)

QA/QC of analytical results is undertaken by Met Éireann and results are formally submitted to the Norwegian Institute for Air Research (NILU), EBAS database http://ebas.nilu.no/. EBAS is a database hosted by NILU which stores observation data of atmospheric chemical composition and physical properties. EBAS hosts data submitted by data originators in support of a number of national and international programs including EMEP. These programs range from monitoring activities to research projects.

12.2 Benefits of the EMEP Network to Ireland

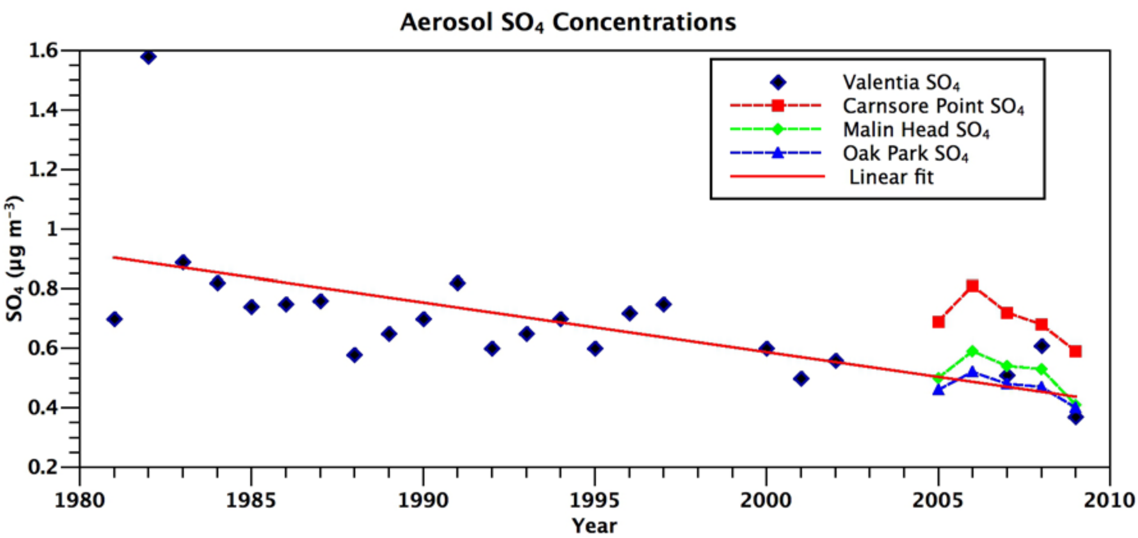
The European Commission uses EMEP modelling and monitoring data as a key part of its evidence base for policy decisions including the Clean Air Policy Package published in December 2013. The EMEP monitoring requirements provide important data for the assessment of environmental issues considered by other conventions including local air quality, climate change, water quality and biodiversity.

The EMEP network is a key source of information in relation to air quality in Ireland as well as for the validation of air quality models for a range of different pollutants on a European scale. Recent EPA funded research has directly shown the importance of a long term

monitoring network in showing improvements in upland ecosystems in particular acid sensitive lakes (Aherne, et al. 2013). Results from the EPA's water quality monitoring in particular acid sensitive lakes network are also submitted to the CLTRAP International Cooperative Programme on Water (ICP Water). The EPA laboratories also participate in the annual ICP Water Laboratory intercomparison.

Whilst the data submitted to Europe is used for modelling and projections purposes, it is also important that national data is assessed for reporting long term trends as well as potential transboundary pollution incidents. Data analysis on the EMEP network has traditionally been undertaken through research fellowship positions. Figure 12.2 presents an example of this analysis showing the results of sulphate (SO_4) data for the Met Éireann site in Valentia from 1980 through to 2005 (Bashir et al., 2006) overlain with data from the EMEP sites between 2005 and 2010. These results show a downward trend in SO_4 since the 1980s showing the success of international conventions such as LRTAP as well as national legislation in reducing atmospheric pollutants. Further analysis of historical data sets for the EMEP network is ongoing and will be published in 2014 (Geever and Martin, 2014 pending).

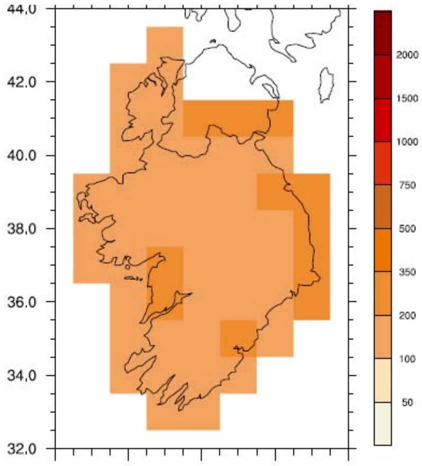
Figure 12.2 Aerosol SO_4 concentrations from high volume filter samples at Valentia, Carnsore Point, Malin Head and Oak Park (1980 to 2010).

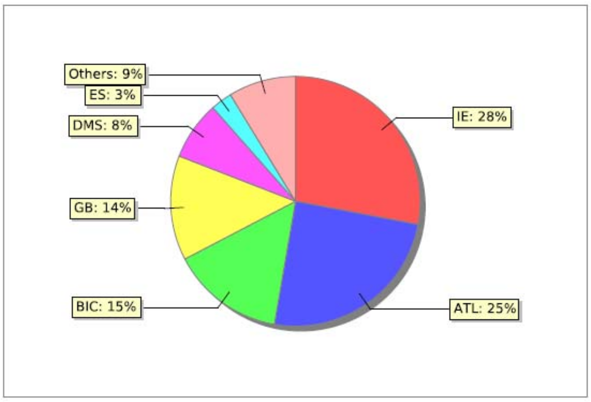


EMEP undertakes analysis of data submitted by CLRTAP parties in terms of measurement data as well as the annual inventories and projections of emissions submitted. Country specific reports are prepared based on this data which contains modelled results of transboundary air pollution for a range of pollutants (typically Sulphur, Nitrogen, Ozone and Particulate Matter). For example, Figure 12.3 below shows the modelled deposition of oxidised sulphur deposition in Ireland. These results are from a 2013 EMEP report prepared by Meteorological Synthesising Centre – WEST (MSC-W) based on 2011 data (EMEP, 2013).

Figure 12.3 below left shows the levels of oxidised sulphur that is deposited in Ireland. The figure on the right hand side shows the six main contributors to oxidised Sulphur in Ireland. As can be seen 28% comes from sources within Ireland itself, with 25% coming from the Atlantic Ocean.

Figure 12.3 (Left) Deposition of oxidised sulphur emissions in Ireland (Unit mg(S)/m2) (Right) Pie Chart shows the six main contributors to oxidised Sulphur in Ireland (Unit %). Source (EMEP, 2013).





The EMEP network is a collaborative network and would not be operational without the support of other national stakeholders in particular Met Éireann and Teagasc. It is proposed that the Irish EMEP monitoring network will continue to complement the National ambient air Quality Network and provide reliable long term monitoring capacity and analytical data on the quality of air in Ireland.

13. Air Quality Research

This chapter gives a brief description of current EPA funded research projects in the thematic areas of ambient air quality and climate change. The EPA Research programme has been funding high quality environmental research in Ireland since the EPA was established in 1994. Research projects can range from small scale studies lasting a few months to large scale projects which are undertaken over a number of years. Fellowships can comprise research specialists working at their academic institution and/or working in-house with EPA on particular environmental topics. Table 13.1 below presents ongoing research projects and research fellowships in the air quality area. This research includes a range of topics such as air quality modelling, monitoring, emission inventories and impact assessment.

The EPA has funded 660 environmental research projects (valued over €10,000) since 2001 varying in size from desk-based studies to large multi-annual projects. A research database is available which contains information about all of these projects and is searchable by: keywords, lead researcher, research institution etc. This database also provides details of the project abstract, expected end date and where relevant a link to the final report/output. http://erc.epa.ie/smartsimple/ . Previously published air quality research can be accessed and downloaded on the EPA website http://www.epa.ie/researchandeducation/

The outputs of air quality research projects and fellowships aim to inform and advance the EPA's monitoring and enforcement activities as well as provide an evidence base for policy decisions at government level. Ongoing engagement with the research community, policy makers, internal colleagues and other air quality stakeholders is important to maintain capacity in this area.

Table 13.1 Summary of ongoing EPA funded air quality related projects

Project Number	Project Title	Organisation
2013-EH-FS-7	Development of a spatially- and temporally-resolved emission inventory for Ireland	University of Dublin, Trinity College (TCD)
2013-CCRP-FS.15	CRiMsON (Consolidation of IRelands Greenhouse Gas and Transboundary MOnitoring Network)	National University of Ireland Galway (NUIG)
2013-EH-MS-14	Assessment of the impact of ammonia emissions from intensive agriculture installations on SACs and SPAs	University College Dublin (UCD)
2013-EH-MS-15	Source Apportionment of Particulate Matter in Rural and Urban Residential Areas (SAPPHIRE)	University College Cork (UCC)
CCRP-09-FS-4-2	Research support for integrated atmospheric studies at Mace Head	National University of Ireland Galway (NUIG)
2011-CCRP-MS-4.5	Emission Factors for Domestic Solid-Fuel Appliances (EFDOSOF)	University College Dublin (UCD)
07-CCRP-4.4.2a	Improved Emissions Inventories for NOx and Particulate Matter from Transport and Small Scale Combustion Installations in Ireland (ETASCI)	University College Dublin (UCD)
CCRP-09-FS-6-4	Air Quality, Atmospheric Deposition and Noise? Climate interactions	National University of Ireland Galway (NUIG)
2012-CCRP-MS.7	Critical Loads and Dynamic Soil-Vegetation Modelling	Trent University
2012-CCRP-MS.8	Ammonia2—Baseline Ammonia Deposition Rates in Ireland and Local impacts of Point Source Emissions	University College Dublin (UCD)
07-CCRP-4.4.4b	Assessing the influence of trans-boundary air pollution on Irish lakes and soils	Trent University
CCRP-09-FS-4-3	Research Support for Mace Head: Instrumentation, Data Systems and Analysis	National University of Ireland Galway (NUIG)
CCRP08Proj-4.1A	Development of critical loads for Ireland	Trent University
2010-AQ-MS-1	Evaluation of the effect of domestic solid fuel burning on ambient air quality in Ireland	Dublin Institute of Technology (DIT)
2012-EH-FS-6	Air quality modelling	University of Dublin, Trinity College (TCD)
2013-CCRP-MS.14	Integrated Modelling Project - GAINS Ireland	APEnvEcon

Below is some further detail on a selection of projects with an important air quality focus:

13.1 Title: Ambient Air Modelling, A Donnelly, Trinity College Dublin

Commenced in 2013, this ambient air modelling project is being developed to include forecasting, increased spatial representativeness of modelled air quality and wider assessment of air quality as stipulated in the CAFE Directive. Currently a statistical point wise forecast is at an advanced stage. This will lead into a more spatially resolved regional model with an auxiliary urban scale model nested within. The benefits of this model work will allow for pollution hotspot identification.

13.2 Title: Emission inventory building for ambient air quality model Institute, O. Naughton, Trinity College Dublin

Commenced in 2014. Development of a bottom up spatially resolved emission inventory has been identified as a key requirement for the furthering of Ireland's ambient air quality modelling capabilities. This project will run in tandem with the ambient air modelling project described above.

13.3 Title: Composition of Particulate Matter in Urban and Rural sites with specific focus on residential emissions, J. Wenger, University College Cork

Commenced in 2014. One area of concern with respect to impacts on human health is the concentration of coarse and fine particulate matter in ambient air and in particular, an understanding of the domestic / residential sources of particulate matter from an Irish perspective. Recent studies have shown variation into the speciation of particulate matter from country to country at a European level, although limited speciated datasets are available throughout EU27. The work of this project will build on previous Irish research studies into the area and have the following goals:

- speciation of particulate matter project investigating urban and rural areas with an emphasis on areas with high usage of peat, coal and wood
- Source apportionment study of particulate matter in the rural and urban residential areas
- Assessment of biomass contribution in different areas
- Assessment of the spatial and temporal variation in indicator compounds for domestic waste burning

13.4 Title: Evaluation of the effect of domestic solid fuel burning on ambient air quality in Ireland, P. Goodman, Dublin Institute of Technology

Commenced in 2011.The use of solid fuel has been long recognised as having negative impacts on air quality. A study conducted by Clancy et al. into the reduction of death rate associated with the Dublin smoky coal ban in 1990, revealed a significant improvement in the public health as a result. The aim of this current project was to investigate the ambient air quality levels, in particular black smoke, PM_{10}, $PM_{2.5}$ and PAH at a number of various towns throughout Ireland, which have varying profiles of residential fuel use.

14. Dioxin Survey

14.1 Origins of Dioxins in Air

"Dioxins" is a collective term for the category of 75 polychlorinated dibenzo-para-dioxin compounds (PCDDs) and 135 polychlorinated dibenzofuran compounds (PCDFs). These compounds or congeners are not formed for specific purposes but arise mainly as unintentional by-products of incomplete or poorly controlled combustion and from certain chemical processes.

They can be formed when any substances containing carbon compounds are burned in the presence of chlorine at temperatures of at least 300°C.

Dioxins, furans, and polychlorinated biphenyls (PCBs) are classified as persistent organic pollutants (POPs) under the Stockholm Convention on POPs which has as its objective the protection of human health and the environment from POPs. Such POPs are also controlled under legislation such as the EU POPs Regulation (EU 2004) and national POPs regulations (DECLG 2010). PCDDs and PCDFs are not produced intentionally except for research and analysis purposes, but their formation is often a by-product of many anthropogenic activities.

The main sources for emissions of dioxins to air in EU-25 are from non-industrial sources, with approximately 30 % of emissions across the EU-25 being as a result of residential combustion, with 15 % from backyard burning.
http://ec.europa.eu/environment/dioxin/sources.htm

Industrial emissions of dioxins and furans are highly controlled and it is estimated that industrial emissions of dioxins and furans in Europe has reduced by approximately 80 % over the last two decades as a result of more stringent legislative requirements.

Across the EU-25 countries the main sources of dioxin emissions are reported as:

- Residential combustion (~ 30%)
- Open burning of waste (backyard burning) (~15%)
- Wood preservation (~15%)
- Iron and steel industry (~ 8%)
- Power production, non-ferrous metals, chemical industry (~ 5% each)

It should be noted that there is no longer any iron and steel manufacturing in Ireland, with the vast majority of dioxin emissions to atmosphere estimated to be from uncontrolled combustion activities and power and heat generation (including residential).

14.1.1 PCBs

Unlike dioxins, PCBs have found widespread use in a number of commercial open and closed applications, due to their physical and chemical properties, such as non-flammability, chemical inertness, high boiling points and high dielectric constants. Typical open applications have been their use in pigments, sealants, rubber products and carbonless copy paper. Closed applications have included use of PCBs in hydraulic and heat transfer systems, transformers and capacitors. The production and use of PCBs has been discontinued for some years but because of their persistent qualities they remain in electrical equipment, buildings and the environment. Dioxins and furans are often found in appreciable quantities as contaminants in PCBs. In Ireland, the Waste Management (Hazardous Waste) Regulations 1998 were brought into force to implement provisions of the PCB Directive which set out the requirements in terms of the disposal of PCBs and registering holdings of PCBs.

Sampling for brominated flame retardants (BFRs) and brominated dioxins and furans (PBDD/F), was undertaken at the same time as the dioxin survey. Five pooled samples, representative of different regions, were analysed.

Samples were taken between June and early August 2013 when the cows could be expected to be grazing outdoors. Analytical results are given in Tables 4 and 5 in Appendix 1.

14.1.2 Toxicity of Dioxins and PCBs

The toxicity of individual dioxin and dibenzofuran compounds (or congeners) varies considerably. The PCDD and PCDF congeners which are likely to be of toxicological significance are those 17 congeners with chlorine atoms at the 2,3,7 and 8 positions. There are also 12 PCB congeners with dioxin like properties, known as dioxin-like PCBs.

A system of Toxic Equivalency Factors (TEFs) or weighting factors is used for assessing relative toxicities of mixtures of Dioxins and Dioxin-like compounds.

Maximum levels for dioxins, dioxin-like PCBs and non-dioxin-like PCBs in foodstuffs including milk, are governed by Regulation, EU 1259/2011. The dioxin limits are 2.5 pg WHO-TEQ/g and the dioxin+ PCB limits are 5.5 pg WHO-TEQ/g. Limits are also set for non-dioxin-like PCBs.

14.1.3 Persistent Organic Pollutants (POPs) & the Stockholm Convention

Dioxins, PCBs and PBDEs (See Chapter 5) are among the substances listed as POPs in the Stockholm Convention. In keeping with its obligations under the Convention, the Environmental Protection Agency as competent authority under the national POPs regulations, has prepared a National Implementation Plan on POPs which details the measures put in place to protect human health and the environment from the POPs that are listed under the Convention, including dioxins, PCBs and PBDEs.

http://www.epa.ie/pubs/reports/waste/haz/POP%20Report_web.pdf.

The plan sets out further priority actions to support the control of POPs showing how it plans to limit and control POPs.

14.2 Survey Results

Direct measurement for dioxins in ambient air is extremely difficult and no limits have set in CAFE.

The most appropriate method for assessing dioxin exposure in the air is to sample Dioxin levels in cows' milk samples taken during the grazing season. The Environmental Protection Agency has carried out a number of such surveys, at almost identical locations in the form of separate reports. These can be used as indicators for the actual average local dioxin exposure by atmospheric deposition. It has now been decided that because the nature of any dioxin contamination in Ireland is of a relatively ubiquitous nature, the reporting of this survey would fit better as a chapter in the Air Quality Report. For further details on how dioxin surveys are carried out, previous report are available to download from the EPA publications website.

Two types of sampling stations were chosen:

Type A	background stations covering the entire country (24 samples)
Type B	potential impact stations in areas of perceived potential risk (14 samples)

14.2.1 Summary

A summary of the milk fat data showing a breakdown of the background (type A), and the potential impact (type B) samples along with the combined data set is presented in Table 11.1. and plotted in Figure 14.1 and Figure 14.2. Data from the individual sampling locations are presented in Tables A17 & A18.

14.2.2 Dioxins

Considering the entire set of samples (Tables 3 and 4), the reported WHO-TEQ ranges for dioxins in milk fat are 0.158 to 0.314 pg with an overall mean values of 0.170 pg WHO-TEQ/g. The highest value was the A4 sample from North Co. Wexford but was still well within EU limits and action values.

14.2.3 PCBs

The highest dioxin-like PCB level was the Cooraclare, Co. Clare sample at 0.292 pg WHO-TEQ/g, around 15% of the EU action level. The mean value was 0.100 pg WHO-TEQ/g with a

range of 0.009 to 0. 292 pg WHO-TEQ/g. There is no separate EU limit value for dioxin-like PCBs.

14.2.4 Dioxins & PCBs

The range for the sum of Dioxins & PCBs is 0.167 to 0.465 pg WHO-TEQ/g with a mean of 0.270 pg WHO-TEQ/g. The highest value was the B6 sample because of the PCB content of this sample as mentioned above.

14.2.5 Comparison with earlier surveys and with other international studies.

It is clear from Figure 14.1 and Figure 14.2 that the 2013 data is below the historic averages for almost all sample locations. A listing of comparable EU and other international studies is given in earlier reports. (EPA 2013). The data from this survey continue to compare favorably with these published studies.

Table 14.1 Summary of dioxin survey results 2013

	Dioxins WHO-TEQincl. LOQ pg/gmilk fat	**Dioxin-like PCBs WHO-TEQincl. LOQ pg/gmilk fat**	**Dioxins and PCBsTotal WHO-TEQincl. LOQ pg/gmilk fat**
Overall mean	0.170	0.100	0.270
Max	0.314	0.292	0.465
Min	0.158	0.009	0.167
Mean A	0.173	0.095	0.269
Mean B	0.163	0.102	0.267
EU limit value	**2.5**	**none**	**5.5**
EU guide level	**1.75**	**2**	**none**

Figure 14.1 Dioxins/Furans 2013 - Data Compared with 2000-2013 Averages

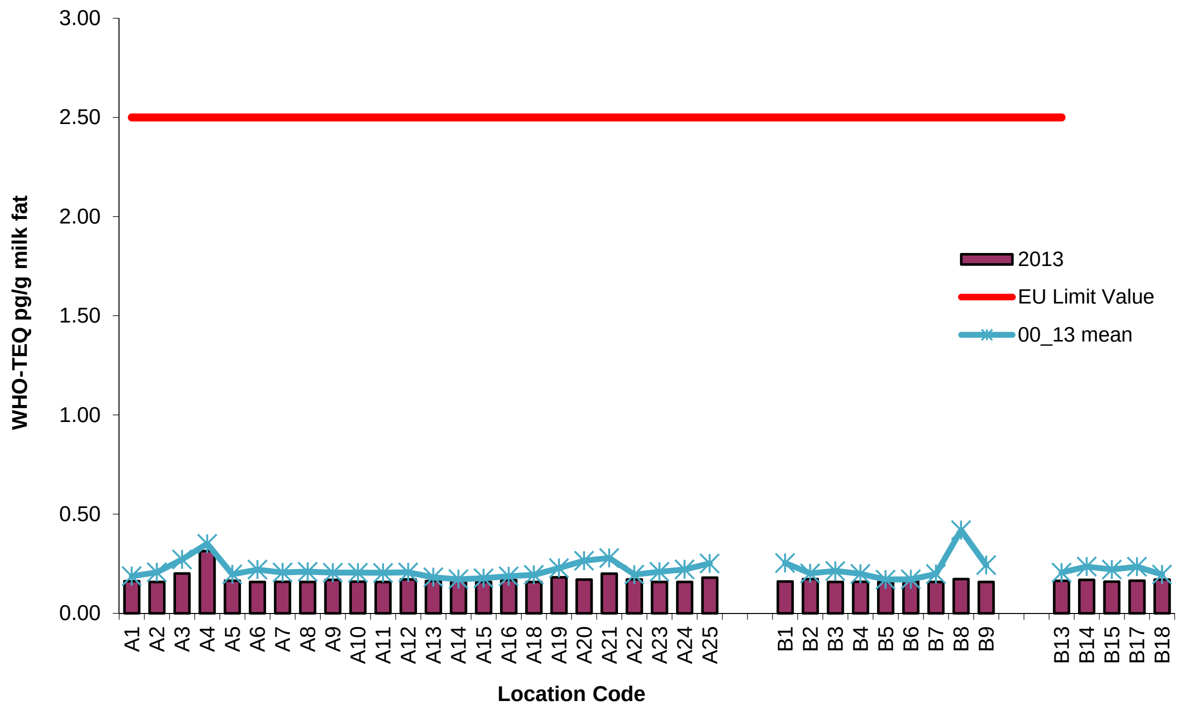
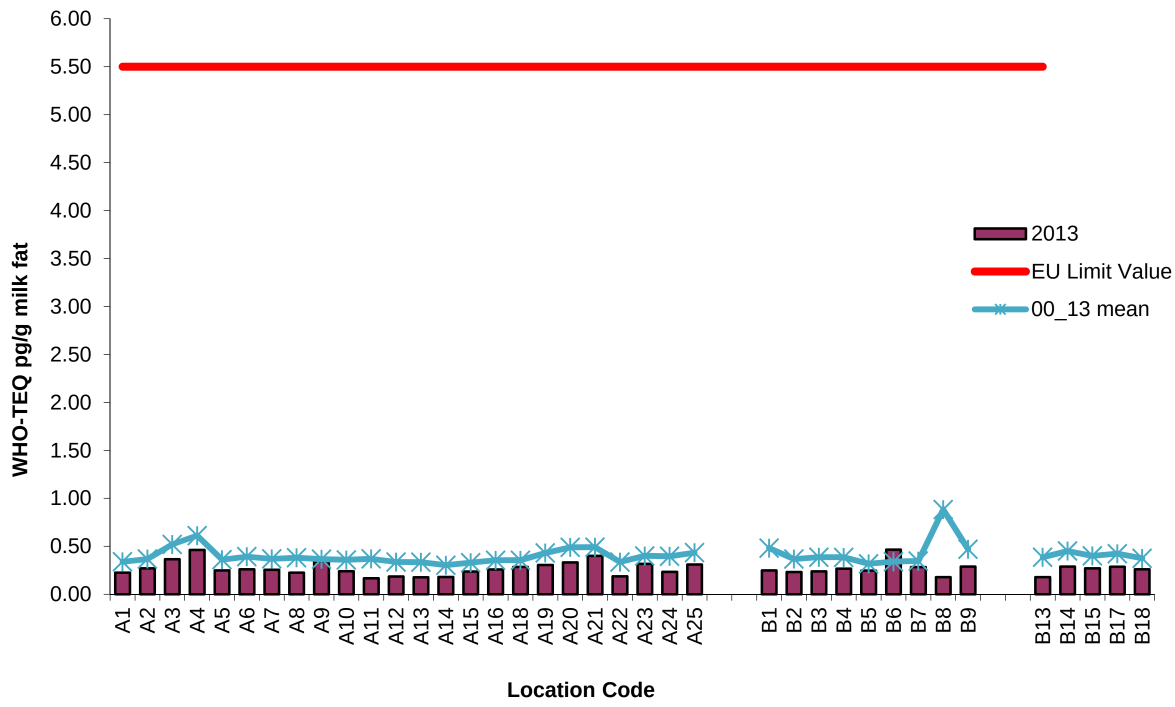


Figure 14.2 Dioxins/Furans + PCBs 2013 - Data Compared with 2000-2013 Averages



14.2.6 Brominated Dioxins and Furans (PBDD/PBDF)

These substances are formed unintentionally, either through, incineration of wastes that include consumer products containing brominated flame retardants like PBDEs, accidental fires or as trace contaminants in mixtures of bromine-containing chemicals.

14.3 Brominated Flame Retardants (BFR) Study.

14.3.1 General

BFRs replaced PCBs as the major chemical flame retardant in the late 1970s and are commonly used in furniture, fabrics and electronic products as a means of reducing the flammability of combustible organic materials.

Polybrominated diphenyl ethers (PBDEs) are of greatest environmental interest among BFRs because they are considered as persistent and bioaccumulative. PentaBDE is considered as very poisonous to water organisms. PBDEs are classified as priority substances according to the EU Water Framework Directive. EU has banned the use of Penta-and OctaBDE since 2004. BDE-47 and BDE-99 are the predominant congeners in environmental samples (FSAI 2005).

Brominated dioxins and furans (PBDD/PBDF) can also be formed as a by-product of the combustion of these substances.

Five pooled samples from the survey were analysed for a range of BFRs and PBDD/PBDFs. PBDEs were the only compounds of any significance detected in this study. The data are summarised in Table 14.2.

The range for Σ−PBDEs (N=5) was 34.3 to 277 ng/kg fat with a mean of 87.5 ng/kg fat. This compares with the mean value of 139 ng/kg fat, from the earlier surveys since 2006 when monitoring for these substances commences and also contrasts favourably with the 2005 FSAI study carried out in the same laboratory where the average concentration for Σ−PBDE was 407 ng/kg fat (N=12) FSAI (2006).

Although there are no maximum limits set for PBDEs, these levels are relatively low by international comparisons.

Table 14.2 Summary of milk fat data for PBDEs

pg/fat	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Mean
	Cork Hbr	Midlands	West	East	N/NW	
Pooled from samples	B1 B2 B14	A5 A8 A9	A7 A15 A24	A3 A20 A23	A11 A19 A25	
PBDEs	109.2	139.1	67.4	74.7	66.3	97.6

14.4 Non Dioxin PCB results

Non-dioxin PCBs were included in the survey. These have a different toxicological profile to the dioxin like-PCBs There is a total of 209 different PCB congeners and for analysis purposes it is considered appropriate to measure sum of the six marker or indicator PCBs; PCB 28, 52, 101, 138, 153 and 180. (EU 2011).

The limit for PCBs in milk fat is 40,000 pg/g. The data ranged from 300 to 1030 with a mean of 397 expressed as pg/g. This compares with a mean value of 447 pg/g in 2012.

It can be seen that the highest value, from the B8 North Dublin area, a suburban area, is less than 3% of the limit value.

14.5 Conclusions and Outlook

All dioxin levels recorded in this survey compare favourably with surveys from other EU countries. While assessment of consumer exposure to dioxins through the consumption of milk was not the object of this environmental survey, the highest levels were well below legislative limits. PCB data is very low compared with EU limits and BFR data continue to remain at low levels although no limits are set for these substances

In many respects the outlook for levels of dioxin and related compounds in the Irish environment will mirror that of PAH compounds (Chapter 10). Both sets of pollutants arise largely from incomplete and inappropriate burning of organic matter and fuels. Considerable efforts have been made in recent times to minimise illegal waste and backyard burning including making more explicit the offence of disposal of waste by uncontrolled or unregulated burning, including backyard burning of household waste (DOEHLG 2009).

Measures to improve energy efficiency put in place through the National Climate Change Strategy 2007-2012, with an increased focus on wasteful fuel consumption and waste management and consequent emphasis on non-combustion energy alternatives, should also have a positive impact on dioxin levels in the future. The Air Quality Regulations 2011 (DOEHLG 2011) giving effect to the EU CAFE Directive (2008/50/EC), is another example of a synergistic effect on dioxin emissions from a related piece of legislation. The CAFE Directive requires that Ireland must reduce its average PM2.5 background concentration by 10% by 2018. Bringing about reductions in particulate levels from combustion should result in reductions in dioxin levels. The National Energy Efficiency Action Plan 2009 – 2020 which aims to achieve by 2020 a 20% reduction in energy demand across the economy, should also have a similar impact (DCENR, 2011).

15. Conclusion and future challenges

Overall, air quality in Ireland compares favourably with other EU Member States and continues to be of good quality relative to other EU countries. However, this status of ‘good’ is relative to the major difficulties other Member States are experiencing. When compared to the tighter WHO air quality guideline values, our air quality does not compare so favourably. This is a useful reminder that as we come to understand more about the nature and effect of poor air quality, it is becoming clearer that there is no ‘safe’ level of air pollution. We as a country must strive, at the very least to maintain our air quality, but with the overall aim of improving this aspect of our precious environment.

The key future challenge for Ireland is in decreasing our PAH, PM_{10} and $PM_{2.5}$ concentrations to below that of the WHO air quality guideline values, particularly if the European Commission’s review on air quality legislation leads it to adopt the more stringent limits recommended by the WHO. The impact of these pollutants on Irish air quality is directly attributable to the choices we make for home heating. Emissions from domestic solid fuel use contribute to high levels of particulate matter and PAH in villages, towns and cities and it is this relationship which needs to be addressed in the coming years.

New regulations in 2011 reducing the sulphur content in coal and in 2012 with the extension of the ban on bituminous coal should bring improvements in air quality, while the work undertaken in the 2013 joint North-South study on all-island air quality, will provide valuable information in further tackling the impact of domestic solid fuel use on air quality. But at the heart of the issue is the choice by individuals to switch from solid fuel to gas or other low-emission fuels or at least implement the use of efficient stoves to burn solid fuel which can further reduce domestic emissions of air pollution. However, it should be noted that shifting from gas or other low emission fuels to a solid fuel stove, even an efficient one, will result in a net increase in emissions, particularly of PM, NO_X and PAH.

Under the CAFE Directive, Ireland is required to reduce levels of $PM_{2.5}$ by 10% by 2020. This reduction will be challenging as it will require an integrated approach across a number of sectors including industrial, transport and residential areas. Also the complex relationship between a reduction in our carbon footprint and decreasing $PM_{2.5}$ concentrations needs to be tackled in the plans to implement the National Emissions Reduction Target (NERT) for 2020.

The EPA’s industrial and waste management licensing regimes, national and EU legislation will continue to be used by the EPA to control emissions to air from industry and power generation to ensure that these sectors will not impact on air emissions and air quality.

Ireland as a country must continue to be vigilant in order to maintain good air quality. Ireland must meet its international commitments on air quality and air emissions and ensure that industrial emissions of pollutants to air continue to be rigorously controlled. Ireland

should also strive to ensure that its industrial sector continues to make use of clean technologies where possible.

Ireland must develop and implement policies to reduce travel demand, increase the use of alternatives to the private motor car, reduce NO_X emissions from motorised transport and also consider our motorised vehicle fuel choice. This process will require joined-up action between Government departments, national agencies and local authorities. These bodies must make air quality an integral part of their traffic management and planning processes. The shift from solid fuel to cleaner alternatives including gas must continue, including consideration of an extension of the natural gas network to smaller towns and villages. A much greater emphasis on energy efficiency measures to bring about a reduction in the overall need for heating fuels, particularly solid fuels, is also needed. Finally, the links between health and air quality must be better communicated by all public bodies involved in air quality assessment and management, to raise awareness of the critical issues with policy and decision makers and with the public. Also an emphasis on the health benefits of clean air and its value as a resource must be stressed, so that 'buy-in' from the public can be achieved with regards to protecting our air quality.

Appendix A – Summary data tables

Table A1 Summary statistics for hourly NO_2 concentrations in Ireland in 2013

	Winetavern St.	Coleraine St.	Rathmines	Dun Laoghaire	Ballyfermot[26]	Blanchardstown	St Anne's Park	Swords	Balbriggan	Old Station Road	Kilkenny Seville Lodge	Mullingar	Emo, Laois	Castlebar, Mayo	Kilkitt, Monaghan
µg/m[27]	Zone A									Zone B	Zone C		Zone D		
Annual mean[28]	31	26	19	16	16	29	12	15	9	23	4	6	4	11	4
Median	27	21	14	11	11	20	9	11	6	20	3	4	3	8	2
% Data Capture	99	97	99	94	100	96	95	88	93	59	87	88	85	98	85
NO2 values >200	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Values >140 (UAT)	1	0	0	0	0	5	0	3	0	0	0	0	0	0	0
Values >100 (LAT)	39	15	2	6	1	88	1	11	0	6	1	0	0	0	0
Hourly max[29]	158	118	107	123	107	154	116	211	86	124	90.1	68	38	100	72

[26] Ballyfermot statistics refer to data collected between 15 March 2013 and 31 December 3013
[27] NO_x is expressed as µg/m^3 NO_2.
[28] NO_2 annual mean limit value for the protection of human health: 40 µg/m^3 applicable from 2010
[29] NO_2 hourly limit value for the protection of human health: No more than 18 hrs > 200 µg/m^3 applicable from 2010.

Table A2 Summary statistics for hourly NO_x concentrations in Ireland in 2013

µg/m[31]	Winetavern St.	Coleraine St.	Rathmines	Dun Laoghaire	Ballyfermot[30]	Blanchardstown	St Anne's Park	Swords	Balbriggan	Old Station Road	Kilkenny Seville Lodge	Mullingar	Emo, Laois	Castlebar, Mayo	Kilkitt, Monaghan
	Zone A									Zone B	Zone C		Zone D		
Annual mean[32]	50	46	28	27	21	62	22	25	14	43	6	12	5	16	5
Median	36	31	18	17	14	31	14	15	9	31	3	7	4	11	3
% Data capture	99	97	99	94	100	96	95	88	93	59	87	88	85	98	85
Hourly max	1209	1000	668	424	523	1006	417	1018	393	698	18 8	197	55	595	231

[30] Ballyfermot statistics refer to data collected between 15 March 2013 and 31 December 3013

[31] NO_x is expressed as µg/m^3 NO_2.

[32] NO_x annual mean limit value for the protection of vegetation: 30 µg/m^3 applicable from 2010. Limit only applies to rural stations in Zone D

Table A3 Summary statistics for hourly SO_2 concentrations in Ireland in 2013

	Winetavern Street	Coleraine Street	Rathmines	Balbriggan	Tallaght	Old Station Road	Ennis	Mullingar	Kilkitt, Monaghan	Shannon Estuary
(µg/m^3)	Zone A					Zone B	Zone C		Zone D	
Annual mean[33]	1	2	2	3	4	5	3	3	3	2
Median	1	1	2	3	3	4	2	2	3	1
% data capture	99	93	95	99	76	58	100	100	93	98
Hourly values > 350	0	0	0	0	0	0	0	0	0	0
Hourly max[34]	25	24	30	65	35	26	106	51	41	47
Daily values > 125	0	0	0	0	0	0	0	0	0	0
Daily max	6	8	11.7	16	15	13	18	32	15	13

[33] SO_2 annual mean limit value for the protection of ecosystems: 20 µg/m^3 applicable from 2001.
[34] SO_2 hourly limit value for the protection of human health: No more than 24 hrs > 350 µg/m^3 applicable from 2005.

Table A4 Summary statistics for rolling 8-hour CO concentrations in Ireland in 2013

	Winetavern Street	Balbriggan	Coleraine Street	Old Station Road	Mullingar
(mg/m^3)	Zone A			Zone B	Zone C
Annual mean	0.0	0.6	0.4	0.3	0.3
Median	0.0	0.6	0.4	0.3	0.3
% data capture	98	99	91	62	100
Values > 10	0	0	0	0	0
Max[35]	2.4	1.6	2.7	3.0	2.0

[35] CO maximum daily 8-hr mean limit value for the protection of human health: 10 mg/m^3.

Table A5 Summary statistics for rolling 8-hour ozone concentrations in Ireland in 2013

	Rathmines	Clonskeagh	Swords	Old Station Road	Kilkenny	Bray	Emo Court	Kilkitt	Mace Head	Castlebar	Valentia
(µg/m^3)	Zone A			Zone B	Zone C		Zone D				
Annual mean	45	54	53	41	56	57	43	60	75	57	72
Median	45	55	53	40	57	58	44	60	76	57	74
% data capture	99	100	91	59	97	100	96	100	100	99	93
No. days > 120[36]	0	0	1	0	1	0	1	1	2	1	1
Max 8-hr value	107	118	124	109	121	114	120	131	130	123	129

36 Max ozone daily 8-hr mean limit: No more than 25 days > 120 µg/m^3.

Table A6 AOT40 values from rural stations (Zone D) in Ireland, 2008 - 2013

(µg/m^3).h[37]	Kilkitt Co. Monaghan	Mace Head Co. Galway	Castlebar Co. Mayo	Valentia Co. Kerry	Emo Court Co. Laois
2009	1546	5347	3112	6131	1488
2010	1232	2315	1051	1230	857
2011	1405	3354	620	1064	280
2012	2046	3606	1757	2417	1375
2013	1482	5064	1366	4436	1017
Average	1542	3937	1581	3056	1003

[37] AOT40 target value for 2010 is 18,000 µg/m^3.h; long-term objective for 2020 is 6,000 µg/m^3.h. AOT40 is calculated 1 May – 31 July.

Table A7 Summary statistics for daily PM_{10} concentrations in Ireland in 2013

µg/m³	Winetavern St	Rathmines	Phoenix Park	Blanchardstown	Dun Laoghaire[38]	Ballyfermot[39]	Balbriggan	Davitt Road[40]	Finglas	St Anne's Park	Tallaght	Heatherton Park	Old Station Road	Galway	Ennis	Mullingar	Bray	Castlebar	Claremorris	Kilkitt
	Zone A											Zone B		Zone C				Zone D		
Annual mean[41]	14	17	14	20	17	12	25	13	15	19	17	15	19	21	20	15	20	15	13	11
Median	12	14	11	17	14	10	21	11	13	18	13	13	16	18	17	13	18	12	11	8
% data capture	93	99	94	100	84	93	93	94	92	99	100	90	95	95	53	74	100	97	95	98
Values > 50[42]	3	8	3	11	5	2	15	1	3	0	5	2	5	11	8	0	4	7	3	3
Daily Max	60	76	72	89	82	62	100	59	64	50	77	67	87	74	95	48	83	70	69	77

[38] Dun Laoghaire statistics refer to data collected between 01 January 2013 and 08 November 2013
[39] Ballyfermot statistics refer to data collected between 28 February 2013 and 31 December 2013
[40] Davitt Road statistics refer to data collected between 27 March 2013 and 31 December 2013
[41] PM_{10} annual mean limit value for the protection of human health: 40 µg/m³ applicable from 2005.
[42] PM_{10} daily limit for the protection of human health: No more than 35 days >50 µg/m³ applicable from 2005.

Table A8 Summary statistics for daily $PM_{2.5}$ concentrations for Ireland in 2013

	Coleraine St	Rathmines	Marino	Old Station Road	Ennis	Longford	Claremorris
µg/m³	Zone A			Zone B	Zone C	Zone D	
Annual mean[43]	11	11	9	11	12	17	8
Median	8	7	7	8	8	12	5
% data capture	89	94	96	95	50	85	96
Daily max	62	76	55	71	86	78	60

[43] Annual mean limit value 25 µg/m³.

Table A9 Summary statistics for chemical composition of $PM_{2.5}$ in 2013

Chemical Species	Claremorris, Co. Mayo
Annual Mean (ug/m^2) [44]	Zone D
Elemental Carbon (Transmittance Correction) [45]	0.1
Elemental Carbon (Reflectance Correction)	0.2
Organic Carbon (Transmittance Correction)	1.4
Organic Carbon (Reflectance Correction)	1.3
Total Carbon	1.5
Chloride (Cl^-)	0.38
Nitrate (NO_3^-)	0.21
Sulphate (SO_4^{2-})	0.33
Ammonium (NH_4^+)	0.41
Calcium (Ca^+)	0.17
Magnesium (Mg^{2+})	0.03
Potassium (K^+)	0.05
Sodium (Na^+)	0.35
% data capture	100

[44] There are no limit values for chemical composition of $PM_{2.5}$.
[45] In the absence of a EN standard for EC/OC, results are reported using both methods for correcting for pyrolysis products.

Table A10 Summary statistics for daily benzene concentrations in Ireland in 2013

	Rathmines	Old Station Road	Balbriggan[46]	Mullingar[47]
(µg/m³)	Zone A	Zone B	Zone A	Zone C
Annual mean[48]	0.94	0.8	0.5	0.5
Median	0.67	0.8	0.5	0.3
% data capture	94	96	63	99
Daily Max	5.77	2.1	2.0	1.0

[46] Balbriggan statistics refer to data collected between 01 January 2013 and 06 June 2013.
[47] Mullingar statistics refer to data collected between 01 January 2013 and 06 June 2013.
[48] Annual mean limit value for benzene is 5µg/m³.

Table A11 Summary statistics for daily ozone precursor VOCs concentrations at Rathmines in 2013

	Benzene	Toluene	Ethylbenzene[49]	m- and p-Xylene	o-Xylene
(μg/m³)			Zone A		
Annual mean[50]	0.94	1.90	0.31	1.48	0.35
Median	0.67	1.45	0.2	1.9	0.3
% data capture	94	94	97	97	97
Hourly max	5.8	12.8	1.9	8.7	2.4

[49] Ethylbenzene, m-and-p-xylene and o-xylene statistics refer to data collected between 1 January 2013 and 30 June 2013
[50] No limit values for toluene, ethylbenzene, m-and-p-xylene and o-xylene.

Table A12 Summary statistics for monthly lead, arsenic, cadmium and nickel concentrations in Ireland in 2013

	Rathmines				Winetavern Street				Heatherton Park				Galway				Kilkitt			
	Zone A								Zone B				Zone C				Zone D			
(ng/m^3)	Pb	As	Cd	Ni	Pb	As	Cd	Ni	Pb	As	Cd	Ni	Pb	As	Cd	Ni	Pb	As	Cd	Ni
Annual mean[51]	3.7	0.3	0.2	3.7	3.1	0.3	0.2	0.9	4.3	0.3	0.3	1.2	2.2	3.6	0.2	1.3	1.8	0.3	0.2	0.4
Median	3.6	0.3	0.2	0.8	3.7	0.3	0.2	0.7	4.4	0.3	0.2	1.0	1.3	0.3	0.2	0.3	1.3	0.3	0.2	0.3
% data capture	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Monthly average max	3.6	0.3	0.2	2.1	5.8	0.7	0.4	2.2	9.7	0.7	0.8	5.2	5.1	0.9	0.2	3.9	3.5	0.3	0.2	0.9

[51] Annual mean limit value for lead is 500 ng/m^3. Target values for remaining heavy metals are applicable from 2013: arsenic 6ng/m^3, cadmium 5ng/m^3, nickel 20ng/m^3.

Table A13 Summary statistics for monthly mercury concentrations in 2013

	Macehead
(ng/m^3)	Zone D
Annual mean[52]	1.50
Median	1.50
% data capture	75
Monthly average max	1.64

[52] No limit values for mercury.

Table A14 Summary statistics for monthly metal deposition concentrations in 2013

Metal[53]	Rosemount, UCD	Shannon Estuary, Co. Limerick	Valentia, Co. Kerry
Annual Mean ($\mu g/m^2/day$) [54]	Zone A	Zone D	
Nickel *	1.3	5.1	0.4
Arsenic *	1.0	1.3	0.4
Cadmium *	0.1	0.04	0.0
Lead *	1.6	1.3	0.7
Mercury *	0.05	0.1	0.0
Aluminium	76.1	47.1	16.8
Chromium	1.3	2.2	0.4
Cobalt	1.0	1.3	0.4
Copper	8.1	2.5	13.3
Manganese	11.3	6.8	2.3
Antimony	1.0	1.3	0.4
Thallium	1.0	1.3	0.4
Vanadium	1.0	1.3	0.4
Zinc	47.5	52.2	37.5
% data capture	100	100	100

[53] The metals marked * require monitoring under the legislation. The remainder are reported for information purposes.
[54] There are no limit values for metal deposition.

Table A15 Summary statistics for monthly PAH concentrations in 2013

Polycyclic Aromatic Hydrocarbon	Rathmines	Winetavern Street	Heatherton Park	Galway	Kilkitt
Annual Mean (ng/m^3)	Zone A		Zone B	Zone C	Zone D
Benzo(a)Pyrene[55]	0.17	0.15	0.46	0.19	0.07
Naphthalene	0.39	0.47	0.96	0.66	0.29
Acenaphtylene	0.02	0.03	0.04	0.02	0.02
Acenaphthene	0.02	0.07	0.10	0.02	0.00
Fluorene	0.05	0.05	0.04	0.04	0.07
Phenanthrene	0.04	0.06	0.07	0.08	0.04
Anthracene	0.01	0.02	0.03	0.03	0.01
Fluoranthene	0.05	0.08	0.14	0.09	0.06
Pyrene	0.05	0.08	0.13	0.07	0.04
Chrysene	0.09	0.09	0.25	0.10	0.03
Benz[a]Anthracene	0.13	0.11	0.26	0.16	0.04
Benzo(b)Fluoranthene	0.23	0.19	0.47	0.25	0.09
Benzo(k)Fluoranthene	0.10	0.11	0.26	0.11	0.05
Benzo(j)Fluoranthene	0.14	0.13	0.36	0.14	0.05
Benzo(g,h,i)Perylene	0.30	0.31	0.75	0.28	0.13
Dibenzo(a,h)Anthracene	0.17	0.21	0.53	0.19	0.09
Indeno(1,2,3-c,d)Pyrene	0.34	0.34	0.86	0.31	0.13
% data capture	100	100	100	100	100

[55] Annual mean limit value for benzo(a)pyrene is 1ng/m^3. There are no limit values for any other PAH.

Table A16 Summary statistics for monthly PAH deposition concentrations in 2013

Polycyclic Aromatic Hydrocarbon	Rosemount, UCD	Shannon Estuary, Co. Limerick
Annual Mean ($ng/m^2/day$) [56]	Zone A	Zone D
Benzo(a)Pyrene	1.7	1.9
Benz[a]Anthracene	3.4	3.8
Benzo(b)Fluoranthene	2.5	2.2
Benzo(k)Fluoranthene	2.5	2.7
Dibenzo(a,h)Anthracene	2.8	2.3
Indeno(1,2,3-c,d)Pyrene	2.0	1.8
% data capture	75	50

[56] There are no limit values for metal deposition.

Table A17 Milk fat related PCDD/F and PCB-TEQ values determined in the background samples A1 - A 25

Sample	Milk supply area	Dioxins	PCBs	Dioxins & PCBs
		pg/g milk fat	*pg/g milk fat*	*pg/g milk fat*
A1	Mitchelstown Area	0.16	0.06	0.23
A2	Co. Waterford	0.16	0.11	0.27
A3	Dublin South.Co./North Wicklow Area	0.20	0.16	0.36
A4	North Co. Wexford	0.31	0.15	0.46
A5	Charleville, Co Cork Area	0.16	0.08	0.25
A6	Ballyragget, Co Kilkenny Area	0.16	0.10	0.26
A7	Renmore, Co Galway Area	0.16	0.10	0.26
A8	Moate, Co Westmeath Area	0.16	0.07	0.22
A9	Tipperary Town/Thurles Areas	0.17	0.17	0.34
A10	Nenagh, Co. Tipperary Area	0.16	0.08	0.24
A11	Cavan/Longford/Leitrim	0.16	0.01	0.17
A12	Drinagh, Co Cork	0.17	0.01	0.18
A13	Bandon Area	0.16	0.01	0.18
A14	North Kerry Area	0.17	0.02	0.18
A15	Co Sligo	0.16	0.08	0.24
A16	Roscommon/East Galway	0.17	0.09	0.26
A18	Roscommon/Leitrim	0.16	0.13	0.28
A19	Co Monaghan	0.18	0.12	0.30
A20	Co Louth	0.17	0.16	0.33
A21	North Kildare/West Dublin	0.20	0.20	0.40
A22	So Kerry (Cahirciveen area)	0.17	0.02	0.19
A23	South Wexford	0.16	0.16	0.32
A24	SE Co. Mayo	0.16	0.07	0.23
A25	Co. Donegal	0.18	0.12	0.31

Table A18 Milk fat related PCDD/F and PCB-TEQ values determined in the potential impact samples B1 - B 18

Sample	Milk supply area	Dioxins	PCBs	Dioxins & PCBs
		pg/g milk fat	*pg/g milk fat*	*pg/g milk fat*
		WHO-TEQ incl. LOQ	**WHO-TEQ incl. LOQ**	**Total WHO-TEQ incl. LOQ**
B1	Carrigtwohill/Cobh/Great Island	0.16	0.09	0.25
B2	Aghada/ East Cork Harbour	0.17	0.07	0.23
B3	Askeaton area	0.16	0.08	0.24
B4	Tarbert Co. Kerry	0.16	0.10	0.27
B5	Clarecastle, Co.Clare	0.16	0.09	0.25
B6	Cooraclare Co.Clare	0.16	0.29	0.47
B7	Ballydine, So. Tipperary	0.16	0.13	0.28
B8	Swords/Mulhuddart. Co.Dublin	0.17	0.01	0.18
B9	Grannagh, So.Kilkenny	0.16	0.12	0.29
B13	Kinsale(Dunderow) Co.Cork	0.16	0.01	0.18
B14	Ringaskiddy area. Co.Cork	0.17	0.12	0.29
B15	Crossakiel (nr Kells) Co.Meath	0.16	0.10	0.27
B17	Carranstown, Co.Meath	0.16	0.12	0.29
B18	Kinnegad, Co Westmeath	0.17	0.09	0.26

References

CEC (Council of the European Communities), 1980. *Directive 1980/779/EEC of 15 July 1980 on air quality limit values and guide values for sulphur dioxide and suspended particulates. O.J.* L229, 30 August 1980.

CEC (Council of the European Communities), 1999. *Directive 1999/30/EC of 22 April 1999 relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air*. *O.J.* L163, 29 June 1999.

The Emissions of Volatile Organic Compounds from Organic Solvents Regulations (S.I. No. 543 of 2002), known as the solvents regulations, is the transposition of the European Solvents Directive 1999/13/EC.

IPPC Directive (2008/1/EC) - *concerning integrated pollution prevention and control.*

The Limitation of Emissions of Volatile Organic Compounds due to the Use of Organic Solvents in Certain Paints, Varnishes and Vehicle Refinishing Product Regulations 2007 (S.I. No. 199 of 2007) transposes the requirements of the European Directive on decorative paints - 2004/42/EC (Deco Paints Directive).

S.I. No. 374 of 1997 - *control of Volatile Organic Compounds Emissions Resulting from Petrol Storage and Distribution Regulations* (which transposes EU Directive 94/63/EC).

S.I. No. 465 of 2011 - *Control of Substances that Deplete the Ozone Layer Regulations* 2011

Regulation (EC) No. 842/2006 *on certain fluorinated greenhouse gases (the F-Gas Regulation)*.

S.I. No. 279 of 2001 – *Fluorinated Greenhouse Gas Regulations* 2011 and S.I. No. 278 of 2011 – EPA Act 1992 (Fluorinated Greenhouse Gas) Regulations 2011.

DEHLG (Department of Environment, Heritage and Local Government), 2004. S.I. No. 53 of 2004. *Ozone in Ambient Air Regulations, 2004*. The Stationery Office, Dublin.

DEHLG (Department of Environment, Heritage and Local Government), 2009. S.I. No. 58 of 2009. *Arsenic, Cadmium, Mercury, Nickel and Polycyclic Aromatic Hydrocarbons in Ambient Air Regulations, 2009.* The Stationery Office, Dublin.

DELG (Department of Environment and Local Government), 2002. S.I. No. 271 of 2002. *Air Quality Standards Regulations, 2002.* The Stationery Office, Dublin.

EPA Licensed Sites – Report on Air Emissions 2013

EC (European Commission) 2010. Press release IP/10/687.

EEA (European Environment Agency), 2013, *Air Quality in Europe 2013*. EEA Report No. 9/2013.

EEA (European Environment Agency), 2014, *Effects of air pollution on European ecosystems*, EEA Technical report No 11/2014

EP and CEU (European Parliament and the Council of the European Union), 2004. *Directive 2004/107/EC of 15 December 2004 relating to arsenic, cadmium, nickel and polycyclic aromatic hydrocarbons in ambient air. OJ* L23, 26 January 2005.

EP and CEU (European Parliament and the Council of the European Union), 2008. *Directive 2008/50/EC of 21 May 2008 on ambient air quality and cleaner air for Europe. OJ* L152, 11 June 2008.

EP and CEU (European Parliament and the Council of the European Union), 2001a. *Directive 2001/81/EC of 23 October on national emissions ceilings for certain atmospheric pollutants.* OJ L309, 27 November 2001.

EPARG (The Environmental Protection Agency Review Group), 2011. *A Review of the Environmental Protection Agency presented to the Minister for the Environment, Community and Local Government.* May 2011.

IARC (International Agency for Research on Cancer) 2013, Press Release No. 221, 17 October 2013.

WHO (World Health Organisation), 2014. *Mortality from Ambient Air Pollution for 2012 – Summary of Results*, WHO Geneva.

WHO (World Health Organisation), 2008, '*Air Quality and Health — Fact sheet No. 313 — Updated August 2008*' (http://www.who.int/ mediacentre/factsheets/fs313/en/) accessed 3 October 2011.

WHO (World Health Organisation), 2005. *Air Quality Guidelines – Global Update*, WHO Geneva.

Aherne et al., 2013. Influence of Transboundary Air Pollution on Acid Sensitive Ecosystems Climate Change Research Programme Report Series No. 31. Environmental Protection Agency.

Bashir et al. ,2006. *Long-Term Trends In Atmospheric Pollutants At Valentia Observatory, Ireland*, Environmental Research Centre – ERC Report 1, Environmental Protection Agency. Available at: http://www.epa.ie/pubs/reports/research/air/ercreport1.html

European Monitoring and Evaluation Programme, 2013. MSC-W - Transboundary Air Pollution by main pollutants (S,N,03) and PM in 2011 – Ireland. Available at: http://www.emep.int/publ/reports/2013/Country_Reports/report_IE.pdf

Leinert. S et al. 2008. *New Transboundary Air Pollution Monitoring Capacity for Ireland*; Environmental Research Centre Report Series No. 10. Environmental Protection Agency. Available at: http://www.epa.ie/pubs/reports/research/air/ercreport9.html

UNECE: Handbook for the 1979 Convention on Long-Range Transboundary Air Pollution and its Protocols, Geneva, United Nations Economic Commissions for Europe, ECE/EB.AIR/85, 2004a. Available at: http://www.unece.org/fileadmin/DAM/env/lrtap/ExecutiveBody/Handbbok.E.pdf

EU 2004 Regulation (EC) no 850/2004 of the European Parliament and of the Council of 29 April 2004 on persistent organic pollutants and amending Directive 79/117/EEC IPPC Directive (2008/1/EC) - *concerning integrated pollution prevention and control.*

DECLG 2010 Persistent Organic Pollutant Regulations 2010 (Statutory Instrument No. 235 of 2010).

EPA 2005b. The Nature and Extent of Unauthorised Waste Activity in Ireland. EPA, Wexford.

EPA 2006. National Waste Report, 2005. EPA, Wexford.

FSAI (Food Safety Authority of Ireland) 2006. Rainer Grümping, Malte Petersen, Arnold Kuchen, Christina Tlustos. Levels Of Polybrominated Diphenyl Ethers In Swiss And Irish Cow's Milk, Organohalogen Compounds 68 (2006)

EU 2011. Commission Regulation No EU 1259/2011 of 28 March 2012 amending Annexes I and II to Directive 2002/32/EC of the European Parliament and of the Council as regards maximum levels and action thresholds for dioxins and polychlorinated biphenyls.

FSAI (Food Safety Authority of Ireland) 2005. Investigation into levels of Dioxins, Furans, PCBs and PBDEs in Irish food 2004. http://www.fsai.ie/publications/reports/dioxins.pdf

DEHLG 2009. Waste Management (Prohibition Of Waste Disposal By Burning) Regulations 2009. S.I. No. 286 of 2009.

DECNR 2014 National Energy Efficiency Action Plan Department of Communications, Energy and Natural Resources 2014

Environmental Protection Agency

The Environmental Protection Agency (EPA) is a statutory body responsible for protecting the environment in Ireland. We regulate and police activities that might otherwise cause pollution. We ensure there is solid information on environmental trends so that necessary actions are taken. Our priorities are protecting the Irish environment and ensuring that development is sustainable.
The EPA is an independent public body established in July 1993 under the Environmental Protection Agency Act, 1992. Its sponsor in Government is the Department of the Environment, Heritage and Local Government.

OUR RESPONSIBILITIES

LICENSING

We license the following to ensure that their emissions do not endanger human health or harm the environment:

• waste facilities (e.g., landfills, incinerators, waste transfer stations);

• large scale industrial activities (e.g., pharmaceutical manufacturing, cement manufacturing, power plants);

• intensive agriculture;

• the contained use and controlled release of Genetically Modified Organisms (GMOs);

• large petrol storage facilities.

• waste water discharges

NATIONAL ENVIRONMENTAL ENFORCEMENT

• Conducting over 2,000 audits and inspections of EPA licensed facilities every year.

• Overseeing local authorities' environmental protection responsibilities in the areas of - air, noise, waste, waste-water and water quality.

• Working with local authorities and the Gardaí to stamp out illegal waste activity by co-ordinating a national enforcement network, targeting offenders, conducting investigations and overseeing remediation.

• Prosecuting those who flout environmental law and damage the environment as a result of their actions.

MONITORING, ANALYSING AND REPORTING ON THE ENVIRONMENT

• Monitoring air quality and the quality of rivers, lakes, tidal waters and ground waters; measuring water levels and river flows.

• Independent reporting to inform decision making by national and local government.

REGULATING IRELAND'S GREENHOUSE GAS EMISSIONS

• Quantifying Ireland's emissions of greenhouse gases in the context of our Kyoto commitments.

• Implementing the Emissions Trading Directive, involving over 100 companies who are major generators of carbon dioxide in Ireland.

ENVIRONMENTAL RESEARCH AND DEVELOPMENT

• Co-ordinating research on environmental issues (including air and water quality, climate change, biodiversity, environmental technologies).

STRATEGIC ENVIRONMENTAL ASSESSMENT

• Assessing the impact of plans and programmes on the Irish environment (such as waste management and development plans).

ENVIRONMENTAL PLANNING, EDUCATION AND GUIDANCE

• Providing guidance to the public and to industry on various environmental topics (including licence applications, waste prevention and environmental regulations).

• Generating greater environmental awareness (through environmental television programmes and primary and secondary schools' resource packs).

PROACTIVE WASTE MANAGEMENT

• Promoting waste prevention and minimisation projects through the co-ordination of the National Waste Prevention Programme, including input into the implementation of Producer Responsibility Initiatives.

• Enforcing Regulations such as Waste Electrical and Electronic Equipment (WEEE) and Restriction of Hazardous Substances (RoHS) and substances that deplete the ozone layer.

• Developing a National Hazardous Waste Management Plan to prevent and manage hazardous waste.

MANAGEMENT AND STRUCTURE OF THE EPA

The organisation is managed by a full time Board, consisting of a Director General and four Directors.

The work of the EPA is carried out across four offices:

• Office of Climate, Licensing and Resource Use

• Office of Environmental Enforcement

• Office of Environmental Assessment

• Office of Communications and Corporate Services

The EPA is assisted by an Advisory Committee of twelve members who meet several times a year to discuss issues of concern and offer advice to the Boa

AN GHNÍOMHAIREACHT UM CHAOMHNÚ COMHSHAOIL

Tá an Ghníomhaireacht um Chaomhnú Comhshaoil (GCC) freagrach as an gcomhshaol a chaomhnú agus a fheabhsú mar shócmhainn luachmhar do mhuintir na hÉireann. Táimid tiomanta do dhaoine agus don chomhshaol a chosaint ó éifeachtaí díobhálacha na radaíochta agus an truaillithe.

Is féidir obair na Gníomhaireachta a roinnt ina trí phríomhréimse:

Rialú: *Déanaimid córais éifeachtacha rialaithe agus comhlíonta comhshaoil a chur i bhfeidhm chun torthaí maithe comhshaoil a sholáthar agus chun díriú orthu siúd nach gcloíonn leis na córais sin.*

Eolas: *Soláthraímid sonraí, faisnéis agus measúnú comhshaoil atá ar ardchaighdeán, spriocdhírithe agus tráthúil chun bonn eolais a chur faoin gcinnteoireacht ar gach leibhéal.*

Tacaíocht: *Bímid ag saothrú i gcomhar le grúpaí eile chun tacú le comhshaol atá glan, táirgiúil agus cosanta go maith, agus le hiompar a chuirfidh le comhshaol inbhuanaithe.*

Ár bhFreagrachtaí

Ceadúnú

- Déanaimid na gníomhaíochtaí seo a leanas a rialú ionas nach ndéanann siad dochar do shláinte an phobail ná don chomhshaol:
- saoráidí dramhaíola (m.sh. láithreáin líonta talún, loisceoirí, stáisiúin aistrithe dramhaíola);
- gníomhaíochtaí tionsclaíocha ar scála mór (m.sh. déantúsaíocht cógaisíochta, déantúsaíocht stroighne, stáisiúin chumhachta);
- an diantalmhaíocht (m.sh. muca, éanlaith);
- úsáid shrianta agus scaoileadh rialaithe Orgánach Géinmhodhnaithe (OGM);
- foinsí radaíochta ianúcháin (m.sh. trealamh x-gha agus radaiteiripe, foinsí tionsclaíocha);
- áiseanna móra stórála peitril;
- scardadh dramhuisce;
- gníomhaíochtaí dumpála ar farraige.

Forfheidhmiú Náisiúnta i leith Cúrsaí Comhshaoil

- Clár náisiúnta iniúchtaí agus cigireachtaí a dhéanamh gach bliain ar shaoráidí a bhfuil ceadúnas ón nGníomhaireacht acu.
- Maoirseacht a dhéanamh ar fhreagrachtaí cosanta comhshaoil na n-údarás áitiúil.
- Caighdeán an uisce óil, arna sholáthar ag soláthraithe uisce phoiblí, a mhaoirsiú.
- Obair le húdaráis áitiúla agus le gníomhaireachtaí eile chun dul i ngleic le coireanna comhshaoil trí chomhordú a dhéanamh ar líonra forfheidhmiúcháin náisiúnta, trí dhíriú ar chiontóirí, agus trí mhaoirsiú a dhéanamh ar leasúchán.
- Cur i bhfeidhm rialachán ar nós na Rialachán um Dhramhthrealamh Leictreach agus Leictreonach (DTLL), um Shrian ar Shubstaintí Guaiseacha agus na Rialachán um rialú ar shubstaintí a ídíonn an ciseal ózóin.
- An dlí a chur orthu siúd a bhriseann dlí an chomhshaoil agus a dhéanann dochar don chomhshaol.

Bainistíocht Uisce

- Monatóireacht agus tuairisciú a dhéanamh ar cháilíocht aibhneacha, lochanna, uiscí idirchriosacha agus cósta na hÉireann, agus screamhuiscí; leibhéil uisce agus sruthanna aibhneacha a thomhas.
- Comhordú náisiúnta agus maoirsiú a dhéanamh ar an gCreat-Treoir Uisce.
- Monatóireacht agus tuairisciú a dhéanamh ar Cháilíocht an Uisce Snámha.

Monatóireacht, Anailís agus Tuairisciú ar an gComhshaol

- Monatóireacht a dhéanamh ar cháilíocht an aeir agus Treoir an AE maidir le hAer Glan don Eoraip (CAFÉ) a chur chun feidhme.
- Tuairisciú neamhspleách le cabhrú le cinnteoireacht an rialtais náisiúnta agus na n-údarás áitiúil (m.sh. tuairisciú tréimhsiúil ar staid Chomhshaol na hÉireann agus Tuarascálacha ar Tháscairí).

Rialú Astaíochtaí na nGás Ceaptha Teasa in Éirinn

- Fardail agus réamh-mheastacháin na hÉireann maidir le gáis cheaptha teasa a ullmhú.
- An Treoir maidir le Trádáil Astaíochtaí a chur chun feidhme i gcomhair breis agus 100 de na táirgeoirí dé-ocsaíde carbóin is mó in Éirinn

Taighde agus Forbairt Comhshaoil

- Taighde comhshaoil a chistiú chun brúnna a shainaithint, bonn eolais a chur faoi bheartais, agus réitigh a sholáthar i réimsí na haeráide, an uisce agus na hinbhuanaitheachta.

Measúnacht Straitéiseach Timpeallachta

- Measúnacht a dhéanamh ar thionchar pleananna agus clár beartaithe ar an gcomhshaol in Éirinn (m.sh. mórphleananna forbartha).

Cosaint Raideolaíoch

- Monatóireacht a dhéanamh ar leibhéil radaíochta, measúnacht a dhéanamh ar nochtadh mhuintir na hÉireann don radaíocht ianúcháin.
- Cabhrú le pleananna náisiúnta a fhorbairt le haghaidh éigeandálaí ag eascairt as taismí núicléacha.
- Monatóireacht a dhéanamh ar fhorbairtí thar lear a bhaineann le saoráidí núicléacha agus leis an tsábháilteacht raideolaíochta.
- Sainseirbhísí cosanta ar an radaíocht a sholáthar, nó maoirsiú a dhéanamh ar sholáthar na seirbhísí sin.

Treoir, Faisnéis Inrochtana agus Oideachas

- Comhairle agus treoir a chur ar fáil d'earnáil na tionsclaíochta agus don phobal maidir le hábhair a bhaineann le caomhnú an chomhshaoil agus leis an gcosaint raideolaíoch.
- Faisnéis thráthúil ar an gcomhshaol ar a bhfuil fáil éasca a chur ar fáil chun rannpháirtíocht an phobail a spreagadh sa chinnteoireacht i ndáil leis an gcomhshaol (m.sh. Timpeall an Tí, léarscáileanna radóin).
- Comhairle a chur ar fáil don Rialtas maidir le hábhair a bhaineann leis an tsábháilteacht raideolaíoch agus le cúrsaí práinnfhreagartha.
- Plean Náisiúnta Bainistíochta Dramhaíola Guaisí a fhorbairt chun dramhaíl ghuaiseach a chosc agus a bhainistiú.

Múscailt Feasachta agus Athrú Iompraíochta

- Feasacht chomhshaoil níos fearr a ghiniúint agus dul i bhfeidhm ar athrú iompraíochta dearfach trí thacú le gnóthais, le pobail agus le teaghlaigh a bheith níos éifeachtúla ar acmhainní.
- Tástáil le haghaidh radóin a chur chun cinn i dtithe agus in ionaid oibre, agus gníomhartha leasúcháin a spreagadh nuair is gá.

Bainistíocht agus struchtúr na Gníomhaireachta um Chaomhnú Comhshaoil

Tá an ghníomhaíocht á bainistiú ag Bord lánaimseartha, ar a bhfuil Ard-Stiúrthóir agus cúigear Stiúrthóirí. Déantar an obair ar fud cúig cinn d'Oifigí:

- An Oifig Aeráide, Ceadúnaithe agus Úsáide Acmhainní
- An Oifig Forfheidhmithe i leith cúrsaí Comhshaoil
- An Oifig um Measúnú Comhshaoil
- An Oifig um Cosaint Raideolaíoch
- An Oifig Cumarsáide agus Seirbhísí Corparáideacha

Tá Coiste Comhairleach ag an nGníomhaireacht le cabhrú léi. Tá dáréag comhaltaí air agus tagann siad le chéile go rialta le plé a dhéanamh ar ábhair imní agus le comhairle a chur ar an mBord.

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