



Department
for Environment
Food & Rural Affairs

EMEP Task Force on Measurements and Modelling

Reference monitoring and low-cost sensors – their differing roles in English policy development.

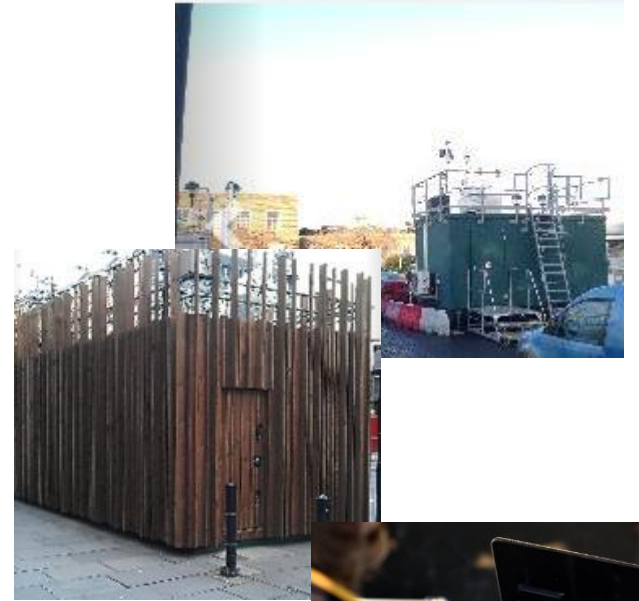
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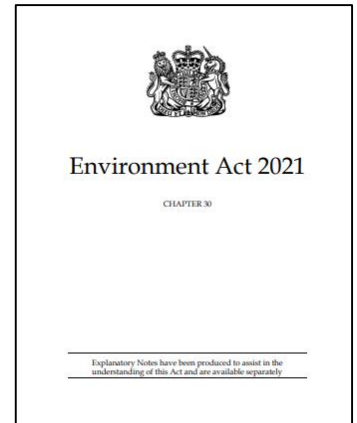
- Background to policy area
- Reference monitoring
- Low-cost sensors



Background to Policy Area

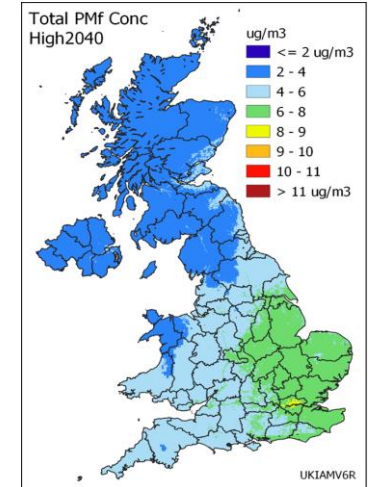
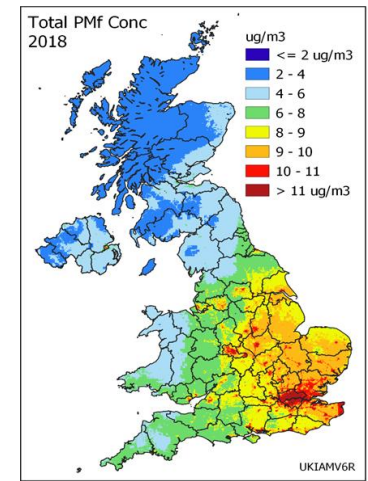
Recent Air Quality Legislative Changes

- Clean Air Strategy was developed and issued in 2019.
- The Environment Act came into force in 2021.
- The Environmental Targets (Fine Particulate Matter) (England) Regulations 2023 set two air quality targets in legislation.
 - an annual mean concentration target of $10 \mu\text{g}/\text{m}^3$ by 2040 (the AMCT).
 - a population exposure reduction target of 35% compared to 2018 by 2040 (the PERT)
- The new $\text{PM}_{2.5}$ targets are in addition to the AQSR limit values and NECR emission ceilings and apply to England only.



Benefits of achieving the targets

- Modelling suggests that achieving the proposed targets will result in 214,000 fewer cases of cardiovascular disease, 56,000 fewer strokes, 70,000 fewer cases of asthma and 23,000 fewer cases of lung cancer over the course of 18 years.
- It will also halve disparities in exposure – benefiting those living in the areas of highest deprivation.
- It will substantially reduce the risk to ecosystems in nitrogen sensitive habitats supporting greater biodiversity.
- The cost benefit ratio is 5:1 – with the economic benefits outweighing the costs.



Monitoring expansion – to assess compliance



Original Network



Original Network and Expanded Network



[Interactive monitoring networks map - Defra, UK](#)

- By end 2027 we will have added 100 + new additional PM_{2.5} monitors. This is to ensure we are able to represent the exposure of the nation as a whole, in addition to measuring the highest concentrations of PM_{2.5}.

PM_{2.5} Equivalence and Reference Monitors

- As part of the expansion programme, it is important to be confident that the PM_{2.5} and PM₁₀ networks are robust and the monitoring data for the targets is trustworthy.
- The equivalence programme is a process of comparing performance of instruments chosen for a network with that of the EU Reference Method and is known as “particulate matter equivalence”. This demonstration enables near real time monitoring (not feasible with the reference method).
- The following Standards are still used in the UK:

BS EN12341:2023 Ambient Air. Standard gravimetric measurement method for the determination of the PM₁₀ or PM_{2.5} mass concentration – the "Reference Method".

BS EN16450:2017 Ambient Air. Automated measuring systems for measurement of the concentration of particulate matter (PM₁₀; PM_{2.5})

- How can we maintain assurance in the concentrations in future years which could undermine compliance legislation, when it becomes more challenging to measure at lower levels of particulate matter?

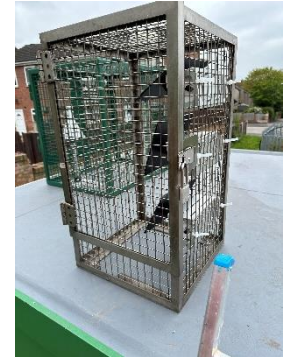


PM_{2.5} Equivalence and Reference Monitors

- **Instigation of a programme of works** looking at instrument performance compared to the European Reference Method.
- Establishing, in addition to our current permanent ongoing equivalence sites an additional 7 temporary sites.
- **Identify any improvements** that could help future iterations of the CEN Standard and the implications of falling concentrations on:
 - the effectiveness of the maths on which equivalence is assessed.
 - the effectiveness of instrument performance.
- This programme of work has demonstrated both the **complexity of uncertainty assessment and the challenges of measuring PM_{2.5}**.
- To maintain confidence in the performance of PM_{2.5} analysers, it is always helpful for the numbers of permanent on-going equivalence sites to increase.

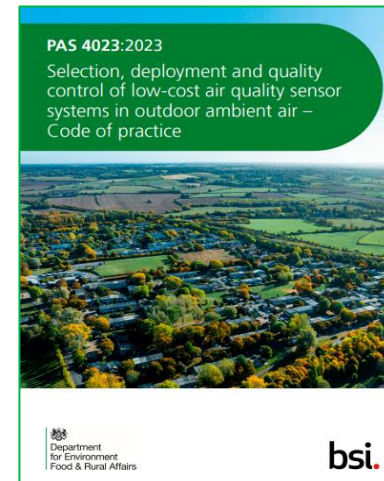
Low Cost Sensors and Reference Methods

- The UK Air Quality Network does not have low-cost sensors as part its monitoring equipment.
- Many of our local authorities use sensors as low-cost additions to reference equivalent methods. The potential advantages are:
 - a small footprint making them easily deployable in the urban environment;
 - a larger area coverage due to increased numbers than fixed point measurements and improved spatial and temporal resolution;
 - a potential of continuous calibration through co-location with reference style analysers and a network calibration.
- It is important that robust quality assurance is performed on the data produced to make it meaningful.
- The key are challenges a) range of end users and ways they are used and b) rapidly developing market is driving the products faster than standards and QA processes can be designed. It needs appropriate and flexible standardisation to be developed and evolved. ⁸



Low Cost Sensors and Reference Methods

- **A PAS (Publicly Available Specification)** has recently been published by BSi as a best practice guide for users. It also includes case studies from local authorities. It has been developed to provide guidance to users to:
 - select sensor systems appropriate for their monitoring needs;
 - deploy sensors in a way that promotes representative sample collection;
 - undertake the quality assurance (QA) processes to generate good quality data.
- Example QA recommendation - *The sensor system should be co-located alongside a traceable reference quality instrument.*



The Future

- Working with Local Authorities, regulators, citizen scientists to understand their sensor systems and the PAS in practice.
- Hold a symposium to share best practice and feed into an update of PAS 4023
- Looking how sensors could supplement the UK National Network reference monitors.

Summary

- Both equivalence reference monitoring and low-cost sensors have a future role to play in English policy development.
 - **Reference equivalence monitors** and the evidence they provide, ensuring that our national air quality monitoring networks are robust and data for the targets is trustworthy.
 - **Reference equivalence monitors** providing future opportunities to understand the challenges in monitoring ever lower levels of particulate matter.
 - **Low costs sensors** providing opportunities for larger area coverage due to increased numbers than fixed point measurements and improved spatial and temporal resolution.
 - **Low costs sensors** with appropriate standardisation and QA have potential as supplementary systems to **reference equivalent monitors** as part of a national air quality network.



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