Air Quality Targets Technical Workshop: Metrics, their calculation and assessment

On 2nd September 2020 an online workshop was held to discuss the technical aspects of defining, calculating and measuring suitable metrics for the air quality targets being developed as part of the Environment Act 2021. Workshop participants were experts in air quality modelling, monitoring, strategy and the health impacts of air pollution mainly from the Air Quality Expert Group (AQEG) and the Committee on the Medical Effects of Air Pollutants (COMEAP), but other academics and consultants with relevant expertise and experience also attended. The workshop was chaired by the AQEG chair; Defra and devolved administration officials observed the discussions.

The workshop participants were divided into four groups, each focused on a different aspect of the target metrics. Three or four questions relating to each topic were posed by Defra officials to the groups. Prior to the workshop participants met with their groups to discuss the questions and during the workshop presented their responses to the rest of the participants and led a plenary discussion on the topic. After the workshop each group prepared a short note summarising their response to the questions taking into account the points raised during the plenary discussion.

The workshop agenda and group notes are provided below. The workshop responses provided by the experts informed the development of the targets. Many of the topics were subject to further discussion with the expert groups and other experts, therefore the notes do not constitute all the expert advice received on metrics.

Agenda

10:00	Welcome and workshop objectives	Ally Lewis, AQEG Chair	5 mins
10:05	Introducing the AQ targets and story so far	Dan Waterman, Defra	15 mins
10:20	Lessons learnt from other target setting	Mohamed Ghalaieny, Defra	15 mins
10:35	Group 1: Defining the metrics	Group 1	
	a. Group presentation		10 mins
	b. Plenary discussion		20 mins
11:05	BREAK – 10 mins		
11:15	Group 2: Calculating the metrics		
	a. Group presentation	Group 2	10 mins
	b. Plenary discussion		20 mins
11:45	Group 3: Measuring the metrics	Group 3	
	a. Group presentation		10 mins
	b. Plenary discussion		20 mins
12:15	BREAK – 10 mins		
12:25	Group 4: The metrics in practice	Group 4	
	a. Group presentation		10 mins
	b. Plenary discussion		20 mins
12:55	Summary and next steps	Ally Lewis, AQEG Chair	5 mins
13:00	CLOSE		

Group 1: Defining the metrics

Key points

- An annual mean metric will be effective in driving action to reduce short-term as well as long term exposure and health impacts.
- The PERT should be expressed as a population-weighted mean concentration.
- Population weighting for the PERT is most directly achieved by averaging across monitors that are sited proportional to the population.
- The choice of historic or future baseline year(s) for the PERT is unresolved.
- Interim targets could include population weighted mean concentration and mean exceedance, reductions in UK emissions and reductions in PM component concentrations where measured. The legal standing for interim targets would need to be clear.
- There is an overwhelming case for both the limit value target and PERT to be national, rather than regional.

Q1: Can a long-term exposure (annual mean) metric be an effective driver for action to reduce PM2.5 and protect against health harm considering the additional short-term impacts of PM?

An annual mean metric will be effective in driving action to reduce short-term as well as long term exposure and health impacts. It is unclear if a 24-h target for $PM_{2.5}$ would lead to any additional abatement over and above measures to reduce long-term average concentrations. Frequency distributions of daily average concentrations are fairly stable, suggesting that policies to reduce long-term exposure would also be sufficient to protect against short-term exposure. However, this is likely to be dependent on the air quality climate and the policies being pursued at the time, and changes in these can presumably change this relationship, so this should be evaluated. Some protection against short-term $PM_{2.5}$ episodes would also be provided by retention of a 24-h standard for PM_{10}, which would simultaneously offer some protection from toxicity associated with coarse particles.

If it is intended to retain current short-term Air Quality Objectives (AQOs), it will be important to consider whether PM_{10} monitoring will continue at its current extent or whether there will be pressure to reduce PM_{10} measurements, while increasing those for $PM_{2.5}$. Given that the current short-term exposure limit value is for PM_{10}, this could be a problem for protection against short-term exposure effects. If on-going/future evidence on exposure relates to $PM_{2.5}$, rather than PM_{10}, it might be preferable to replace the short-term AQO which relates to PM_{10} with one for $PM_{2.5}$.

Q2: How could a population exposure reduction target be defined?

The legal compliance PERT should be as simple as possible. The PERT should not refer to a specific concentration to avoid implication that certain exposures are safe. If progress relative to a concentration is quantified, e.g. for information purposes, then use reduction in (population-weighted) concentration exceedance rather than reduction in population exceedance; the latter does not quantify the full population health benefit of concentration reductions and populations still in

exceedance may not appreciate their risk may have reduced. Exposure reduction expressed as a (population-weighted) mean concentration is easier to understand than a cumulative exposure because it is in the same units and numerical range as the ambient concentrations. Although changing population distributions introduces a degree of 'moving goalposts' to a population-weighted mean, the effect is anticipated to be small.

Unresolved discussion concerns how best to capture a population-weighted concentration in the PERT. Population weighting is most directly achieved by averaging across monitors that are sited proportional to the population, i.e. X monitors per N population. Although this provides only coarse spatial population weighting it is favoured because it is easier to define and defend. Geostatistical (e.g. co-kriging, land-use regression) or other approaches to weighting (dispersion modelling, data reduction, data fusion, etc.) are all forms of modelling and subject to similar criticisms directed at use of dispersion/transport modelling to deliver the $PM_{2.5}$ concentrations in the first place. Also, literature indicates that an impractically large number of measurement sites are required to develop and validate a spatial model for population weighting (10s of locations per urban area). A disadvantage of a monitor-only approach to population weighting is that even with an expanded measurement network quite a large proportion of population exposure may derive from populations in smaller urban areas without a monitor. This will be less of an issue for rural populations whose low population numbers and low ambient contributions contribute relatively little to total population exposure. In addition, there remains unresolved debate on defining the spatial area, or population, that a measurement location represents. Modelling will be needed to inform siting of monitors and to allocate populations without a monitor to a 'suitable' measurement location but this will incorporate some arbitrariness. The issue of whether or not to include 'roadside' or other 'hotspot' locations of exposure (e.g. ports) in population weighting requires further discussion and analysis. A question is the amount to which these locations contribute to total population exposure; and action to reduce exposure in these locations may be more appropriately driven through the limit value. In principle, exposures in these locations could be incorporated via a monitor weighting approach by locating numbers of monitors in different types of location in the same proportion as it is estimated that these locations contribute to total population exposure, but this may again require impractically large numbers of monitors. One suggested approach is to exclude roadside locations from the PERT but include them in the limit value target. A further limitation of a monitor-only approach is that any aspiration to reduce exposure inequalities between population sub-groups will be difficult to assess without spatial modelling; however delivery on any form of PERT should reduce the range of $PM_{2.5}$ concentrations, particularly if accompanied by the condition that concentrations should reduce everywhere they are measured, which in turn reduces both exposure inequality across the whole population and exposure inequality associated with socio-economic status since lower SES is generally associated with higher $PM_{2.5}$.

Unresolved discussion also surrounds choice of baseline year(s). The advantages of a historic baseline are that the PERT can be defined now and it avoids anomalies that may arise from persistent COVID-related impacts in the near future. However, if a change in monitor network is implemented it will be difficult to defend use of different monitor locations between historic and compliance years.

Q3: What could interim targets (5 yearly) look like?

The primary purpose of interim targets is to assess progress, and will need to be set based on projected emissions and modelling reflecting effects of abatement strategies. If a legally binding target is defined based on measurements then corresponding projected improvements can be derived using calculated concentrations for the measurement network, although this will need to recognise uncertainties in the modelling, and representativeness of the measurements. Further discussion is required on

whether a % improvement of absolute improvement should be set, taking account of arguments for the latter reflecting uncertainties and geographical variability in different components of PM2.5.

In assessing progress additional metrics will be useful including changes in UK emissions which are under UK control; as opposed to emissions in other countries (subject to emission ceiling agreements) and from shipping, which contribute to imported PM2.5, especially the long-range SIA. Consideration should be given here to primary PM2.5 emissions within densely populated urban centres where the highest concentrations are likely to occur, and where it is especially important to drive improvement. Assessment of progress will need to consider if the anticipated emission reductions in the UK have been achieved.

Additional metrics for diagnosing progress are population weighted mean concentration, PWMC, which can be used to compare different regions/sub-groups of the population, and to estimate health improvements to justify action taken; and population weighted mean exceedance, PWME, to indicate improvements in exposure above a defined concentration such as the WHO guideline.

Other checks for improvement can make use of ancillary measurements, for example the AGANET network to check projected changes in SIA; and measurements at the supersites to provide source-apportionment including primary sources such as wood-burning, cooking and non-exhaust emissions with large uncertainties.

The legal standing/obligation for interim targets would need to be made clear, including the relationship to other legal obligations, for example on emission reductions.

Q4: Would variable regional targets be beneficial/ feasible?

There is an overwhelming case for both the limit value target and PERT to be national, rather than regional. The main rationale is that the major proportion of the PM2.5 is regional and not under local control, and the levers for control for primary emissions are mostly in the hands of the national rather than local government. Local government has neither the powers nor the resources to effect the improvements needed. National targets will also reduce the risk of complaints of transboundary pollution affecting local concentrations. Measurement statistics for the PERT will be better with more monitors included, which argues against highly granular target setting. Where specific local problems exist, a national limit value target will be sufficient to drive action. London could be considered as a special case of high pollution, high monitor density and high local autonomy, and would be the only realistic candidate for a different target. A PERT for London might drive a greater clean-up in the more deprived (and polluted) areas, but this is unlikely to be feasible elsewhere.

Supporting research/analysis

It would be useful to evaluate the relationship between annual average PM2.5 and frequency distributions of daily average PM2.5 for a range of air quality climates to determine how reduction in annual average would likely reduce the occurrence of higher percentile daily concentrations.

It would be useful to have some form of modelling analysis that estimates the proportion of total population exposure currently contributed by different categories of population locations. The 10

categories defined by Brookes, D.M et al. (2019) might be a useful starting point: Central London, Inner London, Outer London, Inner Conurbations,....Urban (pop 10,000-25,000), Rural; additional categorisation according to roadside/non-roadside would also be helpful (with discussion of what is meant by roadside). [Technical report on UK supplementary assessment under The Air Quality Directive...for 2017]

Continued consideration of the area and/or population represented by an 'urban background' monitor location is required.

Links/dependencies

Inclusion or not of roadside and other 'hotspot' locations (e.g. ports) in quantification of population exposure.

Whether the PERT should include assessment of reductions in sub-group exposure inequalities, and if so, which sub-groups.

The choice of baseline year(s) for the PERT.

The lowest concentration change, for a given absolute concentration, that is larger than the measurement uncertainty for a single monitor and for a network of monitors. (For example: a change of 0.5 ug/m^3 at 12 ug/m^3, a change of 1 ug/m^3 at 5 ug/m^3.)

Group 2: Calculating the metrics

Key points

- Averaging over 3 calendar years will help smooth meteorological variations and provide a more stable long-term reduction metric, although further studies are recommended.
- Methods for consideration to missing data should be avoided, and based largely on setting of clear targets for data capture at individual monitoring stations, or at best follow well established methods of annualisation based on LAQM methods, so long as confidence in the representivity of the data is achieved.
- The metrics should not attempt to account for varying levels of population susceptibility.

Q1: When setting and monitoring a long-term reduction target, is it appropriate to average concentrations over several calendar years?

1) It is well known that there are significant year-to-year variations in annual mean concentrations driven largely by year-to-year variations in meteorological conditions, for example low wind speeds giving rise to higher local concentrations, or more frequent winds from the southeast being associated with polluted air from parts of continental Europe. These meteorological effects, i.e. variation in annual mean concentrations, will a) be strongest at individual sites, b) still be affecting sites over a regional scale, c) be more variable, and possibly in divergent directions, at a UK scale (e.g. meteorology may give rise to a high pollution year in SE England at the same time as a low pollution year in Scotland).
2) These meteorological effects can be smoothed out by averaging annual concentrations across more than one year. They will, to some extent, also be smoothed out by averaging across sites throughout the UK. The current EU $PM_{2.5}$ targets are based on averaging across 3 calendar years (as well as across all sites). This was largely driven by work carried out for Defra in 2005/2006 which showed smoothing over 3 years was likely to be appropriate (testing was for 2, 3, 4 and 5 years for PM_{10} data). The effect of averaging over 3 years for recent $PM_{2.5}$ data has been examined by the group (not formally) and this 3-year averaging would still seem appropriate to smooth out the year-to-year variations.
3) While openair software could be used to remove meteorological (and other) influences (called deweathering) and identify the underlying trend, the group was of the view that this approach should not be used. This was because it would be something of a 'dark art' for the public to understand.
4) The group tended towards a preference for averaging over 3-years to be used as the metric for testing compliance with the long-term target reduction. This would especially apply to examination of results for individual sites, if this is required.
5) For the sake of completeness, the group was of the view that the metric for testing compliance with limit values, as opposed to long-term targets, should be individual calendar years, with no averaging over several years.

Q2: How should any missing data from monitoring stations be dealt with when calculating the two metrics?

The general consensus of the group was for keeping things simple in respect of the management of missing data from monitoring stations: avoiding complicated data manipulation to deal with missing data such that trust in what was being reported then diminished was a clear outcome of the discussions within the group.

Two options were considered:

1) Set clear data capture targets for the achievement of reporting against "limit value" and "target reduction" metrics and then report only on monitoring stations that achieve these. Avoid including reporting on anything else not achieved,
2) If missing data were to be considered then implement an "annualisation" approach that is similar to that of the existing Local Air Quality Management regime as per existing LAQM.TG16 guidance.

The decision on which to implement is dependent upon a number of factors that were identified by the group, which included:

- compliance reporting levels - UK wide; regional or local?
- number of sites at which monitoring is undertaken - whether an over-provision of sites enabled flexibility to be implemented in the reporting regime
- whether data being used to annualise for missing data would be "representative" of the site in question.
- changes in monitoring technology and the challenges in achieving data capture that these may bring over the horizon of the reporting framework.

Q3: Should the metrics account for varying levels of population susceptibility?

The clear consensus was "No".

The rationale for this conclusion was based on the following considerations:

1. Setting metrics for different groups of the population would be open to question – e.g. why it would be acceptable for one group to be subject to a higher exposure than another.
2. As well as susceptibility, there is also the consideration of vulnerability (e.g. socio-economic groups who tend live in more polluted locations).
3. Based on only a small number of studies of sub-groups.
4. Difficult to monitor PM on an appropriate spatial scale.
5. Would rely on ancillary data with additional uncertainties.
6. Difficult to clearly communicate to the public.
7. More open to challenge in a court of law.
8. WHO guidelines designed around a consideration of exposure susceptible groups.

The overall recommendation was that metrics should not be adapted to account for varying levels of population susceptibility. However, this is based on the assumption that the metrics that will be set for the whole population will be designed considering the exposure of susceptible groups. Furthermore, that issues of exposure inequality should be addressed through policy not targets.

Supporting research/analysis

References

Q1: Options for an Exposure-Reduction Approach to Air Quality Management in the UK and the EU for Non-Threshold Pollutants (https://www.aqconsultants.co.uk/CMSPages/GetFile.aspx?guid=57133987-deaa-4ae0-8ea8-850180bc87ff

Q1: Options for an Exposure-Reduction Approach to Air Quality Management in the UK https://www.aqconsultants.co.uk/CMSPages/GetFile.aspx?guid=1cd77465-b05c-4941-a04a-f88e50822253)

Q2: LAQM.TG16

https://laqm.defra.gov.uk/documents/LAQM-TG16-February-18-v1.pdf

Q2: VCM analysis on spatial representivity

http://www.volatile-correction-model.info/

Suggested additional analysis

Q1: It is recommended that further work is carried out using PM2.5 data over the last 15 years on the role of averaging across the whole of the UK to see if this smooths out meteorological influences sufficiently to rely on use of 1-year annual means (over a calendar year). This work should also test the role of averaging over 2, 3 and 4 calendar years, as it might apply to smoothing out individual sites and regional groupings, as well as the whole of the UK.

Q2: update on the spatial representivity of data given the extent of data now available

Links/dependencies

Q2: extent of investment in monitoring and availability of over-provision for clear decisions on what can / cannot be reported on.

Group 3: Measuring the metrics

Key points

- It will be most practical to focus the exposure reduction target solely on measurements made away from any direct influence of local sources.
- It may be appropriate to apply the limit value target to a wider array of settings, similar to the current annual mean Objectives, but this choice will define the policy outcomes of the target-setting. Defining the desired policy outcome goes beyond the remit of this question.
- The choice is also influenced by the modelling scale used in the epidemiological studies used to set the target.
- Regardless of where the targets apply, a monitoring coverage over a cross-section of environments would be desirable.
- Also desirable would be more extensive provision of composition data, and accompanying activity and emission data to inform progress and models.
- The optimal distribution of measurement sites depends strongly on the recommendations of group 1.
- There is no compelling reason to change the current EU reporting zones for regional exposure reduction metrics.
- Clarification of the definition of 'PM' being referred to is needed.

Q1: Should targets utilise only monitoring data that is representative of population wide exposure and therefore focus on use of urban and rural background measurements for compliance assessment?

The question was raised about generally whether the current system of rural and urban background measurements would be fully representative of exposure or whether we would need to include more 'near source' locations. The former would be easier to apply and provide continuity but it may create distrust and disengagement amongst those living near sources of pollution (e.g. roads, industrial sites) and it would not put any constraint on the design or placement of new sources or exposure. While the example of 'roadside' sites was mentioned, it was also pointed out that this was not favoured during prior discussions.

There is some consensus that the exposure reduction target should be assessed exclusively against measurements made at urban and rural background locations. There is, however, some disagreement about whether near-source locations should be excluded from the limit value target as well. The implications of this decision are likely to be profound. This is because including near-source locations will focus policy strongly toward hot-spot locations at the expense of the wider population, while excluding them will potentially allow an increase in exposure within such hot-spots in the future. It is unlikely that a single limit value target can avoid both of these limitations, even though near-source increments are often relatively small when compared with those of pollutants such as NO2.

Some consideration should be given to the pattern of exposure represented by the exposure metric in the original epidemiological studies. Older studies used background monitoring sites and comparisons across cities. Newer studies use finer scale modelling and several studies are pooled together so the 'typical' pattern of exposure needs investigation.

Regardless of where each target applies, placement of new sites should ideally ensure that a cross-section of environments is monitored, such as residential areas near sources of pollution.

Q2: How might a monitoring network to assess population exposure differ to a network to measure annual mean concentration?

The exact nature of the network depends very strongly on the nature of the exposure model implemented and how much this depends on the measurements from different environments and geographical areas. Generally, it is likely that we would wish to focus on areas representative of the overall population, so this would likely mean a focus on urban areas. Including a cross section of different exposure environments would be informative, but care would be needed to make sure that the models and the exposure metrics generated do not deviate significantly from that used to provide the health evidence that underpins the targets. On that basis, the exposure reduction targets themselves are likely to focus on background measurements. Practical issues involved in relocating or setting up new sites must also be considered.

Q3: What level of geographical area or urban area should be considered for a regional exposure reduction target?

This question depends strongly on what exactly the regional exposure reduction targets hope to achieve. Specifically, whose responsibility it would be to ensure the targets are met and who would benefit. As has been pointed out in the other groups, the majority of PM2.5 is secondary and regional in nature, so there would only be so much granularity that could be achieved. It may be possible to exercise greater local influence and authority over meeting the targets if they could be split into primary vs. secondary, but there is currently no clear-cut way of doing this. The sub-group saw no compelling reason to deviate from the zoning that is currently in place for reporting to the European Commission, which would give greater continuity.

Q4: What gaps do you feel there are in the current monitoring network that would need to be addressed for (a) assessing progress using the two metrics proposed and (b) to provide input and validation data for more robust PM assessment using modelling?

Clarification will be required in how 'PM' is defined, as no measurement is perfect and the different metrics can diverge when presented with lower concentrations and a greater variety of environments. Asides any additional monitoring sites proposed in response to question 3, it was felt that having more composition data would help to both assess progress and provide validation data, although it is recognised that this will require additional resource. Furthermore, additional data on activity and emissions alongside measurements would be of benefit to the modelling activities.

Supporting research/analysis

References

Suggestions of additional analysis

A key question to be answered is whether near-source locations should be excluded from the limit value target. It was suggested that the importance of near-source locations to population-weighted exposure could helpfully be modelled. While this could characterise current exposure, the position on new developments, e.g. housing, is to an extent shaped by direct and indirect influences of the NO2 objective on the planning system. Modelling the status quo may not show the effect of choosing to discount near-source locations from the target and thus subsequent planning decisions which could increase near-source exposure. Ultimately, this decision needs to be informed by a clear definition of what the limit value targets are intended to achieve, which is a policy question not for this group.

Links/dependencies

The response to all the questions (in particular 1, 2 and 3) depend very strongly on the outcomes of group 1.

Group 4: The metrics in practice

Key points

- There are two key unanswered questions in terms of policy design: whether near source exposure is relevant (e.g. background vs roadside) and how to integrate national and local action.
- The intended policy outcomes need to be clearly stated and the "targets" simply expressed, while adhering to the evidence based principle
- Existing policy frameworks and approaches, especially on climate change and public health, need to be considered in the development of the policy/target framework
- Good, conscious policy design will help reduce and mitigate unintended consequences but it must be accepted that there will be some - public policy is too complex to anticipate all unintended consequences
- The UK should maintain proactive engagement with relevant international conventions (e.g. CLRTAP) and selected neighbouring countries in order to influence the transboundary impacts on the UK's PM2.5 concentrations. However, policymakers should give careful consideration to the fact that these significant impacts are not within their control.

Q1: What are the challenges of communicating these two metrics?

Main issues

The "limit value" style approach, in isolation, does not accord with the evidence base with respect to population health benefits (absence of threshold), while the exposure reduction approach from the current Air Quality Directive is confusing, lacks interim progress measures and applies only at a national level. The new targets "system" within the Environment Bill framework needs to have clearly stated goals and a means of tracking - and demonstrating - improvement over time. It is noted that clear communication is not the same as simple, e.g. in comparison with Index of Multiple Deprivation, carbon budgets for GHG emissions reductions, etc. The Index of Multiple Deprivation requires a complex calculation using a wide range of diverse datasets, yet it resonates because it is simply expressed. Presentation of the more complex population exposure reduction target needs to be clear so that the underlying intention is fully understood.

The existing AQD (where the current exposure reduction approach is set out) has failed to drive action because:

1. The exposure reduction approach is too nebulous and does not provide any meaningful interim checkpoint to show whether progress is being made. The first time that any view of compliance will be available is September 2021, too late to implement further policy measures if they are needed.
2. The backstop level (i.e. the limit values) is too high and again, fails to drive action. However, its simplicity has led it to be seen at the main target (it was never intended as such).
3. There is a mismatch between the transboundary nature of PM (on local, regional and national scales) and the agency of different bodies charged with taking action.

Recommendations

- General recognition that (1) health benefits continue down to very low AP concentrations (so single target values too narrow without understanding how they relate to variations and the ambition for 'ever lower' to some practicable floor) and (2) that targets/monitoring are not ends in themselves but slightly indirect tools helping to shape broader policy debates about AP reduction strategies and actions.
- Capture the value in locally (or regionally) relevant indicators of status and progress at a higher time resolution (of political cycle - and public communication - relevance).
- A tiered (devolved) approach may drive policy action at multiple levels, ensuring tailored messaging is targeted at appropriate levels (e.g. nationally and locally)
- Distinguish between the end goal and the mechanism for achieving it, e.g. the distinction between the 2050 climate change targets and interim carbon budgets
- Needs to be an inclusive process, and one in which actors understand their realistic contribution to trend reductions.

Q2: Could focusing on meeting these targets drive potentially unforeseen or potentially unhelpful actions?

Main issues

Public policy is complex and highly interlinked. All legislative targets have a warping effect on policy as meeting the target tends to supersede solving the problem the target is intended to represent. There will always be unintended consequences but these can be minimised and mitigated through conscious and careful policy design.

Recommendations

- Be clear about *intended* outcomes and establish a comprehensive evaluation framework within the policy design, in accordance with better regulation principles (e.g. the Magenta Book)
- Make use of well-established policy frameworks, such as
    - Avoid Shift Improve (ASI) to consider side-impacts, co-benefits/disbenefits etc.
    - Reduce-Extend-Protect prioritisation for broadly prioritising actions to reduce population exposure.
- The strongest links are with public health, and so efforts need to be made to engage with and link to the wider public health agenda. There are also some useful concepts within public health which could be co-opted.
- Important that recommendations are understood in the context of the major policy ambitions, including (net) zero carbon.

Q3: How might national targets influence behaviour at a local level? How might local targets to support action differ to the national targets?

Main Issues

National targets are not a driver at the local level, but national policy or local policy is a key driver. Authorities should not be made accountable for things they cannot control. Local authorities cannot control (overall) PM2.5 concentrations due to the overwhelming influence of regional background. However, they can use concentrations to help target localised action and they can control local emission sources (albeit weakly with current powers).

Importance that the balance between limit value and PERT does not drive local action to (unsuccessfully) reduce exposure through (population) location - given the longer lifetime /

transboundary nature of PM, this approach will not succeed. Needs clear communication that the issue is different from local road links & NO2 exceedances.

Consider the regional tier, which captures a significant population. The GLA has been successful in coordinating action in London. Could the Metro Mayors be similarly utilised? There needs to be a meaningful way in which progress on local (and national) action is reflected within the system. Responsibilities should be commensurate with the political and economic levers available to each respective tier.

Recommendations

- Regional/national/international level of PM means national governments must have much stronger responsibility for achieving targets than is the case for NO2. Consideration should be given to emissions targets, potentially at a local or regional level, as a way of mandating and tracking actions at that level.
- LAs need powers, or at least clearer powers, to act on local sources, such as NRMM (construction), domestic heating (beyond proposed changes to Clean Air Acts), public transport fleets, etc. They will also need a significant level of support to gather activity data on these sources - data is available but incomplete in London but often very poor elsewhere.
- Monitoring needs to provide LA/regional information to drive policy change and support public understanding. Network to design (monitor density) to approximate population-weighted mean exposure will more readily allow direct measurements (averages) to be relevant, and reduce the opacity of post-measurement processing to derive a population-weighted indicator.

Q4: How do we take account of transboundary impacts?

Main issues

The extent to which the transboundary components contribute to UK PM2.5 concentrations is significant, and needs to be better communicated so that it is understood by all relevant stakeholders. Information is available from CLRTAP modelling studies, and the datasets which have the largest influence on the modelling calculations relating to impacts on UK concentration fields are of relatively good quality. The CLRTAP will play a key role in setting future targets and ambition levels and coordinating efforts to control emissions across Europe that contribute to PM2.5 concentrations, and it is therefore sensible that Defra continue to play an active role in CLRTAP planning discussions.

Policymakers will need to give careful consideration to the fact that future PM2.5 concentrations will be significantly impacted by a transboundary component which is beyond their control. Any targets which are established will need to explain what can and is being achieved by UK policies and measures, and separately the assumptions that are made about the impacts of the transboundary component. Periodic analyses of these impacts will be required using best science and the most up to date data to monitor progress towards initial projections.

Recommendations

- Good data are important to be able to present an accurate picture. But targets should clearly explain what UK policies and measures are expected to achieve, and separately the expected changes in the impact from the transboundary component. Periodic analyses will be needed not just to monitor progress of UK policies, but also to ensure that best science and the most

up to date data are being used to determine the impacts from the transboundary component.

- It is important to maintain robust independent capability to quantify transboundary calculations and hence be able to verify the results from CLRTAP modelling studies. This would also allow DA level assessments. Observational source apportionment is a key component of this (following international protocols eg WHO / EPA) in conjunction with model approaches (if the latter can be sufficiently standardised - a model to require consultation on the latest / best model approach, rather than write a specific approach into statute, may address the latter challenge).

Supporting research/analysis

References

Suggested additional analysis

- Question 1: Compile a correlation assessment of emissions by source to pick out pollutants that are correlated/anti-correlated with PM2.5. Some interpretation would be needed to then apply this from national to local (i.e. urban) scale
- Question 3: Potential to learn from other sectors on delegation of responsibilities and action between tiers. For example, how is responsibility shared for the water model work - e.g upstream a given authority's remit/responsibility vs water quality arriving downstream in a different authority?
- Question 3: assess viability of measurement network design (monitor density) such that the measurements themselves (or their regional mean) approximate a population-weighted exposure quantification / PERT metric.

Links/dependencies