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Guidelines on appropriate tools and formats for better dissemination of scientific findings for use in decision making on air quality management

Work Package 7

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List of abbreviations

$\mu\text{g}/\text{m}^3$: microgram per cubic meter
ACS study: American Cancer Society Study
CAA: Clean Air Act
CAFE: Clean Air for Europe
CHD: Coronary Heart Disease
COPD: Chronic Obstructive Pulmonary Disease
CRF: Concentration-Response Function
EPA: Environmental Protection Agency (USA)
EPAQS: Expert Panel on air Quality Standards
EU: European Union
HIA: Health Impact Assessment
NAAQS: National Ambient Air Quality Standards
 NO_2 : Nitrogen dioxide
NRC: National Research Council
 O_3 : Ozone
PM: Particulate Matter
 PM_{10} : Particulate Matter with aerodynamic diameter inferior to 10 micrometers
 $\text{PM}_{10-2.5}$: Particulate Matter with aerodynamic diameter between 10 and 2.5 micrometers
 $\text{PM}_{2.5}$: Particulate Matter with aerodynamic diameter inferior to 2.5 micrometers
RR: Relative Risk
WHO: World Health Organization

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Foreword

The science-policy interface in the field of air-quality research concerning the impacts of pollutants and their management in a public health perspective could easily be depicted as protean.

We do not intend here to provide elements of new theories on knowledge transfer or pretend to have uncovered the decisive elements that will make the transfer process more efficient. Instead we have taken a pragmatic approach that allowed us to test, in carefully chosen contexts, a method and tools that enable designing, conducting and eventually assessing the outcome of actions to improve air quality. Our accent was not on uncovering individual factors that may influence the rate of knowledge transfer, but rather on how to create favourable conditions for translating knowledge into action.

The concept of “knowledge” is in itself subject to interpretation. For instance, in our project it centred on the improvement of health impact assessments (HIAs) as decision-support tools in the field of air-quality management. On the other hand, the transfer process is about linking different communities, building relationships, sharing needs between researchers and policy makers as well as a broad diversity of interested parties having different training, cultures and priorities.

At the current stage of the work, we can report on approaches for the two extremities corresponding to:

- 1) Input from public-health science aimed at setting health-protection standards; we try to define features relative to its rigour or credibility
- 2) Action plans developed in order to comply with these standards; we insist on expanding the debate to all issues that are connected to air quality, i.e. those that can be affected by policies to reduce air pollutant emissions and can in turn create obstacles for the improvement of air quality, thus defining performance criteria to evaluate the proposed actions.

We tackled the first aspect through a search for the sources of uncertainties, starting with the collection of opinions (synthetic qualitative judgements on uncertainties relating to specific HIA variables) from public health professionals by the Aphekom centres. The same questionnaire was given to NGO representatives, who expressed their needs and understanding of HIA. This leads to questions on the perception among peers, professionals and stakeholders about the rigorous application of HIA and the accuracy or validity of the results. For the second aspect we chose to use local processes as case studies, with a preference for ongoing processes including multi-stakeholder participation that can theoretically offer a number of advantages: simpler relationship between scientific needs and expected outcome, insight on stakeholder views, needs of authorities at different levels (national to local).

The following two sections provide background and practical guidelines for the use of appropriate tools and methods in order to improve knowledge transfer at the science-decision interface.

I. Background

The protection of human health has been an important driver for policies regulating pollutant emissions in an attempt to improve the ambient air quality. Thus in recent decades, air pollution, both in urban and rural areas, has been reduced mainly through the enforcement of regulations concerning technical (for instance fuel characteristics) and technological (engine performances, exhaust catalysts, particle traps) aspects². However, in the last 10 years or so, for major pollutants like PM (particulate matter), NO₂ or ozone, concentrations either remain stable³ or sometimes increase. In parallel, considerable progress has been made in characterising the impacts on human health of these pollutants (Pope and Dockery 2006). The monitoring systems have become more reliable, the measures of exposure have been improved, risks have been quantified with higher precision, and mechanisms of action have been elucidated, thus leading to appropriate recommendations (Brook et al. 2004). Also, the World Health Organization (WHO) has lowered the guideline values for some pollutants like PM and ozone (WHO 2006).

Highlight n° 1

The Aphekom project aims to contribute to the development and evolution of local and EU policies aimed at reducing both air pollution and its impact on respiratory and cardiovascular morbidity and mortality across Europe

This progress should not mask the fact that pressing gaps still exist and that a continuing effort is necessary in order to generate reliable and actionable information so that decision makers can introduce more effective policies (Russel and Brunekreef 2009), health professionals can better advise vulnerable subgroups and individuals can

make better-informed decisions. Such are the goals of the Aphekom project.

Although recent scientific evidence points to increasing health effects of air pollution, public policies do not seem, at least to public health professionals, to take the measure of this important threat (see for instance Rom and Samet 2007, Annesi-Maesano et al. 2007). Turning science into policy has been a long-standing challenge for environmental problems (Watson 2005). In fact, beyond the science–policy interface, what should be examined is the triptych science–society–decision which stems from the will to involve stakeholders in the decision-making process. In

Highlight n° 2

Aphekom's scientists and specialists propose and report on health-impact indicators and calculate and report on related costs. Furthermore they evaluate strategies designed to reduce air pollution, stimulate dialogue between stakeholders and provide guidance to health professionals on helping patients reduce their exposure to air

this sense, efforts have been devoted in assessing stakeholder needs, including on clean air strategies (Fudge et al. 2003).

The use of scientific information for policy decisions has been under close scrutiny for a number of years (Tuinstra 2007). Fields such as climate change and biodiversity preservation have provided a particularly rich context for analysing interactions and efficient cooperation resulting in policy-making that may satisfy all parties. As expected, researchers have been faced with frustration, misunderstandings, disappointment and a lack of substantial progress in many instances. Thus, logically, the research community has devoted efforts in reflecting on and adapting its communication strategies, in order to improve the appropriation of scientific evidence by the policy-makers and citizens (Grennfelt et al. 2006). The underuse of research results, as has been shown in other areas of health research (Haines et al. 2004), can lead to persisting adverse health outcomes because of insufficiently health-protective air-quality standards for harmful pollutants.

² See for instance: http://ec.europa.eu/environment/archives/air/cafe/activities/pdf/case_study4.pdf
³ EUPHIX: http://www.euphix.org/object_class/euph_airborne_particulate_matter.html

In accordance with the Aphekom project aims, the present document focuses on examples of knowledge-transfer activities and their potential relation to subsequent decisions about air quality policies.

We have adapted an iterative five-step method centred on the framing of the problem and using the deliberation-support tools (multi-criteria and multi-actor assessment) that we have developed. We also provide in a separate section, guidelines for deploying our methodology to improve the transfer to knowledge-users.

Transferring research into practice

There is a substantial literature attempting to analyse the science/decision interface. In most instances, the approach remains descriptive. Despite a general agreement on the importance of transferring knowledge (or knowledge translation as it is sometimes called), there is still a lack of practical conclusions on emerging methods and tools that can enhance the appropriation of research results by the potential users⁴. Some theoretical models try to represent this process of “passing-on” research results and other evidence between academic and practice settings (policy-making): they depict processes that can be linear, cyclical or dynamic multi-directional.

The knowledge transfer pyramid

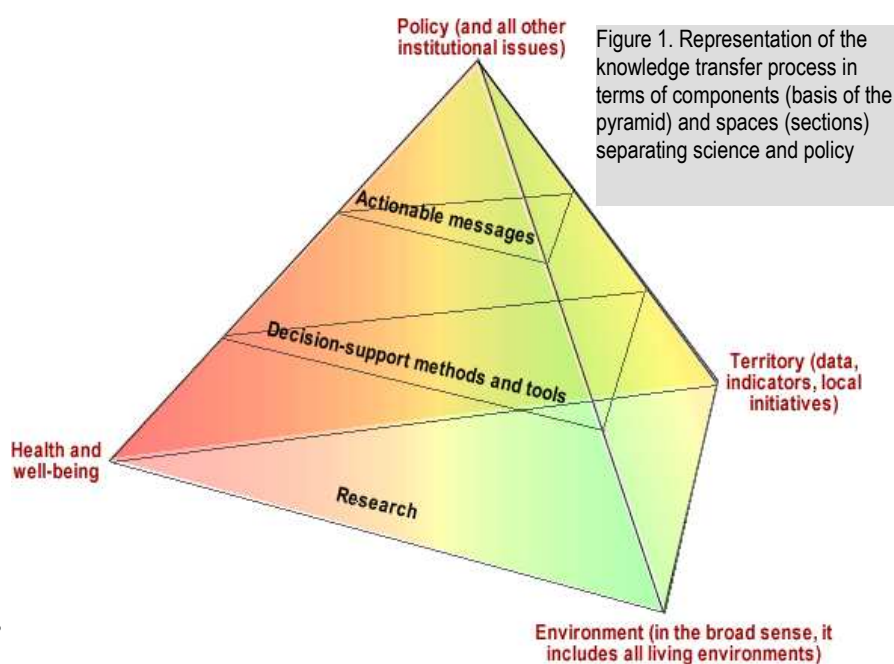


Figure 1. Representation of the knowledge transfer process in terms of components (basis of the pyramid) and spaces (sections) separating science and policy

There have been attempts to identify the intermediaries, mostly focusing on individuals occupying key positions. In some instances, surveys and interviews were used to assess the needs of different audiences⁵. On the other hand, only seldom has the act of knowledge-transfer been defined as a capacity, associated with a requisite set of skills that any of the intermediaries can acquire through training.

Highlight n° 3
 Through a set of interrelated work packages, Aphekom aims to develop and deliver reliable, evidence-based, actionable information and tools on the health impacts and monetary costs of urban air pollution in 25 European cities

The knowledge-transfer pyramid which is shown in figure 1, building on a concept proposed by J.

Lavis (Lavis et al. 2006), identifies components which include environmental factors that can influence health and well-being as well as the territory which is concerned (where the policy

⁴ Ward et al. Journal of Health Services Research & Policy Vol 14 No 3, 2009: 156–164

⁵ See for instance the APHEIS report <http://www.apheis.org/Apheis3NEW1.pdf>, or the ENHIS report entitled *Assessment of information need for environmental health policy making*,

would apply). It also shows simplified levels at the limit of which knowledge-translation can occur. The Aphekom project focuses on the space between decision-support tools (HIA for instance) and actionable messages.

The term of knowledge brokering has now gained wide acceptance and is meant to promote evidence-based decision-making by somehow linking research and policy-makers. It appears in the context of health-related issues in the late 90s when the Government of Canada decided to fund health services research and build the practice of knowledge transfer in the field⁶: *It is (knowledge brokering) the human force that makes knowledge transfer (the movement of knowledge from one place or group of people to another) more effective.*

Our approach, which we have named “environmental learning” with the use of deliberation-support tools, should be considered as one of the possible activities conducive to knowledge transfer at some stage of the complex science-decision interface.

The Aphekom project focuses on messages derived from health impact assessments as a decision-support tool. But should we not investigate the capture of the messages by target audiences? How do we define their “actionability”?

« Loss in translation » at the science/decision interface

Highlight n° 4
Pressing gaps remain in stakeholders' understanding of the continuing threat on health represented by air pollution in urban areas.
The integration of complex scientific evidence into HIA (health impact assessment) and the strengthening of communication tools with stakeholders conducted within Aphekom should improve urban health governance and accountability...

The efficacy of knowledge transfer is often viewed in terms of communication quality, i.e. when a decision does not seem to stand up to what public health scientists consider as adequate protection against air pollution. It is attributed to a possible lack of convincing evidence about health impacts, or to their inadequate presentation resulting in poor understanding by the decision-makers (Annesi-Maesano et al. 2007). We should certainly not minimise this aspect. Beyond the decision-makers,

different categories of stakeholders tend to pick up on specific issues that may influence their position (Wallis 2007).

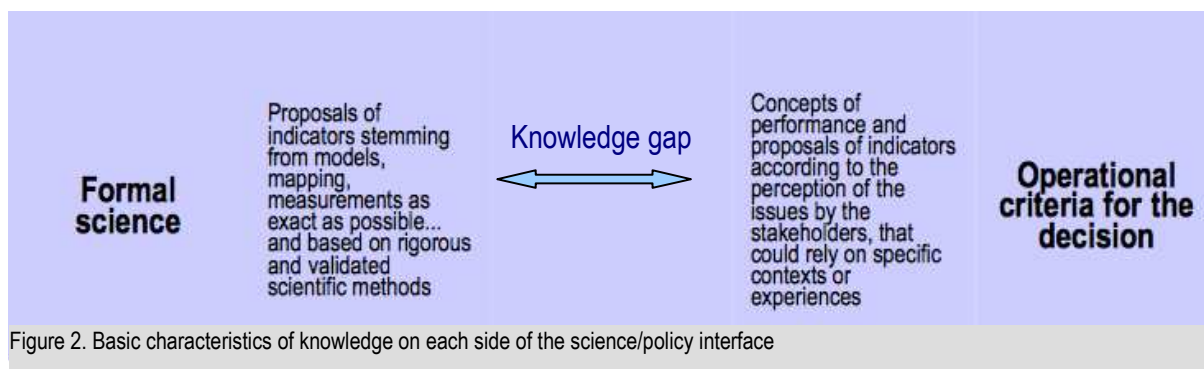


Figure 2. Basic characteristics of knowledge on each side of the science/policy interface

Representatives of the general public are particularly receptive to health impact data, a point that needs to be considered in the communication formats. But mostly, the gap which has to be bridged consists in “transformation” of the knowledge itself, from its formal presentation that fundamental research produces to an operational or actionable set of performance criteria and

⁶ The Theory and Practice of Knowledge Brokering in Canada’s Health System, 2003: http://www.sandy-campbell.com/sc/Knowledge_Translation_files/Theory_and_Practice_e.pdf

indicators. The use of decision-support tools by scientists is meant to make information more amenable to policy decisions. In the same process, the information can be adapted to local settings and enriched by local experiences.

Research operates within a long time-frame and this contrasts with the needs of the policy makers that are immediate or short-term. As a general rule, science does not influence the political agenda. We therefore need to assume that the initiation of the decision-making process cannot be controlled. On the other hand we can consider how to best operate within on-going processes that have their specific organisation frameworks and rules. It is thus important to distinguish the relatively generic forms used for communicating science to policy-makers (policy-briefs, fact sheets, position papers...), as in projects dealing with the “research needs for policy” that the European Commission promotes, without overlooking or minimising their impact on the science–decision interface. Mostly these correspond to the “push” type of strategy linking research to policy, and they are led by researchers (JN Lavis et al⁷). “Pull” strategies apply to policy-makers' demand for evidence necessary for decision. The CAFE programme provides an example (see Box n° 3 for discussion of its outcome). In our case, we subscribe to complex interactive methods based on extensive participation and deliberation-support tools.

Highlight n° 5

APHEKOM WP7 objective: Identify and prioritise uncertainties in the assessment of health impacts of air pollution.

Determine how these uncertainties interfere with the many steps in the decision-making process

In all fields of research there is continuous scientific progress, but at any given time there are always knowledge gaps that are often regrouped under the term “*uncertainties*” (Janssen et al. 2005). Uncertainties encompass a lot of different entities, the typology of which has to be studied in depth (Van der Sluijs et al. 2008) in order to

determine what needs to be eventually done to reduce them (*vide infra*). Nonetheless, these knowledge gaps can be considered (or sometimes used as a pretext) to weaken the science/decision communication (Michaels & Monforton 2005). There are historical examples, such as the chlorofluorocarbon gases (CFCs) and the ozone hole, or the greenhouse effect gases (GEGs) and climate change, where the uncertain nature of science has undoubtedly delayed decisions. However, in other instances, additional factors may also come into play.

Box 1. WHO and knowledge transfer

The WHO, has recognised the importance of communication between the producers of information and the users (not only the policy-makers) in order to improve health. It appears as a core function in the 11th General Program (2006-2015): *shaping the research agenda and stimulating the generation, translation and dissemination of valuable knowledge*, alongside with the more classical: *setting norms and standards, and promoting and monitoring their implementation...*

Terms like “communication” or “information” have more passive connotations compared to the process underlying the knowledge brokering activities. Thus, the WHO is a partner of the European project BRIDGE, whose objectives include “*Develop and revise a framework to organize the ways – concepts, mechanisms and organizational models – in which new and existing knowledge can be transferred into policy initiatives, mechanisms and practices;*”

Thus, it is important to consider various parameters that, at a given point in time, may be critical for the decision-making process. Above (Figure 2), we attempted to express the nature of the gap between science and decision that somehow needs to be bridged through the activities that fall under the term of knowledge brokering. If knowledge transfer is a universally acclaimed major objective in order to promote better evidence-based policy, the various methodologies that have been described in the literature (not only peer-reviewed articles) present a great diversity⁸.

⁷ Assessing country-level efforts to link research to action, Bul. of the WHO, vol 84(8): 620-628 (2006).

⁸ Deliberative processes, inventory of resources, National Collaborating Center for Healthy Public Policies, Canada,

Environmental learning, coping with complexity through deliberative processes

It is beyond the scope of the present guidelines to discuss theories about learning through engagement. While we focus on informing the policy-making process, which could be limited to the dissemination of expert knowledge to decision-makers, we assume that the environmental “problem” is more complex and is characterised by uncertainties. Differences in perspective or priorities are to be expected between scientists and policy-makers, among policy intermediaries such as members of the administration, and all other people concerned including stakeholders or the general public. Many different reasons or principles can be put forward as justifications for the acceptability of a given decision (including perceived uncertainties and risks, distribution of benefits and costs across different constituencies within society). Principles may be “irreducible”, i.e. incomparable, in the sense of being grounded in qualitatively different considerations, making choices that cannot be the result of quantitative trade-offs (i.e. between benefits and risks).

Highlight n° 6

- What is the stakeholders' understanding of this knowledge?
- How important are results of Health Impact Assessments (HIAs) both for all interested parties (including policymakers)?
- How should public health experts share the uncertainties in HIAs that may affect decision-

Thus, interaction with interested parties should be included in all activities within the knowledge transfer process. The term “participation” should encompass a range of possibilities, from a restrictive setting (representatives of different administrations involved in the decision) to a wider civil society involvement, the final choice depending on the context. In that sense, thinking in

terms of target audiences (a passive receptor state) for which information is tailored to their needs is insufficient.

The deliberative setting is designed to foster dialogue, allowing participants to freely express preferences and develop arguments to support choices. It includes exploration of the issues, co-construction of the problem and formulating performance criteria to assess the impact of appropriate actions. The deliberative process also implies discussing (including lay input) what is best evidence, its quality but also its relevance, by eventually confronting scientific data with contextual (local) experience.

Whatever the motivations, participatory evaluation processes are not purely analytical. They are social processes with an inter-subjective dimension, which opens up the possibility of “emergent” properties. Thus, the outcome of the deliberation should be policy-relevant (the decision makers can agree to take into account the conclusions or recommendations) and tend to improve the understanding of the various actors (in the field of the environmental problem) about their own or alternative views, values and options expressed by different participants as well as of those outside of the process.

According to Ortwin Renn, (Renn et al.

Deliberative processes as tools for guiding and supporting policy making are a subject of growing interest. In the context of this inventory, “deliberation” is defined as the critical examination of an issue involving the weighing of reasons for and against a course of action. Deliberation can involve a single individual, but the deliberative processes under discussion here involve group deliberation. Thus, the objective is for participants to establish a dialogue and/or come to a rationally motivated agreement.

Both **transformative and social learning theories** stress two interrelated components, i.e.

- 1 Instrumental learning or cognitive enhancement through the acquisition of new skills or information and knowledge.
- 2 Communicative learning in terms of how a person approaches a situation or point of view and learns how to cooperate with others in solving collective problems, including developing a sense of group solidarity.

1995⁹). these include access to information; equal opportunity to participate; openness to alternative perspectives; an ability to reflect critically upon presuppositions and truth claims and to assess arguments in a systematic manner; a willingness to accept a derived consensus as valid; and freedom from manipulation, coercion and control. Interested parties with their various concerns, duties and point of views, all observe, interpret and make judgements about the state of the environment (at a given scale/territory) and its possible evolution. Representatives of different interest groups (but also individuals) legitimately have different views about what are the important facts and values.

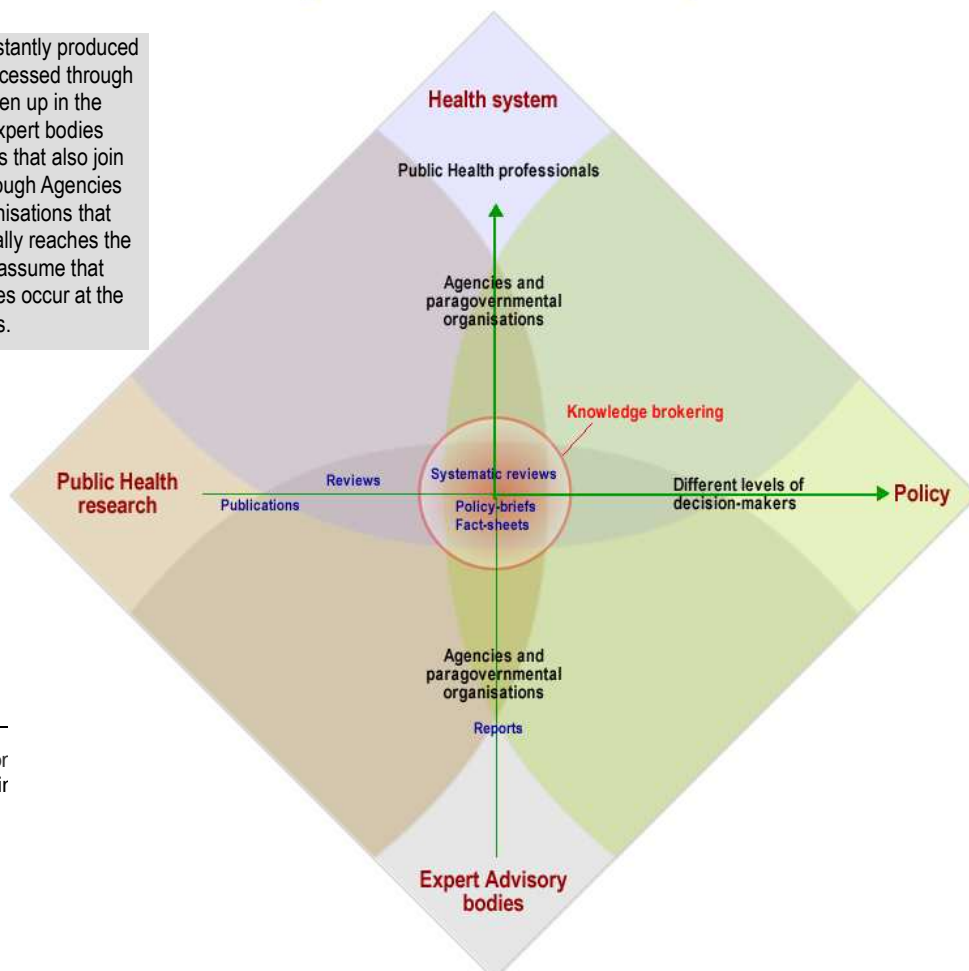
Our purpose is not to bring a solution to the disagreements but rather to highlight them, organise the information and knowledge that are needed, obtain the individual judgements, within a framework that has been agreed on. The improvement of the understanding of the problem and the various solutions can be depicted as a “transformative” learning which can be visualised through the output of the different activities that are part of the knowledge-transfer process.

An attempt to provide a comprehensive description of the science/decision interface

We come now to more formal considerations about the interface between knowledge (science) and practice. The latter can be both at a regulatory level (evidence-based decision) and in relevant professional activity (using research results in practice: i.e. public health professionals, practitioners and patients, local authorities...). Figure 3 represents the flow of information (research results) to different users, restricted to the field of Health. It is a simplified version based on a categorisation of producers and users of knowledge of public health research, health impacts of air quality being an example. It identifies a central area where knowledge brokering activities can take place, but does not provide any clues as to the type of activities, their relative power or participation requirements (for instance involvement of civil society representatives).

Knowledge transfer from research into practice

Figure 3. Knowledge is constantly produced by research efforts, then processed through intermediates before it is taken up in the Health system. In parallel, expert bodies produce reports and opinions that also join the circuit. It is generally through Agencies and paragonovernmental organisations that some form of knowledge finally reaches the decision-making levels. We assume that knowledge brokering activities occur at the intersection of these currents.



⁹ Fairness And Cor Thomas Weblar (eds), Sprir

As a general rule we must assume that knowledge transfer may occur to some extent provided that the scientific data:

- Is understandable and convincing
- Covers the needs of the different stakeholder categories
- Corresponds to legitimate, credible and relevant scientific results.

These general considerations all fit with a conception of a decision which is based on some kind of “optimal” choice, that can be represented by a value along a single axis (cost-benefit analysis for instance). In this perspective, we need to consider whether the discussion on what are adequate health-protective air quality standards fits in that representation, i.e. the “optimal choice” is mainly based on health-related objectives..

Indeed, complex environmental problems, such as improving air quality, involve dealing simultaneously with several issues, protecting human health being only one of them (vide infra). In these cases, we should consider the issues which are of greatest concern to the decision-maker, such as economic costs versus health protection, but also orientation of public investment for infrastructures or interference with other policies such as energy choices or GEG mitigation.

These imply searching for synergies or operating complex trade-offs that cannot be mapped on a single axis basis and that need to become explicit if we want to analyse the reasons behind preferences for a given policy option.

Box 2. Selected teachings from the USA process of establishing a PM standard

It is of course not the purpose here to produce yet another description of the revision of the PM NAAQS in 1994-1997 and its exemplary outcome. A brief description of the context, as well as a tentative interpretation are given below. We propose to use a small set of descriptors that can characterise the data available at any given moment in time and others that provide distinctive features of the decision-making process. We thus propose to use some criteria about the quantity and quality of data on health impacts, the adequacy of monitoring data and the knowledge about the toxicological basis of health impacts. For the process, two aspects seem to be critical: a) who initiates the process and drafts the preliminary documents and b) the extent of public interaction (participation).

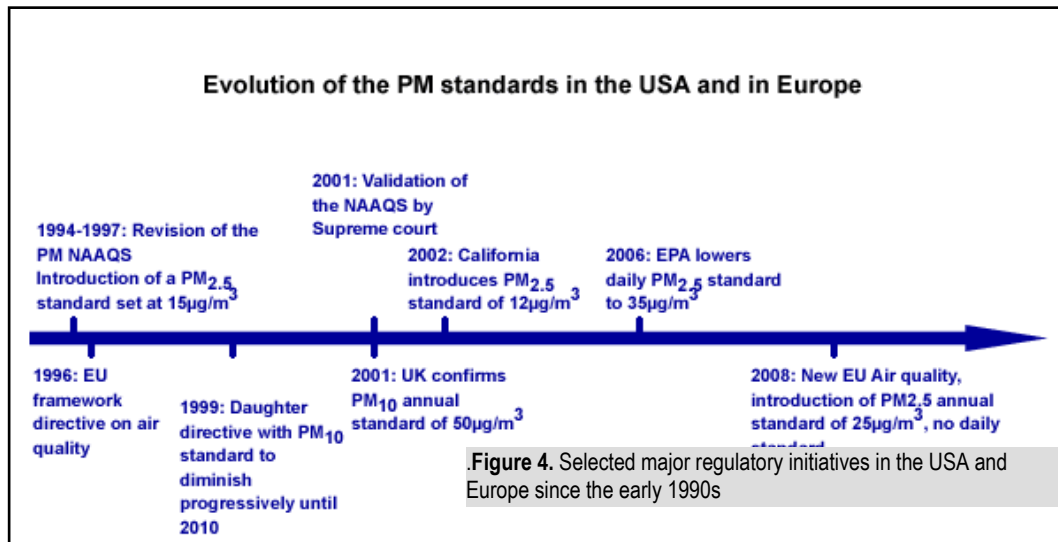
During the period from 1994 to 1997 (ending with the EPA proposed rule, see EPA 2006) and the various events of the subsequent years, including the cases brought to court ending with the final decision by the Supreme court in 2001, a number of documents allow to reconstitute the disputes within the scientific community as well as the arguments that were used in the judicial setting (Esworthy 2005). A detailed analysis will be given elsewhere (in preparation). Uncertainties about the scientific data are the basis of important disagreements on all three criteria proposed above. The evidence on chronic health impacts relied on just 2, albeit large cohorts (Dockery et al. 1993, Pope et al. 1995), monitoring data were poor (most data on PM_{2.5} were calculated as opposed to measured) and mechanistic data were considered insufficient (see for instance the panel report by S Vedal in 1997), although an excellent review published in 1997 suggest the opposite (McClellan 1997). The CASAC documents, available on the EPA site support similar disagreements among its members.

As for the process, the US setting is unique, since EPA (an independent federal agency with internal capacities and public health culture initiates the process, drafts the documents that are submitted to peer review by CASAC and public criticism end proposes the final ruling which has the value of law. This particular point was attacked in court by the American trucks association. The Supreme court confirmed that the CAA properly delegated legislative power to the EPA.

The state of the art and PM standards revision as a case study

The timeline in figure 4 shows a selection of decisions on PM standards, both in the US and in EU over a period of more than 15 years. There are striking differences both at a given point in time and when considering the evolution over time. It is perfectly unclear why almost

simultaneously California¹⁰ and the UK adopt quite different standards (in the UK the value of a PM_{2.5} metric was specifically refuted – EPAQS 2001), on the basis of what should normally be the same science. Similarly, the late adoption of a PM_{2.5} standard in the EU and the value chosen in 2008 cannot be explained only by knowledge gaps, compared to that introduced in the US 11 years earlier (see Box n°1 for a brief discussion), at a time when the scientific evidence on PM_{2.5} was much weaker.



As shown by the comparison of the UK and California decisions which were taken almost simultaneously, the same scientific data can lead to different decisions. In this respect it is interesting to try to provide some clues:

- 1) Did the US 1997 decision anticipate knowledge on health impacts?
- 2) Was the European Commission influenced by considerations other than health in its 2008 directive?

A number of observations need to be taken into account:

- 1) The state of the controversy in the US over the introduction of the PM_{2.5} standard in 1997 (Vedal 1997)
- 2) The fact that the EPA was severely criticised by the scientific community for not revising the PM_{2.5} NAAQS following the publication of the WHO 2006 guidelines (Rom and Samet 2007)
- 3) The relative discrepancy between the CAFE conclusions and the proposal for the new air quality directive elaborated by the Commission which led to vigorous protest by European public health specialists in 2006 (ISEE, ISEA and ERS scientists, 2006)
- 4) The context of 1997 might have been unique. The EPA made a very thorough review of the scientific evidence and also used risk assessment. It is tempting to attribute some influence of the CAA amendments of 1990 and more importantly the publication of the NRC report on “Science and judgement in risk assessment” in 1994 (NRC 2004).

¹⁰

Ambient air quality standards in California: <http://www.arb.ca.gov/research/aaqs/pm/pm.htm>

Nonetheless, the observations on controversies arising at each revision process cluster around similar knowledge gaps or different interpretations that go beyond mere technical points such as taking or not into account natural sources of PM (see for instance the discussion in Esworthy and McCarthy 2006).

Box 3. The CAFE program and the latest EU directive on air quality

The CAFE program was initiated in 2001 by the European Commission as “A Thematic Strategy for Air Quality” (EU CAFE 2001) with the aim of developing a long-term, strategic and integrated policy to protect against the effects of air pollution on human health and the environment. The program was designed as a process involving stakeholders in the different working groups, the representatives of the Commission (DG Environment) assisting the sessions and housing the permanent secretariat.

The program provided the expert phase in the process of the revision of legislative policy on air quality. All groups working within CAFE had no formal decision-making power. They were meant to assist the Commission on strategic orientations. In the CAFE work plan it is clearly indicated that the guidance that would emerge from CAFE “needs to be based on an integrated assessment of a wide range of policy alternatives, taking into account all relevant scientific, technical and political information”.

The program produced several documents, including integrated assessment with the RAINS model, scenario analysis and cost-benefit analysis (Ammann et al. 2005). An extensive comparison with the USA experience was produced as well as detailed assessments of effectiveness of policies and measures.

Despite the important efforts, discussions seem to have remained technical and focused on compliance to existing standards, i.e. those of the first daughter directive of 1999. Recommendations on PM standards were provided in the second position paper on PM, produced in 2004. This paper draw on the WHO guidelines of 2000 and the abundant literature on health impacts of PM. Although the recommendations were rather prudent, the introduction of PM_{2.5} standards to be achieved by 2010 was strongly recommended. A range of values 12-20 µg/m³ for the annual average and 35 µg/m³ for the daily average were proposed.

The CAFE documents insist in detail on feasibility, attainability and considerations such as economic costs. The issue of long range and natural sources is also prominent in the PM overview. Finally, in the 2008 air quality directive, the PM_{2.5} annual standard was set at 25µg/m³ and there was no daily standard, leading to a less stringent regulation compared to the US (Brunekreef & Maynard 2008).

Where should we look for uncertainties?

There are several areas where uncertainties may occur. We focus on just three of them that have generated discussion and may continue to do so:

- 1) The list of possible health impacts from air pollution is getting longer as new endpoints are being investigated and studies become more precise. There are several recent reviews for all causes mortality (Pope and Dockery 2006) or focused on cardiorespiratory impacts (Simkhovich et al. 2008). But there are also emerging ones such as reproductive endpoints and impacts on cognitive functions.
- 2) The characterisation of complex pollutants, particulate matter (PM) being the one that has concentrated much attention. The discussion on the right metric has been going on for a number of years. There is currently a consensus about the importance of the PM_{2.5} fraction, with guidelines on standards proposed by the WHO. It is interesting to note that the coarse fraction (the one between 10 and 2.5 µm in aerodynamic diameter) still retains some interest due to specific impacts (EPA 2006). On the other hand the composition of PM and the identification of the fraction responsible for health effects have fuelled a lot of debate in the last years.
- 3) Assessing the exposure of populations is also in the object of discussion and a lot of scientific effort is devoted to improved measures of exposure (McKone et al. 2009).

All the sources of uncertainties listed above can tip the balance from “wait and see” to immediate action. Also, as new impacts are added in, the economic valuation basis changes, thus modifying the results of the cost-benefit analysis. Finally, as science progresses, new questions prop up. For instance, there is increasing evidence for impacts of the ultrafine fraction of PM (Delphino et al. 2005, Pope and Dockery 2006), which requires important investments in monitoring. Furthermore, this particulate fraction has been shown to penetrate through alternative routes, via the olfactory nerves, possibly generating unforeseen health effects (Calderon-Garciduenas et al. 2007).

Now regarding HIAs, as stated in the Gothenburg consensus paper, “*Health impact assessment (HIA) is a range of tools and procedures used to assess the impact of a proposed policy, plan or programme on the health of a population, including how those effects are distributed across the population*”. These tools have been developed to facilitate health-based policy making. And although HIAs provide simple and convenient quantitative information on health effects per unit exposure¹¹, there are different sources of uncertainty that may compromise its validity. And these uncertainties need to be assessed quantitatively and qualitatively.

In brief

While controversy within the scientific community over complex issues such as health effects of poor air quality is usual, it may interfere with decision-making. For instance, the discussion around the composition of particles and the identification of components that might be specifically related to health effects is a long standing debate (Vedal 1997, Kuhlbusch & Cassee 2006, Russel & Brunekreef 2009). Also, as shown in expert elicitation panels, even for subjects of relative consensus, there is a wide range of opinions among scientists (Cal EPA 2008).

At any moment, knowledge gaps are inevitable but decisions have to be taken, to protect human health. Filling the knowledge gaps can be compared to the barrel of the Danaids, meaning that as some gaps are filled, new ones perpetually appear. For instance, although the impact of mobile sources (traffic-related) pollution has been acknowledged for some time, proximity to traffic as a risk factor is a more recent concern (HEI 2009). Similarly, the focus on vulnerable or susceptible subpopulations has been clearly growing (Johnson & Graham 2005), potentially creating new obligations for air quality regulation.

Knowledge gaps should drive the research policy (NRC 2004), by determining priorities in a given field, but care should be taken not to delay the necessary decisions about standards requisite to protect public health¹².

¹¹ For instance a gain in life expectancy for a given reduction in the target pollutant

¹² A citation of the USA Clean Air Act

II. Practical guidelines

The Aphekom deliberation-support process and online tool

Decision makers who draft policies on air pollution, environmental health and other related issues need to set priorities in often complex environments that involve competing political, economic, health, environmental and social considerations.

To help them find their way through this maze, Work Package 7 of the Aphekom project proposes using a deliberation-support process and online tool that help participants prioritize their individual needs in group discussions, and then reach the best common compromise as a group.

Using this process and tool simplifies and speeds decision making by clarifying individual opinions, focusing group discussions on critical points and finally bridging differences among stakeholders from varying backgrounds.

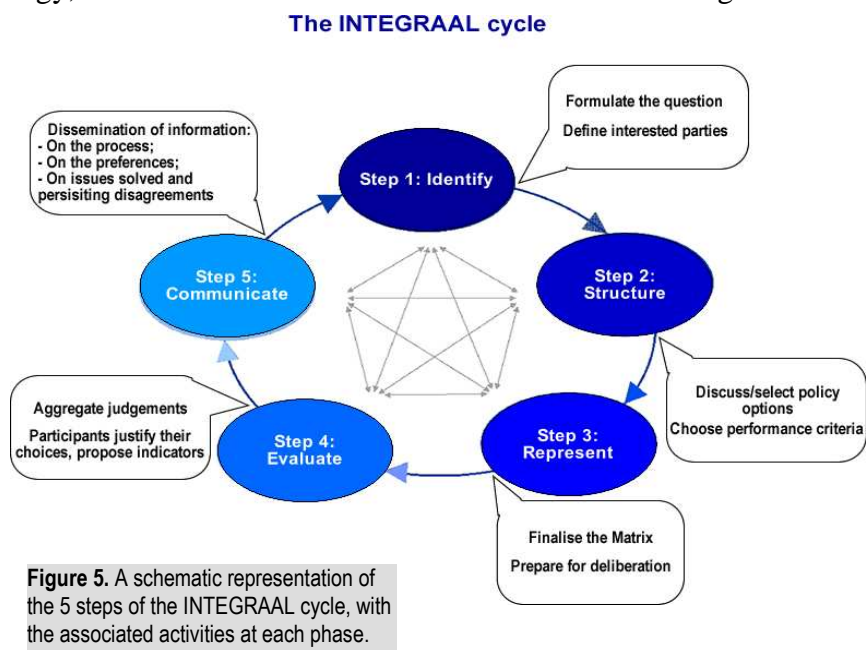
The Aphekom deliberation-support process and online tool builds on the INTEGRAAL method and the deliberation-support tools developed by the REEDS team at UVSQ. It is presented in more details in the section "Understanding Ker-DST".

On the <http://aphekom.kertechno.net/> site you can learn more about the process and tool and how to apply it to your specific needs. The French and Brussels case studies are also described online.

Hereafter we describe the background methods with a few examples.

The general method

The following sections provide guidelines on tools and methods of knowledge transfer and communication. The methodology, i.e. the INTEGRAAL method is summarised in figure 5. It can be depicted as a wide problem-solving cycle that has been previously applied to other complex environmental settings, such as biodiversity, coastal zone management or sustainable agriculture. It must be considered as an iterative collaborative effort which allows at each step to go back and redefine or restructure or change the representation of the problem before returning to the subsequent steps.

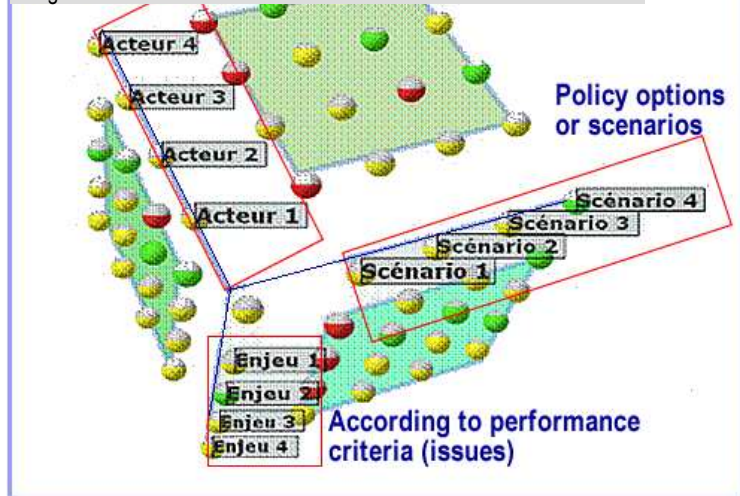


The Deliberation Matrix

In the face of complexity and requirements for collective action, a pragmatic evaluation approach would be to frame the “social choice” as a multi-stakeholder deliberation about the merits and demerits of policy alternatives. We have developed a three-dimensional framework, referred to as “The Deliberation Matrix”, the axes corresponding to:

- An adequate representation of the spectrum of interested parties (**actors**) involved in (or having an influence on) a policy elaboration process;
- A small number of **policy measures**, expressed also as scenarios or “possible futures”;
- A defined spectrum of **performance criteria** for the evaluation, that can be understood as governance issues in the deliberation process, covering all potential impacts (expected or undesirable) of the policy options.

Figure 6. The 3 axes of the deliberation matrix which have to be constructed for the assessment/deliberation. Actors refer to stakeholder categories.



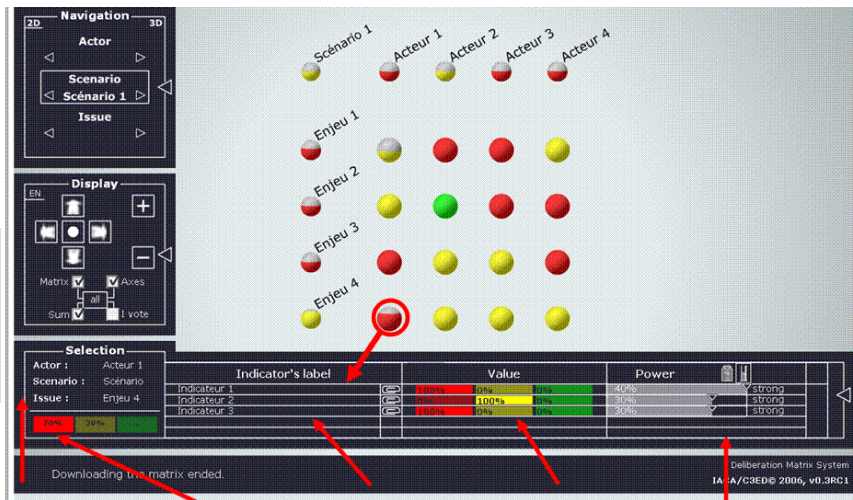
The purpose of the Matrix is to reveal different opinions of participants, at some stage of a decision-making process, in an easy to visualise way. It provides the framework for organising accessible data, information needs and judgements at several levels. For a policy problem at a relevant scale, it is proposed that each participant should offer a judgement (satisfactory, poor, intolerable...) of each option in relation to each performance (or governance) issue. The “participatory” process proceeds through the step-by-step cycle (see Figure 5), including the co-construction of the Matrix itself. The hypothesis behind our framework is that, as the multiple perspectives are brought to bear on a common ground, then the various tensions, uncertainty and dissent (amongst scientists, policy-makers or civil society representatives) can be articulated and explored in a structured way.

Three levels of precision are offered to participants:

- 1) Colour the cell,
- 2) Add a comment to support the colour choice,
- 3) Justify the choice through the use of indicators (their choice is dealt with in a later section).

Once completed, the Matrix can provide the background for further discussion or can serve to relay messages (on consensual or controversial aspects).

Figure 7. The matrix computer interface, showing 4 different actors' choices for a given scenario, according to 4 performance issues. As can be seen, votes differ from one position to another and from actor to actor.



This cell presents the judgement of actor 1 on performance issue 4 for scenario 1 (circled in red)

The majority of actors expressed negative judgements for this cell

Stakeholders have chosen 3 indicators

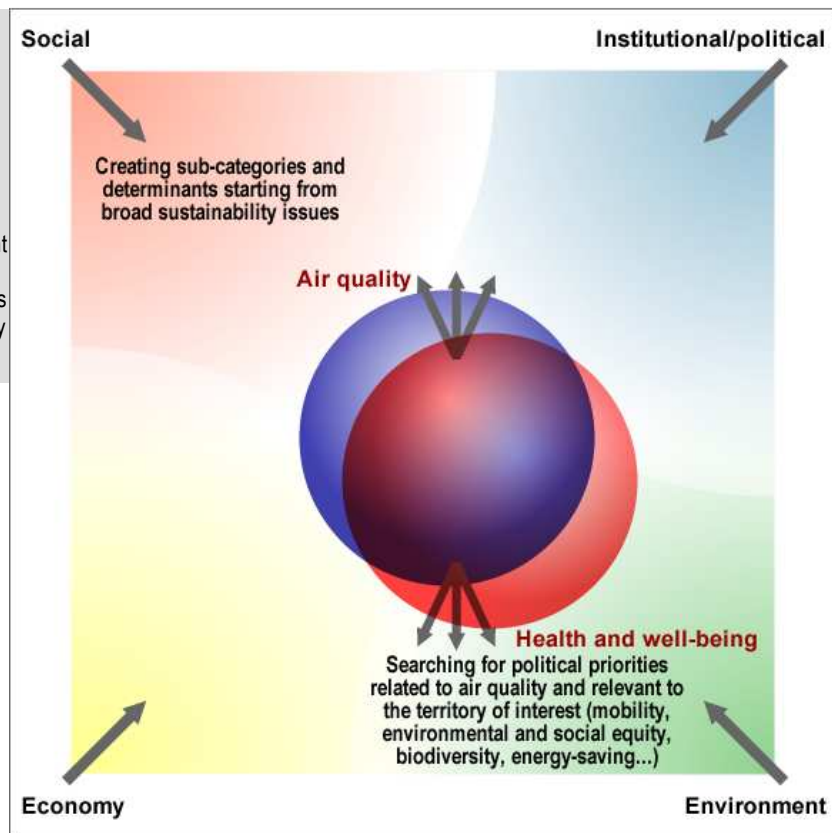
Mixed judgements are provided for the 3 indicators

For actor 1, indicator 1 is the most powerful

Defining the performance issues related to air quality

Defining performance criteria for the assessment

Figure 8. Tentative representation of the space where performance criteria for air quality management options requisite to protect health and well-being can be selected. Different strategies can be followed for defining performance criteria.
1) The efforts can proceed outwards, searching for legal and moral principles that are somehow linked to air quality management (economic development, energy saving, equity...). 2) It is also possible to construct lists of potential subdivisions of broad sustainability issues (social, economy, environment...).











Air quality management may impact different sectors, with contradictory effects. The participants may privilege one or the other, but these areas of dispute often remain implicit (vide infra). It is thus extremely important to list all the relevant issues before hand (as part of step n°2 = structure of the problem).

Health impacts are central, but quality of life may encompass other nuisances such as noise and aspects related to the urban structure. Economic impacts, which can be negative: i.e. cost of measures, or positive: i.e. attractiveness of a clean city, form another dimension. Additional aspects can include environmental (non human) impacts, such as those on ecosystems, energy-related issues or sustainable mobility. Social issues can also be of great concern, especially when principles like equity are put forward in the Plans. This has to do with the unequal distribution of poor air quality and our ability to respect clean air standards everywhere, including socio-economically disadvantaged neighbourhoods. An obvious problem arises in situations of proximity to traffic, for which solutions are most difficult.

The complete list of issues initially proposed in the French case study, as well as the final set that was used in the subsequent step are shown in Table 1. Performance issues are context sensitive. Stakeholders can also contribute with relevant input or propose their reformulation.

Table 1. List of issues discussed with stakeholders and included in the two versions of the assessment interviews

<p>Health impacts</p> 	<p>They are the main focus of the Action Plans and comprise all known pathologies associated with poor air quality, both acute and chronic.</p>	<p>Kept as such in the final assessment form.</p>
<p>Well-being</p> 	<p>Logical consequence of the perception of air quality and how it affects aspects of everyday life. They mainly include esthetic considerations (landscape) or access to services, etc. Noise exposure tends to be expressed through this category.</p>	<p>Although it was proposed to fuse with health impacts, the distinction was maintained in the final version because of the probable different perception.</p>
<p>Social issues</p> 	<p>These issues were introduced in terms of environmental equity. The preamble of the Action Plan itself highlights this principle as one of its pillars. This was clearly a point of controversy and provoked animated debate during the interviews or the focus groups.</p>	<p>In the final version of the assessment table it was renamed to social equity, with a more restricted definition.</p>
<p>Housing</p> 	<p>In the Ile-de-France region there is an important deficit in housing which is considered to affect all aspects of development or welfare and pulling the prices upwards. Thus, regional planifications, especially on urban planning and land use have to take this problem into account.</p>	<p>This was considered as too far from air quality preoccupations and was excluded from the final version.</p>
<p>Economic issues</p> 	<p>Creation of economic activity, business location, type of activity, all influence pressures on infrastructures and urban development and thus, have important consequences on pollutant emissions.</p>	<p>Although some discussions occurred on the distinction between economic activity, potentially negatively influenced by strict emission control and the economic attractiveness of a cleaner air city, this was kept in its simple synthetic definition.</p>
<p>Mobility</p> 	<p>This is a central issue in the French Air Quality legislation and is the object of a specific planification that has to be compatible with the objectives of the Air Quality Action Plan. It targets the length, the duration and the number of movements (in particular for commuters) throughout the area of interest.</p>	<p>Despite its importance, all aspects of mobility can be expressed through well-being, economic and energy issues. Thus it was considered redundant and excluded from the final version.</p>
<p>Environmental impacts</p> 	<p>Beside the health impacts, air pollution has other detrimental environmental effects, especially on ecosystems (water and soil) and agricultural productivity (i.e. through the ozone concentrations). The Action Plans have a specific chapter on these issues.</p>	<p>These rather consensual questions were considered as non essential for the simplified version.</p>
<p>Energy consumption</p> 	<p>Reducing energy consumption is a central target for all policies, with an obvious relation to reduction of greenhouse-effect gases (GEG). Pollutant and GEG reductions generally go in parallel, but there are some fields of contradiction (agricultural fuels and energy production from wood for instance).</p>	<p>The fact that climate change mitigation and air quality management operate at different scales (the latter can have very localised consequences), was the reason for keeping it in the final version.</p>

Box 4 Lessons from the French local case study

The case study was conducted within the process of the revision of the Ile-de-France Regional Air Quality Plan which was initiated by the Regional Council in 2006. It was carried out as a large participatory process including more than 150 people participating in 6 working groups and a consultative committee. At the end of the first round, a provisional document was published on the Internet for public comments. Four thematic round tables were also organised.

In this case study, three of the five steps of the INTEGRAAL method were partially accomplished (steps 2 to 4), providing interesting insight in different stakeholders' perspectives. It must be stressed that the question here is not how to lower the standard values for key pollutants, but rather how to achieve compliance with existing ones, notwithstanding their lack of ambition in terms of health protection.

The generic methodology and its application to the case study are developed in Appendix A. The interviews of the participants in the decision-making process were conducted after the Action plan was elaborated.

During presentations, a criticism was expressed because the method for choosing the performance issues seemed difficult to generalise. Therefore, a different approach was adopted in the **Brussels case-study**. Performance categories, covering basic sustainability issues (economic, social, environmental, health and quality of life) were initially provided, with some examples of sub-categories. The construction of the table was achieved through discussion. Examples of finalised tables are shown below. Two other innovations were tested successfully. 1) Specific determinants were agreed on by the participants, in order to define more precisely the sub-categories; 2) each table heading was formulated as a question which renders the judgements more straightforward.

The tables can be easily transposed to many situations, such as urban planning and land-use. All formulations have to be carefully scrutinised to avoid equivocal situations. Using the determinants should normally lead to judgements that reflect true differences in opinion rather than misunderstanding. For Tables 3 and 4 we have highlighted the changes that were introduced by the focus group, before the assessment.

Table 2. Do the proposed policies favour economic development?

Sub-category	Specific determinants	check
Creation of wealth	Income/economic development	
	Distribution of wealth	
	Benefits to the local or regional communities	
	Technological development (household/family, commercial, industrial, agricultural, infrastructures and medical)	
	Accessibility to infrastructures, services and resources	
Employment opportunities	Creation (or destruction) of jobs	
	Jobs available to local population	
	Diversity of employment opportunities	
Economic attractivity	For the population that works or lives nearby	
	For tourism	
	For business	

Table 3. Do the proposed policies have impacts on equity and social aspects favouring health and quality of life?

Will there be impacts on equity and social aspects?

Sub-category	Specific determinants	Check
Vulnerable and socially unfavoured groups	Aged over 64	
	Children, pregnant women	
	People suffering from pre-existing pathologies (for instance respiratory problems)	
	Socially or economically unfavoured populations	
Equitable access to measures and services	Extra-cost of clean technology	
	Spatial distribution of impacts of the measures	
	Accompanying measures	
	Accessibility to knowledge	
Environmental justice	Proximity to traffic (quantification of the exposed population)	
	Persistence of "hot" spots (special focus on areas of over- or multiple exposures)	
	Equitable distribution of nuisances	
Distant consequences	Change of agricultural production modes	
	Impacts on land-use and price	

Table 4. Do the proposed policies influence favourably health and quality of life?

Do the measures favour Health and Quality of life?

Sub-category	Specific determinants	Check
Impacts on living environments (physical)	Concentrations of harmful pollutants	
	Noise level (co exposure)	
	Vegetal/mineral balance (heat risk)	
Attractivity of the living environments	Accessibility of open spaces in the vicinity	
	Public transport/mobility modes	
	Housing typology	
Individual aspects	Physical activity	
	Freedom to chose (for instance opening windows, mobility mode)	
	Stress, well-being (physical and mental)	

Filling the assessment table

The participatory processes, whether they are linked to the decision-making process, as is the case for the Ile-de-France Action Plan or remain purely advisory, are generally conducted so than they can produce consensus. Areas of controversy and dispute tend to remain implicit, with simple influences on the wording of the recommendations.

Ways have to be defined to allow all divergences to become explicit if we want to have a correct assessment of the proposed policy options. One way to reveal areas of disagreement is to assess the feasibility and efficacy of each option against the different issues that have to be listed and accepted by the participants beforehand. These two features (i.e. feasibility and efficacy) may be influenced by several conditions, including regulatory context, administrative culture or political priorities.

After consensus is reached on the headings (lines and columns) of the assessment table each participant has to provide his judgement for each cell (recommendation versus performance issue). A colour code has been agreed on previously:

Favourable	Marginal	Ambiguous	Negative	Do not know	Not concerned

Individual interviews can be conducted with participants who have given their consent. Explanations are provided in the beginning of the interview, then each person can fill the table and provide also comments relative to (or in support of) his judgements. In the French case study (a table of 6x7), interviews lasted more than 2 hours. A simplified 3-colour scale was used, ambiguous and negative being fused together.

The alternative method is using a focus group. This is more appropriate when the deliberation phase just follows the construction of the assessment table, as was the case in Brussels. A 5 hour meeting was planned with roughly 30 minutes for the introductory presentation, 3 hours to build the assessment table and approximately one and a half hours to fill the table. It must be stressed that the construction and representation phases are meant to be collective **reflexive** exercises. On the other hand, judgements are individual (although they can evolve in time) and are only discussed after handing in the fully completed table.

From Figure 9 it can be seen that there is considerable heterogeneity in the judgements of the different participants.

However, it is also apparent that different options obtain variable scores and that the equity issue concentrates a high proportion of negative judgements (see also the Box no 4 on messages from the French case study).

Box 5. Multi-criteria assessment of three measures included in the Integrated Air-Climate and Energy Plan of the Brussels region

- Agrofuels (measures n° 2 and 8 of the chapter on transport): support the improvement of the environmental performance of vehicles (pages 67-69/184) and manage the delivery of goods for the population of Brussels (pages 75-76/184)
- Types of vehicles (measures n° 2 and 8 of the chapter on transport): support the improvement of the environmental performance of vehicles (pages 67-69/184) and manage the delivery of goods for the population of Brussels (pages 75-76/184)
- Low emission zones (measure n° 4 of the chapter on transport): reexamine the road capacities in the light of environmental objectives, define low emission zones (pages 71/184)

The completed assessment table obtained in Brussels is shown below (Table 5). Note the additional performance category on institutional aspects (vide infra). The measure on agrofuels rated poorly (dominant red and orange judgements) compared to low emission zones (green and yellow are dominant). For some sub-categories, judgements are rather uniform (values differing by 1, i.e. -1 and 0 or 0 and 1), whereas for others all four types of judgement appear on the same line (for instance low emission zones and vulnerable or deprived sub groups), suggesting possible misunderstandings. This can be provided for in subsequent steps.

Table 5. Brussels case study completed assessment sheet

Performance issue	sub-categories	Options																				
		Agrofuels					Types of vehicles					Low emission zones										
Equity and social aspects	Vulnerable or deprived sub groups	0	0	0	-1	0	0	0	0	1	0	1	-1	0	2	0	2	2	-1	-1	-1	1
	Equitable access to measures and services	0	0	-1	1	0	1	0	-1	1	2	1	-1	0	1	-1	-1	1	0	0	1	1
	Environmental justice	0	0	0	1	0	1	0	0	1	1	0	0	0	2	0	-1	2	NR	-1	1	1
	Distant consequences	-1	-1	-1	-1	-1	-1	-1	1	1	0	1	0	0	1	2	1	0	NR	0	0	0
Economic development	Creation of wealth	1	0	1	1	1	2	1	1	2	0	1	2	0	2	1	2	0	1	0	1	1
	Job opportunities	1	1	1	1	1	2	1	1	2	0	1	2	1	2	1	2	0	0	0	1	1
	Economic attractiveness	0	0	0	0	1	0	0	1	1	1	0	0	2	2	2	2	1	2	1	1	1
Health and quality of life	Impacts on living environments	0	0	-1	-1	-1	0	0	1	1	0	1	1	2	-2	2	2	1	1	2	-2	1
	Attractivity of the living environment	0	0	0	-1	0	0	0	1	2	2	0	1	1	-2	2	2	-2	1	2	-2	1
	Individual aspects	0	-1	0	0	0	0	1	1	0	0	1	0	1	1	2	2	-2	-1	2	-2	2
Equilibrium of the environment	Direct impacts	0	-1	-1	0	0	1	0	1	0	2	1	0	1	-2	2	1	1	1	2	-2	2
	Indirect impacts	-1	-1	0	-1	-1	0	1	1	1	2	0	1	1	-2	1	1	1	0	0	1	1
Institutional aspects	Incomplete responsibility	1	-1	1	1	-1	-1	1	1	0	-1	0	1	-1	1	2	2	2	0	0	-2	1
	Current strategies and political priorities	2	-1	1	-1	-1	1	1	2	0	0	0	0	1	1	2	1	1	0	-1	1	1
	Implementation success	2	NR	2	0	-1	1	1	2	0	NR	0	-1	1	1	2	2	2	NR	0	-2	1

Refinements can emerge during the activities, such as the improvements in selecting performance issues.

In the French case study we collected more than 100 comments. After an analysis of their content, almost 90% of them belonged to two categories: skills/training/information and institutional/political issues (regulatory context, responsibilities distributed over different administrations or authorities, but also political priorities). Following this finding, institutional issues were discussed and finally integrated in the assessment table during the Brussels meeting.

Building a second matrix based on the conclusions of the first deliberation can be useful. Results can also be restituted in a follow-up meeting. A third solution can be envisaged, such as putting the results on the Internet and have participants comment in a forum (see our online version of the tool <http://aphekom.kertechno.net/>).

Justifying the judgement with indicators

The deliberation framework highlights information requirements for, on one hand representing the situation and its possible evolution (via for instance a set of scenarios) and, on the other hand, making judgements about the present and eventually future situations (via for instance a set of indicators). The judgements expressed through the deliberation matrix can be supported through the use of indicators, selected from a predetermined list or proposed by each participant. To our knowledge there is no indicator list specifically addressing air quality. A list was compiled following a review of the literature on environmental health or quality of life indicators (R. Lawrence, WHO).

The steps of indicator selection are shown in table 6, which should be read in the following way:

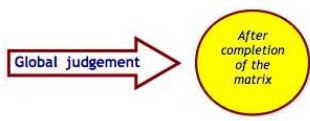
- 1) Identification of the cell (performance issue=equity, policy option=develop Public transport) and the actor's judgement (here “limited”=yellow);
- 2) List the most relevant indicators (i.e. those on which are based current and future states of the air quality and that should provide a justification of the judgement) and provide the estimated tendency;

3) Qualify the tendency in agreement with the synthetic judgement and give a relative weight to each indicator. Comments can also be provided at each step.

The example seems perfectly coherent, the proposed action is not believed to improve sufficiently the accessibility of public transport (distance from home to stop/station), diminish the time to work or reduce significantly the population living close to traffic. The estimated changes appear in step 2, together with corresponding comments. Step 3 includes the colour ratings and relative weights for 3 of the 4 indicators proposed to justify the judgement on how this policy option performs against equity issues.

Table 6. Indicators in support of the judgements in the Deliberation Matrix

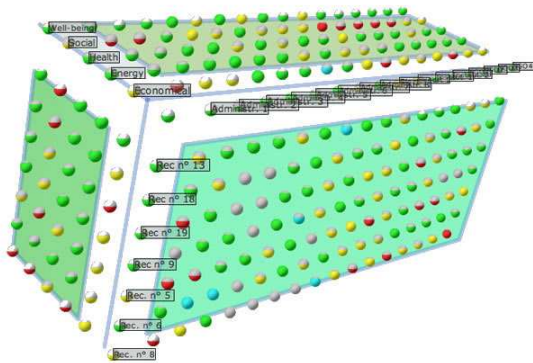
STEP 1 :		STEP 2 :		STEP 3 :					
List the indicators that you feel are appropriate for the selected issue.		Estimate its expected tendency according to the scenario to be assessed.		Qualify the tendency in agreement with your judgement. You can provide a relative weight for each indicator for the given scenario/issue couple.					
Indicators (maximum 5 par cellule)	Tendency ↗ ↘ →	Comments (optional)	Judgement (tick a box)					Weight (%)	Comments (optional)
			Fair	Limited	Poor	Not applicable	No answer		
1 Distance to stop/station	No change							30%	It will improve for some
2 Population in proximity to traffic	No change	At least for hot spots						50%	Action insufficient to reduce exposure in the worst situations
3 Time to work	Decrease	Probably not enough						20%	The less privileged have little choice
4 Price of property (or rent)	?	Some indication of social situation							
5									



For practical information on the deliberation-support process and tool and how it works; to learn more about the French and Brussels case studies; and to create your own deliberative forum, please visit our Web site: <http://aphekom.kertechno.net/>.

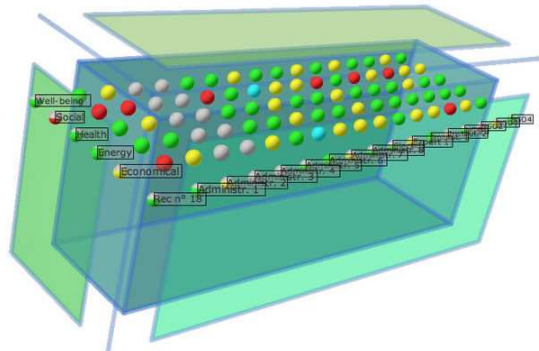
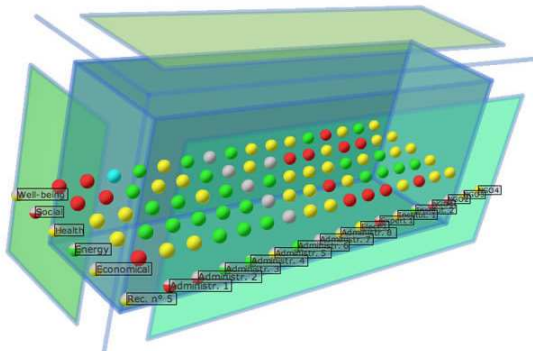
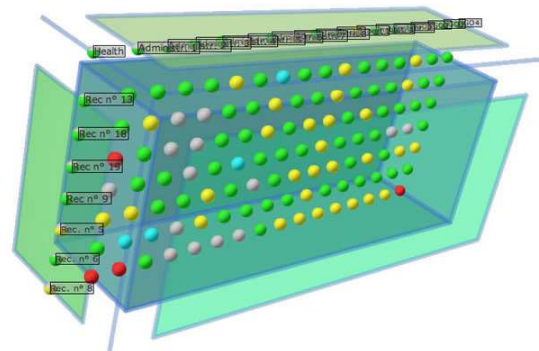
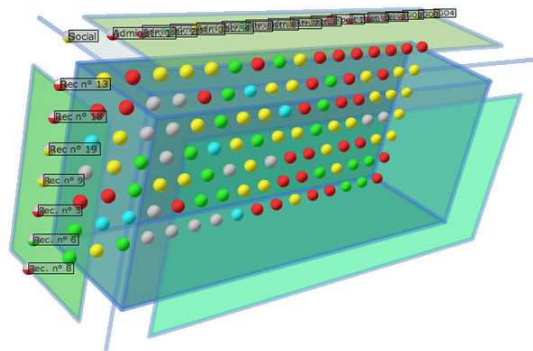
Selected views of the Deliberation Matrix

Figure 9. Different views of the Deliberation Matrix obtained through interviews of participants to the French case-study



The different panels represent : the aggregation of all judgements (top), a focus on health (middle right) or social issues (middle left) and the recommendations on land use (lower left) or public transportation (lower right).

Only the aggregate results are shown for the global matrix, for purpose of clarity. Although the global judgement can be estimated by the number of green or red cases, we have established a colour scale that takes into account all the proportions, providing a dominant colour and a partial filling of the circles, corresponding to the strength of the judgement. A similar code is applied to the aggregate results on the edges of the matrix, which provide a global appreciation of each recommendation (z-axis), actor (x-axis) or issue (y-axis). Thus, social issues get a partial red rating (poor), recommendation n° 5 (urban planning) gets a medium rating (partial yellow), while most actors provide a globally favourable opinion of the Action Plan (partial green).



III. Qualitative assessment of uncertainties in the health impact assessment process in Aphekom

The objective of the Aphekom project is to improve knowledge and communication of the relationship between urban air pollution and health for decision making in Europe. Besides epidemiological and economic tools, the project uses the health impact assessment (HIA) method, a multi-step process that “combines data on population exposure with information on concentration-response functions derived from epidemiological studies to estimate the extent of health effects expected to result from the exposure to the hazardous pollutants in the population” (*Health impact Assessment of Air pollution in the WHO European Region, WHO/ECEH Technical Report, 2001.*

HIA consists mainly of five main steps:

- specify the concentration-response functions (derived from epidemiological studies)
- specify exposure (which pollutants to be studied)
- define the appropriate health endpoints (for example, number of deaths or hospital admissions for respiratory diseases)
- derive population baseline frequency measures for health outcomes in the target population
- calculate the number of attributable cases, the years of life lost or the gain in life expectancy in the target population for pre-defined scenarios of reduction in the pollutant levels.

To ensure transferability of the chosen CRF to the target population, the health data and exposure metric has to be as close as possible to those used in the reference epidemiological study (see Aphekom WP5 Deliverable D5 in www.aphekom.org).

The following figure illustrates the HIA process:

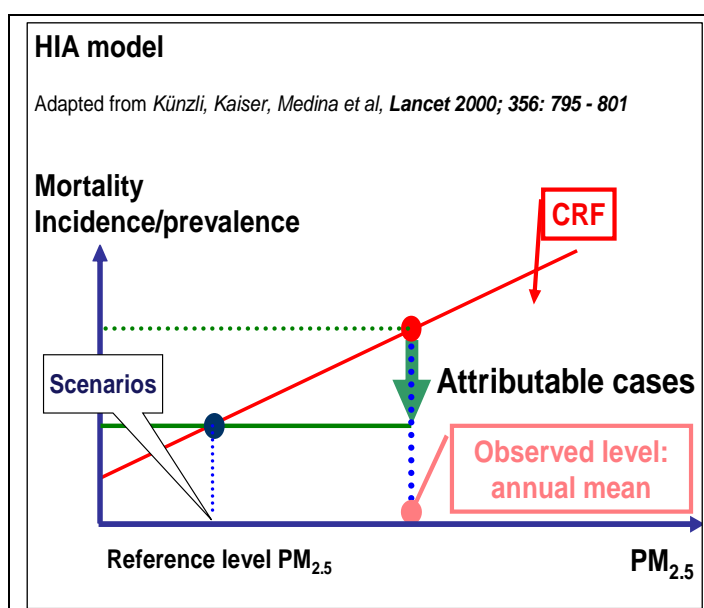


Figure 10. Simple graphical representation of the HIA calculation, using pollutant observed annual mean and a CRF derived from the literature

Guidelines for a qualitative assessment of uncertainties in the HIA process

HIA tools have been developed to facilitate health-based policy making. And although HIAs provide simple and convenient quantitative information on health effects per unit exposure¹³, each step of the HIA process has inherent uncertainties. For instance, uncertainties in:

- the choice of the CRFs based on a range of existing epidemiological studies,
- the sources for health endpoints (death certificates, hospital admissions, ad hoc surveys, etc.)
- the metrics of exposure (particulate matter smaller than 10 or 2.5 micrograms per cubic meter (PM₁₀, PM_{2.5}), proximity to traffic, etc.)

Expert elicitation has been used by scientists to assess uncertainties in the CRFs and to inform HIAs (Kinney et al 2010, COMEAP 2009) but scientists who carry out HIAs have a perception of these uncertainties that may differ from that of other interested parties in NGOs or policy-making institutions, who don't carry out HIAs and who have less basic knowledge on them.

Scientists often use complex mathematical analyses on parameters expressed in numbers. They can apply variability, sensitivity or propagation of error models. However, underlying assumptions cannot be assessed in the same way and therefore shared with stakeholders, in a situation where even the meaning of the terms is not clear enough.

The differences in perception by different stakeholders are poorly researched and may provide interesting learnings which is why we explored a qualitative uncertainty assessment in our project.

Objective

The purpose of this exercise is to allow public health (PH) scientists (providers of knowledge) as well other stakeholders like yourself (users of knowledge) to provide synthetic qualitative judgments on uncertainties related to each component of the HIA process.

With these guidelines what we are aiming at is how to:

- First, provide a common picture representing the opinion of one group of stakeholders at a time (for instance NGOs) on HIA uncertainties, establish the degree of heterogeneity within the group and identify areas where understanding is insufficient,
- Then compare the opinions of different groups of stakeholders with those of the PH scientists, collected with similar tools,
- And to identify critical issues affecting the decision-making process, i.e. those uncertainties that are simultaneously considered high and being highly relevant in the decision-making process. This will help us improve knowledge and communication for specific aspects of the health impacts of air pollution.

Method

The qualitative assessment uses predefined categories inspired from the pedigree analysis which refers to the production of information and the sources of the uncertainties arising in the process.

¹³

For instance a gain in life expectancy for a given reduction in the target pollutant

This is part of the NUSAP method developed by Funtowicz and Ravetz (1990¹⁴). The proposed categories refer to measures (exposure and health data) or assumptions (methodological issues or theoretical understanding). To these we added policy implications (relevance for policy-making).

A standard set of definitions for these categories is provided in the box below.

Box 6. Pre-defined categories inspired from the theory of pedigree analysis (Funtowicz, S.O., Ravetz, J.R., 1990)

Measures:

Proxy: When it is difficult to obtain direct measurements the proxy element refers to how good or close a measure is to the actual measure about which information is sought.

Empirical basis: refers to the degree to which direct observation are used to estimate the variable – measures determined by indirect methods such as models or surveys will score lower than directly observed ones.

Assumptions:

Theoretical understanding: refers to the quality of the theories upon which the assessments are based. A well-established theory will score a higher level than a less established and validated one.

Methodological rigour: refers to the norms applied by peers in the different discipline to collect, check and revise the measures used for the assessments. When the methods used for measuring and processing measures are well established the score would be higher than when they are untested or unreliable.

Validation: degree to which measures are cross-checked against independent sources. Often independent data for the same variable over the same time period are not available and other sets must be used. The more indirect or incomplete the validation, the lower the score will be.

Policy implications:

Relevance for policy-makings: the element may be relevant in the decision making process or may not. The more it is considered to be relevant the higher the score will be. It is probable that the “do not know” or “not applicable” categories will be used for some of the variables.

We need to stress that the intention of the exercise is not to collect expert opinions, but synthetic judgements, according to each participant's understanding of the problem. In order to apply this method in other fields, some knowledge of the NUSAP method and the principles of the pedigree analysis are necessary. Theoretical considerations can be found in the original Ravets and Funtowicz or in Vand der Sluijs et al. publications.

Constructing the assessment table

The process of constructing the assessment table is analogous to the previous examples using the Deliberation Matrix. The options to be assessed, instead of scenarios or policies, are the key parameters of HIA.

In our example, these and the following steps were performed by exchanges among the Aphekom work package leaders, since two tables were elaborated for two different applications of HIA in WP4 and WP5. Two consensus tables were produced for scientists (see example of consensus table in Table 7), each column and line heading expressed as a question. Then, questions were formulated for each cell with the intent of clarity.

14 Funtowicz, S.O., Ravetz, J.R., 1990. Uncertainty and Quality in Science for Policy. Kluwer Academic Publishers, Dordrecht.

Table 7: Structure and contents of the first assessment table, as decided by WP5

Aphek centre: Please indicate your city and name	Aphek uncertainty analysis of the association between chronic exposure to PM2.5 and mortality (WP5)					
Uncertainty assessment table						
HIA component assessed (What are we specifically assessing?)	MEASURES		ASSUMPTIONS		POLICY IMPLICATIONS	
	Proxy	Empirical basis	Theoretical understanding	Methodological rigor	Validation	Relevance for policy-making
	Is the component a direct (as opposed to a surrogate) measure of the value it should represent?	What is the strength of the empirical evidence?	How much consensus is there on the methodology to develop (or apply to HIA) the component?	Is the component a golden standard or are there alternative options?	Has the component been confirmed in local or regional conditions or is there inference from situations in different settings?	How does the uncertainty level of the component influence the decision on management of air quality?
CRF coefficient (PM2.5 and all-cause mortality, ACS study Pope et al, 2002)	Transferability? Surrogate of exposure?	Quality and completeness of the epidemiological study (data and methods)? Causality? Mechanistic plausibility?	How much consensus exists on the selected CRF?	If other CRFs suggested, why? Sensitivity of results to alternative CRFs?	Reproducibility of CRFs? Other concerns?	Confidence of policy-makers in the chosen CRFs?
Health Data (All-cause mortality)	Proximity with true value? Other concerns?	Quality of the health data?	How much consensus on the health indicator?	Sensitivity of results to alternative health indicators?	Reproducibility of health data? Other concerns?	Confidence of policy-makers in the chosen health indicator?
Exposure metric (PM2.5)	Proximity with true value? Other concerns?	Quality and representativeness of estimations?	How much consensus on the method for estimation of exposure? How specific are the effects attributed to the pollutant (for instance role of size, composition) and what impact could that have on HIA?	Sensitivity of results to alternative exposure metrics? Variability of RRs when more precise metrics are used?	Reproducibility of exposure metrics? Other concerns?	Confidence of policy-makers in the chosen exposure metrics? PM2.5 source-related uncertainties (for instance which composition?) and their impact on options for regulation?
Expression of HIA findings (in terms of reduction of the number of deaths for a certain decrease in PM2.5 levels)	not applicable	not applicable	How much consensus on the chosen metric?	Alternative metrics? Why?	Reproductibility at the local and regional levels? Other concerns?	Understanding and interest of the metric for communication with policy makers

Converting the table into a questionnaire

Filling directly the table proved to be a difficult exercise for non-scientists. Thus, it may be useful to convert it into a more classical questionnaire form, leaving plenty of space for comments, suggestions or questions. In our example all the questions from the column and line headings, as well as those in the cells were reproduced on the sheets, as shown in Figure 11.

Header of the questionnaire

Questionnaire WP5
Uncertainty assessment of HIA components in the association between chronic exposure to PM2.5 and all cause mortality

1. Choosing the concentration-response function (CRF) expressed as a relative risk (RR) to quantify the health impact (all cause mortality) due to chronic exposure to PM2.5.

The chosen CRF comes from the ACS study "Lung Cancer, Cardiopulmonary Mortality, and Long-term Exposure to Fine Particulate Air Pollution" C. Arden Pope III, PhD; Richard T. Burnett, PhD; Michael J. Thun, MD; Eugenia E. Calle, PhD; Daniel Krewski, PhD; Kazuhiko Ito, PhD; George D. Thurston, ScD In The Journal of the American Medical Association. Vol. 287 No.9, March 2002 pp. 1132-1141

Aphek centre: Please indicate your city and name	Aphek uncertainty analysis of the association between chronic exposure to PM2.5 and mortality (WP5)					
Uncertainty assessment table						
HIA component assessed (What are we specifically assessing?)	MEASURES		ASSUMPTIONS		POLICY IMPLICATIONS	
	Proxy	Empirical basis	Theoretical understanding	Methodological rigor	Validation	Relevance for policy-making
CRF coefficient (PM2.5 and all-cause mortality, ACS study Pope et al, 2002)	Transferability? Surrogate of exposure?	Quality and completeness of the epidemiological study (data and methods)? Causality? Mechanistic plausibility?	How much consensus exists on the selected CRF?	If other CRFs suggested, why? Sensitivity of results to alternative CRFs?	Reproducibility of CRFs? Other concerns?	Confidence of policy-makers in the chosen CRFs?
Health Data (All-cause mortality)	Proximity with true value? Other concerns?	Quality of the health data?	How much consensus on the health indicator?	Sensitivity of results to alternative health indicators?	Reproducibility of health data? Other concerns?	Confidence of policy-makers in the chosen health indicator?
Exposure metric (PM2.5)	Proximity with true value? Other concerns?	Quality and representativeness of estimations?	How much consensus on the method for estimation of exposure? How specific are the effects attributed to the pollutant (for instance role of size, composition) and what impact could that have on HIA?	Sensitivity of results to alternative exposure metrics? Variability of RRs when more precise metrics are used?	Reproducibility of exposure metrics? Other concerns?	Confidence of policy-makers in the chosen exposure metrics? PM2.5 source-related uncertainties (for instance which composition?) and their impact on options for regulation?
Expression of HIA findings (in terms of reduction of the number of deaths for a certain decrease in PM2.5 levels)	not applicable	not applicable	How much consensus on the chosen metric?	Alternative metrics? Why?	Reproductibility at the local and regional levels? Other concerns?	Understanding and interest of the metric for communication with policy makers

a. In your opinion is the RR from the ACS study transferable/representative³ to different situations?

Judgement (choose what fits best)	Commentary or justification of your choice
<input checked="" type="checkbox"/> High transferability	
<input type="checkbox"/> Average transferability	
<input type="checkbox"/> Low transferability	
<input type="checkbox"/> Lowest transferability/	
<input type="checkbox"/> Do not know	

b. Are the Pope et al. study findings reliable (in terms of quality and completeness of data, methods, causality, plausibility)?

Judgement (choose what fits best)	Commentary or justification of your choice
<input checked="" type="checkbox"/> High reliability of study findings	
<input type="checkbox"/> Average reliability of study findings	
<input type="checkbox"/> Low reliability of study findings	
<input type="checkbox"/> Lowest reliability of study findings	

3 This refers to the possibility to apply the RR to different areas or local settings

Body of the questionnaire

Figure 11. The questionnaire is constructed using all the data from the assessment table: the title of the table becomes the title of the questionnaire, the sections represent the heading of the lines and the cell contents become individual questions that have to be rated.

HIA is not in the field of expertise of all participants (especially stakeholders) and it is difficult to provide answers to some of the questions asked. But in our example the purpose of the survey was to identify information needs, therefore all comments on the inability to provide a judgement on uncertainty, such as the lack of appropriate information or any other reason, were assessed.

Instructions on how to fill the questionnaire



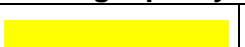


Completing the uncertainty questionnaire should be understood as a relatively intuitive exercise. The questionnaire contains each component of the HIA to be assessed, organized by section (one for each component) and including a series of six specific questions on uncertainties regarding measures, assumptions and policy implications.

The two step process to fill the questionnaire is as follows:

1. **1) One needs to tick the box** that represents the best choice for each question. The boxes correspond to the colour scale provided below. It is a four category scale and should reflect the judgement on the level of uncertainty for each component of the HIA process being assessed. The fifth corresponds to “Do not know”.
2. **Justifying the choice:** what is the critical element that is lacking in order to give an answer? This is important particularly if the “Do not know” option is chosen. Comments in the box are crucial for our analysis because they will allow to obtain information on the range of uncertainties that each participant faces, for each component of the HIA process

Examples of answers to the full questionnaire in WP5 in Appendix C, for WP 4 in Appendix D.

Colour code to apply to the knowledge quality/uncertainty assessment table

				
Lowest quality or Highest uncertainty	Low quality or High uncertainty	Average quality or Average uncertainty	High quality or Low uncertainty	Do not know

Preliminary learnings from our questionnaires

Providers of knowledge (experts in the field), have to reach some kind of agreement on the structure (that is the questions asked) and on the ratings. Our preliminary analysis showed some dispersion in the experts’ opinions that could stimulate discussion among them.

Questionnaires from stakeholders showed that the understanding of the HIA process needed improvement (more than 50% unanswered questions). The column that specifically addressed the impact on decision-making was intended to provide insight on the weight attributed to the HIA components. It did not meet with the expected outcome since many people chose the “do not know” option.

Thus, the method that we propose is but a step in a cyclic process, progressively bridging the gap between scientist and non-scientists.

Conclusions

Seeking synergies and alliances

In a context where there is wide recognition of the urgency to adopt climate change mitigation measures, we need to take advantage of the synergies with actions on both greenhouse-effect gas and pollutant emissions. Of course the scale of air quality management is more local compared to climate change, which has to be integrated in the discussion (again the proximity to traffic issue).

It seems clear that there is scope for an objective alliance with city authorities and urban planners in order to seek coherence in regulating emissions from mobile (i.e. traffic) and other sources (residential heating for instance). The EU-funded INTEGAIIR project produced a Guide for Cities that provides a number of interesting solutions which properly implemented will have beneficial effects on air quality. It seems particularly useful to seek collaboration and urge urban planners to introduce health improvement-related objectives in their own actions.

Citizens are also very receptive to environment-related health impacts. Poor air quality ranks very high in all surveys among public preoccupations. In a yet unpublished survey in France that focused on perception of the effects of proximity to traffic, people tended to complain more about the noise than the air pollution (L. Charles personal communication). This clearly confirms the interest of including aspects of quality of life as well as health.

Less synergistic, not to say antagonistic, aspects have also to be treated. In our literature review, as well as in discussions about other ongoing case studies, there is a diversity of approaches (van Breugel et al. 2005).

Aphekomp provides answers

- How many people in Aphekomp cities live next to traffic pollution / How does this vary across the different cities?
- How many chronic and associated acute diseases could be avoided among the Aphekomp city population if less people were exposed to traffic pollution?
- What would be the health benefits of reducing air pollution levels in the Aphekomp cities?
- What would be the associated health-related monetary benefits?
- Are there any initiatives which were taken in Aphekomp cities that improved air quality?
- What are the health impacts and related monetary value of an implemented policy in air pollution in Aphekomp cities?
- How to deal with uncertainties in the decision-making chain?
- By exploring connexions (air quality as a cross-cutting issue) in the process of the elaboration of Air Quality Action Plans can we:
 - Better integrate scientific input in the needs of interested parties
 - Highlight areas of dissent?
 - Improve the decision by deliberating on the feasibility and the efficacy of the proposed options?

Authorities that deal with traffic regulation tend to favour anti-congestion measures, that is improving traffic flow (bypasses, traffic management, speed limitations) as opposed to more structural (environmental) actions that are intended to reduce pollutant emissions (taxation or low emission zones). The same can occur with certain technical measures that may have marginal influence on air quality. Assessment of the introduction of more recent type of measures such as low emission zones are necessary. Projections of evolution of individual pollutant levels may also be useful.

Of course, if the arguments about efficient management have their

importance, we should not forget that the *in fine* objective is protecting human health. For this reason all data that demonstrate the health benefits of policies on air quality are critical.

Building connexions to bridge the gap

The science – policy interface has been under close scrutiny in a number of fields. The AirNet EU-funded project addressed specifically this aspect. A survey of stakeholder needs was conducted and general recommendations were produced (van Bree et al. 2007). However, the central question seems to have been what results public health scientists should produce and how should they present them to allow decision-makers to more efficiently protect human health from poor air quality. This is a perfectly legitimate question, which is also a primary objective of the Aphekom project. While authors such as Lavis (Lavis 2006) assume that aligning research more closely with user needs will lead to its successful transfer, others suggest that it is the inherent characteristics of the knowledge itself which lead to its successful transfer into practice (Kitson et al. 2008).

Another way of tackling the problem would be to ask why decision makers do not take what public health professionals consider the “right” decision, e.g. the one which will provide adequate protection of human health. Our analysis supports the notion that decision is determined by what is anticipated to be the conditions of feasibility. This is stated in some of the CAFE documents as one of the criteria for the decision. As is also the case for the data on health impacts, the feasibility dimension defines another area of uncertainties, differences in perspective or priorities for the decision makers. It needs to be explicitly taken into account in the process.

The methodology and tools described above do not provide a recipe for overcoming disagreements about the complex problem of improving air quality, nor do they offer a formula to define the “optimal” decision, essential in order to better protect human health. But:

- It permits the transparent organisation and mobilisation of a variety of categories of information and analysis (from diverse sources), with explicit reference to governance (performance) issues;
- It presents in a didactic way, the central challenge of an open political process, which is to negotiate some sort of “compromise” around divergent interests and with recognition of a plurality of legitimate principles for choice (health, quality of life, equity, climate change mitigation);
- It facilitates, through the mobilisation of stakeholders in different components of the deliberation process, the development of a dialogue capacity among knowledge producers (public health is but an aspect) associated with the management problem (e.g. improving air quality) and also between producers and the different classes of users of knowledge in the society;
- It provides a framework for a structured discussion and evaluation of the significance, for the policy or governance issues being addressed, of the different forms of uncertainty that may be associated with the various classes of empirical information, modelling and simulation results being introduced into the deliberation.

The discussion, involving stakeholders, should also go beyond the policy options corresponding to regulatory obligations for the different authorities. Influencing behaviours of all citizens can provide an important contribution in improving air quality, therefore different participatory actions, such as the Brussels citizens' panel, need to be encouraged.

Sharing and communicating uncertainties

Under the general term “uncertainties” different groups of people may include different entities. Even from the scientist point of view these entities encompass measurement or data imprecision (e.g. prevalence of the disease from a sample of the population as opposed to true incidence), poorly representative exposure estimates (e.g. results from only one fixed monitoring station) or even insufficient knowledge (e.g. importance of the composition of PM or the impact of the ultrafine size range). Moving on into the assumptions may add to the difficulties. Expert elicitation has been used by scientists to assess uncertainties in the CRFs and to inform HIAs (Kinney et al 2010, COMEAP 2009). Our work in WP7 provided a common structure as a basis for discussion on the uncertainties inherent to the HIA process between different groups. A similar analysis, applied to another decision-support tool, global burden of disease, has been published by Knoll et al. (2009).

An uncertainty assessment on which a consensus between different parties would be reached is indeed a powerful instrument for communication. Not only the strengths and weaknesses of the HIA can be displayed and explained (validity, transferability, etc.), but also, when the non-scientists express their needs, these can appear as points that have to be taken into account by scientists, increasing confidence in scientific results and social robustness.

In conclusion, this method has its value at the science/decision interface. And we will work to develop it to reduce the gap between providers and users of knowledge in the decision-making process.

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Appendixes

Appendix A: Check-list to be used before deploying deliberation tools

Question	Answer	Comments
Is the action being discussed part of a broader decision-making process?	<p style="text-align: center;">yes <input type="checkbox"/> no <input type="checkbox"/></p> <p><i>(national strategy, local action plans, other)</i></p>	Actions planned in connection with a decision-making process offer advantages: Experts and interested parties have already been identified; policy options have already been developed.
Have I identified all the interested parties?	<p style="text-align: center;">yes <input type="checkbox"/> no <input type="checkbox"/></p> <p>List¹⁵: <i>(administration, local authorities, NGOs, experts, other)</i></p>	All points of view have to be expressed.
How do I choose the policy options to be assessed?	<p><i>(ad hoc, expert opinion, working group, other)¹⁶</i></p>	
What process do I plan to use to define the performance criteria?	<p><i>(focus groups, workshops, other)¹⁷</i></p>	Constructing the assessment table, leading to the deliberative phase, is a sensitive phase. The performance criteria must be unequivocal and relevant for all participants; they should be measurable in some way (indicator selection is important).
Have I prepared the introductory and working documents?	<p><i>(Powerpoint presentations, tables, instructions, other)</i></p>	
What outputs are wanted?	<p><i>(finalised assessment table, tables filled with judgements and comments, reflexive discussion, other)</i></p>	Deliverables and next steps must be defined in advance.
What feedback do participants want?	<p><i>(response to comments, reports, other)</i></p>	Participants normally expect some kind of feedback on their work and want to know how they contributed to the project's results.
What follow-up activities do we want?	<p><i>(meetings, telephone conferences, online forums, other)</i></p>	There is no simple recipe for designing environmental learning processes. However, the general rule points to a stepwise process as depicted by the INTEGRAAL method.
Which evaluation methods should we use?	<p><i>(for the assessment table, the participatory process, the deliberation, other)</i></p>	All planned activities should be designed so that the attainment of primary objectives can be evaluated. Appropriate indicators have to be established before hand.
Has a dissemination strategy been decided?	<p><i>(to whom? what message(s)? in what form? for what expected result?)</i></p>	Depending on the planned target audiences (policy-makers, professional groups, research community, the general public...), formats can include reports, briefs, recommendations, news releases, conferences, seminars and other more interactive events.

¹⁵ The list should comprise the parties most likely to influence the decision and the implementation of policy measures.

¹⁶ Choices can be changed later, but clear rules should be used to choose the options.

¹⁷ The type and timing of their input should be made clear to the participants

Appendix C: Questionnaire WP5 Uncertainty assessment of HIA components in the association between chronic exposure to PM_{2.5} and all cause mortality

The two step process to fill the questionnaire is as follows:

1) **Tick the box** that represents, in your opinion, the best choice for each question. For your information the boxes correspond to the colour scale provided below. It is a four category scale and should reflect your judgement on the level of uncertainty for each component of the HIA process being assessed. The fifth corresponds to “Do not know”.

Colour code to apply to the knowledge quality/uncertainty assessment table

Lowest quality or Highest uncertainty	Low quality or High uncertainty	Average quality or Average uncertainty	High quality or Low uncertainty	Do not know

2) **Justify your choice:** what is the critical element that you are lacking to give an answer? This is important particularly if you chose the “Do not know” option. Your comments in the box are crucial for our analysis because they will allow us to obtain information on the range of uncertainties you are facing for each component of the HIA process.

Choosing the concentration-response function (CRF) expressed as a relative risk (RR) to quantify the health impact (all cause mortality) due to chronic exposure to PM_{2.5}.

In Aphekom, the chosen CRF comes from the ACS study “Lung Cancer, Cardiopulmonary Mortality, and Long-term Exposure to Fine Particulate Air Pollution” C. Arden Pope III, PhD; Richard T. Burnett, PhD; Michael J. Thun, MD; Eugenia E. Calle, PhD; Daniel Krewski, PhD; Kazuhiko Ito, PhD; George D. Thurston, ScD in The Journal of the American Medical Association. Vol. 287 No.9, March 2002 pp.1132-1141

Abstract

Context: Associations have been found between day-to-day particulate air pollution and increased risk of various adverse health outcomes, including cardiopulmonary mortality. However, studies of health effects of long-term particulate air pollution have been less conclusive.

Objective: To assess the relationship between long-term exposure to fine particulate air pollution and all-cause, lung cancer, and cardiopulmonary mortality.

Methods: Vital status and cause of death data were collected by the American Cancer Society as part of the Cancer Prevention II study, an ongoing prospective mortality study, which enrolled approximately 1.2 million adults in 1982. Participants completed a questionnaire detailing individual risk factor data (age, sex, race, weight, height, smoking history, education, marital status, diet, alcohol consumption, and occupational exposures). The risk factor data for approximately 500 000 adults were linked with air pollution data for metropolitan areas throughout the United States and combined with vital status and cause of death data through December 31, 1998.

Main outcome measure: All-cause, lung cancer, and cardiopulmonary mortality.

Results: Fine particulate and sulphur oxide-related pollution were associated with all-cause, lung cancer, and cardiopulmonary mortality. Each 10- $\mu\text{g}/\text{m}^3$ elevation in fine particulate air pollution was associated with approximately a 4%, 6%, and 8% increased risk of all-cause, cardiopulmonary, and lung cancer mortality, respectively. Measures of coarse particle fraction and total suspended particles were not consistently associated with mortality.

Conclusion: Long-term exposure to combustion-related fine particulate air pollution is an important environmental risk factor for cardiopulmonary and lung cancer mortality.

a. In your opinion is the RR from the ACS study a direct¹⁸ (as opposed to a surrogate) measure of the value it should represent?

	Judgement (choose what fits best)	Commentary or justification of your choice
<input checked="" type="checkbox"/>	Direct measure	The measure may act as a surrogate for some other pollutants
<input type="checkbox"/>	Rather direct measure	
<input type="checkbox"/>	Not so direct measure	
<input type="checkbox"/>	No direct measure	
<input type="checkbox"/>	Do not know	

b. Are the Pope et al. study findings reliable (in terms of quality and completeness of data, methods, causality, plausibility)?

	Judgement (choose what fits best)	Commentary or justification of your choice
<input checked="" type="checkbox"/>	High reliability of study findings	This is a well conducted study with large amounts of data
<input type="checkbox"/>	Average reliability of study findings	
<input type="checkbox"/>	Low reliability of study findings	
<input type="checkbox"/>	Lowest reliability of study findings	
<input type="checkbox"/>	Do not know	

c. How much consensus is there on the chosen CRF? Do you know others?

	Judgement (choose what fits best)	Commentary or justification of your choice
<input checked="" type="checkbox"/>	High consensus	This is the best currently available, but because it is US based it may not be directly transferrable to Europe
<input type="checkbox"/>	Average consensus	
<input type="checkbox"/>	Low consensus	
<input type="checkbox"/>	Lowest consensus	
<input type="checkbox"/>	Do not know	

d. If alternative CRFs exist is the one from the ACS study still a golden standard? Will the results be sensitive to alternative CRFs?

	Judgement (choose what fits best)	Commentary or justification of your choice
<input checked="" type="checkbox"/>	Golden standard	There are actually 2 questions here! Until we test and use other alternative CRFs we cannot be sure
<input type="checkbox"/>	Preferred CRF	
<input type="checkbox"/>	Equivalent alternatives	
<input type="checkbox"/>	Not a suitable CRF	
<input type="checkbox"/>	Do not know	

¹⁸ Direct should be understood as a value close to the real situation in the context it was produced

e. To your knowledge is the chosen CRF confirmed by local/regional studies. Is the CRF reproducible?

	Judgement (choose what fits best)	Commentary or justification of your choice
<input checked="" type="checkbox"/>	High reproducibility	Other CRFs are close to the ACS value
<input type="checkbox"/>	Average reproducibility	
<input type="checkbox"/>	Low reproducibility	
<input type="checkbox"/>	Lowest reproducibility	
<input type="checkbox"/>	Do not know	

f. To your knowledge, what is the confidence of the policy-makers in the chosen CRF? You should consider all the answers to sections a to e.

	Judgement (choose what fits best)	Commentary or justification of your choice
<input checked="" type="checkbox"/>	High level of confidence	The answer to this really depends on the individual policy makers and their level of knowledge in the subject area
<input type="checkbox"/>	Average level of confidence	
<input type="checkbox"/>	Low level of confidence	
<input type="checkbox"/>	Lowest level of confidence	
<input type="checkbox"/>	Do not know	

I. Health Data expressed as all-cause mortality

a. To your knowledge, is the mortality data collected through death certificates a good proxy of the true value¹⁹?

	Judgement (choose what fits best)	Commentary on your needs and/or justification of your choice
<input checked="" type="checkbox"/>	Direct measure/High quality	I would think it is the best that is available
<input type="checkbox"/>	Rather direct /Average quality	
<input type="checkbox"/>	Low quality	
<input type="checkbox"/>	Lowest quality	
<input type="checkbox"/>	Do not know	

b. From what you know, what is the quality and representativeness of the chosen health indicator (i.e. all-cause mortality) in Europe (do you know of any possible sources of error)?

	Judgement (choose what fits best)	Commentary on your needs and/or justification of your choice
<input checked="" type="checkbox"/>	High quality and representativeness/low uncertainty	Overall all cause mortality is a good indicator and is comparable from country to country, but in relation to air pollution, cause specific might be more relevant
<input type="checkbox"/>	Average quality and representativeness	

¹⁹ The true value should be understood as a value close to the reality

<input type="checkbox"/>	Low quality and representativeness	
<input type="checkbox"/>	Lowest quality and representativeness /highest uncertainty	
<input type="checkbox"/>	Do not know	

c. To your knowledge is there a good consensus on this health indicator (i.e. all-cause mortality)?

	Judgement (choose what fits best)	Commentary on your needs and/or justification of your choice
<input checked="" type="checkbox"/>	High consensus	As a first source of comparison there consensus
<input type="checkbox"/>	Average consensus	
<input type="checkbox"/>	Low consensus	
<input type="checkbox"/>	Lowest consensus	
<input type="checkbox"/>	Do not know	

d. Is all-cause mortality the most sensitive and reliable health indicator? Could the final results vary if alternative health indicators were used (for instance cause-specific mortality as opposed to all-cause mortality)?

	Judgement (choose what fits best)	Commentary on your needs and/or justification of your choice
<input checked="" type="checkbox"/>	Golden standard	Clearly cause specific should be a more relevant indicator, but coding can vary somewhat from country to country
<input type="checkbox"/>	Correct measure	
<input type="checkbox"/>	Just adequate	
<input type="checkbox"/>	Lowest quality/highest uncertainty	
<input type="checkbox"/>	Do not know	

e. Does the chosen health indicator reflect the local/regional situation? Is it reproducible?

	Judgement (choose what fits best)	Commentary on your needs and/or justification of your choice
<input checked="" type="checkbox"/>	High reproducibility	Its unclear which health indicator you mean here, is it cause specific as in the answer to d above, if so its reproducible on a local/national level
<input type="checkbox"/>	Average reproducibility	
<input type="checkbox"/>	Low reproducibility	
<input type="checkbox"/>	Lowest reproducibility	
<input type="checkbox"/>	Do not know	

f. To your knowledge, what is the confidence of the policy-makers in the chosen health indicator? You should consider all the answers to sections a to e.

	Judgement (choose what fits best)	Commentary on your needs and/or justification of your choice
<input checked="" type="checkbox"/>	High level of confidence	Depends on the level of knowledge of the individual policy makers
<input type="checkbox"/>	Average level of confidence	
<input type="checkbox"/>	Low level of confidence	

<input checked="" type="checkbox"/>	Lowest level of confidence	
<input type="checkbox"/>	Do not know	

II. The choice of PM_{2.5} as an exposure metric

a. To your knowledge, is this metric a reliable measure of population exposure ?

	Judgement (choose what fits best)	Commentary on your needs and/or justification of your choice
<input checked="" type="checkbox"/>	High reliability	Most cities/centres have limited number of monitor stations
<input type="checkbox"/>	Average reliability	
<input type="checkbox"/>	Low reliability	
<input checked="" type="checkbox"/>	Lowest reliability	
<input type="checkbox"/>	Do not know	

b. Is the metric representative of real exposure situations? Is it a good estimate?

	Judgement (choose what fits best)	Commentary or justification of your choice
<input checked="" type="checkbox"/>	High representativity/quality	This depends on the location of the monitoring stations and their locations in relation to local sources
<input type="checkbox"/>	Average representativity/quality	
<input type="checkbox"/>	Low representativity/quality	
<input checked="" type="checkbox"/>	Lowest representativity/quality	
<input type="checkbox"/>	Do not know	

c. How much consensus is there on the method used to estimate the exposure with the chosen metric? How specific (for instance role of size and particles' composition) are the health effects attributed to this exposure and what impact could that have on the HIA findings?

	Judgement (choose what fits best)	Commentary or justification of your choice
<input checked="" type="checkbox"/>	High consensus and specificity	There is a strong association of Pm2.5 with Cardio-vascular health outcomes
<input type="checkbox"/>	Average consensus and specificity	
<input type="checkbox"/>	Low consensus and specificity	
<input checked="" type="checkbox"/>	Lowest consensus and specificity	
<input type="checkbox"/>	Do not know	

d. Are the results sensitive to alternative exposure metrics? In other words, do we obtain different relative risks (RRs) with more precise exposure assessments (for instance role of size and particles' composition)?

	Judgement (choose what fits best)	Commentary or justification of your choice
<input checked="" type="checkbox"/>	High stability of RRs/lowest sensitivity	PM2.5 seems to be a very reliable metric and consistent with other metrics.
<input type="checkbox"/>	Average stability of RRs /low sensitivity	

<input type="checkbox"/>	Low stability of RRs /average sensitivity	
<input type="checkbox"/>	Lowest stability of RRs /highest sensitivity	
<input type="checkbox"/>	Do not know	

e. Is the chosen exposure metric representative of the local/regional situation? Is it reproducible?

	Judgement (choose what fits best)	Commentary or justification of your choice
<input checked="" type="checkbox"/>	High reproducibility	The metric is very site specific
<input type="checkbox"/>	Average reproducibility	
<input type="checkbox"/>	Low reproducibility	
<input type="checkbox"/>	Lowest reproducibility	
<input type="checkbox"/>	Do not know	

f. To your knowledge, what is the confidence of the policy-makers in the chosen exposure metric? You should consider all the answers to sections a to e.

	Judgement (choose what fits best)	Commentary or justification of your choice
<input checked="" type="checkbox"/>	High level of confidence	I suspect that they are not well informed
<input type="checkbox"/>	Average level of confidence	
<input type="checkbox"/>	Low level of confidence	
<input type="checkbox"/>	Lowest level of confidence	
<input type="checkbox"/>	Do not know	

III. Expression of health impact assessment findings in terms of reduction of the number of deaths for a certain decrease in PM_{2.5} levels

a. To your knowledge, is there a consensus on the proposed metric for expression of findings?

	Judgement (choose what fits best)	Commentary or justification of your choice
<input checked="" type="checkbox"/>	High consensus	Among researchers in the field
<input type="checkbox"/>	Average consensus	
<input type="checkbox"/>	Low consensus	
<input type="checkbox"/>	Lowest consensus	
<input type="checkbox"/>	Do not know	

b. Is the proposed metric for expression of findings a golden standard? What do you think of alternatives like gain in life expectancy, years of life lost?

	Judgement (choose what fits best)	Commentary or justification of your choice
<input checked="" type="checkbox"/>	The metric is a golden standard	Other metrics might be more relevant for decision makers
<input type="checkbox"/>	Preferred metric	
<input type="checkbox"/>	Alternatives equivalent	

<input checked="" type="checkbox"/>	Not a suitable metric	
<input type="checkbox"/>	Do not know	

c. Is the chosen metric for expression of findings easily understood and how relevant is it for communication with policy makers?

	Judgement (choose what fits best)	Commentary or justification of your choice
<input checked="" type="checkbox"/>	High relevance for communication purposes	This may vary from country to country
<input type="checkbox"/>	Average relevance for communication purposes	
<input type="checkbox"/>	Low relevance for communication purposes	
<input checked="" type="checkbox"/>	Lowest relevance for communication purposes	
<input type="checkbox"/>	Do not know	

Appendix D: Questionnaire WP4 Uncertainty assessment of HIA components in the association between exposure to traffic and asthma onset in children

Choosing the concentration-response function (CRF) expressed as a relative risk (RR) to quantify the health effect (prevalent children asthma cases) of residential proximity to heavily trafficked streets.

The chosen CRF comes from the study “Traffic, susceptibility and childhood asthma” McConnell R, Berhane K, Yao L, Jerrett M, Lurmann F, et al. in *Environmental Health Perspectives* Vol. 114 No.5, May 2006 pp. 766-772

Abstract

Context: Results from studies of traffic and childhood asthma have been inconsistent, but there has been little systematic evaluation of susceptible subgroups.

Objective: In this study, we examined the relationship of local traffic-related exposure and asthma and wheeze in southern California school children (5–7 years of age).

Methods and main outcome measured: Lifetime history of doctor-diagnosed asthma and prevalent asthma and wheeze were evaluated by questionnaire. Parental history of asthma and child’s history of allergic symptoms, sex, and early-life exposure (residence at the same home since 2 years of age) were examined as susceptibility factors. Residential exposure was assessed by proximity to a major road and by modeling exposure to local traffic-related pollutants.

Results: Residence within 75 m of a major road was associated with an increased risk of lifetime asthma [odds ratio (OR) = 1.29; 95% confidence interval (CI), 1.01–1.86], prevalent asthma (OR = 1.50; 95% CI, 1.16–1.95), and wheeze (OR = 1.40; 95% CI, 1.09–1.78). Susceptibility increased in long-term residents with no parental history of asthma for lifetime asthma (OR = 1.85; 95% CI, 1.11–3.09), prevalent asthma (OR = 2.46; 95% CI, 0.48–4.09), and recent wheeze (OR = 2.74; 95% CI, 1.71–4.39). The higher risk of asthma near a major road decreased to background rates at 150–200 m from the road. In children with a parental history of asthma and in children moving to the residence after 2 years of age, there was no increased risk associated with exposure. Effect of residential proximity to roadways was also larger in girls. A similar pattern of effects was observed with traffic-modeled exposure.

Conclusion: These results indicate that residence near a major road is associated with asthma. The reason for larger effects in those with no parental history of asthma merits further investigation.

a. In your opinion is the RR from the McConnell study a direct²⁰ (as opposed to a surrogate) measure of the value it should represent?

	Judgement (choose what fits best)	Commentary or justification of your choice
<input checked="" type="checkbox"/>	Direct measure	It is related to traffic pollution in general.
<input type="checkbox"/>	Rather direct measure	
<input checked="" type="checkbox"/>	Not so direct measure	
<input type="checkbox"/>	No direct measure	
<input type="checkbox"/>	Do not know	

b. Are the McConnell study findings reliable (in terms of quality and completeness of data, methods, causality, plausibility)?

	Judgement (choose what fits best)	Commentary or justification of your choice
<input checked="" type="checkbox"/>	High reliability of study findings	In general reliable, however, not all the results significant. Furthermore

²⁰ Direct should be understood as a value close to the real situation in the context it was produced

<input checked="" type="checkbox"/>	Average reliability of study findings	prevalence (NOT INCIDENCE) and self-reported symptoms.
<input type="checkbox"/>	Low reliability of study findings	
<input type="checkbox"/>	Lowest reliability of study findings	
<input type="checkbox"/>	Do not know	

c. How much consensus is there on the chosen CRF? Do you know others?

	Judgement (choose what fits best)	Commentary or justification of your choice
<input checked="" type="checkbox"/>	High consensus	The CFRs are always different.
<input type="checkbox"/>	Average consensus	
<input checked="" type="checkbox"/>	Low consensus	
<input type="checkbox"/>	Lowest consensus	
<input type="checkbox"/>	Do not know	

d. If alternative CRFs exist, is the one from the McConnel study still a golden standard? Will the results be sensitive to alternative CRFs?

	Judgement (choose what fits best)	Commentary or justification of your choice
<input checked="" type="checkbox"/>	Golden standard	Still the meta coefficient should be used is available. Especially if there is no consensus what heavily trafficated street means – 5,000, 10,000 or 20,000 etc cars a day. In McConnel et al. study is not even defined, what heavily trafficated street means.
<input type="checkbox"/>	Preferred CRF	
<input checked="" type="checkbox"/>	Equivalent alternatives	
<input type="checkbox"/>	Not a suitable CRF	
<input type="checkbox"/>	Do not know	

e. To your knowledge is the chosen CRF confirmed by local/regional studies. Is the CRF reproducible?

	Judgement (choose what fits best)	Commentary or justification of your choice
<input checked="" type="checkbox"/>	High reproducibility	Not confirmed with local, some regional studies available. As asthma prevalence and diagnosis is different in Eastern-Europe, that causes differences locally. CFR is reproducible with the same databases, but not in another study group 100%.
<input type="checkbox"/>	Average reproducibility	
<input checked="" type="checkbox"/>	Low reproducibility	
<input type="checkbox"/>	Lowest reproducibility	
<input type="checkbox"/>	Do not know	

f. To your knowledge, what is the confidence of the policy-makers in the chosen CRF? You should consider all the answers to sections a to e.

	Judgement (choose what fits best)	Commentary or justification of your choice
<input checked="" type="checkbox"/>	High level of confidence	What I personally think, these issues are far too difficult to understand for policy makers. Most of them fairly know the pollutants, some of them the main health effects – maybe some-one who has very good background might understand CRF.
<input type="checkbox"/>	Average level of confidence	
<input type="checkbox"/>	Low level of confidence	
<input checked="" type="checkbox"/>	Lowest level of confidence	
<input type="checkbox"/>	Do not know	

I. Health Data expressed as prevalence of asthma among children

a. To your knowledge, do the data usually collected through ad hoc surveys represent a direct measure²¹ of asthma cases?

	Judgement (choose what fits best)	Commentary on your needs and/or justification of your choice
<input checked="" type="checkbox"/>	Direct measure/High quality	First, when this questionnaire is meant for not specialist, all the terms should be defined – e.g. what is ad hoc survey. My answer to the question: no. Still the questionnaire or interviews do not give 100% truth. However, what I like to emphasize, there is difference between questionnaire or interviews. Interview is better as you can explain or ask more specifying comments.
<input type="checkbox"/>	Rather direct /Average quality	
<input checked="" type="checkbox"/>	Not so direct /Low quality	
<input checked="" type="checkbox"/>	Not direct /Lowest quality	
<input type="checkbox"/>	Do not know	

b. From what you know, what is the quality and representativeness of the chosen health indicator (i.e. prevalence of asthma) in Europe (do you know of any possible sources of error)?

	Judgement (choose what fits best)	Commentary on your needs and/or justification of your choice
<input checked="" type="checkbox"/>	High quality and representativeness/ low uncertainty	There is huge difference in asthma prevalence among western and eastern Europe. However not so big difference within countries in western Europe. One reason is different prevalence but also the asthma diagnosis is diverse.
<input type="checkbox"/>	Average quality and representativeness	
<input checked="" type="checkbox"/>	Low quality and representativeness	
<input checked="" type="checkbox"/>	Lowest quality and representativeness / highest uncertainty	
<input type="checkbox"/>	Do not know	

c. To your knowledge is there a good consensus on this health indicator (i.e. prevalence of asthma)?

	Judgement (choose what fits best)	Commentary on your needs and/or justification of your choice
<input checked="" type="checkbox"/>	High consensus	It is quite often used
<input checked="" type="checkbox"/>	Average consensus	
<input type="checkbox"/>	Low consensus	
<input checked="" type="checkbox"/>	Lowest consensus	
<input type="checkbox"/>	Do not know	

d. Is prevalence of asthma the most sensitive and reliable health indicator? Could the final results vary if alternative health indicators were used (for instance incident case as opposed to prevalent cases)?

	Judgement (choose what fits best)	Commentary on your needs and/or justification of your choice
<input checked="" type="checkbox"/>	Golden standard	Of course they could vary. It is much more difficult to study incidence and also find significant associations.
<input type="checkbox"/>	Correct measure	

²¹

Direct should be understood as a value close to the reality

<input checked="" type="checkbox"/>	Just adequate	Asthma as indicator – depends on the region.
<input type="checkbox"/>	Lowest quality/ highest uncertainty	
<input type="checkbox"/>	Do not know	

e. Does the chosen health indicator reflect the local/regional situation? Is it reproducible?

	Judgement (choose what fits best)	Commentary on your needs and/or justification of your choice
<input checked="" type="checkbox"/>	High reproducibility	It reflects only the local situations. In local level it is reproducible.
<input checked="" type="checkbox"/>	Average reproducibility	
<input type="checkbox"/>	Low reproducibility	
<input type="checkbox"/>	Lowest reproducibility	
<input type="checkbox"/>	Do not know	

f. To your knowledge, what is the confidence of the policy-makers in the chosen health indicator? You should consider all the answers to sections a to e.

	Judgement (choose what fits best)	Commentary on your needs and/or justification of your choice
<input checked="" type="checkbox"/>	High level of confidence	Of course policy makers understand what is asthma. Strictly speaking about all the aspects, the policy makers have no idea in details what was that all about. The confidence depends how well were the results represented.
<input type="checkbox"/>	Average level of confidence	
<input checked="" type="checkbox"/>	Low level of confidence	
<input type="checkbox"/>	Lowest level of confidence	
<input type="checkbox"/>	Do not know	

II. The choice of % of population living in proximity of heavily trafficked streets as an exposure metric

a. To your knowledge, is this metric a reliable measure of population exposure?

	Judgement (choose what fits best)	Commentary on your needs and/or justification of your choice
<input checked="" type="checkbox"/>	High reliability	Quite reliable. However, problems in interpretation what is heavily trafficated street.
<input checked="" type="checkbox"/>	Average reliability	
<input type="checkbox"/>	Low reliability	
<input type="checkbox"/>	Lowest reliability	
<input type="checkbox"/>	Do not know	

b. Is the metric representative of real exposure situations? Is it a good estimate?

	Judgement (choose what fits best)	Commentary or justification of your choice
<input checked="" type="checkbox"/>	High representativity/quality	For the comment see previous answer.
<input checked="" type="checkbox"/>	Average	

	representativity/quality	
<input type="checkbox"/>	Low representativity/quality	
<input type="checkbox"/>	Lowest representativity/quality	
<input type="checkbox"/>	Do not know	

c. How much consensus is there on the methodology used to estimate the exposure with the chosen metric? How specific are the health effects attributed to this exposure (for instance toxic components of the traffic indicator) and what impact could that have on the HIA findings?

	Judgement (choose what fits best)	Commentary or justification of your choice
<input type="checkbox"/>	High consensus and specificity	This method is in general accepted. It shows well exposure to traffic induced pollution. From that point of view it is also good proxy to toxic components. One of the concerns is noise that has CVD affects as well as air pollution. But as in this paper is only asthma, it is not problem.
<input checked="" type="checkbox"/>	Average consensus and specificity	
<input type="checkbox"/>	Low consensus and specificity	
<input type="checkbox"/>	Lowest consensus and specificity	
<input type="checkbox"/>	Do not know	

d. Are the results sensitive to alternative exposure metrics? In other words, do we obtain different relative risks (RRs) with more precise exposure assessments (for instance more specific components of traffic air pollution like Elemental Carbon, Sulphates...)?

	Judgement (choose what fits best)	Commentary or justification of your choice
<input type="checkbox"/>	High stability of RRs/ lowest sensitivity	Almost no studies available. They could be sensitive.
<input type="checkbox"/>	Average stability of RRs/ low sensitivity	
<input type="checkbox"/>	Low stability of RRs/ average sensitivity	
<input type="checkbox"/>	Lowest stability of RRs/ highest sensitivity	
<input checked="" type="checkbox"/>	Do not know	

e. Is the chosen exposure metric representative of the local/regional situation? Is it reproducible?

	Judgement (choose what fits best)	Commentary or justification of your choice
<input type="checkbox"/>	High reproducibility	See IIIa and IIIb.
<input checked="" type="checkbox"/>	Average reproducibility	
<input type="checkbox"/>	Low reproducibility	
<input type="checkbox"/>	Lowest reproducibility	
<input type="checkbox"/>	Do not know	

f. To your knowledge, what is the confidence of the policy-makers in the chosen exposure metric? You should consider all the answers to sections a to e.

	Judgement (choose what fits best)	Commentary or justification of your choice
<input checked="" type="checkbox"/>	High level of confidence	See If.
<input type="checkbox"/>	Average level of confidence	
<input checked="" type="checkbox"/>	Low level of confidence	
<input checked="" type="checkbox"/>	Lowest level of confidence	
<input type="checkbox"/>	Do not know	

III. Expression of health impact assessment findings, i.e. number of asthma cases prevented

a. To your knowledge, is there a consensus on the proposed metric for expression of findings?

	Judgement (choose what fits best)	Commentary or justification of your choice
<input checked="" type="checkbox"/>	High consensus	Depends on what is wanted to show. In case of that paper it is very good metric.
<input type="checkbox"/>	Average consensus	
<input type="checkbox"/>	Low consensus	
<input checked="" type="checkbox"/>	Lowest consensus	
<input type="checkbox"/>	Do not know	

b. Is the proposed metric for expression of findings a golden standard? What do you think of alternatives like gain in life expectancy, years of life lost?

	Judgement (choose what fits best)	Commentary or justification of your choice
<input type="checkbox"/>	The metric is a golden standard	I think the alternatives are more understandable for public and policy makers. At least in our country most of the policy makers have no idea what is OR. For policy makers we can say – living near to busy streets gives higher risk of getting asthma.
<input type="checkbox"/>	Preferred metric	
<input checked="" type="checkbox"/>	Alternatives equivalent	
<input checked="" type="checkbox"/>	Not a suitable metric	
<input type="checkbox"/>	Do not know	

c. Is the chosen metric for expression of findings easily understood and how relevant is it for communication with policy makers?

	Judgement (choose what fits best)	Commentary or justification of your choice
<input type="checkbox"/>	High relevance for communication purposes	If it is explained it is understandable. Not in detail but in general. But not well in written form. However, I think it is very important to give OR. Without statistics they is no evidence. But it is even more crucial to explain what the values mean; in quite simple way.
<input type="checkbox"/>	Average relevance for communication purposes	
<input checked="" type="checkbox"/>	Low relevance for communication purposes	
<input checked="" type="checkbox"/>	Lowest relevance for communication purposes	
<input type="checkbox"/>	Do not know	