Roinn Cumarsáide, Gníomhaithe
ar son na hAeráide & Comhshaoi
Department of Communications,
Climate Action & Environment

Cleaning Our Air

Public Consultation to inform the development of a National Clean Air Strategy

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1 Introduction

The air that we breathe has significant impacts on our health and well-being. Clean air is, therefore, vital for public health. Significant progress has been made in cleaning our air in recent decades with, for example, the introduction of the 'smoky' coal ban in Dublin more than 25 years ago (and its subsequent extension) and the implementation more generally of European Union (EU) legislation. However, more needs to be done to improve our air quality which is still responsible for significant public health impacts and environmental damage. Air pollution arises from a range of sources across the economy, including home heating, transport, energy and agriculture. In addition, developments in other areas of Government policy can have a negative impact on air quality if not appropriately managed. For example, tax breaks that incentivise diesel vehicles, or schemes to promote biomass for heating need to be carefully formulated so as to avoid unintended negative impacts on air quality and public health.

It is in this context that the Department of Communications, Climate Action and Environment (DCCAE) is developing a national Clean Air Strategy with the aim of promoting clean air policies to enhance and protect the quality of the air we breathe. The Clean Air Strategy will provide the strategic policy framework necessary to identify and promote the integrated measures across government policy that are required to reduce air pollution and promote cleaner air while delivering on wider national objectives.

Given a number of recent developments, including (i) the improved scientific understanding of the health and environment damage caused by air pollution, (ii) the revised World Health Organisation estimates of air pollution's public health impacts, and (iii) the recently finalised EU Clean Air Package legislation, it is timely to issue this consultation paper to inform the development of a national clean air strategy in order to address the challenges and impacts of air pollution.

The issue of indoor air quality is increasingly recognised as an important aspect of exposure to air pollution because typically as much as 90% of our time is spent indoors. For some pollutants, such as those from solid fuel burning, outdoor air quality can be strongly linked to indoor air quality. However, there are many other sources of indoor air pollution such as gases released from new furniture or paints, or a person's living habits, for example, smoking or cooking that can contribute to indoor air pollution but which are beyond the scope of environment policy.

1.1 About this consultation.

This consultation document provides a background to the national, EU and international approaches to improving air quality. It seeks to set out the main sectoral issues in relation to air quality which are of relevance, and for which further actions could be considered in a national clean air strategy. The main issues are identified, based on the overall importance of the emission sources, the consequential public exposure to air pollution, and the resulting health and environment impacts.

The document is structured by sector to address the relevant issues where they arise in an accessible, but comprehensive way. It is designed so as to be inclusive to all, and allow stakeholders to be selective in their responses, choosing to address the issues that affect, or are of relevance to

them. It is hoped that a wide range of stakeholders will make submissions, from the general public that may have an interest in, or have been affected by air pollution issues, to the various interest groups or enforcement bodies, to academics or others who may be expert in the area.

The consultation document is set out as follows:

Chapter 2 provides a background to air pollution, health and environment impacts;
Chapter 3 sets out relevant policy and legislation at national, EU and international levels;
Chapter 4 outlines the sectoral issues and challenges addressing emissions from residential (4.2), transport (4.3), agriculture (4.4), energy (4.5) and industry (4.6);
Chapter 5 details the air quality monitoring, modelling and forecasting arrangements in Ireland;
Chapter 6 summarises the current state of air quality research in Ireland;
Chapter 7 addresses the issues of communication and awareness in relation to air quality;
Chapter 8 sets out the timeline for development of the National Clean Air Strategy.

To facilitate a structured response, a number of questions are set out at the end of each chapter, which range from the general to the specific. However, it is not intended that each respondent should answer every, or even some of the questions. Respondents can choose how they respond, and may choose to respond to particular questions relevant to them, or to respond on the issues of concern without addressing the questions. All submissions are welcome and will be considered in developing the national Clean Air Strategy. The document is open for consultation until the **28th of April 2017**.

Please submit your comments by e-mail or in writing to:

E-mail: cleanair@dccae.gov.ie

Postal submissions:
Clean Air Strategy Consultation
Department of Communications, Climate Action and Environment
Air Quality and Radiation Policy Section
Newtown Road
Wexford
Ireland
Y35 AP90

Please note that submissions may be published on our website and subject to Freedom of Information. Confidential or commercially sensitive submissions should be clearly marked as such, as the Department may publish non-confidential responses to this consultation.

2 Background

Good quality clean air is fundamental to people's health and quality of life, and is essential for a good environment. Protection of the atmosphere is, therefore, a key issue for Ireland. People have little choice but to breathe the air around them, so exposure to air pollution, in contrast to other forms of pollution, cannot be significantly reduced by an individual's practical choices and so is best tackled by effective policy interventions.

Our atmosphere is a shared global resource, and concerted action is required at national, regional and local levels as well as at EU and international levels, to effectively tackle air pollution and safeguard and enhance our vital clean air resource. There are a range of air pollutants from different sectors to which we are being exposed. The key pollutants are highlighted in the infographic below and they are explained in more detail in the glossary section of this document. The Environmental Protection Agency's *Air Quality in Ireland* annual reports also provide more detail on the types and levels of air pollutants being monitoring in Ireland.[3]

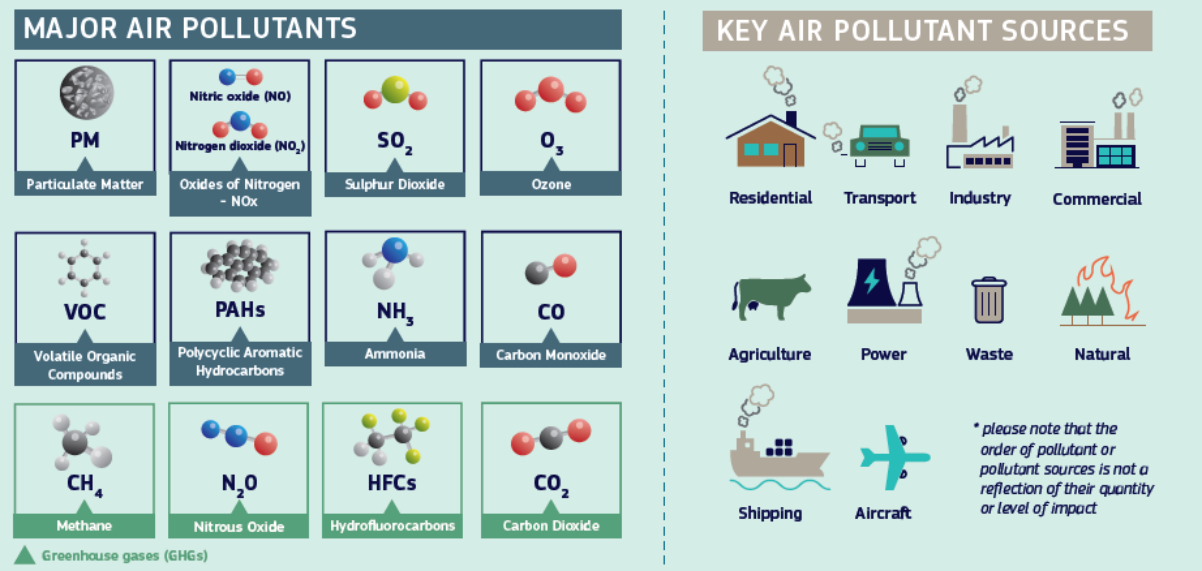

Figure 1: Air Pollution in Ireland infographic (Source: EPA/DCCAE)

The EU 7th Environment Action Programme[4] sets out the main EU actions to reduce environmental harm in the period to 2020 and beyond. The Programme aims to ensure that by 2020 outdoor air quality in the EU will have significantly improved, and moved towards the World Health Organisation (WHO) recommended levels, and that indoor air quality will also improve, in line with the relevant WHO guidelines. The WHO guidelines are based on the best available scientific evidence and understanding of the numerous pathways by which air pollution can damage health. For some pollutants, they are significantly lower than the current legally binding standards set out in EU legislation. However, there is evidence also that for some pollutants, for example, fine particulate matter ($PM_{2.5}$), there is no lower limit at which adverse health impacts do not occur, meaning that air pollution is harmful even at very low levels.

There has been a substantial accumulation of new scientific evidence in recent years on the health effects of air pollution and the associated economic impacts. The WHO have classified air pollution

in general, and particulate matter in particular, as carcinogenic to humans[5,6]. The new and emerging evidence clearly indicates that air pollution impacts are significantly larger than previously estimated. Clean air policy has, in the past, focussed on more visible forms of pollution like 'black' smoke, for example, from coal burning, which has been addressed with some success by policy interventions like the smoky coal ban where it applies. In some ways, clean air policies have been a victim of their own success as for a time air pollution was viewed as a 'solved' problem in Ireland with the policy focus shifting to other issues.

However, new evidence is now showing that invisible forms of pollution like fine particulate matter including black carbon and nitrogen oxides (NO_x) which are less evident to the public are at least as harmful, and perhaps more harmful, than more visible forms of air pollution. The recent Dieselgate emissions scandal regarding 'cheat devices' in diesel vehicles highlights how the public can unwittingly contribute to increased air pollution; and in so doing, be exposed to the damaging effects of this invisible air pollution, believing that the regulatory regime is working effectively to deliver agreed legislative emission standards, and that the vehicles they purchase and drive are cleaner than they are.

2.1 Health Effects

The main health effects of air pollution include stroke, heart disease, lung cancer, and both chronic and acute respiratory diseases, including asthma. These conditions can lead to sickness and ill health as well as premature mortality. The figure below from the European Environment Agency (EEA) presents a summary of the main areas of the body affected. The EEA recently updated its assessment[7] for the health impacts of air pollution in the EU, and now estimates that in 2013 there were over 500,000 *premature* mortalities arising from air pollution in the EU overall, and that 1,500 occurred in Ireland. Put another way, in Ireland air pollution caused a loss in life expectancy of 394 years per 100,000 inhabitants or that a total of 18,200 life years were lost.

In addition to premature mortality, the health impacts from air pollution through sickness and ill health, can result in reduced productivity, absence from work and increased expenditure on medicines and increased hospital admissions. A US study[8] found an increase of around 1% in hospital admissions for cardiovascular outcomes with every 10 $\mu g/m^3$ increase in fine particulate matter ($PM_{2.5}$) in air. These health impacts result in direct economic costs and are estimated by the WHO[9] to be in the region of US$1.6 trillion (tn) in Europe, and for Ireland, around 1.3% of GDP or US$2.5bn per year. Separate estimates from the European Commission put the figure at €2 billion per year, including the loss of 382,000 workdays per year[10]. EPA funded research has estimated the monetary costs of air pollution per tonne of pollutant in Ireland; these costings are designed to be used in the assessment of air pollution impacts of proposed plans and programmes[11]. In a recent report from the OECD the annual global welfare costs of premature deaths from outdoor air pollution are projected to rise from US$ 3 trillion in 2015 to US$ 18-25 trillion in 2060[12].

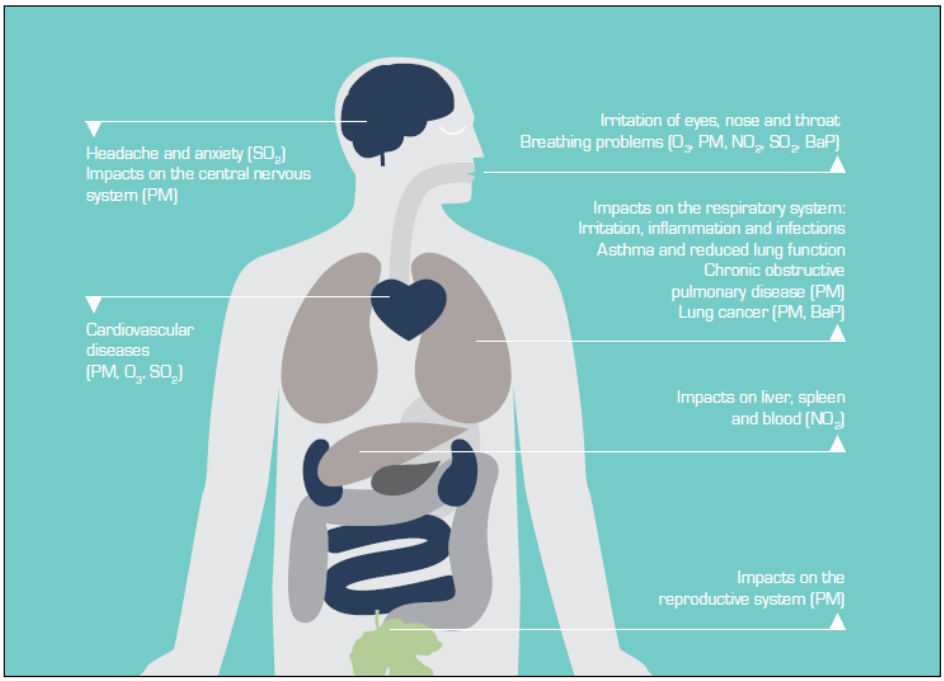

Figure 2: Summary of Health Impacts of Air Pollution: Source: EEA, 2013

Recent EPA reports, *Air Quality in Ireland 2015*[13] and *Ireland's Environment, An Assessment 2016*[14] detail the main air quality trends based on monitoring from the national ambient air quality network. There are monitored exceedances of the WHO guideline values for ozone, PM_{10} and $PM_{2.5}$ at a number of sites though there are no current exceedances of the lower (less protective) EU standards at the existing monitoring locations in Ireland. The reports also highlight the main challenges of reducing air pollution from key sources such as particulate matter emissions from solid fuel burning (e.g. peat, coal and wood) in the residential sector and NO_x emissions from vehicles in the transport sector.

Exceedances of EU standards in other Member States have resulted in infringement proceedings, and this has placed a renewed focus at EU level on the need for full implementaion of existing legislation and for further action to reduce air pollution. The renewed focus also raises the issue of the comparability, consistency and representativeness of the assessment and measurement of air quality across all EU Member States.

2.2 Environmental Effects

Air pollution also has a significant impact on the environment, for example, when washed out of the atmosphere by rain or otherwise, it can have an immediate and longer term impacts, including on biodiversity, water quality and the wider ecosystems services that the environment provides. Historic reductions of sulphur emissions have reduced the threat from 'acid rain' though nitrogen deposition continues to affect plant communities, impacting on sensitive species and biodiversity. This can have knock-on consequences for example, on butterflies and other insects and birds. It could also favour plants and insects that cause allergies or disease, and can contribute to an increase in the occurrence of algal blooms. Ozone which is produced in the atmosphere from certain air

pollutants is an aggressive gas which damages plants and can significantly reduce crop productivity yields.

Under the international Air Convention[15] parties assess the impact that air pollution deposition in Europe is having on the environment and its ecosystems, in particular on habitats. Current assessments indicate that air pollution continues to cause damage to specified sensitive elements of the environment. The figure below shows the exceedance of critical loads of nutrient nitrogen across many parts of Ireland, which are predicted to increase from 45% in 2000 to 47% in 2020 under current legislated emissions.

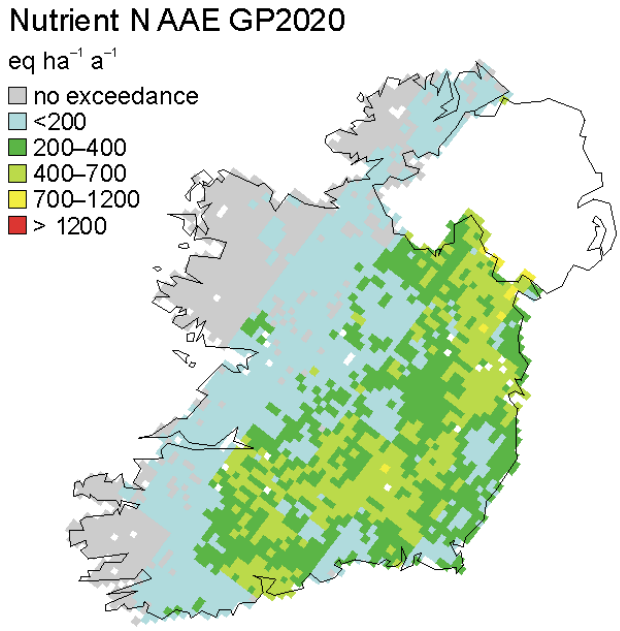

Figure 3: Average accumulated exceedance (AAE) of critical loads of nutrient nitrogen under nitrogen deposition following implementation of the Gothenburg Protocol (GP). (Source: Aherne *et al*.)

2.3 Legislative and regulatory approaches to promote clean air

There is a range of existing EU legislation, which sets standards to (i) reduce emissions from a range of sources, and (ii) limit exposure to pollution in ambient air, with the aim of limiting the human, environment and economic costs of air pollution.

This legislation has recently been updated by the final element of the EU Clean Air Package, the revised National Emissions Ceiling Directive[16], which sets the EU legislative framework and legally binding targets to combat air pollution challenges in the period to 2030 and beyond. EU legislation is complemented by national legislation where such legislation is more appropriate or where no current EU legislation exists, for example, in relation to residential solid fuel use, which is the main source of fine particulate matter air pollution in Ireland.

Sources of air pollution emissions occur across all sectors of the economy and many are also sources of greenhouse gas emissions, so action to address air pollution and climate change can have a mutually reinforcing effect and increase the cost effectiveness of such action. However, there are

some areas of tension between the policy areas, for example, in relation to the promotion of biomass heating or diesel vehicles for climate policy, where the resulting health impacts from increased air pollution acts to offset the climate benefits of such measures. Because air pollution emission sources occur across all sectors of the economy, it is important that air pollution considerations be integrated into other government policy areas, including in energy, transport, residential heating, and agriculture, and it is important that the relevant sectoral policy frameworks take account of it. In addition, recent scientific assessments have highlighted the links between certain air pollutants known as Short Lived Climate Pollutants (SLCPs) that also have a warming effect on the climate. SLCPs include black carbon (BC), methane (CH_4) and tropospheric ozone (O_3) and have detrimental impacts on human health, agriculture and ecosystems.

The primary approach to air pollution control to date has been by regulation, though fiscal measures have also played an important role in reducing air pollution in the past. For example, an excise tax differential was introduced for leaded petrol which brought about a widespread move to lead-free fuel ahead of the EU wide regulatory ban on leaded petrol in 2000. Such measures can continue to play an important role in the transition to cleaner fuels which will be requried as we take the necessary steps to move towards meeting tighter health based WHO air quality guideline values, and a low carbon sustainable society.

The issue of indoor air quality is increasingly recognised as an important aspect of exposure to air pollution, as we spend as much as 90% of our time indoors. Ireland has shown international leadership on this issue when the then Minister for Health introduced the ban on smoking in indoor work places in 2004 to address a significant source of indoor air pollution. However, other threats arise from other indoor sources, for example, research in the EU has found elevated level of toxic air pollutants indoors where stoves and open fires are used[17] as well as evidence[18] of poorer health outcomes, particularly for vulnerable groups, for those living in houses where coal is used for heating.

2.4 A Clean Air Vision for Ireland

The development of a national clean air strategy is an opportunity to define a vision for future air quality in Ireland, and to set goals and targets and a review framework that will deliver that vision. It is important that clean air policy is strongly integrated with other policy areas particularly climate policy so as to strengthen and maximise the synergies, and to increase the cost effectiveness of the measures necessary to transition to a clean low carbon economy, whilst avoiding or minimising perverse outcomes that can arise. To set and achieve air quality goals, it will be necessary to develop an enhanced monitoring network and a national research programme that can identify new and emerging areas for priority policy action, and support its practical implementation.

The 7th Environment Action Programme set the EU's environmental vision. It commits the EU to ensuring that by 2020 the outdoor air quality in the EU has significantly improved, moving closer to WHO recommended levels, while indoor air quality should also improve, informed by the relevant WHO guideline values. Some countries, for example Scotland[19], have adopted the WHO guideline values already to promote improved health protection policies. No specific EU air standards apply to the natural environment to protect biodiversity and its ecosystems services, though international guidelines can provide protection for this natural capital. There is a range of minimum legal

requirements that apply in relation to current and future EU clean air legislation for (i) product source emissions standards, (ii) national emission ceilings and (iii) overall ambient air quality standards. However, reducing air pollution beyond statutory requirements can reduce health impacts and improve health outcomes with benefits for health and well-being in addition to the economic benefits that accrue from reduced health care costs and a healthier more productive population.

Consultation questions

1. Do you have a view on what the main elements of a vision for clear air in Ireland should be?
   - Should consideration be given to going beyond statutory compliance with EU standards as set out in EU legislation, and moving towards WHO guideline values in line with the EU 7th Environment Action Programme?
   - Are there areas where the national monitoring and research network could be enhanced or augmented so that it can better inform clean air and climate policy?
2. Are there any other issues you wish to raise in relation to a vision for clean air in Ireland?

3 Clean Air Policy and Legislation

3.1 National Legislation

The main national legislative provisions to address air pollution in Ireland were introduced under the Air Pollution Act, 1987[20] and it remains the primary basis for national legislation in this country. The Act was introduced at a time when EU[21] air pollution legislation began to develop; it was also a time of very severe winter smogs in Dublin and other cities and towns around the country, resulting from the widespread use of coal for home heating. The uptake of coal use for home heating had been incentivised by government to promote energy security by reducing reliance on imported oil in the wake of the 1970s oil crisis. This had the unintended consequence of increasing pollution from coal-fired home heating which was primarily responsible for the breaches of the EU ambient air quality limits in place at the time. These exceedances proved to be a significant driver for action to address the situation. The air quality limits have since been significantly revised downwards to provide better health protection and reflect better scientific understanding of the impacts of air pollution on people and the environment.

The Air Pollution Act sets out the statutory defintion of air pollution and contains a general obligation to prohibit air pollution along with powers to prevent it. The powers are devolved down to individual local authority level, providing local authorities with a range of powers to address emissions of air pollutants from premises. The Act also provided for the regulation of emissions from a range of large, and smaller industrial sources, however, responsibility for the larger sources has since passed from local authorites to the Environmental Protection Agency (established in 1993) given the complexity and expertise required to effectively regulate large industrial sources. The smaller sources are still regulated by the local authorities under Section 30 of the Act. The Act also provides the Minister for the Environment with powers to make regulations in relation to fuel quality which have been instrumental in tackling 'smog' from residential 'smoky' coal in our larger cities and towns and successfully improving public health where the ban applies. The Air Pollution Act was amended in 2015[22], including with the introduction of fixed penalty notices for a range of offences, though the Act has not been comprehensively reviewed since its introduction. However there have been significant developments in relation to EU clean air legislation in that timeframe.

3.2 EU Legislation

EU legislation has developed over the last number of decades to set complementary legislation (i) to reduce emissions of air pollutants into the atmosphere, and (ii) to limit maximum contentrations for pollutants in the ambient air around us. Emission reduction targets are set at EU and national level, through the National Emissions Ceiling Directive, as well as at source level with, for example standards for road vehicles or industrial installations, set on a prioritised basis. Product standards which prohibit or ban certain 'high emission' products have also played an important role in reducing emissions. For example, EU fuel standards[23] which ban high sulphur petrol and diesel and mandate sulphur free fuels have been very effective in reducing sulphur dioxide (SO_2) emissions. There is currently no EU legislation in force addressing residential emissions, but the 'smoky' coal ban in Ireland is an example of a product standard for residential emissions which has successfully reduced emissions where it has been applied to date.

Standards for air quality, are set in the CAFE (Cleaner Air for Europe) and associated air quality directives[24]. These set maximum concentration levels in the ambient air, that we all breathe, for a range of priority pollutants that impact on human health. The levels of pollution in ambient air are the accumulation of all the emissions released from the multiple and various sources. So the air quality legislation and standards are designed to complement emission legislation by putting an overall limit in ambient air on the permissible levels of pollution we breathe regardless of source. The CAFE directive also sets minimum assessment and measurement requirements which are elaborated in section 3.2.3.

3.2.1 The Clean Air Package

The EU Clean Air Package[25] launched in 2013 contained a suite of policies and legislative proposals to update and modernise EU clean air legislation to reflect improved scientific knowledge and understanding of the health and environment impacts of air pollution. The main components include:

- new **Clean Air Programme for Europe** with measures to ensure that existing targets are met in the short term, and new air quality objectives for the period up to 2030. The package also includes support measures to help cut air pollution, with a focus on improving air quality in cities, supporting research and innovation, and promoting international cooperation
- revised **National Emission Ceilings Directive** with more ambitious and protective national emission ceilings for key pollutants, and
- new **Directive to reduce pollution from medium-sized combustion installations**, such as energy plants for street blocks or large buildings, and small industry installations.

The Clean Air Package is estimated to deliver significant benefits across the EU by 2030, including to:

- avoid 58,000 premature deaths,
- save 123,000 km^2 of ecosystems, (including 56,000 km^2 protected Natura 2000 sites) from nitrogen pollution, and
- save 19,000 km^2 forest ecosystems from acidification.

The main legislative proposal is the revision to the NEC Directive which sets new national targets for 2020 and 2030 for the most important priority air pollutants and was formally adopted at the end of 2016. It sets tighter limits for 2030 for five air pollutants - particulate matter (PM_{10} and $PM_{2.5}$), sulphur dioxide (SO_2), nitrogen oxides (NO_x), ammonia (NH_3) and volatile organic compounds (VOC). The aim of the revised directive is to cut the negative impacts of air pollution on human health by almost half by 2030 by reducing levels of illness, including respiratory and cardiovascular diseases, and premature death. The directive is the central element of the EU Clean Air Package. Consideration of the national approach to implementing and delivering these targets will be a central consideration of the national Clean Air Strategy.

3.2.2 National Emissions Ceilings Directive (2001/81/EC)

Directive 2001/81/EC *on national emission ceilings for certain atmospheric pollutants* set national limits to be achieved since 2010, for four 'classic' air pollutants, namely;

- oxides of nitrogen (NO_x)
- sulphur dioxide (SO_2),
- volatile organic compounds (VOCs) and
- ammonia (NH_3).

Emissions of these pollutants have generally fallen very significantly since the Directive was introduced in 2001, except for ammonia which has remained more or less stable over the early part of the 2000s when the Directive came into force, then falling around 6% broadly in line with a fall in the national livestock herd, though this is now forecast to increase in line with national plans for expansion in the agriculture sector. In contrast, over the same period, SO_2 emissions have decreased by 86%, NO_x emissions by 45% and VOCs by 22%. Ireland has complied to date with the ceilings set for three of the pollutants, but reported emissions of NO_x have remained above the 2010 emission ceiling due to a variety of compounding factors as set out in section 3.2.2.1 below.

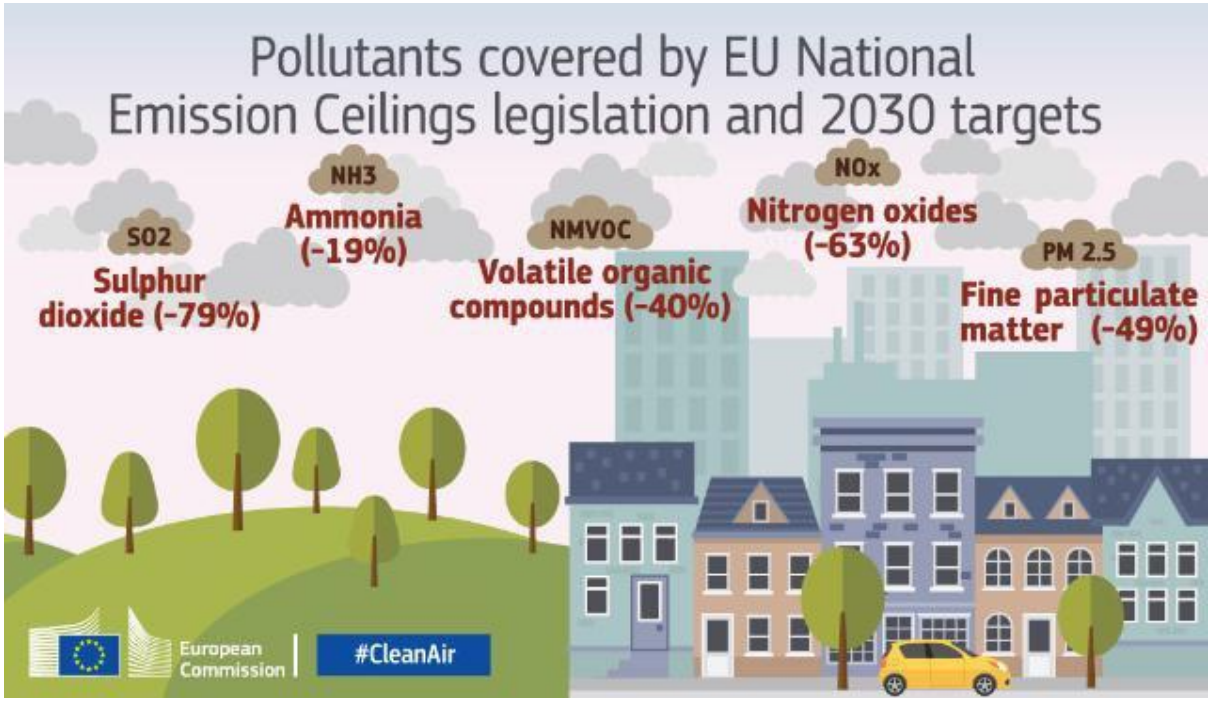

Figure 4: Air Pollutants covered by EU National Emissions Ceilings Directive (Source: European Commisision[26])

3.2.2.1 Compliance Assessment with the NO_x Ceiling

NO_x emissions for Ireland have fallen sharply since the Directive came into force and particularly sharply since 2009 with the global economic recession. However, they have now stabilised and have seen a small year on year rise in 2015. Despite the decline in NO_x emissions, the reported estimates have remained above the 2010 NO_x target, which is set in absolute terms. However, comparison of reported estimates for compliance assessment purposes are complicated by the fact that, in line with best scientific practice, several adjustments have been made to the reported inventory so as to better characterise emission sources and thus improve their accuracy and robustness. These adjustments have been most significant in relation to estimates for emissions from diesel vehicles, because, as highlighted by the recent Dieselgate scandal, real-world driving emissions (RDE) are significantly higher than the test standards set out in EU legislation.

Generally these inventory improvement adjustments have acted to increase the overall emissions estimate, and thus increase the 'distance to target' from the original ceiling, which was specified in absolute terms. This is recognised as a weakness in the existing Directive so the revised legislation sets the future 2020 and 2030 targets as a percentage reduction from a base year (2005) and provides for an adjustment procedure to reflect revisions to inventory estimates so as to facilitate their continual improvement.

The European Commission initiated pilot infringement proceedings against Ireland for the apparent exceedance of the NO_x ceiling, and are currently concluding a technical assessment of the adjustments submitted by Ireland, which if judged valid will bring Ireland into legal compliance. However, further economic recovery in the coming years could put upward pressure on NO_x emissions, so additional abatement measures may be required to reverse this trend in the coming years. The figure below presents the (unadusted) trend in national NO_x emissions from 2000 to 2014 showing the 2010 emission ceiling.

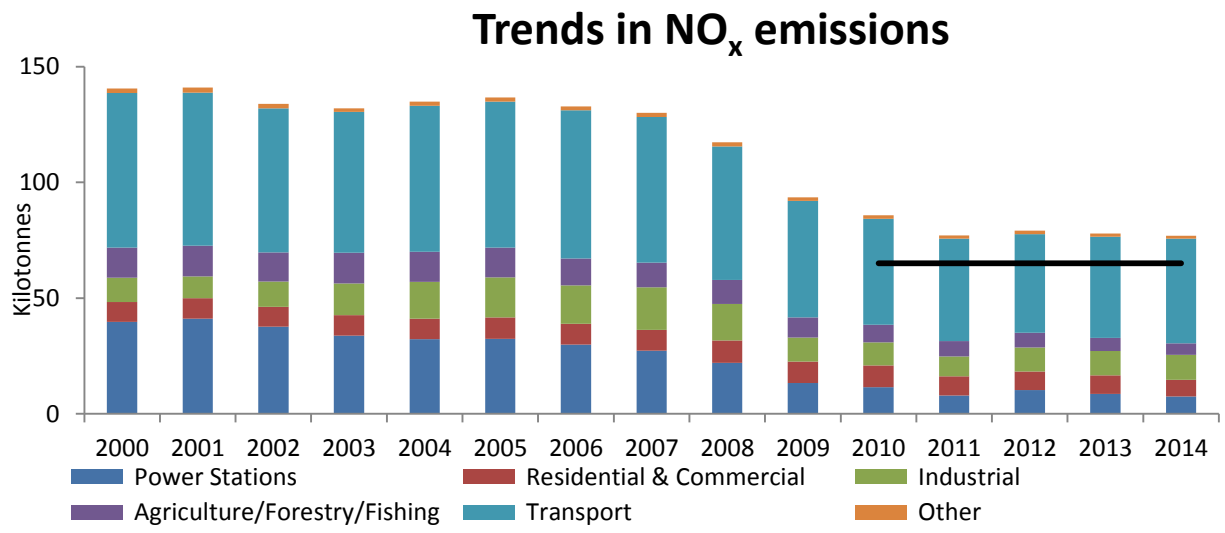

Figure 5: Trends in NO_x emissions (unadjusted) 2000 to 2014 (Source EPA, 2015) – Black line represents 2010 emission ceiling for NO_x.

3.2.3 Ambient Air Quality Standards

Ambient air quality legislation sets limits on the maximum levels of pollutants in the air that we breathe. The limits are set under the CAFE and associated Directives[27] and specify minimum air quality standards for a range of pollutants. These are to be achieved in all areas for public health and environment protection, including where the highest concentrations occur to which the public is likely to be exposed for a significant period). In addition, the CAFE Directive requires member States to achieve a National Emission Reduction Target (NERT) for $PM_{2.5}$ which is set in relation to background levels and requires reductions of $PM_{2.5}$ even below EU limits, in recognition of the fact the $PM_{2.5}$ has health impacts below those EU limits.

These EU standards were set at the beginning of the century to provide health protection, but more recent WHO health based guideline values are a good deal tighter for some particular pollutants, notably particulate matter. The EU is commited in its 7th EAP to move to the WHO guideline values to provide improved levels of health protection. The figure below presents graphically the difference in exposure of the EU urban population to the EU and WHO values.

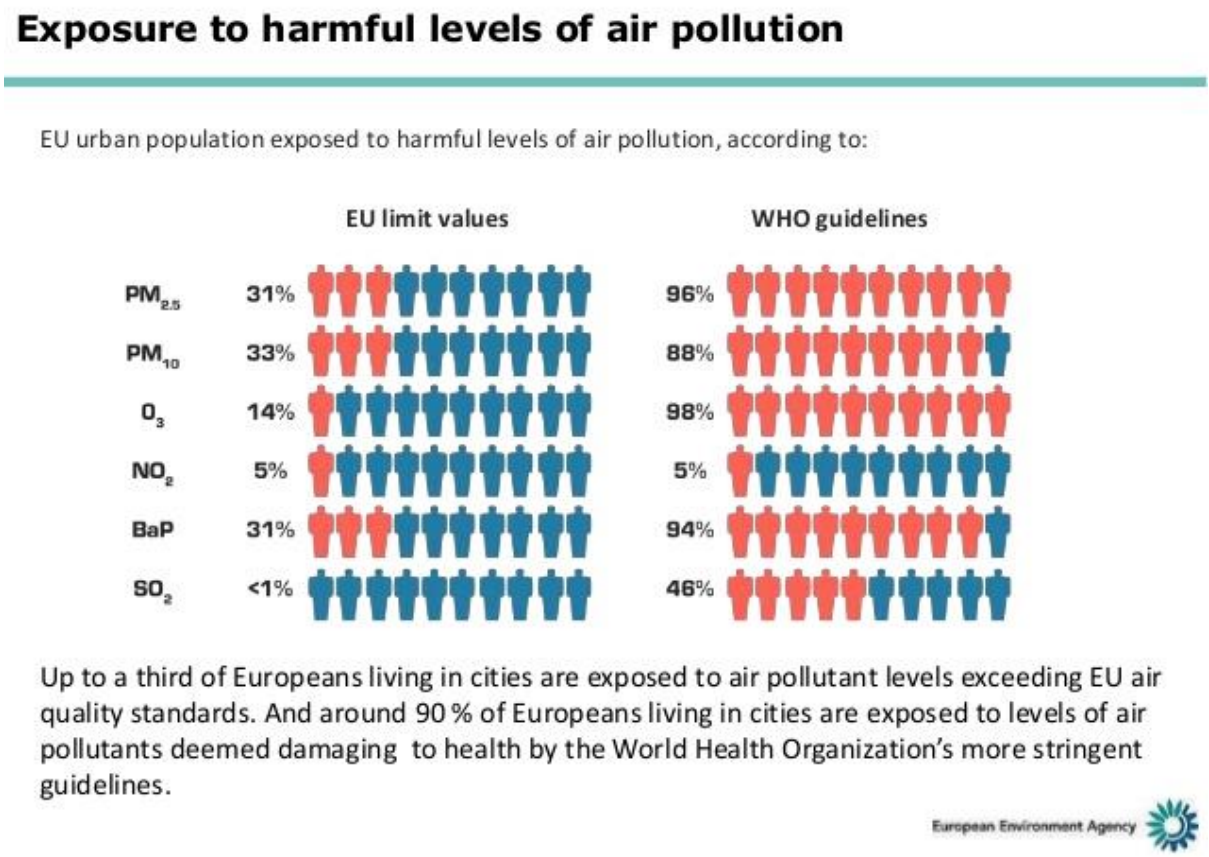

Figure 6: Comparison of EU limit values versus WHO Guideline values for air quality (Source: EEA 2013)

The CAFE Directive has recently been amended by Commission Directive 2015/1480[28] which aims to streamline reporting and promote a more consistent evaluaton of air quality assessement across the EU. It requires implementation of a number of technical precedures and reference methods for Member States, including to maintain records in relation to each air quality monitoring station so that there is confidence that there is adequate spatial representativeness of air quality monitors stations and a consistent approach to the assessement of ambient air quality across all EU Member States. The EPA is the designated competent authority in Ireland with overall responsibility for implementation of the CAFE Directive and the assessment and management of air quality in Ireland. The EPA have just completed consultation on a new national ambient air quality monitoring programme, proposed under Section 65 of the EPA Act, to strengthen its capacity and capability to provide more comprehensive, localised air quality information linked to public health advice[29]. See Section 5 for further information.

3.2.4 The EU Clean Air Dialogues

The EU Clean Air Package will set the legislative framework for EU clean air policies until 2030 and beyond. To supplement the legislative framework, the European Commission is establishing a number of partnership initiatives with Member States to better understand the challenges to the successful implementation of effective clean air policies. As part of the partnership the European Commission is establishing a series of Clean Air Dialogues with Member States which will comprise informal reviews with national policy makers and other stakeholders across all the sectors that contribute to air pollution. Ireland will participate in the pilot phase of the scheme in early 2017, allowing lessons learned to inform development of the national Clean Air Strategy.

3.3 Enforcement of Clean Air Legislation

The enforcement of clean air legislation is conducted by the EPA and the local authorities. The EPA regulate industrial emissions under a range of EU directives including the Industrial Emissions Directive (IED) which specifies maximum emission levels for a wide range of industry sectors and specific sources. In addition the EPA licence waste facilities which are a significant source of public complaint, particularly regarding odours, which is the source of more complaints than any other environmental issue.

Local authorities are primarily responsible for the enforcement of legislation on solid fuel including the ‘smoky coal’ regulations, and they are assisted by an active national implementation group (see 4.2.1.3). Local authorities also regulate a small number of more minor industrial and commercial activities and address a wide range of air pollution incidents including those arising as a result of smoke, dust or odours, many of which are reported to local authorities by members of the public. The EPA reviews the performance of local authorities in relation to enforcement of environmental legislation; for clean air legislation, the most recent assessment[30] found performance to be very variable and below target for all areas examined.

3.4 International Treaties, Conventions and Initiatives

The challenge of air pollution has local, regional and hemispheric impacts. It does not respect political borders and in addition to national and local action, international action is also required. To address the international dimension, a number of regional and UN global conventions have been established to combat these challenges.

3.4.1 World Health Organisation (WHO) – Road map to address the adverse effects of air pollution

In early 2016, the WHO adopted a road map[31] to address air pollution recognising that it is one of the leading avoidable causes of disease and death globally, and the world's largest single environmental health risk. The WHO has stated that the root causes of air pollution and its adverse impacts are predominantly socioeconomic in nature; it is aware of the need to address the social determinants of health, related to development in urban and rural settings, including poverty eradication, which is an indispensable element for sustainable development and for the reduction of the health impact of air pollution. The WHO also recognises that in order to contribute to national policy choices that protect health and reduce health inequities, the health sector needs to engage in cross-sectoral approaches to health, including adopting a *Health in All Policies* approach.

3.4.2 The Air Convention – the Long Range Transboundary Air Pollution (LRTAP) Convention

The Air Convention was one of the first established international regional treaties to address air pollution when it was established in Europe and North America in 1979. The motivating objective at the time was to address 'acid rain' that resulted primarily from sulphur pollution which was coming from the larger industrialised countries, like Germany and Great Britain and impacting the environment, in particular lakes and forests in Scandinavia but also elsewhere. The Convention proved to be very effective at reducing long range transport of sulphur pollution and has since been extended to address a range of other pollutants including nitrogen, ammonia, fine particulate matter, Persistent Organic Pollutants (POPs) and heavy metals.

3.4.2.1 Ratification of Air Convention Protocols

The three most recent protocols to the Air Convention, namely, the Gothenburg, POPs and Heavy Metals Protocols have all been amended and updated in recent years. The most recently established protocol is the amended Gothenburg Protocol which takes an integrated approach to the reduction of atmospheric pollution to reduce environmental and human health impacts. The EU has incorporated these provisions into EU legislation through the revised NEC Directive[16] (2016/2284). Ireland has signed all three protocols and is developing a programme to ratify them.

3.4.3 Stockholm Convention on Persistent Organic Pollutants

The Stockholm Convention controls persistent organic pollutants or 'POPs' including banning or restricting the production, use, import and export of POPs as well as measures to reduce and or eliminate their releases, including emissions to air. Obligations regarding wastes containing POPs are also specified including the requirement to destroy or irreversibly transform the POP content of

wastes. The POPs currently controlled under the Convention comprise pesticides and industrial chemicals and address unintentional combustion related emissions[32].

Ireland is a Party to the Stockholm Convention and the EPA has developed a National Implementation Plan (NIP)[33] setting out how Ireland delivers on its obligations under the Convention. The EPA is currently updating its emission inventory of unintentional POPs to incorporate newly added POPs to the Convention. The provisions of the global Stockholm Convention reflect many of the requirements of the regional POPs Protocol under the Air Convention.

3.4.4 Minamata Convention on Mercury

Mercury is a toxic pollutant that persists in the environment, bio-accumulates in ecosystems and has significant negative effects on human health and the environment. Ireland became a signatory to the Minamata Convention on Mercury in 2014 and - along with the EU and its member States - aims to ratify the Convention in 2017, when it is expected to enter into force.

The main source of unintentional emissions of mercury to air globally is the burning of coal. In Ireland, the largest source of mercury is the residential sector accounting for around half of all emissions[34] which result primarily from the use of solid fuel for home heating. Industrial installations using solid fuel generally have significantly lower air pollution intensities than housing, as pollution abatement equipment is routinely applied in industry, whereas it is not considered feasible to fit such abatement to household chimneys.

3.4.5 Climate and Clean Air Coalition (CCAC)

The Climate and Clean Air Coalition is a partnership under the United Nations Environment Programme (UNEP) comprised of national governments, other governmental bodies and non-governmental organisations. The CCAC promotes the added benefits of addressing the *Short Lived Climate Pollutants* (SLCPs) that have direct human health and environment impacts as well as causing global warming and climate change. SLCPs include black carbon, methane, and hydrofluorocarbons (HFCs), and action to reduce SLCP emissions can deliver immediate health benefits as well as near term reductions in global warming to complement the action being taken to reduce carbon dioxide emissions. The biggest opportunities for SLCP reductions are in developing countries where significant improvements in air quality could be made by applying tried and tested approaches from developed world countries. Ireland is one of 50 country members of the CCAC.

3.4.6 Sustainable Development Goals

The Sustainable Development Goals (SDGs) are a wide ranging set of aims agreed by all nations under the auspices of the UN to promote sustainable development so as to address the many causes of poverty, injustice and environmental damage to the planet. The SDGs apply to both developed and developing countries; the main principles are contained in *Transforming Our World: the 2030 Agenda for Sustainable Development*[35]. The Sustainable Development Goals, 17 in all, are underpinned by 169 targets which outline the specific actions needed for each of the goals to be

achieved. Clean air is an integral part of many of the SDGs and the underpinning targets, particularly Goal 3, to promote good health and well-being for all. The Clean Air Strategy can contribute to Ireland's delivery of the SDGs through the development of clean air policies to promote better public and environment health.

Consultation Questions – Clean Air Policy and Legislation

1. Are there aspects of the Air Pollution Act 1987 that need to be updated to ensure that it remains fit for purpose for the 21st Century?
2. Do the provisions of the Air Pollution Act, 1987, specifically sections 24 and 26, provide effective tools for local authorities to address the negative impacts of air pollution?
3. Do the provisions in relation to local authority licensing of industrial emissions in Part IV of the Act continue to be fit for purpose?
4. Are the fines and penalties for breaches of licences in relation to air pollution sufficient to act as effective deterrents?
5. Should a regional approach be considered for some aspects of Local Authority enforcement of the Air Pollution Act, as is the case for other environment legislation, for example waste management?
    - If so, what enforcement activities would best suit a regional approach?
6. Are there any other issues you wish to raise in relation to clean air policy and legislation?

4 Sectoral issues and challenges

4.1 National Cross Cutting Issues

The different sectors of the economy present different challenges to clean air relating to different pollutants and with different cross linkages to other policy areas. For example, for the residential sector, fine particulate matter ($PM_{2.5}$) is a priority pollutant derived predominantly from solid fuel, and actions to address emissions from solid fuel could have very strong positive impacts for national climate policy, by promoting a transition away from high polluting, high carbon fuels.

For the transport sector, oxides of nitrogen (NO_x) from road transport are the primary challenge, though $PM_{2.5}$ emissions including black carbon from diesel vehicles and shipping are also a concern. The wide range of actions relevant to transport emissions could have interlinked benefits for public health, climate policy, sustainable communities, congestion-reduction and the economy.

Agriculture is responsible for over 98% of all ammonia emissions which impacts on biodiversity through eutrophication and acidification, and also has a significant role in producing fine particulate matter ($PM_{2.5}$) in the atmosphere. Significant PM may also be released from agricultural burning though the scale of the problem is not clear as reliable statistics on its occurrence are not currently available.

4.1.1 Clean Air and Climate Change policy – synergies…but some tensions

Many climate policies that promote and incentivise low carbon and renewable technologies for example can also have positive benefits for air quality. From a climate perspective, we need to transition to clean, low carbon fuels in general. This will mean a move away from much of the solid fuel that is used today, namely, coal and peat, to cleaner alternatives. The majority of climate warming carbon dioxide emissions are produced as a by-product of fossil fuel combustion to produce energy and this is also the case for many air pollutants. So measures which replace or reduce fossil fuel generated energy will also generally reduce air pollution.

4.1.1.1 Pollution swapping

However there are challenges in some areas where climate policies aimed at reducing greenhouse gas emissions are actually resulting in increased air pollution and consequently, in health impacts. The climate policy preference for diesel vehicles came at the expense of increased air pollution emissions, and similarly, an increased use of biomass for heating could increase emissions of PM particularly if it displaces less polluting fuels like natural gas. This phenomenon is sometimes referred to as 'Pollution Swapping' and can impact on the compliance with air pollution and greenhouse gas targets. It is important that the Clean Air Strategy can identity these issues and aim to minimise the pollution swapping that will occur and maximise synergies to promote 'win-win' solutions between climate and clean air policies. The figure below provides a summary illustration of some of the positive and negative interactions that can occur.

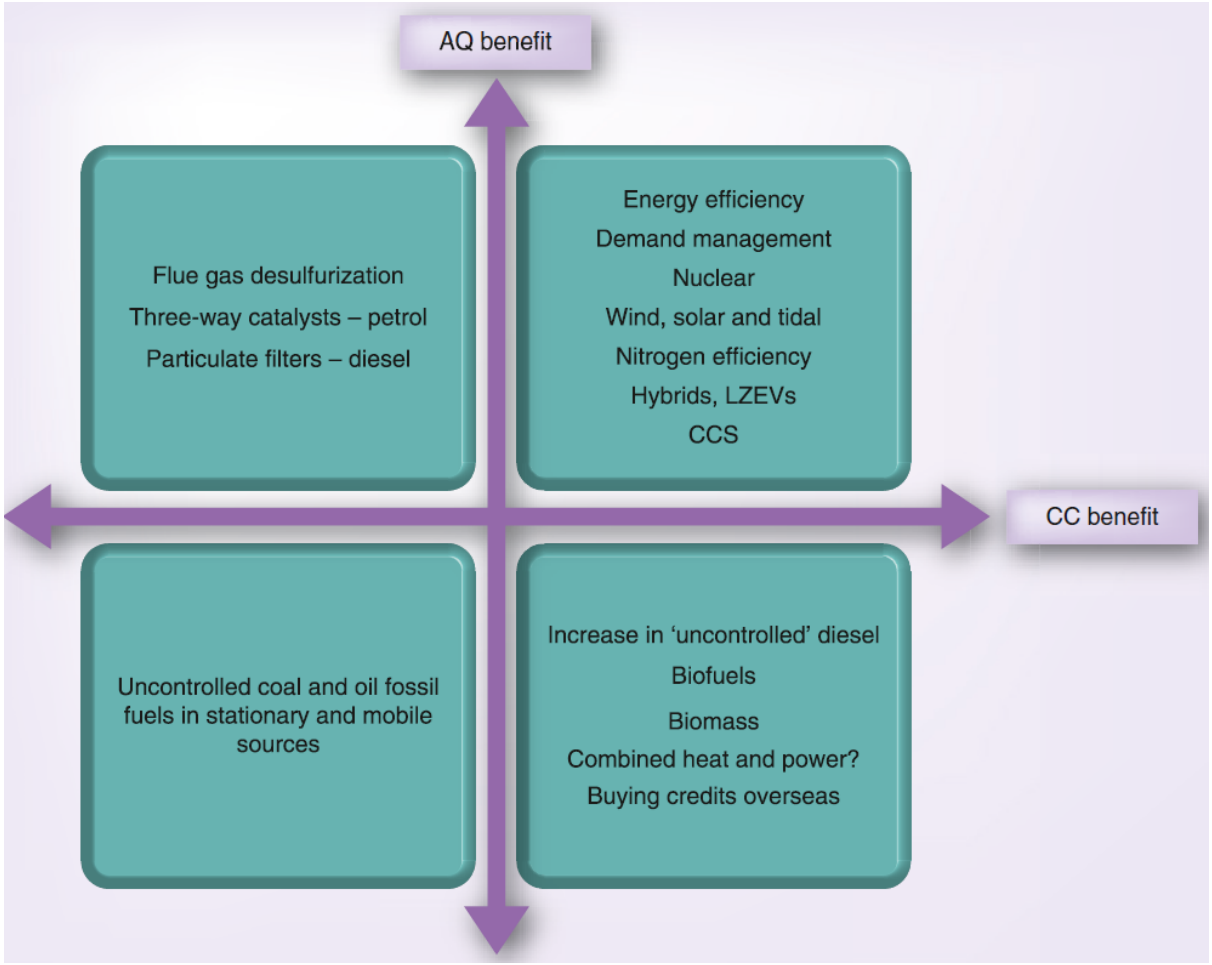

Figure 7: Clean air and climate change policy interactions (Source: Williams/Defra 2012)

4.1.2 National Climate Mitigation Plan

Under the Climate Action and Low Carbon Development Act 2015, a National Mitigation Plan (NMP) must be submitted to Government for approval no later than 10 June 2017. The on-going preparation of the plan is designed to be a whole-of-government approach to tackling greenhouse gas (GHG) emissions. The primary objective of the NMP will be to track measures already underway and identify any new measures that will reduce GHG emissions. This is to ensure that we progress towards achieving our national transition objective to becoming a clean, low carbon, climate resilient and environmentally sustainable economy by 2050.

DCCAE have prepared a briefing document[36] outlining the development of the NMP to date. It covers the four sectors concerned – Agriculture, Transport, Energy (Electricity generation), the Built Environment (Energy Efficiency). It highlights some key questions on how Ireland should achieve its national transition objectives by 2050.

One of the objectives of the national Clean Air Strategy will be to maximise the synergies with the National Mitigation Plan while seeking to avoid or minimise any negative impacts on air quality.

4.2 Residential emissions

The use of solid fuel for home heating is a significant source of air pollution. Residential solid fuels provide around 15% of residential energy, which is less than 5% of the overall national energy demand. However, they are a significant, and often the main source of a range of toxic air pollutants including $PM_{2.5,}$ (~60%), PAHs (~94%) and mercury (~50%)[34]. Though oil and gas taken together are the main source of energy they do not produce significant amounts of particulate matter. Electricity is also a significant source of household heating, though it produces no emissions at the point of use. Along with the on-going decarbonisation of the electricity supply system, recent innovations in relation to electricity based renewable technologies including air source pumps, could make electricity an attractive option as the clean, low carbon energy of choice in the future. The figure below presents the trend in national $PM_{2.5}$ emissions from 2000 to 2014.

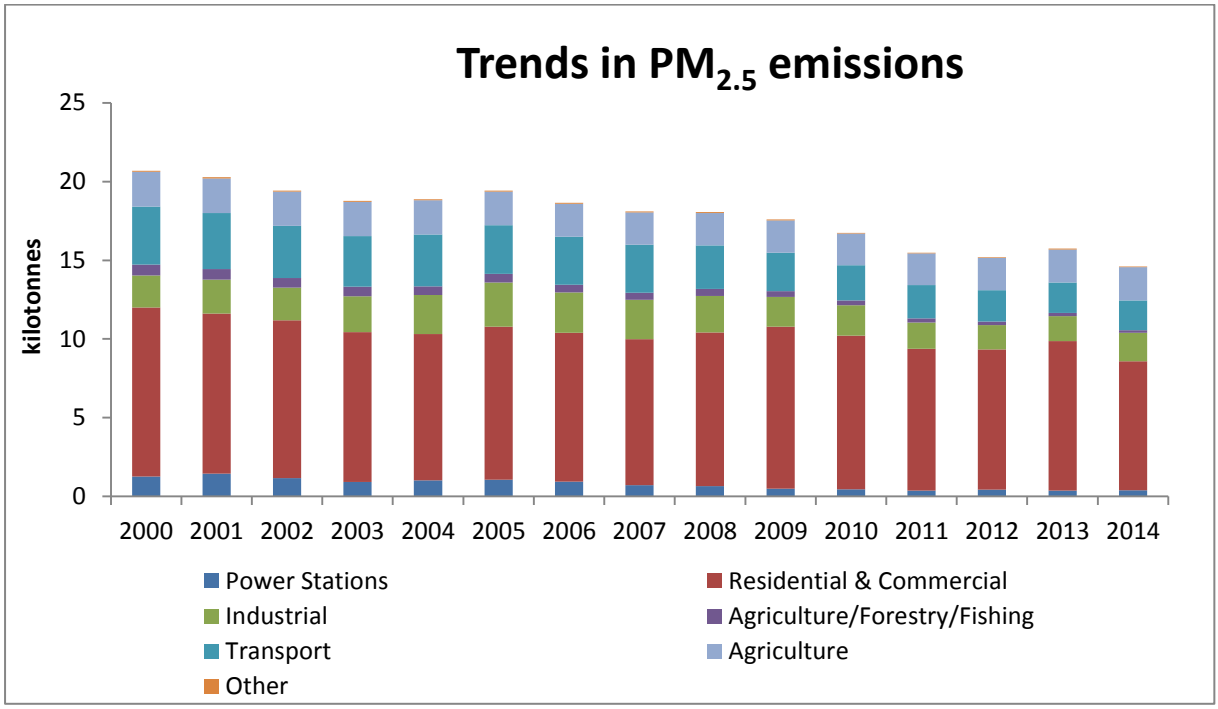

Figure 8: Trends in $PM_{2.5}$ emissions 2000 to 2014 (Source EPA, 2015)

Residential emissions by their nature generally occur in built up residential areas where exposure to the community, including vulnerable populations like children, the ill and the elderly is likely to be highest. Outdoor levels of particulate matter air pollution are often the largest single factor determining indoor air pollution levels, though in addition, indoor exposure to pollutants can increase with emissions entering the room from open fires or while refuelling stoves. A recent study in Belgium found elevated levels of PAHs in properties where a stove or open fire was in use. Reducing people's exposure to these sources will require a transition from solid to cleaner fuels, and in time to emission-free technologies. Separately, climate policy also requires that Ireland transitions from high carbon solid fuels to cleaner renewable fuels so the transition from solid fuel has clear synergies for clean air and climate change policy.

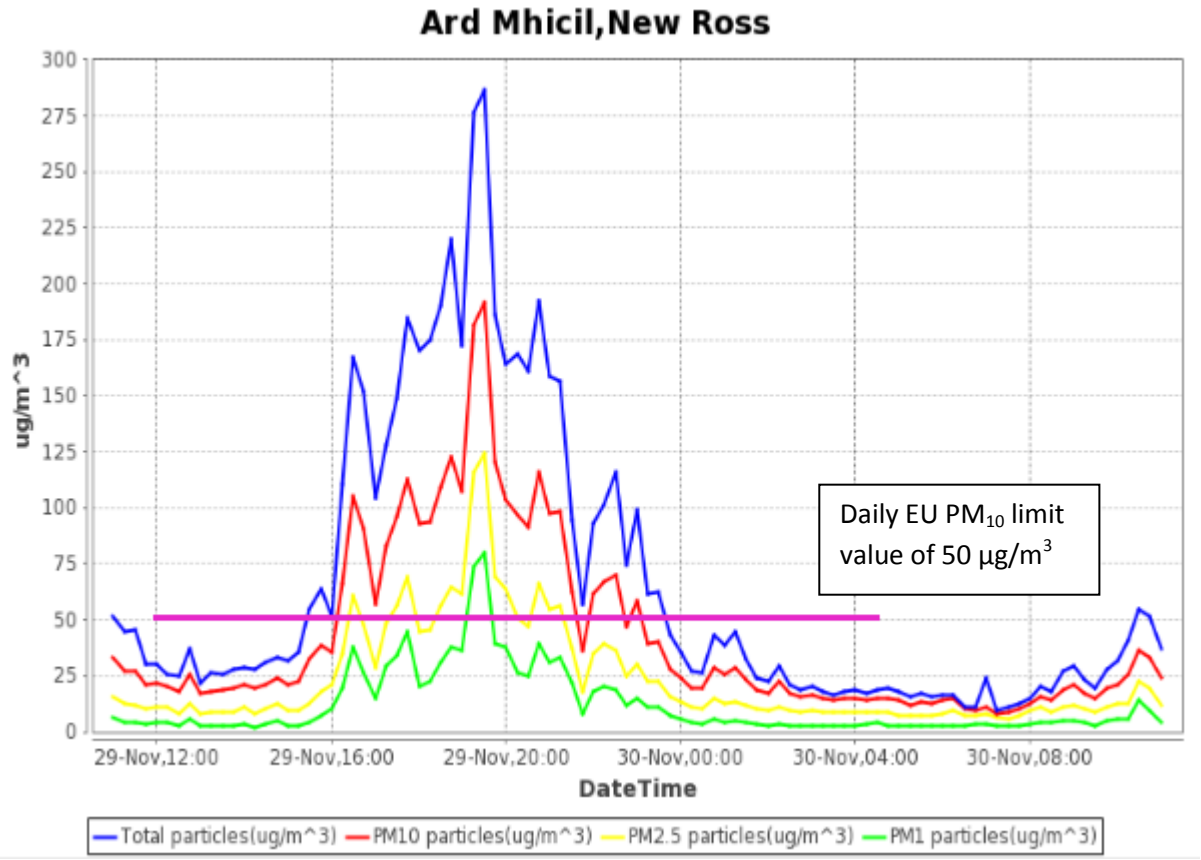

Figure 9: Indicative Air quality monitoring data for 29/30 November 2016, New Ross, Wexford (Source: Wexford County Council.)

Ireland is similar to many EU countries where residential heating is a significant source of $PM_{2.5}$ emissions. However, whereas in other countries biomass is likely to be the source of air pollution, in Ireland the main sources are coal and, particularly in the midlands, peat. The figure above shows recent air pollution levels monitored by Wexford County Council[37] in a residential estate in New Ross where the daily EU limit was exceeded. The pollution levels reflect the daily home heating pattern, with pollution levels rising in the afternoon as home fires are lit, and falling in the late evening close to midnight. While Ireland is relatively unusual in the EU in terms of its reliance on coal and other solid fuels, a similar situation prevails in Northern Ireland. A joint study[38], *Air Pollution from Residential Solid Fuels*, was commissioned under the North South Ministerial Council to consider policy options to reduce emissions from residential solid fuel use and improve air quality (see 4.2.3.1 below).

4.2.1 Current Solid Fuel Legislation

The current regulations[39] under the Air Pollution Act regulate the marketing, sale, distribution and use of bituminous 'smoky' coal as well as setting a maximum limit on the sulphur content of solid fuels. There is a sulphur limit on bituminous coal nationwide, and on all residential solid fuels in 'low smoke zones', which is to be extended nationwide from March 2017 in line with the approach in Northern Ireland thereby creating a single 'all island' standard for sulphur in solid fuel. The regulations currently apply in the larger cities and towns where they have delivered clean air

improvements. EPA data indicates that elevated levels of air pollution can often occur outside the larger urban areas where the regulations do not apply.

4.2.1.1 Verification of Solid Fuel Quality and EPA Solid Fuel Register

All producers of coal which is sold for home heating are subject to an annual audit scheme to verify the environmental parameters of the coal. The scheme known as SWiFT 7 was developed under the auspices of the National Standards Authority of Ireland (NSAI) and in 2015 was revised to extend its scope to include (i) low smoke solid fuels[40] and (ii) biomass blends. The scheme specifies a label (specimen below), and requires that coal placed on the market should use this label as a *marque* of quality and traceability. It demonstrates to the consumer the commitment of the producer to compliance with the national standards for residential coal. Solid fuel suppliers are required to register with the EPA, and to do so they must hold a current certificate under SWiFT 7.

Figure 10: SWiFT 7 Label – Verification of Solid Fuel Quality

4.2.1.2 Petroleum Coke and other solid Fuels

High energy content fuels like petroleum coke or "petcoke'', if not mixed appropriately with other lower energy fuels, can result in intense heat that can damage grates in fireplaces or stoves. Regulations[41] specify that such fuels must contain a maximum of 50% petcoke by weight and be appropriately labelled. Enforcement of these regulations, developed under product standard legislation is primarily a matter for the Competition and Consumer Protection Commission (CCPC) though local authority personnel can also enforce this legislation.

4.2.1.3 Implementation and Enforcement of Solid Fuels Regulations

Effective implementation and enforcement of the regulations is vital to their success; there has been a refocussing of enforcement for the regulations with the establishment of the Local Authority Implementation Group (LAIG) under the auspices of the EPA Office of Environmental Enforcement's Network for Ireland's Environmental Compliance & Enforcement (NIECE). The table below shows a substantial increase in local authority enforcement activity since 2009.

Table 1: Local Authority Enforcement Statistics Enforcement Activity under the Smoky Coal Regulations (Source EPA).

Action	2009	2010	2011	2012	2013	2014	2015
Total number of inspections	275	381	688	567	1008	1002	921
Warning letters issued	14	5	56	331	169	47	78

The Miscellaneous Provisions Act, 2015 provides, *inter alia*, for the application of Fixed Payment Notices (FPNs) or 'on the spot' fines, for certain breaches of the regulations. Fixed penalty notices will support more effective enforcement by local authorities, by providing a streamlined route to the application of a financial penalty for breaches of the regulations. The legislation provides for a range of fixed payment notices, from €250 to €1,000, depending on the seriousness of the alleged offence. Persons found to be marketing, selling or distributing bituminous coal in breach of the Regulations are now liable for a fixed payment notice of up to €1,000.

4.2.1.4 Carbon Tax Relief for Clean (low smoke), Low Carbon Solid Fuels

The Finance Act 2010 (as amended[42]) provides for relief from solid fuel carbon tax for certain fuels to promote the use of clean, low carbon fuel. The provisions were recently commenced by the Minister of Finance as part of Budget 2017. Relief is administered by the Revenue Commissioners and is subject to the verification requirements pursuant to SI 571 of 2016. This should incentivise the promotion of lower carbon fuels. Depending on the scale of the growth of this market, consideration may be given to the development of biomass sustainability criteria in line with European Commission guidance. The relief has been restricted to clean or 'low smoke' solid fuels to avoid unintended health impacts, particularly from particulate emissions if 'smoky' products were promoted.

4.2.3 Future Action to Address Solid Fuel Impacts

The Government's housing strategy, *Rebuilding Ireland*[43] *– An action plan for housing and homelessness* includes the aim of delivering housing in a way that contributes to wider objectives including support for sustainable urban and rural development and maximising the contribution to addressing climate change. However, there is still a very significant existing national housing stock, which is poorly insulated and reliant on inefficient and polluting heating systems. Emissions from residential heating is a key source for several different air pollutants, so there is a need to take further action to reduce emissions from this sector.

The EPA in its 2016 annual air quality report[44] finds that a continued promotion of the shift away from solid fuel as a method of home heating to cleaner alternatives is the key issue regarding particulate matter levels in Ireland and the area where there is the greatest scope for improvements in air quality. It also recommends that reductions in levels of particulate matter in Ireland can begin with the consumer, who once properly informed of the relevant benefits, can make decisions with regard to their choice of home heating fuel. The EPA conclude that any shift from burning of solid fuel to cleaner, more energy efficient methods of home heating will result in improved air quality for

the consumer, their family and neighbours with a resultant improvement in their health. Local authority enforcement officers also report that smoke nuisance from solid fuel home heating is a significant and growing air pollution problem for communities across the country.

4.2.3.1 The North South Ministerial Council (NSMC) Study – Air Pollution from Residential Solid Fuels

A report on air pollution and residential solid fuel was commissioned under the auspices of the NSMC in 2013. The evidence presented in the report confirms that an integrated package of measures is likely to be most effective in improving public health by reducing air pollution from solid fuel use for home heating. The report identified and analysed various policies based on the particular circumstances in the respective jurisdictions, and recommended that these be used to inform policy choices to address the respective air pollution impacts from solid fuel use.

While it is clear that the policies recommended would bring public health benefits, in terms of reduced mortality and morbidity, the report recommends that care needs to be taken to ensure adequate support mechanisms are provided for their effective implementation. These include education and communication and especially by ensuring that energy poverty is addressed.

The recommendations for Ireland include further expansion of the 'smoky' coal ban alongside policies on energy efficiency, as well as fiscal measures to promote the uptake of low emission fuels supplemented by raising the information and communication profile with householders. It is also recommended that consideration be given to harmonised technical standards in relation to solid fuel where appropriate.

4.2.3.2 Fuel Quality Standards

The EU has set minimum fuel quality standards for a range of liquid fuels including petrol, diesel and home heating oil and such standards have proved a very effective way of improving air quality. This approach essentially bans products that do not meet these minimum standards. There are no EU minimum standards for solid fuel so it falls to individual Member States to set these fuel standards where necessary, under the environment provisions of the Lisbon Treaty. The 'smoky' coal ban introduced in Dublin in 1990 is an example of a solid fuel quality standard brought in by a national government to protect public health, banning certain coal products in the city as they did not meet minimum standards, in this case, smoke emission levels. The approach has since been extended to the bigger cities and towns, and in 2015 in line with the recommendations of the NSMC study the then Minister of Environment announced the intention to extend the ban nationwide[45] with a timeline of 2018.

In 2012 a national standard[46] to limit sulphur levels in coal was introduced with a limit of 7,000 ppm, while the EU standard for sulphur in home heating oil is 1,000 ppm. Fuel quality standards have also been set on a voluntary basis for wood under a scheme devised in collaboration with the Department of Agriculture, Food and the Marine (DAFM).

4.2.3.3 Transition from residential coal (Nationwide coal ban)

The complete transition from the use of coal for home heating will be required in the medium term as we transition to a low carbon economy. In the shorter term, a transition from 'smoky' coal will deliver a number of interlinked objectives including health, climate and energy poverty and is in line with the recent WHO guidance[47] on the need to avoid the use of unprocessed coal as a household fuel, in light of the specific health risks. The EU 7th Environment Action Programme also identifies local coal-fuelled heating as a significant source of mutagenic and carcinogenic poly-aromatic hydrocarbons (PAH) and dangerous emissions of particulate matter (PM_{10}, $PM_{2.5}$ and PM_1) highlighting that action is especially needed in areas where people, particularly sensitive or vulnerable groups of society, are exposed to high levels of pollutants; and that, local measures should be complemented with adequate policy at both national and EU level.

The introduction of a national ban is subject to consultation with a range of stakeholders at EU and national level. Preliminary consultations with the European Commission indicate broad support for a transition away from using coal for residential heating as part of the development of wider strategic clean air policies. Successful implementation of an effective national ban will require access to alternative fuels and complementary measures to incentivise their uptake.

4.2.3.4 Complementary measures

It will be important to support the complete transition from coal with complementary measures. As discussed earlier (section 2.3), fiscal measures can be very effective at influencing consumer behaviour, which the EPA has identified as an important consideration in formulating policy solutions to reduce air pollution from solid fuel. Fiscal instruments were effective at promoting the uptake of unleaded petrol, so much so, that by 1999 unleaded petrol comprised 94% of the market in Ireland ahead of the ban deadline of 2000. A similar approach in relation to residential coal might provide consumers with the necessary price signal to exercise their choice for cleaner heating options, cleaning the air where they live without disadvantaging themselves financially. Easy access to cleaner economic substitute fuels is an important consideration to the success of a nationwide coal ban. Access to gas was an important element to the success of the ban in Dublin and the bigger cities and towns, and though the national gas network is not available everywhere, uptake where it is available can be low[48]. However, off (and on) the gas grid, other cleaner alternatives must be made available. Innovation in relation to clean, renewable technologies is making them an increasingly attractive heating option. Regarding solid fuels, there are now a number of manufacturing facilities in construction or planning, that will produce cleaner manufactured products to supply the market where the consumer continues to rely on solid fuels.

4.2.3.5 Updating solid fuel technical standards

The NSMC report recommended that consideration be given to the harmonisation of technical standards in relation to solid fuel where appropriate between Ireland and Northern Ireland. The original regulations introducing the coal ban in Dublin in 1990 set smoke emission standards for certain manufactured solid fuels, but only those containing bituminous 'smoky' coal. The standards were based on (i) an adapted British Standard laboratory test cycle to better reflect the then practice

in relation to home fires in Dublin and (ii) an adapted numerical limit value (10 grammes per hour), double the UK value (of 5 grammes per hour) to reflect the adapted test cycle, but set so as to be broadly equivalent to the UK standards. However, in the intervening period the UK laboratory test cycle was adopted in Ireland though the numerical limit value of the standard was left unaltered. This effectively halved the protection afforded by the standard, which is now double that in place in Northern Ireland and the rest of the UK. It is now timely to consider aligning the emission standard in Ireland with the current standard in Northern Ireland and commensurate with the original standard introduced in Dublin over 25 years ago.

In addition, given the proliferation of different manufactured solid fuels in the intervening years, it seems appropriate to consider whether emission standards should now apply to all manufactured solid fuels to provide health protection from these sources as well. A number of manufactured solid fuels are marketed as '*smokeless*', apparently on the basis that they are outside the current regulations rather than on the basis of their actual smoke emissions. Ongoing EPA funded research led by NUIG has recently found that during a recent pollution event in Dublin the most significant emission source component was likely derived from such manufactured 'smokeless' fuels[49].

4.2.3.6 Peat and turf

The draft National Peatland Strategy[50] is a comprehensive national strategy which provides an integrated approach to address the various impacts of peatland use. The strategy recognises the potential impacts on air quality of the use of peat and turf for home heating. Many of the measures envisaged to mitigate climate, biodiversity and other impacts from peatlands use will also have co-benefits for air quality. The cross Departmental implementation group led by the Department of Arts Heritage, Regional, Rural and Gaeltacht Affairs (DHRRGA), co-ordinates activities to ensure delivery of the actions contained in the strategy.

Bord na Móna is a state body and is the largest producer of peat in Ireland. It produces peat briquettes from milled peat, for supply to the residential heating market. Peat briquettes are not addressed by national smoke control legislation. In October 2015 as part of its commitment to *corporate social responsibility* Bord na Móna published its Sustainability 2030 report[51], which outlined its strategy to replace its large scale peat production operations with alternative energy sources including biomass, wind and solar by 2030. Regarding sod peat or turf, an estimated 300 contractors operate in the sector. Sod peat represents an estimated 60-70% of the residential peat market.

DCCAE along with SEAI and DHRRGA are developing a pilot energy efficiency scheme for those household eligible and availing of the Turf Cutting Compensation Scheme (TCCS). The scheme aims to divert households away from using peat for home heating through the grand aided provision of more sustainable and clean, low carbon heating solutions as well as energy efficiency fabric upgrades to their houses. The scheme will increase energy efficiency, reduce carbon and air pollution emissions from households currently reliant on inefficient and polluting peat fuels for home heating. In doing so it will deliver on a number of cross government objectives, including energy efficiency, clean air and health, and climate while at the same time improving the quality of life for the householders.

4.2.3.7 Wood - quality assurance and standardisation

Official statistics suggest less than 2% of home heating energy is supplied by wood or biomass, though it is acknowledged that there is some uncertainty associated with this estimate. However, biomass, particularly poor quality biomass, can be associated with high emissions, and as it has been promoted by climate policy its use looks set to grow into the future. There are no statutory regulations for biomass quality though a voluntary Wood Fuel Quality Assurance (WFQA) scheme is in place. The scheme was established as an industry initiative[52] with assistance from the DAFM. It is reported that approximately 10% of the *traded* market is sold under this scheme.

There can be a big variation in the quality of wood sold in Ireland, from high quality debarked kiln dried logs under the WFQA to unseasoned logs with high moisture content. Purchasing cheap low quality fuel may prove to be a false economy as much of the fuel is needed to burn off excess moisture in the wood rather than providing heat output to the consumer; and the reduced combustion temperature can result in the increased generation of toxic and carcinogenic air pollutants including Polycyclic Aromatic Hydrocarbons (PAHs) and dioxins which are promoted by the high chlorine levels in the fuel.

Recent research from the European Commission[53] compared emissions from different types of biomass fuels and burning appliances (from open fire to pellet stove). The results found, for example, that emissions from log burning stoves are significantly higher than for wood pellet boilers. An on-going EPA funded research project in University College Cork[54] is looking at $PM_{2.5}$ emissions in rural towns outside the current smoky coal ban areas. Results thus far are showing that in some towns during the heating season, 60 to 70% of the $PM_{2.5}$ mass can come from solid fuel burning with as much or more than 20% being contributed by wood. However, the research does not indicate whether the wood is burned separately or co-burned with other solid fuel, for example, with coal as tinder.

4.2.4. Solid Fuel Appliance Emission Standards – Ecodesign Regulations

In addition to fuel quality, emissions will also be affected by the way in which the fuel is burned. An open fire is the least efficient and most polluting way of heating a home. Up to 80% of the heat is lost up the chimney, and the lower combustion temperature produces more pollutants, and in addition the lower efficiency requires more fuel, which in turn produces more pollution. The poor energy performance of open fires means that they are not generally considered a viable option for heating new homes under the Building Regulations[55]. However, poorly insulated existing homes, reliant on inefficient and polluting heating systems continue to contribute significantly to air pollution.

At present there are no mandatory emission standards to reduce air pollution from solid fuel stoves placed on the market in Ireland[56]. However, the EU Ecodesign Regulations[57] in 2015 set a range of emission standards for solid fuel boilers and stoves which will enter into force in 2022. Members States can introduce their own national emission standards prior to this date including from the Ecodesign standards, to provide for health and environmental protection in the years leading up to

2022. Without some intervention, there is a risk that, in the interim, a significant number of solid fuel appliances will be installed in urban and rural areas over the next 5 to 6 years with no emission standards. There are a small number of stoves on the market already compliant with these standards but it is understood the vast majority are not. Also, there is currently no national accreditation required to install solid fuel appliances, though some training courses are available for installers[58].

Solid fuel stoves are often marketed as an attractive heating option, as the presence of a fire in a room along with the direct heat and smell it provides can be perceived as homely. However, while the smell of a peat or wood fire may be considered attractive - much as the smell of a tobacco pipe was in a previous era - all smoke contains a range of toxic pollutants that impact on health. The absence of mandatory emission standards is significant as there has been an increasing trend in recent years to install free standing and inset stoves, sometimes to meet the Building Regulations renewables energy requirement, and sometimes as a supplementary heating system. The Building Regulations require that a reasonable proportion of the energy consumption to meet the energy performance of a dwelling is provided by renewable energy sources, which includes biomass or wood burning stoves. However, there is no corresponding requirement to regulate the associated emission of air pollution from such sources. Where such stoves are installed or where cleaner more efficient heating systems, like gas or oil are being supplemented or replaced by stoves, air quality can be affected with impacts for the occupants and the neighbouring community. This can be particularly so if the stove is installed in a ground floor extension and the chimney or flue is adjacent to upper floors of the same or neighbouring properties. It is then a matter for the local authorities to seek to resolve the resulting situations which can be problematic[59] and can persist even where installations comply with the Building Regulations. Such problems can be magnified if the stove is used to illegally burn waste which the EPA identify as one of the most significant risk factors for elevated dioxin levels in Ireland[14].

4.2.5 Energy Efficiency and Energy Poverty

A Strategy to Combat Energy Poverty 2016-19[60] sets out the national strategy to address energy poverty. Data suggests there is a correlation between energy poverty levels and those reliant on the use of solid fuel as the primary heating source. The NSMC study assessed the top 40 air pollution emission density hotspots in Ireland against a deprivation indicator and found that almost all of the identified residential pollution hot spots in Ireland are in deprived or very deprived areas. These areas predominantly use solid fuel for heating with little use of oil or gas and so elevated levels of air pollution can impact on health and compound deprivation in these areas.

Action to address energy poverty by increasing energy efficiency and converting to cleaner more efficient fuels can have added health benefits from cleaner air. Households at risk of energy poverty may opt for solid fuels because of the heating system available to them and the fact that solid fuels can be purchased on demand in smaller amounts. Potentially large bi-monthly gas bills are more difficult for households to deal with than more frequent purchases of solid fuels even though these larger, less frequent, payments could be less costly over time. DCCAE will continue to promote energy efficiency as it creates multiple societal benefits, including reducing health impacts by

promoting cleaner fuels, which reduce air pollution and lower carbon emissions as well as reducing reliance on imported fossil fuels and support domestic jobs.

Consultation Questions – Residential Sector

1. Are there particular incentives that could be introduced to promote a quicker transition to clean, low carbon heating in the residential sector?
2. Should complementary measures that could be introduced to support the national ban on bituminous 'smoky' coal by 2018? If yes, please elaborate?
3. Should gas be better promoted for home heating where it is available to houses on the gas grid? If so, how?
4. Are there adequate supplies of cleaner alternative fuels to supply the market and support the transition from 'smoky' coal for residential heating by 2018?
5. In relation to manufactured 'low smoke' solid fuels, should the;
    (i) smoke emission rate of 10 g/hour be revised to be in line with the original standard introduced in 1990, and the current standards in Northern Ireland which have already been adopted for 2018 for biomass blended fuels in Ireland?
    (ii) smoke emission rate criteria apply to all manufactured solid fuels, rather than those just those containing coal?
6. How can better quality wood and biomass quality standards be promoted? Should consideration be given to setting mandatory fuel quality standards?
7. Should consideration be given to bringing forward the date from 2022 for the introduction of Ecodesign standards for residential stoves?
    - Are there other ways to increase the uptake of Ecodesign standards for stoves ahead of the 2022 mandatory deadline?
    - Should Ecodesign standards be required now where biomass combustion is chosen as a renewable energy source to meet Building Regulations requirements?
8. Are there specific targeted retrofit schemes which could be introduced to promote cleaner fuel and cleaner air and address energy poverty, improve energy efficiency?
9. Should consideration be given to requiring all installers of solid fuel appliances to meet a national accreditation or standard (similar to requirements for gas installation etc.)?
10. Are there any other issues you wish to raise in relation to air pollution from the residential sector?

4.3 Transport

Transport, in particular road transport, is a significant source of a range of air pollutants, the most significant of which are NO_x, Particulate Matter (including black carbon) and Volatile Organic Compounds (VOCs) emissions. Though road vehicles have met progressively tighter EU emission limits since the early 1990s when they were first introduced almost half of all NO_x emissions resulted from road transport in 2014.

The EPA in its recent annual Air Quality report stated that pollutants from the transport sector, such as NO_2 is set to become an issue in the coming years for Ireland, driven by increased dependence on fossil fuels and that technological advancements are not likely to fully resolve the challenges faced, even in the long term. It recommended that emphasis and priority should be given to public transport or clean transport over motor vehicles in all aspects of society. The report identified the potential for individual choices that people make to have the most immediate and greatest impact on transport emissions in our urban areas where NO_2 is problematic and where public transport is a viable option.

In addition to road transport, increased sea freight and cruise shipping along with the forecast increase in airline travel means that addressing the transport sector impact on air quality continues to be a significant challenge. 'Smarter Travel - A Sustainable Future'[61] was published by the department of Transport in 2009. It provided the framework to develop policies to address the multiple air and environmental impacts of transport. Sustainable transport policy is also being advanced through the development of transport measures for the National Mitigation Plan and through the National Policy Framework for Alternative Fuels Infrastructure for Transport which is due to be published shortly[62]. A shift from private vehicles to public transport or active travel modes can help address many of the negative effects of road transport including reducing air pollution, greenhouse gas and noise emissions, as well as the economic costs of traffic congestion.

4.3.1 Road Transport

Vehicle emissions are a key source of health impacts from a range of air pollutants including NO_x, particulate matter, black carbon and VOCs particularly in urban areas. In addition to exhaust emissions, abrasion, for example, from tyres and brakes contributes to emissions of particulate matter. Figure 10 below shows the key sources of air pollution from fossil fuelled vehicles. Though petrol and diesel road vehicles have met progressively tigher EU emission limits, known as *Euro standards*, since the early 1990s, increases in road traffic, changes to the the petrol/diesel fuel mix as well as questions over the efficacy of the Euro standards in real driving conditions, and the behaviour of some vehicle manufacturers mean that the air pollution impact from road transport still constitutes a significant impact and presents a significant challenge. As indicated in the figure below from the EEA, the internal combustion engine is a relatively inefficient and polluting way to power a vehicle. The diesel engine is relatively more efficient than a petrol engine but produces generally higher emissions of certain air pollutants including NO_x, particulates and black carbon. A move from solely petrol/diesel powered vehicles to cleaner alternatives like hybrid electric (HEVs) and full electric vehicles (EVs) in the coming years will likely bring significant improvements in fuel efficiency and reduced air and noise emissions.

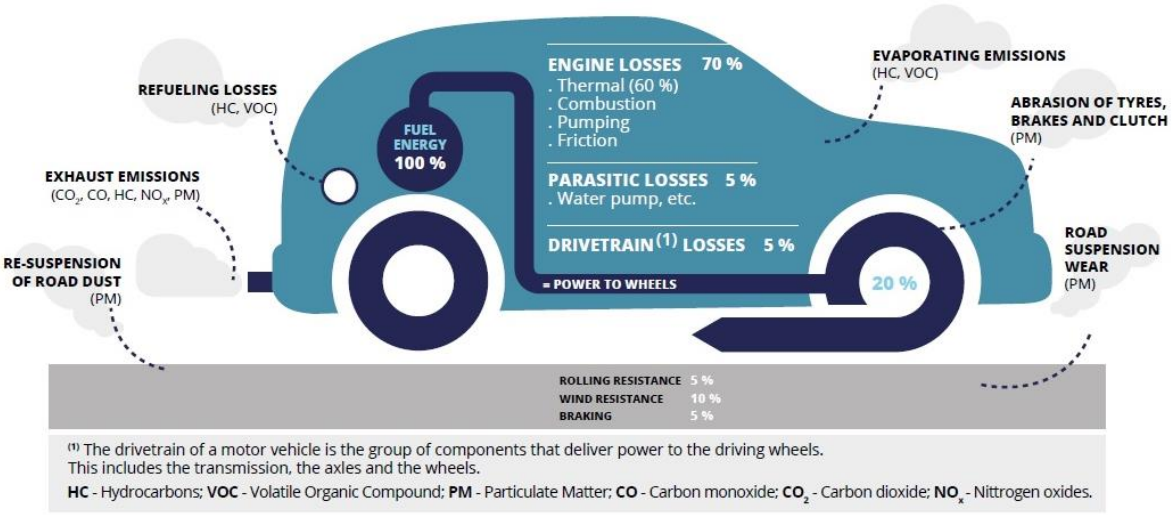

Figure 11: Summary of emissions from fossil fuelled vehicles – (source EEA, 2016)

4.3.1.1 'Dieselisation' - the increasing trend in diesel vehicles.

Policy changes driven by climate considerations, namely to (i) VRT restructuring and (ii) motor tax in 2008 and 2013 as well as (iii) widening the differential between petrol and diesel taxes, have increased the up-take of lower CO_2, but higher polluting diesel vehicles. In 2015, diesel cars outsold petrol at a rate of more than 2.5 to one in Ireland effectively reversing the situation in 2008. Ireland had the highest percentage of new vehicle diesel sales in the EU in 2015 and 2016 at 72.2% and 71% respectively, significantly higher than the EU average of 53.6% and 52.1% respectively[63]. See figure 11 below. A recent Tax Strategy Group report[64] details the trends in diesel fuel and vehicle VRT receipts versus petrol.

The resulting increase in the number of diesel vehicles, particularly in cities, is giving rise to health concerns due to health implications of higher emissions of NO_X, and particulate matter ($PM_{2.5}$, black carbon) emissions associated with diesel fuelled vehicles. This has been an international trend and a number of metropolitan areas including London, Paris and a number of German cities are considering the option of banning diesel vehicles. The Netherlands has proposed a ban on the sale of all internal combustion engine cars from 2025 and Oslo is considering plans to start reducing private cars allowed in the city by 2019.

The OECD have recommended at least an equalisation of excise rates on petrol and diesel to address negative externalities (including air quality impacts) caused by the combustion of these fossil fuels. The Tax Strategy Group paper also outlines how equalisation could be implemented in Ireland suggesting a period of 5 years.

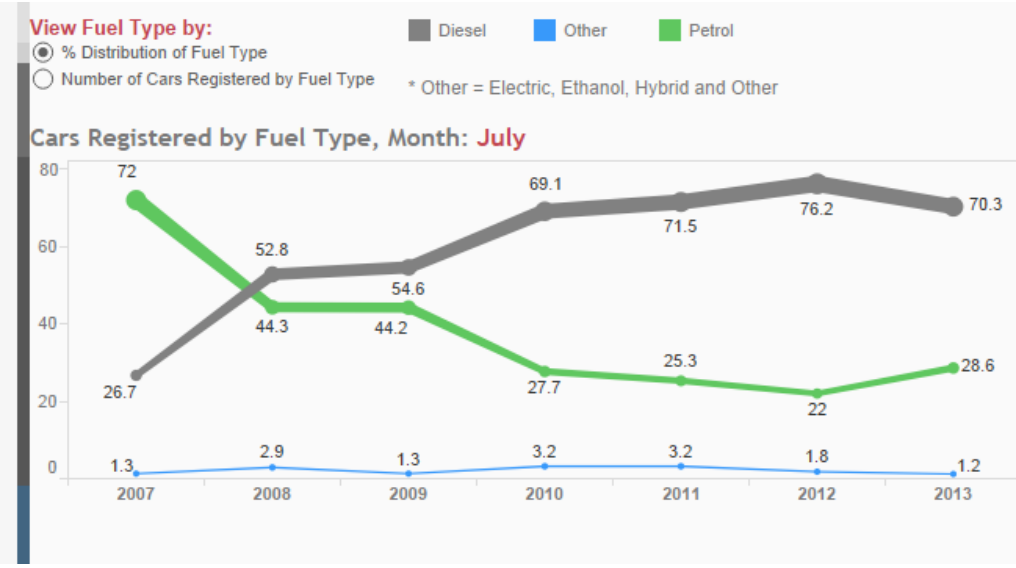

Figure 12: Private vehicle registrations 2007 to 2013 (Source: CSO/All Island Research Observatory[65])

4.3.1.2 Vehicle Emissions Regulation

Vehicle emissions are regulated in the EU under EU Type Approval procedures implemented by each Member State[66]. The National Standards Authority of Ireland (NSAI) is the Type Approval Authority in Ireland and issues approval for a number of vehicle types (including for vehicle emissions) which is valid across the EU. Technical laboratory facilities are not available in Ireland to conduct type approval emissions testing so such tests are conducted abroad.

The Volkswagen diesel emissions scandal has highlighted a number of regulatory shortcomings in EU legislation. To consider these issues, a European Parliament committee of enquiry into Emission Measurements in the Automotive Sector (EMIS) was established. Its draft report identifies Ireland (as one of 4 Member States) that have issued type-approval certificates but not conducted complementary testing[67]. The specific legislative shortcomings highlighted relate to (i) the current emissions test cycle in the EU which is not representative of actual 'on road' real driving emissions (RDE) and (ii) the lack of regulatory oversight by Member States in relation to a vehicle's actual 'in use' emissions over time, rather than just at the time of manufacture. To address these issues the EU has adopted a revised emissions test cycle that incorporates elements of real world driving, and is considering a legislative proposal[68] to revise current arrangements to require greater regulatory oversight at Member State level, including the establishment in each Member State of a Market Surveillance Authority (MSA) to conduct, *inter alia*, 'in use' emissions testing.

Modern cars are highly computerised and monitor a multitude of data on a range of parameters relating to the state of the vehicle during driving which may provide information in relation to a vehicle's actual 'on road' emissions. The OECD Environment Ministers' recently agreed the need for standards for new vehicles to better reflect real world driving emissions, but stressed that there is also a need to focus on emissions from vehicles already in use, e.g. through the use of information in the on-board diagnostic systems that are present in many vehicles and through more on-road vehicle testing[69]. The National Car Test (NCT) is designed to ensures that vehicles using the roads in Ireland roads are subject to a basic safety check at regular intervals. It is managed by the Road Safety Authority (RSA) and includes a basic set of tests related to exhaust emissions. However, the NCT

emissions test is relatively rudimentary compared to Type Approval testing and does not, for example, cover NO_x or interrogate the vehicle's on-board diagnostic system regarding emissions related parameters.

4.3.1.3 Diesel Emissions Scandal in Ireland

In Ireland a reported 117,000 Volkswagen vehicles were affected by the diesel emissions scandal resulting in elevated emissions of NO_x and an associated public health impact while those vehicles remain on the road untreated. VW has written to all owners indicating that they are seeking a technical solution and will revert to owners as soon as possible regarding that technical solution. At the time of going to press, no figures were made available for the number of vehicles in Ireland to which a technical solution had been retrofitted. Recent figures available for Europe suggest less than 10% of vehicles have been retrofitted[70].

4.3.1.4 Removal of Diesel Particulate Filter (DPF)

Modern diesel vehicles are fitted with DPFs to capture much of the fine particles that are generated when diesel fuel is combusted in an engine. Whilst DPFs do not capture all particulate matter they significantly reduce the pollution - by around a factor of five - that would otherwise be emitted to the air. There are various types of DPFs, but all require the filter to be periodically 'regenerated' or cleaned by burning off the particulate deposits collected from the vehicle's exhaust. Cars that regularly take long journeys are able to burn off deposits in the DPF more easily because of the higher engine temperatures on long journeys, whereas cars that take short, mostly urban journeys may not reach the regeneration temperatures often and so are more at risk of the DPF becoming blocked.

It is illegal to drive a car with a DPF that has been removed, however, technically is not an offence for a garage to remove a DPF. To avoid the potentially recurring cost of having a DPF cleaned or replaced when blocked, 'quick fix', low cost services are being offered, advertised openly online, to remove the DPF. It is understood that in all but the crudest of removals, detection by the current NCT procedures is unlikely though, a small number of diesel vehicles have received an 'Incomplete Emissions System' notification since 2014. UK authorities have recently introduced enhanced checks to detect DPF removal and it is reported that significant numbers of removed DPFs have been detected, and this has acted as a deterrent to removal.

4.3.2 Low Emission Zones and charging schemes

Low Emission Zones[71] (LEZs) are generally urban areas where the most polluting vehicles are regulated. Usually this means that vehicles with higher emissions cannot enter the zone, though in some low emission zones the more polluting vehicles have to pay more if they enter the zone. Low Emission Zones can be the most effective way that towns and cities can improve air pollution. Low emission zones reduce emissions of nitrogen dioxide, fine particles and (indirectly) ozone, which are among the main priority air quality pollutants across Europe. Generally the regulation is applied on the basis of a vehicle's Euro standards so that vehicles that do not have the appropriate Euro standards will not be permitted entry or may have to pay a surcharge to enter the zone. In some LEZs, fitting a diesel particulate filter can allow a vehicle access to the zone. Low Emission Zones

have been established in many cities in the UK and across the EU though no LEZs have been considered to date for any urban areas in Ireland.

In many cities around the world a congestion charge has been introduced to better regulate road traffic in congested urban areas. As well as the economic benefits, reduced congestion can deliver a host of co-benefits including cleaner air and better public health, reduced CO_2 and reduced noise. The revenue stream from a congestion charge can be used to promote more sustainable transport modes, for example, walking, cycling and public transport. There can be synergies between the operation of a congestion charge and a low emission zone, as the infrastructure required to operate a congestion charge could be used to implement a LEZ by, for example, identifying specific vehicles and their emission category.

4.3.3 Vehicle Fleets

Cleaning the public transport fleet presents an opportunity to reduce emissions and many European cities have already invested significantly in the electrification and hybridisation of their public transport network as well the retro fitting of existing fleet to reduce nitrogen oxides. The national sustainable development framework, Our Sustainable Future[72] contains a commitment to examine the feasibility of retrofitting gross polluting vehicles, e.g. heavy goods vehicles and buses, with NO_x abatement technology. At EU level, the Clean Vehicles Directive[73] promotes clean and energy-efficient road transport vehicles by requiring public authorities to take into account lifetime energy, environmental and air impacts when purchasing new road vehicles. At least the following must be taken into account; energy consumption, emissions of carbon dioxide (CO_2), oxides of nitrogen (NO_x), non-methane hydro-carbons (NMHC) and particulate matter. Many of the vehicles used in carrying out public services are increasingly operated by private operators – from bus operators, to waste collection and road maintenance companies. Although public authorities do not typically own the vehicles used to carry out such services they may still influence the vehicles used considerably. The Directive is currently being reviewed and its implementation is overseen by Department of Transport, Tourism and Sport (DTTAS).

4.3.4 Shipping

Relative to comparable modes of transport, shipping is generally considered an environmentally friendly mode of transport for both passengers and freight. Shipping emissions by their nature and location are not always readily apparent, and thus have not been subject to the same regulatory controls as land based emission sources. As a result, shipping can be a significant contributor to local and regional air pollution in particular in the form of nitrogen dioxide, sulphur dioxide and PM emissions and it has become a larger component of overall emissions as other sectors have reduced emissions. EPA funded research[74] conducted at the Port of Cork measured the number of fine pollution particles, which can penetrate deep into the respiratory and cardiovascular systems, and found that shipping was second only to road traffic as a source of such particles, confirming the contribution that shipping can make to air pollution. Some of the potential impacts to air quality from shipping activities in Dublin are mentioned in the Dublin Port Company, 2012 to 2040 Masterplan[75], which is currently under review.

A number of recent initiatives at international and EU level are set out below and should deliver further emission reductions. In addition there would appear to be further scope for cost effective measures to be introduced in Ireland to further reduce emissions, particularly at ports.

Figure 13: Exhaust emissions from shipping in Dublin Port

4.3.4.1 The MARPOL (Marine Pollution) Convention

The MARPOL Convention[76] is the main international treaty under the UN International Maritime Organisation (IMO) for the prevention of pollution from ships, and it sets limits on sulphur oxide and nitrogen oxide emissions and prohibits deliberate release of ozone depleting substances. It also provides for the establishment of designated Emission Control Areas (ECAs) which set more stringent standards for SO_x and/or NO_x and have been established in the European waters, in the Baltic Sea, the North Sea and the English Channel. Aside from the Atlantic Ocean and its seas, the seas between Ireland and the UK are some of the few seas in Northern Europe that have not been designated an Emission Control Area under MARPOL, though certain EU[77] controls do apply in areas outside of this designation under EU legislation, for example, in relation to passenger ferries.

Addressing air pollution at sea can be challenging given operational requirements and space constraints on board. Thus a primary focus has been to ensure the use of cleaner fuels by setting standards for sulphur content. In a recent landmark IMO decision with significant beneficial impacts for both the human health and the environment, 1st January 2020 has been confirmed as the implementation date for a significant reduction in the sulphur content of the heavy fuel oil used by ships. The decision to implement a global sulphur limit of 0.5% (by mass) in 2020, reduced from the current level of 3.5% was confirmed in October 2016. An alternative, known as an 'end of pipe' approach, is permitted where sulphur emissions from a ship's exhaust emissions are reduced using abatement technology, similar to that applied for industrial installations. However, this system creates polluted 'wash' water which is more difficult to manage on a ship than on land, and so may

in certain cases be transferring pollution from the air to the aquatic environment, which could be particularly damaging in the closed areas of ports and estuarine waters.

4.3.4.2 Ports and Use of Shore Side Electricity

Emissions from shipping operations at port can also be significant and can be avoided or significantly reduced with the use of 'mains' electricity or what is known as shore side electricity (SSE), rather than relying on the ships generators when docked at port. There are currently no shore side electricity (SSE) supply facilities at any ports in Ireland and there is reported to be little demand from the shipping industry[78].

A report[79] prepared on behalf of the European Commission in 2015 estimated that SSE in Europe has the potential to significantly reduce emissions, including for SO_2 (46%), CO (76%) and NO_x (92%) and CO_2 (25%) when compared against using on-board power generation. The report also monetised the health impacts of emissions from shipping in different ports and found that there were significant marginal damage costs for air pollution associated with shipping emissions for Ireland, in Dublin, in particular, and that the provision of shore side electricity has the potential to reduce these health costs and emissions.

4.3.5 Aviation Emissions

Aviation emissions by their nature are not restricted to national boundaries; the Air Convention requires that only emissions resulting from international landing and take-off cycles are incorporated into national inventories. Newer more efficient aircraft fleets have led to reductions in emissions per passenger kilometre, but the pace of growth in recent years and projected growth in the years ahead mean that technological efficiency gains will not offset the absolute increase in total emissions from aviation.[80] Passenger numbers exceeded 25 million at Dublin Airport in 2015 and future projections of aviation growth expect passenger numbers to exceed 50 million by 2037[81]. While reductions in emissions from aircraft in operation will be delivered by developments in aircraft design and technological developments, there are measures that can be taken in relation to operations to reduce emissions.

As is the case for shipping, fixed electrical ground power (FEGP) for 'berthed' aircraft can significantly reduce air and noise emissions by replacing diesel powered auxiliary power units (APUs), which are still widely used at airports in Ireland. As part of developing a National Policy Framework for Alternative Fuels consideration is being given to conducting a Life Cycle Analysis of rolling out FEGP units at all airports not currently using electricity supply for stationary aircraft.

4.3.6 Rail

Rail is generally considered an environmentally friendly form of transport particularly where the power source is electricity. However, emissions of local PM and black carbon pollution do arise from diesel powered trains which are the only option off the urban electrified network. These emissions can be greatest in train stations where exposure can be highest when the train is idling for periods or

moving out of the station under load - the use of automatic engine shut down technology has been introduced by Irish Rail as part of its energy efficiency programme. Where stations are covered, or partially covered, this can lead to an accumulation of pollutants in the air that can increase exposure to commuters, though occupational exposure is likely to be higher.

Consultation questions – Transport

1. Could a congestion charge promote a shift to public transport in certain urban areas and deliver a range of interlinked benefits including improving air quality, climate policy and sustainable transport by encouraging greater public transport use or use other low impact modes like cycling or walking?
2. Should consideration be given to the introduction of Low Emission Zones in urban areas?
3. Should consideration be given to incorporating air quality considerations into vehicle taxation?
    - If so should these considerations be addressed to VRT, motor tax or fuel taxes or a combination of all three?
4. How can the issue of DPF (Diesel Particulate Filter) removal best be tackled?
    - Should consideration be given to creating a specific offence for removal of a DPFs and/or advertisement of its removal?
    - Could the NCT be expanded to include DPF examination?
5. In the wake of the VW emissions scandal, how can 'in use' vehicle emissions be better regulated?
    - Could the NCT emissions testing have a role in periodic assessment of air pollution emissions, to inform better regulation of 'in use' vehicle emissions?
    - Is there data contained in vehicle On-Board Diagnostics (OBD) systems that could be useful in this regard?
    - Should a programme of national emission testing be conducted in Ireland, as has been done in other countries, to assess real driving emissions from vehicles on the roads?
6. How can a greater consideration of emissions be incorporated into the procurement of new public transport vehicles in line with the EU Clean Vehicles Directive?
7. Are there steps that could be taken to reduce emissions from ports given the anticipated increase in shipping including, for example, cruise traffic?
    - Should consideration be given to introducing an Emission Control Area under MARPOL in the seas between Ireland and the UK?
    - Are there specific steps or incentives that can be taken to promote the uptake of shore side electricity to reduce air pollution from shipping operations whilst in port?
    - Should consideration be given to prohibiting the discharging to seas in Ireland of contaminated 'wash' water from ships air abatement systems?
8. Are there additional air pollution sources or impacts from aviation or rail that should be considered?

4.4 Agriculture

4.4.1 Background

Agriculture, unlike for example transport or energy is not typically seen as a source of air pollution though agricultural activity can lead to significant emissions of certain air pollutants. However, the emissions sources are qualitatively different as they arise primarily from livestock and crop management, which may not be as amenable to technological or other abatement solutions as transport or energy sources. However, a recent scientific assessment[91] under the Air Convention found that ammonia emissions from agriculture in Europe emerge as a key focus for further abatement measures. Recent industry-led strategies including Food Harvest 2020[82] and Food wise 2025[83] forecast significant growth and intensification of the agricultural sector, for example, increasing milk production by 66% by 2025, and this may lead to increased air emissions. Some of this intensification has already occurred, for example, in the dairy sector due to the abolition of the milk quotas in 2015.

Agricultural activities accounted for over 98% of the national ammonia (NH_3) emissions in 2014 and emission reductions in the sector will be needed to reduce ammonia impacts and comply with future EU obligations; there are suggestions that agricultural burning, and burning more generally, should be included in national emissions estimates as it is a source of particulate matter. Ammonia has not been subject to the same focus as pollutants from industry or transport, like NO_x and SO_x which unlike ammonia, have shown very sharp reductions in recent years. Ammonia arises predominately from liquid and solid waste from livestock and the use of artificial fertilisers. Excess ammonia can impact on biodiversity by reducing the species diversity and changing the species composition; it can also react in the atmosphere with other gases such as SO_2 to form *secondary* particulate matter. Under the National Emissions Ceiling Directive (NECD) (see section 3.2.2), Ireland has had a mandatory ceiling for ammonia since 2010. More challenging ceilings for 2020 to 2030 were agreed in December 2016 for all Member States as part of the EU Clean Air Package. The emission trend for ammonia from 2000 to 2014 along with the 2010 national ceiling is presented below.

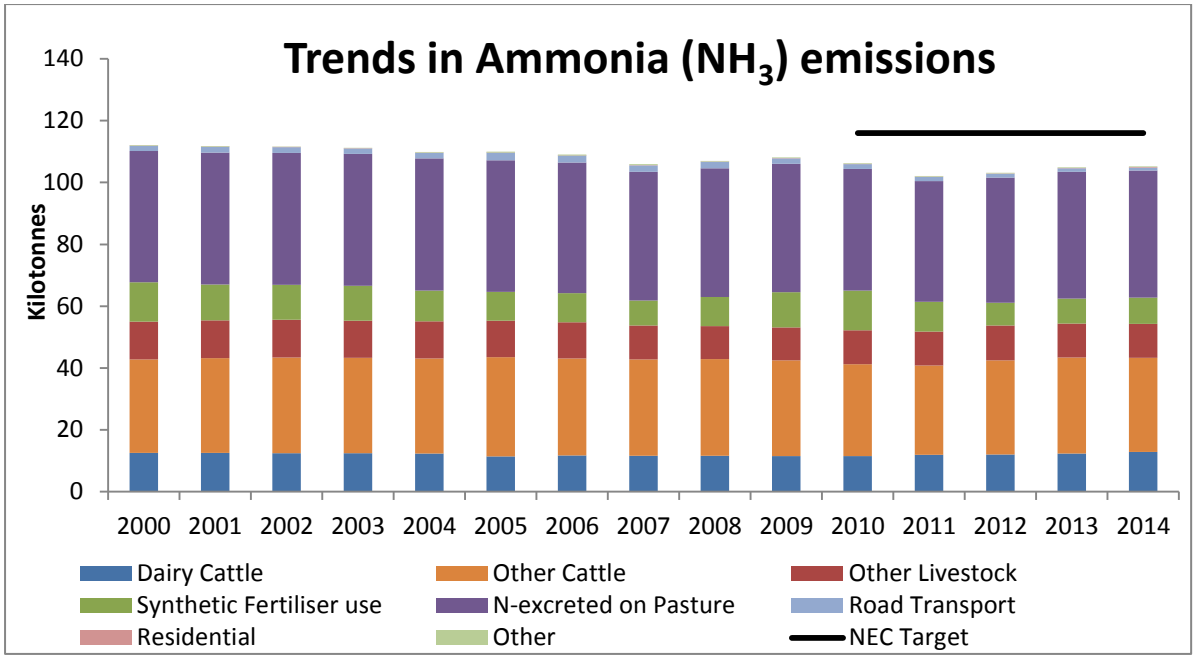

Figure 14: Ammonia emission trends, Ireland 2000 to 2014 incorporating 2010, NECD Ceilings.[84] (Source EPA).

Agriculture is also a significant source of greenhouse gases contributing 33% to Ireland's overall total[85]. This is mainly in the form of methane (CH_4) emissions from ruminant livestock but also from nitrous oxide (N_20) emissions from the use of artificial fertilisers and manure management. Methane is primarily considered a greenhouse gas with climate impacts but it also has air quality impacts, through a series of photochemical (sunlight induced) reactions which lead to the formation of ground level ozone in the atmosphere that damages health and crop productivity. The linkages with climate need to be carefully considered as, for example, action to reduce nitrous oxide (N_2O) could increase ammonia emissions and *vice versa*.

The level of ambition in the Food Harvest 2020 and Food Wise 2025 strategies is evident from national statistics with the dairy cow population 7.7% higher in 2015 compared with 2014 and an increase in milk production of 13.2%. Increased emissions of ammonia from increased livestock numbers and consequent animal waste volumes will make future National Emission Ceiling Directive ceilings for 2020 and 2030 more challenging. A detailed analysis[86] has been undertaken to assess the most cost-effective measures available to deliver the ammonia reductions required to meet future targets. The measures considered are closely inter-linked to those required to deliver methane and nitrous oxide emissions reductions. To assist delivery of the measures and apply international best practice, the revised NECD provides a template for Member States to establish a national advisory code of good agricultural practice to control ammonia emissions, based on the 2014 UNECE Framework Code for Good Agricultural Practice for Reducing Ammonia Emissions[87].

The analysis indicates that much of the ammonia reduction will require the use of modern low emission slurry spreading techniques such as trailing shoe/hose instead of the traditional broadcast 'splash-plate' technique. Also, the use of urea stabilisers for fertilisers and the covering of slurry storage in the pig and dairy sectors can also help reduce ammonia emissions. The current configuration of animal housing in Ireland is reported by Teagasc to make abatement challenging, as

the majority of slurry in cattle and pig slurry-based housing systems is stored under the animals in slatted tanks, with a minority stored in open or closed tanks outside the buildings.

4.4.2 Ammonia concentrations and Critical Loads

As mentioned above, ammonia has not been subject to the same focus of reduction at source as pollutants from transport or energy, like NO_x and SO_x which unlike ammonia, have shown very sharp reductions in recent years. However, the focus is increasingly turning to ammonia as ongoing national and international research is showing the increasing contribution that ammonia plays in the formation of $PM_{2.5}$ which has significant health implications [88,89] and the impacts of excess nitrogen derived from ammonia on biodiversity in terms of acidification and eutrophication[90,91].

Air quality monitoring results in a number of rural towns as part of ongoing EPA funded research by University College Cork[92] found that between 9% and 16% of fine particulate matter ($PM_{2.5}$) derive from ammonia in those locations. Recent EPA funded research conducted a national assessment of the impacts of nitrogen deposition on natural grasslands[93], finding that more than 30% of grasslands were predicted to exceed critical loads of nutrient nitrogen deposition (of which 20% were Natura 2000 areas), above which harmful effects occur. Approximately 80% of nitrogen deposition in Ireland is derived from ammonia emissions.

Separate EPA funded research undertaken by UCD (Ammonia2[94]), monitored ambient ammonia levels across 25 sites in Ireland over a full year. This project repeated a similar monitoring exercise which was undertaken in 1999/2000. The figure below presents the results of ammonia levels monitored over 2013/2014.

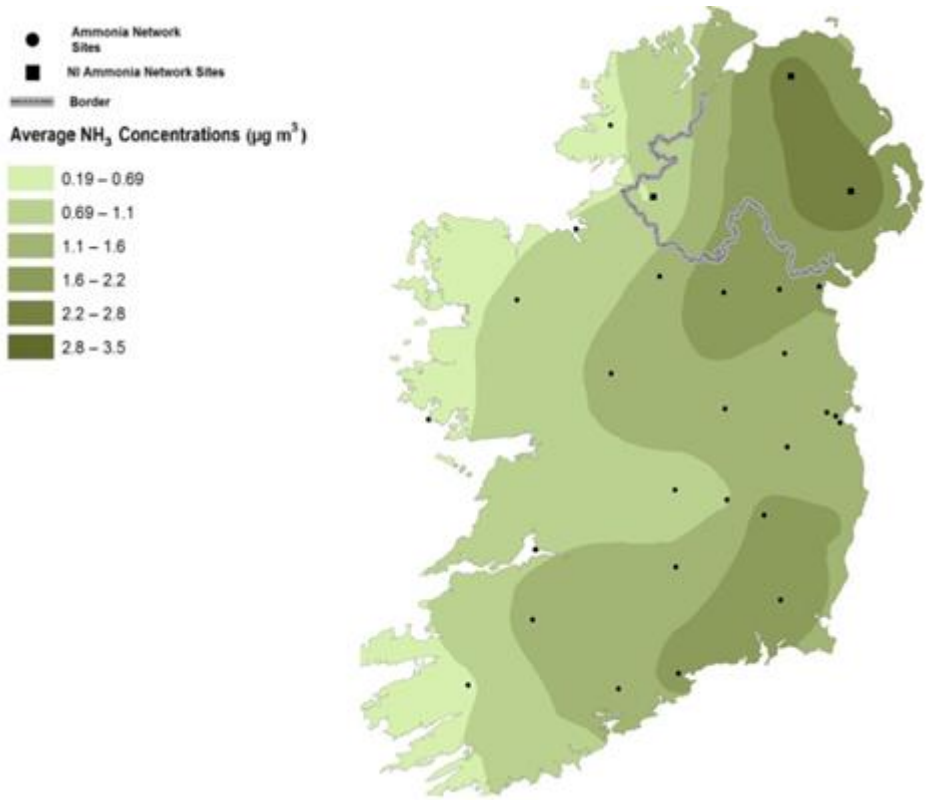

Figure 15: Mean atmospheric ammonia (NH_3) concentrations, averaged over a year at 25 sites in Ireland and 3 sites in Northern Ireland between 2013 and 2014. (Northern Ireland data courtesy of Dr. Yuk Sim Tang, 2015).

The Ammonia2 research project found that the annual average ammonia concentration, 1.72 µg/m^3 from all 25 sites, was higher than the 1.45 µg/m^3 average of the 1999–2000 study. This observed mean is above the critical level[95] for sensitive ecosystems (where lichens and bryophytes are key to ecosystem integrity), but below the critical level for all other vegetation. The results demonstrate significant relationships between observed ammonia levels and total arable area, total cattle population, and pig and poultry emissions across the study sites. This suggests that a net increase in agricultural production will lead to an increase in ambient atmospheric ammonia concentrations and depositions.

4.4.3 Slurry spreading

Liquid and solid animal wastes are used as an organic fertiliser for grass growth and to improve and maintain soil nutrients. The majority of slurry in Ireland is spread using the splash plate technique which broadcasts the slurry mixture into the air before landing on the grass and soil. The splash plate technique can, depending on the timing of the application and the weather conditions, result in significant nitrogen loss to the atmosphere through ammonia volatilisation, as well as creating odour issues.

More modern technology such as trailing shoe and trailing hose equipment for the spreading of slurry can deliver slurry, and consequently nitrogen, more efficiently to the soil, thus reducing volatilisation of ammonia and this helps to mitigate bad odours which can arise during the spreading season and can give rise to complaint from the neighbouring community.

A number of schemes are included in the Rural Development Plan (RDP) 2014-2020[96] under the Targeted Agricultural Modernisation Scheme[97] (TAMS) which provide farmers with a level of support to meet the capital costs associated with establishment of their enterprise and ensuring that they have the most up-to-date technology available to compete in the modern agriculture sector. The level of funding available under these schemes is €395 million. A low-emission slurry spreading actions is also contained within the Green Low-carbon Agri-environment Scheme (GLAS), to complement TAMS and increase the awareness and uptake of this action. It is included as a priority action under tiers 1 and 2 of the Scheme. Approximatley 2,300 farmers have applied for this action under the first two tranches of GLAS. The TAMS which are relevant to protecting and enhancing air and water resources include:

The Low Emission Slurry Spreading (LESS) Equipment Scheme

The principle objective of this scheme is to assist farmers in purchasing low emission slurry spreading equipment (trailing shoe) to increase uptake of nutrients by the crop and therefore reduce losses to air and water. Following the first two tranches of this scheme intake, approximately 450 applications were received.

The Animal Welfare, Safety and Nutrient Storage Scheme

This scheme assists tillage farmers in the storage of animal excreta, soiled water and other farmyard manures and related facilities. Approximately 1,500 applications were received under the first two tranches of the Scheme.

Figure 16: Example of modern low emission trailing shoe slurry spreading system (left) and traditional high emission 'splash plate' slurry spreading systems (right). (Images used by permission of Hi Spec Engineering Ltd. www.hispec.net)

In Denmark, the use of broadcast splash-plate slurry spreading has been banned for over a decade (since 2001) with only low emission slurry spreading techniques allowed[98]. Importantly, these low emission techniques also deliver the slurry below the grass sward onto the ground meaning that cattle can return to graze more quickly in comparison with broadcast slurry spreading. It is important that measures to reduce ammonia emissions are closely aligned with measures aimed at reducing greenhouse gas emissions for climate mitigation as well as nitrates under the Nitrates Directive. Further assessment and focus is needed on this interaction of policies and measures to ensure that pollution swapping does not occur where one pollutant decreases at the expense of another. Teagasc research has indicated that switching fertilisers from CAN (Calcium Ammonia Nitrate) to Urea and urease stabilisers as a climate mitigation measure could result in a substantial reduction in nitrous oxide (N_20) emissions but consequently an increase in ammonia emissions.

4.4.4 Agricultural waste (manure) management

The broadcast slurry spreading technique and the agitation of slurry storage tanks on farms can result in emissions to air, that have the potential to cause odour nuisances to the neighbouring community. The improvement of waste storage facilities, waste handling and spreading techniques can all decrease emissions to air.

An Anaerobic Digestion (AD) or Biogas plant is an established technology for the biological treatment of a range of organic wastes (e.g. slurry, farmyard manure, spent mushroom compost, sewage sludge, industrial sludges etc.), which can be broken down by bacteria in anaerobic or oxygen-free conditions. The European Biogas Association[99] reported that there were 17,240 AD plants in operation at the end of 2014. In comparison to many other MSs, Ireland has had a very low investment in and uptake of AD with only 33 plants in operation. Recent reports from Cré[100], the composting and anaerobic digestion Association of Ireland highlight the potential benefits, growth potential and climate mitigation potential of AD in Ireland. This technology has the potential to treat

agricultural wastes, food wastes and industrial bio-wastes which could help manage gaseous emissions from such wastes (including odours) and produce valuable biomethane gas which could be used for transport and heating purposes along with digestate which can be used as an agricultural fertiliser.

Figure 17: Anaerobic Digestion Plant, Green Generation Ltd., Nurney, Co. Kildare (Courtesy of Green Generation Ltd , http://greengeneration.ie/?page_id=149))

The Draft National Bioenergy Plan[101] includes recommendations to further incentivise the expansion of AD and other bioenergy technologies in Ireland.

4.4.5 Emerging issues - Agricultural burning

Prescribed burning is a practice used in Ireland for agricultural land management purposes. Fire is used as a means to remove scrub, help improve cultivated land or as a means to establish and maintain fire breaks to protect forestry plantations. Many member states have banned the use of fire under the EU Good Agriculture and Environment Condition (GAEC) standards. In Ireland the burning of agricultural residues is banned, however, burning is permitted for the control of growing vegetation in certain types of habitats and conditions subject to the prescribed code for burning, provided the burning is part of an overall landscape management strategy. in accordance with the Wildlife Act 1976 (as amended), it is illegal to burn any growing vegetation on land between the 1st March and 31st August each year if the land is not then cultivated. The DAFM have prepared a Code of Practice[102] which outlines the procedures to be followed when undertaking prescribed burning activities.

The European Commission have noted satellite evidence of emissions from burning in Ireland though Ireland currently does not report emissions from agricultural burning[103]. The satellite image below was taken by the European Space Agency Sentinel 2 satellite as part of the Copernicus programme and shows a large plume of smoke from a fire in Cork in November 2016.

Figure 18: (Left) Satellite image of a fire, Cork November 2016 (Source: ICHEC[104]) and (right) a ground image of air pollution from scrub (*in situ* biomass) burning also in Cork November 2016, both showing local and long range transport of air pollution.

Fires can release significant amounts of pollution to the atmosphere, particularly particulate matter including black carbon, which can cause local air quality issues that can impact on people's health[105], however, they can also have wider regional impacts as the particulates released can reside in the atmosphere for many days and even weeks and be transported over long distances adding to the background levels in cities and towns. The EPA currently prepares estimates of greenhouse gas releases from this type of burning though estimates for air pollutant releases are not currently included in the national emissions estimates as comprehensive data sets to inform such estimates have not been collated.

The DAFM code of practice requires that a detailed burning plan is submitted to Local Fire Services. However, central statistics are not compiled on the number of fires for which a burning plan is submitted. The Fire Services record the fires they attend and they report a category in relation to fires occurring on *Forest/Bog/Grass*[106]. In 2015 they attended 2,505 such fires, though this is not an estimate of the number or scale of agricultural burning incidents but of fires attended, whether started for agricultural management purposes or otherwise.

Any measures that promote alternatives to agricultural burning could have clean air, climate and biodiversity co-benefits, as well as potentially freeing up Fire Services' resources required to deal with poorly planned or illegal fires.

4.4.6 Agricultural 'Green' Waste Burning

The burning of waste is prohibited under waste management legislation[107] . However, there is an exemption currently in place to allow the burning of green waste generated by agricultural practices relating solely to material consisting of uncontaminated wood, trees, tree trimmings, leaves, brush etc. provided alternative disposal options have been considered, for example, waste reduction, reuse and/or recycling measures in line with the waste hierarchy. The exemption provides that burning can only proceed where the alternatives have been found not to be practicable or economic, and then only subject to a number of conditions, including pre-notification of the local authority, and the fire services. This exemption will cease on 1st January 2018[108].

Consultation questions – Agriculture Sector

1. Are the schemes currently in place to promote low emissions spreading technology likely to be sufficient to meet future ammonia targets? If not, how best should such schemes be extended to reduce ammonia emissions?
2. Should a future end date on the use of splashplate slurry spreading be considered following the completion of schemes to incentivise low emission alternatives?
3. Are odour nuisance occurrences a significant impact of slurry spreading? If so are the existing provisions, for example, under the Air Pollution Act sufficient to address them?
4. Can anaerobic digestion technology play a greater role in the management of agricultural wastes? If so, how can it best be further promoted, at farm or community level?
5. In many EU Member States the Critical Loads of Nitrogen are assessed in licensing intensive agricultural activities. Should this assessment process be used for agricultural activities in Ireland?
6. To minimise air pollution releases to the atmosphere and reduce associated impacts on air quality and climate, could current regulation and guidance be improved to promote alternatives to burning practices?
7. Where agricultural land requires on-going prescribed burning to maintain grazing or other conditions, should incentives for such lands be considered to promote alternative uses?
8. Are there datasets that are available to assist development of national estimates of emissions from agricultural burning?

4.5 Energy Sector

Energy in Ireland is highly dependent on imported fossil fuels. The combustion of fossil fuels and biomass[109] for energy production and use across the economy is the primary source of air pollution across the country. The Government's Energy White Paper '*Ireland's Transition to a Low Carbon Energy Future*'[110] outlines the strategic direction of national energy policy to transition to a low carbon economy. The White Paper focuses primarily on greenhouse gas reductions, with the implicit assumption that air pollution reductions will accompany climate mitigation measures. In the short to medium-term, the mix of fossil fuels will need to shift away from more carbon and air pollutant intensive fuels, like peat and coal, to lower-carbon fuels like natural gas. In the longer-term, a complete transition from fossil fuels to clean (non-combustion) renewable energy sources will be required.

4.5.1 Electricity Generation

Fossil fuel fired electricity production is a significant source of air pollution, which is regulated under the Industrial Emissions Directive (IED – see 4.6.1.1) by the EPA. In 2014, around 10% of NO_x and 30% of SO_2 emissions resulted from fossil fuel powered electricity generation. The ESB Moneypoint coal-fired plant in Clare was the largest single source. Emissions from Moneypoint are regulated as part of a Transitional National Plan (TNP) under the IED until June 2020 which means it can offset its emissions against reductions made by other installations in the TNP and *vice versa*. Industrial installations have significantly lower air pollution intensities than, for example, residential emissions, however, because of their large absolute emissions, continuous monitoring systems are necessary in some cases and on-going proactive regulation is required to ensure emissions remain as low as practicable in line with the principle of the *best available techniques (BAT)*. The Energy White Paper indicates that Moneypoint is due to close in 2025 and will be replaced with low-carbon generation technology. Any delay in this timetable could have implications for (i) air quality in Ireland and the wider region as well as (ii) meeting emission reductions commitments under the revised National Emissions Ceilings Directive.

4.5.2 Renewable Heat Incentive (RHI)

Under the 2009 Renewable Energy Directive, Ireland is committed to ensure that by 2020, 12% of national heating demand will come from renewable sources. Bioenergy is expected to be the predominant means of delivering the renewable heat target, with biomass (solid bioenergy) expected to comprise the most significant component. The Draft Bioenergy Plan[111] identifies a Renewable Heat Incentive (RHI) subsidy scheme as the most cost-effective way to promote bioenergy. It is planned that a Renewable Heat Incentive (RHI) will provide a subsidy to commercial and industrial scale heat users, not covered by the EU Emissions Trading System (ETS).

From a climate change perspective, substituting some fossil fuels with bioenergy can potentially be positive; even though bioenergy releases carbon dioxide, it can be less carbon intensive than fossil fuel, depending on its origin. However, from an air quality perspective moving to biomass fired boilers can be negative with potential increases of emissions of particulate matter and NO_x emissions. Specifying air emissions criteria as part of the RHI scheme may help to mitigate to some degree the impact that biomass installations can have on air quality, though if there is significant displacement of cleaner fuels like natural gas, overall emissions may rise at the expense of air quality

and public health. The figure below compares the emission standards for the biomass appliances supported by the RHI scheme in the UK with an average gas boiler. NO_x emissions from a biomass boiler which just complies with the UK RHI standards will be significantly higher than a gas boiler, whilst PM emissions are orders of magnitude higher.

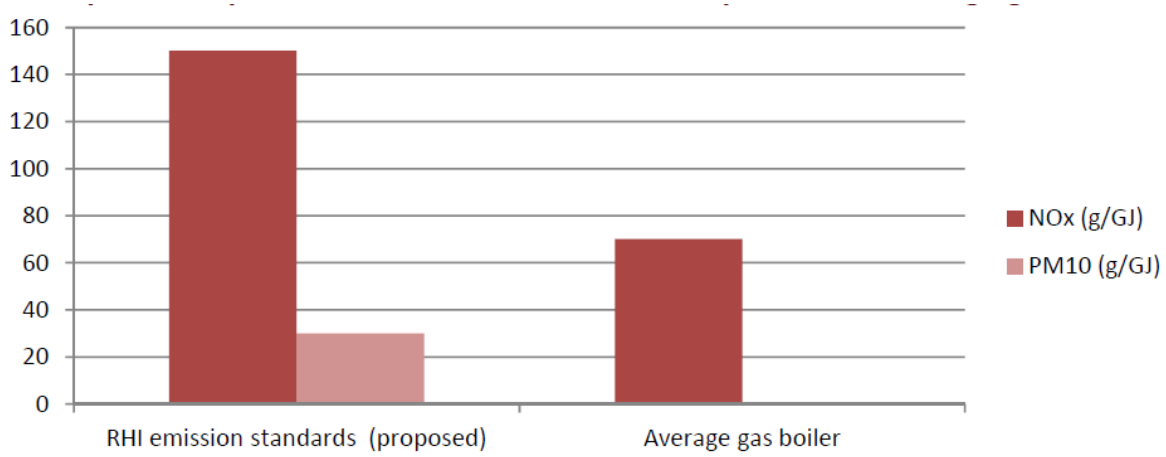

Figure 19: UK RHI Biomass air emissions standards compared to an average gas boiler (Source: Environmental Protection UK). **Note:** *No bar appears in the chart for PM_{10} for the Average gas boiler as emissions are considered negligible.*

Emissions from biomass combustion are dependent on a number of key factors including;

- Quality of appliance
- Fuel quality
- Installation and on-going operation of appliance
- Emission abatement used
- Servicing and maintenance

It is important that the health impacts and compliance with legal obligations under the NECD are fully considered when devising policies to meet the renewable heat targets. The need to ensure a joined up Government approach and highlight specific links and competing priorities between different public policy objectives needs to be carefully considered. The issue of potential impacts of the RHI on air quality is addressed in the ongoing RHI consultation which is open until March 3rd, 2017[112].

4.5.2.1 Air Quality requirements for an RHI in Ireland[113]

There is currently no guidance on air emissions to apply for to an RHI scheme. The findings from the ongoing RHI consultation will inform the specific requirements that might apply to support the scheme, the consultation on the Clean Air Strategy will inform wider strategic policy considerations.

In the UK, the RHI scheme requires eligible biomass boilers (including CHP) to hold an Emission Certificate to demonstrate they meet minimum air quality standards, details of which available on the internet[114,115]. An emissions calculation tool[116] to estimate the impacts that an RHI biomass installation may have on local air quality has also been developed in the UK.

4.5.3 Planning requirements

There are a number of exemptions under planning legislation[117] regarding a range of renewable energy technologies (e.g. solar panels, ground source heat pumps and biomass installations etc). These exemptions are included in order to facilitate the uptake and installation of renewable energy technologies, though they also mean that certain biomass installations, below the scope of the MCP Directive (see section 4.6.1.2), can be established with potential impacts on air quality though without being subject to planning approval or any other regulatory oversight.

4.5.4 Energy Efficiency and Retrofitting in the Residential Sector

The Energy White paper commits to supporting energy efficiency in the residential sector, to ensure that, by 2030, the Better Energy Programme delivers the number of deeper energy efficiency upgrades required to put the residential sector on a realistic trajectory to a low carbon energy future. The Sustainable Energy Authority of Ireland (SEAI) currently grant aid a number of key programmes[118] to improve energy efficiency and reduce fuel bills, including, the *Better Energy Homes scheme* open to all home owners, and the *Warmer Homes Scheme (WHS)* for vulnerable households in receipt of the National Fuel Allowance Scheme. The 'Superhomes' pilot scheme run by Tipperary Energy Agency promotes 'deep' retrofit measures. As well as average financial savings of €1000 – €1500 per year on energy, 'Superhome' owners have also reported the associated benefits of living in a more comfortable, healthier house with better air quality[119].

Consultation Question – Energy Sector

1. What are the best means of regulating the air pollutant emissions from relevant biomass plant that will be supported by the Renewable Heating Initiative (RHI) scheme in Ireland?
2. Is guidance needed at a local level to ensure that biomass installations related to the RHI scheme or otherwise do not cause air quality issues particularly in relation to those which are exempted from planning legislation?
3. How could transparency regarding large emissions sources regulated under the IED be improved? Should data from continuous emissions monitoring systems be made more readily available online?
4. Are there any other issues you wish to raise in relation to energy policy and clean air?

4.6 Industry and other sectors

4.6.1 Industrial Sector

The most significant industrial sources of air pollution are regulated by the EPA. Approximately 780 industrial and waste facilities are licenced by the EPA under the Industrial Emissions Directive or related national regulations. In addition, smaller scale installations are regulated under the Solvents Directive. The local authorities regulate smaller operators (mainly dry cleaners and car body shops), in addition to paint products under the Solvents and Deco paints directives respectively. In addition, a small number of smaller commercial and SME facilities are regulated by local authorities with regards to emissions to air under Part IV of the Air Pollution Act, 1987.

Two pieces of new EU legislation addressing emissions from medium-scale combustion plants and smaller commercial and residential scale boilers have recently been introduced under the EU Clean Air Package. The two pieces of legislation, namely the Medium Combustion Plant Directive[120], and the Ecodesign Regulations[121], however, have a gap between their respective scopes, meaning that for installations falling between the scopes of the two sets of legislation, no EU emissions standards apply.

4.6.1.1 Industrial Emissions Directive

Large industrial and waste facilities are licensed by the EPA under the Industrial Emissions Directive[122] (IED). Emissions to air from licensed facilities are generally regulated by specifying maximum pollutant concentration in the exhaust gases as emission limit values (ELVs) in the license. Where these ELVs are not met then the EPA can take enforcement action to reduce or prevent emissions. A small number of older power stations are currently regulated under the IED Transitional Nation Plan (TNP)[123] which progressively reduces overall annual emissions from a historic baseline, from 2016 until June 2020.

The total number of complaints recorded by the EPA regarding licensed facilities has reduced significantly in recent years; in 2014 1,058 complaints were received relating to air/odour/noise at EPA licensed industrial and waste sites[124] . Many of these complaints relate to odour issues and arise predominantly from a small number of sites in the Food and Drink sectors and non-hazardous waste and waste transfer station sectors.

4.6.1.2 EU Medium Combustion Plant (MCP) Directive

The EU Medium Combustion Plant (MCP) Directive has recently become law as part of the EU Clean Air Package, and will regulate air pollutant emissions for industrial and commercial facilities falling below the thresholds of the IED. Medium combustion plants are used for a wide variety of applications (for example, providing heat and power in hospitals, universities and hotels, district heating and cooling and providing heat/steam for industrial processes) and are potentially a significant source of emissions of sulphur dioxide (SO_2), nitrogen oxides (NO_x) and Particulate Matter (PM). The number of sites in Ireland that will be subject to the MCP is estimated at around 1,700.

The MCP requirements will apply to new facilities from December 2018, and depending on size, to existing facilities from 2025 and 2030. The Directive will complement existing legislation in place under the Large Combustion Plant (LCP) chapter of the IED[125] which the EPA implements to regulate emissions from such large combustion plants, i.e. those with a rated thermal input equal to or greater than 50 MW. The MCP Directive is due to be transposed into legislation in Ireland by December 2017, and will require the designation of a national Competent Authority to oversee implementation of its provisions.

4.6.1.3 Deco-Paints and Solvents Directives

The EPA is the Competent Authority for the enforcement of the Decorative paints and Solvents Directives[126], with the local authorities responsible for enforcement activities at non-EPA licensed sites. These Directives are concerned with controlling emissions of VOCs from a range of industrial and commercial sectors (e.g. dry cleaning, car refinishing), and by enforcing maximum levels of volatile organic compounds (VOCs) contained in various products (e.g. paints, varnishes). Fixed Penalty Notices (FPNs) have recently been introduced for breaches of the Deco paints regulations which will assist enforcement of the regulations but there remain some enforcement challenges due to a lack of awareness and capacity regarding the regulations particularly within some smaller scale operators in the sectors.

4.6.2 Waste Management Sector

The most recent national waste policy 'A Resource Opportunity'[127] provides a roadmap on how Ireland will move to the virtual elimination of landfill. This is to be achieved by applying the principles of the waste hierarchy to prevent, reduce, reuse and recycle waste, seeking to maximise the resources that can be recovered and putting in place the most appropriate technologies to treat residual waste. Waste management can be a significant source of odour nuisance from the handling at facilities, in particular, of biodegradable waste primarily from food waste which releases odours as it breaks down, or biologically degrades over time. Landfills can produce methane which can generate the air pollutant ozone and is also a greenhouse gas. It can be released to the atmosphere though landfill sites in Ireland now contain methane capture and recovery equipment. The number of landfill sites is reducing as the principles of the waste hierarchy are applied and waste-to-energy capacity is developed in Ireland. Emissions to the atmosphere from waste-to-energy plant are regulated by the EPA under the IED. In relation to unplanned releases to the atmosphere, there is potential for fires to occur at waste facilities and more stringent conditions relating to waste storage and fire risk assessment have been attached to EPA licences in recognition of this risk and following a number of high profile fires with significant atmospheric releases.

4.6.2.1 Odour issues

According to the recent EPA report, *Ireland's Environment, An Assessment* 2016, the EPA receives more complaints about odours than any other environmental issue. The EPA carried out 769 site visits in the 2013-2015 period with specific attention directed towards more problematic sites (e.g. odour-causing landfills or waste transfer stations). Of the 1,058 complaints received in 2014 for EPA licensed sites, over 788 or 74% of these were related to odour complaints. The waste sector,

particularly non-hazardous waste facilities and landfills, as well as the food and drink sector continues to be the source of a high number of odour complaints.

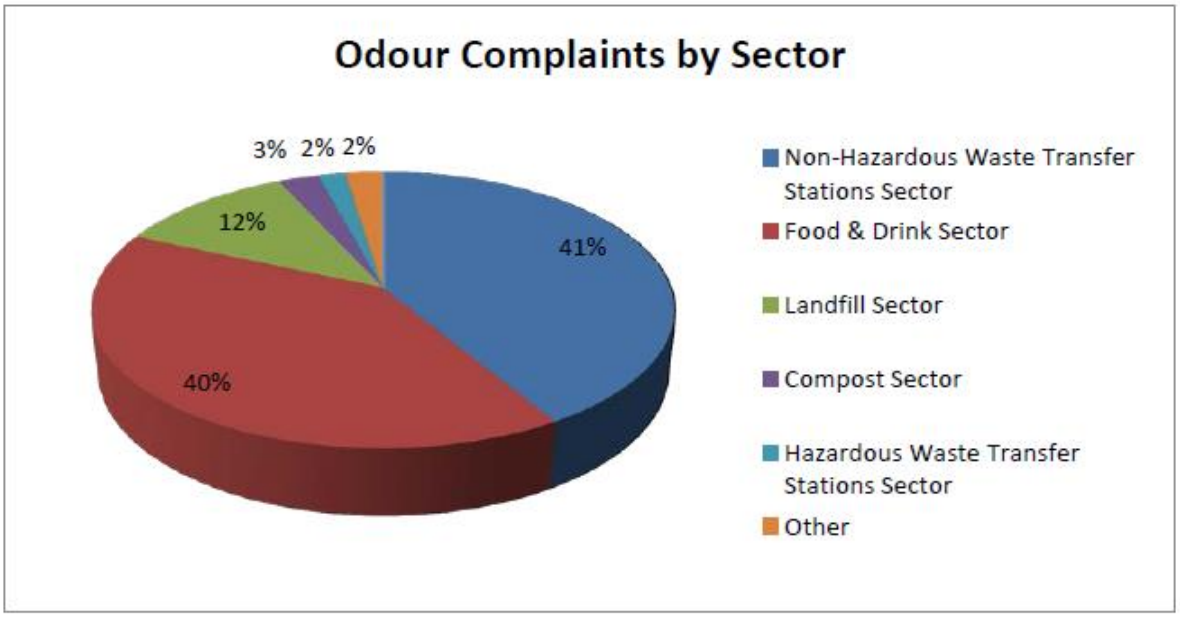

Figure 20: Odour Complaints at EPA licensed facilities in 2014 by sector (Source: EPA, 2015)

4.6.2.2 Illegal waste burning

Under the Waste Management (Prohibition of Waste Disposal by Burning) Regulations 2009[128] it is an offence to burn waste without having appropriate authorisation. As referred to in the residential section 4.2.4, illegal waste burning, can be a source of nuisance, either inside or outside a property and remains an issue across the country. It is reported anecdotally, that the recent trend in the installation of stoves in urban and rural areas has facilitated an increase in illegal waste burning in the home. However, reliable statistics on this activity are by their nature difficult to gather. In addition to nuisance, the noxious emissions from burning waste, can be toxic and include a range of carcinogenic pollutants, like dioxins. The EPA identify illegal waste burning in fireplaces, gardens and fields as one of the most significant risk factors for elevated dioxin levels in Ireland**Error! Bookmark ot defined.**

Local authorities have enforcement powers in relation to waste management, however, raising awareness and changing behaviour is an important part of addressing illegal waste burning in the home and associated fly tipping. In 2017, Household Waste Management Compliance will be a priority with local authorities in conjunction with the Waste Enforcement Regional Lead Authorities (WERLAs)[129] implementing a program to survey the disposal routes of domestic waste.

4.6.2.3 Bioaerosols – an emerging issue

An ongoing EPA funded project at UCC (OLBAS Project[130]) is studying the levels of bio-aerosols in the atmosphere in particular from activities on green waste/composting sites. The project is using state of the art monitoring instrumentation to detect bioaerosols in real time and compare against the traditional monitoring method (as specified in EPA licenses) where samples are collected by

impaction over a short time period and subsequently analysed by identification from exposure to agar plates. Exposure to some bioaerosols such as the *Aspergillus* fungus can have adverse health impacts on some people. The project aims to provide 'proof of principle' for the use of new monitoring techniques for near real time monitoring and identification of bioaerosols. Previous EPA funded research in this area (UCC Biochea[131] project) has also shown the potential for this technology to be used for pollen monitoring and for potential healthcare activity in biohazard monitoring.

Consultation questions - Industry and Other Sectors

1. Is there a need for review and strengthening of local authority and EPA powers in relation to dealing with nuisance, and in particular odour nuisance?
2. How can the enforcement of the prohibition on illegal waste burning be improved?
    a. Is there sufficient awareness of the impact it causes?
    b. Is the existing legislation sufficient to allow enforcement officers to take action?
3. A 'gap' exists between proposed new pieces of legislation, namely the MCP and the Eco Design Directive (EDD). How can the gap that exists between the EDD and Medium Combustion Plants Directive (MCPD) best be dealt with for appliances/plant that come into this range in Ireland (for example through a future Renewable Heat Incentive (RHI) scheme)?
4. Are there other emerging issues related to industrial or other sources that require action?

5 Understanding the air quality challenge

5.1 National emissions Modelling and Monitoring

The EPA is the leading authority in Ireland dealing with atmospheric protection. It has a number of statuary roles in informing actions to protect national air quality, these include;

- The provision of comprehensive data on emissions of air pollutants annually including providing these on a spatially disaggregated basis
- The operation of the national ambient air quality monitoring network
- Provision of air quality information and alerts based on exceedances of key thresholds

Data on emissions and ambient air pollutants are reported to the UNECE and EU bodies where these are used to determine compliance with agreed emissions reductions and air quality targets e.g. under the National Emissions Ceiling (NEC) and Clean Air For Europe (café) Directives. Emissions data are also used in a variety of air quality and integrated assessment modelling activities. For air pollution impacts analysis, pan European analysis is provided by chemical transport models developed by organisations such as EMEP[132] and the ESA Copernicus programme. (See sections 5.3 below). These models and services are designed to address a range of requirements arising from the need to understand the sources, transport and impacts of air pollutants for various receptor systems including human health, vulnerable terrestrial and fresh water ecosystems.

Integrated assessment modelling by models such as RAINS/GAINS[133,134] include analysis of emissions abatement technologies and policies and their associated costs in determining optimal and cost effective pathways for achievement of European policy goals such as the national emissions reductions targets established under the NEC Directive. These systems and models are under continuous development in order to meet information and analysis requirements in addressing the range of challenges that arise from air pollution.

5.2 Advancing national pollutant emissions inventories

The national air pollution emissions inventories prepared by the EPA, provide key data on the extent of pollutant emissions in Ireland. These inventories are also provided on a spatially disaggregated format. These data are therefore central to the analysis of policies and measures to reduce air pollution and improve air quality. It is therefore essential that the inventory data are as comprehensive and accurate as possible and that the information they provide is utilised to inform actions from local to national levels. Currently updates and revisions to the inventory process are advanced through research carried out under the EPA Climate research pillar and has focused on the development of nationally specific emission factors for key activities.

5.3 Monitoring air quality

The EPA in association with some local authorities manages the national ambient air quality monitoring network in Ireland. There are a total of 31 monitoring stations throughout the country

that monitor a range of air quality parameters under the CAFE Directive. Air quality data and annual air quality reports can be accessed on the EPA website[135].

The EPA in conjunction with Met Éireann and Teagasc also manages the national component of EMEP monitoring network[136]. EMEP is the main scientific body under the UNECE Air Convention and is designed to respond to the information needed to address impacts on ecosystems, human health, materials and climate change. The EMEP network of monitoring sites provides essential information on air pollution levels in non-urban areas across Europe. A number of EMEP sites are also part of the Global Atmospheric Watch (GAW network) which contributes atmospheric composition data to the Global Climate Observation System (GCOS). Mace Head and Valentia Observatory managed by NUIG and Met Éireann respectively are GAW sites[137].

The development of an advanced network of sites which includes atmospheric profiling of air pollution is being advanced as a European Research Infrastructure termed ACTRIS[138]. It is likely that ACTRIS will be linked to the Integrated Carbon Observation System (ICOS) which is designed to monitor atmospheric greenhouse gases. Currently ICOS related monitoring sites are operated and supported by the EPA, DAFM, NUI Galway and Teagasc and monitor CO_2, CH_4 and N_20. EMEP/ICOS atmospheric sites are operational at Carnsore Point, Wexford; Malin Head, Donegal; Valentia Co, Kerry; Oak Park. Co Carlow and Mace Head, Galway.

The EPA is currently reviewing the extent of the national ambient air quality monitoring network following a recent public consultation process[139] and the results of this review will help to inform the development of the National Clean Air Strategy. In summary, the EPA is proposing to expand the current network from 31 to 66 stations. These sites will be supplemented by a proposed minimum of 14 indicative monitoring stations (see section 4.2.), bringing the network to a total of 80 monitoring stations. The figure below presents the existing monitoring network with the proposed network.

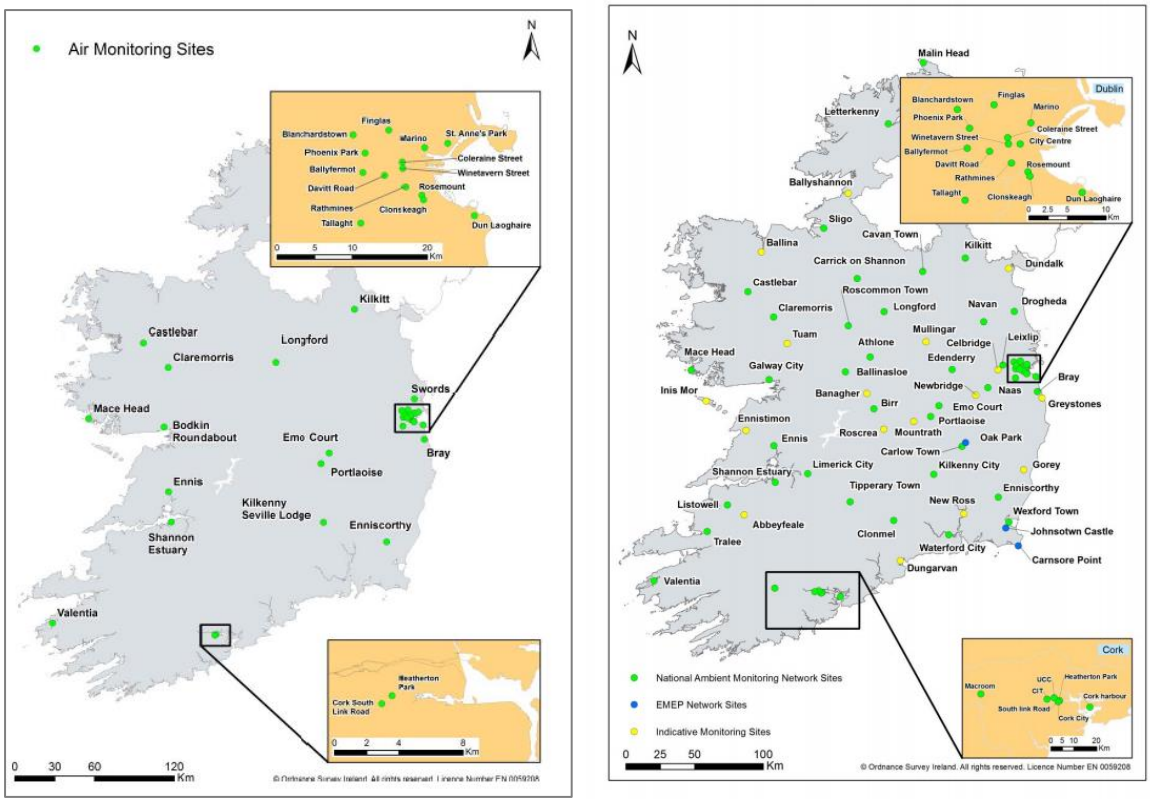

Figure 2: Ambient Air Quality Monitoring Stations - Existing 2016 (left) and proposed (Right) (Source: EPA[140])

The improvement in measurement and analytical technology has, and will further allow, a much better understanding of air quality sources and impacts. This is particularly the case for particulate matter (PM). For effective policy action to mitigate the impacts of PM on human health it is essential to understand the composition of the atmosphere and the causes of high levels of PM[141].

Radon gas, is the second greatest cause of lung cancer in Ireland. However, it is not considered a 'classic' air pollutant as it occurs naturally. Its prevalence depends on the local geology and the main exposure occurs indoors where the gas can build up. The EPA Office of Radiological Protection (ORP) are responsible for monitoring radon in Ireland. Government policy to reduce the health risk from this gas is set out in the National Radon Control Strategy of 2014.[142]

5.3.1 Use of Satellite data

Copernicus[143] is a European system for monitoring the Earth coordinated and managed by the European Commission in conjunction with European Space Agency (ESA), the European Environment Agency and Member States.

Copernicus consists of a complex set of systems which collect data from multiple sources: earth observation satellites (e.g. Sentinel satellites) and *in situ* sensors such as ground stations, airborne and sea-borne sensors. It processes these data and provides users with reliable and up-to-date information through a set of services related to environmental and security issues.

The services address six thematic areas: land, marine, atmosphere, climate change, emergency management and security. They support a wide range of applications, including environment protection, management of urban areas, regional and local planning, agriculture, forestry, fisheries, health, transport, climate change, sustainable development, civil protection and tourism.

Some Copernicus services are operational since 2012 (land monitoring and emergency management) or 2015 (atmosphere monitoring and marine monitoring) while others are in their development phase (climate change monitoring and services for security applications). Copernicus users can also have a direct access to satellite data provided free of charge to users.

Some national organisation such as Irish Centre for High End Computing (ICHEC), Met Éireann, EPA and universities access Copernicus services however further national coordination is needed to gain the full benefit from these monitoring services.

5.3.2 Ammonia monitoring

Ammonia is not covered by the CAFE Directive and so is not monitored by the EPA's national ambient air quality monitoring network. Recently published research[144] from the EPA funded Ammonia2 project shows average ambient ammonia concentrations exceeding critical levels across many parts of the country and in particular those areas with high agricultural activity (see section 4.4).

Existing emission projections for the agricultural sector indicate that ammonia emissions will increase in the coming years due to the Food Wise 2025 strategy. Ammonia has been shown to play an increasing important role in the formation of $PM_{2.5}$ levels which has significant health implications. Existing national research demonstrates that many Natura 2000 sites in Ireland are already exceeding their critical Load of Nitrogen as well as the critical levels of ambient ammonia. Continued deposition of excessive nitrogen over an extended period will continue to lead to biodiversity impacts in terms of species diversity, species density and potential loss of ecosystem services and function.

Additional monitoring requirements on top of those actions specified within the Environmental Assessment report for the Food Wise 2025[145] strategy will be needed to monitor the concentrations of ambient ammonia from the agricultural sector.

5.3.3 Black Carbon (BC) Monitoring

Black carbon is a very fine constituent of particulate matter (PM), and as such is can penetrate into the respiratory system with associated health impacts. It is formed by the incomplete combustion of fossil fuels, biomass and biofuels and is directly emitted into the air. Major sources include vehicles (particularly diesel road vehicles), non-road mobile machinery (e.g. construction machines), ships, residential heating (e.g. coal fires or stoves) and open biomass burning (e.g. forest fires or burning of agricultural waste).[146]

Whilst black carbon is monitored at a number of background EMEP sites in Ireland, it is not monitored routinely as part of ambient urban monitoring networks[147] where some of the main

sources occur. Two ongoing EPA funded projects by UCC and NUIG have deployed black carbon monitoring equipment alongside other air quality instruments to enable identification and analysis of pollution sources.

As a party to the Air Convention, Ireland reports annual inventories of black carbon. Increased monitoring of black carbon in urban networks could assist in a more accurate inventory and improve our understanding of the main sources of this climate and air pollutant, for example, allowing quantification of the impact on air quality of the significant increase in the diesel vehicle stock in Ireland.

5.4 Air Quality Modelling and Forecasting

The ability to model and forecast air quality at a local, regional and national scale is important generally for air quality management purposes, and particularly in instances such as industrial fires, wildfires in natural areas and during periods when polluted air is transported from the United Kingdom and mainland Europe. Such services can alert and warn the public about poor air quality particularly those sections of the population such as young, elderly or immune suppressed who may be particularly impacted from poor air quality events.

At an EU level, programmes such as MACC[148] are developing air quality modelling and forecasting capacity that Member States can use but are also encouraging countries to develop their own services so that they can provide up to date and future forecasts of air quality to their citizens in a similar way to daily weather forecasts. Indeed the cooperation of expert agencies like Met Éireann is integral to the development of such national capacity. The EPA are currently developing modelling and forecasting services whilst a number of academic institutions such as NUI Galway in conjunction with Met Éireann, have developed international expertise in this area; for example through the development of a volcanic ash forecasting model in response to the disruption caused by the eruption of the Eyjafjallajökull volcano in Iceland in 2010 and 2011[149].

In recent years there have been a number of accidental fires in natural and industrial areas. Where pollution from these instances impacts on local communities it is necessary to determine the air quality levels for the duration of the incidents. The EPA also plans to expand its existing Air Quality Health Index (AQIH) as part of the review of the National Ambient Air Quality Monitoring Programme as referred to in section 5.3 above.

5.4.1 National Pollen Forecasting

Part of the EPA funded OLBAS research project (See section 4.6.2 above) project is also looking at the possibility of developing a national pollen monitoring service in Ireland. At present it is reported that up to 24% of the population suffer from hay fever symptoms[150]. Currently, a pollen forecast is provided during relevant months of the year by Met Éireann[151]. The forecast provides details on the levels of tree, grass and weed pollen and spores on a regional basis. However, this forecast is based on monitoring and modelling undertaken at the National Pollen and Aerobiology Research Group at University of Worcester in the UK and not on monitoring data in Ireland.

All the forecasts are based on data produced by the National Pollen Monitoring Network in the UK, combined with the information from weather forecasts, local vegetation and typography types and information about biological factors and the weather in the preseason period that influences the amount of pollen produced.[152] National monitoring data in representative locations could provide a more robust basis to forecast pollen in Ireland. Pollen is not considered a classic air pollutant and does not come within the remit of EU or national air quality legislation.

5.5 Use of New Technologies for Emergency Response and Enforcement

The use of Unmanned Aerial Vehicles (UAVs) or drones is becoming increasingly prevalent across a range of regulatory and enforcement disciplines. In Ireland S.I. No. 563 of 2015 outlines the requirements for The Irish Aviation Authority (IAA) to permit the use of certain drones[153] in Irish Airspace.

In Dublin, the Fire Brigade is using drone aircraft with thermal imaging capacity to assist in emergency response to major fire incidents. This technology enables information to be gathered in situations where it may be dangerous or impossible for emergency response personnel to access[154]. The EPAs' Office of Environmental Enforcement (OEE) also use remotely piloted aircraft system (RPAS) as part of its enforcement work. Examples of the use of this technology for EPA operations include surveying of industrial and waste licenced sites, incident/complaint investigation, investigation of unlicensed activities, pollution investigation and evidence gathering for legal cases, river, lake and estuary surveys.[155]

In the Unites States, drones are being trialled for air quality purposes for citizen science projects to monitor air quality in local communities, to monitor ozone levels for research purposes and for the monitoring of methane levels from oil and gas fields.

From an air quality perspective, the use of drones could be further explored in relation to local authority enforcement for example in situations of illegal land burning or 'backyard' burning of waste. They could also be used in conjunction with the Fire Brigade to enable early warning information to be disseminated to local communities regarding air quality in the event of major industrial or chemical fires.

Consultation Questions – understanding the Air Quality challenge

1. How can pollutant emissions data be better used in informing actions from local to national levels?
2. How can data from the various observation activities carried out in Ireland be better used or developed to enhance responses to air quality and climate challenges?
3. Beyond the scope of the CAFE Directive monitoring requirements (see section 5.3), are there other air quality monitoring activities that Ireland should be undertaking?
4. How could an ammonia monitoring network for Ireland best be developed? Are there synergies to be gained by alignment with monitoring in other environmental areas e.g. under the Water Framework Directive/Nitrates Directive?
5. How can the monitoring capacity that exists in universities be best harnessed to inform knowledge of air pollution sources?
6. Programmes such as Copernicus and MACC are providing real-time high resolution data on a range of air quality parameters though its satellite and remote sensing activities. How can Ireland make better use of this data and how should it be used?
7. How could Unmanned Aerial Vehicles such as drones be used to improve air quality management in Ireland?
8. Are there examples of other types of technology that could be used for air quality purposes?
9. Are there other issues you wish to raise in relation the monitoring, modelling and forecasting of air quality?

6 Research on Air Quality issues

The scientific outputs from research activities play a vital role in informing policy in environmental protection. Advancements in air quality monitoring, modelling and satellite data availability are providing much more detailed local, regional and global information on air quality than heretofore. This data is helping to shape policy measures to improve air quality and also to highlight the interactions between air quality and climate change.

Ireland has a vibrant and recognised environmental research community. It also has some internationally recognised centres for atmospheric research such as the Mace Head Atmospheric Research Observatory in NUI Galway[156] and the Centre for Research on Atmospheric Chemistry in University College Cork[157].

6.1 EPA Research Programme

The EPA's Environmental Research programme[158] is the main funding mechanism for environmental research in Ireland. The EPA programme comprises three key pillars;

1. Sustainability
2. Water, and
3. Climate

The programme does not have a specific theme addressing air quality issues, though the climate pillar includes them. Since 2007 the EPA have funded over 50 air quality related projects with a budget of over € 11 million[14]. Many of the current EPA research projects and the outputs from recent publications have informed the policy development to date and will further inform the development of the Clean Air Strategy itself. Input from both the EPA Advisory Committee[159] and the EPA Health Advisory Committee is important in identifying potential research topics for different environmental issues including air quality.

6.2 Science Foundation Ireland and Irish Research Council

Science Foundation Ireland (SFI) provides a range of research awards and grants across a range of scientific disciplines[160]. This includes SFI Investigator awards, career development awards and Research Centre and Infrastructure calls. The Irish Research Council (IRC) manages a suite of inter-linked research schemes, funding scholars at various career stages, from postgraduate study to senior research project-based awards[161].

6.3 European Commission - Horizon 2020 Research Programme

The EPA is one of a number of national contact points for the European Commission's Horizon 2020[162] research programme. Recent examples of Irish research involvement in Horizon 2020 projects include the ISCAPE[163] project coordinated by University College Dublin (UCD) which aims to integrate and advance the control of air quality and carbon emissions in European cities in the context of climate change through the development of sustainable and passive air pollution remediation strategies, policy interventions and behavioural change initiatives.

6.4 LIFE Funding

The EU LIFE Programme provides funding opportunities for the support of Environment, Nature Conservation and Climate Action projects throughout the EU. Applications are encouraged from public and private organisations seeking co-funding for projects. DCCAE administers this programme for Irish project's applications[164].

The implementation of air pollution policies relies on a robust science-policy interface. The publication of EPA funded air quality research as well as other national, European and international research will further inform policy development in the Clean Air Strategy.

Consultation questions – Research

1. What are the important current and emerging air quality issues in Ireland that require research?
2. Are there air quality areas and topics that have not been previously investigated that require additional research? If so please provide some examples of topics?
3. How can the national research capacity that exists in Universities on air quality issues be best used to achieve the clean air vision?
4. Do you have any other issues you wish to raise in relation air quality research?

7 Communication and Awareness

Communication to the wider public of the impacts of air pollution on public health and the environment and the differences that individuals can make through lifestyle choices is important in promoting action to promote cleaner air. The EPA *Draft National Ambient Air Quality Monitoring* programme (see section 5.3) proposes a more spatially extensive network which will facilitate improved data to raise public awareness of air quality issues and to promote 'citizen science', the engagement of the public in monitoring air quality using new technologies. The EPA are also developing capacity in the area of Air Quality Forecasting through its AQIH to use weather and air quality information to predict what air quality will be like a few days in advance, which may be of particular interest to vulnerable groups.

The smoky coal ban in Dublin was recognised nationally and across the EU as a positive clean air policy, however, the impacts from continuing solid fuel use and other air pollutant sources such as transport and agriculture are less well communicated. Examples of areas of existing and potential air pollution problems that could benefit from a communications and awareness raising programme are set in out below.

7.1 Tidy Towns Clean Air Award

For the first time in 2016, a Clean Air award was included in the National Tidy Towns award. This new award aims to encourage communities to promote awareness of the importance of clean air for human health and the environment. A tidy and litter-free town should also promote clean air and a healthy environment for the community. In particular, the award recognises projects that raise awareness of the potential impact that local choices, such as choice of home heating fuel, can have on the air we breathe in our towns and our communities. The winning town in 2015, Emly, Co Tipperary demonstrated a good understanding of air quality issues in particular focusing on residential and agricultural emissions.

7.2 The Green Schools

Green Schools[165] is an environmental management and education programme for schools run by An Taisce. It promotes long-term, whole-school action for the environment and is operated in partnership with local authorities with the support of a range of government departments and agencies. The scheme focuses on a number of themes including climate change and energy though there is no theme addressing clean air issues directly.

7.3 Non-Governmental Organisations (NGOs)

The Asthma Society[166] of Ireland launched their 'Clean Air' Advocacy campaign in November 2015. A number of information seminars were organised around the country and articles placed in local newspapers. The campaign supports policies that promote clean air, including the nationwide extension of the 'smoky' coal ban to protect the health of its members who suffer in particular in the winter heating season due to particulate pollution from the use of solid fuels.

7.4 Illegal waste burning

Waste burning is illegal under waste legislation, and continues to pose a problem and by its nature it is an area on which it is difficult to gather statistics and enforcement is also difficult, as outlined in section 4.6.2.2. However, it is an issue which a greater public awareness of the health impact could play an effective role in changing behaviour and promoting best practice in relation to waste disposal from the home. An accessible communication program could be helpful in this regard and could be allied more generally to best practice in relation to solid fuels where they continue to be used.

7.5 Maintenance of solid fuel burning appliances

The sales of solid fuel stoves for home heating in Ireland have seen a considerable increase in recent years. The air pollution created by the use of a solid fuel stove can vary depending on a range of factors including the stove design, installation, maintenance, fuel quality and operator behaviour. Awareness of the influence of these factors by the suppliers, installers and users of such appliances can lead to excessive emissions.

SEAI[167] have also produced some best practice guidance on wood burning boilers that includes maintenance advice. There has also been increased awareness raising on carbon monoxide[168] issues in recent years.

Consultation Questions – Communication and Awareness

1. How can the general public best be made more aware of the health impacts of air pollution?
2. Is enough information readily available to the general public about air quality where they live and work?
3. National awareness campaigns have been undertaken on issues like Waste (Race against waste) climate change (change.ie) and energy efficiency (the Power of One campaign). What issues might a national clean air awareness campaign encompass and how could its impact be measured?
    - Are there particular issues that would benefit from an awareness raising campaign, for example, what choices can the individual make that reduce air pollution in a person's area?
    - Should a clean air theme be developed for the Green Schools programme?

8 Timeline for a National Clean Air Strategy

This consultation document will inform the development of the National Clean Air Strategy. Submissions received will be considered in drafting the National Clean Air Strategy which will be finalised in 2017. The strategy comes under the requirements of the Strategic Environmental Assessment (SEA) directive, which requires potential environmental impacts flowing from the strategy to be assessed. A number of public events are planned for the coming year to present the draft Clean Air Strategy following which a final Strategy will then be published. An outline of the timeline is presented in table 2 below.

Task	Indicative dates
Release of Public Consultation Document and initiation of consultation	1st March 2017
Engagement with Commission on Clean Air Dialogue	1/2nd March 2017
Strategic Environmental Assessment (SEA) and Appropriate Assessment (AA) Screening	March 2017
Closing of consultation	28th April 2017
Analysis of responses	Q2 2017
Engagement with stakeholders	Q2 2017
Preparation of Draft Clean Air Strategy	Q2-3 2017
Seek Government Approval to publish Strategy	Q4 2017
Publish Clean Air Strategy	Q4 2017

Table 2: Timeline for development of a National Clean Air Strategy.

Clean Air Strategy Key Performance Indicators (KPIs)

A number of key performance indicators will be included in the clean air strategy in order to track progress towards cleaner air**.** Some suggested indicators are included below.

- Air quality exceedances of EU limits and WHO guideline values
- Air quality and emission trends
- National Emission Ceiling Directive targets linked to related greenhouse gas targets
- Number of EPA and Local Authority complaints related to air pollution – The EPA and Local Authorities receives hundreds of complaints each year from illegal burning, slurry spreading
- Transposition of EU directives
- Ratification of Air Convention protocols
- Indicators from other sectoral policy areas

Governance of the Clean Air Strategy

An interdepartmental group led by DCCAE will be set up to inform the development of the Clean Air Strategy to ensure the strategy will build on existing national plans and polices across other departments. The Draft strategy in 2017 will provide more detail on the resource requirements, guidance and governance.

Consultation questions

1. Are there particular metrics or benchmarks should be considered in tracking the progress of a Clean Air Strategy ?
2. Are there any other issues you wish to raise in relation to development of a national clean air strategy?

Glossary of terms

Major Air Pollutants

Particulate matter (PM)

Particulate matter (PM) is both directly emitted to the atmosphere (primary PM) and formed in the atmosphere (secondary PM). The chief precursor gases for secondary PM are SO_2, NO_x (a family of gases that includes nitrogen monoxide (NO) and NO_2), NH_3 and volatile organic compounds (VOCs; a class of chemical compounds whose molecules contain carbon). The main precursor gases NH_3, SO_2 and NO_x react in the atmosphere to form ammonium, sulphate and nitrate compounds. These compounds form new particles in the air or condense onto pre-existing ones and form so-called secondary inorganic aerosols. Certain VOCs are oxidised to form less volatile compounds, which form secondary organic aerosols. Primary PM originates from both natural and anthropogenic sources. Natural sources include sea salt, naturally suspended dust, pollen and volcanic ash. Anthropogenic sources, which are predominant in urban areas, include fuel combustion in thermal power generation, incineration, domestic heating for households and fuel combustion for vehicles, as well as vehicle (tyre and brake) and road wear and other types of anthropogenic dust.

Black carbon (BC)

Black carbon (BC) is one of the constituents of fine PM and has a warming effect. BC is a product of incomplete combustion of organic carbon as emitted from traffic, fossil fuels and biomass burning, and industry.

Ozone (O_3)

Ground-level (tropospheric) ozone (O_3) is not directly emitted into the atmosphere. Instead, it is formed through a series of photochemical (sunlight induced) reactions which lead to the formation of ground level ozone in the atmosphere following emissions of precursor gases such as NO_x and VOCs of both natural (biogenic) and anthropogenic origin.

Nitrogen oxides (NO_x)

The major sources of nitrogen oxides (NO_x) are combustion processes (e.g. in fossil-fuelled vehicles and power plants). Most NO_2 is formed by the oxidation of emissions of NO. NO accounts for the majority of NO_x emissions, although smaller amounts of NO_x emissions are directly emitted as NO_2. This applies for most combustion sources except for newer diesel vehicles, which may emit as much as 55% of their NO_x as NO_2 (Grice et al., 2009), because their exhaust after-treatment systems increase oxidation of NO, which leads to higher direct NO_2 emissions.

Benzo[a]pyrene (B[a]P)

Benzo[a]pyrene (B[a]P) is emitted from the incomplete combustion of various fuels. The main sources of B[a]P in Europe are domestic home-heating, in particular wood- and coal-burning, waste-burning, coke and steel production, and road traffic. Other sources include outdoor fires and rubber-tyre wear.

Sulphur oxides (SO_x)

Sulphur oxides (SO_x), a family of gases that includes SO_2 and sulphur trioxide (SO_3), are mainly emitted from the combustion of fuels containing sulphur. The main anthropogenic emissions of SO_2 derive from residential heating, stationary power generation and transport. Volcanoes are the biggest natural source of SO_x.

Carbon Monoxide (CO)

Carbon monoxide (CO) is a gas emitted as a result of the incomplete combustion of fossil fuels and biofuels. Road transport was once a major source of CO emissions, but the introduction of catalytic converters reduced these emissions significantly.

Benzene (C_6H_6)

Benzene (C_6H_6) is an additive to petrol, and most of its emissions come from traffic in Europe. These C6H6 emissions have declined sharply since the introduction of the Fuel Quality Directive (EU, 2009). In general, contributions to C6H6 emissions made by domestic heating are small (about 5% of total emissions), but in areas in which wood burning accounts for more than half of domestic energy needs, it can be a substantial local source of C6H6. Other sources include oil refining, as well as the handling, distribution and storage of petrol.

Ammonia (NH_3)

The agricultural sector is the major source of NH_3 emissions. These emissions derive mainly from the decomposition of urea in animal wastes and uric acid in poultry wastes. Emissions depend on the animal species, age, weight, diet, housing systems, waste management and storage techniques. Ammonia emissions also arise due to inorganic fertiliser use.

Volatile organic compounds (VOCs)

Volatile organic compounds (VOCs) are emitted by the use of solvents in products and industry, road vehicles, household heating and power generation. VOCs are the key component in the formation of ground-level ozone

Acronyms and terms

AQIH	EPA's Air Quality Index for Health
Bioaerosols	A bioaerosol is an aerosol comprising particles of biological origin or activity which may affect living things through infectivity, allergenicity, toxicity, pharmacological or other processes. Particle sizes may range from aerodynamic diameters of ~ 0.5 to 100 μm.[169]
CAFE	Clean Air for Europe Directive (2008/50/EC)
LRTAP Convention	The Long-Range Transboundary Air Pollution Convention also known as the Air
Critical Load	A quantitative estimate of an 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
DAFM	Department of Agriculture Food and Marine
DCCAE	Department of Communications, Climate Action and Environment

EC	European Commission
ELVs	Emission Limit Values
EMEP	European Monitoring and Evaluation Programme
EPA	Environmental Protection Agency
EU	European Union
HFCs	Hydrofluorocarbons
Hg	Mercury
Limit value	Level to be attained and not exceeded
mg/m^3	Milligrammes per cubic metre
NSAI	National Standards Authority of Ireland
NSMC	North South Ministerial Council
NECD	National Emission Ceiling Directive
NO	Nitric oxide
NO_2	Nitrogen dioxide
NO_x	Oxides of nitrogen, a mix NO and NO_2
POPs	Persistent Organic Pollutants (POPs) are a group of substances that are toxic, persistent in the environment, bioaccumulate in the food chain and can be transported long distances, principally by air and water.
PAH	Polycyclic aromatic hydrocarbon
Pb	Lead
Petcoke	Petroleum Coke or is a high energy solid fuel that is a by-product of oil refining and is sometimes used as a constituent of residential solid fuel because of its high energy content
PM_{10}	Particulate matter with diameter < 10 µm
$PM_{2.5}$	Particulate matter with diameter < 2.5 µm
ppm	Parts per million
SO_2	Sulphur dioxide
Target value	Level to be attained where possible over a given period
Troposphere	Region of the atmosphere from ground level to ~10-15 kilometres
UNEP	United Nations Environment Programme
Radon	A naturally occurring radioactive gas formed in the ground by the radioactive decay of uranium which is present in all rocks and soils.
SLCPs	Short Lived Climate Pollutants
VOCs	Volatile organic compounds
µm	Micron
$µg/m^3$	Microgrammes per cubic metre
WERLA	Waste Enforcement Regional Lead Authority
WHO	World Health Organisation

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