

Chapter 2

Air



Air Quality and Transboundary Air Emissions

Introduction

Ireland's air quality currently is good, relative to other EU Member States, but maintaining this standard is a growing challenge. While monitoring stations show that Ireland continues to meet all EU air quality standards, localised air quality issues do arise. Ireland's good air quality is largely thanks to the prevailing clean Atlantic air and the absence of large cities and heavy industry.

In Ireland, air quality has improved significantly over the decades through a number of policy measures at European and national level. The introduction of the smoky coal ban in Dublin in 1990 is a good example of a national policy that led to significant improvements regionally and locally. The phasing out of lead in petrol and improved vehicle emission standards and technologies (where legitimately delivered) are examples of European policy changes that have been aimed at improving the air we breathe.

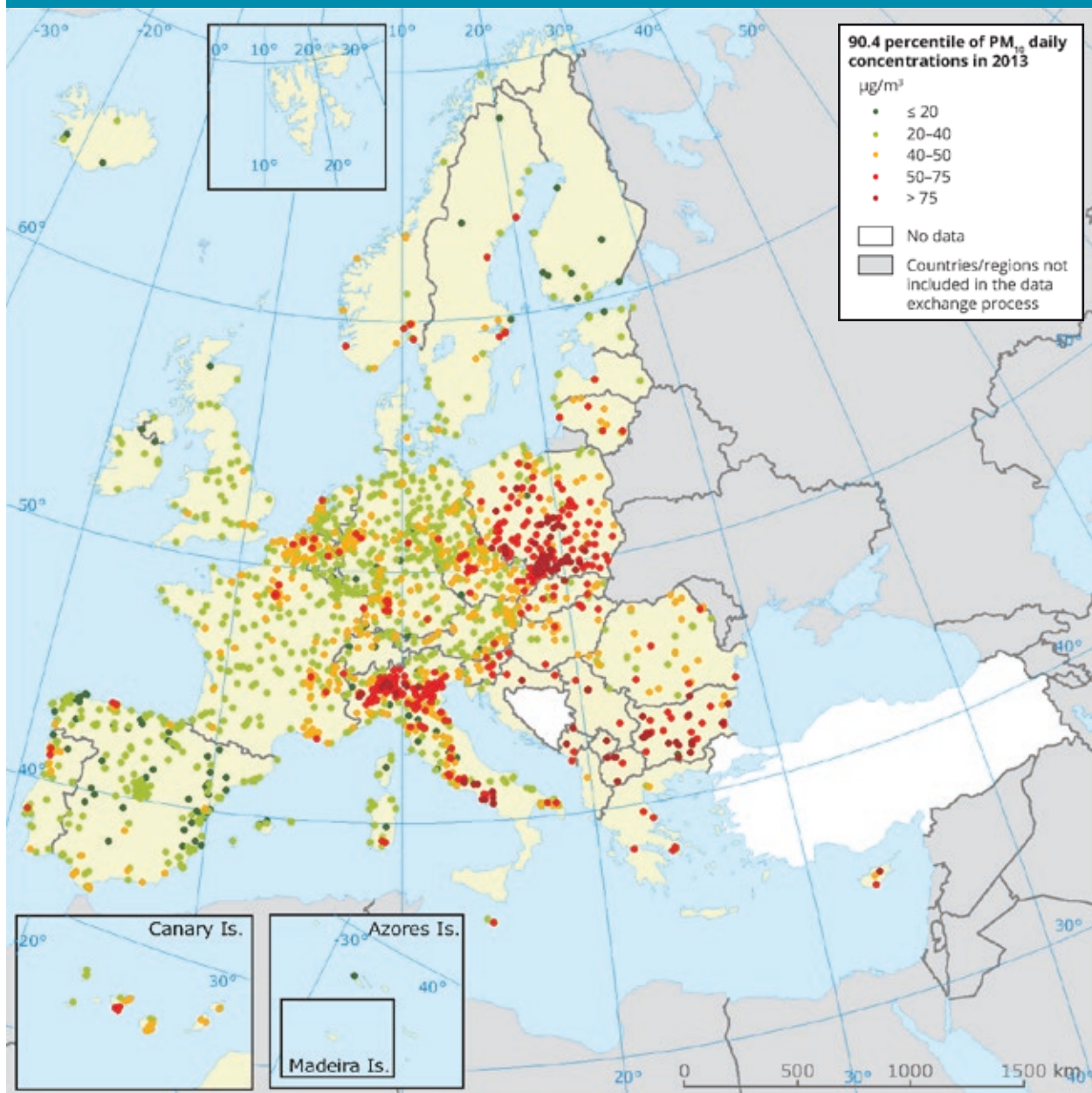
However, in urban areas such as Dublin and Cork, levels of nitrogen dioxide are close to the specified EU limit values for air quality as a result of exhaust emissions from vehicles. Levels of particulate matter (PM) in smaller towns that do not have a smoky coal ban can also be high, sometimes higher than in towns where such a ban is in place.

Vehicle and residential heating emissions also contribute to a higher concentration of greenhouse gases (GHGs) in the atmosphere. This is a global issue which is covered in several sections of this report: the transport sector is covered in more detail in Chapter 10 and the health issues associated with air pollution are highlighted in Chapter 8. Policy action to tackle air quality issues associated with vehicle and residential heating emissions will have co-benefits for GHG mitigation.

Ireland faces many challenges in order to meet new air quality standards for fine particulate matter (PM_{2.5}) concentrations by 2020. Concentrations of polycyclic aromatic hydrocarbons (PAHs) also show a concerning trend in Ireland, with the major source being residential combustion of solid fuel. This chapter makes reference to the World Health Organization (WHO) air quality guidelines for particulate matter (PM₁₀), ozone, nitrogen dioxide and sulphur dioxide (WHO, 2005); and also to the WHO air quality guidelines update, which includes PM_{2.5} (Krzyzanowski and Cohen, 2008). These guidelines were developed by the WHO to inform policymakers and provide appropriate air quality targets worldwide, based on the latest health information available. When the updated WHO health based standards (for PM_{2.5}) are applied, a significantly higher proportion of the urban population are classed as being exposed to harmful levels of air pollution (EEA, 2014). Ireland should adopt these stricter WHO values, particularly for particulate matter and ozone, as with the increased understanding of the science of air quality and its impact on health has come the realisation that compliance with EU air quality limit values is not enough to protect the health of Irish from the negative effects of poor air quality (WHO, 2016).

A key part of the approach to tackling these issues is better engagement with the public on the topic of air quality. The first step in this process is an increased access to air quality data and information. This is highlighted in the EPA's National Ambient Air Quality Monitoring Programme (AAMP) which proposes three main pillars along with under-pinning supporting actions including, a greatly expanded national monitoring network, increased modelling and forecasting capability and an increase in citizen engagement.



Figure 2.1 PM₁₀ Concentrations in Europe in 2013 (Source: EEA, 2013)

For Ireland to continue to comply with its international commitments on air quality and air emissions, industrial emissions of pollutants into the air must continue to be rigorously controlled and policies should be implemented to increase the use of alternatives to the private car and to improve efficiencies of motorised transport. Government departments, national agencies and local authorities need to make air quality an integral part of their traffic

management and planning processes. With respect to the levels of particulate matter and PAHs observed across Ireland, households, in particular, need to use more efficient methods to burn fuel, and a shift from solid fuel to cleaner alternatives, including gas, should be promoted and undertaken, where this is feasible.



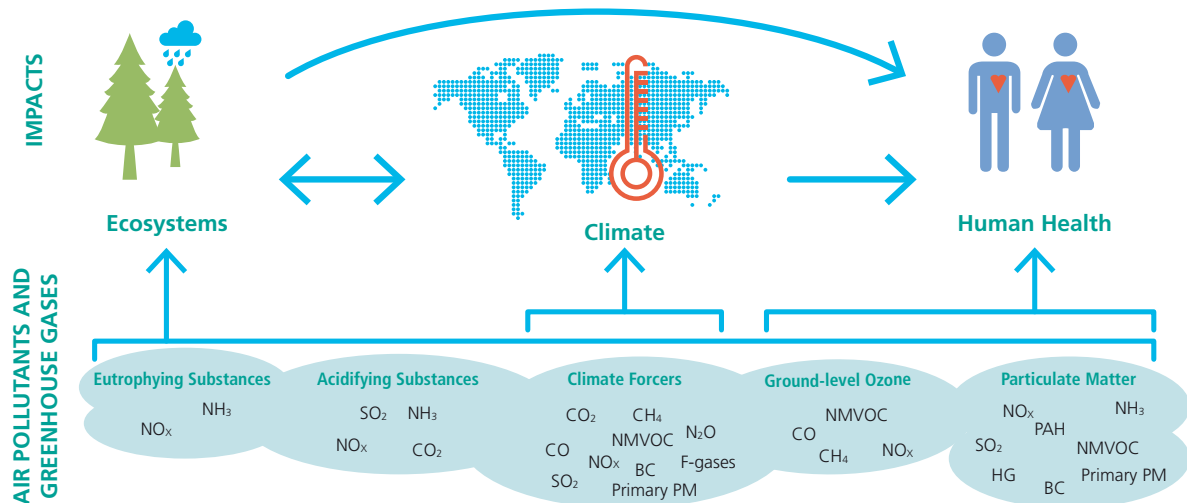
Finally, the clear links between air quality and its effects on health need to be better communicated to the public in a variety of ways, with the provision of more localised information and access to air quality data being paramount. This will allow the public to make informed decisions about their health and it will also provide a policy impetus to make the necessary changes at a local and national level to maintain good air quality and improve it in other circumstances. Ireland will also have to have a greater awareness of the impact of agriculture on air quality, in particular its contribution to emissions of non-methane volatile organic compounds (NMVOCs) and ammonia with the resultant influence on particulate matter (EPA, 2015a). This is particularly important in respect of the planned implementation of Food Wise 2025 which aims to significantly increase agricultural output, in particular from the dairy sector. EPA funded research on ammonia and on critical loads of atmospheric nitrogen show an exceedance of acceptable levels across many habitats due to emissions predominantly from the agricultural sector¹ (www.ucd.ie/ammonia/; EPA, 2013; Kelleghan *et al.*, 2014; EPA, in press).

Air Quality and Health

Air pollution and health impact: a very significant issue in Europe

Under WHO² and EU³ estimates, more than 400,000 premature deaths are attributable to poor air quality in Europe annually, which elevates air quality to being a policy priority. In Ireland the premature deaths attributable to air pollution are estimated at 1,200 people. The most common causes of premature death attributable to poor air quality are strokes and heart disease. The economic impact is also significant, with the increased costs of healthcare and lost working days. A recent report by the OECD concluded that the economic cost of air pollution (in terms of global economic output) will, by 2060, equate to US\$330 per person per annum, or US\$176 billion; and the annual number of work days lost is estimated to rise to 3.7 billion (OECD, 2016). What all of this means at a human level is that, across Europe, tens of thousands of people are losing 3–4 years of their lives because of air pollution, years they could have been spending with their families and communities in good health had they

Figure 2.2 Impacts of Air Pollution (Source: EEA, 2014)



2 www.euro.who.int/en/health-topics/environment-and-health/air-quality/news/news/2014/03/almost-600-000-deaths-due-to-air-pollution-in-europe-new-who-global-report

3 www.eea.europa.eu/media/newsreleases/many-europeans-still-exposed-to-air-pollution-2015/premature-deaths-attributable-to-air-pollution

1 www.ucd.ie/ammonia/

not been exposed to dangerous levels of air pollution throughout their lives. It should also not be forgotten that air pollution has significant impacts on ecosystems and buildings (EEA, 2014).

EU Directives on Air Quality

Co-ordination of air pollution monitoring required to protect health

In order to protect our health, vegetation and ecosystems, EU directives have set air quality standards for a wide variety of pollutants. The current standards are contained in the Directive on Ambient Air Quality and Cleaner Air for Europe (the CAFE Directive 2008/50/EC; and the fourth Daughter Directive 2004/107/EC).⁴ These directives also include rules on how Member States should monitor, assess and manage ambient air quality. The EPA, as the national competent authority for Ireland, is tasked with co-ordinating and managing this monitoring programme. A nationwide network of 31 monitoring stations measures levels of air pollutants in each zone; the majority of these deliver information in real time to the public.⁵ The EPA is currently in the process of developing a new National Ambient Air Quality Monitoring Programme, which will be built on three key pillars:

- national monitoring network;
- modelling and forecasting;
- citizen science/citizen engagement.

The EPA is recommending that the new programme will involve a greatly expanded national monitoring network providing enhanced real-time information to the public and supplemented by an increased local authority capacity to conduct indicative monitoring. The network can be supported and enhanced by increased modelling and forecasting capability, with the aim of providing an ongoing air quality forecast model to the public. Supporting both of these elements will be citizen science initiatives to encourage greater engagement of the public in air quality issues. These changes should greatly improve our national capacity for air quality and public health protection.

Ireland currently participates in an international network of carbon monitoring stations, the International Carbon Observation System (ICOS), with a purpose of improving knowledge of GHG in our atmosphere and harmonising the science⁶, and also participates in the European Monitoring and Evaluation Programme (EMEP)⁷ for international co-operation to solve transboundary air pollution problems. The national ICOS and EMEP stations are located at Malin Head, Donegal; Mace Head, Galway; Oak Park, Carlow; and Carnsore Point, Wexford.



Transboundary Air Emissions

Air pollution has no borders

Air pollution can be transboundary. Pollution that originates in one country can impact negatively on a neighbouring country. Monitoring at national and international EMEP⁸ sites indicates a number of important pathways for transboundary pollution to reach Ireland, e.g from the UK, Europe, North America and from marine sources. Transboundary air pollution is associated with health impacts from fine particulate matter, acidification, eutrophication and ozone formation, which damages ecosystems, vegetation and human health.

The landmark agreements that was intended to control emissions of transboundary pollutants was the 1999 UNECE⁸ Gothenburg Protocol under the Convention on Long-range Transboundary Air Pollution (CLRTAP), was given effect in the EU by the National Emission Ceilings (NEC) Directive 2001/81/EC⁹.

The NEC Directive sets upper limits, or “ceilings”, for national emissions from each EU Member State. The pollutants include sulphur dioxide (SO₂), nitrogen oxides (NO_x), volatile organic compounds (VOCs) and ammonia (NH₃) – which were considered the four key transboundary pollutants.

The amended Gothenburg Protocol now includes targets for 2020 and the NEC Directive will include targets for 2030. Both the Gothenburg Protocol 2020 and the NEC Directive 2030 include ceilings for PM_{2.5} emissions for the first time given the recognition of the health impacts and transboundary nature of fine particulate matter.

4 www.ec.europa.eu/environment/air/quality/legislation/existing_leg.htm

5 www.epa.ie/air/quality/

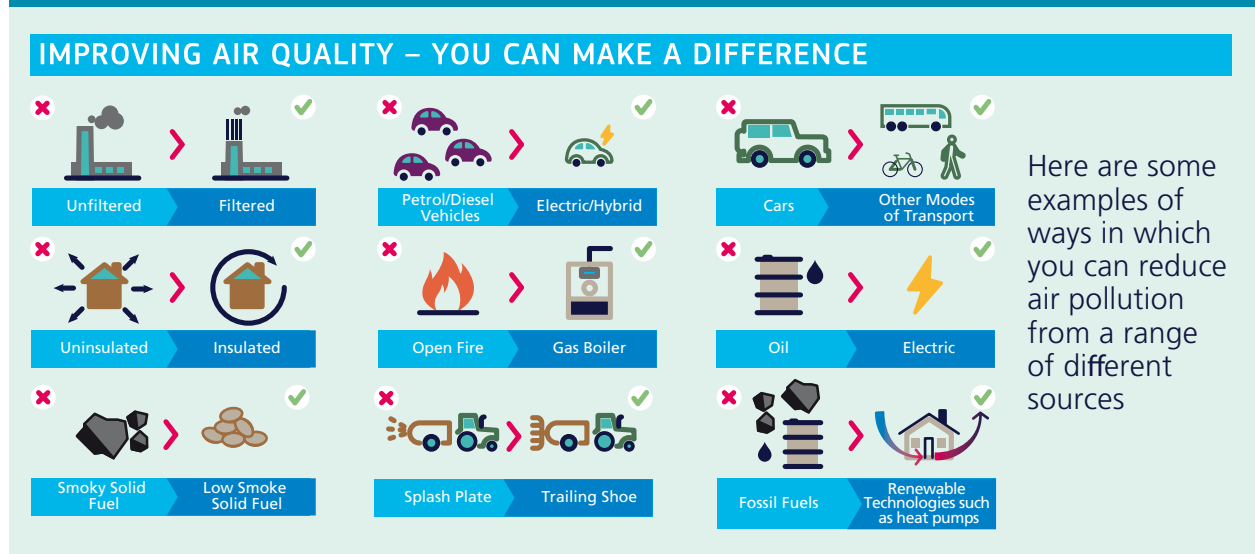
6 www.icos-ri.eu/

7 www.emep.int/

8 UNECE is the United Nations Economic Commission for Europe, which was established in 1947 and tasked with promoting pan-European economic integration.

9 www.ec.europa.eu/environment/air/pollutants/ceilings.htm

Figure 2.3 Air Pollution in Ireland (Source: EPA & DECLG, 2015)



The Current Air Quality Situation in Ireland

Main Air Pollutants

Monitoring is carried out for pollutants that impact on health and vegetation

Air quality monitoring in Ireland is governed by EU legislation which requires the measurement of NO_x , SO_2 , carbon monoxide (CO), ground level ozone (O_3), particulate matter (PM_{10} and $\text{PM}_{2.5}$), benzene, heavy metals and PAHs. Concentrations of these pollutants are then compared with a set of limit and target values for the protection of human health, ecosystems and vegetation. The pollutants of most concern are NO_x , PM and O_3 . Recently, PAHs have also been recognised as a problem pollutant.

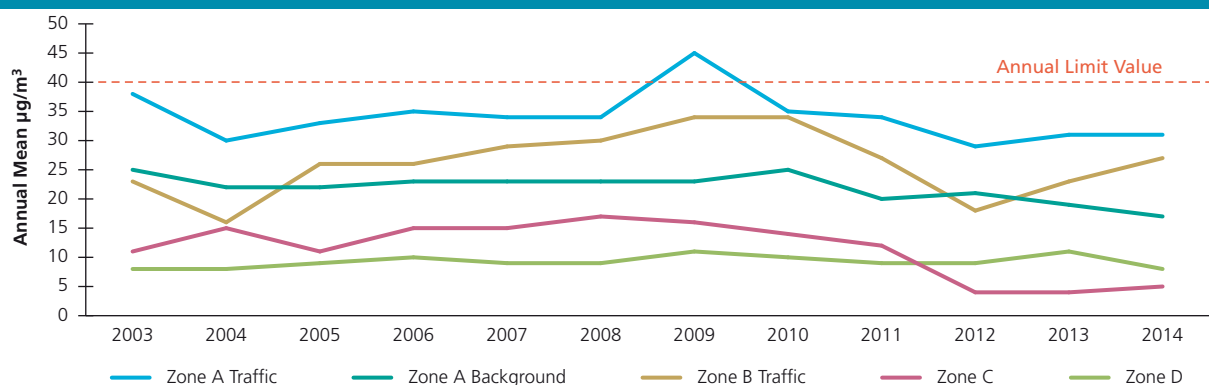
The infographic at Figure 2.3 summarises national air pollution facts and information.

Oxides of Nitrogen (NO_x)

Main source is vehicle exhausts and high temperature combustion sources

NO_x is the collective term for the gases nitric oxide (NO) and nitrogen dioxide (NO_2). The source of NO_x is typically any process of high-temperature combustion, most commonly the burning of fossil fuels in the combustion engines of motor vehicles. Short-term exposure to NO_2 gas is associated with adverse respiratory effects, while NO_x in general contribute to the formation of ground-level ozone and acid rain. NO_2 concentrations in Ireland were static for the period 2008–2014, perhaps because of a combination of the economic downturn and favourable weather. It will be important to remain vigilant to increasing NO_2 levels, particularly from transport, in light of the economic recovery.

Figure 2.4 Annual Mean Nitrogen Dioxide Concentrations 2004–2014 (Source: EPA, 2015)





Particulate Matter (PM₁₀ and PM_{2.5})

A priority for action because of health impacts associated with this air pollutant which has both urban and rural sources

PM₁₀ refers to particles with a diameter of less than 10 micrometres. These particles can penetrate the lungs, while the related pollutant PM_{2.5} refers to particles with a diameter of less than 2.5 micrometres. This smaller size allows them to penetrate the alveoli of the lungs, where gaseous exchange occurs. In Ireland, the main source of particulate matter in ambient air is agriculture (through secondary formation) (EPA, 2015a). However, in urban settings, domestic use of solid fuel and diesel fuelled vehicular traffic are the principal sources. PM₁₀ concentrations have decreased in urban environments since the early 2000s, mainly as a result of the shift from residential solid fuel and developments in diesel particulate filter technology. The picture in smaller towns and villages in Ireland is different, where the predominant source of PM is combustion of solid fuel. Because of the lack of access to cleaner alternative heating sources such as gas, and

also the absence of a ban on the burning of smoky coal, there has been no observed decrease in PM concentrations over the same period (EPA, 2015b). As part of the EU CAFE Directive, the National Exposure Reduction Target (NERT) requires a mandatory 10% reduction in the average concentration of PM_{2.5} across Ireland by the year 2020. This is a challenging reduction and will require an integrated approach across a number of sectors including industrial, agricultural, transport and residential emissions. Figure 2.5 shows annual concentrations from 2004 to 2014 for monitoring sites across Ireland, with reference to the EU limit value and the WHO air quality guideline value for PM₁₀. As can be seen from the graph, at certain monitoring locations in Ireland values are above the WHO air quality guideline levels (WHO, 2016).

Polycyclic Aromatic Hydrocarbons (PAHs)

Pollution sources linked to emissions from traffic and household use of solid fuel

PAHs are organic compounds predominantly originating from solid fuel burning, particularly wood burning and, to a lesser extent, vehicle emissions. PAHs in Ireland are measured by monitoring for benzo[a]pyrene (BaP), which acts as a marker for PAHs and is a potent carcinogen (EEA, 2015). PAH monitoring in Ireland began in 2009, with levels at one of the stations coming close to the limit value of 1 ng/m³ in 2014. A reduction in the use of solid fuel as a home-heating source across Ireland would mitigate PAH impact on air quality into the future.

Ground-level Ozone (O₃)

Not a direct emission but formed as a result of a reaction of a mix of air pollutants during sunny weather

Ozone is a gaseous species that is formed as a secondary pollutant in the ground level atmosphere from the chemical reaction of NO_x, CO and VOCs in the presence of sunlight. Ozone can also be present in the troposphere as a result of downwards flux from the ozone-rich

Figure 2.5 Annual Mean PM₁₀ Concentrations 2004-2014 (Source: EPA)

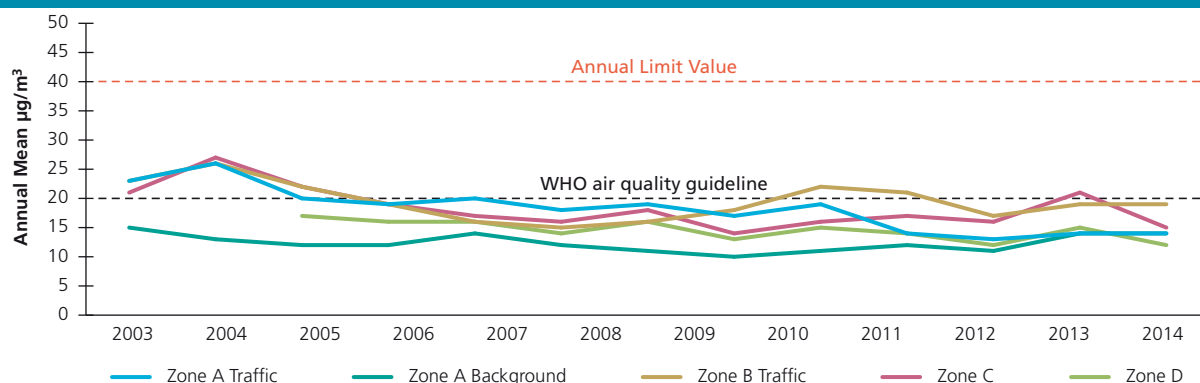
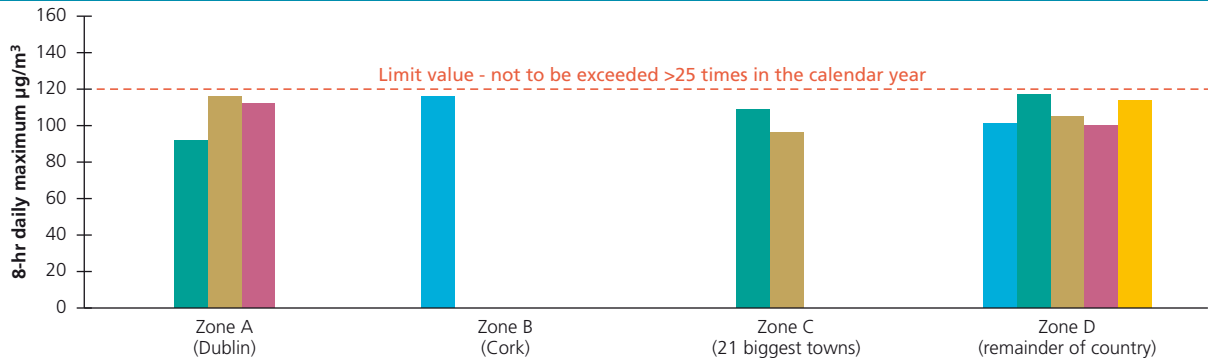


Figure 2.6 Eight-hour Average and Daily Maximum Values Observed at Ozone Monitoring Stations Across Ireland in 2014 (Source: EPA, 2015b)



stratosphere, where it occurs naturally and plays an important role in absorbing harmful UV radiation. Ozone is a powerful oxidising substance whose presence in rural areas damages crops and vegetation. High concentrations of ozone affect the functioning of the respiratory system leading to irritation of the throat and lungs. It is particularly harmful for those who suffer from respiratory ailments such as asthma and bronchitis. Ozone levels in Ireland, which are highly influenced by transboundary sources, are low in comparison with those in mainland Europe. Average concentrations in Ireland are generally below the thresholds for effects on human health and vegetation set down in the CAFE Directive, but can exceed the WHO air quality guideline values for ozone.

Other Pollutants

Most controlled air pollutants show low levels in Ireland

Measured levels for the rest of the legislatively important pollutants are low in Ireland, with concentrations of SO_2 , CO, benzene, lead, arsenic, cadmium, nickel and mercury below all relevant limit and target values (EPA, 2015b).

Quantity of Air Pollutants Emitted

Transboundary Air Pollutants

Emissions of transboundary pollutants have been reducing across Europe

Monitoring of transboundary pollutants in Europe is primarily covered by the 1999 UNECE Gothenburg Protocol under the Convention on Long-range Transboundary Air Pollution (CLRTAP) and the EU NEC Directive. Prior to the Gothenburg Protocol the pollutants that were originally of concern were the gaseous species NO_x , SO_2 and VOCs. These pollutants, which cause acidification, eutrophication and ground-level ozone formation, have shown declining concentrations since the introduction of the legislation. Ammonia (NH_3) was later included in the list of pollutants for the Gothenburg Protocol and more recently, with the replacement of the original legislation with the 2020 Gothenburg Protocol and the 2030 NEC Directive, emissions ceilings for $\text{PM}_{2.5}$ have also been introduced. The current position in Ireland is shown in Table 2.1.

Figure 2.7 NO_x Emission Sources and Trends 1990-2014 (Source: EPA, 2015b)

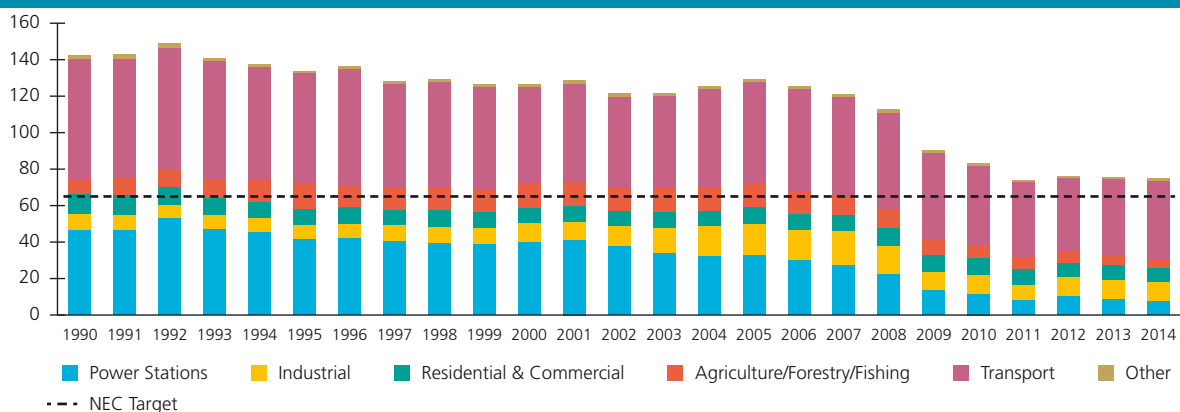


Table 2.1: State of Progress for Limiting Transboundary Air Pollutants in Ireland

Sulphur Dioxide (SO₂)

Overview – Transboundary emissions that can cause acid deposition have significantly reduced in Ireland. SO₂ emissions are linked to combustion processes.

SO₂ is a gaseous species that readily undergoes atmospheric chemistry in water vapour to form sulphuric acid (H₂SO₄) which leads to acidification of ecosystems and damage to vegetation.

Progress against the emission ceiling target

Ireland achieved the 2010 emission ceiling of 42 kilotonnes (kt) in 2009. It is anticipated that Ireland will continue to meet its objectives under the 2020 Gothenburg Protocol and the 2030 NEC Directive.

Key steps towards achieving the target

Fuel switching in the power generation and industrial sectors has aided in the achievement of Ireland's commitments on SO₂. Further reductions in the sulphur content of fuel oil, gas oil, diesel and gasoline, and a decrease in coal and peat use for heating in Irish homes should help maintain this situation.

Oxides of Nitrogen (NO_x)

Overview – Emissions linked to high-temperature combustion. Also relevant to acidification and eutrophication processes.

Any processes that involve high-temperature combustion in the presence of oxygen and nitrogen lead to the production of NO_x as a by-product.

Progress against the emission ceiling target

Ireland is one of the 11 EU Member States that did not meet their 2010 emission ceiling for NO_x.

Key steps towards achieving the target

A reduction in the contribution of transport combustion sources (mainly road transport) will be crucial for Ireland to achieve its commitments under the 2020 Gothenburg Protocol and the 2030 NEC Directive. Technological advances and verified success with real-world applications of Euro 6 emissions standards for vehicles will also be important to achieving the target.

Volatile Organic Compounds (VOC)

Overview – Emissions linked to solvent use and transport.

The main sources of VOC emissions are solvent use, transport and agriculture.

Progress against the emission ceiling target

Ireland's emission ceiling for VOCs is 55 kt and this was achieved in 2009.

Key steps towards achieving the target

Catalyst controls and improved vapour abatement technologies in gasoline vehicles achieved large reductions in VOC emissions. The contribution from solvent use remains relatively constant in absolute terms, although drivers such as population, paint use and pharmachem industrial activity have increased in recent years.

Ammonia (NH₃)

Overview – Emissions risk not meeting EU emissions targets if cattle numbers increase to their pre-2000 levels.

NH₃ emissions can lead to the formation of aerosol particulate matter, and eutrophication.

Progress against the emission ceiling target

The emission ceiling for NH₃ under the previous Gothenburg protocol was 116 kt. Under the revised National Emissions Ceiling Directive, Ireland's targets for 2020 and 2030 have, following EU negotiations, been amended to a 1% reduction for 2020 and a 5% reduction for 2030 (based on a 2005 baseline).

Key steps towards achieving the target

98% of national NH₃ emissions arise from activities in the agricultural sector. This is especially pertinent with the adoption of the planned 2030 NEC target, and Ireland's planned implementation of Food Wise 2025, which will lead to a risk of higher NH₃ emissions.



Other Transboundary Pollutants

Further information on the wide range of transboundary pollutants covered by the Convention on Long-range Transboundary Air Pollution can be found on the EPA website.¹⁰

Responses

EU Legislation

Limits set for ambient air quality by the EU have not been exceeded

Limit values have been established by the European Union based on contributions by environmental and health experts in order to help mitigate the impact on Member State populations. Upon exceedance of these limit values, Member States must implement air quality plans to assess and combat the problem. Since the last State of the Environment report (EPA, 2012), Ireland has not exceeded any EU legislative limit or target values at the stations in the current monitoring network.

Clean Air Policy Package

A new strategy on air pollution from the European Commission

Following a review of the 2005 thematic strategy on air pollution by the European Commission, a new strategy for air quality was announced in 2013. Under the review, the existing ambient air quality legislation remains unchanged, though the 7th Environmental Action Programme¹¹

commits to moving towards the WHO guide values by 2020. Overall national emissions are targeted under a revision of the NEC Directive while emission standards from Medium-sized Combustion Plants (MCP) have been agreed and will come into force for new plant from 2017 and for existing plant in 2025 and 2030 depending on size.¹²

WHO Guideline Values

Stricter air quality standards for key parameters developed

The WHO has devised air quality guidelines for particulate matter (PM₁₀ and PM_{2.5}), BaP, ozone, nitrogen dioxide and sulphur dioxide (WHO, 2005; Krzyzanowski and Cohen, 2008). These guidelines were developed by the WHO in order to inform policymakers and provide appropriate air quality targets worldwide, based on the latest health information available. Since 2012, the EPA's annual reports have been assessing air quality against these much more stringent air quality indicators. There have been exceedances of the guideline values for particulate matter, ozone and PAHs (EEA reference level¹³) and the EPA has called for the adoption of these more stringent WHO guidelines for particulate matter and ozone.

Industry

Emissions of specific air pollutants from industry and power have reduced in recent years

Industrial Emissions (IE) and Integrated Pollution Control (IPC) licensing, enforced by the EPA, help to curb emissions from industry and the power generation sectors of Ireland. This has been effective – trends have shown all pollutants decreasing or holding steady (EPA, 2015a) against a backdrop of increased economic activity, which indicates a decoupling of economic growth and emissions. The introduction of the Medium Combustion Plant Directive will have a positive impact on emissions from industry.

Residential Heating

A significant source of particulates that the extension of the smoky coal ban aims to address

Comparison of national ambient air monitoring results with WHO guideline values for particulates and PAHs shows the need for progress with regard to reducing levels of emissions attributable to residential heating. The ban on the marketing, sale and distribution of bituminous fuel (the "smoky coal ban"), which was first introduced in Dublin in 1990 and extended over the intervening period to 26 other cities and towns, and now also includes a ban on use of such fuels, has proved effective. The implementation of a nationwide smoky coal ban, as announced by Minister

¹⁰ erc.epa.ie/clrtap/

¹¹ www.ec.europa.eu/environment/action-programme/

¹² www.ec.europa.eu/environment/industry/stationary/mcp.htm

¹³ www.eea.europa.eu/themes/air/air-quality/resources/air-quality-map-thresholds



Kelly at the Clean Air Conference in Dublin in September 2015, should help to improve air quality for all citizens. However, continued use of peat and wood will contribute to air pollution in residential areas. EPA funded research being undertaken by a UCC led group (SAPPHIRE)¹⁴ aims to deliver detailed information on the chemical composition and sources of airborne particulate matter in rural and urban residential areas of Ireland so as to assist appropriate health focused policy interventions.

Road Transport

While exhaust emission limits become stricter, this is offset by increases in the numbers of cars

New EU emissions standards for vehicles, cleaner technology, and a reduction in the number of vehicles using the roads as a result of the economic downturn led to a decrease in NO₂ in our urban centres. However, this is unlikely to continue into the future. Economic recovery will most likely lead to an increase in NO₂ levels. The failure of real-world emissions of NO_x Euro 5 class vehicles to meet the standards set for them has had a disproportionate impact on ambient air (EEA, 2015). Euro 5 class vehicles showed a reduction in NO₂ emissions in laboratory tests; however, these reductions were not observed in real-world driving. As a result, projections of NO₂ emission reductions did not come true and an increase in vehicle numbers actually led to increasing NO₂ levels across Europe. Ongoing non-compliance with NO_x ceiling levels is a concern and needs to be addressed. The actions set out in the Department of Transport's *Smarter Travel – A Sustainable Transport Future*¹⁵ should be implemented to improve air quality. These include actions to reduce travel demand, increase alternatives to the private car and improve the efficiency of motorised transport. Enhanced incentives to encourage vehicle owners to switch to electric options should also be encouraged.

Shipping

Loading and unloading activities at ports can have considerable localised impact on emissions of particulate matter

As an island nation, Ireland is heavily dependent on shipping for the import and export of goods. Sulphur dioxide is a pollutant that is closely linked to shipping. As the economy continues to recover, activity in this sector is likely to increase. In-port activities associated with loading and unloading can also have a considerable local and regional impact on emissions of particulate matter. The 2012 revision of the Directive on the sulphur content of liquid fuels (SI No. 273 of 2014), which ensures that liquid oils and gas oils have a maximum sulphur content of 1% and 0.1% respectively, has had a positive impact on observed SO₂ levels.

Transboundary Air Pollution

Relative to other EU countries, Ireland rarely experiences transboundary air pollution impacts

Although Ireland's prevailing wind direction is from the south-west, bringing in a cleaner North Atlantic air mass, occasionally transboundary air pollution from continental Europe (and, more rarely, pollution from volcanic eruptions in Iceland) and beyond arrives. Springtime transboundary events bringing elevated particulate matter associated with Saharan dust have been a feature. There has also been a number of short-term air pollution episodes associated with European generated ozone, particulate matter and NO_x. These are likely to continue into the future. With regard to ozone and NO_x, a pan-European approach is required to tackle the problem. Recent research has suggested that a portion of the 'Saharan' dust may in fact be due to transboundary ammonia induced particulate matter (Vieno *et al.*, 2016). The European Commission has made a start in this regard by agreeing the "EU Clean Air Policy Package", the main components of which are:

- A Clean Air Programme for Europe, describing the problem and setting out new interim objectives for reducing health and environmental impacts up to 2030. It also defines the necessary emission reduction for the key pollutants and the policy agenda that will be necessary to achieve these objectives
- A revised NEC Directive, containing updated national ceilings (caps) for six key air pollutants (PM, SO₂, NO_x, VOCs, NH₃ and CH₄ (methane) for 2020 and 2030
- A new Directive for Medium-sized Combustion Plants between 1 and 50 MWth
- A ratification proposal for the amended Gothenburg Protocol under the 1979 UNECE Convention on Long-range Transboundary Air Pollution.

¹⁴ www.ucc.ie/en/crac/research/sapphire/

¹⁵ <http://www.smartertravel.ie>

EPA Air Research Programme

Between 2007 and 2015, the EPA funded over 50 air-related research projects, with a total commitment of approximately €11 million. The projects funded include desk studies, fellowships, as well as small- and medium-scale projects.

The air research theme deals with (1) urban and rural air quality, (2) transboundary air pollution, (3) ecological effects, as well as health impacts, (4) emissions inventories and projections, (5) sources of air pollution, notably industrial, agricultural, residential and transport and (6) cross-cutting issues with climate change. The research programme encourages a broad stakeholder engagement including the business community, NGOs, civic society and the public. The outputs of EPA-funded research have informed national thinking, contributed to EU analysis, and have been presented and used in UN forums, including the UNECE LRTAP Convention.

More details are available at: www.epa.ie/researchandeducation/research/researchpillars/climate/

Key Achievements of Air Pollution Research

- Development of the EMEP transboundary air pollution monitoring network and support for activities at Mace Head and Valentia (Global Atmospheric Watch sites for the World Meteorological Organization).
- Development of a volcanic ash model (developed after the eruption of Iceland's Eyjafjallajökull volcano). This model has subsequently been adopted by the Irish Aviation Authority as one of its tools to determine the risk to flights in the event of a volcanic eruption.
- Emission inventories for (1) certain combustion parameters from a number of sources including transport, small-scale combustion installations and residential combustion, (2) ammonia from agricultural installations and (3) persistent organic pollutants.
- Integrated modelling – co-benefits and trade-off for air quality and climate change policies (e.g. “dieselification” and increased biomass burning).
- Highlighting that air quality is also an issue outside large towns and cities, especially for those places where solid fuel is prevalent, e.g. off the natural gas grid or outside the ban areas for smoky coal. Identification, using source apportionment techniques, that residential combustion of solid fuels is a significant contributor to air pollution in small towns.
- Development of critical loads for designated habitats under the EU Habitats Directive (92/43/EEC); assessment of the influence of transboundary air pollution on Irish lakes and soils; baseline ammonia deposition rates (and deposition map) for Ireland; assessment of the influence of ammonia emissions from intensive agricultural installations on designated habitats under the EU Habitats Directive.
- Research on bioaerosol monitoring techniques.
- Development of an air quality forecast model.
- Use of source apportionment techniques (monitoring and modelling) for local and transboundary air pollution.

Priority Areas for Air Pollution Research

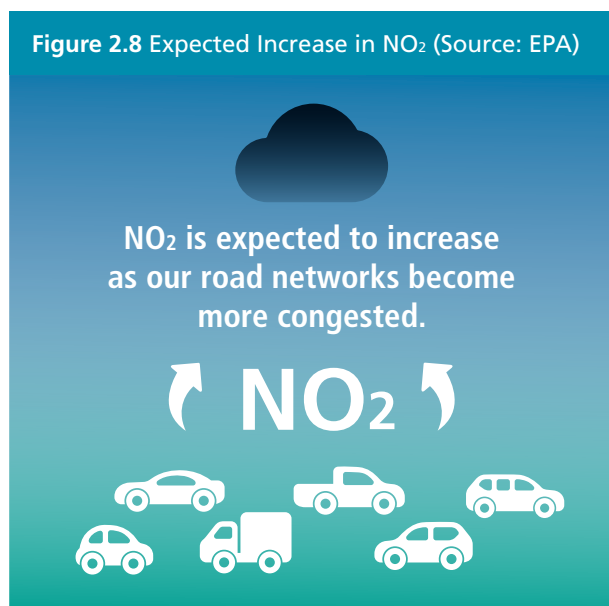
- Supporting the national clean air strategy (drafting in progress), with a particular focus on the CAFE Directive, the WHO guidelines and the LRTAP Convention.
- Ensuring that the policies designed to meet air quality requirements match those policies designed to meet climate change imperatives.

Outlook for Air Quality in Ireland

Reducing particulate matter in air is a key health target that will need wide engagement and sector targets for transport, energy and agriculture

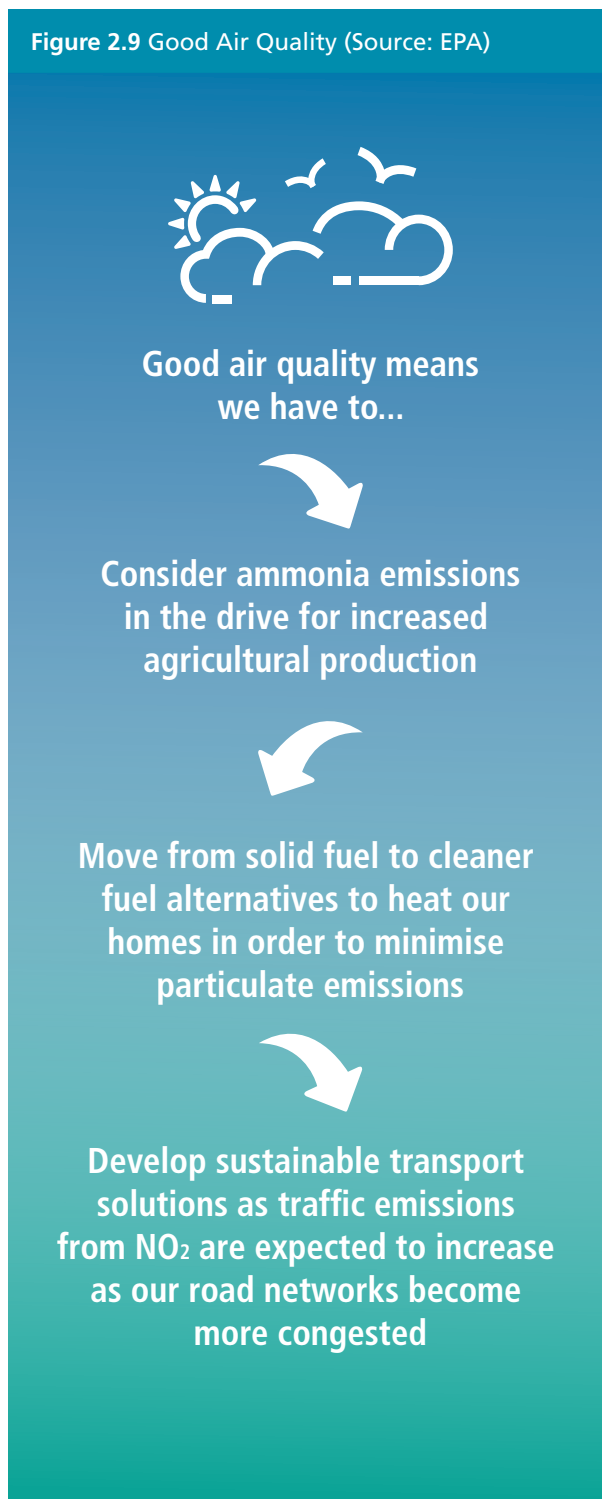
Air quality in Ireland is generally of an acceptable standard. Currently, we are not in exceedance of any EU legislative or target values. However, when compared with the more stringent WHO guideline values and EEA reference level values, ozone, particulate matter and PAHs emerge as pollutants of concern in the short term, while NO₂ is expected to increase as our road networks become more congested. With regard to PM_{2.5}, under the National Exposure Reduction Target (NERT) Ireland is obliged to reduce annual average PM_{2.5} levels by 10% before 2020 from a baseline level. This will prove challenging if activity in a number of sectors increases without any consideration of abatement or alternatives.

Figure 2.8 Expected Increase in NO₂ (Source: EPA)



Continuing emissions from domestic solid fuel use are contributing to high levels of particulate matter and PAHs in villages, towns and cities. The nationwide ban on smoky coal due in 2018 will have an impact on levels of particulate matter, particularly in rural towns and villages. However, there is a need for regulation of solid fuel beyond coal. Peat burning is still prevalent in many parts of the country – most particularly in rural areas – and contributes significantly in terms of particulates. Wood and peat burning is emerging as a potentially significant contributor to PAH and particulate matter levels in Ireland, along with a wide variety of other solid fuel products that are on the market. In the case of industry there are mitigation options available, particularly through the use of electrostatic precipitators, for example, and in the residential sector there are non-combustion options for heating.

Figure 2.9 Good Air Quality (Source: EPA)



Essential to the goal of improving our air quality will be a shift for Irish consumers from solid fuel to cleaner fuel alternatives, along with an awareness of the impact our choice of fuel for home heating has on the air quality and the impacts on our locality.

Incentives for people to use alternatives should continue to be encouraged at a national level.

Figure 2.10 Clean Air Strategy (Source: EPA)



Air quality pollutant concentrations in Ireland depend on a number of factors, some of which are beyond our control – such as the weather, population size or the economy. However, the most important influence on these levels of concentration, which we very much have within our control, is the quantity of pollutants being emitted by the various sectors – industry, residential, agricultural and transport. Any decrease in quantity of emissions from these sectors, or any shift to cleaner fuel sources, will yield benefits for air quality and, thus, will lead to health benefits for the population.

Conclusions and Future Challenges

To ensure better health status for our population, we should not be complacent about our air quality

In order for all Irish citizens to experience good air quality, a number of steps must be taken in relation to our regional and local emissions of particulate matter, ozone, PAHs and NO_x. First, the passing of WHO guideline values into EU and Irish legislation would provide a real impetus for action in this area. To support this change in legislation, there is a need for increased air quality monitoring. This need is mirrored by a desire from the public for greater access to air quality data and information and a proposed solution is outlined in the EPA's National Ambient Air Quality Monitoring Programme (AAMP). In addition, the Department of Communications, Climate Action and the Environment (DCCAIE) is in the process of developing a clean air strategy for Ireland, which should highlight some of these issues and propose some policy solutions. The introduction of the nationwide ban on smokey coal in 2018 is to be welcomed and should help shift the use of solid fuel to cleaner alternatives, including gas. Government incentives for businesses and private home owners should be expanded to encourage a switch to cleaner energy alternatives. Group schemes for gas installations off the national grid should be encouraged, in the same way as already existing water schemes.

Regulation of all solid and biomass fuels, coupled with the introduction of a national fuel testing laboratory service, should be prioritised as a matter of urgency to keep pace with the rate of change in the fuels market. Regulation of stove emissions along with an information campaign on the use and maintenance of various solid fuel appliances, should be implemented. A national campaign for greater energy efficiency in our homes and workplaces would also help, as this would lead to a reduction in energy demand. This in turn should lead to reductions in emissions. Reduced energy demand through greater energy efficiency would also help Ireland meet its climate change targets. The work and programmes of the Sustainable Energy Authority of Ireland (SEAI) and local schemes such as the Tipperary 'Superhomes'¹⁶ are particularly important in this regard.

Pathway to Good Air Quality

Ireland is required to meet its international commitments on air quality and 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.

The implementation of the revised NEC Directive across Europe, as part of the EU Clean Air Policy Package, will have a positive impact on background levels of pollutants in Ireland, particularly NO_x, and possible future impacts for ammonia. A rise in ammonia through agricultural expansion could lead to an increase in the secondary formation of particulate matter – this issue needs to be monitored carefully in the coming years. Measures such as anaerobic digestion of animal wastes with associated energy recovery and low-emission land spreading practices can have multiple benefits for air quality, water quality and climate change.

Tackling transport sector pollutants will require

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a combination of secured national investment, advancements in technology, policy developments and, most importantly, a shift in behaviour by us as individuals where we are provided with viable alternatives. While there is hope that technological advancements will yield improved reductions in pollutants from motorised vehicles, or potentially a viable alternative to fossil fuel as a motor fuel, these improvements are aspirational and for an indefinite time in the future. Policy changes can be implemented immediately and will yield results more quickly. Emphasis and priority should be given to public transport or clean transport over conventional internal combustion vehicles in all aspects of society. However, it is the individual choices that people make that will have the most immediate and greatest impact on transport emissions in our urban areas where NO₂ is problematic and where public transport is a viable option.

Ireland's air mass is subject to occasional transboundary impacts of pollutants, in particular ozone and particulate matter. To tackle this problem, an integrated, pan-European approach is needed to reduce the levels of ozone precursor compounds in our air.

To tie all these strands together, education will be of paramount importance, particularly increasing public awareness and understanding of the link between air quality and health. Many of the sources of air pollutants are also the sources of GHGs, so an increased understanding and policy alignment of air quality and climate change is essential. More research is needed into the links between air quality and public health, specifically in order to develop a better understanding of the links between air quality data and the health impacts and mortality rates associated with pollution. This understanding will help to identify the critical issues and help policymakers implement the necessary changes to improve our air quality and associated public health.

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