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Air Pollution Policies
foR Assessment
of Integrated Strategies
At regional and Local scales

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WP 2 Review and gaps identification in AQ and HA methodology at regional and local scale.

LWA

D2.2 Synergies among national, regional and local approaches, including emission abatement technologies

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Summary

The present deliverable concerns the review of the results in the APPRAISAL database with respect to Topic 1 “Identify/characterize how emission abatement strategies at the national level are considered and integrated in the definition of regional and/or local Plans and Programmes to improve the air quality, and vice-versa”.

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1. Introduction

The APPRAISAL Project is a FP7-ENVIRONMENT Coordination Action funded by the European Commission within the call FP7-ENV-2012-one-stage, Grant Agreement number 303895. The project started officially on June 1st 2012 and initial activities started shortly after.

One of the main purposes of APPRAISAL is to perform an overall review of the methodologies, from simple (e.g. scenario approach) to more comprehensive ones (e.g. full cost-benefit analysis) that are used in different countries to compile local and regional air quality plans. To this end in WP2 *'Review and gaps identification in Air Quality and Health Assessment methodologies at regional and local scale'* activities were established aiming to address this particular reviewing objective. More in particular a questionnaire was designed and a database structure defined in which the WP2 work was broken down into five subjects which are included in the database structure: (i) synergies among national, regional and local approaches, including emission abatement policies; (ii) air quality assessment, including modelling and measurements; (iii) health impact assessment approaches; (iv) source apportionment; and (v) uncertainty and robustness, including Quality Assurance / Quality Control (QA/QC).

The present deliverable concerns the review of the results in the APPRAISAL database with respect to Topic 1 "Identify/characterize how emission abatement strategies at the national level are considered and integrated in the definition of regional and/or local Plans and Programmes to improve the air quality, and vice-versa".

The analysis has included, where appropriate, reference to actual activities undertaken by respondents.

2. IAM scale approaches

This section is devoted to the analysis of the synergies between 'top down' and 'bottom up' approaches in Integrated Assessment, focussing on compliance with Air Quality limit values.

2.1 Top down and bottom up approaches

Integrated Assessment (largely using IIASA's RAINS/GAINS model) has been at the heart of European air quality policy development for nearly two decades. However, until very recently, European level integrated assessment has not been designed to directly assess strategies to deliver compliance with air quality limit values all over Europe. There are a number of reasons for this; here we highlight just four important ones.

(i) **Limitations from modelling Scale**: The first is the difficulty of modelling the whole European region at a scale fine enough to contribute anything meaningful to the understanding the relationship between further European-wide measures and air quality compliance at a given air quality monitoring station.

(ii) **Limitations of Country-Wide Activity Proxies**: The second is that by its very nature, European-wide modelling is 'top down' and uses average country-wide proxies for key activities that strongly influence compliance at a given monitoring station (e.g. the split between urban, rural and highway driving; composition of urban fleets; composition of fuels used in non-transport sectors such as residential and commercial heating). The specific efficacy in a given urban zone, even of measures set at the European level (the improvements introducing new Euro standards for vehicles for example) will only be approximated by such a top down approach. Furthermore, such approaches are not suitable for exploring the role of non-technical or zone specific measures such as low emission zones or captive fleet retrofits and fuel changes. Exploring these strategies as a route to achieving compliance requires a bottom up approach.

(iii) **Limitation of Country to Grid Source-Receptor relationships**: Thirdly, current European-wide or 'top down' approaches are limited to 'country to grid' relationships between an emission change and the corresponding change in concentration in a given grid. Clearly this limits its application to exploring national level initiatives.

(iv) **Limitation of Annual Impact Focus**: Fourthly, and finally, at the European scale, relationships between emission changes and air quality are limited to annual mean values whilst some of the more challenging air quality limit values are based on daily or hourly averages (e.g. Exceedances of Daily PM10 threshold).

It is important to note that while such limitations impact the ability of this top-down approach to directly assess compliance with air quality limit value at individual measuring stations, the use of European scale IAM to inform the targets of the current Thematic Strategy on Air Pollution indirectly contributes to further progress in reaching compliance. This is not to imply that such contributions are cost-optimal for compliance, as discussed later.

This inability of European scale IAM to directly address the compliance challenge (at least until very recently) has contributed to some of the difficulties in achieving compliance with AQLVs (e.g. PM10 and NO2) from the implementation of Europe-wide measures in a number of Member States. As a consequence, many Member States have had to declare a significant number of Air Quality Management Areas, 'AQMAs'. For example, today, there are more than 700 AQMAs in the UK alone). The formal air quality plans designed to address the non-compliance issues in these AQMAs have largely been based on **'bottom up' approaches using combinations of local air quality modelling and measurements campaigns**.

As we'll see in the next section from the pilot questionnaire results, while essentially **all responders recognise the need to appropriately account for the wider scale**, not all have been able to bring the local (bottom up) and European/National scale together.

2.2 Top Down versus Bottom: Synergies and Future Outlook

In the context of the EC4MACS project and with a view to contributing to the current revision of the EU Thematic Strategy on Air Pollution, an important new capability has been recently added to the GAINS model. This combines the classic source-receptor relationship derived from EMEP (though now at 28x28 km rather than 50x50) with, at least for PM, sub-EMEP grid spatial variations derived from European-wide modelling using the Chimere model at the finer resolution of 7x7km. Importantly, it also makes full-use of the detailed measurement data from AIRBASE to build semi-empirical relationship between emissions and compliance with PM10 and NO2 binding air quality limit values in individual air quality management zones ([1]). To date this capability has not been incorporated into the optimisation strategy of GAINS.

At the same time new models and tools (as RIAT+ [2], develepod in the frame of OPERA project, see www.operatool.eu; LEAQ model [3]; the DSS developed in [4]) for the regional and local scales are designed following a bottom-up approach and including the effects of the european AQ policy as well as in the optimization procedure.

Both processes (top-down to bottom-up - GAINS - and viceversa - regional and local integrated assessment models) provide some important early insights into the complementary roles of 'top down' and 'bottom up' integrated assessment for compliance with air quality limit values.

The following figures, abstracted from [5], show the evolution of compliance from a base year of 2010 to 2025 (assuming current legislation only) and the further improvement for the optimised A5 so-called 'Central Policy Scenario' by 2025. The further compliance achieved in 2030, by implementing all technical measures (MTFR), is the fourth map in each case. Their assessment of compliance with the annual mean NO2 limit value and the daily PM10 exceedances limit value are both shown. In each case, the limit values used for assessing compliance are those of the current Ambient Air Quality Directive, which will potentially undergo major revision as part of the current AQPR process.

Some important observations can be made from these two series:

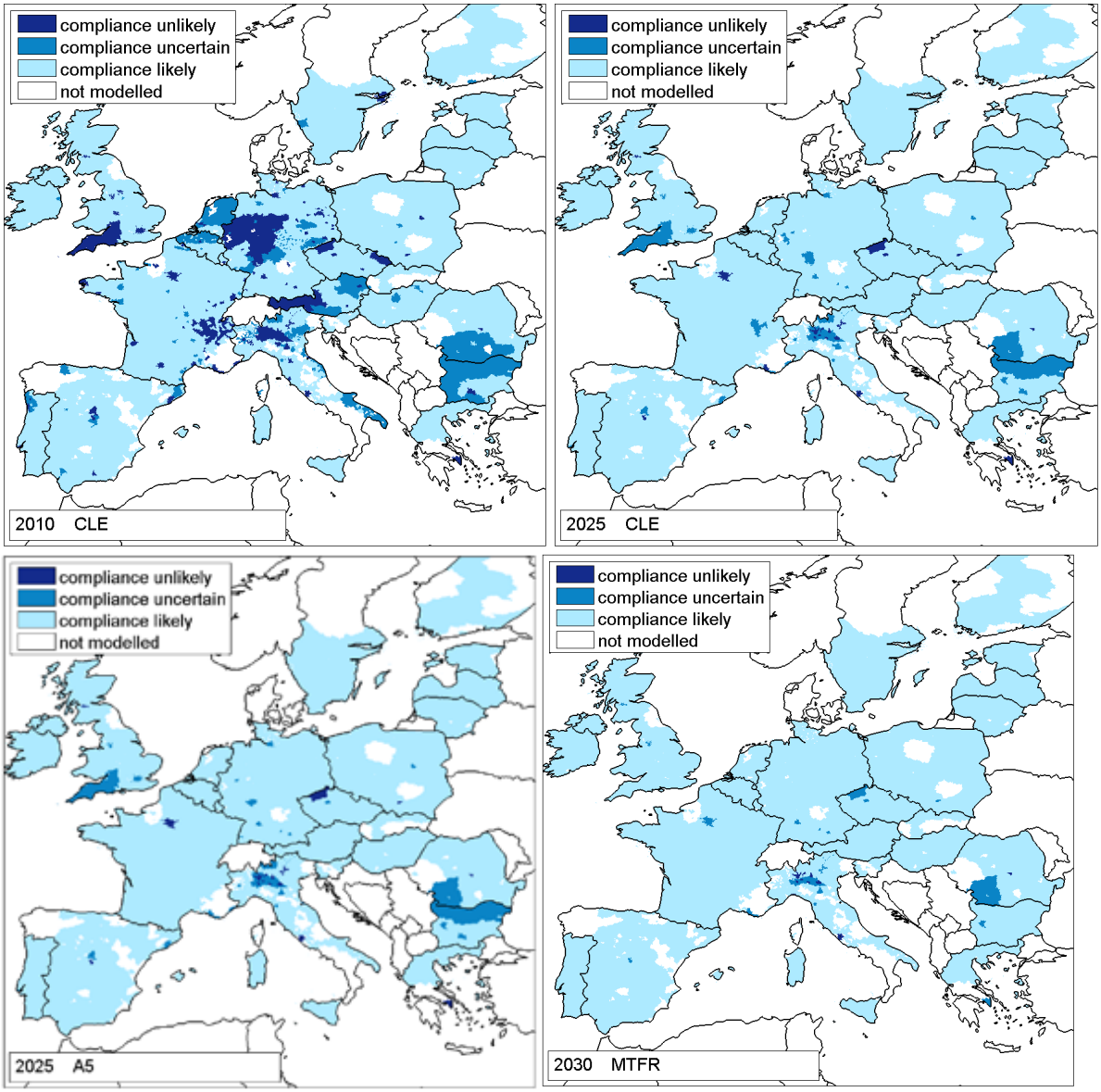


Figure 1. NO2 Annual Mean Compliance Assessment via GAINS 2013 ([5]).

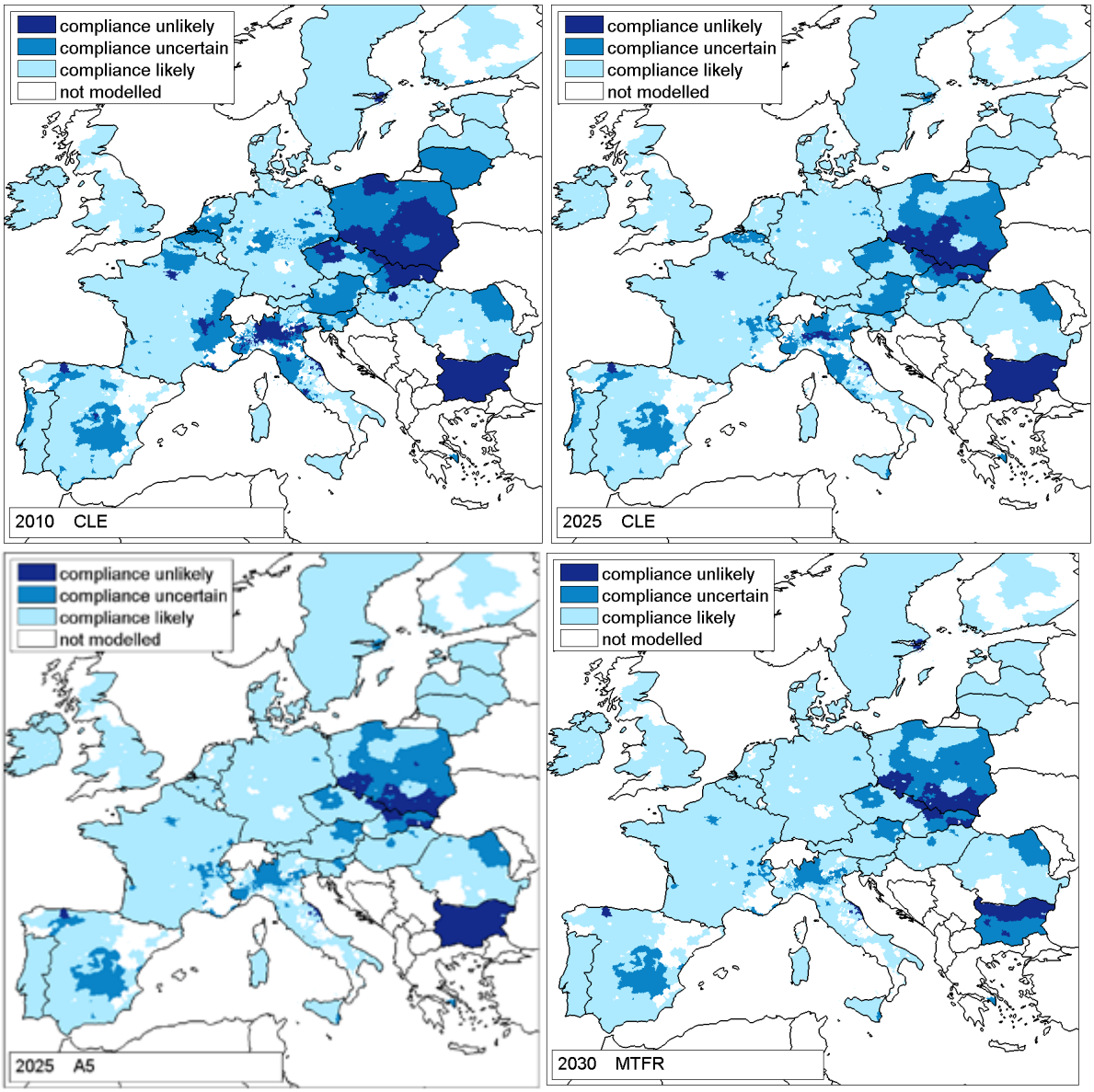


Figure 2. PM10 Compliance Assessment via GAINS 2013 ([5]).

(i) **Ubiquitous non-compliance versus discrete islands of non-compliance**: The first observation in comparing the 2010 map with the 2025 CLE case is the clear move away from a general picture of non-compliance (2010) to more geographically discrete remaining areas of non-compliance. Further European wide measures (already mandated) here bring about a significant improvements in compliance especially in the EU-15 Member States. What is also clear by comparing the 2025 CLE with the 2025 A5 (designated 'central policy scenario' in Report #10) is the limited potential of further EU-Wide measures to improve compliance; this is further underlined by comparing the 2025 A5 scenario with the 2030 MTFR scenario. This move with time towards discrete islands of residual non-compliance.

(ii) Introducing tougher European-wide measures to address residual non-compliance confined to 10% of the urban zones in Europe (the extent of NO2 non-compliance according to IIASA in the 2025 CLE scenario) would likely be significantly more costly than directly addressing the non-compliance areas with specifically designed measures based on bottom-up Integrated Assessment using regional/local data. This has significant implications for the role of regional/local 'bottom up' approaches to develop effective Air Quality Management Plans to efficiently achieving compliance.

(iii) In this regard, some regional Integrated Assessment tools (such as RIAT, OPERA, LEAQ) with their ability **to identify cost-optimised local strategies are already quantifying the cost-effective split between further European wide measures and regional/local measures**. They will inevitably need to find wider application and play an increasing role in this emerging 'discrete islands of non-compliance' EU. Even at this early stage of the APPRAISAL project, the pilot questionnaire responses, as seen in what follows, highlight the timeliness of these recent developments.

(iv) A further observation comes from comparing the 2025 CLE cases with the 2025 A5 scenario. A5 is a high ambition scenario (delivering 75% of the further health benefits of MTFR for the EU as a whole). At this high ambition level for the EU as a whole, a number of individual Member States are already driven to MTFR. Yet, from an AQ compliance perspective it does not substantially change the picture from 2025 CLE. This points to an **increasing role for targeted technical and non-technical measures in order to achieve compliance. As already noted, such measures (low emission zones, special fuels for captive fleets, captive fleet retrofitting etc.) can only be appropriately designed using 'bottom up' tools**.

3. The Database

The APPRAISAL Database is structured in 5 main topics

- Synergies among national, regional and local approaches, including emission abatement policies
- Air quality assessment and planning, including modelling and measurement
- Health impact assessment approaches
- Source apportionment
- Uncertainty and robustness, including QA / QC

In order to populate the database, a questionnaire structured according to the relevant database fields was prepared and distributed to selected institutions or project contact persons.

The questions dealing with synergies among national, regional and local approaches, including emission abatement policies are presented in the following (topic 1).
To simplify data elaboration and guide the experts in filling out the questionnaire, a number of **questions** with multiple choice answers were included:

- Which is the decision level of your activity?
- What air pollution and climate strategies and legislation are included in your activity?
- What emission sector are you addressing with your air pollution mitigation measures?
- What type of measures (technical or non-technical) did you consider?

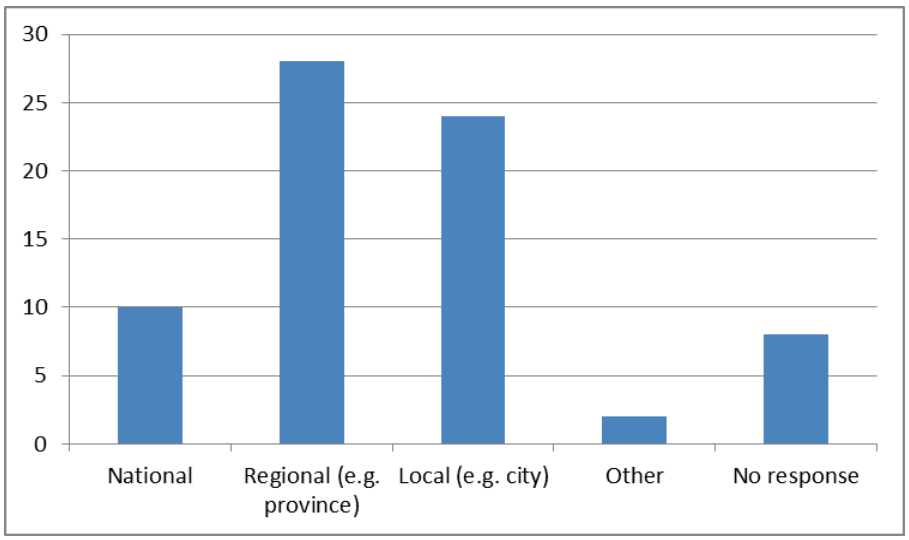
To give experts the chance to express more freely their views, a few **open questions** were included in the questionnaire:

- Were synergies among policies at different scales important in your assessment?
- Did you identify conflicts or inconsistencies among scales? If yes can you list them in order of priority (from more to less crucial aspects)?
- How did you combine the results at different scales?
- What do you see as remaining issues?

4. Results from the Database

Here the answers related to the topic 1 (Synergies among national, regional and local approaches, including emission abatement policies) are analyzed and commented.

Q t1.1 Contribution to decision level:



(Figure 3 Contributions to decision levels (multiple selections possible).

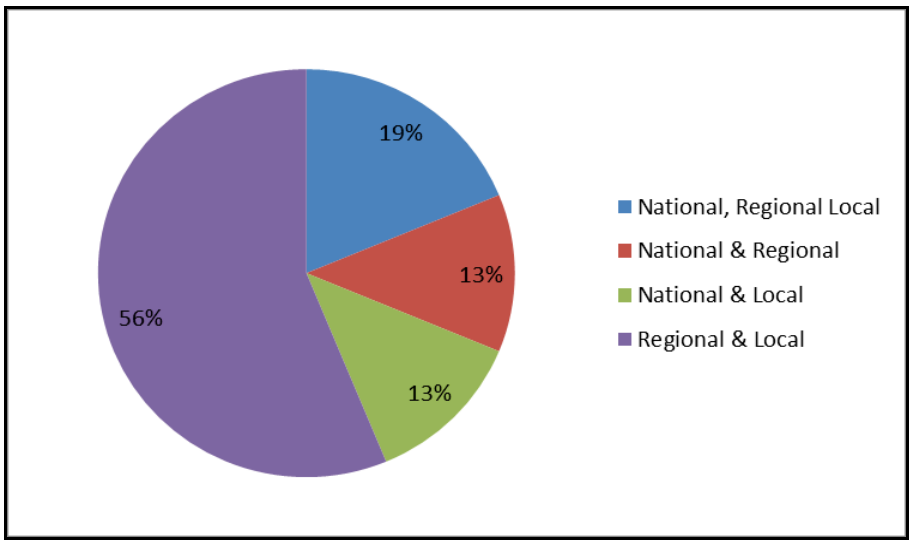


Figure 4 Analysis of combinations of contributions to decision levels.

Of the responses analysed, 16 combined input from one or more source (Figure 3 and Figure 4). In particular

- 3 responses contributed to combined Regional, Local and National decisions,
- 2 responses contributed to combined National and Regional decisions,
- 2 responses contributed to combined National and Local decisions and
- 9 contributed to combined Regional and Local decisions.

Note the emphasis on regional and local decisions (both combined and individually), hence this will impact on relevant data sources and approaches used.

Q t1.2. What air pollution, climate strategies and legislation are included in your activity (multiple selections possible).

Q t1.2.1 European Union Strategies

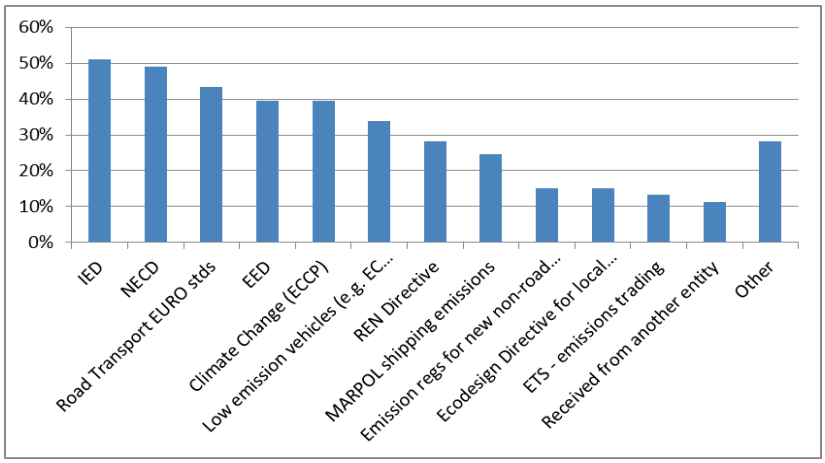


Figure 5 Analysis of responses to the inclusion of European Strategies. (53/53 responses).

The main EU strategies considered in the plans are IED, NECD and EURO standards. Given the profile of responses reported in Q t1.1, it raises the question of how these strategies are being referenced with respect to local and regional plans.

Q t1.2.2 National Strategies

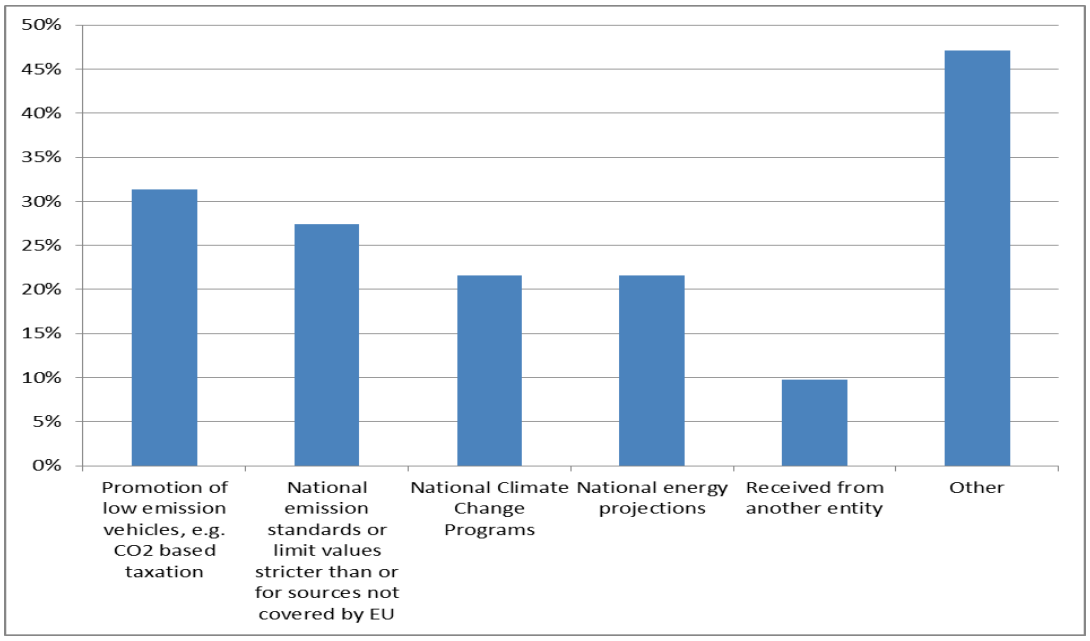


Figure 6 Analysis of responses to the inclusion of National Strategies (2 "no responses" excluded from the percentage calculation).

Q t1.2.3 Regional Strategies

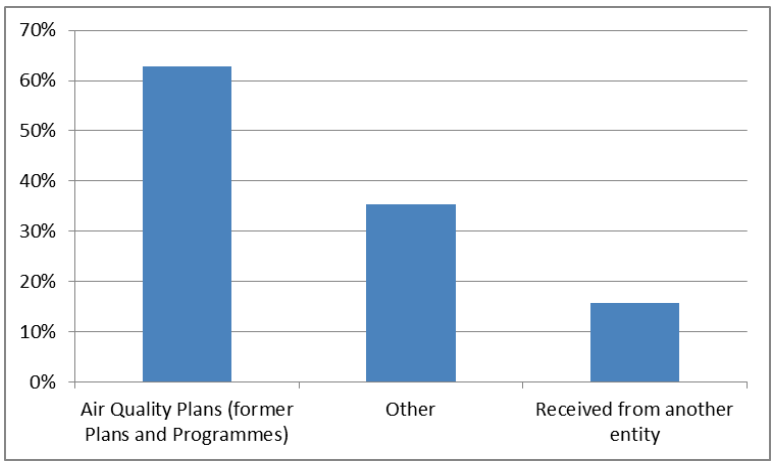


Figure 7 Analysis of responses to the inclusion of regional strategies. (2 "no responses" excluded from the percentage calculation).

Q t1.2.4 Local Strategies

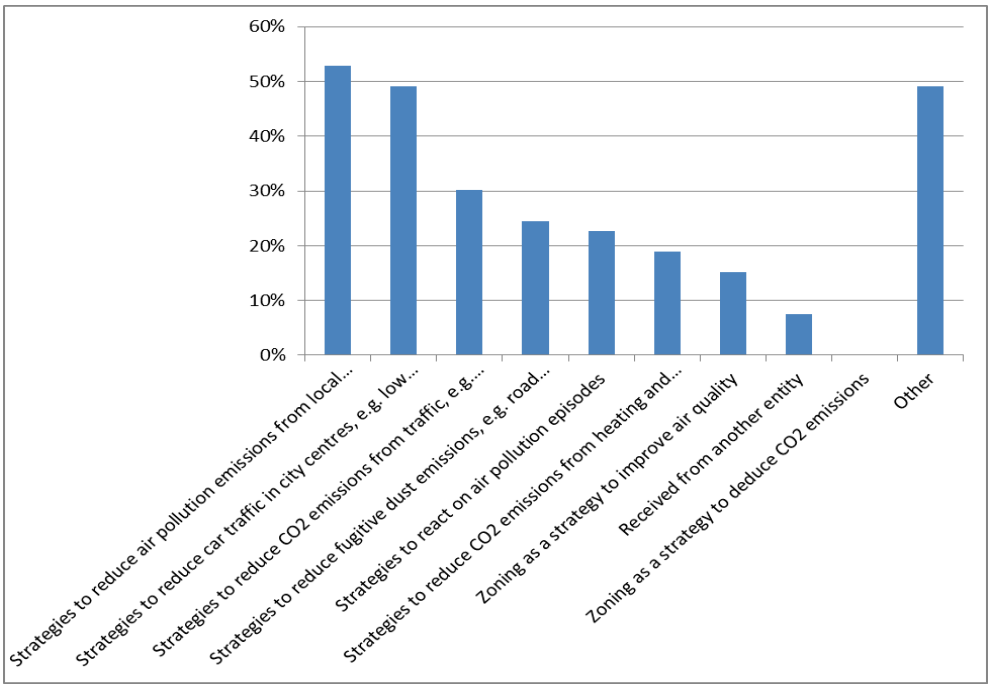


Figure 8 Analysis of reponses to the inclusion of local strategies. There is high number of "other" responses given to these questions (18%). However the "other" free text responses are only recorded in a handful of cases.

In all the above responses (related to Q t1.2, considering EU, national, regional and local strategies) there was not sufficient data supplied to draw any conclusions about the "Other" category of responses. There was no definition of the "received from another entity" category.

Q t1.3 What emission sector are you addressing with your air pollution mitigation measures?

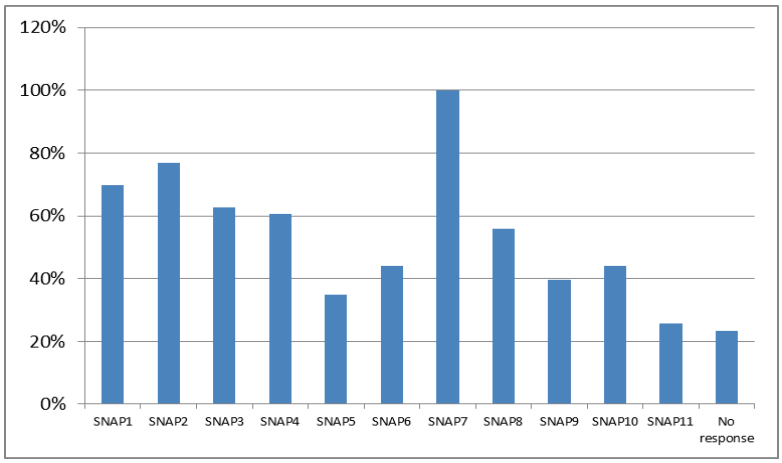


Figure 9 Analysis of SNAP[1] sectors being addressed by air pollution measures.

This Figure highlights the significance of SNAP 7 and SNAP 2 in defining measures.

Q t1.4 What type of measure (technical or non-technical) did you consider?

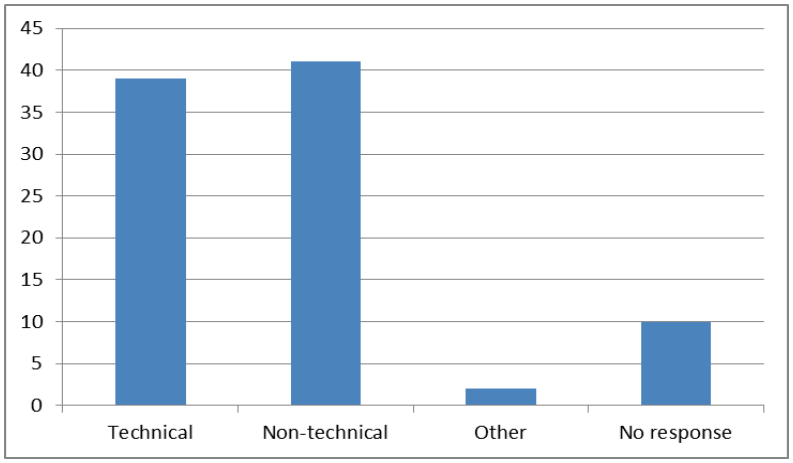


Figure 10 Analysis of response to the type of air pollution mitigation measures considered.

It is noteworthy that the non-technical measures considered are of the same order as the technical measures.

[1] SNAP1-combustion in energy and transformation industries; SNAP2-non-industrial combustion plants; SNAP3-combustion in manufacturing industry; SNAP4-production processes; SNAP5-extraction and distribution of fossil fuels and geothermal energy; SNAP6-solvent and other product use; SNAP7-road transport; SNAP8-other mobile sources and machinery; SNAP9-waste treatment and disposal; SNAP10-agriculture; SNAP11-other sources and sinks.

Q t1.5.1 Were synergies among policies at different scales important in your assessment?

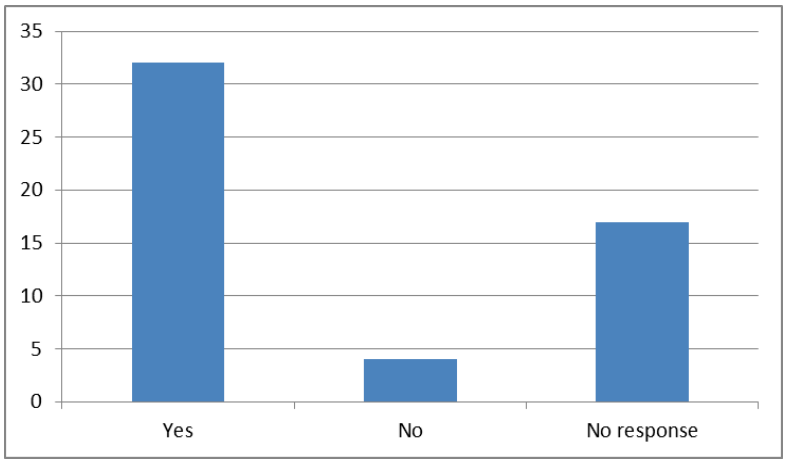


Figure 11 Analysis of responses to the importance of synergies in assessment. More than 50% (32/53) felt synergy among policies was an important point.

From the responses to the question on the importance of synergies, it seems that the main ways of accounting for policies at different scales depends on whether the work is *air quality planning* or *air quality modelling*.

If it is the former, the emphasis is on ensuring *improvements expected from national policies are accounted for in smaller scale plans*. If it is the latter then the *impact of larger scale emissions as background concentrations was considered*. Some respondents also passed comment on the *conflict and/or gaps between the levels of responsibility for policy and planning/implementation*. These comments included reference to situations where national measures were not perceived as having the capability to meet local targets or where transboundary ozone was a factor.

The dominant response to this question was the recognition of the need for coordination and synergy in order to produce effective plans. Currently, this appears to be provided through the knowledge of the AQ community rather than through explicitly coordinated policy measures.

Q t1.5.2 Did you identify conflicts or inconsistencies among scales? If yes can you list them in order of priority (from more to less crucial aspects)?

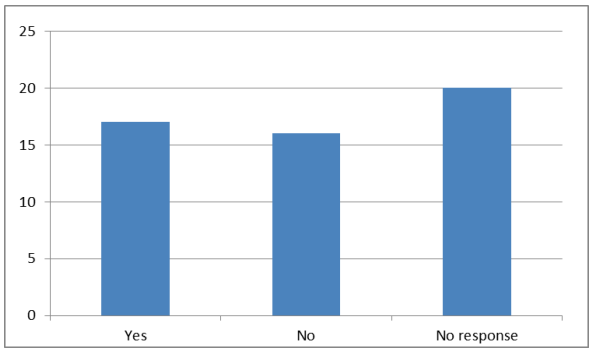


Figure 12 Analysis of responses to identification of conflicts or inconsistencies of scales.

The responses to this question were fairly evenly split although a large number were “no response”.
The answers indicating conflicts noted:
(i) decreasing NOx emissions can increase ozone exposure,
(ii) emission inventory formulation can be inconsistent between scales,
(iii) mismatches between administrative divisions and responsibilities,
(iv) conflicts between reducing CO2, NOx and PM emissions from diesel vehicles,
(v) issues with balancing emission inventories with point sources data at national level,
(vi) some issues with consistent categorisation of GAINS/CORINAIR/IPCC,
(vii) AQLVs not necessarily being the best indicator for human health impacts.

Q t1.5.3 How did you combine the results at different scales?

This question had 28 replies with a wide range of comments. There was difficulty in combining results at different scales and some said it was not attempted. Others commented on particular function of the tools that they used allowing them to use nesting to “zoom” scales.
Signifcantly, some were using background levels of pollutants as input to finer scale work. The question of how to handle transboundary pollution was also an issue. Comment was made on the application of cross scale policy application of EU scale emission reduction technologies. One comment referred to using statistical methodology to apply health impacts derived from the large scale case to the city scale case. It was also expressed that combining results is an active area of on-going work.

Q t1. 5.4 What do you see as the remaining issues?

This question had 23 replies identifying remaining issues. There was one theme which was expressed several times – that of the need for better quality information particularly with respect to emissions inventories. In this context the value of temporal emissions data was noted. Other common themes were the need for integration across policy levels, the difficulties of PM control, the need to have stricter NEC values to achieve emission limit values, the conflict between cost benefit analysis and using cost to drive behaviour change. One respondent mentioned the problem of resource constraint in carrying out a complete IA exercise and is working on simplifying approaches. Another respondent noted the role of health impact assessment in developing and implementing policy. Implementation of the AQ plan was noted three times as a remaining issue but it was not clear if this was a factual comment or an expression of an issue to be overcome.

5. Current practice for assessment and planning tools with respect to synergies across different scales

To investigate what sources were considered in determining suitable control strategies we focused on the questions dedicated to detailing the emission input that was used:

- Which emission SNAP sectors are you addressing with your air pollution mitigation measures? (topic 1, question 4)
- Which emission inventory was used (EMEP/ National/regional or local/ project specific)? (topic 2, question 7)
- What is your emission inventory approach? (topic 2, question 7)
- To what level of detail did you disaggregate the emissions into sectors, subsectors, activities or fuel type used? (topic 2, question 7)

For the analysis of the questions found in topic 2 we only considered those questionnaires which covered both topic 1 and topic 2. This was the case for 42 of the 53 questionnaires collected.

5.1 Current practice based on air quality plans

From the information reported for the SNAP sectors (shown in a previous Figure) we deduce that traffic related emissions (SNAP 7, 92%) were the focus of most AQP with less prominent roles for non-industrial combustion (SNAP2: 76%) and combustion of manufacturing industry (SNAP 3: 64%). This is off course related to the pollutants targeted: 80% of the plans target nitrogen oxides for which traffic and combustion in general is the main source.

Certain control measures only apply to a small fraction of the emissions that belong to a certain SNAP sector. To consider such measures adequately in the AQP, emissions need to be further disaggregated and assigned to subsectors, activities or fuel type to which the measures apply. More than 60% of the AQP consider a further subdivision of the SNAP level 1 macro-sectors into sectors and activities and 55% consider more than one level of detail (Figure 13).

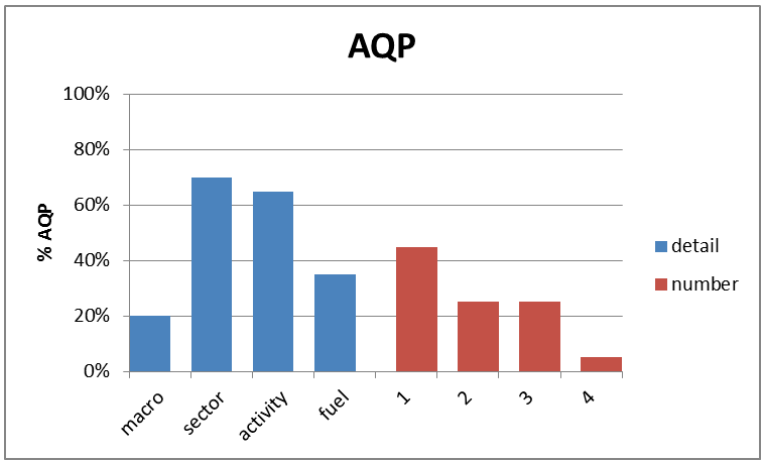


Figure 13 Detail of the disaggregation considered in the emission inventory for the AQP (detail, blue) and number of different detail levels considered (number).

Besides the level of disaggregation also the emission inventory data source (EMEP/ National/ regional or local/ project specific) and the number of these different sources that were combined is an indication of resources committed to the emission inventory on which the AQP is based (Figure 14). 33 % of the AQP rely on a single source of information. Notable is that the EU (EMEP) inventory is least mentioned as the source of information.

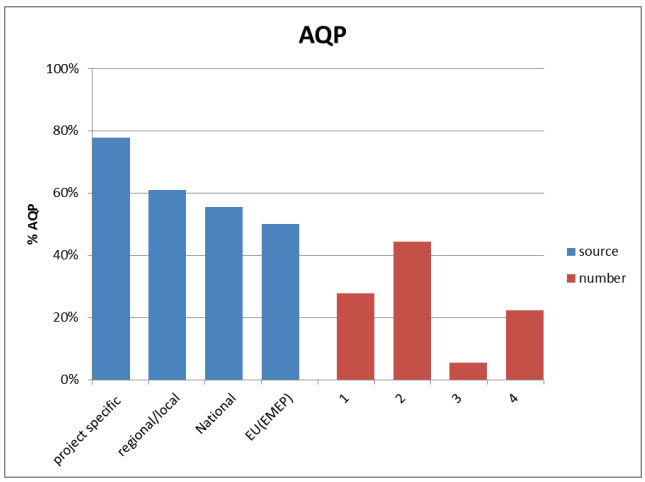


Figure 14 Source of the emission inventory and number of inventories combined in the AQP.

5.2 Current practice based on research projects

For the projects which are not Air Quality Plans the attention to the different sectors is more equilibrated albeit also for these projects the transport sector (SNAP 7) remains the most important sector. The difference in the number of SNAP sectors considered is more apparent: 50% of the projects consider at least 10 SNAP sectors compared to 20 % of the AQP. For the research projects more than 75% consider sectors, activities and fuel types in

the disaggregation and more than 80% take into account at least two levels of disaggregation which is more than for the AQP (Figure 15).

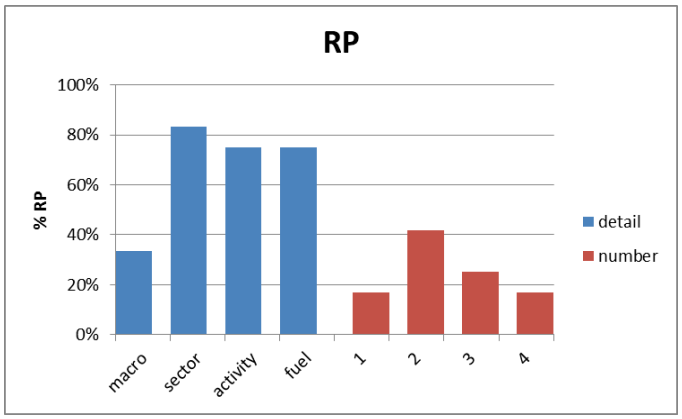


Figure 15 Detail of the disaggregation considered in the emission inventory for the research projects (detail, blue) and number of different detail levels considered (number).

Somewhat surprising research projects rely less on project specific emission inventories (Figure 16) and seem to rely more on official data. The EU (EMEP) inventory is again not the main source for emission data. When multiple inventories are combined, research projects tend to combine more inventories than the AQP: 36% of the respondents state that they rely on all 4 emission inventory options listed compared to 22 % for the AQP.

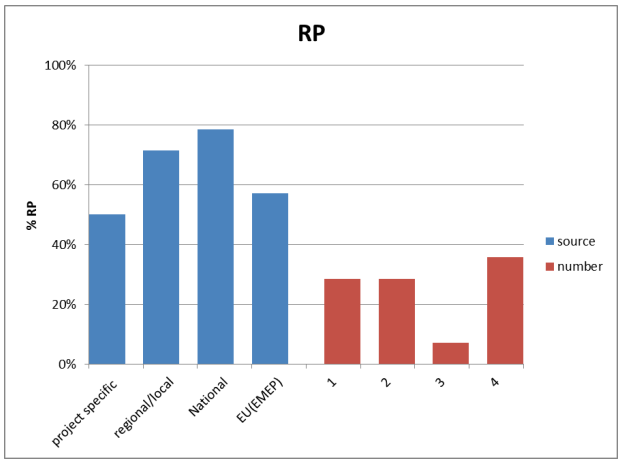


Figure 16 Source of the emission inventory and number of inventories combined in the research projects.

6. Limitations of the current assessment and planning tools and key areas for future research and innovations

The quantification of the effectiveness of specific measures for a zone presumes that the **emission inventory** disaggregates the emissions both spatially and according to the level of detail required by the measures considered. This level of detail is unfortunately lacking in most inventories and is a major source of uncertainty in assessing the effect of measures. The official national and European (EMEP) level emission inventories do not cater for this level of detail and only contain emission totals for the member state as a whole. Most of the AQP studies therefore combine the information from the EMEP inventory with other inventories or do not use EMEP at all. Where EMEP is generally accepted as the emission inventory for modeling at the European or national scales, there is currently no such standard at the local scale and there is a clear need for further insight into compiling detailed emission inventories for assessing measures at the local scale.

With the difficulties of balancing and reconciling emissions inventories between EU, national, regional and local scales, key areas of future research might include:

(i) emissions inventory harmonisation including temporal profiles,

(ii) integrating cost benefit methodology and/or commentary into Air Quality Planning

(iii) a research project to identify an integration methodology and benefits for cross scale planning and policy. An obvious candidate would be vehicle emissions.

(iv) similar to iii, a research project to identify which emissions and measures can be treated effectively on a “disaggregated” scale and whether or not this approach can be extended from the bottom up to contribute to larger scale policy or measures.

(v) research activities to develop methodologies to assess the impact of regional/local emissions on secondary pollution.

(vi) the main area of decision levels reported in the sample were regional and local. Suggest a research initiative to target policy and measure formulation that is synergistic to these decision levels.

The above comments are supported by the analysis of Topic 2 Q7 which shows the mismatch between AQP practice and the Research Projects. Making the Research Projects more directly relevant to the work of AQP should be considered.

Article 25 of the Directive deals with the problem of **transboundary air pollution**. To be effective an air quality plan should appropriately take into account the contribution of sources outside the zone considered in the plan. This is especially true for long lived and secondary pollutants. In those cases larger scale modelling is needed to properly incorporate the effect of the boundary conditions or at least a sensitivity analysis should be required to quantify the importance of the boundary conditions. If results at different scales are combined, the consistency of the inputs used should be checked and care should be taken to account for differences between the models.

On the other hand the problem of transboundary air pollution can be read as the issue to assess the impact of regional-local emissions, in other words, **to quantify the effective**

potential of regional-local policies in a specific domain. Methodologies shoul be formalized and developped to fill this gap.

7. Contribution to the AQD

With respect to emissions the Directive 2008/50/EC requires an Air Quality Plan to report on the origin of pollution (Annex XV) by providing a list of the main emission sources responsible for pollution (map) and reporting the total quantity of emissions from these sources (tonnes/year). The Commission Implementing Decision of 12 December 2011 requires the AQP to report on the emission scenario and the total emission for both the baseline and for the projection as well as the reduction in annual emissions due to the applied measures.

The Directive acknowledges the importance “to identify and implement the most effective emission reduction measures at local, national and Community level” (article 2). This presumes that the emission inventory used for the AQP is sufficiently detailed to allow mapping measures to the specific emissions affected at the different administrative levels that have to be considered. Emission inventories and projections as needed for the assessment and planning at the local scale are currently developed ad hoc. It is recommendable to take an initiative to harmonize the criteria and the procedures for developing local emission inventories, technical and non-technical measure database including application rates and costs.

8. Summary

The overall objective in WP2.2 is to identify and/or characterize how emission abatement strategies at the national level are considered and integrated in the definition of regional and/or local plans and programmes to improve the air quality and vice-versa. In this respect, it is worth noting that some 60% of respondents to Question 11 in the previous section indicate that synergies among national, regional and local approaches are taken into account.

In Topic 1, considered in this section, the first two questions appear to have a contrasting response. In fact, the majority of respondents appear to use input from regional and local synergies in their approaches. However, when asked which strategies were included in their decision making process, the major European Directives predominated. This raises the question of how they were being referenced in the context of regional and local plans.

On looking at the response to the question on National Strategies, the main focus appears to be on transport. The selection “other” formed the majority response but without sufficient detailed responses in this or under the regional and local headings it is impossible to be absolutely categorical, although looking at the analysis performed with respect to local strategies and SNAP sectors respectively, it is clear that transport is a high priority.

The analysis with respect to the type of measure shows a greater number of non-technical measures being considered. It might be of benefit to expand on this question and obtain more informative responses in this category.

On examining the responses to the open questions in Topic 1, it is recognised that there is a common difficulty with balancing and reconciling emissions inventories, between EU, national, regional and local scales. The scale of the emission inventory is directly related to the scale of the study being undertaken and mismatches in inventories across scales inhibits cross scale modelling.

In conclusion, there is a common difficulty with balancing and reconciling emission inventories. In addition, there is a recognition that policy needs to be written which takes account of the channels of responsibility for implementation. Policy which is written without taking into account these factors risks becoming “undeliverable”, both in terms of attainability of targets and in terms of an appropriate executive function or body.

Perhaps most significantly in this pilot sample, there exists no critical review mechanism and cost benefit analysis does not appear to be an integral aspect of the process.

9. References

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