Review of: Provisions for Air Quality Measurement, Air Quality Modelling, Management Framework, Assessment, and Public Information; and Stakeholder Consultation Support

Assessment of the AQUILA Recommendations for the revision of the current Air Quality Legislation

Final report

Client: European Commission, DG Environment

28th June 2013
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1 Analysis of the AQUILA recommendations

1.1 Introduction

This report has been carried out as a part of Special Agreement 4 under Framework Contract ENV C3/2011/FRA/008 in response to the request from the European Commission, Directorate-General Environment: Services to support the Review of the Thematic Strategy on Air Pollution, in particular concerning the Review of: Provision for Air Quality Measurement, Air Quality Modelling, Management Framework, Assessment, and Public information; and stakeholder Consultation Support.

The present report concerns an analysis of the AQUILA (a network of European reference laboratories, see the description in section 1.1.2 below) recommendations on changes to the air quality directive in relation to air quality measurements in the European monitoring programmes. The aim of the presented work is to provide guidance for the European Commission with respect to possible adaptation of these recommendations in possible future amendments of the Air Quality legislation. In the following we will briefly outline the background for the AQUILA recommendations by introducing the air quality directive, the AQUILA network and the listed recommendations.

1.1.1 The European Air Quality Directive (Directive 2008/50/EC)


1.1.2 The AQUILA network

The Network of Air Quality Reference Laboratories (AQUILA) had its constituting meeting in December 2001 at the Joint Research Centre ISPRA. The aim of the network is to “provide expert judgement, promote harmonisation of air quality measurements among EU, EFTA and CCs, co-ordinate QA/QC activities, carry out method development and validation, participate in standardisation activities, develop common research projects and pilot studies, and offer a forum for information exchange in form of training courses, workshops and conferences”. The creation of the AQUILA network was formally accepted by the participating institutes one year after the constituting meeting, and a memorandum of understanding has subsequently been signed by most of the partners. Since the constituting meeting, the AQUILA network has met once or twice a year. One of the main outcomes of these meetings has been the AQUILA position paper containing the networks recommendations for the revision of the current Air Quality legislation (the position paper is currently available as draft by 5.
June 2012). It is the recommendations in this position paper which are analysed in the present report.

1.2 The AQUILA recommendations

In the meetings of the network, the AQUILA recommendations have been through a series of iterations before finding the current form of the position paper (of 5. June 2012). During these iterations the number of recommendations has been reduced in order to focus on those with highest priority. After these iterations, the high priority recommendations that are also the ones treated in this analysis are the following 12:

1. Roles and responsibilities of National Reference Laboratories
2. Inter-comparisons
3. Type approval
4. Terms and definitions
5. Ion analysis in PM$_{2.5}$
6. Ozone precursors
7. Mercury and other Heavy Metals
8. Elemental Carbon/Organic Carbon
9. Average Exposure Indicator
10. Deposition
11. EN standards use and impact
12. Poly-Aromatic Hydrocarbons

In the following sections these 12 recommendations are shortly described one by one. In the description focus is on the impact these recommendations on future air quality monitoring in the European member states.

1.2.1 Roles and responsibilities of National Reference Laboratories

The AQUILA recommendations concerning roles and responsibilities of the National Reference Laboratories (NRLs) may be formulated in short as: to ensure accreditation of NRLs. The term “National Reference Laboratory (NRL)” is not used directly in the current EU Directive 2008/50/EC, but the directive states in Article 3 that the Member States (MS) shall designate, at the appropriate levels, the competent authorities and bodies responsible for:

a) Assessment of ambient air quality
b) Approval of measurement systems (methods, equipment, networks and laboratories)
c) Ensuring the accuracy of measurements
d) Analysis of assessment methods
e) Coordination of their territory if community-wide quality assurance programmes are being organised by the Commission
f) Cooperation with the other MS and the Commission

The AQUILA network thus defines the NRLs as the institution designated by the single MS for being responsible for the above. According to the position paper, the AQUILA network finds that the roles and responsibilities of the NRL’s are insufficiently described in the Directive, and they therefore recommend the following amendments/changes to Article 3:

- An item on the validity of modelling results
- Wording about community-wide quality assurance (QA) programmes should be modified
- Requirements for quality QA programmes on the national level should be added
- And that the NRL’s are introduced and defined explicitly
Section C of Annex I of EU Directive 2008/50/EC describes the data quality objectives (DQO), and we will here shortly outline the current text to give the background for the AQUILA recommendations in this regard.

- **Part A** concerns data quality objective for ambient air quality assessment. This concerns the following pollutant measures: sulphur dioxide ($SO_2$), nitrogen dioxide ($NO_2$), nitrogen oxides ($NO_x$), carbon monoxide (CO), Benzene, particulate matter ($PM_{10}/PM_{2.5}$), ozone ($O_3$) and related NO and $NO_2$. For field measurements demands have been outlined regarding: uncertainty, minimum data capture, minimum time coverage (for urban background and traffic, as well as for industrial sites). For indicative measurements demands have been outlined regarding: uncertainty, minimum data capture and minimum time coverage. In addition requirements with respect to modelling uncertainties are specified.

- **Part B** concerns results of air quality assessment. In this part it is stressed that the following information shall be compiled for zones and agglomerations in the MS:
  - Description of assessment activities carried out
  - The specific methods used, with references to descriptions of methods.
  - The source of data and information.
  - A description of results.
  - The population potentially exposed to levels in excess of any limit value for protection of human health.

- **Part C** concerns quality assurance for ambient air assessment: *data validation*. The institutions designated to Article 3 shall ensure the following: - that all measurements are undertaken in relation to the assessment of ambient air quality pursuant to Article 6 and 9 are traceable in accordance with the requirements set out in Section 5.6.2.2 of the ISO/IEC 17025:2005:
  - that the institutions operating networks and individual stations have an established quality assurance and quality control system which provides for regular maintenance to assure the accuracy of measuring devices.
  - that a QA/QC process is established for the process of data collection and reporting and that the institutions appointed for this task actively participate in the related Community-wide quality assurance programmes.
  - that the national laboratories, when appointed by the appropriate competent authority or body designated pursuant to Article 3, that are taking part in community-wide inter-comparisons covering pollutants regulated in this Directive, are accredited according to EN/ISO 17025 by 2010 for the reference methods referred to in Annex VI. These laboratories shall be involved in the coordination on MS territory of the community wide QA programmes to be organised by the Commission and shall also coordinate, on the national level, the appropriate realisation of reference methods and demonstrate of equivalence of non-reference methods.

The AQUILA network recommends a modification of the last bullet so that it would read as follows: That National Reference Laboratories (NRLs) are appointed by Member States. These National Reference Laboratories shall take part in community-wide quality assurance programmes and inter-laboratory comparisons organised by the Commission covering pollutants regulated in this Directive and shall be involved in their coordinating on Member State territory. These laboratories shall also coordinate, on the national level, the appropriate realisation of reference methods and the demonstration of equivalence of non-reference methods.

The NRLs shall be accredited according to ISO/IEC 17025:2005 for the reference methods referred to in Annex VI – according to their tasks – by 20xx and NRL shall take part in organising inter-laboratory comparisons on the national level.
Here the AQUILA network furthermore suggests a new bullet point to be added (to Section C Annex 1): That the national reference laboratories support the work by the European network AQUILA set up by the Commission. The cooperation of the NRLs and the AQUILA is described in an appropriate Memorandum of Understanding between the European Commission and the NRLs.

Some general remarks from the study concerning Roles and responsibilities of NRL issues within the EU: The following remarks are partly also valid for the next item the AQUILA recommendation for Inter-comparison.

1.2.2 Inter-comparisons

The Directive 2008/50/EC Article 3 requires MS to designate at appropriate levels, the competent bodies responsible for the assessment of air quality, approval of measurements systems, ensure accuracy of measurements, and coordination of quality programmes on their territory. Annex I Section C sets requirements regarding measurements traceability, accreditation to ISO 17025, active participation in country-wide quality assurance programmes, and in addition it describes the National Reference Laboratories roles in these activities.

The Joint Research Centre (JRC) ISPRA of the European Commission organizes QA programmes for atmospheric gaseous and particulate pollutants regulated in the EU. Inter-comparison exercises have been organised for SO$_2$, NO/NO$_x$, CO, O$_3$, BTEX, VOCs, PM$_{2.5}$/PM$_{10}$, As/Cd/Ni/Pb and polycyclic aromatic hydrocarbons (PAH) during the past 15 years. This has provided important feedback to participating laboratories and other interested organisations, and information regarding sampling, measurement and calibration methods, and data assessments of the performance of the participating laboratories.

Participation in these inter-comparisons has until now been voluntary. Summarizing reports have been sent to the participating laboratories after evaluation of the results, but the AQUILA network finds that there is a lack of impact of the reports and their data. They therefore require that AQUILA network participants conform to document N37 http://ies.jrc.ec.europa.eu/aquila-project/role-and-tasks-of-national-reference-laboratories.html, and in case of any failure to achieve required data quality objectives remediation measures must be taken to improve this and to demonstrate satisfactory results.

The AQUILA network “sees the necessity for participation of National Air Quality Reference Laboratories in these quality assurance programmes of the Joint Research Centre, and to clarify how unsatisfactory results must be dealt with”.

Some general remarks from the study concerning Inter-comparison issues within the EU: Se also the remarks in the above general comments to the item concerning Roles and responsibilities of NRLs. Regarding the text: “If this participation produces unsatisfactory results then the national laboratory should demonstrate at the next possible occasion satisfactory remediation measures, and provide a report to the JRC on these.”: This will impose increased costs for the NRLs primarily for administrative work and report writing.

1.2.3 Type approval

The Directive 2008/50/EC Annex VI specifies requirements for using specific reference measurement methods for assessment of atmospheric concentrations of eight ambient air pollutants (SO$_2$, NO$_2$ & NO$_x$, Lead, PM$_{10}$, PM$_{2.5}$, Benzene, CO, and O$_3$). These specified reference methods are prescribed in international standards developed by the European standardization organisation CEN. Continuous measurement methods are specified in five of the standards: EN 14211:2005 (NO$_x$), EN 14212:2005 (SO$_2$), EN 146625:2005 (O$_3$), EN 14626 (CO), and EN
14662:2005 (Benzene). These standards specify type-approval test procedures for demonstrating that the applied measurement method complies with the data quality objectives specified in Directive 2008/50/EC Annex 1. The Annex VI Section B in the Directive states that other measurement methods than the reference methods are permitted given that these are demonstrated to be equivalent. The Directive 2008/50/EC Annex VI Section E specify requirements of type-approval tests of measurement methods for mutual recognition by MS: “In carrying out the type of approval to demonstrate that equipment meets the performance requirements of the reference methods listed in Section A, competent authorities and bodies designated pursuant to Article 3 of Directive 2008/50/EC shall accept test reports issued in other Member states by laboratories accredited to the EN ISO 17025 standard for carrying out such tests”.

The AQUILA network suggest modifying the latter since “it is the exact meaning, the intension, and the interpretation(s), of this text in the current AQD that should be re-considered in detail – in order to provide a clearer, more transparent, and more specific and harmonised understanding of this text throughout the EU. 

General conclusions from the study concerning Type approval issues within the EU:

The AQUILA recommended modifications to the current text in Annex VI in the AQ-Directive concerning Type Approval issues are for most countries not expected directly to impose changes in the present costs for the National Reference Laboratories if there are at present no involvements in Type Approval testing and etc. and if there will be no such involvements in the future.

1.2.4 Terms and definitions

The AQUILA network suggests a number of new terms and definitions:

- **National competent authority** “organisation within the Member State that is designated by its national government to have overall responsibility for enacting all provisions of this Directive”
- **Competent body** “Organisation designated by the National Competent Authority in the Member State to carry out one or more technical or administrative functions at a national level that are required by this Directive, particularly those functional responsibilities that are specified in Article 3”
- **Reference (measurement method)** “European standard method developed by CEN, referred to this Directive, and specified as the reference method for the measurement of a specific ambient air pollutant”
- **Equivalent method** “A measurement method other than the reference method for the measurement of a specified regulated air pollutant, capable of meeting the Data Quality Objectives given this Directive for which equivalence has been demonstrated”
- **Time coverage** “Fraction of a calendar year to be covered by measurements”
- **Data capture** “Fraction of time period defined by time coverage for which valid measurement results are obtained”
- **Data coverage** “The fraction of a calendar year for which valid measurement data are available”
- **Preventive maintenance** “Equipment maintenance based on the manufacturer’s recommendations. Supplementary written recommendations based on practical experiences of e.g. NRL?”
- **Valid measurement result** “Results that are considered reliable based on: 1) Technical validation with respect to instrument status (calibration status, acceptable results of QC checks and method detection limit 2) Considerations of plausibility with respect to: expected results, correlations with results for other pollutants, correlations with results from nearby stations, meteorology, seasonal trends in concentrations”
- **Individual measurements** “Measurements covering a time period to the shortest reference method period associated with a limit value, target value or alert threshold value (with exception of components for which the shortest reference period is a year): 1h for nitrogen dioxide,
sulphur dioxide, ozone; 8h for carbon monoxide; 24h for PM and constituents; variable for benzene, depending on method used; variable for equivalent methods.

- Objective estimation “Generation of information for concentration, and/or deposition level of a specified pollutant obtained through expert analysis, possibly including use of statistical tools”

General conclusions from the study concerning Terms and definitions issues within the EU: This item is dealing with the wording and precision of different terms and definitions in the AQ-directive why this item has been regarded as cost neutral in all the responses from the questionnaires and the case studies.

1.2.5 Ion analysis

In consultation with EMEP Chemical Coordinating Centre (CCC), the AQUILA network has proposed the following modifications to AOD 2008/EC Annex IV Part B:

B. Substances

Measurements of PM must include at least the total mass concentrations of appropriate compounds to characterize its chemical composition. At least the list of chemical species given below shall be included: Na⁺, K⁺, Ca²⁺, Mg²⁺, NH₄⁺, SO₄²⁻, NO₃⁻, Cl⁻, elemental carbon and organic carbon. In the absence of EN standard measurement methods, MS are requested to use the methods described by the EMEP programme, by CEN Technical Reports or international standards. MS shall inform the Commission on the sampling and analytical methods used to determine the aerosol chemical composition. In addition the AQUILA network recommends that in Article 6 (point 5) the expression PM₂.₅ in brackets should be deleted.

The proposal is to remove the specific reference to PM₂.₅ in Article 5 (point 5) and Annex IV, in AOD 2008/EC. This concerns rural background locations, where it in this way also will be allowed to use the methods described by the EMEP programme, to measure PM (for instance TSP by the Filter Pack method).

1.2.6 Ozone precursors

The AQUILA network has a series of recommendations regarding measurements of ozone precursors:

- Monitoring the list of individual VOCs should remain part of the requirements of the Directive
- TNMHC appears to be a non-relevant measurement and it should be removed from the list of ozone precursors to be measured
- There may be a need for the development of EN standard(s) for the analysis of these compounds in ambient air
- There is a need for a definition of DQO for VOC ozone precursors in terms of their data capture and a target measurement uncertainty only, in line with current legislation
- When appropriate, low cost sampling and analysis methods should be used; i.e., when the final uncertainty of the data agrees with the DQO for the representative sampling time – this is already allowed provided the method is demonstrated as equivalent.

1.2.7 Mercury and other Heavy Metals

- The AQUILA network has recommended that:
  1. Reference methods published since publication of the Directive should be included in the revised Directive e.g. as in Annex V of 4th DD. In particular: EN 15852:2010 Ambient air quality – Standard method for the determination of total gaseous mercury; EN 15853:2010 Ambient air quality – Standard method for the determination of mercury deposition; EN 14902:20057AC:2006 Ambient air quality – Standard method for the measurement of Pb, Cd, As and Ni in the PM_{10} fraction of suspended particulate matter; EN 15841:2009 Ambient air
quality – Standard method for the determination of arsenic, cadmium, lead and nickel in atmospheric deposition

2. Total gaseous mercury (TGM) measurements should be mandated in urban and industrial areas where the population is exposed, similarly to PM-bound metals e.g. a change to Article 4.9 of the 4th DD.

3. An air quality standard is desired for elaboration of uncertainty of measurements; an addition to Annex I of the 4th DD.

4. Specified explicitly that metals including mercury, in PM samples, taken at different times, may be combined for digestion and analysed as a composite sample (as explicitly stated in the directive for PAH samples) – a clarification of Annex IV.I is required.

5. Explicitly specified that sub-sampling of PM filters for mercury and other metals for subsequent analyses is allowed, provided there is evidence that sub-samples are representative and that detection sensitivity is not compromised when compared with relevant DQO – a clarification of Annex IV.I is requested.

6. As an alternative to daily sampling, weekly sampling can be allowed for metals in PM provided that collection characteristic are not compromised – a clarification of Annex IV.I is required.

7. Limit/target values are to be quoted to the number of significant figures commensurate to the allowable uncertainty in their determination. In most cases this will mean two significant figures e.g. target value of 5 ng m$^{-3}$ for Cd. Similarly is recommended for lower and upper thresholds in Annex I and II; It is recommended to be explicitly stated in Annex I and II whether a value equal to the target or limit value at the number of significant figures stated is considered in excess of the target or limit value or not.

1.2.8 Elemental Carbon/Organic Carbon

The AQUILA network recommends:

1. Changing the title of Annex IV to “Measurements of PM composition”. Keeping the requirement for measurements at urban background locations, e.g. some of those used for the AEI. Although road-side locations would be interesting, these are not suggested to explicitly feature in the Directive

2. Total Carbon to be inserted as supplementary information in addition to EC and OC, and defined as mass concentration of carbon in PM samples in the list of components in Annex IV. It is recommended to insert a text “Total Carbon shall be reported as subdivided into categories including OC and EC, using methods to be reported by MS”. A need for a CEN Total Carbon standard method is addressed in the recommendations, and suggested possible as a main part of the updated CEN/TR 16243:2011. This would include a standard EC/OC method as an informative Annex.

1.2.9 Average Exposure Indicator

The AQUILA network recommends:

1. As update of the Table in AQD Annex XIV section B; A) introducing an additional decimal place, with no overlap, into the left hand column for AIE in 2010, and b) Changing the NERT from percentages to absolute numbers with ranges.

13. That the dates specified for the monitoring of PM$_{2.5}$ in this Annex should be different for new MS that may not have acquired valid data during the currently specified time periods.

General conclusions from the study concerning Average Exposure Indicator issues within the EU:
This item is dealing with only minor technicalities concerning the calculations of the AEI why this item has been regarded as cost neutral in all the responses from the questionnaires and the case studies.
1.2.10 Deposition of heavy metals and PAHs

The AQUILA network recommends


14. Lead in deposition should be considered in the same way as the other heavy metals in the 4th DD

15. Deposition measurements should be clearly specified as mandatory in urban and industrial areas where the population is exposed, similarly to PM-bound metals or organic compounds e.g. as a change to Article 4.9 of the 4th DD.

16. A target value for total deposition measurements is desired to allow uncertainty calculation, as percentage to be applicable in the region of this value

17. Minimum Time Coverage for the total deposition measurements of the regulated compounds is to be included even if it is equal to the value given for the measurements (in Annex IV.I).

1.2.11 EN Standards use and impact

The AQUILA network proposes to modify text regarding uncertainty and here merge/replace current text in 2008/50/EC and 2004/107/EC. New proposed text:

The measurement uncertainty (expressed at the 95% confidence level) of the assessment methods must be evaluated in accordance with the principles of the Guide to the Expression of Uncertainty in Measurement (JCGM 100:2008). The uncertainties to be compared with the DQO in the above data table are for results of individual measurements averaged over the reference period of the limit value, target value or threshold value. The uncertainties for fixed measurements to be compared with the DQO shall be calculated at the level of the limit value, target value or threshold value.


The AQUILA recommended modifications of the text proposal for the measurement uncertainty section, merging/replacing current text from 2008/50/EC and 2004/107/EC according to the following text: “The measurement uncertainty (expressed at the 95 % confidence level) of the assessment methods must be evaluated in accordance with the principles of the Guide to the Expression of Uncertainty in Measurement (JCGM 100:2008). The uncertainties to be compared with the data quality objectives in the above table are for results of individual measurements averaged over the reference period of the limit value, target value or threshold value. The uncertainties for fixed measurements to be compared with the data quality objectives shall be calculated at the level of the limit value, target value or threshold value. The EN Standards mentioned in Annex I provide information for the assessment of the measurement uncertainties for the measurement parameters under consideration. Other Standards that may be used to assess the uncertainty include:

• EN-ISO 20988: 2008 – Guidelines for estimating measurement uncertainty
ISO 21748:2010 – Guidance for the use of repeatability, reproducibility and trueness estimates in measurement uncertainty estimation

ISO 5725-2:1994 – Accuracy (trueness and precision) of measurement methods and results – Part 2: Basic methods for the determination of repeatability and reproducibility


The above is dealing with the clarification, wording and updating the literature reference to the new GUM (Guide to the Expression of Uncertainty in Measurement) in the AQ-direcitive.

Standards that are currently referred to in 2008/50/EC and 2004/EC/107

Reference methods for ambient air monitoring:


- EN 14907:2005 Ambient Air Quality – Reference gravimetric measurement method for the determination of the PM2.5 mass fraction of suspended particulate matter in ambient air.

These above two standards are currently revised and merged into one EN 12341 rev. The CEN enquiry process has just started. The date of publication will depend on the review process, comments from the different AQ expert communities, and the editorial processing at VDI/DIN and CMC. An official draft version of the standard (prEN 12341:2012-07) has been circulated in autumn 2013. When EN 12341 rev is not published before the publication of the AQD rev, references to both old standards need to be kept; a comitology procedure may then be used to address the revision and merging.


- EN 14212:2005. Ambient air quality – Measurement method for the determination of the concentration of sulphur dioxide by UV fluorescence.


These above four standards have been revised and will be published in 2012. References should be made to the revised standards.

These additions in themselves are not expected directly to impose changes in the present costs for the National Reference Laboratory as this part is concerned with references to revised and updated standards. The revised and updated standards will be followed by most of the National Reference Laboratories whether or not references are made to them in the AQ-Directive. However if the revised standards will cause changes in the current measuring routines, calibration practises, instrumental set-ups, data quality objectives and etc. this can impose potential increased costs.
1.2.12 Polycyclic Aromatic Hydrocarbons (PAHs)

The AQUILA network recommends that:

1. Reference methods published since publication of the Directive are included explicitly in the revised AQD; this includes: EN15549:2008; EN 15980:2011; The TS describing measurement of the 6 other PAHs in air is likely to be available in short time and should then be added.

18. Sub-sampling of PM filters for PAH subsequent analyses is explicitly allowed provided there is evidence that the sub-sample is representative of the whole, and provided that detection sensitivity is not compromised when compared with the relevant DQO of the Directive (Annex IV.1)

19. Time coverage for fixed PAH measurements: For the avoidance of doubt, the required time coverage for fixed measurements of the other PAHs are included even if this is simply equal to the value given for indicative measurements (Annex IV.1).

20. Target values should be quoted to the number of significant figures commensurate with the allowable uncertainty in their determination. In most cases this will mean two significant digits (e.g. target value of 1.0 ng m$^{-3}$ for BaP). The same is true for lower and upper assessment thresholds (Annex I and II).

1.3 Grouping of recommendations

In relation to receiving answers in a questionnaire survey that is send out to all the MS, a high number of questions will generally be an obstacle for a good response rate. In order to reduce the number of questions to be answered by the MS, the AQUILA recommendations have therefore been grouped into 10 categories; categories that in the following are termed option 1 to 10. These grouping of the AQUILA recommendations are as follows:

1. Roles and responsibilities of NRLs + terms and definitions.
2. Inter-comparisons + EN standards.
3. Type approval
4. Ion analysis.
5. Ozone precursors.
6. Mercury and heavy metals.
8. Average exposure indicator.
9. Deposition of heavy metals and PAHs.

By applying this grouping, the set of recommendations were reduced from 12 to 10; a procedure that made it possible to shorten the questionnaire somewhat and hopefully also made it easier for the MS respond.
2 Methodology in the Cost Assessment

2.1 Introduction

In this chapter, the methodology behind the performed cost assessment is described. Within this assessment on a bottom-up and a top-down approach has been applied. The bottom-up approach is based on data from the information request that was carried out in December 2012 - January 2013. The top-down approach was intended to be used for filling in missing information in the information request by use of the detailed case study surveys. However, it turned out that the quality of the information survey was rather poor and procedures had to be adjusted accordingly (explained in detail in the sections that follow). The detailed cost estimate for the case study countries was adjusted according to the EU standard cost model (Hasler et al., 2013). This EU standard cost model fixes the tariffs that are used for cost evaluation to defined values according to different salary groups (scientist, technicians, etc.) (see (Hasler et al., 2013) details in this regard). It was found that at least for Denmark the hourly tariffs used in the EU cost model are significantly lower than those that are commonly used in the Danish public service. It is expected that this also applies to the tariffs used for cost evaluation in at least some of the other MS. Additionally; the EU cost model operates with overhead costs of only 25%. In comparison, the Danish NRL receives a 116% overhead for services carried out for the Danish Environmental Protection Agency as part of the operation of the national monitoring network. It is expected that most other member states are operating with overhead costs much higher than the 25% applied in the EU cost model.

For the European-wide overall cost assessment there was one basic assumption that was applied for all AQUILA recommendations: it was assumed that all MS currently comply with the requirements of the air quality directive (AQD) 2008/50/EC and 2004/107/EC in their on-going air quality monitoring programmes. It is known that not all measurements are carried out according to standards and that there are cases where not all pollutants listed in the AQD are measured at all required sites. However, the detailed information about these deviations from compliance with the AQD is not available, and the assumption of compliance with the AQD furthermore makes the results of the cost assessment easier to compare and interpret.

2.2 The bottom-up approach: Information request for each option and sub-recommendation

2.2.1 Overview

The information request was sent out to all the 27 MS (plus Croatia as a future MS) in the beginning of January 2013. Due to the tight time schedule of the project, the MS were given only two weeks to respond to the information request. However, some of the MS asked for a prolongation of the response period. A high response rate was considered very important for the outcome of the project and despite for the tight time schedule a prolongation was therefore granted. After four weeks it was necessary to carry on with the analyses and therefore collect the responses that had arrived at that time. Despite for the prolonged response period, only a limited number of information requests were received, in detail responses were received from 17 MS: Denmark, Belgium, Hungary, UK, Finland, Germany, Czech Republic, Lithuania, Latvia, Ireland, Italy, France, Poland, Sweden, Luxembourg, Spain (only one province), and Romania. The questions concerning quantitative cost estimates were filled in to some extent by 15 countries. No countries except Denmark provided costs for all of the items. The Table 2.1 provides an overview of the responses to the various options.
The table provides an overview by country and option. When ‘Yes’ is indicated this means that the MS has answered some or all of the questions in relation to the cost. Note that ‘Yes’ also represents the cost neutral answer. Germany, Hungary, UK, Spain, Sweden and Ireland provided more cost neutral data than others. When ‘No’ is indicated this means that the MS didn’t provide any cost data - no data. Finally the empty cells – no response at all from the MS.

Table 1 Responses to information request concerning AQUILA data

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Table 2.2 below shows a summary of all costs that were reported in the responses to the information requests given per option and country. It is clear that the data coverage is patchy and highly incomplete, and that the bottom-up approach cannot be used for providing a full assessment for Europe.
Discussion of the obtained results

In the analysis of the received information requests it was found that the responses from the various countries showed a high variation in both quality and quantity. In the responses from the single MS information was provided for some options whereas information regarding other options was not provided at all. It varied strongly between MS to which options they had provide information. One the reason for the highly inhomogeneous responses turned out to be that the coordination of the monitoring programmes in some countries is partly split to different groups and institutions, and in some cases it is outsourced to private companies. This means that the required information had to be provided by a number of different persons serving different parts of the responsibility for the monitoring activities. This again made the responses to the questionnaire survey difficult to handle, especially within short response time period. Except for the Danish survey, none of the information requests were complete, a fact that also made the selection of case study countries somewhat difficult.

Selection of case study countries

Within the cost assessment, Denmark was early in the process selected as one of the case study countries, as the authors of this report work for the NRL (DCE, AU) in Denmark that is the overall responsible for and de facto carries out the Danish air quality monitoring. The DCE, AU thus has very deep insight into the Danish air quality monitoring programme, and all the necessary information for the detail assessment could therefore be obtained.

Based on the quality of the received information requests, a number of MS were selected as case study countries. This selection was based on an analysis of quality level and usability of returned answers to the questionnaire survey. Unfortunately, very few MS responded with detail to AQUILA options, and this proved limited options for the selection of case study countries. It was a major aim of the selection case study countries to validate the results from the corresponding information requests. However, a country was also positively evaluated in case DCE, AU had good contacts to the corresponding responsible persons in that country. This was based on the consideration that
such contact would increase the chances for a phone interview addressed to someone with a good overview of the monitoring programme in the specific country. This information was extracted from personal contacts made during a number of European meetings on issues related to air quality directives in the previous years. In addition, it was the aim to make a selection of countries representing different economic levels, different political histories and infrastructures, and thus also different expected or known levels of the national monitoring networks. Taking into account this complex combination of criteria, we selected Denmark, Hungary, Lithuania, and Ireland as case study countries for the AQUILA assessment. Initially also Spain was in play, but a close inspection revealed that the provided information concerned one single province (Galicia) and not the entire country. From personal contact to the responding party in Galicia, it turned out not to be easy to collect information for Spain as a whole and this country was therefore deleted from the list of case study countries.

2.3.1 Phone interviews

The three case study countries Ireland, Hungary and Lithuania were contacted and the time for a phone interview was arranged (for Denmark a phone interview was not necessary as DCE, AU is the responsible NRL). Each of these phone interviews with the case study countries lasted about two intensive hours. The aim of the interview was to fill in missing information and validate results from the received information requests. The various options were discussed in detail to make sure that the respondents had understood all questions correctly and thereby ensure that all information was as correct as possible. The aim was to receive valuable data on these selected countries, to validate the data in the information request, but also to compare this information to the model results, which are exclusively based on Danish data.

In all three cases it was found, that the contact persons in the phone interviews were highly competent, and furthermore that they generally were very familiar with the AQUILA recommendations. Nevertheless, it also became evident, that some of the questions were partly misunderstood in the responses to the information request. The phone interviews were used to clarify these points and to re-evaluate some of the data. Thereby it was possible to ensure a high quality of the cost assessment for the case study countries. Following this procedure, the information request was checked through option by option and additional information was received.

One major problem in relation to the data received in the information requests was identified by the fact that the MS responded based on their actual state of the monitoring networks and not starting from the assumption of compliance with the current AQD. In some cases the MS are currently not living up to the actual AQD. This means that their anticipated costs reported in the information requests were too high as they calculated in the cost of upgrading from current level of monitoring to compliance with the current AQD. Such issues were clarified during the phone interviews for the case study countries, and the data was corrected according to an implementation of the AQUILA recommendations from an assumed starting point of current compliance with the AQD. However, this illustrated the high uncertainty in the cost assessment with regard to those MS for which no phone interviews were available.

Despite it had been stressed in the information request that the MS were to estimate the change in cost compared with compliance with the current AQD, it was thus clear from the interviews with the case study countries that this was often not the case – most likely also for some MS that were not case study countries. Furthermore the provided estimates in the responses to the information request from at least some MS are expected to be partly not based on change in costs but instead based on the full costs of the future legislation regarding the specific option. This is what has to be expected based on the information received from single MS as case study countries. The
conclusion on this was that the quality of the data in the information survey was insufficiently good to be used for the final cost assessment.

2.4 Top-down approach using scaling to other member states

The top-down approach is based on simple scaling. Originally this was intended only to be applied for those options were information has not been provided in the information request. However, the applied top-down approach has taken a couple of iterations before finding its final form. Initially the top-down approach was thus intended to be based on scaling to the single country within groups around all four case study countries. The placement of the single country in these four different groupings were selected based on similarities between countries regarding historical background, economical status, expected pollutant load, expected status of the monitoring network, as well as climatic pattern in the region where the country is located. The four groupings were as follows (with the case study country given in bold):

**Denmark:** Belgium, Germany, France, Luxemburg, the Netherlands, Austria, Finland and Sweden

**Ireland:** United Kingdom, Portugal, Spain, Greece, Italy, and Czech Republic

**Lithuania:** Latvia, and Estonia

**Hungary:** Romania, Bulgaria, Slovenia, Slovakia, Cyprus, Malta, Poland, and Croatia

These four groupings were then used to estimate costs for the single based on scaling with the case study country in which the specific country was grouped. The grouping was thus used as basis for deriving an initial top-down cost assessment for the entire Europe; a cost assessment that was used as basis for the consultation survey (see next section).

2.4.1 The consultation survey

The consultancy survey took place in March 2013. The aim of the AQUILA part of this survey was to ask the MS to evaluate the initial cost assessment based on the grouping around the four case study countries while benchmarking the costs of individual MS to all 27 other member states. It was decided in the consultation survey to focus on the estimated staff time to carry out the various recommendations with regard to human resources used for this implementation. This decision was made since actual cost in Euro might be hard to evaluate when the European cost model is applied using low overhead and fixed salary rate that may not apply to actual conditions in the specific country. The MS were therefore presented estimated staff time for each option, and were asked to evaluate whether estimates were in compliance with their expectations. Here we have shown the graphs for estimated staff time to carry out option 1 as an example (Figure 2.1).

In addition, the costs for facilities, equipment, operation and maintenance were also estimated for all MS using the same approach as for staff time estimates, basing the calculations on the above described groupings of individual countries around a base study country. In contrast, these estimates were made in EURO as no different salary levels and overheads had to be taken into account. An example of such a figure included in the consultation survey is shown in Figure 2.2. Figures showing the data for the nine other options are provided in the consultation survey shown in Appendix B.

The MS were asked to evaluate whether the staff time estimates and the estimates for cost of facilities, equipment, operation and maintenance for the single options were acceptable or either
too high or too low. These indications were requested to be evaluated in 25% intervals (+100%, +75%, +50%, +25%, 0%, -25%, -50%, -75%, -100%). The full questionnaire used in the consultation survey is shown in Appendix B.

Figure 2.1  Estimated staff time to carry out option one and presented to the MS in the consultation survey. The estimate is based on scaling around all four case study countries.
In total six consultancy surveys were returned from Ireland, Czech Republic, Belgium, Latvia, United Kingdom and Germany. Ireland and Czech Republic responded that the estimated costs were acceptable and thereby did not need to be corrected. The remaining responders provided either percentage corrections or new cost figures. United Kingdom found that the calibration with respect to Ireland did not fit well with their expectation to costs of implementing the AQUILA recommendations. In a workshop in Brussels with participation from several MS it turned out that the scaling towards all four case study countries lead to an inhomogeneous assessment and specific problems in calibrating data were stressed. Based on the response in the consultation survey and the discussions in Brussels, it was decided to apply only scaling with respect to the detailed survey from Denmark. This meant, however, that the actual reported data in the consultation survey could generally not be applied in the final assessment as this was based on scaling towards all four case study countries and not solely on Denmark. However, a few corrections were implemented. Latvia specified explicitly in the response to the survey their estimated cost in relation to equipment and facilities for option 2 and 9. This data was applied in the final cost assessment. Furthermore United Kingdom specified that this country the option 1 was to be cost neutral, and also this was applied in the final cost assessment.

2.4.2 Top-down cost assessment accounting for consultation survey and using Denmark as basis

The phone interviews and the discussions with MS in the subsequent workshop in Brussels demonstrated that the quality of the data in the information survey was insufficiently good to form
the basis for the cost assessment. The cost assessments for the various MS are thus calculated from the detailed Danish assessment by a simple scaling. This scaling is performed using ratio in number of inhabitants between Denmark and the specific country as scaling factor, but still accounting for differences in tariffs and salary levels in the specific country. The scaling based on the detailed assessment from Denmark was chosen for two reasons: - first of all the degree of detail in Danish assessment was the highest, and the quality also believed to be highest, - secondly a procedure based on scaling to all the case study countries was tested but this was found to produce a very inhomogeneous assessment. There are cases where Denmark will deviate from the average MS but at least the figures in the assessment are directly comparable for the various countries. The detailed assessment for the remaining case study countries are then used to evaluate this variability.
3 The Final Assessment

This section provides a presentation of the obtained results from the cost assessment for the AQUILA recommendations. The presentation is given with the grouping of the recommendations (option 1 – 10) that was used in the questionnaire survey sent to the MS. Together with the cost assessments that are all based on the detailed Danish cost assessment, plots are also provided showing comparisons between the assessment based of the Danish survey and the detailed cost assessments carried out for the remaining three case study countries: Ireland, Lithuania and Hungary. These plots with comparisons between the detailed assessment for the case study countries and the assessment based on Danish data are used to give an indication of the robustness of the overall assessment. The presentation of the final assessment has been given the following structure; for each option three sub-sections are given: regarding the assessment for Denmark, the overall European assessment, and the comparison for the remaining case study countries.

3.1 Option 1: Roles and responsibilities of NRLs + terms and definitions

In the present AQD for a number of pollutant measurements there are currently no specific demands to be accredited or to participate in inter-laboratory comparisons and other community-wide quality assurance programmes so this change will cause additional costs to most MS.

Regarding the introduction of a new bullet point five into the Section 3 part C in AQD: “that the national reference laboratories support the work done by the European network AQUILA set up by the Commission. The cooperation of NRLs and AQUILA is described in an appropriate Memorandum of Understanding between the European Commission and the NRLs.” This is not expected to impose changes in the present costs for the NRLs so far the term support is understood the same way as it is today and the point is to be seen as a formalization of the AQUILA status by making an explicit reference to AQUILA in the AQD.

3.1.1 The assessment for Denmark

An amendment to the air quality directive (AQD) that will be defining the NRLs and their responsibilities will not pose any additional cost for the air quality monitoring in Denmark (or in other MS for that sake).

Implementation of national QA programmes is similarly not expected to pose additional costs in Denmark. The reason for this is that the Danish NRL is responsible for and carries out all the relevant air quality monitoring in relation to the AQD in the country. The Danish NRL is thus already implementing national QA programmes and no extra activities are therefore expected in relation to this recommendation.

The next part of the recommendation concerns that the support of the NRL to the work done by the AQUILA network. In the recommendation this is to be setup by the Commission and described in a memorandum of understanding between the European Commission and the NRLs. Neither this recommendation is expected to cause additional cost in Denmark, as long as the term “support” is understood in the same way as today; an assumption that has been made in the current cost assessment.
However, the AQUILA recommendation will demand that for all regulated pollutants, the NRL shall participate in inter-laboratory comparisons and other community-wide QA programmes organized by the Commission on a more frequent and routinely basis that at present.

3.1.2 The result of the cost assessment for Europe

The obtained result for the cost assessment regarding option 1 is given in Figure 3.1. The cost of this option is related to inter-laboratory comparisons and other community-wide QA and this is the reason for cost associated with data generation and compilation mainly and to smaller extend additional equipment and staff costs. The differences in costs between the MS reflect differences in country size but also differences in tariffs and salaries.

![Figure 3.1 The obtained cost assessment for option 1 for the various member states given in Euro.](image)

The results are based on scaling of the detailed assessment for Denmark. The plot shows in different colours of the bars, the estimated cost split into equipment and facilities, data generation and compilation, operation and maintenance, reporting and administration, staff capacity and additional staff costs. The scaling is performed using number of inhabitants in the country as scaling factor and accounting for differences in tariffs and salary levels in the specific country.

3.1.3 Comparison to the results for the case study countries

The assessment for the remaining case study countries show that at least these MS do not expect additional costs to arise from the inter-laboratory comparisons and other community-wide QA. The interpretation of this recommendation is clearly very important for the result.
The comparison concerns Denmark that was used as basis for the overall European assessment and the results for Lithuania, Hungary, and Ireland. To ease the comparison also the results obtained in scaling from the Danish assessment is shown for Lithuania, Hungary and Ireland.

3.2 Options 2: Inter-comparisons + EN standards

3.2.1 The assessment for Denmark

Institutions operating monitoring networks and individual stations have an established QA/QC system assuring continued accuracy of measuring devices, and this system is to be regularly reviewed by the NRL. This is not estimated to have cost in Denmark as the Danish NRL is responsible for all activities in this regard and already handling QA/QC.

The AQUILA recommendation includes a demand for evaluation of measurement uncertainty to be performed in accordance with Guide to the Expression of Uncertainty in Measurement. Again this is not expected to pose additional cost in Denmark since this is already being done in the Danish air quality monitoring programme.

The monitoring activities are to follow EN standards for all pollutant measurements. For Denmark there is a potential additional cost of implementing reference methods for deposition monitoring.

NRLs accredited according to EN/ISO 17025 for the relevant methods, and that NRLs at least every three years take part in Community-wide QA programmes organized by the JRC. When the latter falls out unsatisfactory, the NRL has to demonstrate in report to JRC at the next possible occasion that satisfactory remediation measures have been applied. In Denmark will this pose additional costs provided that all pollutant measurements shall take part in inter-laboratory comparisons and other Community-wide AQ programmes on a more frequent and routinely basis that current (this is...
overlapping with option 1). Furthermore the remediation measures to be taken in case of unsatisfactory results in the inter-comparisons will also pose additional costs in Denmark.

### 3.2.2 The result of the cost assessment for Europe

The obtained result for the cost assessment regarding option 2 is given in Figure 3.3. The largest cost is related to operation and maintenance, but also equipment and facilities as well as data generation and compilation.

![Figure 3.3 The obtained cost assessment for option 2 for the various member states given in Euro.](image)

The obtained result for the cost assessment regarding option 2 is given in Figure 3.3. The largest cost is related to operation and maintenance, but also equipment and facilities as well as data generation and compilation.

The results are based on scaling of the detailed assessment for Denmark. The plot shows in different colours of the bars, the estimated cost split into equipment and facilities, data generation and compilation, operation and maintenance, reporting and administration, staff capacity and additional staff costs. The scaling is performed using number of inhabitants in the country as scaling factor and accounting for differences in tariffs and salary levels in the specific country.

### 3.2.3 Comparison to the results for the case study countries

The comparison of the assessment based on Danish data and the detailed assessments for the remaining case study countries show that especially operation and maintenance cost were estimated higher in the Danish assessment than they were by the other MS (Figure 3.4). However, the overall differences are moderate and reflecting the general uncertainty in the assessment.
Figure 3.4 Comparison of the detailed cost assessment for the case study countries for option two given in Euro.

The comparison concerns Denmark that was used as basis for the overall European assessment and the results for Lithuania, Hungary, and Ireland. To ease the comparison also the results obtained in scaling from the Danish assessment is shown for Lithuania, Hungary and Ireland. Concerning the cost estimates that Ireland provided, these were assigned for buying new equipment and performing some testing. Compared with the Danish estimate the amount allocated by Ireland may appear high, but the overall sum is still rather moderate.

3.3 Option 3: Type approval

3.3.1 The assessment for Denmark
Type approval concerns documentation of the applied monitoring devices compliance with standards. In Denmark this is not expect to pose additional costs as these activities are considered mainly to be an issue for providers of the monitoring devices. In the detailed Danish assessment the type approval is thus considered cost neutral.

3.3.2 The result of the cost assessment for Europe
Since the Danish assessment is applied as basis for the European assessment, type approval is estimated to be cost neutral for the MS.

3.3.3 Comparison to the results for the case study countries
For Hungary and Lithuania this option was considered cost neutral just as for the Danish assessment. For Ireland, however, it is estimated that some time will be allocated to evaluate documentation for type approval.
3.4 Option 4: Ion analysis

3.4.1 The assessment for Denmark

The recommendation concerns particle measurements and chemical composition. The AQUILA position paper states that measurements of particulate matter must include at least the total mass concentration, and concentrations of appropriate compounds to characterize its chemical composition. The recommendation will mean that there will no longer be a specific demand for PM$_{2.5}$ and PM$_{10}$ measurements. The recommendation is considered as a relaxation of the AQD allowing for EMEP methods to be applied rather than the current directive method. In the absence of EN standards, MS are requested to use methods described by the EMEP programme, by CEN Technical reports or by international standards. MS need to inform the Commission on sampling and analytical methods used to determine the aerosol chemical composition.

For Denmark this recommendation is considered as a relaxation that will lead to reduction of cost for the monitoring activities. The reductions will related to operation and maintenance as well as data generation and data compilation. In Denmark the proposal will affect one of the rural background stations for which measurements of both PM$_{2.5}$ and TSP are performed at the same site. Because of the simultaneous EMEP-TSP measurements and measurements of PM$_{2.5}$ at this site the implementation of the proposal will lead to savings as one of these can then be close down.
3.4.2 The result of the cost assessment for Europe

The European wide assessment for option 4 is shown in Figure 3.5. Since all countries are scaled according to Denmark, the actual savings in specific MS depend on to which degree more than one type of particle sampling is performed on one or more monitoring sites.

![Figure 3.6 The obtained cost assessment for option 4 for the various member states given in Euro.](image)

The results are based on scaling of the detailed assessment for Denmark. The plot shows in different colours of the bars, the estimated cost split into equipment and facilities, data generation and compilation, operation and maintenance, reporting and administration, staff capacity and additional staff costs. The scaling is performed using number of inhabitants in the country as scaling factor and accounting for differences in tariffs and salary levels in the specific country.

3.4.3 Comparison to the results for the case study countries

In Denmark it is found that particle measurements at one of the rural background sites could be reduced when this recommendation is implemented. However, the other three case study countries did not point at any potential savings for this option. This must then indicate that no stations in these countries have both EMEP TSP measurements and PM$_{2.5}$/PM$_{10}$ at the same site. Based on the telephone interviews with case study countries, Denmark are not expected to be representative for many countries. However, it seems likely that there will be monitoring sites in the MS where this will lead to savings; otherwise the recommendation would probably not have been suggested by the AQUILA network.
3.5 Option 5: Ozone precursors

3.5.1 The assessment for Denmark

The AQUILA recommendation suggests that individual VOCs remain part of the requirements of the revised AQD. However, total non-methane VOCs are removed from the list of ozone precursors. Air quality objectives (AQDs) for ozone precursors are defined in terms of data capture requirements and a target measurement uncertainty. Low cost sampling and analysis methods can be applied as long as they comply with AQO for the representative sampling time. The recommendation is considered not to put additional demands on the monitoring in Denmark, but neither to open for a relaxation of the activities. This recommendation is thus considered to be cost neutral for Denmark.

3.5.2 The result of the cost assessment for Europe

Since the European assessment is based on the results for Denmark, the overall assessment is considered to be cost neutral for all MS.

3.5.3 Comparison to the results for the case study countries

Just as for Denmark, all Lithuania, Ireland and Hungary considered this recommendation to be cost neutral. There is thus consensus in the four detailed assessments.
3.6 Option 6: Mercury and heavy metals

3.6.1 The assessment for Denmark

This recommendation concerns mercury and heavy metals. The AQUILA network suggests that total gaseous mercury (TGM) measurements are made mandatory similarly to particle bound metals in urban and industrial areas where the population is exposed. This will call for additional measurements (and thereby additional costs) as mercury is not currently measured at these sites in the Danish monitoring network. Metals, including mercury, taken at different times, may be combined for digestion and analyzed as composite samples. According to the recommendation, sub-sampling of PM filters for mercury and other metals for subsequent analyses is allowed, provided that the detection sensitivity is not compromised. Alternatively to daily sampling, weekly sampling for metals in PM can be allowed provided that the collection characteristics are not compromised. This latter part of this recommendation is considered as a relaxation for Denmark and will reduce costs of monitoring activities. For Denmark the savings in the PM measurements will be higher than the additional cost of extra mercury measurements.

3.6.2 The result of the cost assessment for Europe

The results of the cost assessment for option 6 are shown in Figure 3.8.

![Figure 3.8](image)

**Figure 3.8** The obtained cost assessment for option 6 for the various member states given in Euro.

The results are based on scaling of the detailed assessment for Denmark. The plot shows in different colours of the bars, the estimated cost split into equipment and facilities, data generation and compilation, operation and maintenance, reporting and administration, staff capacity and additional staff costs. The scaling is performed using number of inhabitants in the country as scaling factor and accounting for differences in tariffs and salary levels in the specific country.

3.6.3 Comparison to the results for the case study countries
The comparison concerns Denmark that was used as basis for the overall European assessment and the results for Lithuania, Hungary, and Ireland. To ease the comparison also the results obtained in scaling from the Danish assessment is shown for Lithuania, Hungary and Ireland.

### 3.7 Option 7: Elemental Carbon/Organic Carbon

#### 3.7.1 The assessment for Denmark

The AQUILA recommendation suggest that Total Carbon is reported as sub-divided into categories including organic carbon (OC) and elemental carbon (EC). This is current practice in Denmark and therefore considered cost neutral.

#### 3.7.2 The result of the cost assessment for Europe

Since the European assessment is based on the results for Denmark, the overall assessment is considered to be cost neutral for all MS.

#### 3.7.3 Comparison to the results for the case study countries

The assessment for the remaining three case study countries also pointed at this recommendation as cost neutral.

### 3.8 Option 8: Average exposure indicator

#### 3.8.1 The assessment for Denmark

This recommendation concerns a change to the way the exposure indicators are calculated and presented. Such a change is not considered to provided additional work for the Danish NRL and is therefore found to be cost neutral.
3.8.2 The result of the cost assessment for Europe
Since the European assessment is based on the results for Denmark, the overall assessment is considered to be cost neutral for all MS.

3.8.3 Comparison to the results for the case study countries
In compliance with the assessment for Denmark, also the results for the other three case study countries pointed at this recommendation to be cost neutral.

3.9 Option 9: Deposition of heavy metals and PAHs

3.9.1 The assessment for Denmark
Including reference methods published since the publication of the AQD is not expected to lead to any extra burdens in relation to economy or man power in Denmark. We do not have information concerning how many MS that already follow these reference methods, and it is thus difficult to know to what extent this will lead to extra resource burdens to the MS/NRLs but it is likely to have some impact on the MS especially for some of these. Implementation will lead to more homogeneous data and may therefore indirectly affect AQ. The more homogeneous data availability will provide some benefit in environmental management and regulation and thus also concerning information level. It will improve somewhat the equity and coherence.

Regarding to add Lead in deposition to be considered in the same way as other Heavy Metals this is again not expected to cause additional costs in Denmark. Since the phasing out of Lead in gasoline, lead is generally a minor issue, and this modification to the AQD is thus considered to be of little impact in Denmark as well as in the other MS.

Concerning making it mandatory to perform deposition measurements; this will be highly resource demanding and with little impact on air quality as metals are already measured in air samples.

Concerning target values and minimum time coverage for for total deposition measurements of the regulated compounds; this will give need for monitoring or estimates based on air samples. The latter will not be expensive whereas the first (see above) is resource demanding and with little impact on human health as this is already regulated through concentration samples.

In Denmark deposition of Heavy Metals are not measured at rural and industrial locations. To fulfill the proposal there will be extra costs to establish sampling stations and to analyze samples.

3.9.2 The result of the cost assessment for Europe
The results of the cost assessment for option 9 on heavy metals and PAHs are shown in Figure 3.10.
The results are based on scaling of the detailed assessment for Denmark. The plot shows in different colours of the bars, the estimated cost split into equipment and facilities, data generation and compilation, operation and maintenance, reporting and administration, staff capacity and additional staff costs. The scaling is performed using number of inhabitants in the country as scaling factor and accounting for differences in tariffs and salary levels in the specific country.

### 3.9.3 Comparison to the results for the case study countries

The interview revealed that in Ireland deposition monitoring is already being carried out in urban areas. This recommendation is therefore considered to be cost neutral in the country (See Figure 3.11). Similarly for Hungary it is estimated to be cost neutral as it is considered that there are no relevant industrial areas in the country were monitoring would be required. However, for Lithuania additional costs are expected and these are in the same range as the estimate based on the Danish assessment.
Figure 3.11 Comparison of the detailed cost assessment for the case study countries for option nine given in Euro.

The comparison concerns Denmark that was used as basis for the overall European assessment and the results for Lithuania, Hungary, and Ireland. To ease the comparison also the result obtained in scaling from the Danish assessment is shown for Lithuania, Hungary and Ireland.

3.10 Option 10: Polycyclic aromatic hydrocarbons (PAHs).

3.10.1 The assessment for Denmark
The AQUILA network states that PAH vapor phase monitoring need not to be included as the most toxic loads are all particle bound. It is suggested that sub-sampling from PM filters for PAH for subsequent analyses are explicitly allowed, provided that there is evidence that these sub-samples are representative of the whole, and provided that the detected sensitivity is not compromised. The required time coverage for fixed PAH measurements of the remaining PAH compounds needs to be included in the revised AQD. This recommendation is considered to be cost neutral for Denmark as it describes current practice.

3.10.2 The result of the cost assessment for Europe
Since the European assessment is based on the results for Denmark, the overall assessment is considered to be cost neutral for all MS.

3.10.3 Comparison to the results for the case study countries
In compliance with the assessment for Denmark, also the results for the other three case study countries pointed at this recommendation to be cost neutral.
3.11 The overall cost assessment for AQUILA recommendations

Just for providing an overview Table 3.1 presents the total costs for each for the 10 options for all the MS. The figures are the final cost assessment based on scaling with the detailed Danish assessment. Values have been rounded to nearest 100 Euro, but the uncertainty is considerably higher that what this indicates.

Table 3 The total cost of all options given for each country in the AQUILA cost assessment based on scaling with the detailed assessment for Denmark

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<th>Option 3</th>
<th>Option 4</th>
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4 Summary and Conclusions

The work presented in this report aims at producing a cost assessment of the AQUILA recommendations. It was a challenge for this work that many of these recommendations are open for interpretation, and others concern defining what is a national reference laboratory (NRL) and defining other terms. The latter will not impose any costs to the member states (MS), but the issue of open interpretation means that when the recommendations are to be implemented in the air quality directive (AQD), a change of wording may impose changes of the costs for the MS.

The cost assessment for the AQUILA recommendations was carried out using two different approaches: a bottom-up and a top-down approach. The bottom-up approach took outset in an information request send to the 27 MS (+ Croatia as a future MS). Before sending this information request to the MS the AQUILA recommendations were reduced from 12 to 10 options in order to simplify the work for the MS. For this procedure, some recommendations were combined, but all sub-recommendations were still implemented in the final group of 10 options. A basic underlying assumption throughout the cost assessment was that all member states currently carry out their air quality monitoring in full compliance with the current air quality directive. In the information request this was stressed together with a statement that this assessment aimed at estimating the difference in cost between compliance with current AQD and a future AQD with implementation of the AQUILA recommendations. Responses to the information request were received from in total 17 MS. The responses were, however, patchy and incomplete and did not provide the necessary basis for a full bottom-up cost assessment. Denmark was the only MS that provided a complete data set for the information request.

A series of case study countries were selected for performance of a detailed cost assessment. The case study countries were selected on basis of the completeness and quality level of the information survey but also on basis of consideration about expected pollutant levels, expected level of monitoring network, historical background, climatic conditions etc. The selected case study countries were: Ireland, Hungary, Lithuania and Denmark. The assessment for Denmark was carried out by the authors of this report since the air quality monitoring in Denmark is performed by DCE, AU. For the remaining case study countries a detailed phone interview was carried out. During the phone interviews it quickly became evident that a number of misunderstandings had taken place for the responses of the information request. These misunderstandings as identified for the case study countries most likely also have taken place for a number of other MS that not have been interviewed. First of all it was clear that many of the options had been answered based on current status of the air quality monitoring programmes in the specific countries. Furthermore, many options had been estimated from full cost of performing air quality monitoring in compliance with the recommendation and not the difference in cost between current legislation and the recommendation has been considered.

The top-down approach took a couple of iterations before reaching its final form. The 27 MS + Croatia were grouped around the four selected case study countries. Costs were estimated for the countries in a given grouping based on simple scaling to the selected case study country. This scaling was performed using the ratio in number of inhabitants between the country in question and the case study country. From the phone interview it was decided that data in the information request from those MS that were not case study countries was not of sufficient quality to be used in the final assessment. A full cost assessment was performed from the scaling around the case study countries for which the the quality of the data in the information request was proven and validated by the phone interviews.
A consultation survey was performed to evaluate the top-down cost assessment. The MS were asked to evaluate the estimated staff time and cost for facilities, equipment, operation and maintenance in intervals of 25% going from +100% to -100% by benchmarking these resources calculated for their specific country against the resources of the other MS that were calculated for those countries. Only six countries replied to the consultation survey: Ireland, Czech Republic, Belgium, United Kingdom and Germany. One of the outcomes of the consultation survey was that the approach of scaling to groupings around all four case study countries turned out not to be ideal. This was furthermore supported by discussions in a workshop in Brussels with participation from a number of MS. It was therefore decided to change the methodology and use only Denmark for calibration to the European MS. However, this change in the methodology also implied that most of the information provided in the consultation survey could not be used in the final cost assessment. Parts of the information was implemented including information from United Kingdom that option 1 for this country was considered cost neutral. Similarly some specified cost from Latvia concerning equipment and facilities for options 2 and 9 were implemented in the final cost assessment.

The final cost assessment was then based on the detailed assessment for Denmark, but the results from the remaining case study countries were used to evaluate the quality of the assessment based on Danish data. The results show that option 5 (ozone precursors), 7 (elemental carbon/organic carbon), 8 (Average exposure index), and 10 (Polycyclic aromatic hydrocarbon) will be cost neutral, and option 3 (type approval) is cost neutral for all MS except Ireland.

**Option 1** concerns the definition of NRLs and their responsibilities. An amendment to the AQD defining NRLs and stressing support to the work of the AQUILA network will not pose additional costs to the MS. For the latter part of this, it is assumed that such support will not go beyond current activity levels. Concerning the responsibilities of the NRLs, the recommendations include a strengthening on the requirements for participation in inter-laboratory comparisons and other community-wide QA programmes. The recommendation states that all regulated pollutants have to take part in these AQ activities, and in Denmark this is estimated to have additional costs. United Kingdom on the other hand stated explicitly that they do not expect this to pose additional costs for the country.

**Option 2** concerns inter-comparisons and applying of EN standards. A requirement for evaluation of measurement uncertainty was not estimated to pose additional costs as this is considered to be part of current practise. Implementation of standards made after the ratification of the AQD is similarly not expected to pose additional costs as this is already current standard in the air quality monitoring programmes in the MS. A different situation occurs with regard to the requirement for all regulated pollutants to be included in community-wide QA programmes and for the NRLs to demonstrate satisfactory remediation measures when inter-comparison studies turn out unsatisfactory. This will pose additional costs for equipment, its operation and maintenance.

**Option 3** concerns type approval, meaning documentation that concerns measurement devices and their compliance with standards. For Denmark this is considered to be a cost only to manufacturers of the devices, whereas Ireland expects to use staff time on controlling documentation.

**Option 4** concerns particle measurements and their chemical composition. The AQUILA recommendation contains a relaxation of the current AQD. The suggestion is that there will be no specific demand for PM2.5 and PM10 when TSP is measured applying EMEP standards. For Denmark this means that activities may be reduced at one monitoring station that is simultaneously
measuring all three PM samples. The phone interviews with the case study countries indicated that this reduction may not be representative for all the other MS.

For **Option 5**, the AQUILA recommendation suggests that the individual VOCs remain part of the listed ozone precursors. However, the recommendation was interpreted in the way that it will not strengthen the demands for VOC measurements. Thereby the relaxation of the AQD allowing low cost sampling and analysis will not directly affect costs. The result is that this recommendation will be overall cost neutral.

**Option 6** concerns measurements of mercury and heavy metals. The AQUILA recommendation suggests making the measurement of total gaseous mercury (TGM) mandatory similarly to heavy metals in urban and industrial areas. This will pose additional costs in Denmark. However, the recommendation also contains a relaxation of the AQD allowing sub-sampling and longer sampling times given the fact that data quality objectives (DQO) are not compromised. For Denmark the overall savings in relation to the latter are higher than the additional costs caused by TGM measurements. For the other case study countries this option was found to pose additional costs, and the assessment based on Danish data may therefore not be representative for the other MS.

**Option 7** concerns reporting of total carbon sub-divided into organic and elemental carbon. This is current standard in Denmark, and the detailed phone interviews showed that this is also the case in Ireland, Hungary and Lithuania. It is therefore considered that this option will be cost neutral to implement in the MS.

**Option 8** concerns the way the average exposure indicators are calculated and presented. Such a change in the calculation and presentation procedure is not estimated to pose additional costs neither in Denmark nor in the other case study countries. It is therefore considered that this option will be cost neutral to implement in the MS.

**Option 9** concerns measurements of deposition of heavy metals and PAHs. The AQUILA recommendation suggests that deposition of heavy metals become mandatory at rural and industrial sites. This will be expensive, and the gains are questionable since these pollutants are already measured in air samples. This recommendation furthermore includes a requirement for lead measurements where levels may exceed guidelines; a recommendation that will not pose additional costs since levels of lead have generally been low since the out-phasing of lead in gasoline. In Ireland the latter was not considered an additional cost since it was already part of the on-going monitoring activity. Hungary did not find that they had industrial areas where this could be a requirement. For Lithuania, however, results were comparable to what was found for Denmark.

**Option 10** concerns measurements of polycyclic aromatic hydrocarbons. The recommendation suggests that vapour phase PAHs need not to be monitored. Furthermore it is suggested that sub-sampling is allowed provided samples are representative of the whole. For Denmark this is considered to be in compliance with current monitoring practise, and the other case study countries responded with similar results. This option is therefore considered cost neutral to implement in the other MS.
References


Appendix A Results of the information survey

This Appendix presents graphics with the results of the information survey.

**Figure A.1** The results of the information survey for Option 1

**Figure A.2** The results of the information survey for Option 2.
Figure A.3 The results of the information survey for Option 3.

Figure A.4 The results of the information survey for Option 4.
Figure A.5 The results of the information survey for Option 5.

Figure A.6 The results of the information survey for Option 6.
Figure A.7 The results of the information survey for Option 7.

Figure A.8 The results of the information survey for Option 8.
Review of: Provisions for Air Quality Measurement, Air Quality Modelling, Management Framework, Assessment, and Public Information; and Stakeholder Consultation Support

Figure A.9 The results of the information survey for Option 9.

Figure A.10 The results of the information survey for Option 10.
Figure A.11: The total cost according to the data from the information survey.
Appendix B: The AQUILA Consultation Survey

Background

In November 2012, you received an Information Request asking for possible costs and resources required for your Member State should the AQUILA recommendations be implemented. Thank you to everyone who took the time to respond to this request. We have analysed the data received and estimated the individual costs and resources across all Member States for each AQUILA option. We would like to provide you with the opportunity to review our findings to date and comment on the validity of the results. Respondents should benchmark and comment on your Member State costs and resources for each individual AQUILA option in comparison to other European Member States.

The following short consultation survey should take approximately 30 min to complete. We appreciate your participation in this consultation.

If you have any questions on this survey please contact: Ole Hertel (oh@dmu.dk) and Andreas Massling (anma@dmu.dk).

Introduction to the AQUILA Options

The AQUILA Network of Air Quality Reference Laboratories was established with the objectives to provide expert judgement, to promote the harmonisation of air quality measurements among EU, EFTA and Candidate Countries, to co-ordinate Quality Assurance/Quality Control (QA/QC) activities, method development and validation, to participate in standardisation activities, to develop common research projects and pilot studies and to offer a forum for information exchange in the form of training courses, workshops and conferences.

Within the general context of the air quality policy review, the AQUILA network analysed a set of seventeen questions related to air pollution assessment methodologies, and produced a position paper presenting and discussing specific recommendations for the revision of the current Air Quality legislation.

The options to be considered in the coming pages of this consultation relate to the following:

- Option 1: Roles and responsibilities of National Reference Laboratories (NRLs) + terms and definitions.
- Option 2: Inter-comparisons & EN standards.
- Option 3: Type approval.
- Option 4: Ion analysis.
- Option 5: Ozone precursors.
- Option 6: Mercury and heavy metals.
- Option 8: Average exposure indicator.
- Option 9: Deposition of heavy metals and PAHs.
- Option 10: Polycyclic aromatic hydrocarbons (PAHs).

Introductory Questions

Which Member State do you represent?

What are your roles / responsibilities in your Member State?
Option 1: Roles and responsibilities of National Reference Laboratories (NRLs) + terms and definitions.

**Description of the Issue:** Include in the Air Quality Directives (AQD) a definition of NRLs and demand establishing a memorandum of understanding (MOU) between the NRLs and the Commission. Furthermore that the AQD require conformity to quality assurance programmes, as well as demand for accreditation of NRLs to reference methods listed in the Directive (Appendix VI). The "Terms and definitions part" concerns precision of the wording of AQD text.

**Option 1 Consultation Questions**

**Question 1.1:** Do you think that the resources given in the following graph (showing the resource distribution in person-months per year for technicians and scientists for each country in EU) are realistic to implement the described recommendations into the monitoring programme in your country?

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![Figure 1: Staff time in man-months (data calibrated using case study countries)](image)

- CROATIA: 0.00
- UNITED KINGDOM: 0.00
- SPAIN: 0.00
- SLOVENIA: 0.00
- SLOVAKIA (Slovak Republic): 0.00
- ROMANIA: 0.00
- PORTUGAL: 0.00
- POLAND: 0.00
- MALTA: 0.00
- LITHUANIA: 0.00
- LATVIA: 0.00
- ITALY: 0.00
- IRELAND: 0.00
- HUNGARY: 0.00
- GREECE: 0.00
- ESTONIA: 0.00
- CZECH REPUBLIC: 0.00
- CYPRUS: 0.00
- BULGARIA: 0.00
- LUXEMBOURG: 0.19
- FINLAND: 0.09
- DENMARK: 0.80
- AUSTRIA: 0.31
- SWEDEN: 0.45
- BELGIUM: 0.41
- NETHERLANDS: 15.56
- FRANCE: 24.11
- GERMANY: 30.75

- Total staff time
Question 1.2: Do you think that the expenses given in the following graph (showing the expenses distribution in EURO per year – also instruments and facilities are calculated not as one-time investments, but as costs divided by 5 with relation to a 5-year lifetime) are realistic to implement the described recommendations into the monitoring programme in your country?

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Figure 2: Facilities, equipment, operation and maintenance costs

- CROATIA: 0
- UNITED KINGDOM: 0
- SPAIN: 0
- SLOVENIA: 0
- SLOVAKIA (Slovak Republic): 0
- ROMANIA: 0
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- ESTONIA: 0
- CZECH REPUBLIC: 0
- CYPRUS: 0
- BULGARIA: 0
- LUXEMBOURG: 220
- FINLAND: 9,330
- DENMARK: 2,462
- AUSTRIA: 3,649
- SWEDEN: 34,045
- BELGIUM: 4,704
- NETHERLANDS: 18,245
- FRANCE: 38,268
- GERMANY: 36,050

Total cost in Euros
Option 2: Inter-comparisons & EN standards.

Description of the Issue: Quality assurance for ambient air quality assessment: data validation specified in the AQD (section C, Annex I) is strengthened according to the following points:

- that institutions operating networks and individual stations have an established quality assurance and quality control system which provides for regular maintenance to assure the continued accuracy of measuring devices and this system shall be regularly reviewed by the relevant NRL, where this is different;
- that the appointed national laboratories, are accredited according to EN/ISO 17025 for the relevant methods (referred in Annex VI). NRLs shall be responsible for the coordination in MS territory of the Community wide quality assurance programmes organised by JRC and on the national level, for the appropriate use of reference methods, and the demonstration of equivalence of non-reference methods;
- that NRLs, take part at least every three years in the community-wide quality assurance programmes organized by JRC. If this participation produces unsatisfactory results then NRLs have demonstrate at the next possible occasion satisfactory remediation measures, and report this to JRC; and
- The measurement uncertainty of the assessment methods has to be evaluated in accordance with Guide to the Expression of Uncertainty in Measurement.

Option 2 Consultation Questions

Question 2.1: Do you think that the resources given in the following graph (showing the resource distribution in person-months per year for technicians and scientists for each country in EU) are realistic to implement the described recommendations into the monitoring programme in your country?

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Question 2.2: Do you think that the expenses given in the following graph (showing the expenses distribution in EURO per year – also instruments and facilities are calculated not as one-time investments, but as costs divided by 5 with relation to a 5-year lifetime) are realistic to implement the described recommendations into the monitoring programme in your country?

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Option 3: Type approval.

Description of the Issue: In carrying out type approval NRLs have to accept test reports issued from accredited NRLs in other MS provided these are carried out according to CEN standard reference measurement methods in a fully comprehensive and exact manner, and provided the manufacturer of the methods conforms to the requirements of EN 15267 parts 1 and 2. The detailed test reports and all the results of the tests shall be publicly available for acceptance by other competent authorities or their designated bodies. A formal decision by the competent authority or its relevant designated competent body is required to accept test reports.

Option 3 Consultation Questions

Question 3.1: Do you think that the resources given in the following graph (showing the resource distribution in person-months per year for technicians and scientists for each country in EU) are realistic to implement the described recommendations into the monitoring programme in your country?
Question 3.2: Do you think that the expenses given in the following graph (showing the expenses distribution in EURO per year – also instruments and facilities are calculated not as one-time investments, but as costs divided by 5 with relation to a 5-year lifetime) are realistic to implement the described recommendations into the monitoring program in your country?
Option 4: Ion analysis.

**Description of the Issue:** Measurements of PM must include at least the total mass concentration and concentrations of appropriate compounds to characterize its chemical composition. The following chemical species have to be included: Na\(^+\), K\(^+\), Ca\(^{2+}\), Mg\(^{2+}\), NH\(_4^+\), SO\(_4^{2-}\), NO\(_3^-\), Cl\(^-\), Elemental Carbon and organic carbon. In the absence of EN standard measurement methods, MS are requested to use methods described by the EMEP programme, by CEN Technical Reports or by International standards. MS need to inform the Commission on the sampling and analytical methods used to determine the aerosol chemical composition.

**Option 4 Consultation Questions**

**Question 4.1:** Do you think that the resources given in the following graph (showing the resource distribution in person-months per year for technicians and scientists for each country in EU) are realistic to implement the described recommendations into the monitoring programme in your country?
Question 4.2: Do you think that the expenses given in the following graph (showing the expenses distribution in EURO per year – also instruments and facilities are calculated not as one-time investments, but as costs divided by 5 with relation to a 5-year lifetime) are realistic to implement the described recommendations into the monitoring programme in your country?
Option 5: Ozone precursors.

**Description of the Issue:** It is suggested that individual VOCs remain part of the requirements of the revised AQD. However, total non-methane VOCs are removed from the list of ozone precursors. AQO for ozone precursors are defined in terms of data capture requirements and a target measurement uncertainty. Low cost sampling and analysis methods can be applied as long as they comply with AQO for the representative sampling time.

**Option 5 Consultation Questions**

Staff time and Facilities, equipment, operation and maintenance costs are for all Member States are consider to be zero.

**Question 5.1:** Do you consider this to be an accurate reflection of the potential cost implications for the implementation of this option in your Member State?

Option 6: Mercury and heavy metals.

**Description of the Issue:** Total gaseous mercury (TGM) measurements should be mandated in urban and industrial areas where the population is exposed, similarly to PM-bound metals. Metals, including mercury, in PM samples, taken at different times, may be combined for digestion and
analysed as composite samples. Sub-sampling of PM filters for mercury and other metals for subsequent analyses are allowed, provided sub-sample is representative of the whole, and provided that the detection sensitivity is not compromised. Alternatively to daily sampling, weekly sampling for metals in PM can be allowed provided that the collection characteristics are not compromised.

**Option 6 Consultation Questions**

**Question 6.1:** Do you think that the resources given in the following graph (showing the resource distribution in person-months per year for technicians and scientists for each country in EU) are realistic to implement the described recommendations into the monitoring programme in your country?

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**Figure 1: Staff time in man-months (data calibrated using case study countries)**
**Question 6.2:** Do you think that the expenses given in the following graph (showing the expenses distribution in EURO per year – also instruments and facilities are calculated not as one-time investments, but as costs divided by 5 with relation to a 5-year lifetime) are realistic to implement the described recommendations into the monitoring program in your country?

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Figure 2: Facilities, equipment, operation and maintenance costs

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<td>SLOVAKIA (Slovak Republic)</td>
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<td>AUSTRIA</td>
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Description of the Issue: It is suggested that Total Carbon is reported as subdivided into categories including Organic Carbon (OC) and Elemental Carbon (EC). In principle EC is mostly primary soot-like material formed by incomplete combustion processes such as from vehicle exhausts. The soot-like material may be relevant for health effects, or as a proxy for health-relevant emissions. OC is a much more complex mixture, with secondary aerosol formation having a major role.

Option 7 Consultation Questions
Staff time and Facilities, equipment, operation and maintenance costs are for all Member States are consider to be zero.

Question 7.1: Do you consider this to be an accurate reflection of the potential cost implications for the implementation of this option in your Member State?

Option 8: Average exposure indicator.
Description of the Issue: The average exposure indicator (AEI) is based on measurements in urban background agglomerations and zones, and is assessed as a several-calendar year running mean concentration (for the periods between 2008-2010, 2009-2011 or exceptionally 2009-2010), averaged over all of the sampling points (wherever valid results have been achieved). The AQUELA recommendations can be summarized to:
- Introduce an additional decimal place in the AQD Annex XIV table B, with no overlap, for AEI in 2010 and change the national exposure reduction target (NERT) from percentages to absolute numbers with ranges;
- The dates specified for monitoring PM$_{2.5}$, should be different for new MS that may not have acquired valid data during the currently specified time periods.

Option 8 Consultation Questions
Staff time and Facilities, equipment, operation and maintenance costs are for all Member States are consider to be zero.

Question 8.1: Do you consider this to be an accurate reflection of the potential cost implications for the implementation of this option in your Member State?

Option 9: Deposition of heavy metals and PAHs.
Description of the Issue: It is suggested to set up deposition monitoring networks. Deposition measurements are suggested to be mandatory in urban and industrial areas. Target values are to be defined for total deposition measurements. Lead is to be considered in the same way as other heavy metals. Requirement specified on time coverage for total deposition measurements of the regulated pollutants.

Option 9 Consultation Questions
Question 9.1: Do you think that the resources given in the following graph (showing the resource distribution in person-months per year for technicians and scientists for each country in EU) are realistic to implement the described recommendations into the monitoring program in your country?
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Figure 1: Staff time in man-months (data calibrated using case study countries)

Question 9.2: Do you think that the expenses given in the following graph (showing the expenses distribution in EURO per year – also instruments and facilities are calculated not as one-time investments, but as costs divided by 5 with relation to a 5-year lifetime) are realistic to implement the described recommendations into the monitoring program in your country?
Option 10: Polycyclic aromatic hydrocarbons (PAHs).

Description of the Issue: The AQUILA network states that PAH vapour phase monitoring need not to be included as the most toxic loads are all particle bound. It is suggested that sub-sampling of PM filters for PAH for subsequent analyses are explicitly allowed, providing there is evidence that the sub-sample is representative of the whole, and provided that the detection sensitivity is not compromised. The required time coverage for fixed PAH measurements the other PAH need to be included in the revised AQD.

Option 10 Consultation Questions

Staff time and Facilities, equipment, operation and maintenance costs are for all Member States are consider to be zero.
**Question 10.1:** Do you consider this to be an accurate reflection of the potential cost implications for the implementation of this option in your Member State?

**Thank You**
Many thanks for completing this consultation.
If you have any additional comments then please provide them here