DRAFT CLEAN AIR STRATEGY 2018 CONSULTATION

A submission from the Royal Society of Chemistry to the Department of Environment Food and Rural Affairs (Defra)

This document is in response to Defra's Consultation paper on the Draft **Clean Air Strategy** 2018, which is open for written submissions until 14 August 2018.

About us

With over 52,000 members and a knowledge business that spans the globe, the Royal Society of Chemistry is the UK's professional body for chemical scientists, supporting and representing our members and bringing together chemical scientists from all over the world. Our members include those working in large multinational companies and small to medium enterprises, researchers and students in universities, teachers and regulators. See www.rsc.org

Introduction

Chemical scientists have an important role to play in reducing air pollution as well as in helping us to understand and monitor it. Scientists and engineers worldwide are tackling this issue, and we aim to support chemistry's vital role in understanding air pollution and developing solutions to reduce it. The RSC has convened discussions on atmospheric chemistry, which informs our approach here.

We have convened a number of Faraday Discussions on atmospheric chemistry. The discussion in 2016 focused on Chemistry in the Urban Atmosphere and in particular on the contribution of the chemical sciences to understanding air quality and the role of data modelling. In 2017, the Faraday Discussion Atmospheric Chemistry in the Anthropocene focused on emerging issues such as interactions between anthropogenic and biogenic emissions, the impacts of climate on air quality, and new instrumental tools and platforms for atmospheric chemistry. A summary and research papers from the discussion meetings have been published.

Many of our members are actively engaged in understanding, monitoring and tackling air pollution. Our Automation and Analytical Management Interest Group hold an annual meeting on monitoring ambient air. Professor Frank Kelly, of King's College London, presented our Environmental Chemistry Group Distinguished Guest Lecture 'Inside the engine – from chemistry to human health. The lecture and symposium explored the chemistry of diesel engine emissions, emissions policy, and their effect on human health. Our multidisciplinary journal Environmental Science: Processes & Impacts publishes high quality papers in all areas of the environmental chemical sciences, including chemistry of the air. We would also be willing and able to connect DEFRA to our network of chemical scientists.

We provide a partial response below that covers specific matters relating to Understanding the Problem (Chapter 1), Protecting the Nation's Health (Chapter 2) and Securing Clean Growth and Innovation (Chapter 4). We provide a narrative response, in order to highlight issues that we as a scientific community think are important to consider when developing the final Clean Air Strategy and detailed National Air Pollution Control Programme.

Chapter 1: Understanding the Problem

- **Chemical emissions into the air change frequently and unpredictably as society and technology evolve.**
- **A clean air strategy must have sufficient scientific and technical 'surveillance' capability to anticipate and identify emergent pollution sources early in order to develop and evaluate possible interventions, to increase the ability to prevent air quality problems.**
- **Whilst welcoming extra investment for air quality modelling, we caution against an over–reliance on modeling for air pollution information and encourage a substantial expansion in the use of direct observations and measurements to inform policy, particularly for those chemicals and parameters that are beyond those stipulated in air quality directives.**
- **We highlight an information deficit on how best to control complex mixtures of pollutants and their effects on health and the environment, when compared to pure substances.**

The underlying cause of poor air quality is chemical emissions to the air. These do not have fixed physical properties but change frequently, and unpredictably, as society and technology evolve. A key challenge for Government is to ensure that the Clean Air Strategy (CAS) can tackle the major air pollution issues of relevance for today *and* develop regulatory and scientific intelligence systems that can adapt to detect future air pollution sources before they become problems.

Air pollution in the UK has gone through many different phases over the past 100 years from sulphur smogs to acid rain, photochemical ozone and most recently roadside NO_2. In each case, the emergence of a new dominant source of pollution has required revision of previous strategies and implementation of new ones. A strategy for managing future emissions, whatever their source, is essential and the UK should be equipped with sufficient scientific and technical 'surveillance' capability to identify emergent pollution sources early in order to develop and evaluate possible interventions. Surveillance should preferably be untargeted in terms of chemicals selected for analysis to avoid missing an 'unforeseen consequence', such as the impact of diesel NOx emissions. Limiting surveillance, for example, only to chemicals specified in air quality directives, could result in emergent risks from other chemicals only being identified when they become a problem.

The largest uncertainties in future national air quality lie in planning and forecasting on the multi-year to decadal scale. Whilst operational pollution forecasts can already accurately predict air quality a few days in advance, longer-term predictions are much more difficult to make, as they are driven by a range of factors, particularly uncertainties in technology, society and economics. It is difficult to forecast the evolution of existing pollution sources, such as the current vehicle fleet, and there remains a high potential for new sources or activities to emerge.

A detailed understanding of pollutants and their chemistry is important for interpreting health and environmental effects, regulating emissions, and developing pollution-reducing technologies. U.K. chemists, supported initially by Defra in the 1990s, have developed the "master chemical mechanism"(MCM), which provides the world's most detailed description of air pollution chemistry. It describes 7000 species[1] and more than 15000 reactions and is the gold standard against which global forecast and policy models are tested. The MCM includes descriptions of the chemical reactions involved in degradation of volatile organic compounds in the lower atmosphere. This helps policy makers to "test" how effective a piece of proposed regulation or legislation would be.

We welcome the Government investment of £10m to improve modelling, data and analytical tools to give a more precise picture of current air quality and the impact of policies on it in future. Although modelling is important and necessary, however, we are concerned that modelling alone may be insufficient to predict future problems and allow the development of mitigation strategies in time.

Computational models are fundamental to the prediction of weather and climate, both of which are underpinned by solid unchanging underlying physical principles. In contrast, chemical emissions to the air do not have fixed physical properties, but change frequently and unpredictably. We therefore caution against an over–reliance on modeling for air pollution information and encourage a substantial expansion in the use of observations to inform policy, particularly for chemicals and for parameters that are beyond those stipulated in air quality directives. Too narrow a focus only on meeting specific regulatory measurement requirements may blind Government to emergent sources of pollution, or limit the ability to evaluate how well air quality policies are working.

The range of sources and pollutants addressed in the CAS is considerable. Some pollutants such as SO_2, NH_3, NO_2 and O_3 are individual chemicals about which much is known in terms of toxicology, impacts, sources and indeed abatement strategies and technologies. Other pollution classes that are also known to affect health, such as particulate matter (PM) and non-methane volatile organic compounds (NMVOCs) are groupings of very complex mixture, which can vary by location, by season and by emitting source. There is an information deficit on how best to control complex mixtures such as these and how mixtures of chemicals may have different effects on health and the environment, when compared to pure substances.

Implementation of the CAS may see some of those mixtures change quite substantially, for example the amount of ammonium nitrate in Particulate Matter may reduce (from agriculture and NOx abatement), but the proportion of difficult to manage particulate

[1] A 'species' refers to a grouping of chemicals with similar characteristics

content from non-exhaust emissions (e.g. road, tyre and brake wear) may increase. There is a need better to understand the impacts of changing the mixture as well as the overall amount of PM mass.

Chapter 2: Protecting the Nation's Health

- **Accurate monitoring and measurement of atmospheric pollutants is vital for ensuring regulatory compliance and can help us to understand further the relationship between poor health and air pollution.**
- **We welcome the ambition in the specific objectives for $PM_{2.5}$ (particulate matter with a diameter of 2.5 micrometers or less) using the World Health Organisation (WHO) lower limit value of 10 microgram / m^3. At the same time, we argue that it is vital to establish the extent to which this lower target would be attainable in densely populated cities, even in a fully electrified transport future noting the uncertainties associated with non-exhaust emissions.**
- **Targets for $PM_{2.5}$ reduction that are not technically attainable for fundamental physical reasons may require a more flexible approach to their implementation in some highly urbanized environments.**

Accurate monitoring and measurement of pollutants is vital for checking regulatory compliance with national and international air quality regulations. Such measurements can also help us to understand correlations between health problems and air pollution, for example, the relationship between different types of particulate matter and cardiovascular problems. Chemical scientists play a vital part in developing our understanding here.

The inclusion in the CAS of some specific objectives for $PM_{2.5}$ using the World Health Organisation (WHO) limit value of 10 microgram/m^3 is welcome and highly ambitious. It appears uncertain however, to what extent this lower target would be attainable in the most densely large populated cities, even in a fully electrified transport future. The non-exhaust emissions (NEE) of electric vehicles[2] are one important area of uncertainty that may possibly confound meeting the lower targets by busy roads. Electric vehicles are growing in popularity and their non-exhaust particulate matter emissions, from road, tyre and brake wear, are comparable to those of conventional vehicles.

Targets for reduction that are not attainable for fundamental physical reasons risk acting as a distraction, and may lead to wider disengagement or disillusionment. Some scientific evaluation of the technical feasibility of $PM_{2.5}$ limits in highly urbanized environments is needed. **An ambition to achieve better air quality outcomes and protect human health**

[2] V.R.J.H. Timmers, P.A.J. Achten, Non-exhaust PM emissions from electric vehicles, Atmos. Environ. 134 (June 2016) p10-17

may in future require the adoption of individual exposure targets or differential limit values dependent on locations. Any such approach would need a robust underpinning by scientific evidence.

Chapter 4: Securing Clean Growth and Innovation

- **The polluting effects of non-methane volatile organic compounds (NMVOCs) are unique to each chemical, so a species-level (chemicals with similar characteristics) risk/impact based approach to regulation and abatement is essential, rather than regulating or abating purely by total mass of NMVOC emissions.**
- **A targeted approach to NMVOC abatement is one area that is most likely to have a beneficial impact on the environment, be cost effective and encourage innovation in new formulations and products.**

Tackling NMVOC emissions offers many opportunities for the UK Chemical Industry to become world leaders by harnessing the opportunities for innovation and investment in clean growth. The Clean Air Strategy identifies new measures to reduce emissions of Non-Methane Volatile Organic Compounds to meet 2030 National Emission Ceiling Directive (NECD) and United Nations Economic Commission for Europe (UNECE) Convention on Long-range Transboundary Air Pollution (CLRTAP) targets. This may affect many different industry sectors, chemical products and processes.

The polluting effects of NMVOCs are unique to each chemical. It is therefore essential to adopt a species-level risk/impact based approach to regulation and abatement, rather than regulating or abating purely by total mass of NMVOC emissions (which is currently prescribed in regulation). There is a significant body of well-tested knowledge about the atmospheric chemistry of individual NMVOCs. Government and industry should use this knowledge to prioritize reductions of the most damaging species.

A targeted approach to NMVOC abatement is one area that may have both beneficial impacts on the environment as well as being cost effective and encourage innovation in new formulations and products. A collaborative approach, where regulators worked closely with industries, was exceptionally successful in the reduction of halocarbon emissions responsible for stratospheric ozone depletion.

We welcome the Government partnership with UKRI that will seek ways to support further investment in clean air innovation to enable the development of novel technologies and solutions that tackle emissions from industry, vehicles, products, combustion and agriculture and support both improvements in air quality and decarbonisation.

Contact

The Royal Society of Chemistry would be happy to discuss any of the points raised in our response in more detail. Please direct any questions to Dr. Steven Lipworth, Policy Advisor, Environment & Regulation: lipworths@rsc.org, 020 7440 3337.