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Welsh Government

Welsh Government Consultation Response

University of Southampton response to 'Fine particulate matter air quality targets'

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Fine particulate matter air quality targets

Question 1a: To what extent do you agree with the level of ambition proposed for the Annual Mean Concentration Target (AMCT)?

Agree

Question 1b: Please explain your answer

Agree, with caveats. Wales' proposed AMCT of 10 µg/m³ by 2035 is evidence-based and is achievable (indeed the lowest achievable level according to supplied modelling), materially improves public health, and is more ambitious than England's 2040 date when this consultation was launched. However, it falls short of the EU's default 2030 timeline, the new interim 2030 target set out in December's Environmental Improvement Plan, and the WHO 2021 guideline (5 µg/m³), so we'd recommend strengthening delivery with interim milestones and a 2029/30 review to consider bringing the date forward if cross-border and domestic measures outperform projections. Similarly, there should be scope to further tighten the target concentration at this time, if it appears to be feasible.

1) Achievability in a transboundary context is convincingly demonstrated

The consultation's modelling shows the earliest feasible date to reach 10 µg/m³ nationwide is 2035, even under ambitious measure scenarios, once uncertainty and inter-annual meteorology are accounted for. Lower levels (e.g., the WHO 5 µg/m³ guideline) are not judged realistically attainable across Wales by 2040.

Source apportionment indicates that the majority of PM2.5 averaged as a concentration across Wales, originates outside Welsh control (natural and long-range transport from the rest of the UK and beyond). The consultation estimates that only ~22% of the annual mean concentration in 2030 derives from emissions within Wales (and ~78% from the rest of the UK/natural/transboundary), which materially constrains what a devolved administration can deliver unilaterally by earlier dates or at lower concentration levels. However, it is also worth noting that most PM in the urban centre of Cardiff (and likely other urban population centres), originates from Wales. Indeed, in terms of population-weighted means (i.e. mean concentrations weighted towards populated areas, representing what people are actually exposed to), most PM2.5 is likely of Welsh origin. Nonetheless, it is important that the contribution of PM2.5 originating from non-Welsh (and especially non-Welsh UK) sources is emphasised as a target for mitigation in discussions with the devolved governments, and similarly that PM2.5 originating in Wales and moving to other UK locations is similarly targeted for mitigation in Wales.

The technical annexes detail a multi-model, nested approach (CMAQ with local AERMOD/RapidAir), explicit model verification against monitors, and incorporation of a 1.2 µg/m³ RMSE adjustment for uncertainty, giving confidence that the 10 µg/m³ by 2035 standard is stretching yet realistic.

Given the proportion of imported transboundary PM and quantified uncertainty, 2035 at 10 µg/m³ is a proportionate "highest-achievable" national limit that will still drive action where concentrations are highest.

However, it should be noted in the "Air pollution in the UK 2024: compliance assessment summary" published by Defra in September 2025, only one site (Marylebone Rd) exceeded the current 2040 limit of 10 µg/m3 in 2024, as such it should be questioned whether the modelling is overcautious, especially considering the recent unexpected reductions in UK PM2.5, which is in part related to reductions in agricultural emissions from continental Europe. (https://doi.org/10.5194/egusphere-egu25-3541, 2025.) Indeed, there are several examples where a priori modelling has turned out to be somewhat inaccurate compared to what actually manifested.

2) Comparative ambition is balanced and credible (Wales > England; Wales < EU default)
England's statutory target is 10 µg/m³ by 2040 (with a 35% PERT reduction by 2040). Wales' 2035 date is therefore more ambitious than England's current law and delivery plan. The EU Ambient Air Quality Directive (EU) 2024/2881 aligns the 2030 PM2.5 limit with 10 µg/m³ across Member States, while allowing extensions up to 2040 under specified conditions. Wales' 2035 sits between the EU's default (2030) and its extension window, which is a credible compromise given Wales' dependence on upwind measures in England and continental Europe.

The proposal explicitly aligns the concentration level with WHO's Interim Target 4 (10 µg/m³) (though not with the 5 µg/m³ guideline), mirroring the level already adopted by the EU and England, which supports consistency of instrumentation, assessment, and cross-border policy coordination.

Choosing 10 µg/m³ now - and 2035 for achievement - positions Wales credibly: ahead of England on legally-binding timing, albeit behind the new 2030 interim target, compatible with the EU's tightened standard, and mindful of devolved levers and cross-border dependencies.

3) Health and economic evidence show large net benefits even at 10 µg/m³, while acknowledging no safe threshold.

The consultation's impact assessment projects substantial health gains (e.g. 40–82 statistical deaths avoided per year on average across scenarios, >700 QALYs/year in central cases) and strong net benefits (benefit–cost ratios 3.6 - 4.3) when moving to 10 µg/m³ by 2035 with the proposed PERT. Demonstrating that this target delivers material population health improvements and good value for money.

COMEAP (the UK's independent medical advisory committee) continues to find no evidence of a lower threshold for adverse effects of long-term $PM_{2.5}$ exposure and recommends continuing reductions even at low concentrations; it also endorsed the value of a population exposure reduction target to maximise health benefits. This underlines the importance of pairing the AMCT with a PERT, as Wales proposes.

The WHO 2021 Air Quality Guidelines lowered the annual $PM_{2.5}$ guideline to 5 µg/m³ because health risks persist at very low concentrations. While Wales cannot yet meet 5 µg/m³ everywhere, the twin-track of a national 10 µg/m³ limit plus exposure-reduction keeps policy aligned with global health science and delivers meaningful benefits now.

The health and economic case is compelling at 10 µg/m³, and the added PERT sensibly addresses the "no safe threshold" reality by driving continuous improvement below the cap.

Constructive caveats and suggestions (to strengthen the ambition without changing the headline)
1. Set interim milestones (e.g. sectoral and geographic progress checks for 2028–2030) and publicly track them. This matches the EU's 2030 default and would allow Wales to tighten the date if feasible at the first statutory review, depending on UK-wide and EU progress on precursors (NO_x, NH_3, SO_2) under Gothenburg/NEC commitments.

2. Maximise UK-level coordination (e.g. with Defra) on ammonia and NO_x controls, shipping, and non-exhaust road dust to reduce imported PM2.5 and secondary aerosol formation. Crucial given the majority external contribution to Welsh concentrations.

3. Embed earlier evidence review (by 2029/30) to consider advancing the date to 2032-2033, and further assessing whether more stringent AMCT targets might subsequently be set, if monitored trends and cross-border measures outperform the central scenario. This mirrors COMEAP's emphasis on continuous reduction and ensures agility if conditions improve faster than modelled.

On balance, we agree with the ambition of Wales' AMCT (10 µg/m³ by 2035). It is technically achievable given current constraints, comparatively ambitious within the UK, and health- and value-positive, especially when coupled with the proposed PERT. The key is to lock in interim milestones and an early review (including rapid establishment of the necessary additional monitoring stations), so that Wales can tighten the date if transboundary and domestic measures deliver faster-than-expected gains.

Question 2a: To what extent do you agree with the level of ambition proposed for the Population Exposure Reduction Target (PERT)?

Agree

Question 2b: Please explain your answer.

Agree, with caveats. The proposed PERT of a 25% reduction in population-weighted mean PM2.5 exposure by 2035 (vs 2019) is well-justified by Wales' modelling, aligned with current health science on "no safe threshold", and proportionate given Wales' substantial transboundary PM2.5 burden. We would pair this with firm interim waypoints and an early review so the percentage (or date) can be tightened if monitored trends and UK/EU measures outperform the central scenario.

The chosen baseline is very important - the modelling and PERT setting here is against the Welsh

2019 concentration. In order to comment effectively it would be useful to understand why 2019 was selected – it is implied that this is due to 2019 being the year the most recent Welsh Air Quality target was met? The equivalent PERT for England is against a 2018 baseline, and so selecting 2019 prevents direct comparison with air quality mitigation performance for sites in England, although setting the Welsh PERT against Welsh 2018 PM2.5 concentrations would likely result in a different baseline and thus different extent of change required to meet targets. It should be considered whether there are benefits of harmonisation.

1) The evidence shows 25% by 2035 is the most ambitious deliverable option without relying on speculative measures

However, the consultation's compliance matrix indicates that a 27.5% exposure reduction by 2035 PERT option remains borderline achievable across non-speculative scenarios (and non-borderline achievable by 2040), with diminishing returns beyond that date in the central modelling.

The underlying air-quality modelling nests CMAQ with local dispersion, is verified against monitors, and explicitly propagates a 1.2 μg/m³ RMSE to handle model uncertainty i.e. the PERT proposal rests on conservatively adjusted concentration projections rather than optimistic assumptions.

Source apportionment shows that the majority of PM2.5 concentration in Wales is not within Welsh control (long-range transport/natural sources dominate), which constrains the feasible pace of population-wide exposure reduction absent accelerated upwind action in England and Europe. However, this is a spatial average. In terms of population exposure (i.e. population-weighted average concentration), one is being used as a surrogate for the other.

Setting 25% by 2035 is comfortably achievable within Wales' sphere of control while reflecting verifiable modelling and uncertainty bounds. A slightly more ambitious target, of 27.5%, may focus minds as well as potentially evidencing a desire to lead on this within the UK.

2) A PERT directly targets health risk where science says there's no safe threshold
COMEAP continues to find no evidence of a lower threshold for the chronic mortality effects of $PM_{2.5}$ and specifically recommends continuing reductions even at low concentrations, which supports using a PERT to drive population-wide improvement beyond any single limit value.
COMEAP's advice note to Defra welcomed the exposure-reduction approach as key to maximising public-health gains (while noting targets must be achievable), reinforcing the rationale for a Welsh PERT alongside the concentration cap.

The WHO 2021 guidelines lowered the annual $PM_{2.5}$ guideline to 5 μg/m³ and emphasise health benefits at concentrations well below past standards, another reason to prioritise exposure reduction, not just hotspot compliance.

Implication: A PERT of 25% by 2035 operationalises the "no safe threshold" evidence by cutting average exposure for the whole population, not only the highest-concentration locations.

3) Comparative ambition is balanced and credible
a. England's statutory PERT is 35% by 2040 (vs 2018); Wales' 25% by 2035 (vs 2019) is earlier in time and coupled with a tighter AMCT date (2035 vs England's 2040), yielding a comparable trajectory per decade, especially given Wales' higher reliance on upwind reductions cf-target-delivery-plan). Although it should be noted that December's Environmental Improvement Plan commits to an interim PERT of 30% compared to 2018 to be achieved by December 2030.

Although the EU's 2024 ambient air quality Directive does not set a PERT metric, it tightens PM2.5 to 10 μg/m³ by 2030 (with conditional extensions to 2040) and strengthens monitoring/model requirements—policy context that supports Wales' twin-track approach of a national limit plus exposure reduction.

Wales' own integrated impact assessment and consultation show that the AMCT+PERT package delivers substantial net health and economic benefits (e.g. positive BCRs 3.6-4.3 across scenarios), indicating the exposure-reduction component contributes materially to value-for-money.

Implication: The Welsh PERT is credible relative to peers, consistent with international directions of travel, and demonstrably beneficial.

Constructive caveats and suggestions (to lock in ambition)
1. Publish interim PERT waypoints and a public trajectory (e.g. 2028/2030 checks) to maintain momentum and enable course-correction before 2035>Mirroring the EU's 2030 milestone for the 10 μg/m³ level and ensuring transparency in year-on-year exposure trends.

2. Strengthen cross-border levers with UK Government on NO_x, NH_3 and SO_2 (key $PM_{2.5}$ precursors) under the NEC/Gothenburg framework, given the large external contribution to Welsh exposure. This includes agriculture (ammonia) and shipping/transport measures to reduce secondary aerosol formation.

3. Expand and optimise the monitoring base for the PERT, using the recommended 3-year rolling mean and additional monitors at representative urban background sites—to reduce uncertainty in the population-weighted mean and ensure robust compliance assessment.

4. Earlier review point (by 2029/30): if measured and modelled trends outperform the central case e.g., due to faster decarbonisation, domestic combustion controls, or UK-wide ammonia reduction. Consider raising the PERT (e.g. >25%) or bringing the date forward in line with COMEAP's advice to keep driving exposure down.

On balance, we agree with the level of ambition for Wales' PERT: 25% by 2035 is evidence-based, health-led, and feasible given transboundary constraints, while the twin-track with the AMCT locks in equity and continuous improvement. The key is to operationalise ambition with interim milestones, strengthened monitoring, and a scheduled early review so that ambition can be tightened if real-world progress allows.

Question 3a: To what extent do you agree with the proposed arrangements for assessing PM2.5 levels and achievement of the targets?

Neither agree nor disagree

Question 3b: Please explain your answer.

Neither. The proposed assessment arrangements for PM2.5 are broadly sound, align with recognised standards, and should yield robust, comparable determinations of compliance with both the AMCT and PERT. We would, however, strengthen four areas: (i) faster expansion and spatial optimisation of the monitoring network, (ii) a formal hybrid (monitoring + modelling) framework for the PERT, (iii) tighter transparency rules for any subtraction of "natural contributions", and (iv) clearer data-quality objectives and audit processes in the regulations themselves.

Comments
1) The core design is roughly consistent with best practice and legal standards
Wales' plan to assess the AMCT as an annual mean at each monitoring location (no multi-year smoothing) upholds the integrity of a concentration limit and mirrors established UK/EU compliance practice, where annual caps are assessed against ratified fixed-station data with formal QA/QC. This is an appropriate and conservative design for a "minimum standard" metric.

The proposal to base both targets' compliance on fixed measurements that meet AQS-equivalent standards is also sound. Defra's national framework specifies reference/equivalent methods (e.g., CEN EN 12341 gravimetric and EN 16450 for automated methods) and data-quality objectives (e.g.~85% data capture, ≤25% uncertainty at the limit value), which are consistent with the Welsh intent to maintain at least AQS-level QA/QC. Ensuring parity with these norms will keep Welsh data robust and comparable.

Retaining zones/agglomerations for reporting is a pragmatic choice that aligns with historic compliance reporting in the UK and with EU requirements on network representativeness and transparency under the recast Ambient Air Quality Directive (EU) 2024/2881. This supports continuity, comparability, and efficient integration with existing infrastructure.
The basic architecture (metrics, fixed monitoring, standards, and reporting geographies) is compatible with UK and EU practice and should produce defensible compliance determinations.

2) The PERT methodology is epidemiologically appropriate and aligned with expert advice
Population-weighted exposure indicator assessed over a 3-year rolling mean of representative sites is well-aligned with public-health science, which emphasises average long-term exposure rather than isolated hotspots for chronic PM2.5 risks. The Clean Air Advisory Panel's advice (as reflected in the consultation) and COMEAP's position that there is no established safe threshold for long-term PM2.5 (hence the need for continuous reductions) justify a PERT that focuses on background exposure rather than near-source spikes.

COMEAP has also explicitly endorsed the exposure-reduction approach to maximise population health

benefit, complementing any concentration limit. Using a multi-year average for the PERT smooths meteorological noise and is common in exposure metrics used for health-impact assessment.

WHO's 2021 guidelines (5 µg/m³) underline benefits at even low concentrations, reinforcing the need to drive down average exposure for all, not only to clear hotspots—exactly what a PERT operationalises.

The PERT assessment method is reasonably fit for purpose to capture health-relevant exposure and to guide continuous improvement.

3) Network expansion and QA/QC commitments are positive, but timing and coverage could be tighter.

The proposal to add at least 9 $PM_{2.5}$ monitors and to codify minimum siting and performance requirements is welcome, as present coverage (11 sites) is sparse for robust population-exposure estimation; the plan to require updated minima by 2033 provides a legal backstop.

EU law is moving toward stronger monitoring-and-modelling integration and improved representativeness under Directive 2024/2881, and the UK already implements comprehensive QA/QC and ratification procedures across national networks. Wales' intent to meet AQS-equivalent standards keeps it aligned—but accelerating deployment would better support the 2035 target assessments and earlier public accountability.

The direction is correct; earlier network expansion and explicit DQOs in the regulations would strengthen confidence in the PERT and AMCT determinations

Where we recommend strengthening the arrangements
1. Adopt a formal hybrid assessment for PERT (monitoring + modelling).

The EU directive explicitly emphasises enhanced monitoring and modelling to support compliance assessment. Wales should codify a hybrid population exposure method that fuses ratified fixed-site measurements with validated dispersion/chemical transport modelling and small-area population weighting (with uncertainty bands). This would mitigate sparse-network bias and support PWMC estimates with better spatial granularity and equity insights.

2. Bring forward the monitoring uplift (before 2033) and optimise coverage.

To underpin the 2035 targets, most new sites should be operational well before 2033, prioritising urban-background locations that dominate population exposure, complemented by rural-background to resolve regional baselines and transboundary signals. Publish a siting plan linked to population density, gradients, and representativeness analysis.

3. Clarify the rules for "natural contribution" subtraction and ensure transparency.

While subtraction is permitted for meeting UK compliance for PM10, this is not permitted for PM2.5 and the evidence onhealth risk from $PM_{2.5}$ is strongest for mass concentration which exists regardless of source. This additionally risks Wales becoming out of step with England. Wales should require:
Method statements (data, thresholds, uncertainties) published alongside any subtraction,
Independent technical review before use in compliance decisions, and
Public reporting of "with" and "without subtraction" values so trends remain intelligible to stakeholders.

4. Bake in explicit DQOs and audits in the regulations.

Mirror the UK national practice by specifying minimum data capture, measurement uncertainty, ratification, and audit requirements (e.g., EN 12341/EN 16450 equivalence demonstrations) in the Welsh regulations or statutory guidance, not just in supporting documents, to avoid ambiguity.

5. Publish uncertainty with all compliance determinations.

Given the consultation already quantifies model RMSE (\~1.2 µg/m³) and inter-annual variability, require publication of confidence intervals (or "compliance bands") around the national PERT indicator and site-level AMCT assessments, in line with evolving EU emphasis on transparent uncertainty.

Question 4a: To what extent do you agree with the provision in the draft regulations to allow the subtraction of the ‘natural contribution’ to particulate matter where exceedances of a target are due in whole or in part to these natural contributions?

Strongly disagree

Question 4b : Please explain your answer.

Strongly disagree with allowing subtraction of the “natural contribution” when determining compliance, while recognising there are narrow, defensible circumstances (clearly evidenced exceptional natural events) where discounting might be justified if accompanied by strict safeguards and transparent dual-reporting.

Why we disagree
England does not allow this.
1) Public-health protection should be source-agnostic until such time clear differential harm has been established.

The consultation itself (via CAAP) acknowledges that PM2.5 has negative health impacts irrespective of source, even if natural contributions are beyond the Welsh Government’s control. Allowing subtraction therefore risks understating the health burden the public experiences.

COMEAP continues to advise that there is no known safe threshold for long-term PM2.5; it recommends continued reductions even at low concentrations. Discounting natural fractions at the point of compliance could weaken incentives to reduce all exposure that matters for health.

WHO (2021) tightened the PM2.5 guideline to 5 µg/m³, reflecting robust evidence of harm at very low levels; that logic is indifferent to whether particles are “natural” or “anthropogenic”. Indeed, there is no good evidence that “natural" PM is less harmful than anthropogenic PM, with the possible exception of sea salt spray (which would mainly fall in the PM10-2.5 fraction).

Implication: Compliance metrics should reflect real exposure; otherwise, the legal picture may say “compliant” while the health risk remains materially unchanged.

2) Attribution is scientifically uncertain, and interactions are complex
The consultation highlights the complexity of interactions between natural and anthropogenic PM2.5 sources and calls for “a robust method of assessment and justification” before any subtraction. That complexity is not trivial when secondary aerosol formation and mixed source contributions drive annual means.

Even the consultation’s model validation shows material uncertainty (root-mean-square error \~1.2 µg/m³ for annual $PM_{2.5}$), and notes challenges in resolving contributions at discrete locations. In this context, confidently quantifying and subtracting a “natural” component for compliance carries real risk of misclassification.

Implication: Given the measurement/modelling uncertainty and source mixing, subtraction could systematically under-state concentrations for compliance purposes unless guardrails are exceptionally tight.

3) Policy necessity is limited—and the risk to transparency is non-negligible
The EU’s recast Ambient Air Quality Directive (EU) 2024/2881 does allow discounting natural/exceptional events—but only with strict documentation and transparency. The intent is to avoid penalising states for clearly exogenous spikes (e.g., volcanic ash, Saharan dust), not to weaken routine health protections.

UK compliance data show that PM2.5 annual limits have recently been met without needing natural subtraction—suggesting that, for annual means, discounting is rarely essential. That argues for extreme caution before building broad subtraction provisions into Welsh compliance determinations.

Moreover, in Wales the majority of PM2.5 is externally derived, but much of that is anthropogenic (from the rest of the UK/Europe), not “natural;” subtraction won’t address this dominant driver, yet could confuse accountability for exposure the public still breathes.

Implication: The practical need for routine subtraction is limited; the cost in terms of transparency and perceived dilution of protection can be high if not tightly bounded.

If Ministers retain the provision, we recommend strict guardrails

1. Dual reporting (mandatory).
Publish both unadjusted and “natural-subtracted” values for every compliance determination and trend report, with the evidential basis (measurements, modelling, back-trajectories) available for scrutiny, mirroring the transparency envisaged under the EU framework

2. Limit the scope to clearly evidenced exceptional events.
Apply subtraction only to discrete, well-documented and unusual/rare episodes (e.g. industrial accidents/fires) and not to routine “natural” baselines (e.g., diffuse sea salt) that are integral to the regional aerosol climate. Require independent expert verification before use.

3. Exclude subtraction from the PERT.
Keep the Population Exposure Reduction Target strictly unadjusted, so Wales’ core health-focused metric reflects the actual population-weighted exposure people experience; this is consistent with COMEAP’s emphasis on continuous reduction and the consultation’s rationale for a PERT.

4. Set explicit evidentiary standards and audits.
In regulations or statutory guidance, define minimum methods (e.g. reference/equivalent measurements, receptor modelling, chemical speciation where feasible, trajectory analysis), uncertainty disclosure, and independent audit prior to any subtraction. Align with UK QA/QC and the enhanced monitoring-and-modelling expectations signalled by the EU directive.

5. Require remedial action plans even when “compliant by subtraction.”
Where subtraction flips an exceedance to compliance, still require a targeted action plan to reduce anthropogenic co-contributors that amplify the health impact during natural episodes (e.g. NO_x/NH_3 precursors), to maintain the principles of prevention and equity.

Extent of agreement: Disagree. From a health-protection and measurement-science perspective, allowing subtraction risks under-representing real exposure and blurring accountability, unless confined to rare, clearly evidenced natural episodes with full transparency and dual reporting. If the provision is retained, the guardrails above are essential to preserve trust, comparability, and the primacy of the health signal that the PM2.5 targets are designed to convey.

Question 5: We have asked some specific questions. If you have any other relevant thoughts or comments on our proposals, please provide them here.

Consider greater harmonisation with other UK nations such as with baselines, methods, assumptions, made public and consider publishing the raw unaltered data.

We suggest that establishment of new monitoring stations would be a great time to embed in monitoring for pollutants of emerging concern such as ultrafine PM monitoring by particle number concentration, and black carbon. Monitoring of emerging concern pollutants was recommended in paragraph (14) of EU directive (EU) 2024/2881 (below). Both black carbon and ultrafine PM are components of PM2.5,and may be key in carrying risk burden, as such this represents an outstanding opportunity for longitudinal study. Whilst Wales is not an EU member state, this recommendation is grounded in evidence and should be considered. Wales does not currently have any sites in the UK Particle Concentrations and Numbers Network and only one site in the Black Carbon Network

Relevant paragraph from EU 2024/2881
(14) It is important that pollutants of emerging concern, such as ultrafine particles, black carbon and elemental carbon, as well as ammonia and the oxidative potential of particulate matter, be measured at monitoring supersites at both rural background locations and urban background locations in order to support scientific understanding of their effects on human health and the environment, as recommended by the WHO. For Member States whose territory is less than 10 000 km2 measuring at monitoring supersites at urban background locations would be sufficient.

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