Clean Air Strategy for Northern Ireland

A Public Discussion Document

November 2020

Sustainability *at the heart of a living, working, active landscape valued by everyone.*

Department of
Agriculture, Environment and Rural Affairs
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Executive Summary

Clean air is vital for human health and our natural environment. Increasingly, research is showing us that the effects of air pollution on human health are more complex and widespread than previously thought.

In Northern Ireland, we face similar issues with air pollution to the rest of the UK and Europe - most notably, levels of nitrogen dioxide found in urban centres, arising principally from road traffic, in particular, diesel engines. In addition to this, we have problems with emissions from household heating and from agriculture.

Northern Ireland has not had its own dedicated Clean Air Strategy before now. There is, however, increasing recognition that existing air quality policy and frameworks are not delivering the expected improvements in air quality.

There is a wide range of policy options set out in this public discussion document. They are based on research, on examples of best practice elsewhere, and on our understanding of the air quality problems in Northern Ireland. This document represents a comprehensive review of air quality policy and legislation in Northern Ireland and invites views on possible solutions to take forward. Some of these solutions may be related to decarbonisation of the energy sector, and we refer to these in the relevant chapters.

Chapter 1 in this document looks at air quality in Northern Ireland and the levels of pollutants we monitor. It examines the health impacts of air pollution and looks at trends in the levels of air pollutants here.

Chapter 2 looks at air pollution from road transport. Greater Belfast area is one of 37 UK reporting areas that in 2015 breached the EU Air Quality Directive's annual mean limit value for nitrogen dioxide. The levels of this pollutant that we measure here come primarily from road traffic.

Chapter 3 examines air pollution from household burning of solid fuel, which takes place to a greater extent in urban areas of Northern Ireland compared with urban areas in the rest of the UK. Levels of particular pollutants monitored here show that solid fuel burning presents air pollution risks in urban centres. In addition, solid fuel burning is a major contributor to winter pollution episodes.

The agriculture sector in Northern Ireland produces high levels of ammonia, an air pollutant that can damage sensitive habitats, as well as contribute to levels of fine particulate matter. **Chapter 4** deals with agricultural emissions.

Chapter 5 considers emissions from industry, and the regulatory regimes that are currently in place to limit them.

Chapter 6 looks at the Local Air Quality Management (LAQM) system. This system was set up in the early 2000s, and supports councils in their review of air quality. The LAQM system is underperforming in that it is not showing us improvements in air quality from one year to the next.

Finally, **Chapter 7** looks at how we might increase the effectiveness of our communications, which relate to both the impacts of air pollution, as well as the actions that individuals can take to reduce air pollution.

This document is intended to provoke discussion towards policy options that could contribute to meeting the challenges associated with achieving the following Outcomes of the Northern Ireland Civil Service (NICS) Outcomes Delivery Plan:

Outcome 2 - 'We live and work sustainably - protecting the environment';

Outcome 4 - 'We enjoy long, healthy, active lives'; and

Outcome 12 - 'We give our children and young people the best start in life.'

In doing so, we also promote the DAERA's core Vision, which is that we may enjoy

'Sustainability at the heart of a living, working, active landscape, valued by everyone'.

Chapter 1 - The Background: Sources and Effects of Air Pollution

1.1 Health and Mortality Impacts of Air Pollution

The health effects of air pollution are now well established and backed up by research that shows clear links between air pollution and negative health outcomes.

A report published by Public Health England in 2014 estimated that in 2010, 553 deaths in over-25s in Northern Ireland were attributable to exposure to anthropogenic air pollution ($PM_{2.5}$[1]). The fraction of mortality due to anthropogenic air pollution in Northern Ireland district council areas ranged from 5.2% in Belfast to 2.5% in Fermanagh with an average for Northern Ireland being 3.8%.[2] The report estimated that, overall, deaths in the whole of the UK due to $PM_{2.5}$ exposure was ca. 5.3%.

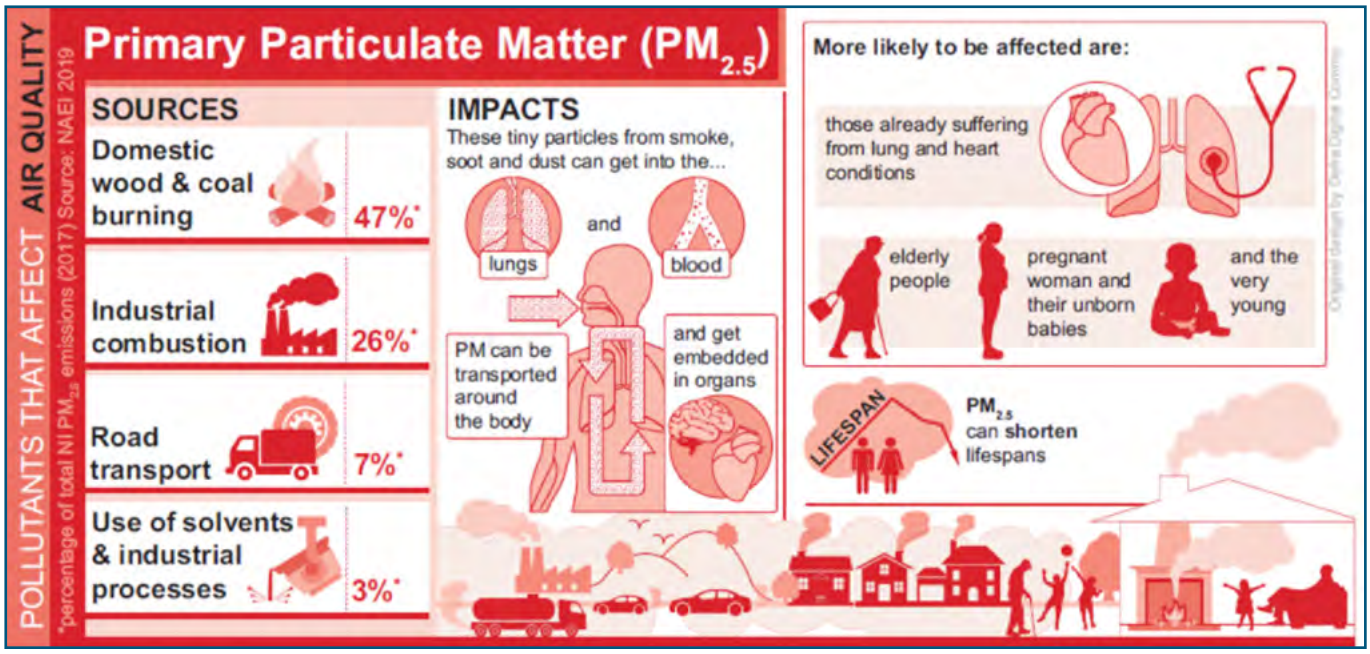
A report published by the Committee on Medical Effects of Air Pollution contains an estimate of annual UK deaths due to exposure to air pollution of between 28,000 and 36,000 people.[3] This analysis takes into account exposure to two major air pollutants - nitrogen dioxide, NO_2, and particulate matter, $PM_{2.5}$. These two air pollutants are more generally found at levels of concern than others.

Meanwhile, the International Agency for Research on Cancer (IARC) has classified outdoor air pollution - as a whole - as a cancer-causing agent (carcinogen).[4]

1 PM2.5 refers to fine particulate matter, suspended in the air, where the diameter of particles is 2.5 micrometers or less. Levels of $PM_{2.5}$ are measured in microgrammes per cubic meter of air: See infographic on page XX.
2 Public Health England, Estimating Local Mortality Burdens Associated with Particulate Air Pollution, 2014, p21. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/332854/PHE_CRCE_010.pdf
3 COMEAP, 2018, Associations of long-term average concentrations of nitrogen dioxide with mortality: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/734799/COMEAP_NO2_Report.pdf
4 WHO, IARC: 'Outdoor air pollution a leading environmental cause of cancer deaths': https://www.iarc.fr/wp-content/uploads/2018/07/pr221_E.pdf

1.2 Air Pollutants of Concern

Fig 1-1 Particulate matter ($PM_{2.5}$)



Note: all pollutant infographics courtesy of Defra Digital Comms, 2019. Figures are specific to NI, from the UK National Atmospheric Emissions Inventory 1990-2017.[5]

Particulate matter (PM) consists of fine particles that, once in the air, are harmful to human health. Particulate matter can be classified as either particles with a diameter of less than 10 micrometers (PM_{10}) or even smaller, as $PM_{2.5}$ (particles with a diameter of less than 2.5 micrometers). Smaller particles, such as $PM_{2.5}$, are more harmful, because as well as acting as a respiratory irritant, they can penetrate deeper into the lungs. The very smallest particles, ultrafine $PM_{0.1}$ (the smallest fraction of $PM_{2.5}$), are nano-particles smaller than 0.1 microns and are thought, once inhaled, to be able to pass directly into the bloodstream. The available evidence suggests that long-term exposure to $PM_{2.5}$ can lead to premature mortality.

PM is formed as a by-product of burning fuels, in particular solid fuels. The biggest sources of PM in Northern Ireland are domestic wood and coal burning, industrial combustion and road transport. Particles from brake wear, tyre wear and road surface wear currently constitute 60% and 73% (by mass), respectively, of particulate matter emissions from road transport, and will become more dominant in the future.[6] Increasingly, evidence is emerging to show that ammonia emissions (which are predominantly from agricultural activities) are a significant source of PM, as ammonia reacts with other air pollutants to form PM.

5 National Atmospheric Emissions Inventory, *Air Quality Pollutant Inventories for England, Scotland, Wales and Northern Ireland, 1990-2017*: https://uk-air.defra.gov.uk/assets/documents/reports/cat09/1910031755_DA_Air_Pollutant_Inventories_1990-2017_Issue_1.1.pdf

6 Air Quality Expert Group, *Non-Exhaust Emissions from Road Traffic,* 2019*:* https://uk-air.defra.gov.uk/assets/documents/reports/cat09/1907101151_20190709_Non_Exhaust_Emissions_typeset_Final.pdf

Regulations controlling PM

EU Air Quality Directive 2008/50/EC; Air Quality Standards (NI) Regs 2010 (limits on concentrations of PM in ambient air), EU National Emissions Ceilings Directive - limits on total emissions on PM.[7]

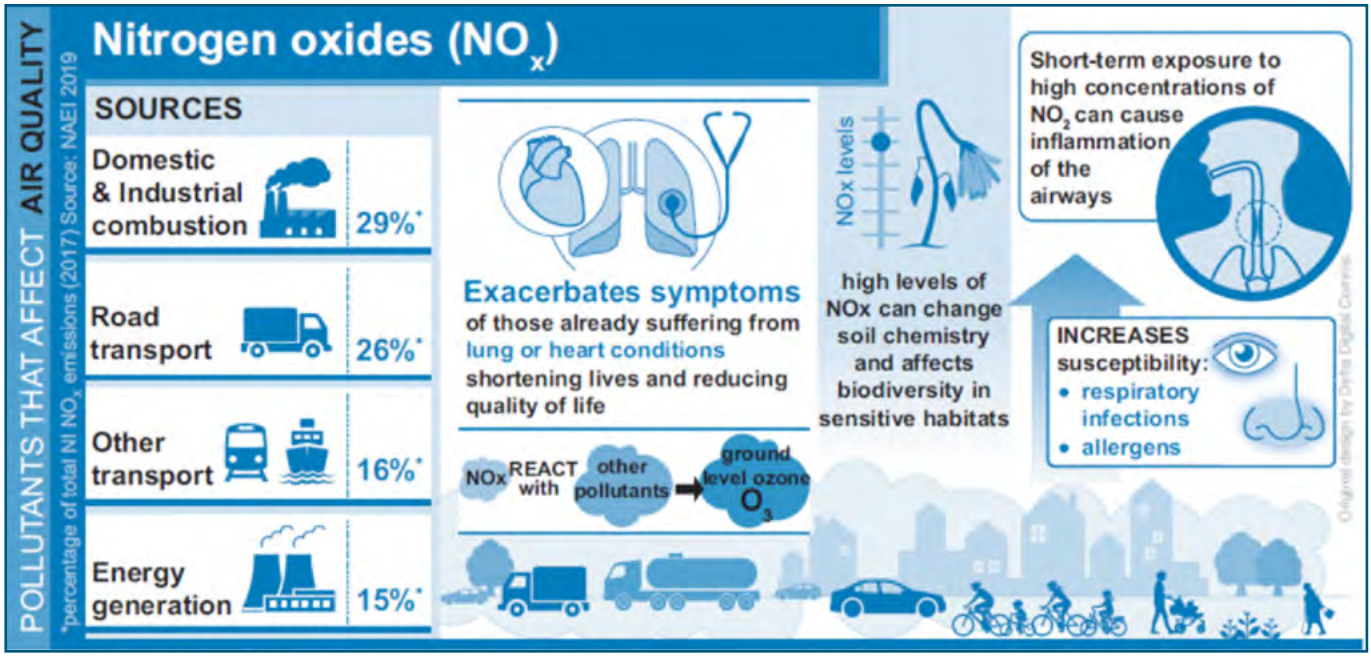
EU Vehicle Standards Regulations (Euro-class vehicles), (limits on the amount of PM permitted in exhaust fumes).[8]

EU Industrial Emissions Directive and Pollution Prevention Control (NI) Regulations (limits on the amount of PM emitted by industrial processes and e.g. power generation).[9]

PM monitoring in Northern Ireland

Ten sites (PM_{10}); two sites ($PM_{2.5}$). No exceedances observed from 2011-2017.

Fig 1-2 Nitrogen oxides (NO_x)



Nitrogen oxides (NO_x) is the term used for two oxides of nitrogen - nitrogen monoxide, NO, and nitrogen dioxide, NO_2. Nitrogen dioxide is the main species of concern, which can cause health effects; however, most NO, when emitted into the air, rapidly reacts with oxygen to form NO_2. NO_2 can exacerbate symptoms of heart and lung conditions, thereby reducing quality of life for affected individuals. NO_2 can also adversely affect plant life and biodiversity in sensitive habitats.

7 Information on a range of air quality legislation, including EU Directives and NI regulations can be found on the Department's website: https://www.daera-ni.gov.uk/articles/air-quality-monitoring-policy-and-legislation
8 http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32007R0715&from=en
9 https://www.daera-ni.gov.uk/articles/industrial-emissions-directive

The major sources of NO_x are domestic, industrial combustion and road transport. The NO_x emitted by road transport, however, poses more of a problem for local air quality, because it leads to increased concentrations of this pollutant at ground level, sometimes in busy streets. Monitoring and modelling of NO_2 concentrations show that this pollutant is a problem at a number of roads and monitoring sites in Northern Ireland.

Regulations controlling NO_x and NO_2

Air Quality Directive 2008/50/EC and Air Quality Standards (NI) Regulations.

National Emissions Ceilings Directive - sets limits for total amount of NO_x emitted by Member States.

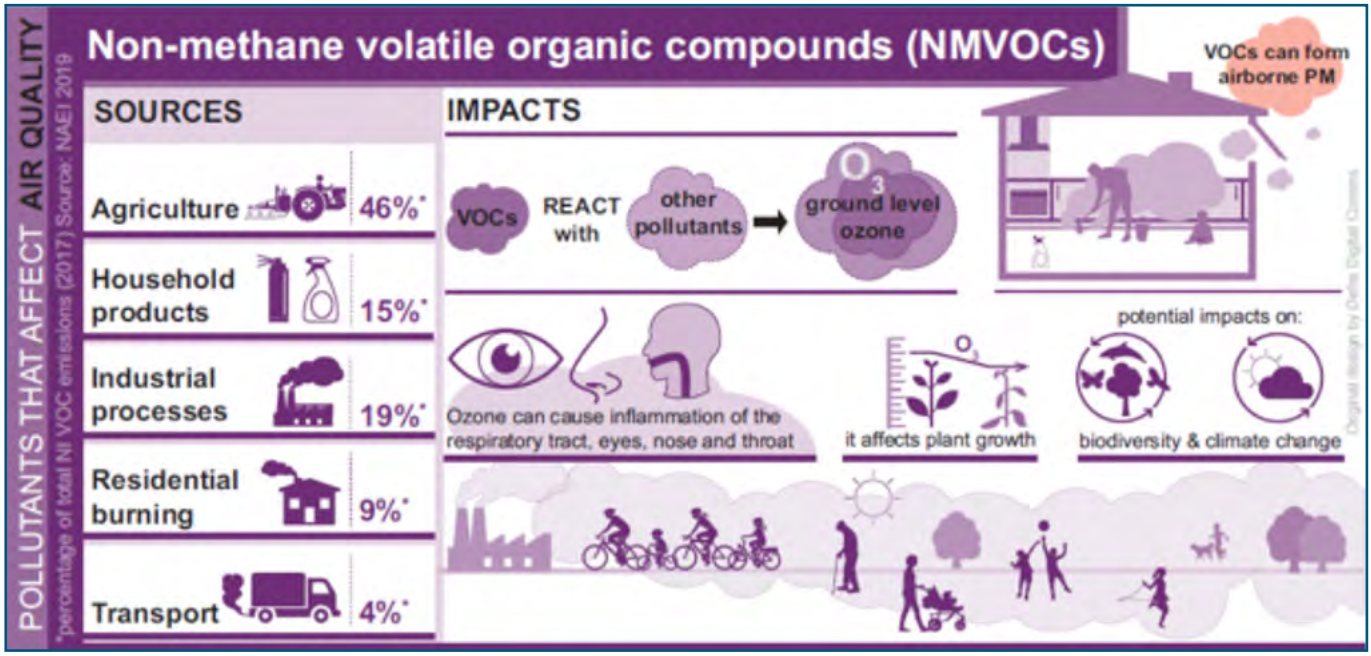
Industrial Emissions Directive - sets limits for the amount of NO_x emissions permitted for industrial processes and e.g. power generation.

EU Vehicle Standards Regulations - set limits for the amount of NO_x permitted in vehicle exhaust emissions.

NO_2 monitoring in Northern Ireland

Monitored at 16 sites; exceedances reported at three sites during 2017: Belfast Stockman's Lane, Downpatrick Roadside; and Dungiven (extrapolated value).

Fig 1-3 Volatile Organic Compounds (VOCs)



Volatile organic compounds can occur naturally, as emissions from vegetation, and as man-made emissions from, for example, household products, industrial processes and burning fossil fuels. In Northern Ireland, the biggest source of VOCs is agriculture. VOCs can persist for long periods in the air and, when they react with other air pollutants - in particular nitrogen oxides, NO_x, in the presence of sunlight - they can lead to the formation of ground-level ozone. Ground-level ozone is therefore a secondary air pollutant, that is not emitted directly, but rather is formed from other air pollutants. Levels of VOCs are monitored much less than other air pollutants.

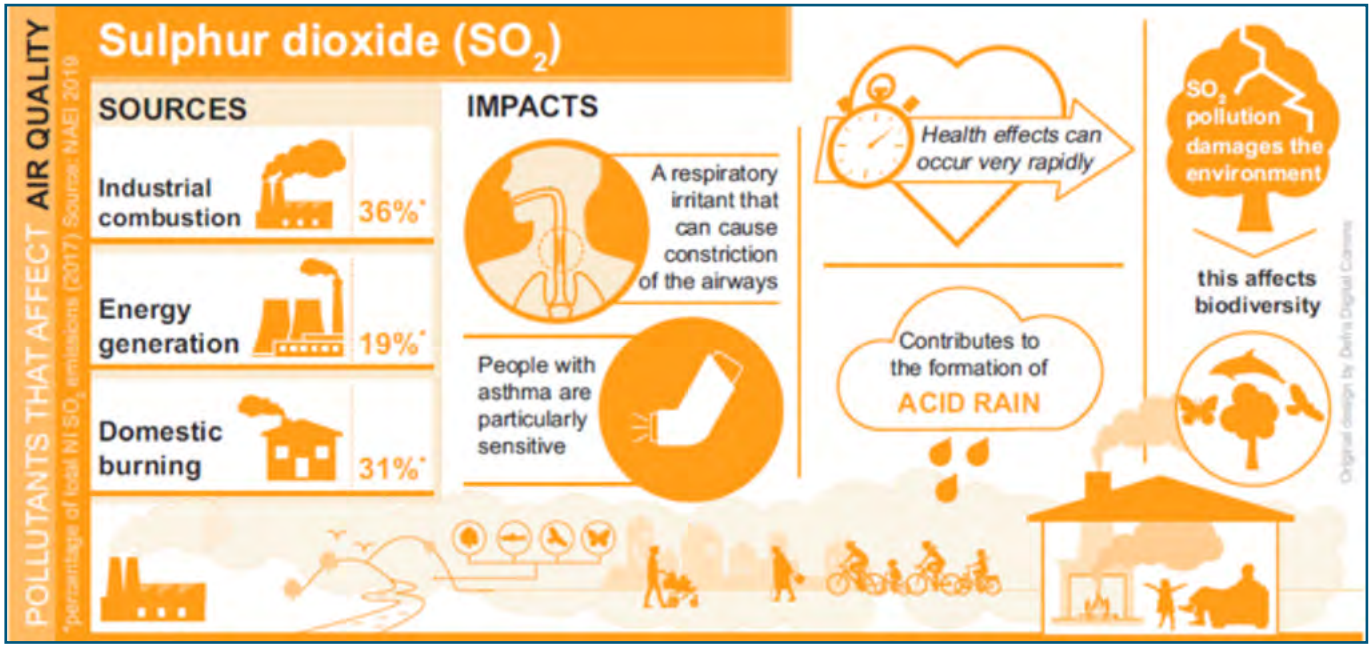
Ground-level ozone should not be confused with stratospheric ozone, found much higher up in the atmosphere, which protects us from harmful ultraviolet radiation. Ozone at ground level has a wide range of harmful effects: it can cause inflammation of the respiratory tract and damage plant growth. Ozone, once formed, is a transboundary pollutant, in that it can persist in the atmosphere and be transported long distances. Ozone levels can vary from year to year because of weather conditions and transboundary transport.

Regulations controlling VOCs:

National Emissions Ceilings Directive - sets limits for total emissions of VOCs.

Stage I and Stage II Petrol Vapour Recovery Directives - set limits on the amount of VOCs that may be emitted by industrial processes; require petrol vapour recovery equipment to be installed at filling stations.[10]

Fig 1-4 Sulphur dioxide (SO_2)



10 http://ec.europa.eu/environment/industry/stationary/petrol.htm

Sulphur dioxide is an acidic gas with a pungent, choking odour. It can be produced naturally, such as from volcanic eruptions, but the main sources of concern are man-made. Sulphur dioxide is produced as a by-product when fuels that contain small amounts of sulphur are burned: these are invariably fossil fuels such as coal, oil and gas. The largest sources of sulphur dioxide in Northern Ireland are power generation and solid fuel combustion (particularly household heating).

Sulphur dioxide can have direct health effects - particularly on sensitive individuals such as those with asthma - because it is a rapidly acting respiratory irritant. It can also lead to the formation of acid rain which damages plant life and biodiversity.

Regulations controlling sulphur dioxide

Air Quality Directive 2008/50/EC and the Air Quality Standards (NI) Regs 2010 - set limit values for the levels of sulphur dioxide in ambient air.

National Emissions Ceiling Directive - sets limits for total emissions of sulphur dioxide.

Industrial Emissions Directive and Regulations (limits on the amount of SO_2 emitted by industrial processes and e.g. power generation).

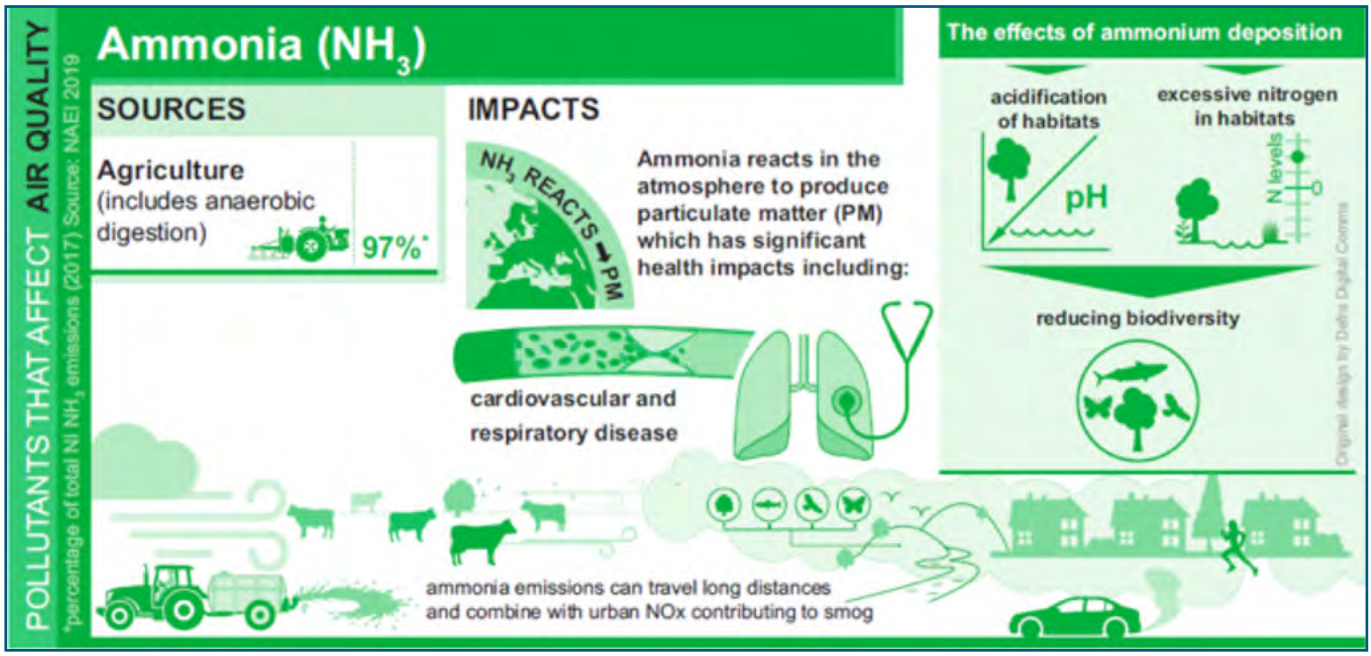
Sulphur Content of Liquid Fuels Regulations; Sulphur Content of Solid Fuels Regulations - set limits for the amount of sulphur that is permitted in fuels.[11]

Sulphur dioxide monitoring in Northern Ireland

Monitored at five sites in 2017. No exceedances of limit values observed since 2001.

11 http://www.legislation.gov.uk/nisr/2014/147/contents/made
http://www.legislation.gov.uk/nisr/1998/329/contents/made

Fig 1-5 Ammonia (NH_3)



Ammonia is a gas that is emitted from a number of sources and can cause problems for human health and plant life. The main source of ammonia emissions in Northern Ireland is from agricultural activities - in particular, manure handling, storage and spreading.

Ammonia acts as an effective fertiliser, both through direct atmospheric contact with plants, and through deposition in rainfall. Sensitive habitats such as bog and heathland are naturally nutrient-poor and their species composition reflects this, as the plants there have adapted to survive in these conditions. Nutrient enrichment by ammonia emissions disrupts this balance and adversely affects species composition, thereby affecting biodiversity.

Ammonia can persist for a long time in the atmosphere and be transported for long distances. It can react with other air pollutants like nitrogen dioxide and sulphur dioxide to form ammonium aerosols, which are precursors for fine particulate matter, $PM_{2.5}$, which has adverse effects on human health.

Regulations controlling ammonia emissions

National Atmospheric Ceilings Directive - sets limits on the total amount of ammonia that may be emitted by Member States.

Industrial Emissions Directive - sets limits on the amount of ammonia that may be emitted by industrial processes; in particular, the amount of ammonia emitted by intensive agricultural installations.

Ammonia monitoring in Northern Ireland

Monitored at three sites as part of the National Ammonia Monitoring Network (ammonia in ambient air); and at two sites (ammonia in precipitation). Results are used to inform modelling of ammonia levels and precipitation values across Northern Ireland. A recently commissioned research project has added a further 25 ammonia monitoring sites to Northern Ireland's network, with the aim of better understanding ammonia levels at local levels (**see Chapter 4**).

1.3 Health-Based Air Quality Standards and other Sources of Evidence

World Health Organisation (WHO) guidelines on air pollution state that: 'By reducing air pollution levels, countries can reduce the burden of disease from stroke, heart disease, lung cancer, and both chronic and acute respiratory diseases, including asthma.[12]

The WHO and European Environment Agency both highlight that life expectancy is estimated to be 8.6 months lower than it would otherwise be, due to PM exposures from human sources and also that ozone is a major factor in asthma morbidity and mortality, while nitrogen dioxide and sulphur dioxide also can play a role in asthma, bronchial symptoms, lung inflammation and reduced lung function.

The EU has set health-based objectives and Target Values for air pollutants, and the UK Air Quality Strategy has also set its own objectives. In most cases, the UK Air Quality Strategy, on which Local Air Quality Management is based, has targets at least as stringent as EU requirements (in the case of ozone and benzo[a]pyrene, more so). Meanwhile, WHO guidelines for particulate matter are stricter still.

Meanwhile, the WHO has set guidelines for levels of air pollutants in ambient (outside) air - these are shown in **Table 1-2**, along with the corresponding objectives and targets for EU air quality directives as well as the UK Air Quality Strategy.

12 WHO Factsheet 'Ambient (outdoor) air quality and health', September 2016. http://www.who.int/mediacentre/factsheets/fs313/en/

Table 1-2 - Air quality objectives, targets and guidelines

Pollutant for Funding	UK Air Quality Strategy Objective	Concentration measured as[1]	European Obligations	WHO guidelines
Particles (PM_{10})	50 µg/m³ not to be exceeded more than 35 times a year	24 hour mean	50 µg/m³ not to be exceeded more than 35 times a year	Annual mean 20 µg/m³ 24hr mean 50 µg/m³
	40 µg/m³	Annual mean	40 µg/m³	
	Indicative 2010 objectives for PM_{10} (from the 2000 strategy and Addendum) have been replaced by an exposure reduction approach for $PM_{2.5}$ (except in Scotland - see below)			
Particles ($PM_{2.5}$) Exposure Reduction	25 µg/m3	Annual mean	Target value - 25 µg/m³	Annual mean 10 µg/m³ 24hr mean 25 µg/m³
	Target of 15% reduction in concentrations at urban background		Target of 20% reduction in concentrations at urban background	
Nitrogen dioxide	200 µg/m³ not to be exceeded more than 18 times a year	1 hour mean	200 µg/m³ not to be exceeded more than 18 times a year	Annual mean 40 µg/m³ 1hr mean 200 µg/m³
	40 µg/m³	Annual mean	40 µg/m³	
Ozone	100 µg/m³ not to be exceeded more than 10 times a year	8 hour mean	Target of 120 µg/m3 not to be exceeded by more than 25 times a year averaged over 3 years	8hr daily maximum 100 µg/m³
Sulphur dioxide	266 µg/m³ not to be exceeded more than 35 times a year	15 minute mean	-	
		1 hour mean		
	350 µg/m³ not to be exceeded more than 24 times a year		350 µg/m³ not to be exceeded more than 24 times a year	
	125 µg/m³ not to be exceeded more than 3 times a year	24 hour mean	125 µg/m³ not to be exceeded more than 3 times a year	
Polycyclic Aromatic Hydro-carbons	0.25 ng/m³ B[a]P	As annual average	1 ng/m³	
Benzene	16.25 µg/m³	Running annual mean	-	
	5 µg/m³	Annual average	5 µg/m³	
	3.25 µg/m³	Running annual mean	-	

Pollutant for Funding	UK Air Quality Strategy Objective	Concentration measured as[1]	European Obligations	WHO guidelines
1,3-butadiene	2.25 µg/m^3	Running annual mean	-	
Carbon monoxide	10 mg/m^3	maximum daily running 8 hour mean/ in Scotland as running 8 hour mean	10 mg/m^3	
Lead	0.5 µg/m^3	Annual mean	0.5 µg/m^3	
	0.25 µg/m^3	Annual mean	-	
Objectives for the Protection Of Vegetation and Plant Health				
Nitrogen oxides	30 µg/m^3	Annual mean	30 µg/m^3	
Sulphur dioxide	20 µg/m^3	Annual mean	20 µg/m^3	
	20 µg/m^3	Winter average	20 µg/m^3	
Ozone: protection of vegetation and eco-systems	Target value of 18,000 µg/m3 based on AOT40 to be calculated from 1 hour values from May to July and to be achieved, so far as possible, by 2010	Average over 5 years	Target value of 18,000 µg/m3 based on AOT40 to be calculated from 1 hour values from May to July and to be achieved, so far as possible, by 2010	

NB: Scotland has more stringent thresholds.[13]

In its annual *Air Quality in Europe* report, the European Environment Agency states that air pollution is the '...single largest environmental health risk in Europe', with heart disease and stroke the most common causes of death attributable to air pollution, followed by lung diseases and lung cancer.[14]

The Committee on the Medical Effects of Air Pollution (COMEAP) [15] has studied the link between exposure to particulate matter and chronic bronchitis and estimated that 722,000 cases of a particular type of bronchitis in 2010 in the UK were attributable to exposure to PM_{10}, and that a 1μgm-3 reduction in PM_{10} could have reduced this number of cases by 65,000.[16]

13 https://uk-air.defra.gov.uk/assets/documents/Air_Quality_Objectives_Update.pdf
14 European Environment Agency, Air Quality in Europe 2016, Nov 2016, p11. http://www.eea.europa.eu/publications/air-quality-in-europe-2016
15 COMEAP provides independent advice to government departments and agencies on how air pollution impacts on health. Its members come from a range of specialist fields such as air quality science, atmospheric chemistry, toxicology, physiology, epidemiology, statistics, paediatrics and cardiology. https://www.gov.uk/government/groups/committee-on-the-medical-effects-of-air-pollutants-comeap
16 https://www.gov.uk/government/publications/comeap-long-term-exposure-to-air-pollution-and-chronic-bronchitis

Meanwhile, a key finding of a COMEAP report on the health effects of exposure to particulate matter air pollution is an estimate of a reduction of six months in average UK life expectancy due to exposure to particulate matter.[17] Research indicates that short-term exposure to traffic pollution (i.e. in busy streets) may prevent the beneficial cardiopulmonary effects of exercise, in older people with certain chronic health conditions [18], while other researchers have found that increased exposure to air pollution during exercise does not outweigh beneficial effects of physical activity on the risk of asthma and chronic obstructive pulmonary disease (COPD).[19]

A Welsh study found that concentrations of air pollutants were highest in the most disadvantaged areas and could exacerbate health inequalities[20], while a French study of the exposure of the atmospheric exposure to air pollution of pregnant women concluded that '…pregnant women from the most deprived neighbourhoods were those most exposed to health-threatening atmospheric pollutants.'[21] Meanwhile, a study looking at associations between air pollution and socioeconomic characteristics, ethnicities and age profiles in England and the Netherlands concluded that: '…our results suggest that measures to reduce environmental inequality should include a focus on traffic-related emissions in urban areas.'[22]

A report by the Royal College of Physicians (RCP) and the Royal College of Paediatrics and Child Health, Every Breath We Take, estimates that in the region of 40,000 deaths per year in the UK are attributable to air pollution, and that the vulnerable and disadvantaged are more at risk than other groups in society.[23]

The RCP report sets out a list of recommendations. Some of the key recommendations are as follows:

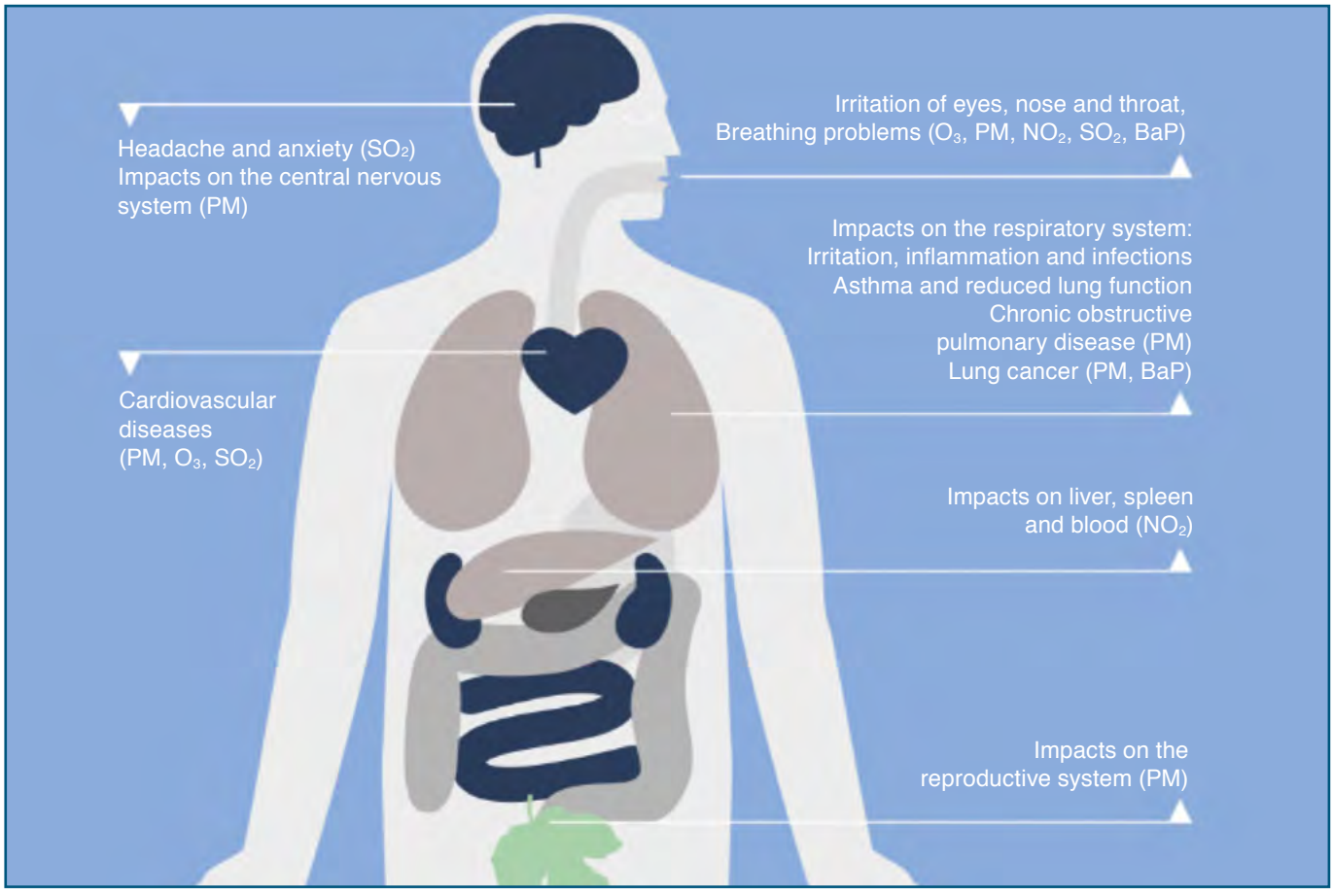
- Empower local government and incentivise business to plan for the long term;
- Educate regarding the harmful health impacts of air pollution;
- Promote alternatives to cars fuelled by petrol and diesel - walking, cycling, public transport, electric and hydrogen-powered vehicles;
- Tougher regulations, putting the onus on polluters;
- Effective air pollution monitoring in urban areas and near schools with clear communication of levels;

17 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/304641/COMEAP_mortality_effects_of_long_term_exposure.pdf
18 R. Sinharay *et. al.*, 'Respiratory and cardiovascular responses to walking down a traffic-polluted road compared with walking in a traffic-free area in participants aged 60 years and older with chroniclung or heart disease and age-matched healthy controls: a randomised, crossover study', *Lancet*, 2018; 391: 339-49.
19 J.E. Fisher *et. al.*, 'Physical activity, air pollution, and the risk of asthma and chronic obstructive pulmonary disease', *American Journal of Respiratory Critical Care Medicine*, 2016; 194(7): 885-865.
20 Brunt H. *et al, Journal of Public Health*, 2016;39 No. 3: 485-497.
21 Ouidir M. *et al*, Journal of Epidemiology and Community Health, 2017;71: 1026-1036.
22 Fecht D. *et al,* Environmental Pollution, 2015;198: 201-210.
23 Holegate S, Grigg J, Raymond A, Ashton J, Cullinan P, Exley K, Fishwick D, et al. Every Breath We Take: The Lifelong Impact of Air Pollution. Royal College of Physicians and Royal College of Paediatrics and Child Health. 2016, xiii. https://www.rcplondon.ac.uk/projects/outputs/every-breath-we-take-lifelong-impact-air-pollution

- Act to protect public health when air pollution levels are high;
- Tackle inequality by prioritising actions in deprived areas;
- Protect those most at risk through planning policies and impact assessments, with healthcare professionals helping vulnerable patients protect themselves;
- Leading by example in the NHS.

Figure 1-6 shows some of the main negative health impacts associated with exposure to air pollution.

Figure 1-6 - Health impacts of air pollutants: European Environment Agency[24]



You will see in the rest of this document, that some of the report's recommendations are already being dealt with in detail in Northern Ireland, for example, promoting travel alternatives (see **Chapter 2** on Transport). Others, for example, acting to protect public health when air pollution levels are high, are in place to an extent here (**Section 1.10**). There remains then some areas in which we have yet to put effective measures in place, for example, regarding education on the harmful effects of air pollution (**see Chapter 7** on Communication).

24 https://www.eea.europa.eu/media/newsreleases/air-pollution-still-causing-harm

The RCP report further recommends that more research and evidence is needed on the health impacts and costs to society of air pollution, along with the development of new, wider-ranging air pollution monitoring programmes (**see Sections 1.10-1.12 and Chapter 7**), as well as 'smart' technologies that individuals can use.

A recent example of this is a scoping project being taken forward by BT in conjunction with Belfast City Council, which aims to investigate the use of sensors which can monitor, among other things, air quality, and are interconnected as part of a data network. The issue of low-cost air quality monitoring sensors is one that arises regularly, and a primary concern is the accuracy and reliability of such sensors, in comparison with official MCERTS[25] accredited monitoring equipment and methods. Co-location studies of test sensors along with official monitoring sites can prove to be of use in such assessments. Such 'unofficial' assessment methods cannot be used to assess statutory compliance, e.g. with Air Quality Directive objectives. Nevertheless, there could be value in enabling district councils to avail of such methods, which can give at least an indicative indication of air quality levels.

A problem that has emerged when seeking to assess the impacts of air pollution at a local level is the availability of relevant, specific local data from hospitals, health trusts and GP surgeries.

To better understand the impact of air pollution on health and to help health services respond to that, routinely available health data should be used to model impacts and predict likely spikes in demand. Developing additional information sources, particularly related to primary care services could yield important benefits and should be explored. DAERA and the Department of Health should work together to allow health data to be combined with air pollution data. Consideration could be given to developing an air quality health surveillance function, using some of the principles used for flu surveillance.

This will assist in monitoring the impact of interventions to reduce air pollution on health as well as helping services predict likely increases in demand. The information could also be used as an advocacy tool and to demonstrate the impact of air pollution on health.

A study is being taken forward in this area, which will enable us to better understand the value of this approach. The Department for Economy has agreed to fund an SBRI Data Challenge project.[26] Project partners, including Belfast City Council and the Health Trust are agreeing to share data assets including the official AQMS data, Traffic Data, Urban Healthy Living data, health data at a small geospatial level (using prescription data to infer disease and usage) and socio-economic data. Project details are available at: https://www.gov.uk/government/news/northern-ireland-sbri-competitions-apply-for-funding

25 https://www.gov.uk/government/publications/mcerts-performance-standard-for-continuous-ambient-air-quality-monitoring-systems

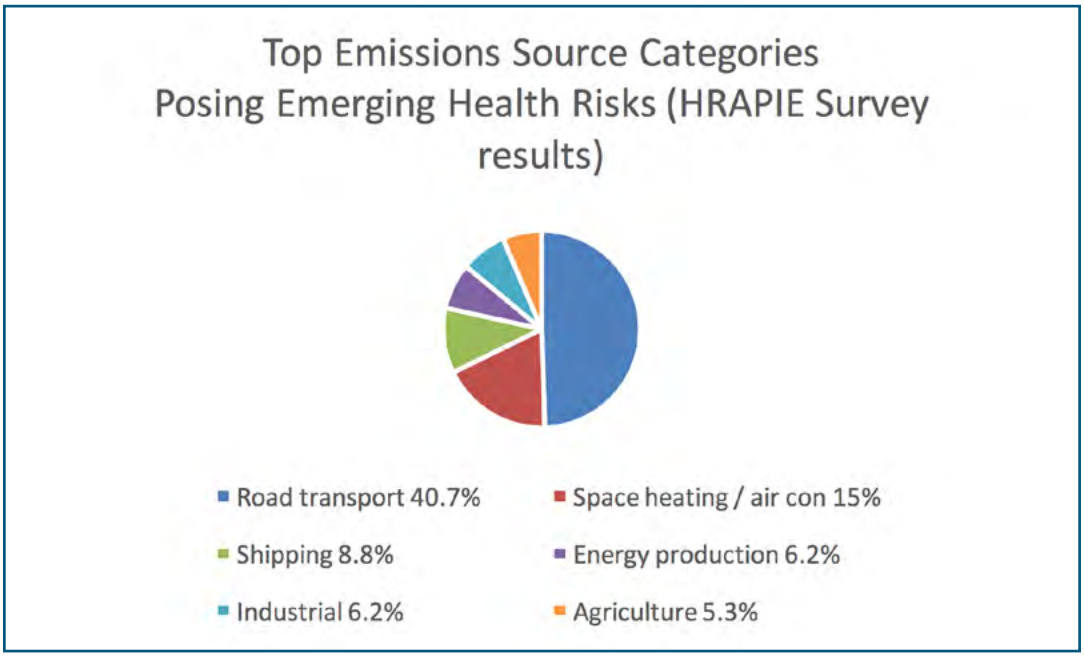
26 (The Small Business Research Initiative (SBRI) is a well established process to connect public sector challenges with innovative ideas from industry, supporting companies to generate economic growth and enabling improvement in achieving government objectives): https://sbri.innovateuk.org/

1.4 'No Safe Level' Approach

Research is increasingly pointing to the conclusion that - for exposure to particulate matter $PM_{2.5}$ at least - there is 'no safe level' of air pollution, and that exposure to incremental levels of $PM_{2.5}$ even below objectives can be associated effects on mortality.[27] The WHO (International Agency for Research on Cancer - IARC) has now classified outdoor air pollution as 'carcinogenic to humans' (Group 1). PM was evaluated separately and was also classified as carcinogenic to humans (Group 1).[28] Unlike for other air pollutants, there are already exposure reduction targets (as well as objectives relating to mean concentrations) for $PM_{2.5}$ in EU legislation as well as the UK AQS (**see Table 1-3**).

A WHO Europe project to comprehensively review research on the health impacts of air pollution ('Review of Evidence on Health Aspects of Air Pollution (REVIHAAP)') notes that health impacts, '…in some cases occur at air pollution concentrations lower than those serving to establish [WHO] guidelines.'[29] Results from another WHO Europe project ('Health Risks of Air Pollution in Europe (HRAPIE))[30] sought to survey and collect existing and emerging concerns from air pollution experts. The project found that the top emissions source categories (of a total of 16) posing an emerging health risk identified by respondents are shown in **Figure 1-7**

Figure 1-7 - HRAPIE survey results



27 https://www.gov.uk/government/publications/health-matters-air-pollution/health-matters-air-pollution
28 https://www.iarc.fr/en/media-centre/iarcnews/pdf/pr221_E.pdf
29 http://www.euro.who.int/__data/assets/pdf_file/0004/193108/REVIHAAP-Final-technical-report-final-version.pdf?ua=1
30 http://www.euro.who.int/__data/assets/pdf_file/0017/234026/e96933.pdf?ua=1

The top pollutant of concern identified in the HRAPIE survey was particulate matter, in particular, $PM_{2.5}$.

The new LAQM Annual Status Report introduced by Defra in 2016 includes a new section on $PM_{2.5}$ for local authorities, stating that: 'local authorities are expected to work towards reducing emissions and/or concentrations of $PM_{2.5}$ (particulate matter with an aerodynamic diameter of 2.5μm or less). There is clear evidence that $PM_{2.5}$ has a significant impact on human health, including premature mortality, allergic reactions, and cardiovascular diseases.'[31]

The recent consultation on LAQM in Wales has taken the 'no safe level' approach into consideration in developing Welsh air quality exposure indicators for nitrogen dioxide and $PM_{2.5}$, based on modelled levels of pollutants and census data. The Welsh government has proposed that new policy guidance will stress the public health benefits from actions to reduce air pollution, beyond simply achieving technical compliance with national air quality objectives.[32]

Research has concluded that harmful effects from air pollution '…occur on a continuum of dosage and even at levels below air quality standards previously considered to be safe.' [33]

Nevertheless, it is important to maintain air quality standards as metrics for use in assessing achievement with health-based objectives.

As outlined in **Table 1-3**, WHO guidelines for particulate matter [34]- both PM_{10} and $PM_{2.5}$ - are more stringent than the corresponding EU Air Quality Directive or UK Air Quality Standard objectives and target values:

Table 1-3 - Objectives, targets and guidelines for $PM_{2.5}$

Pollutant	EU and UK annual mean objective/target value	WHO annual mean guideline
PM_{10}	40	20
$PM^{2.5}$	25	10

The Scottish government has already written into legislation the requirement to comply with the WHO guideline on $PM_{2.5}$.[35]

WHO Guidelines on Particulate Matter

Q: Should there be legally binding targets for particulate matter, which are based on WHO guidelines?

31 http://laqm.defra.gov.uk/review-and-assessment/report-templates.html
32 https://consultations.gov.wales/sites/default/files/consultation_doc_files/160913_local_air_quality_and_noise_management_in_wales_en.pdf
33 D.E. Schraufnagel *et. al.*, 'Air Pollution and Noncommunicable Diseases', CHEST, 2019; 155(2): 409-416.
34 WHO, Air quality guidelines - global update 2005: https://www.who.int/phe/health_topics/outdoorair/outdoorair_aqg/en/
35 The Air Quality (Scotland) Amendment Regulations 2016: http://www.legislation.gov.uk/ssi/2016/162/pdfs/ssi_20160162_en.pdf

1.5 Economic Impacts of Air Pollution

Guidance published by Defra provides a way of estimating the costs, to society in the UK, per tonne of air pollutants emitted by small-scale activities for a range of air pollutants. The costs take into account the impacts of exposure to air pollution on health - both chronic mortality effects (which consider the loss of life years due to air pollution) and morbidity effects (which consider changes in the number of hospital admissions for respiratory or cardiovascular illness) - in addition to damage to buildings (through building soiling) and impacts on materials. Costs per tonne of pollutant emitted range from ca. £6k for ammonia, nitrogen dioxide and sulphur dioxide, to almost £106k per tonne of particulate matter.[36]

The WHO has estimated the cost of air pollution to economies in the WHO Europe region, with the figure for the United Kingdom being $83 billion (£61 billion).[37]

In May 2018, Public Health England (PHE) published a report on the estimation of costs to the NHS and social care in England due to the health impacts of air pollution.[38] A microsimulation model was used to consider the impact of fine particulate matter ($PM_{2.5}$; <2.5µm in diameter) and nitrogen dioxide (NO_2), air pollutants with known long-term effects.

The Department of Health (DoH) has produced estimated burden costs for Northern Ireland using figures from the PHE report for England and scaling them based on population differences. DoH has estimated that in 2017, the Health and Social Care (HSC) costs associated with diseases related to air pollution ($PM_{2.5}$ and NO_2) were around £1.5m. The overwhelming contribution is from $PM_{2.5}$ (96%).

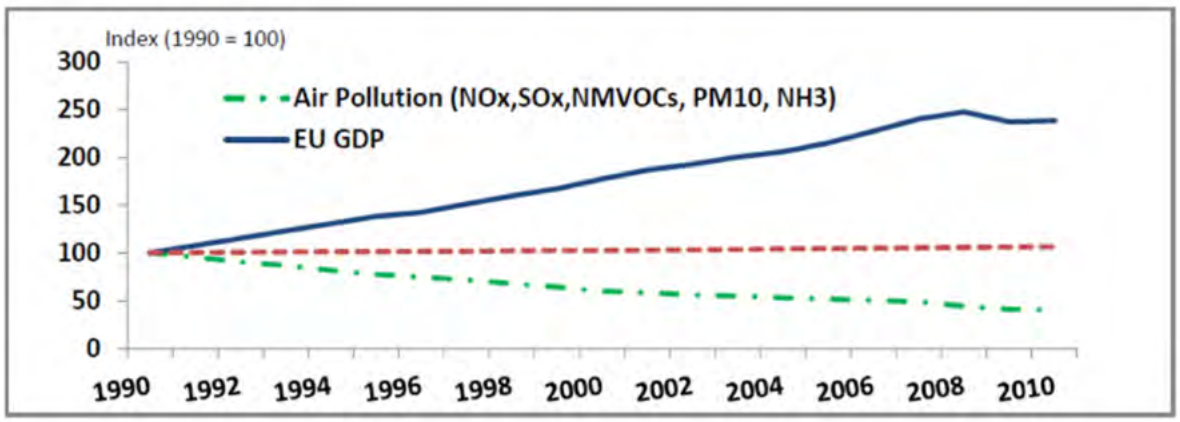
Taking into account information on diseases where the evidence for an association with air pollution is currently less robust, then the costs could rise to nearly £5.4m ($PM_{2.5}$ 48%, NO_2 52%).

Annual estimates for Health and Social Care (HSC) costs in Northern Ireland associated with diseases related to air pollution ($PM_{2.5}$ and NO_2) are in the range of £1.5m - £5.4m.

Projections of future costs by DoH indicate that in the period 2017-2025, the total cost to the HSC of air pollution in Northern Ireland is likely to be in the region of £55m - £190m. The sector that will see the largest share of this expenditure will be secondary care. However the costs in all the other sectors combined is likely exceed this spend. For the period 2017-2035, the combined cost ($PM_{2.5}$ and NO_2) is likely to be in the region of £182m - £635m. When all diseases are included, air pollution is expected to cause 84 thousand new cases of disease in Northern Ireland between 2017 and 2035.

36 https://www.gov.uk/guidance/air-quality-economic-analysis
37 http://www.euro.who.int/__data/assets/pdf_file/0008/276956/PR_Economics-Annex_en.pdf?ua=1
38 Public Health England, ***Air pollution: a tool to estimate healthcare costs:*** https://www.gov.uk/government/publications/air-pollution-a-tool-to-estimate-healthcare-costs

Figure 1-8 - Air pollution and GDP, Europe 1990-2012



Source: *Presentation of EC*

When considering the cost of improving air quality, it is useful to consider the above graph (**Figure 1-8**), which shows how GDP growth in the EU is decoupled from levels of air pollutants. Although many other factors come into play, it is worth noting that reductions in air pollutants across the EU have accompanied economic growth and therefore intervention policies will have a long term benefit to the economy.

1.6 Environmental Effects

Air pollution has negative effects on plants, trees and water bodies that support our wildlife. Most people are aware of the 'acid rain' phenomenon, something which has been partly addressed by the lowering of sulphur emissions from the fuels that we burn, in particular from the power generation industries. Nitrogen emissions, however, still contribute to the acidification of rainfall.

Nitrogen emissions - in the form of ammonia - constitute the biggest threat that we have to biodiversity in Northern Ireland. Ammonia emissions come largely from agricultural activities, such as manure handling, storage and spreading and are responsible for acidification as well as nutrient enrichment. Both of these things damage plants as well as altering the composition of plants in sensitive habitats like bogs and peatlands.

Ground-level ozone is a secondary pollutant, formed by the interaction of other air pollutants in the presence of sunlight. It directly damages plants, and its impact on crops can have significant cost implications for the agricultural sector.

There is increasing recognition that air pollution, through its harmful effects on plant life as well as specialised habitats and ecosystems, can adversely affect Natural Capital (a definition of 'Natural Capital'[39] is given in the box below.) In this way, air pollution can have further negative impacts on the economy.

Impacts of air pollution on habitats and ecosystems are discussed more fully in **Chapter 4**.

39 NCC Natural Capital Committee, The State of Natural Capital: Towards a framework for measurement and valuation, April 2013, 10. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/516707/ncc-state-natural-capital-first-report.pdf

1.7 Legislation and Regulation

Air quality in Northern Ireland is assessed and controlled under two systems: the first relating to EU policy and legislation, while the second is UK policy.

EU Policy and Legislation

Directive 2008/50/EC (Cleaner Air for Europe - the CAFE Directive) sets objectives for levels of particulate matter PM_{10} and $PM_{2.5}$, oxides of nitrogen NO_x, sulphur dioxide SO2, lead Pb, carbon monoxide CO and ground-level O_3. The Fourth Daughter Directive 2004/107/EC sets Target Values for arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons (PAHs) in ambient air.

The requirements of these directives are transposed by the Air Quality Standards Regulations (NI) 2010 and place a duty on NI government departments to assess and achieve compliance. Assessment is done by monitoring at six sites that are part of the UK's Automatic Urban and Rural Network (AURN), and also by national modelling of pollutants. There are two reporting zones in Northern Ireland for the purposes of the Directive - the Greater Belfast Metropolitan Area is one, while the remainder of Northern Ireland makes up the other.

The National Emissions Ceilings (NEC) Directive was introduced in 2001 and set limits for total emissions of air pollutants (sulphur dioxide, ammonia, non-methane volatile organic compounds (NMVOCs) and nitrogen oxides) by Member States which were to be met by 2010 and maintained the after. The UK met its 2010 targets for total emissions of these pollutants, while projections show that 2020 ceilings will also not be exceeded.

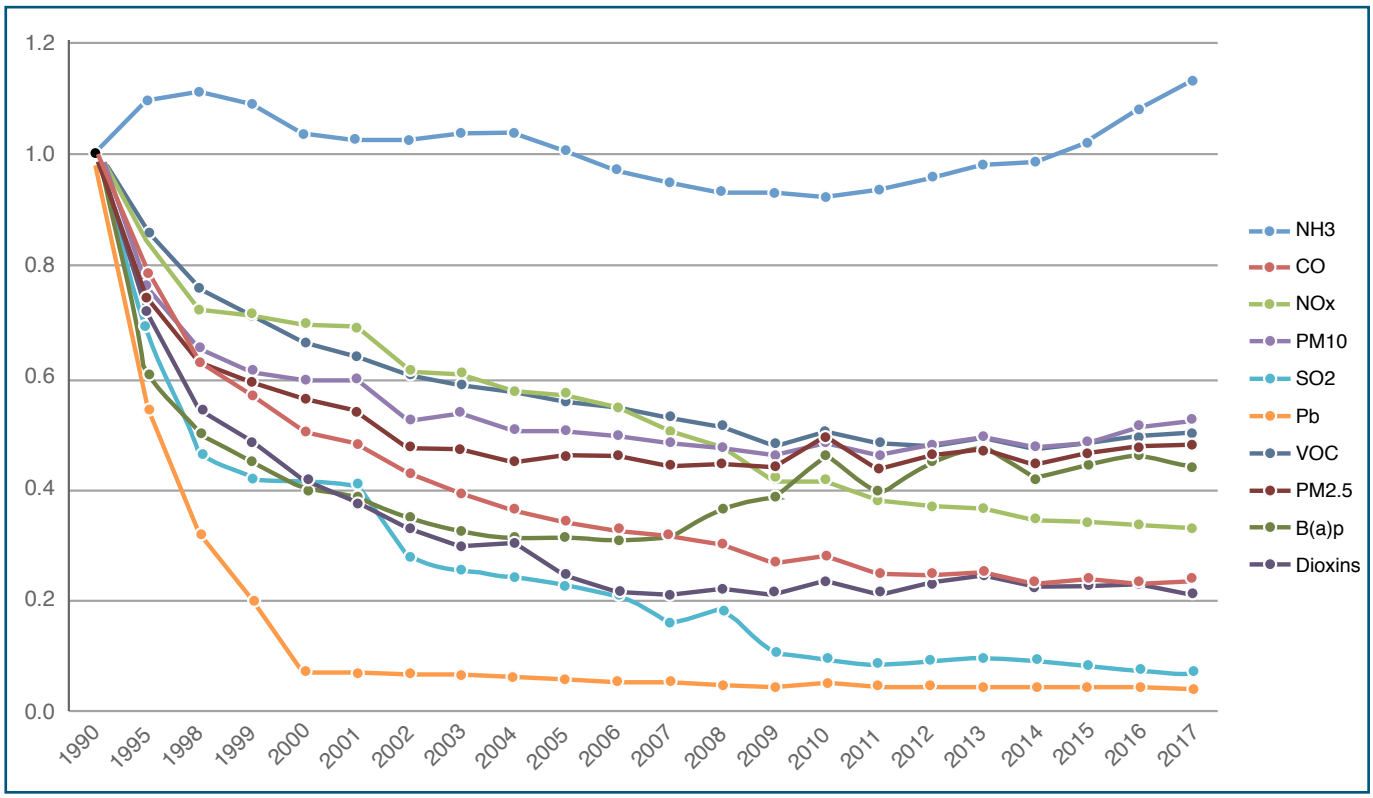
The EU's 7th Environment Action Programme, published in 2013, sets out a framework that establishes key priority objectives to 2020 and beyond.[40] The Programme has a number of Thematic Priorities, one of which is: 'To safeguard the Union's citizens from environment-related pressures and risks to health and well-being'. Part of this is a commitment to ensure that, by 2020, 'outdoor air quality in the Union has significantly improved, moving closer to WHO recommended levels, while indoor air quality has improved, informed by relevant WHO guidelines.' [41] A Clean Air Package, launched in 2013, aims to prevent 58,000 premature deaths due to exposure to air pollution, and to limit damage to sensitive habitats and forests caused by air pollution.[42]

The key legislative element of the Clean Air Package was the proposal to revise the NEC Directive. The revised NEC Directive was adopted in 2016, with stricter targets on national emissions ceilings to be met by 2020 and 2030. A requirement of the NEC Directive is for each Member State to produce National Air Pollution Control Programme (NAPCP), which were to have been submitted to the Commission by April 2019. The NAPCP sets out the measures that Member States are taking to meet emissions ceiling targets.

40 http://ec.europa.eu/environment/action-programme/
41 http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32013D1386, Annex, 54.
42 http://ec.europa.eu/environment/air/clean_air_policy.htm

Figure 1-9, below, shows the normalised trend for emissions of all air pollutants in Northern Ireland from 1990-2017; 1990 levels are indexed at 1.0. These figures are prepared for the National Atmospheric Emissions Inventory, and are estimates based on data provided from multiple sources and used as part of overall UK figures in assessing compliance with the National Emissions Ceilings Directive.[43]

Figure 1-9 - Normalised trends for all air pollutants in Northern Ireland, 1990-2017



NAEI figures show that levels of all air pollutants, except ammonia, are less than they were in 1990. The reductions since 1990 for each pollutant are set out in **Table 1-4**, as well as the percentage of total UK emissions that Northern Ireland's emissions represent in each case.

43 *National Atmospheric Emissions Inventory: Air Pollutant Inventories for England, Scotland, Wales and Northern Ireland 1990-2016,* Ricardo Energy and Environment, 2018, 28-36.

Table 1-4 - Northern Ireland total emissions estimates

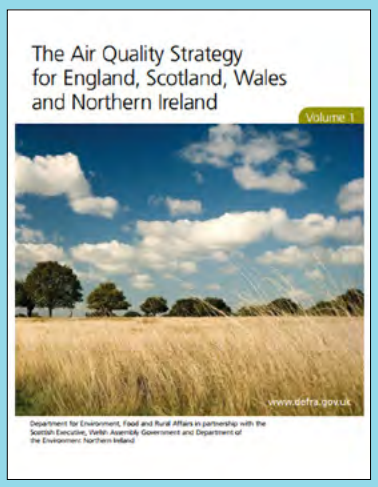
Pollutant	Change 1990-2017, %	Proportion of UK total in 2017, %
Ammonia	+13	12
Particulate matter PM_{10}	-50	5
Volatile Organic Compounds VOC	-50	4
Nitrogen oxides NO_x	-67	4
Carbon monoxide CO	-77	4
Sulphur dioxide SO_2	-93	5
Lead Pb	-95	3

In comparison with the other air pollutants, ammonia is clearly an outlier, both in terms of its long-term emissions trend as well as the estimated contribution it makes to total UK emissions. Ammonia emissions are examined further in **Chapter 4**, which focuses on agricultural emissions.

Another important element of the Clean Air Package is the Medium Combustion Plant (MCP) Directive, adopted in 2015, which sets emissions controls on MCPs and generators, which can be a significant source of air pollution and many of which have not been previously controlled by emissions legislation. As its name suggests, the MCP Directive is aimed at combustion plant in the mid-range, between large combustion plants (rated at greater than > 50 MWth), which are controlled by the Industrial Emissions Directive (IED) and smaller appliances like heaters and boilers with a thermal rating of less than 1 MWth, which are covered by the Ecodesign Directive.[44]

UK Policy

The second of the two systems is concerned with compliance with objectives set by the UK Air Quality Strategy[45], which was first published in 1997 and updated in 2007. This strategy sets objectives that are mostly aligned with those in Directives mentioned above, although some are stricter (e.g. for benzo[a]pyrene, lead), while it also contains objectives for some pollutants not covered by the directives (benzene, 1,3-butadiene). The strategy is supplemented by a Technical Guidance document, the latest version of which was published in 2016 (LAQM. TG16)[46]. The Technical Guidance document is designed to support local authorities in carrying out their statutory Local Air Quality Management duties. The Technical Guidance is complemented by policy guidance, for which a Northern Ireland version is available (LAQM.PG(NI)09)[47].



44 http://ec.europa.eu/environment/industry/stationary/mcp.htm
45 https://www.gov.uk/government/publications/the-air-quality-strategy-for-england-scotland-wales-and-northern-ireland-volume-1
46 https://laqm.defra.gov.uk/documents/LAQM-TG16-April-16-v1.pdf
47 http://www.airqualityni.co.uk/news-and-reports/useful-guidance

The requirements of the Strategy are implemented by Part III of the Environment (NI) Order 2002[48]. Here, district councils are required to periodically review and assess air quality within their districts. Where air quality objectives are being exceeded, or are at risk of being so, then councils must declare an Air Quality Management Area (AQMA) and draw up a corresponding Action Plan that sets out measures for dealing with the pollution exceedance. The Action Plan, where appropriate, is drawn up with input from a Relevant Authority - for example, in the case of pollution from road transport emissions, this would be the Department for Infrastructure.

The Local Air Quality Management (LAQM) system has been established for councils to fulfil their statutory duties under the Order and assess compliance with objectives in the UK Air Quality Strategy and to declare AQMAs and Action Plans where they have ascertained high levels of air pollution, which are in breach of objectives (or are at risk of being so). The Department provides funding to councils under the LAQM grant scheme to carry out monitoring and associated air quality duties.

Northern Ireland's Clean Air Order[49] was introduced in 1981, and contains powers that allow district councils to declare Smoke Control Areas. In such areas, only 'authorised fuels' (low-smoke fuels) may be burned in fireplaces, or 'exempted appliances' (such as efficient wood-burning stoves) may be used. It is an offence, under the Order, for smoke to be emitted from buildings in Smoke Control Areas. District councils enforce Smoke Control provisions. Evidence and research relating to levels of polycyclic aromatic hydrocarbons in urban centres in Northern Ireland show that solid fuel burning can present air pollution risks here (**See Chapter 3 on Household Emissions**).

The Northern Ireland Executive's Public Health Strategic Framework, 'Making Life Better', features air quality, along with other aspects of the physical environment in one of its Outcomes (Outcome 12 - 'Making the Most of the Physical Environment'), and indicators and baselines are given for four key air pollutants - nitrogen dioxide, PM_{10} particulate matter, benzo[a]pyrene and ozone.[50] A key action of this Outcome is, 'improving air quality to achieve objectives and targets established to protect health, and alerting those more likely to be affected when levels of air pollution are high,' and key delivery partners cited are the then Department of the Environment (now DAERA) and district councils. The alerts aspect of this commitment are covered by the arrangements for high air pollution alerts that are jointly issued by DAERA and Department of Health (**see Section 1.10)**.

48 http://www.legislation.gov.uk/nisi/2002/3153/contents/made
49 http://www.legislation.gov.uk/nisi/1981/158/contents
50 https://www.health-ni.gov.uk/sites/default/files/publications/dhssps/making-life-better-strategic-framework-2013-2023_0.pdf

1.8 The UK Clean Air Strategy

In January 2019, Defra published the UK Clean Air Strategy. This Strategy sets out the comprehensive action that is required from across all parts of government and society to achieve widespread reduction in the exposure of the population to air pollution. Defra's Clean Air Strategy was published in January 2019.

The Strategy recognises that so far the public debate about air pollution has been focused on outdoor sources of air pollution, particularly emissions from cars and other vehicles. One aim of the Strategy is to raise awareness of the breadth of everyday activities that contribute to air pollution.

The Strategy sets out the actions that will be taken in England and also how the devolved administrations intend to make their share of emissions reductions.

Key points for England:

- New goals to cut public exposure to particulate matter, as suggested by the World Health Organisation;
- A new statutory framework for Clean Air Zones (CAZs), which will amalgamate existing frameworks around Clean Air, Smoke Control, and Air Quality Management Areas;
- Defra will introduce legislation to prohibit the most polluting solid fuels, such as bituminous ('household' or 'smoky') coal, as well as wet wood. These can be significant sources of particulate matter in urban areas;
- Changing Smoke Control legislation to make it easier for local authorities to enforce;
- New appraisal tools for assessing consideration of the health impacts of air pollution;
- A national code of Good Agricultural Practice, aimed at reducing ammonia emissions from agricultural activity;
- Extension of environmental permitting to the dairy and intensive beef sectors;
- Regulation of the agricultural sector by requiring adoption of low emissions spreading techniques.

UK-wide measures include:

- Road to Zero, which sets out plans to end the sale of new conventional petrol and diesel cars and vans by 2040;
- New legislation will enable the Transport Secretary to compel manufacturers to recall vehicles for any failures in emissions control systems;
- Plans to reduce emissions from shipping and aviation. The rail industry will produce recommendations and a route map for the phase-out of diesel-only trains by 2040.

Some of these measures also feature as policy options for consideration in this discussion document.

1.9 Regulation

Air quality is regulated at district council level, normally as part of Environmental Health duties and can relate to Smoke Control enforcement, or to smoke nuisance from bonfires, or dust nuisance from construction sites. The council also regulate certain small (Part C) industrial activities for air emissions under the Pollution Prevention and Control (Industrial Emissions) Regulations 2013 (PPC Regulations), for example, dry cleaners, coal yards, petrol stations and car refinishing.

Northern Ireland Environment Agency regulates emissions of air pollutants from certain industrial installations as part of the PPC Regulations. The largest installations, for example, large power stations, waste incinerators or cement factories are subject to integrated (Part A) permitting, which means that the emissions to air, land and water are all subject to conditions in the permit.

Some other less polluting activities (Part B activities) are subject to air emissions controls only, for example, quarries.

1.10 Air Quality Monitoring in Northern Ireland

At the time of writing, air pollutants were measured at 20 automatic monitoring sites in Northern Ireland, with Newry Mourne and Down District Council to commission a mobile monitoring station in 2019/20. The pollutants measured at these sites are: nitrogen oxides, particulate matter, ground-level ozone, sulphur dioxide, heavy metals, benzene, carbon monoxide and polycyclic aromatic hydrocarbons.

A list of all the monitoring sites, along with the pollutants that they measure, is given in **Table 1-5**.

Twelve of these sites are run by district councils to assess compliance with objectives set out in the UK Air Quality Strategy. A further six sites form part of the UK-wide Automatic Urban and Rural (AURN) monitoring network, run by the Department in conjunction with Defra and the other Devolved Administrations and the district councils, and used for assessing compliance with EU air quality directives. A further site measures levels of PAHs alone. In addition, a number of sites have equipment measuring Black Carbon, heavy metals and PAHs and so are part of these UK-wide monitoring networks.[51]

The Department maintains a website, www.airqualityni.co.uk, which shows close to real-time monitored air pollution data from 20 monitoring stations (**see Figure 1-10**). The Department also publishes an annual summary report on all the air quality monitoring that has taken place over the previous year. The most recent edition of this report (for 2017) shows that UK air quality objectives were met for all the above pollutants with the exception of nitrogen dioxide at

51 Details of all monitoring networks can be found on the Defra website: https://uk-air.defra.gov.uk/interactive-map
Black Carbon Monitoring Network Report: https://uk-air.defra.gov.uk/library/reports?report_id=844
Heavy Metals Monitoring Network Report: https://uk-air.defra.gov.uk/library/reports?report_id=919
Polycyclic Aromatic Hydrocarbons (PAHs) Monitoring Network Report: https://uk-air.defra.gov.uk/assets/documents/reports/cat05/1611011541_Defra_PAH_2015_annual_report.pdf

some roadside sites, and PAHs at three urban background sites.[52] One site (Stockman's Lane in Belfast), used for monitoring compliance with the Air Quality Directive, showed exceedance of the annual mean limit value for NO_2. In addition, one site (Derry Brandywell) showed an exceedance of the EU Target Value for benzo[a]pyrene (see Chapter 3 on Household Emissions).

In addition to monitoring for the above pollutants, there are also three sites here that are part of the UK's Black Carbon Monitoring Network. Black Carbon and PAHs are discussed in more detail in Chapter 3, which deals with household emissions.

A summary of monitoring sites in Northern Ireland is given in **Table 1-5**.

A discussion on the need to increase the size of the monitoring network is set out in the following section.

1.11 UK Daily Air Quality Index (DAQI) and Air Quality Alerts

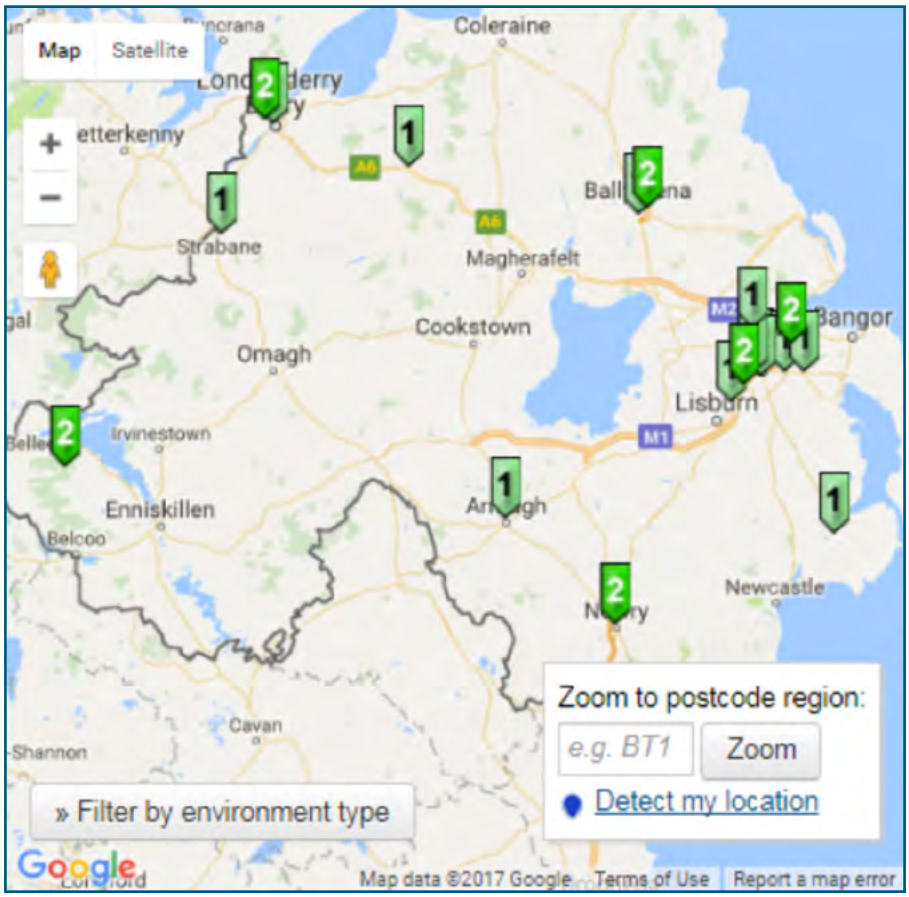
The DAQI was developed by the Committee on Medical Effects of Air Pollution (COMEAP), based on health evidence, and last reviewed in 2011. The DAQI is designed to easily communicate health-based air quality bandings to the public.

The pollutants included in the current index are particulate matter (PM_{10}), ozone (O_3), sulphur dioxide (SO_2), carbon monoxide (CO) and nitrogen dioxide (NO_2). The index has four bands indicating 'Low', 'Moderate', 'High' and 'Very High' levels of air pollution. These bands are further divided into a ten-point scale to provide greater gradation of air pollution levels.

DAQI levels are reported in real time on the Department's www.airqualityni.co.uk website (see **Figure 1-10**).

52 Department of Agriculture, Environment and Rural Affairs , *Air Pollution in Northern Ireland 2017*, http://www.airqualityni.co.uk/assets/documents/technical-reports/0369_DAERA_Air_Pollution_Report_2017_screen_Feb_19.pdf

Figure 1-10 - Map and summary of real-time air quality levels from the www.airqualityni.co.uk website



Latest Summary: Number of monitoring sites in each pollution band:

Very High (10)	0 Sites (0%)
High (7-9)	0 Sites (0%)
Moderate (4-6)	0 Sites (0%)
Low (1-3)	19 Sites (100%)

Values are based on pollution level measured for the latest hour and are provisional

Table 1-5 - local air quality monitoring sites in Northern Ireland

Site	Type	Pollutants	Networks
AURN sites			
Armagh Lonsdale Road	Urban roadside	NO_x, PM_{10}	AURN
Ballymena Ballykeel	Urban background	BC, NO_x, PAH, SO_2,	AURN, Black Carbon, PAH
Ballymena Antrim Road	Urban roadside	NO_x	AURN
Belfast Centre	Urban background	BC, CO, NO_x, PM_{10}, $PM_{2.5}$, SO_2, heavy metals	AURN, Black Carbon, Heavy Metals
Belfast Stockman's Lane	Urban roadside	NO_x, PM_{10}	AURN
Londonderry Rosemount	Urban background	NO_x, O_3, $PM_{2.5}$, PM_{10}, SO_2	AURN
Lough Navar	Rural background	O_3, PM_{10}, heavy metals	AURN, Heavy Metals
LAQM sites			
Belfast Newtownards Road	Urban roadside	NO_x	LAQM
Belfast Ormeau Road	Urban roadside	NO_x	LAQM
Belfast Westlink Roden Street	Urban roadside	NO_x	LAQM
Castlereagh Dundonald	Urban roadside	NO_x	LAQM
Downpatrick	Urban roadside	NO_x	LAQM
Dungiven	Urban roadside	NO_x	LAQM
Lisburn Kilmakee	Urban background	BC, PAH, PM_{10}, SO_2	LAQM, PAH, Black Carbon
Londonderry Dale's Corner	Urban roadside	NO_x	LAQM
Londonderry Strathfoyle Bawnmore Place	Urban background	PM_{10}	LAQM
Newry Canal Street	Urban roadside	PM_{10}	LAQM
Newtownabbey Antrim Road	Urban roadside	NO_x	LAQM
North Down Holywood	Urban roadside	NO_x, PM_{10}	LAQM
Strabane	Urban background	BC, PM_{10}, SO_2	LAQM, Black Carbon
Other			
Londonderry Brandywell	Urban background	PAH	PAH

However, the current approach for air quality monitoring was established to support assessment of compliance with air quality objectives; it was not set up to provide information to inform air quality alerts. Thus, only specific pollutants are monitored at specific locations, where, according to predefined criteria, they are deemed to present a problem. During a widespread air pollution episode, it is likely that sites measuring PM will register 'HIGH' levels, while sites measuring only NO_x could measure 'MODERATE' or even 'LOW' levels. This presents a misleading picture to the public, since, looking at the DAQI map would suggest that air pollution levels are only a problem

in particular locations and not others, while the overall extent of the problem is merely limited by available monitoring.

In addition, there are a significant number of towns in which there is no air quality monitoring. A targeted approach based on human exposure could set a population threshold - for example, 10,000 people - and require that air quality monitoring is carried out in any settlement with a greater population than this. If this approach were adopted, then the following towns and villages would become part of Northern Ireland's air quality monitoring network:

- Cookstown, Dungannon, Limavady, Enniskillen, Banbridge, Larne, Omagh, Antrim, Coleraine, Carrickfergus and Newtownards.

This would bring to 31 the number of monitoring stations in Northern Ireland, if at least one station was sited in each of the above towns.

Supplementing Air Quality Monitoring

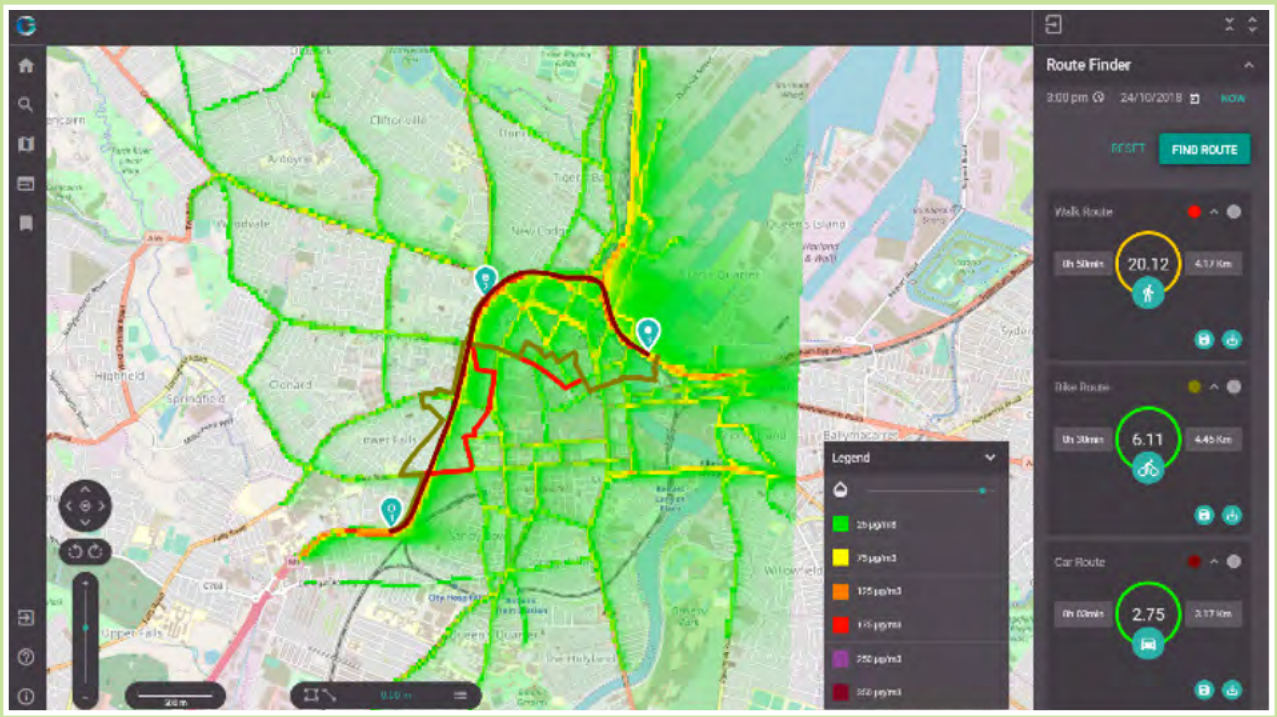
- The Urban Healthy Living (UHL) Project

UHL was funded by UK Space Agency's Space for Smarter Government Programme that aims to adapt satellite-enabled air pollution monitoring to support public health programmes and healthcare delivery in an urban setting.

The project's objective was to demonstrate the use of a space-enabled technology for traffic related air pollution monitoring and to spur innovative interventions healthy living and disease prevention. Using a blend of technology the project produced air pollution models that were visualised on 3D maps, making complex information accessible. UHL also prototyped a routing map that could allow clinical patients to better self-manage their respiratory conditions by selecting the routes and modes of transport that limit their exposure to pollutants.

Partners involved include four SMEs, Belfast Health Trust, Senior Clinicians from the Mater and Royal Hospitals, BCC City Innovation, Air Quality and Healthy Cities.

The UHL project officially completed Phase 1 in January 2019 with a Dissemination workshop in Belfast City Hall. However, the work, partnerships, data and learnings are feeding into further projects.



1.12 Low Cost Air Quality Monitoring

In recent years, with the progression of technology, there has been an increasing number of low-cost methods of air quality monitoring available. These sensors are typically much smaller in size than standard automatic air quality monitoring equipment that is sited in dedicated monitoring stations, and which is officially certified[53] for use in the UK air quality monitoring network.

Official advice from the UK Air Quality Expert Group is that '…not all sensors are equal and they must be evaluated individually.'[54] However, this is not to say that low-cost air quality monitoring sensors have no role in local air quality management. They could, for example, be used by councils for indicative results in screening assessments of air quality, and used to inform whether or not the council needs to proceed with installation of further, accredited air quality monitoring equipment. This idea is explored further in the chapter on Local Air Quality Management (**see Section 6.2**)

Air Quality Monitoring

Q: Should all automatic monitoring sites measure at least NO_x and PM?

Q: Should the current urban air quality monitoring network be expanded?

Q: Should a targeted approach to exposure, based on population, be used to expand the current monitoring network?

Q: What are your views on using a population figure of 10,000 as a threshold that triggers the requirement to monitor air quality?.

53 https://www.gov.uk/government/publications/mcerts-performance-standard-for-continuous-ambient-air-quality-monitoring-systems
54 https://uk-air.defra.gov.uk/library/aqeg/pollution-sensors.php

1.13 Trends in Air Pollution

Air quality in Northern Ireland has, in general, seen improvements over the years. Urban smogs that were once a feature of life in cities here in the 1940s and 1950s are a thing of the past. Some air pollutants, such as benzene, carbon monoxide, 1,3-butadiene and sulphur dioxide have not shown any exceedance of air quality objectives for many years now.

However, our road side air quality monitoring data suggests there remain problems with levels of nitrogen dioxide from road traffic at roadsides. Levels of this pollutant do, in general, appear to be decreasing, though at different rates in different locations (**see Figure 1-11**).[55]

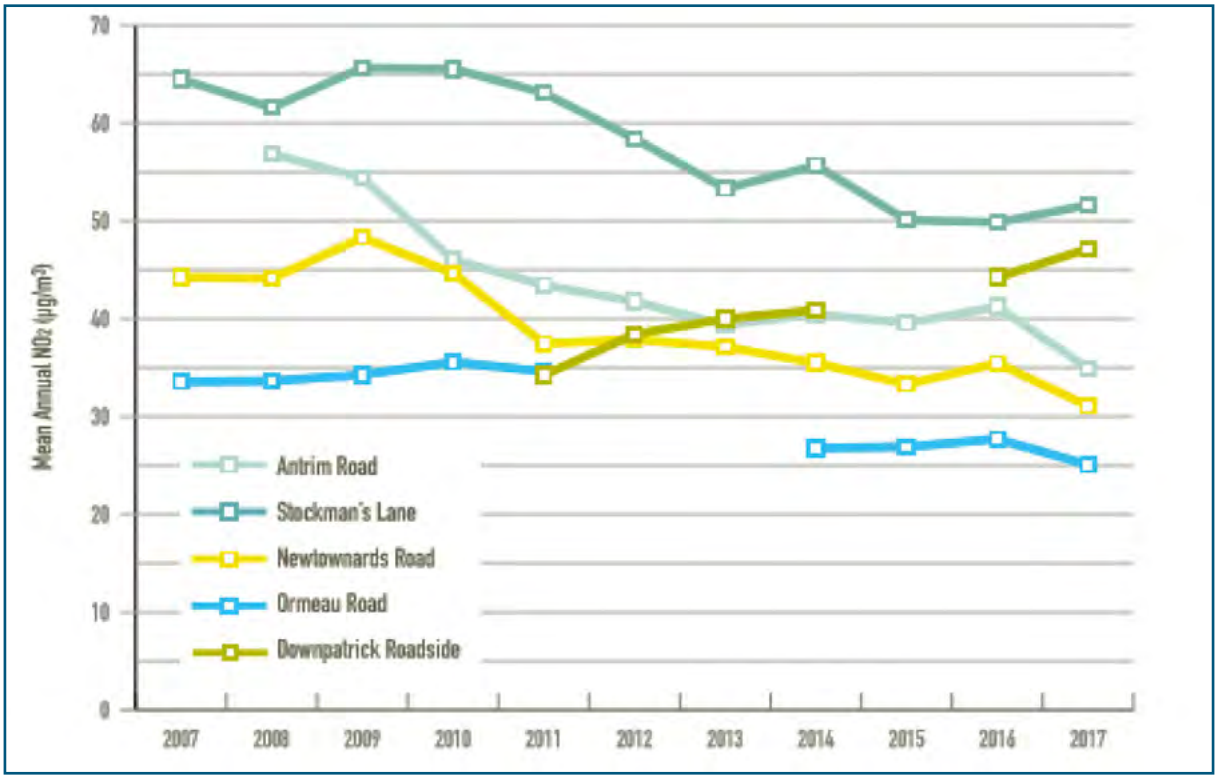


Figure 1-11 - annual mean levels of nitrogen dioxide at roadside monitoring sites

Population exposure to nitrogen dioxide is known to arise principally as a result of road traffic emissions in urban centres, something that is borne out by the differences in levels measured between urban roadside and urban background sites. Unlike industrial emissions of nitrogen dioxide, road transport produces causes high emissions at ground level.

Although we do not see breaches of objectives for particulate matter, levels of this pollutant can become significantly elevated during winter episodes of high air pollution.

Levels of polycyclic aromatic hydrocarbons (PAHs) monitored here remain relatively high in comparison with urban centres in the rest of the UK.

55 *Air Pollution in NI 2017,* 15: https://www.daera-ni.gov.uk/sites/default/files/publications/daera/DAERA%20Air%20Pollution%20Report%202017%20screen%20Feb%2019.pdf

Research carried out by the Department in 2012 showed that the relatively high levels of PAHs measured here are as a result of household solid fuel burning.[56] This is further borne out by observations from the UK Black Carbon Network.[57] The EU Fourth Daughter Directive and the UK Air Quality Strategy both set objectives for benzo[a]pyrene, a representative PAH. Monitoring at the three PAH sites here shows that the EU Target Value for B[a]P was exceeded at multiple sites in 2011 and 2012, and then again in 2016, when the Londonderry Brandywell site registered an exceedance of the annual mean Target Value. Meanwhile, the stricter UK AQS objective for B[a]P continues to be exceeded at all sites in every year (**see Chapter 3 on Household Emissions**).

1.14 Air Pollution Episodes

Figure 1-12 - Air Pollution headline from 24 Nov 2016

In Northern Ireland, we typically see around five episodes of high air pollution each year, during which levels of pollutants - usually particulate matter - reach ‘HIGH’ or ‘VERY HIGH’ levels according to the Daily Air Quality Index (levels 7-10).

These episodes occur in the colder months of the year, when cold, settled weather leads to the formation of temperature inversion layers in which pollutants are trapped near ground level and a lack of wind means that they are not dispersed. Coincidental with these cold weather conditions is an increased level of household heating, and where solid fuel is used as the heating source, then emissions of particulate matter and PAHs increase.

Pollution episodes can occur at any time of the year, however, with the most recent occurring during the Easter period in 2019.

56 NPL, Polycyclic Aromatic Hydrocarbons in Northern Ireland, Feb 2012. http://www.airqualityni.co.uk/assets/documents/504120308_pah_in_ni_report_final_published_version_v2.pdf
57 NPL, 2014 Annual Report for the UK Black Carbon Network, Jul 2015. https://uk-air.defra.gov.uk/library/reports?report_id=844

When a high air pollution episode is either forecast, or monitored, then DAERA coordinates a Press Release, in agreement with the Department of Health, for immediate issue. DAERA also issues a text message on its *Air Aware* SMS alert service. This subscription service is aimed primarily at individuals with health conditions that could be affected by high air pollutant levels and those involved with their health care, and has over 900 subscribers.

Figure 1-13 - from the Department's air quality website

However, research carried out by Public Health Ontario in conjunction with others suggests that issuing air quality alerts alone has a limited effect on public health and that implementing enforced public actions to reduce air pollution on high pollution days could be warranted.[58] This is already done in, for example, the Bay Area of San Francisco, where residents are asked by the Air District not to burn wood during cold, still winter days when levels of wood smoke can rise to unhealthy levels.[59]

1.15 Carbon Emissions

Air pollution and climate change share some similar sources, specifically in relation to the combustion of fossil fuels which generates carbon dioxide (the main greenhouse gas of concern) as well as many of the air pollutants previously mentioned.

However, we need to be cautious, as some conflicts as well as synergies exist. Thus, some strategies that have sought to lower carbon emissions - the promotion of diesel vs. petrol cars, small-scale biomass combustion - can raise levels of air pollutants. A report by the International Energy Agency examined the effects on air pollution of energy policy scenarios for different world regions, and predicted that, by 2040, there would be a 55% reduction in European Union NO_x emissions, due to increasing controls on road transport emissions and a 47% reduction in SO_2 emissions due to declining use of coal in energy generation. This compares with only a predicted 20% reduction in $PM_{2.5}$ emissions by 2040, because of the increased uptake of biomass.[60]

58 Hang Chen *et. al.*, 'Effect of air quality alerts on human health: a regression discontinuity analysis in Toronto, Canada', *Lancet Planet Health,* 2018; 2: e19-26.
59 http://www.sparetheair.org/stay-informed/particulate-matter/wood-smoke/recommended-no-burn-days
60 International Energy Agency, *Energy and Air Pollution:* World Energy Outlook Special Report, 2016, Ch6, 153: https://www.iea.org/publications/freepublications/publication/WorldEnergyOutlookSpecialReport2016EnergyandAirPollution.pdf

It is clear that an integrated approach is therefore needed. In particular, strategies to lower carbon emissions should take account of possible effects on air quality, whether adverse or positive, and where possible strategies on both air quality and carbon reduction should be coordinated.

The UK Committee on Climate Change produced a report in February 2019, 'Reducing Emissions in Northern Ireland', which sets out how Northern Ireland can reduce its greenhouse gas emissions between now and 2030 in order to meet UK-wide climate change targets. Overall, Northern Ireland's fair contribution to the UK's fifth carbon budget requires emissions reductions of at least 35% against 1990 levels by 2030.[61] The report examines carbon emissions from a range of sectors in Northern Ireland and identifies gaps and deficiencies in current policy which are barriers to achieving sustained carbon reductions.

The report does recognise that there are '…wider benefits to climate action through reduced air pollution and other health benefits.' Specifically in relation to biomass, the report recommends that, 'Biomass for heating in urban areas should not be supported due to air quality concerns.' (p83). A future consultation on Northern Ireland's Energy Strategy will consider heating sources in urban areas.

Biomass

Q: Should biomass heating be discouraged in urban areas or in areas with poor air quality?

As a requirement of EU Regulation 2018/1999 on the Governance of the Energy Union and Climate Action, each Member State had to submit to the Commission a draft of its integrated national energy and climate plan covering the period from 2021 to 2030. Among the recommendations that the Commission put in response to the UK's plan was that the UK should: 'Present the impacts on air pollution for the various scenarios, providing underpinning information, and considering synergies and trade-off effects'.[62]

1.16 Noise Pollution

Some sources of air pollution have little to no association with noise, for example smoke from chimneys, others, however, have much more of a distinction for example vehicle noise. As air and noise pollution share many of the same sources improving the quality of air can have a subsequent impact on improving the quality of noise.

61 https://www.theccc.org.uk/publication/reducing-emissions-in-northern-ireland/
62 COMMISSION RECOMMENDATION of 18.6.2019 on the draft integrated National Energy and Climate Plan of the United Kingdom covering the period 2021-2030 {SWD(2019) 279 final}

In its assessment of the environmental burden of disease in the European region, the World Health Organisation has ranked air and noise pollution as the two leading stressors impacting upon human health[63], with an estimated 600,000 premature deaths occurring annually due to poor air quality.[64] In addition, at least 16,600 cases of premature death occur in Europe each year as a result of noise from major road traffic alone.[65] The European Commission estimates that combined social cost of both air and noise pollution could be nearly 1 trillion Euros, which is much more than smoking with a social cost of only 544 billion Euros.[66]

Air and noise pollution share many of the same sources such as industry, aircraft, railways and road vehicles. The European policy on both pollutants also shares much common ground, with an emphasis on monitoring and modelling to assess the state and impact. Then there is a common requirement to draw up action plans in order to tackle the problem. Indeed, the EU Air Quality Directive stipulates that action plans should ensure consistency with other plans required under the Environmental Noise Directive in order to achieve the relevant environmental objectives. What may be beneficial for air quality, may also be helpful in reducing the detrimental effects of noise.

Studies have shown that the effects of air and noise pollution on health are indiscriminate, but it also demonstrated that very often the populations most affected are those that are more socially disadvantaged, particularly where road traffic emissions are concerned (EC, 2016). It is therefore, likely that reducing noise and air pollution will have a positive impact upon health for a great many people, but especially those that need it most. This strategy proposes that efforts to reduce air pollution should be consistent with plans to also tackle noise pollution in Northern Ireland and the potential synergies and benefits to the wellbeing of the population as a whole should be borne in mind by authorities with responsibility for drawing up and implementing action plans.

Noise and Air Quality

Q: Should the connectivity between air quality and noise issues be improved through requiring consideration of each in Noise and Air Quality Action Plans?

Q: Given that air pollution, carbon emissions, and noise often share the same sources, what are your views on including noise and carbon emissions as a consideration in Low Emissions Zones?

63 WHO, 20111, Burden of disease from environmental noise, WHO Regional Office for Europe
64 WHO/OECD, 2015, *Economic cost of the health impact of air pollution in Europe: Clean air, health and wealth*
65 EEA, 2017, Noise in Europe, European Environment Agency https://www.eea.europa.eu/themes/human/noise accessed 20th December 2017
66 EC, 2016, *Links between noise and air pollution and socio-economic status,* Science for Environment Policy, In-depth report 13. European Commission, September 2016

A further issue that arises in Northern Ireland is that Air Quality Action Plans are drawn up by district councils in conjunction with relevant authorities (for example, DfI), while Noise Action Plans are drawn up by their own prescribed competent authorities (e.g. Translink, airports, DfI, and NIEA). This means there is potential for disconnect between the two issues.

1.17 Research

DAERA will continue to support research, and to commission its own research into levels of air pollutants and impacts of air pollution. Moving forward DAERA will build on its existing relationships with other government departments and district councils to help inform research needs, and ensure that these take account of its Science Transformation Strategy.

1.18 Challenges

In Northern Ireland, we face similar issues with air pollution to the rest of the UK and Europe - most notably, levels of nitrogen dioxide in urban centres, arising principally from road traffic, in particular, diesel engines. Actions to address levels of nitrogen dioxide air pollution are therefore actions that try to reduce the number of vehicles on our roads, or to promote the shift to cleaner vehicles (**see Chapter 2**). The Greater Belfast area is one of 37 UK reporting areas that in 2015 breached the EU Air Quality Directive's annual mean limit value for nitrogen dioxide. In 2017, the UK government prepared a revised National Air Quality Plan to deal with these widespread exceedances. Meanwhile, the NICS Outcomes Delivery Plan has an air quality indicator that is based on nitrogen dioxide levels monitored at locations across Northern Ireland. As previously mentioned, the NI Executive's Public Health Strategy also acknowledges the role that reducing air pollution can play in improving public health and makes a commitment to working towards reducing air pollutant levels, and has indicators based on levels of four key air pollutants.

We also have problems with air pollution from household burning of solid fuel, which takes place to a greater extent in urban areas of Northern Ireland compared with urban areas in the rest of the UK. Levels of PAHs monitored here show that solid fuel burning presents air pollution risks in urban centres. In addition, solid fuel burning is a major contributor to winter pollution episodes. The increasing popularity of wood-burning stoves is also contributing to air pollution from the household heating sector, particularly where unseasoned wood is used as a fuel (**see Chapter 3**).

The agriculture sector in Northern Ireland produces high levels of ammonia, an air pollutant that can damage sensitive habitats, as well as contribute to levels of fine particulate matter: emissions of ammonia in Northern Ireland are disproportionately high, with 2016 total emissions making up 11% of total UK ammonia emissions.

The revised National Emissions Ceilings (NEC) Directive, has more stringent targets for air pollutants - the ones of principal concern for Northern Ireland are ammonia emissions (**see Chapter 4**) and particulate matter emissions, while major emissions sources such as power generation will also come under increasing pressure (**see Chapter 5**).

The Local Air Quality Management (LAQM) system was set up in the early 2000s, under which councils review air quality and declare, where necessary, Air Quality Management Areas (AQMAs). The idea of the system is to revoke AQMAs as soon as air quality standards improve to an acceptable level; however, in practice, we find that the number of AQMAs in Northern Ireland does not change from one year to the next (**see Chapter 6**).

The LAQM system is therefore underperforming in that it is not showing us improvements in air quality from one year to the next. It is also worth noting that air quality policy and legislation needs to be supported by effective communications, which relate to both the impacts of air pollution, as well as the actions that individuals can take to reduce air pollution (**see Chapter 7**).

Our principal challenges in dealing with air pollution fall under the following categories:

- **Road transport emissions**
- **Household solid fuel emissions**
- **Agricultural emissions**
- **Industrial emissions**
- **Local Air Quality Management**
- **Communications**

These challenges - and proposals for addressing them - will be examined in detail in the following chapters.

Chapter 2 - Transport

Efficient transport movements are vital to our economy and way of life, and yet road transport is one of our most significant sources of air pollution. This is reflected in the NICS Outcomes Delivery Plan indicator on air quality, which is based on levels of nitrogen dioxide at monitoring stations across Northern Ireland.

While road transport is responsible for a range of pollutant emissions, those of greatest concern are in particular nitrogen oxides and particulate matter.

High concentrations of nitrogen dioxide monitored at ground level in our towns and cities are largely due to vehicle exhaust emissions.

Nitrogen oxides, NO_x, and nitrogen dioxide, NO_2

During normal combustion processes, nitrogen and oxygen in the air can combine at high temperatures to form nitrogen monoxide and nitrogen dioxide, together known as NO_x. Nitrogen monoxide, NO, quickly combines with oxygen in the air to form nitrogen dioxide, NO_2. NO_2 is known to irritate the airways and evidence suggests it may have other health impacts. There are limit values set for the amount of NO_2 in our air, for the protection of human health.

Particulate matter (PM) arises as a by-product of the combustion of petrol and diesel and can be thought of primarily as unburnt carbon from the chemical process of combustion. The PM emissions from diesel combustion are many times greater than from petrol combustion. However, depending on the vehicle type, an equal or much greater amount of particulate matter is seen to come from physical processes, such as brake pad, tyre and road surface wear.

Although no objectives for PM are exceeded in Northern Ireland, we still need to address what levels there are, bearing in mind the ‘no safe level’ approach, referred to in **Section 1.4**. However, this chapter has a particular focus on NO_x emissions, since exceedances of EU and UK Air Quality Strategy limits have been observed for this pollutant.

2.1 No_x Emissions from Road Transport

The Air Quality Directive and the UK Air Quality Strategy both set limits for nitrogen dioxide, NO_2 in ambient air. NO_2 can be emitted directly from combustion sources, but may also be formed when nitrogen monoxide, NO, is emitted and reacts with air.

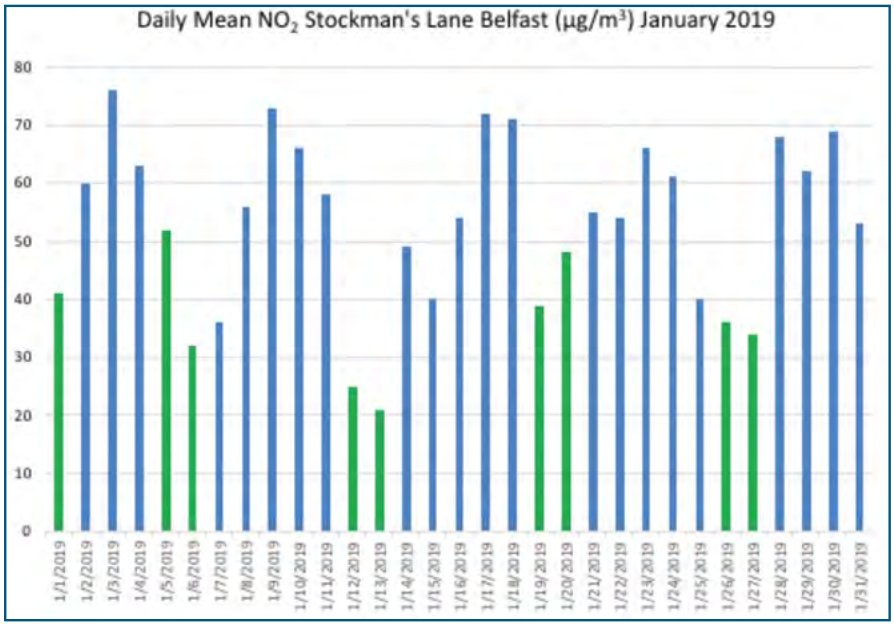


Figure 2-1

NO and NO_2, together are referred to as 'NO_x'.

Figure 2-1 shows the daily mean concentration of NO_2 measured at Stockman's Lane in Belfast during January 2019. Although there is a degree of variability (most likely due to wind), it is evident that the highest levels of NO_2 are seen on weekdays (blue bars) when compared with weekends (green bars): this suggests that commuter/business traffic, greater on weekdays, is contributing to higher levels of NO_2. In addition, levels measured on Tuesday January 1st - a public holiday - are lower than the following weekdays.

An analysis of NO_2 measured on a typical weekday is shown in **Figure 2-2**. We can see that NO_2 levels correspond with traffic behaviour, with highest levels occurring during peak traffic times (morning) and levels falling to their lowest overnight.

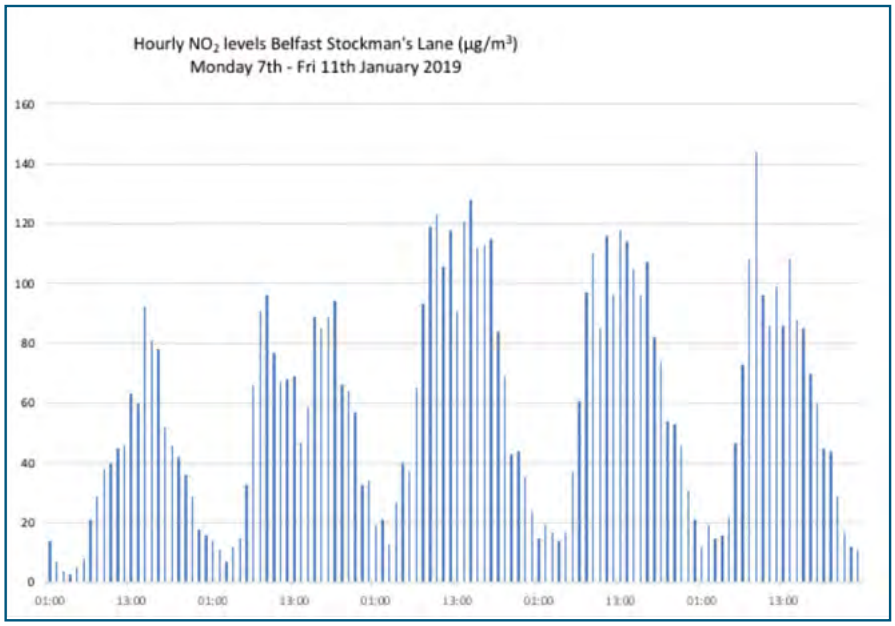


Figure 2-2

Levels of NO_2 measured at roadside locations are clearly due to vehicle exhaust emissions, with the highest levels of NO_2 found near the busiest roads.

An analysis of National Atmospheric Emissions inventory figures[67] shows that in 2017, road transport contributed 26% of Northern Ireland's NO_2 emissions, made up of 17.7% from passenger cars, 4.2% from light goods vehicles (LGV), and 3.6% from heavy goods vehicles vehicles, including buses and coaches. (**Figure 2-3**). Although road transport accounted for only 26% of Northern Ireland's total NO_2 emissions, it is the location of these emissions - on our roads, often close to homes, schools and shops in urban areas - that make their health impacts greater than those from other sources such as energy and industry, in terms of human exposure.

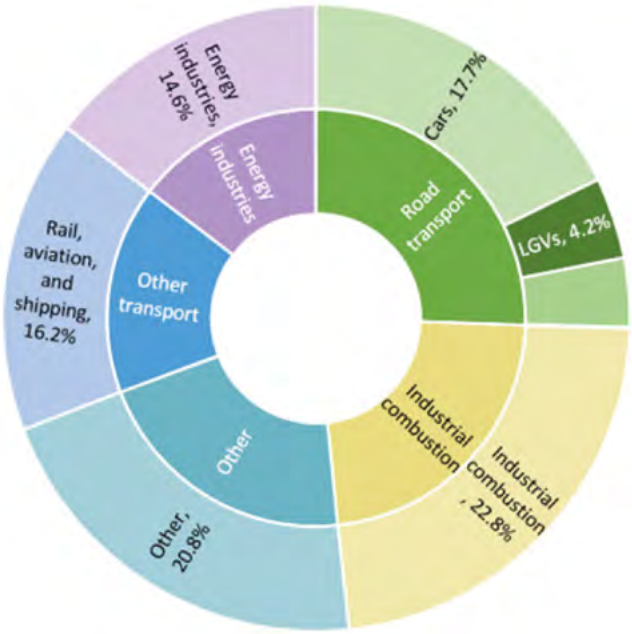


Figure 2-3 - NO_2 emissions in Northern Ireland 2017

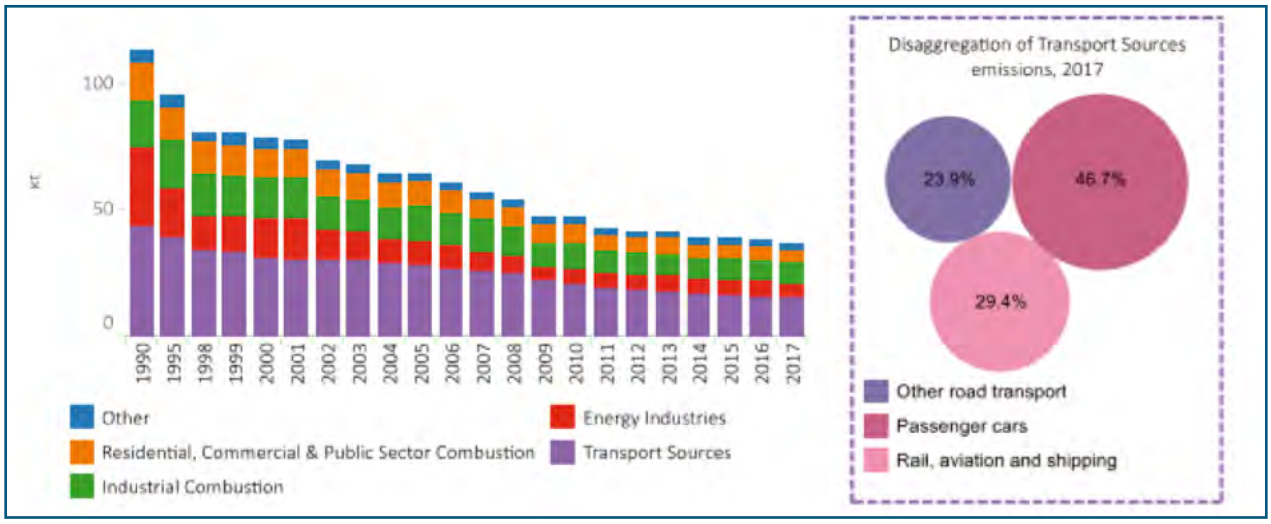


Figure 2-4 - Emissions of nitrogen oxides in Northern Ireland 1990-2017

67 https://uk-air.defra.gov.uk/assets/documents/reports/cat09/1910031755_DA_Air_Pollutant_Inventories_1990-2017_Issue_1.1.pdf

Figure 2-4 shows the long-term trend in NO_x emissions since 1990, again from the National Atmospheric Emissions Inventory, and also shows that almost 47% of total transport NO_x emissions are from passenger cars, with a further 24% coming from other road transport sources such as buses and HGVs. NO_x emissions from the road transport sector are of particular importance because they are associated with high population exposure to these pollutants.

It is worth noting that, with respect to inventory calculations of emissions from road vehicles in Northern Ireland, these are no longer informed by vehicle census data, but instead now rely on applying trends from vehicle-km data from Great Britain. The UK CCC has therefore recommended that NI government resume collecting vehicle traffic data.[68]

Research has found that nitrogen dioxide, produced from road traffic, can react with volatile organic compounds released by urban trees leading to the formation of ground-level ozone that further worsens air quality.[69] A report by the Air Quality Expert Group notes that there are potential benefits of vegetation in changing dispersion and deposition processes and also potential problems.[70] In addition, although tree planting may shield nearby housing from air pollution, it can increase the canyon effect of a particular street or road, thereby concentrating air pollution for car users and cyclists. However, given that urban trees provide shade and can act as noise barriers, careful consideration must be given to their positioning to avoid unintended adverse consequences and outlined above.

Breaches of the EU air quality directive limit values for NO_2 are found along certain roads in Northern Ireland, as set out in the following section.

2.2 Air Quality Directive Exceedance

As has already been set out in Section 1.12, Greater Belfast is one of the reporting zones under the EU Air Quality Directive, for which an exceedance of nitrogen dioxide limit values has been identified. National modelling (using the UK Pollution Climate Model, PCM) has indicated that the main exceedances appear along the A12 Westlink/A2 Sydenham Bypass.[71] As these roads are major arterial routes, vital to Northern Ireland's road network, tackling exceedances here is challenging.

It had been known for some time that emissions of NO_x from (diesel) vehicles were higher than those stated by Euro Standards. This was finally confirmed when the emissions issue involving diesel cars came to light. As a result of this, emission factors used in UK air quality modelling and pollutant inventory compilation have had to be revised upwards. Emission Factors are explained in the information box on the following page.

National modelling using the Pollution Climate Model (PCM) initially showed that levels of NO_2 along the A12 Westlink would be in exceedance of the Directive limit value until 2020; the latest figures, prepared using the higher emissions factors (that are more reflective of real-world driving

68 UKCCC, *Reducing Emissions in Northern Ireland,* 88.
69 Churkina, G. *et. al.*, Effect of VOC Emissions from Vegetation on Air Quality in Berlin during a Heatwave. *Environmental Science &Technology,* 51(11): 6120-6130.
70 https://uk-air.defra.gov.uk/library/reports.php?report_id=966
71 https://uk-air.defra.gov.uk/research/air-quality-modelling?view=modelling

conditions), suggest that compliance will now not be achieved until 2023. These modelled levels take into account projected changes in volumes of road traffic and in particular local fleet composition, i.e. vehicle turnover, with older cars being replaced by newer ones with more efficient engines and tighter emissions controls in compliance with Euro vehicle standards.

What are Emission Factors?

Emission Factors (EFs) are vital pieces of information that we use to prepare emissions inventories as well as in emissions modelling. An EF is based on evidence and observation and will tell us the average amount of a pollutant emitted by a particular unit and activity. Examples of EFs include:

- Grams of nitrogen dioxide emitted by a diesel car per km travelled;
- Grams of methane emitted per year per head of grazing cattle;
- Grams of sulphur dioxide emitted per year per household burning coal.

EFs are average values that incorporate many assumptions, but they give us a manageable way of **estimating** emissions. We use EFs along with **activity data** to get estimates of total emissions of pollutants. The activity data is supplied by statisticians across NI departments.

Mass of pollutant = activity data x EF
Mass of NO_2 emitted = (number of diesel cars and kms travelled)
x (EF for a diesel car per km)

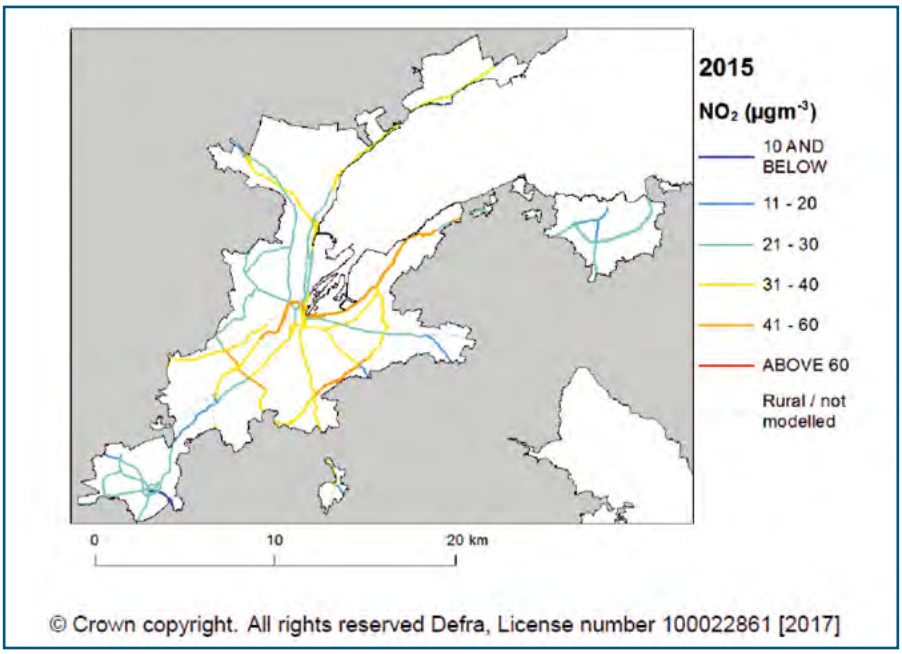


Figure 2-5 - map of modelled exceedances of NO_2 in Greater Belfast in 2015
(exceedances of the annual mean limit value are shown in orange)[72]

72 As well as modelled values, compliance maps illustrate stretches of road where monitored values at specific locations are likely indicative of exceedance along the entire stretch of road: this is the case with Balmoral Avenue-Stockman's Lane -Kennedy Way, based on results from the Stockman's Lane AURN monitoring station.

Figure 2-5 shows that the modelled areas of exceedance in 2015 are the A12 Westlink, the M3, the A2 Sydenham Bypass towards Holywood and parts of the A55 ring-road (along the Knock dual carriageway, as well as the Balmoral Avenue-Stockman's Lane-Kennedy Way section).

Projections using the UK-wide PCM approach show that the A12 Westlink will be the last area to remain in exceedance of the Directive's limits, and that this will not comply with the NO_2 annual mean objective until at least 2023; however, it is important to note that these projections are based on 'business as usual' scenarios, incorporating vehicle fleet composition and traffic behaviour, and do not take into account any traffic reductions as a result of local measures (such as the Belfast Rapid Transit system, for example).

Local Nitrogen Dioxide Modelling by Belfast City Council

Recognising that detailed local modelling which uses more local traffic data could provide further accuracy with regard to compliance timeframes, DAERA engaged Belfast City Council to undertake detailed local modelling of nitrogen dioxide levels.

The results of this modelling project suggest that compliance will be achieved in Greater Belfast in 2021, one year earlier than is predicted by the UK-wide PCM modelling approach. In addition, this local modelling has shown that exceedances of the nitrogen dioxide limit value are only present along the M1 Motorway/A12 Westlink, and not along the other roads suggested by PCM such as A55 Knockbreda and A2 Sydenham Bypass. Nevertheless, the M1/A12 is perhaps the most difficult stretch of road on which to tackle NO_2 exceedances, given its role as a key transport corridor that is central to Northern Ireland's strategic road network.

Petrol vs Diesel

Although, in general, diesel cars are more fuel-efficient than petrol ones, and emit less carbon per mile travelled, they emit on average six times the amount of nitrogen oxides for the recent averaged fleet.[73]

73 Wakeley et al., UK Informative Inventory Report (1990 to 2015), Ricardo AEA, Jan 2017, 147: https://uk-air.defra.gov.uk/assets/documents/reports/cat07/1703161205_GB_IIR_2017_Final_v1.0.pdf

Northern Ireland's Vehicle Fleet

At the end of 2018:

- There were 1,180,542 vehicles licensed in Northern Ireland - an increase of 1.9% from the previous year
- From 2006 to 2016, the number of vehicles in Northern Ireland increased by 18%
- This compares with 14% in Scotland, 13% in England, and 11% in Wales
- 61% of all vehicles were fuelled by diesel
- This included 462,311 diesel cars (56% of all cars)
- There were 358,772 petrol cars (44% of all cars)

At 20th June 2019, there were 2,794 'Plug-in' Grant eligible cars.
During 2018/19, 82% of households had access to a car or van (figure for England was 76% in 2018).

Figure 2-6 shows the number of petrol and diesel cars registered on Northern Ireland's roads since 2004. The data show that 2007 was the first year in which the number of diesel cars[74] exceeded those of petrol, with the gap widening every year since.

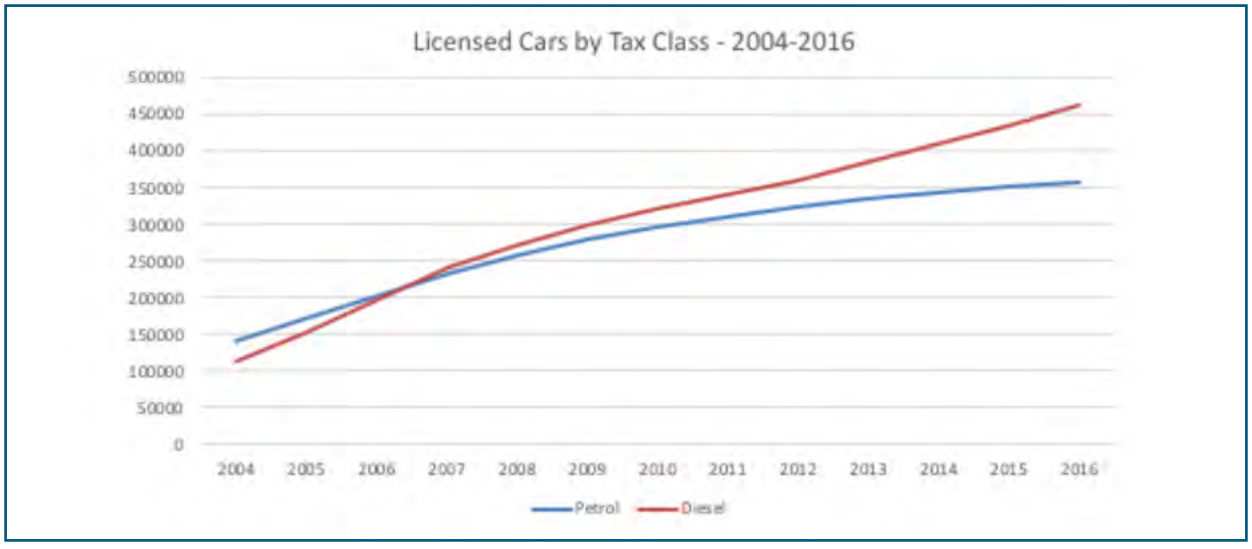


Figure 2-6 - petrol-diesel split of Northern Ireland car fleet 2004-2016

74 According to vehicle classifications used in transport statistics, cars can either be counted in the 'LGV' (light goods vehicle) category or in the 'car' category. Combined figures have been used.

Figure 2-7 shows figures for emissions of nitrogen oxides from petrol and diesel cars, taken from the National Atmospheric Emissions inventory. Nitrogen oxides emissions were at relatively high levels from petrol cars in the 1990s, but improvements in engine technology has seen overall NO_x emissions from cars decrease to just over 20% of 1990 levels, while increased diesel ownership means that diesel NO_x emissions in 2017 represented 90% of the total.

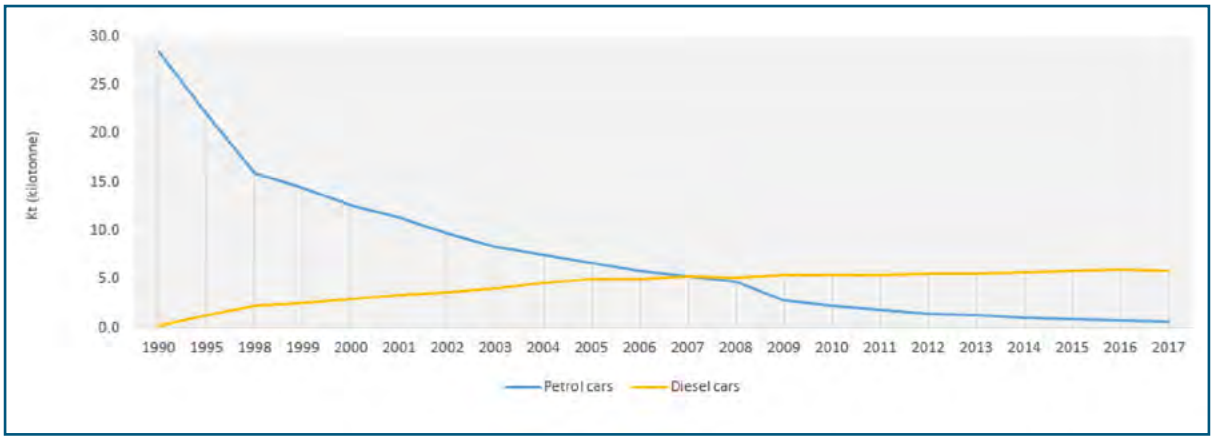


Figure 2-7 - Emissions of nitrogen oxides (t), NO_x, from petrol and diesel car fleets in Northern Ireland, 2010-2017.[75]

The popularity of diesel vehicles is one of the reasons for the problems we now see with levels of nitrogen dioxide. However, obtaining accurate emissions readings from diesel vehicles has been complicated by attempts to cheat the system such as 'Dieselgate', whereby it became known that some diesel vehicles were not performing under real-world driving conditions during official vehicle test cycles, and so their 'official' emissions varied greatly from real-world emissions (see Section 3.2).

In addition, emissions 'cheat devices' which give false emissions readings are being fitted to vehicles to circumvent emissions rules and cut the costs of operating. From September 2018, the Driver and Vehicle Standards Agency (DVSA) enforcement staff have been checking lorries for emissions cheat devices. If caught they must remove the device and repair the emissions devices or else they will face fines, have their vehicle taken off the road or potentially, lose the operators' licence.[76]

Driver and Vehicle Agency (DVA) enforcement staff routinely check the integrity of vehicle exhaust and emission control systems at the roadside and any vehicle detected with a defective emission control system or cheat device will be prohibited from use until it undergoes further technical inspection and is found to be compliant with legal requirements.

In addition, the user of an offending vehicle may be issued with a Fixed Penalty Notice or face prosecution action.

75 *Atmospheric Emissions Inventory* , Appendix H, 97.
76 https://www.gov.uk/government/news/checks-for-lorry-emission-cheats-start-across-great-britain

2.3 Measures to Tackle Air Quality Problems from Road Transport

Vehicle Standards

The UK Climate Change Committee report notes that there is limited scope in incentivising improvements in vehicle standards in Northern Ireland (these are a reserved matter). Policy would therefore be more effective in other areas such as providing ULEV infrastructure or encouraging public transport and active travel.[77]

Nevertheless, at a UK level, there have been recent changes in the vehicle excise duty for diesel cars. Any diesel car first registered on or after 1 April 2018 which does not comply with the real driving emissions standard (RDE2) will be required to pay a higher tax band[78].

These changes have also been reflected in the car fuel consumption database.[79] The database provides information on how consumers can reduce the impact of their vehicle on the environment, how they can identify which vehicles have lower fuel consumption/use alternative fuel types, and help them to establish the vehicle excise duty (VED) for specific vehicles.

The database will change to allow the Euro Standard to be expressed in full, making it easier for the system to identify if the VED supplement should be applied. Other changes include allowing manufacturers to include the Real Driving Emissions (RDE), which can aid consumers in choosing cleaner vehicles.

There have also been changes to the Environmental Label to update the summary of information on the fuel consumption of the vehicle, which must be clearly visible and displayed on or near to a car in the showroom. The changes include providing additional information on air quality. An example of the new label can be seen in **Figure 2-8**.

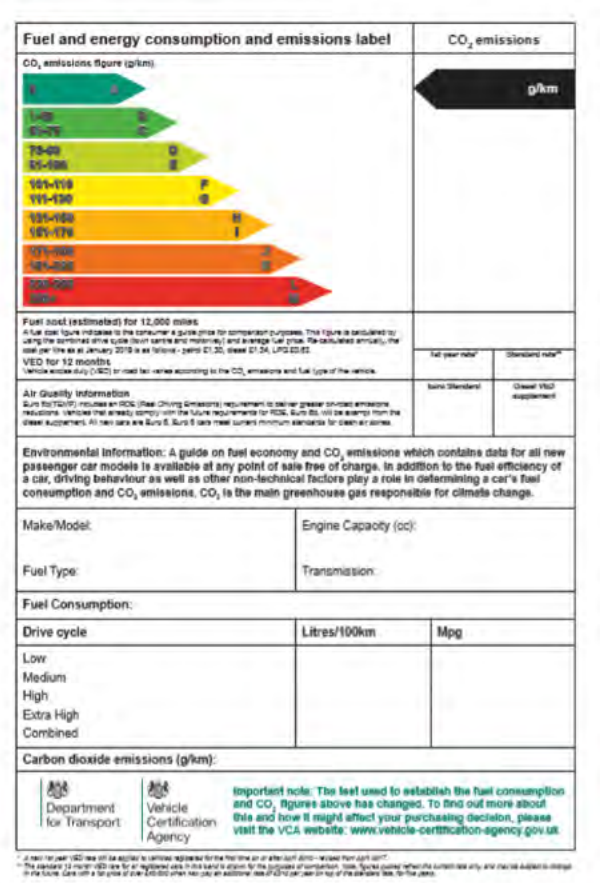


Figure 2-8 - New standard environmental label 2019

77 UK CCC, *Reducing emissions in Northern Ireland*, 90.
78 https://www.gov.uk/government/publications/vehicle-excise-duty-introduction-of-the-diesel-supplement/vehicle-excise-duty-introduction-of-the-diesel-supplement
79 http://www.dft.gov.uk/vca/fcb/new-car-fuel-consump.asp

Policy Recommendations

The National Institute of Health and Care Excellence (NICE) has produced a Quality Standard, 'Air pollution: outdoor air quality and health'.[80] The Standard covers road traffic-related pollution and its impact on health, and describes high quality actions in priority areas for improvement. The Standard is supported by four Quality Statements. These are presented in **Table 2-1**. Whilst the NICE Standards are based on the English policy model, **Table 2-1** has been adapted to suggest how this model might apply in Northern Ireland.

An assessment of technology options to reduce road transport emissions (both greenhouse gases and air pollutants) by Policy Exchange (**Figure 2-9**) shows modal shift to be an option with both high air quality potential and low consumer cost.[81] The report contains a number of recommendations for government including the introduction of Clean Air Zones, vehicle scrappage schemes, and recommendations on other vehicle fuel technologies such as biodiesel, gas and electric vehicles. The recommendations on modal shift include investment in improved public transport and increasing the proportion of the overall transport budget that is spent on cycling and walking.

80 https://www.nice.org.uk/guidance/qs181
81 Policy Exchange, 2017: *Driving down emissions: How to clean up road transport?* https://policyexchange.org.uk/publication/driving-down-emissions-how-to-clean-up-road-transport/

Table 2-1 - Adaptation of "NICE Quality Standard, 'Air pollution: outdoor air quality and health', Quality Statements"

Statement	Aims	Who?	Comments
1 - Strategic Plans	Key strategies including Local Development Plans should take account of how they will address air pollution, including enabling zero- and low-emission travel and developing buildings and spaces to reduce exposure to air pollution.	Department for Infrastructure, NI district councils	The recommended quality measures - for example levels of air pollutants, and outcomes, such as percentage of people walking and cycling - have a very strong read-across to the NICS Outcomes Delivery Plan and the indicator on air quality which supports Outcome 2.
2 - Planning applications	Local planning authorities assess proposals to minimise and mitigate road-traffic-related air pollution in planning applications for major developments.	District councils, DAERA, Department for Infrastructure	In NI, Council planners consult with Environmental Health Departments regarding possible air quality impacts. **Supplementary planning guidance should be updated**.
3 - Reducing emissions from public sector vehicle fleets	Public sector organisations reduce emissions from their vehicle fleets to address air pollution. Publicising these measures can set good example.	The NI Transport Holding Company (Translink), Department for Infrastructure, NI government departments, district councils.	Organisations could use the Organisations could use the NHS Sustainable Development Unit's Health Outcomes of Travel Tool (HOTT).[82]
4 - Advice for people with chronic respiratory or cardiovascular conditions	Children, young people and adults with chronic respiratory or cardiovascular conditions are given advice at routine health appointments on what to do when outdoor air quality is poor.	Department of Health, Health Trusts, HSC Health and Social Care Northern Ireland, GP surgeries, DAERA.	Standard health advice should be agreed and tie in with advice offered by NI Direct and high air pollution alerts issued by DoH and DAERA.

82 https://www.sduhealth.org.uk/delivery/measure/health-outcomes-travel-tool.aspx

	Time to deployment	Decarbonisation potential	Air quality potential	Consumer cost	Infrastructure requirements
Conventional vehicle (inc. non plug in hybrids)	Fast	Medium	Medium	Low	Low
Battery electric vehicles & plug in hybrids	Medium	High	High	Medium	High
Hydrogen fuel cell electric vehicles	Slow	High	High	High	High
Biofuels	Medium	Low	Low	Low	Low
Gaseous fuels	Fast	Low	High	Low	Low
Modal shift	Varies	Medium	High	Low	Varies
Mobility as a service (e.g. car sharing)	Fast	Medium	Medium	Low	Low
Autonomous vehicles	Slow	Uncertain	Uncertain	High	High

Figure 2-9 - High level assessment of technology options for cleaning up road transport

NICE has considered the evidence relating to local interventions aimed at reducing road-traffic-related air pollution and the potential benefits to health. The NICE guidelines recommend a range of interventions in the areas of planning policy, local development, clean air zones, public sector transport and vehicle fleets, smooth driving and speed reduction, the promotion of walking and cycling, and raising awareness of road-traffic-related air pollution and its impacts.[83]

83 https://www.nice.org.uk/guidance/NG70

Measures To Address Air Quality Directive Exceedance

As a result of exceedances of the Directive limit values for NO_2 across the UK, a UK Action Plan has had to be drawn up, showing the UK's overall approach, underpinned by detailed Zone Plans which highlight local measures. The main measures for the Belfast Zone Plan are shown in the box below.

As can be seen, measures to tackle NO_2 are focused primarily on promoting modal shift from private car use to other, lower-emissions forms of transport, such as: public transport (including Park and Ride schemes), active travel (walking and cycling).

The measures therefore appear in the Air Quality Zone Plan for Greater Belfast[84] (prepared to address exceedances of the Air Quality Directive).

Local Measures to Tackle NO_2 in Belfast

- **Belfast Rapid Transit**
  A more frequent and reliable service for passengers, using diesel-electric hybrid vehicles. Road Space is allocated to give priority to BRT vehicles by way of 12-hour bus lanes.
- **Belfast Transport Hub**
  A class-leading integrated public transport hub for Belfast. The Hub is set to be located on the 20-acre site of the existing Europa bus centre and Great Victoria Street train station. The new hub will offer a fully integrated transport solution, catering for rail, bus and coach, taxi, car and bicycle users.
- **Urban car parking restrictions**
  Parking spaces in Belfast City Centre will be more closely managed using a combination of time restrictions, payment levels and residents' parking schemes, to reduce the availability and use of spaces by commuters
- **Belfast Multi-Modal Transport Model**
  A computer-based multi-modal transport model and support services in order to assist DfI to prioritise transport investment. The model will be used to test impacts of potential new highways, public transport, walking and cycling schemes at the planning and prioritisation stages.
- **Bicycle Strategy for NI**
- **Ecar NI - Ultra Low Emission Vehicles**
- **Park & Ride for bus and rail services**
- **York Street Interchange**
  A major road scheme that will improve traffic flow and ease congestion along the A12 Westlink
- **Fleet improvement (buses)**
- **Public bike-hire scheme**

84 http://www.belfastcity.gov.uk/buildingcontrol-environment/pollution/pollution-about.aspx

2.4 Modal Shift

Encouraging a modal shift to active travel (walking and cycling) and greater use of public transport will have a significant impact on reducing air pollution from transport, whilst improving health and wellbeing. **Figure 2-10** is taken from the NICS Outcomes Delivery Plan indicator for percentage of journeys undertaken by walking, cycling and public transport, which uses information taken from the Travel Survey for Northern Ireland.[85]

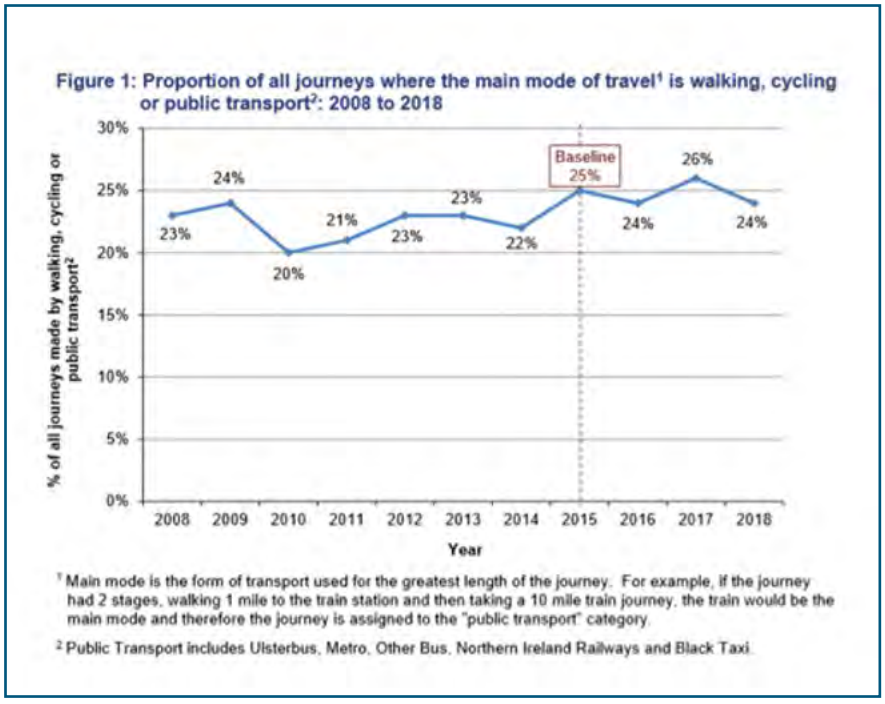
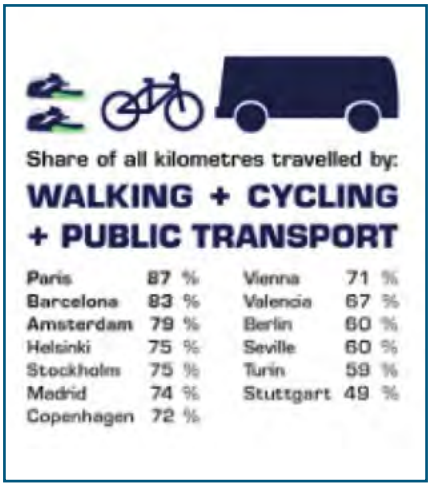


Figure 2-10 - journeys in Northern Ireland where the main mode of travel is walking, cycling or public transport 2008-2018

In 2018, just under one quarter (24%) of all journeys were taken by walking, cycling or public transport. There has been no statistically significant change comparing the figure for 2018 to that for the baseline year (25% in 2015). Indeed, there has been no significant change in modal choice when comparing to the earliest available Travel Survey for Northern Ireland data.

The proportion of all journeys made by walking, cycling or public transport for residents of Belfast Local Government District was 41% in 2015-2017. Meanwhile, the proportion of all journeys made in Northern Ireland by car was 70%[86]; this compares with 61% in England.[87]

85 Department for Infrastructure, Travel Survey for Northern Ireland: https://www.infrastructure-ni.gov.uk/articles/travel-survey-northern-ireland
86 Department for Infrastructure (2018), TSNI Headline Report 2015-2017: https://www.infrastructure-ni.gov.uk/publications/travel-survey-northern-ireland-depth-report-2015-2017
87 Department for Transport (2018), National Travel Survey: England 2017: https://www.gov.uk/government/statistics/national-travel-survey-2017



The information box below 'Short Journeys' shows how 78% of short journeys in Greater Belfast were made by car: arguably, these are journeys that could have been made by walking, cycling and public transport.

Looking at active travel in other European cities shows that the share of all kilometres travelled by walking, cycling and public transport can be as high as 87%, in the case of Paris.[88] In cities like Paris, Barcelona, Amsterdam, Stockholm and Copenhagen, there are high levels of walking and cycling (ranging from 42-68%), meaning that the proportion of kilometres travelled by car are conversely low.

Short Journeys

- In 2015-17 across Northern Ireland, **journeys under 5 miles** accounted for over 64% of all journeys made (78% in Greater Belfast)
- Of these, 62% were made by car (47% in Greater Belfast)
- 35% of all journeys were less than 2 miles long and 47% of these journeys were taken by car (for residents of Belfast, 43% of all journeys were less than two miles long and 33% of these were undertaken by car).
- The majority of journeys within urban areas and smaller towns are short, often less than one mile. These journeys are primarily undertaken by car.

Increasing the proportion of journeys undertaken by walking, cycling and public transport has the potential to reduce the number of private cars on our roads, and to decrease associated emissions of nitrogen oxides. It is also clear that a focus on short journeys - which are more suitable for walking or cycling - could deliver benefits. Clearly, a comprehensive and attractive public transport system in urban areas can help, as can a safe and attractive network of cycle facilities. The key change factor is to develop transport policies which prioritise walking, cycling and public transport (particularly in our towns and cities) rather than prioritising the flow of motor vehicles.

In addition, greater integration of land-use planning and transport planning processes can make a significant contribution. This is discussed in further detail in Chapter 7. The designation of areas for development should consider whether key services are accessible by public transport and active modes to provide a realistic alternative to private car. Planned increases in urban development densities in public transport corridors can help locate housing closer to jobs and services, boost public transport patronage and reduce private car use. The new Belfast Metropolitan Transport Plan will be prepared in conjunction with the land-use planners responsible for the new Local Development Plans in the Belfast area.

88 https://www.eea.europa.eu/media/infographics/transport-in-cities/view

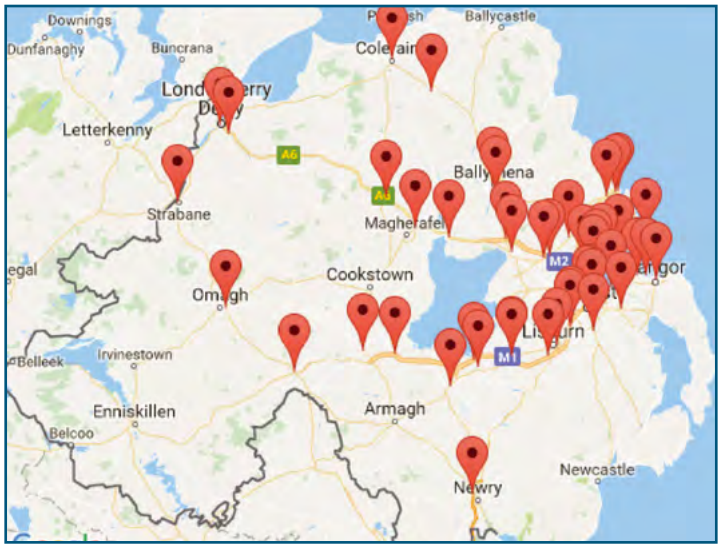


Figure 2-11 - Park & Ride Schemes in Northern Ireland[89]

Figure 2-11 shows the location of Park & Ride Schemes. Park & Ride Schemes encourage people, in particular commuters, to leave their cars at outlying rail and bus stations or stops and transfer to public transport, so reducing the amount of private car traffic into urban areas. Park & Ride sites can also be used as meeting points for car-sharing, which also reduces private car volumes. Unlike walking and cycling, Park & Ride is primarily for longer journeys.

At the time of writing, there were 57 Park & Ride sites. 25 of these were in the Belfast metropolitan area (combined total of 4216 spaces), while 32 were outside the Belfast metropolitan area (5043 spaces). Translink estimates that current sites are operating at approximately 90+% capacity and accommodate over 8000 cars on a typical day, which equates to almost 50km of traffic.

Under the Strategic Park & Ride Delivery Programme 2013-2016, 2,100 additional spaces at 14 locations across Northern Ireland were delivered. This included four major new facilities at Bangor (222 spaces), Ballymartin (420 spaces), Dundonald (520 spaces) and Tamnamore (312 spaces). The total investment by government over this period was around £9.5m.

A new ambitious programme for 2016-2020 has been established, which aims to deliver further facilities across Northern Ireland, subject to the availability of funding. This Programme has already delivered over 1,250 additional spaces.

Figures from an October 2018 survey of Park & Ride usage reveal that the majority of Park & Ride facilities are over 90% full on a daily basis. This reinforces the importance of these facilities to the travelling public.

Some measures included in Belfast City Council's 2015 Air Quality Action Plan, as well as the Department's Air Quality Plan for Greater Belfast, will further promote public transport over private car travel, including the Belfast Rapid Transit system, introduced in September 2018, and

89 http://www.translink.co.uk/Services/Other-Translink-Services/Park--Ride/

the Belfast Transport Hub at Weaver's Cross and the Belfast Rapid Transit system, introduced in September 2018. The Glider vehicles are powered by diesel-electric hybrid technology reducing carbon emissions by 30% compared to the buses they replaced. The service has proved extremely popular since launching with 45,000 additional passenger journeys made each week. Overall Glider patronage has exceeded expectations with 9.7 million journeys i.e. a 70% increase when compared to the 2013 baseline figure recorded indicating a step change in public transport provision.

Translink - Measures to Promote Modal Shift

Northern Ireland's public transport provider, Translink, continues to work on several fronts in promoting modal shift:

- new trains introduced in 2003/04 passenger journeys on the railways have more than doubled to over 15m per year;
- introduction of 'Glider' along with associated ticketing upgrades, road priority and increased Park and Ride facilities has seen an 8% modal shift from private car use.

Planned measures that will further increase modal shift include:

- new vehicles with the latest environmental credentials;
- further development of Park and Ride sites;
- Introduction of a new integrated, account-based ticketing system;
- Roll out of real time passenger information throughout the bus network across Northern Ireland;
- Full integration between services both in relation to journeys and fares.

2.5 Public Transport - Translink

Providing high quality public transport not only enables a region to thrive, it also helps to address the challenge of congestion and air quality, creating healthier towns and cities. On an individual level it gives people choices, freedom and more opportunities in terms of business, education, shopping, travel, tourism and leisure pursuits.

UITP, the International Association of Public Transport, reports that on average, public transport consumes three to four times less energy per passenger than cars for every mile travelled.[90]

Northern Ireland's public transport provider, Translink, has developed a corporate strategy entitled 'Get on Board' which sets out its vision: "To be Your First Choice for Travel in Northern Ireland." Their mission is to work innovatively and efficiently taking a collaborative approach

90 https://www.uitp.org/sites/default/files/Grow%20with%20Public%20Transport.pdf

with all relevant stakeholders to deliver a transformation in public transport, providing integrated services which connect people, enhance the economy and improve the environment, enabling a thriving Northern Ireland.

The Strategy sets out how Translink will deliver results across four key objectives:

- To deliver excellent bus and rail service performance.
- To deliver outstanding customer satisfaction at every touch point.
- To grow the number of passengers using public transport.
- To deliver value for money.

A key part of Translink's strategy, in the context of clean air, is to ensure the most environmentally friendly and fuel-efficient vehicles are in operation across their fleet, with fleet strategy developed which will result in a **zero emission** bus fleet by 2040, by including the following measures:

- Belfast/Foyle Metro - no more diesel and minimum standard of hybrid 2019;
- Introduction of first zero emission buses Belfast/Foyle Metro 2021
- Euro VI conversion of all Belfast/Foyle Metro 2022;
- Commence introduction of zero emissions across all routes (except Goldline) 2025;
- Belfast/Foyle Metro complete zero emission fleet 2030;
- Commence introduction of zero emission coach (Goldline) 2032; and
- Total zero emission fleet 2040.

Translink are continuing to work on bringing forward plans to improve the frequency and capacity on the rail network and have a Rail Network Utilisation Strategy which prioritises the investment needs arising from the Future Rail Investment Strategy. The Rail Network Utilisation Strategy has been developed to scope potential fleet investment in order to increase passenger capacity on the rail network.

In terms of the rail fleet strategy, the size of the fleet is much smaller than in bus and there are fewer options. The technologies including diesel hybrids, bi-modes (Diesel-Electric) and full electric trains are deemed the most feasible options at present and are already being considered by Translink. Translink currently has an aspiration to achieve an entirely **zero-emission** fleet by 2040. At this stage, it is not clear whether electrification of all or part of either the NI Railways network and/or the cross-border route is economically justified. Further work is required in this area to ascertain the feasibility of whole route electrification by 2040, as well as ongoing monitoring of the advancement of zero-emission alternatives such as hydrogen power.

Translink's Fleet Strategy in summary:

- Translink will target a zero-emission bus and rail fleet by 2040, through migration towards propulsion systems supplied by energy generated from sustainable energy sources;
- All Translink Metro (Belfast and Foyle) and Goldline fleets will meet Euro VI Diesel Engine Emission standards by the end of 2022;
- All Belfast and Foyle Metro services will be operated by zero-emission vehicles by 2030;
- New bus and train fleets will be procured focusing on:
    - Improving the customer experience;
    - Safety standards;
    - Sustainability/carbon neutral technologies;
    - Zero emissions;
    - Life cycle cost efficiency;
    - Modernity/innovation.

As an example of the efficacy of this approach an assessment of the Environmental improvements achieved by Translink's Strategy shows that by 2030, the proposed bus fleet would emit approximately 61% less CO_2, 90% less NO_x and 91% less PM, compared with the emissions from the 2019 fleet.

It must be borne in mind however that zero emission is in the context of the exhaust emissions only. There will still be the non-exhaust emissions from the vehicles i.e. tyre, road and brake wear particles. The use of public transport does, however, help to mitigate these emissions very effectively. For example, one Glider (with 8 tyres) can replace 80 cars with 320 tyres thereby significantly reducing tyre wear particles and silicate dust from road wear. Also, because it is a hybrid, it utilises energy recovery and thereby reduces brake dust emissions.

However, reducing the emissions of the Translink fleet will only provide benefits to the people of Northern Ireland if a real and sustained modal shift can be achieved.

Currently, on the other main radial routes serving Belfast, only 15% of the lanes have bus prioritisation measures and in other major urban areas with significant air quality issues, such as Derry/Londonderry, there are no bus prioritisation measures. This may therefore be a factor that requires consideration, moving forward.

2.6 - Glider

Glider, introduced in 2018, is contributing enormously to social, economic and environmental benefits to wider society by offering a modern, high quality, public transport service providing people with better access to jobs, hospitals, shops, schools, colleges, and entertainment. It aligns closely with the objectives of the draft Programme for Government and plays a pivotal role in helping Belfast deliver its plans for sustainable growth as set out in the Belfast Agenda and Draft Local Development Plan Strategy.

Glider is helping customers to be more sustainable in how they live their lives, by getting them out of their cars and onto an environmentally friendly fleet of hybrid vehicles, reducing carbon, reducing emissions, providing paperless ticketing and a high quality environment in terms of accessibility, space, security and on-board information. Glider also incorporates high quality halts enabling easy access to vehicles, real-time information for easier journey planning and off-vehicle ticketing to speed up the boarding process.

Glider contributes socially and economically linking East Belfast, West Belfast and Titanic Quarter via the city centre. The programme of works to deliver the Glider was carried out over a period of approximately 5 years and included the development of 30 bespoke vehicles, a new advanced ticketing system, new modern and sustainable service centre for the maintenance of the vehicles, over 100 new interactive Glider halts, a new Park & Ride site and interchanges in East and West Belfast which also support active travel, and extensive road and public realm improvements across approximately 25km of roads. It also included a step change in road priority with bus lanes installed across approximately 50% of the Glider routes.

Research shows strong correlations between a good public transport system and the promotion of competitiveness and sustainable development of an area. It has also been found to assist in delivering an environmentally sustainable economy. Translink has been, and is, raising awareness about the importance of more sustainable lifestyles by:

- Encouraging mode shift away from non-essential car use by providing a safe, economic and reliable alternative to the private car;
- For the first time, providing a direct cross-city service linking East and West Belfast, improving connectivity between historically divided communities and improving access and mobility for deprived communities and those with disabilities, particularly to essential services;
- Contributing to active travel and quality of life improvements via the provision of complementary secure cycle shelters along the dedicated route, enhancing multi-modal opportunities; and
- Reducing congestion and contributing to the Belfast Air Quality Action Plan 2015-20.

Translink is influencing changes to more responsible behaviour by having early meaningful engagement with all sectors, in particular disability and community groups, in order to deliver a highly accessible, successful outcome.

Changes to more responsible behaviour is already evident as Translink have delivered unprecedented growth in public transport in Belfast, with over 40,000 additional passengers using the Glider corridors each week. It is estimated that there has been an 8% modal shift on the routes served by the Glider service.

This is also evidenced by the Park and Ride site at Dundonald were usage has already increased by approximately 75%. Glider vehicles are demonstrating a 10% to 40% improvement in fuel efficiency when compared with current double-deck buses in Belfast (dependent upon vehicle type). A 90% reduction in NO_x and particulate matter emissions has also been recorded.

2.7 - Cycling

Promoting everyday cycling can make a significant contribution to reducing the number of short journeys currently made by car. A Bicycle Strategy published in 2015 by the former Department for Regional Development centred on development of a comprehensive network of infrastructure for the bicycle, support for people who travel by bicycle, and the promotion of cycling for short journeys. In some European cities such as Copenhagen, cycling has grown to become the dominant form of transport within the city.[91]

Cycling in Northern Ireland

The former Department for Regional Development published '*Northern Ireland Changing Gear - a Bicycle Strategy for Northern Ireland*' in August 2015 with a vision of 'a community where people have the freedom and confidence to travel by bicycle for everyday journeys'.

The Strategy is based on three pillars:

- BUILD a comprehensive network for the bicycle
- SUPPORT people who choose to travel by bicycle
- PROMOTE the bicycle as a mode of transport for everyday journeys

The ambition of the strategy is to increase the proportion of all journeys undertaken by bicycle from <1% to around 6% in 2025 and 12% by 2040. '*Exercise - Explore - Enjoy: a Strategic Plan for Greenways*' was published in November 2016 with proposals for a 1,000km greenway network across Northern Ireland.

A Belfast Bicycle Network of around 130km is currently being developed with the aim of bringing good quality segregated bicycle infrastructure within the reach of most people within the city by 2025. New segregated cycle tracks at Alfred Street, College Square, High Street and Middlepath Street are being delivered to better link existing bicycle infrastructure with the city centre.

91 http://kk.sites.itera.dk/apps/kk_pub2/?mode=detalje&id=823

In Northern Ireland, sustainable travel initiatives are supported by other stakeholders, such as SusTrans - a UK charity that promotes walking and cycling. The information on SusTrans, below, shows that it is involved in initiatives that aim to promote walking and cycling, instead of car use, whether this is to schools, hospitals or workplaces.

Sustrans Northern Ireland

SusTrans is a charity that makes it easier to walk and cycle. SusTrans Northern Ireland projects underway include:

- Active School Travel Programme: tackling the problem of congestion and air pollution at school gates by encouraging more pupils and staff to walk and cycle.
- Leading the Way with Active Travel - Belfast and North West: sponsored by PHA and working with large public sector employers to support employees in actively travelling to work.
- CHIPS (Cycle Highway Innovation for Smarter People Transport and Spatial Planning) Project - EU funded project that aims to improve air quality through changing a commute to work by car to one by bike, mainly along the Comber Greenway corridor. Based in East Belfast, it involves engaging with employees and working with EU partners to share learning and experiences. Over the last three years, it has involved engagement with 15,000 employees. It has established an Active Travel Hub at CS Lewis Square, which has become a public-facing point of engagement for Active Travel activities, offering cycle training, bike maintenance and route planning. A fleet of e-Bikes was purchased to support more people in cycling to work, but who face more challenging commutes for reasons such as distance, topography or who feel they need some to build up fitness levels gradually.
- Legislative amendment is currently being planned that will exempt e-bikes from the current licence, tax, insurance and other requirements that must be in place to operate e-bikes in NI. As such these bikes have not yet been deployed.

One area that could see growth is electric bicycles (‘e-bikes’, or ‘pedelecs’), which could enable people who find that distance of fitness limits their ability to cycle to work, and a future SusTrans project will aim to look at this.

DAERA has recently committed funding to SusTrans to support employment of an Active Travel Officer for three years.

In 2019, SusTrans released its third biennial report, *Bike Life 2019 Belfast*.[92] The report uses local cycling data, modelling and representative survey information to produce headline facts and figures that give valuable insights into cycling in Belfast. Some of these include:

- 51% of residents surveyed feel that they should cycle more;
- 5% of residents surveyed cycle five or more days a week in Belfast. This compares with 13% for public transport, 51% for walking, and 54% for car or van.

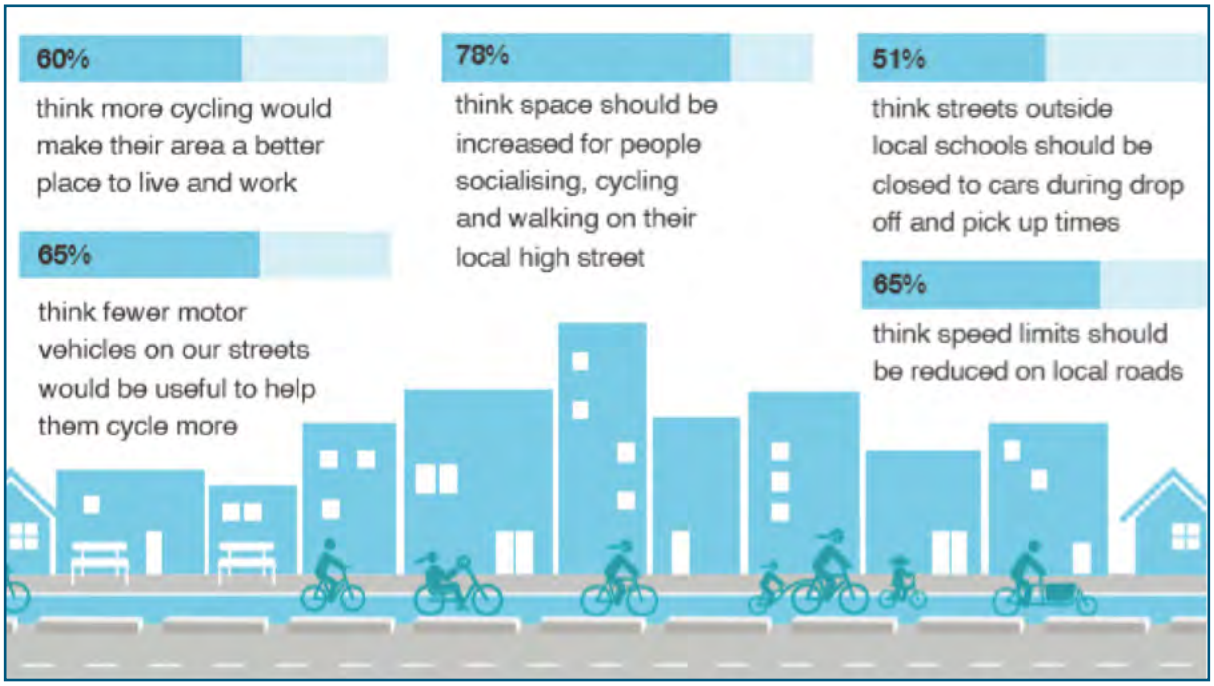


Fig 2-12 - from 'Bike Life 2019 Belfast', Sustrans

Among survey respondents interviewed by SusTrans, a majority of people feel that more cycling would make their area a better place to live and work (**Fig 2-12**).

However, barriers to cycling were also identified, with safety being the single largest barrier to more people cycling - 48% of residents do not cycle, or cycle less often due to concerns over safety.

A new Cycle-Friendly Employer Accreditation Scheme for the UK was piloted in Belfast, which rewards companies who make their workplaces supportive for cycle commuters. Organisations must meet a range of measures including communications, training and incentives for staff as well as physical facilities such as secure cycle parking, showers and changing rooms.

Another Sustrans report, 'Bike Life: Transforming Cities', which uses data from Bike Life 2017 from seven cities, including Belfast.[93]

92 https://www.sustrans.org.uk/media/5943/200228-bikelife19_belfast_v58_web.pdf
93 https://www.sustrans.org.uk/media/2940/2940.pdf

Key findings in this report are taken from modelling studies from 2017 to 2040, which, assume a doubling of the number of cycling trips approximately every eight years. For Belfast in 2040, this could mean:

- 115,000 cycle trips every day;
- Prevention of 31 early deaths, from increased physical activity;
- Avoidance of 1,600 long-term health conditions;
- A saving of 20,000 tonnes of greenhouse gas emissions;
- An annual economic benefit of £101 million.[94]

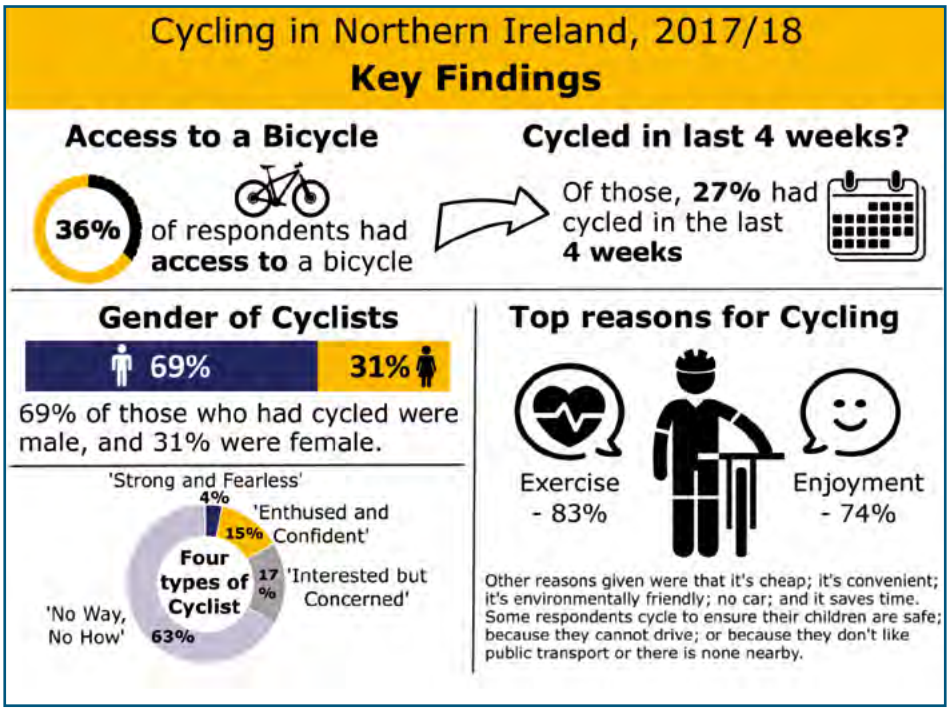


Figure 2-13 - 2017/18 Key figures: Cycling in Northern Ireland report

Figure 2-13 shows statistics from the 2017/18 Cycling in Northern Ireland report[95] which is produced by the Department for Infrastructure (DfI).

A further report by DfI shows that just over half of survey respondents are satisfied with cycling in their area, though only 17% of people would be likely to use cycling for short journeys. Walking and public transport show higher rates of satisfaction, and much higher rates of likelihood to use these methods for short journeys (see **Figure 2-14**)[96]

94 The cumulative economic benefit between 2017 and 2040 is estimated at £1.1 billion.
95 https://www.infrastructure-ni.gov.uk/system/files/publications/infrastructure/cycling-in-northern-ireland-2017-18.pdf
96 Department for Infrastructure, *Attitudes to Walking, Cycling and Public Transport in Northern Ireland 2018/2019:* https://www.infrastructure-ni.gov.uk/sites/default/files/publications/infrastructure/attitudes-to-walking-cycling-and-public-transport-in-northern-ireland-2018-2019_0.pdf

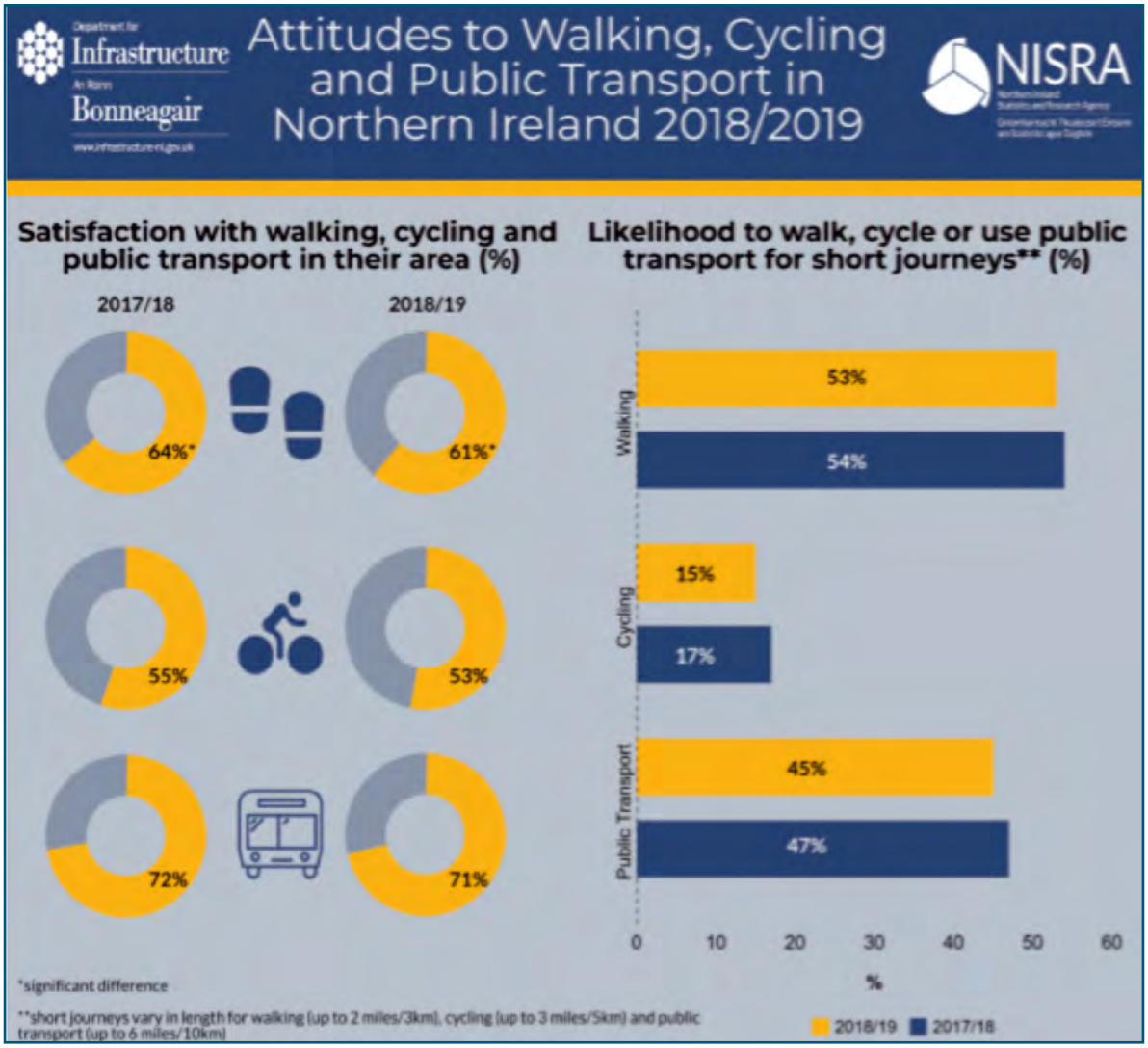


Figure 2-14 - Key figures: Attitudes to Walking, Cycling and Public Transport in Northern Ireland 2018/2019

Encouraging Modal Shift and Sustainable Transport

Q: Are there any potential measures not included here that you believe could help encourage a shift away from private car use to walking, cycling, and public transport?

2.8 Ultra Low Emissions Vehicles (ULEVS)

Ultra low emissions vehicles (ULEVs) include vehicles powered purely by electricity, 'e-cars', as well as 'plug-in hybrids' that run both on electricity as well as a conventional combustion engine. Hydrogen and Biogas low and zero emission vehicles are also being developed and demonstrated across the UK. ULEVs have obvious benefits for local air quality, with none of the tail pipe emissions associated with petrol and diesel vehicles. Increasing uptake of electric vehicles (EVs) will impact overall electricity demand, but could also provide benefits to the electricity network and indeed consumers through greater flexibility of supply and demand.[97] The overall carbon emission impact of Electric Vehicles will depend on the electricity generation mix, and a future Energy Strategy will consider targets for renewable generation. As of 20 June 2019, there were 2,794 Plug-in Grant eligible cars registered in Northern Ireland.

The ecar charging network, owned, operated and maintained by the ESB Group through its ESB ecars business, is made up of 160 double-headed 22kW fast charge points and 17 50kW rapid charge points across 177 locations Northern Ireland; together with charge points in the Republic of Ireland, ESB operates almost 1100 charge points across the island of Ireland.[98]

Fig 2-15 - e-car Charge Point

97 https://www.economy-ni.gov.uk/sites/default/files/consultations/economy/energy-strategy-call-for-evidence.pdf p55
98 https://www.ecarni.com/charge-point-map

The Continuous Household Survey for 2015/16, which was based on a random sample of 4,500 domestic addresses, contained questions about ecars; the ecar findings from the survey are presented in a separate DfI publication.[99] The dataset from the survey contains responses for 3,340 survey respondents aged 16 and over, who answered the ecar question set. The survey found that of those questioned, 94% said that they were 'not at all likely' to buy an electric vehicle as their next car, with 6% saying that they would be 'quite likely' and 1% 'very likely' to buy an electric vehicle as their next car (percentages have been rounded to whole numbers and so do not sum to 100). Key factors that would encourage electric vehicle purchase were found to include: no vehicle duty, grant towards purchase and low running costs and no vehicle duty.

The market for ultra low emission vehicles has changed in more recent years, with a steady growth in the uptake of electric vehicles, greater choice of models available that offer greater range capability with falling prices. However, the cost of vehicles continues to have an impact even with current grant arrangements in place (which are administered by OLEV - the Office for Low Emissions Vehicles). Other concerns include the range capability of vehicles between charges, and availability of charging facilities.

The UK CCC Report chapter on emissions from transport notes that tax and vehicle standards are reserved matters, and therefore outside the competence of NI government. However, the Committee proposes a number of actions that would further encourage the uptake of ULEVs:

- operating and promoting UK government-funded schemes, such as ecarni;
- pursuing opportunities to secure UK government funding for ULEV infrastructure in Northern Ireland;
- providing leadership via public sector and bus fleets;
- using the infrastructure budget on electric vehicle charging infrastructure;
- setting targets for ULEV sales that go beyond those in the Road to Zero Strategy.
- Addressing non-financial barriers for ULEVs: parking, and access to priority lanes and bus lanes.

As an example of action being taken elsewhere in the UK, in Scotland, the Electric Vehicle Loan and Low Carbon Transport Business Loans schemes both provide interest-free loans of up to £35,000 spread over six years towards the cost of an electric vehicle.

ENCOURAGING ULEVs

Q: What would encourage you to consider buying an electric vehicle as your next car?

99 https://www.infrastructure-ni.gov.uk/publications/public-attitudes-towards-electric-vehicles-northern-ireland-20152016

2.9 Clean Air Zones

Defra's Action Plan for tackling nitrogen dioxide is centred on an approach whereby Clean Air Zones (CAZs) are implemented in urban areas where nitrogen dioxide levels exceed EU limit values. A national Clean Air Zone Framework has been published. The Framework sets out the principles local authorities should follow when setting up Clean Air Zones in England, explains the approach they should take if they are introducing a zone to improve air quality, and the types of measures they should include. The Welsh government has also consulted on a Clean Air Zone framework.

NICE guidance on air pollution and health recommends that Clean Air Zones are considered, where poor air quality is due to traffic congestion and that these could:

- include restrictions or charges on certain classes of vehicle
- support zero- and low-emission travel (including active travel)
- include targets to progressively reduce pollutant levels below EU limits and aim to meet World Health Organization air quality guidelines
- aim to reduce exposure to air pollution across the whole zone rather than focusing on air pollution hotspots.[100]

Defra has published a Framework for Clean Air Zones[101], which states that, as a minimum, CAZs should:

- be in response to a clearly defined air quality problem, seek to address and continually improve it, and ensure this is understood locally;
- have signs in place along major access routes to clearly delineate the zone; be identified in local strategies including (but not limited to) local land use plans and policies and local transport plans at the earliest opportunity to ensure consistency with local ambition;
- provide active support for ultra-low emission vehicle (ULEV) take up through facilitating their use;
- include a programme of awareness raising and data sharing;
- include local authorities taking a lead in terms of their own and contractor vehicle operations and procurement in line with this framework;
- ensure bus, taxi and private hire vehicle emission standards (where they do not already) are improved to meet Clean Air Zone standards using licensing, franchising or partnership approaches as appropriate; and
- support healthy, active travel.

100 Air pollution, NICE guideline [NG70].
101 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/612592/clean-air-zone-framework.pdf

Low Emission Zones (LEZs)/CAZs can incorporate many measures, such as might already be found in AQMA Action Plans, but at their most stringent they entail the restriction of certain vehicle types, or introduce monetary charging for vehicles to enter. However, LEZs are more suited to NO_2 exceedances in city centre streets and are therefore not an obvious solution to exceedances along major trunk roads such as the A12 and A2 in Northern Ireland.

However, a CAZ, as the NICE recommendations suggest, can be used to reduce pollutant levels to not only below EU limits, but also to meet WHO air quality guidelines, which are more stringent, and therefore have the potential to deliver greater public health benefits.

Establishing CAZs for road emissions transport would, however, add another layer to clean air area designations, in addition to Smoke Control Areas and Air Quality Management Areas. There is a possibility to combine all types of air pollution management areas into a single entity. This idea is discussed further in **Chapter 6**.

Low Emissions Zones

Q: Do you think that DAERA should develop a Low Emissions Zone Framework for dealing specifically with transport emissions in Northern Ireland?

or

Q: Would you be in favour of Low Emissions Zones for urban areas also covering other sources of pollution, for example those from household heating?

Q: What are your views on vehicle charging cordons for entry to the most polluted parts of urban areas in Northern Ireland?

2.10 Local Air Quality Management and Road Transport

In Northern Ireland, 17 AQMAs have been declared as a result of air pollutant emissions from road traffic. As set out in Section 1.5, district councils have a duty to review and assess air quality and where there are exceedances, to declare Air Quality Management Areas (AQMAs). Councils must draw up Action Plans for AQMAs, with input from Relevant Authorities. In the case of transport emissions, the Relevant Authority is the Department for Infrastructure, DfI, which has responsibility for roads and transport here.

Further, more detailed information on Local Air Quality Management can be found in Chapter 6.

Councils do not have the required powers to deal with road transport emissions, as these could involve measures such as: traffic re-routing, signal phasing and road bypass schemes. Some of these powers, such as those set out in the Environment Order (Northern Ireland) 2002 and Air Quality Regulations (Northern Ireland) 2003, require action by other Departments and there

is also an obligation to support district councils in improving air quality. AQMAs are revoked by councils when the air quality situation has improved to an extent that exceedances of air quality objectives are no longer a problem, nor are at risk of being a problem in the future.

In the case of road transport, levels of pollutants are gradually reducing as vehicle standards become more stringent over time. However, in general, AQMAs declared for road transport have not yet been revoked, as significant individual measures to reduce pollution have not been put in place.

Councils do, however, have the ability to incentivise other forms of transport and to work with Translink to promote public transport. Belfast City Council has successfully implemented a public bike-hire scheme that has 300 bikes spread across 30 docking stations in places including Titanic Quarter, the Gasworks, Queen's University and York Street.

The then Department of the Environment published Local Air Quality Management Policy Guidance LAQM PG (NI) 09 in 2009. This policy guidance now needs to be updated to reflect subsequent changes in planning policy and in the roles of local authorities after Local Government Reform, and incorporating the views expressed in this consultation and actions elsewhere in the UK.

Chapter 3 - Household Emissions

Emissions from household heating present a significant problem for local air quality. The primary pollutants of concern here are particulate matter and polycyclic aromatic hydrocarbons (PAHs). The levels of these pollutants emitted by home heating activity depend on a) the fuel being burned, and b) the appliance used to burn the fuel.

The highest levels of pollutants are emitted from solid fuels, such as coal, peat and wood, although emissions are significantly reduced in the case of 'smokeless' coal and other 'smokeless' fuel products, which include manufactured fuels such as ovoids. Oil and, to an even greater extent, natural gas emit far less air pollution. **Table 3-1**, below, shows emissions factors for a range of pollutants from a range of fuels.

Fuel	NI UK
Coal	392
Anthracite & Ovoids	35 Anthracite 98 SSF
Lignite	N/A
Sod Peat	494 peat
Peat Briquettes	494 peat
Kerosene	3.2 burning oil
LPG	3.3
Petcoke	102
Natural gas	0.5
Biomass	642 Wood
Gasoil	3.2

The data in **Table 3-1** show that emissions of pollutants, for example, PM_{10}, are highest for solid fuels such as coal (392 grams of PM_{10} per gigajoule of energy produced), and peat (494), down to smokeless fuels (98), domestic heating oil (3.2), with the cleanest being natural gas (0.5).

It is worth noting that the highest emission factor for PM_{10} here is for biomass (wood).

Table 3-1 Emissions Factors, in grams of pollutant per unit of useful heat output, from a range of fuels used in home heating[102]

102 Ricardo Energy & Environment, *Residential Solid Fuel and Air Pollution, North South Ministerial Council (NSMC),* 2016, 33. https://www.daera-ni.gov.uk/sites/default/files/publications/daera/residential-fuel-air-pollution-study.PDF

What are PAHs?

Polycyclic aromatic hydrocarbons - or PAHs - are compounds that can be formed as by-products of certain combustion processes. They are known to be potent human carcinogens (able to cause cancer) and are one of the cancer-causing constituents of cigarette smoke. They are emitted in highest levels from inefficient burning of 'dirty' solid fossil fuels - for example, bituminous coal or peat in open fires.

There are a whole range of PAHs, and so a health-based Target Value has been set by the EU for one PAH in particular - benzo[a]pyrene, or B[a]P. PAHs are measured at three sites in Northern Ireland, which are part of the UK-wide PAH network: Ballymena Ballykeel, Lisburn Kilmakee and Londonderry Brandywell.

The appliance in which fuels are burned also has a bearing on the amount of pollutants released.

Monitoring of pollutants like PAHs[103] and Black Carbon show that emissions from home heating are a problem in Northern Ireland as compared with other parts of the UK; this will be discussed in the following sections.

3.1 Legislation and Controls

The Clean Air (NI) Order of 1981 introduced controls for the emission of smoke in urban areas. Under the Order, district councils here can declare parts of their district as Smoke Control Areas (SCAs). In a SCA, the emission of smoke from a premises is prohibited. Households may only burn 'authorised fuels' in any appliance, or use 'exempted appliances' when burning specifically prescribed fuels other than authorised fuels. This means that the burning of bituminous ('household' or 'smoky') coal in an open fire would be prohibited. Examples of permitted burning would include: gas central heating, oil-fired central heating, or the burning of 'smokeless' coal, untreated wood, or anthracite in an efficient, closed-fronted fireplace or stove.

Where Smoke Control Areas are declared, then district councils and the Department must contribute to the cost of any work that householders must carry out (for example, installing oil-fired or gas heating systems) to ensure that they are able to comply with Smoke Control provisions.

District councils' Environmental Health Officers enforce Smoke Control provisions. Enforcement actions (such as letters to householders) are often follow-ups to complaints by other householders in the area. District councils may also choose to launch information campaigns, in which they remind householders in SCAs what fuels they may burn, and in what appliances.

To date, 126 SCA's have been declared by district councils in Northern Ireland. Some of these declarations go back to the late 1960s. Smoke Control appears to have been most successful in the

103 Public Health England, *Polycyclic aromatic hydrocarbons (Benzo[a]pyrene) Toxicological Overview,* 2018: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/737017/PAH_TO_PHE_240818.pdf

Greater Belfast area, where the majority of the city has been declared as falling under Smoke Control. In other urban centres, SCAs may only have been declared for certain streets or parts of towns. This makes enforcement of Smoke Control and awareness by householders more difficult in these areas.

Evidence shows that a substantial amount of solid fuel burning takes place in the evenings or at weekends[104], which also makes enforcement difficult in the absence of a night-time or out-of-hours Environmental Health service being provided by the council (only Belfast City Council provides out-of-hours services in terms of noise complaints).

Legislation states that unauthorised fuels are only allowed to be sold in Smoke Control Areas where the use is not intended within the Smoke Control Area.[105] In practice, this is difficult to monitor and enforce.

In the example of bonfires in the gardens of domestic properties, the smoke arising from these has the potential to cause pollution and become a statutory nuisance.

If bonfires[106] do occur in the boundary of a domestic property it should not causes nuisance or disturbance to nearby residents. If a nuisance or disturbance is identified it can be reported to the council, any action regarding smoke from domestic bonfires is governed by Statutory Nuisance procedures[107]. If the issue becomes a regular complaint and the Council is satisfied the smoke is causing a nuisance at neighbouring properties, the Council shall serve an Abatement Notice on the person responsible requiring them to reduce or cease the burning.

The provision of doorstep recycling where householders are encouraged to deposit their garden waste in their designated bin, the collection of larger items from householders by the council and the provision of civic amenity sites should mitigate against the need for the burning of any waste in the garden of domestic properties. However, garden waste bins are not provided to householders in all areas.

With respect to plant tissue waste, a waste management exemption[108] does exist which permits the burning of this material in the open. However several restrictions do apply, for example the exemption holder must adhere to a specific interpretation of plant tissue and operational land and additional conditions.

104 Hessey *et. al.*, 2016 Annual Report for the UK Black Carbon Network, NPL, July 2017, 33.
105 The Smoke Control Areas (Sale or Delivery of Unauthorised Fuel) Regulations (Northern Ireland) SR 1998/328.
106 https://www.gov.uk/garden-bonfires-rules
107 This is actioned under the Clean Neighbourhoods and Environment (NI) Act 2011.
108 https://www.daera-ni.gov.uk/articles/burning-waste-land-open-paragraph-30-exemption

3.2 Polycyclic Aromatic Hydrocarbons (PAHs)

The strongest evidence for air pollution from household heating comes from levels of PAHs monitored at sites here in Northern Ireland. **Figure 3-1** shows the annual mean values of B[a]P (benzo[a]pyrene) monitored across the UK PAH monitoring network. Levels are monitored by equipment that continuously draws air through filter paper, which is periodically changed. The used filter papers are sent to a laboratory for analysis. This method only gives average results over a specific time period - for example, a month - depending on how long filter papers remain in the monitoring equipment between changes. Monthly values are averaged over the year to give an annual mean value.

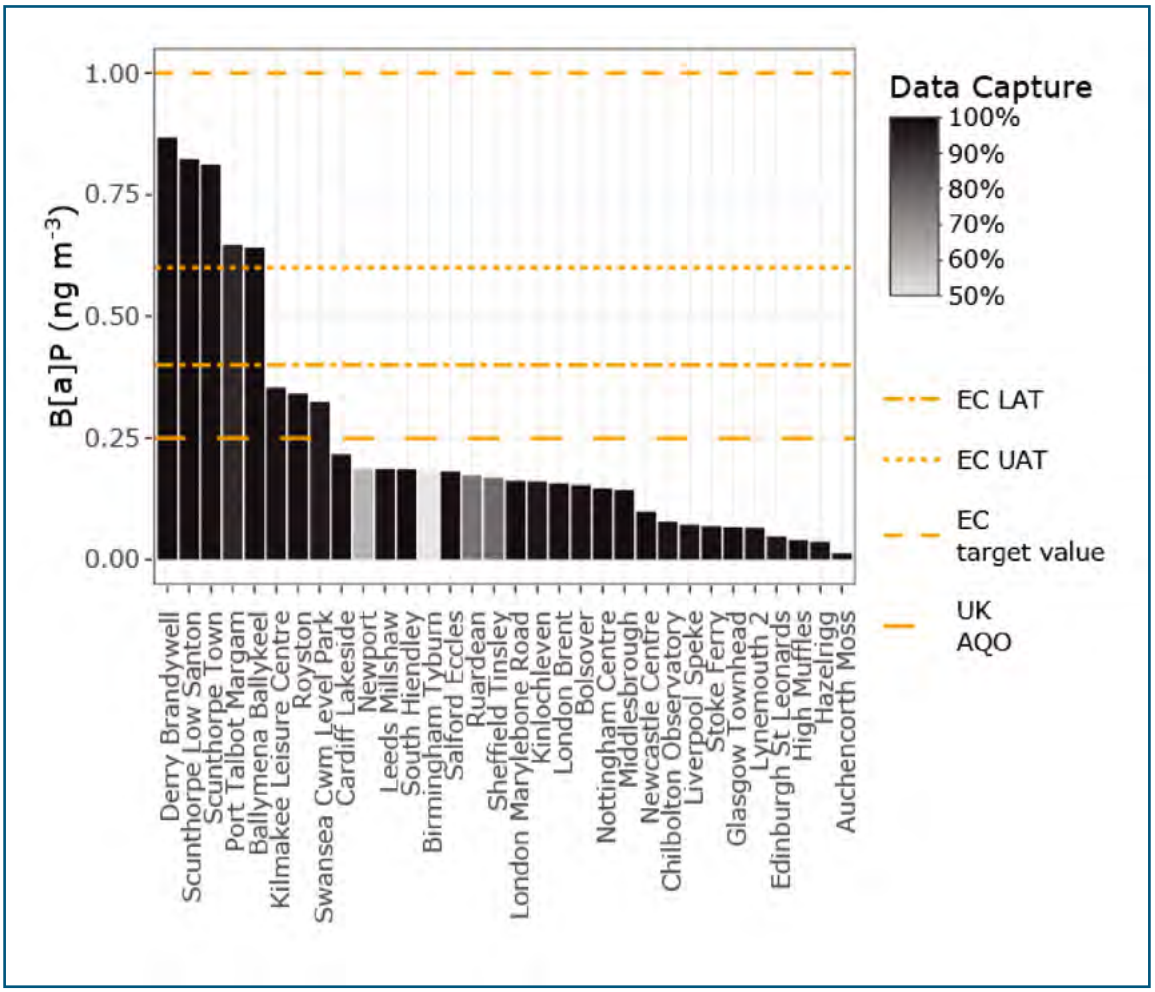


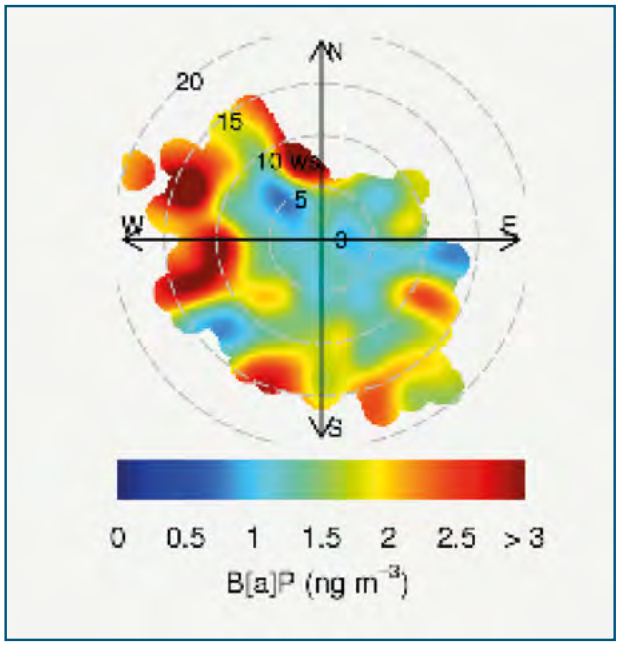
Figure 3-1 - Annual mean B[a]P concentration recorded at monitoring sites in the UK in 2017[109]

109 UK PAH Monitoring Network Report, 2019 (unpublished).

The three Northern Ireland monitoring sites - Derry Brandywell, Ballymena Ballykeel and Kilmakee Leisure Centre - have recorded the first, fifth and sixth highest annual mean values of B[a]P in the UK in 2017. The Derry Brandywell site was one of three UK sites at which the EU annual mean target value for B[a]P (1ngm^{-3}) was breached in 2016 (this is further discussed in **Section 3.6**). It is worth noting the following in relation to the sites with the seven highest monitored levels of B[a]P:

- Scunthorpe Santon & Scunthorpe Town: near steel works.
- Royston: Upwind from coke works.
- Port Talbot Margam: Next to steel works.
- Ballymena Ballykeel, Londonderry Brandywell and Lisburn Kilmakee: Stations in Northern Ireland with domestic solid fuel use.

The fact that levels of B[a]P monitored in urban settings in Northern Ireland are comparable in magnitude to those monitored in locations with heavy industry in England and Wales illustrates that there is a different emissions profile here. It also demonstrates a significant problem with B[a]P levels in residential settings in Northern Ireland.



Bivariate polar plots (such as **Figure 3-2**), using wind speed and direction with concentrations give further insight into the sources of PAHs at monitoring sites. The polar plots show the variation of B[a]P concentration under different combinations of wind speed and wind direction; therefore, these plots can be used to deduce which direction of prominent sources of B[a]P emissions.

Figure 3-2

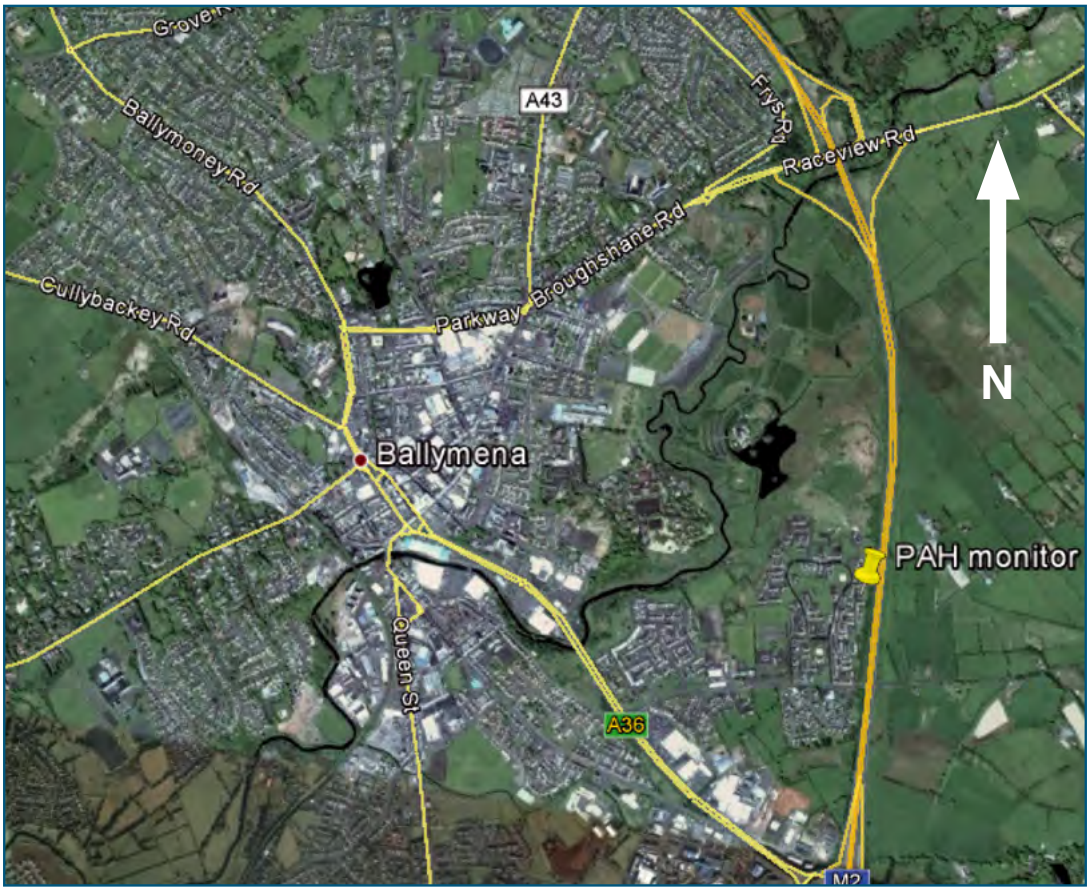
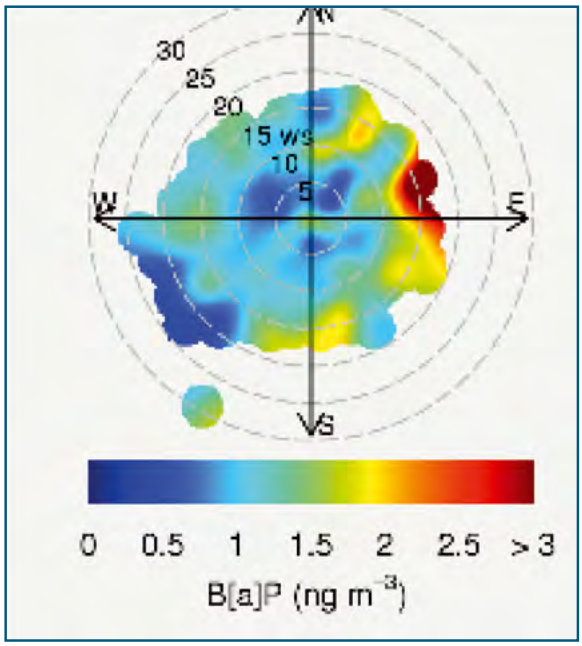


Figure 3-3 - location of PAH monitor in Ballymena (Ballykeel)

As can be seen from the first of these plots, for the Ballymena monitoring site, concentrations of B[a]P tend be highest when the wind direction is from the west-northwest. Therefore, the main sources of PAH emissions lie to the west/northwest of the monitor: these are built up areas of housing.



A bivariate polar plot (see **Figure 3-4**) constructed for the PAH montoring site at Derry Brandywell is shown here. In this case, it suggests that the highest levels of B[a]P are recorded at the Brandywell monitoring site when the wind is coming from the east. The main sources of B[a]P pollution to the east of the monitoring site include low-rise terraced housing.

Figure 3-4

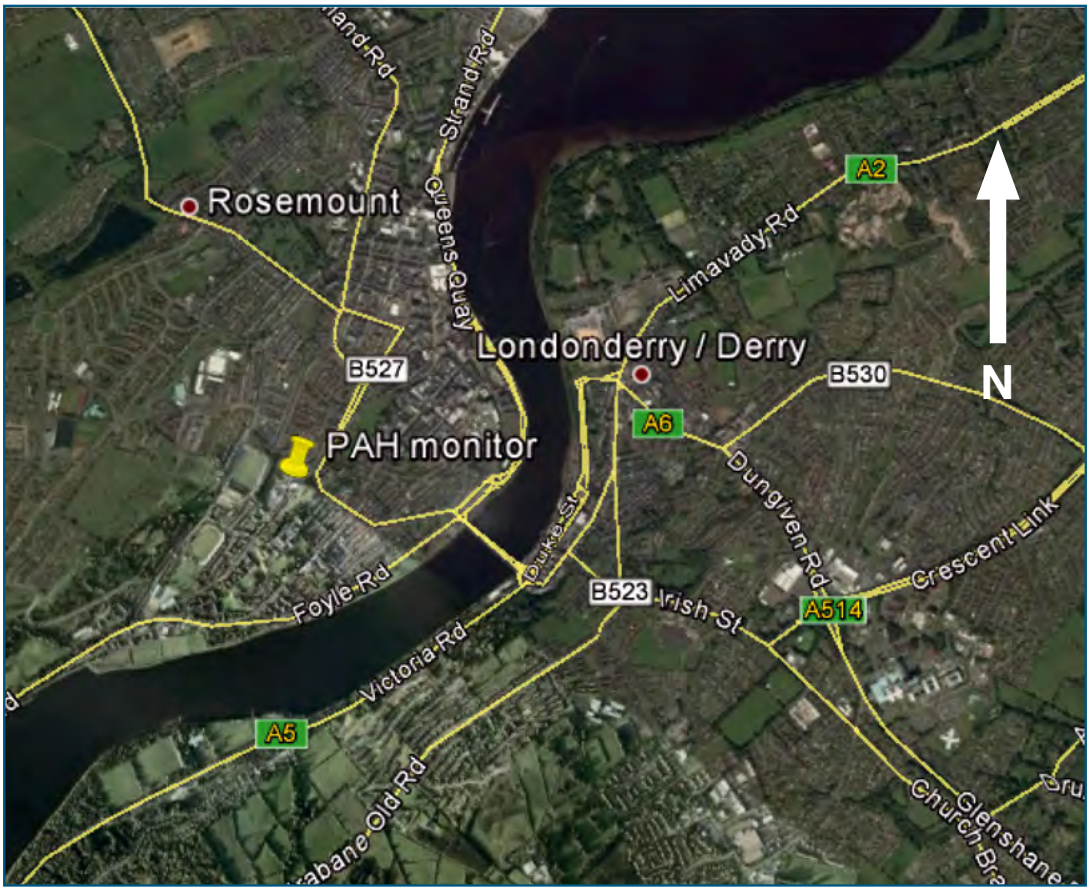


Figure 3-5 - location of PAH monitor in Derry/Londonderry (Brandywell)

Figure 3-6 shows monthly mean levels of B[a]P measured at Northern Ireland sites during 2017 (Derry Brandywell is highlighted) and demonstrates a clear seasonality in concentrations. Levels of B[a]P are highest in the winter months, when home heating activity is at its greatest level and they are correspondingly lower in the warmer months of the year.

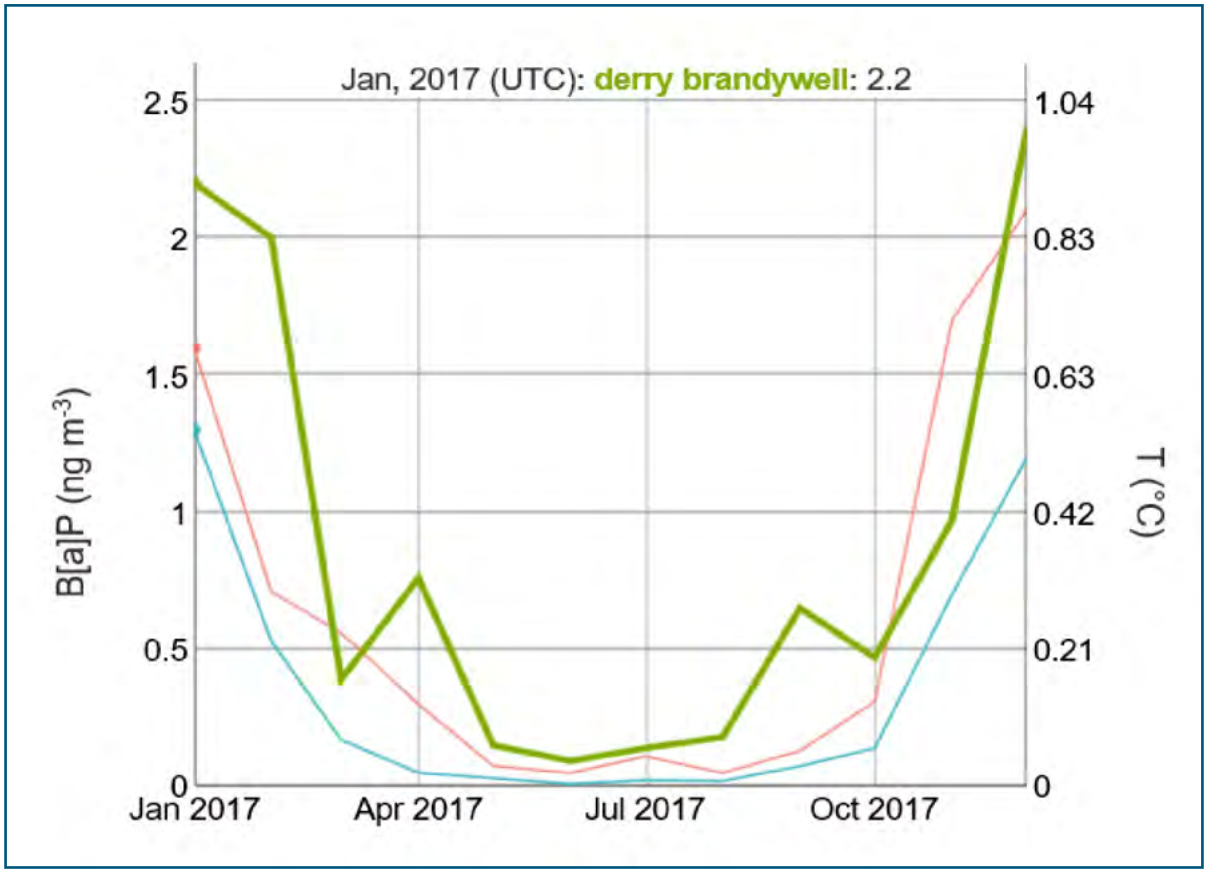


Figure 3-6 - average monthly B[a]P levels at three monitoring sites in Northern Ireland (Derry Brandywell, green; Dunmurry Kilmakee, blue; Ballymena Ballykeel, red)[110].

In 2012, the then Department of the Environment commissioned research to examine the reasons for the relatively high levels of PAHs measured here. The research found that the levels were due to solid fuel burning, in particular, bituminous coal, and recommended more effective enforcement of Smoke Control provisions.[111]

Similarly, a report commissioned by the North South Ministerial Council sought to study emissions from residential fuels in both Northern Ireland and the Republic of Ireland. The report recommended that, in Northern Ireland, Smoke Control Areas should be reviewed.[112]

110 UK PAH Monitoring Network Report 2017.
111 Butterfield *et. al.,* Polycyclic Aromatic Hydrocarbons in Northern Ireland, NPL, February 2012.
112 *Residential Solid Fuel and Air Pollution, NSMC.*

3.3 Black Carbon

Black Carbon (BC) is typically formed through the incomplete combustion of fossil fuels, biofuel, and biomass, and is emitted in both anthropogenic and naturally occurring soot. A network of 16 sites across the UK monitored BC in 2016, with four of these in Northern Ireland - Belfast Centre, Lisburn Kilmakee, Ballymena Ballykeel and Strabane.

Black Carbon

Black Carbon (BC) is most typically noted as the main component of soot or dark smoke, and is measured using relatively cheap and simple instruments called aethalometers.

Aethalometers measure BC by drawing a stream of air through filter paper and shining light on this to measure absorbance. There are two types of light source used - visible light and UV.

Visible light absorbance gives an indication of the amount of BC itself, while UV absorbance gives an indication of particular compounds in the BC, in particular, PAHs. In this way, UV-readings from aethalometers can be used to give insight into likely PAH levels where PAH monitors are not installed.

The latest summary report for the UK's Black Carbon Monitoring Network[113] showed that levels of Black Carbon measured by visible light ranged from 0.8 $\mu g.m^{-3}$ at Dunmurry Kilmakee to 4.9 $\mu g.m^{-3}$ at Marylebone Road (**Figure 3-7**) in London. The high levels of BC at the London is due to road traffic pollution.

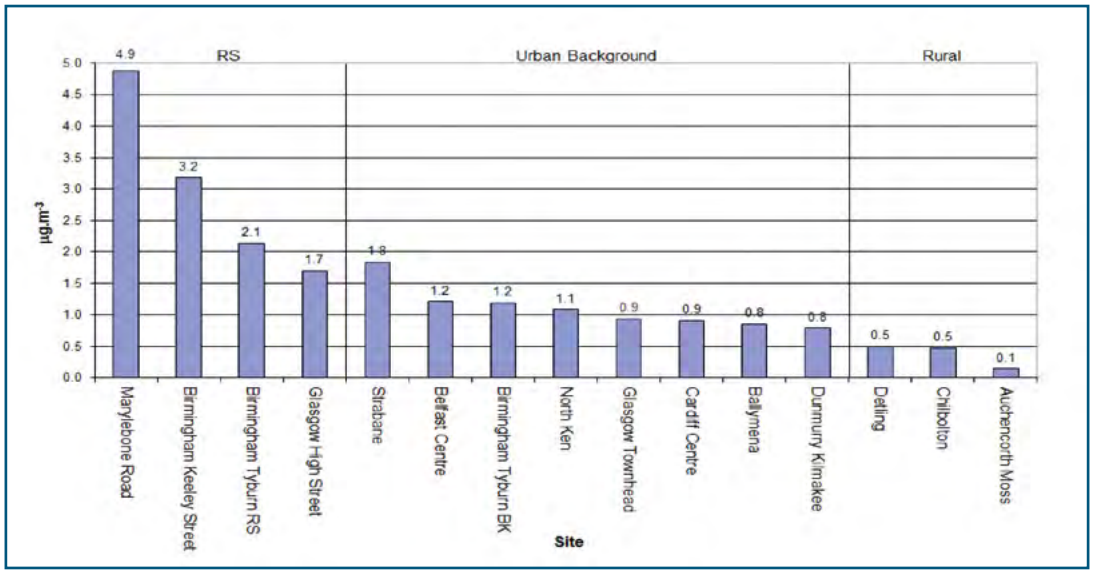


Figure 3-7 - Black carbon levels (visible portion) at UK monitoring sites (RS refers to 'Roadside Sites')

113 2016 Annual Report for the UK Black Carbon Network.

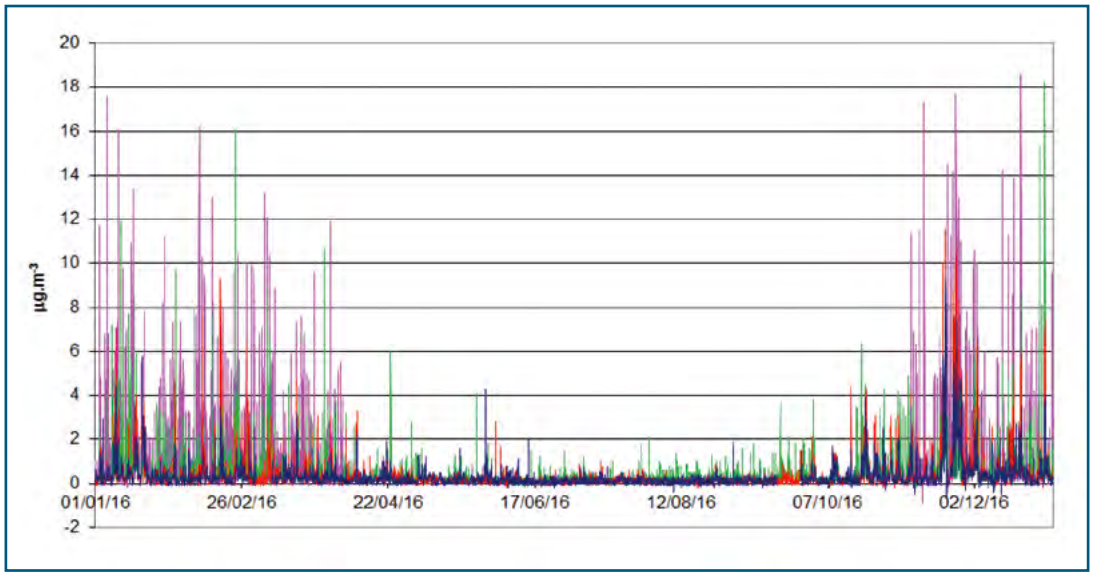


Figure 3-8 - UV component levels at BC monitoring sites in Northern Ireland in 2016

Meanwhile, the annual mean UV component concentrations ranged from 0.1 $\mu g.m^{-3}$ at Auchencorth Moss (a rural background site in Scotland) to 0.5 $\mu g.m^{-3}$ at Ballymena. Strabane had the highest UV component concentration and showed a mean of 1.6 $\mu g.m^{-3}$, but this is skewed as the site only measured in the winter months during 2016 and so the figure of 1.6 $\mu g.m^{-3}$ is higher that it would be had it been monitored over a year.

The Strabane site recorded an annual mean value of 0.9 $\mu g.m^{-3}$ the previous year, which was the highest UV reading across the whole network.

The UV component concentrations measured at the four monitoring sites in Northern Ireland show a strong element of seasonality - that is, that they are highest in winter (see **Figure 3-8**).

This seasonality is part of the evidence that shows us that high UV-absorbent BC (and by inference, PAH) levels in Northern Ireland are due to domestic heating, since this is at its highest levels in colder months. We can further see this when we consider the UV component levels measured at three monitoring sites in Scotland, where BC levels are not believed to be due to domestic heating sources (**Figure 3-9**).

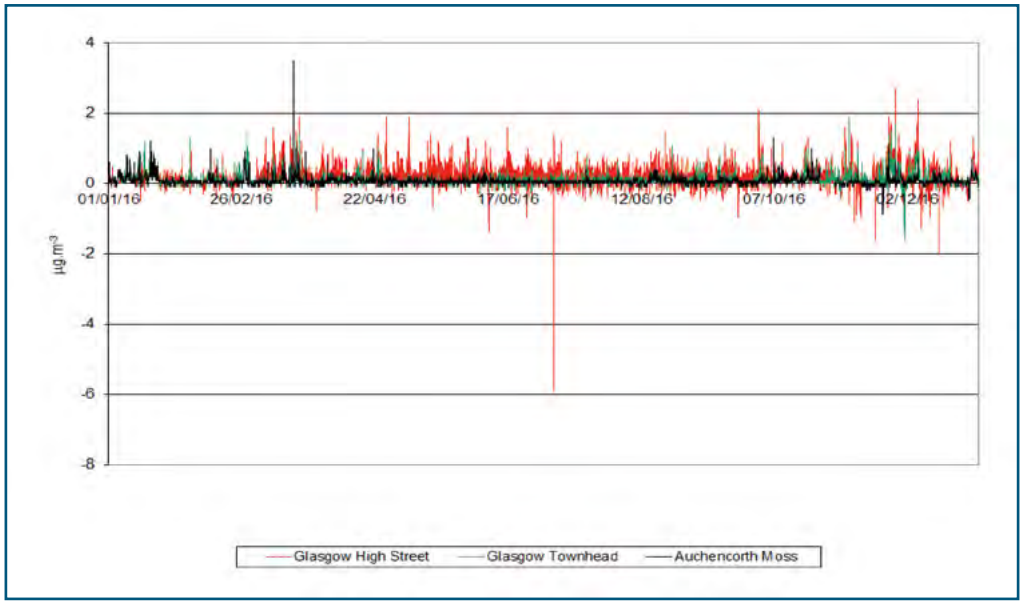


Figure 3-9 - UV component levels at three monitoring sites in Scotland during 2016

The levels in Scotland are much lower in magnitude, reaching a maximum of *ca*. 3.5 $\mu g.m^{-3}$, while the maximum levels reached in colder months in Northern Ireland are regularly in the 12-16 $\mu g.m^{-3}$ range.

Co-location studies of PAH monitors at BC monitors enable BC measurements to be used as a proxy for likely PAH levels, where PAH is not currently monitored. The UV BC levels monitored at Strabane indicate that there has *likely* been an exceedance of the EU Target Value for benzo[a] pyrene at this site in the previous six years.

The National Physics Laboratory (NPL) study on PAHs carried out for the then Department of the Environment in 2012 used modelling to demonstrate that there are likely exceedances of the EU Target Value for B[a]P in at least some parts of most urban areas in Northern Ireland.[114]

114 NPL, *Polycyclic Aromatic Hydrocarbons in Northern Ireland,*

3.4 Trends

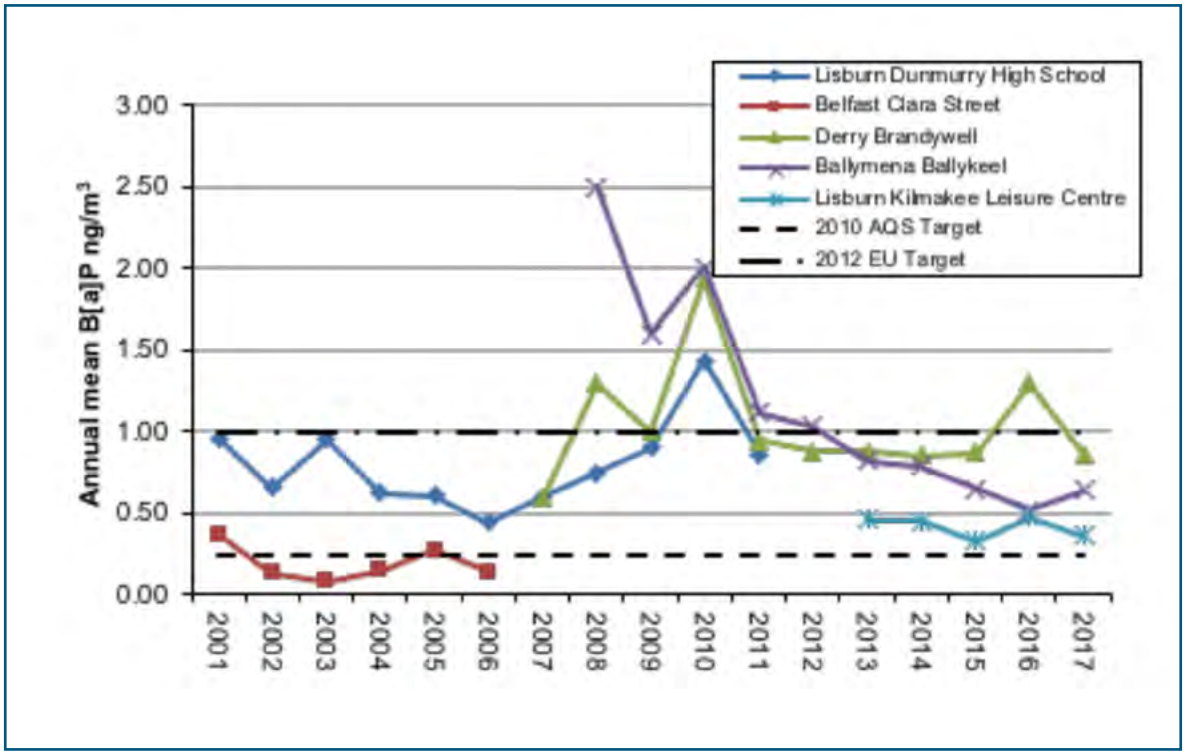


Figure 3-10 - levels of benzo[a]pyrene measured at monitoring sites in Northern Ireland between 2001 and 2017

Examining the time series for levels of B[a]P in recent years (see **Figure 3-10**)[115] can give us an indication of trends in this pollutant and in solid fuel burning.

The most noticeable thing from the graph is the spike in concentrations of B[a]P for 2010: the winter of 2010-2011 was particularly cold and demonstrates the increased level of household heating that occurred during this particular season.

Other time series have been discontinued - for example, Belfast Clara Street, after the site closed - though it is worth noting in this case the low levels of B[a]P measured, given that Greater Belfast, as mentioned previously, is largely under Smoke Control provisions.

At the Derry Brandywell site, there is no obvious trend from 2011-2015, with a breach of the EU Target Value in 2016 (see **Section 3-6**), while Ballymena Ballykeel and Lisburn Kilmakee sites appear to be showing downward trends.

Information on the monthly levels of B[a]P measured at the Derry Brandywell site in 2016 indicate that this year's high annual mean value may largely be due to a pollution event that happened in late November.

115 Northern Ireland Environmental Statistics Report 2017, DAERA, 2017, 24. https://www.daera-ni.gov.uk/sites/default/files/publications/daera/ni-environmental-statistics-report-2017_2.PDF

The Department issued an air pollution alert for this event (see **Figure 3-11**, left).

Figure 3-11

3.5 Particulate Matter Episodes

Each year sees in the region of winter air pollution episodes in Northern Ireland that are primarily due to high levels of particulate matter from solid fuel burning. These episodes happen in the colder months of the year, when home heating activity is increased.

Figure 3-12 shows the levels of particulate matter and nitrogen dioxide measured during the month of November 2016 at the Londonderry Rosemount monitoring station.

Analysis of this episode indicates the following:

- Levels of all air pollutants increased, as the calm, relatively windless weather conditions meant that pollutants built up near ground level;
- Nitrogen dioxide levels from car traffic increased, due to not being dispersed;
- Particulate matter levels increased, due to not being dispersed, though to a greater degree than the increases seen in NO_2, because of an increase in activity (home heating using solid fuels).

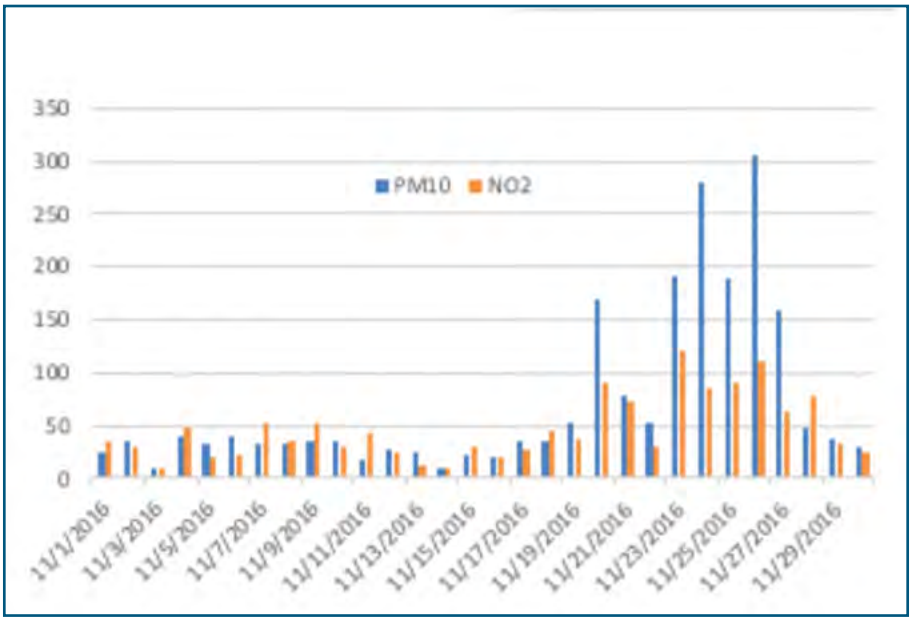


Figure 3-12 - levels of particulate matter PM_{10} and nitrogen dioxide NO_2 measured at Londonderry Rosemount during the month of November 2016

Combined with PAH monitoring data (see **Fig 3-6**), we can conclude that home heating - in particular, solid fuel use - is a major factor in particulate matter air pollution episodes in the winter.

3.6 Fuel Poverty and Fuel Use

Combustion of solid fuel produces significantly more air pollution than other heating methods, as can be seen from **Table 3-2**.

Fuel	Location with respect to Smoke control areas	PM_{10} Annual emission per household
Solid Fuel	Outside	24.2
Soild Fuel	Inside	3.7
Oil	All	0.21
Gas	All	0.02
2 or more types	Outside	12.3
2 or more types	Inside	2.1

Table 3-2 - Annual emissions of PM_{10} from households using different fuel types, inside and outside Smoke Control Areas in Northern Ireland

The highest amount of pollution is produced by households burning solid fuels outside Smoke Control Areas, followed by households with two or more types of heating, which is likely to be gas or oil heating as a primary method alongside open fires or stoves as a secondary method.

Limiting the amount of solid fuel burning activity by households therefore has the greatest potential to reduce air pollutant emissions from this sector.

However, fuel poverty[116] is a very significant issue of concern in Northern Ireland; 42% of households here were classed as being in fuel poverty in 2011, while in 2016, this figure had dropped to 22%.[117] The drop was largely due to 'lower average fuel prices, lower modelled household energy use and increased income.' Any restrictions on fuel have the potential to further exacerbate the problem and so it is vital to know the extent of housing that relies solely on solid fuel.

Census data for Northern Ireland (2011) provides data on the prevalence of different types of household heating.[118] Further analysis has been carried out on the different types of fuels used for home heating inside and outside Smoke Control Areas (see **Table 3-3)**.[119]

Type of central heating	Number of households		Percentage of households		
	Northern Ireland	Smoke control areas	Northern Ireland	Smoke control areas	Outside SCAs
No central heating	3,766	919	0.5%	0.5%	0.5%
Oil central heating	437,269	87,183	62.2%	49.1%	66.6%
Gas central heating	120,956	67,761	17.2%	38.2%	10.0%
Electric (including storage heaters) central heating	24,671	9,505	3.5%	5.4%	2.9%
Solid Fuel (for example wood, coal) central heating	18,120	2,954	2.6%	1.7%	2.9%
Other central heating	4,083	785	0.6%	0.4%	0.6%
Two or more types of central heating	94,410	8,390	13.4%	4.7%	16.4%
Total	**703,275**	**177,497**	**100%**	**25.2%**	**74.8%**

Table 3-3 - prevalence of different types of home heating inside and outside Smoke Control Areas

116 A household is said to be in fuel poverty if it needs to spend more than 10% of its income on energy costs: https://www.communities-ni.gov.uk/topics/housing/fuel-poverty
117 NI House Condition Survey 2016, https://www.nihe.gov.uk/Documents/Research/HCS-Main-Reports-2016/HCS-Main-Report-2016.aspx, 58.
118 http://www.ninis2.nisra.gov.uk/public/Theme.aspx?themeNumber=136&themeName=Census+2011
119 *Residential Solid Fuel and Air Pollution,* NSMC, 81.

The data in **Table 3-3** shows that 2.6% of households in Northern Ireland were classed as using solid fuel (wood and coal) for home heating. The corresponding figure for households within Smoke Control Areas is 1.7%, which would account for a certain amount of conversion of households to other means of heating within these areas.

In relation to wood use alone, a 2016 survey on domestic wood burning, carried out by the UK Department for Energy and Climate Change (DECC), (now the Department for Business, Energy and Industrial Strategy, BEIS), gave a representative figure (based on 1,024 respondents) of 18.1% of households in Northern Ireland using wood as a heating source.[120] This was the highest figure for any region of the UK.

A study by King's College on particulate matter pollution from wood burning has established that wood burning activity is not correlated with temperature. Therefore, in the main, wood burning is carried out for decorative purposes in households, and is not used as a primary heating source.[121]

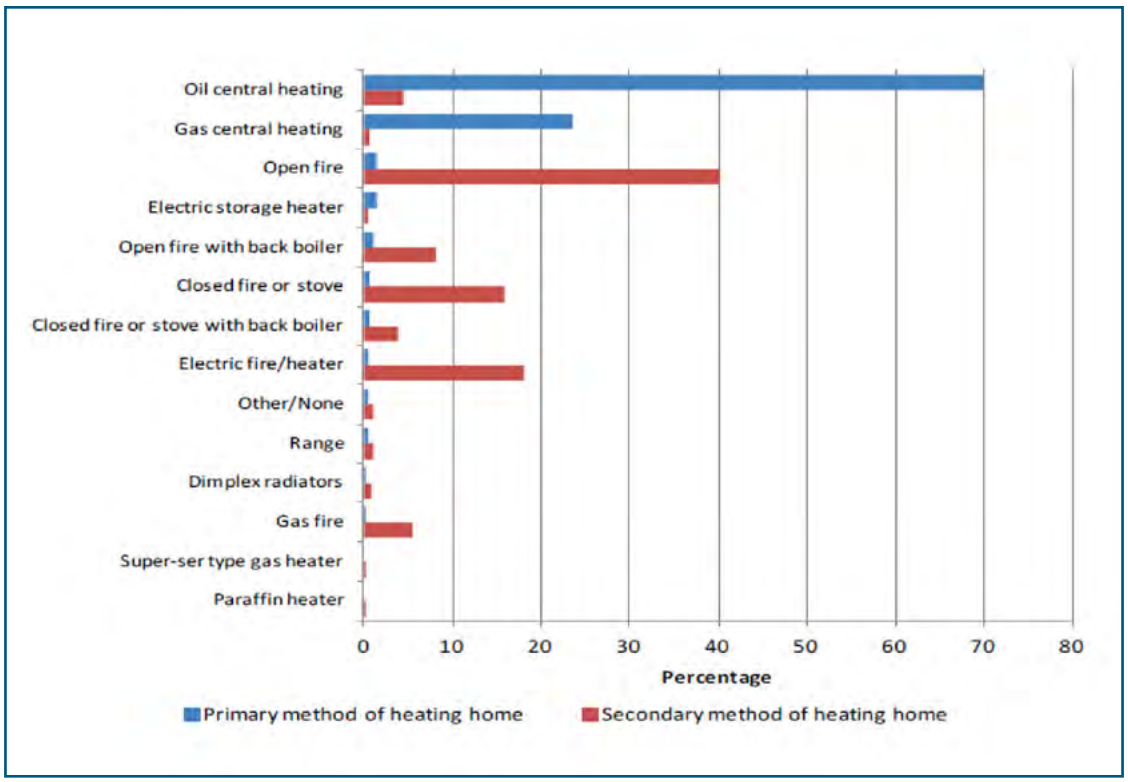


Figure 3-13 - home heating: NISRA Continuous Household Survey 2016/17

120 DECC, Domestic Wood Use Survey (2016), p70: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/517572/Summary_results_of_the_domestic_wood_use_survey_.pdf

121 King's College London, Environmental Research Group, NPL National Physical Laboratory, 'Airborne particles from wood burning in UK cities', March 2017, 4.

More recent information has been gathered in NISRA's Continuous Household Survey, (CHS) 2016/17 on household fuel use. A summary of the responses received (**Figure 3-13**) shows that a majority of households who use an open fire do so as a *secondary* method of heating their homes. Thus, in an effort to reduce air pollution from household heating in Northern Ireland, serious consideration needs to be given to promoting behaviour change in individuals who are choosing to light an open fire, when this is not, of necessity, their primary heating source.

An analysis of the findings carried out by NISRA states that: 'Some households burn solid fuels to heat their home, with this being the primary method of heating for 4% of households, and a secondary method for 68% of households.'

These results from the CHS - and from the 2011 Census - suggest to us that measures to reduce the use of solid fuel, for example, in SCAs, do not have an impact on the majority of households. Because, though, there is a danger of exacerbating fuel poverty for those households who *do* use solid fuel as a primary heating source, we need to take this into consideration in developing policy, and so we then look at the energy costs associated with various home heating activities.

An analysis of heating costs by fuel type and appliance[122] has shown that, in terms of heat energy delivered, there is no significant difference in heating costs between the use of household coal or cleaner coals in efficient closed-fronted appliances (natural gas heating being the cheapest option), while open fires, with or without back boilers are in all cases more costly in terms of energy delivered. This misconception about the costs and energy output associated with solid fuel is something that the Department endeavours to address through education.

Therefore, widening the extent of SCAs - in which a small number of householders may therefore be forced to convert from using open fires as a primary heating source - should not exacerbate fuel poverty, but on the contrary, alleviate it in these cases, assuming there is financial assistance available to householders, where necessary, for conversion of heating systems. It is worth nothing that the Department for Economy's Energy Strategy Call for Evidence is considering the consumer impact of changes to heating sources, and not just solid fuels in open fires.[123]

A further reason for increasing the extent of SCAs is to improve indoor air quality. Research has found that levels of airborne particles in the same room as an open fire burning wood, can reach levels that are harmful to human health, particularly during ignition, refuelling and cleaning stages of operation.[124]

As a result of the exceedance of benzo[a]pyrene recorded at the Derry Brandywell site in 2016, DAERA coordinated action with Derry City and Strabane District Council. Funding was provided to the Council to undertake a survey of fuel use, so that the Council could become better equipped to make future decisions around Smoke Control policy and whether or not any new Smoke Control Areas need to be declared. The survey was completed in March 2019 and

122 *Residential Solid Fuel and Air Pollution,* 81-82.
123 https://www.economy-ni.gov.uk/sites/default/files/consultations/economy/energy-strategy-call-for-evidence.pdf, 24.
124 Castro A. *et. al.,* 'Impact of the wood combustion in an open fireplace on the air quality of a living room: Estimation of the respirable fraction', Science of the Total Environment: 628-629, 2018, 169-176.

indicated that 75% of households used oil for their primary heating source, while 22% used natural gas. The remaining 3% was made up of electricity, coal and wood, with coal accounting for 2%.

Most households (68%) did not have a secondary heating source. However, of the remaining 32% that did, the most popular heating source was coal (19%). Electricity (8%) and wood (3%) were less popular methods.

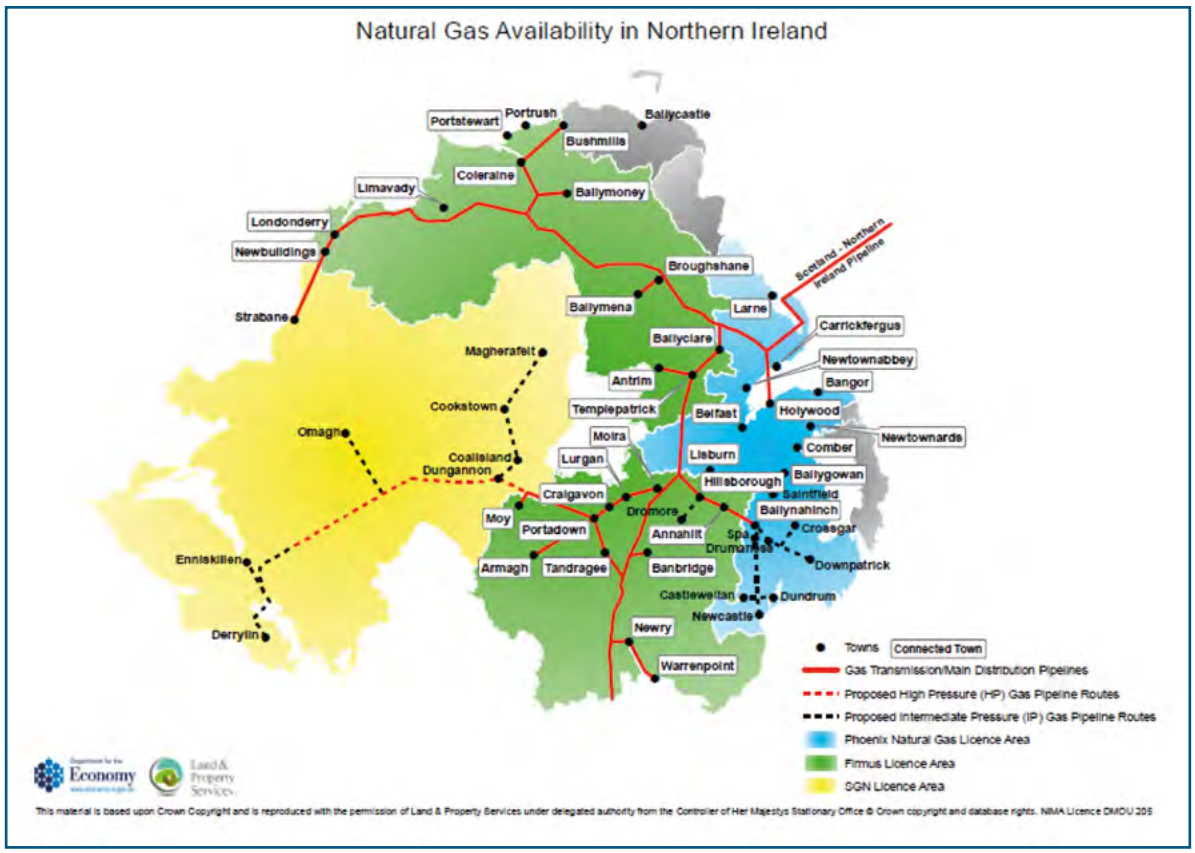


Fig 3-14 Current and planned availability of natural gas in Northern Ireland

The findings of the fuel survey indicate that a small proportion of households (2%) who are reliant on coal burning as their primary means of home heating would be most affected by any restrictions on coal use, such as that imposed by expanding Smoke Control Areas.

Limited access to the natural gas grid has historically been a major factor in household fuel choices in Northern Ireland, although there has been significant expansion of the network in recent years (see **Fig 3-14**).

Natural Gas in Northern Ireland

The natural gas industry was established in NI from 1996 when a new natural gas pipeline was provided between NI and Scotland, and Phoenix Natural Gas was granted a licence to develop new gas networks in the Greater Belfast area, which also includes Larne, North Down, and Lisburn. Two new gas transmission pipelines were completed in NI between 2004 and 2006, and *firmus energy* was licenced to provide new gas networks in their ''10 Towns area'' outside Greater Belfast, which now encompasses over 20 urban areas including Londonderry, Limavady, Ballymena, Coleraine, Ballymoney, Antrim, Craigavon, Banbridge, Armagh, Newry and Warrenpoint. There are now some 250,000 consumers connected to the natural gas network in NI, and further connections in the existing gas licence areas are expected to replace more polluting fuels such as coal and oil.

Mutual Energy and SGN were granted licences by the Utility Regulator in 2015 to develop new gas networks to connect 8 towns in the West to gas, including Dungannon, Coalisland, Cookstown, Magherafelt, Omagh, Strabane, Enniskillen, and Derrylin. Gas consumers have already been connected in the Strabane area, and work to provide new inter-town pipelines to connect the remaining 7 towns in the West is nearing completion. The £250m project is being grant supported by the NI Executive, and aims to connect around 40,000 energy consumers to natural gas.

Phoenix Natural Gas has been granted a licence extension to provide new gas networks to 13 towns and villages in East Down. The £60m project includes Hillsborough, Dromore, Ballygowan, Ballynahinch, Saintfield, Downpatrick, Castlewellan, and Newcastle, where new inter-town gas pipelines have been laid. Work by Phoenix is continuing to provide new distribution pipelines with the aim of connecting some 28,000 energy consumers to gas.

The natural gas industry in NI is subject to regulation by the Utility Regulator, and to encourage gas uptake, gas companies have provided switching incentives for domestic energy consumers. These have included a free gas meter and pipeline connection to the property from a gas main in the adjacent street, and sometimes low interest finance towards converting to gas. Other switching incentives have included the DfC Boiler Replacement scheme which provides financial support to replace older central heating boilers. Additionally there is the DfC Affordable Warmth Scheme, and the NI Sustainable Energy Programme (NISEP) which supports the provision of energy efficiency measures and conversion to natural gas.

Increasing connection of domestic customers to the natural gas network should see a shift away from more polluting heating methods, such as the burning of solid fuels, and a corresponding decrease in associated air pollutants. However, along with this, the increasing popularity of modern wood-burning stoves is something that could cause an increase in emissions.

Another factor affecting some households' fuel choice is the prohibitive cost of home heating oil deliveries in bulk quantities, whereas more polluting solid fuels such as coal and wood are available in small quantities. There have been some efforts to address this situation: a

collaboration between the Housing Executive and Bryson Energy has seen the setting up of 27 oil buying clubs, where monthly oil deliveries are made within manageable budgets.[125]

The Eco-design specifies standards for solid fuel home stoves with a heating capacity of less than 50kW from 2020. It will be illegal to manufacture and sell new stoves from 1st January 2022 that do not comply with the Ecodesign requirements. These limits apply to all stoves and not just those in Smoke Control Areas.

This will have a positive impact on air quality as the limits are more stringent than those in the current Smoke Control regime.

The Energy Labelling scheme started in January 2018, and by encouraging more efficient stoves may improve air quality by reducing the amount of fuel burnt and consequential emissions for the same heat output.

As far as biomass goes, it is worth noting, as previously mentioned in Chapter 1, that the UK Climate Change Committee, in its report on lowering carbon emissions in Northern Ireland, has said that, 'Biomass for heating in urban areas should not be supported due to air quality concerns.'[126]

3.7 Sulphur Content of Solid Fuels

Burning high sulphur fuels leads to increased emissions of sulphur dioxide in the atmosphere. Regulations currently specify that the content of sulphur that is permitted in solid fuels in Northern Ireland may not exceed 2 per cent.[127] Some manufactured smokeless fuels can have levels in excess of this limit.

There are exemptions in the regulations for storage and for export from Northern Ireland. Coal importers and distributors may therefore legally possess high sulphur fuel; however, it is problematic and expensive for district councils here to find out if any of this high sulphur fuel is ending up on the domestic market and being sold to householders.

It is believed that there exists a problem in Northern Ireland with the presence of high-sulphur fuel on the domestic market. Any revision of Clean Air legislation should seek to address current deficiencies.

125 HECA Home Energy Conservation Authority Annual Progress Report 2018, https://www.nihe.gov.uk/getmedia/33e6e0cf-8043-403c-b0e4-94a3e82acf69/Home-Energy-Conservation-Authority-Annual-Progress-Report-2018.pdf.aspx?ext=.pdf
126 https://www.theccc.org.uk/publication/reducing-emissions-in-northern-ireland/ (83).
127 http://www.legislation.gov.uk/nisr/1998/329/contents/made

3.8 Further Smoke Control Measures in England

Defra have in recent years been actively addressing the issue of household emissions, in particular those from wood burning. Their Clean Air Strategy, published in January 2019, sets out the actions which Government will take to reduce emissions from domestic burning. This includes legislating to prohibit the sale of the most polluting fuels, ensuring that only the cleanest stoves are available for sale by 2022, changing existing smoke control legislation to make it easier to enforce, and giving new powers to local authorities to take action in areas of high pollution.

On 21 February 2020 Defra published the government response to the consultation on the cleaner domestic burning of solid fuels and wood in England which ran between August and October 2018. The proposals in this consultation invited comments on actions announced in the Clean Air strategy

On considering the consultation responses, the following policies will now be adopted for England:

i) Wood

- All wood sold for domestic combustion in volumes under 2m3 must have a moisture content of 20% or less. This will come into effect one year from publication of the Government Response with small foresters being given an extra year to become compliant.
- Suppliers of wood in volumes in excess of $2m^3$ will be required to provide customers with instructions for seasoning wet wood, and these will be accompanied by a warning advising that wood is not suitable to be burnt without appropriate drying.
- Retailers will be required to store seasoned wood in such a way as to keep it dry and not exceed the 20% moisture level.

ii) Manufactured Solid fuels

- The existing smoke control area sulphur and smoke emission standards for manufactured solid fuels will be extended to cover the whole of England. This will come into effect one year from publication of the Government Response.

iii) Coal

- Sales of all pre-packaged bituminous house coal (i.e. that sold through retailers, supermarkets and DIY stores) will be banned one year from publication of the Government Response. This ban will not apply to loose sales of coal direct to customers via approved coal merchants for a further two years.

The phased transition with regard to coal acknowledges that those who burn coal as a primary heat source are more likely to be in fuel poverty and are most likely to have their coal delivered by registered coal merchants. There are plans to work with coal merchants through the Approved Coal Merchants Scheme to ensure they advise and educate their direct delivery customers with a view to switching them from coal to Manufactured Solid Fuels during the two year transition period during which they will still be able to deliver coal directly to customers.

Prior to the publication of the consultation response Defra have worked closely with industry sectors to initiate change. These discussions with industry have led to the development of a voluntary industry standard scheme for seasoned wood, 'Ready to Burn', which is a wood fuel certification mark accredited through 'Woodsure', a not-for-profit industry association.[128] Wood suppliers who can demonstrate that their fuel has a moisture content of 20% or less can join 'Woodsure', and have their wood fuel labelled as 'Ready to Burn'. Guidance is published online for purchasers of wood.[129]

The average moisture content of wood tested by Woodsure differs between seasoned wood (wood that is stored over the long-term and allowed to dry naturally), which has an average moisture content of 18.5%, and kiln-dried wood, which has an average moisture content of 12.6%.

DAERA is currently in discussions with Woodsure regarding the promotion of the scheme in Northern Ireland and in May 2019, DAERA shared Defra guidance leaflets on wood burning with district councils for their own use in raising awareness of the issue.

Defra is also developing a communications campaign targeted at domestic burners, to improve awareness of the environmental impact of their actions.

The leaflet shown here[130] sets out guidance for householders on open fires and wood-burning stoves, and is for distribution to Local Authorities. The leaflet has information organised under the following headings:

- 'Fuel Use' - burning less, using only seasoned wood (link to the 'Woodsure scheme' - see below), properly seasoning chopped wood, using smokeless coal instead of household coal, not burning waste;
- 'Maintain your open fire/stove' - regular (annual) maintenance of stoves, getting chimney swept (up to twice a year);

128 https://woodsure.co.uk/firewood-ready-to-burn/
129 https://www.readytoburn.org
130 Leaflet is provided to, and publicised by Local Authorities, for example: https://www.birmingham.gov.uk/downloads/file/8827/open_fires_and_wood_burning_stoves_leaflet

- 'Choose the right appliance' - Defra-approved and Ecodesign standard stoves;
- 'Know the law in Smoke Control Areas', 'Outdoor burning', 'Benefits of following these steps', 'What you can do'.

Another information leaflet for householders has been developed by UK chimney sweep organisations, entitled: 'We all breathe the same air'.[131] This is available for consumers to provide clear advice on the procedures to follow when lighting a stove to minimise smoke.

3.9 Energy Efficiency and Housing Standards

The choice of fuel to heat houses is secondary to the energy efficiency of the house itself, with well insulated, more energy-efficient homes needing less heat, thereby reducing household heating costs as well as air pollutant and carbon emissions.

Across all dwellings in Northern Ireland, it is reported that 68% rely on home heating oil, while 98% have loft insulation and 87% have full double glazing. The Standard Assessment Procedure (SAP) rates energy efficiency of individual houses. The overall efficiency for Northern Ireland in 2016 was 65.83, and social housing homes on average had a higher SAP (72.63) than owner occupier dwellings (65.11).[132] Policy in this area may therefore need to consider how to further target owner occupier dwellings to raise the overall SAP of this part of Northern Ireland's housing stock.

A number of schemes exist in Northern Ireland that give support towards addressing energy efficiency in households.

• The Affordable Warmth Scheme[133]

This scheme is available through NIHE, with Department for Communities and District Council involvement. This scheme is only available for owner/occupiers or householders of a privately rented property in Northern Ireland, where the gross annual household income is less than £20,000.

In the case of privately rented properties, landlords must give consent for any energy efficiency improvements to be done and will also have to contribute towards the cost of the work.

The scheme provides support focused on insulation, heating systems and window replacement.

131 Leaflet available at Northumberland County Council website, e.g.:http://www.northumberland.gov.uk/NorthumberlandCountyCouncil/media/Public-Protection/Pollution/We-All-Breathe-the-Same-Air.pdf
132 Continuous Household Survey, 2016. HECA Annual Progress Report 2018.
133 https://www.nidirect.gov.uk/articles/affordable-warmth-grant-scheme

• Boiler Replacement Scheme[134]

This Scheme, funded by Department for Communities and administered through NIHE, is for owner occupiers whose total gross income is less than £40,000 and is to help with the cost of replacing boilers which are 15 years or older with new boilers. As well as upgrading older oil boilers, it may be used to convert from oil to gas or to a wood pellet boiler. Support provided under the Scheme ranges from £400 (£500 if controls fitted) for those with household income of £20,000 to £40,000, to £700 (£1,000 if controls fitted) for household incomes less than £20,000.

• Northern Ireland Sustainable Energy Programme (NISEP) Grants[135]

NISEP is administered by the EST on behalf of the Utility Regulator (UR) and NISEP schemes are delivered by private sector energy suppliers and energy services companies:

- Priority (low-income) Households - whole house solutions Includes insulation (cavity wall and loft), energy-saving light bulbs, and installation of gas central heating systems. There are six schemes in operation that provide assistance based on a range of criteria (households with solid fuel or Economy 7 heating systems within the gas network) and target recipients (housing association tenants, pensioners).
- Priority (low-income) Households - individual measures Includes assistance with insulation and energy-saving light bulbs.
- Non-priority Domestic
- Discounts for home insulation
- Business
  A wide range of schemes for commercial premises that includes funding assistance for measures such as air conditioning efficiency, lighting, heat recovery technology, air compression systems, commercial boilers, and electric motor technology.

As well as measures to influence fuel use in Northern Ireland, we consider that energy efficiency measures have the potential to reduce air pollution from home heating, as well as helping to address the problem of fuel poverty, therefore consideration should be given to the continuation of support for measures that promote or enable energy efficiency in the home, where appropriate.

134 https://www.nihe.gov.uk/index/benefits/boiler_replacement_allowance.htm
135 https://www.uregni.gov.uk/publications/northern-ireland-sustainable-energy-programme-nisep-list-schemes-2019-2020

3.10 Discussion

Monitoring evidence clearly shows that there are relatively high levels of air pollutants associated with solid fuel-burning in Northern Ireland. Section 3.1 highlighted the extent and limitations of the Smoke Control approach here. To summarise, these are:

- No new Smoke Control Areas being declared;
- Piecemeal nature of Smoke Control Areas in towns and cities;
- Difficulty of enforcing Smoke Control provisions;
- Ability to buy non-authorised fuels in Smoke Control Areas;
- Lack of awareness by households of the negative air quality impacts of burning solid fuels;
- Perception by householders that the most polluting fuels ('smoky' or 'household' coal) offers the best value, in comparison with low-smoke fuels.

Data from the Continuous Household Survey carried out by NISRA tells us that it is likely that only a small proportion of households (4%) use solid fuel as their primary method of home heating, while research survey information indicates that converting from open fire heating to closed-fronted fire heating results in cheaper energy costs to the householder, while there is no significant difference in heating costs between 'smoky' fuels such as household coal and peat, and cleaner solid fuels.

Therefore, we propose that:

- The number and extent of Smoke Control Areas in Northern Ireland should be reviewed;
- Councils should consider declaring the entirety of urban centres as Smoke Control Areas;
- Legislation should be changed so that unauthorised fuels, such as bituminous coal, can no longer be bought in Smoke Control Areas;
- Legislation or controls should be introduced that prohibit the sale of unseasoned wood logs for home burning;
- Information on Smoke Control should form part of councils' annual LAQM reporting (see **Chapter 6**).

There is potential to incorporate Smoke Control Areas, which deal with household emissions, along with Air Quality Management Areas, and possibility Clean Air Zones into a single air quality management entity. This idea is explored further in **Chapter 6**.

Clean Air and Smoke Control

Q: Should urban areas, in their entirety, be designated as Smoke Control Areas?

Q: Should the law should be changed so that non-smokeless fuels **may not under any circumstances** be sold in Smoke Control Areas?

Q: Should government ban the sale to the general public of smoky/bituminous/household coal in Northern Ireland?

Q: Should government ban the import, into Northern Ireland, of high-sulphur coal?

Q: Should government ban the sale to the general public of unseasoned wood in Northern Ireland at retail outlets?

Q: Are there any further things you think that central and local government could be doing to address air pollution from burning solid fuels?

Chapter 4 - Agricultural Emissions

4.1 Introduction

The agriculture sector is a vital part of the Northern Ireland economy, with 1.4% of Gross Value Added coming from this sector and accounting for 2.6% of total civil employment (the corresponding figures for the whole of the UK are 0.5% and 1.0%, respectively).[136] Agricultural activities can give rise to a number of different air pollutants.

Particulate matter, emitted directly from poultry and pig farming, is estimated at 22.7% of Northern Ireland's total PM_{10} emissions in 2015[137]. Livestock housing with solid manure management systems emit more PM than buildings with a slurry management system, because loose and relatively dry bedding materials release particles when disturbed. Animal activity causes less PM emissions if the litter is moist, and the air leaving buildings can also be filtered to remove PM emissions.

Ammonia

Ammonia, NH_3, is a pungent gas whose odour is detectable in low concentrations.

In agricultural activity, ammonia arises as a result of bacterial and enzymatic degradation of nitrogenous substances such as proteins, in manure and slurry.

Atmospheric ammonia can, at high concentrations, have direct impacts on plants. Ammonia contains nitrogen in a form that is readily taken up by plants, and this can lead to problems with species balance in delicate ecosystems. Although ammonia is an alkaline gas, its deposition can lead to soil acidification, which has negative impacts on plant health.

Ammonia emissions can also lead to deposition of nitrogen compounds, often at long distances from the sources, causing indirect effects through nutrient enrichment and acidification.

However, the main pollutant of concern from agricultural activities is ammonia. The information box above focuses on the effects that ammonia in the atmosphere and in precipitation can have on plants and ecosystems, through eutrophication. However, ammonia can also - indirectly - have significant impacts on human health, through the formation of secondary inorganic (ammonium) compounds, which are a component of fine particulate matter, specifically, $PM_{2.5}$.

These ammonium compounds arise when ammonia, itself an alkaline gas, undergoes reactions with acidic air pollutants such as sulphur dioxide and nitrogen dioxide to form fine particles of ammonium sulphate and ammonium nitrate. Particles of these chemical species can act as nuclei for the formation of $PM_{2.5}$. $PM_{2.5}$ has widespread health impacts in the human body - not

136 The Statistical Review of Northern Ireland Agriculture 2018, available at: https://www.daera-ni.gov.uk/publications/statisticsal-review-ni-agriculture-2007-onward
137 *Air Quality Pollutant Inventories,* 44.

just in the lungs - leading to increases in ischaemic heart disease and stroke. A substantial amount of $PM_{2.5}$ - perhaps in the region of 20% - that is routinely monitored in our air is now believed to have arisen from ammonia in the atmosphere. A report on $PM_{2.5}$ in the UK by the UK Air Quality Expert Group states that:

'The contribution of ammonia compounds to Secondary Inorganic Aerosol varies in time and space but is generally between a few percent and 20%. Secondary inorganic aerosol is estimated to contribute around 40% of total $PM_{2.5}$ in the UK.

'Policy strategies for $PM_{2.5}$ therefore need to take into account emission reductions for a wide range of primary PM components and secondary PM precursors and to focus primarily on the abatement of ammonia.' The report also suggests that ammonia emissions are the reason for levels of PM have remained static, despite declining levels of primary PM emissions, such as from combustion and road traffic.[138]

4.2 Controls and Legislation

Ammonia is not classed as a local air quality pollutant. This means that there are no limits or targets for ammonia in ambient air in the EU ambient air quality directives 2008/50/EC and 2004/107/EC, which cover, for example, pollutants like NO_x, PM and SO_2. Nor are there limits in ambient air for ammonia in the UK Air Quality Strategy; district councils do not measure levels of ammonia in urban centres.

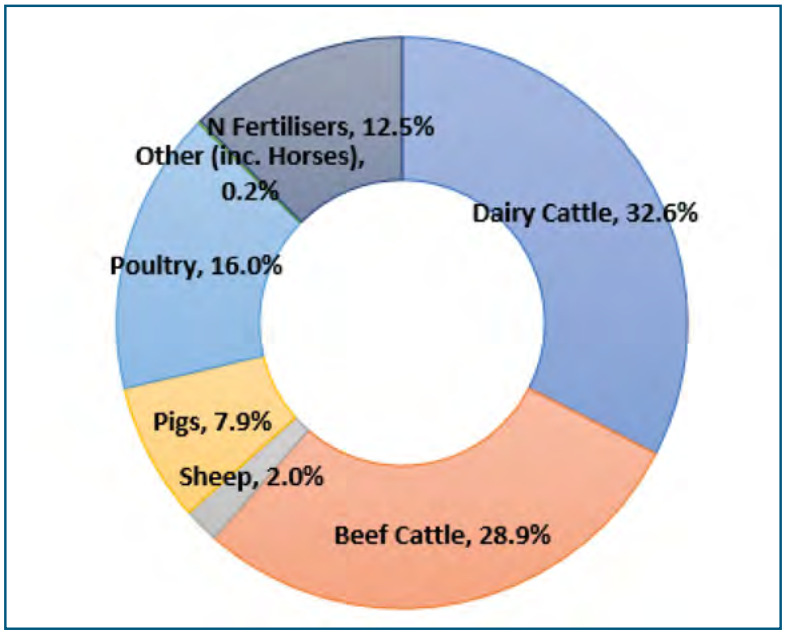


Figure 4-1 - breakdown of agricultural ammonia emissions in 2017, by species (fertiliser emissions also included)

138 Air Quality Expert Group, 2012, Fine Particulate Matter (PM2.5) in the United Kingdom, 153: https://uk-air.defra.gov.uk/assets/documents/reports/cat11/1212141150_AQEG_Fine_Particulate_Matter_in_the_UK.pdf

Ammonia is, however, controlled under the Pollution Prevention and Control Regulations, which specify the amount of ammonia which may be emitted from industrial premises and agricultural installations exceeding certain thresholds. The thresholds are: for poultry installations, 40,000 birds; pig farms with more than 750 sows or 2,000 production pigs of at least 30kg.

Agricultural ammonia emissions are spread across the various sectors of the NI farming industry. Cattle account for 69% of ammonia emissions with this total split between the dairy sector (37%) and the beef sector (32%). The lamb and arable sectors make a smaller contribution to ammonia emissions with sheep responsible for 2% of emissions and 7% of emissions are caused by N fertiliser. This reflects the size and nature of these sectors. The poultry sector is responsible for 14% of ammonia emissions while pigs account for 8% of total ammonia emissions.

Critical Levels and Critical Loads

Ammonia can act as a very effective form of nutrient nitrogen when deposited in rainfall, or in direct contact with plants. In sensitive habitats like upland bogs, nutrients are often in short supply and the plants found there have adapted to this scarcity of nutrients.

Research has shown the amount of atmospheric reactive nitrogen that can be directly absorbed by different types of habitats, before damage to plants or to species composition starts to occur. An example would be ammonia emissions coming from poultry housing that is near a protected bog, or nitrogen dioxide from vehicle emissions near a busy road. This is sometimes called dry deposition, and in this case relates to the Critical Level.

Critical levels are defined as "concentrations of pollutants in the atmosphere above which direct adverse effects on receptors, such as human beings, plants, ecosystems or materials, may occur according to present knowledge".[139]

Ammonia is also a long-range pollutant, i.e. it can persist in the atmosphere over long distances. Ammonia emitted by various sources gives rise to a background level, and ammonia also dissolves in rainfall. When ammonia is in the air for long enough, it mixes and reacts with other air pollutants, giving ammonium compounds. These ammonium compounds are important for two reasons: they can form fine particulate aerosols, harmful to human health, and they can be deposited in rainfall - known as wet deposition. The amount of nitrogen that can be absorbed by a habitat from both dry and wet deposition is the Critical Load.

Critical Loads are defined as: "a quantitative estimate of exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge".

A map of sensitive habitats and critical levels and loads is produced for all areas of the UK. Ammonia emissions are mapped and modelled to estimate concentrations and likely deposition across the UK.

139 http://www.unece.org/env/lrtap/WorkingGroups/wge/definitions.htm

When the deposition maps and the Critical Loads maps are compared, then we are given a picture on Critical Loads Exceedances. These exceedances tell us the excess nitrogen being deposited on sensitive habitats.

Critical levels, loads and exceedances are used to map habitat vulnerability as well as to inform the environmental assessments of relevant planning and permitting applications for agricultural development.

The National Emissions Ceiling Directive (NEC Directive) sets limits for each Member State on the total emissions of a basket of air pollutants, including ammonia. The NEC Directive implements the requirements of the UNECE Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (Gothenburg Protocol), to which the EU is a signatory on behalf of Member States, and to which the UK is a signatory in its own right. The Directive reflects the Gothenburg targets for 2020 and sets additional targets for 2030. The UK's commitment to the Gothenburg Protocol will be unaffected by Brexit.

For the UK, the EU targets are to reduce ammonia levels by 8% by 2020 and then by 16% by 2030, compared to 2005 levels. The Devolved Administrations will be expected to make their contribution to the UK's target, and have fed in to the UK's National Air Pollution Control Programme, published in July 2019, which sets out the actions being undertaken to reduce the UK's total emissions of pollutants.

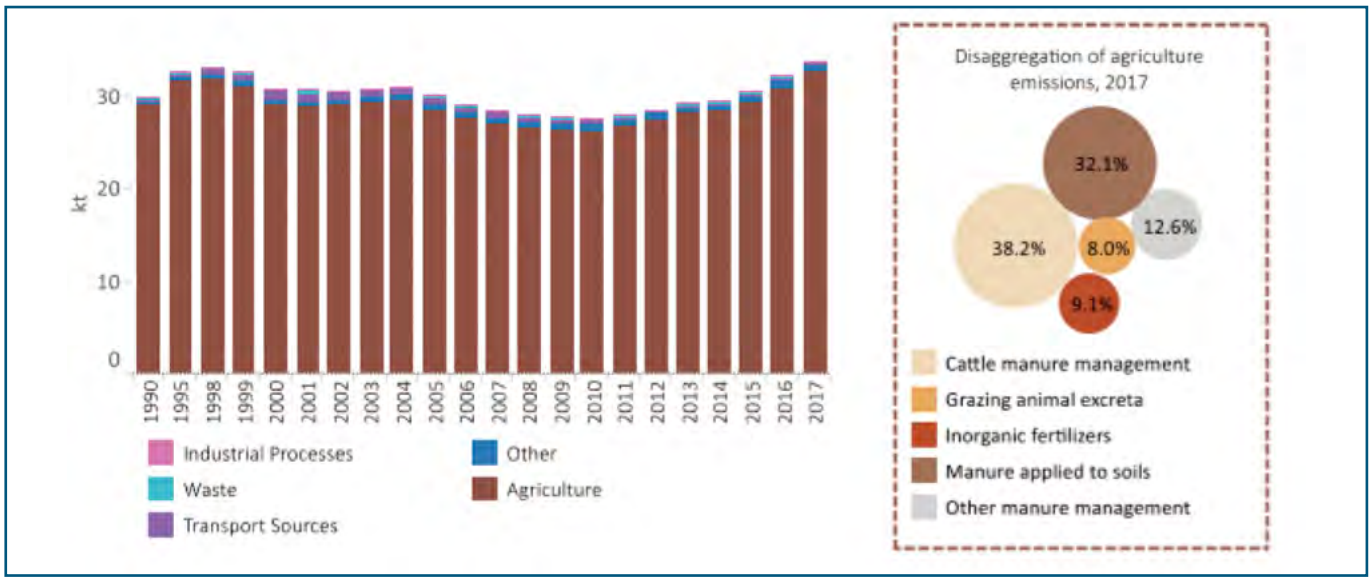


Figure 4-2 - total ammonia emissions in Northern Ireland 1990-2017

With regard to the harmful effects of nitrogen deposition on sensitive, protected habitats, the Habitats Directive (reporting under Article 17)[140] requires Member States to submit information on the ecological status of all priority habitats and designated sites. It is this reporting that has identified that a majority of protected sites in Northern Ireland are breaching the critical loads for nitrogen deposition. Ammonia emissions from agricultural activities are the most significant cause of these breaches, although some areas also experience transboundary deposition.

140 https://www.eea.europa.eu/data-and-maps/data/article-17-database-habitats-directive-92-43-eec-1

4.3 Emissions - Inventories and Models

Estimates of ammonia emissions start with the NARSES model[141], which uses a mass-flow method to estimate ammonia emissions from agriculture. Year-specific activity data are fed into the model, including livestock counts, housing methods and feed. Because NARSES it is a mass-flow model, nitrogen (TAN - Total Ammoniacal Nitrogen) is accounted for from the nitrogen (protein) content of feed, through excretion, and then on to handling of manure. This is important, as ammonia can be emitted at discrete stages of the livestock farming process.

Other modelling tools (AENEID, FRAME and CBED)[142] take outputs from the NARSES model and, with incorporation of ammonia monitoring data, predict ambient concentrations of ammonia as well as wet and dry deposition of ammonia.

Finally, in considering environmental impacts during the assessment of planning applications relating to agricultural installations, ammonia emissions at individual farm level are estimated using SCAIL and ADMS models[143]. As is the case with inventory estimates and concentration modelling of all air pollutants, assumptions are used which can affect the accuracy of results. Emissions Factors are used in the NARSES model - for example, the amount of ammonia excreted per head of livestock per year, in a particular housing type. These Emissions Factors are based on experimental data.

An Expert Working Group, at the request of a previous DAERA Minister, produced a report called *Making Ammonia Visible*. Some of the key recommendations of the report include the examination and, where appropriate, revision of Emissions Factors, to ensure that the data used in the compilation of the Northern Ireland ammonia emissions inventory is as accurate as possible (see **Section 4-7**).

DAERA and the Northern Ireland Agri Food and Biosciences Institute (AFBI) are taking forward a work programme which seeks to address evidence gaps in this area. Work is also being undertaken to expand the current level of ammonia monitoring in Northern Ireland.

4.4 Monitoring

Ammonia is not classed as an ambient air quality pollutant and so it is not monitored at either the Department's AURN monitoring stations, or at district councils' LAQM monitoring stations.

The UK Environmental Action Network Precip-Net measures a range of chemical species in water bodies.[144] There are three of these sites in Northern Ireland:

- Beagh's Burn (Glens of Antrim)
- Hillsborough Forest
- Lough Navar

141 NARSES ref
142 http://www.apis.ac.uk/overview/pollutants/overview_NH3.htm ; http://www.apis.ac.uk/popup/cbed
143 https://www.daera-ni.gov.uk/ammonia-emission-dispersion-modelling
144 https://uk-air.defra.gov.uk/networks/network-info?view=precipnet

For example, the amount of nitrogen as ammonium N recorded at Beagh's Burn in 2018 is given in **Figure 4-3**:

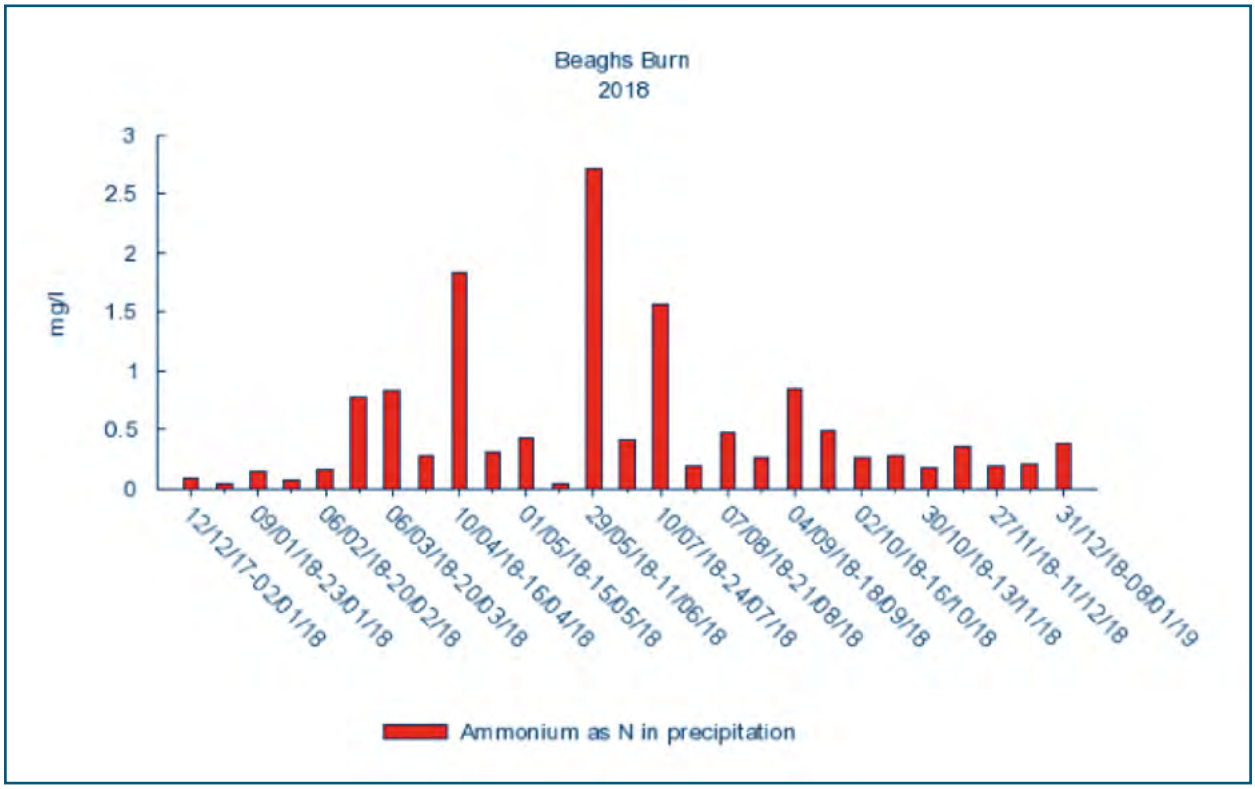


Figure 4-3: Ammonium (as N) in precipitation measured at Beagh's Burn, 2018

It is worth noting that the values are, in general, highest in the warmer months of the year, and lowest in the colder months. We might infer that this demonstrates a coincidence with agricultural activities, for example manure spreading, particularly since other chemical species measured do not show this seasonal pattern.

For example, measured concentrations of sodium are shown in **Figure 4-4**. Sodium is most likely present due to airborne sea salt aerosol, and so its concentrations are more dependent above all on weather conditions.

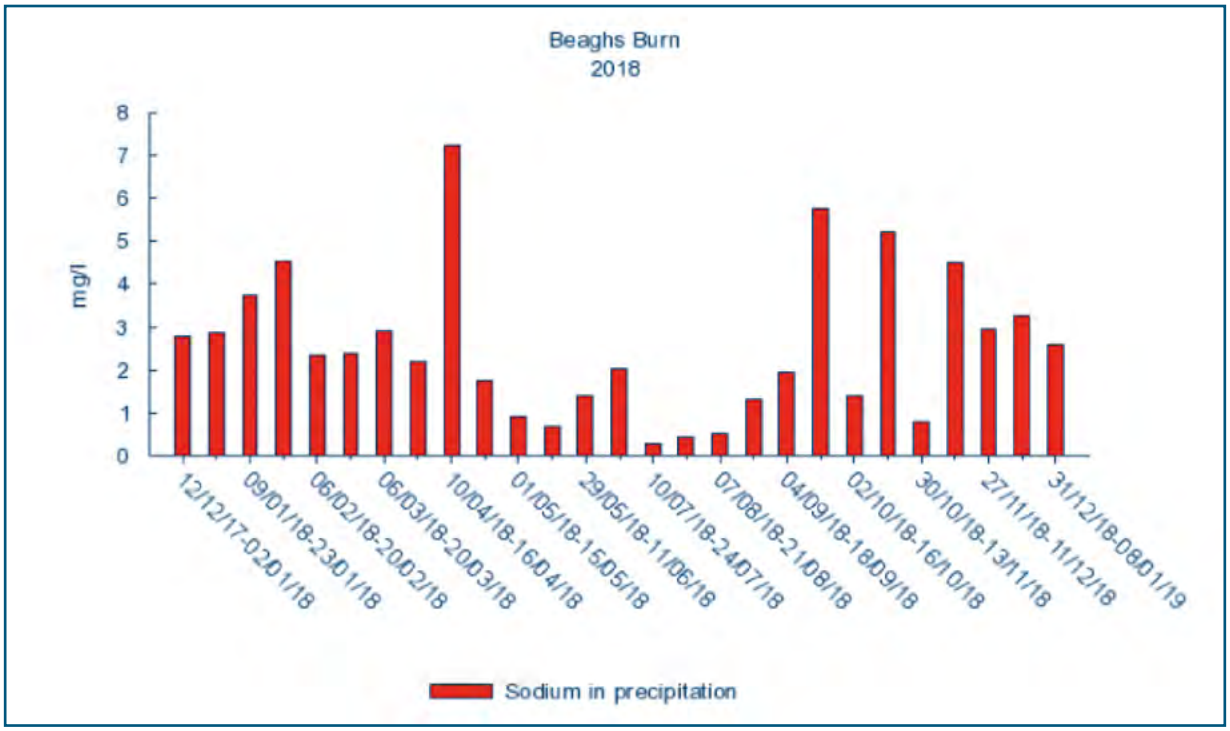


Figure 4-4: sodium measured in precipitation at Beagh's Burn, 2018

The National Ammonia Monitoring Network has also three sites in Northern Ireland; two of these coincide with the UK EAN Precip-Net sites.[145]

They are:

- Hillsborough
- Lough Navar
- Coleraine.

145 http://www.pollutantdeposition.ceh.ac.uk/networks

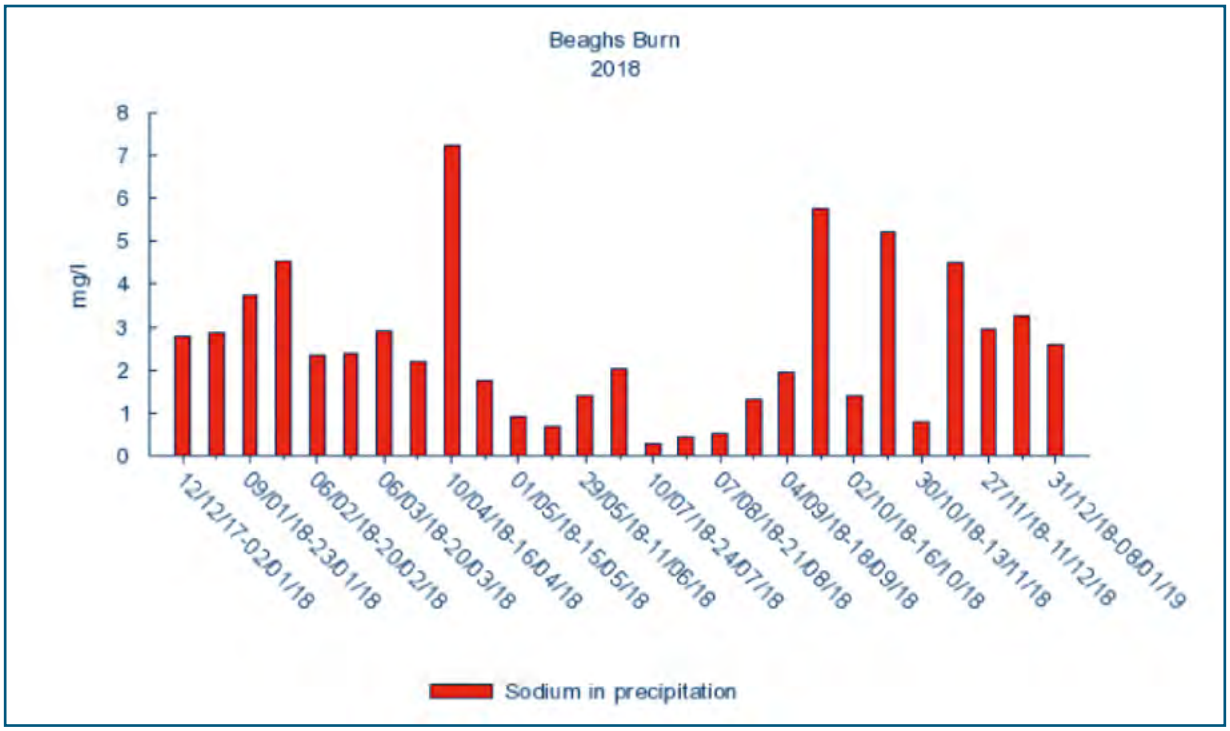


Fig 4-5: Ammonia (NH_3) ambient concentrations at Coleraine, 2018

Again, a seasonal concentration pattern is seen, this time in ambient ammonia concentrations.

Results from the ammonia monitoring networks are used to inform modelling of ammonia concentrations and deposition (see **Section 4.3**).

A DAERA-AFBI research initiative, in conjunction with Centre for Ecology and Hydrology has established a further 28 ammonia monitoring stations in Northern Ireland. The majority of these are alpha samplers, which are a low-cost, passive method of obtaining average ammonia concentrations over a particular time period (usually one month). Three of the new monitoring stations feature automated delta samplers, which use pumped air to give further information on ammonia concentrations, based on airflow. The expanded monitoring network is shown in **Figure 4-6**:

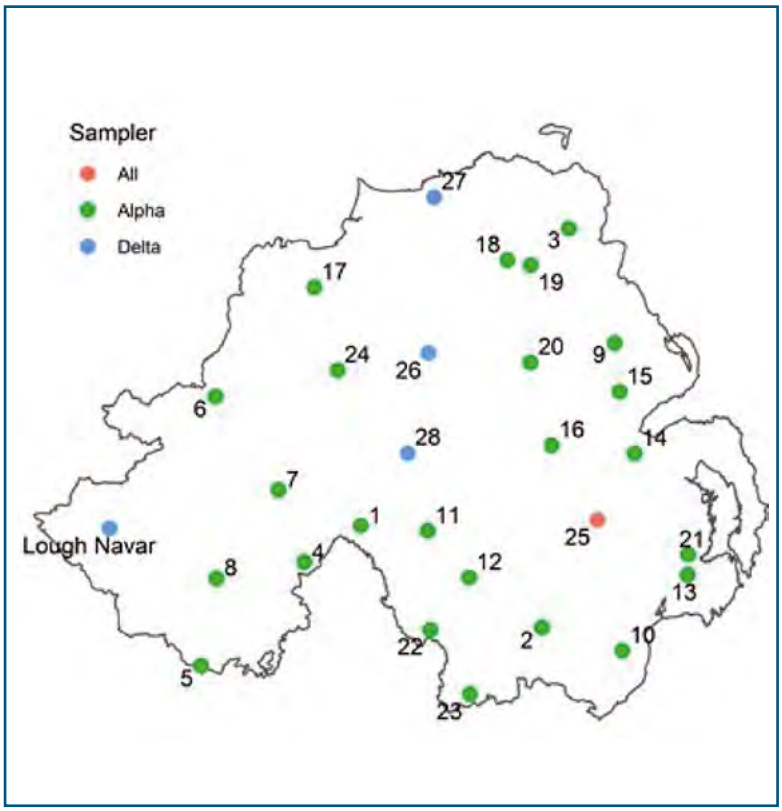


Fig 4-6: Expanded ammonia monitoring network

4.5 Emissions - Sources and Trends

According to latest inventory figures, Northern Ireland emissions of ammonia in 2017 made up 11% of the UK's total ammonia emissions[146], despite only having 2.8% of the UK population and 5.9% of total UK land area. This relatively high contribution reflects the importance of the agriculture sector here and it also reflects the nature of Northern Ireland a food-exporting region in which agriculture is dominated by livestock, with relatively little arable farming.

In 2017, Northern Ireland's ammonia emissions were 13% greater than 1990 levels, and also 13% greater than those in the 2005 NECD baseline year. Ammonia emissions in Northern Ireland peaked in the late 1990s and by 2010, ammonia emissions were 17% less than they had been in 1998. However since 2010, there has been a notable increase in ammonia emissions. Emissions were 23% higher in 2017 than they had been in 2010 with significant spikes experienced in recent years. For example, ammonia emissions increased by 5.8% from 2015 to 2016 and then a further 5.1% from 2016 to 2017.

In 2017, agriculture contributed 96% of NI ammonia emissions, and **Figure 4-8** shows the breakdown according to various agricultural activities. This high proportion of ammonia from agricultural activities is in line with the rest of the EU, where the average is 94%.[147]

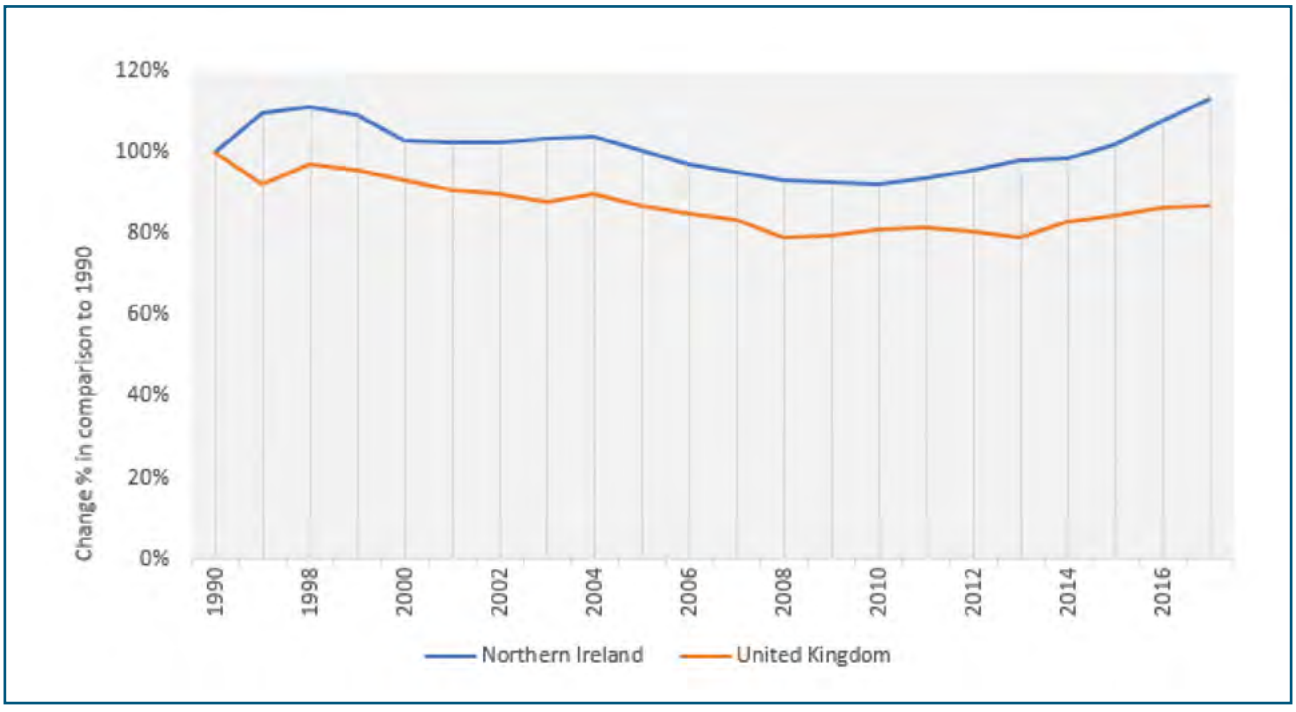


Figure 4-7 - ammonia emissions from 1990 to 2017(% change since 1990) for Northern Ireland and for the UK as a whole.

146 *National Atmospheric Emissions Inventory* 1990-2017.
147 http://ec.europa.eu/eurostat/statistics-explained/index.php/Agri-environmental_indicator_-_ammonia_emissions

The management and application of manure from livestock housing is the key driver of ammonia emissions in Northern Ireland and is responsible for a combined 85% of all agricultural emissions. Chemical fertiliser accounts for 7% of emissions when animal excretion while grazing produces 8% of ammonia, this relatively low proportion highlights the relative importance of grassland grazing systems in limiting ammonia emissions. These statistics clearly show the importance of manure and slurry management throughout the agricultural system, from how diet influences the nitrogen content of slurries and manures to the technology used to apply those manures to land. A key principle is the need to avoid ammonia loss through the agricultural system. Where emissions are avoided in one part of the nitrogen cycle, that positive behaviour can be undone by poor practices at a later point in the cycle.

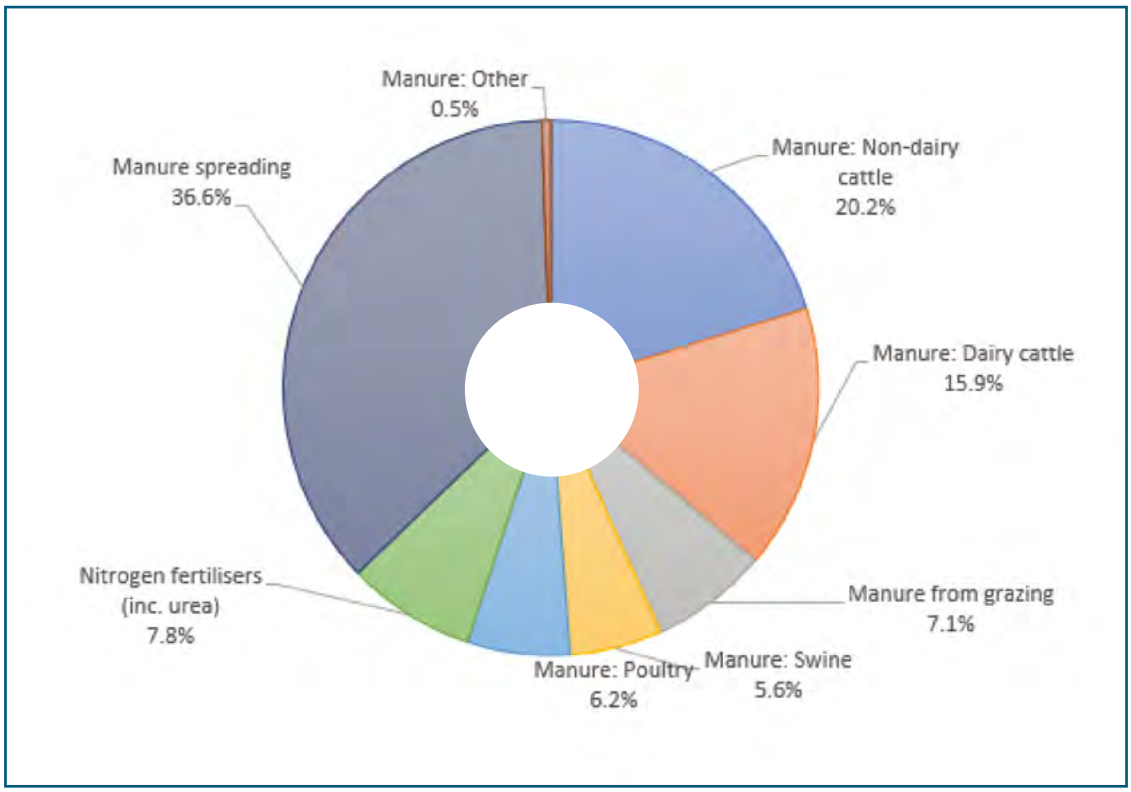


Figure 4-8 - breakdown of NI agricultural ammonia emissions in 2017, by activity

4.6 Nitrogen Deposition

Nitrogen can be deposited on habitats from the release of ammonia emissions direct from agricultural installations like animal housing, or from manure spreading in nearby fields. Critical Loads have been determined for different types of habitats (for example, raised bogs), while Critical Levels are estimated for different species of higher plants (trees, shrubs and flowering plants) as well as lower plants (for example, mosses, ferns and lichens). Exceedances of Critical Levels are used to determine whether or not installations or activities will have direct-acting harmful effects on habitats from dry deposition of ammonia.

As ammonia persists in the atmosphere over long distances and timescales, it contributes to regional background levels of ammonia. It is also washed out in rainfall (wet deposition). Both dry and wet deposition contribute to the overall nitrogen loading to sensitive sites.

Figure 4-9 shows the estimated critical loads exceedances for land types across the UK. Areas of high agricultural output can be seen on the map as areas in which there are high exceedances of Critical Loads for nutrient nitrogen.

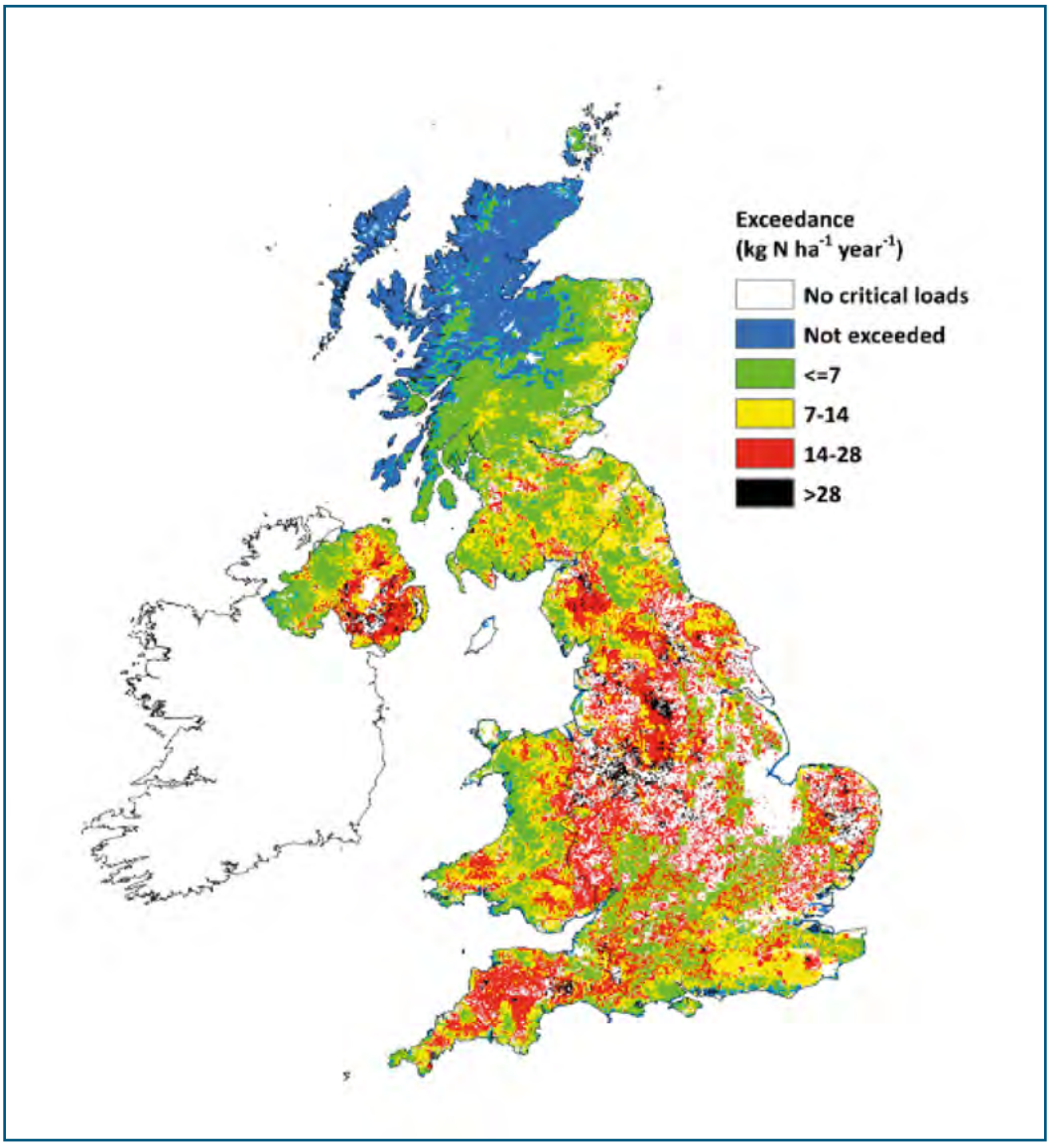


Figure 4-9 - Critical Loads Exceedances from atmospheric deposition of nutrient nitrogen[148]

148 Centre for Ecology and Hydrology: http://www.cldm.ceh.ac.uk/exceedances/maps Nitrogen critical loads, for all habitats combined, based on UK 5x5 km deposition data averaged for 2012-2014. These maps were updated in 2017 following a minor update to the deposition data.

However, only a small proportion of land cover are designated sites - *ca.* 10% - although this figure rises when we consider all priority habitats (see **Figure 4-10**).[149] When we specifically consider sensitive habitats, such as Areas of Special Scientific Interest (ASSIs) and Special Areas of Conservation (SACs), we find that almost all are being damaged by excessive atmospheric nitrogen loading, and specifically, ammonia from agricultural activities.

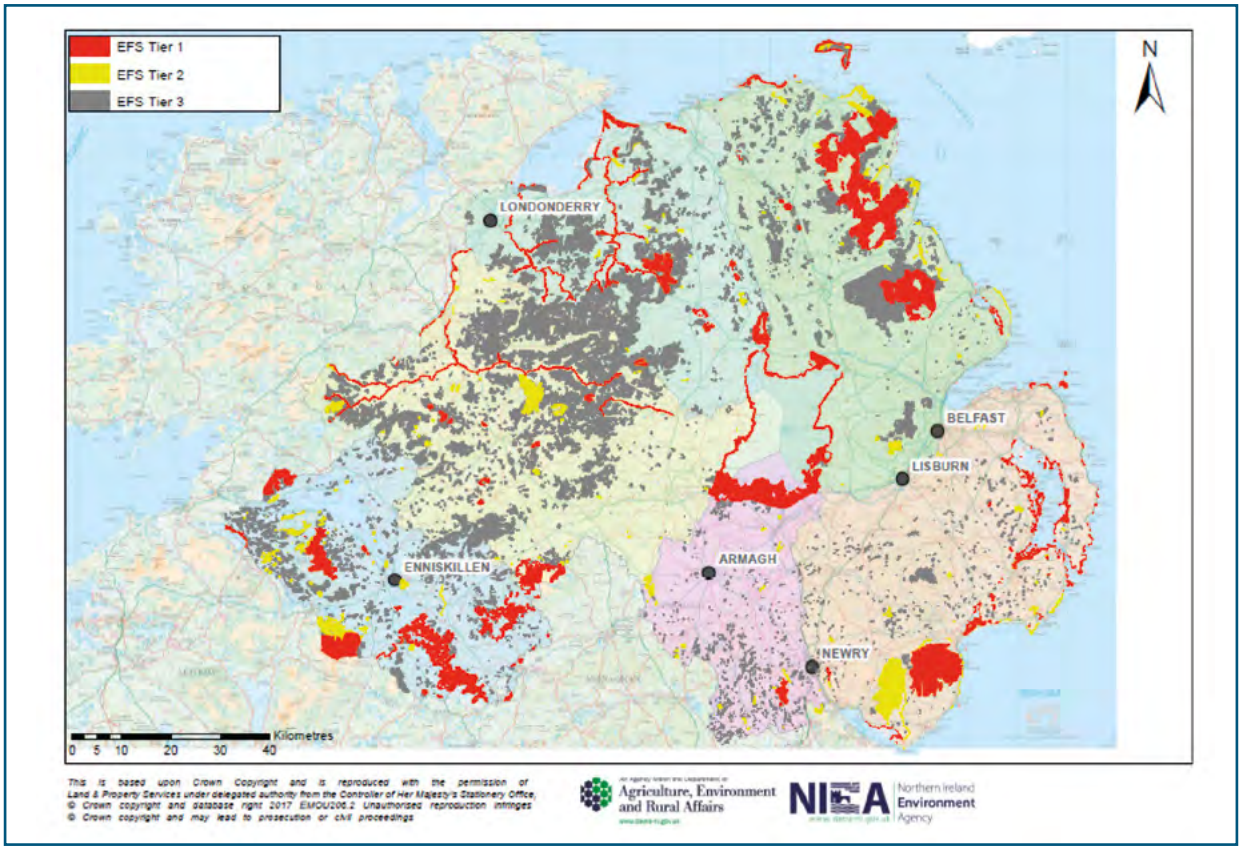


Figure 4-10 - priority habitats in Northern Ireland, according to Environmental Farming Scheme Tier classifications

Based on figures in the EMIND report[150], on average, agriculture contributes to ~59 % of total N deposition (to low-growing semi-natural features) received by SACs, and contributes ~90 % of the N deposition from locally depositing species (wet and dry deposition from NH_3 and NO_2).

A substantial proportion of SACs in Northern Ireland are estimated to be subject to high concentrations of agricultural NH_3 from emission sources close to their site boundary. The dominant emission source of NH_3 (i.e. the largest contribution to estimated NH_3 emissions within the 2km (or larger) buffer zone) for most SACs is cattle farming (~73 %).

NI Environment Agency is consulted on planning applications for agricultural installations and then provide advice to planning authorities as to the potential effects of activities on protected sites, and impacts of ammonia emissions/nitrogen deposition are estimated using the APIS (Air Pollution Information System) tool.[151]

149 https://www.daera-ni.gov.uk/sites/default/files/publications/daera/EFS%20Higher%20Level%20Tiers%20Map.PDF
150 NIEA, EMIND report, not yet published.
151 http://www.apis.ac.uk/

4.7 Expert Working Group Report

In July 2016, the DAERA Minister asked the independent Expert Working Group on Sustainable Land Management to examine the agricultural ammonia issue and to produce an annex to their main Report. The Expert Working Group is an independent group, which draws its members from across the farming, agri-food, environment and government sectors. The group was appointed to examine land management in Northern Ireland and identify an approach to ensure that the objectives of 'Going for Growth' are achieved in a sustainable manner. The group produced its original report on land management in October 2016.

In December 2017, the group published an annex to the main report *Making Ammonia Visible*[152], dealing specifically with ammonia emissions from agriculture. The recommendations from the annex will be considered by DAERA, and used to inform its approach as it develops a DAERA Action Plan for Ammonia.

The key recommendations of *Making Ammonia Visible* are as follows:

- Ammonia emissions must be addressed through a partnership approach that incorporates communication and education, research, and implementing ammonia mitigation measures;
- Scientific research should address the significant evidence gaps within the ammonia emissions inventory;
- An enhanced regime for monitoring ammonia in Northern Ireland should be established;
- DAERA should adopt a set of guiding principles when assessing planning applications in relation to ammonia. These guiding principles should focus on encouraging the implementation of ammonia mitigation measures;
- Farmers should begin to implement the ten ammonia mitigation measures highlighted in the report;
- Government should take steps to permanently end the use of splashplates for slurry spreading and also the use of non-stabilised urea fertiliser;
- The existing Greenhouse Gas Implementation Partnership (which includes government, industry and environment sector membership) should be revamped to incorporate ammonia within its remit. This new Agri Emissions Partnership should lead the awareness and communications campaign for famers.

The ammonia emissions inventory for Northern Ireland (and the other Devolved Administrations) is prepared by Rothamsted Research. Emissions inventory estimates - as well as data from ammonia monitoring sites - are used by Centre for Ecology and Hydrology to undertake modelling of ammonia emissions. In the case of the Northern Ireland inventory, specific activity data is provided by DAERA (for example in relation to farm surveys, livestock numbers).

152 https://www.daera-ni.gov.uk/sites/default/files/publications/daera/Ammonia%20Annex-%20Expert%20Working%20Group%20%28final%29.pdf

During a review of the NI ammonia inventory, it was felt that improvements may be possible both in terms of activity data used for inventory estimates as well as some of the emissions factors applied, as well as the extent of ammonia monitoring that is used to help inform modelling.

DAERA has therefore commissioned a scientific research programme on ammonia. This research programme is funded by DAERA and led by AFBI, in partnership with CEH and Rothamsted who are key contributors to, and authors of, the UK ammonia inventory. The objectives of the research programme are to:

- Feed new NI-specific data into the ammonia models;
- Collate activity data on farm management practices in Northern Ireland;
- Update emissions factors associated with key farm activities in Northern Ireland, such as the housing of cattle in slatted-floor slurry systems;
- Assess the costs, environmental impacts and cumulative effects of the ammonia mitigation measures proposed by the Expert Working Group;
- Increase monitoring of atmospheric ammonia concentrations in Northern Ireland.

4.8 Way Forward

The Department has set up an Ammonia Project Board, specifically tasked with examining the issues and evidence surrounding the ammonia problem in Northern Ireland, its negative impacts on biodiversity and habitats, and the difficulties it presents for the expansion of the agricultural sector in Northern Ireland. The objective of this Project Board is to work with stakeholders to achieve sustained reductions in ammonia emissions from Northern Ireland farms so that nitrogen deposition from local and background sources does not negatively impact on nature, while facilitating the sustainable development of a prosperous agri-food industry.

Its key task is to develop a comprehensive approach to ammonia, with a detailed set of proposals, which will achieve the tangible and sustained reductions in emissions required. DAERA is committed to working with stakeholders as it develops this approach and will be launching a public discussion on a draft series of proposals.

Agricultural Emissions

Q: Do you think that the process in place to address ammonia emissions in Northern Ireland is appropriate?

Chapter 5 - Industrial Emissions

Industrial activities play an important role in the economic well-being of Northern Ireland by contributing to sustainable development and growth, but this can also have a significant impact on the environment. The industrial sector accounts for a significant proportion of air pollution emissions in Northern Ireland and the sources include various types of activities ranging from large power stations to petrol station forecourts. Air pollution emissions from industry are, however, subject to strict regulation.

Figure 5-1 shows emissions of air pollutants from the industrial sector (including power generation) in Northern Ireland from 2000 to 2017. For many pollutants (NH_3, PM_{10}, Pb, VOCs), there has been little change over the time series. The biggest changes are seen in emissions of NO_x and SO_2. The strong decline in emissions of SO_2 is due to the introduction of Combined Cycle Gas Turbines (e.g. at Ballylumford from 2003) at a number of power stations, and the installation of the flue gas desulphurisation equipment at Kilroot.

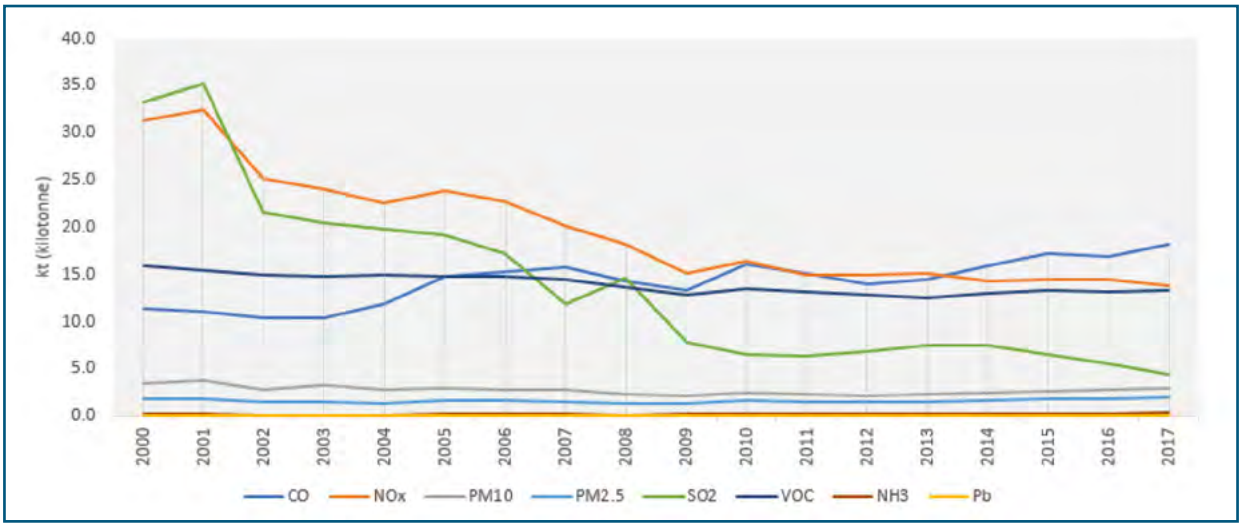


Figure 5-1 Emissions of air pollutants from industry in Northern Ireland from 2000-2017

For NO_x, the decline is largely driven by reductions in coal use in power stations (the expansion of the NG network helped with this) and the installation of various abatement technologies. Additionally, there has been some fuel switching from gas oil to natural gas in the other industrial combustion sector which contributes to the decline observed.

The decrease in NO_x and SO_2 emissions which are due to changes in power generation can be seen more clearly in **Figure 5-2**, below.

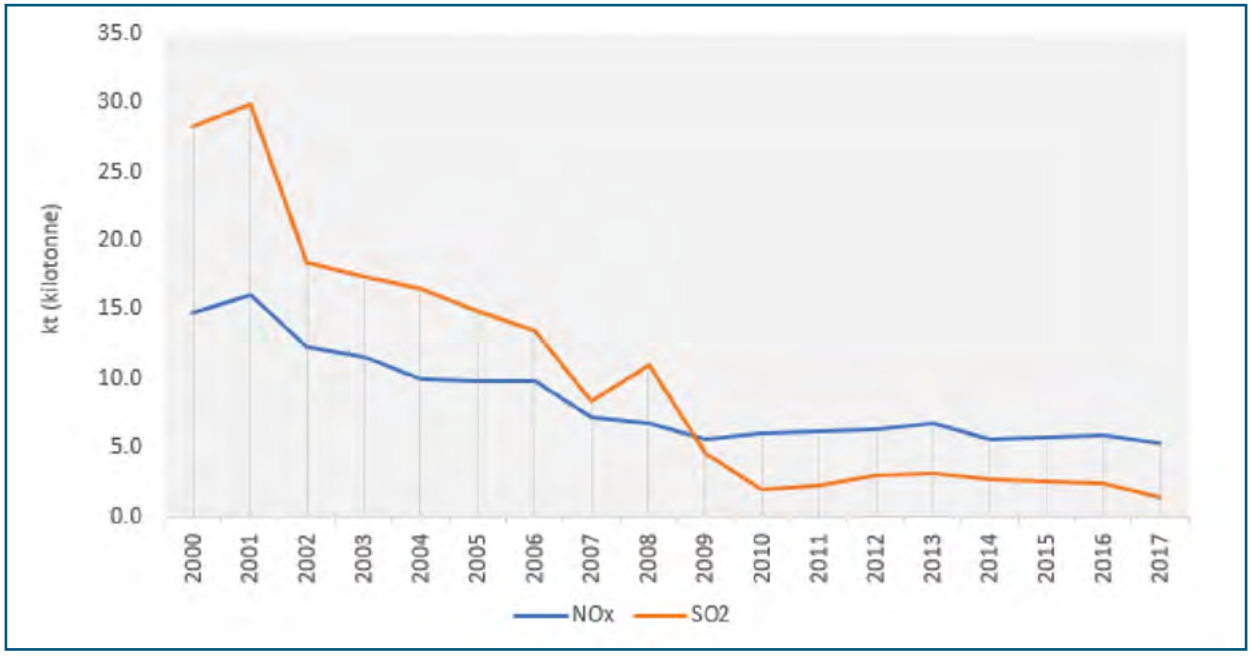


Figure 5-2 Emissions of NO_x and SO_2 emissions from power generation in NI, 2000-2017

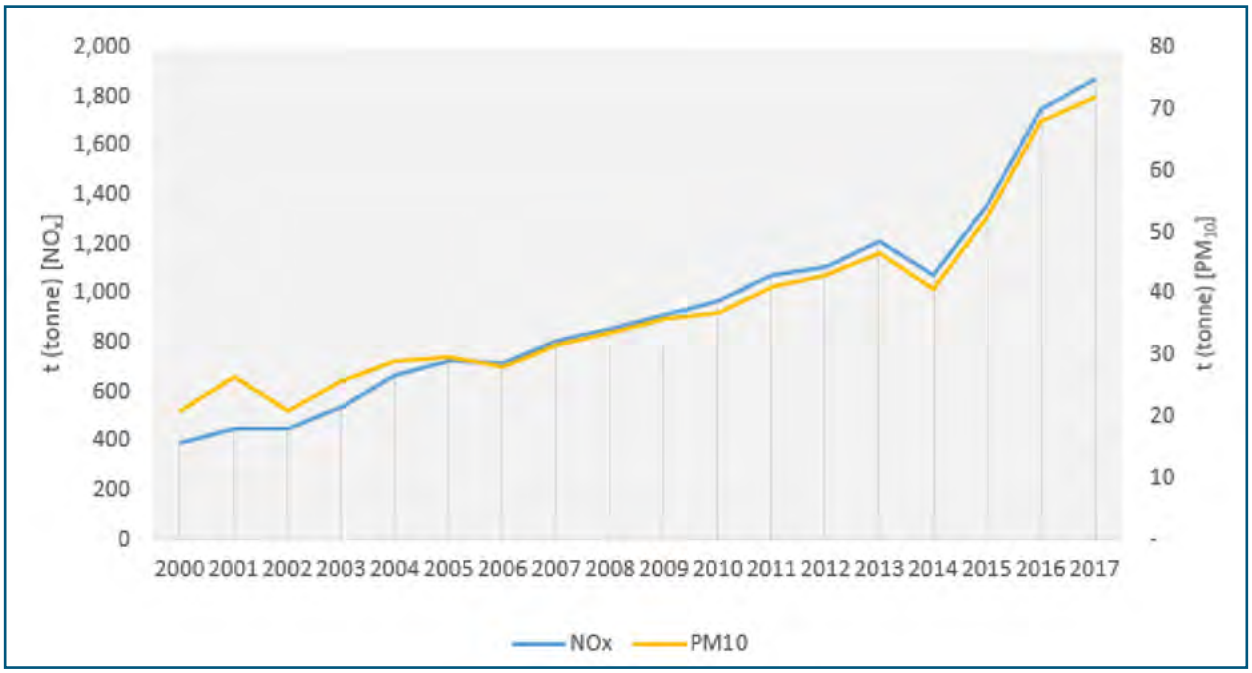


Figure 5-3 - NO_x and PM_{10} emissions from 'Energy from Waste' activities in Northern Ireland 2000-2017

Emissions from 'Energy from Waste' activities, as well as from Anaerobic Digestion are examined here, as they are activities that are showing growth. **Figure 5-3** shows that PM_{10} emissions from EfW have increased along with emissions of NO_2; however, they are much smaller in magnitude compared to NO_x emissions. NO_x emissions from EfW are now almost 9% as large as NO_x emissions from the power generation sector.

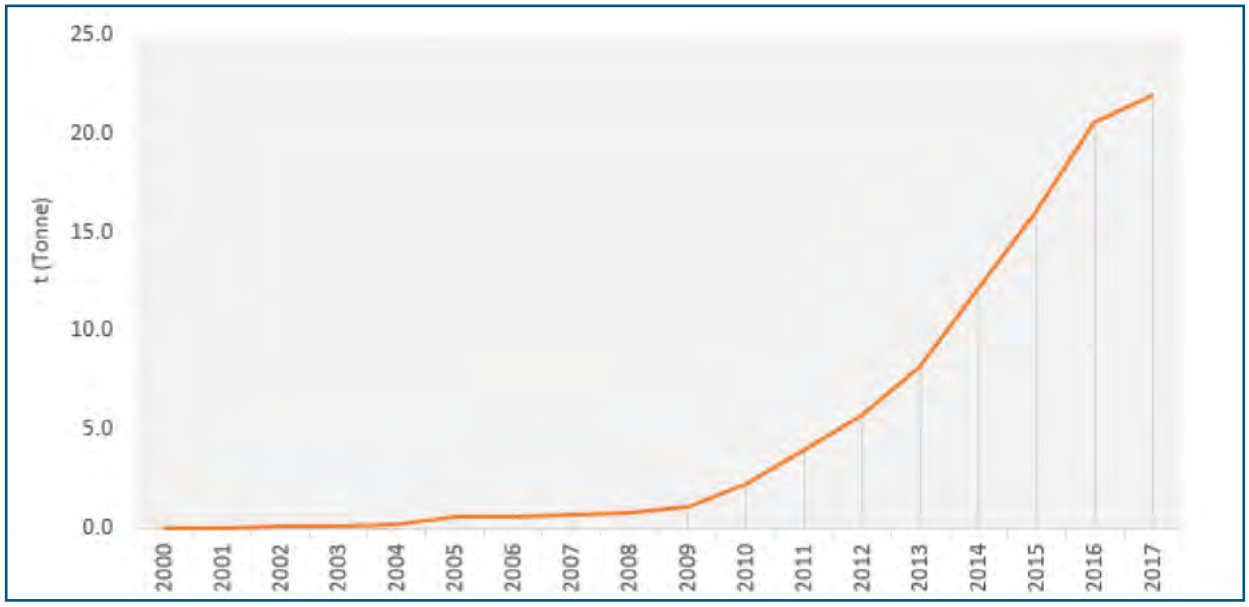


Figure 5-4 Ammonia emissions from Anaerobic Digestion activities in Northern Ireland from 2000 to 2017

Ammonia emissions from Anaerobic Digestion have increased substantially over the time series; however, they are currently still small in the scale of overall ammonia emissions, which are dominated by agricultural activities, in particular, manure storage, handling and spreading.

Regulation in the European Union

The largest industrial installations account for a considerable share of total emissions of key atmospheric pollutants and also have other important environmental impacts, including emissions to water and soil, generation of waste and the use of energy. Emissions from industrial installations have therefore been subject to EU-wide legislation for some time and currently the main pieces of legislation that govern industrial emissions are as follows:

- **Directive 2010/75/EU on industrial emissions (IED):** The IED sets out the main principles for the permitting and control of installations based on an integrated approach and the application of best available techniques (BAT). BAT is the most effective techniques to achieve a high level of environmental protection, taking into account the costs and benefits.

  On 7 January 2014, the IED repealed and replaced Directive 2008/1/EC on integrated pollution prevention and control (IPPC), Directive 2000/76/EC on waste incineration, Directive 1999/13/EC on activities using organic solvents and Directives 78/176/EEC, 82/883/EEC and92/112/EEC concerning titanium oxide production. On 1 January 2016, Directive 2001/80/EC on large combustion plants (LCP) was also repealed.

- **Directive 1994/63/EC and Directive 2009/126/EC** on petrol storage & distribution**:** Two related directives that aim to prevent emissions to the atmosphere of volatile organic compounds (VOCs) by imposing measures on key steps in the storage and distribution of petrol from terminals, to service stations, and to individual vehicles.

- **Regulation 166/2006 on the European Pollutant Release and Transfer Register** (E-PRTR): The E-PRTR gives the public access to detailed information on the emissions and the off-site transfers of pollutants and waste from around 30 000 industrial facilities, of which there are about 139 such facilities in Northern Ireland (See **Figure 5-5**).

More recently the Directive (EU) 2015/2193 on medium combustion plants (MCP) has entered into force in Europe. This regulates emissions of sulphur dioxide (SO_2), nitrogen oxides (NO_x) and dust from the combustion of fuels in plants with a rated thermal input equal to or greater than 1 megawatt (MWth) and less than 50 MWth. It also lays down rules to monitor emissions of carbon monoxide (CO).

It fills the regulatory gap at EU level between large combustion plants (≥ 50 MWth), covered under the IED and smaller appliances (heaters and boilers <1 MWth) covered by the Ecodesign Directive.

Medium combustion plants are used for a wide variety of applications (electricity generation, domestic/residential heating and cooling, providing heat/steam for industrial processes, etc.) The estimated number of MCPs in the Northern Ireland is around 1,200.

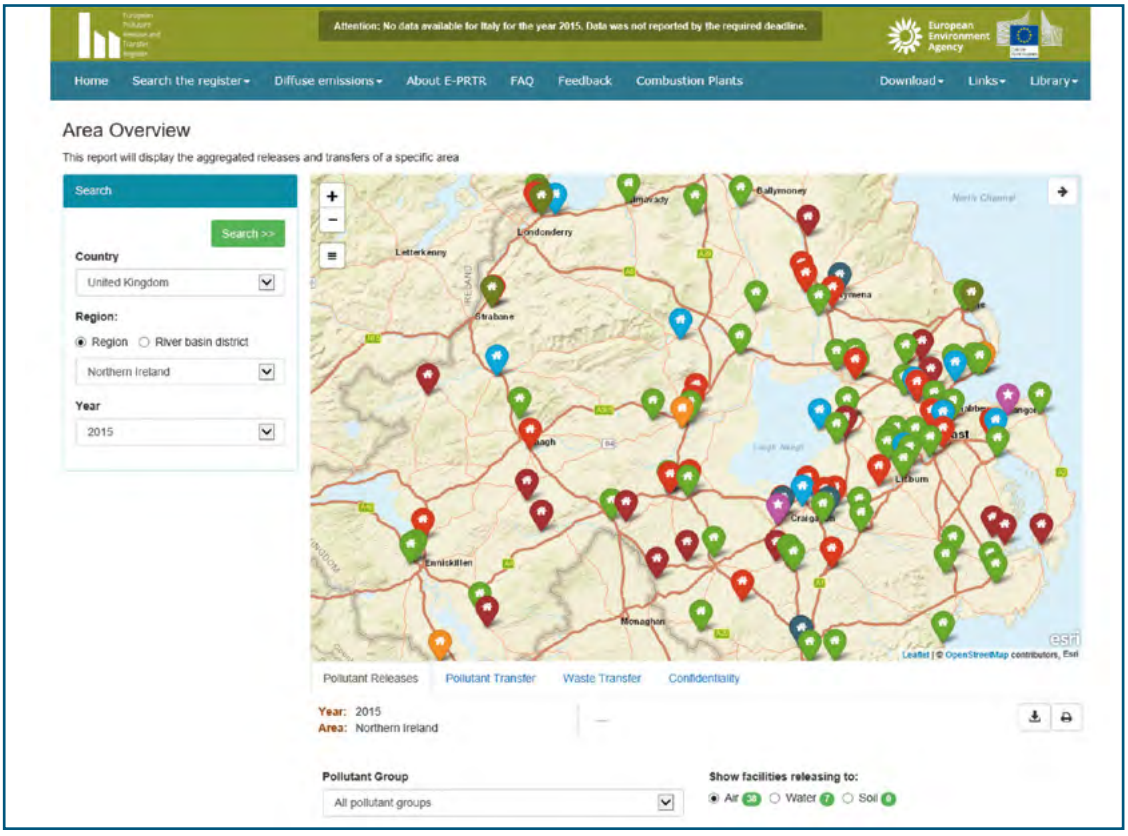


Figure 5-5 European Pollutant Release and Transfer Register (E-PRTR) for relevant industry in Northern Ireland (EEA 2017)

The MCP Directive was transposed into Northern Ireland legislation in 2018 and will help to contribute to the implementation of the obligations arising from the Gothenburg Protocol under the UNECE Convention on Long-Range Transboundary Air Pollution.

The emission limit values is in place since December 2018 for new plants and must be applied by 2025 or 2030 for existing plants, depending on their size. The Directive has flexibility provisions for district heating plants and biomass firing that will ensure climate and air quality policies are consistent and their synergies are maximized.

Industrial processes are responsible for a significant proportion of Northern Ireland greenhouse gas emissions, as illustrated by **Figure 5-6**.

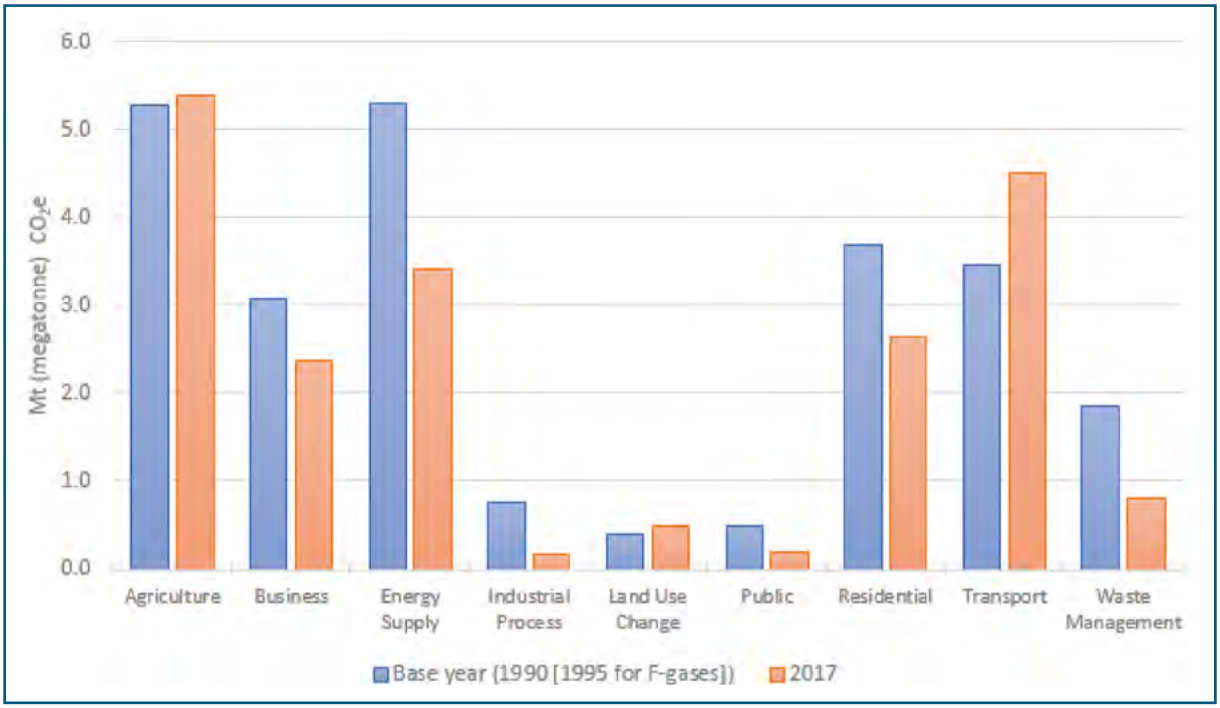


Figure 5-6 Greenhouse gas emissions in Northern Ireland by sector, 1990-2017
(Note: the base year for UK greenhouse gas emissions is 1990 for carbon dioxide, methane and nitrous oxide and 1995 for fluorinated gases)

Generally, the emissions of greenhouse gases from industry has been decreasing, particularly for the energy production sector where the conversion from coal to gas fired power stations has reduced emissions of certain gases in Northern Ireland. Greenhouse gas emissions per unit of electricity generated decreased 36% from 631gCO_2/kWh in 2004 to 406gCO_2/kWh in 2017. This has been driven by the growth of renewable generation in Northern Ireland, a shift away from coal use towards gas for electricity generation, and improvements in energy efficiency.[153]

153 https://www.daera-ni.gov.uk/news/carbon-intensity-indicators-published

Regulation in Northern Ireland

In Northern Ireland, atmospheric emissions from industry have been regulated for many decades, most recently with a modernized system of pollution control introduced in 1998. This was updated in 2003 and then again in 2013 in order to reflect the corresponding EU legislative changes.

Industrial processes prescribed by The Pollution Prevention and Control (Industrial Emissions) Regulations (Northern Ireland) 2013 are required to have a permit in order to operate. The permit allows the holder to operate a process subject to certain conditions.

The conditions attached to such a permit aim to limit or prevent the emission of certain prescribed substances from the particular site to which it relates.

Anyone operating a process which is prescribed by the regulations must use Best Available Techniques (BAT) to control and manage this risk, while striking a balance between costs and environmental benefits.

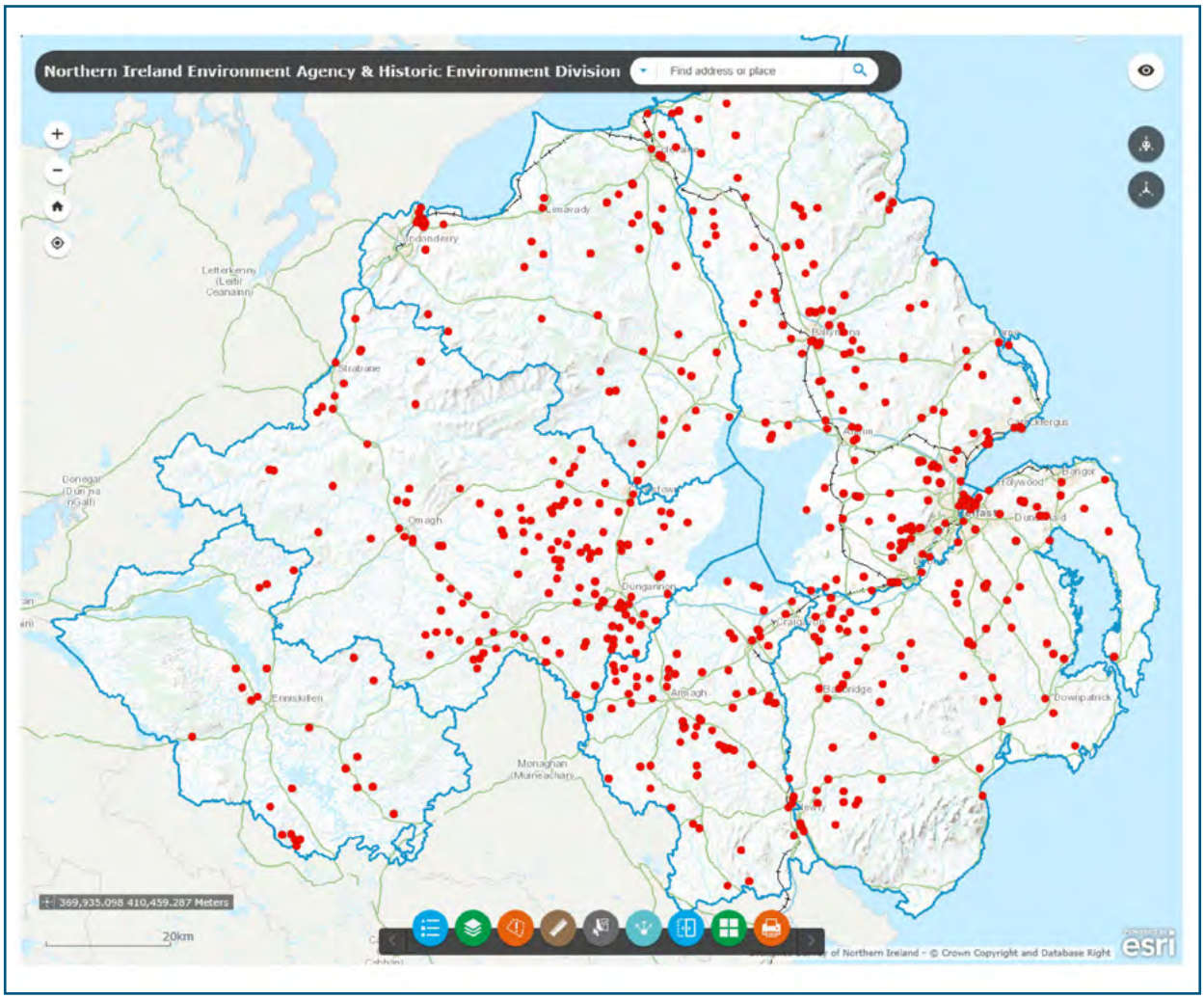


Figure 5-7 Part A and B authorized IPPC premises in Northern Ireland

The Northern Ireland Environment Agency (NIEA) is the authority responsible for regulating those premises where there is potential for emissions to the land, air or water. This is known as Integrated Pollution Prevention and Control (IPPC) and the premises to be regulated are categorised as Part A and Part B Processes. There are more than 450 Part A and B permits issued by NIEA as illustrated in **Figure 5-7**.

District councils are responsible for Local Air Pollution Prevention and Control (LAPPC) and premises prescribed in the regulations are known as Part C processes which have the potential to cause emissions to the air only. There are more than 500 Part C permits issued by District Councils.

Industrial Air Pollution

Q: Are there any industrial sectors or air pollutants that require new or further investigation?

Chapter 6 - Local Air Quality Management

The Environment (Northern Ireland) Order 2002, as amended, requires local government councils to review the quality of the air within their districts. Part of this review is an assessment of the quality of air against an agreed set of standards. Where these standards are failing to be achieved the council may designate Air Quality Management Areas (AQMAs), and an Action Plan must be developed for each area. This management system lies at the foundation of improving air quality in Northern Ireland.

To assist eligible councils in the monitoring and assessment of their air quality, DAERA has a Local Air Quality Management (LAQM) grants scheme which draws down from its Environment Fund. Councils apply annually for funding from the Department to carry out air quality monitoring and assessment, and to prepare and implement action plans.

Councils are required to submit an annual report, in accordance with Policy Guidance LAQM PG (NI) 09,[154] of the results of their air quality assessment. This report gives a holistic view on all aspects of the air quality in the region, from past assessments to new monitoring data and developments, as well as trends demonstrating air quality improvement or deterioration, outlining any AQMAs in place as well as corresponding Action Plans.

6.1 Air Quality Monitoring Methods

Assessment of air quality within district councils is carried out in using two methods:

- passive sampling; and
- automatic point monitoring systems.

Passive sampling is used to measure nitrogen dioxide concentrations, using diffusion tubes. The main source of nitrogen dioxide in urban centres is vehicle emissions. Siting diffusion tubes across the council area provides a low-cost method of building up a picture of the NO_2 spread across the district and helps to identify any hotspots or emerging trends. Reviewing monitoring data from the diffusion tubes over time can track the effectiveness of an Action Plan and provide a basis for the identification of areas that may need to be designated as Area Quality Management Areas or alternatively highlight existing AQMAs which may be eligible for revocation.

Automatic point monitoring systems are placed in specific locations, which are selected with the help of guidance set out in the Local Air Quality Technical Guidance, LAQM TG (16)[155], and also in accordance with siting criteria as set out in the Air Quality Directives. Sites are classified in accordance with their location as set out in the Guidance.

154 Available at: http://www.airqualityni.co.uk/news-and-reports/useful-guidance
155 https://laqm.defra.gov.uk/documents/LAQM-TG16-April-16-v1.pdf

They can be either:

- Urban Centre;
- Urban Background;
- Suburban;
- Roadside;
- Kerbside;
- Industrial;
- Rural; or Other.

Sites are used to monitor a range of pollutants, including oxides of nitrogen NO_2, sulphur dioxide SO_2, carbon monoxide CO, ozone O_3 and particulate matter PM_{10} and $PM_{2.5}$.

These pollutants are all present in measurable amounts; councils monitor those pollutants, which are more challenging in respect of compliance with objectives. In Northern Ireland this focus is on both particulate matter, PM, and nitrogen dioxide, NO_2. Particulate matter measured here is associated with the burning of solid fuels by households for heating, and with vehicle emissions.

Figure 6-1, below, is a snapshot from the Department's website www.airqualityni.co.uk on a day in mid-February 2020; it shows the locations of these monitoring stations in Northern Ireland (Note that the number at each station is indicating the Daily Air Quality Index at the time of the snapshot).[156]

Figure 6-1 air quality monitoring sites in Northern Ireland, as of February 2019

156 www.airqualityni.gov.uk

For all the pollutants monitored in Northern Ireland there are objectives and limit values set out in Table 2 of the Air Quality Strategy for England, Scotland, Wales and Northern Ireland[157]. Sites where these limit values are exceeded are carefully monitored and, if necessary, are declared as AQMAs, each of which is then subject to an Action Plan to improve the air quality and meet the required standards.

Table 6-1 (overleaf) shows the limit values from Schedule 2 of the UK Strategy.

6.2 Low Cost Air Quality Monitors

With the emergence of low-cost monitoring technologies, there is now scope for increased monitoring of pollutants such as PM and NO_x (**see Section 1.10**). It is acknowledged that the accuracy of these instruments cannot be validated in the same way as certified automatic monitoring systems in place at permanent monitoring stations. However, there is perhaps a place for these monitors in the LAQM system, for screening purposes. Under the LAQM grant scheme, councils should consider purchasing and installing low-cost monitors, which would enable them to undertake screening assessments for air quality. These screening assessments could help councils decide whether or not more detailed assessments of air quality are needed and whether certified automatic monitoring equipment should be installed.

Low-Cost Air Quality Monitoring

Q: In addition to existing monitoring, should councils more widely adopt low-cost air quality monitoring systems, for screening purposes?

Local Air Quality Management Grants Scheme

Local councils can apply annually for financial support in connection with air quality monitoring, reviews, assessments and management and the preparation and implementation of action plans. The criteria for funding are based on the identification of air quality problems where parameters listed in Table 2 of the UK Air Quality Strategy are exceeded or may be exceeded and support is needed for longer-term monitoring and council-led mitigation measures.

The financial assistance is dependent on whether the council has submitted annual Progress Reports and any Air Quality Action Plans (or Action Plan Progress Reports) that are required for AQMAs.

157 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69336/pb12654-air-quality-strategy-vol1-070712.pdf

Table 6-1 National air quality objectives

Pollutant	Air Quality Objective -protection of human health	
	Concentration	Averaging period
Benzene	3.25 $\mu g/m^3$	Annual mean
PAHs	0.25ng.m^{-3} B[a]P	Annual mean
1,3-butadiene	2.25 $\mu g/m^3$	Annual mean
Carbon monoxide	10 mg/m^3	Running 8-hour mean
Lead	0.25 $\mu g/m^3$	Annual mean
Ozone	100 $\mu g/m^{-3}$ Not to be exceeded more than 10 times a year	8-hour mean
Nitrogen dioxide	200 $\mu g/m^{-3}$ not to be exceeded more than 18 times a year	1-hour mean
	40 $\mu g/m^{-3}$	Annual mean
Particulate matter (PM_{10})	50 $\mu g/m^{-3}$, not to be exceeded more than 35 times a year	24-hour mean
	40 $\mu g/m^{-3}$	Annual mean
Particulate matter ($PM_{2.5}$) exposure reduction	25 $\mu g/m^{-3}$	Annual mean
Sulphur dioxide	350 $\mu g/m^{-3}$, not to be exceeded more than 24 times a year	1-hour mean
	125 $\mu g/ m^{-3}$, not to be exceeded more than 3 times a year	24-hour mean
Pollutant	**Protection of vegetation and ecosystems**	
	Concentration	**Averaging period**
Nitrogen oxides	30 $\mu g/m^{-3}$	Annual mean
Sulphur dioxide	20 $\mu g/m^{-3}$	Annual mean
Ozone: protection of vegetation & ecosystems	18,000 $\mu g/m^{-3}$	Average over 5 years

6.3 Air Quality Management Areas

In general, the principal sources of air pollution within district councils are road transport and the burning of solid fuels by households. The ongoing review, assessment and reporting of air quality by local district councils can highlight areas where the national air quality objectives are not being met. In instances where the objectives are not being met, the area is declared as an Air Quality Management Area. This area could be limited to several streets or a much more sizable area. Northern Ireland currently has 19 AQMAs in 9 of its 11 councils; **Figure 6-2** shows the location of these AQMAs. Once an AQMA has been declared, the Council must devise an

Action Plan to set out long- and short-term objectives to tackle the sources of air pollution. The AQMA remains in place until the council can provide adequate evidence to demonstrate that the national air quality objectives are being consistently met and that future exceedances of these objectives are unlikely.

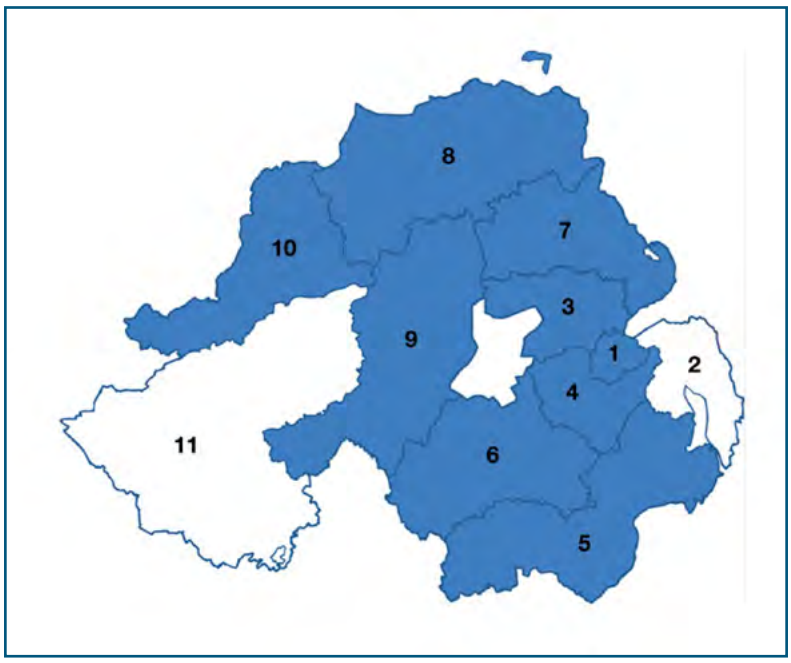


Figure 6-2 - AQMAs in Northern Ireland

Key:

1 Belfast City Council AQMAs: M1/Stockman's Lane, Cromac Street/Bridge St/Short Strand, Upper Newtownards Rd, Ormeau Rd.

2 North Down and Ards Borough Council - no AQMAs

3 Antrim and Newtownabbey Borough Council AQMA: Newtownabbey Elmfield

4 Lisburn and Castlereagh City Council AQMA: Normandy Court Dundonald

5 Newry Mourne and Down District Council AQMAs: Newry Canal Street and Newry Urban Centre

6 Armagh City, Banbridge and Craigavon Borough Council AQMA: entire council area

7 Mid and East Antrim Borough Council AQMAs: Ballykeel and Linen Hall Street

8 Causeway Coast and Glens Borough Council AQMA: Dungiven

9 Mid Ulster District Council AQMAs: Magherafelt, Moy, and Newell Road

10 Derry City and Strabane District Council AQMAs: Dales Corner, Buncrana Road, and Spencer Road (all in Londonderry)

11 Fermanagh and Omagh District Council - no AQMAs.

A more detailed summary of the AQMAs in Northern Ireland can be seen below in **Table 6-2**. Active AQMAs are in bold text.

Table 6-2

Council Area	AQMA	Date and reason for Designation	Date Revoked	Action Plan?
Antrim and Newtownabbey	**Newtownabbey Borough Council Air Quality Management Area No. 3 Antrim Road, Elmfield**	29th June 2009 Nitrogen Dioxide	Still in operation	Y
	Newtownabbey Borough Council AQMA No. 1 Ballyclare	25 October 2004 Particulate Matter	27 November 2006	N/A
	Newtownabbey Borough Council AQMA No. 2 Ballyclare, Main Street	28th January 2008 Nitrogen Dioxide	18 December 2012	
	Newtownabbey Borough Council AQMA No. 4 Sandyknowes			
	Antrim BC AQMA No. 1	October 2004 Sulphur Dioxide	31 January 2011	
Ards and North Down	Ards BC revocation order No1	1st March 2005 Particulate Matter	01 December 2007	N/A
Armagh Banbridge and Craigavon	**Armagh City, Banbridge and Craigavon Borough Council Air Quality Management Area**	1 February 2018 Nitrogen Dioxide	Still in operation	pending
	Armagh City and District Council Air Quality Management Area	14th January 2008 Nitrogen Dioxide	1 February 2018	Y
	Greenpark Terrace (Armagh)	1st December 2012 Nitrogen Dioxide		
	Bridge Street	23 January 2012 Nitrogen Dioxide	2014	N/A
	Flush Place			
Belfast	**M1-Westlink AQMA**	31st August 2004 Nitrogen Dioxide and Particulate Matter	1 September 2015 AQMA 1 revoked for Particulate Matter only	Y
	Cromac Street and Albertbridge Street AQMA	31st August 2004 Nitrogen Dioxide	Still in operation	
	Upper Newtownards Road AQMA			
	Ormeau Road AQMA			

Council Area	AQMA	Date and reason for Designation	Date Revoked	Action Plan?
Causeway Coast and Glens	**Dungiven**	1st December 2008 Nitrogen Dioxide	Still in operation	Action Plan Outstanding
	Glebeside Estate	1st September 2005 Particulate Matter	2010	N/A
Derry and Strabane	**AQMA No. 1 (Creggan Road)**	23 February 2005 Nitrogen Dioxide	Still in operation	Y
	AQMA No. 2 (Buncranna Rd)	22 December 2011 Nitrogen Dioxide		
	AQMA No. 3 (Dales Corner)			
	AQMA No. 4 (Spencers Rd)	7th February 2013 Nitrogen Dioxide		
	AQMA No. 4 (Strand Rd)			
	Strabane	30st June 2004 PM_{10}	Revoked 16th October 2018	
	Castlederg			
	Newtownstewart			
Fermanagh and Omagh	None			
Lisburn and Castlereagh	**Castlereagh**	31st January 2011 Nitrogen Dioxide	Still in operation	Y
Mid and East Antrim	**Ballykeel**	9th November 2003 Particulate Matter and Sulphur Dioxide	Still in operation	
	Linenhall Street	8th February 2010 for Nitrogen Dioxide		
	Dunclug	25th October 2004 Particulate Matter and Sulphur Dioxide	September 2011	N/A
	Carrickfergus	June 2004 Particulate Matter	2007	
	Greenisland	June 2004 Particulate Matter	2007	

Council Area	AQMA	Date and reason for Designation	Date Revoked	Action Plan?
Mid Ulster	**Magherafelt (Church Street)**	14th February 2012 Nitrogen Dioxide	Still in operation	None
	The Moy (Charlemount Street)	8th October 2012 Nitrogen Dioxide		Y
	Dungannon (Newell Road)			
	Stewartstown Road	8th October 2012 Nitrogen Dioxide	10th November 2014	N/A
	Church Street (Dungannon)	14th January 2008 Nitrogen Dioxide		
Newry Mourne and Down	**Newry (Canal Street)**	18th April 2013 Particulate Matter	Still in operation	None
	Newry (Urban Centre)	5th August 2009 Nitrogen Dioxide		Y
	Kilmorey Street	22 August 2006 Particulate Matter	5th August 2009	N/A
	Canal Street			
	Water Street			
	Bridge Street			
	St Marys Street			

6.4 Annual Air Quality Reports And Action Plans

Annual air quality reports and action plans are an essential part of the monitoring and review of air quality within a council area.

Councils are required to submit reports annually. Guidance on how to complete the report can be found on the DEFRA LAQM support pages.[158] The aim of the reports is to review local air quality monitoring results of the past year and assess whether these have exceeded the health-based air quality objectives set out in the Air Quality Strategy. This will in turn influence the scope of the AQMAs and/or Action Plans. The report covers ongoing and newly arisen issues in the area, past monitoring results, the scope of the AQMAs - past, current and potential for future AQMAs, as well as trends in results from both diffusion tubes and the Automatic Monitoring Stations. The report also looks at planning applications for future developments and assesses the potential impact they may have on the local air quality.

Both annual reports and Action Plans are submitted annually to the Report Submission Website, they are assigned to a member of the independent appraisal team, who prepare the appraisal report, which is then approved or rejected by the Department.

Action Plans are drafted by district councils upon the designation of AQMAs. Action Plans should contain proposals which will result in the achievement of the air quality standards and objectives. Councils are required to consult with the Department and also with Relevant Authorities (for example, DfI), as prescribed under the Environment Order, on the content of the plans and seek their agreement on the actions and the proposed timelines for their achievement. There is also an expectation on the councils to review the Action Plans in light of emerging monitoring trends; to reflect the achievement of the actions laid, alterations in timelines or include details of new proposals.

Action Plans aim to tackle issues surrounding the generation of pollutants listed in the Air Quality Strategy that exceed these limit values, and then lay out the steps the councils and Relevant Authorities aim to take to reduce these emissions or minimize their impacts. The overall objective of these Action Plans are that their proposed measures will lead to improved air quality in the designated area and the achievement of air quality standards.

The Action Plans currently in place can been seen in **Table 6-2**.

158 https://laqm.defra.gov.uk/review-and-assessment/review-and-assessment.html

6.5 Review Of Northern Ireland District Councils' Action Plans

Proposals throughout the Action Plans across the councils are fairly consistent. Issues are largely around vehicle emissions and how these can be mitigated or reduced by changing public travel patterns. Some of the common themes are noted below:

- Promoting awareness in the local community and schools of using sustainable modes of transport;
- Initiatives to promote/increase the use of public transport;
- Improvements in bus lanes;
- Increasing the bicycle network and number of bicycle stands;
- Replacing council diesel/petrol vehicles with electric and hybrid versions;
- Increasing and expanding existing park and ride facilities; and
- Improvements in road layouts to alleviate traffic congestion.

6.6 Deprivation, Air Quality and AQMAs

Northern Ireland Multiple Deprivation Measure (2017)[159] describes a metric used to classify the spatial distribution of deprivation or disadvantage in Northern Ireland.

The most deprived parts of Northern Ireland are concentrated in larger urban areas, i.e. Derry/ Londonderry and Belfast, extending to some parts of Greater Belfast[160]. Social housing is often fund in such urban areas, close to main arterial routes which pass in, out and around cities large towns. These areas are prone to high concentrations of PM_{10}, $PM_{2.5}$ and NO_2[161], pollutants derived primarily from road transport and solid fuel burning.

An example of this can be seen in **Figure 6-3**, which shows the locations of four Air Quality Management Areas in Belfast (all of which were declared for levels of NO_2), against the backdrop of census outputs areas, which are ranked from the least to the most deprived. The Air Quality Management Areas and air quality monitoring station in these regions are centred on the main arterial routes, which are seen to be located within areas of deprivation (shaded in blue on the map) and social housing.

The M1-Westlink corridor AQMA can be seen on the far left of the map. Predicted air pollution levels have been generated from national modelling outputs. These outputs, which have been prepared using the most recent emission factors available but which do not take into account

159 https://www.nisra.gov.uk/statistics/deprivation/northern-ireland-multiple-deprivation-measure-2017-nimdm2017
160 http://www.ninis2.nisra.gov.uk/InteractiveMaps/Deprivation/Deprivation%202017/SOA_Deprivation_Map/atlas.html
161 http://www.airqualityni.co.uk/news-and-reports/technical-reports

local-scale mitigation measures, suggest that compliance along the M1-Westlink corridor will not be achieved until 2022. Given that the health impacts of NO_2 are well known (see Background Chapter for further discussion), Action Plans for AQMAs need to consider the relationship between deprivation and poor air quality when drawing up mitigation measures, ensuring that resources are targeted at alleviating the pressures of air pollution on densely populated urban areas and areas close to city centres.

This is in line with one of the recommendations of the RCP report 'Every Breath We Take': 'Tackle inequality by prioritising actions in deprived areas' (**see Section 1.1**).

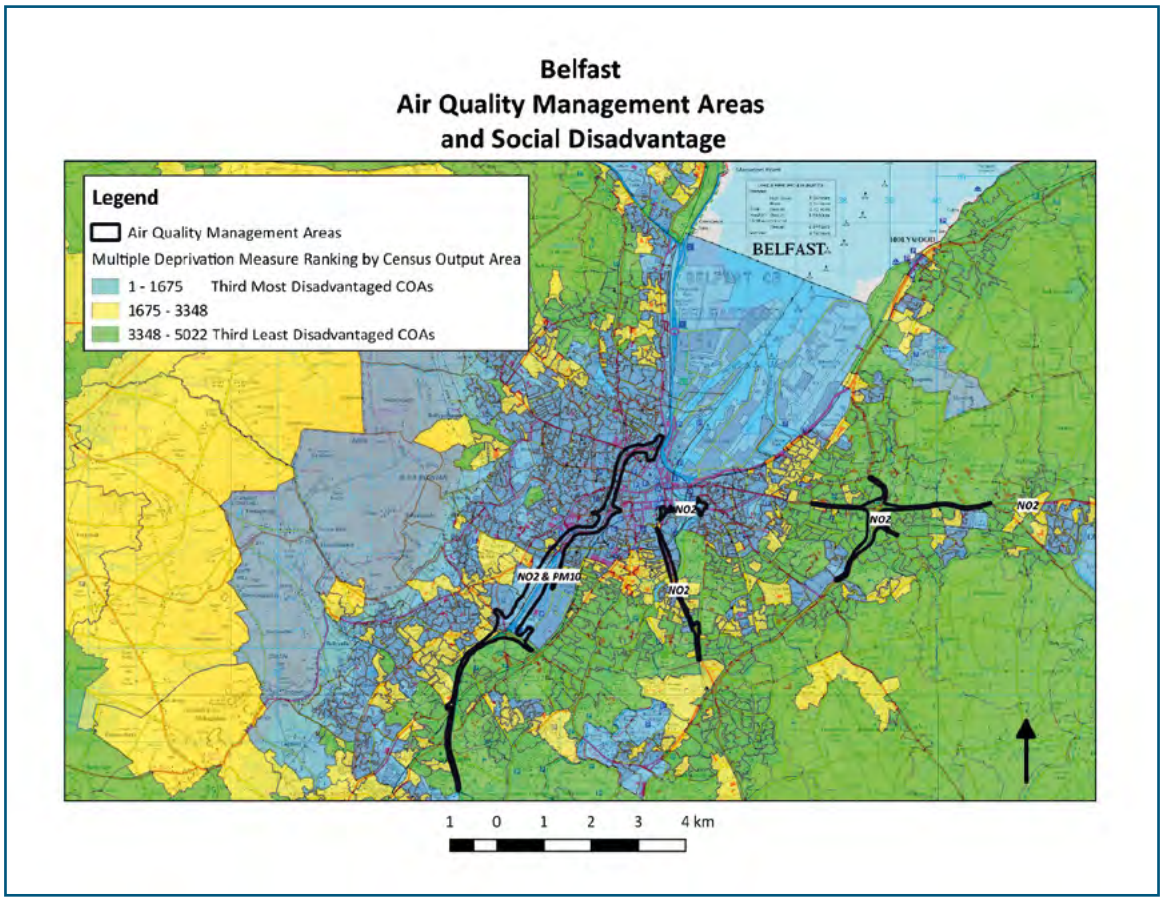


Figure 6-3 - AQMAs and classifications of deprivation, Greater Belfast

6.7 Planning and Air Quality

Planning functions fall under the Department for Infrastructure (DfI). This is split into:

- Strategic Planning, which covers applications deemed to have regional significance; and
- Planning Policy, which develops overarching planning legislation and policy.

Local government councils are responsible for local development planning.

Local Development Plans

Council local development plans comprising a Plan Strategy and Local Policies Plan, to provide the framework for developing lands in local council areas. They seek to facilitate sustainable development and growth whilst protecting environmental assets in the district. The new system is a plan led system so all planning decision must be made in accordance with the new plans unless there are other material considerations that indicate otherwise.

Strategic Planning Policy Statement for Northern Ireland

Guidance produced by DfI's Strategic Planning Policy Statement for Northern Ireland (SPPS)[162], supports the role of all planners in both central and local government. It sets out strategic subject planning policy for a wide range of planning matters with the aim of furthering sustainable development.

The SPPS recognises the importance of green infrastructure and its conservation and protection and its role in improving air quality (Annex A - Managing Noise and Improving Air Quality). It directs planning authorities to take air quality into consideration when proposing policies or managing development and how this can positively contribute to improving air quality, taking into account the existing and future air quality in the area, with regard to Air Quality Management Area (AQMA) Action Plans and also focuses on the provision of improved infrastructure that encourages walking, cycling and public transport.

Regional Development Strategy (RDS 2035)

The Regional Development Strategy[163] is a spatial strategy which commits to reducing our carbon footprint, facilitating mitigation and adapting to climate change whilst improving air quality. It recognises the health impacts of air pollution and considers the protection of AQMAs as one of a number of important mitigating measures.

162 https://www.planningni.gov.uk/index/policy/spps_28_september_2015-3.pdf
163 https://www.infrastructure-ni.gov.uk/sites/default/files/publications/infrastructure/regional-development-strategy-2035.pdf

Both the SPPS and the Regional Development Strategy support the work of the councils through the Local Air Quality Management (LAQM) process, by acknowledging the importance of AQMAs and the continued development of sustainable travel and a move away from car travel. With this in mind, the LAQM process needs to continue to evolve and become more focused on outcome-based targets to provide adequate support to both the policy and strategy and to make a more direct impact on the improvement of air quality in Northern Ireland.

Strategic Environmental Assessment (SEA)[164]

This derives from a Directive of the same name, which has the primary aim of a high level of protection of the environment and to contribute to the integration of environmental considerations into the preparation and adoption of plans and programmes with a view to promoting sustainable development. An SEA is only required where the plan or programme is deemed to have significant impact on the environment. After being screened in, a plan or programme is subject to a scoping stage, where environmental topics such as air quality are identified. An environmental report is prepared, that sets out baseline information and possible impacts of the plan or programme on the scoped-in topics (such as air quality). All stages are subject to consultation and public reporting. Monitoring and review of the significant environmental effects identified is required.

6.8 Changes To The LAQM Process

Diffusion tube and automatic monitoring station data from district council reports show that although there may appear to be some reduction in PM_{10} & NO_2 over the years, there is no sign of a consistent year-on-year decrease. Rather, the levels have continued to fluctuate with no sign of an overall downward trend emerging. In several cases, NO_2 levels have been increasing. Relationships between AQMAs, monitoring results and action plans do not demonstrate that the current management of air quality within the council areas is delivering the required or expected reductions in levels of air pollutants.

This is shown by the numbers of AQMAs declared and revoked since the introduction of the Air Quality Regulations (Northern Ireland) 2003. During this fifteen year period there have been 43 AQMA Orders put in place; of these, 24 have been revoked[165], nine have been in place for ten years or more and eight have been in place for five years or more. The longevity of the AQMAs demonstrates the lack of impact that LAQM Action Plans and monitoring programmes have had on improving the air quality within these areas.

164 https://www.daera-ni.gov.uk/topics/land-and-landscapes/strategic-environmental-assessment

165 Newry (Urban Centre) was created to encompass four existing AQMAs in the area, Canal Street was revoked for Particulate Matter in 2009, and in 2013 it was designated for Nitrogen Dioxide. Westlink AQMA was part revoked for Particulate Matter in 2015, the Nitrogen Dioxide part of the designation remains in place. In 2018 Armagh City, Banbridge and Craigavon BC extended their AQMA to encompass the entire council area.

As of May 2019 there were 19 AQMAs in place across Northern Ireland, with most of the designations being based on NO_2 exceedances. Without a significant reduction in the number of NO_2 AQMAs by 2021, there could be a risk to delivery of Outcome 2 of the NICS Outcomes Delivery Plan as assessed by the indicator on NO_2 concentrations across Northern Ireland.

Given this picture, the LAQM grants scheme will need to change to support councils in outcome-based approaches that have direct impacts on improving air quality.

Allocation of grant funding

DAERA proposes that the grant application process will change to allow Local Authorities and also non-governmental organisations or other similar bodies to bid for money to develop projects which demonstrate outcomes where the activities, supported by the grant money, will have a direct impact on the improvement of air quality in the region or location. These Projects could be designed to focus on tackling one or two sources of pollution or they may focus specifically on areas with exceedances. Projects would have the scope to have varying timeframes deemed reasonable for the proposed work programme. DEFRA, for example, have evaluation criteria, in the form of an online questionnaire, to assess applications for funding. It must be shown how projects:

- will deliver on improving air quality
- offer value for money
- fit with the local authority's air quality strategy
- will deliver objectives on time and on budget
- will measure outcomes
- will communicate project outcomes to stakeholders and the rest of the local authorities.

DAERA will take its lead from this format of evaluation to help the formal assessment of projects put forward by councils in Northern Ireland. Projects would be expected to be completed within 12 months. Projects recently funded by DEFRA can be seen on their Air Quality Grant Programme web page.[166] For comparison, details of the 2017/18 funding are shown in the table below:

166 https://www.gov.uk/government/collections/air-quality-grant-programme

Table 6-3 - Defra-funded air quality initiatives and projects

Local Authority	Project
Barnsley MBC (with Doncaster)	ECO-STARS bus and taxi fleet
Blaby District Council	Schools and SMEs behavioural change and action plan
Bradford Metropolitan District Council	Air quality feasibility study
Canterbury City Council	Awareness campaign in schools and community on transport and domestic burning stoves
Cheshire West and Chester	Local research on domestic stoves and health impacts
City of York Council (with Lancaster, Mid Devon)	Local authority officer knowledge sharing online platform
East Sussex (and various south coast councils)	Action plan for schools and businesses in AQMAs
Kirklees (Bradford, Calderdale, Wakefield)	Domestic/commercial awareness campaign and action plan
London Borough of Tower Hamlets	Community action plan and business engagement on emissions from industry and transport
Oxford City Council	Electric vehicle charging points, electric fleet, technical study
Portsmouth City Council	Communications package and cycling infrastructure
Reading Borough Council	Electric vehicle charging points, electric fleet, technical study
Spelthorne Borough Council (Surrey Air Alliance)	Communications package and cycling infrastructure
St Helens Council (and some nearby councils)	Air quality website for Liverpool residents
Staffordshire and Stoke on Trent (with Tamworth, Lichfield, South Staffordshire, Stafford, Cannock Chase, Newcastle-under-Lyme and The Moorlands)	Council partnership action plan, public and business engagement, business and school travel plans with annual monitoring, electric vehicle charging point and a clean air campaign.
Westminster City Council (Cross River Partnership and nearby boroughs)	Working with businesses across 5 boroughs to help reduce their emissions.

On 23 March 2018, DEFRA launched a £220 million pound Clean Air Fund to tackle roadside emissions. The fund was developed to support local authorities deliver plans to tackle air quality issues, after findings from the Air quality plan for nitrogen dioxide (NO_2) in UK (2017) outlined that councils with the worst levels of air pollution at busy road junctions and hotspots must take robust action in the shortest time possible.

In addition to this, DEFRA ran an implementation fund which local authorities can access to take action as soon as possible to improve air quality. Some of the actions supported are detailed below:

- £11.7 million to the 28 local authorities with the biggest air quality challenges to help carry out the work needed to develop air quality plans, including securing resource and expertise;

- £24.5 million to the same 28 local areas to support a range of measures to take action locally. Examples include installing electric charge point hubs in car parks; junction improvements; bus priority measures; building cycle routes; incentivising ultra-low emission taxis through licensing schemes and leasing electric vehicles; and traffic management and monitoring systems;
- £2.4 million from the 2017/18 Air Quality Grant for local community projects to tackle air quality at a grass roots level. This comes in addition to £3.7 million already awarded in last year's Air Quality Grant, which included an award winning project taken forward by Westminster City Council to provide advice and toolkits for small and medium businesses to reduce transport emissions from deliveries associated with their operations;
- £1.65 million to support the 33 local authorities that have been asked to conduct targeted feasibility studies to identify measures that could bring forward compliance dates within the shortest possible time.[167]

In Northern Ireland, Automatic Urban and Rural Network (AURN) sites - which are part of the official UK-wide monitoring network - will continue to be supported by central government, along with those district council monitoring sites that are used to inform the NICS Outcomes Delivery Plan air quality indicator.

Aside from this, more emphasis may be given to allocation of grant monies to support measures that improve air quality.

AQMAs

Councils could be encouraged to extend or combine existing AQMAs to form a single AQMA (or a Low Emissions Zone) encompassing the entire urban area. For example, the Greater Manchester Combined Authority (GMCA) has brought together all 10 district councils in the area to form a single regional AQMA[168], while here in Northern Ireland, in 2018, Armagh, Banbridge and Craigavon council extended their AQMA to encompass the entire council area.

The current approach with AQMAs is to focus on pollutant hotspots. However, emerging best practice suggests solutions to air pollution hotspots are more readily achieved by spreading the focus to wider urban areas; for example, traffic emissions at a particular junction are best considered in the context of wider urban infrastructure. This approach means that there is less risk of pollution simply shifting from the known hotspot to another location.

In addition, in tackling air pollution from road transport, it is important to remember that a high proportion of car journeys within urban areas may be less than one mile and often pass through more deprived neighbourhoods (see Chapter 2). With this in mind, councils should take account of the potential impact on areas of higher deprivation when prioritising funding for measures within their urban AQMAs.

167 https://www.gov.uk/government/news/260-million-of-clean-air-funding-launched-by-government
168 http://www.manchester.gov.uk/downloads/download/4166/air_quality_reports

A shift from localised AQMAs to wider urban LEZs could see the following:

- Expanded geographic coverage for improving and safeguarding air quality;
- Consideration of all aspects of air pollution within the area in question;
- Improved public communications on air quality;
- Unlike AQMAs, the impetus would not be to revoke the LEZ, but rather to keep it in place to continue to safeguard air quality. Instead, the goal would be to improve and then maintain the status of the LEZ.

Action plans

Action plans would need to be inclusive of the proposed project, therefore all current Action Plans should be revaluated by 30 April 2020. Councils could consider joining resources for region-wide initiatives and events, linking in with positive impacts on health, wellbeing & lifestyle enhancements.

Revised plans may be restructured by prioritising measures, with the primary emphasis on a standalone objective of the improvement of air quality, leading to the revocation of AQMAs. Action Plans should undergo substantial review every five years, with measures updates provided annually, with a summary of how the council intends to monitor and evaluate the plan against their intended achievements.

AQMAs

Q: Should AQMAs should be discontinued and replaced instead with Low Emissions Zones, which cover all aspects of air quality, including Smoke Control?

Q: Where applicable, should the entirety of urban districts should be declared as AQMAs (or Low Emissions Zones)?

Annual reports

Where previously each council participated in a three year cycle of Updating and Screening Assessment (USA) reports followed by two progress reports, the system will change to reflect that of the other Devolved Administrations with an Annual Status Report (ASR).

The new reporting date will be moved to 30th September. Once agreed, this new system could commence from September 2021.

Annual reports should set out:

- Assessment of local air quality according to monitoring results and against Air Quality Standards and EU objectives;

- Any new monitoring in place, or plans for new monitoring;
- Any projects undertaken in the previous year, or ongoing, by the district council, or others;
- Any improvement or deterioration in air quality;
- Any significant planning proposals or developments, which could have positive or negative impacts on local air quality;
- Details of AQMAs/Low Emissions Zones/Smoke Control Areas. Smoke Control information should include detail on complaints and enforcement undertaken;
- A Traffic Light Rating.

Traffic Light Rating

Councils would be encouraged to attach a traffic light rating to Low Emissions Zones. The Department would produce a colour-coded map of district councils in Northern Ireland. The Department would encourage councils to report as accurately as possible their own assessment, in order to:

- help obtain support to address air quality problems;
- aid the Department in prioritising air quality funding;
- aid councils in prioritising measures with co-benefits between air quality and, for example, sustainable transport or fuel poverty.

Examples of ratings are:

	1. Continuing exceedance of AQ objectives 2. Deteriorating air quality 3. Limited evidence of measures being undertaken to address air quality problems 4. Poor handling of Smoke Control
	5. Exceedance of AQ objectives 6. No improvement in air quality 7. Evidence of measures being undertaken to address air quality problems 8. Adequate handling of Smoke Control
	9. No exceedance of AQ objectives 10. Improvement in air quality 11. Evidence of measures in place to protect air quality 12. Good handling of Smoke Control

Action Plans could then be developed, and revised, based on the assessments contained in the Annual Status Reports.

Annual Reports

Q: What are your views on having a traffic-light system for councils to report on?

Monitoring locations

Monitoring locations will need to be kept under review and should be addressed as part of the annual report.

Table 6-4 - Proposed new requirements for LAQM in Northern Ireland

Item	Additional elements
1. Bidding for grant money	District councils or NGOs can bid for money - • either solely or • with another council • with other non-governmental organisations or other similar bodies.
2. Items permissible under grant funding	Primary focus will be on outcome-based projects which demonstrate potential for measurable improvements in air quality. Projects will be designed to focus on tackling one or two sources of pollution or they may focus specifically on areas with exceedances. Projects which lead to the revocation of AQMAs (or improvements in the RAG status of Low Emissions Zones) are particularly encouraged. Affiliate AURN and monitoring sites associated with the NICS Outcomes Delivery Plan indicator on air quality are still eligible for funding.
3. Allocation of grant money	Non-AURN sites, diffusion tubes and salaries previously supported by the grant process may still be eligible for funding only if they demonstrate that they are directly linked to the improvement of air quality in the region
New requirements for AQMAs	
4. Merging or extending AQMA's to cover the urban area	AQMAs should be replaced with LEZs and extended to the entirety of urban areas, incorporating all sources of pollution.
New requirements for Action Plans	
5. Linking grant funded projects to Action plans	Grant-funded projects to improve air quality must be a primary objective on the Action Plan.
6. Revision of Action Plans	Current Action Plans should be fully revised by 30 April 2020 and every 5 years thereafter. Updates on actions and progress to be submitted by 30th March on an annual basis (to tie in with end of Financial Year/LAQM Final Claims). Action Plan objectives should be prioritised by outcome, i.e. the objectives with the most impact should be the primary focus. All Action Plans must have the primary objective of the improvement of air quality leading to the revocation of AQMAs.

	New requirements for Progress Reports
7. Linkages between grant funded activities, Progress Reports and Action Plans	Annual Status Reports must contain a section that demonstrates relatable links between grant funded projects, AQMAs/LEZs, monitoring results and Action Plans.
8. Smoke Control Areas (SCA)	Inclusion of a dedicated section on Smoke Control Areas (SCAs) to cover: SCA maps, numbers of complaints and enforcement details and any linkages to increases in air pollution levels. Problem areas and actions to tackle these need to be included in the Action Plan as an objective.
9. Review of monitoring locations	Locations should be constantly under review and district councils should be open to relocating them based on monitoring results and current guidance. Details on any review and relocation should be included.

LAQM

Q: What are your views on the proposals to change the LAQM process, in particular to grant funding for outcome-based measures as opposed to monitoring?

Q: Are there any further measures you would suggest to help achieve a significant reduction or revocation of all AQMAs by 2021?

An example of how this revised process could function is as follows:

Council X has existing Smoke Control Areas and transport-related AQMAs

The entire Council or urban area is declared as a Low Emissions Zone (LEZ)

The Council, in conjunction with e.g. DfI, prepares an Annual Status Report, with a Status Rating for the LEZ within its district (or for the whole district if this is declared an LEZ)

The Council (or government department) develops an Action Plan for the LEZ, to improve air quality. The Action Plan is drawn from the ASR

Councils, NGOs and other bodies - using the information in the ASR and with reference to Action Plans - may submit bids to the Department to fund outcome-based measures that will improve the status of the LEZ

LEZs remain in place and their status is monitored. The aim is to bring improvements to the status of all LEZs and/or maintain good levels of air quality.

Chapter 7 - Communication

This chapter covers aspects of information and communication in relation to air quality in Northern Ireland, including government commitments to improve air quality.

Public Health England's 'Review of interventions to improve outdoor air quality and public health', examines 'behaviour change' as one of five key policy areas.[169] It notes that awareness campaigns such as participation in 'Clean Air Day', can be effective. It also highlights that providing information and advice to businesses and the public explaining how people can minimise their contribution to air pollution can prove to be effective.

This chapter examines how social media and awareness campaigns are now moving forward in Northern Ireland in this area.

7.1 Northern Ireland Programme for Government

In the absence of an Executive, the Northern Ireland Civil Service has developed an Outcomes Delivery Plan to ensure the business of government is discharged as effectively as possible and in a coordinated manner.

The Plan's staring point is the framework of 12 outcomes that was developed by the previous Executive, consulted on and refined during 2016-17. The framework reflects population conditions in 12 key areas of economic and societal wellbeing that people said matter most to them. Taken together, these outcomes provide a direction for the work of departments which fully reflects and respects the strategic direction set by the former Executive, has wide political support and is welcomed by people in every sector - public, private and voluntary.

The outcomes go beyond merely fulfilling statutory obligations and will in future be able to target those things that make real improvements to the quality of life for the citizen. The outcomes are supported by 49 indicators which provide a basis for measuring change.

Outcome 2: 'We live and work sustainably, protecting the environment', has particular relevance for DAERA.

One of the indicators that underpins Outcome 2 is an air quality indicator: 'Levels of nitrogen dioxide in Northern Ireland'. Nitrogen dioxide has been chosen as the pollutant on which to base this indicator as nitrogen dioxide is the pollutant causing most air pollution issues here at present, featuring as the reason for declaring Air Quality Management Areas in a majority of cases, as well as an exceedance of EU limit values. Nitrogen dioxide pollution in urban centres is chiefly as a result of road traffic emissions (**see Chapter 2**).

169 Public Health England, *Review of interventions to Improve Outdoor Air Quality and Public Health*: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/795185/Review_of_interventions_to_improve_air_quality.pdf, 12.

Ten monitoring sites in Northern Ireland have been chosen on which to base this indicator. These sites were selected according to the robustness of their data record and the reliability of the site in the longer term.

The ten sites are listed below:

1. Belfast Stockmans Lane
2. Belfast Newtownards Road
3. Belfast Westlink Roden St
4. Derry Dales Corner
5. Newtownabbey Antrim Road
6. North Down Holywood
7. Castlereagh Dundonald
8. Armagh Lonsdale Road
9. Downpatrick Roadside

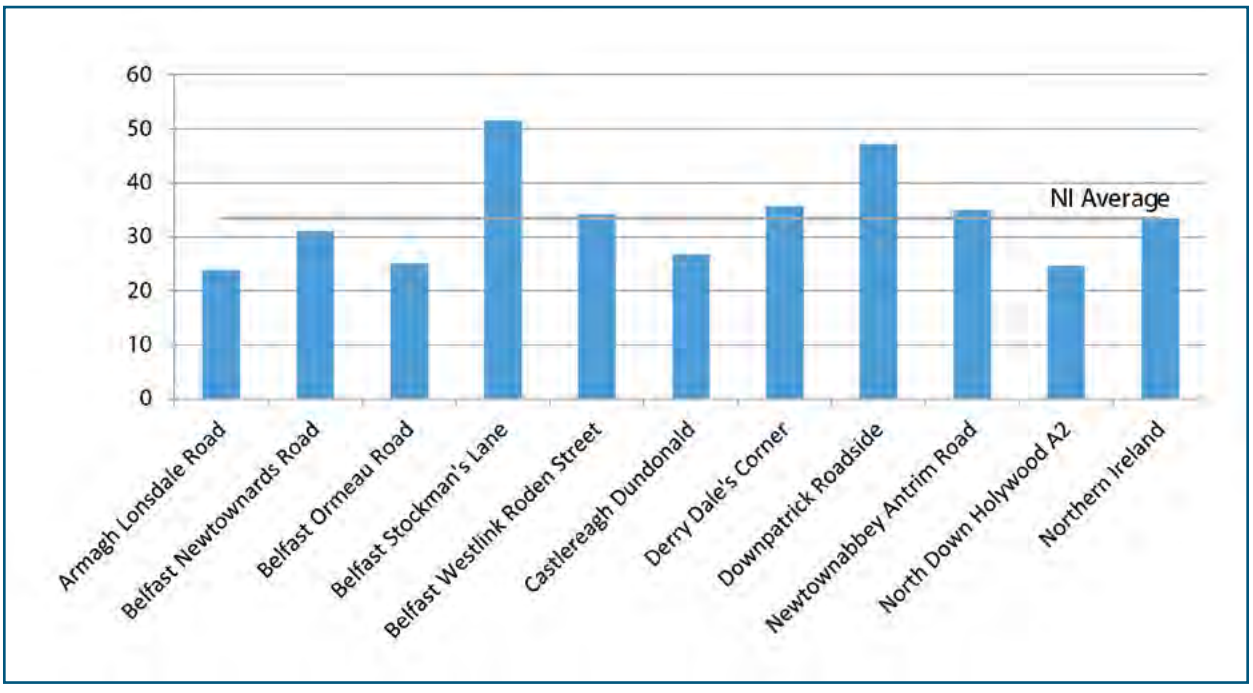


Fig 7-1 - annual average level of NO_2 monitored at ten sites, 2017

Figure 7-1 shows exceedances at individual monitoring locations, which do not show up in the average annual mean graph.

Three urban traffic-related sites exceeded the objective for annual mean NO_2 in 2017: Belfast Stockman's Lane, Downpatrick and Dungiven (the Dungiven value is given by extrapolation, because of low data-capture at this site in 2017).

The Stockman's Lane site falls within the Belfast Metropolitan Urban Area reporting zone. This zone has been identified to the EU Commission as having air quality which breaches the objective for NO_2 as set out in the Air Quality Directive (**see Chapter 2**).

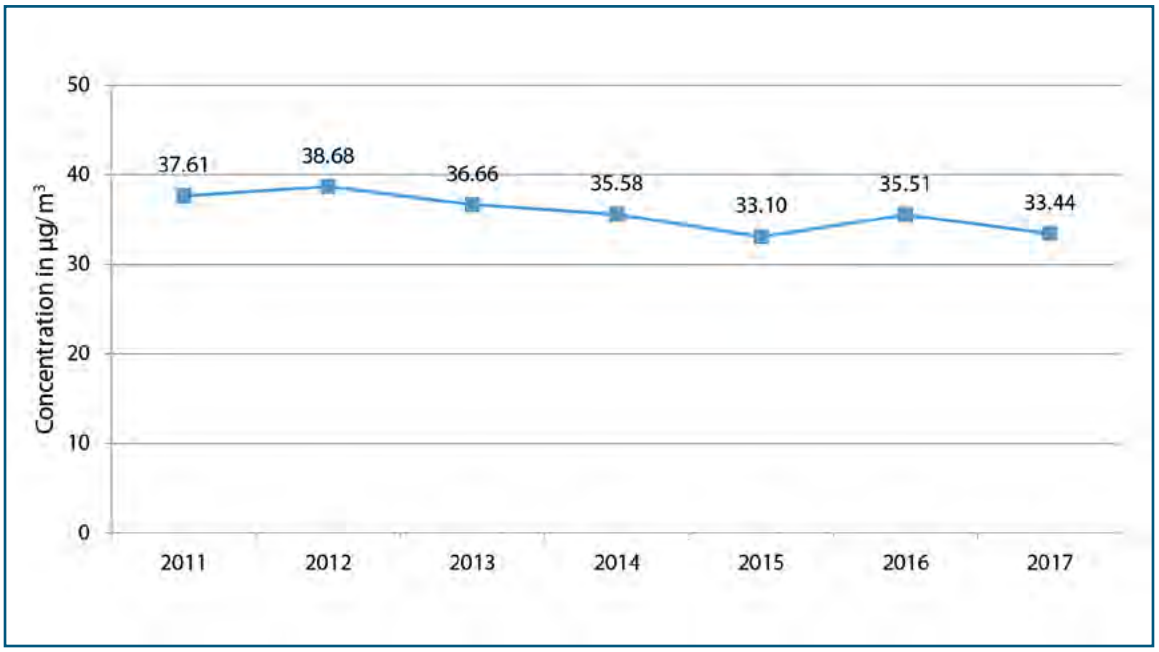


Fig 7-2 - 10 sites average of annual mean NO_2, 2011-2017

Values at the ten sites have been averaged for the years 2011 to 2017 and are detailed in the above graph (**Figure 7-2**).

There is a slight downward trend evident in the 10-site-average values over the time series. However, it is worth bearing in mind that roadside pollutant levels are also affected by weather conditions, which vary from one year to the next, and by local traffic conditions which may also be subject to changes. In general, as measures start to come on stream, then the average concentrations are expected to decline further. Details of measures can be found in **Chapter 2**.

The key actors involved in delivering improvements in air quality that will be reflected in this indicator are shown in **Table 7-1**.

Table 7-1 Delivery Plan for air quality

Key Partner	Their Role
DAERA	- Deliver air quality policy and legislation - Fund Local Air Quality Management scheme (which allows councils to review and assess air quality in their districts) - Oversee councils' Air Quality action planning process - Develop, with DfI and councils, Action Plans in respect of breaches of Air Quality Directive.
DfI	- Road infrastructure projects: • Bypasses and road schemes to improve journey times. • Traffic management schemes to reduce congestion. • Introduction of Microprocessor Optimised Vehicle Actuation (MOVA) at selected traffic signal junctions to assist traffic movement and reduce air pollution from stationary vehicles. - Sustainable transport measures: • Cycle only links in Belfast City Centre and cycle lanes in towns • Park & Ride schemes • Electric vehicle charging infrastructure • Public transport schemes (such as Belfast Rapid Transit ('Glider'), Belfast Transport Hub) • Application of transport planning practices to assess travel options and to develop and promote realistic sustainable alternatives to private car use. Measures relating to sustainable planning: • Promote and encourage the implementation of Strategic Planning policy and guidance on air quality through: • Governance and oversight of planning system • Consideration of regionally significant applications
District councils	- Assessment of air quality through the Local Air Quality Management scheme - Drawing up Action Plans to deal with air quality problems - Working with DfI to reduce road traffic and ease congestion in urban centres - Incorporation of air quality considerations into Community Planning, Local Development Planning and the determination of individual planning applications.

7.2 Air Quality Forum

DAERA has committed to setting up an Air Quality Forum, which is intended to, among other things, oversee measures associated with improving the air quality indicator, as well as to discuss any reforms coming from this review of air quality policy. Based on the outcomes of the Innovation Lab work (see below), we feel that the Forum would also be the ideal place to discuss, with stakeholders, the more effective communication of air quality impacts and the role that individuals can play in reducing air pollutant emissions.

The Forum will also serve to act as a focus between government departments, district councils and other stakeholders.

Air Quality Forum

Q: Do you have any suggestions for the membership of the Air Quality Forum?

7.3 Social Media

It is recognised that social media, given it capacity for public engagement, increasingly has a part to play in communicating issues and helping to promote behaviour change.[170] [171]

Given this, it is clear that NI central and local government should be aiming to engage more with the public through social media platforms. DAERA, along with Department of Health, other departments and public sector bodies have been engaging in a project, called MyNI, to explore this.

MyNI is a digital stakeholder engagement tool that uses a suite of social media channels, supported by a website. These channels and the site are using engaging content, digital marketing tools and techniques that are all designed to appeal to people in Northern Ireland with different needs and interests.

The purpose of MyNI is to pro-actively make people simultaneously aware of multiple Government and other trusted information and services that will influence a positive behavioural change that would make people better off and also contribute to NICS Outcomes Delivery Plan (Programme for Government) outcomes.

An example of this would be when MyNI uses its social media feeds to make people aware of and interested in using an interactive map of household recycling centres. By clicking on the map, users will see where their nearest centre is and the variety of household waste that that centre will take for recycling. Additional content, relating to air quality and greenhouse gas emissions, will motivate these users to sort and take their waste to that centre.

170 Luo, J. S., & Smith, B. N., "Behavior Change Communication Using Social Media: A Review" in S*ocial Media Mental Health Practice in a Digital World,* Springer, 2015, 183-197.
171 Adewuyi, E.O. & Adefemi, K., Behaviour Change Communication Using Social Media: A Review, T*he International Journal of Communication and Health,* 2016(9), 109-116.

To date, MyNI campaign activity has been led mostly by DAERA. Over the coming months, DAERA will collaborate with other Government Departments and trusted providers of information and services. Together they will plan and implement a cross-cutting campaign that will contribute to 2020 Year of Climate Action (YOCA), leading to COP26. This campaign will integrate Clean Air Strategy messages and calls-to-action.

YOCA and COP26 provide timely, high-profile platforms for people to focus on. At the same time, they share the goals of Outcome 2: We live and work sustainably - Protecting the Environment.

MyNI is available to access now:

https://www.facebook.com/MyNILife/

https://twitter.com/MyNILife

https://www.instagram.com/mynilife/

7.4 NI Innovation Lab Exercise

Established in 2014, the Department of Finance's Innovation Lab responds to challenges where effective service provision for the public has proved most difficult. It aims to improve public services by creating new and ground-breaking innovations through transformation and invention.

DAERA has engaged the services of the Innovation Lab in the preparation of this Strategy - specifically with a view to examining Information and Communication Aspects of the air quality problems that we face. A Stakeholder Workshop was facilitated by Innovation Lab in October 2017 at Crawfordsburn Country Park, with representatives from central and local government as well as NGOs.

Figure 7-3 shows a System Dynamics modelling output that feedback from the workshop was used to inform. The modelling output shows the complex inter-connectedness of topics, causes, effects and potential solutions which become apparent when considering, in this case, air pollution from road transport.

Preliminary feedback from the stakeholder workshop was used to feed into FusionFest. FusionFest is an annual social innovation festival which was held in Londonderry/Derry and Belfast on 19th and 20th October 2017 respectively.

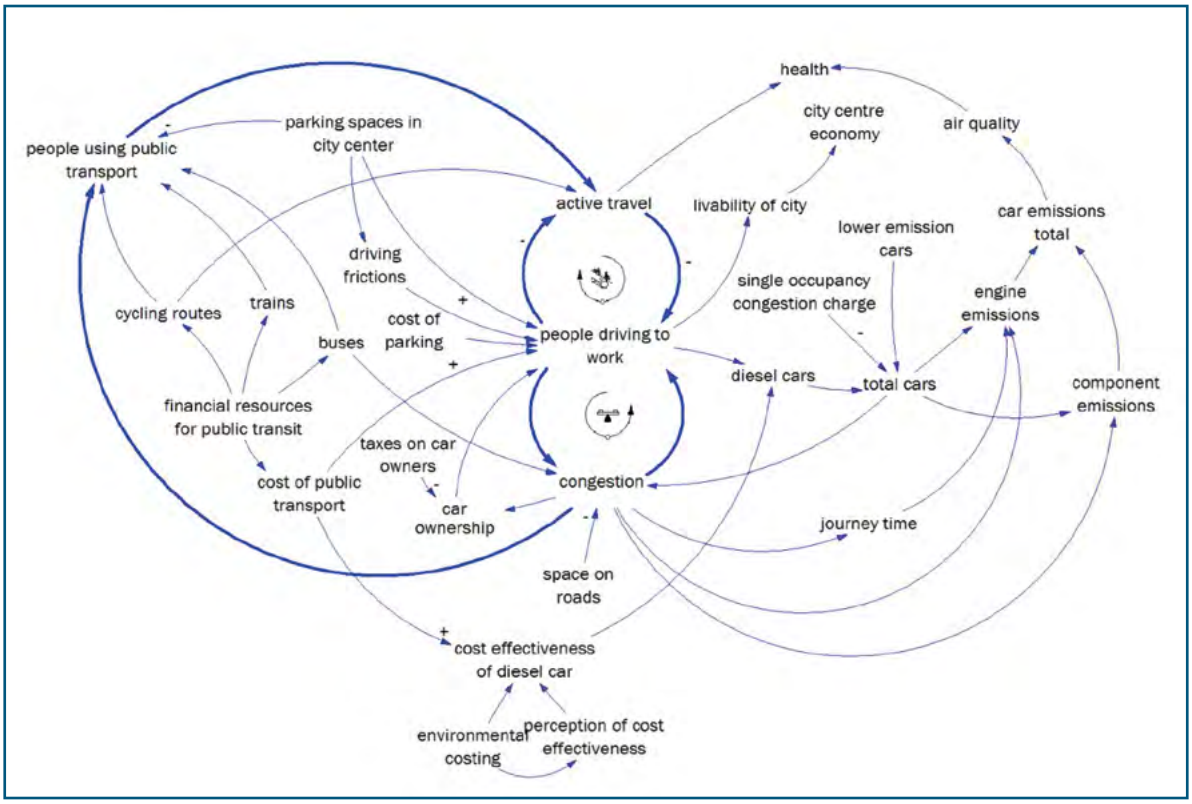


Fig 7-3 Systems Dynamics modelling of issues identified (feedback from stakeholders taking part in discussion exercise on road transport)

The Lab held a session at each in order to provide an opportunity for engagement on the issue of shaping the policy environment, and chose the Air Quality issue as the project of its focus.

In Derry/Londonderry the resounding message was that of the need for better engagement with the public by way of new and improved approaches to consultation. The group viewed air quality as a significant issue and one that the public would readily be more engaged in commenting on (and then addressing on an individual level) if they were to be made aware of the strategy. They viewed the existing communication by government website and generic stakeholder engagement as being limited, and with the perception that this may be deliberately so. Fuel poverty was a second prevalent area of discussion, with the group noting that those individuals living in more socially deprived areas do not have the resources to fund home heating that is less damaging to the environment.

Conclusions from Innovation Lab Work

While transport issues are clearly a leading cause of poor air quality, the group model building workshop elicited a latent structure underpinning transportation issues. The core recommendations from a systems perspective are as follows, and should be viewed as a linked set:

1. Regional development strategy:

- Housing policy: focus on policy and legislation around new build and retrofitting housing to tackle emissions from housing. Vitally, line up this policy with an analysis of the relative merits of gentrification initiatives versus supporting a semi-rural culture.
- Flexible working policies. Work with DfE to incentivize working from different locations in a way that is aligned with housing and regional development strategies.

  The recommendation is to take active travel and transport issues into consideration only in this joint context of housing and work patterns. Evidently this pertains to all activities in work and life, such as accessing public services, designing shopping centres etc.

2. Specificity of messaging:

- Focus on messaging and communications which are relevant to local people, and which relate to local data and lifestyles. This message came out strongly in the FusionFest activities with the public and in the context of how consultations should be run.

  In addition, the report produced by the Innovation Lab notes that:

  - Air quality itself may not be a sufficient lever to promote behaviour change. To promote behaviour change, it is sometimes necessary to look at what the best lever is, for example, financial considerations;
  - Air quality is often an invisible problem, and we need ways in which to make long-term impacts meaningful in the present;
  - This is particularly relevant in the case of health impacts, which are often long-term, e.g. decrease in life expectancy;
  - A major concern is that the public is not cognisant of the extent to which air quality is impacting on the life of the individual.

As a result of these findings, DAERA proposes to:

- Make communication and awareness of air quality impacts and individuals' role in reducing air pollution one of the key Terms of Reference for the Air Quality Forum;

- Develop a communications programme around air quality, with the aim of making the public more aware of the impacts of air pollution at a local level as well as the actions they can take at an individual level to reduce their contribution to air pollution;

- Work with other government departments to make them aware of the conclusions reached on Housing Policy and to communicate the message of Flexible Working and its benefits to the wider stakeholder group.

Communications

Q: Is increasing awareness of air quality impacts at a local level is the best way of promoting behaviour change by individuals to reduce air pollution?

7.5 Tracking Progress

Since air pollutant levels are subject to prevailing weather conditions, average annual concentrations may vary from year to year. This is why it is important to consider long-term trends in air pollution. Public Health England's analysis of air quality interventions notes that, 'It is better to reduce air pollution at source than to mitigate the consequences.'[172]

Measurements of air pollutants will of course be paramount to monitoring the delivery of measures resulting from revised air quality policy in Northern Ireland; however, given the preceding AQEG comments, it is important to bear in mind that other metrics will need to be used.

Communications

Q: Do you have any further comments or suggestions on how the impacts of policy interventions can be tracked in Northern Ireland?

172 Public Health England, *Review of Interventions,* 9.

Appendix 1 Consultation Questions

Chapter 1 - Sources and Effects of Air Pollution

1. Should there be legally binding targets for particulate matter, which are based on WHO guidelines?
2. Should all automatic monitoring sites measure at least NO_x and PM?
3. Should the current urban air quality monitoring network be expanded?
4. Should a targeted approach to exposure, based on population, be used to expand the current monitoring network?
5. What are your views on using a population figure of 10,000 as a threshold that triggers the requirement to monitor air quality?
6. Should biomass heating be discouraged in urban areas or in areas with poor air quality?
7. Should the connectivity between air quality and noise issues be improved through requiring consideration of each in Noise and Air Quality Action Plans?
8: Given that air pollution, carbon emissions, and noise often share the same sources, what are your views on including noise and carbon emissions as a consideration in Low Emissions Zones?

Chapter 2 - Transport Emissions

9: Are there any potential measures not included here that you believe could help encourage a shift away from private car use to walking, cycling, and public transport?

10: What would encourage you to consider buying an electric vehicle as your next car?

11: Do you think that DAERA should develop a Low Emissions Zone Framework for dealing specifically with transport emissions in Northern Ireland?

Or

Would you be in favour of Low Emissions Zones for urban areas also covering other sources of pollution, for example those from household heating?

12: What are your views on vehicle charging cordons for entry to the most polluted parts of urban areas in Northern Ireland?

Chapter 3 - Household Emissions

13: Should urban areas, in their entirety, be designated as Smoke Control Areas?

14: Should the law should be changed so that non-smokeless fuels may not under any circumstances be sold in Smoke Control Areas?

15: Should government ban the sale to the general public of smoky/bituminous/household coal in Northern Ireland?

16: Should government ban the import, into Northern Ireland, of high-sulphur coal?

17: Should government ban the sale to the general public of unseasoned wood in Northern Ireland at retail outlets?

18: Are there any further things you think that central and local government could be doing to address air pollution from burning solid fuels?

Chapter 4 - Agricultural Emissions

19: Do you think that the process in place to address ammonia emissions in Northern Ireland is appropriate?

Chapter 5 - Industrial Emissions

20: Are there any industrial sectors or air pollutants that require new or further investigation?

Chapter 6 - Local Air Quality Management

21: Should councils more widely adopt low-cost air quality monitoring systems, for screening purposes?

22: Should AQMAs should be discontinued and replaced instead with Low Emissions Zones, which cover all aspects of air quality, including Smoke Control?

23: Where applicable, should the entirety of urban districts should be declared as AQMAs (or Low Emissions Zones)?

24: What are your views on having a traffic-light system for councils to report on?

25: What are your views on the proposals to change the LAQM process, in particular to grant funding for outcome-based measures as opposed to monitoring?

26: Are there any further measures you would suggest to help achieve a significant reduction or revocation of all AQMAs by 2021?

Chapter 7 - Communication

27: Do you have any suggestions for the membership of the Air Quality Forum?

28: Is increasing awareness of air quality impacts at a local level is the best way of promoting behaviour change by individuals to reduce air pollution?

29: Do you have any further comments or suggestions on how the impacts of policy interventions can be tracked in Northern Ireland.

Appendix 2 Consultation Abbreviations

μgm^{-3}	Micrograms per cubic meter (unit of concentration for air pollutants)
APIS	Air Pollution Information System
AQMA	Air Quality Management Area
ASSI	Area of Specific Scientific Interest
AURN	Automatic Urban and Rural Network
B[a]P	Benzo[a]pyrene - a polycyclic aromatic hydrocarbon (PAH)
BAT	Best Available Techniques
BC	Black Carbon
CAFÉ Directive	Cleaner Air for Europe Directive 2008/50/EC
CAZ	Clean Air Zone
CHIPS	Cycle Highway Innovation for Smarter People Transport and Spatial Planning (SusTrans Project)
CHS	Continuous Household Survey
CO	Carbon monoxide
COMEAP	Committee on the Medical Effects of Air Pollution
DAERA	Department of Agriculture Environment and Rural Affairs NI
DAQI	Daily Air Quality Index
DECC	Department for Energy and Climate Change (London) - now BEIS
Defra	Department for Environment Food and Rural Affairs (London)
DfI	Department for Infrastructure
EMIND	
E-PRTR	e- Pollutant Release and Transfer Register
HDV	Heavy Diesel Vehicle
HRAPIE	Health Risks of Air Pollution in Europe survey
IED	Industrial Emissions Directive 2010/75/EU
IPPC	Industrial Pollution Prevention and Control
LAQM	Local Air Quality Management
LAQM PG NI 09	Local Air Quality Management NI Policy Guidance
LAQM TG 16	Local Air Quality Management Technical Guidance
LCP	Large Combustion Plant
LGV	Light Goods Vehicle
MCP	Medium Combustion Plant

NECD/NEC Directive	National Emissions Ceilings Directive 2016/2284
NH_3	Ammonia
NICS	Northern Ireland Civil Service
NIEA	Northern Ireland Environment Agency
NISEP	Northern Ireland Sustainable Energy Programme
NISRA	Northern Ireland Statistics and Research Agency
NMVOC	Non-methane volatile organic compound
NO_2	Nitrogen dioxide
NO_x	Nitrogen oxides
NSMC	North-South Ministerial Council
O_3	Ozone
OLEV	Office for Low Emissions Vehicles
PAHs	Polycyclic aromatic hydrocarbons
Pb	Lead (metal)
PCM	Pollution Climate Model
PfG	Programme for Government
PM	Particulate matter
PM_{10}	Particulate matter with a diameter of less than 10 microns
$PM_{2.5}$	Particulate matter with a diameter of less than 2.5 microns
PPC	Pollution Prevention and Control
RCP	Royal College of Physicians
RDS	Rural Development Strategy
REVIHAAP	Review of Evidence on Health Aspects of Air Pollution
SAC	Special Area of Conservation
SCA	Smoke Control Area
SO_2	Sulphur dioxide
SPPS	Strategic Planning Policy Statement
UK AQS	UK Air Quality Strategy
ULEV	Ultra Low Emissions Vehicle
UNECE	United Nations Economic Commission for Europe
VOC	Volatile Organic Compound
VSL	Value of Statistical Life
WHO	World Health Organisation

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